UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

REPLY TO THE ATTENTION OF:
SR-6J

2021-06-29

(via email only)
Linda B. Albrecht
Department of the Army
Army Environmental Command
ATTN: MAIL STOP 112, IMAE-E
2455 Reynolds Road
JBSA Fort Sam Houston, TX 78234-7588

Re: U.S. EPA Review/Approval of U.S. Army Responses to Comments on the Draft Final Fiscal Year 2020 Annual Performance Report; New Brighton/Arden Hills/TCAAP NPL Site

Dear Ms. Albrecht,

The United States Environmental Protection Agency (EPA) has completed a review of the U.S. Army's responses to EPA comments on the Draft Final Fiscal Year 2020 Annual Performance Report, Twin Cities Army Ammunition Plant. EPA's comments on the subject report were transmitted on March 29, 2021. EPA received the Army's responses to comments on May 20, 2021. A comment resolution conference call was held on May 28, 2021. Army submitted Second Round Responses to Comments on June 21, 2021, per direction provided during the May 28, 2021 conference call. EPA reviewed the Army's Second Round Responses to Comments, and transmitted an email on June 22, 2021 requesting additional revisions to ensure Army's Second Round Responses to Comments were fully responsive to EPA's comments. Army transmitted its final revisions on June 25, 2021. The Army's June 25, 2021 submittal has adequately addressed EPA's comments, the submittal passes the Consistency Test, and EPA approves the Fiscal Year 2020 Annual Performance Report, as transmitted on June 25, 2021.

If you have any questions or concerns, please contact me via email at patel.viral@epa.gov or via telephone at (312) 886 6943.

Sincerely,

X Viral Patel

Viral Patel
Remedial Project Manager
Signed by: VIRAL PATEL

cc: *(via email only)*
Linda Albrecht - USACE
Brigitte Hay, Kathryn Grant - MPCA
Hoa Voscott, Tim Molitor, Kevin Havlicek - Arcadis

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June 29, 2021

Linda B Albrecht
Department of the Army
Army Environmental Command
ATTN: MAIL STOP 112, IMAE-E
2455 Reynolds Rd
JBSA Fort Sam Houston TX 78234-7588

RE: Consistency Test for the Final Twin Cities Army Ammunition Plant Fiscal Year 2020 Annual Performance Report, New Brighton/Arden Hills Superfund Site, Arden Hills, Minnesota

Dear Linda Albrecht:

The Minnesota Pollution Control Agency (MPCA) has completed review of the subject *Final Twin Cities Army Ammunition Plant Fiscal Year 2020 Annual Performance Report, New Brighton/Arden Hills Superfund Site* (2020 APR) dated June 25, 2021. Based upon our review of the draft documents, the responses to comments (RTCs), and the final version, the 2020 APR is approved and passes the Consistency Test.

If you have any questions please contact Brigitte Hay at 651-757-2497 or by email at Brigitte.hay@state.mn.us.

Sincerely,

Brigitte Hay

This document has been electronically signed

Brigitte Hay
Project Manager
Remediation Division

Cc:
Linda Albrecht - USACE
Viral Patel – USEPA
Kathryn Grant - MPCA
Hoa Voscott, Tim Molitor, Kevin Havlicek - Arcadis

FINAL

Twin Cities Army Ammunition Plant

FISCAL YEAR 2020 ANNUAL PERFORMANCE REPORT

New Brighton/Arden Hills Superfund Site

June 25, 2021

FISCAL YEAR 2020 ANNUAL PERFORMANCE REPORT

New Brighton/Arden Hills Superfund Site

Prepared for:
Remediation Project Manager
Twin Cities Army Ammunition Plant

U.S. Army Environmental Command
2455 Reynolds Road, Building 2266
Fort Sam Houston, Texas 78234
Contract No. W91ZLK-13-D-0009-0010

Prepared by:

PIKA Arcadis U.S., Inc. (Joint Venture)
123 North Third Street, Suite 705
Minneapolis, Minnesota 55401
Tel 612.339.9434

June 25, 2021

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ACRONYMS AND ABBREVIATIONS

APR	Annual Performance Report
AO	advanced oxidation
AOP	advanced oxidation potential
ARARs	Applicable or Relevant and Appropriate Requirements
Army	United States Army
AS	air sparging
Barr	Barr Engineering
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cis-1,2-DCE	cis-1,2-dichloroethene
COCs	constituents of concern
CRA	Conestoga-Rovers & Associates, Inc. (now GHD)
EBS	Environmental Baseline Survey
ESD	Explanation of Significant Difference
FFA	Federal Facility Agreement
FS	feasibility study
FY	fiscal year
GAC	granular activated carbon
GOS	Global Operating Strategy
gpm	gallons per minute
HRL	Health Risk Limits
JV	PIKA Arcadis U.S., Inc. a Joint Venture
LUC	land use control
LUCRD	land use control remedial design
MCL	maximum contaminant level
MDH	Minnesota Department of Health
MDNR	Minnesota Department of Natural Resources
MNA	monitored natural attenuation
MNARNG	Minnesota Army National Guard
MOS	Micro Operating Strategy

MPCA	Minnesota Pollution Control Agency
MW	monitoring well
NB/AH	New Brighton/Arden Hills
NBCGRS	New Brighton Contaminated Groundwater Recovery System
NBM	New Brighton Municipal
NEPA	National Environmental Policy Act
OS	Operating Strategy
OU	Operable Unit
PCE	perchloroethylene or tetrachloroethene
PGAC	permanent granular activated carbon
PGRS	Plume Groundwater Recovery System
PLC	programmable logic controller
PM	preventative maintenance
POTW	Publicly-Owned Treatment Works
PTA	Primer/Tracer Area
QAPP	Quality Assurance Project Plan
ROD	Record of Decision
SGRS	Source Groundwater Recovery System
Shaw	Shaw Environmental & Infrastructure, Inc. (formerly Stone & Webster)
Site	New Brighton/Arden Hills Superfund Site
SRI-FS	Supplemental Remedial Investigation and Feasibility Study
SVE	soil vapor extraction
SWBCA	special well boring and construction area
SWCA	special well construction area
TCAAP	Twin Cities Army Ammunition Plant
TCE	trichloroethene
TGRS	TCAAP Groundwater Recovery System
USACHPPM	United States Army Center for Health Promotion and Preventive Medicine
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
VOC	volatile organic compound

Wenck	Wenck Associates, Inc.
WWP	wet well pump
μg/L	micrograms per liter

1 EXECUTIVE SUMMARY

This Fiscal Year (FY) 2020 Annual Performance Report (APR) summarizes the status of remedy implementation, and addresses how the remedies are performing, for each of the three operable units (OUs) related to the New Brighton/Arden Hills (NB/AH) Superfund Site. Figure 2-1 shows the approximate locations of the three OUs. This APR covers FY 2020 (October 1, 2019 through September 30, 2020).

Records of Decision (RODs) have been signed for each of the three OUs:

- OU1 ROD signed 1993; Amended 2006 (#1); Explanations of Significant Difference (ESD) signed in 2020 (#1).
- OU2 ROD signed 1997; Amended 2007 (#1), 2009 (#2 and #3), 2012 (#4), 2014 (#5) and 2018 (#6); ESDs signed in 2009 (#1 and #2), and 2021 (#3).
- OU3 ROD signed 1992; Amended 2006 (#1).

The RODs, and subsequent Amendments and ESDs, present the major components of the final remedies for the media of concern. This APR looks at each of the major components and addresses:

1. Are the remedies being implemented? (Compliance check with the RODs and ROD Amendments)
2. Are the remedies doing what they are supposed to?

Table 1-1 summarizes the status of remedial actions at the end of FY 2020. Following are highlights of the accomplishments for each OU, as well as other activities during FY 2020.

Operable Unit 1 (OU1)

OU1 consists of the “north” plume of volatile organic compound (VOC) groundwater impacts. The current remedy for OU1 consists of pumping from six municipal wells (New Brighton Municipal [NBM] wells NBM #3, #4, #5, #6, #14, and #15), treating the extracted groundwater through the Permanent Granular Activated Carbon (PGAC) and Ultraviolet/Peroxide Advanced Oxidation Process (AOP) systems. The treated water is distributed by the New Brighton water supply system as potable water. Highlights for FY 2020 are:

- A new treatment system using ultraviolet/AOP was brought online in November 2018. ESD#1 to the 1993 OU1 ROD was prepared to add 1,4-dioxane to the list of contaminants of concern (COCs) and the document the addition of AOP treatment for 1,4-dioxane,
- The Minnesota Department of Health (MDH) Special Well Boring and Construction Area (SWBCA) remains in effect. The MDH has the regulatory responsibility to assure that wells constructed in the advisory area meet appropriate well construction and human health requirements. In FY 2020, there were no new recommendations for abandonment of wells or alternate water supply wells. One well was added to the well inventory list for FY 2021 and will be evaluated for abandonment or alternate water supply in the FY 2021 APR based on data collected during FY2021.

Operable Unit 2 (OU2)

OU2 is the 1983 Twin Cities Army Ammunition Plant (TCAAP) property boundary, when the NB/AH Superfund Site was placed on the National Priorities List. Sites within OU2 include Shallow Soil Sites, Deep Soil Sites, Site A Shallow Groundwater, Site C Shallow Groundwater and Surface Water, Site I Shallow Groundwater, Site K Shallow Groundwater, Building 102, Deep Groundwater, and various Aquatic Sites. Highlights for activities within OU2 during FY 2020 are:

- Shallow Soil Sites: No activities other than ongoing United States Army (Army) implementation of land use controls (LUCs).
- Deep Soil Sites: No activities other than ongoing Army implementation of LUCs.
- Site A Shallow Groundwater
    - In accordance with the Site A Shallow Groundwater: 10-Year Evaluation Report (Wenck Associates, Inc. [Wenck] 2008a), and with regulatory approval, the groundwater extraction system was shut down on September 24, 2008 to evaluate monitored natural attenuation (MNA) through abiotic degradation as a potential remedy component in lieu of groundwater extraction and discharge. The groundwater system remained in stand-by mode in case MNA did not adequately control plume migration and one or more extraction wells needed to be restarted. In late 2015, following review of FY 2015 groundwater monitoring results, MNA was deemed an acceptable remedy by the USEPA and MPCA. The Army, USEPA, and MPCA drafted an amendment to the 1997 OU2 ROD in FY 2017 to document the change in this remedy component. Formal approval of the ROD amendment was received during FY 2018 (OU2 ROD Amendment #6 (2018)). Annual monitoring was completed in FY 2020 per the monitoring plan.
    - Monitoring results from the four contingency wells located along the north side of County Road I did not exceed the approved action levels, which are equal to the cleanup levels for all Site A COCs in FY 2020. Well 01U902 exceeded the trigger level in FY 2018 but was below the trigger level in both FY 2019 and FY 2020.
    - A workplan has been approved by the MPCA and USEPA for 2021 to further delineate the plume with temporary monitoring wells (MWs) and potentially adding up to three permanent monitoring wells off post to the north of Site A. A vapor intrusion study will also be conducted under this workplan.
    - The MDH SWBCA remains in effect. In FY 2020, there were no locations identified in need of well abandonment or alternate water supply.
- Site C Shallow Groundwater
    - In accordance with the Site C Groundwater Extraction System Evaluation Report (Wenck 2008c), and with regulatory approval, the groundwater extraction system was shut down on November 13, 2008. System operation ceased because the lead concentrations in the groundwater plume contacting extraction wells are now below groundwater cleanup levels.
    - Only monitoring wells located near the source area still exceeded the groundwater cleanup level for lead in FY 2020.
    - None of the groundwater contingency locations exceeded the approved lead trigger levels in FY 2020.
    - Continued monitoring is recommended with follow-up discussions to evaluate formal changes to the remedy to eliminate the groundwater extraction component.

- Site I Shallow Groundwater
  - All Site I Unit 1 monitoring wells were abandoned in FY 2014 to allow demolition of building 502 and related soil cleanup activities by Ramsey County; therefore, no new groundwater quality data are available to evaluate.
  - Previous investigations show Unit 1 groundwater is discontinuous and does not extend beyond Site I; rather, Unit 1 impacts migrate downward into Unit 3, which is hydraulically influenced by the TCAAP Groundwater Recovery System (TGRS) operation.
  - Monitoring well 01U667 will be reinstalled following redevelopment related grading to occur in the area. The well was scheduled to be reinstalled in 2017 but was delayed due to the extent of grading to be completed. The well will be reinstalled upon completion of the regrading and related construction at the site.
- Site K Shallow Groundwater
  - The Site K groundwater extraction trench and treatment system continued to operate as designed. For FY 2020, the system captured and treated 5,227,133 gallons of water and maintained a continuous zone of capture downgradient of the former Building 103. A total of 7.76 pounds of VOCs were removed in FY 2020.
  - Groundwater samples were collected from all eight wells scheduled for sampling in FY 2020. With the exception of relatively stable trichloroethene (TCE) concentrations in 01U615, the overall trend throughout Site K Unit 1 monitoring wells continues to show a gradual decrease in TCE concentrations over the last 20 plus years of sampling.
  - The extracted water was treated and discharged to Rice Creek in compliance with discharge criteria.
  - Fifteen Unit 1 wells at Site K were abandoned as part of redevelopment activities in FY 2014; three of these wells are scheduled to be reinstalled upon the completion of the regrading and related construction. One Unit 1 Site K well was abandoned in FY 2017 as part of redevelopment activities and will not be reinstalled.
- Building 102 Shallow Groundwater
  - Annual monitoring was completed in FY 2020 per the monitoring plan. VOC concentrations were generally similar to those observed in FY 2019.
  - The well adjacent to Rice Creek (01U048) continued to show shallow groundwater discharging to Rice Creek with VOC levels below the site cleanup levels.
- Aquatic Sites: All aquatic sites are closed except Round Lake. The SRI/FS is ongoing at Round Lake.
- Deep Groundwater
  - The TGRS operated in accordance with the 1997 OU2 ROD.
  - The TGRS operated at a rate sufficient to support the conclusion that the OU2 5 µg/L TCE source area footprint is hydraulically captured respective of the 1997 OU2 ROD. In FY 2020, the TGRS

extracted and treated approximately 920,294,200 gallons of water. The mass of VOCs removed was 2,013 pounds, 205 pounds more than FY 2019. The total VOC mass removed by the TGRS through FY 2020 is 222,480 pounds.

- Groundwater analytical data collected from monitoring wells show the TCE concentration to be stable to decreasing. This decrease demonstrates that the TGRS is removing VOC mass from the aquifer.
- Effluent VOC concentrations were below contaminant specific requirements for all sampling events.
- Sampling for 1,4-dioxane continued in FY 2020. Sample results were similar to that reported in FY 2015, FY 2016, FY 2017, FY 2018 and FY 2019.
- The ESD #3 document, finalized on October 15, 2020 and signed in 2021 addressed the following:
  - Addition of 1,4-dioxane as a COC.
  - Addition of advanced oxidation (AO) treatment for 1,4-dioxane.
- The ESD #3 document lists the following improvements for the deep groundwater remedy:
  - Installation of new source area extraction wells at Site D, Site G and Site I.
  - Routing of the new source area extraction wells and existing source area extraction wells to a new treatment system, named the Source Groundwater Recovery System (SGRS), to remove 1,4-dioxane and TCE through AO and air stripping.

Operable Unit 3 (OU3)

OU3 contains the South Plume of VOC groundwater impacts which is treated by MNA. Overall, the statistical evaluation of groundwater data collected in FY 2020 indicates stable to declining concentration trends at the center and edge of the South Plume. 1,4-dioxane sampling continued in FY 2020 with results similar to FY 2015, FY 2016, FY 2017, FY 2018 and FY 2019.

Other Investigation and/or Remediation Activities Not Prescribed by a Current ROD

- Round Lake Supplemental Remedial Investigation and Feasibility Study (SRI-FS)

During FY2020, the Draft Final SRI/FS was provided to regulators in August. Additional concerns from the United States Fish and Wildlife Service (USFWS) caused the Final SRI/FS to be revised and the Final SRI/FS was resubmitted in January 2021.

2 INTRODUCTION

2.1 Purpose

This Annual Performance Report (APR) is intended to both summarize the status of remedy implementation and address remedy performance. This APR covers remedial actions at the New Brighton/Arden Hills (NB/AH) Superfund (Site) from October 1, 2019 through September 30, 2020 (Fiscal Year [FY] 2020). The NB/AH Site is divided into three designated Operable Units (OUs): OU1, OU2, and OU3 (Figure 2-1). OU1 encompasses off-site deep groundwater also referred to as the North Plume. OU2 includes soil, sediment, surface water, and groundwater impacts in the area that comprised the Twin Cities Army Ammunition Plant (TCAAP) in 1983, when the NB/AH Site was placed on the National Priorities List. OU2 also includes the Site A shallow groundwater plume that extends off the north end of the former TCAAP property boundary. OU3 consists of off-site deep groundwater sometimes referred to as the South Plume. Records of Decision (ROD) were developed and signed for each OU:

- OU1 ROD signed 1993; Amended 2006 (#1); Explanations of Significant Difference (ESD) signed in 2020 (#1).
- OU2 ROD signed 1997; Amended 2007 (#1), 2009 (Amendment #2 and #3), 2012 (#4), 2014 (#5), and 2018 (#6); ESDs signed in 2009 (#1 and #2) and 2020 (#3).
- OU3 ROD signed 1992; Amended 2006 (#1).

The RODs, subsequent Amendments, and ESDs present the major components of the final remedies for the media of concern. Monitoring activities and submittal of this APR are in fulfillment of the Federal Facility Agreement (FFA) signed in 1987 by the United States Army (Army), United States Environmental Protection Agency (USEPA), and Minnesota Pollution Control Agency (MPCA) with performance assessment answered via two questions:

1. Are all of the remedies being implemented? (Compliance check with the RODs)

2. Are the remedies performing as required?

For each OU, this APR answers the questions posed above by evaluating the major components of the selected remedies of each ROD (and subsequent modifications). Performance standards are then presented for each major remedy component and subsequently used to evaluate successful implementation or completeness. For some remedy components, performance standards are clearly defined in the RODs (soil or groundwater cleanup levels). For others (alternate water supply) performance standards are less clear but may have been agreed upon within work plans or design documents. With performance standards identified, this APR then addresses both questions discussed above through a series of sub-questions, written to facilitate a focused and user-friendly document promoted, as possible, in the form of figures and or graphs.

In addition to reporting on FY 2020, proposed future monitoring is also presented (Appendix A), with proposed changes in monitoring locations and or sampling frequencies highlighted in yellow. Monitoring covers a rolling 5-year time span (i.e., currently FY 2020 through FY 2024 where the next year FY 2020 will drop off and FY 2025 will be added). Performance monitoring alternates between major and minor annual sampling events to verify the overall groundwater remedy and to contour the perimeter of the plume that defines the area of concern. Most wells in OU1, OU2 deep groundwater, and OU3 are sampled during major annual sampling events with a smaller number of these wells sampled during minor annual sampling events. The selected wells located at Building 102, Site A, Site C, and Site K are sampled annually. Offsite Well Inventory wells are industrial wells that are sampled every four years and coincide with major sampling events. These industrial wells are part of a tracked list of privately owned wells that exist within the boundaries of the SWBCA, and are discussed further in Appendix E.

2.2 Brief Overview of TCAAP

TCAAP was constructed between August 1941 and January 1943 in the northern portion of the Minneapolis – St. Paul metropolitan area, in Ramsey County, surrounded by the cities of New Brighton, Arden Hills, Mounds View, and Shoreview, Minnesota (Figure 2-1). TCAAP primarily produced and proof-tested small-caliber ammunition and related materials for the Army. Other uses included manufacture of munitions-related components, handling/storage of strategic and critical materials for other government agencies, and various non-military activities. Production began in 1942, and operations alternated between periods of activity and standby related to wars until manufacturing ceased in 2005. During active periods, solvents were used as part of some manufacturing operations. Disposal of solvents and other wastes resulted in soil and groundwater impacts that migrated beyond the original TCAAP boundary.

Groundwater impacts were first discovered in July 1981, leading to soil and groundwater investigations on and off-site. In 1983, when it was determined the source of impacts and groundwater impacts were from TCAAP, the NB/AH Site was placed on the National Priorities List.

Several known and potential contaminant source areas on the TCAAP property were initially identified within the original TCAAP boundary that is OU2: Sites A, B, C, D, E, F, G, H, I, J, K, 129-3, 129-5 and 129-15 (Figure 2-2). The 1997 OU2 ROD specified requirements for each site except Site F (which was addressed under the Resource Conservation and Recovery Act prior to 1997) and Site J (a sewer line determined not to have a release). Additionally, other areas have also undergone investigation and or remediation, namely the Grenade Range, Outdoor Firing Range, Trap Range, 135 Primer/Tracer Area (PTA) (and adjacent stormwater ditch), 535 PTA, Water Tower Area, Environmental Baseline Survey (EBS) Areas and Building 102. These areas are also shown on Figure 2-2.

Since 1983 the size of the federal portion of TCAAP has periodically shrunk due to property transfers. Some property has been transferred out of federal ownership to Ramsey County and the City of Arden Hills. Other property is still owned by the federal government, but control has been reassigned to the Army Reserve or the National Guard Bureau, which has licensed property to the Minnesota Army National Guard (MNARNG). Figure 2-3 presents the different property owners in OU2 at the end of FY 2020, along with the organizations responsible for control. The minimal remaining property controlled by Base Realignment and Closure, referred to as Base Realignment and Closure-controlled (BRCC) is currently in the process of being transferred out of federal ownership. These property transfers do not alter the responsibilities or liability of the Army under the FFA.

2.3 Hydrogeologic Units and Well Nomenclature

For purposes of studies and work related to the site, four hydrogeologic units have been designated: Unit 1 (the Fridley Formation), Unit 2 (the Twin Cities Formation), Unit 3 (the Hillside Sand), and Unit 4 (the Prairie du Chien and Jordan Formations), described in Appendix B, along with well designation nomenclature overview. A well-designation cross-reference guide is included in Table B-1 within Appendix B. The well index includes all Army owned or used wells to gather groundwater elevation or water quality data, sorted by Minnesota unique well identification number. Well information includes the Army designation (Installation Restoration Data Management Information System number), Minnesota unique number, and any other name(s). Well locations included in the monitoring plan are shown on Figure B-2 (OU1/OU3 wells) and Figure B-3 (OU2 wells) in Appendix B. With a known well name, the location can be identified using the “Edit, Find” or “Edit, Search” function and typing in the well name, which will highlight the desired well name on the figure. Available information concerning a well, including well logs and other information, can be viewed in the Appendix B Attachment, which is sorted by the Minnesota unique number. See instructions in Appendix B for more information.

2.4 Data Collection, Management, and Presentation

Performance monitoring data were collected in accordance with the FY 2020: Monitoring Plan for Groundwater Monitoring Wells, Monitoring Plan for Remedial Treatment Systems, Monitoring Plan for Surface Water and New Brighton Water System Sampling and Analysis Plan. Data were collected by the PIKA Arcadis U.S., Inc. Joint Venture (JV) on behalf of the Army, Conestoga-Rovers & Associates, Inc. (CRA; now GHD) on behalf of Northrop Grumman, and Barr Engineering (Barr) on behalf of the City of New Brighton. Data collection, management, and presentation are discussed in Appendix C. Lastly, comprehensive groundwater levels and quality databases from 1987 through FY 2020 are contained in Appendix D.1.

Are the data complete and representative (are we making decisions based on complete and technically-sound information)?

Yes. The data were collected in accordance with the FY 2020 Monitoring Plan and verified and validated in accordance with the Quality Assurance Project Plan (QAPP) for Performance Monitoring (PIKA-Arcadis JV 2020a), which is updated as appropriate.

Data tables in the various report sections and the comprehensive water quality databases (Appendix D.1) show the assigned data qualifiers as a result of data verification and or data validation. The data qualifiers assigned to FY 2020 data are explained in the data table footnotes. Data verification (performed on 100 percent [%] of the data) and data validation (performed on a minimum of 10% of the data) were provided to the USEPA and MPCA via submittal of quarterly Data Usability Reports covering FY 2020 information. The MPCA/USEPA have received and approved the following FY 2020 Data Usability Reports: FY 2020 Q1 DUR 105 – approved April 3, 2020, FY 2020 Q2 DUR 106 – approved May 22, 2020, FY 2020 Q3 DUR 107 – approved October 28, 2020 and FY 2020 Q4 DUR 108 – approved February 12, 2021.

Regarding completeness, Appendix C.2 summarizes any deviations from the FY 2020 Monitoring Plan. The field and laboratory completeness goals for performance monitoring are both 95%, except for TCAAP Groundwater Recovery System (TGRS) effluent, Site K effluent, and well inventory samples, for which field and laboratory completeness goals are 100%. Actual field and laboratory completeness were both

100%, meeting overall completeness goals (dry, frozen, or inoperative wells were not considered as missed samples, nor owner nonresponsive or refused sample collection). Also, the actual field and laboratory completeness for the subset of samples with 100% completeness goals was successful at 100%.

Regarding quality control samples, the QAPP specifies field duplicates, equipment rinse blanks, and matrix spike/matrix spike duplicates are to be collected at overall frequencies of 10%, 10%, and 5%, respectively. Actual quality control sample frequencies met these goals, with respective frequencies of 11%, 11% and 7%.

With regard to data validation, the performance monitoring QAPP specifies that data validation be completed at an overall rate of 10%, with 100% validation of well inventory samples. All data requiring 100% data validation were fully validated, meeting the specified validation rates for performance monitoring.

FY 2020 data are deemed to be representative and meet data quality objectives based on: 1) adherence to QAPP-specified sampling and laboratory analytical procedures; 2) completion of data verification and data validation; and 3) comparability to historical results (any substantial deviations from historical and or anticipated results are discussed within the site-specific sections of this APR).

3 OPERABLE UNIT 1: DEEP GROUNDWATER

The 1993 OU1 ROD was amended in 2006 to formalize adoption of groundwater quality statistical analysis. Primary elements of the 1993 OU1 ROD are as follows (amendment changes in italics):

1. Providing alternate water supplies to residents with private wells within the North Plume.
2. Implementing drilling advisories that would regulate the installation of new private wells within the North Plume as a Special Well Construction Area (SWCA).
    a. Please note that for the purposes of this report, the SWCA is referred to as the special well and boring construction area (SWBCA). SWCA has historically been referenced in RODs and other reporting documents. However, in the most recent modification (MDH 2016), the MDH references this area now as the SWBCA for TCAAP.
3. *Extracting groundwater from the North Plume using the New Brighton Contaminated Groundwater Recovery System* (NBCGRS), subject to the following:
    a. The initial aggregate groundwater extraction rate shall be consistent with long-term NBCGRS operating history.
    b. Future decreases in the aggregate extraction rate will be determined by the Army, USEPA, and MPCA using a transparent public process and rational engineering, scientific, and economic analyses at least as rigorous as those employed in the feasibility study (FS) that was the basis for the original remedy selection.
    c. Future changes to the aggregate or individual well extraction rates will be made to assure that the rate of restoration of the aquifer will not be slowed or result in a duration of remedy longer than was contemplated by the original 1993 OU1 ROD.
    d. The facilities comprising the NBCGRS may be modified as necessary to assure the restoration of the full aerial and vertical extent of the aquifer in a timeframe as contemplated in 3.c, above (OU1 ROD Amendment #1 (2006), pages 5-2 and 5-3).
4. Pumping the extracted groundwater to the permanent granular activated carbon (PGAC) Water Treatment Facility in New Brighton for removal of VOCs by a pressurized granular activated carbon (GAC) system.
5. Discharging all treated water to the New Brighton municipal distribution system.
6. *Monitoring the groundwater to verify effectiveness of the remedy through measurement of overall plume shrinkage (geographically) and decreasing contaminant concentrations*.

Requirement No. 6 is met by evaluating analytical groundwater data according to statistical methods contained in the OU1 Technical Group Technical Memorandum Statistical Evaluation Method for Water Quality Data, Operable Unit 1, dated December 2004 (and any subsequent addendums or revisions approved by the USEPA and MPCA). The statistical analysis is conducted annually and is reported in this APR.

The OU1 remedy encountered a new and substantial issue in FY 2015 that continued to affect remedy performance into the first quarter of 2019. In early 2015, Minnesota Department of Health (MDH) notified the City of New Brighton that an emerging contaminant, 1,4-dioxane, had been detected in New Brighton's water supply (with detections up to 6.8 micrograms per liter [µg/L]). The NBCGRS wells extract groundwater from the Prairie du Chien and or Jordan Aquifers (Upper and Lower Unit 4). Concentrations of 1,4-dioxane in samples collected from New Brighton's deeper municipal wells (Mount Simon Aquifer) were non-detect. Currently, no 1,4-dioxane federal drinking water standard exists; however, a state MDH health risk limit (HRL) of 1 µg/L is in place, with most of the 1,4-dioxane concentrations in samples collected from the NBCGRS exceeding the MDH HRL. NBCGRS ceased pumping operations from the shallow aquifer on April 15, 2015. The City switched to preferential extraction from deep aquifer wells while evaluating removal technologies. A pilot study report for AO technology for treatment of 1,4-dioxane was completed in August 2016.

A preliminary design review was held with the Army and regulators in December 2016. A new treatment technology using ultraviolet/peroxide advanced oxidation potential (AOP) was selected for pilot study in 2017, with upgrades to the New Brighton water treatment plant completed in November 2018 when pumping from six municipal wells was restarted. The 2020 OU1 ESD #1 memorialized the addition of 1,4-dioxane to the list of COCs and the modification of groundwater treatment technology to include the AOP treatment for 1,4-dioxane. The six major components of the remedy prescribed by 1993 OU1 ROD, OU1 Amendment #1 (2006) are evaluated below, including discussion of the effects of the remedy time-out noted above.

3.1 Remedy Component #1: Alternate Water Supply/Well Abandonment

Description: "Providing an alternative water supply to residents with private wells within the North Plume." (1993 OU1 ROD, page 2).

- Clarified by the *OU1 Alternate Water Supply Plan* (Montgomery Watson 1995) to delete "residents with" because the remedy applies to other wells in addition to residential wells. The plan also lists the criteria for identifying the wells that are eligible for an alternate water supply.
- Clarified by the *OU1 Alternate Water Supply Plan* to also include well abandonment.
- Clarified by the *OU1 Alternate Water Supply Plan* (page i-2) to also encompass OU3 and the OU2 Site A shallow groundwater plume.

Performance Standard (how do you know when you've achieved the remedy):

For alternate water supply, when the owners of all wells that meet all the following criteria have been offered and provided with an alternate water supply (or when the well owners have rejected the offers):

i. The well is located within the area affected by groundwater plumes that originate at OU2, as shown on Figures E-1, E-2 and E-3 in Appendix E,

ii. The well is completed in an affected aquifer,

iii. The well contains detectable concentrations of the NB/AH Site-related constituents of concern (COCs) identified on page 18 of the 1993 OU1 ROD (or page 26 of the 1992 OU3 ROD, or Table 1 of the 1997 OU2 ROD, as appropriate for the well location),

iv. The well is used in a manner to cause exposure (uses are defined in the *OU1 Alternate Water Supply Plan*), and

v. The well owner does not already have an alternate water supply.

If eligible well owners refuse the offer to have an alternate water supply provided, this also satisfies the performance standard.

For well abandonment, when the owners of <u>all</u> wells that meet all the following criteria have been offered and provided abandonment (or when the well owners have rejected the offers):

i. The well is located within the area affected by groundwater plumes that originate at OU2,

ii. The well is completed in an affected aquifer,

iii. The well contains detectable concentrations of the NB/AH Site-related COCs identified on page 18 of the 1993 OU1 ROD (or page 26 of the 1992 OU3 ROD, or Table 1 of the 1997 OU2 ROD, as appropriate for the well location),

iv. The well was constructed prior to the MDH SWBCA advisory,

v. The well is being used by the well owner or use was discontinued due to impacts, and

vi. The well is used in a manner to cause exposure (uses are defined in the Alternate Water Supply Plan).

If eligible well owners refuse the offer for abandonment, this also satisfies the performance standard. An exception to abandonment would be if the well is needed for groundwater monitoring.

Also, note that per Appendix E, program requirements for both alternate water supply and well abandonment have been clarified such that a well should contain a cleanup level exceedance (or an additivity of 1.0, similar to the MDH Hazard Index calculation), rather than merely “detectable concentrations” as noted above. On a case-by-case basis, review by the Army, USEPA, and MPCA could lead to an Army offer for alternate water supply and or well abandonment for a given well with detectable concentrations that do not exceed a cleanup level (or additivity criteria), particularly if that well is used to supply drinking water.

Is this remedy component being implemented?

Yes. The Alternate Water Supply and Well Abandonment Program has been implemented and is an ongoing, Army maintained program. The process of identifying wells eligible for alternate water supply and or abandonment is accomplished by maintaining a “well inventory” (Appendix E). The well inventory is a database that was initially developed in 1992 and has been periodically updated since (now annually as part of the APR). For the purposes of the well inventory, a study area was established to encompass the groundwater plume (same area as the MDH SWBCA). The well inventory is intended to include all wells within the study area, whereas areas of concern are defined by the edge of the groundwater plume, plus an additional ¼-mile buffer. The wells are grouped into categories (e.g., location relative to the area of concern, type of use, active/non-active status, sealed). Wells in categories with the potential to be impacted are sampled every four years to see if they qualify for alternate water supply and or abandonment. Thus, maintenance of the well inventory consists of the following tasks:

1. Check if the area of concern needs to be adjusted based on the extent of impacts.
2. Check if there are any previously unknown wells to be added to the database (coordination with the MDH as described in Appendix E).
3. Sample wells on a prescribed schedule.
4. Take the appropriate course of action per results.
5. Update the well inventory database with any new information (e.g., water quality results, owner information, construction information, well re-categorizing).
6. Report findings in the APR.

The following questions and answers summarize developments since the last APR with respect to OU1.

Did the area of concern within OU1 change during FY 2020, as defined by the 5 µg/L contour line?

As shown on Figure 3-1, the area of concern did not change significantly during FY 2020. The well inventory study area encompasses the FY 2020 area of concern.

Were any additional water supply wells discovered within the area of concern for OU1 that are completed within an aquifer of concern?

Yes. Six wells were disclosed through property transfer that are in use and located within the area of concern for OU1 in FY 2020. These six wells are classified as Category 4a wells due to their unknown depth. An additional well was classified as 4b due to unknown location and unknown depth. An attempt will be made to reclassify these seven wells in FY 2021 and will be sampled if reclassified as Category 1a, 1b, 1c, 2a, 2b or 2c. One additional well was also discovered within the area of concern through property transfer that is not in use (category 2a). This well will be added to the FY 2021 sampling plan for confirmation that it is not in operation or will be sampled if found to be in use.

One commercial water supply well for a distillery was constructed in June of 2020, however, this well was installed at the southern extent of the SWBCA, south of the area of concern. The well, while constructed in the Jordan aquifer, was permitted and tested in accordance with MDH guidelines. See Appendix E.1 for additional information.

Were any water supply wells within the area of concern for OU1 sampled during FY 2020 (outside of those included in the OU1 performance monitoring plan)? If yes, what were the findings?

Yes. FY 2020 was a sampling event year for the well inventory that is completed every four years and coincides with a major annual sampling event. A total of 13 of the attempted 17 industrial wells listed in the FY 2019 Appendix A.1 Well Inventory list were sampled during FY 2020. One well was not sampled due to no response from the property owner and three wells were inaccessible; two were inoperable and one had no sample point. Of the 13 wells sampled, five were non-detect for VOCs. The remaining eight wells had detections of VOCs below their corresponding MDH HRL with the exception of well number 234544, which had a detection of trichloroethene (TCE) above the MDH HRL. This well, located at R&D Systems, is used for irrigation purposes.

Additionally, ten of the wells had detections of 1,4-dioxane, four of which exceeded the MDH HRL of 1 µg/L. The wells at which 1,4-dioxane was detected above the MDH HRL are not utilized for drinking water. Their uses are listed below:

- 234421 (Bioclean) – Truck washing,
- 234544 (R&D Systems) – Irrigation,
- 509542 (Shriners Hospital) – Irrigation, and
- 547801 (Midway Industrial) – Irrigation.

See Appendix E for additional information.

Were any well owners offered an alternate water supply and or well abandonment during FY 2020?

At this time, it is recommended for the Army to offer alternate water supply and well abandonment for well 234421, due to exceedances of the MDH HRL for 1,4-dioxane. The other wells that exceeded the MDH HRL will require a second confirmation sample before being offered an alternate water supply and well abandonment in accordance with the Alternate Water Supply Plan that can be referenced in Appendix E, detailed in Figure E-4.

It is also recommended for the Army to offer well abandonment for wells 234338 and UNK0553071, due to their current status as a category 1d well (drinking water well not in operation). These wells were inspected as part of the FY 2020 well inventory sampling efforts and were deemed inactive and offline (category 1d). The Army wishes to abandon them in accordance with the Alternate Water Supply Plan for wells that exist in the SWBCA. Due to the inability to sample these wells and their recommended abandonment these have been removed from the Appendix A.1 Well Inventory Monitoring Plan, but can still be found in the Well Inventory Index in Appendix E.

For OU1, are there any well owners that meet the criteria, but have not yet been provided an alternate water supply?

No.

For OU1, are there any wells that meet the criteria, but have not yet been abandoned?

No.

Is any sampling of water supply wells (excluding those included in the OU1 performance monitoring plan) proposed prior to the next report?

Yes. With several exceedances of 1,4-dioxane detected in well inventory wells above the MDH HRL, it is recommended that the Army attempt to sample all of the wells listed in Appendix A.1 in FY 2021. All 15 of the wells that were requested for sampling in FY 2020 will be requested for resampling, which include the 13 sampled, one well that was nonresponsive (756236) in FY 2020, and the one well that was inaccessible for sampling (433298). Please note that while 433298 was not accessible for sampling, a secondary irrigation well (200180) is located on the same property and was sampled as part of the FY 2020 well inventory sampling. In addition, the well that was disclosed in appendix E.1 (847062) has been requested for confirmation sampling.

Well UNK0573104, which was added to the well inventory after disclosure during FY 2020 as a category 2a well, has also been included in the FY 2021 sampling plan. This sampling is in accordance with the well inventory steps as described in Appendix E.

This sampling event will be in concurrence with the Alternate Water Supply Plan and will also be used as a form of data verification.

Are there any changes or additional actions required for this remedy component?

Yes, letters outlining the results of sampling will be sent to well owners during FY 2021.

3.2 Remedy Component #2: Drilling Advisories

Description: "Implementing drilling advisories that would regulate the installation of new private wells within the North Plume as a SWCA." (1993 OU1 ROD, page 2).

Performance Standard (how do you know when you've achieved the remedy):

For initial implementation, when the MDH has issued a SWBCA Advisory. Implementation will continue until such time that the groundwater concentrations are below the cleanup levels.

Has the MDH issued a SWBCA Advisory?

Yes, in June 1996. In June 1999, the MPCA requested the MDH extend the SWBCA boundary further southwest to the Mississippi River and Marshall Avenue ensuring the southern boundary fully encompassed the plume. The SWBCA also covers OU3 and, as of April 2016, all of OU2. The current boundary of the SWBCA is shown on Figure E-1 (Appendix E).

Are any changes or additional actions required for this remedy component?

No.

3.3 Remedy Component #3: Extract Groundwater

Description: Extracting groundwater from the North Plume using the NBCGRS, subject to the following:

1. The initial aggregate groundwater extraction rate will be consistent with the long-term operating history of the NBCGRS.
2. Future decreases in the aggregate extraction rate will be determined by the Army, USEPA, and MPCA using a transparent public process and rational engineering, scientific, and economic analyses at least as rigorous as those employed in the FS that was the basis for the original remedy selection.
3. Future changes to the aggregate or individual well extraction rates will be made to assure that the rate of restoration of the aquifer will not be slowed or result in a duration of remedy longer than was contemplated by the original 1993 OU1 ROD.
4. The facilities comprising the NBCGRS may be modified as necessary to assure the restoration of the full aerial and vertical extent of the aquifer in a timeframe as contemplated in 3.c, above (OU1 ROD Amendment #1 (2006), pages 5-2 and 5-3).

Through January 2008, the remedy component consisted of recovering deep (Unit 4) groundwater using three primary City of New Brighton wells (New Brighton Municipal [NBM] #4, #14, and #15) with three alternate wells (NBM #3, #5, and #6). NBM #3 and #4 were existing wells completed in both the Prairie du Chien and Jordan formations. NBM #5 and #6 were existing wells completed in the Jordan formation. NBM #14 and NBM #15 were constructed in the Prairie du Chien formation as part of the remedy and began pumping in December 1996 and March 1998, respectively. The locations of the recovery wells are shown on Figure 3-1.

The extracted groundwater is used as part of the New Brighton water supply system, and as such, New Brighton took the lead on design and construction of the system and is responsible for system operation. The federal government is paying for the OU1 remedy.

In 2006, New Brighton and the Army modified the NBCGRS operation to allow more flexibility, and to increase removal of contaminant mass from the aquifer. In November 2007, the USEPA and MPCA provided consistency approval of the revised pumping rates. Appendix A.5 (Table D-1 and Table D-2 from the settlement agreement between the Army and New Brighton) presents the new pumping rates in effect as of January 2008.

The revised pumping approach does not affect the approved statistical analysis used to evaluate the effectiveness of the remedy as set forth by the OU1 ROD Amendment #1 (2006). The Army has made it clear to New Brighton that if the changes cause statistical evaluation results that are not in compliance with the OU1 ROD Amendment #1 (2006), the pumping allocations will revert to the previous scheme.

Performance Standard (how do you know when you've achieved the remedy):

When the NBCGRS is operating consistent with long-term NBCGRS operating rates.

During FY 2020, did the OU1 extraction system operate per the New Brighton operational plan and consistent with past operations?

Yes. Based on past operations, the target average daily pumping rate is 3.168 million gallons per day as shown in Appendix A.5. In FY 2020, the volume of water pumped by the NBCGRS was 1.292 billion gallons, which translates to a daily average of 3.53 million gallons per day.

Are any changes or additional actions required for this remedy component?

No.

3.4 Remedy Component #4: Removal of VOCs by GAC and AOP

Description: "Pumping the extracted groundwater to the PGAC Water Treatment Facility in New Brighton for removal of VOCs by a pressurized GAC system." (1993 OU1 ROD, page 2)

A new treatment system using ultraviolet/AOP was brought online in November 2018. A 2020 ESD #1 to the 1993 OU1 ROD was prepared to add 1,4-dioxane to the list of COCs and to document the addition of AOP treatment for 1,4-dioxane.

Treatment by the PGAC and the AOP system along with iron and manganese removal and chlorination makes the recovered groundwater suitable for municipal drinking water purposes. The treatment system is located approximately one-third mile south of Interstate 694 near Silver Lake Road. The City of New

Brighton is responsible for operation and maintenance of the PGAC and AOP, with cost reimbursement from the Army for the operations related to the remedy.

Performance Standard (how do you know when you've achieved the remedy):

When the treated water meets the maximum contaminant level (MCL) and non-zero maximum contaminant level goals established by the Safe Drinking Water Act for the constituents of concern, as identified on page 18 of the 1993 OU1 ROD. In addition, when the treated water is less than the MDH HRL for 1,4-dioxane.

Did the treated water meet the MCLs and non-zero maximum contaminant level goals established by the Safe Drinking Water Act for the OU1 chemicals of concern?

Yes.

Is any sampling of the treated water proposed prior to the next report?

Yes, sampling will continue on a monthly basis.

Are any changes or additional actions required for this remedy component?

No.

3.5 Remedy Component #5: Discharge of Treated Water

Description: "Discharging all of the treated water to the New Brighton municipal distribution system." (1993 OU1 ROD, page 2).

Performance Standard (how do you know when you've achieved the remedy):

When the connection to the New Brighton municipal supply system has been completed and water is being discharged.

Is the treated water being discharged to the New Brighton municipal distribution system?

Yes.

Are any changes or additional actions required for this remedy component?

No.

3.6 Remedy Component #6: Groundwater Monitoring with Verification of Continuing Aquifer Restoration

Description: "Monitoring the groundwater to verify the effectiveness of the remedy through measurement of overall plume shrinkage (geographically) and decreasing contaminant concentrations" (OU1 ROD Amendment #1 (2006), page 5-3).

Performance Standard (how do you know when you've achieved the remedy):

When performance groundwater monitoring verifies aquifer restoration.

Is this remedy component being implemented?

Yes. Performance monitoring programs have been established to collect the data required to verify the effectiveness of remedy components #1 through #6. Table 3-1 summarizes the performance monitoring requirements, implementing parties, and the specific documents that contain the monitoring plans.

Were the groundwater monitoring requirements for this remedy met?

Yes. FY 2020 was a major annual sampling event of Army wells and included sampling of well inventory wells. Also, with the detection of 1,4-dioxane in the NBCGRS wells, the USEPA and MPCA requested that the Army analyze groundwater samples for 1,4-dioxane at all scheduled OU1 sampling locations during the June-July 2020 sampling event. All the required and requested sampling was completed.

Is any groundwater monitoring proposed prior to the next report?

Yes. Monthly monitoring of the OU1 extraction system wells and treatment system effluent is performed by the City of New Brighton in accordance with the “New Brighton Water System Sampling and Analysis Plan,” June 1997.

Other groundwater monitoring will be in accordance with the Groundwater Monitoring Plan included as Appendix A.1. A “minor” event is planned for FY 2021.

Does groundwater monitoring show aquifer restoration is occurring?

Historical groundwater data trends and quality (Appendix D) indicate there has been significant improvement in groundwater conditions as a result of both TGRS and NBCGRS operation. FY 2020 monitoring data are consistent with data prior to NBCGRS shutdown for NBCGRS upgrades. Since startup in 2018 TCE trends in the NBCGRS wells appear to be stable for well NBM #6 and decreasing for wells NBM #3, #4, #5, #14 and #15, (Figure 3-2).

Figure 3-3, Figure 3-4, and Figure 3-5 show both the TCE and 1,4-dioxane plumes depicted by depth and geology (5 µg/L for TCE; 1 µg/L for 1,4-dioxane) in the Upper and Lower Unit 3 Combined, Upper Unit 4, and Lower Unit 4 portions of the aquifer for FY 2020, along with cross-section lines, based on the June-July 2020 sampling event. Figure 3-3 presents the combined Upper and Lower Unit 3 TCE plume with the highest concentrations residing near the OU2 source areas. There were no significant changes of the plumes in FY 2020. The last changes of the plume came in FY 2019 with the Unit 3 plume shifting just downgradient of the OU2 source areas, Sites D, G, and I. The plume was updated using groundwater concentration data from the vertical aquifer profiling drilling event that took place from September through December 2019. In general, concentrations decline as the plume moves toward the southwest due to mass removal by the TGRS and as concentrations migrate into bedrock via deeply eroded bedrock valleys as mapped by the Minnesota Geologic Survey (Mossler 2013). The regional presence of these valleys within and beyond TCAAP affects groundwater movement. TCAAP is divided roughly in half by a southeast-to-northwest trending bedrock valley, which is joined from the east by a branching valley containing south trending dead-end tributary valleys crossing portions of OU1.

The buried valleys may act as hydraulic short-cuts, allowing groundwater to move directly from Unit 3 into bedrock. Moreover, buried valleys create isolated points and bedrock knobs, cut off from adjacent bedrock by valley-fill sediments. In a bedrock aquifer system as complex as this, groundwater does not flow uniformly from up-to-down-gradient, distributed evenly along parallel paths, but is concentrated in the highest permeability, most-interconnected beds, within conduits (Prairie du Chien formation) and beddingplane fractures (Jordan). Figures 3-4 and 3-5 present both TCE and 1,4-dioxane in the Upper and Lower Unit 4 bedrock plumes, respectively. Additionally, unlike historical plume maps, these figures show a conceptual representation of bedrock geology. As presented in both figures, eroded bedrock valleys are filled with overburden where concentration isocontours follow the bedrock topography. Further discussion on buried bedrock valleys and the effect on local hydrogeology is discussed in the remedy review report, which was approved by regulators in June 2018.

Figure 3-1 shows the 1 µg/L TCE contour for Upper Unit 4 in 1990, 1999, 2009, and the 1 µg/L TCE contour for 2020. Figures 3-6, 3-7 and 3-8 depict cross-sections showing the OU1 plume. Figures 3-6 and 3-7 overlap to some extent and should be viewed together. Figure 3-9 depicts the 100 µg/L TCE contour for Upper Unit 4 for certain years between 1990 and 2020, similar to Figure 3-1 which shows the 1 µg/L TCE contour over that same period. In general, the plumes show “no trend” or stable concentrations (see statistical analysis below); as Figure 3-1 shows, the plume footprint remains similar to 2009. Figure 3-9 shows a smaller plume compared to 2009 with the 2020 plume receding towards the northwest, most likely due to the NBCGRS. A slight northward shift was observed in FY 2015 and FY 2016 of the 1 µg/L and 100 µg/L TCE contours on the northwest edge of the plume, likely a result of the NBCGRS shutdown to upgrade the facility to treat 1,4 Dioxane beginning in April 2015. This shift was first observed following the FY 2015 sampling event and was observed slightly farther north again in FY 2016. This trend appears to have reversed since the NBCGRS was started back up and the plumes appear to have receded. The water level data from June--July 2020 for Upper Unit 4 are presented as a potentiometric map on Figure 3-10.

The OU1 Technical Group Technical Memorandum Statistical Evaluation Method for Water Quality Data, Operable Unit 1 (Army 2004) was prepared to develop statistical methods specifically selected to evaluate the long-term progress of remediation, plume evolution, and aquifer restoration in OU1. The OU1 2004 Technical Memorandum states the objective of the statistical evaluation as follows:

“Verify progress in cleanup of the plume through measurement of overall geographic plume shrinkage and decreasing COC concentrations.”

The OU1 2004 Technical Memorandum identified five issues that need to be statistically evaluated with respect to the above objective:

1. Measure changing concentrations immediately downgradient of the TGRS, as this area is the first to be affected by any potential COC migration via TCAAP.
2. Measure changes in the geographical size of the plume over time.
3. Measure changes in concentrations immediately downgradient of the NBCGRS, as this is the first area to be affected by any potential COC migration outside of NBCGRS capture.
4. Measure any unforeseen changes in plume configuration. This addresses the possibility that changing flow patterns may cause a shift in the plume but not necessarily any change in size. A plume shift may require a redistribution of pumping.
5. Measure the long-term trends in overall VOC concentrations (as an indicator of COC mass). This provides an overall picture of remedial progress.

The OU1 2004 Technical Memorandum developed a series of five well groups designed to address each of the issues listed above. For each group, appropriate statistical tools were specified, and a threshold identified that would trigger closer scrutiny by the Army and regulators (USEPA and MPCA). Appendix D.2.1.5 shows the factors to consider and potential additional actions that may be implemented if the statistical threshold is triggered. As Appendix D.2.1.5 shows, a threshold trigger initiates a closer look at the data and the context of the data in terms of remedy performance or potential risk. A threshold trigger does not automatically require any specific action. The five groups, corresponding to the five issues discussed above are:

Group 1: Downgradient of the TGRS capture zone. This zone should show reductions over time in response to TGRS mass removal and containment. Groundwater velocities may be reduced in this area and response may be slow. Furthermore, individual wells near the stagnation zone may show increases in COC concentrations during some points in time, as the plume shifts in response to changes in pumping.

Group 2: Plume Edge Wells. This zone includes wells that define the edges of the plume downgradient of the TGRS. These are wells with low concentrations of VOCs (less than 100 µg/L) that will indicate a reduction in overall plume size if VOC concentrations continue to decline.

Group 3: Downgradient Sentinel Wells. This is a zone downgradient of the NBCGRS stagnation zone. This group includes three wells but more accurately is defined as a geographic area immediately downgradient of the NBCGRS. This group should help demonstrate improvement due to the VOC mass removal by the NBCGRS over time, analogous to Group 1 and the TGRS.

Group 4: Lateral Sentinel Wells. These are “clean” wells downgradient of the TGRS that are beyond the current plume boundaries. These wells should help identify large, unexpected, lateral changes in plume configuration, such as a shifting or expansion of the plume boundary.

Group 5: Global Plume Mass Wells. This group includes all the monitoring wells necessary to construct a contour map of the VOC plume. Production wells are not used in Group 5 because the data may not be comparable to monitoring well data. Some wells located within OU2 are included in Group 5 to support the contouring near the OU2 boundary. This group reflects the overall VOC mass in the aquifer and should show an overall reduction in VOC mass over time.

In October 2005, the Army received a consistency determination from regulators on Modification #1 to: *OU1 Technical Group Technical Memorandum Statistical Evaluation Method for Water Quality Data, Operable Unit 1,* prepared by the Army, dated December 2004. This modification created well Group 6 to address the Jordan portion of the Unit 4 aquifer.

Group 6: Jordan Wells. The group includes all Jordan monitoring wells, the Prairie du Chien wells nested with them, and NBM Wells #3, #4, #5, and #6. The inclusion of the Prairie du Chien wells is to facilitate comparing the trends between it and the Jordan monitoring wells at these locations. This group will help identify any changes in the plume occurring in the Jordan portion of the aquifer. Additional detail on the well groups and analysis is presented in the OU1 Technical Memorandum, Modification #1 and Appendix D.2.

Table 3-2 presents the FY 2020 groundwater quality data for OU1 collected to support the statistical analysis developed by the OU1 Technical Group. Historical TCE concentrations at any well can be viewed in the Appendix D Groundwater Quality: Organic Data spreadsheet included on the FY 2020 APR compact disc. The statistical analysis in Appendix D.2 follows the format described in the OU1 Technical Memorandum and Modification #1.

Table 3-3 summarizes the statistical results for all groups, from Appendix D.2, reflecting the data collected through FY 2020. Table 3-3 includes an assessment of the statistical thresholds that were triggered in the analysis and brief comments addressing these threshold triggers. Only wells that were sampled in 2020 and have “increasing” or “no significant” trends are discussed below. For discussion of other wells or well groups, refer to the FY 2016 APR.

Group 2 (Plume Edge Wells):

409549 (No Significant Trend): TCE concentrations at this well have fluctuated between 4.4 µg/L and 220 µg/L since it was installed in 1985. The erratic increases and decreases in TCE concentrations over the years have resulted in a high “p-value” and results in no significant trend for this well. The concentration has been steadily increasing over the last 10 years but decreased to 28 µg/L in FY 2018 and 23.7 µg/L in FY 2020, which is well within the historical trend at the well.

409557 (Probably Increasing): Concentrations in this well have been steadily increasing from 37 µg/L in FY 2009 to 82 µg/L in FY 2020. An apparent outlier in FY 2018 of 17 µg/L results in the higher p-value preventing it from being statistically significant trend. Continued monitoring of this well is appropriate to evaluate how the plume is shifting.

03L833 (No Significant Trend): TCE concentrations show a generally decreasing trend since FY 2011 and have consistently been below 5 µg/L; therefore, a “no significant trend” result is not of concern.

03L848 (No Significant Trend): TCE concentrations show a generally decreasing trend since FY 2013 and have consistently been below 5 µg/L; therefore, a “no significant trend” result is not of concern.

03U805 (Increasing): TCE concentrations in this well had historically been below of 3 µg/L until FY 2013 when the concentration rose to 19 µg/L. Concentrations have since increased to 94 µg/L in FY 2020. The trend indicates an increasing trend and most likely reflects plume shift. This well is located on the southern edge of the OU1 plume immediately downgradient from the TGRS.

04U843 (Increasing): Concentrations in this well have been steadily increasing from 98 µg/L in FY 2009 to 220 µg/L in FY 2018 and 207 µg/L in FY 2020. This well is in the central part of the north plume not far downgradient of the TGRS and just downgradient of 04U847, which has the highest concentration of TCE in OU1. As this area is outside of the TGRS capture zone, this well may continue to increase as migration of TCE from 04U847 continues downgradient.

04U845 (No Significant Trend): The erratic increases and decreases in TCE concentrations over the years have resulted in a high “p-value” and thus a no significant trend outcome for this well. The concentrations have ranged from 6.3 µg/L to 14 µg/L. Continued monitoring of this well is appropriate to evaluate how the plume is shifting.

04U846 (Probably Increasing): Concentrations in this well have been steadily increasing from 10 µg/L in FY 2009 to 26 µg/L in FY 2016 and 25.2 µg/L in FY 2020. A decrease of TCE concentration in FY 2018 to 17 µg/L results in the higher p-value preventing it from being statistically significant trend. Concentrations at this well have historically been erratic, with a maximum concentration of 120 µg/L in FY 1988 and dipping down below 1 µg/L from FY 1998 through FY 2001. It is located towards the south side of the OU1 plume. The historically erratic trend is likely due to varying flow patterns created by the NBCGRS.

04U849 (No Significant Trend): Concentrations at this well appear to be stable between 70 µg/L to 80 µg/L since FY 2011. This well is located near the center of the plume and is expected to have stable concentrations with no significant trends.

04U875 (No Significant Trend): Concentrations of TCE at this well have consistently been below 3 µg/L since FY 2009; therefore, a “no significant trend” result is not of concern.04U877 (No Significant Trend): Concentrations of TCE at this well have consistently been below 2 µg/L since FY 2009; therefore, a “no significant trend” result is not of concern.

<u>Group 5 Unit 3 Wells:</u>

409550 (No Significant Trend): TCE concentrations have been between 24.7 µg/L and 34 µg/L since FY 2009. The raw trend for this well is slightly increasing; however, the well is in the center of the north plume and therefore the increasing raw trend most likely represents slight shifts in the core of the plume.

03U822 (No Significant Trend): TCE concentrations increased from 120 µg/L in FY 2009 to 160 µg/L in FY 2013 before stabilizing at 150 µg/L in FY 2015 and FY 2016. The concentration has since fallen sharply to 42 µg/L in FY 2018 and 18.5 µg/L in FY 2020. This well is in the center of the north plume and therefore the erratic concentrations most likely represent slight shifts in the core of the plume.

<u>Group 6 (Jordon Wells):</u>

04J708 (Increasing): TCE concentrations at this well have increased steadily since FY 2009. The concentration in FY 2020 was 8.73 µg/L. This well is located on the southern edge of the OU1 plume and may indicate a slight shift or expansion of the plume.

04J834 (No Significant Trend): Concentrations of TCE at this well have consistently been non-detect or less than 1 µg/L since FY 2009; therefore, a “no significant trend” result is not of concern.

04J836 (Probably Increasing): This well is directly downgradient from the NBCGRS and has previously shown “No Significant Trend”. TCE concentrations have increased slightly from 10 µg/L in FY 2013 to 40 µg/L in FY 2016 and then decreased to 26 µg/L in FY 2018. Concentrations again fell in FY 2020 to 2.85 µg/L. This general increase from FY 2013 to FY 2016 may have been influenced by the NBCGRS shut down in FY 2015.

04J837 (No Significant Trend): Concentrations of TCE at this well have consistently been less than 4 µg/L since FY 2009 with the exception of a concentration of 12 µg/L in FY 2015. The “no significant trend” result is not of concern as long as the TCE concentration continues to remain below the TCE cleanup limit of 5 µg/L.

04J838 (No Significant Trend): TCE concentrations at this well have historically been stable around 30 µg/L; however, in FY 2018 the concentration decreased to 0.91 µg/L and then increased back to 63.4 µg/L in FY 2020 which is within the historical range.

04J839 (Probably Increasing): TCE concentrations at this well have historically been below 5 µg/L; however, in FY 2018 the concentration increased to 6.1 µg/L and again increased to 28.6 µg/L in FY

2020. This well is downgradient from the NBCGRS and may show the plume is shifting northwards slightly. Continued monitoring is appropriate to further evaluate how the OU1 plume is shifting.

04J849 (Increasing): This well had historically been a non-detect well. TCE was 0.7 µg/L in FY 2016 and jumped to 59 µg/L in FY 2017. The concentration decreased again in FY 2018 to 1.3 µg/L and 1.4 µg/L in FY 2020. Continued annual monitoring is appropriate to further evaluate how the OU1 plume is shifting.

Group 6 (Nested Wells):

04U713 (No Significant Trend): Concentrations of TCE at this well have consistently been non-detect or less than 1 µg/L since FY 2009; therefore, a "no significant trend" result is not of concern.

04U834 (No Significant Trend): Concentrations of TCE at this well have consistently been non-detect or less than 2 µg/L since FY 2009 with the exception of a concentration of 6.1 µg/L in 2018. In FY 2020, the concentration was 1.13 µg/L. The "no significant trend" result is not of concern as long as the TCE concentration remains below the cleanup limit of 5 µg/L.

04U836 (No Significant Trend): This well is near the NBCGRS; therefore, greater variability is expected. TCE concentrations at this well have historically varied between 23 µg/L and 79 µg/L and concentration during FY 2020 was 44 µg/L.

04U837 (Probably Increasing): This well is near the NBCGRS; therefore, greater variability is expected. TCE concentrations at this well have historically remained below 5 µg/L; therefore, a "No Significant Trend" result is not of concern.

04U838 (No Significant Trend): TCE concentrations have been below 3 µg/L since FY 2009 but increased to 47 µg/L in FY 2018. In FY 2020 this concentration is once again below 3 µg/L. Continued monitoring will be conducted to assess the overall trend.

04U839 (Increasing): This well is near the NBCGRS; therefore, greater variability is expected. The well is located on the west/northwest edge of the plume and has historically had concentrations below 3 µg/L; however, the concentration increased to 15 µg/L in FY 2015 and concentrations have been between 40 µg/L and 50 µg/L during the five most recent sampling events. This increase may be influenced by the NBCGRS shut down.

Overall Statistical Assessment:

Area weighted concentrations and their statistical analysis for Group 1, Group 3 and Group 5 can be found in the FY 2016 APR. Discussion of established threshold triggers can also be found in the FY 2016 APR. These triggers highlight specific areas of the plume that are changing over time. This type of behavior is expected in a large complex flow system such as OU1. The thresholds triggered do not suggest any problems with the remedial systems but suggest movement within the established plumes. Overall, the data met the statistical criteria developed in this APR for assessing the remedial progress in the OU1 aquifers. The data show continuing improvement in the OU1 plume through FY 2020. The statistical behavior of the OU3 plume is addressed in Section 13.

How much VOC mass has been removed (at each well and total)?

The NBCGRS removed a total of approximately 342 pounds of VOCs during FY 2020. NBM Wells #3, #4, #5, #6, #14 and #15 removed 101, 74, 96, 69, 0.25, and 2 pounds respectively. The total cumulative VOCs removed by the NBCGRS through the end of FY 2020 is 24,216 pounds.

Figure 3-11 shows the annual VOC mass removed (graph top), annual pumping volumes, and annual mass removal per unit volume pumped since FY 1997 (when NBM #14 was brought online). Mass removal in FY 2020 was similar albeit slightly less than mass removal prior to the remedy time-out. Generally, mass removal has been decreasing since FY 1998, when the last extraction well was activated (NBM #15). This overall decline in mass removal is consistent with observed decreasing trends for TCE in OU1 deep groundwater, suggesting that aquifer restoration is progressing.

Are any changes or additional actions required for this remedy component?

No.

3.7 Other Related Activity in FY 2020

OU1 optimization activities were conducted in October and November 2020 to fill existing data gaps, improve the overall OU1 conceptual site model, and support future remedial optimization by determining if an additional NBCGRS extraction well is recommended to improve contaminant extraction and, if so, to identify a well location that will maximize contaminant mass removal. This work included a program of downhole hydrostratigraphic and groundwater quality profiling on existing OU1 wells. The scope of work consisted of geophysical logging and vertical aquifer profiling of wells under pumping conditions. A final report consisting of the findings and recommendations from these activities will be completed and submitted during FY 2021.

4 OPERABLE UNIT 2: SHALLOW SOIL AND DUMP SITES

The 1997 OU2 ROD and subsequent Amendments and ESDs are discussed in Sections 4 through 12 of this APR. This section specifically addresses the shallow soil and dump sites. Relevant modifications to the 1997 OU2 ROD include Amendments #1 (2007), #3 (2009), #4 (2012), #5 (2014), and ESD #2 (2009).

Through the OU2 Remedial Investigation/Feasibility Study (RI-FS) process, Sites A, C, E, H, 129-3, and 129-5 were found to have inorganic and/or organic COCs above the cleanup goals specified in Table 1 of the 1997 OU2 ROD. Unpermitted landfills, or dumps, were identified within Sites A, B, E, H, and 129-15. The 1997 OU2 ROD (page 2) describes nine remedy components to address the shallow soil and dump sites.

The OU2 ROD Amendment #1 (2007) modified the requirements for Site C-2 soil and sediment (note that Site C groundwater and surface water is addressed separately in Section 7). Because the depth to groundwater is shallow at Site C-2, it was not feasible to remove all contaminated soil and sediment. The Amendment modified remedy component #2 related to excavation of soil, to allow the placement of a 4-foot thick soil cover over areas where impacts remain in-place above the cleanup levels. The OU2 ROD Amendment #1 (2007) also specified land used controls (LUCs) as an additional remedy component for Site C-2.

The OU2 ROD Amendment #2 (2009) addressed shallow groundwater at Site I, which is discussed in Section 8.

The OU2 ROD Amendment #3 (2009) affected the shallow soil and dump sites in four principal ways:

1. OU2 ROD Amendment #3 (2009) documented, as final remedies, the additional actions performed for shallow soil at Site D and the dump at Site G, after completion of the deep soil requirements set forth for both in the 1997 OU2 ROD (see Section 5 of this APR for discussion of the deep soil).
2. OU2 ROD Amendment #3 (2009) documented the use of soil covers as part of the final remedy at Sites E, G, H, and 129-15.
3. OU2 ROD Amendment #3 (2009) documented final remedies for five sites with soil impacts that were not originally included in the 1997 OU2 ROD: Grenade Range, Outdoor Firing Range, 135 PTA Stormwater Ditch, Trap Range, and Water Tower Area. At these sites, either previous removal actions had been completed that reduced soil impacts to below cleanup levels, or investigations had determined that no action or no further action was needed. The Amendment incorporated the remedies for these sites into the overall remedy for OU2.
4. OU2 ROD Amendment #3 (2009) specified LUCs as an additional remedy component for shallow soil and dump Sites D, E, G, H, 129-15, Grenade Range, and Outdoor Firing Range. LUCs are not needed for the 135 PTA Stormwater Ditch or Trap Range because impact levels are suitable for unlimited use / unrestricted exposure. The Water Tower Area is also suitable for unlimited use / unrestricted exposure; however, it is located within the area having blanket land use restrictions as specified in the land use control remedial design (LUCRD).

ESD #1 is discussed in Section 6 (Site A shallow groundwater), Section 9 (Site K shallow groundwater), and Section 12 (OU2 deep groundwater).

ESD #2 specified LUCs as an additional remedy component for Sites A, C-1, 129-3, and 129-5. ESD #2 also documented that no further action is required at Site B. Site B is located within the area having blanket land use restrictions.

The OU2 ROD Amendment #4 (2012) was signed in January 2012 and documents previously completed soil removal actions conducted at two sites: the 535 PTA and Site K. No further action is required for the soils located near the excavation areas at these two sites; though the excavation area for the 535 PTA is located within the area of the Arden Hills Army Training Site that has restricted commercial use. The OU2 ROD Amendment #4 (2012) also addressed Building 102 shallow groundwater, discussed in Section 10, and OU2 aquatic sites, discussed in Section 11.

The OU2 ROD Amendment #5 (2014) was signed in March 2014 and documents previously completed soil removal actions conducted at soil areas of concern at three sites: Site A, the eastern portion of the 135 PTA, and the MNARNG EBS Areas. It also documents that LUCs are required at these sites.

4.1 Remedy Components #1 through #9: Soil Remediation

The nine remedy components specified in the 1997 OU2 ROD (page 2) have been completed for the shallow soils and dumps at Sites A, C, D, E, G, H, K, 129-3, 129-5, 129-15, Grenade Range, Outdoor Firing Range, 135 PTA Stormwater Ditch, the eastern portion of the 135 PTA, 535 PTA, MNARNG EBS Areas, and Water Tower Area. Remedy Components #1 through #8 addressed the characterization, excavation, sorting, treatment, disposal, site restoration, site access restrictions (during remedial actions), and limited period of post-remediation groundwater monitoring. Remedy Component #9 addressed the characterization of dumps at Sites B and 129-15. The characterization work at both sites led to a determination that no further action was required at Site B and construction of a cover at Site 129-15, which were documented through OU2 ESD #2 (2009) and OU2 ROD Amendment #3 (2009), respectively.

4.2 Remedy Component #10: Land Use Controls

Description: “OU2 ROD Amendments and ESDs made LUCs a part of the remedy for shallow soil and dump sites where impacts remain-in-place above levels that allow for unlimited use and unrestricted exposure. LUCs are also necessary to protect the integrity of the soil covers constructed at various sites.”

Performance Standard (how do you know when you’ve achieved the remedy):

Initial implementation was done when the USEPA and MPCA provided consistency approval for an OU2 LUCRD document. Implementation will continue indefinitely unless further action is taken that would allow for unlimited use and unrestricted exposure.

Has a LUCRD document been approved to address LUC issues for OU2, and is it being implemented?

Yes. The USEPA and MPCA provided consistency approval for the OU2 LUCRD in September 2010 and it has been implemented by the Army. The most recent revision, LUCRD Revision 6, was approved by the USEPA and MPCA in October 2020. This revision documents the partial delisting of soil, surface water, and sediment (not groundwater) at five aquatic sites located within OU2 (Rice Creek, Sunfish Lake, Marsden Lake North, Marsden Lake South, and Pond G). Figure 2-3 presents property under federal ownership at the end of FY 2020, along with the organizations responsible for control.

Was an annual site inspection for LUCs conducted in FY 2020?

Yes. On August 11, 2020, MNARNG, and JV conducted the annual inspection of OU2 sites. The checklist that was completed during the inspection is included as Appendix F.

Did the inspection identify any follow-up actions needed to maintain the protectiveness of the LUCs?

No. The LUC inspection form includes the following observations noted during the inspection:

- Outdoor Firing Range LUC - Excavation, there was excavation as part of the construction of the division headquarters building. Construction completed in early August 2020. This excavation was included as the soil disturbance occurred near the firing range, but did not disturb the soil cap at Site H or the 842 yard bullet catcher berm.
- Site G LUC - there were three (3) small trees, approximately 2 inches in diameter, around the south perimeter of the soil cap. The trees appeared to be just outside of the soil cap but were removed.
- Site C Institutional Controls - north fence removed by Ramsey County. This does not violate land use controls because no soil cap was disturbed.

5 OPERABLE UNIT 2: DEEP SOIL SITES

For purposes of the 1997 OU2 ROD, Sites D and G were considered deep soil sites because VOC impacts extended to depths between 50 and 170 feet. Some additional shallow soil COCs were also present at Site D, and Site G also contains a dump. The 1997 OU2 ROD (pages 2 to 3) describes seven remedy components to be implemented for these two sites:

1. Remedy Component #1: Groundwater Monitoring,
2. Remedy Component #2: Restrict Site Access (During Remedial Actions),
3. Remedy Component #3: Soil Vapor Extraction (SVE) Systems,
4. Remedy Component #4: Enhancements to the SVE Systems,
5. Remedy Component #5: Maintain Existing Site Caps,
6. Remedy Component #6: Maintain Surface Drainage Controls and
7. Remedy Component #7: Characterize Shallow Soils and Dump.

For Remedy Component #1, ongoing groundwater monitoring near these two sites is completed as part of OU2 deep groundwater monitoring (Section 12) and is not discussed in this section. Remedy Components #2 to #6 were related to continued operation of the SVE systems that had been installed in 1986, shut down in 1998, and subsequently removed completing Remedy Components #2 to #6.

Regarding Remedy Component #7, additional shallow soil investigation work (for non-VOC COCs) was completed at Site D, and characterization work of the dump was completed at Site G, which completed this remedy component. The investigation/characterization work led to removal of shallow soils at Site D and construction of a cover at Site G, which were documented through the OU2 ROD Amendment #3 (2009).

In summary, the deep soil requirements of the 1997 OU2 ROD have been completed. There are ongoing LUC requirements for the shallow soil at Site D and the dump at Site G, as discussed in Section 4.

6 OPERABLE UNIT 2: SITE A SHALLOW GROUNDWATER

Shallow groundwater at Site A has been impacted by VOCs and antimony. The selected remedy in the 1997 OU2 ROD incorporates the use of a groundwater extraction system, which began operation May 31, 1994. When operating, the system conveyed extracted groundwater to the sanitary sewer for treatment at a Publicly-Owned Treatment Works (POTW). However, as further discussed below, the groundwater system ceased operation (with regulatory approval) on September 24, 2008, while implementation of monitored natural attenuation (MNA) was being evaluated.

The original 8-well groundwater extraction system that was selected in the 1997 OU2 ROD began operation May 31, 1994. On July 11, 2000, with regulatory approval, extraction well (EW)-5 through -8 (the “second line” of extraction wells) were shut down due to VOC concentrations in these wells having declined below cleanup levels. In July 2008, the USEPA and MPCA approved the Site A Shallow Groundwater: 10-Year Evaluation Report (Wenck Associates, Inc. [Wenck] 2008a). The 10-Year Report was prepared to fulfill a requirement of the 1997 OU2 ROD, which states that for shallow groundwater impacts at Site A, “should aquifer restoration not be attained within the ten- year lifespan of the remedy, additional remedial measures will be addressed.” Because the 10-year mark had been reached and impacts were still present above the cleanup levels, the 10-Year Report was prepared to discuss the status of the site and to evaluate any potential changes to the remedy that would be beneficial. MNA (through abiotic degradation) was the recommended alternative for Site A that was approved by the USEPA and MPCA.

In September 2008, the USEPA and MPCA approved the Site A Shallow Groundwater: Monitoring and Contingency Plan (Wenck 2008b), and EW-1 through EW-4 (the “first line” of extraction wells) were shut off on September 24, 2008. The Monitoring and Contingency Plan presented the monitoring plan to be implemented when the extraction wells were shut off and presented the contingency actions that will be taken by the Army if groundwater monitoring indicates that any of the identified trigger points are exceeded. These monitoring and contingency actions were incorporated into this APR, and thus any changes to monitoring and contingency actions must be approved by the USEPA and MPCA through revisions to this APR.

The decision to proceed with MNA was based in part on the MPCA and USEPA natural attenuation study at the site (2000) and follow-up MPCA/USEPA microcosm studies that have verified that abiotic degradation of VOCs in Site A groundwater is occurring at substantial rates. Such degradation acts to reduce COC mass and mobility by breaking down the COCs as they move downgradient. The decision to proceed with MNA was also based on the absence of any likely receptors. The closest potential groundwater receptor is located approximately 1,000 feet downgradient from 01U352 (EW-2) and 01U353 (EW-3). This domestic well has not been operable for many years (and even when it was, the water was only used for irrigation purposes). Beyond this unlikely receptor, there are no other existing downgradient receptors between the plume and Rice Creek, which is approximately 1,800 feet away.

Based on a November 11, 2015 Technical Memorandum submitted by the Army that documented the FY 2015 monitoring results and recommended changing the remedy to MNA, the USEPA and MPCA approved changing the remedy to MNA in lieu of groundwater extraction and discharge. This change was approved in OU2 ROD Amendment #6 in early FY 2018. These extraction wells are included in the monitoring plan for Site A. Therefore, they will not be sealed.

As part of a Site A Work Plan approved in October 2020, the JV will conduct vapor and groundwater sampling in FY 2021 to further delineate the plume with temporary monitoring wells and potentially adding up to three permanent monitoring wells off post to the north of Site A.

6.1 Remedy Component #1: Groundwater Monitoring

Description: “Groundwater monitoring to track plume migration and remedy performance.” (1997 OU2 ROD, page 3).

Performance Standard (how do you know when you’ve achieved the remedy):

When a performance groundwater monitoring program has been established and ongoing monitoring is compliant with the program.

Is this remedy component being implemented?

Yes. Table 6-1 summarizes performance monitoring requirements, implementing parties, and monitoring plan documents. The FY 2020 Monitoring Plan is included in Appendix A, and the FY 2020 water quality monitoring locations and frequencies are also summarized on Figure 6-1. Any deviations are explained in Appendix C.2. Figure 6-2 presents June 2020 measured groundwater elevations and groundwater contours.

Were the groundwater monitoring requirements for this remedy met?

Yes.

Is any groundwater sampling proposed prior to the next report?

Yes, annual sampling of Site A groundwater monitoring wells will be according to the monitoring plan in Appendix A.1.

Groundwater sampling of water supply wells related to alternate water supply and well abandonment will be in accordance with recommendations in Appendix E.

Additionally, as part of the Site A Work Plan approved in 2020, the JV will conduct vapor and groundwater sampling in FY 2021. The result of the investigation will lead to the installation of up to three new monitoring wells; these new wells will be added to the annual monitoring requirements for Site A.

Are any changes or additional actions required for this remedy component?

Yes. As first proposed in the FY 2015 APR, monitoring of wells 01U350, 01U351 (EW-1), and 01U354 (EW-4) ceased in FY 2017. These wells are essentially redundant monitoring points to nearby wells 01U108, 01U116, and 01U138, respectively. However, 01U350 is used as a monitoring point in place of 01U108 due to an obstruction that has prevented monitoring since FY 2017. As of the end of FY 2020, 01U108 has been abandoned.

6.2 Remedy Component #3A: Land Use Controls

Description: The 1997 OU2 ROD (page 3) stated: “Institutional controls to restrict new well installations and provide alternate water supplies and well abandonment as necessary.” For ease of discussion, the requirement has been broken into two pieces, with this section focusing on the LUCs. OU2 ESD #1 clarified the LUC component to include protection of the groundwater monitoring and extraction system infrastructure.

Performance Standard (how do you know when you’ve achieved the remedy):

Implementation of LUC will continue until such time that the groundwater concentrations are below the cleanup levels.

Has the MDH issued a SWBCA Advisory for the area impacted by Site A?

Yes, issued June 1996, revised in December 1999 and April 2016; however, these revisions did not affect the boundary for the Site A vicinity.

Has a LUCRD document been approved to address LUC issues for OU2, including Site A groundwater, and is it being implemented?

Yes. The USEPA and MPCA provided consistency approval for the OU2 LUCRD in September 2010, which is being implemented by the Army. Subsequent revisions to the OU2 LUCRD have not changed the LUCs for Site A.

Was an annual site inspection for LUCs conducted in FY 2020?

Yes. On August 11, 2020, the Army, MNARNG, and JV conducted the OU2 site annual inspection, with a completed checklist included as Appendix F.

Did the inspection identify any follow-up actions needed to maintain the protectiveness of the LUCs?

No.

6.3 Remedy Component #3B: Alternate Water Supply/Well Abandonment

Description: The 1997 OU2 ROD (page 3) states: "Institutional controls to restrict new well installations and provide alternate water supplies and well abandonment as necessary." For ease of discussion, the requirement has been broken into two pieces, with this section focusing on the alternate water supplies and well abandonment.

Performance Standard (how do you know when you've achieved the remedy):

Complete. When well owners who qualify have been offered and provided with alternate water supply and/or have had their wells abandoned (or the offers have been rejected).

Is the remedy component being implemented?

Yes. The OU1 Alternate Water Supply and Well Abandonment Program is underway and was expanded to cover the area affected by the OU2 Site A shallow groundwater plume. See Section 3.1 for further information.

Did the boundary of the Site A plume get any bigger during FY 2020, as defined by the 1 µg/L contour?

No. Table 6-2 presents the FY 2020 groundwater quality data for Site A. Using these data, Figure 6-3 shows the tetrachloroethene (PCE) concentrations and Figure 6-4 shows the cis-1,2-dichloroethene (cis-1,2-DCE) concentrations. The latter is a degradation product of the former and represents the larger aerial footprint. The plume for cis-1,2-DCE decreased in size as shown on Figure 6-5, however, beginning in 2019 it appeared that the groundwater plume is moving in a northwestern direction past the boundary of TCAAP and contingency well locations. A workplan was approved in October 2020 by the MPCA and USEPA for 2021 to further delineate the plume with temporary monitoring wells and potentially adding up to three permanent monitoring wells off post to the north of Site A.

Were any additional water supply wells discovered within the area of concern for the Site A plume that are completed within the aquifer of concern?

No.

Were any water supply wells within the Site A plume sampled during FY 2020? If yes, what were the findings?

No

Were any well owners offered an alternate supply and/or well abandonment in FY 2020?

No.

Within the Site A plume, are there any well owners that meet the criteria, but have not yet been provided an alternate water supply?

No.

Within the Site A plume, are there any wells that meet the criteria, but have not yet been abandoned?

No.

Is any sampling of water supply wells proposed prior to the next report?

No. There are no water supply wells in the vicinity of Site A vicinity that require sampling.

Are any changes or additional actions required for this remedy component?

No.

6.4 Remedy Component #5: Source Characterization/ Remediation

Description: “Source characterization/remediation” (1997 OU2 ROD, page 3).

Performance Standard (how do you know when you’ve achieved the remedy):

For characterization, when the investigation answered needed questions to prepare remedial design documents. For remediation, when soil COC concentrations are below cleanup levels specified in Table 1 of the 1997 OU2 ROD.

Is this remedy component being implemented?

Yes. Source-characterization work has been completed. Stone & Webster performed investigation work in 1997 and the Final Site A Investigation Report (Stone & Webster Environmental Technology & Services 1997) was issued December 12, 1997. The report delineated the extent of both VOC-contaminated and metal- contaminated soils requiring remediation. The source of VOC-contaminated soils was found to be the “1945 Trench.”

Remediation has been completed. Shaw Environmental and Infrastructure, Inc. (Shaw, formerly Stone & Webster) completed removal of metal-contaminated soils in FY 1999. Construction of an air sparging (AS) / SVE system to remediate VOC-contaminated soils was completed by Stone & Webster in FY 2000, which began operation in early FY 2001. The AS system was shut off permanently in June 2001 due to a lack of increase in SVE VOC levels and a concern regarding potential plume spreading. The AS system was being implemented voluntarily by the Army and was not a 1997 OU2 ROD requirement. Soil samples were collected within the source area in July 2002 (and previously in August 2001). In both events, the results showed minimal reduction in soil VOC concentrations. Since it appeared that many years of SVE system operation would be required before soil cleanup levels would be reached, if ever, the Army ceased SVE system operation on August 21, 2002. The Army submitted a work plan clarification to the USEPA and MPCA for excavation of source area VOC-contaminated soils, which received regulatory approval in early FY 2003. Post approval, 688 cubic yards of contaminated soil were excavated by Shaw and transported off-site to a permitted disposal facility (see Figures 6-3 and 6-4 for the location of the soil excavation area at the former 1945 Trench). The Site A Former 1945 Trench Closeout Report (prepared by Shaw) received regulatory consistency in FY 2004.

Are any changes or additional actions required for this remedy component?

No.

6.5 Overall Remedy for Site A Shallow Groundwater

Performance Standard (how do you know when you've achieved the remedy):

When the cleanup levels in Table 1 of the 1997 OU2 ROD have been attained throughout the aerial and vertical extent of the Site A plume (1997 OU2 ROD, page 54).

Has the Site A shallow groundwater remedy been completed (i.e., have the cleanup levels in Table 1 of the 1997 OU2 ROD been attained throughout the aerial and vertical extent of the Site A plume)?

No. Table 6-2 presents the FY 2020 groundwater quality data and highlights the value that exceeded the cleanup level. The cleanup level of cis-1,2-DCE (70 µg/L) was exceeded by a concentration of 389 µg/L in well 01U139. None of the other COCs exceeded their respective cleanup levels in FY 2020.

What impact is MNA having on contaminant concentrations?

As evident in Table 6-2, and on Figures 6-3 and 6-4, PCE and TCE continue to be degraded to cis-1,2-DCE via natural attenuation. This degradation generally occurs within the distance between the source area and the first line of extraction wells (EW-1 through EW-4), with primarily only cis-1,2-DCE being detected downgradient of the first line of extraction wells. Figure 6-6 shows the cis-1,2-DCE concentrations plotted on geologic cross sections to illustrate the vertical extent of impacts (the cross-section locations are illustrated on Figure 6-4). cis-1,2-DCE continues to be degraded via an abiotic process as the plume migrates. The MPCA and USEPA initially evaluated attenuation at the site using computer modeling of COC degradation, as documented in Evaluation of Natural Attenuation of Chlorinated Solvents in Ground Water at the Twin Cities Army Ammunition Plant (MPCA and USEPA 2000). The MPCA conducted a follow-up microcosm study (unpublished), the results of which were presented to the Army and USEPA on April 10, 2007. The work conducted in this study showed that the degradation being observed at Site A was an abiotic process (not biological), which likely involves the presence of the mineral magnetite in soils. Note that the predominant degradation process does not "degrade through" vinyl chloride, which is no longer monitored at the site given the historical lack of detections that led to the 1997 OU2 ROD not selecting this compound as a COC.

Since September 2008 when the "first line" of extraction wells was shut off, some wells have shown decreased concentrations while others have, in some periods, shown increased concentrations (see Figures 6-7, 6-8, 6-9 and 6-10). Collectively, the cis-1,2-DCE water quality trends evident on Figures 6-7 through 6-10 indicate the concentrations have essentially stabilized. Historically, the contingency locations (the four 900-series wells located along the north side of County Road I) have peaked and now show stable or decreasing trends at concentrations below the cis-1,2-DCE cleanup level of 70 µg/L (Figure 6-10). However, during FY 2018, contingency location 01U902 had a cis-1,2-DCE concentration of 92 µg/L while all other contingency locations remained below the cleanup level. In FY 2019 and now FY 2020, cis-1,2-DCE concentrations in all contingency wells were once again below the cleanup level. However, there is evidence that this cis-1,2-DCE plume is migrating in a northwesterly direction past the contingency locations. As discussed previously, there is a work plan that was approved in October 2020 and slated for 2021 to further investigate and delineate the shallow groundwater plume north of Site A.

Concentrations of cis-1,2-DCE in 01U901 and 01U903 have been at or near non-detect since 2008. Throughout their lifetime, these concentrations have been well below the cleanup level.

The concentrations of cis-1,2-DCE in 01U902 had stabilized between 15 and 20 µg/L by June 2013. However, concentrations began to increase in 2016. cis-1,2-DCE concentrations for well 01U902 were 29 µg/L in 2016, 35 µg/L in 2017, and then exceeded the cleanup level with 92 µg/L in 2018. Since 2018, the concentration has once again dropped below the cleanup level with 42 µg/L in FY 2019 and 37 µg/L in FY 2020.

The concentration of cis-1,2,-DCE in 01U904, which increased to a peak of 57 µg/L in June 2013, decreased steadily through FY 2014 and stabilized between approximately 20 and 30 µg/L through FY 2017 before becoming non-detect in FY 2018, FY 2019 and FY 2020.

Concentrations of cis-1,2-DCE at EW-8 have been less than 1 µg/L since December 2012.

Concentrations of cis-1,2-DCE at EW-7 peaked just above the cleanup level in December 2012 and have steadily declined to non-detect in June 2019 and June 2020.

Through FY 2016, cis-1,2-DCE concentrations at EW-5 appeared to have stabilized below the cleanup level; however, concentration increased from 32 µg/L in FY 2016 to 200 µg/L in FY 2017 and then to 300 µg/L in FY 2018. Since FY 2018, concentrations have once again dropped below cleanup levels to 1.8 µg/L in 2019 and 0.4 µg/L in 2020.

A generally increasing trend of cis-1,2-DCE concentrations above the cleanup level had been observed at EW-6 from 78 µg/L in FY 2012 to 290 µg/L in FY 2017. These concentrations have since fallen below the cleanup level during the FY 2018, FY 2019 and FY 2020 sampling events. The reason for this is unclear but continued monitoring of EW-6 will be performed.

In the monitoring wells located between the two rows of extraction wells (Figure 6-8), concentrations of cis-1,2-DCE appeared to have stabilized or to have been on a declining trend. 01U139, currently the well with the highest concentration of cis-1,2-DCE at Site A, had a peak concentration of 510 µg/L in June 2013, and appeared to have stabilized between 240 and 350 µg/L. However, in June 2017, the cis-1,2-DCE concentration increased to 540 µg/L and then to 710 µg/L in FY 2018. This upward trend did not continue as this concentration decreased in June 2019 to 180 µg/L and then increased 389 µg/L in FY 2020. Future monitoring will be evaluated to confirm the overall trend.

01U140, after showing three exceedances of the cleanup level between 80 and 100 µg/L in FY 2011 and FY 2012, has shown a steadily declining cis-1,2-DCE concentration to 0.60 µg/L in FY 2019 and non-detect in FY 2020.

01U157 had two slight exceedances of the cis-1,2-DCE cleanup level in FY 2011 and FY 2012 of 73 µg/L and 96 µg/L and then appeared to have stabilized between 18 and 25 µg/L; however, the cis-1,2-DCE concentration in June 2017 increased to 380 µg/L. This peak was not sustained though as the concentration decreased to non-detect in FY 2018, 0.44 µg/L in FY 2019, and 1 µg/L in FY 2020. Future monitoring will be evaluated to confirm the overall trend.

01U158 had a peak cis-1,2-DCE concentration of 410 µg/L in April 2011, but had since stabilized between 28 and 67 µg/L. The observed cis-1,2-DCE concentration of 80 µg/L in June 2016 was the first exceedance of the cleanup level at 01U158 since December 2011. The June 2017 concentration decreased to 13 µg/L and was 12 µg/L in FY 2018. In June 2019, this concentration increased to 55 µg/L; however, this concentration then became non-detect in 2020. The overall trend at this location still appears to be stable.

In EW-1 through EW-4 (Figure 6-7), concentrations of cis-1,2-DCE have been at or near non-detect since FY 2010 or earlier. Sampling has been discontinued at EW-1 and EW-4, as discussed in Section 6.1. In FY 2020, samples were collected from EW-2 and EW-3 showed cis-1,2-DCE concentrations of 0.5 µg/L in EW-2 and non-detect in EW-3.

In summary, the cis-1,2-DCE plume has largely stabilized following shutdown of EW-1 through EW-4 in FY 2008. Most importantly, contingency locations 01U901, 01U903, and 01U904 along the north side of County Road I show stable or decreasing trends at concentrations below the cis-1,2- DCE cleanup level of 70 µg/L (despite 01U904 being located directly downgradient of EW-6). The cis-1,2-DCE concentration in 01U902 increased slightly in FY 2016, FY 2017 and again in FY 2018 to above the cleanup level. In FY 2019, the concentration was once again below the cleanup level, but will require continued monitoring to assess this potential upward trend.

Were any trigger levels exceeded at any of the contingency locations?

No. The four contingency locations are 01U901, 01U902, 01U903 and 01U904, which are the four monitoring wells located along the north side of County Road I. The trigger level is equal to groundwater cleanup levels and none of the contingency locations had detections of COCs exceeding their respective cleanup levels in FY 2020 (Table 6-2). As noted previously, 01U901 and 01U903 have been at or near non-detect for cis-1,2-DCE since FY 2008 and well below the cleanup level throughout their history. Concentrations of cis-1,2-DCE in 01U904 show a stable trend with cis-1,2-DCE concentrations below the cleanup level of 70 µg/L with the past three annual events being non-detects. Concentrations of cis-1,2-DCE at 01U902 have been generally increasing since FY 2015, with FY 2018 being the only year the well exceeded the cleanup level.

The *Site A Shallow Groundwater: Monitoring and Contingency Plan* (Wenck 2008b) noted that if the groundwater trigger is exceeded, three key contingency actions are required:

1. The Army will contact the well owner at 1783 Pinewood Drive to verify the well remains out of service (and will do this annually for as long as the trigger is being exceeded).
2. The Army will prepare and submit a plan to address the exceedance to the USEPA and MPCA for approval.
3. The Army will prepare and submit a plan to evaluate the indoor air pathway.

The third action was perhaps the most critical item, as no soil vapor sampling had ever been conducted at Site A prior to 2008. Increasing VOC groundwater concentrations in any of the wells north of County Road I would raise the question of whether these increases could cause an increase in soil gas VOC concentrations leading to a vapor intrusion risk. A vapor intrusion report had been prepared previously: Off-TCAAP Vapor Intrusion Pathway Analysis, Operable Unit 1, Operable Unit 3, and Operable Unit 2 (Site A) prepared by Tecumseh/Wenck Installation Support Services, May 2005. This report concluded the vapor intrusion pathway for the off-site Site A plume was incomplete because the concentrations in groundwater were below the USEPA generic screening criteria. However, no actual soil vapor sampling was conducted for that report. In December 2012, the MPCA requested that soil vapor sampling be conducted because their 2008/2010 vapor intrusion guidance is newer than the 2005 report and states that groundwater screening levels should not be used as a single line of evidence for decisions regarding vapor intrusion risk. Based on this MPCA request, the Army prepared an investigation QAPP, which was approved by the USEPA and MPCA in June 2013, and then conducted the vapor intrusion investigation work in July 2013. This work was documented in the Site A Vapor Intrusion Investigation Report (Wenck 2014), which received regulatory consistency approval in FY 2014. The report concluded that no significant VOC concentrations are present in soil gas near the 14 samples collected (10 of which were located along the north side of County Road I), and that there is no significant soil vapor risk.

Due to the shifting of the Site A plume downgradient since the June 2013 investigation work, an additional groundwater and soil vapor investigation work plan has been approved by the MPCA and USEPA. The work plan describes a program of temporary soil vapor and groundwater sampling investigation followed by installation of three new groundwater monitoring wells. The investigation points and wells will be located north of County Road I and are intended to delineate the leading edge of the Site A shallow groundwater plume and assess the potential for vapor risk to nearby receptors, most notably the residences north of Site A. While there are no groundwater receptors that would necessitate addressing the groundwater exceedance, per contingency action #2, additional monitoring wells will allow for continued monitoring as the plume shifts downgradient.

With regard to the first contingency action, according to the TCAAP Well Inventory and MDH records, the well at 1783 Pinewood Drive was sealed in 2014. No further action is required in regard to this contingency action.

The contingency locations will be sampled according to the monitoring plan in FY 2021 and the data will be further evaluated.

Can it be determined whether MNA is an adequate long-term remedy for Site A in lieu of groundwater extraction and discharge? (If MNA is determined to be adequate, a recommendation to formally change the remedy should be made.)

Yes. In the November 11, 2015 Technical Memorandum, the Army recommended that MNA be implemented as the long-term remedy for Site A in lieu of groundwater extraction and discharge. This recommendation was made in consideration of three key facts: 1) the vapor intrusion investigation concluded that there is no significant soil vapor risk north of County Road I; 2) the only known groundwater receptor between Site A and Rice Creek (1783 Pinewood Drive) was sealed in 2014; and 3) 1,4-dioxane was not found to be present in Site A shallow groundwater. The OU2 ROD Amendment #6 (2018) was approved in FY 2018, changing the remedy to MNA for Site A shallow groundwater.

Annual monitoring of Site A wells for VOCs will continue in FY 2021 according to the monitoring plan in Appendix A.

Do additional remedial measures need to be addressed?

No.

7 OPERABLE UNIT 2: SITE C SHALLOW GROUNDWATER

Impacts to Site C shallow groundwater had not occurred at the time of the 1997 OU2 ROD. In FY 1997, the United States Army Environmental Command sponsored a technology demonstration to phyto-remediate Site C lead-contaminated soil. During the growing seasons, ethylenediaminetetraacetic acid and acetic acid were applied to the soils to improve metals uptake by the crops. It had the unintended consequence of causing migration of lead from the soils into the shallow groundwater present within a few feet from the ground surface. In FY 2000, the MPCA took enforcement action, requiring the Army to implement corrective actions. Initially, the Army installed a groundwater recovery trench to contain the lead plume (operated between November 2000 and July 2001). On July 6, 2001, the Army began operating three extraction wells to contain the plume (replacing recovery trench operation), with discharge of extracted groundwater (treated as necessary) to a POTW. In FY 2004, a Stipulation Agreement was signed that resolved the enforcement action and directed that response actions be conducted under the authority of the FFA. The OU2 ROD Amendment #1 (2007) incorporated the existing groundwater extraction system as the final remedy.

On November 13, 2008, the groundwater system was shut off (with regulatory approval) because the lead concentrations in the three extraction wells had been below the groundwater cleanup level since March 2008 (i.e., the area of lead concentrations exceeding the groundwater cleanup level was not reaching the extraction wells and operation of the extraction system was no longer required for plume containment). The recommendation to de-energize the extraction system was presented in the Site C Groundwater Extraction System Evaluation Report (Evaluation Report; Wenck 2008c) and was approved by the USEPA and MPCA in November 2008. The OU2 ROD Amendment #1 (2007) prescribes four major components of the remedy, and until a decision is made to formally change the remedy, the original components of the OU2 ROD Amendment #1 (2007) will be retained in this section (with discussion that is appropriate to the current remedy implementation status).

The Evaluation Report also presented the monitoring plan to be implemented at the point that the extraction wells were shut off and the contingency actions that will be taken by the Army if groundwater and or surface water monitoring indicates that any of the stated trigger points are exceeded. These monitoring and contingency actions have been incorporated into this APR, and thus any changes to monitoring and contingency actions must be approved by the USEPA and MPCA through revisions to the APR.

At some point, the remedy could be formally changed. This change would presumably require an ESD, at a minimum, or possibly a ROD amendment. However, given that groundwater cleanup levels may be reached throughout Site C within a few years, it may not be necessary to go through the process of formally changing the remedy. Evaluation in future APRs will ultimately determine whether the USEPA, MPCA, and Army should formally change the remedy or, possibly, whether the site should be closed.

7.1 Remedy Component #1: Groundwater and Surface Water Monitoring

Description: "The existing Site C groundwater monitoring program will be revised as needed." "A new surface water monitoring plan will be prepared" (OU2 ROD Amendment #1 (2007), page 39-40).

Performance Standard (how do you know when you've achieved the remedy):

When a performance groundwater and surface water monitoring program has been established and ongoing monitoring is in compliance with the program.

Is this remedy component being implemented?

Yes. Table 7-1 summarizes the performance monitoring requirements, the implementing parties, and the documents that contain the monitoring plans. FY 2020 monitoring was conducted in accordance with the Monitoring Plans included in Appendix A. The water quality monitoring locations and frequencies are also summarized on Figure 7-1, and any deviations explained in Appendix C.2.

Were the monitoring requirements for this remedy met?

Yes, all groundwater and surface water samples were collected as per the FY 2020 monitoring plan in Appendix A.

Is any sampling proposed prior to the next report?

Yes. Groundwater and surface water monitoring at Site C will continue in accordance with the monitoring plans shown in Appendix A.1 and A.3, respectively.

Are any changes or additional actions required for this remedy component?

No.

7.2 Remedy Component #2: Groundwater Containment

Description: "Three extraction wells, EW-1 through EW-3, will continue collecting contaminated groundwater" (OU2 ROD Amendment #1 (2007), page 38).

Is this remedy component being implemented?

No. As discussed previously, because the area of lead concentrations that exceed the groundwater cleanup level no longer extends to the extraction wells, the extraction system is no longer operating, and this remedy component is not currently being implemented.

7.3 Remedy Component #3: Discharge of Extracted Water

Description: "Extracted groundwater will be pretreated onsite (as necessary) to meet the sanitary sewer discharge limit" (OU2 ROD Amendment #1 (2007), page 38).

Is this remedy component being implemented?

No. As discussed previously, because the area of lead concentrations that exceed the groundwater cleanup level no longer extends to the extraction wells, the extraction system is no longer operating, and this remedy component is not currently being implemented.

7.4 Remedy Component #4: Land Use Controls

Description: “LUCs will be established to protect the groundwater extraction, treatment, and monitoring system and to prohibit the drilling of water supply wells within the contaminated portion of the Unit 1 aquifer” (OU2 ROD Amendment #1 (2007), page 39).

Performance Standard (how do you know when you’ve achieved the remedy):

For initial implementation, when the USEPA and MPCA have provided consistency approval for an OU2 LUCRD document. Implementation will continue until such time the groundwater concentrations are below the cleanup levels.

Has a LUCRD document been approved to address LUC issues for OU2, including Site C groundwater, and is it being implemented?

Yes. The USEPA and MPCA approved the OU2 LUCRD in September 2010 and it is being implemented by the Army. The most recent Revision 6 of the OU2 LUCRD was approved by the USEPA and MPCA in October 2020 and the LUCs for groundwater and a soil cover for Site C remain in place.

Was an annual site inspection for LUCs conducted in FY 2020?

Yes. On August 11, 2020, the Army, MNARNG, and JV conducted the annual inspection of OU2 sites. The checklist that was completed during the inspection is included as Appendix F.

Did the inspection identify any follow-up actions needed to maintain the protectiveness of the LUCs?

No. The LUC inspection form includes the observation noted during the inspection:

- Site C Institutional Controls - north fence removed by Ramsey County. This did not violate the land use controls because no soil cap was disturbed.

7.5 Overall Remedy for Site C Shallow Groundwater

Performance Standard (how do you know when you've achieved the remedy):

When the cleanup levels in Table 1 of the OU2 ROD Amendment #1 (2007) have been attained throughout the aerial and vertical extent of the Site C plume.

Has the Site C shallow groundwater remedy been completed (i.e., have the cleanup levels in Table 1 of the OU2 ROD Amendment #1 (2007) been attained throughout the aerial and vertical extent of the Site C plume)?

No. Table 7-2 presents FY 2020 groundwater quality data and highlights the values that exceed the lead cleanup level. Surface water quality data are presented on Table 7-3. Figure 7-2 presents groundwater elevation contours based on groundwater measurements at Site C wells in June 2020. Figure 7-3 shows the lead results for groundwater and surface water locations. Figures 7-4 and 7-5 show the lead concentrations plotted on geologic cross sections for Site C to illustrate the vertical extent of impacts (the cross-section locations are illustrated on Figure 7-3).

In FY 2020, lead exceeded the groundwater cleanup level of 15 µg/L in three monitoring wells located near the source area (MW-3, MW-13, and MW-14). The lead concentrations at MW-3, MW-13, and MW-14 were detected at 49.6 µg/L, 21.6 µg/L, and 38.1 µg/L, respectively. The water quality trends (dissolved lead) for wells nearest the source (MW-3, MW-13, MW-14, and MW-15) are shown on Figure 7-6. Figure 7-6 indicates the variable concentrations observed at individual wells in FY 2020 has occurred throughout recent years for the four source area wells. Overall, lead concentrations at source area wells have decreased significantly in the last 10 years indicating substantial progress towards reaching groundwater cleanup levels.

Surface water monitoring results were all below the surface water cleanup level in FY 2020.

Were any trigger levels exceeded at any of the contingency locations?

No. The Site C contingency locations and trigger levels are shown in Table 7-4. Depending on the location, the trigger level is either equal to the groundwater cleanup level or a surface water cleanup level. Groundwater and surface water results (Table 7-2 and Table 7-3) show that trigger levels were not exceeded in FY 2020. If a trigger level were exceeded, the Army would implement contingency action(s) specified in the footnotes to Table 7-4.

Can it be determined whether a formal change to the remedy should be made (to eliminate the groundwater extraction and discharge components) or, possibly, whether the Site should just be closed?

No. Three wells still exceeded the cleanup level. Additional monitoring should be conducted before this determination is made.

Do additional remedial measures need to be addressed?

No. Site C wells have had stable COC concentrations and the existing groundwater plume does not appear to be migrating. Continued monitoring of the site will be performed to evaluate when closure for Site C is appropriate.

8 OPERABLE UNIT 2: SITE I SHALLOW GROUNDWATER

VOCs have been identified in Unit 1 (perched aquifer) at Site I. The selected remedy in the 1997 OU2 ROD consisted of four components: groundwater monitoring, groundwater extraction, POTW discharge, and additional characterization.

The additional investigation and Predesign Investigation Work Plan were completed in FY 2000. Based on these documents, the proposed remedy was to consist of a dual phase vacuum extraction system, which combined groundwater extraction with SVE, to be installed beneath Building 502. A dual phase extraction pilot test subsequently determined that the technology was not feasible due to the low Unit 1 permeability. The OU2 ROD Amendment #2 (2009) revised the requirements for shallow groundwater to groundwater monitoring, additional characterization, and LUCs. These three major remedy components are evaluated in the following sections.

8.1 Remedy Component #1: Groundwater Monitoring

Description: "Groundwater monitoring to track remedy performance." (1997 OU2 ROD, page 3).

Performance Standard (how do you know when you've achieved the remedy):

When a monitoring plan has been established and ongoing monitoring is in compliance with the plan.

Is the remedy component being implemented?

Yes. Table 8-1 summarizes the performance monitoring requirements, the implementing parties, and documents containing monitoring plans. Appendix A summarizes the FY 2020 monitoring plan and any deviations are explained in Appendix C.2.

As previously approved by the USEPA and MPCA, all Site I (Building 502) Unit 1 monitoring wells were abandoned in FY 2014 prior to the demolition of Building 502. Only well 01U667 is scheduled to be replaced, which could be delayed beyond FY 2020 due to the extent of pending re-grading associated with planned site redevelopment. Because well 01U667 was not replaced in FY 2020, no groundwater sampling was conducted during FY 2020. Once reinstalled, monitoring well 01U667 will be sampled annually in accordance with the FY 2020 - FY 2024 Monitoring Plan (Appendix A.1). Figure 8-1 presents a site plan for Site I, including the former locations of the now abandoned monitoring wells and a cross-section location presented on Figure 8-2.

Is any groundwater sampling proposed prior to the next report?

Yes, although it is contingent on completion of grading activities in this area and subsequent reinstallation of monitoring well 01U667. Groundwater monitoring at Site I will be in accordance with the monitoring plan provided in Appendix A.1.

Are any changes or additional actions required for this remedy component?

Yes. Monitoring well 01U667 must be reinstalled after grading activities have been completed.

8.2 Remedy Component #2: Additional Investigation

Description: “Additional characterization of the Unit 1 and Unit 2 soil and groundwater.” (1997 OU2 ROD, page 3).

Performance Standard (how do you know when you’ve achieved the remedy):

When the work has been completed according to an agency approved work plan.

Has the remedy component been implemented?

Yes. Additional investigation results were included in Appendix A of the Predesign Investigation Work Plan (January 1999), which resulted in a pilot study to evaluate dual phase vacuum extraction technology applicability. The resultant Predesign Investigation Report (March 2001) concluded that neither dual phase extraction nor groundwater extraction is feasible at Site I. The OU2 ROD Amendment #2 (2009) removed the groundwater extraction and POTW discharge component of the remedy.

Are any changes or additional actions required for this remedy component?

No.

8.3 Remedy Component #3: Land Use Controls

Description: “LUCs will be established to protect the groundwater extraction, treatment, and monitoring system and to prohibit the drilling of water supply wells within the contaminated portion of the Unit 1 aquifer.” (OU2 ROD Amendment #1 (2007), page 39).

Performance Standard (how do you know when you’ve achieved the remedy):

Implementation of the LUCs will continue until the groundwater concentrations are below the cleanup levels.

Has a LUCRD document been approved to address LUC issues for OU2, including Site I groundwater, and is it being implemented?

Yes. The USEPA and MPCA provided consistency approval for the OU2 LUCRD in September 2010, and the LUCRD is being implemented by the Army. Subsequent revisions to the LUCRD have not changed the groundwater LUCs for Site I.

Following additional soil investigation and remediation completed by Ramsey County in 2014 and 2015, the site is now suitable for unrestricted use / unlimited exposure and soil LUCs at Site I are no longer necessary. The USEPA and MPCA provided consistency approval for the OU2 LUCRD Revision 5 in March 2018, which formally removes Site I soil LUCs.

Was an annual site inspection for land use controls conducted in FY 2020?

On August 11, 2020, the Army, MNARNG, and JV conducted the annual OU2 site inspection. The completed checklist is included as Appendix F.

Did the inspection identify any follow up actions needed to maintain the protectiveness of the LUCs?

No.

8.4 Overall Remedy for Site I Shallow Groundwater

Performance Standard (how do you know when you've achieved the remedy):

When the cleanup levels in Table 1 of the 1997 OU2 ROD have been attained throughout the aerial and vertical extent of the Site I plume (1997 OU2 ROD, page 55).

Has the Site I shallow groundwater remedy been completed (i.e., have the cleanup levels in Table 1 of the 1997 OU2 ROD been attained throughout the aerial and vertical extent of the Site I plume)?

No. Groundwater monitoring was not conducted in FY 2020 due to the approved abandonment of all Unit 1 wells related to Site I demolition activities; however, the most recent groundwater quality data (from FY 2013) suggests that cleanup levels have not been attained. Table 8-2 presents FY 2013 data and highlights values that exceeded the cleanup level. The concentration of TCE in former well 01U632 had decreased over time but was still above the cleanup level in FY 2013. Results from the sampling of well 01U667 indicated concentrations of 1,2-dichloroethene and vinyl chloride remained above the cleanup levels. Figure 8-3 presents the FY 2013 Site I shallow groundwater TCE and vinyl chloride sample results.

Do additional remedial measures need to be addressed?

Yes. As requested by Northrup Grumman (Orbital ATK at the time) in their letter dated August 12, 2013 and approved by the USEPA and MPCA on August 14, 2013, all Unit 1 monitoring wells were abandoned in 2014. In accordance with the Northrup Grumman request and regulatory approval, monitoring well 01U667 will be reinstalled at the same location and depth following completion of redevelopment-related grading to occur at former Building 502. However, due to the significant extent of grading to occur, reinstallation of 01U667 could be delayed.

9 OPERABLE UNIT 2: SITE K SHALLOW GROUNDWATER

VOC impacts have been identified in Unit 1 (perched aquifer) at former Building 103. The limits of the VOC plume in the perched groundwater have been defined to be beneath and immediately northwest of former Building 103.

The remedy selected in the 1997 OU2 ROD consisted of seven components that incorporated the existing groundwater extraction trench and air stripper, which began operation in August 1986. The remedy also included additional investigation of the unsaturated soils beneath the building slab. OU2 ESD #1 added LUCs as a remedy component in 2009.

9.1 Remedy Component #1: Groundwater Monitoring

Description: "Groundwater monitoring to track remedy performance." (1997 OU2 ROD, page 3).

Performance Standard (how do you know when you've achieved the remedy):

When a monitoring plan is established, and monitoring is in compliance with the plan.

Is the remedy component being implemented?

Yes. Table 9-1 summarizes the performance monitoring requirements, the implementing parties, and the monitoring plan documents. Appendix A summarizes the FY 2020 monitoring plan and any deviations are explained in Appendix C.2.

Water levels are collected annually from monitoring wells and bundle piezometers in the vicinity of the groundwater collection and treatment system. In FY 2014, 15 Unit 1 monitoring wells were permanently abandoned, as approved by the USEPA and MPCA on August 14, 2013 and May 7, 2014. In FY 2017, one Unit 1 monitoring well (01U047) was permanently abandoned as approved by the USEPA and MPCA in September 2017. The monitoring wells currently included in the Site K Monitoring Plan were sampled in June 2020. Figure 9-1 presents the sampling and water level monitoring locations, as well as the location of the monitoring wells that have been abandoned. Figure 9-1 also shows the cross-section alignment.

Three of the wells abandoned in 2014 (01U608, 01U609, and 01U611) were scheduled to be reinstalled in spring 2017; however, the schedule has been extended due to delays associated with site redevelopment. Once reinstalled, the wells will have the same monitoring requirements as prior to abandonment. Wells 01U608 and 01U609, once reinstalled, will be added to the water level monitoring list and well 01U611 will be added to the annual water quality sampling list. Monitoring well 01U047 was permanently abandoned in FY 2017 for site redevelopment activities and will not be reinstalled once the redevelopment activities are completed.

Is any groundwater sampling proposed prior to the next report?

Yes. Groundwater monitoring at Site K will be in accordance with the monitoring plan shown in Appendix A.1.

Are any changes or additional actions required for this remedy component?

Yes. Wells 01U608, 01U609, and 01U611, which were abandoned in 2014, are scheduled to be reinstalled once construction activities associated with site redevelopment are completed.

9.2 Remedy Component #2: Sentinel Wells

Description: "Installation of sentinel wells at the bottom of Unit 1 and top of Unit 3." (1997 OU2 ROD, page 3).

Performance Standard (how do you know when you've achieved the remedy):

When the wells have been installed according to a regulator approved work plan.

Is the remedy component being implemented?

Yes. The Upper Unit 3 sentinel well was installed in February 2000 to monitor potential VOCs migration through the Unit 2 till aquitard into the Unit 3 aquifer.

Existing piezometers were used to accomplish the deep Unit 1 sentry monitoring. Piezometers 01U625D, 01U626D, 01U627D, and 01U628D were used since they monitor the Unit 1 aquifer base near the trench. The issue is the potential for dense non-aqueous phase liquid to migrate beneath the trench along the Unit 1/Unit 2 interface. These four piezometers are screened at that interface. Figure 9-1 shows the location of the Upper Unit 3 sentinel well (03U621) and the piezometers.

What are the results of the Unit 1 piezometer and Unit 3 sentinel well sampling?

The piezometers (Unit 1 sentinel wells) were sampled in March 2000 with results showing no dense non-aqueous phase liquid presence at the Unit 1/Unit 2 interface, as discussed in the FY 2000 APR. This was a one-time sampling event, as required by the MPCA/USEPA approved Predesign Investigation Work Plan, Site K, TCAAP, CRA, February 1999, and as documented in the Predesign Investigation Report, Site K, TCAAP, CRA, December 2001, for which regulatory concurrence was received.

The Unit 3 sentinel well (03U621) was sampled in March, July, and September 2000 and in January 2001 for the quarterly sampling required by the Predesign Investigation Work Plan. Subsequently, the well was incorporated into the regular TCAAP monitoring plan. The well was sampled in June 2020 for FY 2020 with results presented in Table 9-2. No Site K COCs were detected in the Unit 3 sentinel well at concentrations above the method detection limit. However, the 03U621 sample reported a 1,4-dioxane concentration of 10.9 µg/L (11.0 µg/L, duplicate) as presented in Table 9-7. This is likely related to the presence of 1,4-dioxane in Unit 3 groundwater throughout the western portion of TCAAP, as opposed to a release from Site K.

Are any changes or additional actions required for this remedy component?

No.

9.3 Remedy Component #3: Hydraulic Containment

Description: "Use of existing interceptor/recovery trench to contain the plume and remove impacted groundwater." (1997 OU2 ROD, page 3).

Performance Standard (how do you know when you've achieved the remedy):

When the trench is operating as designed and capturing all groundwater exceeding the cleanup levels as presented in Table 1 of the 1997 OU2 ROD, and further described below.

Is the remedy component being implemented?

Yes. The groundwater collection system continues to provide capture (as described later) of the Unit 1 groundwater, upgradient of the trench and beneath the former Building 103 footprint, as designed. In FY 2014, the Building 103 slab was removed as part of the site redevelopment activities.

Is the system providing hydraulic capture of the plume?

Yes. Water level data are presented in Table 9-3. Figure 9-2 presents a plan view of the groundwater contours from the June 2020 round of groundwater level measurements. At nested wells, the numerically lowest water elevation was used to create the plan view contours. Monitoring wells downgradient (i.e., 01U627) of the extraction trench show consistently higher water levels than those near of the trench (i.e., 01U626). This demonstrates that the horizontal hydraulic gradient has been reversed toward the extraction trench due to system operation.

Vertical capture was also effective as illustrated on Figure 9-3. As shown on the figure, groundwater both upgradient and downgradient of the trench is captured and collected. The upward gradient exhibited on the downward gradient side of the trench (01U626) indicates that groundwater does not migrate below the trench. The monitoring coverage provided by the bundle piezometers demonstrates complete vertical and horizontal hydraulic capture.

Upgradient well (01U625C) is obstructed. The cause of the obstruction is unknown. An unsuccessful attempt was made to remove the obstruction in the spring of 2017 and 2018 and again in the spring of 2019. Well 01U625C is not critical in the collection trench flow evaluation. Historically, this well has maintained a similar groundwater elevation as 01U625B and 01U625D (Appendix D). Based on FY 2016, FY 2017, FY 2018, and FY 2019 groundwater elevation data showing the return to typical levels, the abandonment of 01U625C, without subsequent replacement, is recommended.

Figure 9-4 presents the TCE concentrations from the 2020 annual sampling event. The plume was originally defined based on data from all of the monitoring wells. The plume was then refined based on the results of the 2014 geoprobe investigation. The current monitoring well network is used to confirm the plume contours and measure the progress of remediation. Thus, the contours on Figure 9-4 were drawn with consideration of the extensive historical data, specifically the 2014 data from the geoprobe investigation.

Are any changes or additional actions required for this remedy component?

Not at this time. Two monitoring wells (01U604 and 01U628) historically used to monitor hydraulic capture were abandoned in 2014 because of site redevelopment activities. However, existing wells (01U603, 01U612, 01U615, 01U617, 01U621, 01U625, 01U626 and 01U627) located up and down gradient of the collection trench provide adequate coverage for shallow groundwater hydraulic and water quality monitoring and verify hydraulic containment at Site K. Additional monitoring (including the need for additional monitoring wells) will be evaluated upon completion of redevelopment plans for the area.

9.4 Remedy Component #4: Groundwater Treatment

Description: “Treatment of contaminated groundwater using air stripping.” (1997 OU2 ROD, page 3).

Performance Standard (how do you know when you’ve achieved the remedy):

When the air stripping facility is treating water to the cleanup standards.

Is the remedy component being implemented?

Yes. During FY 2020, the treatment system functioned and was operational 95% of the time. During FY 2020, a regular maintenance schedule was maintained. Appendix H.1 summarizes operational data and events at the groundwater extraction and treatment system.

Are any changes or additional actions required for this remedy component?

No.

9.5 Remedy Component #5: Treated Water Discharge

Description: “Discharge of treated groundwater to Rice Creek.” (1997 OU2 ROD, page 3).

Performance Standard (how do you know when you’ve achieved the remedy):

When the system is operating as designed and the treated water discharges to the storm sewer that outlets to Rice Creek. Treated water is required to meet the substantive requirements of Document No. MNU0009579 (MPCA), which contains the state-accepted discharge limits for surface water. Sampling and analysis are performed to monitor performance (see below).

Is the remedy component being implemented?

Yes. See discussion in Section 9.6.

Are any changes or additional actions required for this remedy component?

No.

9.6 Remedy Component #6: Discharge Monitoring

Description: “Monitoring to track compliance with discharge requirements.” (1997 OU2 ROD, page 3).

Performance Standard (how do you know when you’ve achieved the remedy):

When a monitoring plan is established and is being implemented in accordance with the plan.

Is the remedy component being implemented?

Yes. Treatment system monitoring consisted of quarterly influent and effluent sampling. Influent and effluent analytical results are presented in Table 9-4 (organics) and Table 9-5 (inorganics). The discharge met the treatment requirements during FY 2020.

As reported in the FY 2017 APR, infrequent exceedances of the phosphorus and zinc discharge criteria have historically occurred, but no cause has been determined. Sampling procedures were modified to thoroughly flush all sampling piping before effluent samples are collected. This procedure has apparently reduced the potential that particles accumulating on the piping are not being carried over into the samples causing historical exceedances of zinc and phosphorus limits.

Are any changes or additional actions required for this remedy component?

No.

9.7 Remedy Component #7: Additional Investigation

Description: "Additional characterization of the unsaturated Unit 1 soil." (1997 OU2 ROD, page 3).

Performance Standard (how do you know when you've achieved the remedy):

When the additional investigation has been completed according to a regulator approved work plan.

Is the remedy component being implemented?

Yes. The work plan was approved in FY 1999. A report of the investigation results received a consistency determination from regulators on December 6, 2001. The report defined the extent of VOC contaminated soils beneath Building 103 and refined the location of the source area. The report and subsequent follow up sampling resolved anomalous dissolved zinc, lead and nickel data at two monitoring wells. Zinc, lead, and nickel are no longer groundwater concerns.

Are any changes or additional actions required for this remedy component?

No.

9.8 Remedy Component #8: Land Use Controls

Description: "LUCs will be established to protect the groundwater extraction, treatment, and monitoring system and to prohibit the drilling of water supply wells within the contaminated portion of the Unit 1 aquifer." (OU2 ROD Amendment #1 (2007), page 39).

Performance Standard (how do you know when you've achieved the remedy):

Implementation of the LUCs will continue until such time the groundwater concentrations are below the cleanup levels.

Has a LUCRD document been approved to address LUC issues for OU2, including Site K groundwater, and is it being implemented?

Yes. The USEPA and MPCA provided consistency approval for the OU2 LUCRD in September 2010 and it is being implemented by the Army. Subsequent revisions to the LUCRD have not affected the groundwater LUCs for Site K.

Was an annual site inspection for LUCs conducted in FY 2020?

On August 11, 2020, the Army, MNARNG, and JV conducted the annual inspection of OU2 sites. The checklist that was completed during the inspection is included as Appendix F.

Did the inspection identify any follow-up actions needed to maintain the protectiveness of the LUCs?

No.

9.9 Overall Remedy for Site K

Performance Standard (how do you know when you've achieved the remedy):

Once the cleanup levels in Table 1 of the 1997 OU2 ROD have been attained throughout the aerial and vertical extent of the Site K plume (1997 OU2 ROD, page 55).

Has the Site K shallow groundwater remedy been completed (i.e., have the cleanup levels in Table 1 of the 1997 OU2 ROD been attained throughout the aerial and vertical extent of the Site K plume)?

No. Overall, the remedy for Site K continued to operate consistent with past years and in compliance with the required performance criteria.

Table 9-6 presents the VOC mass removal and monthly flow rates. The treatment system captured and treated 5,227,133 gallons of water resulting in the removal of 7.76 pounds of VOCs from the aquifer in FY 2020. The cumulative VOC mass removal is 404.9 pounds of VOCs.

As shown on Figure 9-4, June 2020 TCE concentrations ranged from non-detect to 1,360 µg/L. In general, site-wide TCE concentrations were lower than those reported in FY 2019. Monitoring wells 01U611 and 01U615 monitored the core of the plume. However, well 01U611 was abandoned in 2014 for site redevelopment activities and will be reinstalled once the redevelopment activities are completed; no 01U611 data are available for FY 2020. Prior to abandonment, TCE concentrations at monitoring well 01U611 had been relatively stable over the previous seven years, ranging from 4,900 µg/L to 11,000 µg/L.

The TCE concentration at well 01U615 slightly decreased from 1,900 µg/L in FY 2019 to 1,360 µg/L in FY 2020. The FY 2020 concentration of TCE at 01U615 is on the low end compared with historical concentrations from the last ten years of sampling, which have ranged from 1,200 µg/L to 3,700 µg/L. Concentrations of cis-1,2-DCE at well 01U615 have increased since FY 2014 with the FY 2019 concentration of 2,400 µg/L representing the highest concentration ever reported for this well. The FY 2020 concentration of cis-1,2-DCE at well 01U615 decreased to 1,390 µg/L. Recent increases in cis-1,2-DCE are not surprising because this compound is a known degradation product of TCE. Figure 9-5 shows TCE and total 1,2-dichloroethene versus time for 01U615. Water levels measured during the FY 2020 monitoring at 01U615 were consistent with FY 2018 elevations. This well has historically exhibited fluctuating groundwater elevations.

Prior to 2014, concentrations of TCE in monitoring well 01U603 had always been non-detect (less than 1.0 µg/L). However, in May 2014, TCE was detected at 2,000 µg/L in 01U603. Well 01U603 was resampled in July 2014 (5,600 µg/L) and September 2014 (4,600 µg/L). The July and September 2014 results confirmed that elevated concentrations of TCE and other VOCs are present in the well. Groundwater samples collected downgradient of 01U603 as part of a Site K geoprobe investigation in September 2014 showed that high TCE concentrations were localized and had not migrated from the immediate vicinity of the 01U603. The geoprobe investigation in 2014 determined that historically high groundwater levels in April and May 2014 likely mobilized TCE in the former storm sewer bedding that was present underneath the former building footprint. The geoprobe results were submitted to the USEPA and MPCA in a letter dated February 3, 2015. Since that time, TCE concentrations in 01U603 have steadily declined to 1.24 µg/L

Well 01U617 continues to exhibit low and relatively consistent concentrations of 1,2-dichloroethene downgradient of the groundwater collection system's capture zone. The concentration at this well has continued to decrease from those measured in FY 2014 and previous years. The detected 1,2-dichloroethene concentration is below the cleanup level for Site K.

Do additional remedial measures need to be addressed?

No.

9.10 Other Related Activity in FY 2020

As detailed in Section 12, in March 2015, the USEPA and MPCA requested sampling and analysis for 1,4-dioxane to be included in the annual sampling event for Site K. The analysis was added to all regularly scheduled monitoring wells in 2015 and 2016. Due to low 1,4-dioxane concentrations in Unit 1 wells (less than 1 µg/L), no Unit 1 wells were required to be sampled for 1,4-dioxane in FY 2017. Unit 3 monitoring well 03U621 had a 1,4-dioxane concentration exceeding the HRL in FY 2015, FY 2016, FY 2017, FY 2018, and FY 2019; therefore, monitoring well 03U621 was sampled for 1,4 dioxane in FY 2020. The 1,4-dioxane concentration at 03U621 increased from 9.3 µg/L (FY 2016) to 10.9 µg/L (11.0, duplicate) (FY 2020). As mentioned above, the presence of 1,4-dioxane in 03U621 is likely related to its presence in Unit 3 groundwater throughout the western portion of TCAAP, as opposed to a release from Site K.

Table 9-7 presents the FY 2020 1,4-dioxane sampling results. No Federal MCL has been established for 1,4-dioxane; however, the MDH established an HRL value of 1.0 µg/L as shown in Table 9-7.

In 2020, the Army requested the United States Geological Survey (USGS) Maryland-Delaware-DC Water Science Center (MD-DE-DC WSC) to conduct a groundwater treatability study to assess bioremediation as a destructive remedy for VOCs in Site K groundwater plume. Initial field work began in November 2020 which consisted in part of installing a new well where former well 01U611 was located. Additional work will continue throughout FY2021 and will be reported separately when completed.

10 OPERABLE UNIT 2: BUILDING 102 SHALLOW GROUNDWATER

The former Building 102, shown on Figure 10-1, was constructed in 1942 and used periodically until the 1980s for production of small caliber ammunition and various other munitions components. Between March 2002 and February 2004, shallow (Unit 1) groundwater impact was discovered emanating from beneath Building 102 (discovered during the Phase I and Phase II Environmental Site Assessment in support of a future TCAAP property transfer).

Additional groundwater investigation was conducted and is documented in the Groundwater Investigation Report for Building 102 (Wenck and Keres Consulting, Inc. 2006), approved by the USEPA and MPCA in FY 2006. The Army then proceeded to address the remedy for Building 102 shallow groundwater as a non-time critical removal action under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). To support the Engineering Evaluation/Cost Analysis, additional groundwater investigation was conducted in FY 2007 and FY 2008 to further define the extent and magnitude of groundwater impacts. Delineation was completed and COCs were identified, including TCE and related chlorinated VOCs (TCE was found to be degrading to cis-1,2-DCE and vinyl chloride through abiotic degradation). The Engineering Evaluation/Cost Analysis documenting the additional investigation work and recommending a remedy for Building 102 shallow groundwater was approved by the USEPA and MPCA in FY 2008.

The Army Action Memorandum documenting the final remedy selection for Building 102 groundwater MNA was signed in FY 2009. The remedy also includes LUCs to prohibit installation of water supply wells in the contaminated portion of the Unit 1 aquifer and protect the groundwater monitoring system infrastructure (i.e., monitoring wells). The OU2 ROD Amendment #4 (2012) formally documented selection of MNA and LUCs for the Building 102 groundwater remedy and thereby added this site to the OU2 remedy.

The decision to proceed with MNA was based on strong evidence from water quality monitoring (i.e., degradation products) and on MPCA microcosm studies that verified abiotic degradation of VOCs in Building 102 groundwater was occurring at substantial rates. Such degradation acts to reduce COC mass and mobility by breaking down the COCs as they migrate. The decision to proceed with MNA was also based on the absence of any groundwater receptors.

10.1 Remedy Component #1: Monitored Natural Attenuation

Description: “Use of naturally-occurring abiotic degradation to limit plume mobility and to ultimately restore the aquifer” (OU2 ROD Amendment #4 (2012), page 4-1).

Performance Standard (how do you know when you’ve achieved the remedy):

When a monitoring program is established, and monitoring is in compliance with the regulator approved Annual Monitoring Plan.

Is the remedy component being implemented?

Yes. Appendix A summarizes the FY 2020 monitoring plan and any deviations are explained in Appendix C.2. Details of the groundwater monitoring program are discussed in the next section.

10.2 Remedy Component #2: Groundwater Monitoring

Description: "Groundwater monitoring to track remedy performance and to verify that groundwater reaching Rice Creek does not exceed state surface water standards" (OU2 ROD Amendment #4 (2012), page 4-1).

Performance Standard (how do you know when you've achieved the remedy):

When a performance groundwater monitoring program has been established and ongoing monitoring is in compliance with the program.

Is this remedy component being implemented?

Yes. Table 10-1 summarizes performance monitoring requirements, implementing parties, and the documents that contain the monitoring plans. The FY 2020 Monitoring Plan is included in Appendix A, documenting the water quality monitoring locations and frequencies. Building 102 groundwater level data collected in June 2020 are shown as groundwater elevation contours on Figure 10-2. Groundwater quality data collected in FY 2020 are shown in Table 10-2. Groundwater quality data for FY 2020 are also shown on an aerial view of Building 102 for three of the COCs: TCE (Figure 10-3), cis-1,2-DCE (Figure 10-4), and vinyl chloride (Figure 10-5). Figure 10-6 shows the vinyl chloride concentrations plotted on a geologic cross section for Building 102 to illustrate the vertical extent of impact (the cross-section location is illustrated on Figure 10-5). The Pace (TN) reporting limit (RL) for vinyl chloride of 1 µg/L does not meet the project reporting limit goal of 0.1/0.09 µg/L. The method detection limit (MDL) for vinyl chloride is 0.3 µg/L, which is approximately equal to the Cleanup Level/Action Level, and Pace (TN) reports detections between the MDL and RL. Per the 2020 QAPP (rev18) the Pace (TN) RL of 1 µg/L is considered acceptable for the project at this time.

Following the sampling of 1,4-dioxane at Building 102 from FY 2015 through FY 2019, it was determined that it was not a COC in Building 102 shallow groundwater. Monitoring for 1,4-dioxane was discontinued at Building 102 beginning in FY2020.

Were the groundwater monitoring requirements for this remedy met?

Yes.

Is any groundwater sampling proposed prior to the next report?

Yes. Groundwater monitoring at Building 102 will be in accordance with the monitoring plan shown in Appendix A.1.

Are any changes or additional actions required for this remedy component?

No.

10.3 Remedy Component #3: Land Use Controls

Description: "LUCs to restrict installation of water supply wells into the contaminated portion of the Unit 1 aquifer and to protect the infrastructure related to this alternative (monitoring wells)" (OU2 ROD Amendment #4 (2012), page 4-2).

Performance Standard (how do you know when you've achieved the remedy):

Implementation of the LUCs will continue until such time that the groundwater concentrations are below the cleanup levels.

Has a LUCRD document been approved to address LUC issues for OU2, including Building 102 groundwater, and is it being implemented?

Yes. The USEPA and MPCA provided consistency approval for the OU2 LUCRD in September 2010 and is being implemented by the Army. Subsequent revisions of the LUCRD have not changed the groundwater LUCs for Building 102.

Was an annual site inspection for LUCs conducted in FY 2020?

Yes. On August 11, 2020, the Army, MNARNG, and JV conducted the annual inspection of OU2 sites. The completed checklist from the inspection is included as Appendix F.

Did the inspection identify any follow-up actions needed to maintain the protectiveness of the LUCs?

No.

10.4 Overall Remedy for Building 102 Shallow Groundwater

Performance Standard (how do you know when you've achieved the remedy):

When the cleanup levels in OU2 ROD Amendment #4 (2012) have been attained throughout the aerial and vertical extent of the Building 102 plume (OU2 ROD Amendment #4 (2012), page 2-13).

Has the Building 102 shallow groundwater remedy been completed (i.e., have the cleanup levels in the table on Page 2-13 of OU2 ROD Amendment #4 (2012) been attained throughout the aerial and vertical extent of the Building 102 plume)?

No. As shown in Table 10-2, cleanup levels have not been reached throughout the aerial extent of the plume and the site cannot be closed. TCE concentrations exceed the cleanup level in four monitoring wells (0L581, 01L584, 01U581, and 01U584). Wells 01L584 and 01U584 also exceed the cleanup level for vinyl chloride.

What impact is MNA having on contaminant concentrations?

Natural attenuation continues to occur, with TCE being the primary VOC present in the source area vicinity, and primary degradation products being present in downgradient wells (e.g., primarily cis-1,2-DCE and vinyl chloride in 01L584 and 01U584). Significant changes that were noted in the FY 2020 groundwater quality results include:

- 01U579 and 01U580 (source area): TCE concentration decreased marginally from FY 2018 to FY 2019 in 01U579 and 01U580 from 1.5 µg/L and 1.2 µg/L to 0.45 µg/L and 0.71 µg/L, respectively. These concentrations stayed relatively stable in FY 2020 with 0.55 µg/L in 01U579 and 0.23 µg/L in 01U580. Historically, the concentrations in these two wells have shown relatively large increases and decreases.
- Vinyl chloride was detected at an estimated (estimated because the detection is below the laboratory reporting limit) value of 0.32 µg/L and 0.27 µg/L in wells 01L584 and 01U584, respectively. These estimated concentrations exceed the cleanup level for vinyl chloride of 0.18 µg/L.
- 01L582 (further downgradient of the source area): Concentration of cis-1,2-DCE decreased (16 µg/L to 8.6 µg/L); however, this well appears to be stable and is still below the cleanup level of 70 µg/L. The vinyl chloride concentration decreased to 0.06 µg/L, which is below the Building 102 cleanup level.
- 01L581 and 01U581 both exceeded the cleanup level for TCE (5 µg/L) in FY 2019 and again exceeded this level in FY 2020. Both wells seemed to stay relatively stable if not slightly increasing from FY 2019 to FY 2020; 01L581 increased from 5.1 µg/L to 7.1 µg/L and 01U581 increased from 18 µg/L to 22 µg/L.
- 01L584 and 01U584 also both exceeded the cleanup level for TCE (5 µg/L) in 2020. This is the first time 01U584 has exceeded the cleanup level for TCE since FY 2013. 01L584 has exceeded the cleanup level for TCE since FY 2012. 01U584 slightly exceeded with a concentration of 5.72 µg/L and 01L584 had a concentration of 15 µg/L.

Were any trigger levels exceeded at the contingency location?

No. The contingency location is 01U048, located next to Rice Creek. The trigger level is equal to groundwater cleanup levels. No COCs for Building 102 shallow groundwater exceeded their respective cleanup levels in FY 2020 at well 01U048 (Table 10-2).

Do additional remedial measures need to be addressed?

No. However, it should be noted that as part of Ramsey County's site redevelopment work, Ramsey County has relocated a section of Rice Creek to create more space for construction of a new I-35W / County Road H interchange. The relocation work, which took place in early 2016, placed Rice Creek much closer to the west side of the Building 102 plume. In FY 2016, Ramsey County installed two sets of nested monitoring wells adjacent to the revised creek location, on the east side of the creek to monitor if this remeander caused groundwater flow to shift westerly towards the creek. Based on the data collected by JV since 2015 and Bay West (on behalf of Ramsey County) since 2016, there is no apparent change in the Building 102 plume configuration or groundwater flow. The groundwater flow has continued in the same general NW trend toward the contingency well 01U048 prior to the Rice Creek remeander. However, the Army recommends the continued annual monitoring of the Ramsey County wells until MNA has been deemed complete for the Building 102 groundwater impacts.

Bay West, working on behalf of Ramsey County, provided the "Groundwater Monitoring Report – April 2020 Sampling Event for the Rice Creek remeander, TCAAP Redevelopment" to Arcadis in January 2021. According to quarterly groundwater monitoring performed at Building 102 beginning in March 2017 after completion of the remeander through April 2020, there appear to be no impacts to groundwater quality. Ramsey County wells sampled in this event include 01URC1D, 01URC1S, 01URC2D, and 01URC2S. Vinyl chloride was detected in 01URC1D during the March 2017 event at a concentration of 0.058 µg/L and at a concentration of 0.086 µg/L during the August 2018 event, which are well below the MDH HRL of 0.2 µg/L. 01URC1D also had low level detections of cis-1,2-DCE in February 2018, August 2018, May 2019, and April 2020; concentrations were 5.7 µg/L, 2.9 µg/L, 1.9 µg/L and 2.2 µg/L, respectively, which are below the MDH HRL of 6 µg/L. Bay West has recommended ceasing groundwater monitoring of the Rice Creek remeander monitoring wells as part of the FY 2020 reporting. For a more detailed summary of the Rice Creek remeander groundwater monitoring, refer to Bay West, 2020 included as Appendix G.

It should also be noted that Ramsey County plans further development in this area that may result in loss of monitoring wells (subject to Army and regulatory approval) due to installation of a storm water control basin. Ongoing efforts will be made by the Army to address any issues resulting from Ramsey County's development plans.

11 OPERABLE UNIT 2: AQUATIC SITES

The Tier II Ecological Risk Assessment Report (U.S. Army Center for Health Promotion and Preventative Medicine [USACHPPM] 2004) for aquatic sites, was approved by the MPCA and USEPA in December 2004. In June 2005, the Army submitted a draft FS for aquatic sites to support the risk management decisions with respect to “No Further Action” or “Implement a Remedy” for each aquatic site. Following comments to the draft FS, it was agreed by the Army that additional sampling of Marsden Lake and Pond G would be conducted. This sampling was completed in 2008. Revised draft FS versions were submitted in January 2009 and April 2010. After review of the 2010 draft FS, the USEPA and MPCA requested that the Army prepare a work plan for collection of additional Round Lake sediment data (Round Lake is located off the southwest corner of OU2). Given the time required to collect the additional data, the Army, USEPA, and MPCA agreed to separate the FS into two documents: one for Round Lake and one for the OU2 aquatic sites, (i.e., Rice Creek, Sunfish Lake, Marsden Lake North, Marsden Lake South, and Pond G). These sites are located as shown on Figure 11-1.

The USEPA and MPCA provided consistency for the Rice Creek, Sunfish Lake, Marsden Lake, and Pond G FS in January 2011. No Action was recommended for Rice Creek, Sunfish Lake, Marsden Lake North, and Marsden Lake South. A remedy was recommended for Pond G (surface water hardness adjustment) to attain compliance with the Minnesota surface water standard for lead (Class 2Bd chronic standard). OU2 ROD Amendment #4 (2012), which documents selection of the recommended alternative, was signed in January 2012. The most recent revision, LUCRD Revision 6, was approved by the USEPA and MPCA in October 2020. This revision documents the partial delisting of soil, surface water, and sediment (not groundwater) at five aquatic sites located within OU2 (Rice Creek, Sunfish Lake, Marsden Lake North, Marsden Lake South, and Pond G).

The USEPA and MPCA provided consistency for the Pond G Remedial Design / Remedial Action Work Plan in March 2012, and the pond was treated in June 2012. The pond surface water was then monitored in FY 2012 and FY 2013, and results verified compliance with the surface water standard for lead. The completed Pond G remedial action work and surface water monitoring results were documented in the Remedial Action Completion and Close Out Report, Pond G (Wenck 2013b), which received regulatory consistency approval in FY 2014. The report recommended that the Pond G site be closed with no long-term maintenance, monitoring, or LUC requirements. The 2014 CERCLA five-year review also indicated final concurrence regarding the adequacy of the Pond G remedy, and the Pond G site has been closed. Since the completed remedy does not result in hazardous substances remaining on-site above levels that allow for unlimited use and unrestricted exposure, future CERCLA 5-year reviews are not required for Pond G and as noted above, there are no monitoring or LUC requirements.

12 OPERABLE UNIT 2: DEEP GROUNDWATER

The selected remedy for the Deep Groundwater in the 1997 OU2 ROD consists of five remedial components that include continued use of the TGRS, with modifications to improve VOC removal from the source area. It also includes an annual review of new and emerging technologies potentially applicable to the Deep Groundwater. This APR documents all performance and monitoring data collected from October 2019 through September 2020.

Historical Design and Evaluation of TGRS Remedial Action

Historical design has been previously discussed in various APRs to date. As a brief summary, an Interim Response Action Plan for TCAAP (USEPA 1987) was prepared providing specific criteria for the Boundary Groundwater Recovery System which started on October 19, 1987. Initially operated as six extraction wells on the southwest OU2 boundary, the Boundary Groundwater Recovery System was later expanded between 1987 and 1989 to include six additional extraction and five source control wells as part of the TGRS. The TGRS was designed to prevent TCE mass migrating from OU2 towards OU1 based on a 5 µg/L TCE plume contour width at the southwestern OU2 boundary. As the TCE plume has narrowed since the start of operation, select wells positioned outside the plume footprint, or not contributing substantive capture benefit, have been turned off. As of 2020, the TGRS operates with 10 wells including eight boundary extraction wells and two source control wells with treated effluent discharged to the Arsenal Sand and Gravel Pit where it recharges overburden sands (Upper and Lower Unit 3). The TGRS was designed to operate at a maximum theoretical capacity of 2,900 gallons per minute (gpm), which includes a significant safety margin above its current operational flow rate to accommodate potential fluctuations in system operation.

The 1989 Annual Monitoring Report was the first report covering the fully configured TGRS, which concluded that a continuous zone of capture, approximately 4,500 feet wide, was developed at the TCAAP property boundary. The zone of capture widened to approximately 8,300 feet upgradient of the boundary. This zone of capture was developed at average system pumping rates of 2,400 to 2,700 gpm.

In FY 2003, the Army received regulatory approval on the TGRS Operating Strategy (OS) document. The OS was based, in part, on findings from the 1989 Annual Monitoring Report. The OS presented a TGRS Global Operating Strategy (GOS) for the entire TGRS extraction system and a Micro Operating Strategy (MOS) for selected well groups. Evaluations now consider and compare actual pumping rates to the GOS and MOS rates presented in the Final TGRS OS.

In 2013, the Minnesota Safe Drinking Water Limit (HRL) for 1,4-dioxane (an emerging COC) was reduced from 30 µg/L to 1 µg/L. In early 2015, 1,4-dioxane was detected in New Brighton's water supply above the HRL. In March 2015, the USEPA and MPCA requested sampling and analysis for 1,4-dioxane to be included in 2015 and 2016 TCAAP groundwater sampling events at OU1, OU2, and OU3 monitoring and extraction wells. All locations sampled except two of the extraction wells (B1 and B11) had 1,4-dioxane concentrations exceeding the HRL. Samples collected from the TGRS influent and effluent indicated that no 1,4-dioxane concentration reduction was accomplished by the treatment system.

In 2017, the Army performed a remedy review with the USEPA and MPCA. The highest 1,4-dioxane concentrations were observed in wells near Site G at concentrations greater than 200 µg/L. 1,4-dioxane-impacted water had historically been discharged from the TGRS treatment system at concentrations less than 20 µg/L to the gravel pit upgradient of Site K. Lesser concentrations have been identified on the western portion of the site, including at Site K (as described in Section 9).

Operation of the TGRS remedy has been effective in reducing COC concentrations at nearly all OU2 monitoring wells by over approximately one order of magnitude. Significant reductions in TCE concentrations were evident during the early 1990s; however, slower relative declines in TCE concentration have occurred over the last 10 to 20 years. A remedy review was conducted and approved by the regulators in June 2018 that presented the conceptual plan for improving containment the source areas with additional extraction wells and installing a new treatment system targeting source area contamination. This APR presents improvements for consideration toward overall mass removal and TGRS operational efficiency.

The Army conducted subsurface investigations at Sites D, G and, I in 2019 and 2020 resulting in the installation of additional extraction wells in these source areas. These extraction wells will be routed to a new source area groundwater treatment system (SGRS) where (together with the other source area wells) 1,4-dioxane and TCE will be removed prior to discharge. As a result, 1,4-dioxane (and VOC) loading into the TGRS treatment system will be reduced which in turn will eventually decrease 1,4-dioxane concentrations across the site. Details of the design are planned to be finalized and approved during FY 2021 and installation is scheduled to be completed during FY 2022.

TGRS Modifications

- During 2020, improvements to the TGRS were completed to improve operations and increase groundwater extraction, including:
    - Electrical and controls upgrades to the TGRS building.
    - Electrical and mechanical upgrades to existing operating extraction wells.
    - Installation of a larger pump in extraction well B4.
- As of September 2019, the TGRS has operated with 10 wells including eight boundary extraction wells and two source control wells with treated effluent discharged to the Arsenal Sand and Gravel Pit where it recharges overburden sands. Extraction well SC2 has been shut down since September 2018 (with agency approval) and is intended to be replaced as part of the TGRS improvements planned during FY 2021).
    - The ESD #3 document finalized on October 15, 2020 and signed in 2021, addresses the addition of 1,4-dioxane as a COC; and the addition of remedial technologies to treat 1,4-dioxane.
- The ESD #3 document lists the following improvements for the deep groundwater remedy:
    - Installation of new source area extraction wells at Site D, Site G and Site I.
    - Routing of the new source area extraction wells and one existing source area extraction well to a new AO system, named SGRS, to remove and treat 1,4-dioxane and TCE.
    - Routing of the effluent from the SGRS to a co-located new air stripper to remove residual VOC contaminants.
    - Discharge of the treated groundwater from the SGRS to the gravel pit.

For more detailed discussion on historical modifications refer to previous APRs.

12.1 Remedy Component #1: Hydraulic Containment and Contaminant Removal from the Source Area

Description: "Groundwater extraction to hydraulically contain the contaminated source area to the 5 µg/L TCE concentration contour and optimize the removal of COCs from the source area through pumping of select wells." (1997 OU2 ROD, page 3).

Performance Standard (how do you know when you've achieved the remedy):

When the TGRS is containing the contaminated source area to the 5 µg/L TCE contour and the system is operated to maximize the COC removal from the source area.

Is the remedy component being implemented?

Yes. The TGRS operated in FY 2020 consistent with the requirements of the 1997 OU2 ROD. Table 12-1 presents the TGRS cleanup requirements per the 1997 OU2 ROD. During FY 2020, the TGRS average extraction rate was approximately 1,751 gpm, as shown in Table 12-2. This rate meets the GOS Total System Operational Minimum (1,745 gpm), which the Army and the regulators agree meets the 1997 OU2 ROD requirements with an adequate safety factor.

Two of the three individual well groupings were above their respective MOS minimums for FY 2020. The B1, B11 and B13 well grouping was below the MOS minimum of 415 gpm due to an approved February 2013 B11 shut down and TGRS maintenance event. B11 will continue to be monitored to verify containment.

How is the system operated and what preventative maintenance measures were conducted during the year?

Summary of Operations

Previous APRs denote the Summary of Operations. As of 2020, the TGRS operates with 10 wells including eight southwestern boundary extraction wells (B1, B3, B4, B5, B6, B8, B9, and B13) and two source control wells downgradient of interior OU2 source areas (SC1 and SC5). The TGRS layout is presented on Figure 12-1.

On September 6, 2018, GHD (on behalf of the Army) submitted an email to the USEPA and MPCA requesting to discontinue pumping at SC2 because of extensive maintenance due to fouling (the well was down since July 2018) with very little benefit in the way of hydraulic containment or mass removal (typical operation was near 30 gpm). The USEPA and MPCA agreed to the request in an email dated September 11, 2018. Additional extraction wells at Sites D, G, and I were installed as part of the improvements planned for FY 2021 and FY 2022.

A new control system for the TGRS and new mechanical piping in pumphouses B1, B4, B5, B6, B8, B9, and SC5 were installed during FY 2020.

System Operation Specifications

- Part of the remedy for deep groundwater at TCAAP is groundwater extraction consisting of 17 extraction wells connected by a force main to an air stripping treatment facility. This system is called the TGRS. The air stripping treatment facility was designed to include:
  - Four air stripping towers,
  - Four air blowers that provide air to each tower,
  - Four wet wells that are used to accumulate extracted groundwater before pumping to the towers for treatment, and
  - Four wet well pumps used to pump water from the wet wells to the treatment towers.

In general, the influent and effluent water flow rates at the treatment plant are designed to be equal, thereby providing continuous operation of all processes and equipment. The following is a summary of the original system design parameters:

- The groundwater extraction system, including the treatment center and 17 TGRS extraction wells, was originally designed to provide a theoretical hydraulic capacity of 2,900 gpm and a sustained daily average capacity of 2,730 gpm.
- The influent to the treatment plant is divided between Towers 1 and 2, each receiving up to a maximum of 1,450 gpm.
- Wet Well Pumps 1 and 2 (WWP#1 and WWP#2 located in Wet Wells 1 and 2) transfer water to Towers 4 and 3, respectively. Each pump and tower handle up to a maximum of 1,450 gpm.
- Wet Well Pumps 3 and 4 (WWP#3 and WWP#4 located in Wet Well 3) discharge treated water to an end use at a combined rate of up to a maximum of 2,900 gpm.
- Air blowers provide air to the towers. Each blower for Towers 1 and 2 is designed to provide 6,000 to 7,000 standard cubic feet per minute. The blowers for Towers 3 and 4 are designed to provide 9,000 to 14,000 standard cubic feet per minute.

The TGRS was modified to allow for two air stripping tower treatments instead of the original design of four air stripping tower treatments, which resulted in a reduction of energy use while still meeting the 5 µg/L TCE effluent discharge limit. WWP#1 and WWP #2 (40 horsepower each) and blowers 1 and 2 (5 horsepower each) were shut down and the valves to Towers 1 and 2 were closed. Since March 2010, groundwater has been effectively treated by air stripping Towers 3 and 4 while Towers 1 and 2 remain in standby.

Water level sensors within the wet wells communicate with the programmable logic controller (PLC) according to changing water levels. A complete and balanced operation should provide continuing water levels above the low-level sensors and below the high-level sensors. However, given the probability of unbalanced flows for any number of reasons (e.g., changing hydraulic heads, maintenance, repairs, temporary malfunctions), the PLC has provisions within its program to cycle-off the extraction well(s) or WWPs according to high water levels occurring in the wet wells; and in turn, cycle-off the WWPs according to low levels occurring within these wet wells.

The system operates such that the WWPs cycle rather than the extraction well pumps. The rationale is that there are a relatively small number of motors, starters, and electrically controlled valves associated with the wet wells when compared with the extraction well field. This also provides for more continuous and complete hydraulic capture within the aquifer units. However, the extraction well field will cycle if necessary, starting with the least contaminated extraction well, B7 (if operating), and followed by the other extraction wells in a predetermined sequence. In summary, the priority of operation is as follows:

- Maintain constant operation of all extraction wells and air stripping towers above the operating minimum.
- Maintain the desired flow rates at individual wells.
- If operating in four tower mode, maintain WWP#1 and WWP#2 pumping rates equal to or slightly above the combined pumping rate of the extraction well field.
- Maintain treatment center WWP#3 and WWP#4 pumping rate equal to or slightly above the WWP#1 and WWP#2 pumping rate (if operating in four tower mode) or slightly above the combined pumping rate of the extraction well field (if operating in two tower mode).

FY 2020 Maintenance and Inspection Activity

During FY 2020, the following inspection and maintenance activities occurred:

<u>Preventive Maintenance (PM)</u>: The extensive PM program allowed the operations staff to identify and repair or replace equipment to avoid a downtime failure. The program consists of monthly, quarterly, and annual maintenance tasks. When required, further repair work was scheduled rather than waiting for the failure to occur. A broad range of system-specific information was collected during FY 2020 PM. This information is used to direct future repair work.

<u>Electrical Inspection and Temperature Survey</u>: A system-wide electrical inspection and infrared temperature survey was performed to identify loose connections and overheating components. Component overheating often precedes equipment failure. Electrical components that were identified as failing were replaced.

<u>Verification of Flow Meters</u>: As part of the routine PM, flow meters in the pumphouses were compared to a factory-calibrated flow meter. Flow volume measurements before and after conducting maintenance on the meters were compared to verify the consistency of measurements. Meters found to be out of calibration were replaced or recalibrated.

<u>Daily Tracking of Flow Rates</u>: Pumphouse and treatment center meter readings were recorded in the course of the daily inspections. Daily meter readings were tabulated, and the flow rates were calculated and reviewed by the operations staff. Early detection of changes in flow rate was critical in the early identification of failing equipment. By early detection of flow rate changes, equipment repair was typically scheduled before a failure occurred.

Did the system operate at a rate sufficient for complete capture?

Yes. At 1,751 gpm, the total extraction well pumping rate was above the GOS Total System Operational Minimum (1,745 gpm) where the Army and the regulators agree that 1997 OU2 ROD requirements are met with an adequate safety factor. The TGRS OS pumping scheme was developed, in part, on the findings in the 1989 Annual Monitoring Report and updated to hydraulically capture the 5 µg/L TCE contour for the TCE source areas based on 2001 chemical data. A factor of safety was added to the base theoretical capture rate (1,200 gpm) to provide a buffer and/or flexibility for system maintenance. Based on this approach, a minimum combined TGRS extraction rate of 1,745 gpm was agreed to by the Army and the regulators that 1997 OU2 ROD requirements are met with an adequate safety factor.

Figure 12-2 plots the TGRS daily average flow rate from October 1, 2019 through September 30, 2020 and shows operation above the Operational Minimum for the majority of the time (310 days or 85% of the time) in FY 2020. Significant loss of extraction water volume occurred due to power outages, significant downtime issues with well B9, and the downtime during the decommissioning of the old PLC and the installation of the new PLC radio telemetry control system. These issues have since been remedied. Appendix H.2 provides additional information on the various downtimes throughout FY 2020.

The monthly and annual volume of water pumped is presented in Tables 12-2 and 12-3. Table 12-2 presents the pumphouse metered monthly flow volumes of each extraction well. The individual pumphouse flow meters are used to determine the amount of groundwater extracted from the various well groups, individual extraction wells, and the total amount of groundwater extracted during the FY. Table 12-3 presents the historical combined pumphouse-metered flow volume (extraction wells) and the flow volumes metered at various stages in the treatment center.

As shown on Table 12-2, the TGRS successfully captured and treated approximately 920,294,200 gallons of contaminated water from October 2019 through September 2020 based on the sum of the individual pumphouse flow meters. This volume converts to an average flow rate of 1,751 gpm, which meets the GOS minimum of 1,745 gpm.

Monthly Flow Reports

Each month a Monthly Flow Report is prepared. The report includes the month’s meter totalizer readings, calculated flow volumes, and operational notes. Flow volumes are presented on a daily basis and are totaled to provide a monthly flow volume. A compilation of FY 2020 operational notes is presented in Appendix H.2. During FY 2020, the sum of the individual pumphouse flow meters was used to measure total flow volumes in monthly reports for comparison with OS limits. Daily variation in readings at individual wells is primarily due to differences in the time of day when meter readings were taken.

How much down time occurred during the year?

The down time for each extraction well over the last five years is presented in Table 12-4. A summary of average down time for the pumphouses and the treatment center by the category of failure is presented in Table 12-5. A description of each down time event, organized chronologically, is presented in Appendix H.2. The same descriptions organized by affected pumphouse, treatment center, and force main is presented in Appendix H.3.

Treatment center and extraction well down times resulted primarily from planned preventative maintenance and planned modification of components in the pumphouses, treatment center, and electrical service. The downtime in FY 2020 increased from FY 2019 (from 6.1 days in FY 2019 to 15.3 days in FY 2020). The increase in downtime is primarily due to more downtime in the preventative maintenance and system modification categories, including:

- Planned shutdown of pumps in extraction wells B3, B8, and B9 to decrease influent flow volume to the TGRS during the cleaning of air stripper Towers 3 and 4.

- Planned power outage during the installation of the new TGRS control system and new mechanical piping in pumphouses B1, B4, B5, B6, B8, B9 and SC5.

Description of Downtime Categories

Pumphouse component failures accounted for an average of 1.4 days down time per pumphouse. The major pumphouse repairs causing down time were:

- Electrical issues (including power outages).
- Installation of new control panel and related installation of new mechanical piping in multiple pumphouses.
- Reduced pressure zone backflow preventer troubleshooting and repair in multiple pumphouses.

Treatment center component failures and repairs that caused pumphouse down time consisted of electric check valve maintenance, malfunctions and repairs, and electrical control equipment failures.

Treatment center component failures, repairs, and adjustments accounted for an average of 0.2 day down time per pumphouse. The major treatment center repair causing substantial down time was an issue with a failure in the motor control center for Pump 3. The motor control center parts were removed and rebuilt by a vendor, then reinstalled to correct this issue.

Electrical service system failures accounted for an average of 2.6 days down time per pumphouse. Electrical storm damage, an untagged jumper on a power pole west of Building 116, and power grid failures were the primary causes of down time.

PM procedures and system modifications accounted for an average of 6.4 days, and 4.6 days of respective down time in FY 2020. As previously detailed, most of this down time was related to the planned cleaning of the air stripper towers, and the planned improvements to the control panel and related improvements to mechanical piping within multiple pumphouses. For the most part, other PM was performed without interruptions to the treatment system. PM procedures are described in the project Operation and Maintenance Manual.

Forcemain failures only accounted for an average of 0.1 day of down time in FY 2020. Downtime included in this category was associated with the annual routine inspection and exercising of the TGRS forcemain butterfly valves.

There were no additional days of down time assigned to the miscellaneous category for FY 2020.

Were there any major operational changes during the year?

No. However, a larger pump was installed in extraction well B4 in September 2020 to increase extraction volume and mass removal of VOCs from the center of the TCE plume.

Did the system achieve hydraulic capture?

Yes. Hydraulic capture was achieved via groundwater extraction greater than the GOS Operational Minimum at which the Army and the regulators agree that the 1997 OU2 ROD hydraulic capture requirements are met with an adequate safety factor. In addition, a remedy review has been conducted and approved by the regulators presenting improvements for consideration toward overall mass removal and TGRS operational efficiency. The OU2 remedy review received regulatory approval in June 2018.

General stable or decreasing TCE concentrations were evident at many wells across the TGRS boundary since FY 2001. Moreover, comparison of the OU1 TCE plume footprint over the past 20 years as summarized in the last four USEPA five-year reviews and further discussed below indicates a stable bedrock TCE plume footprint. Groundwater elevation measurements collected in June 2020 are presented in Appendix D.

How much VOC mass was removed by the system and how is it changing with time?

As discussed above, the TGRS extracted and treated approximately 920,294,200 gallons of water from October 2019 through September 2020. Based on the monthly influent and effluent VOC concentrations and the monthly flow totals as measured by the extraction well flow meters, the TGRS removed a total of 2,013 pounds of VOCs from October 2019 through September 2020. The VOC mass removal in FY 2019 was 1,807 pounds. When comparing the FY 2020 to FY 2019 and past years and taking into account operational downtime, the trend still depicts an overall reduction in mass removal.

Average VOC influent concentrations increased slightly from 234.8 µg/L in FY 2019 to 264.7 µg/L in FY 2020. Table 12-6 summarizes the individual VOC mass contribution of each extraction well and the entire system. Overall, the TGRS has removed over 111 tons (222,480 pounds) of VOCs from the aquifers since 1987 and 22.9 tons of VOCs since the end of FY 2001 (the TGRS OS was based on data through 2001).

The total mass removed is based on the monthly TGRS influent and effluent sampling and flow through the treatment system. The monthly sampling of the treatment system provides the best estimate of overall mass removal, compared to the individual extraction well sampling, due to the larger number of samples and consistency in the month-to-month analytical results. The percent contributions for each well are based on the average flows and the semi-annual VOC results from each well.

VOC samples were collected semi-annually from the TGRS operating extraction wells. Wells B2 and B11 are shut down but were temporarily operated for June 2020 sampling. Table 12-7 summarizes the sampling results for the extraction wells. Variations in detection limits from round to round are the result of varying sample dilution performed by the laboratory when dilutions are required due to the high concentrations of some analytes. The locations of the extraction wells are presented on Figure 12-1.

Appendix I.1 presents TCE concentrations versus time graphs for each extraction well. As shown, TCE concentrations have declined in each well, and now at many wells TCE concentrations appear to be stable or still declining. Since FY 2001, the following extraction wells have shown the most improvement (greater than 50% reduction) in TCE concentrations:

- SC3 (5.5 µg/L in FY 2001 to non-detect [less than 0.190 µg/L] in FY 2020 – 97% reduction),
- B10 (5.1 µg/L in FY 2001 to 0.383JP µg/L [reporting limit: 1.0 µg/L] in FY 2020 – 92% reduction),
- B6 (230 µg/L in FY 2001 to 27.5 µg/L in FY 2020 – 88% reduction),
- B4 (500 µg/L in FY 2001 to 79.7 µg/L in FY 2020 – 84% reduction),
- B5 (410 µg/L in FY 2001 to 80.8 µg/L in FY 2020 – 80% reduction),
- B1 (180 µg/L in FY 2001 to 81.2 µg/L in FY 2020 – 55% reduction),
- SC2 (100 µg/L in FY 2001 to 28 µg/L in FY 2018 – 72% reduction),

- B3 (8.7 µg/L in FY 2001 to 2.50 µg/L in FY 2020 – 68% reduction),
- B9 (110 µg/L in FY 2001 to 30.5 µg/L in FY 2020 – 72% reduction),
- SC4 (6.9 µg/L in FY 2001 to 3.18 µg/L in FY 2020 – 54% reduction) and
- B8 (21 µg/L in FY 2001 to 7.33 µg/L in FY 2020 – 65% reduction).

Only three extraction wells (B2, SC5, and SC1) have shown less than a 50% reduction in TCE concentrations since FY 2001. In FY 2020, extraction well B11 reported a TCE concentration of 5.22 µg/L, the highest TCE concentration at the well since FY 2000. Given that the TCE concentration at B11 had been less than 1.0 µg/L since FY 2013, the well was resampled in December 2020 and TCE concentrations of 2.56 µg/L (1.53 µg/L, duplicate) were reported. As such, the concentration reported for the June 2020 was likely anomalous.

Table 12-6 illustrates seven extraction wells, B1, B4, B5, B9, B13, SC1, and SC5, that are located in the centers of the plume (see Figures 12-7 and 12-8) and achieve the largest rates of VOC removal. These seven wells together accounted for over 98% of the VOC mass removed.

The source control wells, SC1 through SC5, together accounted for over 81% of the VOC mass removed while accounting for only 6.3% of the water pumped by the system. SC5, in particular, removed 73.3% of the total VOC mass at a rate of only approximately 92 gpm (5.3% of the total water pumped by the system). This illustrates the efficiency of extracting groundwater from near the source areas, which is further discussed in the remedy review document.

Five additional source area extraction wells SC-6, SC-7, SC-8, SC-9, and SC-10 have been installed and additional wells are planned to be installed during FY 2021. When these wells become operational in FY 2022, VOC and 1,4-dioxane mass removal will substantially increase.

What do the long-term trends in the monitoring wells show?

A majority of wells on and off TCAAP exhibit decreasing trends in TCE concentration since FY 2001, indicating an overall improvement in water quality both upgradient and downgradient of the TGRS. Due to the complexity of the flow system, changes in flow direction over time, and the variation in chemical transport properties across the study area, the trends may not reflect a uniform or easily predictable pattern.

Several wells were identified in previous APRs, or when reviewing the FY 2020 database that have inconsistent or upward trends in TCE concentrations that warrant further observation and discussion:

Well	Trend Observation
03L806	Trend identified in FY 2001 APR. TCE concentrations have steadily decreased from 620 µg/L in 2013 to 28.6 µg/L in FY 2020. Maintain annual sampling frequency to determine if this downward trend continues.
04U806	Trend identified in FY 2001 APR. Dropped from 1,000s of µg/L in early to mid-1990s. TCE steadily decreased from 470 µg/L in FY 2001 to 96 µg/L in FY 2007. In FY 2008, TCE spiked at 380 µg/L, but concentrations decreased the next year and have varied between 52 µg/L and 220 µg/L since FY 2009 with a notable steadily decreasing trend (35.1 µg/L in 2020). Maintain annual sampling frequency.

Well	Trend Observation
03U094	Trend identified during FY 2004 data review. TCE increased from 170 µg/L in FY 2003 to 470 µg/L in FY 2005. From FY 2005 to FY 2013, TCE concentrations decreased to 80 µg/L in FY 2013, a historical low concentration. The TCE concentration increased to 610 µg/L in FY 2015, the highest concentration since 1996. Since then, the TCE concentration decreased to 360 µg/L in FY 2016 and 278 µg/L in FY 2020. Maintain biennial sampling frequency (next event FY 2022).
03M806	Trend identified during FY 2003 data review. TCE concentrations dropped from approximately 900 µg/L in FY 1987, to less than 100 µg/L from FY 1993 through FY 1996. In FY 2003, TCE increased to 1,300 µg/L, a historical high concentration. TCE concentrations decreased from 680 µg/L in FY 2008 to 390 µg/L (400 µg/L, duplicate) in FY 2020. Maintain annual sampling frequency.
03U711	Trend identified in FY 2001 APR. TCE concentrations decreased from approximately 1,000 µg/L in FY 1994 to 75 µg/L in FY 1999 but rebounded to 250 µg/L by FY 2004. Since FY 2004, concentrations have steadily decreased to 27 µg/L in FY 2016 and 28.5 µg/L in FY 2020. Maintain biennial sampling frequency (next event FY 2022).
03L809	Trend identified in FY 2001 APR. TCE concentrations decreased from over 3,000 µg/L to 67 µg/L through 1998 but rebounded to 520 µg/L by FY 2001. Since FY 2001, concentrations have decreased to 133 µg/L in FY 2020. Maintain biennial sampling frequency (next event FY 2022).
04U843	Trend identified in FY 2001 APR. TCE concentrations were below 15 µg/L from the late 1980s through 1997, and then increased to between 22 µg/L and 38 µg/L from 1998 through 2001. In FY 2003, TCE dropped below 1 µg/L, and has since been steadily increasing; it was 207 µg/L in FY 2020. This well is nearly 1 mile from the TGRS and is part of the OU1 sampling program; also see Section 3. Maintain biennial sampling frequency (next event FY 2022).
04U841	Trend identified in FY 2001 APR. TCE concentrations were below 10 µg/L through 1995, and then increased to 25 µg/L in FY 2001. In FY 2003, TCE decreased to 5 µg/L, but rebounded to 19 µg/L in FY 2005. TCE appears stabilized around 20 µg/L, with concentrations ranging between 10 and 24 µg/L since FY 2005 (10.3 µg/L in FY 2020). The well is nearly 0.5 mile from TGRS and is part of the OU1 sampling program; also see Section 3. Maintain biennial sampling frequency (next event FY 2022).
03U822	Trend identified during FY 2003 data review. TCE concentrations were below 25 µg/L through FY 1998, and then peaked at 375 µg/L in FY 1999. Concentrations have ranged between 42 and 160 µg/L from FY 2005 to FY 2015 (18.5 µg/L in 2020). Well is approximately 1 mile from TGRS and is part of the OU1 sampling program; also see Section 3. Maintain biennial sampling frequency (next event FY 2022).
03L822	Trend identified in FY 2001 APR. TCE concentration increased from less than 5 µg/L during the early 1990s to over 600 µg/L from 1999 through 2003. Concentrations steadily decreased from 620 µg/L in FY 2003 to 180 µg/L in FY 2011 but rebounded slightly in FY 2013 to 220 µg/L. The TCE concentration decreased slightly in FY 2016 to 190 µg/L and again in FY 2020 to 129 µg/L. The well is approximately 1 mile from TGRS and is part of

Well	Trend Observation
	the OU1 sampling program; also see Section 3. Well historically showed 1,1,1-trichloroethane as major COC. Maintain biennial sampling frequency (next event FY 2022).

12.2 Remedy Component #2: Groundwater Treatment

Description: "Groundwater treatment using air stripping." (1997 OU2 ROD, page 3).

Performance Standard (how do you know when you've achieved the remedy):

When the air stripping treatment facility is treating water and meeting the cleanup requirements in Table 1 of the 1997 OU2 ROD.

Is the remedy component being implemented?

Yes. The air stripping treatment facility has been operating since 1986.

Did the treatment system meet the treatment requirements in the 1997 OU2 ROD?

Yes. Influent and effluent water were sampled on a monthly basis during FY 2020. The influent and effluent database for FY 2020 is provided in Appendix I.2. Figure 12-6 presents a graph of influent TCE versus time. This graph is cumulative and includes data from before 1989, when the system consisted of only six extraction wells. The average FY 2020 influent TCE concentration was 211.5 µg/L, which is a 12% increase from 188.3 µg/L in FY 2019. FY 2020 represents the 20th year since the TGRS was reconfigured to pump more in the centers of the VOC plumes and pump less on the edges of the plumes where VOC concentrations are much lower. The influent TCE concentrations had been steadily decreasing for several years likely due to the overall decrease in plume concentration.

Figure 12-6 also presents a graph of the effluent TCE concentration versus time. As indicated, the effluent was below 5 µg/L TCE for all sampling events in FY 2020. A review of the FY 2020 database indicates that the effluent remained below the treatment requirements for all other VOC compounds specified in the 1997 OU2 ROD. Comparison of influent and effluent concentrations for all specified VOC compounds indicates an average removal efficiency of 98.9%. As expected, effluent concentrations of TCE increased slightly after the treatment was changed to two tower operation (two tower operation was tested in February 2011 and went into full operation in March 2011). The maximum effluent TCE concentration in FY 2020 was 3.29 µg/L and the average was 2.57 µg/L, which are both well below the discharge limit.

What was the mass of VOCs emitted into the air?

The air stripping towers remove VOCs with an efficiency of approximately 98.9%. The air emissions are equal to the VOC mass removal rates presented in Table 12-6. Air emissions averaged 5.5 pounds per day based on the VOC mass removal rates. The total VOC emissions from October 2019 through September 2020 were 2,013 pounds.

Per the 1997 OU2 ROD, ESD #3, the system is scheduled to be modified during FY 2021 to substantially reduce VOC air emissions by routing all new and existing source area extraction wells to the new SGRS system.

12.3 Remedy Component #3: Treated Water Discharge

Description: "Discharge of treated water to the on-site gravel pit." (1997 OU2 ROD, page 3).

Performance Standard:

When the gravel pit is accommodating the discharge from the treatment system and allowing it to recharge to the aquifer.

Is the remedy component being implemented?

Yes. Based on visual observation during FY 2020, there were no noticeable changes in Gravel Pit performance. The Gravel Pit is accommodating the TGRS discharge as designed.

12.4 Remedy Component #4: Institutional Controls

Description: **"**Institutional controls to restrict access to contaminated aquifers and prevent exposure to contaminated groundwater." (1997 OU2 ROD, page 4).

Performance Standard (how do you know when you've achieved the remedy):

When a special well construction area and alternate water supply have been established and private wells in impacted areas have been sealed.

Is the remedy component being implemented?

Yes. There are no private users of groundwater on the property and no potable water supply. There are institutional controls in place for future groundwater use associated with upcoming property redevelopment.

Are any changes or additional actions required for this remedy component?

Yes. On April 20, 2016, the MDH issued a memorandum updating the SWBCA that noted the rezoning of the TCAAP facility for future development and updated the SWBCA boundary to include the entirety of TCAAP (MDH 2016). As such, all wells and borings constructed or modified within the SWBCA must first be approved by the MDH.

12.5 Remedy Component #5: Review of New Technologies

Description: "Reviews of new and emerging technologies that have the potential to cost-effectively accelerate the timeframe for aquifer restoration. Reviews shall be performed by the Army and reported annually in accordance with the consistency provisions of the TCAAP FFA." (1997 OU2 ROD, page 4).

The intent is to consider new technologies of merit, which is not on any set schedule. To have merit, a new technology must have promise in reducing cost and time for cleanup. There may be years when no technologies are considered. It is envisioned that at any time, any interested party (Army, USEPA, and MPCA) can suggest new technologies for consideration. If a technology is agreed to have merit by the Army, USEPA, and MPCA, then the Army will evaluate the technology. The level of effort for evaluations can range from simple literature searches to extensive treatability studies. On an annual basis, the Army will report on:

- Whether or not any new technologies were identified and considered to have merit that year.
- The progress or results of any evaluations during that year.
- Any planned evaluations for the following year.

Performance Standard (how do you know when you've achieved the remedy):

When the Army reports on the status of any reviews of emerging technologies in the annual monitoring report.

Is the remedy component being implemented?

Yes. Since the FY 1997 APR, the Army reports annually on the status of any reviews of emerging technologies.

- In September 2002, the MPCA and USEPA announced they would be conducting a natural attenuation microcosm study using carbon dating. In October 2002, the Army drilled a boring at Site G to collect soil for the study. The study results were published in 2004.
- The MPCA identified a study involving the addition of vegetable oil to groundwater that is being monitored at the Navy site in Fridley, Minnesota, as a potential technology of interest.

Were any new technologies identified and considered to have merit during FY 2020?

ESD #3 document finalized on October 15, 2020 and signed in 2021, was prepared to address the following:

- Addition of 1,4-dioxane as a COC, and
- Addition of remedial technologies to treat 1,4-dioxane.

The ESD #3 document lists the following improvements for the deep groundwater remedy:

- Installation of new source area extraction wells at Site D, Site G, and Site I,
- Routing of the new source area extraction wells and existing source area extraction wells to a new AO system, SGRS, to remove and treat 1,4-dioxane and TCE,
- Routing of the effluent from the SGRS to a co-located new air stripper to remove residual VOC contaminants and
- Discharge of the treated groundwater from the SGRS to the gravel pit.

What is the status and/or findings of any previously initiated reviews of emerging technologies?

The MPCA continued its research into natural attenuation processes at TCAAP. The MPCA and USEPA published the results of the microcosm study for deep groundwater sediments in 2004 showing that abiotic degradation of cis-1,2-DCE is an important factor contributing to the natural attenuation of this compound at the site. (*Non-biological Removal of cis-dichloroethylene and 1,1-dichloroethylene in aquifer sediment containing magnetite*. Environmental Science and Technology, 38: 1746-1752.)

Are any new reviews planned at this time for the coming year?

Yes. Extraction well and treatment system design plans will be prepared and implemented.

12.6 Remedy Component #6: Groundwater Monitoring

Description: **"**Groundwater monitoring to track remedy performance." (1997 OU2 ROD, page 4).

Performance Standard (how do you know when you've achieved the remedy):

When a regulator approved monitoring plan is in place and monitoring is conducted according to the plan.

Is the remedy component being implemented?

Yes. Monitoring in FY 2020 was consistent with the 1997 OU2 ROD. Water level measurements and water quality samples were collected as stated in Appendix A.1. Appendix A summarizes the FY 2020 monitoring plan and any deviations are explained in Appendix C.2. Monitoring was as follows:

Groundwater

TGRS groundwater level measurements were collected during December 2019 and June 2020 according to the monitoring plan. Appendix D contains the comprehensive groundwater quality and water level database for the TGRS monitoring wells. Water quality samples were collected from TGRS wells according to the monitoring plan. Groundwater samples were collected at wells stated in Appendix A.1. All wells were sampled for VOC (8260D) analysis and 1,4-dioxane (8270 SIM), except for those at Site A and Building 102 where 1,4-dioxane was determined not to be a COC. FY 2020 was a "large round" year in the biennial sample program and samples were collected from a select list of wells. Table 12-8 presents the groundwater quality data for FY 2020. Figures 12-7 through 12-9 present plan views of the TCE and 1,4-dioxane plumes and Figures 12-10, 12-11, 12-14, and 12-15 present a cross sectional view of the plume along the property boundary. Results from the FY 2020 groundwater sampling showed that most of the wells sampled continued to have declining or stable TCE concentrations. Notable steadily decreasing trends are observed at 04U806 (decrease from 725 µg/L in FY 2000 to 35.1 µg/L in FY 2020), 03U708 (steady decrease from 120 µg/L in FY 2005 to 25.3 µg/L in FY 2020), and 03L806 (620 µg/L in FY 2013 to 28.6 µg/L in FY 2020).

Although the general trend at most wells since 1999 appears to be declining or stable, the monitoring wells listed below had notable increases in TCE concentration in FY 2020:

- 03U020 (50 µg/L in 2018 to 71.5 µg/L in 2020).
- 03U093 (120 µg/L in 2019 to 156 µg/L in 2020).
- 03U708 (<1.0 µg/L in 2019 to 25.3 µg/L in 2020).
- B11 (<1.0 µg/L in 2019 to 5.22 µg/L in 2020).
- 03U805 (49 µg/L in FY 2018 to 94 µg/L in FY 2020).

Wells 03U020, 03U093, and 03U708 are within the capture zone of the TGRS extraction system; therefore, the significance of these increases (if they are indeed real increases, and not laboratory or field anomalies) are minimal. The TCE result for 03U708 of 25.3 µg/L is similar to TCE concentrations reported between FY 2015 and FY 2018 (between 37 and 20 µg/L); therefore, the FY 2019 result (< 1.0 µg/L) was likely anomalous. As stated earlier, the June 2020 TCE result for well B11 (5.22 µg/L) was lower (2.56 µg/L, 1.53 µg/L duplicate) when resampled in December 2020. All of these wells will continue to be monitored and no further sampling beyond the scheduled events is necessary at this time.

Related to the increase in TCE concentration at 03U805, it is clear that this finding is representative of an increasing trend at this well. As shown on Figure 12-3, 03U805 is immediately downgradient (west) of well 03U711. Both wells are just outside the TGRS extraction system zone of hydraulic capture and likely within or just outside the hydraulic stagnation zone. Figure 12-16 provides a comparison of the TCE concentration history at these two wells. As shown, TCE concentrations have steadily decreased at 03U711 since FY 2003, whereas TCE concentrations have increased at 03U805 since FY 2013. The increasing trend at 03U805 is not believed to be the result of a lack of capture from the existing extraction system, but the result of a migration from the 03U711 area.

<u>Estimated TCE Plume Width</u>

The 2003 TGRS OS stated that the actual measured width of the 5 µg/L TCE plume at the source area based on FY 2001 analytical data was 3,600 feet (this value was then rounded up to 4,000 feet to determine an operating minimum flow rate noted in Section 12-1). Since that time, 22.9 tons of VOCs have been removed from groundwater. TCE concentrations are decreasing across the site, especially at the following wells that have been below 5 µg/L since 2001: B10, SC4, 03L021, 03L833, 03U701, 04J702, 04U701, 04U702, and 04U833. Monitoring well 03U672, which was located outside the southern end of the 5 µg/L TCE plume, decreased from 3.1 µg/L in FY 2001 to not detectable (less than 1 µg/L) from FY 2003 until it was abandoned in FY 2014. Well 03U677 replaced 03U672 in September 2014 and has never contained detectable concentrations of VOCs (including TCE).

As a result, the TCE plume width is narrowing. Figure 12-12 shows FY 2020 TCE data with the 5 µg/L TCE contours for FY 2001 and FY 2020. The overall FY 2020 sample results are similar, or lower compared to the previous sample results.

Based on these contours, the estimated width of the source area TCE plume has decreased approximately 17% from 3,600 feet to 3,000 feet or approximately 83% of the FY 2001 width. According to the TGRS OS, overall TGRS operating goals will be reviewed if the source area plume width shrinks to 75% of the FY 2001 width, or 2,700 feet. At the boundary, the TCE plume narrowing is more pronounced, having decreased approximately 24% from 4,600 feet to 3,500 feet, which represents an approximately 76% decrease from the FY 2001 width.

The Army has completed the investigation of the Site D, G, and I source areas and has installed five extraction wells in these source areas, which is expected to significantly increase mass removal and accelerate the shrinking of the TCE plume.

Treatment System

The TGRS treatment system influent and effluent was sampled monthly during FY 2020 in accordance with the FY 2020 to FY 2024 monitoring plan. Groundwater samples from the extraction wells were collected in December 2019 and June 2020 in accordance with the FY 2020 to FY 2024 monitoring plan.

Is there additional monitoring proposed prior to the next report?

No additional monitoring for FY 2021 is proposed beyond what is presented in the Monitoring Plan (Appendix A) of the FY 2020 APR. Table 12-9 and Appendix A of this APR provides the FY 2020 to FY 2024 monitoring plan. Once new extraction wells are operating during FY 2021, then they will be monitored consistent with an approved work plan.

12.7 Overall Remedy for Deep Groundwater

Did the TGRS meet the requirements of the 1997 OU2 ROD?

Yes.

- Hydraulic containment in Units 3 and 4 extends upgradient within OU2 beyond the 5 µg/L contour, meeting the VOC criterion in the 1997 OU2 ROD.
- The total average extraction well water pumped exceeded Total System Operational Minimum (1,745 gpm). The FY 2020 annual average extraction rate was 1,751 gpm.
- The TGRS extracted and treated 920,294,200 gallons of water and removed 2,013 pounds of VOCs from October 2019 to September 2020. Average VOC influent concentrations increased by 11.3% from FY 2019.
- Groundwater analytical data of the source area show a general decrease in TCE concentration. This concentration decrease demonstrates that the TGRS is effectively removing VOC mass from the aquifer.
- Effluent VOC concentrations were below COC-specific requirements for all sampling events.

Do any additional measures need to be addressed?

As stated previously, the ESD #3 document finalized October 15, 2020 and signed in 2021, identified the following improvements for the deep groundwater remedy:

- Installation of new source area extraction wells at Site D, Site G and Site I.
- Routing of the new source area extraction wells and existing source area extraction wells to a new AO system, the SGRS, to remove and treat 1,4-dioxane and TCE.
- Routing of the effluent from the SGRS to a co-located new air stripper to remove residual VOC contaminants.
- Discharge of the treated groundwater from the SGRS to the gravel pit.

12.8 Other Related Activity in FY 2020

In 2020, monitoring wells proposed for sampling in the FY 2020 Monitoring Plan were sampled for 1,4-dioxane. Table 12-10 presents the results of the 1,4-dioxane sampling for the TGRS influent, effluent, and extraction wells. No Federal MCL has been established for 1,4-dioxane; however, the MDH has established an HRL value of 1.0 µg/L. All locations sampled except extraction well B2 had 1,4-dioxane concentrations exceeding the HRL.

The TGRS influent and effluent were sampled in June 2020 where 1,4-dioxane concentrations were virtually identical in influent and effluent samples, indicating no concentration reduction from the treatment system. The monitoring well sampling results are presented on Table 12-11. A majority of the monitoring wells sampled (52 of 77) had 1,4-dioxane concentrations exceeding the HRL, with the highest concentrations found in the samples at 03L014 (64.3 µg/L), 03U021 (62.5 µg/L), 03U094 (130 µg/L), and 03U659 (43.1 µg/L). Figure 12-13 shows the 1,4-dioxane concentrations in plan view for the west portion of OU2. Figures 12-14 and 12-15 present cross-sectional views of the plume along the property boundary.

As stated in Section 12.1, a new control system for the TGRS and new mechanical piping in pumphouses B1, B4, B5, B6, B9, and SC-5 were installed during FY 2020.

13 OPERABLE UNIT 3: DEEP GROUNDWATER

An amendment to 1992 OU3 ROD was developed, amended and finalized in August 2006 that significantly changed the OU3 remedy. The basis for the OU3 ROD Amendment #1 (2006) was the "Groundwater Statistical Evaluation, OU3" technical memorandum, which received consistency from the regulators on May 2, 2005. This document presented a statistical evaluation showing that the South Plume has been receding since at least 1996, including the period after the Plume Groundwater Recovery System (PGRS) was shut off in 2001. The South Plume had a receded well upstream of the PGRS, which was basically pumping clean water. The OU3 ROD Amendment #1 (2006) removed the need for a pump and treat remedy, eliminating the PGRS extraction well and treatment train. Figure 13-1 presents an OU3 site plan.

The PGRS was an off-site groundwater extraction and treatment system and municipal potable water supply. The PGRS consisted of NBM #13 and a GAC treatment plant. New Brighton used the water for municipal supply. The PGRS was designed to contain the South Plume of VOC impacts emanating from the former TCAAP property and to prevent further downgradient migration. Recovered groundwater was treated and used by the City of New Brighton to fulfill its municipal water supply demand.

The PGRS began operating on May 3, 1994. In 1997, the PGRS influent dropped below the 1992 OU3 ROD required limits for all VOCs. In December 1999, under an agreement with the regulators, the PGRS pumping rate was reduced from a nominal rate of 1,000 gpm to 400 gpm to help determine if the VOC concentration reductions were the result of actual plume decreases or the result of dilution from over pumping. In conjunction with the flow rate decrease, a quarterly monitoring program was undertaken to monitor for potential "rebound" in VOC concentrations. By the end of FY 2000, no rebound was observed and a review of the historical database for all of OU3 and the associated source area in OU2 revealed that the entire South Plume had dramatically decreased in size and concentration since the early 1990s. The VOC concentration decreases were such that the leading edge of the South Plume, at the PGRS, dropped below the 1992 OU3 ROD requirements.

The results of this evaluation were presented to the regulators on September 6, 2000, and a report titled "Plume History Evaluation, Operable Unit 3," CRA, was submitted to the regulators on October 10, 2000. The report documents the history of plume size and concentration reductions throughout OU3. Based on the dramatic reductions in plume size and concentration, the report recommended shutting down the PGRS, which the regulators subsequently accepted. The City of New Brighton stopped significant pumping in August 2001 and the PGRS was maintained in standby status. During the period May through September 2003, the PGRS was operated solely to satisfy peak water supply demands and then was placed back into standby status throughout FY 2004, FY 2005 and FY 2006. The City of New Brighton conducted an evaluation of its municipal system to, in part, determine the future use of the PGRS extraction well and treatment system. The City of New Brighton decided the PGRS treatment system and well NBM #13 were not part of the city's long-term water supply plan. During FY 2007, the PGRS treatment system was dismantled and NBM #13 was abandoned.

13.1 Remedy Component #1: Monitored Natural Attenuation

Description: "Monitored natural attenuation." (OU3 ROD Amendment #1 (2006), page 17).

Performance Standard (how do you know when you've achieved the remedy):

When a monitoring program is established and monitoring is in compliance with the regulator approved Annual Monitoring Plan.

Is the remedy component being implemented?

Yes. Appendix A summarizes the FY 2020 monitoring plan and any deviations are explained in Appendix C.2. Details of the groundwater monitoring program are discussed in Section 13.2.

13.2 Remedy Component #2: Groundwater Monitoring

Description: "Monitoring of the groundwater for VOCs to verify the effectiveness of the selected remedy and the natural attenuation of the South Plume." (OU3 ROD Amendment (2006), page 17).

Performance Standard (how do you know when you've achieved the remedy):

When a monitoring program is established, and monitoring is in compliance with the regulator approved Annual Monitoring Plan.

Is the remedy component being implemented?

Yes. Appendix A summarizes the FY 2020 monitoring plan and any deviations are explained in Appendix C.2.

Groundwater samples were collected from sixteen OU3 wells in FY 2020 as part of OU1, OU2, and OU3 annual sampling. Except for well 04U832, samples were collected as specified in the monitoring plan and analyzed for VOCs and 1,4-dioxane at locations shown on Figure 13-1. The specific purpose of monitoring each well is provided in Appendix A. Groundwater elevations were also measured during the monitoring event and are presented in Appendix D.1. Well 04U832 was inadvertently missed for chemical sampling in FY 2021 (groundwater elevation measurements were collected). As a result, this well has been added for chemical sampling in FY 2021.

Table 13-1 summarizes the analytical results for the sixteen monitoring wells that were sampled in FY 2020. The wells sampled contained TCE concentrations similar to those reported for the previous sampling events. The TCE concentration in downgradient sentry well 04U863 remained less than 1.0 µg/L or not detectable (less than 1.0 µg/L) for the eighth consecutive year, after rising above 1.0 µg/L for the first time since December 1999 in FY 2012 (1.2 µg/L).

What were the results of the Statistical Analyses?

The Mann-Kendall statistical analysis has historically been completed for ten edge-of-plume and center-of-plume wells. In FY 2020, only well 03M848 was sampled within the ten edge-of-plume and center-of-plume wells. A summary of the statistical analyses was completed for well 03M848 and the other nine wells were included with FY 2020 results for an overview of the site as presented in Table 13-2. A spreadsheet and graph presenting the Mann-Kendall test results for the wells are provided in Appendix J.

The trend for 03M848, which has historically been the center of the South Plume, changed from decreasing to no trend or stable as concentrations have remained relatively constant over the last five sampling events. The TCE concentrations at 03M848 have steadily decreased from 1,400 µg/L (FY 1996) to 700 µg/L (FY 1999) to 450 µg/L (FY 2003) to the current concentration of 110 µg/L in FY 2020. In summary, the data collected in FY 2020 from the center of the South Plume represented by 03M848, indicate stable concentration trends.

Are contingency actions warranted?

No. The OU3 ROD Amendment #1 (2006) requires contingency actions to be considered when the Mann-Kendall statistical analysis shows that a well at the edge of the South Plume has an increasing trend. The wells analyzed in FY 2020 showed a decreasing or stable trend.

What groundwater monitoring is proposed before the next report?

Since the 1,4-dioxane issue in FY 2015, sampling has been conducted including 1,4-dioxane. 1,4-dioxane will continue to be monitored in FY 2021. The proposed OU3 monitoring requirements are presented in Table 13-3 and Appendix A.

Also, since a sample from well 04U832 was not collected in FY 2020, this well has been added for chemical sampling for FY 2021.

13.3 Remedy Component #3: Drilling Advisories

Description: "Continued implementation of the drilling advisories that regulates the installation of new private wells within OU3 as a Special Well Construction Area." (OU3 ROD Amendment #1 (2006), page 17).

Performance Standard (how do you know when you've achieved the remedy):

When an SWBCA Advisory is issued.

Has the MDH issued a Special Well Construction Area Advisory?

Yes, in June 1996. In June 1999, via the MDH the SWBCA boundary extended southwest including the Mississippi River and Marshall Avenue to ensure plume coverage. The SWBCA also covers OU3 and all of OU2 as of April 2016, with the current boundary shown on Figure E-1 (Appendix E).

Are any changes or additional actions required for this remedy component?

No.

13.4 Overall Remedy for OU3

Is the Remedy for OU3 Operating in Compliance with the 1992 OU3 ROD and OU3 ROD Amendment #1 (2006)?

Yes. In FY 2020, groundwater monitoring took place as prescribed in the Annual Monitoring Plan. The annual sampling round of FY 2020 indicates that the South Plume footprint appears to be decreasing or at least stable, with a stable to decreasing trend at the center of the plume.

Are any changes or additional actions required for OU3?

No. No additional actions are necessary because no increasing trends at the edge of the plume were identified by the statistical analysis.

13.5 Other Related Activity in FY 2020

In FY 2020, samples from 16 wells were collected for 1,4-dioxane analysis for OU3 annual sampling presented in Table 13-4. The wells sampled contained 1,4-dioxane concentrations slightly higher than those reported for the previous sampling events.

14 OTHER INSTALLATION RESTORATION ACTIVITIES DURING FY 2020

This section summarizes the status of other activities that are related to the Installation Restoration Program but are not required in the RODs for OU1 through OU3.

14.1 Round Lake

The *Tier II Ecological Risk Assessment Report* (USACHPPM 2004) for aquatic sites (including Round Lake), was approved by the MPCA and USEPA in December 2004. In June 2005, the Army submitted a draft FS for aquatic sites to support the risk management decisions with respect to “No Further Action” or “Implement a Remedy” for each aquatic site. Based on comments to the draft FS, it was agreed to conduct additional sampling of Marsden Lake and Pond G, which was completed in 2008. A revised FS was submitted in January 2009. Based on comments received and resolution thereof, the Army then submitted a revised (redlined) FS in April 2010. After review of this report, USEPA and MPCA requested that the Army prepare a work plan for collection of additional Round Lake sediment data. Given the time required to collect the additional data, the Army, USEPA, and MPCA agreed to separate the FS for aquatic sites into two documents: one for Round Lake and one for Rice Creek, Sunfish Lake, Marsden Lake, and Pond G.

The USEPA and MPCA provided consistency approval for the QAPP for Round Lake Sediment Investigation in January 2011. The sediment sampling work was completed in January to February 2011. A Draft Summary of Investigation Findings was submitted in May 2011, and a meeting between the Army, USEPA, MPCA, Minnesota Department of Natural Resources (MDNR), U.S. Fish and Wildlife Service (USFWS), and the TCAAP Restoration Advisory Board was held in June 2011 for preliminary discussion of the findings. Final core dating results were distributed in February 2012. In March 2012, the Army provided responses to the stakeholder comments on the Round Lake portion of the April 2010 FS, which had been placed on hold pending collection and evaluation of the 2011 sediment data. A comment resolution meeting was then held in April 2012, and a TCAAP Restoration Advisory Board meeting was held in May 2012, primarily to discuss the status of the Round Lake FS.

With USEPA and MPCA agreement, the Army initiated a strategy to revise the FS in segments, with the intent to gain agreement/approval at key steps along the way. In accordance with this strategy, the Army submitted revised Sections 1 through 5 of the Round Lake FS in August 2012, and the USEPA and MPCA provided comments in September 2012. The Army sought clarifications on these comments, and ultimately submitted responses to those comments and the proposed redlines to Sections 1 through 5 in January 2013. The USEPA and MPCA provided comments to that submittal in March 2013. Through this process (and the multiple earlier drafts of the FS), it became clear that the Army, USEPA, and MPCA did not agree on the ecological risks and commensurate remedy associated with Round Lake. Given the difficulty reaching a consensus, the U.S. Army Environmental Command desired a fresh look at the ecological risk by someone who has national experience with such matters and obtained the assistance of the Risk and Regulatory Analysis Team of the Environmental Sciences Division at the Oak Ridge National Laboratory. In early FY 2014, the Army submitted *a* Supplemental Remedial Investigation and Feasibility Study for Round Lake (Wenck 2013a) which incorporated the Supplemental Ecological Risk

Assessment (Oak Ridge National Laboratory 2013). Comments received from the USEPA and MPCA in March 2014 indicated that significant disagreement remained. In April 2014, the Army, USEPA, and MPCA entered an “informal dispute resolution” phase which continued in FY 2015 and FY 2016. In a teleconference between the USEPA Region 5 Federal Facilities Chief and Headquarters Department of the Army personnel on September 20, 2016, an agreement was reached in which the Army would submit a revised Supplemental Remedial Investigation and Feasibility Study (SRI-FS) in the third quarter of FY 2017. The document was submitted for regulator review on May 10, 2017. The regulators provided written comments in July 2017, with the Army responses issued on October 6, 2017. At the end of FY 2018, a revised Final SRI-FS for Round Lake was prepared and submitted to the USEPA and MPCA on September 7, 2018.

A meeting was held on June 18, 2019 with the USFWS, USEPA, MPCA, and the Army to consider the current ecological risk to the ecosystem, understand USFWS goals for Round Lake, discuss remedial alternatives, and define the path forward for Round Lake. The Army provided the Round Lake SRI-FS USFWS comments and Army responses to the stakeholders on September 19, 2019. A meeting was held on September 25, 2019 with the USFWS, USEPA, MPCA, and the Army. The objectives of the meeting were to discuss comments on the SRI-FS, next steps in the CERCLA process, cleanup value, and the list of remedial alternatives. It was agreed that the SRI-FS would be revised based on the agreed upon cleanup value of 0.6 mean probable effect concentration quotient, the agreed list of alternatives, and comments on the SRI-FS. A call was held on October 2, 2019 with the USFWS, USEPA, MPCA, and the Army to discuss applicable or relevant and appropriate requirements (ARARs). The Army submitted the Draft Final SRI-FS for the Round Lake New Brighton/Arden Hills Superfund Site and September 2018 SRI-FS for Round Lake New Brighton/Arden Hills Superfund Site USFWS comments and Army responses to the stakeholders and the USFWS, USEPA, MPCA, and MDNR on December 4, 2019.

The MPCA and USEPA provided comments on the December 2019 draft of the SRI-FS on January 17 and 21, 2020, respectively. No comments were received from the USFWS before the planned Round Lake meeting was held on February 25, 2020. During the meeting, the Army agreed to prepare draft text to address the ARARs for USFWS review and approval (before the Remedial Action section in the SRI-FS). The USFWS stated that they wanted agreement on the ARARs prior to providing comments on the SRI-FS. MDNR provided comments on April 13, 2020 and a team call with the MDNR was held on May 13, 2020 to discuss their comments and draft Army responses, and the meeting minutes were sent out on June 15, 2020. The USFWS finally provided their comments on May 22, 2020 and the Army provided response on June 27, 2020 prior to the team call on July 14, 2020 to discuss the USFWS comments and Army responses. Draft minutes were provided on July 28, 2020.

The Army provided the Field Habitat Assessment Memo on July 30, 2020 describing the field habitat assessment that the Army planned to conduct in August. The field visit will enable the Army (with the MDNR and USFWS assistance) to verify habitat conditions for the Bald Eagle, Blanding Turtle, and Ghost Tiger Beetle around Round Lake. The assessment was completed on August 20, 2020.

The Draft Final SRI-FS was submitted on August 17, 2020. The USEPA provided a Consistency Letter on August 24, 2020, which requires a Draft Proposed Plan in 40 days (end of September 2020). A call was held with stakeholders on September 1, 2020 to discuss steps to finalize the SRI-FS. On September 3, 2020, the MPCA issued a letter to the USEPA to request a 30-day extension for the completion of the SRI-FS to allow the MPCA and MDNR to complete state coordination. The USEPA provided concurrence to the MPCA's request for extension and the deadline for the Final SRI-FS was changed to October 1, 2020. The MPCA provided an email on October 2, 2020 that revised their position on state acceptance of alternatives presented in the Round Lake SRI-FS based on state land use and management needs, rather than solely MPCA acceptance based on protectiveness of benthic organisms. The revised MPCA position ranks Alternative 4 100% state acceptance, Alternative 8 at 25% state acceptance, and all others at zero percent state acceptance. Previously (per their Email from August 26, 2020) their position was Alternatives 4A, 4B, 6A, 6B, 8 and 9 were 100% desirable and Alternative 7 was 25% based on acceptance to benthic organisms.

Army submitted a "Request for extension to the FS and PP for Round Lake" on October 14, 2020 and it was approved by the USEPA on October 16, 2020 and MPCA on October 19, 2020. After submittal of the revised Draft Final SRI-FS which incorporated MPCA's latest comments on October 27, 2020, MPCA provided their Consistency Letter on October 28, 2020. The USFWS comments were provided on November 23, 2020 and the Army held a call with them to discuss the comments on December 1, 2020. The Army requested an additional extension for the SRI-FS to end of January 2021, dated December 14, 2020. The extension was approved by the USEPA and MPCA on December 14 and 15, 2020, respectively. The Final SRI-FS in tracked changes will be provided by end of January 2021. After formal regulatory approval, the Draft Final Proposed Plan will be submitted followed by a public meeting and Draft Final ROD.

14.2 Source Control Well Installation

Following the review of all data collected during the FY 2019 groundwater profiling investigation and optimization for OU2, as presented in Final Source Investigation and Completion Letter Report (PIKA-Arcadis JV 2020b), new source control wells were installed: one at Site D (SC-6), two at Site G (SC-7 and SC-8) and two at Site I (SC-9 and SC-10). The extraction wells were installed within the zone of highest mass flux at each site to maximize COC removal and support overall plume reduction. The five 8-inch diameter extraction wells were installed via mud rotary drilling within the ideal locations to control COC source discharge and enhance ongoing source mass recovery. The wells are screened in the saturated unconsolidated alluvium (Unit 3) with a steel riser and stainless-steel screen (full well construction details are included in Appendix B, Table B-1).

Due to upcoming development on Ramsey County property, the County requested that the two Site I extraction wells (SC-9 and SC-10) be relocated upgradient of the investigation boring transect to be installed within the proposed Ramsey County right-of-way. Specifically, SC-9 was re-located approximately 20 feet upgradient of I-1 and SC-10 is located approximately 75 feet upgradient of I-4, at I-10. To install the well within the zone of highest mass flux upgradient of the previous investigation transect, three additional vertical aquifer profile borings were advanced utilizing rotosonic drilling methods prior to installing SC-10. The Site I investigation borings were located approximately 25 feet apart along a northwest-southeast trending transect and within the proposed Ramsey County right-of-way.

The new SGRS (as referenced in Section 12), consists of an AO and air stripper treatment system to remove 1,4-dioxane, TCE, and 1,1,1-trichloroethane from groundwater extracted from the source area control wells. Flow to the SGRS will consist of groundwater pumped from the five source area control wells (SC-6 through SC-10) and two existing source area well (SC-1 and SC-5).

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TABLES

Table 1-1
Status of Remedial Actions
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Acronyms and Abbreviations on Page 4.

	Remedy Component	Is the component being implemented?	Is the component doing what it is supposed to?	Has the component undergone final closeout?	Decision Document	Comments
Operable Unit 1: Deep Groundwater						
#1	Alternate Water Supply/Well Abandonment	Yes	Yes	No	1993 OU1 ROD	
#2	Drilling Advisories	Yes	Yes	No	1993 OU1 ROD	
#3	Extract Groundwater	Yes	Yes	No	1993 OU1 ROD, OU1 ROD Amendment #1 (2006)	NBCGRS pumping has resumed as of November 2018
#4	Removal of VOCs by GAC (Discharge Quality)	Yes	Yes	No	1993 OU1 ROD	
#5	Discharge of Treated Water	Yes	Yes	No	1993 OU1 ROD	
#6	Groundwater Monitoring with Verification of Continuing Aquifer Restoration	Yes	Yes	No	OU1 ROD Amendment #1 (2006)	
	Overall Remedy	Yes	Yes	No		
Operable Unit 2: Shallow Soil Sites						
#1-7	Soil Remediation					
	Site A	Yes	Yes	Yes	1997 OU2 ROD, OU2 ESD #2 (2009), OU2 ROD Amendment #5 (2014)	
	Site C	Yes	Yes	Yes	1997 OU2 ROD	
	Site E	Yes	Yes	Yes	1997 OU2 ROD, OU2 ROD Amendment #3 (2009)	
	Site H	Yes	Yes	Yes	1997 OU2 ROD, OU2 ROD Amendment #3 (2009)	
	Site 129-3	Yes	Yes	Yes	1997 OU2 ROD, OU2 ESD #2 (2009)	
	Site 129-5	Yes	Yes	Yes	1997 OU2 ROD, OU2 ESD #2 (2009)	
	Grenade Range	Yes	Yes	Yes	1997 OU2 ROD, OU2 ROD Amendment #3 (2009)	
	Outdoor Firing Range	Yes	Yes	Yes	1997 OU2 ROD, OU2 ROD Amendment #3 (2009)	
Operable Unit 2: Shallow Soil Sites Continued						
	135 PTA Stormwater Ditch	Yes	Yes	Yes	1997 OU2 ROD, OU2 ROD Amendment #3 (2009), OU2 ROD Amendment #5 (2014)	
	535 Primer/Tracer Area	Yes	Yes	Yes	1997 OU2 ROD, OU2 ROD Amendment #4 (2012)	
	Site K Soils	Yes	Yes	Yes	1997 OU2 ROD, OU2 ROD Amendment #4 (2012)	
	Water Tower Area	Yes	Yes	Yes	1997 OU2 ROD, OU2 ROD Amendment #3 (2009)	
	Soil AOCs (Site A, 135 PTA, EBS Areas)	Yes	Yes	Yes	1997 OU2 ROD	
#8	Groundwater Monitoring	Yes	Yes	Yes		
#9	Characterization of Dumps	Yes	Yes	Yes		
	Site B	Yes	Yes	Yes	1997 OU2 ROD, OU2 ESD #2 (2009)	
	Site 129-15	Yes	Yes	Yes	1997 OU2 ROD, OU2 ROD Amendment #3 (2009)	
#10	Land Use Controls	Yes	Yes	No	OU2 ROD Amendments and ESDs, OU2 LUCRD	Implementation of the OU2 LUCRD is an ongoing requirement.
	Overall Remedy	Yes	Yes	Partially		

Table 1-1
Status of Remedial Actions
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Acronyms and Abbreviations on Page 4.

	Remedy Component	Is the component being implemented?	Is the component doing what it is supposed to?	Has the component undergone final closeout?	Decision Document	Comments
Operable Unit 2: Deep Soil Sites						
#1	Groundwater Monitoring	Yes	Yes	Yes	1997 OU2 ROD	
#2	Restrict Site Access During Remediation	Yes	Yes	Yes	1997 OU2 ROD	Long-term land use controls are addressed by Remedy Component #8.
#3	SVE Systems	Yes	Yes	Yes	1997 OU2 ROD	Systems were turned off in 1998.
#4	Enhancements to SVE Systems	Yes	Yes	Yes	1997 OU2 ROD	Neither system required operation with enhancements. Both SVE systems have been dismantled.
#5	Maintain Existing Site Caps	Yes	Yes	Yes	1997 OU2 ROD	This remedy component was intended to minimize short-circuiting of airflow when the SVE systems were operating. The long-term land use controls for the cap/cover that must be maintained at Sites D and G (due to shallow soil contamination at Site D and the Site G dump) are addressed by Remedy Component #8.
#6	Maintain Surface Drainage Controls	Yes	Yes	Yes	1997 OU2 ROD	
#7	Characterize Shallow Soils and Dump	Yes	Yes	Yes	1997 OU2 ROD	
#8	Land Use Controls	Yes	Yes	No	1997 OU2 ROD	Implementation of the OU2 LUCRD is an ongoing requirement.
	Overall Remedy	Yes	Yes	Partially		
Operable Unit 2: Site A Shallow Groundwater						
#1	Groundwater Monitoring	Yes	Yes	No	1997 OU2 ROD	
#2	Groundwater Containment/Mass Removal	No	Not Applicable	No	1997 OU2 ROD, 2017 OU2 ROD	The groundwater extraction system was shut off on 9/24/08 and was in standby while implementation of MNA was evaluated. In late 2015, MNA was deemed an acceptable remedy, and therefore a ROD amendment was prepared in FY2017 to document the change in this remedy component. The OU2 ROD Amendment #6 was approved in FY 2018.
#3A	Land Use Controls	Yes	Yes	No	1997 OU2 ROD, OU2 ESD #1	Implementation of the OU2 LUCRD is an ongoing requirement.
#3B	Drilling Advisory/Alternate Water Supply/Well Abandonment	Yes	Yes	No	1997 OU2 ROD	
#4	Discharge of Extracted Water	No	Not Applicable	No	1997 OU2 ROD, 2017 OU2 ROD	See comment for Remedy Component #2.
#5	Source Characterization Remediation	Yes	Yes	Yes	1997 OU2 ROD	
	Overall Remedy	Yes	Yes	No	1997 OU2 ROD, OU2 ROD Amendment #6 (2018)	USEPA and MPCA have approved a formal change of the remedy to MNA. A ROD amendment was prepared and approved in FY 2018.
Operable Unit 2: Site C Shallow Groundwater						
#1	Groundwater and Surface Water Monitoring	Yes	Yes	No	OU2 ROD Amendment #1 (2007)	
#2	Groundwater Containment	No	Not Applicable	No	OU2 ROD Amendment #1 (2007)	Since the lead plume no longer extends to the extraction wells, the groundwater extraction system was shut off on 11/13/08. Future monitoring will determine whether a ROD modification will be prepared to document the change in this remedy component, or whether the Site can be closed.
#3	Discharge of Extracted Water	No	Not Applicable	No	OU2 ROD Amendment #1 (2007)	See comment for Remedy Component #2.
#4	Land Use Controls	Yes	Yes	No	OU2 ROD Amendment #1 (2007)	Implementation of the OU2 LUCRD is an ongoing requirement.
	Overall Remedy	Yes	Yes	No	OU2 ROD Amendment #1 (2007)	

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Acronyms and Abbreviations on Page 4.

	Remedy Component	Is the component being implemented?	Is the component doing what it is supposed to?	Has the component undergone final closeout?	Decision Document	Comments
Operable Unit 2: Site I Shallow Groundwater						
#1	Groundwater Monitoring	Yes	Yes	No	1997 OU2 ROD	
#2	Additional Investigation	Yes	Yes	Yes	1997 OU2 ROD, OU2 ROD Amendment #2 (2009)	
#3	Land Use Controls	Yes	Yes	No	OU2 ROD Amendment #1 (2007)	Implementation of the OU2 LUCRD is an ongoing requirement.
	Overall Remedy	Yes	Yes	No	1997 OU2 ROD	
Operable Unit 2: Site K Shallow Groundwater						
#1	Groundwater Monitoring	Yes	Yes	No	1997 OU2 ROD	
#2	Sentinel Wells	Yes	Yes	Yes	1997 OU2 ROD	
#3	Hydraulic Containment	Yes	Yes	No	1997 OU2 ROD	
#4	Groundwater Treatment	Yes	Yes	No	1997 OU2 ROD	
#5	Treated Water Discharge	Yes	Yes	No	1997 OU2 ROD	
#6	Discharge Monitoring	Yes	Yes	No	1997 OU2 ROD	
#7	Additional Investigation	Yes	Yes	Yes	1997 OU2 ROD	
#8	Land Use Controls	Yes	Yes	No	OU2 ROD Amendment #1 (2007)	Implementation of the OU2 LUCRD is an ongoing requirement.
	Overall Remedy	Yes	Yes	No	1997 OU2 ROD	
Operable Unit 2: Building 102 Shallow Groundwater						
#1	Monitored Natural Attenuation	Yes	Yes	No	OU2 ROD Amendment #4 (2012)	
#2	Groundwater Monitoring	Yes	Yes	No	OU2 ROD Amendment #4 (2012)	
#3	Land Use Controls	Yes	Yes	No	OU2 ROD Amendment #4 (2012)	Implementation of the OU2 LUCRD is an ongoing requirement.
	Overall Remedy	Yes	Yes	No	OU2 ROD Amendment #4 (2012)	
Operable Unit 2: Aquatic Sites						
#1	Pond G Surface Water Treatment	Yes	Yes	Yes	OU2 ROD Amendment #4 (2012)	
#2	Pond G Surface Water Monitoring	Yes	Yes	Yes	OU2 ROD Amendment #4 (2012)	
	Overall Remedy	Yes	Yes	Partially		
Operable Unit 2: Deep Groundwater						
#1	Hydraulic Containment and Contaminant Mass Removal	Yes	Yes	No	1997 OU2 ROD	
#2	Groundwater Treatment	Yes	Yes	No	1997 OU2 ROD	
#3	Treated Water Discharge	Yes	Yes	No	1997 OU2 ROD	
#4	Land Use Controls	Yes	Yes	No	1997 OU2 ROD	Implementation of the OU2 LUCRD is an ongoing requirement.
#5	Review of New Technologies	Yes	Yes	No	1997 OU2 ROD	Currently evaluating optimization strategies for the TGRS
#6	Groundwater Monitoring	Yes	Yes	No	1997 OU2 ROD	
	Overall Remedy	Yes	Yes	No		

Table 1-1
Status of Remedial Actions
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Acronyms and Abbreviations on Page 4.

	Remedy Component	Is the component being implemented?	Is the component doing what it is supposed to?	Has the component undergone final closeout?	Decision Document	Comments
Operable Unit 3: Deep Groundwater						
#1	Monitored Natural Attenuation	Yes	Yes	No	OU3 ROD Amendment #1 (2006)	
#2	Groundwater Monitoring	Yes	Yes	No	OU3 ROD Amendment #1 (2006)	Long-term land use controls are addressed by Remedy Component #8
#3	Drilling Advisories	Yes	Yes	No	OU3 ROD Amendment #1 (2006)	
	Overall Remedy	Yes	Yes	No	1992 OU3 ROD, OU3 ROD Amendment #1 (2006)	

Acronyms and Abbreviations:
ESD = Explanation of Significant Difference
GAC = granular activated carbon
MNA = monitored natural attenuation
MPCA = Minnesota Pollution Control Agency
NBCGRS = New Brighton Contaminated Groundwater Recovery System
OU = Operable Unit
OU2 LUCRD = Operable Unit 2 Land Use Control Remedial Design
ROD = Record of Decision
SVE = soil vapor extraction
TGRS = TCAAP Groundwater Recovery System
VOC = volatile organic compound

Table 3-1
Summary of OU1 Monitoring Requirements
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Twin Cities Army Ammunitions Plant
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Remedy Component	Monitoring Requirements	Implementing Party	Documents Containing the Monitoring Plan
#1: Alternate Water Supply / Well Abandonment	a. Water quality data for the perimeter of the plume to define the area of concern	Army	OU1 Groundwater Monitoring Plan in the Annual Performance Report
	b. Water quality data for water supply wells to determine eligibility for alternate supply/abandonment	Army	Well Inventory Report
#2: Drilling Advisories	a. Verification that drilling advisories are in place and functioning as intended	Army/MDH	N/A
#3: Extract Groundwater	a. Pumping volume and rates for each extraction well for comparison to target flowrates	New Brighton	New Brighton Water System Sampling and Analysis Plan
	b. Water levels from monitoring wells to draw contour maps, if desired	Army	OU1 Groundwater Monitoring Plan in the Annual Performance Report
#4: Removal of VOCs	a. Effluent water quality to demonstrate compliance with the Safe Drinking Water Act	New Brighton	New Brighton Water System Sampling and Analysis Plan
#5: Discharge of Treated Water	a. Verification of discharge	New Brighton	N/A
#6: Groundwater Monitoring with Verification of Continuing Aquifer Restoration	a. Water quality, to assist in evaluation of statistical improvements in groundwater quality.	Army	OU1 Groundwater Monitoring Plan in the Annual Performance Report
	b. Water quality data throughout the North Plume to evaluate remedial progress	Army	OU1 Groundwater Monitoring Plan in the Annual Performance Report

Acronyms and Abbreviations:
MDH = Minnesota Department of Health
N/A = not applicable
OU1 = Operable Unit 1
VOC = Volatile Organic Compound

Table 3-2
OU1 Groundwater Quality Data
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Twin Cities Army Ammunitions Plant
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Notes and Abbreviations on Page 2.

Sample Location	Date	Trichloroethene (µg/L)	1,1,1-Trichloroethane (µg/L)	1,4-Dioxane (µg/L)	1,1-Dichloroethene (µg/L)	cis-1,2-Dichloroethene (µg/L)	1,1,2-Trichloroethane (µg/L)	1,1-Dichloroethane (µg/L)
OU1 Cleanup Level [a]		5	200	---	6	70	3	70
MDH HRL [b]				1				
03L811	06/22/20	25.3 J+	< 1.00 U	18.1	0.478 J	0.212 J	< 1.00 UJ	0.473 J
03L822	07/06/20	129	< 1.00 U	19.8	4.31	7.06	< 1.00 U	2.54
03L832	06/26/20	< 1.00 UJ	< 1.00 U	0.652	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
03L832 (Dup)	06/26/20	5.01 J	< 1.00 U	0.633	0.288 J	0.322 J	< 1.00 U	0.236 J
03L841	06/26/20	< 1.00 UJ	< 1.00 U	3.38	< 1.00 U	0.482 J	< 1.00 UJ	0.183 J
03L846	06/26/20	1.31	< 1.00 U	17.1	7.52	23.4	< 1.00 U	12.4
03L846	06/26/20	1.51	< 1.00 U	17.9	8.71	27.3	< 1.00 U	14.4
03M843	06/22/20	< 1.00 U	< 1.00 U	15.2	< 1.00 U	< 1.00 U	< 1.00 UJ	< 1.00 U
03U811	06/16/20	< 1.00 U	< 1.00 U	11.8	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
03U821	06/22/20	10.7	< 1.00 U	14.1	0.527 J	0.812 J	< 1.00 UJ	0.512 J
03U822	07/06/20	18.5	< 1.00 U	12.2	2.01	34.3	< 1.00 U	1.79
04J822	06/22/20	1.46 J+	< 1.00 U	0.703	0.432 J	0.786 J	< 1.00 UJ	0.931 J
04J834	06/23/20	0.285 J+	< 1.00 U	< 0.444 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
04J836	07/06/20	2.85	< 1.00 U	1.91	< 1.00 U	0.151 J	< 1.00 U	0.323 J
04J837	06/29/20	0.602 J	< 1.00 U	1.04	< 1.00 U	< 1.00 U	< 1.00 UJ	0.377 J
04J838	06/29/20	63.4	1.03	4.37	3.88	3.34	< 1.00 U	2.51
04J839	07/06/20	28.6	0.479 J	7.24	2.53	0.986 J	< 1.00 U	1.91
04J847	07/01/20	525	3.32	36.4	20.6 V	5.11	< 1.00 U	20.7 V
04J849	06/16/20	1.20	0.741 J	0.542	0.712 J	< 1.00 U	< 1.00 U	0.470 J
04J882	06/23/20	< 1.00 U	< 1.00 U	< 0.472 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
04U821	06/22/20	15.9 J	< 1.00 U	14.5	0.878 J	0.548 J	< 1.00 UJ	0.967 J
04U834	06/23/20	1.13 J+	< 1.00 U	< 0.444 U	< 1.00 U	< 1.00 U	< 1.00 UJ	< 1.00 U
04U836	07/06/20	43.8	0.651 J	8.66	3.94	4.69	< 1.00 U	3.15
04U837	06/29/20	1.38	< 1.00 U	0.914	< 1.00 U	0.295 J	< 1.00 UJ	0.175 J
04U838	06/29/20	1.10	< 1.00 U	< 0.400 U	< 1.00 U	0.291 J	< 1.00 UJ	< 1.00 U
04U839	07/01/20	31.9	0.737 J	5.40	2.76	0.891 J	< 1.00 U	2.36
04U841	06/26/20	10.3	0.877 J	3.16	1.58	0.433 J	< 1.00 U	1.56
04U843	06/22/20	207	22.1	20.1	36.7	3.27	< 1.00 UJ	19.3
04U844	06/23/20	186 J+	7.97	12.7	14.7	4.20	0.192 J+	11.2
04U846	06/26/20	25.2	< 1.00 U	20.0	11.1	27.3	< 1.00 U	16.4
04U847	06/18/20	359	2.68	35.6	20.4	3.81	< 1.00 U	17.0
04U847 (Dup)	06/18/20	414	2.73	29.1	19.2	3.60	< 1.00 U	16.2
04U849	06/23/20	70.3 J+	1.95	10.9	5.25	0.792 J	< 1.00 UJ	4.10
04U850	07/06/20	22.3	0.166 J	6.46	2.64	9.08	< 1.00 U	2.74

Table 3-2
OU1 Groundwater Quality Data
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Notes and Abbreviations on Page 2.

Sample Location	Date	Trichloroethene (µg/L)	1,1,1-Trichloroethane (µg/L)	1,4-Dioxane (µg/L)	1,1-Dichloroethene (µg/L)	cis-1,2-Dichloroethene (µg/L)	1,1,2-Trichloroethane (µg/L)	1,1-Dichloroethane (µg/L)
OU1 Cleanup Level [a]		5	200	---	6	70	3	70
MDH HRL [b]				1				
04U855	07/01/20	23.3	0.366 J	5.01	1.39	0.213 J	< 1.00 U	1.21
04U871	06/18/20	16.3	0.374 J	4.31	1.19	2.15	< 1.00 U	2.66
04U872	06/16/20	7.52	0.160 J	1.26	0.527 J	1.60	< 1.00 U	0.707 J
04U875	06/19/20	< 1.00 U	< 1.00 U	< 0.400 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
04U877	06/25/20	0.417 J+	< 1.00 U	1.03	< 1.00 U	< 1.00 U	< 1.00 U	0.328 J
04U879	06/30/20	1.40	< 1.00 U	0.998	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
04U880	06/22/20	0.191 J+	< 1.00 U	< 0.444 U	< 1.00 U	< 1.00 U	< 1.00 UJ	< 1.00 U
04U881	06/23/20	15.9 J+	0.492 J	1.62	0.640 J	0.220 J	< 1.00 UJ	1.23
04U882	06/23/20	18.6 J+	0.634 J	1.68	1.11	< 1.00 U	< 1.00 U	0.767 J
04U883	06/23/20	< 1.00 UJ	< 1.00 U	< 0.472 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
200154	06/18/20	< 1.00 U	< 1.00 U	0.295 J	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
234546	07/13/20	5.51	< 1.00 UJ	0.893	0.341 J	< 1.00 UJ	< 1.00 UJ	0.435 J
409547	06/25/20	1.23	0.756 J	6.08	5.27	1.18	< 1.00 UJ	5.96
409548	06/26/20	0.551 J	< 1.00 U	1.90	0.286 J	1.89	< 1.00 U	0.369 J
409549	07/06/20	23.7	0.328 J	8.87	2.21	0.580 J	< 1.00 U	2.09
409550	07/06/20	24.7	< 1.00 U	10.2	0.503 J	0.342 J	< 1.00 U	0.663 J
409555	06/22/20	< 1.00 U	< 1.00 U	< 0.400 U	< 1.00 U	< 1.00 U	< 1.00 UJ	< 1.00 U
409556	06/30/20	< 1.00 U	< 1.00 U	< 0.472 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
409557	06/25/20	81.6 J+	3.00	9.62	15.0	4.27	< 1.00 U	10.5
512761	06/18/20	2.49	< 1.00 U	0.559	< 1.00 U	< 1.00 U	< 1.00 U	0.102 J
PJ#318	06/19/20	0.793 J	< 1.00 U	< 0.400 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
PJ#318 (Dup)	06/19/20	0.809 J	< 1.00 U	< 0.400 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U

Footnotes:

a. The cleanup level for OU1 Groundwater is from page 18 of OU1 Record of Decision. Gray shading indicates exceedance of the cleanup level.

b. No OU1 cleanup level has been established for 1,4-dioxane. For reference, the Minnesota Department of Health (MDH) Health Risk Limit (HRL) for 1,4-dioxane is 1 µg/L. Gray shading indicates exceedance of the HRL.

Acronyms and Abbreviations:

--- = no relevant cleanup level or HRL for this compound.
< X.X U = analyte was not detected above the Reporting Limit (RL)
Dup = duplicate
J = reported value is between the method detection limit and the RL
+ = reported value may have a potential positive bias
- = reported value may have a potential negative bias
V = Surrogate recovery is not within method control limits
OU = Operable Unit
µg/L = micrograms per liter

Table 3-3
Group 1, 2, 3, 5, and 6 Mann-Kendall Summary for OU1
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Notes and Abbreviations on Page 2.

Group	S Value	P Value	R^2 Value	Fraction of Detections	Results Trend	Threshold Triggered?	Comments
Group 1 NP							
Group 1 SP							
Group 2 Wells:							
409549	-2	0.443	0.0508	7 / 7	No Significant Trend	Yes	Near plume center, plume shifted slightly
409557	11	0.0680	0.0499	7 / 7	Probably Increasing Trend	Yes	Between north & south plume, lateral dispersion
03L673	-11	0.0280	0.644	6 / 6	Decreasing Trend	No	
03L833	-5	0.235	0.0328	6 / 6	No Significant Trend	Yes	TCE concentrations consistently below 5 µg/L; therefore, no significant trend not of concern.
03L848	-5	0.235	0.186	6 / 6	No Significant Trend	Yes	TCE concentrations consistently below 5 µg/L; therefore, no significant trend not of concern.
03L859	-9	0.0680	0.585	6 / 6	Probably Decreasing Trend	No	
03U805	11	0.0280	0.828	6 / 6	Increasing Trend	Yes	Southern edge of north plume, plume shifted slightly
04U673	-13	0.00830	0.712	6 / 6	Decreasing Trend	No	Near south plume center, plume shifted slightly
04U821	-12	0.0515	0.482	7 / 7	Probably Decreasing Trend	No	
04U833	-14	0.0900	0.241	8 / 9	Probably Decreasing Trend	No	
04U841	-16	0.0102	0.853	7 / 7	Decreasing Trend	No	
04U843	19	0.0116	0.666	8 / 8	Increasing Trend	Yes	Near plume center
04U845	-3	0.360	0.0202	6 / 6	No Significant Trend	Yes	Continued monitoring is appropriate to evaluate how the plume is shifting.
04U846	10	0.0935	0.356	7 / 7	Probably Increasing Trend	Yes	Near plume center, historically erratic
04U849	-6	0.274	0.00222	8 / 8	No Significant Trend	Yes	See Group 6 summary.
04U854	-9	0.0680	0.531	6 / 6	Probably Decreasing Trend	No	
04U859	-14	0.00490	0.853	6 / 6	Decreasing Trend	No	
04U875	-11	0.114	0.302	2 / 8	No Significant Trend	Yes	TCE concentrations consistently below 3 µg/L; therefore, no significant trend not of concern.
04U877	5	0.391	0.0105	12 / 12	No Significant Trend	Yes	On east plume boundary, raw trend decreasing
Group 3							
Group 5							
Group 5 Unit 3 Wells:							
409550	-11	0.114	0.164	8 / 8	No Significant Trend	Yes	Raw trend is decreasing
03L822	-19	0.0116	0.657	8 / 8	Decreasing Trend	No	
03U821	-18	0.00340	0.769	7 / 7	Decreasing Trend	No	
03U822	-6	0.236	0.458	7 / 7	No Significant Trend	Yes	Between 120 and 160 µg/L since 2003
Group 6 OU1 Jordan Wells:							
04J077	-22	0.0120	0.545	9 / 9	Decreasing Trend	No	
04J702	-12	0.0182	0.835	6 / 6	Decreasing Trend	No	
04J708	15	0.00140	0.977	6 / 6	Increasing Trend	Yes	Southern edge of north plume, plume shifted slightly
04J713	0	0.577	2010	0 / 6	--	No	All ND

Table 3-3
Group 1, 2, 3, 5, and 6 Mann-Kendall Summary for OU1
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Notes and Abbreviations on Page 2.

Group	S Value	P Value	R^2 Value	Fraction of Detections	Results Trend	Threshold Triggered?	Comments
04J822	-48	<0.001	0.800	12 / 12	Decreasing Trend	No	
Group 6 OU1 Jordan Wells Continued:							
04J834	-3	0.386	0.0164	3 / 7	No Significant Trend	Yes	TCE concentrations consistently ND or less than 1 µg/L; therefore, a no significant trend result is not of concern
04J836	12	0.0890	0.167	8 / 8	Probably Increasing Trend	Yes	Close proximity to NBCGRS wells, likely influenced by shutdown
04J837	-9	0.169	0.00263	8 / 8	No Significant Trend	Yes	Close proximity to NBCGRS wells, likely influenced by shutdown
04J838	3	0.386	0.000992	7 / 7	No Significant Trend	Yes	Close proximity to NBCGRS wells, likely influenced by shutdown
04J839	12	0.0890	0.396	8 / 8	Probably Increasing Trend	Yes	Below 5 µg/L
04J847	-24	0.0803	0.286	13 / 13	Probably Decreasing Trend	No	Near plume center
04J849	45	0.00227	0.0461	7 / 13	Increasing Trend	Yes	Below 1 µg/L
04J882	0	--	--	0 / 7	--	No	All ND
Group 6 Nested Unit 4 Wells:							
04U077	-15	0.00140	0.885	6 / 6	Decreasing Trend	No	
04U702	-13	0.00830	0.921	6 / 6	Decreasing Trend	No	Below 3 µg/L
04U708	-9	0.0680	0.659	2 / 6	Probably Decreasing Trend	No	
04U713	-5	0.235	0.264	4 / 6	No Significant Trend	Yes	TCE concentrations consistently ND or less than 1 µg/L; therefore, a no significant trend result is not of concern
04U834	-2	0.443	0.112	5 / 7	No Significant Trend	Yes	TCE concentrations consistently ND or less than 1 µg/L; therefore, a no significant trend result is not of concern
04U836	-13	0.110	0.236	8 / 9	No Significant Trend	Yes	Close proximity to NBCGRS wells, likely influenced by shutdown
04U837	1	0.500	0.00371	8 / 8	Probably Increasing Trend	Yes	Raw trend is decreasing
04U838	8	0.155	0.165	7 / 7	No Significant Trend	Yes	Below 3 µg/L since 2009
04U839	21	0.0170	0.635	9 / 9	Increasing Trend	Yes	Close proximity to NBCGRS wells, likely influenced by shutdown
04U847	-14	0.0540	0.301	8 / 8	Probably Decreasing Trend	No	Raw trend is decreasing
04U882	-10	0.0935	0.204	6 / 7	Probably Decreasing Trend	No	

General Notes:
Response Threshold triggers are defined in Table D.2.1.3.
Acronyms and Abbreviations:
ND = non-detect
NBCGRS = New Brighton Contaminated Groundwater Recovery System
OU = Operable Unit
P Value = represents uncertainty in the trend
R^2 Value = represents the fit of the data to the regression
S Value = indicates increasing (positive S) or decreasing (negative S) trend
µg/L = micrograms per liter

Table 6-1
Summary of Site A Shallow Groundwater Monitoring Requirements
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Remedy Component		Monitoring Requirements		Implementing Party	Documents Containing the Monitoring Plan
#1:	Groundwater Monitoring	a.	Outlined below		
#2:	Containment and Mass Removal	a.	None. The groundwater extraction system was shut down in September 2008 allowing implementation of Monitored Natural Attenuation (MNA) to be evaluated. In late 2015, MNA was deemed an acceptable remedy, and a Record of Decision amendment approved in FY 2018.		
#3A:	Land Use Controls	a.	None		
#3B:	Alternate Water Supply / Well Abandonment		See Operable Unit 1, Remedy Component #1 which also includes the area north of Site A		
#4:	Discharge of Extracted Water	a.	None (see #2 above)		
#5:	Source Characterization / Remediation	a.	None. volatile organic compound-contaminated soils in the source area (1945 Trench) were excavated and transported to a permitted offsite disposal facility in FY 2003.		
OR:	Overall Remedy (Attainment of Cleanup Goals)	a.	Water quality data throughout the Site A plume to evaluate attainment and to verify that Natural Attenuation is adequately controlling plume migration.	Army	Site A Monitoring Plan in the Annual Performance Report

Table 6-2
Site A Groundwater Quality Data
FY 2020 Annual Performance Report
Twin Cities Army Ammunitions Plant
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Acronyms and Abbreviations on Page 2.

Sample Location	Date	Tetrachloroethene µg/L	Trichloroethene µg/L	cis-1,2-Dichloroethene µg/L	1,1-Dichloroethene µg/L	1,2-Dichloroethane µg/L	Chloroform µg/L	Benzene µg/L	Antimony µg/L
Site A Cleanup Level [a]		7	30	70	6	4	60	10	6
01U039	06/24/20	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 5.00 U	< 1.00 U	NA
01U102	06/30/20	< 1.00 UJ	< 1.00 UJ	< 1.00 U	< 1.00 U	< 1.00 U	< 5.00 U	< 1.00 U	NA
01U103	06/22/20	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 5.00 U	< 1.00 U	5.93 J
01U103 (Dup)	06/22/20	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 5.00 U	< 1.00 U	4.85 J
01U115	06/26/20	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 5.00 U	< 1.00 U	NA
01U116	06/24/20	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 5.00 U	< 1.00 U	NA
01U117	06/29/20	3.69	< 1.00 UJ	19.2	< 1.00 U	< 1.00 U	< 5.00 U	< 1.00 U	NA
01U117 (Dup)	06/29/20	3.85	< 1.00 UJ	18.4	< 1.00 U	< 1.00 U	< 5.00 U	< 1.00 U	NA
01U126	07/06/20	< 1.00 UJ	< 1.00 UJ	< 1.00 U	< 1.00 U	< 1.00 U	< 5.00 U	< 1.00 U	NA
01U138	06/23/20	0.336 J	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 5.00 U	< 1.00 U	NA
01U139	06/26/20	< 1.00 U	0.362 J	389	0.446 J	< 1.00 U	< 5.00 U	3.53	NA
01U140	06/19/20	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 5.00 U	< 1.00 U	NA
01U157	07/06/20	< 1.00 U	< 1.00 U	1.03	< 1.00 U	< 1.00 U	< 5.00 U	< 1.00 U	NA
01U158	07/06/20	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 5.00 U	< 1.00 U	NA
01U350 [b]	06/22/20	1.12	0.203 J	< 1.00 U	< 1.00 U	< 1.00 U	< 5.00 U	< 1.00 U	NA
01U352	06/30/20	< 1.00 UJ	< 1.00 UJ	< 1.00 U	< 1.00 U	< 1.00 U	< 5.00 U	< 1.00 U	NA
01U353	06/30/20	< 1.00 UJ	< 1.00 UJ	0.497 J	< 1.00 U	< 1.00 U	< 5.00 U	< 1.00 U	NA
01U355	06/25/20	< 1.00 U	< 1.00 U	0.404 J	< 1.00 U	< 1.00 U	< 5.00 U	< 1.00 U	NA
01U356	06/19/20	< 1.00 U	< 1.00 U	5.08	< 1.00 U	< 1.00 U	< 5.00 U	< 1.00 U	NA
01U357	06/19/20	NA	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 5.00 U	< 1.00 U	NA
01U358	06/19/20	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 5.00 U	< 1.00 U	NA
01U358 (Dup)	06/19/20	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 5.00 U	< 1.00 U	NA
01U901	06/24/20	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 5.00 U	< 1.00 U	NA
01U902	06/23/20	< 1.00 U	< 1.00 U	36.6	< 1.00 U	< 1.00 U	< 5.00 U	0.686 J	< 10.0 U
01U902 (Dup)	06/23/20	< 1.00 U	0.297 J	34.3	< 1.00 U	< 1.00 U	< 5.00 U	0.799 J	NA
01U903	06/23/20	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 5.00 U	< 1.00 U	NA
01U904	06/24/20	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 5.00 U	< 1.00 U	< 10.0 U

Footnotes:

a. The cleanup level for Site A Groundwater is from Table 1 of OU2 Record of Decision. Gray shading indicates exceedance of the cleanup level.

b. 01U108 was not sampled due to an obstruction in the well. 01U350 was sampled as an alternate.

Acronyms and Abbreviations:

< X.X U = analyte was not detected above the Reporting Limit (RL)

J = reported value is between the method detection limit and the RL

NA = sample was not analyzed for compound

µg/L = micrograms per liter

Table 7-1
Summary of Site C Shallow Groundwater Monitoring Requirements
FY 2020 Annual Performance Report
Twin Cities Army Ammunitions Plant
Arden Hills, Minnesota

PIKA ARCADIS
a joint venture

Remedy Component		Monitoring Requirements		Implementing Party	Documents Containing the Monitoring Plan
#1:	Groundwater and Surface Water Monitoring	a.	Outlined below		
#2:	Groundwater Containment	a.	None. The groundwater extraction system was shut down in November 2008, since the area of groundwater that exceeded the groundwater cleanup level no longer extended to the extraction wells.		
#3:	Discharge of Extracted Water	a.	None (see #2 above)		
#4:	Land use controls to Restrict Well Installation and to Protect the Remedy Infrastructure	a.	None.		
OR:	Overall Remedy (Attainment of Cleanup Goals)	a.	Groundwater quality data throughout the Site C plume to evaluate attainment and to verify that operation of a groundwater extraction system is not required. Also surface water data in the plume vicinity to verify that groundwater does not impact surface water above surface water standards.	Army	Site C Monitoring Plan in the Annual Performance Report

Table 7-2
Water Quality Data for Site C Groundwater
FY 2020 Annual Performance Report
Twin Cities Army Ammunitions Plant
Arden Hills, Minnesota

PIKA ARCADIS
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Sample Location	Date	Lead (Dissolved) (µg/L)
Site C Cleanup Level [a]		15
01U046	06/22/20	< 6.00 U
01U561 (MW-1)	06/23/20	< 6.00 U
01U562 (MW-2)	06/23/20	< 6.00 U
01U563 (MW-3)	06/23/20	49.6
01U564 (MW-4)	06/24/20	< 6.00 U
01U564 (MW-4) Dup	06/24/20	< 6.00 U
01U567 (MW-7)	06/23/20	< 6.00 U
01U571 (MW-11)	06/23/20	< 6.00 U
01U573 (MW-13)	06/23/20	21.6
01U574 (MW-14)	06/22/20	38.1
01U575 (MW-15)	06/22/20	< 6.00 U
01U576 (MW-16)	06/23/20	< 6.00 U

Footnotes:
a. The cleanup level for Site C Groundwater is from Table 1 of OU2 Record of Decision Amendment #1. Gray shading indicates exceedance of the cleanup level.

Acronyms and Abbreviations:
< X.X U = analyte was not detected above the Reporting Limit
Dup = duplicate
OU = Operable Unit
µg/L = micrograms per liter

Sample Location	Date	Lead (Dissolved) (µg/L)
Surface Water Cleanup Level [a]		6.9
NE Wetlands	06/22/20	< 6.00 U
NE Wetlands	06/23/20	< 6.00 U
NE Wetlands	06/24/20	< 6.00 U
SW-5	06/22/20	< 6.00 U
SW-5	06/23/20	< 6.00 U
SW-5	06/24/20	< 6.00 U
SW-5 (Dup)	06/24/20	< 6.00 U
SW-6	06/22/20	< 6.00 U
SW-6	06/23/20	< 6.00 U
SW-6	06/24/20	< 6.00 U

Footnotes:

a. The cleanup level for Site C Surface Water is from Table 1 of OU2 Record of Decision Amendment #1. Gray shading indicates exceedance of the cleanup level.

Acronyms and Abbreviations:

< X.X U = analyte was not detected above the Reporting Limit

Dup = duplicate

OU = Operable Unit

µg/L = micrograms per liter

PIKA ARCADIS a joint venture

Sampling Location	Contingency Role	
	Trigger for Contingency Action [a]	Contingency Action
MW-4	If 3-event moving average > 15 µg/L	Note [c]
MW-7	If 3-event moving average > 15 µg/L	Note [c]
MW-11	If 3-event moving average > 15 µg/L	Note [c]
MW-16	If 3-event moving average > 15 µg/L	Note [c]
01U046	If 3-event moving average > 6.9 µg/L	Note [d]
NE Wetland [b]	If one sampling event > 6.9 µg/L	Note [d]
SW-5 [b]	If one sampling event > 6.9 µg/L	Note [d]
SW-6 [b]	If one sampling event > 6.9 µg/L	Note [e]

Footnotes:

a. Water quality monitoring is for dissolved lead in monitoring wells and surface water.

b. Surface water sampling is performed on three consecutive days and results are averaged for comparison to the trigger.

c. Army notify USEPA/MPCA within 1 week from receipt of data and submit an evaluation report within 30 days from notification.

d. Army notify USEPA/MPCA within 1 week from receipt of data; initiate monthly sampling of SW-5, SW-6, the NE Wetland, and the replacement wetland; and submit an evaluation report within 30 days from notification.

e. Army notify USEPA/MPCA within 1 week from receipt of data; initiate monthly sampling of SW-5, SW-6, the NE Wetland, and the replacement wetland; and submit an evaluation report within 30 days from notification. If SW-6 exceedance continues for 3 consecutive months, contain the surface water at SW-6, treat (if necessary) and discharge to sanitary sewer.

Acronyms and Abbreviations:

MPCA - Minnesota Pollution Control Agency

µg/L = micrograms per liter

USEPA - United States Environmental Protection Agency

Table 8-1

Summary of Groundwater Monitoring Requirements
Fiscal Year 2020
Site I, OU2
Arden Hills, Minnesota

Remedy Component		Monitoring Requirements		Responsible Party	Documents Containing the Monitoring Plan
#1	Groundwater Monitoring	a.	Groundwater quality and water levels to track remedy progress	Northrop Grumman	Site I Monitoring Plan in Annual Performance Report
#2	Additional Investigation	a.	None (completed)		
#3	Land Use Controls	a.	None		
OR	Overall Remedy	a.	Water quality data to evaluate attainment	Northrop Grumman	Site I Monitoring Plan in Annual Performance Report

Table 8-2

Most Recent Groundwater Quality Data (FY 2013)
Site I, OU2
Arden Hills, Minnesota

			cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Trichloroethene	Vinyl Chloride
Site I Cleanup Level[1]			70 (total)		30	0.20
Location	**Date**	**Dup**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
01U064	4/26/2013		4.2	< 1.0	0.94 JP	< 1.0
01U632	4/26/2013		27	0.35 JP	120	< 1.0
01U636	4/26/2013		< 1.0	< 1.0	< 1.0	< 1.0
01U639	4/26/2013		< 1.0	< 1.0	9.5	< 1.0
01U640	4/26/2013		< 1.0	< 1.0	< 1.0	< 1.0
I01MW	4/26/2013		< 1.0	< 1.0	0.33 JP	< 1.0
I02MW	4/26/2013		< 1.0	< 1.0	0.62 JP	< 1.0
I02MW	4/26/2013	D	< 1.0	< 1.0	0.76 JP	< 1.0
I05MW	4/26/2013		< 1.0	< 1.0	1.6	< 1.0
01U667	8/13/2013		500	1.4	4.7	300

Notes:

(1) Cleanup levels for Site I are from the OU2 Record of Decision. Shading indicates exceedance of the cleanup level.

D - Field Duplicate

JP - Result is qualified as estimated since the detection is below the laboratory quantitation limit.

µg/L - micrograms per liter

Table 9-1

Summary of Groundwater Monitoring Requirements
Fiscal Year 2020
Site K, OU2
Arden Hills, Minnesota

Remedy Component	Monitoring Requirements	Responsible Party	Documents Containing the Monitoring Plan
#1 Groundwater Monitoring	• Outlined below		
#2 Sentinel Wells	a. Water quality to monitor potential migration	Northrop Grumman	Site K Monitoring Plan in Annual Performance Report
#3 Hydraulic Containment	a. Water levels for use in drawing contour maps showing capture	Northrop Grumman	Site K Monitoring Plan in Annual Performance Report
	b. Pumping volumes and rates for reporting	Northrop Grumman	Site K Monitoring Plan in Annual Performance Report
#4 Groundwater Treatment	• None		
#5 Treated Water Discharge	• None		
#6 Discharge Monitoring	a. Treated effluent water quality for comparison to substantive requirements criteria for discharge maximum daily concentration	Northrop Grumman	Site K Monitoring Plan in Annual Performance Report
#7 Additional Investigation	a. None (completed)		

Table 9-2

Groundwater Quality Data
Fiscal Year 2020
Site K, OU2
Arden Hills, Minnesota

			cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Trichloroethene
Site K Cleanup Level[1]			**70 (Total DCE)**		**30**
Location	**Date**	**Dup**	µg/L	µg/L	µg/L
01U128	06/23/2020		< 1.00	0.212 JP	< 1.00
01U603	06/23/2020		5.83	0.478 JP	1.24
01U615	06/22/2020		1390	81.5 JP	1360
01U617	06/22/2020		2.09	0.158 JP	< 1.00
01U618	06/22/2020		0.737 JP	0.272 JP	2.57
01U621	06/23/2020		< 1.00	< 1.00	< 1.00
03U621	06/23/2020		< 1.00	< 1.00	< 1.00
03U621	06/23/2020	D	< 1.00	< 1.00	< 1.00
K04-MW (482083)	06/23/2020		< 1.00	< 1.00	0.242 JP

Notes:

(1) Cleanup levels for Site K are from the OU2 Record of Decision. Shading indicates exceedance of the cleanup level.

DEC - Dichloroethene

JP - Result is qualified as estimated since the detection is below the laboratory quantitation limit.

µg/L - micrograms per liter

Table 9-3

Groundwater Elevation Monitoring
Fiscal Year 2020
Site K, OU2
Arden Hills, Minnesota

Well ID	Groundwater Elevation (June 2019)	Groundwater Elevation (Historical Maximum)	Groundwater Elevation (June 2020)
01U047	Abandoned	875.75	Abandoned
01U048	875.85	876.61	874.17
01U052	876.71	876.64	875.89
01U065	Abandoned	874.91	Abandoned
01U128	876.91	878.33	878.33
01U601	Abandoned	886.65	Abandoned
01U602	Abandoned	886.37	Abandoned
01U603	881.40	882.86	881.27
01U604	Abandoned	879.79	Abandoned
01U605	Abandoned	879.61	Abandoned
01U607	Damaged	887.56	887.06
01U608	Abandoned	888.06	Abandoned
01U609	Abandoned	886.83	Abandoned
01U611	Abandoned	887.16	Abandoned
01U612	880.98	884.70	880.85
01U613	Abandoned	886.15	Abandoned
01U615	882.92	883.71	882.91
01U616	Abandoned	882.75	Abandoned
01U617	880.88	883.22	880.60
01U618	884.25	885.58	884.37
01U619	Abandoned	886.60	Abandoned
01U620	Abandoned	881.93	Abandoned
01U621	881.76	883.87	881.63
01U624A	Abandoned	881.66	Abandoned
01U624B	Abandoned	881.63	Abandoned
01U624C	Abandoned	881.64	Abandoned
01U624D	Abandoned	881.64	Abandoned
01U625A	881.83	883.95	881.69
01U625B	881.78	883.90	881.66
01U625C	Obstructed	887.91	Obstructed
01U625D	881.76	883.91	881.65
01U626A	881.71	882.77	881.92
01U626B	881.28	883.50	881.11
01U626C	881.28	883.58	881.11
01U626D	881.33	883.61	881.17
01U627A	882.70	883.14	883.14
01U627B	881.37	883.57	881.22
01U627C	881.29	883.56	881.13
01U627D	881.30	883.57	881.13

Table 9-3

Groundwater Elevation Monitoring
Fiscal Year 2020
Site K, OU2
Arden Hills, Minnesota

Well ID	Groundwater Elevation (June 2019)	Groundwater Elevation (Historical Maximum)	Groundwater Elevation (June 2020)
01U628A	Abandoned	880.39	Abandoned
01U628B	Abandoned	880.34	Abandoned
01U628C	Abandoned	880.25	Abandoned
01U628D	Abandoned	880.25	Abandoned
482085 (K01MW)	Abandoned	887.09	Abandoned
482084 (K02MW)	Abandoned	887.41	Abandoned
482083 (K04MW)	883.88	885.38	884.05
03U621	861.81	862.73	862.73

Note:
All elevations are in feet.

Table 9-4

Treatment System Concentrations (Organics)
Fiscal Year 2020
Site K, OU2
Arden Hills, Minnesota

			1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Trichloroethene	Vinyl chloride
	Effluent Limit(1)		**--**	**7.0**	**3.8**	**70**	**100**	**10**	**0.18**
Location	**Date**		**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
Effluent	12/04/2019		0.259 U	0.398 U	0.361 U	2.1	0.396 U	0.398 U	0.259 U
Effluent	12/04/2019	D	0.259 U	0.398 U	0.361 U	2.1	0.396 U	0.398 U	0.259 U
Effluent	03/03/2020		0.259 U	0.398 U	0.361 U	4.60	0.396 U	0.767 J	0.259 U
Effluent	03/03/2020	D	0.259 U	0.398 U	0.361 U	4.57	0.396 U	0.771 J	0.259 U
Effluent	06/22/2020		0.100 U	0.188 U	0.0819 U	1.49	0.149 U	0.265 J	0.234 U
Effluent	06/22/2020	D	0.100 U	0.188 U	0.0819 U	1.76	0.149 U	0.328 J	0.234 U
Effluent	09/15/2020		0.100 U	0.188 U	0.0819 U	0.126 U	0.149 U	0.190 U	0.234 U
Effluent	09/15/2020	D	0.100 U	0.188 U	0.0819 U	0.140 J	0.149 U	0.190 U	0.234 U
Influent	12/04/2019		0.259 U	0.398 U	0.361 U	140.0	15.1	33.2	0.965 J
Influent	03/03/2020		0.259 U	0.398 U	0.361 U	120	15.2	36.4	0.695 J
Influent	06/22/2020		0.100 U	0.262 J	0.0819 U	100	12.2	32.0	0.691 J
Influent	09/15/2020		0.100 U	0.409 J	0.0819 U	169.0	17.6	41.4	1.31

Notes:
(1) Substantive Requirement Document Concentration Limit, Maximum Daily Effluent Concentration

J - Analyte value is between the Method Detection Limit (MDL) and the Reporting Detection Limit (RDL)
U - The analyte was not detected at the MDL
D - Field Duplicate
µg/L - micrograms per liter

Table 9-5

Treatment System Concentrations (Inorganics)
Fiscal Year 2020
Site K, OU2
Arden Hills, Minnesota

			Copper	Cyanide	Lead	Mercury	Silver	Zinc	Total Phosphorus
	Effluent Limit[(1)]		21	17	106	0.20	3.4	134	1
Location	Date		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L
Effluent	12/04/2019		3.31 J	2.52 J	0.262 J	0.0490 U	0.310 U	12.6 J	0.234 B
Effluent	3/3/2020		3.85 J	1.80 U	0.495 J	0.0490 U	0.310 U	10.2 J	0.192
Effluent	6/22/2020		4.69 U	1.80 U	2.95 U	0.100 U	1.91 U	9.16 U	0.203 B
Effluent	9/15/2020		4.69 U	1.80 U	2.95 U	0.100 U	1.91 U	9.16 U	0.257

Notes:

(1) Substantive Requirement Document Concentration Limit, Maximum Daily Effluent Concentration.
J - Analyte value is between the Method Detection Limit (MDL) and the Reported Detection Limit (RDL).
B - The analyte was detected in the associated method blank
mg/L - milligrams
U - The analyte was not detected at the MDL
µg/L - micrograms per liter

Table 9-6

Summary of Monthly VOC Removal
Fiscal Year 2020
Site K, OU2
Arden Hills, Minnesota

Month	Total Monthly Flow (gallons)	Total VOC Influent (µg/L)	Total VOC Effluent (µg/L)	Total VOCs Treated (lbs)	Total VOCs Remaining (lbs)	Total VOC Mass Removed (lbs)
Cumulative as of September 30, 2019						397.1
October[1]	467,266	189.27	2.10	0.74	0.01	0.73
November[1]	491,394	189.27	2.10	0.78	0.01	0.77
December	476,296	189.27	2.10	0.75	0.01	0.74
January[1]	479,473	172.30	5.35	0.69	0.02	0.67
February[1]	418,349	172.30	5.35	0.60	0.02	0.58
March	493,128	172.30	5.35	0.71	0.02	0.69
April[1]	490,175	145.15	1.92	0.59	0.01	0.59
May[1]	491,385	145.15	1.92	0.60	0.01	0.59
June	438,440	145.15	1.92	0.53	0.01	0.52
July[1]	388,900	229.72	0.14	0.75	0.00	0.75
August[1]	326,071	229.72	0.14	0.63	0.00	0.62
September	266,256	229.72	0.14	0.51	0.00	0.51
Total - FY 2020	5,227,133					7.76
Cumulative To Date						404.9

Notes:

[1] Influent and Effluent VOC concentrations from the quarterly VOC samples collected on 12/4/2019, 3/3/2020, 6/22/2020 and 9/15/2020.
lbs - pounds
µg/L - micrograms per liter

Table 9-7

1,4-Dioxane Groundwater Sampling Results
Fiscal Year 2020
Site K, OU2
Arden Hills, Minnesota

			1,4-Dioxane
Screening Criteria (HRL)			**1.0**
Location	**Date**		**µg/L**
03U621	6/23/2020		10.9
03U621	6/23/2020	D	11.0

Notes:

D Duplicate
HRL Health Risk Limit (Minnesota Department of Health). Shading indicates exceedance of the HRL.
µg/L micrograms per liter

Table 10-1
Summary of Building 102 Shallow Groundwater Monitoring Requirements
FY 2020 Annual Performance Report
Twin Cities Army Ammunitions Plant
Arden Hills, Minnesota

PIKA ARCADIS a joint venture

Remedy Component		Monitoring Requirements		Implementing Party	Documents Containing the Monitoring Plan
#1:	Monitored Natural Attenuation (abiotic degradation)	a.	Outlined below		
#2:	Groundwater Monitoring	a.	Outlined below		
#3:	Land Use Controls to Restrict Well Installation and to Protect the Remedy Infrastructure	a.	None.		
OR:	Overall Remedy (Attainment of Cleanup Goals)	a.	Groundwater quality data throughout the Building 102 plume to evaluate attainment and to verify that groundwater reaching Rice Creek does not exceed state surface water standards.	Army	Building 102 Monitoring Plan in the Annual Performance Report

Table 10-2
Building 102 Groundwater Quality Data
FY 2020 Annual Performance Report
Twin Cities Army Ammunitions Plant
Arden Hills, Minnesota

PIKA ARCADIS a joint venture

Sample Location	Date	Trichloroethene (µg/L)	cis-1,2-Dichloroethene (µg/L)	1,1-Dichloroethene (µg/L)	Vinyl Chloride [b] (µg/L)
Building 102 Cleanup Level [a]		5	70	6	0.18
01L581	06/24/20	7.05 J+	4.24	< 1.00 U	< 1.00 U
01L582	06/25/20	< 1.00 U	8.39	< 1.00 UJ	< 1.00 U
01L582 (Dup)	06/25/20	< 1.00 U	8.16 J-	< 1.00 UJ	< 1.00 U
01L583	06/24/20	< 1.00 UJ	< 1.00 U	< 1.00 U	< 1.00 U
01L584	06/24/20	14.9 J+	11.3	< 1.00 U	0.322 J
01U048	06/24/20	< 1.00 UJ	< 1.00 U	< 1.00 U	< 1.00 U
01U579	06/24/20	0.550 J-	0.187 J-	< 1.00 UJ	< 1.00 UJ
01U580	06/25/20	0.227 J-	0.237 J-	< 1.00 UJ	< 1.00 UJ
01U581	06/24/20	22.0 J+	30.9	< 1.00 U	< 1.00 U
01U582	06/25/20	< 1.00 UJ	1.47 J-	< 1.00 UJ	< 1.00 UJ
01U583	06/24/20	< 1.00 UJ	< 1.00 U	< 1.00 U	< 1.00 U
01U584	06/25/20	5.72	4.30	< 1.00 UJ	0.265 J

Footnotes:

a. The cleanup level for Building 102 Groundwater is from page 2-13 of OU2 Record of Decision Amendment #4. Gray shading indicates exceedance of the cleanup level.

b. The Pace (TN) reporting limit (RL) for vinyl chloride of 1 µg/L does not meet the project reporting limit goal of 0.1/0.09 µg/L. The method detection limit (MDL) for vinyl chloride is 0.3 µg/L, which is approximately equal to the Cleanup Level/Action Level, and Pace (TN) reports detections between the MDL and RL. Per the 2020 QAPP(rev18) the Pace (TN) RL of 1 µg/L is considered acceptable for the project at this time.

Acronyms and Abbreviations:

< X.X U = analyte was not detected above the indicated Reporting Limit
+ = reported value may have a potential positive bias
- = reported value may have a potential negative bias
Dup = duplicate
J = reported value is between the MDL and the RL
NA = sample not analyzed for this compound
OU = Operable Unit
µg/L = micrograms per liter
UJ = The analyte was not detected above the MDL. However the MDL is approximate and may or may not represent the actual MDL

Table 12-1

Groundwater Cleanup Levels
TGRS, OU2
Arden Hills, Minnesota

Substance	Expected Level in Discharge (ppb)	Operable Unit 2 Rod Requirements (ppb)
Volatile Organic Compounds (VOCs)		
cis-1,2-Dichloroethene plus trans-1,2-Dichloroethene	<1.0	70
1,1-Dichloroethene	<1.0	6.0
1,1,1-Trichloroethane	<1.0	200
1,2-Dichloroethane	<1.0	4.0
Trichloroethene	<5.0	5.0
1,1-Dichloroethane	<1.0	70
Tetrachloroethene	<1.0	5.0

Notes:
ppb - parts per billion

Table 12-2

Extraction Well Water Pumped
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

	Volume of Water Pumped (gallons)												
	B1	**B3**	**B4**	**B5**	**B6**	**B8**	**B9**	**B11**	**B13**	**SC1**	**SC2**	**SC5**	**Total**
October 2019	11,483,100	1,932,100	11,977,400	14,273,500	9,469,400	2,235,400	4,390,600	0	5,027,200	856,000	0	4,067,900	65,712,600
(gpm)	256	42	267	319	211	49	97	0	112	19	0	91	1,464
November 2019	9,987,600	8,055,500	11,019,000	11,528,700	9,063,500	6,377,800	12,115,100	0	4,525,400	866,100	0	4,447,800	77,986,500
(gpm)	232	187	256	269	211	149	282	0	105	20	0	103	1,814
December 2019	10,167,200	8,224,500	11,247,500	14,075,900	9,300,700	6,829,300	12,476,800	0	4,643,400	876,300	0	4,589,600	82,431,200
(gpm)	228	185	253	315	209	154	280	0	104	20	0	103	1,851
January 2020	10,058,100	7,802,000	11,172,700	14,876,200	9,103,800	6,711,100	12,435,200	0	4,655,000	865,100	0	4,593,500	82,272,700
(gpm)	225	175	250	333	204	150	279	0	104	19	0	103	1,842
February 2020	9,316,500	7,087,500	9,777,800	13,903,500	8,311,600	6,120,400	11,532,600	0	4,324,500	767,900	0	4,322,500	75,464,800
(gpm)	224	170	235	334	200	147	277	0	104	18	0	104	1,812
March 2020	9,801,600	7,596,300	10,467,200	14,901,300	9,120,900	6,733,900	12,374,300	0	4,773,900	840,000	0	4,368,000	80,977,400
(gpm)	219	169	233	332	203	150	276	0	107	19	0	98	1,806
April 2020	9,609,600	7,830,400	9,954,000	14,065,300	8,711,000	6,501,300	11,844,000	0	4,574,100	810,000	0	4,070,600	77,970,300
(gpm)	223	182	231	327	202	151	275	0	106	19	0	94	1,811
May 2020	9,906,300	7,724,600	10,317,500	14,521,000	9,390,600	6,725,600	12,312,800	0	4,750,200	812,800	0	3,985,300	80,446,700
(gpm)	221	173	231	325	210	150	275	0	106	18	0	89	1,798
June 2020	9,451,700	7,394,500	10,038,900	14,082,400	9,208,600	6,526,700	12,007,900	0	4,522,500	791,200	0	4,113,000	78,137,400
(gpm)	219	171	233	327	214	152	279	0	104	18	0	94	1,811
July 2020	9,013,100	7,661,900	9,441,900	13,531,500	8,805,800	6,526,400	10,512,100	0	4,346,800	722,400	0	3,372,300	73,934,200
(gpm)	203	172	212	304	198	147	235	0	98	16	0	76	1,662
August 2020	9,142,400	6,738,300	8,270,400	11,436,500	7,891,000	6,182,600	11,555,800	0	4,413,100	709,600	0	3,357,000	69,696,700
(gpm)	207	153	188	261	179	141	262	0	100	16	0	76	1,583
September 2020	8,144,300	6,115,400	12,320,600	14,073,900	9,421,900	6,497,000	10,329,700	0	4,326,400	707,900	0	3,326,600	75,263,700
(gpm)	189	140	286	327	217	150	239	0	99	16	0	76	1,739
Total FY 2020	**116,081,500**	**84,163,000**	**126,004,900**	**165,269,700**	**107,798,800**	**73,967,500**	**133,886,900**	**0**	**54,882,500**	**9,625,300**	**0**	**48,614,100**	**920,294,200**
Operational Minimum (gpm)	225	170	195	195	210	135	275	80	110	20	30	100	1,745

	B1, B11, B13	**B4, B5, B6**	**B4, B5, B6, B8, B9**	**Total System**
FY20 Average Flow Rate (gpm)	325	759	1,155	1,751
MOS Operational Minimum (gpm)	415	600	1,010	1,745

Table 12-3

Historic Treatment Center Water Meter Totals
TGRS, OU2
Arden Hills, Minnesota

	Volume of Water Pumped (gallons)									
	Extraction Wells	Meter 1	Meter 2	Total Meters 1 & 2	Meter 3	Meter 4	Total Meters 3 & 4	Meter 5	Meter 6	Total Meters 5 & 6
FY 1989	1,033,353,676	501,826,000	560,836,000	1,062,662,000	383,736,000	587,596,000	971,332,000	493,681,000	582,955,000	1,076,636,000
FY 1990	1,008,415,750	493,915,000	526,417,000	1,020,332,000	371,391,000	588,642,000	960,033,000	487,946,000	543,726,000	1,031,672,000
FY 1991	1,382,327,590	666,166,000	708,313,000	1,374,479,000	523,702,000	789,947,000	1,313,649,000	601,307,000	649,621,000	1,250,928,000
FY 1992	1,401,346,600	68,289,000	724,328,000	1,407,227,000	557,169,000	772,509,000	1,329,678,000	767,707,000	677,735,000	1,445,442,000
FY 1993	1,388,206,172	666,814,000	725,341,000	1,392,155,000	504,027,000	651,149,000	1,155,176,000	729,078,000	762,791,000	1,491,869,000
FY 1994	1,245,663,275	660,700,000	659,953,000	1,320,653,000	457,210,000	715,668,000	1,172,878,000	653,913,000	550,131,000	1,204,044,000
FY 1995	1,369,361,500	706,114,000	683,982,000	1,390,096,000	500,275,000	739,744,000	1,240,019,000	495,616,000	274,507,000	770,123,000
FY 1996	1,341,763,220	734,443,000	629,327,000	1,363,770,000	503,518,000	754,399,000	1,257,917,000	4,000	600,035,000	600,039,000
FY 1997	1,213,035,110	688,312,000	568,804,600	1,257,116,600	538,625,000	586,515,000	1,125,140,000	13,000	578,900,000	578,913,000
FY 1998	1,196,007,900	624,784,000	540,353,000	1,220,604,000	511,065,000	603,871,000	1,114,936,000	58,000	178,076,000	178,134,000
FY 1999	1,158,224,870	623,500,000	496,773,200	1,177,206,200	398,620,000	718,384,000	1,117,004,000	26,000	17,000	43,000
FY 2000	1,148,448,350	635,724,000	489,669,000	1,183,258,000	389,709,000	663,807,000	1,053,516,000	0	0	0
FY 2001	1,113,163,360	614,341,000	443,167,000	1,113,164,000	318,517,000	718,661,000	1,037,178,000	0	0	0
FY 2002	917,318,879	491,082,800	434,959,700	926,042,500	225,460,000	650,839,000	876,299,000	0	0	0
FY 2003	904,295,450	545,281,000	345,993,000	891,274,000	125,965,000	750,518,000	876,483,000	0	0	0
FY 2004	908,718,760	518,391,900	376,889,660	895,281,560	216,177,000	680,633,000	896,810,000	0	0	0
FY 2005	895,339,710	520,073,000	363,275,000	883,348,000	224,823,000	658,405,000	883,228,000	0	0	0
FY 2006	929,715,590	534,305,000	377,499,000	911,804,000	266,299,000	669,900,000	936,199,000	0	0	0
FY 2007	945,317,300	447,901,000	487,701,000	935,602,000	281,061,000	833,161,000	1,114,222,000	0	0	0
FY 2008	943,318,161	424,289,615	512,634,095	936,923,709	217,134,430	778,717,620	995,852,050	0	0	0
FY 2009	925,232,745	357,698,000	552,505,000	910,203,000	173,004,000	795,057,000	968,061,000	0	0	0
FY 2010	933,789,205	368,260,000	556,160,000	924,420,000	61,957,000	894,152,000	956,109,000	0	0	0
FY 2011	952,379,000	183,460,000	268,747,000	452,207,000	15,479,000	890,850,000	906,329,000	0	0	0
FY 2012	964,996,900	0	0	0	695,000	848,465,000	849,160,000	0	0	0
FY 2013	924,550,600	0	0	0	5,503,000	883,772,000	891,338,000	0	0	0
FY 2014	937,934,854	0	0	0	3,956,000	895,176,000	899,132,000	0	0	0
FY 2015	920,197,600	0	0	0	8,122,000	724,325,000	732,447,000	0	0	0
FY 2016	907,577,164	0	0	0	7,145,000	690,956,000	698,101,000	0	0	0
FY 2017	929,926,100	0	0	0	2,349,000	525,834,000	528,183,000	0	0	0
FY 2018	917,437,500	0	0	0	143,000	581,946,000	582,089,000	0	0	0
FY 2019	931,962,300	0	0	0	246,000	5,146,000	5,392,000	0	0	0
FY 2020	920,294,200	0	0	0	2,853,000	0	2,853,000	0	0	0

Table 12-4

Pumphouse Down Time
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

Well Name	FY20 Down Time (Days)	FY19 Down Time (Days)	FY18 Down Time (Days)	FY17 Down Time (Days)	FY16 Down Time (Days)
B1	10.4	11.4	10.9	3.3	4.2
B2	(1)	(1)	(1)	(1)	(1)
B3	31.6	3.9	3.6	3.7	9.7
B4	10.2	0.8	13.8	3.3	6.5
B5	9.4	0.8	32.0	4.0	9.1
B6	9.9	4.5	17.9	8.7	7.8
B7	(1)	(1)	(1)	(1)	(1)
B8	26.5	16.8	8.1	7.1	8.9
B9	28.6	10.8	14.8	11.2	21.7
B10	(1)	(1)	(1)	(1)	(1)
B11	(1)	(1)	(1)	(1)	(1)
B12	(1)	(1)	(1)	(1)	(1)
B13	8.6	2.1	18.8	4.3	3.9
SC1	8.5	2.9	6.2	3.9	10.7
SC2	(1)	(1)	25.2	3.7	81.3
SC3	(1)	(1)	(1)	(1)	(1)
SC4	(1)	(1)	(1)	(1)	(1)
SC5	8.8	6.6	4.3	20.2	11.7

Note:
(1) The extraction well was not in operation during the fiscal year.

Table 12-5

Down Time By Category
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

Category	**Down Time (Days)**
Pumphouse Component	1.4
Treatment Center Component	0.2
Electrical Service	2.6
Miscellaneous	0.0
Preventive Maintenance	6.4
System Modification	4.6
Forcemain	0.1
Total System Equivalent	15.3
Anticipated Down Time for Fiscal Year 2021	
Pumphouse Component	4.0
Treatment Center Component	1.5
Electrical Service	2.0
Miscellaneous	1.0
Preventive Maintenance	1.0
System Modification	0.5
Forcemain	1.0

Table 12-6

VOC Mass Loading Summary
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

Well	Percent Contribution to VOC Mass Removal	FY 2020 Total Pounds VOCs Mass Removed
B1	3.5%	70.3
B2[1]	0.0%	0.00
B3	0.1%	2.55
B4	4.2%	83.8
B5	5.5%	109.7
B6	1.3%	25.7
B7[1]	0.0%	0.00
B8	0.2%	5.01
B9	1.8%	36.2
B10[1]	0.0%	0.00
B11[1]	0.0%	0.00
B12[1]	0.0%	0.00
B13	2.1%	42.4
SC1	8.0%	162
SC2[1]	0.0%	0.00
SC3[1]	0.0%	0.00
SC4[1]	0.0%	0.00
SC5	73.3%	1,475
Fiscal Year 2020 Total (lbs)		**2,013**
Daily Average (lbs/day)		**5.5**

Notes:

[1] Extraction well was not in operation during the fiscal year.

Table 12-6

VOC Mass Loading Summary
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

Historical Total

Fiscal Year		Pounds VOC Mass Removed
2020		2,013
2019		1,807
2018		1,911
2017		1,988
2016		1,731
2015		1,748
2014		2,020
2013		2,082
2012		1,801
2011		1,834
2010		2,096
2009		2,167
2008		2,292
2007		2,507
2006		2,552
2005		2,663
2004		3,291
2003	(First year of reconfigured system)	3,041
2002		2,852
2001		3,418
2000		4,499
1999		4,878
1998		6,132
1997		6,210
1996		10,655
1995		13,355
1994		15,070
1993		20,165
1992		24,527
1991		26,760
1990		18,005
1989	(First year of full scale system)	19,510
1988		4,800
1987		2,100
Total		**222,480**

Table 12-7

VOC Concentrations in TGRS Extraction Well Samples
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

Location	Alias	Date	Dup	1,1,1-Trichloroethane ug/L	1,1-Dichloroethane ug/L	1,1-Dichloroethene ug/L	1,2-Dichloroethane ug/L	cis-1,2-Dichloroethene ug/L	Tetrachloroethene ug/L	Trichloroethene ug/L
03F302	B1	12/04/2019		3.8 JP	< 1.0	2.4 JP	< 1.0	3.3	1.5	58.3
03F302	B1	6/24/2020		4.10	0.510 JP	1.09	< 1.00	3.64	< 1.90 UB0.394	81.2
03F302	B1	6/24/2020	D	3.90	0.665 JP	0.680 JP	< 1.00	3.60	2.12	78.0
03F303	B2	6/24/2020		< 1.00	< 1.00	0.831 JP	< 1.00	1.02	< 1.30 UB0.394	28.8
03F304	B3	12/04/2019		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	2.69
03F304	B3	6/24/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	2.50
03F305	B4	12/04/2019		5.49 JMS152/150	2.31	2.46 JMS126/131	< 1.00	1.67 JMS127	< 1.00	74.2
03F305	B4	6/24/2020		4.84	2.17	1.27	< 1.00	1.21	< 1.00 UB0.394	79.7
03F306	B5	12/04/2019		2.86 JP	2.19	2.80	< 1.00	1.08	4.93	71.8
03F306	B5	12/04/2019	D	2.85 JP	2.00	2.60	< 1.00	1.01	4.98	70.2
03F306	B5	6/24/2020		2.33	2.53	2.07	< 1.00	0.849 JP	4.82	80.8
03F307	B6	12/04/2019		0.483 JP	0.298 JP	0.476 JP	< 1.00	< 1.00	< 1.00	28.4
03F307	B6	6/24/2020		0.427 JP	0.243 JP	0.332 JP	< 1.00	< 1.00	< 1.00	27.5
03F308	B7	6/24/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	2.30
03F312	B11	6/24/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	5.22
03F319	B13	12/04/2019		3.93 JP	0.998 JP	0.955 JP	< 1.00	6.52	< 1.00	88.6
03F319	B13	6/24/2020		3.48	1.10	0.880 JP	< 1.00	5.22	< 1.00 UB0.394	95.5
03U301	SC1	12/04/2019		47.9 JP	5.87	7.25	< 1.00	159	0.496 JP	2250
03U301	SC1	6/9/2020		29.2 JP	4.83	6.45	< 1.00	147	0.575 JP	1710
03U315	SC3	6/22/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
03U316	SC4	6/22/2020		0.159 JP JL125	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	3.18
03U317	SC5	12/04/2019		770	25.5	53.6	1.77	9.24	7.22	3070
03U317	SC5	6/9/2020		856	20.8	49.5	1.40	11.8	6.51	3210
PJ#309	B8	12/04/2019		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	6.95
PJ#309	B8	6/24/2020		< 1.00	< 1.00	0.463 JP	< 1.00	< 1.00	< 1.00	7.33
PJ#310	B9	12/04/2019		1.26 JP	1.21	1.64	< 1.00	0.657 JP	< 1.00	31.2
PJ#310	B9	6/24/2020		0.964 JP	1.21	1.10	< 1.00	0.503 JP	< 1.00	30.5
PJ#311	B10	6/24/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	0.383 JP
PJ#313	B12	6/24/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00

Notes:

D	- Field Duplicate
JP	- Result is qualified as estimated since the detection is below the laboratory reporting limit.
JL#	- Result is qualified as estimated due to outlying LCS recovery. The following numerical value is the associated %LCS recovery.
JMS#	- Result is qualified as estimated due to outlying MS recovery. The following numerical value is the associated % MS recovery.
UB#	- Result is qualified as non-detect based on a associated blank detection. The following numerical value is the blank concentration.

Table 12-8

Groundwater Quality Data
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

			1,1,1-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene
TGRS Cleanup Level (1)			200	70	6	4	70	5	5
Location	Date	Dup	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
03L002	6/10/2020		0.477 JP	0.533 JP	0.968 JP	< 1.00	0.164 JP	< 1.00	12.8
03L007	6/15/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
03L014	6/17/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
03L017	6/15/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	0.275 JP
03L018	6/17/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
03L020	6/05/2020		0.316 JP	0.189 JL129130	< 1.00	< 1.00	0.189 JP	< 1.00	6.64
03L021	6/15/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	1.56
03L077	6/08/2020		1.28	0.190 JP	0.933 JP	< 1.00	0.163 JP	< 1.00	23.1
03L078	6/10/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
03L079	6/10/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	0.867 JP
03L802	6/11/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	1.36
03L806	6/11/2020		0.871 JP	0.146 JP	0.289 JP	< 1.00	< 1.00	< 1.00	28.6
03L809	6/16/2020		2.46	1.29	2.01	< 1.00	1.07	< 1.00	133
03L833	6/16/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	1.58
03L833	6/16/2020	D	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	1.46
03M002	6/10/2020		0.587 JP	1.91	1.70	< 1.00	0.598 JP	< 1.00	21.7
03M020	6/05/2020		1.51	0.481 JL129130	0.385 JP	< 1.00	0.177 JP	< 1.00	20.1
03M802	6/11/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	6.13
03M806	6/11/2020		0.851 JP	41.1	30	< 1.00	9.66	< 1.00	390
03M806	6/11/2020	D	0.843 JP	40.6	29.8	< 1.00	9.20	< 1.00	400
03U002	6/18/2020		2.34	0.254 JP	0.687 JP	< 1.00	0.520 JP	< 1.00	14.5
03U003	6/12/2020		3.52	1.27	1.44	< 1.00	1.96	< 1.00	34.5
03U003	6/12/2020	D	3.45	1.30	1.42	< 1.00	2.15	< 1.00	36.6
03U005	6/15/2020		< 1.00	0.182 JL130	< 1.00	< 1.00	0.412 JP	< 1.00	< 1.00
03U007	6/15/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
03U009	6/18/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
03U014	6/17/2020		120	2.62	3.82	< 1.00	1.88	< 1.00	176
03U017	6/15/2020		0.967 JP	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	1.32
03U017	6/15/2020	D	0.988 JP	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	1.31
03U018	6/17/2020		14.7	0.460 JP	1.32	< 1.00	7.61	< 1.00	27.5
03U018	6/17/2020	D	14.3	0.498 JP	1.25	< 1.00	7.13	< 1.00	26.8
03U020	6/05/2020		19.4	2.52 JL129130	3.51	< 1.00	2.10	< 1.00	71.5
03U021	6/15/2020		6.38	4.02 JL130	3.26	< 1.00	3.00	< 1.00	117
03U027	6/15/2020		0.396 JP	< 1.00	0.300 JP	< 1.00	0.861 JP	< 1.00	10.7
03U028	6/12/2020		0.229 JP	< 1.00	< 1.00	< 1.00	0.653 JP	< 1.00	17.1
03U029	6/12/2020		0.726 JP	0.183 JP	< 1.00	< 1.00	0.710 JP	< 1.00	9.13
03U030	6/15/2020		< 1.00	< 1.00	< 1.00	< 1.00	0.267 JP	< 1.00	7.44
03U032	6/17/2020		0.226 JP	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	0.242 JP
03U077	6/08/2020		0.595 JP	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	9.85
03U078	6/10/2020		1.80	< 1.00	0.721 JP	< 1.00	1.41	13.7	51.3
03U079	6/10/2020		6.44	0.338 JP	1.17	< 1.00	1.49	< 1.00	63.8
03U092	6/18/2020		0.483 JP	< 1.00	< 1.00	< 1.00	0.845 JP	< 1.00	8.81
03U092	6/18/2020	D	0.568 JP	< 1.00	< 1.00	< 1.00	0.883 JP	< 1.00	9.24
03U093	6/17/2020		84.6	0.765 JP	5.67	< 1.00	4.88	< 1.00	156
03U094	6/09/2020		168	7.68	4.48	< 1.00	13.1	< 1.00	278
03U096	6/17/2020		6.93	0.402 JP	1.02	< 1.00	< 1.00	< 1.00	19.7
03U099	6/16/2020		0.534 JP	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	1.71

Table 12-8

Groundwater Quality Data
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

			1,1,1-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene
TGRS Cleanup Level (1)			200	70	6	4	70	5	5
Location	Date	Dup	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
03U114	6/17/2020		0.723 JP	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	4.54
03U659	6/12/2020		45.8	8.49	6.92	< 1.00	117	0.370 JP	695
03U671	6/18/2020		2.58	< 1.00	0.946 JP	< 1.00	0.412 JP	27.2	49.9
03U677	6/24/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
03U701	6/08/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	0.894 JP
03U702	6/08/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	0.578 JP
03U703	6/05/2020		0.714 JP	< 1.00	< 1.00	< 1.00	0.161 JP	4.01	8.22
03U708	6/10/2020		1.37	< 1.00	0.309 JP	< 1.00	0.241 JP	6.63	25.3
03U709	6/09/2020		4.51	0.575 JP	1.36	< 1.00	0.820 JP	< 1.00	28.9
03U710	6/24/2020		1.51	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	31.5
03U711	6/16/2020		3.34	0.627 JP	1.40	< 1.00	0.563 JP	0.739 JP	28.5
03U715	6/18/2020		2.15	0.102 JP	0.260 JP	< 1.00	< 1.00	< 1.00	15.6
03U801	6/11/2020		< 1.00	< 1.00	< 1.00	< 1.00	0.309 JP	< 1.00	15.0
03U803	6/18/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	0.315 JP
03U804	6/11/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	0.426 JP
03U805	6/16/2020		0.616 JP	10.7	13.7	0.181 JP	6.34	2.99	94.0
03U806	6/11/2020		< 1.00	0.516 JP	0.286 JP	< 1.00	< 1.00	0.521 JP	33.3
04J077	6/09/2020		0.873 JP	1.66	1.96	< 1.00	0.695 JP	< 1.00	57.3
04J708	6/10/2020		0.761 JP	1.25	0.697 JP	< 1.00	0.216 JP	< 1.00	8.73
04J713	6/08/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
04U002	6/10/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	0.815 JP
04U002	6/10/2020	D	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	0.818 JP
04U007	6/15/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
04U020	6/05/2020		< 1.00	0.212 JL129130	< 1.00	< 1.00	< 1.00	< 1.00	1.67
04U020	6/05/2020	D	< 1.00	0.225 JL129130	< 1.00	< 1.00	< 1.00	< 1.00	1.67
04U077	6/09/2020		1.24	0.382 JP	1.28	< 1.00	0.529 JP	< 1.00	31.3
04U510	6/16/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	0.238 JP
04U701	6/08/2020		0.181 JP	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	2.79
04U701	6/08/2020	D	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	2.74
04U702	6/08/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	1.02
04U708	6/10/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
04U709	6/09/2020		< 1.00	0.204 JP	0.200 JP	< 1.00	< 1.00	< 1.00	5.43
04U711	6/16/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	0.287 JP
04U713	6/08/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	0.351 JP
04J702	6/08/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	0.909 JP
04U802	6/11/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	0.381 JP
04U806	6/11/2020		0.687 JP	0.820 JP	0.870 JP	< 1.00	0.315 JP	< 1.00	35.1
04U833	6/16/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	0.481 JP
PJ#806	6/11/2020		0.176 JP	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	12.3

Notes:

(1) - Cleanup levels for TGRS are from the OU2 ROD. Shading indicates exceedance of the cleanup level.
D - Field Duplicate
JP - Result is qualified as estimated since the detection is below the laboratory reporting limit.
JL# - Result is qualified as estimated due to outlying LCS recovery or recoveries. The following numerical value is the associated % LCS recovery or recoveries.

Table 12-9

Summary Of OU2 Deep Groundwater Monitoring Requirements
TGRS, OU2
Arden Hills, Minnesota

Remedy Component	Monitoring Requirements	Implementing Party	Documents Containing the Monitoring Plan
#1 Hydraulic Containment and Mass Removal	a. Water levels to draw contour maps showing hydraulic zone of capture	Northrop Grumman/Army	Deep groundwater monitoring plan in Annual Report
	b. Pumping volumes and rates for comparison to design rates	Northrop Grumman/Army	Deep groundwater monitoring plan in Annual Report
	c. Influent and extraction well water quality for overall mass removal calculations	Northrop Grumman/Army	Deep groundwater monitoring plan in Annual Report
#2 Groundwater Treatment	• Outlined below		
#3 Treated Water Discharge	• Effluent monitoring to verify attainment of treatment requirements	Northrop Grumman/Army	Deep groundwater monitoring plan in Annual Report
#4 Land Use Controls	• None		
#5 Review of New Technologies	• None		
#6 Groundwater Monitoring	a. Water levels to draw contour maps showing hydraulic zone of capture	Northrop Grumman/Army	Deep groundwater monitoring plan in Annual Report
	b. Groundwater quality to verify attainment of clean up goals	Northrop Grumman/Army	Deep groundwater monitoring plan in Annual Report
Overall Remedy	a. Groundwater quality to verify attainment of clean up goals	Northrop Grumman/Army	Deep groundwater monitoring plan in Annual Report

Table 12-10

1,4-Dioxane Concentrations in Extraction Wells
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

				1,4-Dioxane
		Screening Criteria (HRL)		**1.0**
Location	**Alias**	**Date**	**Dup**	**µg/L**
03F302	B1	06/24/2020		2.76
03F302	B1	06/24/2020	D	2.94
03F303	B2	06/24/2020		0.513
03F304	B3	06/24/2020		7.35
03F305	B4	06/24/2020		26.4
03F306	B5	06/24/2020		16.1
03F307	B6	06/24/2020		14.1
03F308	B7	06/24/2020		15.9
PJ#309	B8	06/24/2020		12.9
PJ#310	B9	06/24/2020		16.2
PJ#311	B10	06/24/2020		16.0
03F312	B11	06/24/2020		1.35
PJ#313	B12	06/24/2020		10.8
03F319	B13	06/24/2020		8.69
03U301	SC1	06/09/2020		18.2
03U315	SC3	06/22/2020		11.5
03U316	SC4	06/22/2020		13.8
03U317	SC5	06/09/2020		12.9
TGRSE		06/24/2020		14.5
TGRSI		06/24/2020		14.5
TGRSI		06/24/2020	D	13.9

Notes:

HRL - Health Risk Limit (Minnesota Department of Health).
Shading indicates exceedance of the HRL

D - Field Duplicate

Table 12-11

1,4-Dioxane Concentrations in Monitoring Wells
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

			1,4-Dioxane
Screening Criteria (HRL)			1.0
Location	**Date**	**Dup**	**µg/L**
03L002	06/10/2020		14.3
03L007	06/15/2020		< 0.400
03L014	06/17/2020		11.5
03L017	06/15/2020		14.7
03L018	06/17/2020		13.6
03L020	06/05/2020		11.0
03L021	06/15/2020		10.7
03L077	06/08/2020		15.4
03L078	06/10/2020		2.86
03L079	06/10/2020		1.25
03L802	06/11/2020		0.652
03L806	06/11/2020		15.7
03L809	06/16/2020		18.1
03L833	06/16/2020		16.0
03L833	06/16/2020	D	16.0
03M002	06/10/2020		14.7
03M020	06/05/2020		12.7
03M802	06/11/2020		< 0.400
03M806	06/11/2020		18.9
03M806	06/11/2020	D	18.0
03U002	06/18/2020		4.98
03U003	06/12/2020		0.514
03U003	06/12/2020	D	0.424
03U005	06/15/2020		< 0.400
03U007	06/15/2020		< 0.400
03U009	06/18/2020		< 0.400
03U014	06/17/2020		64.3

Table 12-11

1,4-Dioxane Concentrations in Monitoring Wells
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

			1,4-Dioxane
Screening Criteria (HRL)			**1.0**
Location	**Date**	**Dup**	**µg/L**
03U017	06/15/2020		12.3
03U017	06/15/2020	D	12.1
03U018	06/17/2020		1.01
03U018	06/17/2020	D	1.02
03U020	06/05/2020		6.49
03U021	06/15/2020		62.5
03U027	06/15/2020		< 0.400
03U028	06/12/2020		< 0.400
03U029	06/12/2020		0.880
03U030	06/15/2020		< 0.400
03U032	06/17/2020		4.68
03U077	06/08/2020		10.7
03U078	06/10/2020		< 0.400
03U079	06/10/2020		< 0.400
03U092	06/18/2020		3.18
03U092	06/18/2020	D	3.33
03U093	06/17/2020		2.03
03U094	06/09/2020		130
03U096	06/17/2020		7.84
03U099	06/16/2020		0.326 JP
03U114	06/17/2020		< 0.400
03U659	06/12/2020		43.1
03U671	06/18/2020		< 0.400
03U677	06/24/2020		0.710
03U701	06/08/2020		11.2
03U702	06/08/2020		10.1
03U703	06/05/2020		< 0.400

Table 12-11

1,4-Dioxane Concentrations in Monitoring Wells
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

			1,4-Dioxane
	Screening Criteria (HRL)		1.0
Location	**Date**	**Dup**	**µg/L**
03U708	06/10/2020		0.828
03U709	06/09/2020		5.14
03U710	06/24/2020		0.870
03U711	06/16/2020		3.89
03U715	06/18/2020		7.08
03U801	06/11/2020		< 0.400
03U803	06/18/2020		< 0.400
03U804	06/11/2020		0.580
03U805	06/16/2020		7.62
03U806	06/11/2020		8.94
04J077	06/09/2020		16.6
04J708	06/10/2020		9.30
04J713	06/08/2020		9.04
04U002	06/10/2020		13.3
04U002	06/10/2020	D	12.6
04U007	06/15/2020		< 0.400
04U020	06/05/2020		11.4
04U020	06/05/2020	D	10.8
04U077	06/09/2020		17.4
04U510	06/16/2020		0.287 JP
04U701	06/08/2020		15.4
04U701	06/08/2020	D	14.8
04U702	06/08/2020		14.4
04U708	06/10/2020		7.95
04U709	06/09/2020		9.03
04U711	06/16/2020		8.63
04U713	06/08/2020		14.4

Table 12-11

1,4-Dioxane Concentrations in Monitoring Wells
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

			1,4-Dioxane
		Screening Criteria (HRL)	1.0
Location	**Date**	**Dup**	**µg/L**
04J702	06/08/2020		15.5
04U802	06/11/2020		0.869
04U806	06/11/2020		15.5
04U833	06/16/2020		15.0
PJ#806	06/11/2020		15.8

Notes:

HRL - Health Risk Limit (Minnesota Department of Health). Shading indicates exceedance of the HRL.
D - Field Duplicate
JP - Result is qualified as estimated since the detection is below the laboratory reporting limit.

Table 13-1

Groundwater Quality Data
Fiscal Year 2020
Operable Unit 3

			1,1,1-Trichloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	cis-1,2-Dichloroethene	Trichloroethene
OU3 Cleanup Level[1]			**200**	**3.0**	**70**	**6.0**	**70**	**5.0**
Location	**Date**	**Dup**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
03L673	06/04/2020		< 1.00	< 1.00	0.357 JP	0.414 JP	4.50	75.8
03L832	06/04/2020		0.878 JP	< 1.00	2.88	4.24	3.20	50.0
03L848	06/04/2020		< 1.00	< 1.00	< 1.00	< 1.00	1.58	1.59
03L854	06/03/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
03L859	06/03/2020		0.976 JP	0.183 JP	3.60	7.73	1.18	5.75
03M848	06/04/2020		< 1.00	< 1.00	0.290 JP	0.431 JP	9.65	110
03U673	06/04/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	1.31
04J866	06/03/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
04U673	06/04/2020		< 1.00	< 1.00	< 1.00	< 1.00	0.754 JP	21.4
04U845	06/03/2020		< 1.00	< 1.00	< 1.00	0.213 JP	0.462 JP	8.26
04U848	06/04/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	2.90
04U854	06/03/2020		< 1.00	< 1.00	< 1.00	< 1.00	0.321 JP	7.07
04U859	06/03/2020		1.54	< 1.00	2.12	2.89	0.874 JP	21.6
04U860	06/04/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
04U860	06/04/2020	D	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	0.192 JP
04U863	06/04/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	0.287 JP
04U866	06/03/2020		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
04U866	06/03/2020	D	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00

Notes:

(1) - Cleanup levels for OU3 are from the OU3 ROD. Shading indicates exceedance of the cleanup level.
D - Field Duplicate
JP - Result is qualified as estimated since the detection is below the laboratory quantitation limit.

Table 13-2

Mann-Kendall Statistical Summary
Fiscal Year 2020
Operable Unit 3

	Well	Kendall S	Number of Data Points	Raw Trend	Confidence	Coefficient of Variance	Raw Trend Decision	MAROS Conclusion	TRCLE Concentration 2020
Edge of Plume Wells									
	03L673	-8	6	Decreasing	89.81%	0.1997	Stable or No Trend	Stable	75.8
	03L848	-11	6	Decreasing	97.20%	0.3324	Definite	Decreasing	1.59
	04U673	-11	6	Decreasing	97.20%	0.2795	Definite	Decreasing	21.4
*	04U832	8	6	Increasing	89.81%	0.1021	Stable or No Trend	No Trend	59
	04U845	-7	6	Decreasing	86.40%	0.3080	Stable or No Trend	Stable	8.26
	04U848	-13	6	Decreasing	99.17%	0.2274	Definite	Decreasing	2.9
	04U854	-9	6	Decreasing	93.20%	0.1682	Probable	Decreasing	7.07
Center of Plume Wells									
	03L859	-6	6	Decreasing	81.46%	0.2040	Stable or No Trend	Stable	5.75
	03M848	-5	6	Decreasing	76.50%	0.0996	Stable or No Trend	Stable	110
	04U859	-14	6	Decreasing	99.51%	0.3496	Definite	Decreasing	21.6

Notes:

* - Denotes sample results collected in FY 2018

Table 13-3

Summary of Groundwater Monitoring Requirements
Operable Unit 3

	Remedy Component		Monitoring Requirements	Implementing Party	Documents Containing the Monitoring Plan
#1	Monitored Natural Attenuation		Outlined below.		
#2	Groundwater Monitoring	a.	Water levels for use in drawing contour maps.	Northrop Grumman	OU3 Monitoring Plan in Annual Report
		b.	Groundwater sampling to track progress of clean-up and attenuation of plume.	Northrop Grumman	OU3 Monitoring Plan in Annual Report
#3	Drilling Advisories	a.	Verification that drilling advisories are in place and functioning as intended.	Army/MDH	NA
OR:	Overall Remedy	a.	Water quality monitoring to verify attainment of clean-up goals.	Northrop Grumman	OU3 Monitoring Plan in Annual Report

Table 13-4

1,4-Dioxane Groundwater Sampling Results
Fiscal Year 2020
Operable Unit 3

			1,4-Dioxane
Screening Criteria (HRL)			**1.0**
Location	**Date**	**Dup**	**µg/L**
03L673	06/04/2020		2.56
03L832	06/04/2020		4.18
03L848	06/04/2020		1.11
03L854	06/03/2020		< 0.400
03L859	06/03/2020		4.22
03M848	06/04/2020		0.718
03U673	06/04/2020		< 0.400
04J866	06/03/2020		< 0.400
04U673	06/04/2020		0.908
04U845	06/03/2020		0.833
04U848	06/04/2020		1.02
04U854	06/03/2020		0.930
04U859	06/03/2020		5.00
04U860	06/04/2020		0.376 JP
04U860	06/04/2020	D	0.413
04U863	06/04/2020		< 0.400
04U866	06/03/2020		< 0.400
04U866	06/03/2020	D	< 0.400

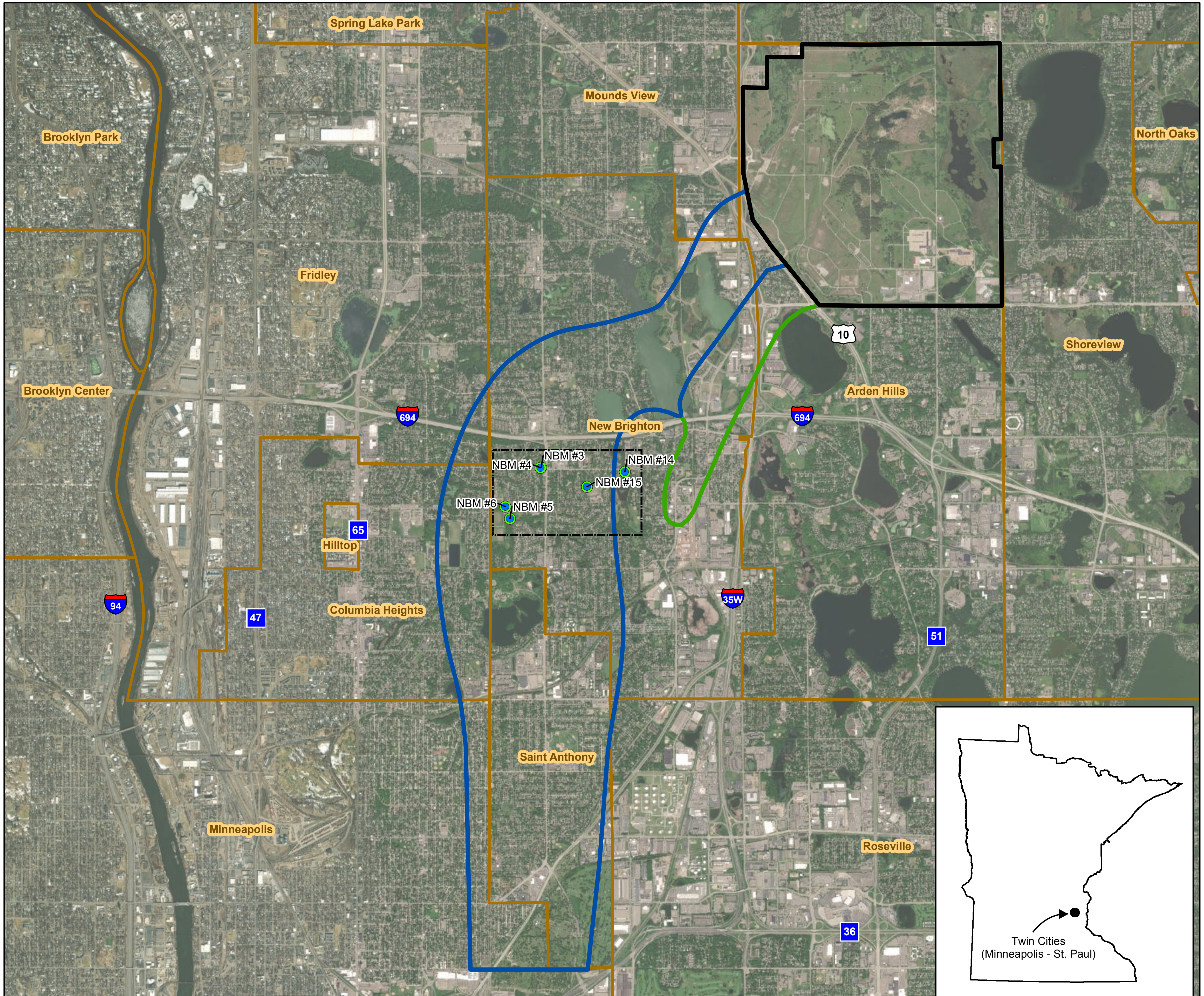
Notes:

HRL Health Risk Limit (Minnesota Department of Health). Shading indicates exceedance of the HRL.

D - Field Duplicate

JP - Result is qualified as estimated since the detection is below the laboratory reporting limit

FIGURES



LEGEND:

- Operable Unit 1 (North Plume)
- Operable Unit 2 of the New Brighton/ Arden Hills Superfund Site (the same area occupied by the Twin Cities Army Ammunition Plant in 1983, when the Site was placed on the NPL.)
- Operable Unit 3 (South Plume)
- Municipal Boundary
- New Brighton Community Groundwater Remediation System Location
- New Brighton Municipal Wells

0 4,000 8,000 Feet

GRAPHIC SCALE

NOTES:

1. Operable Unit Areas adapted from Figure 2 of the OU2 ROD.
2. 2016 Aerial Photograph (Source: DigitalGlobe, Vivid - USA)

TWIN CITIES ARMY AMMUNITION PLANT
ARDEN HILLS, MINNESOTA

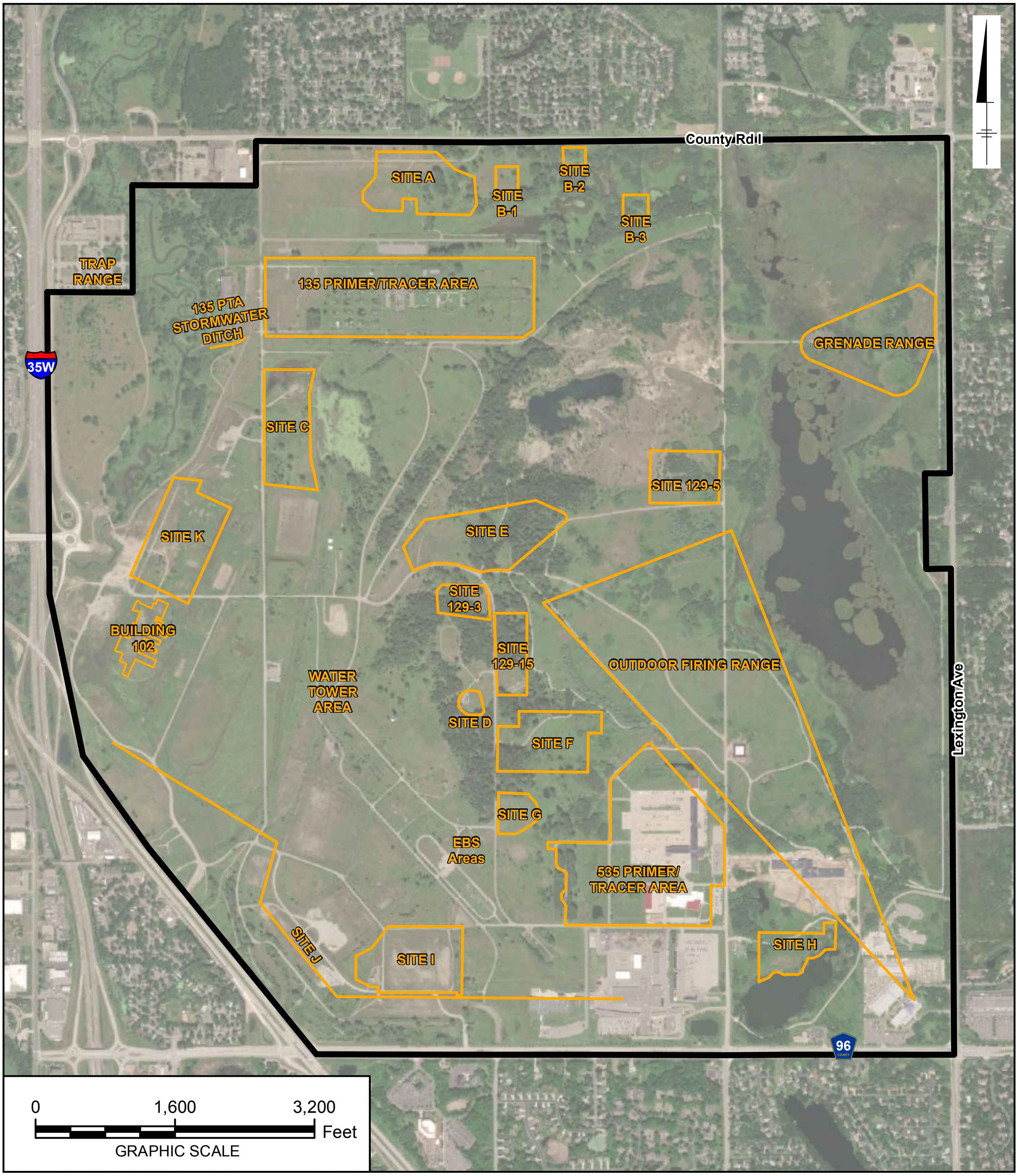
ANNUAL PERFORMANCE REPORT

Conceptual Illustration of Operable Units

PIKA ARCADIS a joint venture

FIGURE **2-1**

City: Minneapolis Div/Group: IMDV Created By: MG Last Saved By: KGPeters
TCAAP
F:\TCAAP\RegEdits\2020_07\F2_1_Conceptual Illustration of Operable Units.mxd 6/30/2020 10:54:50 AM



LEGEND:

Operable Unit 2

General NPL Site Boundary (See Note 1)

NOTES:

1. General NPL site boundaries determined during the initial site investigations. Please refer to the latest site reports for the current boundary definitions.
2. 2016 Aerial Photograph (Source: DigitalGlobe, Vivid - USA)

TWIN CITIES ARMY AMMUNITION PLANT
ARDEN HILLS, MINNESOTA

ANNUAL PERFORMANCE REPORT

Operable Unit 2
Site Boundaries

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FIGURE 2-2

City: Minneapolis Div/Group: IMDV Created By: MG Last Saved By: KGPeters
TCAAP
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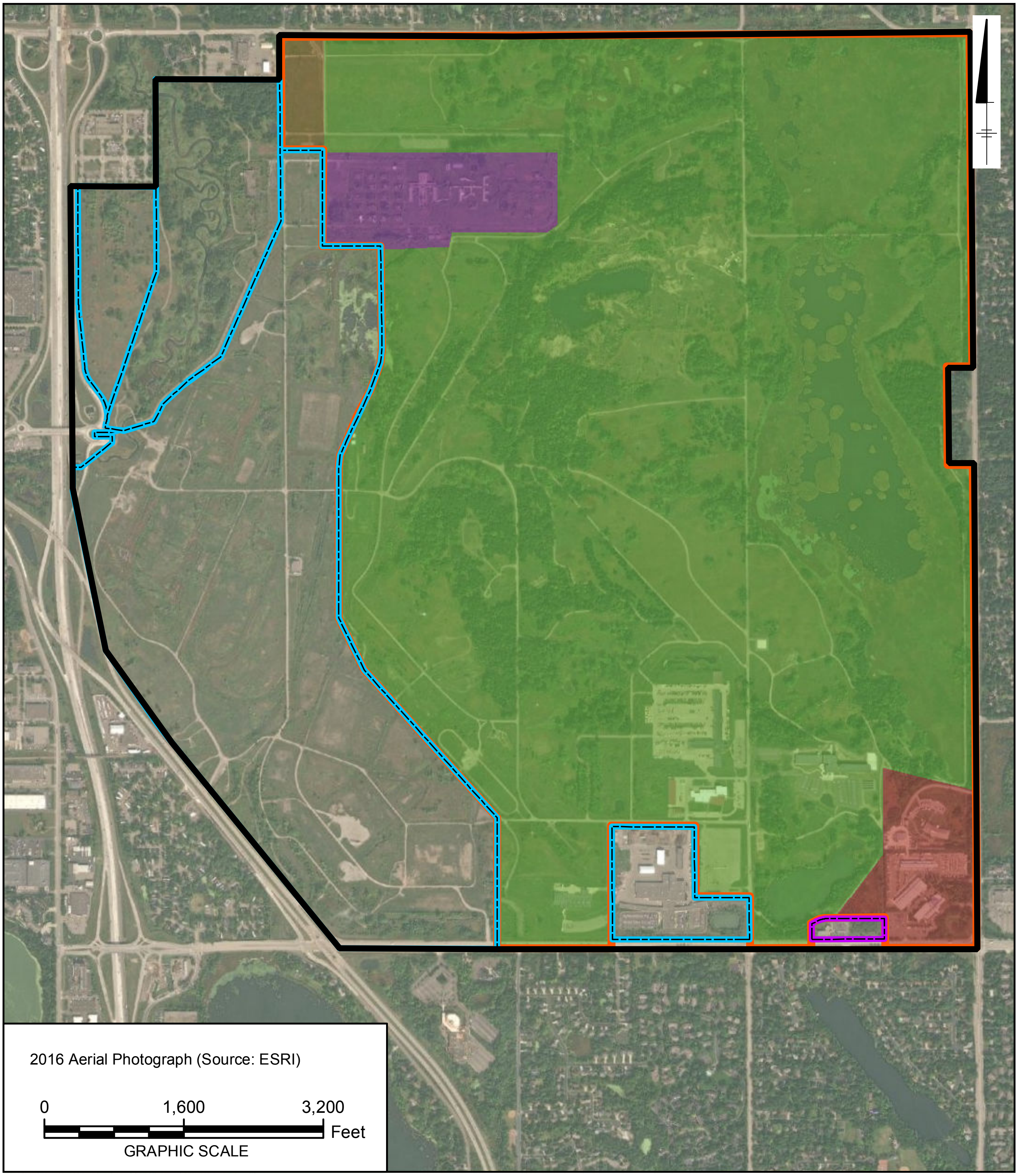

LEGEND:

- Operable Unit 2 Boundary
- City of Arden Hills - Owned Property
- Ramsey County - Owned Property
- Federally - owned property controlled by the U.S. Army
- Control Delegated to the Base Realignment and Closure Division (what remains of TCAAP)
- Control Delegated to the U.S. Army Reserve
- Control Delegated to the National Guard Bureau, who in turn has licensed use of the property to the Minnesota Army National Guard
- Easement to Ramsey County

TWIN CITIES ARMY AMMUNITION PLANT
ARDEN HILLS, MINNESOTA

FY 2020 Annual Performance Report

Property Ownership Within Operable Unit 2

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FIGURE
2-3

City: Minneapolis Div/Group: IMDV Created By: MG Last Saved By: KGPeters
TCAAP
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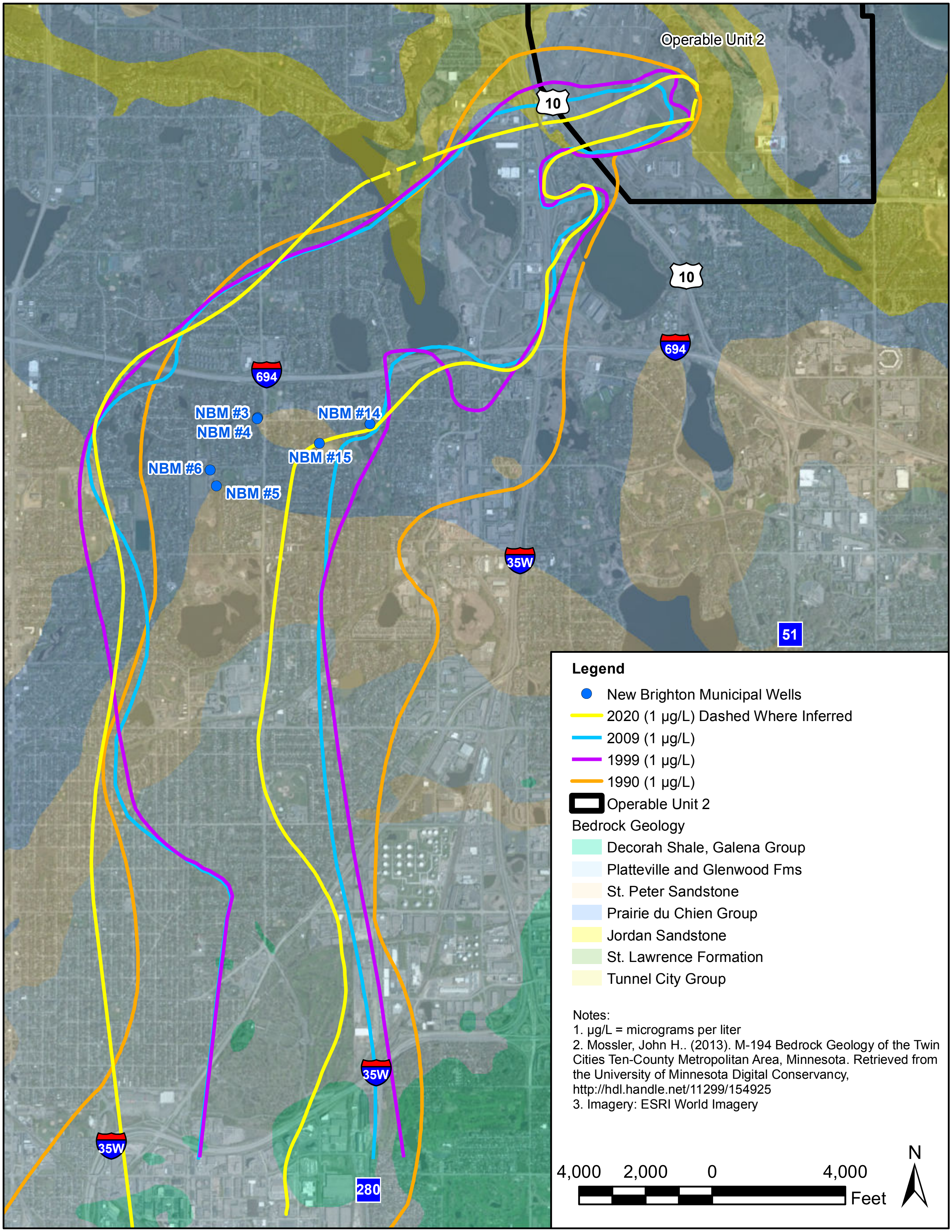

ANNUAL PERFORMANCE REPORT

Upper Unit 4,
1 µg/L Trichloroethene Isoconcentration Map

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FY 2020

Figure 3-1

Path: F:\TCAAP\RegEdits\2020_12\Figure_3-1 Upper Unit 4 1ug TCE_FY2020.mxd
Date: 1/29/2021 Time: 8:48:16 AM User: KGPeters

FIGURE 3-2

NEW BRIGHTON MUNICIPAL WELLS: TRICHLOROETHENE WATER QUALITY TRENDS

Twin Cities Army Ammunition Plant

Arden Hills, Minnesota

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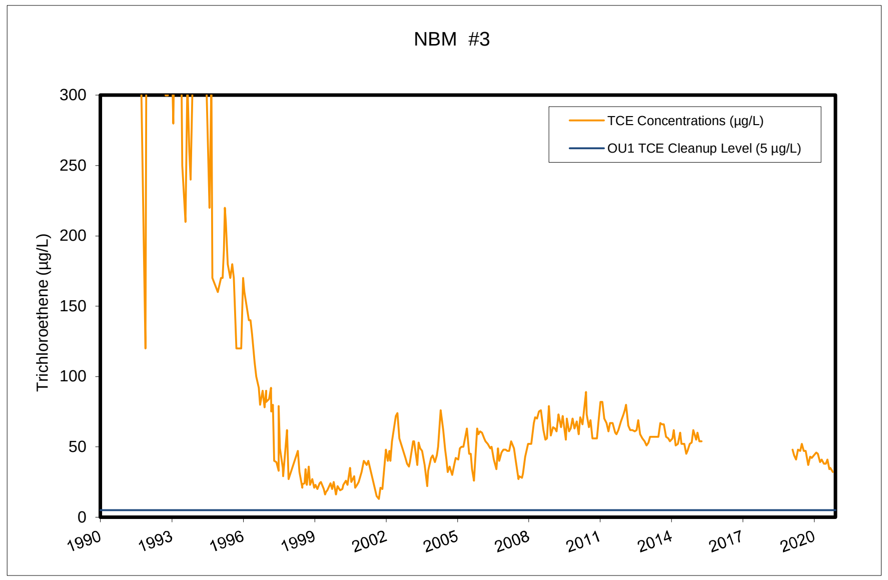
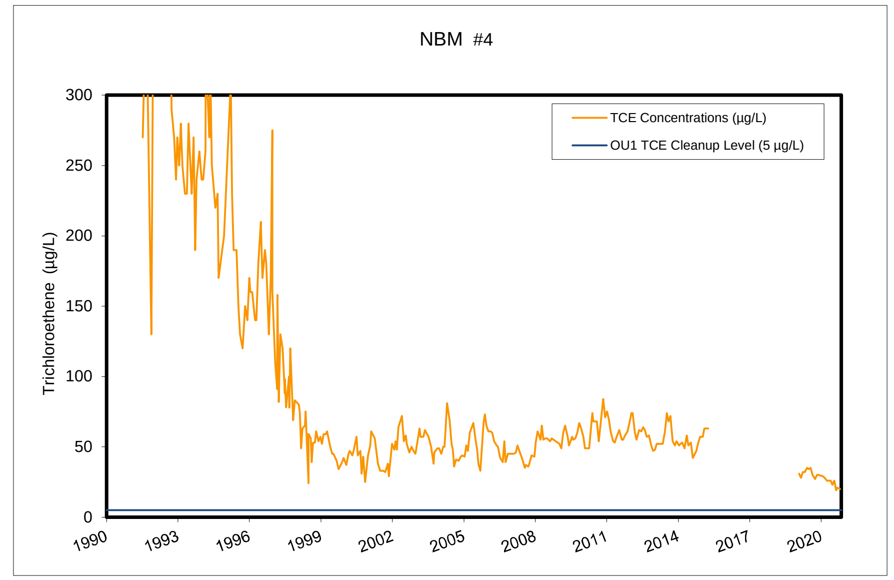
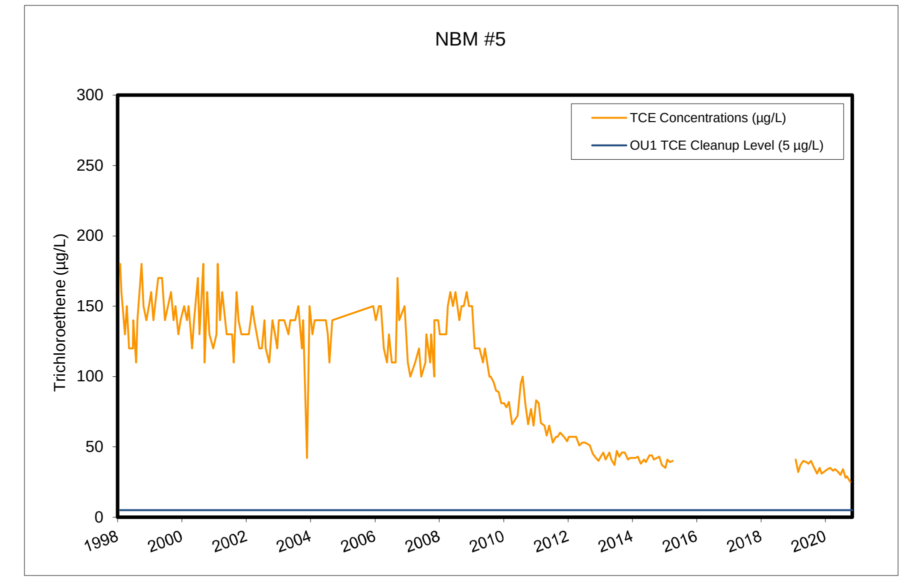
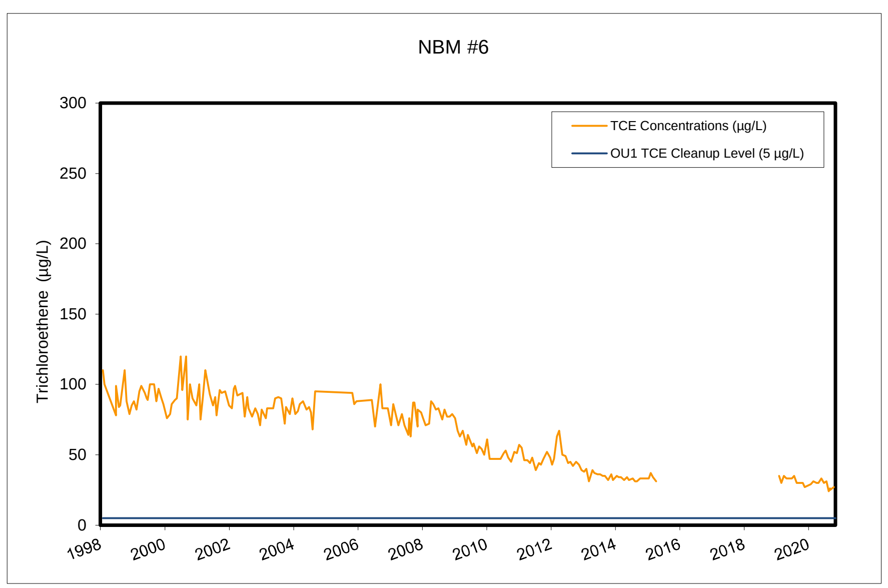
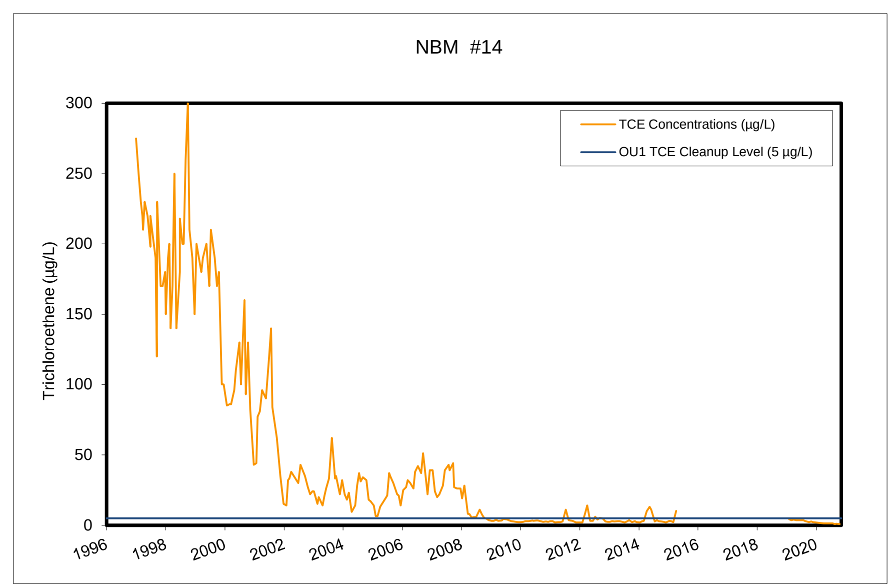
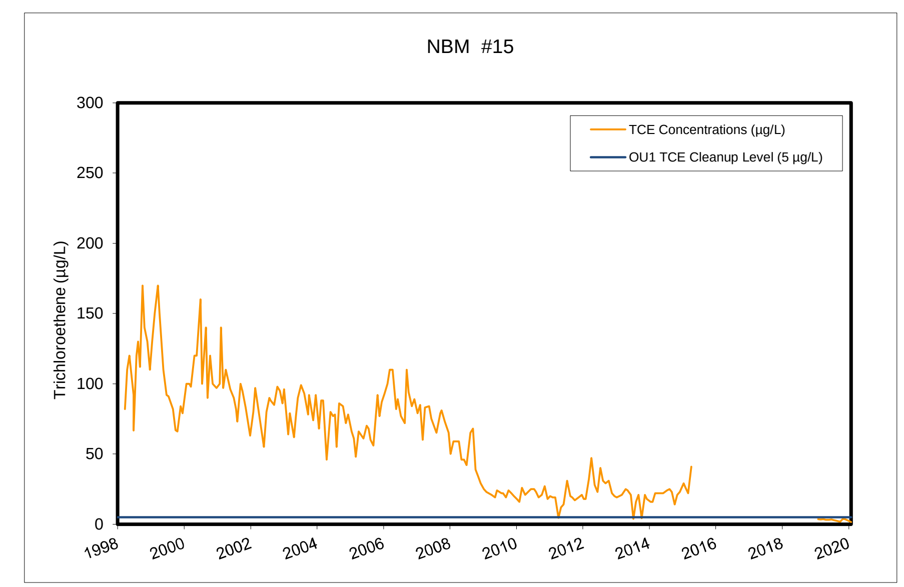






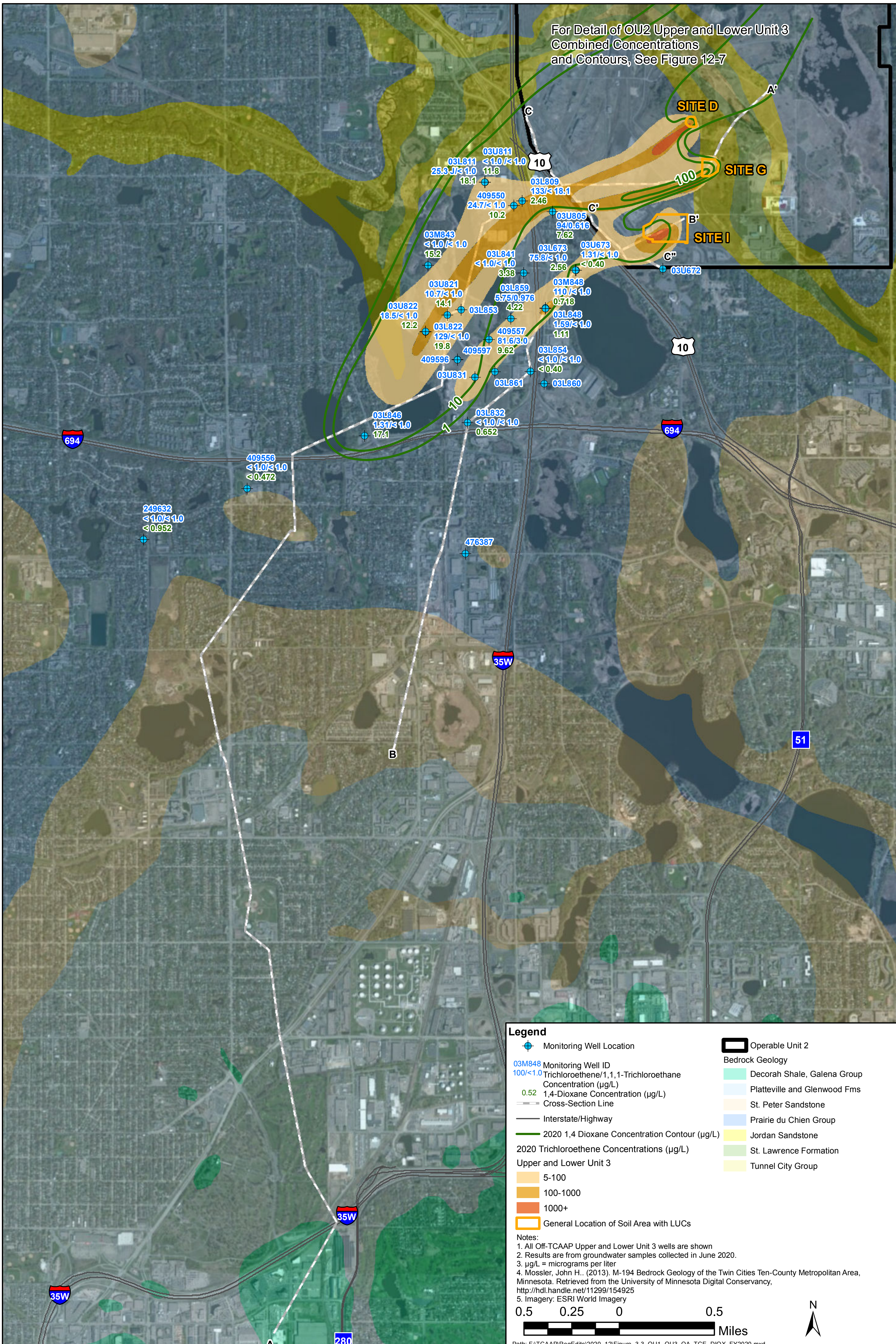






Note: Routine pumping of the NBCGRS was ceased on April 15, 2015, with notice to the USEPA/MPCA, due to detection of 1,4-dioxane in the Prairie du Chien and Jordan Aquifer municipal wells. Since the granular activated carbon (GAC) does not remove 1,4-dioxane, New Brighton is preferentially pumping deep aquifer wells that have no detectable 1,4-dioxane while the City evaluates the feasibility of 1,4-dioxane removal technologies. This has been referred to as a "Remedy Time-Out," and normal pumping of the NBCGRS will not be resumed until a technology is selected and modification of the NBCGRS is designed and constructed. The Fridley Interconnection was also closed on April 15, 2015.

Update: The routine pumping of the NBCGRS began again in 2019 following the implementation of a treatment system for 1,4-dioxane.



ANNUAL PERFORMANCE REPORT

OU1 & OU3, Upper and Lower Unit 3 Combined, Trichloroethene and 1,4-Dioxane Isoconcentration Map, June 2020

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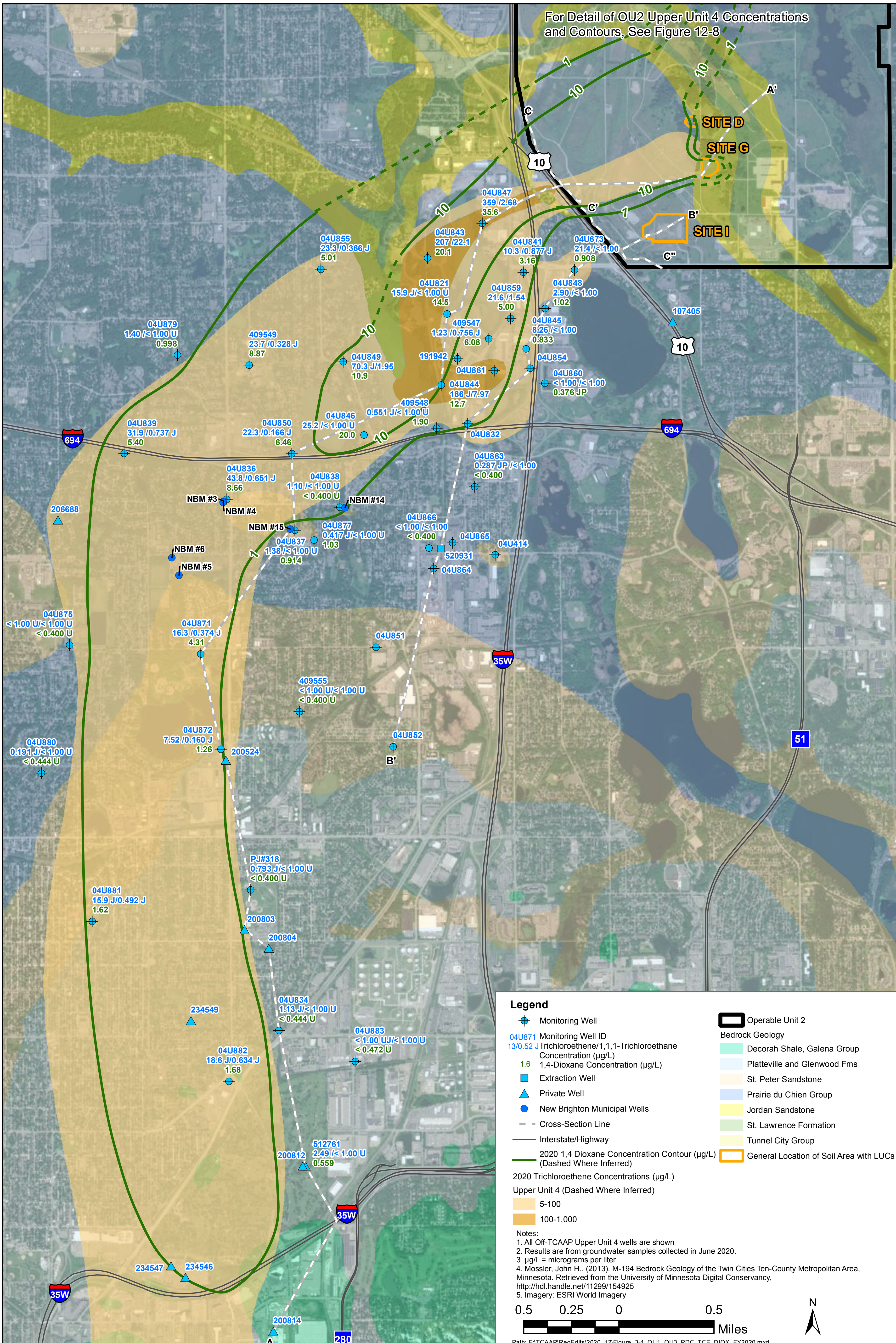
Figure 3-3



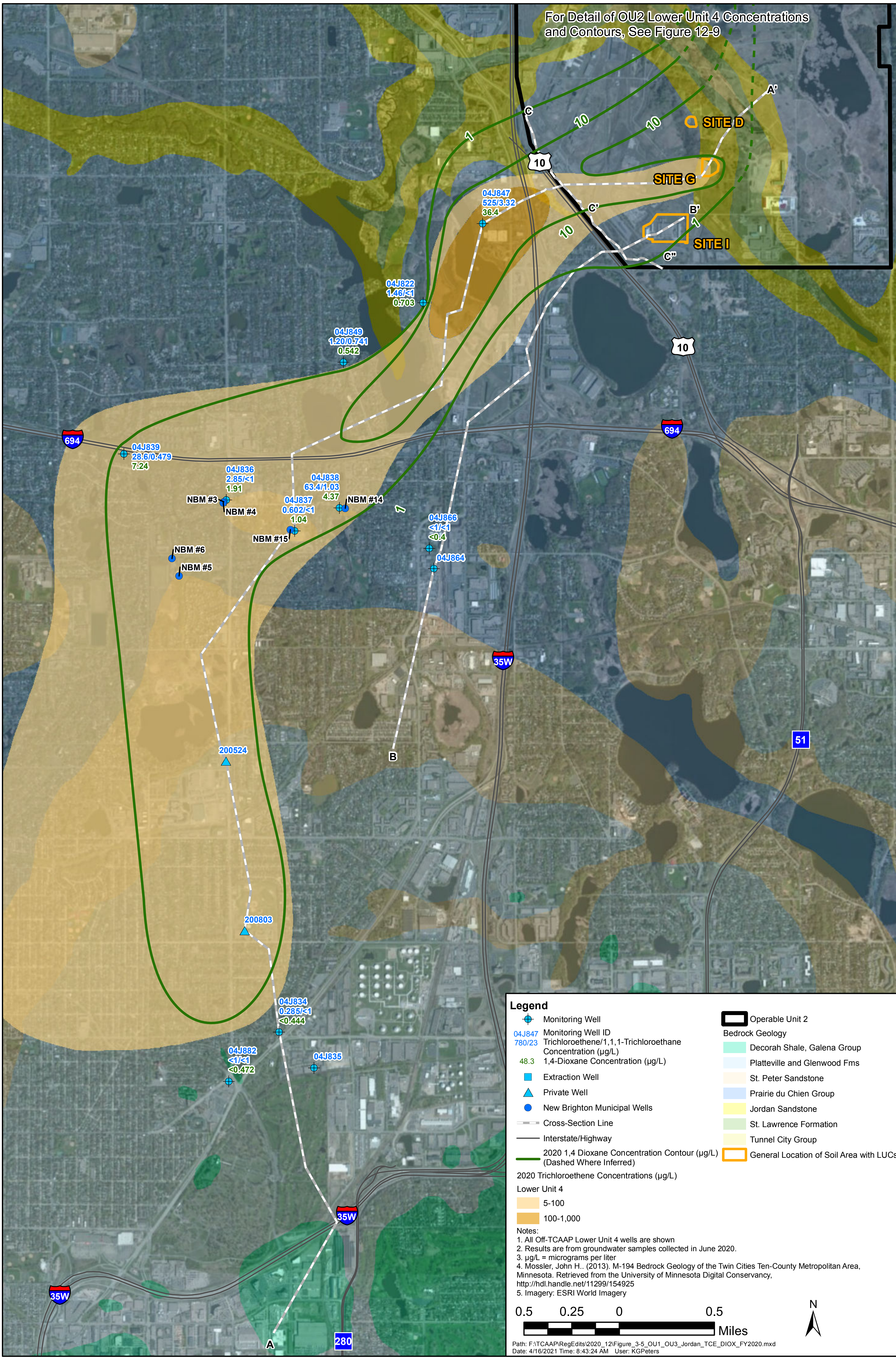
ANNUAL PERFORMANCE REPORT

OU1 & OU3, Upper Unit 4, Trichloroethene and 1,4-Dioxane Isoconcentration Map, June 2020

PIKA ARCADIS a joint venture

FY 2020

Figure 3-4



ANNUAL PERFORMANCE REPORT

OU1 & OU3, Lower Unit 4, Trichloroethene and 1,4-Dioxane Isoconcentration Map, June 2020

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FY 2020

Figure 3-5

FY 2020 Annual Performance Report
Figure 3-6
OU2-OU1 Trichloroethene Cross Section A-A' (North Half)

U.S Army - TCAAP
Arden Hills, Minnesota

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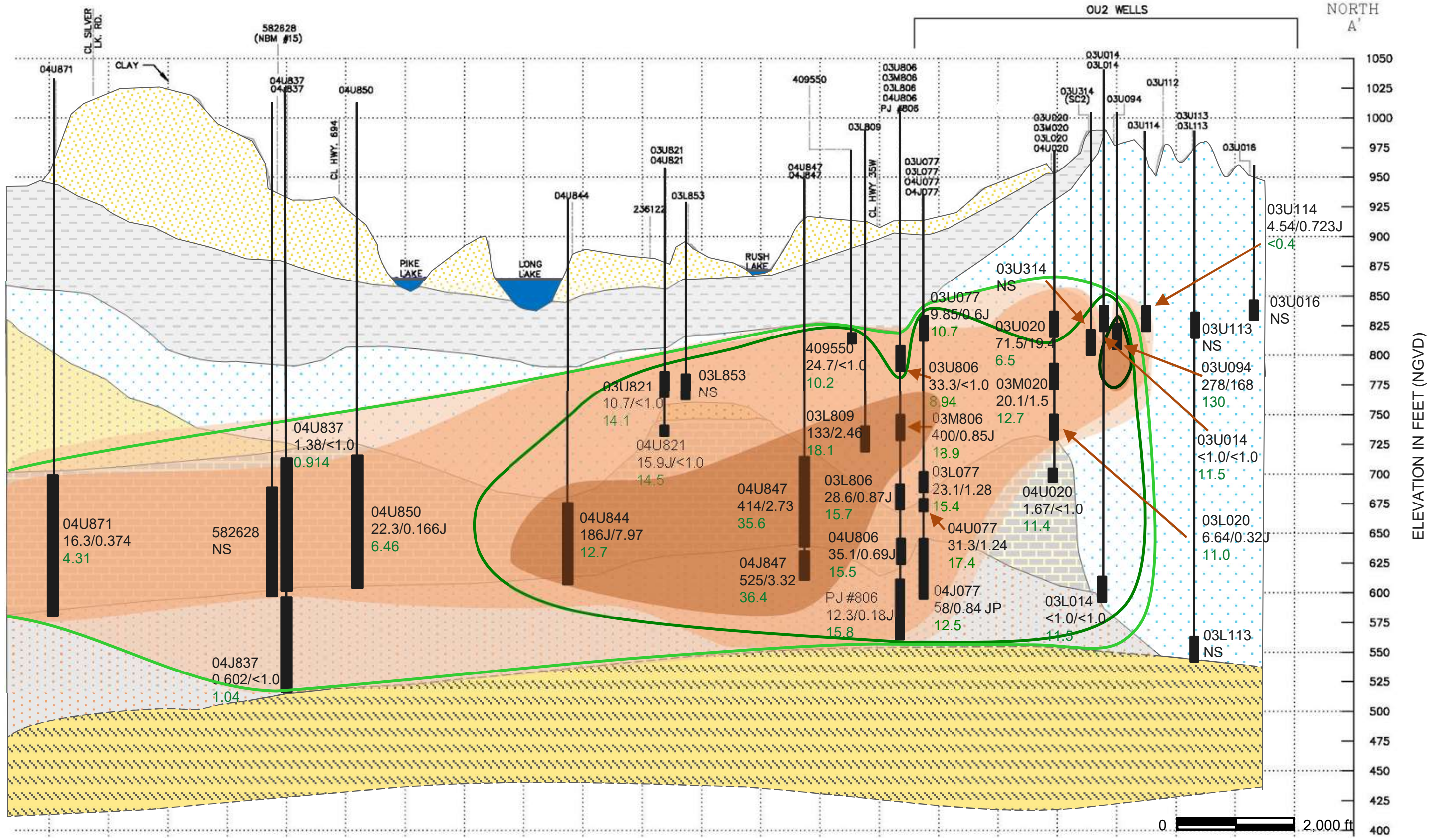

Legend

04J077 Well ID
NS Not Sampled
µg/L Micrograms per Liter
NGVD National Geodetic Vertical Datum
69/1.5 Trichloroethene/1,1,1-Trichloroethane Concentration (µg/L)

36.9 1,4-Dioxane concentration (µg/L)
J Reported value is between the method detection limit and reporting limit

Geologic Contact (inferred where dashed)
Screened Interval

Trichloroethene Concentration (µg/L)
5-10
10-100
>100

1,4-Dioxane Concentration (µg/L)
1-10
10-100
100-1,000

Unit 1
Unit 2
Unit 3
St. Peter Sandstone
Upper Unit 4
Lower Unit 4
St. Lawrence Formation

FY 2020 Annual Performance Report
Figure 3-7
OU2-OU1 Trichloroethene Cross Section A-A' (South Half)
U.S Army - TCAAP
Arden Hills, Minnesota

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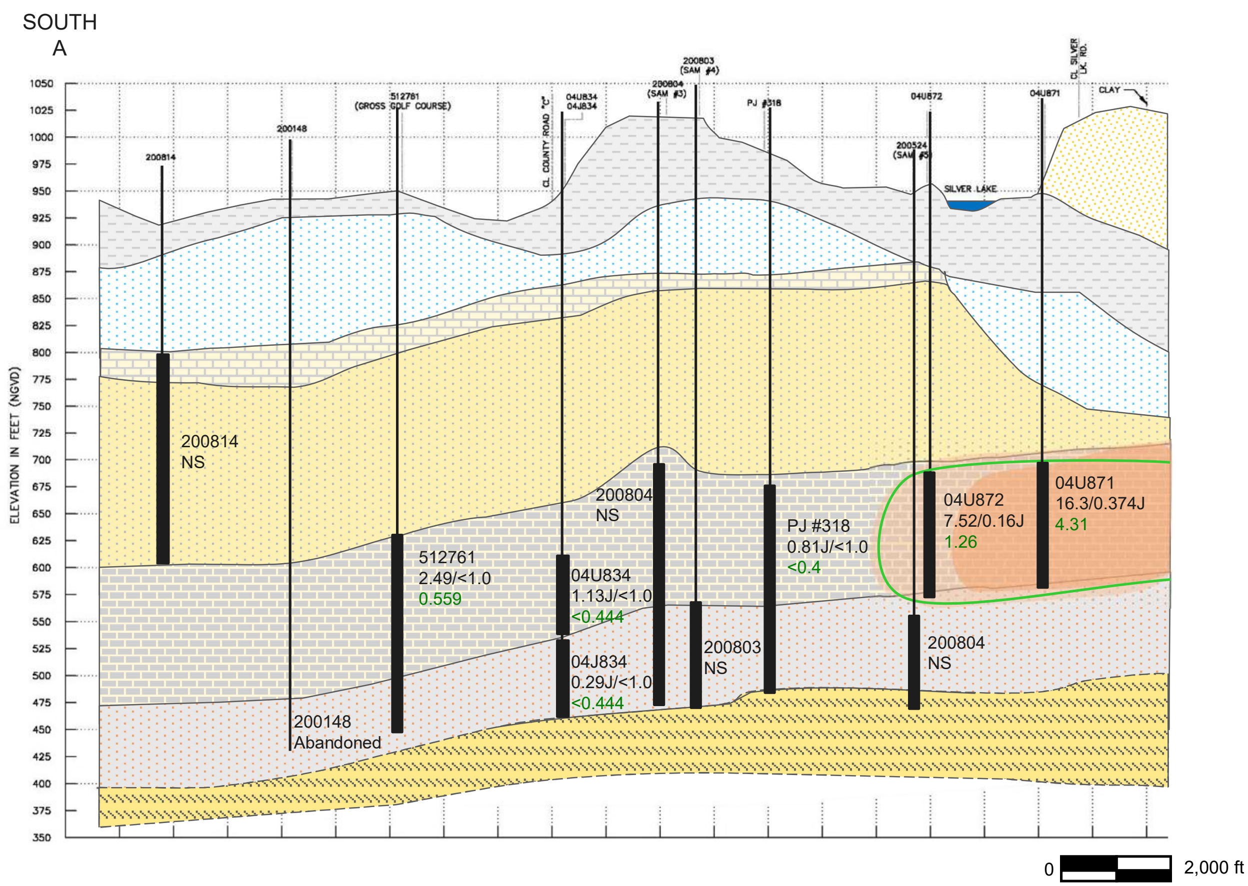


Legend

512761	Well ID
NS	Not Sampled
µg/L	Micrograms per Liter
NGVD	National Geodetic Vertical Datum
J	Reported value is between the method detection limit and reporting limit
2.6/ND	Trichloroethene/1,1,1-Trichloroethane Concentration (µg/L)
3.4	1,4-Dioxane concentration* (µg/L)
—	Geologic Contact (inferred where dashed)
▌	Screened Interval

Trichloroethene Concentration (µg/L)

- 5-10
- 10-100

1,4-Dioxane Concentration (µg/L)

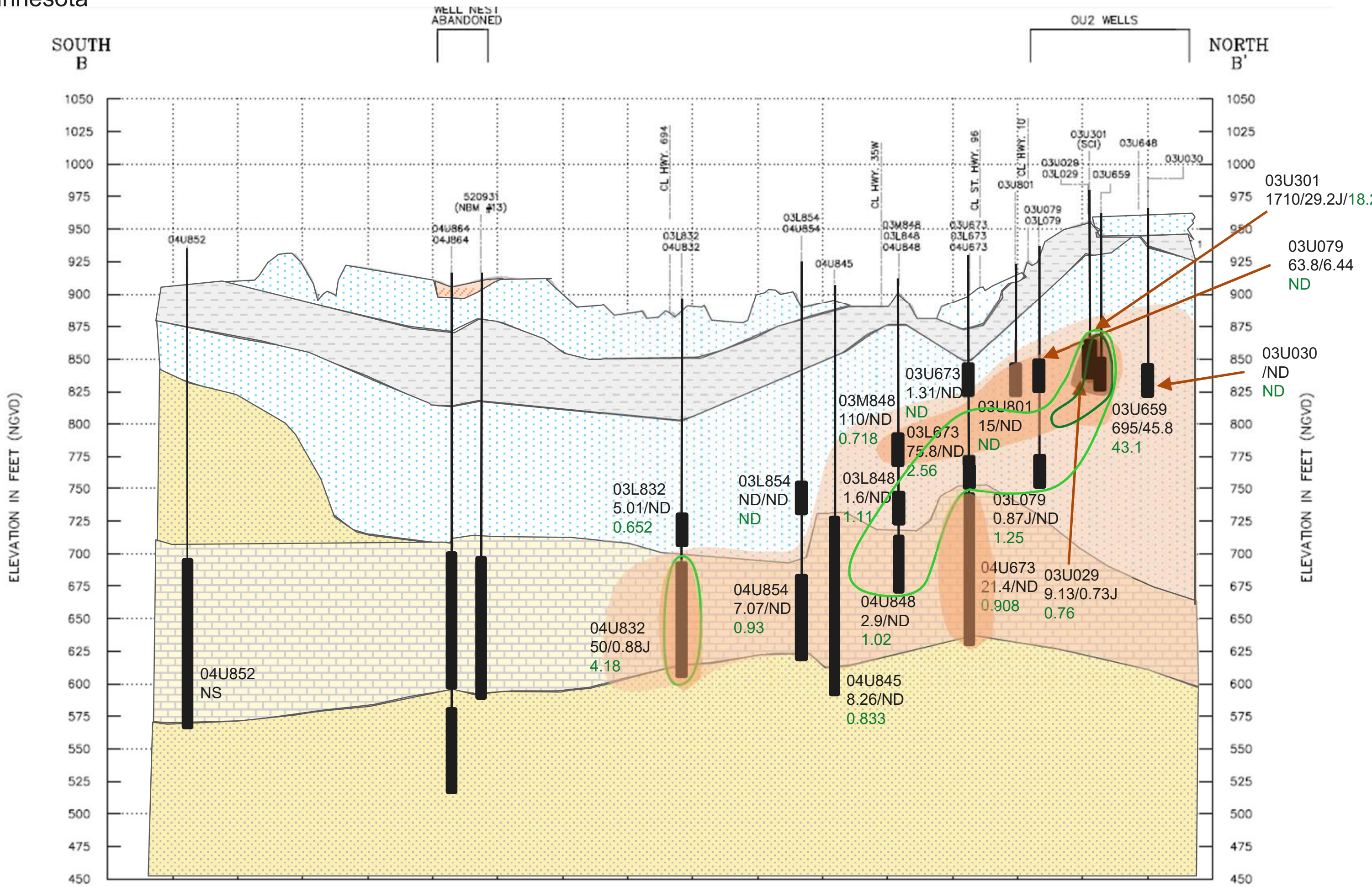
- 1-10

- Unit 1
- Unit 2
- Unit 3
- Platteville Limestone
- St. Peter Sandstone
- Upper Unit 4
- Lower Unit 4
- St. Lawrence Formation

FY 2020 Annual Performance Report
Figure 3-8
OU2-OU3 Trichloroethene Cross Section B-B’

U.S Army - TCAAP
Arden Hills, Minnesota

PIKA ARCADIS a joint venture



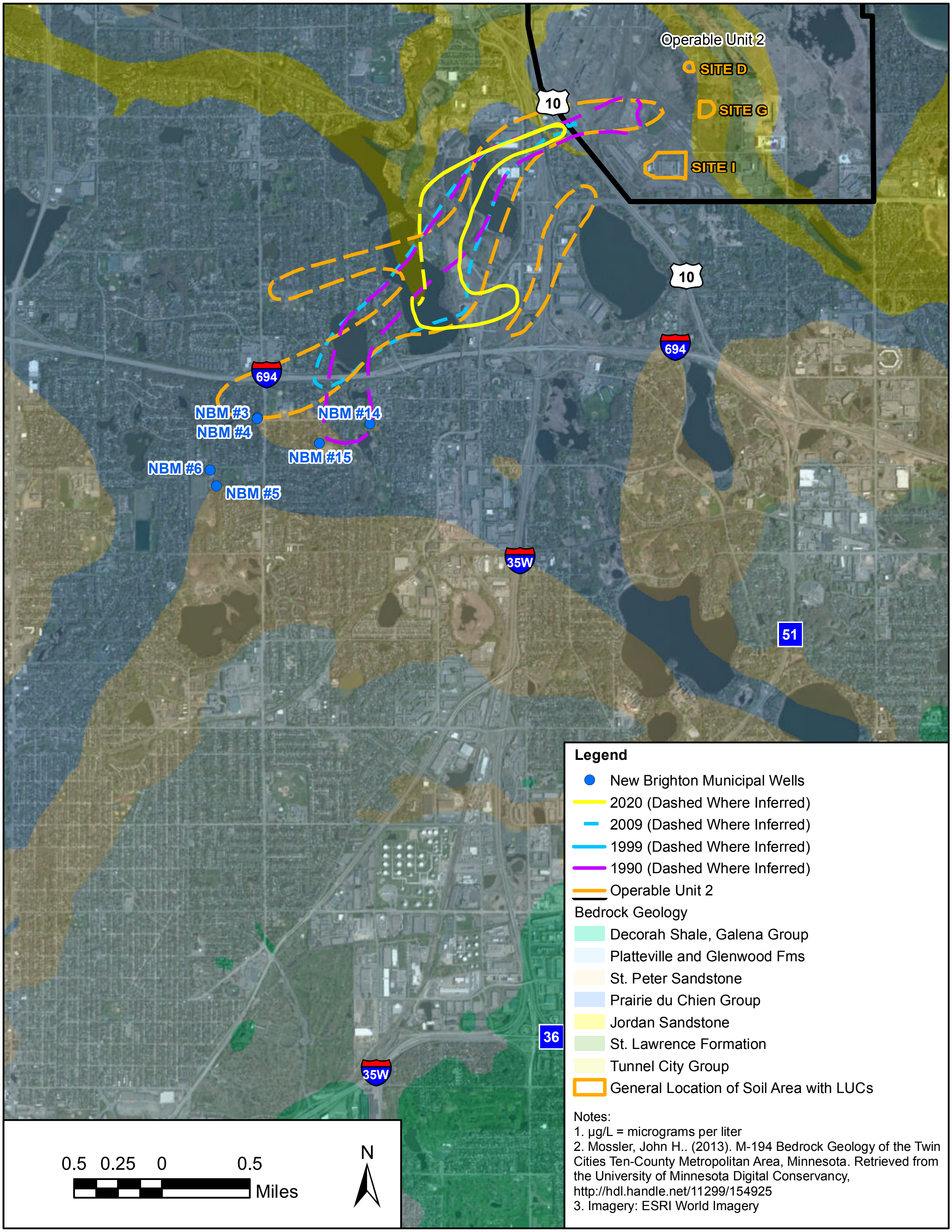
Legend

03U079	Well ID
NS	Not Sampled
µg/L	Micrograms per Liter
NGVD	National Geodetic Vertical Datum
55/8.2	Trichloroethene/1,1,1-Trichloroethane Concentration (µg/L)
0.25	1,4-Dioxane concentration* (µg/L)
J	Reported value is between the method detection limit and reporting limit
	Geologic Contact (inferred where dashed)
	Screened Interval

Trichloroethene Concentration (µg/L)
- 5-10
- 10-100
- > 100

1,4-Dioxane Concentration (µg/L)
- 1-10
- 10-100

- Fill
- Unit 1
- Unit 2
- Unit 3
- Platteville Limestone
- St. Peter Sandstone
- Upper Unit 4
- Lower Unit 4
- St. Lawrence Formation



ANNUAL PERFORMANCE REPORT

Upper Unit 4,
100 µg/L Trichloroethene Isoconcentration Map

PIKA ARCADIS a joint venture

FY 2020

Figure 3-9

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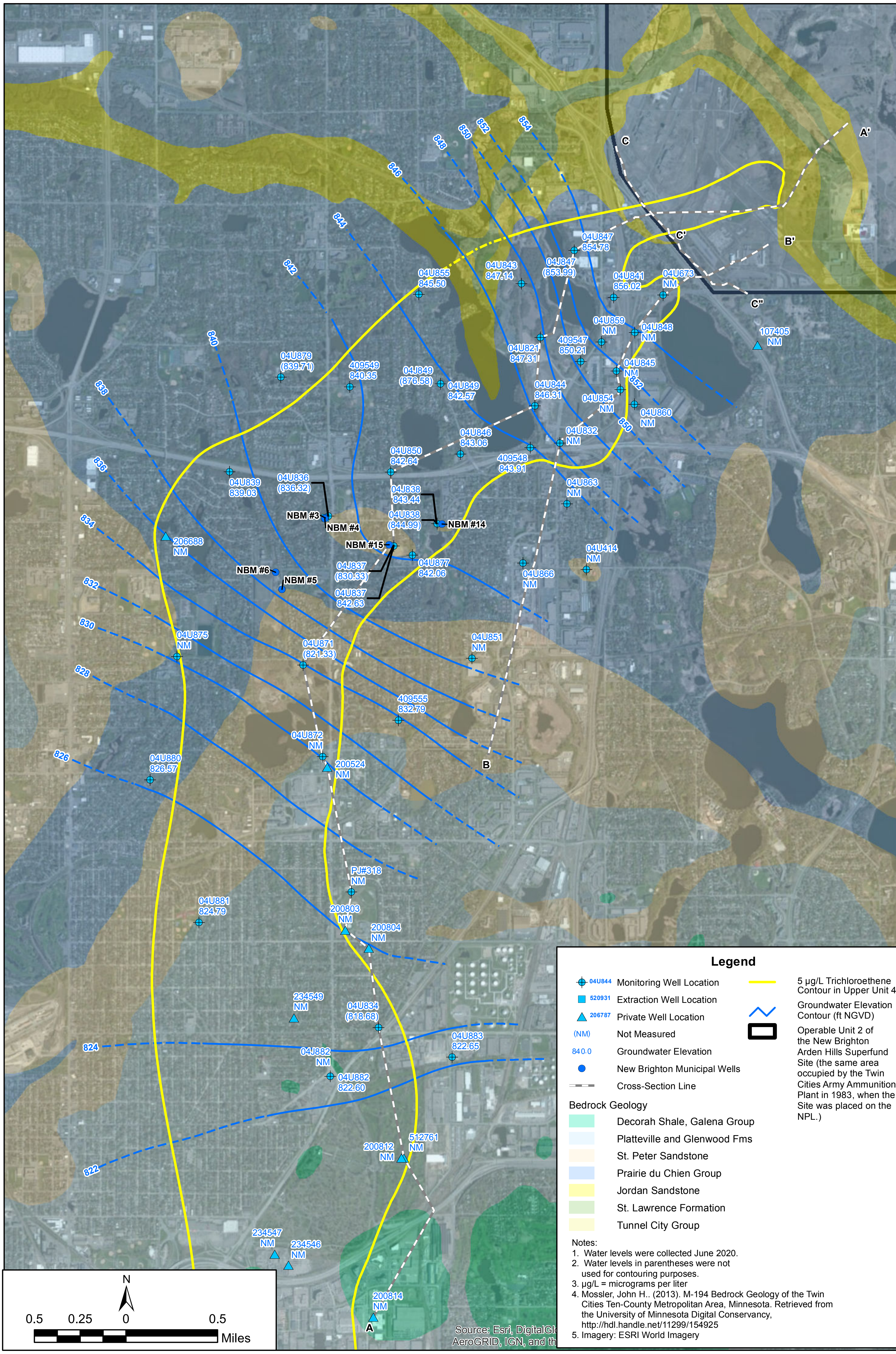

ANNUAL PERFORMANCE REPORT

OU1 & OU3, Upper Unit 4, Potentiometric Map, June 2020

PIKA ARCADIS a joint venture

FY 2020

Figure 3-10

Path: F:\TCAAP\RegEdits\2020_12\Figure_3-10_OU1 OU3 Upper Unit 4 Potentiometric_FY2020.mxd
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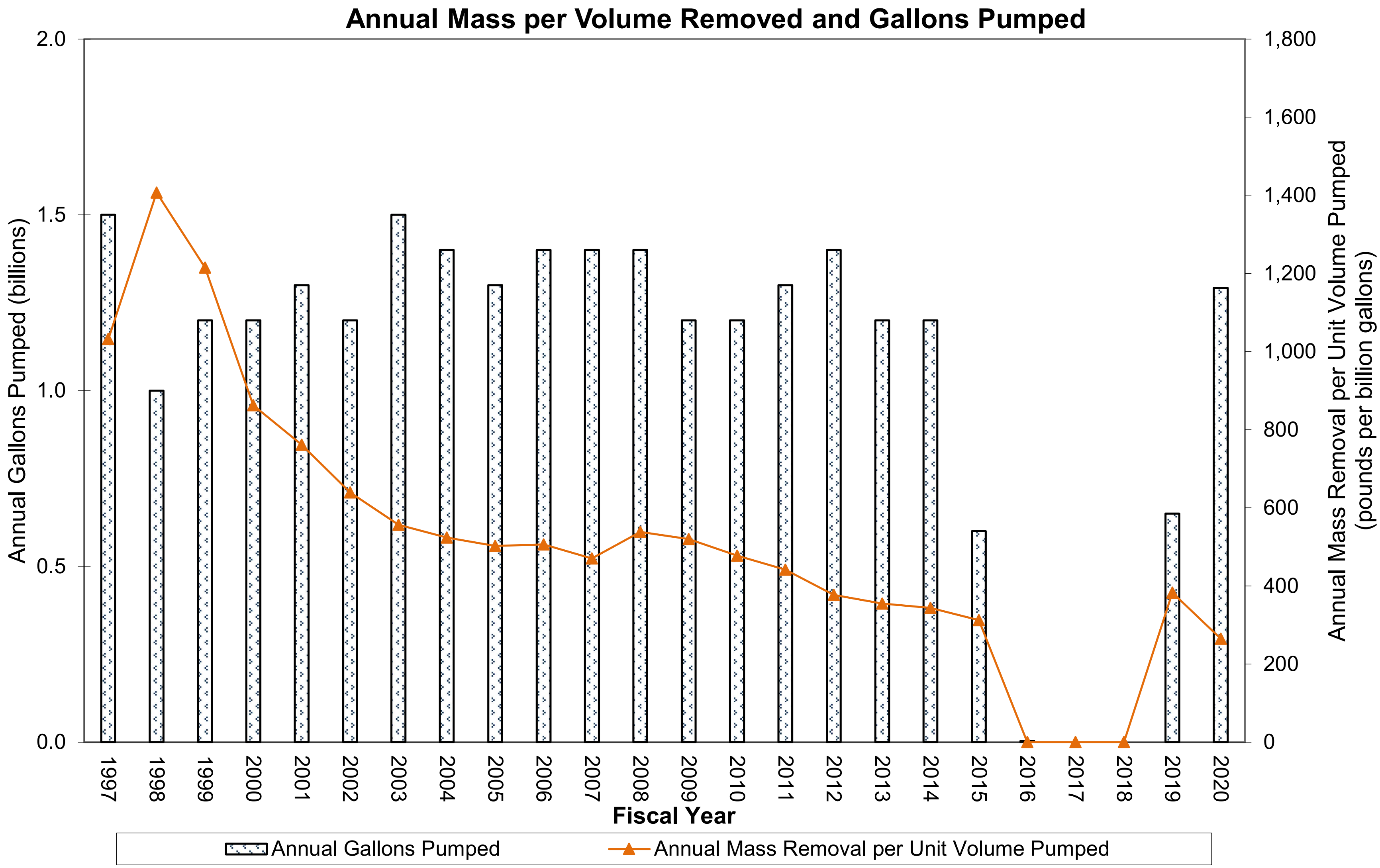
FIGURE 3-11
OU1, NBCGRS MASS REMOVAL HISTORY

FY 2020 Annual Performance Report



ANNUAL PERFORMANCE REPORT

Site A, Groundwater Monitoring Plan

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FY 2020

Figure 6-1

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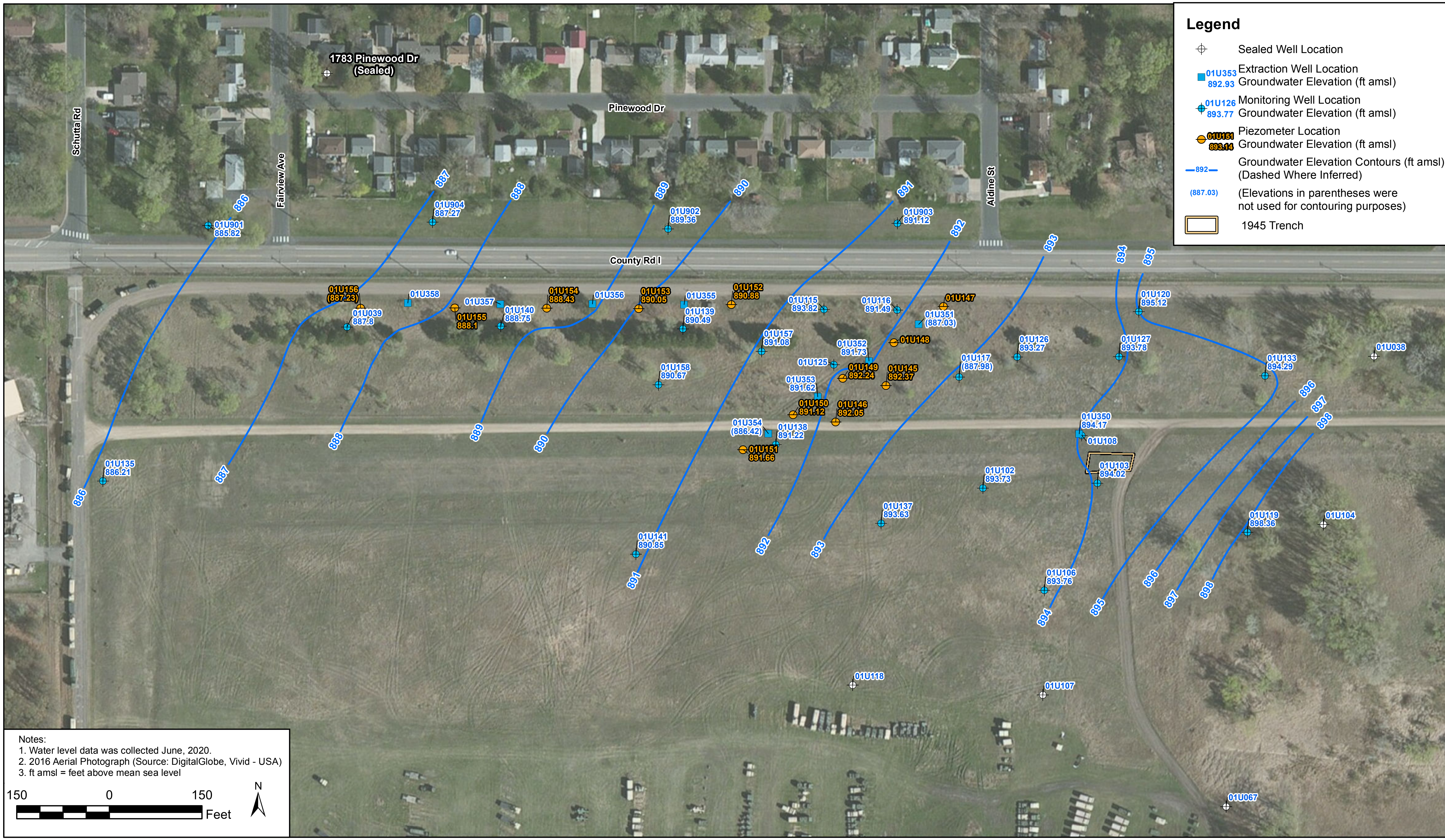

ANNUAL PERFORMANCE REPORT	PIKA ARCADIS a joint venture	FY 2020
Site A, Unit 1, Potentiometric Map, June 2020		Figure 6-2

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ANNUAL PERFORMANCE REPORT

Site A, Unit 1, Tetrachloroethene Isoconcentration Map, June-July 2020

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Figure 6-3

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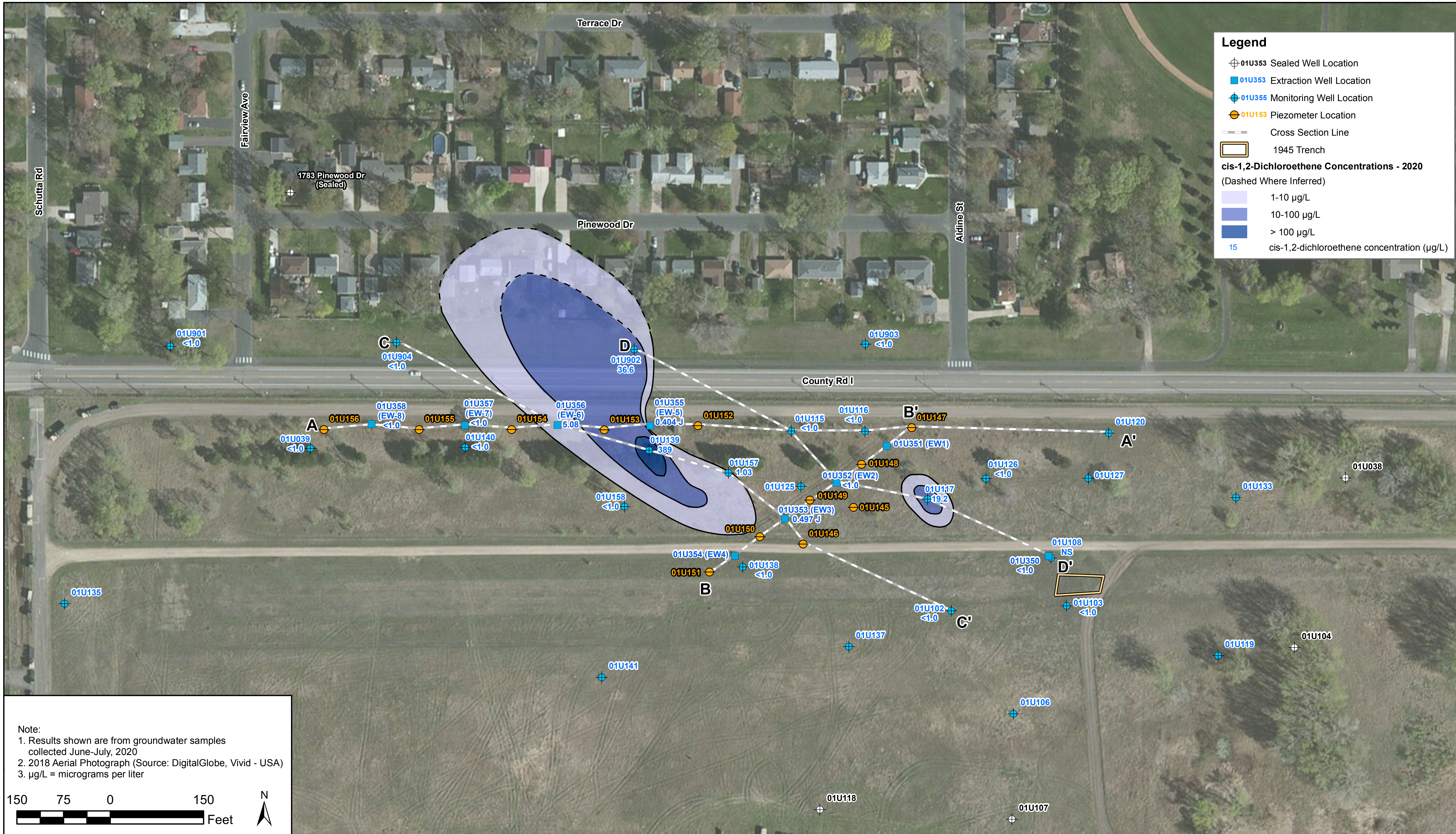

ANNUAL PERFORMANCE REPORT

Site A, Unit 1, cis-1,2-Dichloroethene Isoconcentration Map, June-July 2020

PIKA ARCADIS a joint venture

FY 2020

Figure 6-4

Path: F:\TCAAP\RegEdits\2020_12\F6_4_Site A cis-1,2 DCE Plume Map_FY2020.mxd
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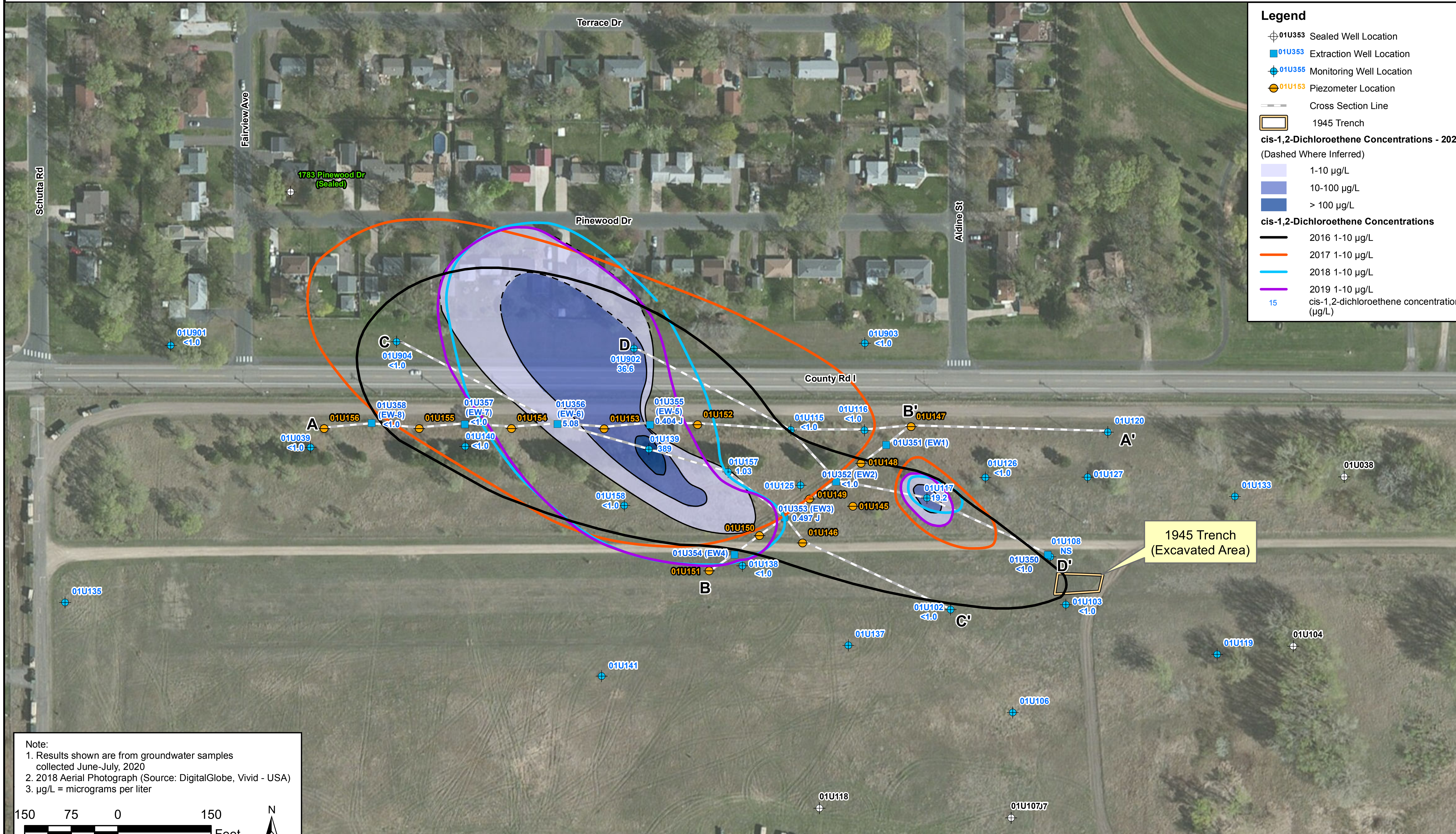

ANNUAL PERFORMANCE REPORT	PIKA ARCADIS a joint venture	FY 2020
Site A, Unit 1, cis-1,2-Dichloroethene Plume Comparison		Figure 6-5

Path: F:\TCAAP\RegEdits\2020_12\Fig_6-5_Site A cis-1,2 DCE Plume Comparison Map_FY2020.mxd
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FY 2020 Annual Performance Report
Figure 6-6
cis-1,2-Dichloroethene Cross Sections A, B, C, D

U.S Army - TCAAP
Arden Hills, Minnesota

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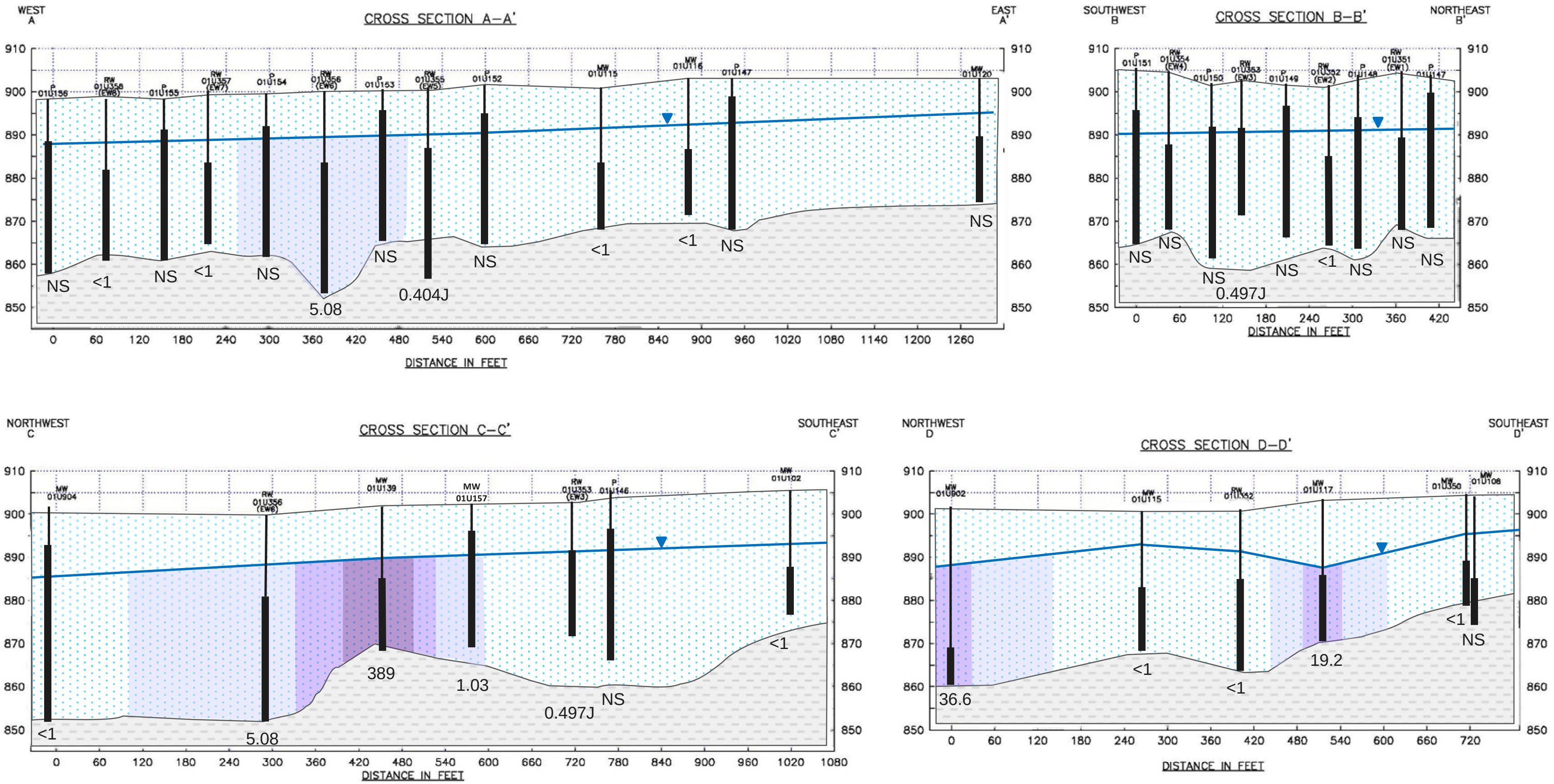

Legend

cis-1,2-Dichloroethene Plume Concentration (µg/L)

- 1-10
- 10-100
- > 100

µg/L Micrograms per Liter

24 cis-1,2-Dichloroethene Concentration (µg/L) – June-July 2020

Water Table

Screened Interval

Figure 6-7

Site A, cis-1,2-Dichloroethene Water Quality Trends: Extraction Wells 1 Through 4

Twin Cities Army Ammunitions Plant
Arden Hills, Minnesota

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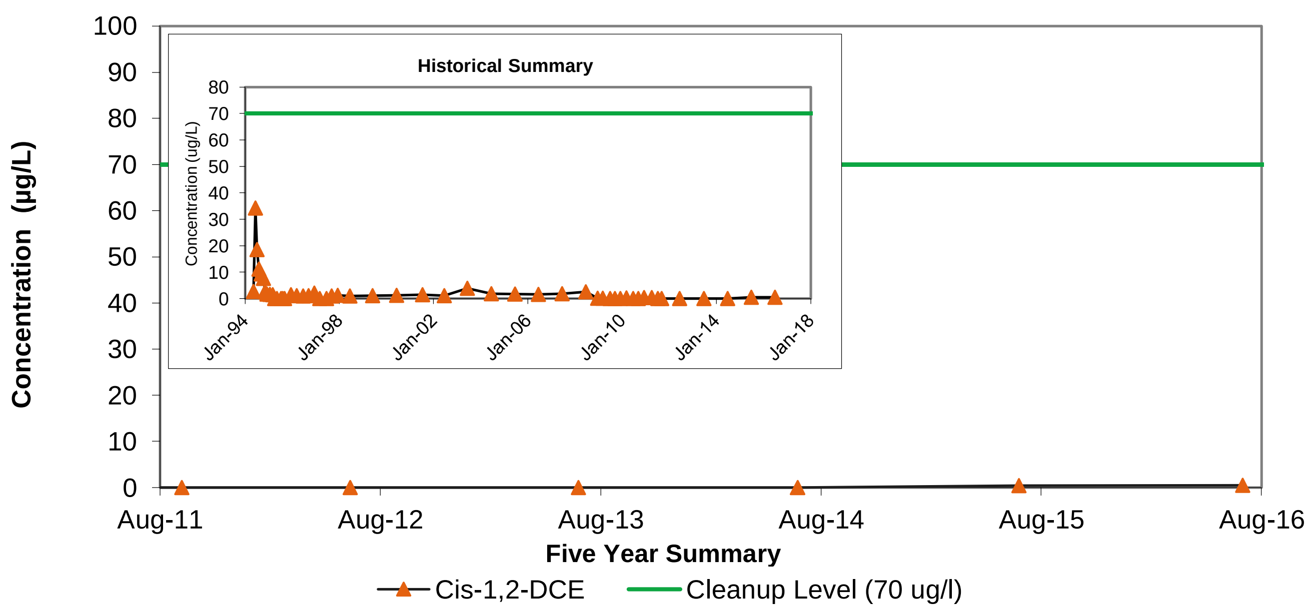
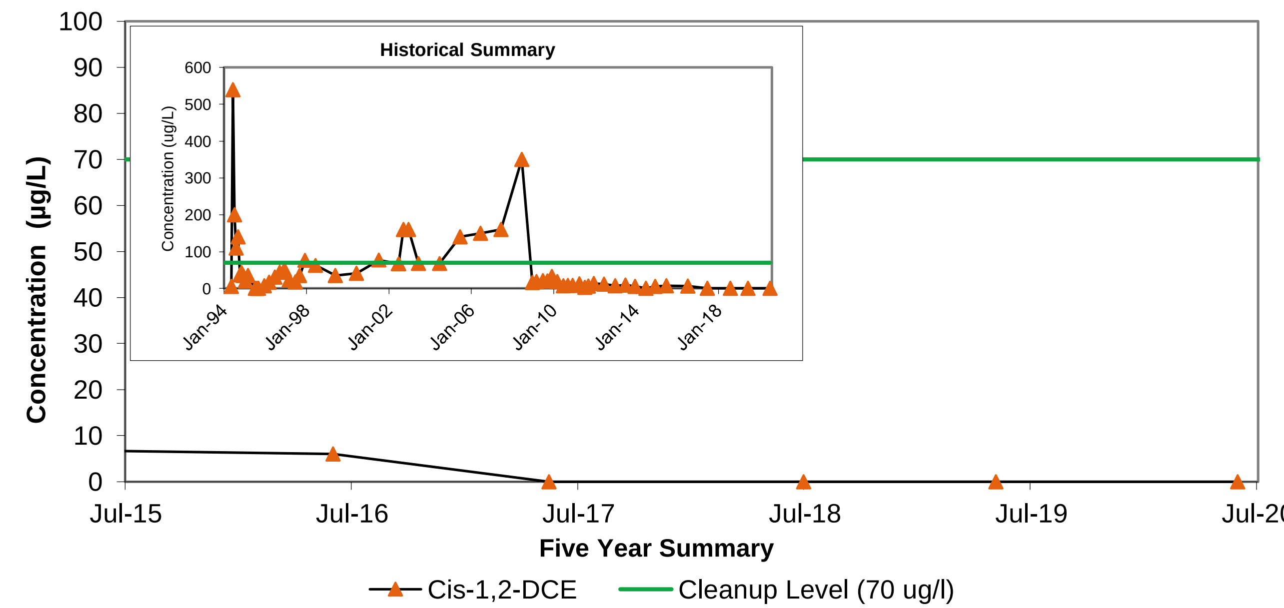
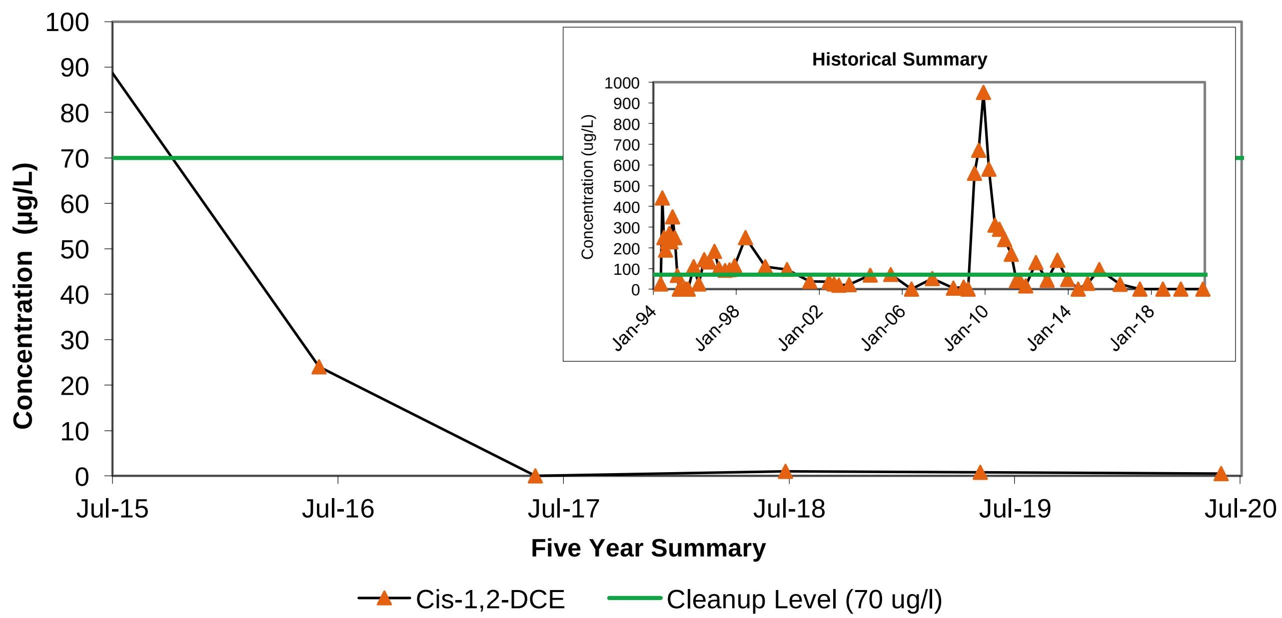
01U351 (EW1)



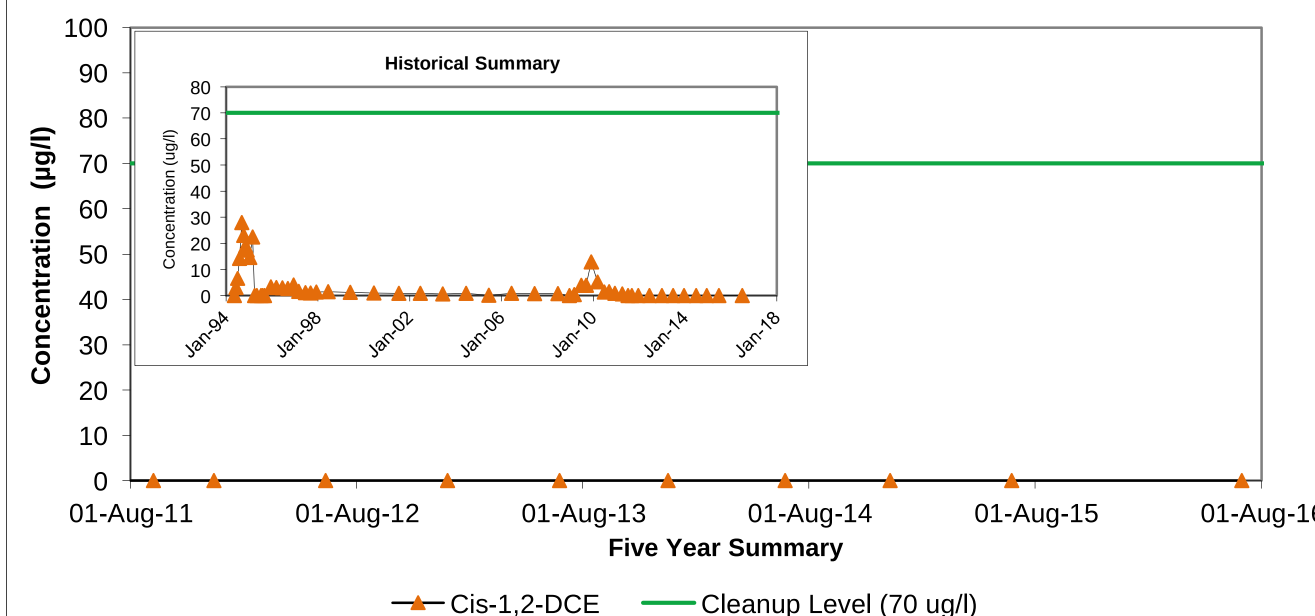
01U352 (EW2)



01U353 (EW3)



01U354 (EW4)

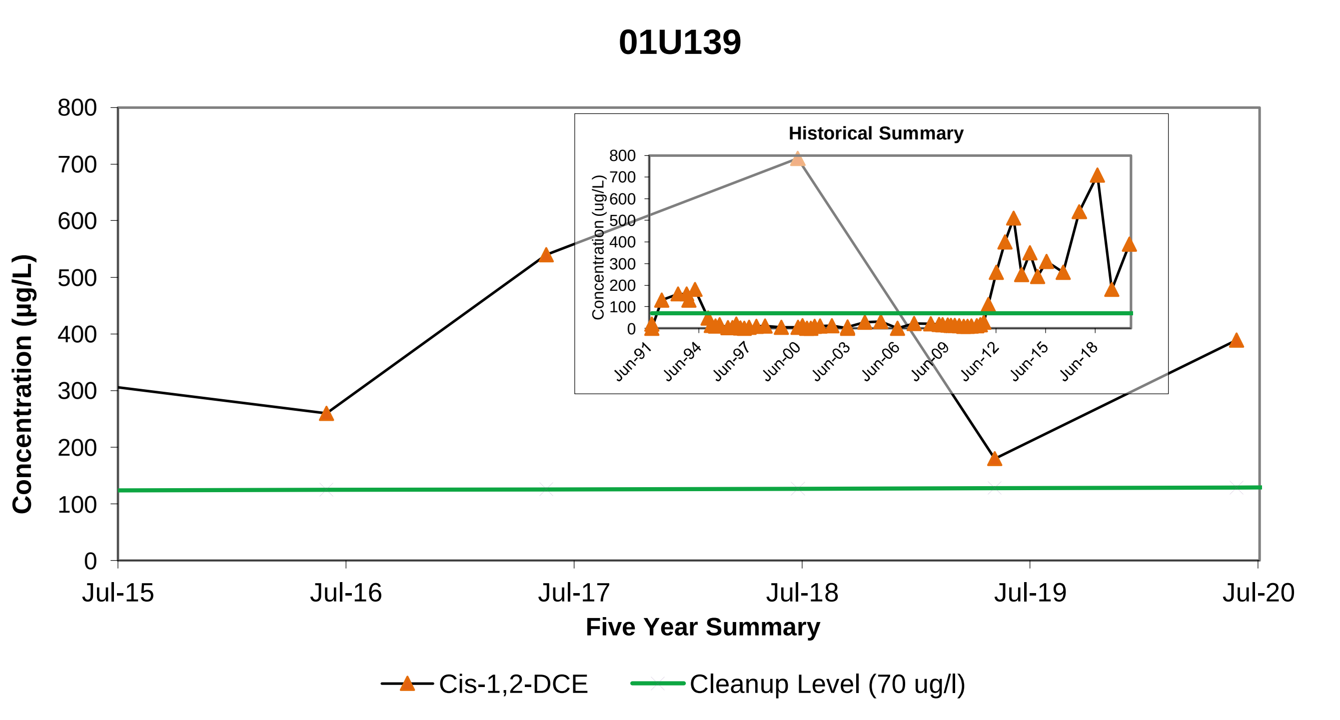


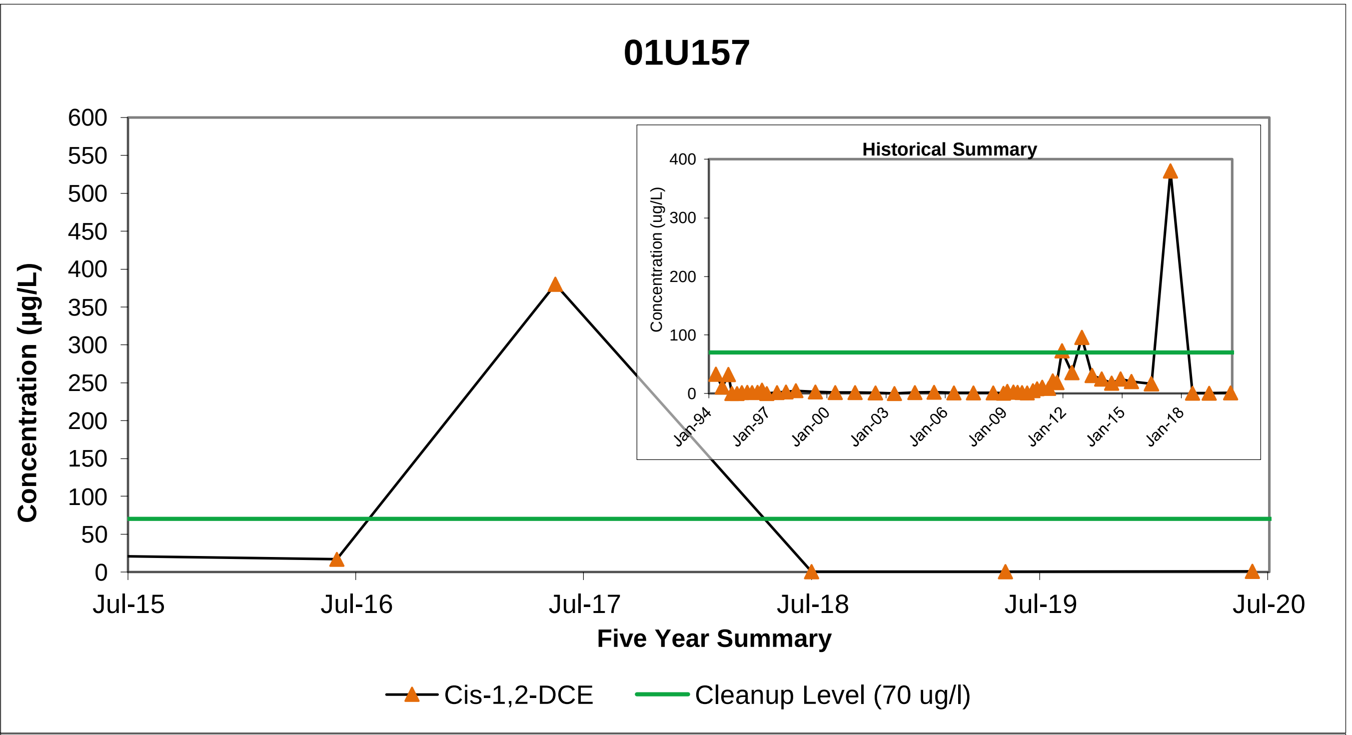
Acronyms and Abbreviations:
EW = Extraction Well
µg/L = micrograms per liter

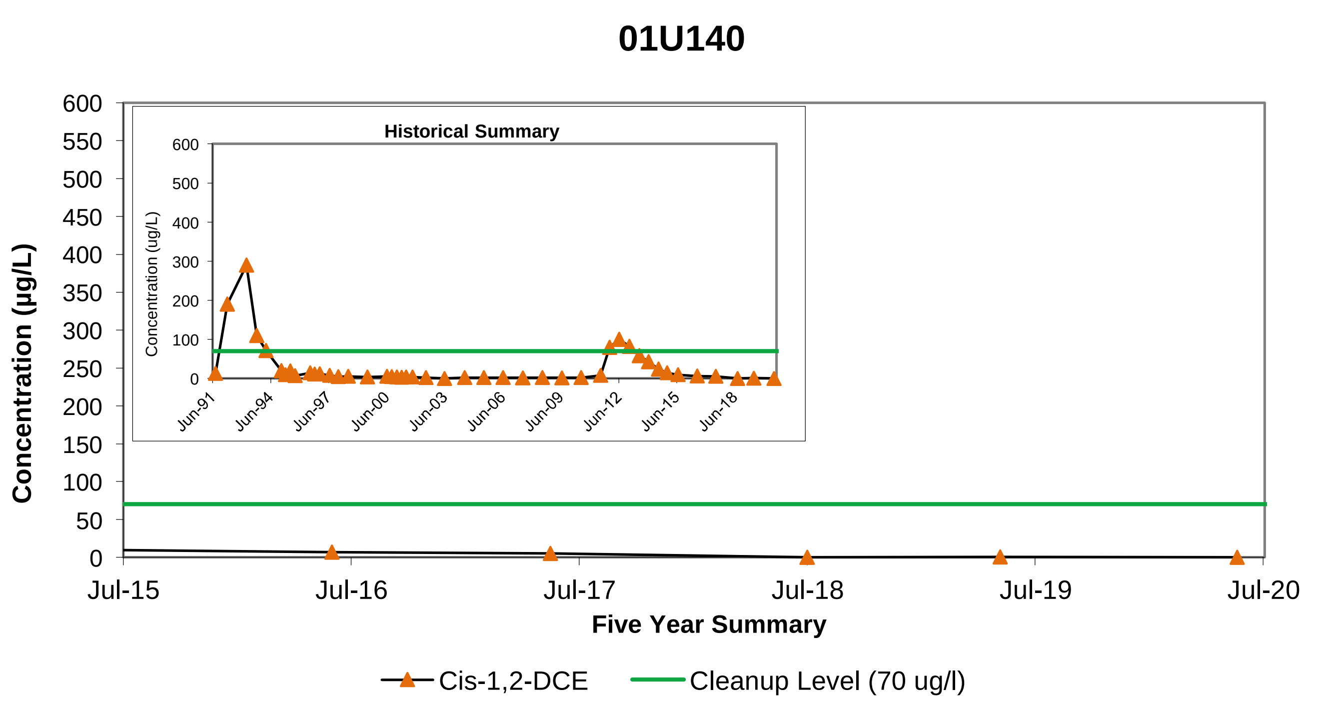
Site A, cis-1,2-Dichloroethene Water Quality Trends: Monitoring Wells

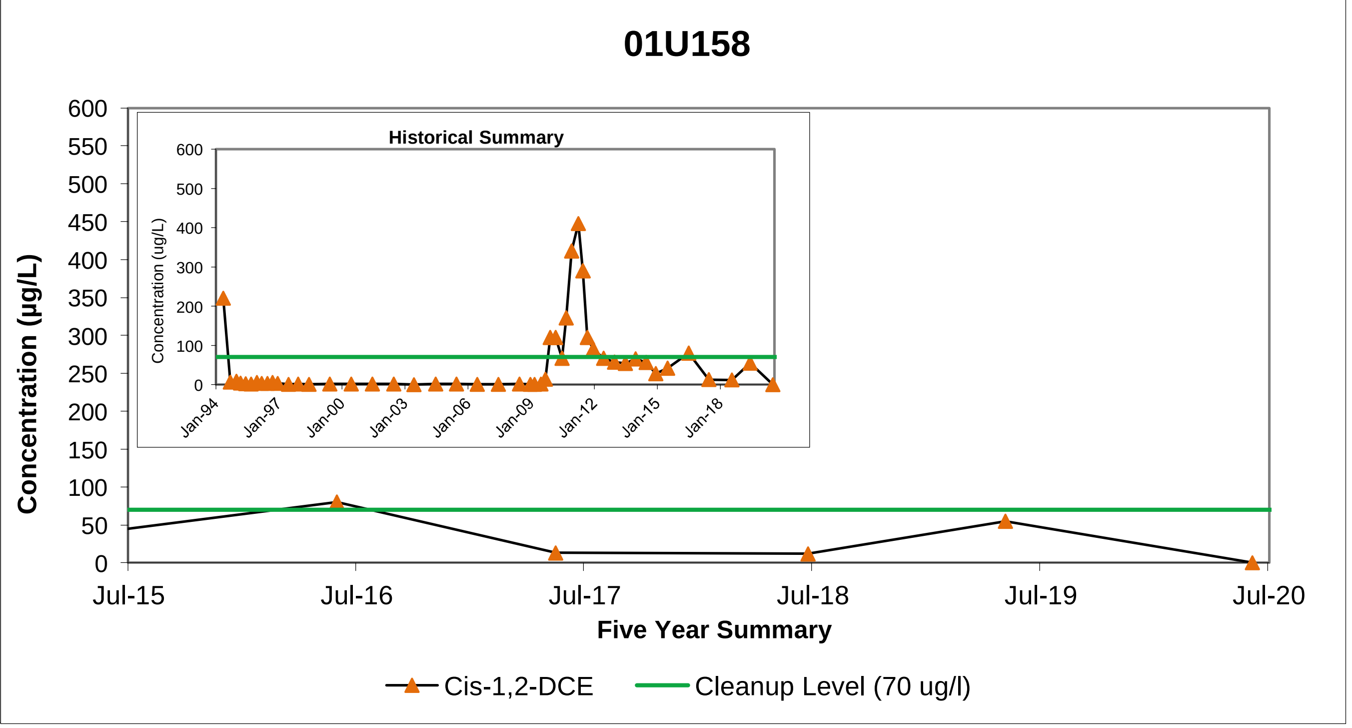
Twin Cities Army Ammunitions Plant
Arden Hills, Minnesota

PIKA ARCADIS a joint venture



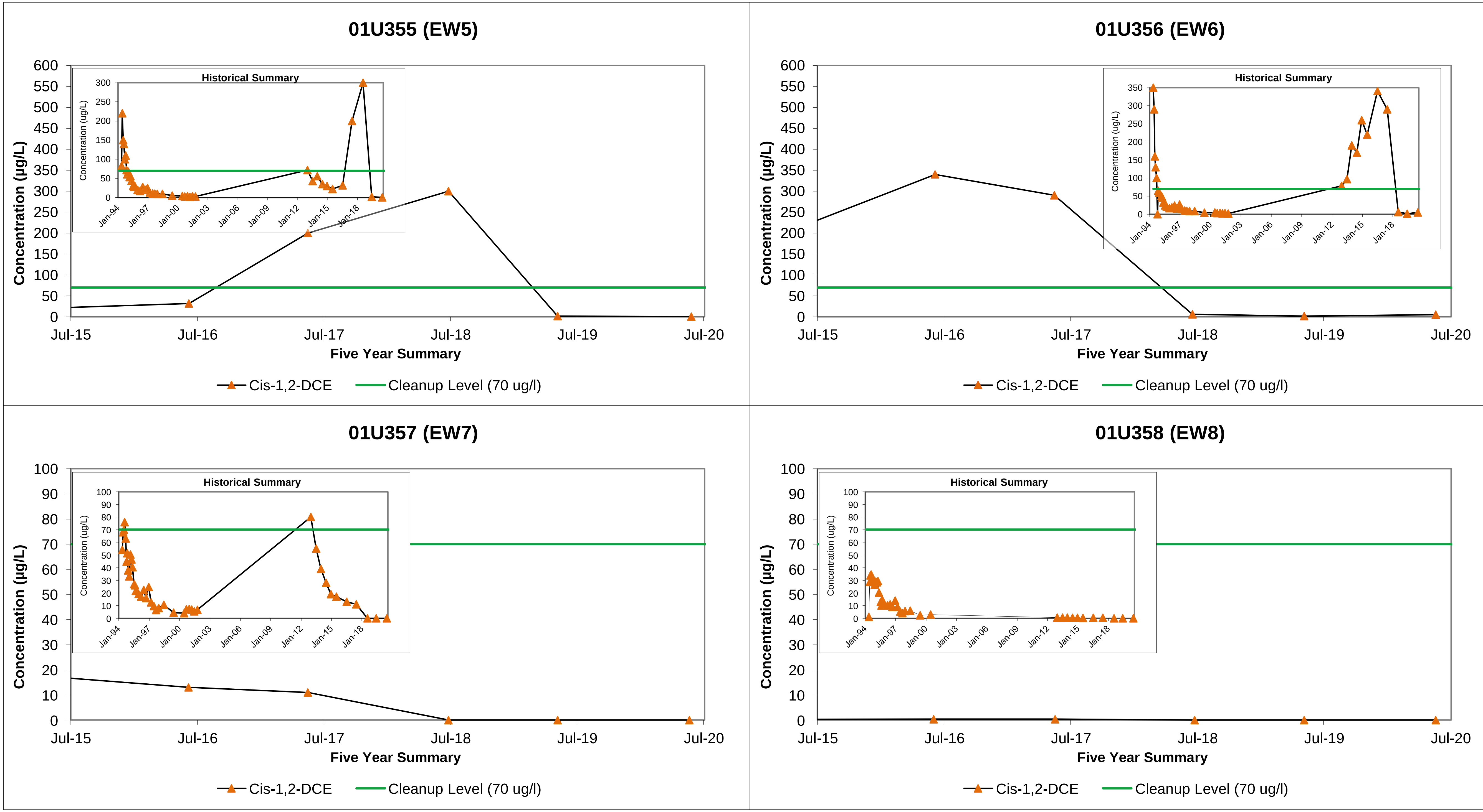






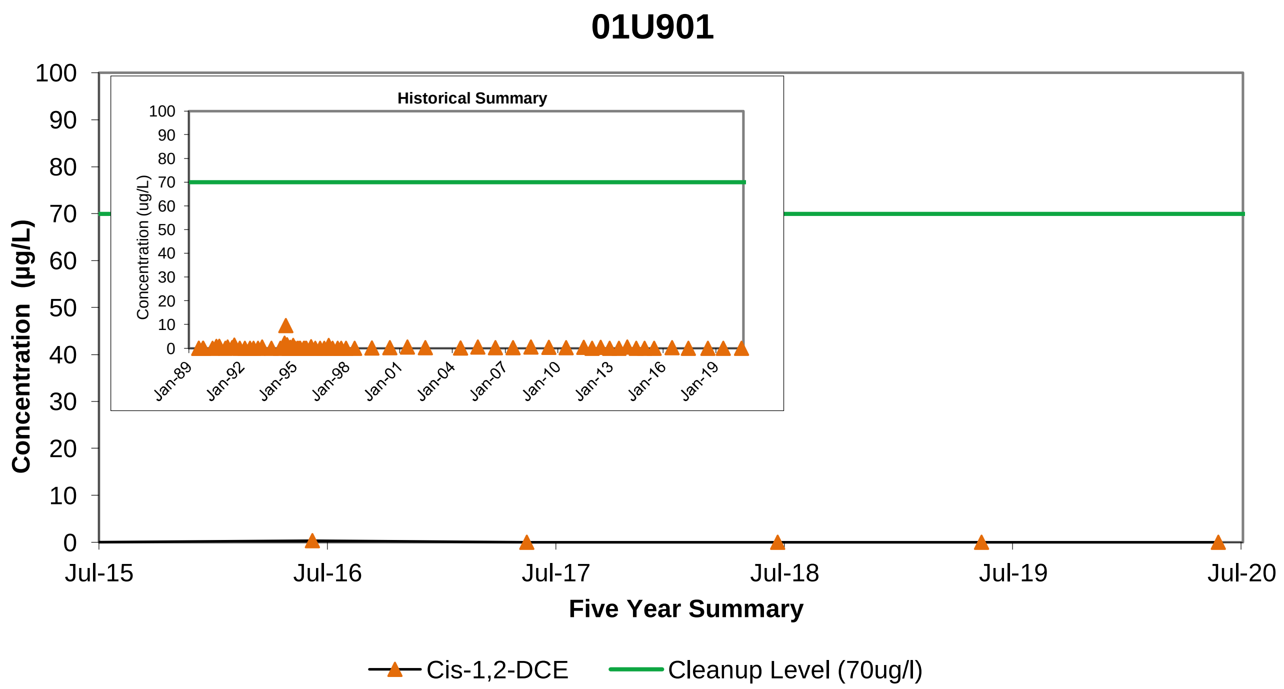
Acronyms and Abbreviations:
µg/L = micrograms per liter

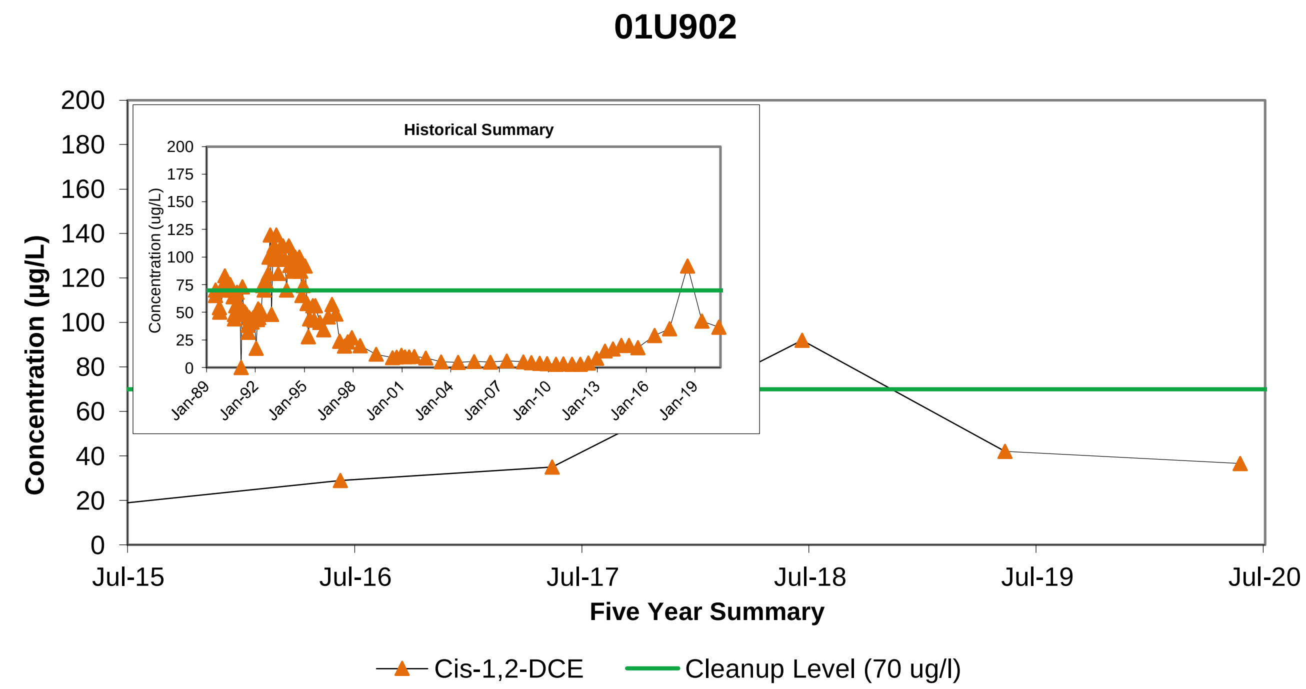
FY 2020 Annual Performance Report
Figure 6-9
Site A, cis-1,2-Dichloroethene Water Quality Trends: Extraction Wells 5 through 8
Twin Cities Army Ammunitions Plant
Arden Hills, Minnesota

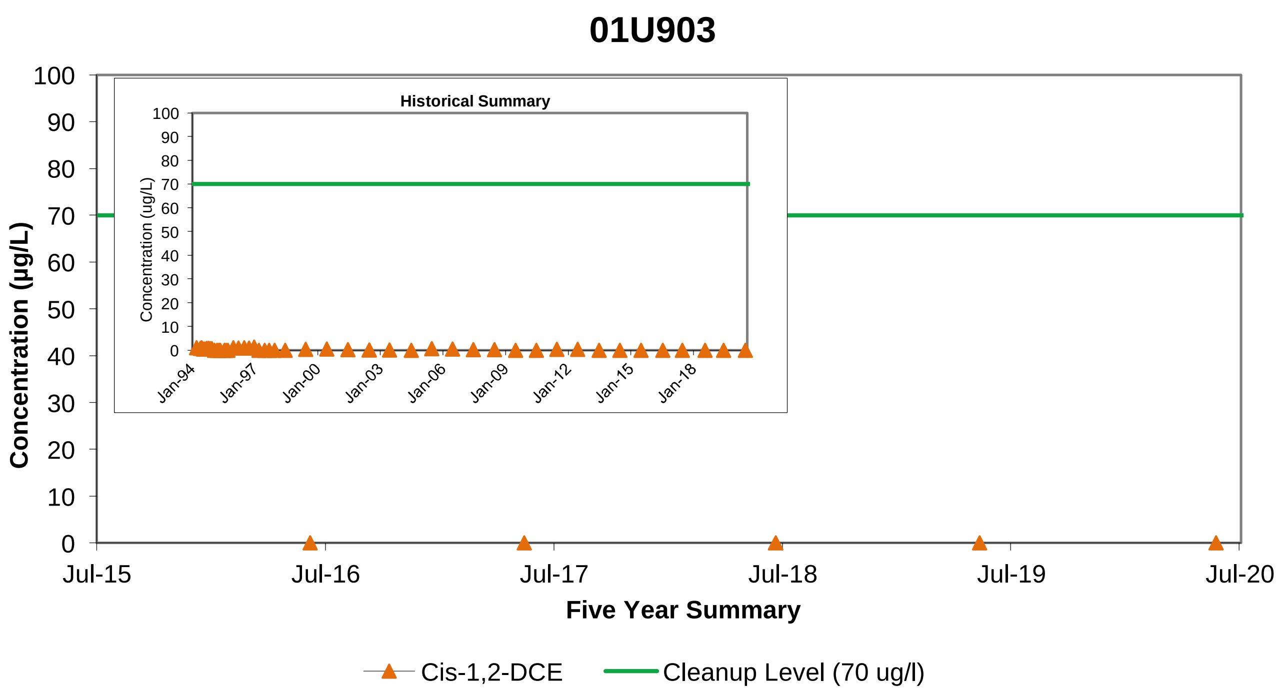


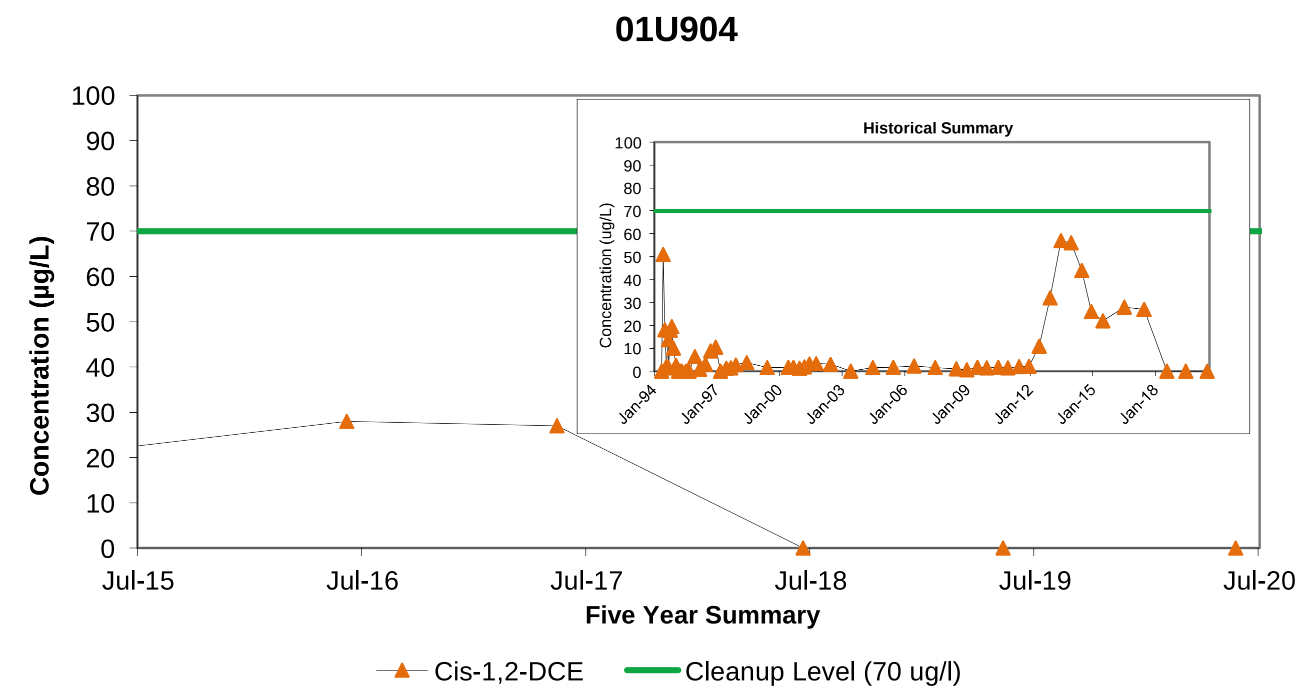
Acronyms and Abbreviations:
EW = Extraction Well
µg/L = micrograms per liter

FY 2020 Annual Performance Report
Figure 6-10
Site A, cis-1,2-Dichloroethene Water Quality Trends: Contingency Locations
Twin Cities Army Ammunitions Plant
Arden Hills, Minnesota

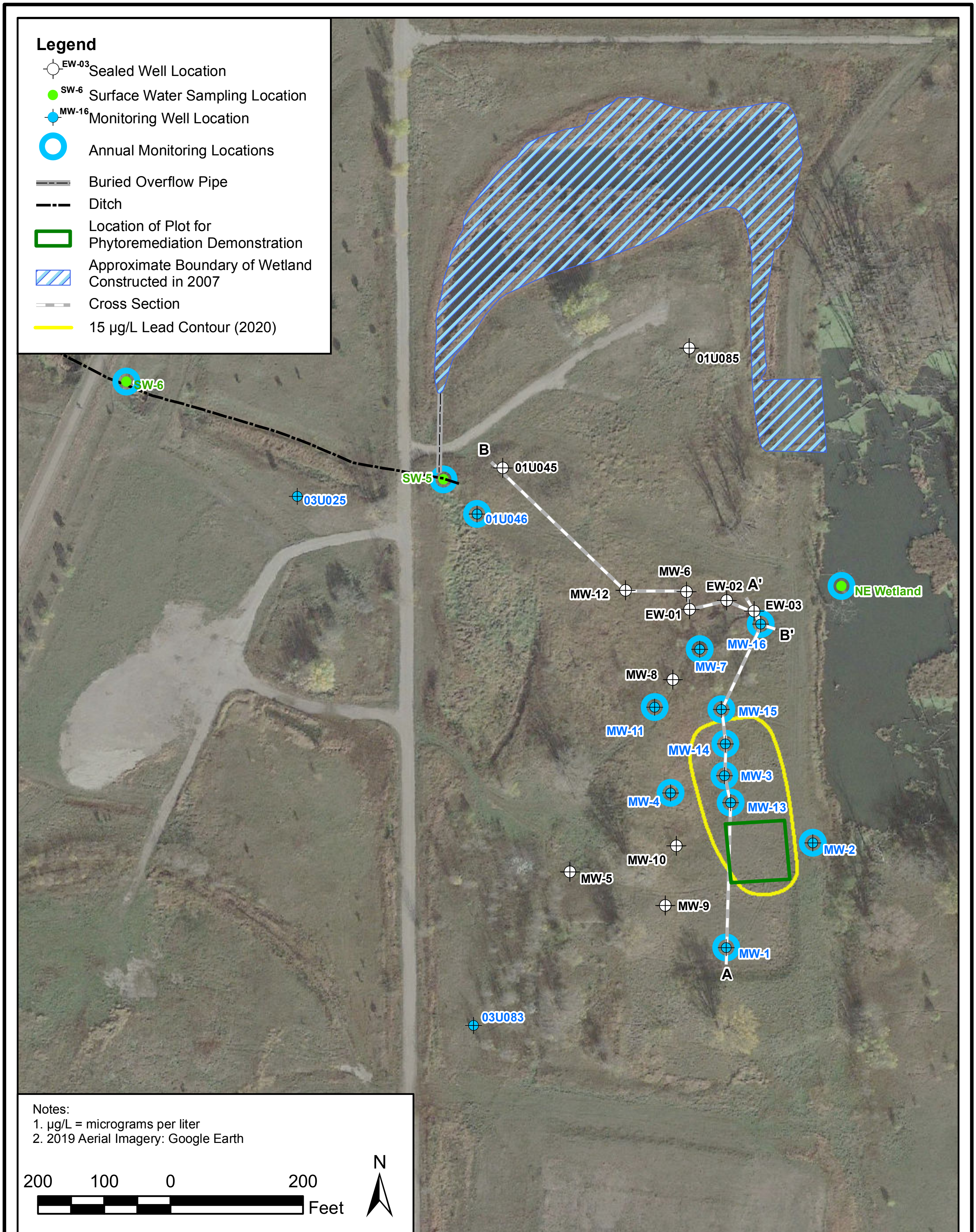








Acronyms and Abbreviations:
µg/L = micrograms per liter



ANNUAL PERFORMANCE REPORT

Site C Monitoring Plan June 2020

PIKA ARCADIS a joint venture

FY 2020

Figure 7-1

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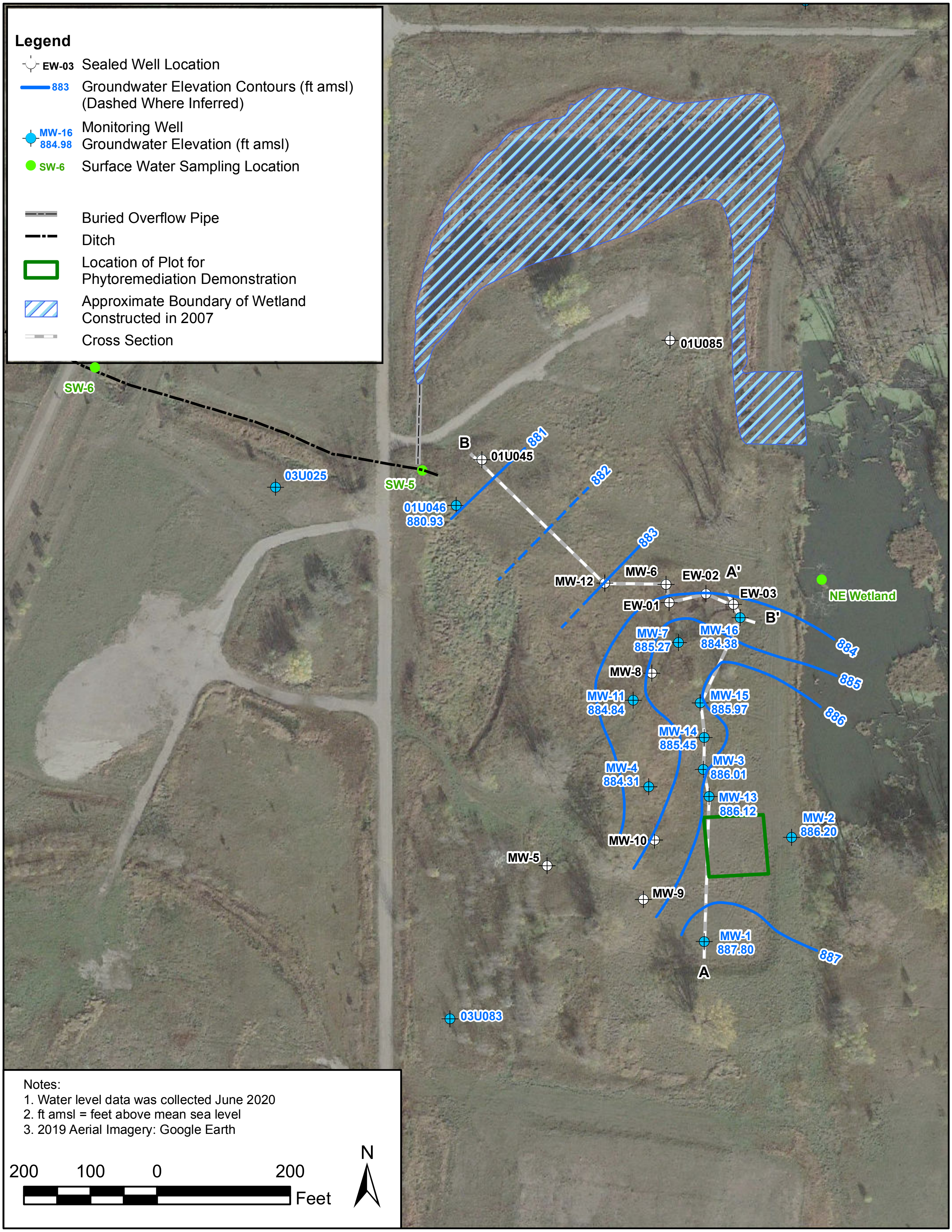

ANNUAL PERFORMANCE REPORT

Site C, Unit 1, Potentiometric Map, June 2020

PIKA ARCADIS a joint venture

FY 2020

Figure 7-2

Path: F:\TCAAP\RegEdits\2020_12\F7_2_Site C Potentiometric Map_FY2020.mxd
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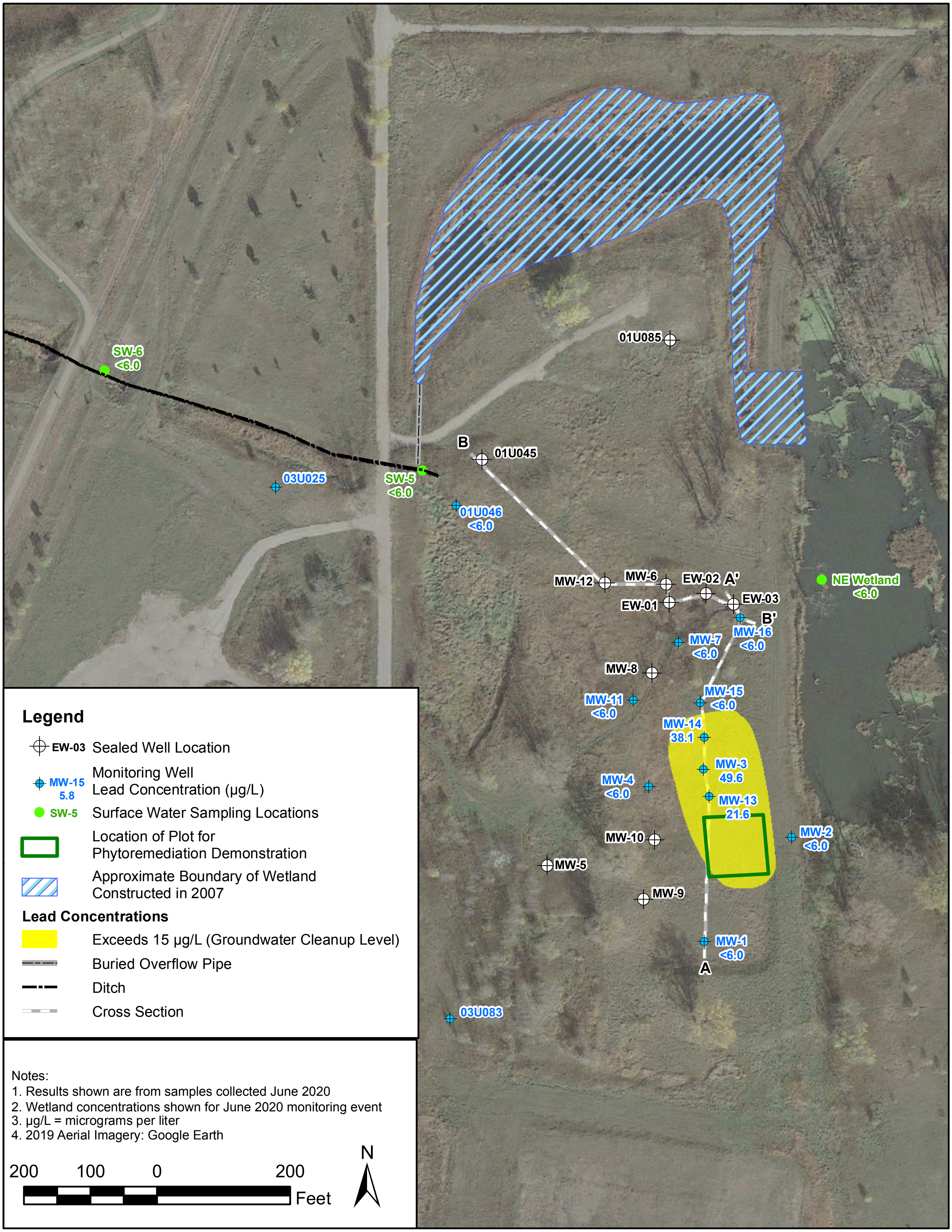

Notes:
1. Results shown are from samples collected June 2020
2. Wetland concentrations shown for June 2020 monitoring event
3. µg/L = micrograms per liter
4. 2019 Aerial Imagery: Google Earth

ANNUAL PERFORMANCE REPORT
Site C, Unit 1, Lead Results, June 2020

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Figure 7-3

Path: F:\TCAAP\RegEdits\2020_12\F7_3_Site C Lead in GW_FY2020.mxd
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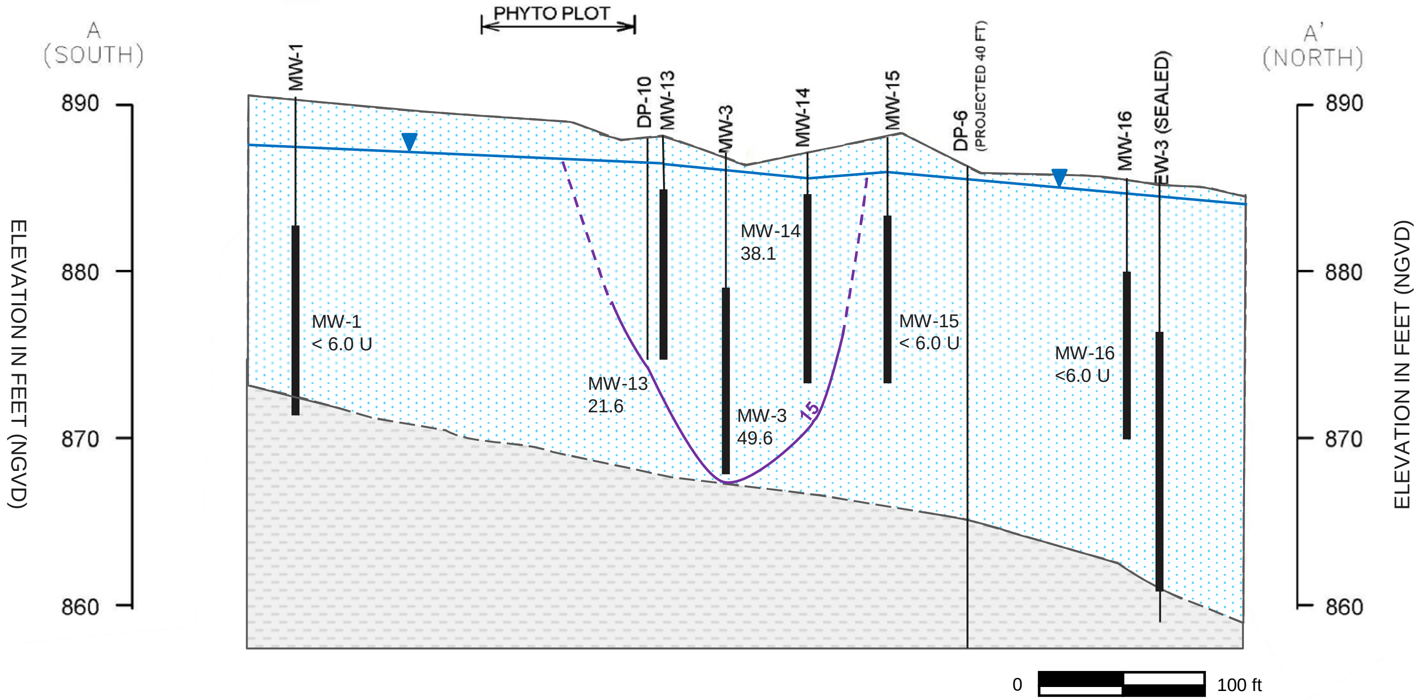
FY 2020 Annual Performance Report
Figure 7-4
Site C Cross Section A-A'

U.S Army - TCAAP
Arden Hills, Minnesota



Legend

	Upper Unit 1
	Upper Unit 2
	Water Table
	Screened Interval
	Geologic Contact (inferred where dashed)
MW-3	Well ID
µg/L	Micrograms per Liter
	15 µg/L Dissolved Lead Concentration Contour (Groundwater Cleanup Level) dashed where inferred
1.6	Dissolved Lead (µg/L) – June 2020
NGVD	National Geodetic Vertical Datum

FY 2020 Annual Performance Report
Figure 7-5
Site C Cross Section B-B'

U.S Army - TCAAP
Arden Hills, Minnesota

PIKA
ARCADIS
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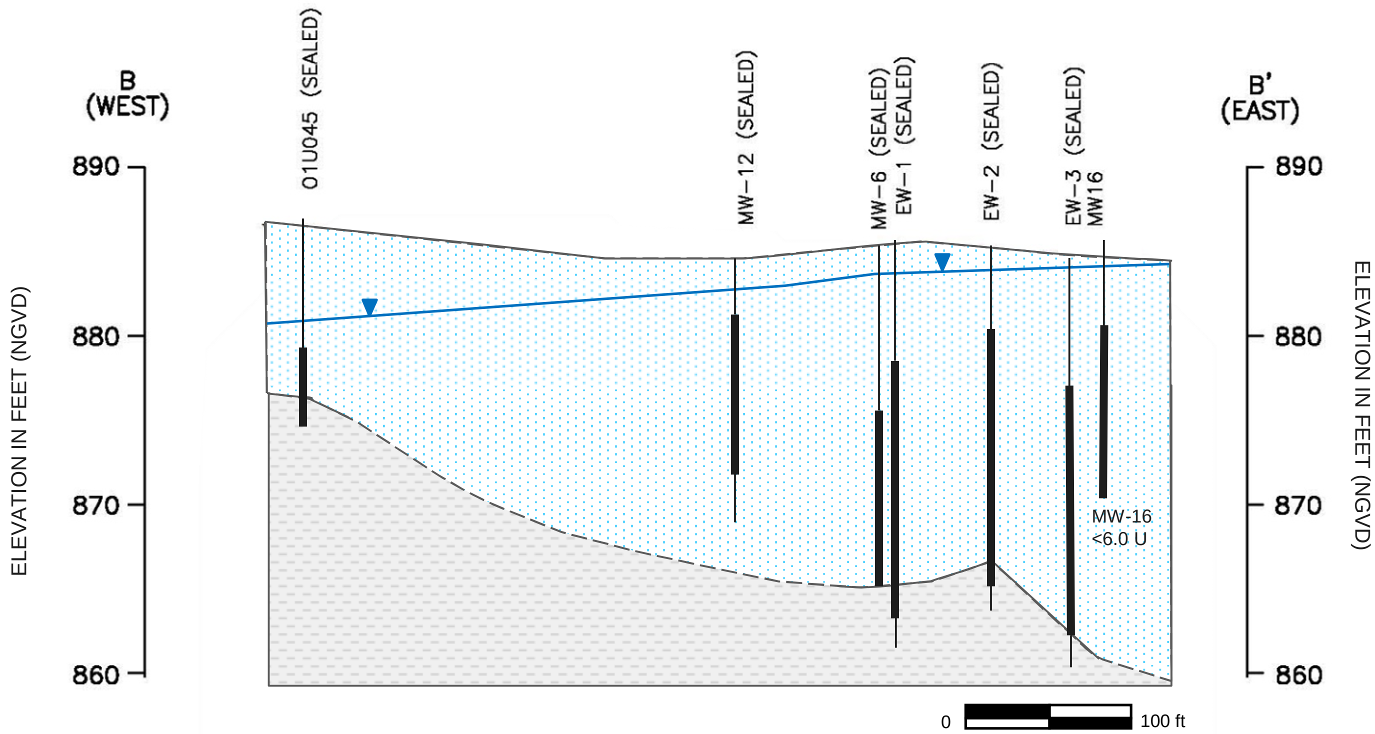
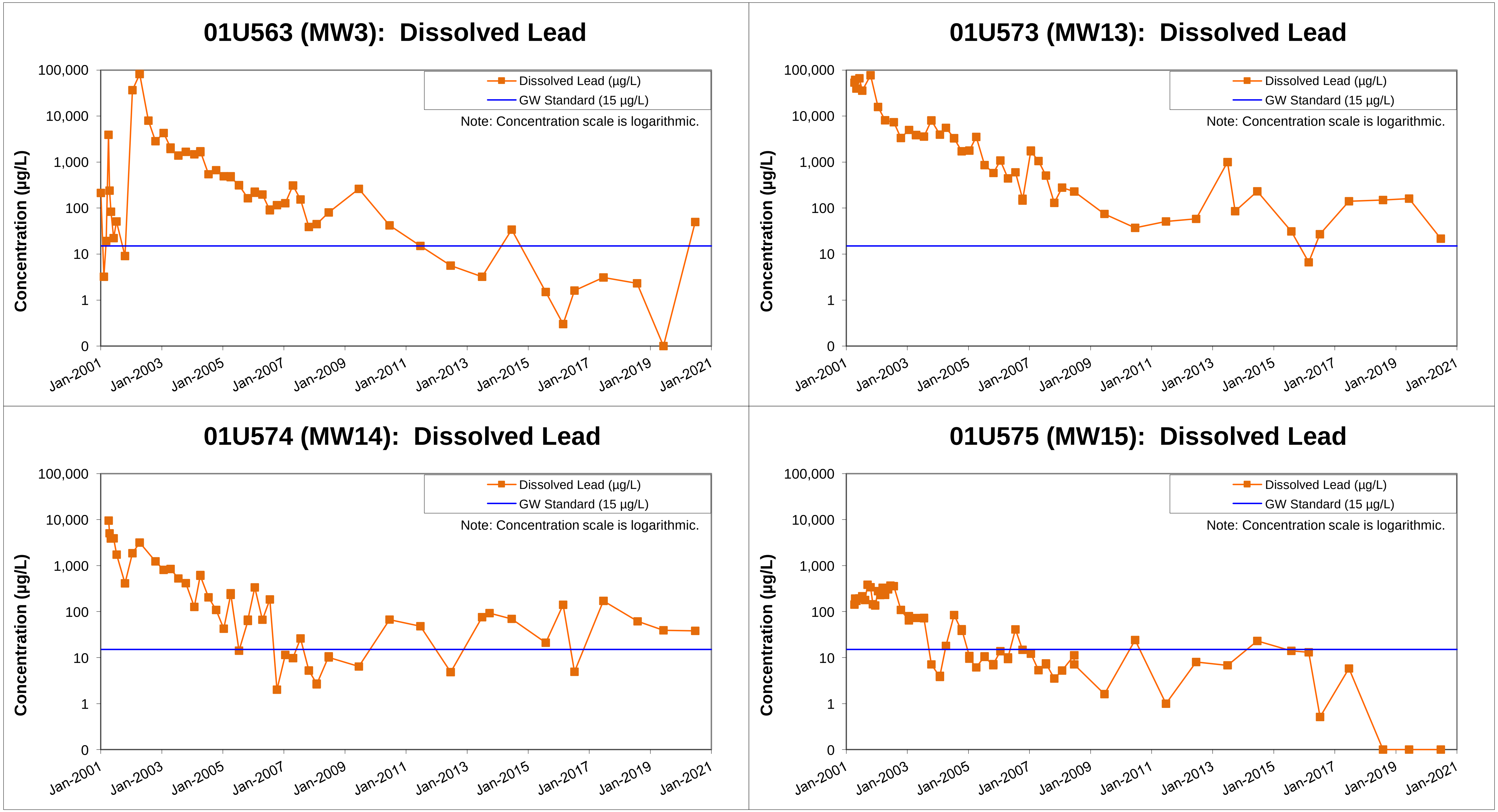


Legend

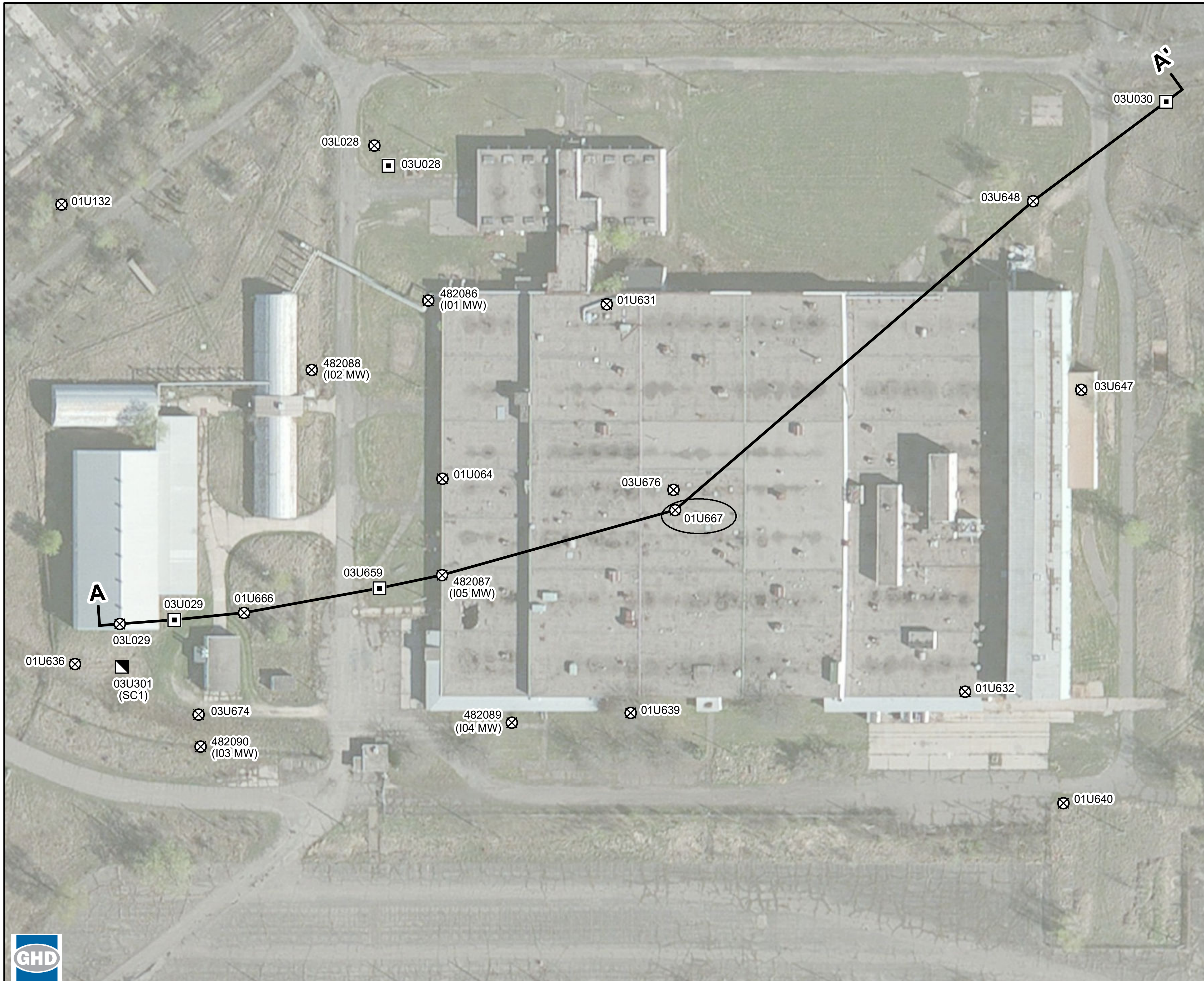
Upper Unit 1
Upper Unit 2
Water Table
Screened Interval
Geologic Contact (inferred where dashed)
MW-6 Well ID
μg/L Micrograms per Liter
0.30 U Dissolved Lead (μg/L) – June 2020
NGVD National Geodetic Vertical Datum

FY 2020 Annual Performance Report
Figure 7-6
Dissolved Lead Trends

Twin Cities Army Ammunitions Plant
Arden Hills, Minnesota



Acronyms and Abbreviations:
MW = monitoring well
µg/L = micrograms per liter



N

0 50 100 ft

LEGEND

WELL ABANDONED DURING REDEVELOPMENT

UNIT 3 MONITORING WELL LOCATION

TGRS EXTRACTION WELL LOCATION

ABANDONED WELL TO BE REPLACED

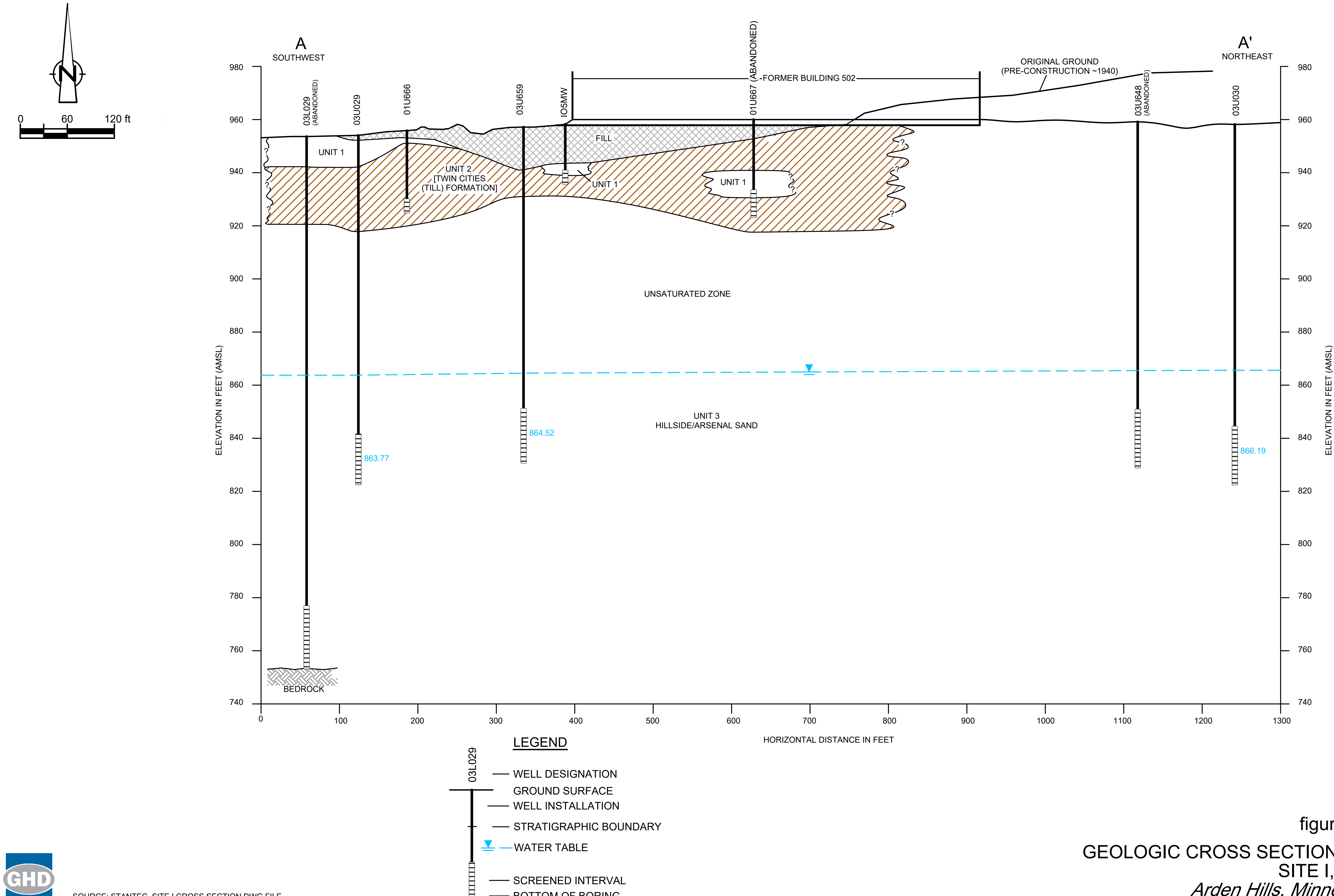
HYDROGEOLOGIC CROSS SECTION LOCATION

NOTE: BUILDING 502 DEMOLISHED IN 2014

figure 8-1

SITE PLAN
SITE I, OU2
Arden Hills, Minnesota

11221407-43(RPT-APR)GIS-SP001 APR 28/2021

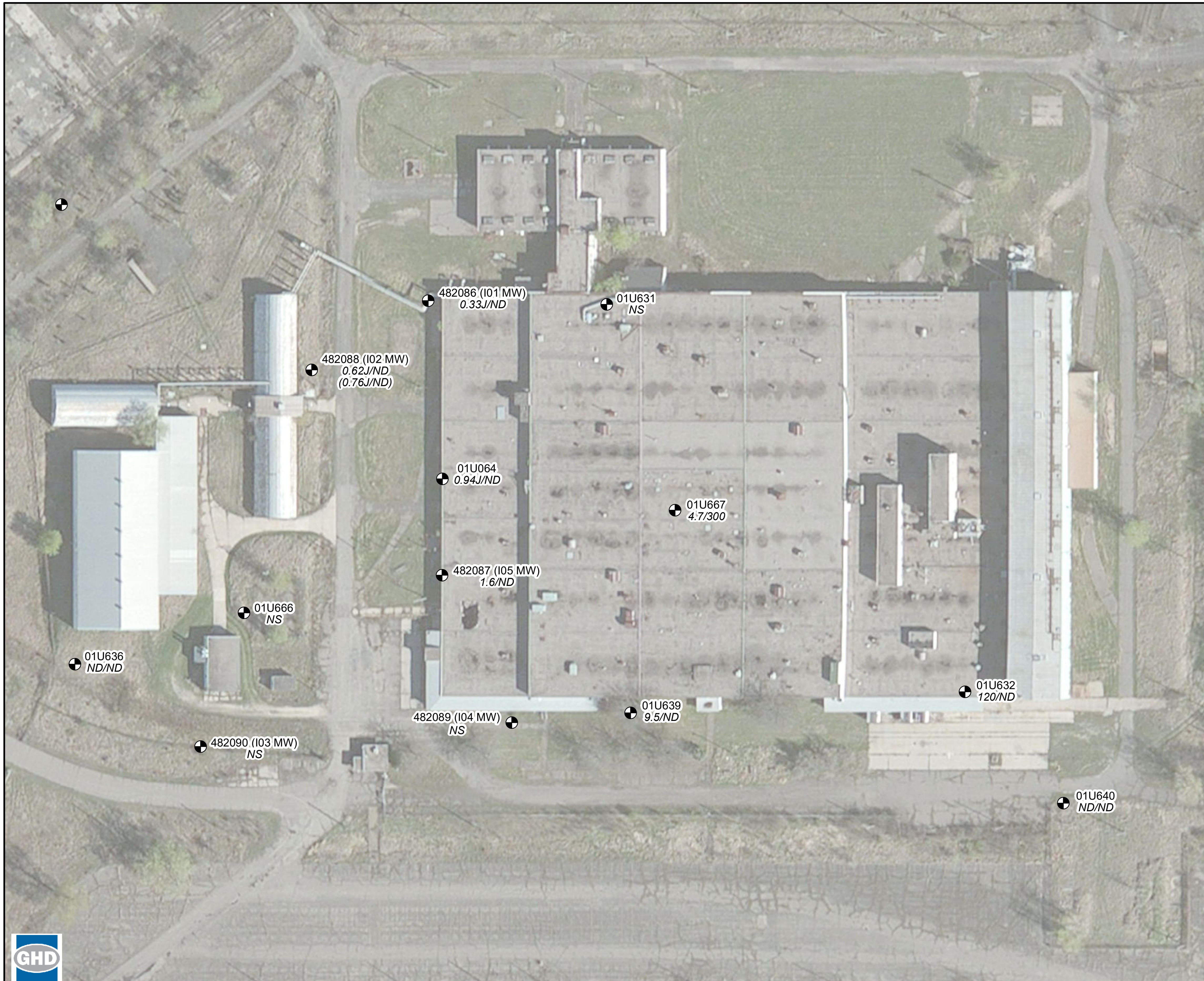


SOURCE: STANTEC, SITE I CROSS SECTION DWG FILE

figure 8-2

GEOLOGIC CROSS SECTION A-A'
SITE I, OU2
Arden Hills, Minnesota

N:\US\St Paul\Projects\563\11221407\Digital_Design\ACAD 2020\Figures\RPT-001\11221407(RPT-001)GN-WA013.DWG Plot Date: JAN 04, 2021



LEGEND

4.7/300	FY 2013 TCE / VINYL CHLORIDE CONCENTRATION (µg/L)
J	ESTIMATED CONCENTRATION
( )	DUPLICATE RESULTS
ND	ANALYTE NOT DETECTED
NS	WELL NOT SAMPLED
	UNIT 1 MONITORING WELL

NOTE: BUILDING 502 DEMOLISHED IN 2014

figure 8-3

TCE AND VINYL CHORIDE CONCENTRATIONS - FY 2013
SITE I, OU2
Arden Hills, Minnesota

11221407-43(RPT-APR)GIS-SP002 DEC 21/2020

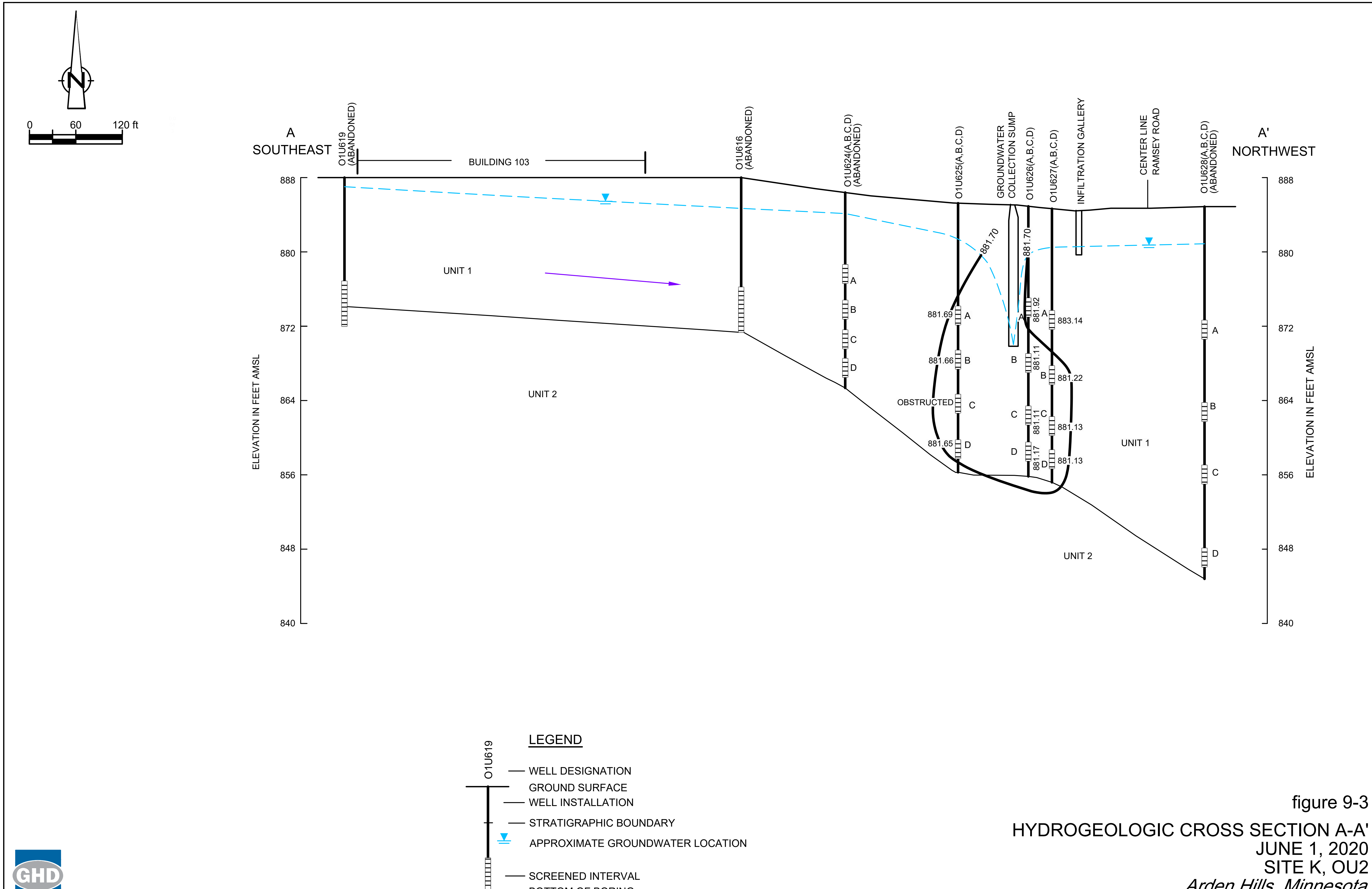
figure 9-1

SITE PLAN
SITE K, OU2
Arden Hills, Minnesota

figure 9-2

GROUNDWATER CONTOURS
UNIT 1 - JUNE 1, 2020
SITE K, OU2
Arden Hills, Minnesota

11221407-43(RPT-APR)GIS-SP004 JAN 04/2021



SOURCE: STANTEC, SITE K CROSS SECTION DWG FILE

figure 9-3

HYDROGEOLOGIC CROSS SECTION A-A'
JUNE 1, 2020
SITE K, OU2
Arden Hills, Minnesota

N:\US\St Paul\Projects\563\11221407\Digital_Design\ACAD 2020\Figures\RPT-001\11221407(RPT-001)GN-WA001.DWG Plot Date: JAN 06, 2021

LEGEND

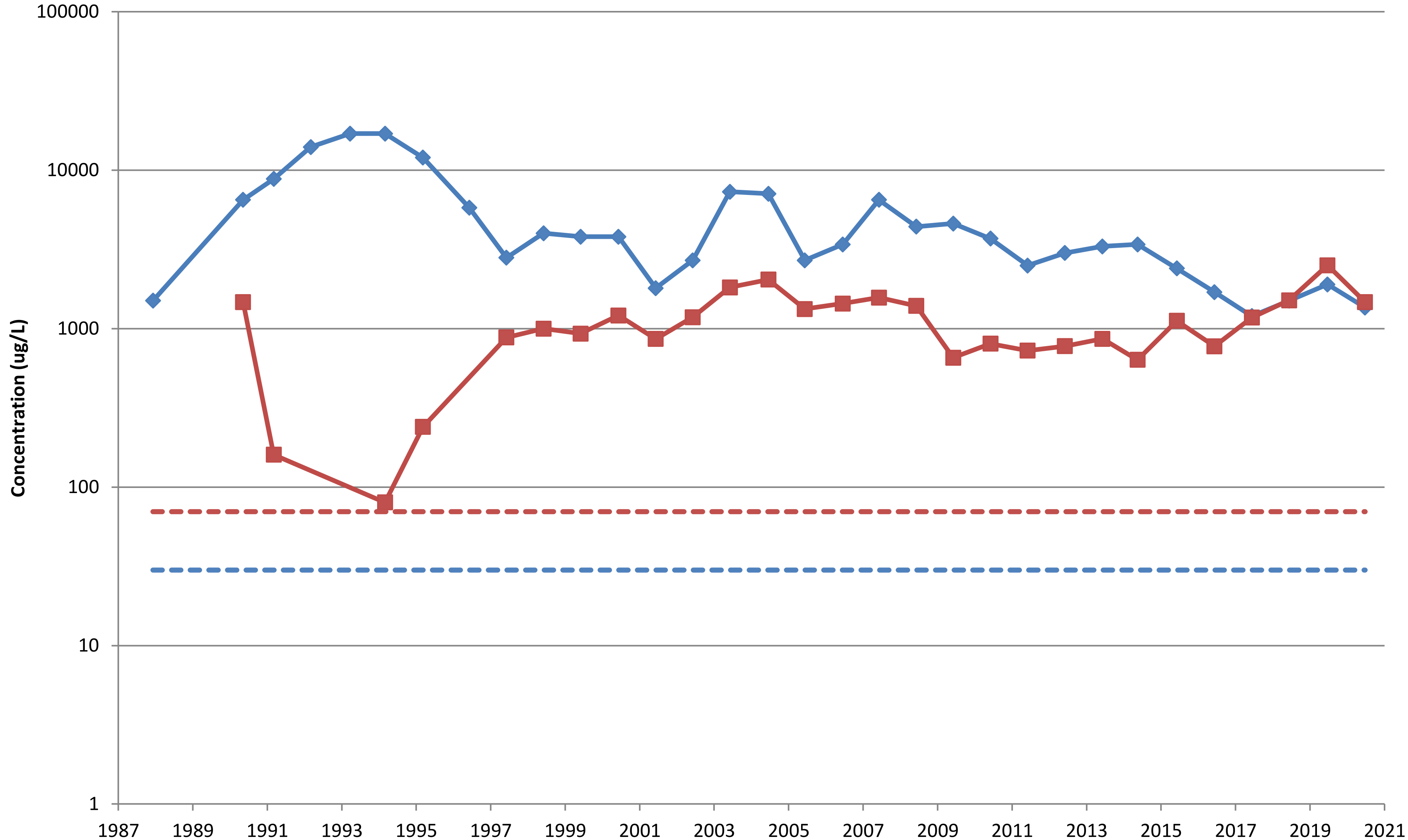
1200	TCE CONCENTRATION
ND	TCE NOT DETECTED
	1000 µg/L TCE PLUME LIMIT (ESTIMATED BASED ON 2014 DATA)
	ANNUAL WATER QUALITY MONITORING WELL LOCATION
	ANNUAL UNIT 1 WATER LEVEL MONITORING WELL LOCATION
	ANNUAL UNIT 3 WATER QUALITY SENTINAL WELL LOCATION
	ABANDONED WELL
	BUILDING 102 MONITORING WELL LOCATION
	GEOPROBE BORING LOCATION FROM 2014 INVESTIGATION
	SITE K COLLECTION TRENCH LOCATION

NOTE:
BUILDING 103 DEMOLISHED IN 2006;
CONCRETE SLAB REMOVED IN 2014

figure 9-4

TCE CONCENTRATIONS
UNIT 1 - JUNE 2020
SITE K, OU2
Arden Hills, Minnesota

11221407-43(RPT-APR)GIS-SP005 JUN 03/2021



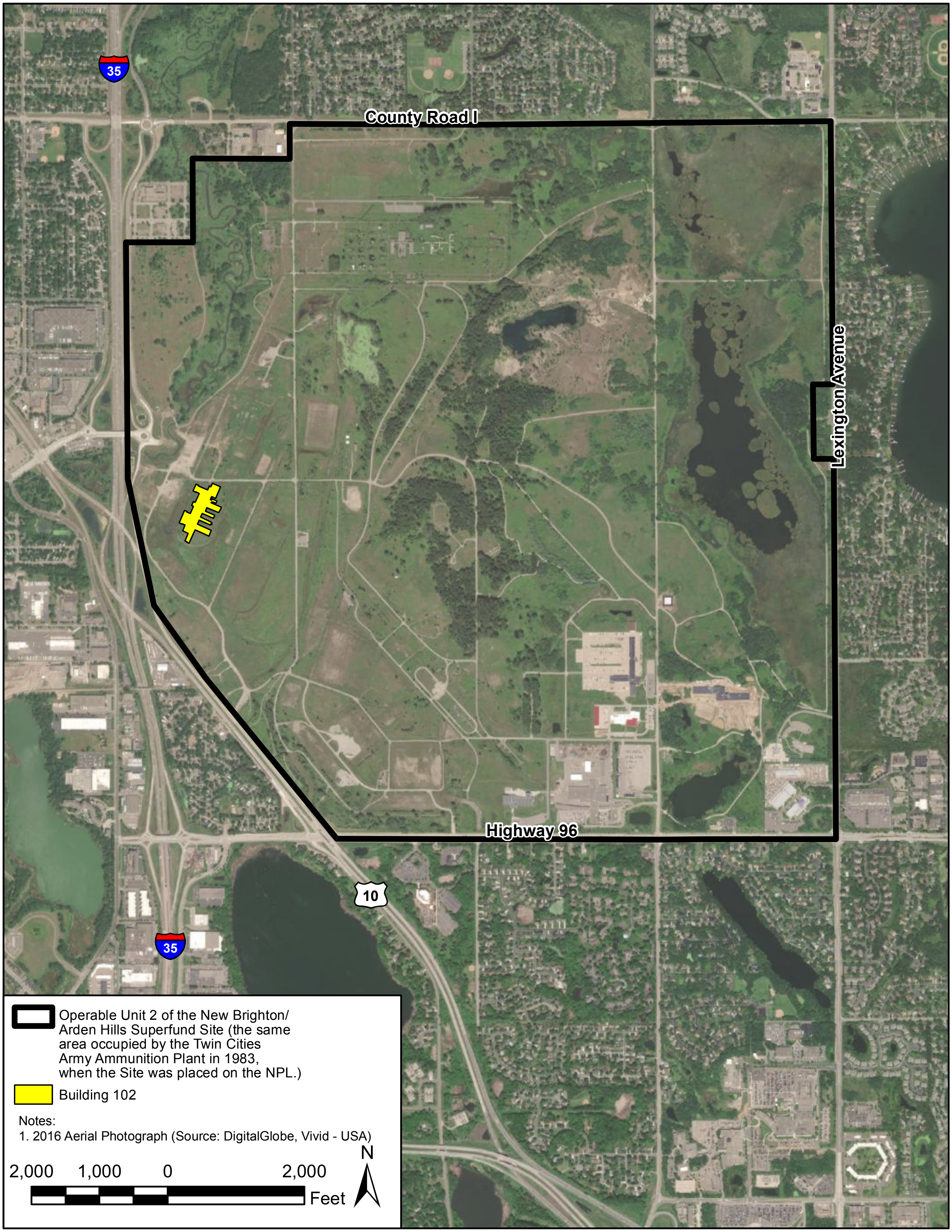
LEGEND

Trichloroethene
Total 1,2-Dichloroethene
Trichloroethene Site K Cleanup Level
Total 1,2-Dichloroethene Site K Cleanup Level

figure 9-5

VOC CONCENTRATIONS OVER TIME
WELL 01U615
SITE K, OU2
Arden Hills, Minnesota

11221407-43(RPT-APR)GIS-SP006 DEC 21/2020



ANNUAL PERFORMANCE REPORT

Location of Building 102

PIKA ARCADIS a joint venture

FY 2020

Figure 10-1

Path: F:\TCAAP\RegEdits\2020_07\F10_1_Bldg 102 Location Map_FY2019.mxd
Date: 6/29/2020 Time: 8:13:08 AM User: KGPeters

Notes:
1. Lowest well in well nests was used for contouring.
2. Water levels in parenthesis were not used for contouring.
3. Groundwater elevations measured June 2020
4. ft amsl = feet above mean sea level
5. 2019 Aerial Imagery: Google Earth

200 100 0 200 Feet
N

ANNUAL PERFORMANCE REPORT

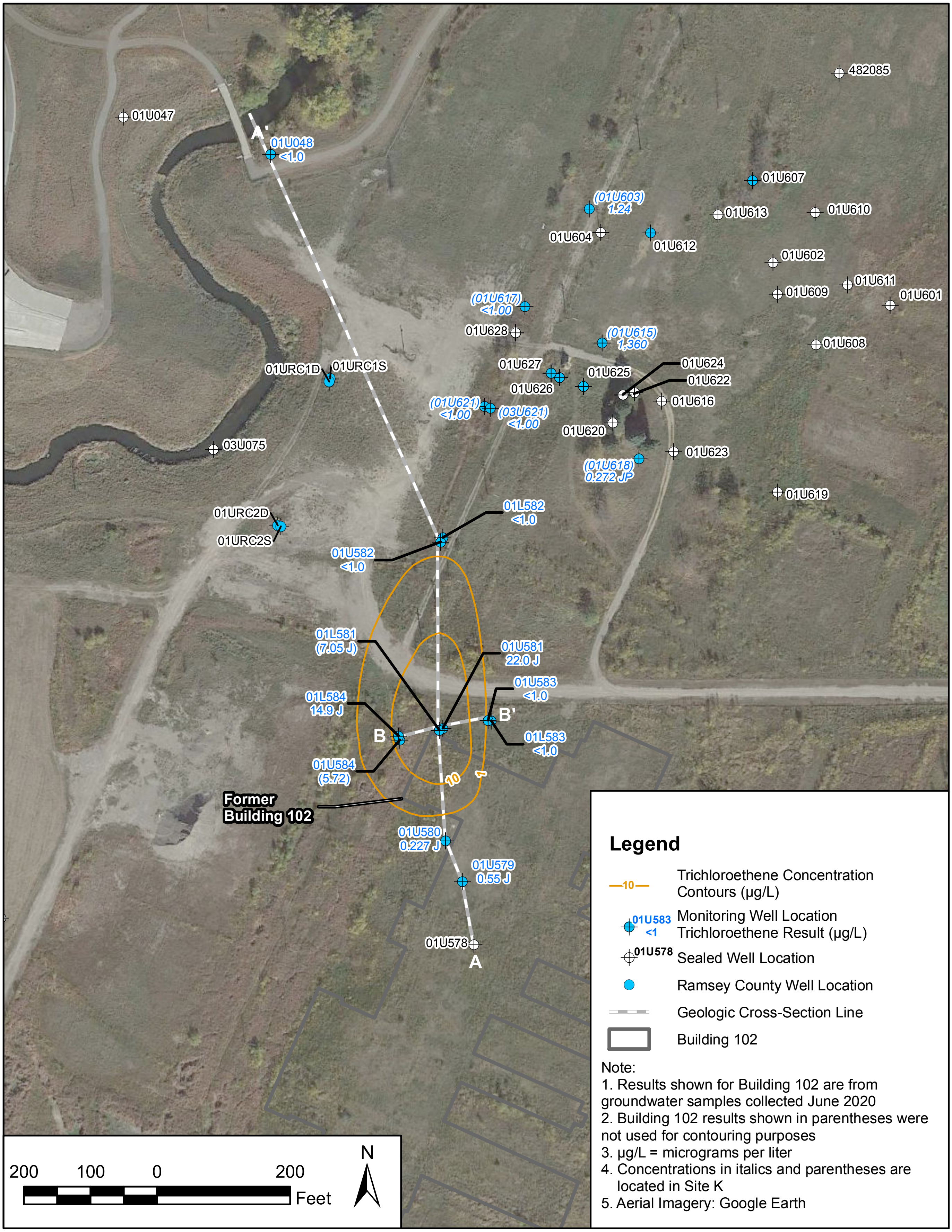
Building 102, Unit 1, Potentiometric Map, June 2020

PIKA ARCADIS a joint venture

FY 2020

Figure 10-2

Path: F:\TCAAP\RegEdits\2020_12\F10_2_Bldg 102 Potentiometric Map_FY2020.mxd
Date: 4/16/2021 Time: 9:12:28 AM User: KGPeters



Note:
1. Results shown for Building 102 are from groundwater samples collected June 2020
2. Building 102 results shown in parentheses were not used for contouring purposes
3. µg/L = micrograms per liter
4. Concentrations in italics and parentheses are located in Site K
5. Aerial Imagery: Google Earth

ANNUAL PERFORMANCE REPORT

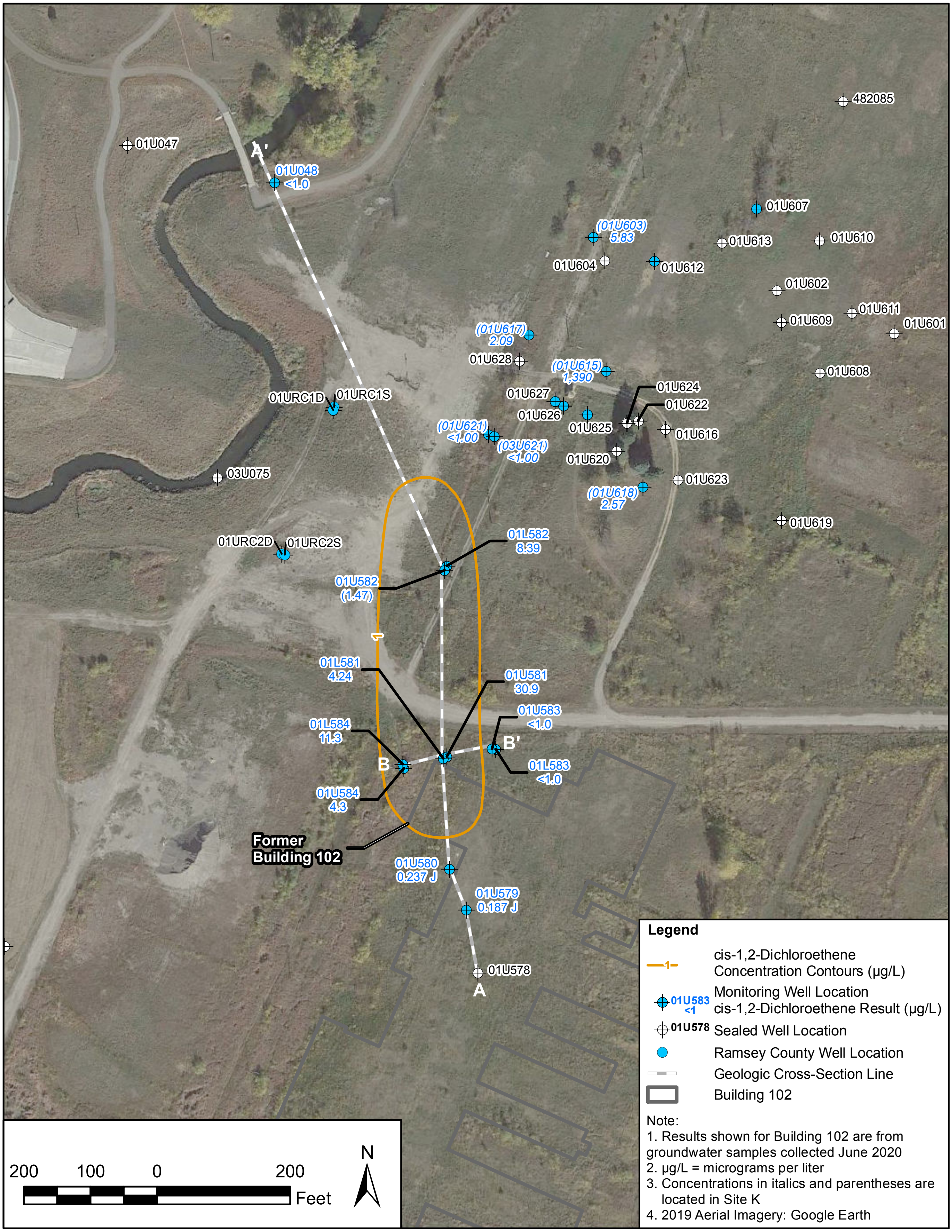
Building 102, Unit 1,
Trichloroethene Results, June 2020

PIKA ARCADIS a joint venture

FY 2020

Figure 10-3

Path: F:\TCAAP\RegEdits\2020_12\F10_3_Bldg 102 Trichloroethene Results_FY2020.mxd
Date: 1/28/2021 Time: 10:10:22 AM User: KGPeters



ANNUAL PERFORMANCE REPORT

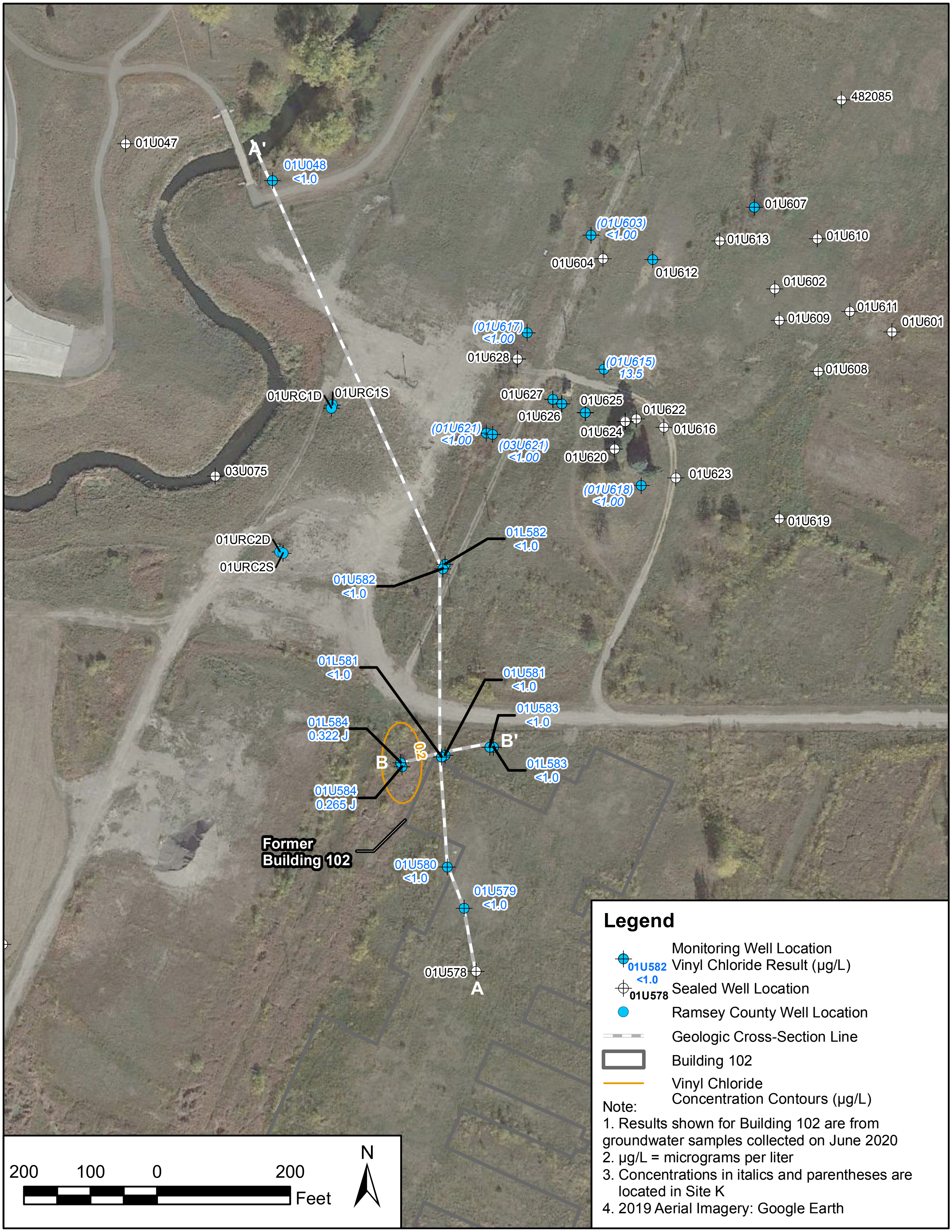
Building 102, Unit 1,
cis-1,2-Dichloroethene Results, June 2020

PIKA
ARCADIS
a joint venture

FY 2020

Figure 10-4

Path: F:\TCAAP\RegEdits\2020_12\F10_4_Bldg 102 Cis Results_FY2020.mxd
Date: 4/16/2021 Time: 9:15:13 AM User: KGPeters



ANNUAL PERFORMANCE REPORT

Building 102, Unit 1,
Vinyl Chloride Results, June 2020

PIKA
ARCADIS
a joint venture

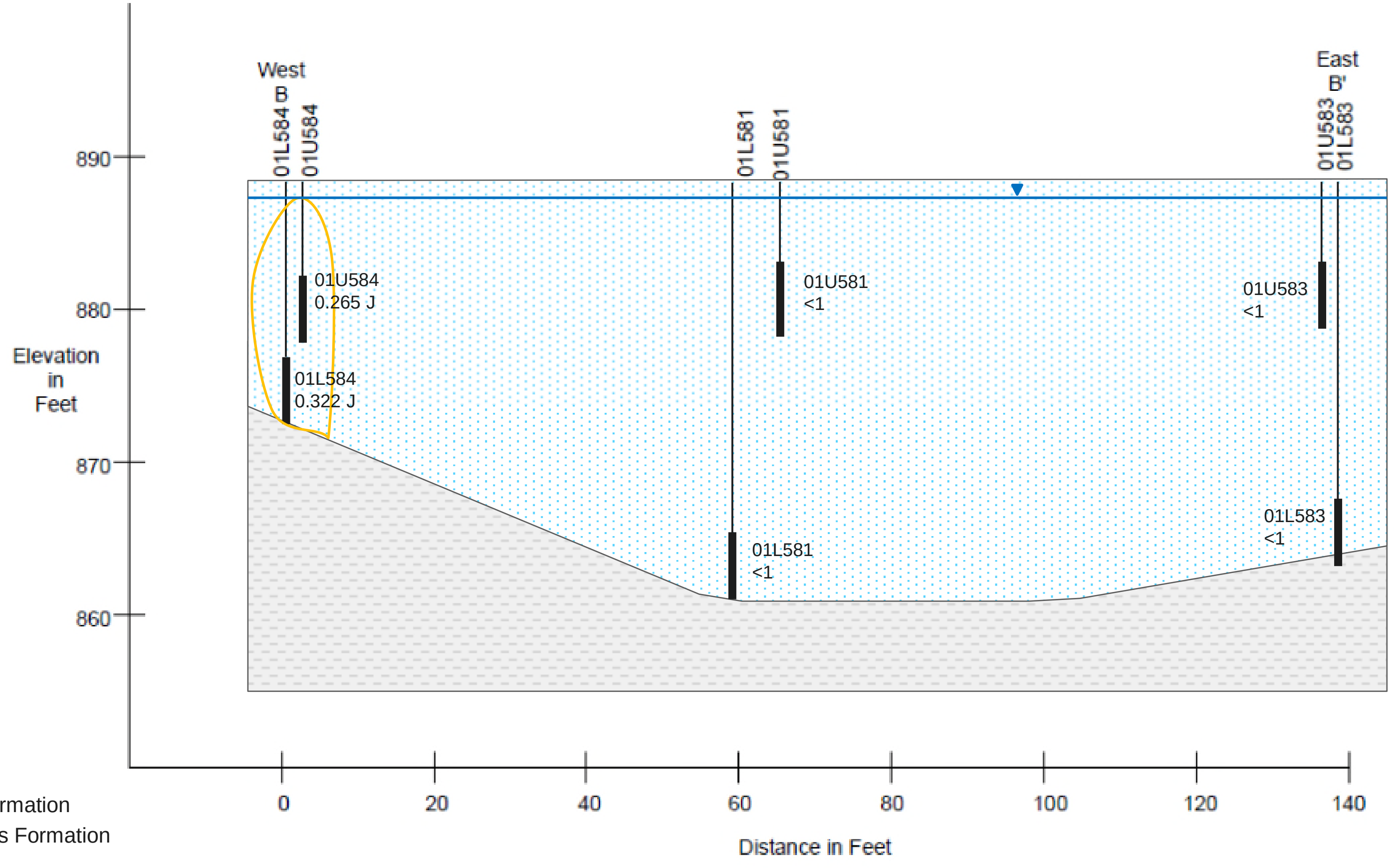
FY 2020

Figure 10-5

Path: F:\TCAAP\RegEdits\2020_12\F10_5_Bldg 102 Vinyl Results_FY2020.mxd
Date: 1/28/2021 Time: 10:05:34 AM User: KGPeters

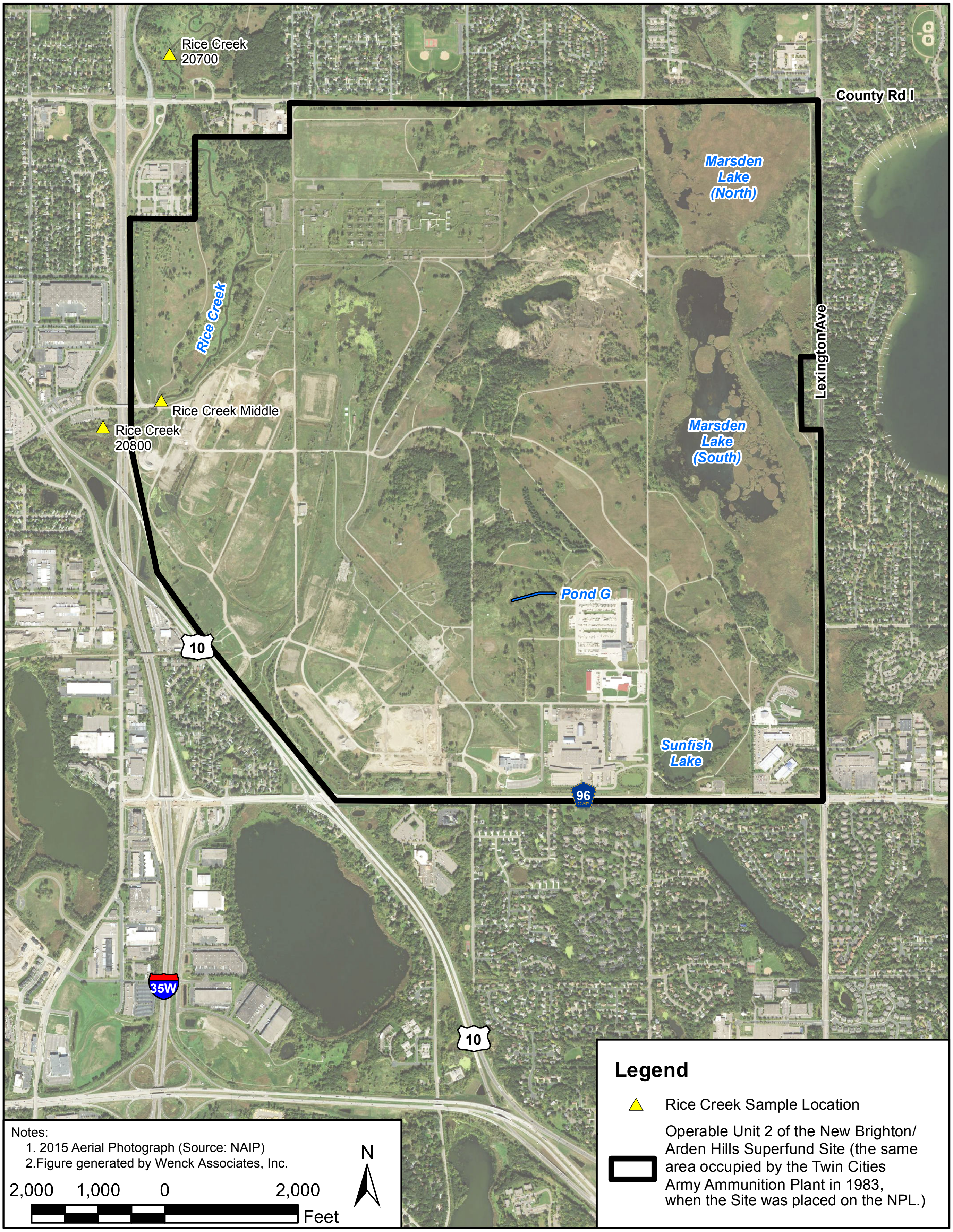
FY 2020 Annual Performance Report
Figure 10-6
Building 102, Vinyl Chloride Cross Section B-B'

U.S Army - TCAAP
Arden Hills, Minnesota



Legend

Fridley Formation
Twin Cities Formation
01U579 Monitoring Well ID
0.18 Vinyl Chloride Concentration (µg/L) (June 2020)
Vinyl Chloride Concentration Contour (0.2 µg/L)
Water Table



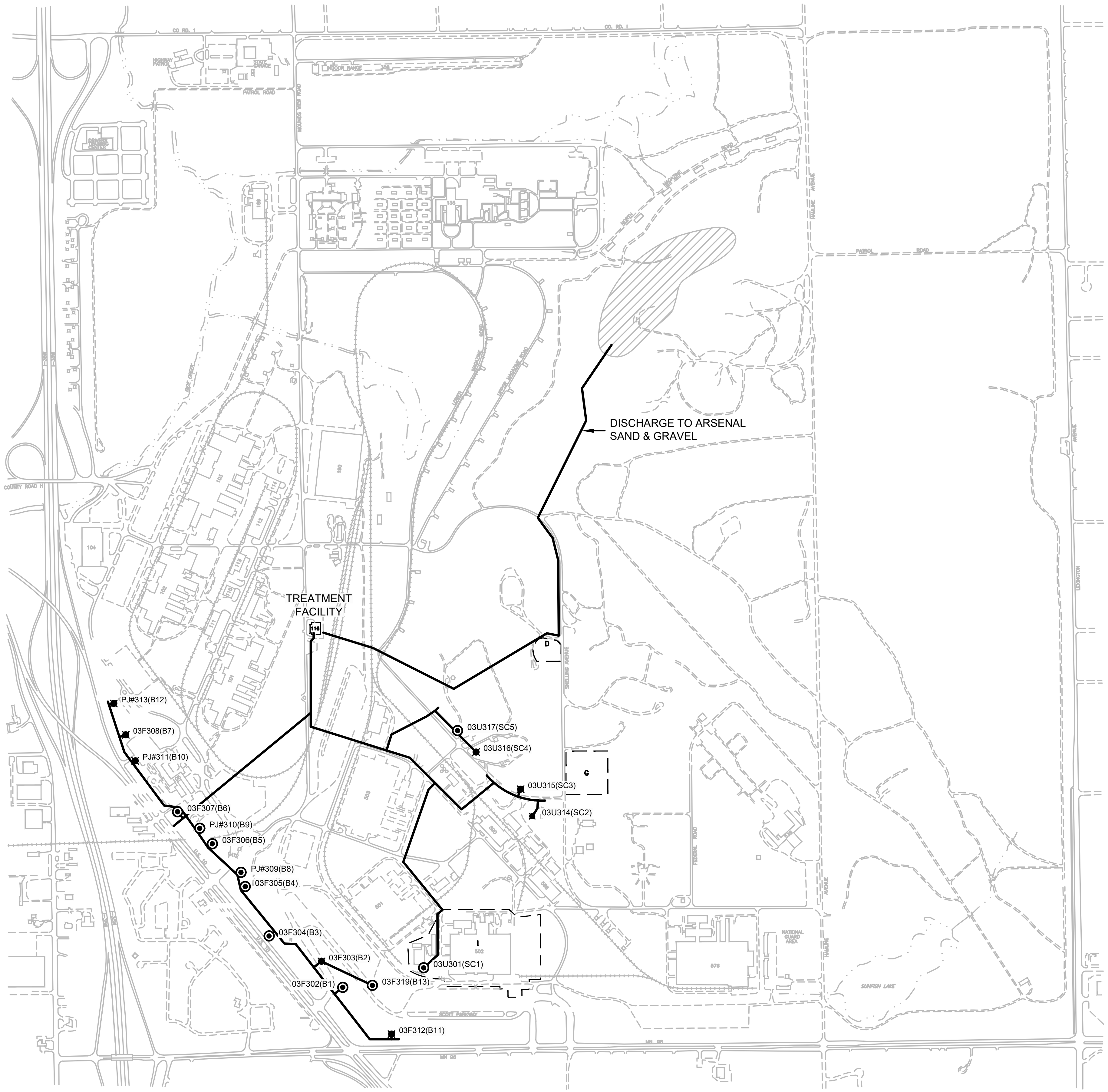
ANNUAL PERFORMANCE REPORT

OU2 Aquatic Sites and Sampling Locations

PIKA ARCADIS a joint venture

FY 2020

Figure 11-1



0 400 1200ft

LEGEND

PRIMARY ROAD
SECONDARY ROAD
RAILROAD
DRAINAGE
BUILDING
BUILDING REMOVED
SOURCE AREA
ACTIVE EXTRACTION WELL LOCATION
INACTIVE EXTRACTION WELL LOCATION

EXTRACTION WELL NAME CROSS REFERENCE

B1	03F302
B2	03F303
B3	03F304
B4	03F305
B5	03F306
B6	03F307
B7	03F308
B8	PJ#309
B9	PJ#310
B10	PJ#311
B11	03F312
B12	PJ#313
B13	03F319
SC1	03U301
SC2	03U314
SC3	03U315
SC4	03U316
SC5	03U317

figure 12-1

TGRS LAYOUT
OPERABLE UNIT 2
Arden Hills, Minnesota

N:\US\St Paul\Projects\563\11221407\Digital_Design\ACAD 2020\Figures\RPT-001\11221407(RPT-001)GN-WA002.DWG Plot Date: DEC 15, 2020

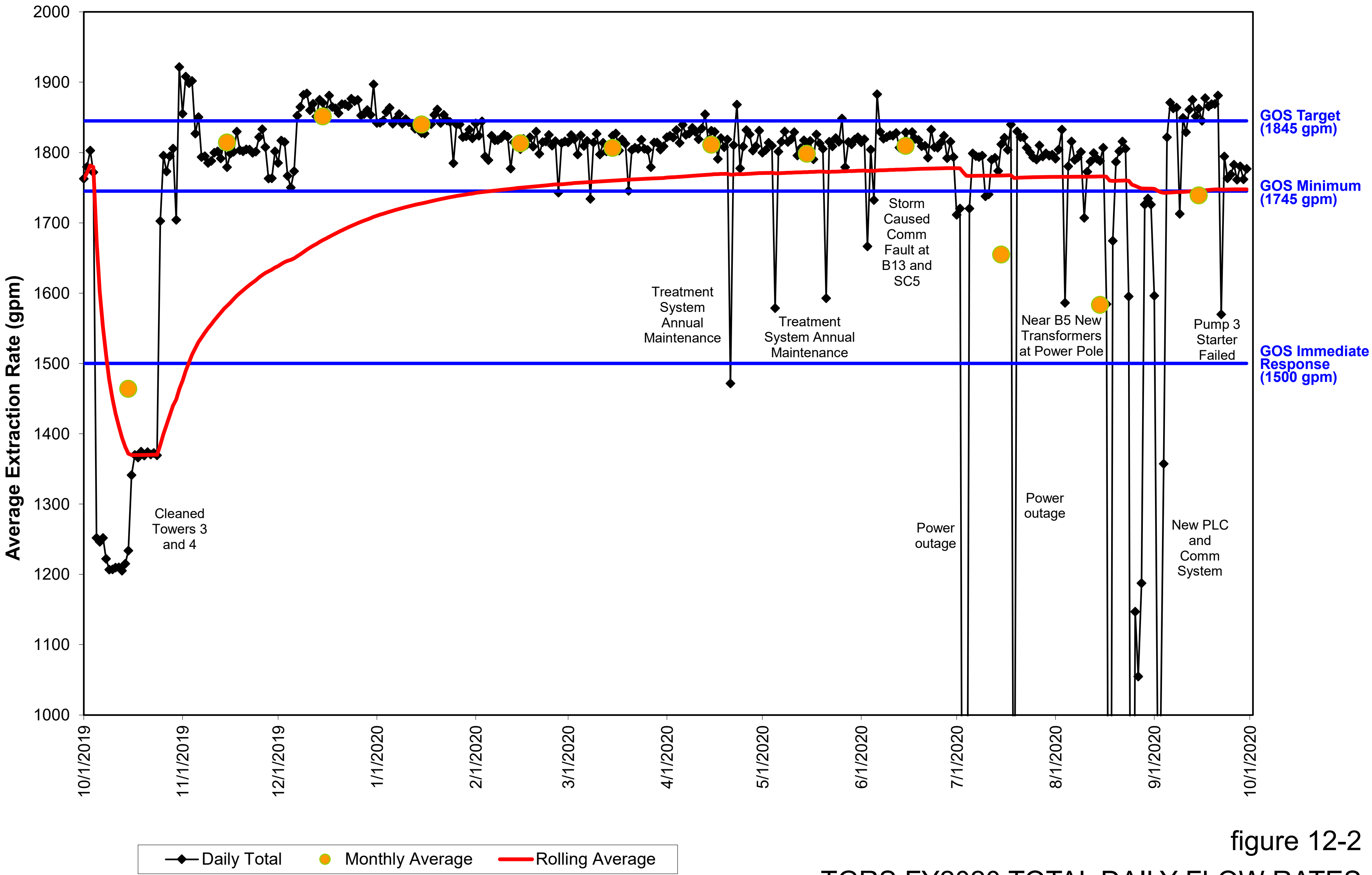
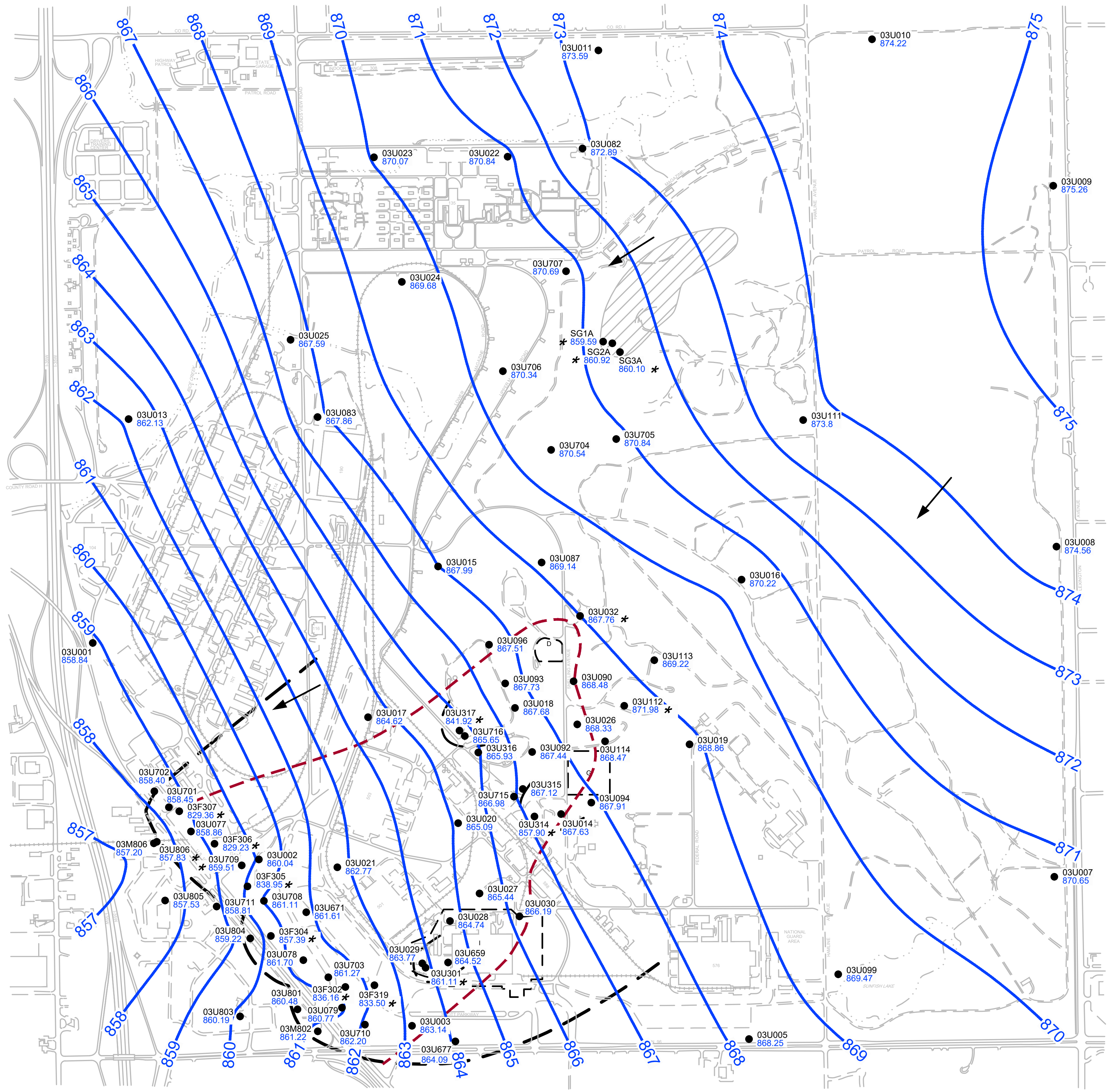


figure 12-2

TGRS FY2020 TOTAL DAILY FLOW RATES
OPERABLE UNIT 2
Arden Hills, Minnesota

11221407-43(RPT-APR)GIS-SP007 DEC 21/2020



LEGEND

- PRIMARY ROAD
- SECONDARY ROAD
- RAILROAD
- DRAINAGE
- BUILDING
- BUILDING REMOVED
- SOURCE AREA
- WELL LOCATION
- 869.15 GROUNDWATER ELEVATION IN FEET AMSL
- 861 GROUNDWATER CONTOUR
- DIRECTION OF GROUNDWATER FLOW
- LIMIT OF CAPTURE
- NOTE: GROUNDWATER CONTOURS ARE INTERPOLATED FROM THE DATA POINTS SHOWN.
- * GROUNDWATER ELEVATION NOT USED IN CONTOURING
- ARSENAL SAND AND GRAVEL PIT TREATED WATER DISCHARGE AREA. (APPROXIMATE BOUNDARIES)
- 5 µg/L TCE PLUME BOUNDARY

EXTRACTION WELL NAME CROSS REFERENCE

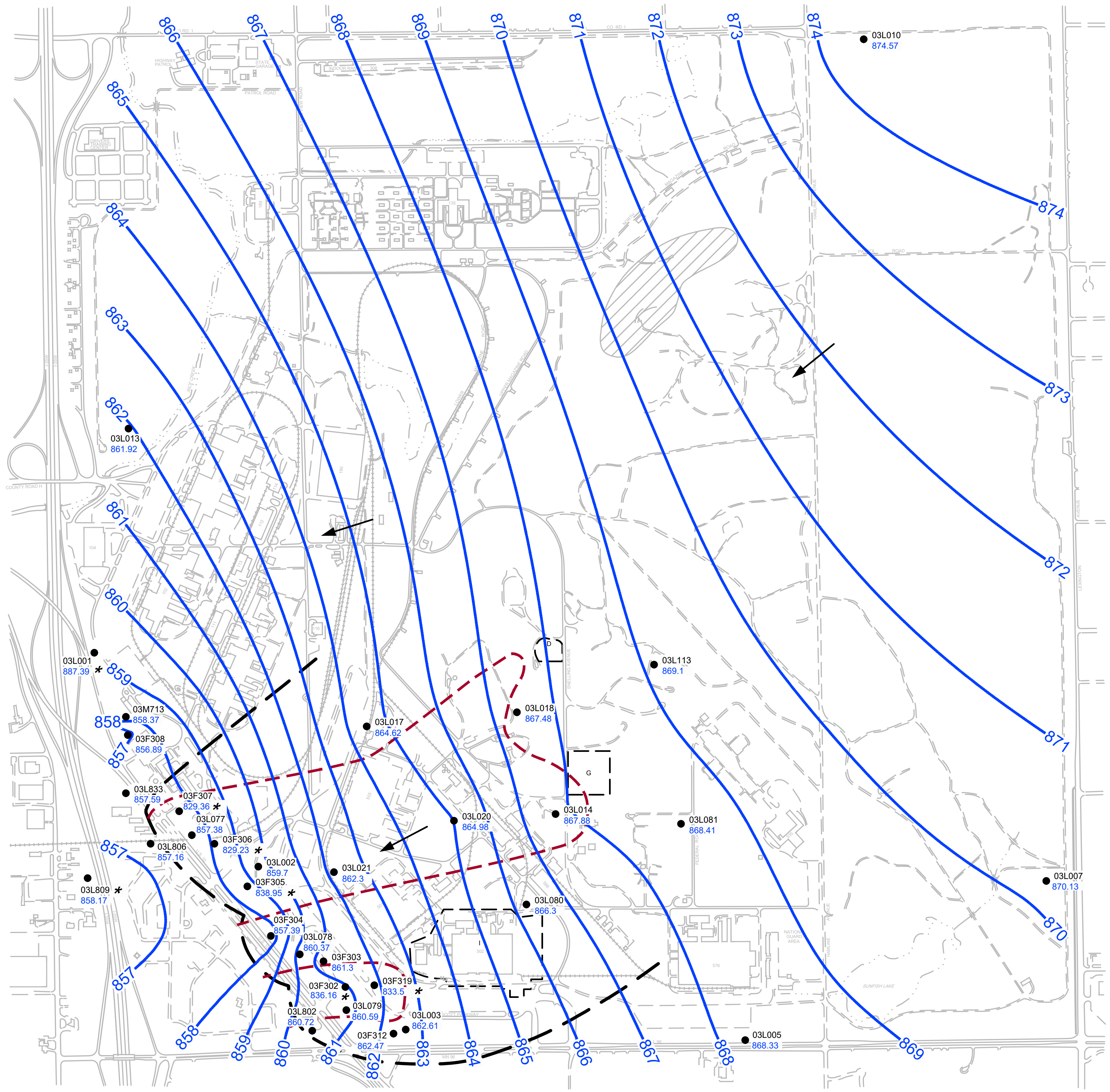
B1	03F302
B2	03F303
B3	03F304
B4	03F305
B5	03F306
B6	03F307
B7	03F308
B8	PJ#309
B9	PJ#310
B10	PJ#311
B11	03F312
B12	PJ#313
B13	03F319
SC1	03U301
SC2	03U314
SC3	03U315
SC4	03U316
SC5	03U317

GHD

figure 12-3

OU2, UPPER UNIT 3, POTENTIOMETRIC MAP
JUNE 2020
OPERABLE UNIT 2
Arden Hills, Minnesota

N:\US\St Paul\Projects\563\11221407\Digital_Design\ACAD\Figures\RPT-001\11221407(RPT-001)GN-WA003.DWG Plot Date: APR 27, 2021



0 600 1200 ft

LEGEND

PRIMARY ROAD
SECONDARY ROAD
RAILROAD
DRAINAGE
BUILDING
BUILDING REMOVED
SOURCE AREA
WELL LOCATION
862.46 GROUNDWATER ELEVATION IN FEET AMSL
861 GROUNDWATER CONTOUR
DIRECTION OF GROUNDWATER FLOW
LIMIT OF CAPTURE
NOTE: GROUNDWATER CONTOURS ARE INTERPOLATED FROM THE DATA POINTS SHOWN.
* GROUNDWATER ELEVATION NOT USED IN CONTOURING
ARSENAL SAND AND GRAVEL PIT TREATED WATER DISCHARGE AREA. (APPROXIMATE BOUNDARIES)
5 µg/L TCE PLUME BOUNDARY

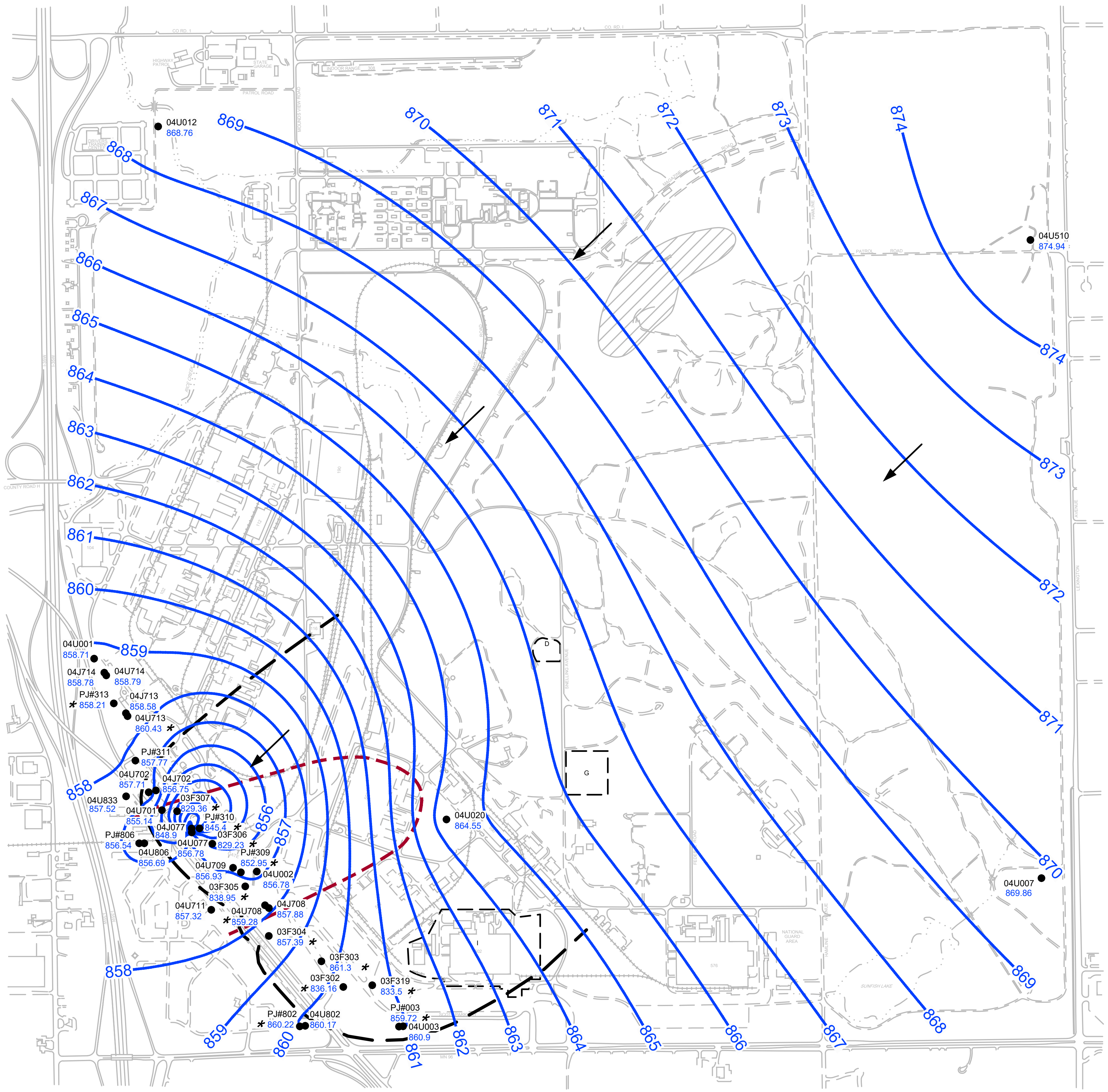
EXTRACTION WELL NAME CROSS REFERENCE

B1	03F302
B2	03F303
B3	03F304
B4	03F305
B5	03F306
B6	03F307
B7	03F308
B8	PJ#309
B9	PJ#310
B10	PJ#311
B11	03F312
B12	PJ#313
B13	03F319
SC1	03U301
SC2	03U314
SC3	03U315
SC4	03U316
SC5	03U317

figure 12-4

OU2, LOWER UNIT 3, POTENTIOMETRIC MAP
JUNE 2020
OPERABLE UNIT 2
Arden Hills, Minnesota

N:\US\St Paul\Projects\563\11221407\Digital_Design\ACAD\Figures\RPT-001\11221407(RPT-001)GN-WA004.DWG Plot Date: APR 27, 2021



0 600 1200 ft

LEGEND

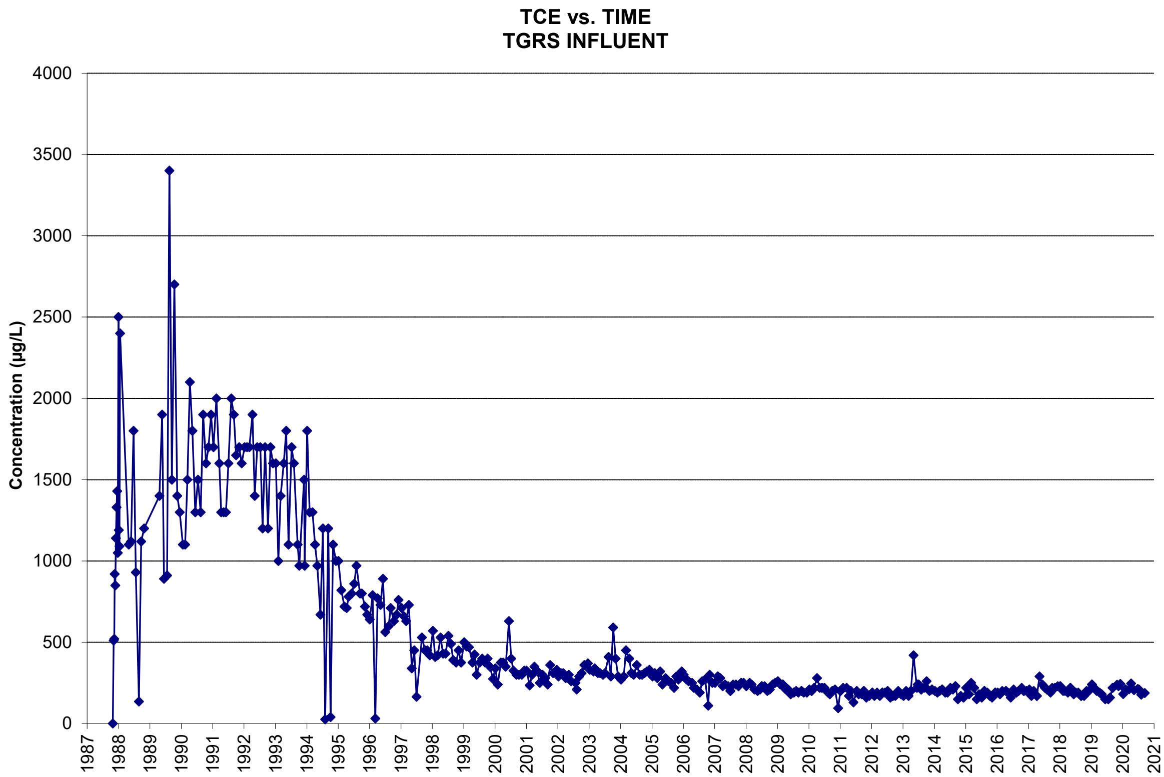
	PRIMARY ROAD
	SECONDARY ROAD
	RAILROAD
	DRAINAGE
	BUILDING
	BUILDING REMOVED
	SOURCE AREA
	WELL LOCATION
869.67	GROUNDWATER ELEVATION IN FEET AMSL
858	GROUNDWATER CONTOUR
	DIRECTION OF GROUNDWATER FLOW
	LIMIT OF CAPTURE
	NOTE: GROUNDWATER CONTOURS ARE INTERPOLATED FROM THE DATA POINTS SHOWN.
*	GROUNDWATER ELEVATION NOT USED IN CONTOURING
	ARSENAL SAND AND GRAVEL PIT TREATED WATER DISCHARGE AREA. (APPROXIMATE BOUNDARIES)
	5 μg/L TCE PLUME BOUNDARY

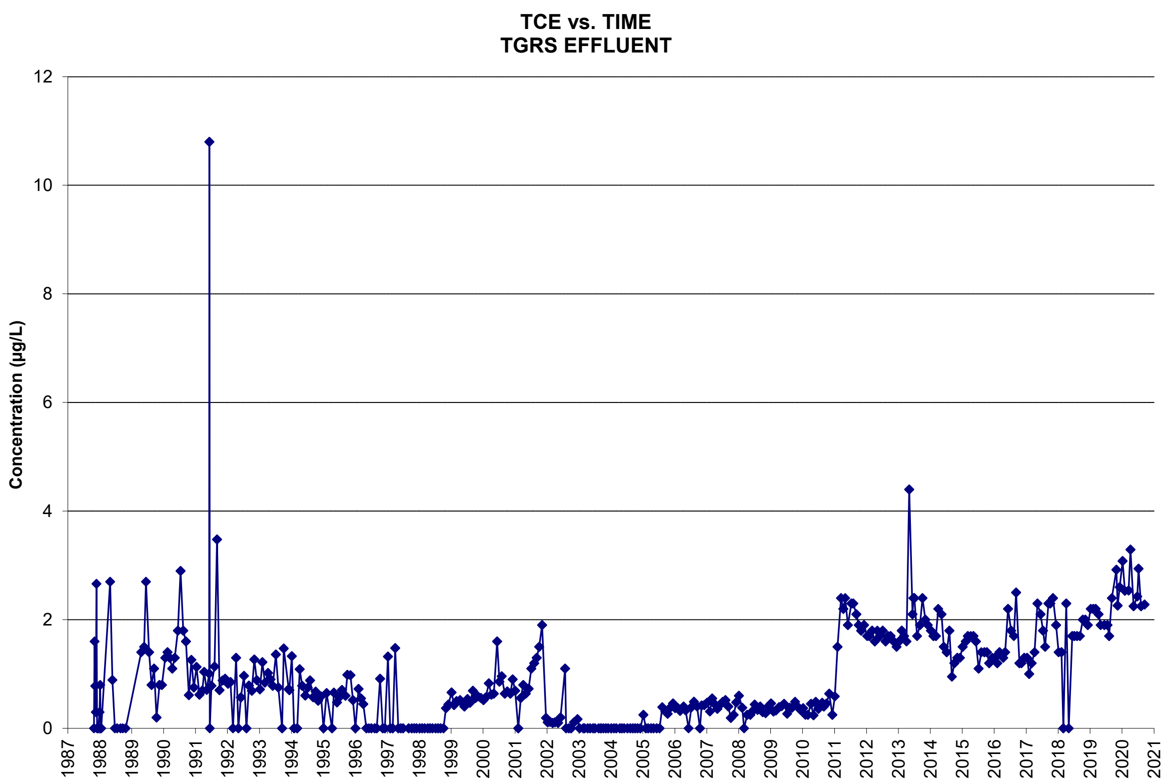
EXTRACTION WELL NAME CROSS REFERENCE

B1	03F302
B2	03F303
B3	03F304
B4	03F305
B5	03F306
B6	03F307
B7	03F308
B8	PJ#309
B9	PJ#310
B10	PJ#311
B11	03F312
B12	PJ#313
B13	03F319
SC1	03U301
SC2	03U314
SC3	03U315
SC4	03U316
SC5	03U317

figure 12-5

OU2, UPPER UNIT 4, POTENTIOMETRIC MAP
JUNE 2020
OPERABLE UNIT 2
Arden Hills, Minnesota



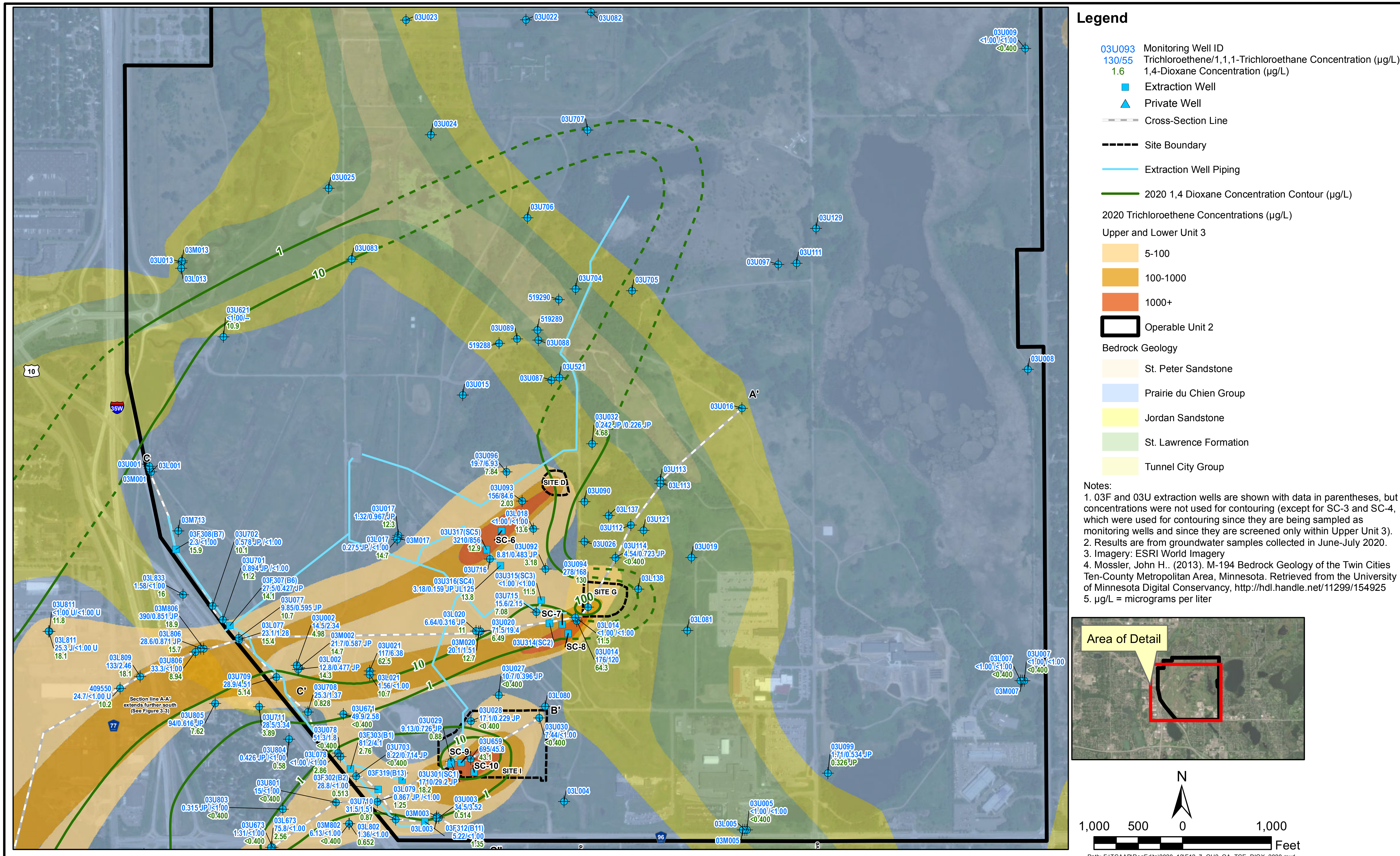


NOTE: SAMPLES REPORTING CONCENTRATIONS OF NON-DETECT WERE PLOTTED AS ZERO. WHEN DUPLICATE SAMPLES WERE COLLECTED, THE HIGHER CONCENTRATION WAS REPORTED.

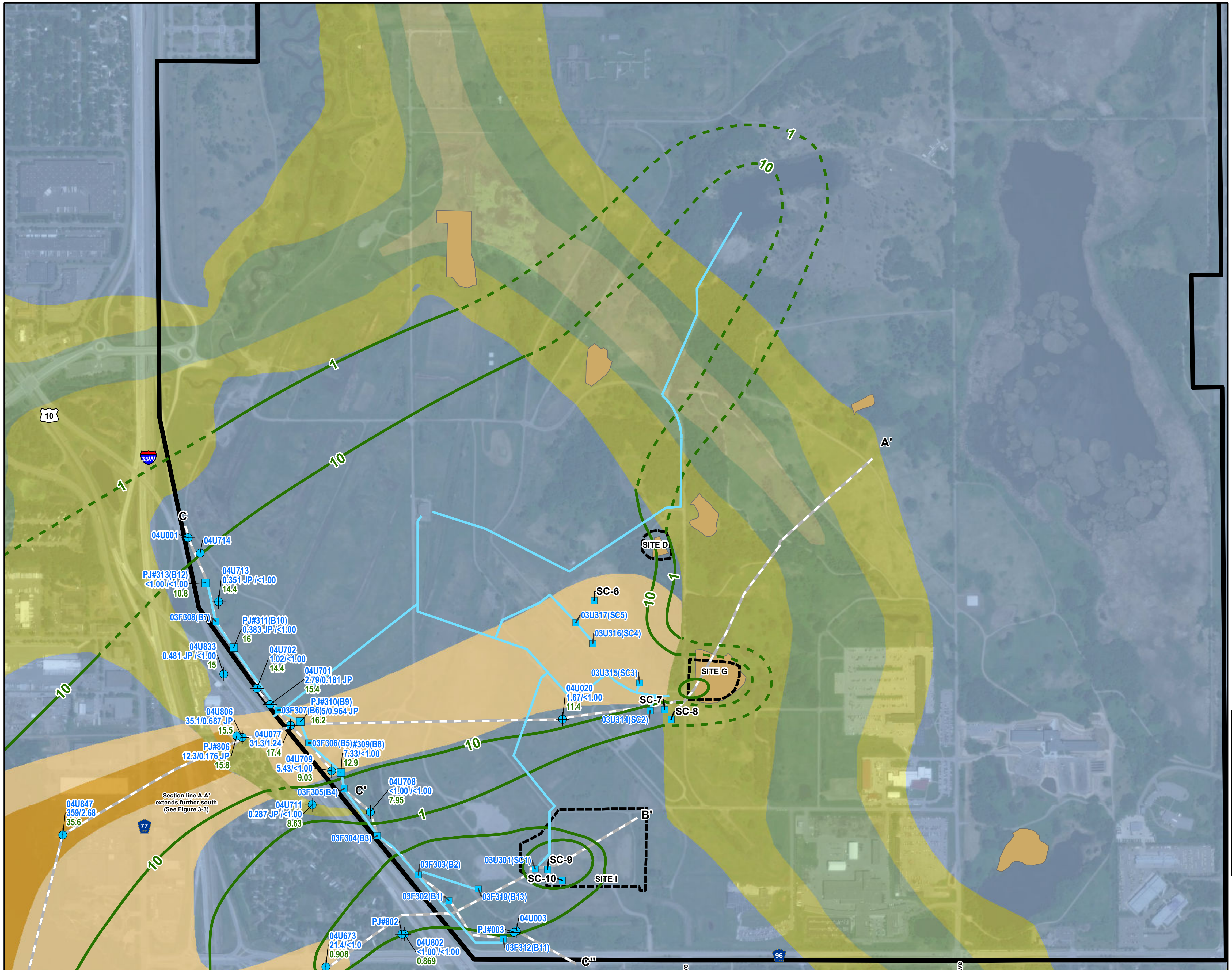
figure 12-6

TGRS TREATMENT SYSTEM PERFORMANCE
OPERABLE UNIT 2
Arden Hills, Minnesota

GHD



ANNUAL PERFORMANCE REPORT	PIKA ARCADIS a joint venture	FY 2020
OU2, Upper and Lower Unit 3 Combined, Trichloroethene and 1,4-Dioxane Isoconcentration Map, June-July 2020		Figure 12-7



Legend

Monitoring Well

04U806 Monitoring Well ID
52/0.88 JP Trichloroethene/1,1,1-Trichloroethane Concentration (µg/L)
13.2 1,4-Dioxane Concentration (µg/L)

Extraction Well

Private Well

Cross-Section Line

Site Boundary

2020 1,4 Dioxane Concentration Contour (µg/L) (Dashed Where Inferred)

Extraction Well Piping

Soil Covers

2020 Trichloroethene Concentrations (µg/L)
Upper Unit 4 (Dashed Where Inferred)

5-100

100-1,000

Operable Unit 2

Bedrock Geology

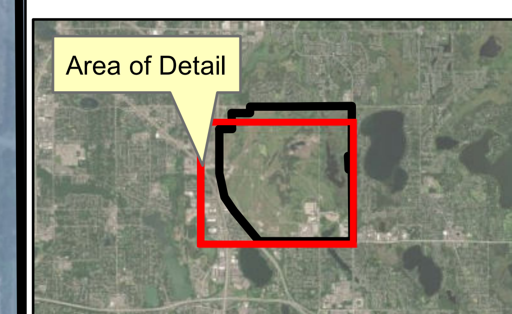
Prairie du Chien Group

Jordan Sandstone

St. Lawrence Formation

Tunnel City Group

Notes:
1. All PJ# extraction wells are shown with data in parentheses, but were not used for contouring.
2. Results are from groundwater samples collected in June-July 2020.
3. Imagery: ESRI World Imagery
4. Mossler, John H.. (2013). M-194 Bedrock Geology of the Twin Cities Ten-County Metropolitan Area, Minnesota. Retrieved from the University of Minnesota Digital Conservancy, http://hdl.handle.net/11299/154925
5. µg/L = micrograms per liter
6. FY 2018 monitoring data are used in the delineation of contaminant plume boundaries but are not included on this figure



N

1,000 500 0 1,000 Feet

Path: F:\TCAAP\RegEdits\2020_12\F12_8_OU2_QA_TCE_DIOX_2020.mxd

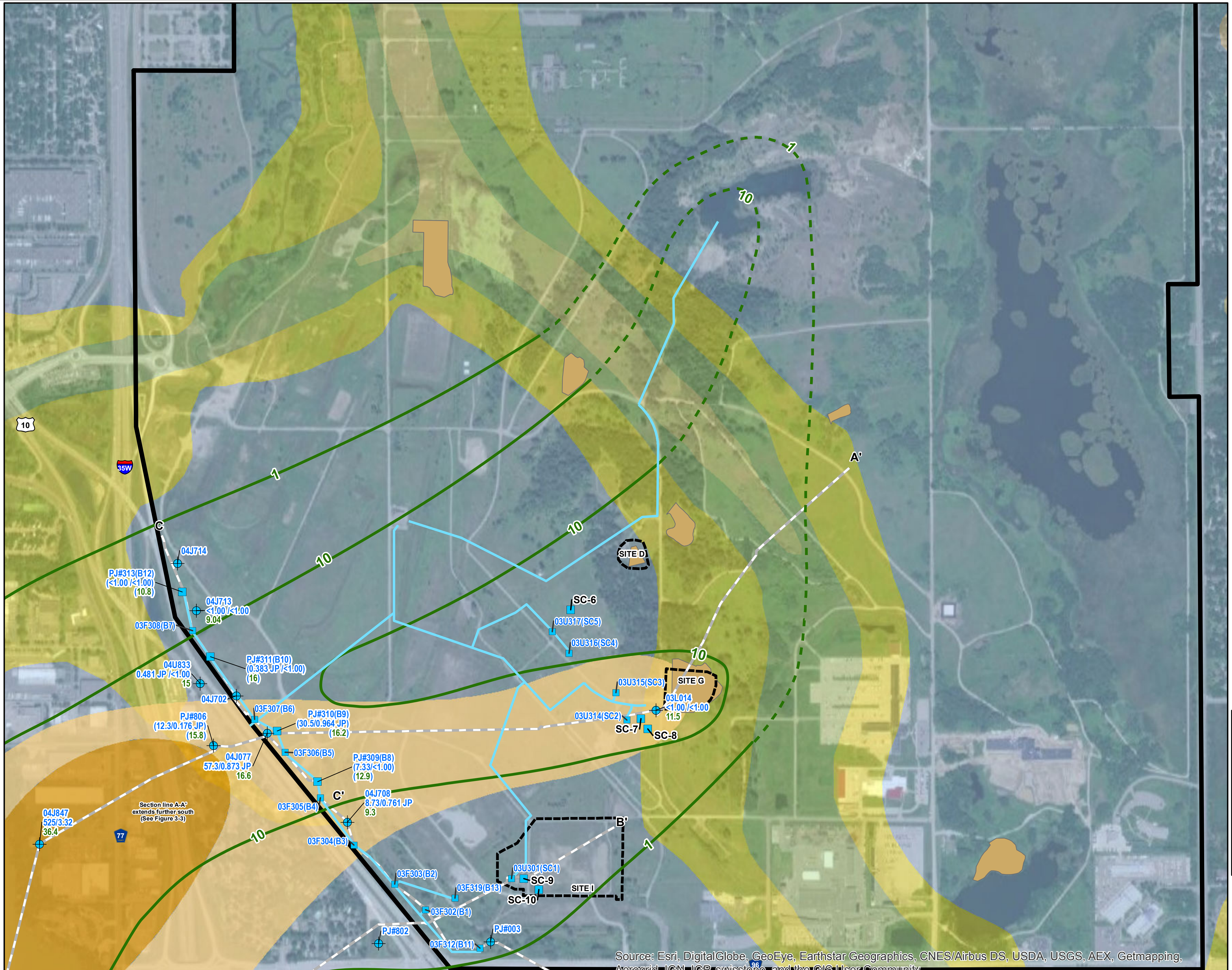
ANNUAL PERFORMANCE REPORT

OU2, Upper Unit 4, Trichloroethene and 1,4-Dioxane Isoconcentration Map, June-July 2020

PIKA ARCADIS a joint venture

FY 2020

Figure 12-8



Legend

- Monitoring Well
- 04J077 Monitoring Well ID
- 51/0.91 JP Trichloroethene/1,1,1-Trichloroethane Concentration (µg/L)
- 13.0 1,4-Dioxane Concentration (µg/L)
- Extraction Well
- Private Well
- Cross-Section Line
- Extraction Well Piping
- Soil Covers
- Site Boundary
- 2020 1,4 Dioxane Concentration Contour (µg/L) (Dashed Where Inferred)

2020 Trichloroethene Concentrations (µg/L)

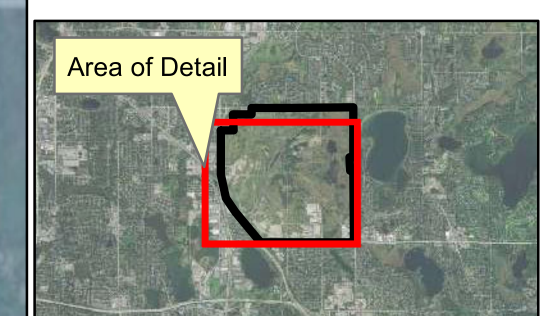
Lower Unit 4

- 5-100
- 100-1,000
- Operable Unit 2

Bedrock Geology

- St. Peter Sandstone
- Prairie du Chien Group
- Jordan Sandstone
- St. Lawrence Formation
- Tunnel City Group

Notes:
1. All PJ# extraction wells are shown with data in parentheses, but were not used for contouring.
2. Results are from groundwater samples collected in June-July 2020.
3. Imagery: ESRI World Imagery
4. Mossler, John H.. (2013). M-194 Bedrock Geology of the Twin Cities Ten-County Metropolitan Area, Minnesota. Retrieved from the University of Minnesota Digital Conservancy, http://hdl.handle.net/11299/154925
5. µg/L = micrograms per liter
6. FY 2018 monitoring data are used in the delineation of contaminant plume boundaries but are not included on this figure

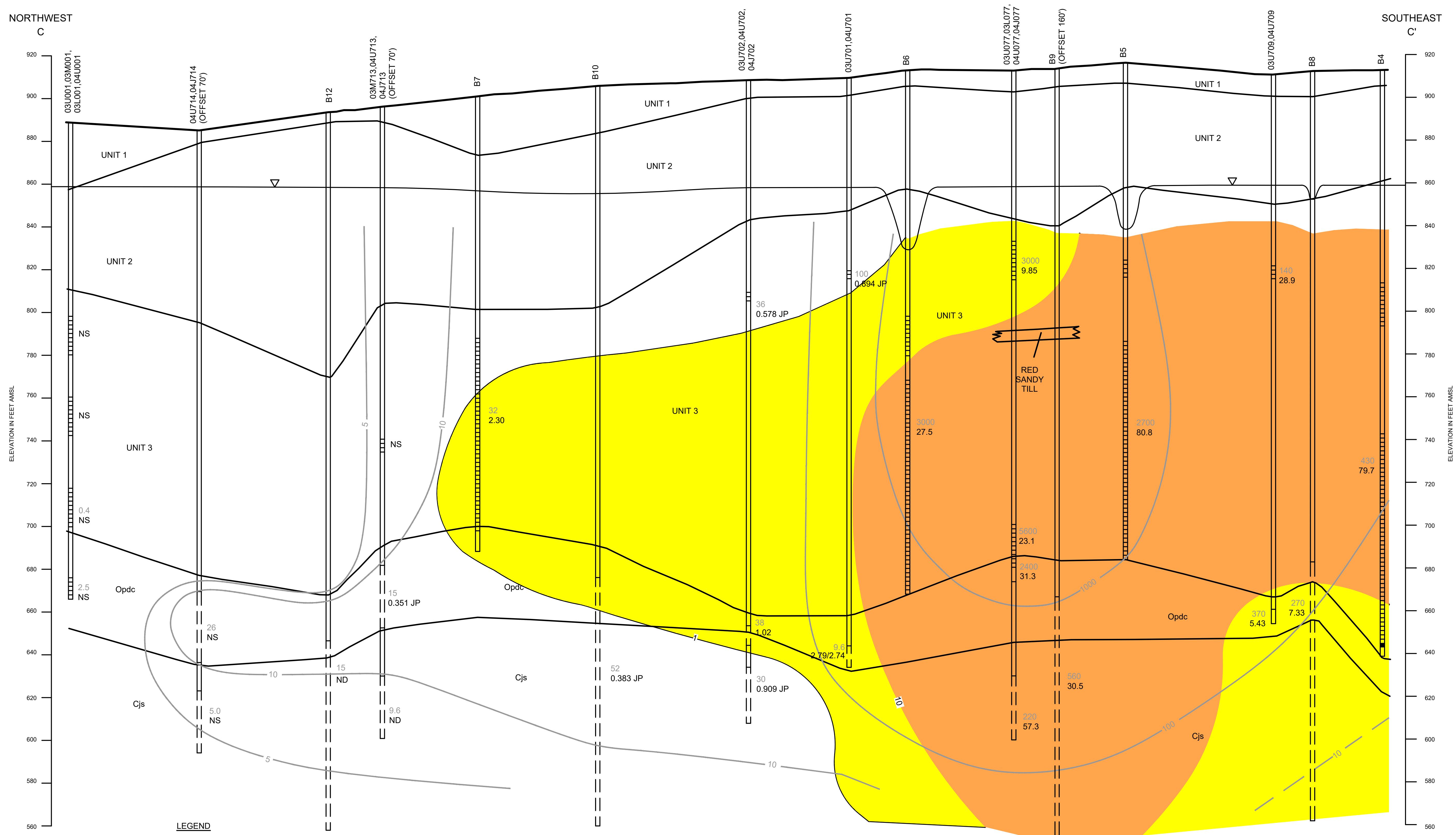


N

1,000 500 0 1,000 Feet

Path: F:\TCAAP\RegEdits\2020_12\F12_9_OU2_Jordan_TCE_DIOX_2020.mxd

ANNUAL PERFORMANCE REPORT	PIKA ARCADIS a joint venture	FY 2020
OU2, Lower Unit 4, Trichloroethene and 1,4-Dioxane Isoconcentration Map, June-July 2020		Figure 12-9



LEGEND

100 TRCLE CONTOUR IN µg/L (10-89)

100 TRCLE CONTOUR IN µg/L (06-20)

OPEN HOLE INTERVAL

SCREENED INTERVAL

2020 TRCLE CONCENTRATION

( ) DUPLICATE SAMPLE

NS NOT SAMPLED

ND NON DETECT

VERTICAL SCALE 0 20 SCALE IN FEET

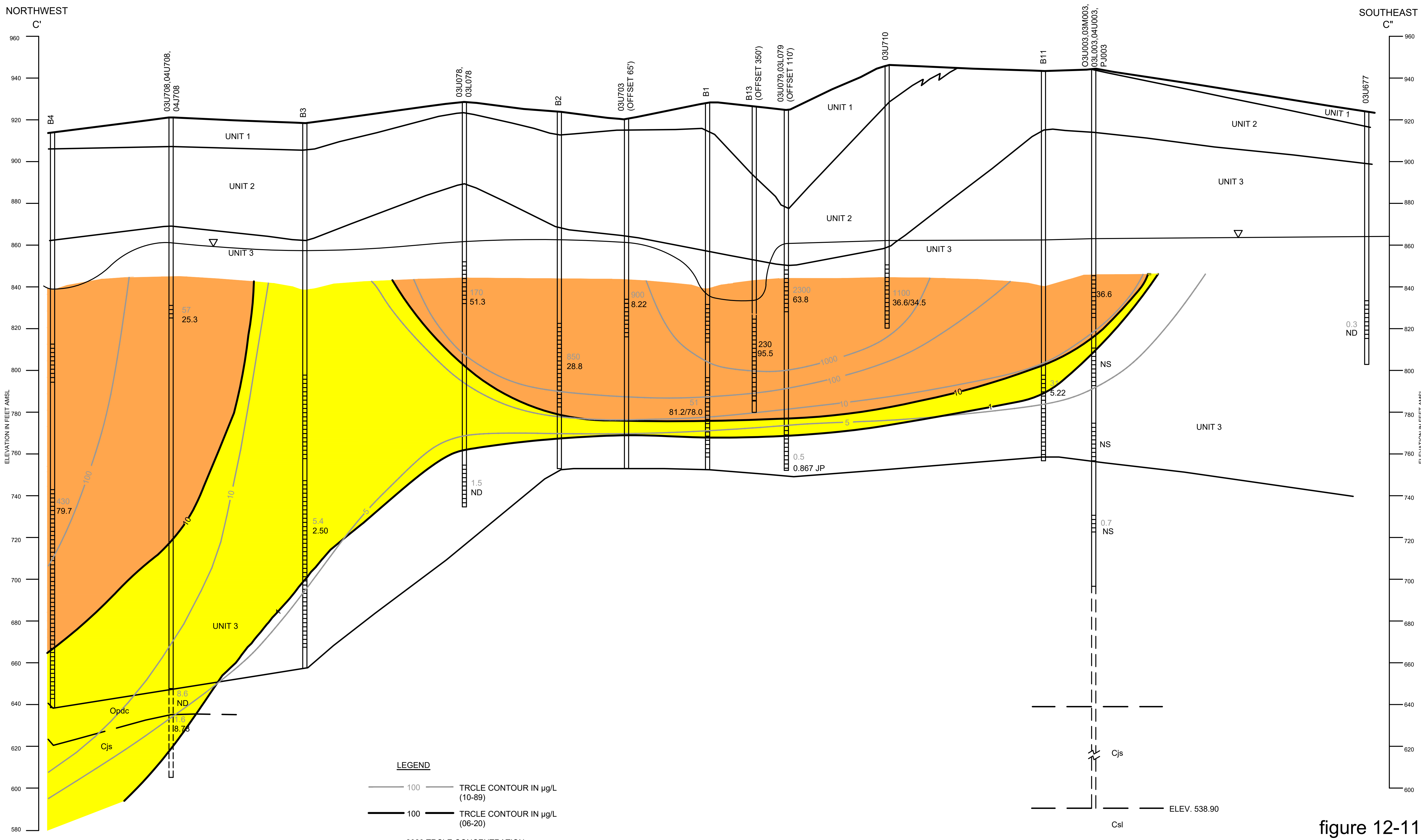
HORIZONTAL SCALE 0 100 SCALE IN FEET

GHD

figure 12-10

JUNE 2020 GROUNDWATER TRCLE DATA
CROSS SECTION C-C'
OPERABLE UNIT 2
Arden Hills, Minnesota

N:\US\St Paul\Projects\563\11221407\Digital_Design\ACAD\Figures\RPT-001\11221407(RPT-001)GN-WA006.DWG Plot Date: APR 23, 2021



LEGEND

100 TRCLE CONTOUR IN µg/L (10-89)

100 TRCLE CONTOUR IN µg/L (06-20)

2020 TRCLE CONCENTRATION

( ) DUPLICATE SAMPLE

SCREENED INTERVAL

OPEN HOLE INTERVAL

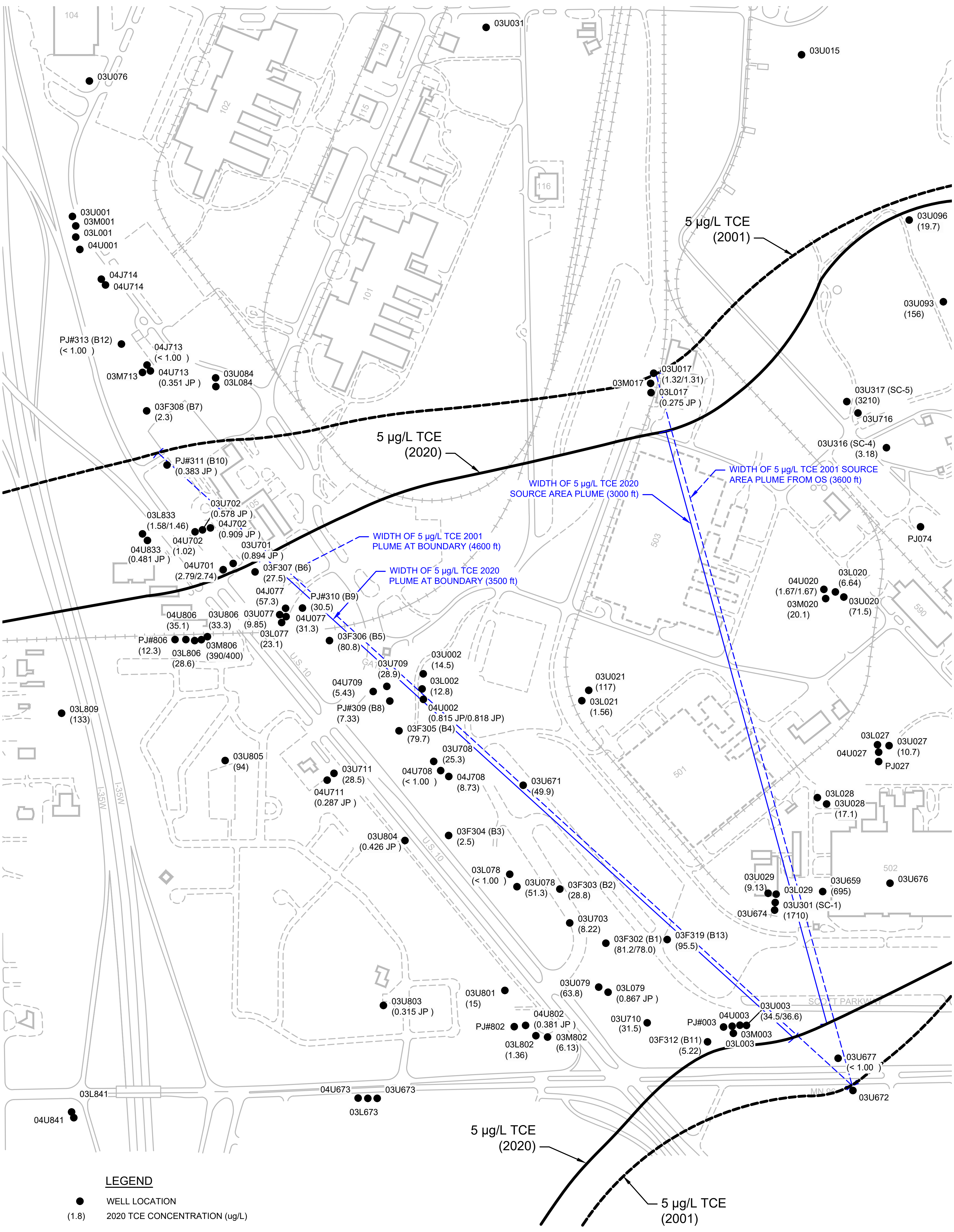
VERTICAL SCALE 0 20 SCALE IN FEET

HORIZONTAL SCALE 0 100 SCALE IN FEET

figure 12-11

JUNE 2020 GROUNDWATER TRCLE DATA
CROSS SECTION C'-C"
OPERABLE UNIT 2
Arden Hills, Minnesota

N:\US\St Paul\Projects\563\11221407\Digital_Design\ACAD\Figures\RPT-001\11221407(RPT-001)GN-WA007.DWG Plot Date: APR 27, 2021



LEGEND

● WELL LOCATION

(1.8) 2020 TCE CONCENTRATION (ug/L)

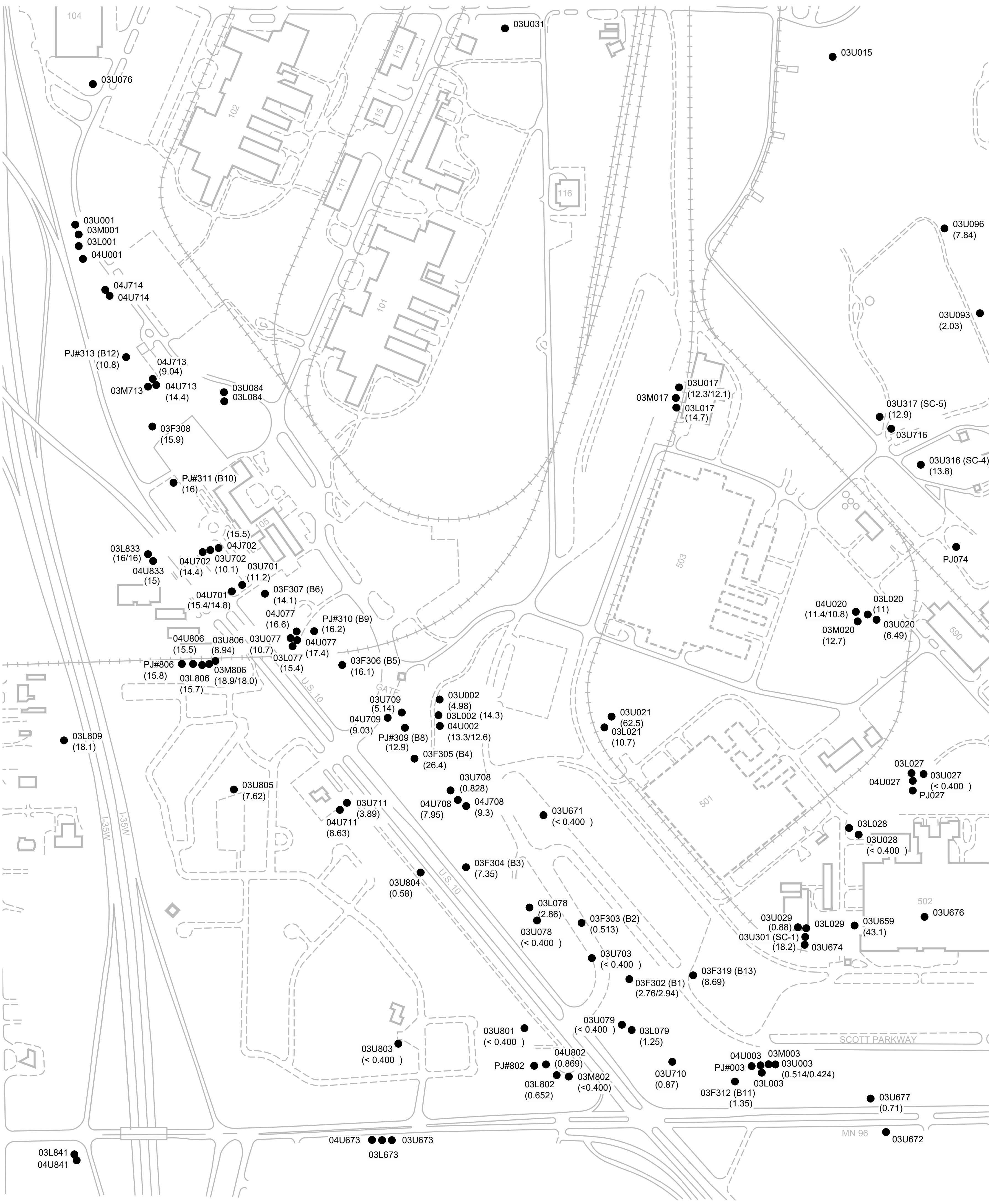
N

0 200 500ft

figure 12-12

TGRS ANNUAL MONITORING DATA - WEST PORTION
TCE CONCENTRATIONS (µg/L) JUNE 2020
OPERABLE UNIT 2
Arden Hills, Minnesota

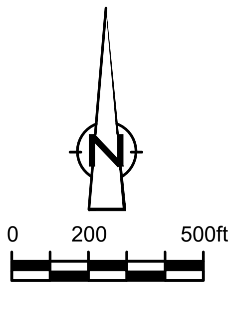
N:\US\St Paul\Projects\563\11221407\Digital_Design\ACAD 2020\Figures\RPT-001\11221407(RPT-001)GN-WA008.DWG Plot Date: JAN 18, 2021



LEGEND

● WELL LOCATION

(3.9) 2020 1,4-DIOXANE CONCENTRATION



GHD

figure 12-13

TGRS ANNUAL MONITORING DATA - WEST PORTION
1,4-DIOXANE CONCENTRATIONS (µg/L) JUNE 2020
OPERABLE UNIT 2
Arden Hills, Minnesota

N:\US\St Paul\Projects\563\11221407\Digital_Design\ACAD 2020\Figures\RPT-001\11221407(RPT-001)GN-WA009.DWG Plot Date: JAN 04, 2021

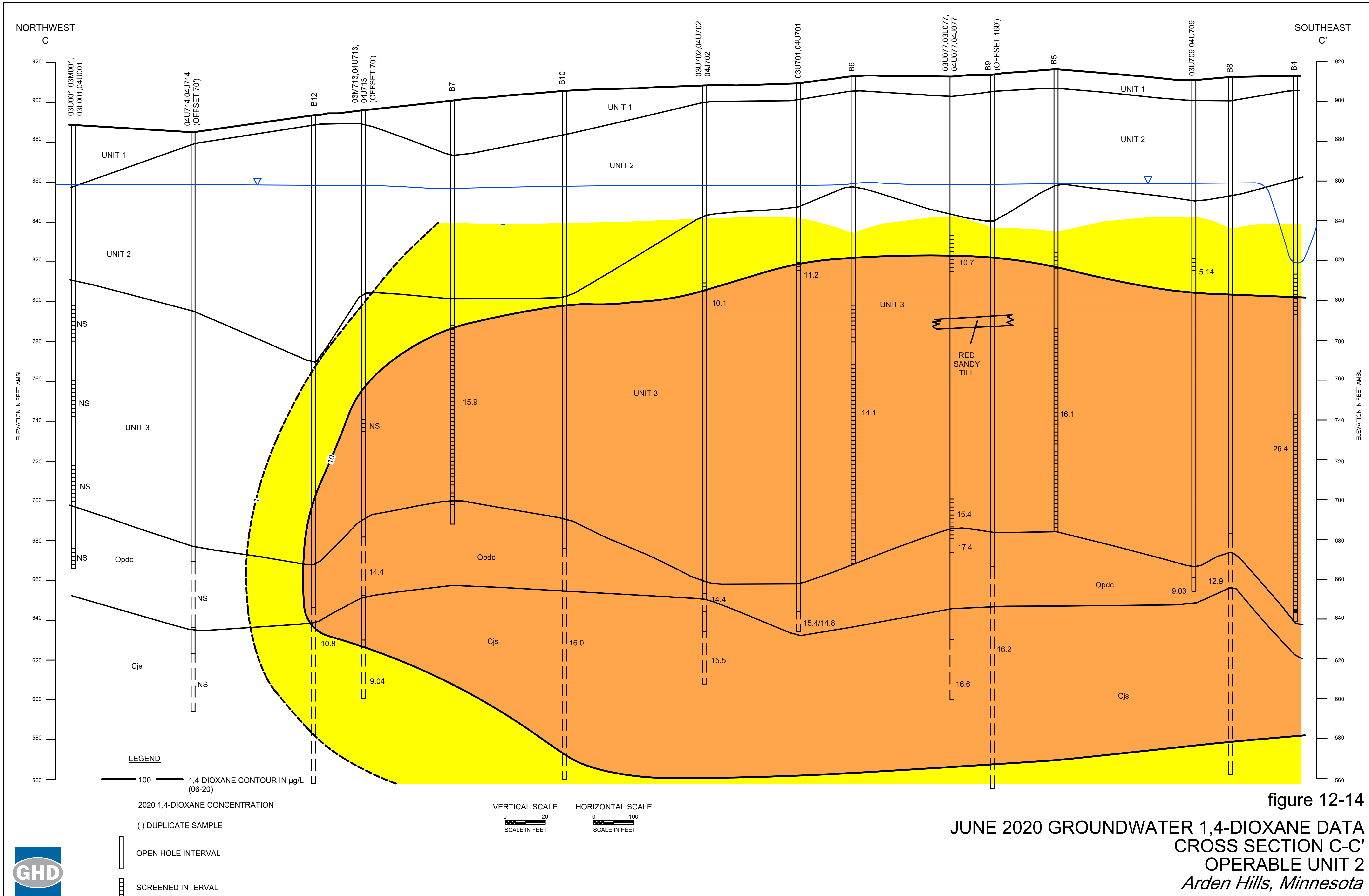


figure 12-14

JUNE 2020 GROUNDWATER 1,4-DIOXANE DATA
CROSS SECTION C-C'
OPERABLE UNIT 2
Arden Hills, Minnesota

N:\US\St Paul\Projects\563\11221407\Digital_Design\ACAD 2020\Figures\RPT-001\11221407(RPT-001)GN-WA010.DWG Plot Date: JAN 06, 2021

LEGEND

100 — 1,4-DIOXANE CONTOUR IN µg/L (06-20)

2020 1,4-DIOXANE CONCENTRATION

( ) DUPLICATE SAMPLE

SCREENED INTERVAL

OPEN HOLE INTERVAL

VERTICAL SCALE 0 20 SCALE IN FEET

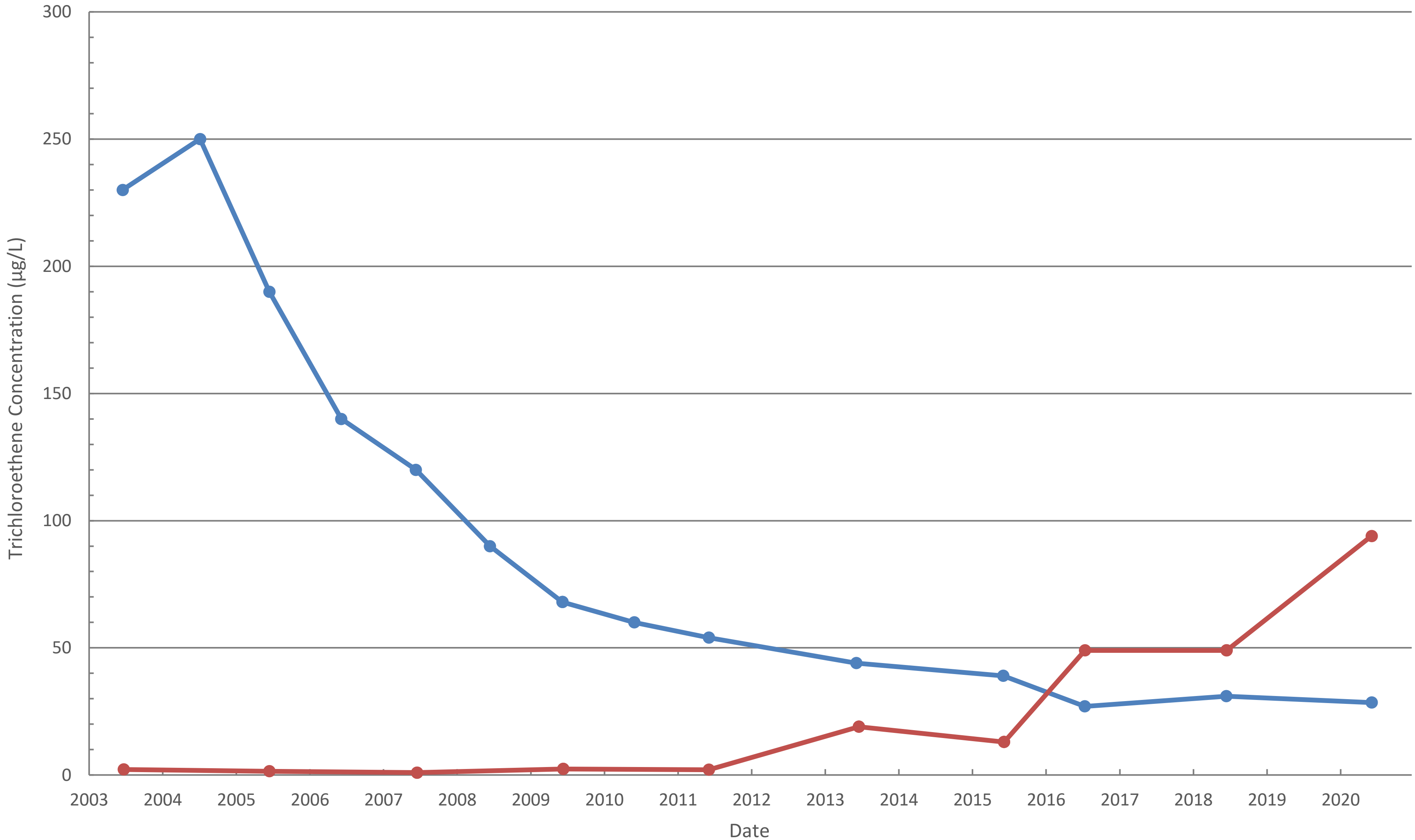
HORIZONTAL SCALE 0 100 SCALE IN FEET

GHD

figure 12-15

JUNE 2020 GROUNDWATER 1,4-DIOXANE DATA
CROSS SECTION C'-C"
OPERABLE UNIT 2
Arden Hills, Minnesota

N:\US\St Paul\Projects\563\11221407\Digital_Design\ACAD 2020\Figures\RPT-001\11221407(RPT-001)GN-WA011.DWG Plot Date: JAN 06, 2021



LEGEND

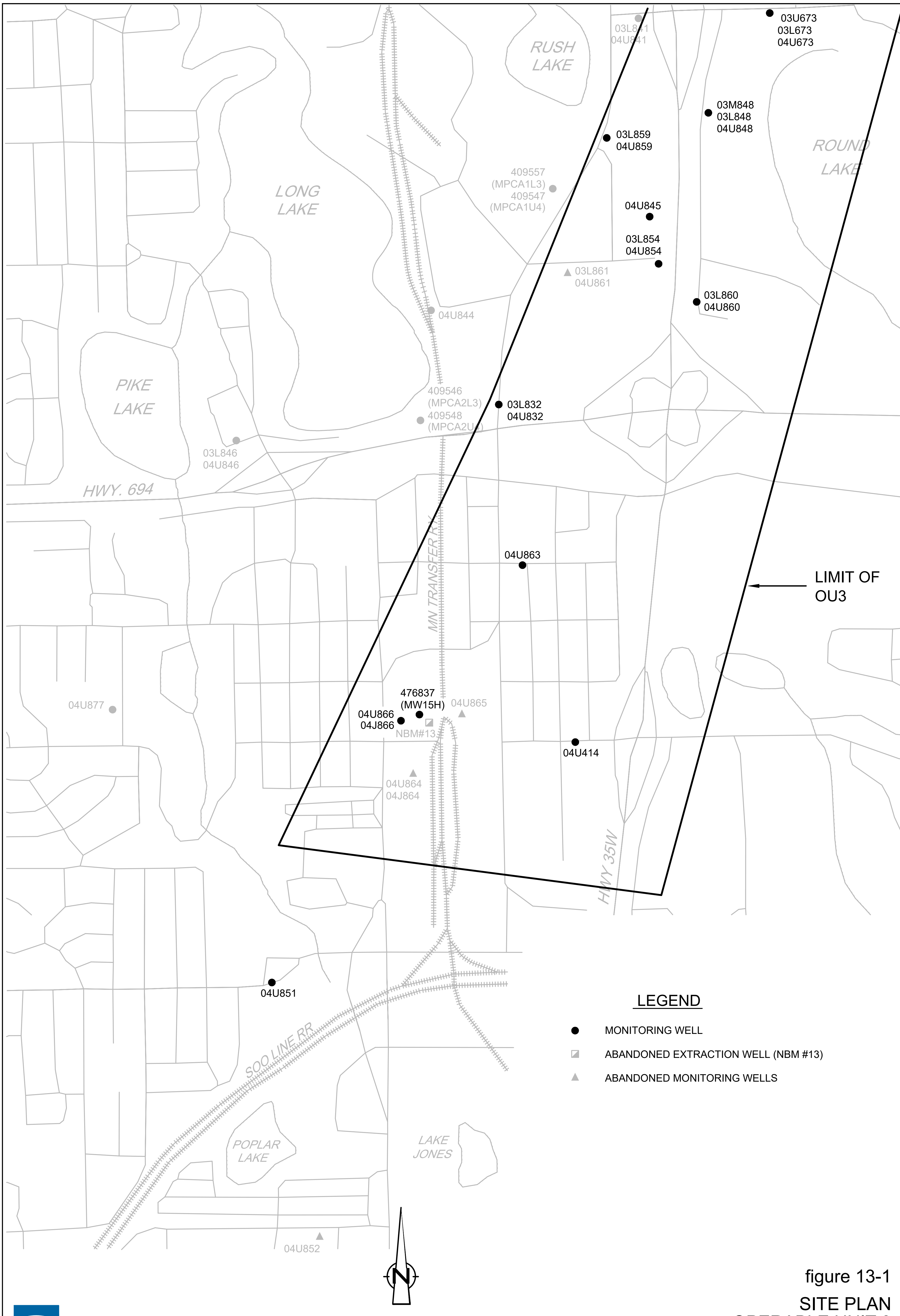
03U711

03U805

figure 12-16

HISTORICAL TCE CONCENTRATIONS (2003-2020)
WELLS 03U711 AND 03U805
OPERABLE UNIT 2
Arden Hills, Minnesota

11221407-43(RPT-APR)GIS-SP009 JAN 18/2021



GHD

figure 13-1

SITE PLAN
OPERABLE UNIT 3
Arden Hills, Minnesota

N:\US\St Paul\Projects\563\11221407\Digital_Design\ACAD 2020\Figures\RPT-001\11221407(RPT-001)GN-WA012.DWG Plot Date: DEC 15, 2020

Appendix A

FY2020 - FY2024 Monitoring Plan

Unit Designations:

01U - Upper Fridley Formation	03M - Middle Hillside Formation	SL - St. Lawrence	J - Jordan
01L - Lower Fridley Formation	03L - Lower Hillside Formation	UNK - Unknown	
03U - Upper Hillside Formation	SP - St. Peter	PC - Prairie du Chien	

Footnotes:

(A) Indicates that the monitoring is the responsibility of Orbital ATK.
(B) Indicates that the monitoring is the responsibility of the Army.
(1) "L (A or B)" denotes a water level measurement by the appropriate party.
(2) "Q (A or B)" denotes a water quality sampling by the appropriate party. The required analyte list for each specific site is shown in Appendix A.4.
(3) The designations refer to the following purposes:

- ❖ Operable Unit 1 Water Quality
  - 1.a = To contour the perimeter of the plume which defines the area of concern for alternate water supply/well abandonment
  - OR = Overall remedy. To evaluate attainment of the cleanup levels throughout the plume
- ❖ Operable Unit 1 Water Levels
  - 3.b = To contour water levels for evaluation of containment
- ❖ Site A Water Quality
  - OR = Overall remedy. To evaluate attainment of the cleanup levels throughout the plume
- ❖ Site A Water Levels
  - OR = Overall remedy. To evaluate groundwater flow direction relative to plume location
- ❖ Site C Water Quality
  - OR = Overall remedy. To evaluate attainment of the cleanup levels throughout the plume
- ❖ Site C Water Levels
  - OR = Overall remedy. To evaluate groundwater flow direction relative to plume location
- ❖ Site I Water Quality
  - 1.a = To track remedy progress
  - OR = Overall remedy. To evaluate attainment of the cleanup levels throughout the plume
- ❖ Site I Water Levels
  - 1.a = To track remedy progress
- ❖ Site K Water Quality
  - OR = Overall remedy. To evaluate attainment of the cleanup levels throughout the plume
- ❖ Site K Water Levels
  - 3.a = To contour water levels for evaluation of containment

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- Building 102 Water Quality
  - OR = Overall remedy. To evaluate attainment of the cleanup levels throughout the plume
- Building 102 Water Levels
  - OR = Overall remedy. To evaluate groundwater flow direction relative to plume location
- TGRS Water Quality
  - OR = Overall remedy. To evaluate attainment of the cleanup levels throughout the plume
- TGRS Water Levels
  - 1.a = To contour water levels for evaluation of containment
- Operable Unit 3 Water Quality
  - OR = Overall remedy. To evaluate attainment of the cleanup levels throughout the plume
- Operable Unit 3 Water Levels
  - 2.a = To contour water levels for evaluation of MNA remedy

(4) Sampling performed by the City of Saint Anthony. Army collects sample only if in production and not being sampled by City of Saint Anthony; otherwise Army uses Saint Anthony data.
(5) Sample extraction well annually or biennially, as shown, since it is no longer being pumped.
(6) Wells 04U414 and 04U851 monitored every 5 years during event preceding 5-year review
(7) Sample OU1 private water supply well as late as September 30, if necessary due to temporary inaccessibility.

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Well Information			Notes	June 20	June 21	June 22	June 23	June 24	Purpose For Monitoring[3]		Comments
Unit	Well I.D.	Common Name							Water Quality	Water Level	
Operable Unit 1											
03U	03U811			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	3.b	MPCA recommended annual sampling
03U	03U821			Q,L(B)	---	Q,L(B)	---	Q,L(B)	OR	3.b	
03U	03U822			Q,L(B)	---	Q,L(B)	---	Q,L(B)	1.a, OR	None	
03U	03U831			---	---	---	---	---	---	---	abandoned 2006
03U	409550	PCA 6U3		Q,L(B)	---	Q,L(B)	---	Q,L(B)	OR	None	
03U	409596	BS118U3		---	---	---	---	---	---	---	abandoned 2007, may need replacement
03M	03M843			Q,L(B)	---	Q,L(B)	---	Q,L(B)	1.a, OR	None	
03L	03L811			Q,L(B)	---	Q,L(B)	---	Q,L(B)	OR	3.b	
03L	03L822			Q,L(B)	---	Q,L(B)	---	Q,L(B)	OR	None	
03L	03L832			Q,L(B)	---	Q,L(B)	---	Q,L(B)	OR	None	
03L	03L841			Q,L(B)	---	Q,L(B)	---	Q,L(B)	1.a, OR	None	
03L	03L846			Q,L(B)	---	Q,L(B)	---	Q,L(B)	1.a, OR	None	
03L	03L853			---	---	---	---	---	---	---	
03L	409556	PCA4L3		Q,L(B)	---	Q,L(B)	---	Q,L(B)	1.a, OR	None	
03L	409557	PCA1L3		Q,L(B)	---	Q,L(B)	---	Q,L(B)	1.a, OR	None	
03L	409597	BS118L3		---	---	---	---	---	---	---	abandoned 2007, may need replacement
PC	04U821			Q,L(B)	---	Q,L(B)	---	Q,L(B)	OR	3.b	
PC	04U834			Q,L(B)	---	Q,L(B)	---	Q,L(B)	OR	None	
PC	04U836	MW-1		Q,L(B)	---	Q,L(B)	---	Q,L(B)	OR	3.b	
PC	04U837	MW-3		Q,L(B)	---	Q,L(B)	---	Q,L(B)	OR	3.b	
PC	04U838	MW-5		Q,L(B)	---	Q,L(B)	---	Q,L(B)	OR	3.b	
PC	04U839	MW-7		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	3.b	MPCA recommended annual sampling
PC	04U841			Q,L(B)	---	Q,L(B)	---	Q,L(B)	OR	3.b	
PC	04U843			Q,L(B)	---	Q,L(B)	---	Q,L(B)	1.a, OR	3.b	
PC	04U844			Q,L(B)	---	Q,L(B)	---	Q,L(B)	OR	3.b	
PC	04U846			Q,L(B)	---	Q,L(B)	---	Q,L(B)	OR	3.b	
PC	04U847			Q,L(B)	---	Q,L(B)	---	Q,L(B)	OR	3.b	
PC	04U849			Q,L(B)	---	Q,L(B)	---	Q,L(B)	OR	3.b	
PC	04U850			Q,L(B)	---	Q,L(B)	---	Q,L(B)	OR	3.b	
PC	04U855			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	1.a, OR	3.b	MPCA recommended annual sampling
PC	04U871			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	3.b	
PC	04U872			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	3.b	
PC	04U875			Q,L(B)	---	Q,L(B)	---	Q,L(B)	1.a, OR	3.b	
PC	04U877			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	3.b	
PC	04U879			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	1.a, OR	3.b	MPCA recommended annual sampling
PC	04U880			Q,L(B)	---	Q,L(B)	---	Q,L(B)	1.a, OR	3.b	
PC	04U881			Q,L(B)	---	Q,L(B)	---	Q,L(B)	1.a, OR	None	
PC	04U882			Q,L(B)	---	Q,L(B)	---	Q,L(B)	OR	None	
PC	04U883			Q,L(B)	---	Q,L(B)	---	Q,L(B)	1.a, OR	None	
PC	191942	BS118U4		---	---	---	---	---	---	---	abandoned 2007, may need replacement
PC	200154	UM Golf Course		Q(B)	---	Q(B)	---	Q(B)	1.a, OR	---	
PC	200814	American Linen		---	---	---	---	---	---	---	

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Well Information			Notes	June 20	June 21	June 22	June 23	June 24	Purpose For Monitoring(3)		Comments
Unit	Well I.D.	Common Name							Water Quality	Water Level	
PC	206688	Cloverpond		Q(B)	---	Q(B)	---	Q(B)	1.a, OR	---	
PC	234547	Honeywell Ridgeway		---	---	---	---	---	---	---	
PC	409547	PCA1U4		Q,L(B)	---	Q,L(B)	---	Q,L(B)	OR	3.b	
PC	409548	PCA2U4		Q,L(B)	---	Q,L(B)	---	Q,L(B)	OR	3.b	
PC	409549	PCA3U4		Q,L(B)	---	Q,L(B)	---	Q,L(B)	OR	3.b	
PC	409555	PCA5U4		Q,L(B)	---	Q,L(B)	---	Q,L(B)	1.a, OR	3.b	
PC	512761	Gross Golf Course #2		Q,L(B)	---	Q,L(B)	---	Q,L(B)	OR	3.b	
PC	554216	New Brighton #14									See Appendix A.2
PC	582628	New Brighton #15									See Appendix A.2
J	04J822			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	3.b	
J	04J834			Q,L(B)	---	Q,L(B)	---	Q,L(B)	OR	None	
J	04J835			---	---	---	---	---	---	---	
J	04J836	MW-2		Q,L(B)	---	Q,L(B)	---	Q,L(B)	OR	3.b	
J	04J837	MW-4		Q,L(B)	---	Q,L(B)	---	Q,L(B)	OR	3.b	
J	04J838	MW-6		Q,L(B)	---	Q,L(B)	---	Q,L(B)	OR	3.b	
J	04J839	MW-8		Q,L(B)	---	Q,L(B)	---	Q,L(B)	OR	3.b	
J	04J847			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	3.b	
J	04J849			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	3.b	
J	04J882			Q,L(B)	---	Q,L(B)	---	Q,L(B)	OR	None	
J	200524	St. Anthony #5		Q(B)	---	Q(B)	---	Q(B)	OR	---	Army gets St. Anthony Data
J	200803	St. Anthony #4		Q(B)	---	Q(B)	---	Q(B)	OR	---	Army gets St. Anthony Data
J	206796	New Brighton #5									See Appendix A.2
J	206797	New Brighton #6									See Appendix A.2
PC/J	200804	St. Anthony #3		Q(B)	---	Q(B)	---	Q(B)	OR	---	Army gets St. Anthony Data
PC/J	200812	Gross Golf #1		---	---	---	---	---	---	---	
PC/J	206792	New Brighton #4									See Appendix A.2
PC/J	206793	New Brighton #3									See Appendix A.2
PC/J	233221	R&D Systems, N. Well		---	---	---	---	---	---	---	
PC/J	234549	Reiner		---	---	---	---	---	1.a, OR	---	Well out of service
PC/J	PJ#318			Q,L(B)	---	Q,L(B)	---	Q,L(B)	OR	None	
UNK	234546	Honeywell Ridgeway		Q(B)	---	Q(B)	---	Q(B)	OR	---	
Operable Unit 2 - Site A Shallow Groundwater											
01U	01U038			---	---	---	---	---	---	---	abandoned FY14
01U	01U039			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U040			---	---	---	---	---	---	---	abandoned FY14
01U	01U041			---	---	---	---	---	---	---	abandoned FY14
01U	01U063			L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U067			---	---	---	---	---	---	---	abandoned FY14
01U	01U102			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U103			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	Including antimony
01U	01U104			---	---	---	---	---	---	---	abandoned FY14
01U	01U105			---	---	---	---	---	---	---	abandoned FY14
01U	01U106			L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	

Well Information			Notes	June 20	June 21	June 22	June 23	June 24	Purpose For Monitoring(3)		Comments
Unit	Well I.D.	Common Name							Water Quality	Water Level	
01U	01U107			---	---	---	---	---	---	---	abandoned FY14
01U	01U108			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U110			---	---	---	---	---	---	---	abandoned FY14
01U	01U115			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U116			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U117			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U118			---	---	---	---	---	---	---	abandoned FY14
01U	01U119			L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U120			L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U125			---	---	---	---	---	---	---	
01U	01U126			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U127			L(B)	L(B)	L(B)	L(B)	L(B)	OR	OR	
01U	01U133			L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U135			L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U136			---	---	---	---	---	---	---	abandoned FY14
01U	01U137			L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U138			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U139			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U140			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U141			L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U145	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U146	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U147	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U148	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U149	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U150	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U151	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U152	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U153	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U154	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U155	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U156	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U157			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U158			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U350			---	---	---	---	---	OR	OR	
01U	01U351	EW-1		---	---	---	---	---	OR	OR	
01U	01U352	EW-2		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U353	EW-3		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U354	EW-4		---	---	---	---	---	OR	OR	
01U	01U355	EW-5		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U356	EW-6		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U357	EW-7		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U358	EW-8		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U901			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	

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Well Information			Notes	June 20	June 21	June 22	June 23	June 24	Purpose For Monitoring[3]		Comments
Unit	Well I.D.	Common Name							Water Quality	Water Level	
01U	01U902			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	Including antimony
01U	01U903			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U904			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	Including antimony
Operable Unit 2 - Site C Shallow Groundwater											
01U	01U045			---	---	---	---	---	---	---	abandoned FY14
01U	01U046			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U085			---	---	---	---	---	---	---	abandoned FY14
01U	01U551	EW-1		---	---	---	---	---	---	---	abandoned FY14
01U	01U552	EW-2		---	---	---	---	---	---	---	abandoned FY14
01U	01U553	EW-3		---	---	---	---	---	---	---	abandoned FY14
01U	01U561	MW-1		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U562	MW-2		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U563	MW-3		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U564	MW-4		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U565	MW-5		---	---	---	---	---	---	---	abandoned FY14
01U	01U566	MW-6		---	---	---	---	---	---	---	abandoned FY14
01U	01U567	MW-7		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U568	MW-8		---	---	---	---	---	---	---	abandoned FY14
01U	01U569	MW-9		---	---	---	---	---	---	---	abandoned FY14
01U	01U570	MW-10		---	---	---	---	---	---	---	abandoned FY14
01U	01U571	MW-11		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U572	MW-12		---	---	---	---	---	---	---	abandoned FY14
01U	01U573	MW-13		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U574	MW-14		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U575	MW-15		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U576	MW-16		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
Operable Unit 2 - Site I Shallow Groundwater											
01U	01U064			---	---	---	---	---	---	---	abandoned FY14
01U	01U631			---	---	---	---	---	---	---	abandoned FY 14
01U	01U632			---	---	---	---	---	---	---	abandoned FY14
01U	01U636			---	---	---	---	---	---	---	abandoned FY14
01U	01U639			---	---	---	---	---	---	---	abandoned FY14
01U	01U640			---	---	---	---	---	---	---	abandoned FY14
01U	01U666			---	---	---	---	---	---	---	abandoned FY14
01U	01U667			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	OR	abandoned FY14, replacement pending
01U	482086	I01MW		---	---	---	---	---	---	---	abandoned FY14
01U	482087	I05MW		---	---	---	---	---	---	---	abandoned FY14
01U	482088	I02MW		---	---	---	---	---	---	---	abandoned FY14
01U	482089	I04MW		---	---	---	---	---	---	---	abandoned FY14
01U	482090	I03MW		---	---	---	---	---	---	---	abandoned FY14
Note: All of the Site I shallow groundwater wells were sealed in FY14. Following soil remediation under Building 502, only 01U667 was re-installed (with annual sampling).											
Operable Unit 2 - Site K Shallow Groundwater											
01U	01U047			L(A)	L(A)	L(A)	L(A)	L(A)	---	3.a	

Well Information			Notes	June 20	June 21	June 22	June 23	June 24	Purpose For Monitoring(3)		Comments
Unit	Well I.D.	Common Name							Water Quality	Water Level	
01U	01U048			L(A)	L(A)	L(A)	L(A)	L(A)	---	3.a	
01U	01U052			L(A)	L(A)	L(A)	L(A)	L(A)	---	3.a	
01U	01U065			L(A)	L(A)	L(A)	L(A)	L(A)	---	3.a	
01U	01U128			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	3.a	
01U	01U601			---	---	---	---	---	---	---	abandoned FY14
01U	01U602			---	---	---	---	---	---	---	abandoned FY14
01U	01U603			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	3.a	
01U	01U604			---	---	---	---	---	---	---	abandoned FY14
01U	01U605			---	---	---	---	---	---	---	abandoned FY14
01U	01U607			L(A)	L(A)	L(A)	L(A)	L(A)	---	3.a	
01U	01U608			L(A)	L(A)	L(A)	L(A)	L(A)	---	---	abandoned FY14, replacement pending
01U	01U609			L(A)	L(A)	L(A)	L(A)	L(A)	---	---	abandoned FY14, replacement pending
01U	01U611			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	---	---	abandoned FY14, replacement pending
01U	01U612			L(A)	L(A)	L(A)	L(A)	L(A)	---	3.a	
01U	01U613			---	---	---	---	---	---	---	abandoned FY14
01U	01U615			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	3.a	
01U	01U616			---	---	---	---	---	---	---	abandoned FY14
01U	01U617			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	3.a	
01U	01U618			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	3.a	
01U	01U619			---	---	---	---	---	---	---	abandoned FY14
01U	01U620			---	---	---	---	---	---	---	abandoned FY14
01U	01U621			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	3.a	
01U	01U624			---	---	---	---	---	---	---	abandoned FY14
01U	01U625			L(A)	L(A)	L(A)	L(A)	L(A)	---	3.a	
01U	01U626			L(A)	L(A)	L(A)	L(A)	L(A)	---	3.a	
01U	01U627			L(A)	L(A)	L(A)	L(A)	L(A)	---	3.a	
01U	01U628			---	---	---	---	---	---	---	abandoned FY14
01U	482083	K04-MW		Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	3.a	
01U	482084	K02-MW		---	---	---	---	---	---	---	abandoned FY14
01U	482085	K01-MW		---	---	---	---	---	---	---	abandoned FY14
03U	03U621			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	3.a	
Operable Unit 2 - Building 102 Shallow Groundwater											
01U	01U048			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U578			---	---	---	---	---	---	---	abandoned FY14
01U	01U579			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U580			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U581			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U582			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U583			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U584			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01L	01L581			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01L	01L582			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01L	01L583			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	

Well Information			Notes	June 20	June 21	June 22	June 23	June 24	Purpose For Monitoring(3)		Comments
Unit	Well I.D.	Common Name							Water Quality	Water Level	
01L	01L584			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
Operable Unit 2 - Deep Groundwater (TGRS)											
03F	03F302	B1									See Appendix A.2
03F	03F303	B2	(5)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
03F	03F304	B3									See Appendix A.2
03F	03F305	B4									See Appendix A.2
03F	03F306	B5									See Appendix A.2
03F	03F307	B6									See Appendix A.2
03F	03F308	B7	(5)	Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03F	03F312	B11	(5)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
03F	03F319	B13									See Appendix A.2
03U	03U001			L(A)	---	L(A)	---	L(A)	---	1.a	
03U	03U002			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U003			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U004			---	---	---	---	---	---	---	Abandoned FY13
03U	03U005			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U007			Q,L(A)	---	Q,L(A)	---	Q,L(A)	Background	1.a	
03U	03U008			L(A)	---	L(A)	---	L(A)	---	1.a	
03U	03U009			Q,L(A)	---	Q,L(A)	---	Q,L(A)	Background	1.a	
03U	03U010			L(A)	---	L(A)	---	L(A)	---	1.a	
03U	03U011			L(A)	---	L(A)	---	L(A)	---	1.a	
03U	03U012			L(A)	---	L(A)	---	L(A)	---	1.a	
03U	03U013			L(A)	---	L(A)	---	L(A)	---	1.a	
03U	03U014			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U015			L(A)	---	L(A)	---	L(A)	---	1.a	
03U	03U016			L(A)	---	L(A)	---	L(A)	---	1.a	
03U	03U017			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U018			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U019			L(A)	---	L(A)	---	L(A)	---	1.a	
03U	03U020			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U021			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U022			L(A)	---	L(A)	---	L(A)	---	1.a	
03U	03U023			L(A)	---	L(A)	---	L(A)	---	1.a	
03U	03U024			L(A)	---	L(A)	---	L(A)	---	1.a	
03U	03U025			L(A)	---	L(A)	---	L(A)	---	1.a	
03U	03U026			L(A)	---	L(A)	---	L(A)	---	1.a	
03U	03U027			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U028			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U029			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U030			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U031			---	---	---	---	---	---	---	abandoned FY14
03U	03U032			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U075			---	---	---	---	---	---	---	abandoned FY14

Appendix A.1
FY 2020 - FY 2024
Monitoring Plan for Groundwater Monitoring Wells
FY 2020 Annual Performance Report
Twin Cities Army Ammunitions Plant
Arden Hills, Minnesota

PIKA ARCADIS a joint venture

Well Information			Notes	June 20	June 21	June 22	June 23	June 24	Purpose For Monitoring[3]		Comments
Unit	Well I.D.	Common Name							Water Quality	Water Level	
03U	03U076			---	---	---	---	---	---	---	abandoned FY14
03U	03U077			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U078			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U079			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U082			L(A)	---	L(A)	---	L(A)	---	1.a	
03U	03U083			L(A)	---	L(A)	---	L(A)	---	1.a	
03U	03U084			---	---	---	---	---	---	---	abandoned FY14
03U	03U087			L(A)	---	L(A)	---	L(A)	---	1.a	
03U	03U088			L(A)	---	L(A)	---	L(A)	---	1.a	
03U	03U089			L(A)	---	L(A)	---	L(A)	---	1.a	
03U	03U090			L(A)	---	L(A)	---	L(A)	---	1.a	
03U	03U092			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U093			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
03U	03U094			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U096			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U097			---	---	---	---	---	---	---	
03U	03U099			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
03U	03U111			L(A)	---	L(A)	---	L(A)	---	1.a	
03U	03U112			L(A)	---	L(A)	---	L(A)	---	1.a	
03U	03U113			L(A)	---	L(A)	---	L(A)	---	1.a	
03U	03U114			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U121			---	---	---	---	---	---	---	
03U	03U129			---	---	---	---	---	---	---	
03U	03U301	SC1									See Appendix A.2
03U	03U314	SC2									See Appendix A.2
03U	03U315	SC3	(5)	Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U316	SC4	(5)	Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U317	SC5									See Appendix A.2
03U	03U521			---	---	---	---	---	---	---	
03U	03U647			---	---	---	---	---	---	---	abandoned FY14
03U	03U648			---	---	---	---	---	---	---	abandoned FY14
03U	03U658			---	---	---	---	---	---	---	abandoned FY13
03U	03U659			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U671			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U672			---	---	---	---	---	---	---	abandoned FY14, replaced by 03U677
03U	03U674			---	---	---	---	---	---	---	abandoned FY14
03U	03U675			---	---	---	---	---	---	---	
03U	03U676			---	---	---	---	---	---	---	abandoned FY14
03U	03U677			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	constructed FY14
03U	03U701			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U702			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U703			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U704			L(A)	---	L(A)	---	L(A)	---	1.a	
03U	03U705			L(A)	---	L(A)	---	L(A)	---	1.a	

Well Information			Notes	June 20	June 21	June 22	June 23	June 24	Purpose For Monitoring(3)		Comments
Unit	Well I.D.	Common Name							Water Quality	Water Level	
03U	03U706			L(A)	---	L(A)	---	L(A)	---	1.a	
03U	03U707			L(A)	---	L(A)	---	L(A)	---	1.a	
03U	03U708			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
03U	03U709			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U710			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U711			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U715			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U716			L(A)	---	L(A)	---	L(A)	---	1.a	
03U	03U801			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
03U	03U803			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U804			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U805			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03U	03U806			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
03U	519288	E101-MW		---	---	---	---	---	---	---	
03U	519289	E102-MW		---	---	---	---	---	---	---	
03U	519290	E103-MW		---	---	---	---	---	---	---	
03M	03M001			L(A)	---	L(A)	---	L(A)	---	1.a	
03M	03M002			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03M	03M003			L(A)	---	L(A)	---	L(A)	---	1.a	
03M	03M004			---	---	---	---	---	---	---	Abandoned FY13
03M	03M005			L(A)	---	L(A)	---	L(A)	---	1.a	
03M	03M007			L(A)	---	L(A)	---	L(A)	---	1.a	
03M	03M010			L(A)	---	L(A)	---	L(A)	---	1.a	
03M	03M012			L(A)	---	L(A)	---	L(A)	---	1.a	
03M	03M013			L(A)	---	L(A)	---	L(A)	---	1.a	
03M	03M017			L(A)	---	L(A)	---	L(A)	---	1.a	
03M	03M020			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03M	03M713			L(A)	---	L(A)	---	L(A)	---	1.a	
03M	03M802			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
03M	03M806			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
03L	03L001			L(A)	---	L(A)	---	L(A)	---	1.a	
03L	03L002			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03L	03L003			L(A)	---	L(A)	---	L(A)	---	1.a	
03L	03L004			---	---	---	---	---	---	---	Abandoned FY13
03L	03L005			L(A)	---	L(A)	---	L(A)	---	1.a	
03L	03L007			Q,L(A)	---	Q,L(A)	---	Q,L(A)	Background	1.a	
03L	03L010			L(A)	---	L(A)	---	L(A)	---	1.a	
03L	03L012			L(A)	---	L(A)	---	L(A)	---	1.a	
03L	03L013			L(A)	---	L(A)	---	L(A)	---	1.a	
03L	03L014			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03L	03L017			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03L	03L018			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03L	03L020			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03L	03L021			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	

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Well Information			Notes	June 20	June 21	June 22	June 23	June 24	Purpose For Monitoring[3]		Comments
Unit	Well I.D.	Common Name							Water Quality	Water Level	
03L	03L027			---	---	---	---	---	---	---	abandoned FY14
03L	03L028			---	---	---	---	---	---	---	abandoned FY14
03L	03L029			---	---	---	---	---	---	---	abandoned FY14
03L	03L077			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03L	03L078			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03L	03L079			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03L	03L080			L(A)	---	L(A)	---	L(A)	---	1.a	
03L	03L081			L(A)	---	L(A)	---	L(A)	---	1.a	
03L	03L084			---	---	---	---	---	---	---	abandoned FY14
03L	03L113			L(A)	---	L(A)	---	L(A)	---	1.a	
03L	03L802			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
03L	03L806			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
03L	03L809			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
03L	03L833			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
PC	04U001			L(A)	---	L(A)	---	L(A)	---	1.a	
PC	04U002			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
PC	04U003			L(A)	---	L(A)	---	L(A)	---	1.a	
PC	04U007			Q,L(A)	---	Q,L(A)	---	Q,L(A)	Background	1.a	
PC	04U012			L(A)	---	L(A)	---	L(A)	---	1.a	
PC	04U020			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
PC	04U027			---	---	---	---	---	---	---	abandoned FY14
PC	04U077			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
PC	04U510			Q,L(A)	---	Q,L(A)	---	Q,L(A)	Background	1.a	
PC	04U701			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
PC	04U702			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
PC	04U708			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
PC	04U709			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
PC	04U711			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
PC	04U713			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
PC	04U714			L(A)	---	L(A)	---	L(A)	---	1.a	
PC	04U802			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
PC	04U806			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
PC	04U833			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
J	04J077			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
J	04J702			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
J	04J708			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
J	04J713			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
J	04J714			L(A)	---	L(A)	---	L(A)	---	1.a	
PC/J	PJ#003			L(A)	---	L(A)	---	L(A)	---	1.a	
PC/J	PJ#027			---	---	---	---	---	---	---	abandoned FY14
PC/J	PJ#309	B8									See Appendix A.2
PC/J	PJ#310	B9									See Appendix A.2
PC/J	PJ#311	B10	(5)	Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	
PC/J	PJ#313	B12	(5)	Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	1.a	

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Well Information			Notes	June 20	June 21	June 22	June 23	June 24	Purpose For Monitoring(3)		Comments
Unit	Well I.D.	Common Name							Water Quality	Water Level	
PC/J	PJ#802			L(A)	---	L(A)	---	L(A)	---	1.a	
PC/J	PJ#806			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
---	Staff Gauges			L(A)	---	L(A)	---	L(A)	---	---	
Operable Unit 2 - Unit 1 Wells											
01U	01U035			---	---	---	---	---	---	---	
01U	01U043			---	---	---	---	---	---	---	
01U	01U044			---	---	---	---	---	---	---	
01U	01U045			---	---	---	---	---	---	---	
01U	01U046			---	---	---	---	---	---	---	
01U	01U060			---	---	---	---	---	---	---	
01U	01U072			---	---	---	---	---	---	---	
01U	01U085			---	---	---	---	---	---	---	
Operable Unit 3											
03U	03U673			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	2.a	
03M	03M848			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	2.a	
03L	03L673			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	2.a	
03L	03L832			L(A)	---	L(A)	---	L(A)	---	2.a	
03L	03L848			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	2.a	
03L	03L854			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	2.a	
03L	03L859			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	2.a	
03L	03L860			L(A)	---	L(A)	---	L(A)	---	2.a	
03L	03L861			---	---	---	---	---	---	---	Abandoned FY06
03L	476837	MW15H		---	---	---	---	---	---	---	
PC	04U414	414U4	(6)	Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	2.a	
PC	04U673			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	2.a	
PC	04U832			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	2.a	Contingency Action for FY08
PC	04U845			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	2.a	Contingency Action for FY08
PC	04U848			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	2.a	
PC	04U851		(6)	Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	2.a	
PC	04U852			---	---	---	---	---	---	---	Abandoned FY09
PC	04U854			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	2.a	
PC	04U859			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	2.a	
PC	04U860			Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	2.a	
PC	04U861			---	---	---	---	---	---	---	Abandoned FY06
PC	04U863	323U4		Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	2.a	
PC	04U864	324U4		---	---	---	---	---	---	---	Abandoned FY09
PC	04U865	325U4		---	---	---	---	---	---	---	Abandoned FY09
PC	04U866	326U4		Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	2.a	
PC	520931	NBM #13		---	---	---	---	---	---	---	Abandoned FY07
J	04J864	324 J		---	---	---	---	---	---	---	Abandoned FY09
J	04J866	326 J		Q,L(A)	---	Q,L(A)	---	Q,L(A)	OR	2.a	
Well Inventory											
(Entries under "Notes" refer to the well inventory category)											

Well Information			Notes	June 20	June 21	June 22	June 23	June 24	Purpose For Monitoring[3]		Comments
Unit	Well I.D.	Common Name							Water Quality	Water Level	
---	200180	Town & Country Golf Course	1b	Q(B)	Q(B)	---	---	Q(B)	Well Inventory	---	2279 Marshal Ave
---	200522	Windsor Green	1b	Q(B)	Q(B)	---	---	Q(B)	Well Inventory	---	Silver Lake Rd & Cty Rd E
---	200523	Windsor Green	1b	Q(B)	Q(B)	---	---	Q(B)	Well Inventory	---	Silver Lake Rd & Cty Rd E
---	234421	BioClean (BioChem)	1b	Q(B)	Q(B)	---	---	Q(B)	Well Inventory	---	2151 Mustang Dr
---	234544	R&D Systems	1b	Q(B)	Q(B)	---	---	Q(B)	Well Inventory	---	2201 Kennedy St NE
---	249632	Montzka, Harold	1b	Q(B)	Q(B)	---	---	Q(B)	Well Inventory	---	2301 N Upland Crest NE
---	433298	Town & Country Golf Course	1b	Q(B)	Q(B)	---	---	Q(B)	Well Inventory	---	2279 Marshall Ave
---	509052	Shriners Hospital	1b	Q(B)	Q(B)	---	---	Q(B)	Well Inventory	---	2025 E River Rd
---	537801	Midway Industrial	1b	Q(B)	Q(B)	---	---	Q(B)	Well Inventory	---	4759 Old Hwy 8
---	756236	Alcan	1c	Q(B)	Q(B)	---	---	Q(B)	Well Inventory	---	150 26th Ave SE
---	UNK0573104	Murlowski	2a	---	Q(B)	---	---	Q(B)	Well Inventory	---	1589 26th Avenue NW
---	200176	Waldorf Paper Products	2b	Q(B)	Q(B)	---	---	Q(B)	Well Inventory	---	2236 Myrtle Ave
---	249007	Walton, Toni	2b	Q(B)	Q(B)	---	---	Q(B)	Well Inventory	---	4453 Old Hwy 10
---	S00002	Midland Hills Country Club	2b	Q(B)	Q(B)	---	---	Q(B)	Well Inventory	---	2001 N Fulham St
---	200076	Old Dutch Foods, Inc	2c	Q(B)	Q(B)	---	---	Q(B)	Well Inventory	---	2375 Terminal Rd
---	236439	Waldorf Paper Products	2c	Q(B)	Q(B)	---	---	Q(B)	Well Inventory	---	2250 Wabash Ave

General Notes:

The next major sampling event for Well Inventory will be in June 2024 (conducted every 4 years)

All of the Site I shallow groundwater wells were sealed in FY14.

Appendix A-2
FY 2020-FY 2024 Monitoring Plan for Remedial Treatment Systems
FY 2020 Annual Performance Report
Twin Cities Army Ammunitions Plant
Arden Hills, Minnesota

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Location	Sampling Frequency	Parameters
OU1: Deep Groundwater [1]		
● Extraction Wells NBM#4, #14, and #15	- Monthly	- Pumping Volumes
(and also NBM#3, #5, and #6)	- Monthly	- Water Quality [2]
● PGAC Effluent	- Monthly	- Water Quality [2]
OU2: Site K Remedial Action		
● Extracted Groundwater	- Monthly	- Pumping Volume
● Treatment System Effluent [Outfall 391 (010)]	- See Appendix A.3	- See Appendix A.3
OU2: TCAAP Groundwater Recovery System (TGRS)		
● Extraction Wells	- Monthly	- Pumping Volumes
	- Semi-Annually	- Water Levels
	- Semi-Annually	- Water Quality [2]
● Treatment System Influent	- Monthly	- Pumping Volumes
	- Monthly	- Water Quality [2]
● Treatment System Effluent	- Monthly	- Water Quality [2]

Footnotes:

1. Performed by the City of New Brighton using their Sampling and Analysis Plan.
2. The required analyte list for each specific site is presented in Appendix A.4.

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Analysis	Analytical Method	Units	Site K Effluent	Site C Surface Water Locations		
			(Outfall 010)	(SW-5)	(SW-6)	(NE Wetland)
Flow Rate	---	gal/day	Continuous			
Total Flow	---	gal	M			
pH	(field)	(pH)	Q			
Hardness	(field)	(pH)	Q			
Cyanide	9012A	mg/L	Q			
Copper	6020	mg/L	Q			
Lead	6020	mg/L	Q	A	A	A
Mercury	7470A	mg/L	Q			
Phosphorus (Total)	365.4	mg/L	Q			
Silver	6020	mg/L	Q			
Zinc	6020	mg/L	Q			
Trichloroethene	8260C	mg/L	Q			
1,1-Dichloroethene	8260C	mg/L	Q			
1,1-Dichloroethane	8260C	mg/L	Q			
Cis-1,2-Dichloroethene	8260C	mg/L	Q			
Trans-1,2-Dichloroethene	8260C	mg/L	Q			
Vinyl Chloride	8260C	mg/L	Q			
1,2-Dichloroethane	8260C	mg/L	Q			

Acronyms and Abberviations:
A = Annually in June
M = Measurement required once per month
mg/L = milligrams per liter
Q = Analysis required once per quarter

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Note: Cleanup Levels (in µg/L) from each Record of Decision are shown below for use in determining the required method detection limits. Also note that these lists represent the minimum list of analytes. A larger analyte list may be utilized by the monitoring organization, if so desired. In FY 2020,1,4-dioxane (Method 8270 SIM) was also analyzed for at all summer VOC sampling locations with the exception of Site A. December TGRS extraction well sampling and treatment system influent/effluent sampling in months other than June were analyzed for VOCs only. 1,4-dioxane will continue to be monitored in OU1, OU2, and OU3 Deep Groundwater, Site K Unit 3, and TGRS

OU1 (DEEP GROUNDWATER) [1]	Cleanup Levels
1,1-Dichloroethane	70
1,1-Dichloroethene	6
cis-1,2-Dichloroethene	70
1,1,1-Trichloroethane	200
1,1,2-Trichloroethane	3
Trichloroethene	5
1,4 Dioxane	1

SITE A (SHALLOW GROUNDWATER) [2]	
Antimony*	6
1,1-Dichloroethene	6
1,2-Dichloroethane	4
Benzene	10
Chloroform	60
cis-1,2-Dichloroethene	70
Tetrachloroethene	7
Trichloroethene	30

*Antimony is only monitored at these 3 wells:
01U103, 01U902 and 01U904 (June only)

SITE C (SHALLOW GROUNDWATER) [3]	
Lead	15

SITE I (SHALLOW GROUNDWATER) [2]	
1,2-Dichloroethene (cis and trans)	70
Trichloroethene	30
Vinyl Chloride	0.2

BLDG 102 SHALLOW GROUNDWATER [4]	Cleanup Levels
Vinyl Chloride[5]	0.18
cis-1,2-Dichloroethene	70
Trichloroethene	5
1,1-Dichloroethene	6

SITE K (SHALLOW GROUNDWATER) [2]	
1,2-Dichloroethene (cis and trans)	70
Trichloroethene	30

OU2 (DEEP GROUNDWATER) [2]	
1,1,1-Trichloroethane	200
1,1-Dichloroethane	70
1,1-Dichloroethene	6
1,2-Dichloroethane	4
cis-1,2-Dichloroethene	70
Tetrachloroethene	5
Trichloroethene	5
1,4 Dioxane	1

OU3 (DEEP GROUNDWATER) [6]	
1,1-Dichloroethane	70
1,1-Dichloroethene	6
cis-1,2-Dichloroethene	70
1,1,1-Trichloroethane	200
1,1,2-Trichloroethane	3
Trichloroethene	5

WELL INVENTORY SAMPLING

VOCs (report full VOC list)

Footnotes:

(1) From Page 18 of the OU1 Record of Decision.
(2) From Table 1 of the OU2 Record of Decision.
(3) From Table 1 of Amendment #1 to the OU2 Record of Decision.
(4) From Page 2-13 of Amendment #4 to the OU2 Record of Decision.
(5) Vinyl chloride is also analyzed by SW-846 Method 8260C - SIM at wells 01U048, 01U582, and 01L582.
(6) From Page 26 of the OU3 Record of Decision.

Analytical Methods:
VOCs: SW-846 Method 8260C
Antimony & Lead: SW-846 Method 6020

Table D-1
Remedial Production Ranges for Normal Operation
(Effective January 2008)

NBCGRS Well	Estimated Physical Capacity Range			Remedial Production Range		Flow Rate Equivalents (24-hr Production Basis)	
	Normal Individual Low (gpm)	Normal Individual High (gpm) (See Note 1)	Peak Combined High (gpm) (See Note 1)	Lower Limit (MGD)	Upper Limit (MGD)	Lower Limit (gpm)	Upper Limit (gpm)
3 (See Note 2)	300	600	400	0.000	0.576	0	400
4 (See Note 2)	500	1,100	900	1.152	1.296	800	900
3 + 4 (See Note 2)	800	n/a	1,300	1.152	1.872	800	1,300
5	400	850	750	0.864	1.080	600	750
6	400	850	750	0.000	1.080	0	750
5 + 6 (See Note 3)	800	1,700	1,500	0.864	2.160	600	1,500
14	500	1,200	1,000	0.000	1.440	0	1,000
15	500	1,200	1,000	1.152	1.440	800	1,000
TOTAL WELL CAPACITY	2,600	n/a	4,800	**3.168**	**6.912**	**2,200**	**4,800**
TREATMENT CAPACITY		3,200	5,000				
NBCGRS SYSTEM LIMIT		3,200	4,800				

NOTES:

1. During peak production periods with all wells running, individual well capacities are limited by interference, high drawdown, and high system head losses
2. While shown individually to illustrate normal operational intent, enforceable target is for combined Well 3 plus Well 4 since the wells are located in close proximity and effectively operate as a single point source. Wells 3 and 4 can be used interchangeably to produce total daily target.
3. While shown individually to illustrate normal operational intent, enforceable target is for combined Well 5 plus Well 6 since the wells are located in close proximity and effectively operate as a single point source. Wells 5 and 6 can be used interchangeably to produce total daily target.

15 FEB 2008
Michael R. Fix
Twin Cities Army Ammunition Plant

2/15/08
Grant M. Wyffels
City of New Brighton

Table D-2
Alternate Remedial Production Ranges for Contingent Events
(Effective January 2008)

Event	Normal Operation			Well 3 and/or 4 Down			Well 5 and/or 6 Down			Well 14 Down			Well 15 Down		
Well / Pair	Priority	Lower Limit (MGD)	Upper Limit (MGD)	Priority	Lower Limit (MGD)	Upper Limit (MGD)	Priority	Lower Limit (MGD)	Upper Limit (MGD)	Priority	Lower Limit (MGD)	Upper Limit (MGD)	Priority	Lower Limit (MGD)	Upper Limit (MGD)
3 + 4	2	1.152	1.872	NA	**0.000**	**0.000**	2	1.440	1.872	2	1.152	1.872	1	1.440	1.872
5 + 6	3	0.864	2.160	2	1.728	2.160	NA	**0.000**	**0.000**	3	0.864	2.160	2	1.728	2.160
14	4	0.000	1.440	3	1.152	1.440	3	1.152	1.440	NA	**0.000**	**0.000**	3	0.720	1.152
15	1	1.152	1.440	1	1.152	1.440	1	1.152	1.440	1	1.152	1.440	NA	**0.000**	**0.000**
Total		3.168	6.912		4.032	5.040		3.744	4.752		3.168	5.472		3.888	5.184

Appendix B

Monitoring Well Index

Purpose

The purpose of the well index is to identify all wells, both past and present, that:

- Have been used to collect water quality data or groundwater elevations in regard to work at the New Brighton/Arden Hills Superfund Site (including private wells and offsite monitoring wells sampled by the Army); or
- Are owned by the Army; or
- Are located within the boundaries of OU2 (the former TCAAP property)

In addition, the well index aims to identify the current status (in use, sealed, abandoned, etc.) of these wells.

The well index does not include wells identified in the Well Inventory Update (Appendix E) that have not been sampled by the Army at any point in history.

The list contained in the well index is by no means a compilation of all available data. Other data may exist regarding an individual well that was not discovered or searched out during the course of this effort. The list is intended to be a reasonable effort to gather the data concerning the wells that is readily available. Therefore, if additional data is desired concerning a certain well, it may be possible to search out and obtain that data from records not searched during the course of the investigation.

Background

OU2 and OU1/OU3 wells have been installed in four hydrogeologic units beneath the site. These hydrogeologic units, as referred to in this report, are conceptually illustrated on Figure B-1 and are described below:

Unit 1: This unit, referred to as the Fridley Formation, consists of alluvium and lacustrine deposits above the Twin Cities Formation (Unit 2). The formation is made up of fine- to medium-grained sand and clayey silt, which acts as an unconfined aquifer with an estimated hydraulic conductivity of 8.3 x 10^{-3} cm/sec (International Technology Corp. 1992). The Unit 1 deposits are discontinuous at the New Brighton/Arden Hills Superfund Site (NB/AH Site) and range in thickness from zero to 50 feet. They are predominantly limited to the north, east, and southwest portions of the site. Groundwater in Unit 1 is also discontinuous.

Unit 2: Known as the Twin Cities Formation, Unit 2 consists of Quaternary aged glacial till and, similar to Unit 1, is discontinuous at the NB/AH Site. Unit 2 is generally regarded as an aquitard to vertical migration of groundwater; however, sand and gravel lenses may contain water.

Unit 3: This unit consists primarily of the Quaternary aged Hillside Sand Formation, which is continuous beneath OU2. Near the center of OU2, the Hillside Sand Formation is overlain by the Arsenal Sand, which forms a kame. There is no distinct lithologic contact between the Hillside Sand and the Arsenal Sand, and both are considered included in Unit 3. Unit 3 ranges in thickness from 25 to 450 feet. For monitoring purposes, the Unit 3 aquifer thickness has been arbitrarily subdivided into thirds designated as upper, middle, and lower.

Unit 4: This unit consists collectively of bedrock from the Prairie du Chien Group and Jordan Formation (Ordovician and Cambrian periods, respectively). For monitoring purposes, the Prairie du Chien Group is referred to as Upper Unit 4, while the Jordan Formation is Lower Unit 4. The Jordan Formation varies from fine- to coarse-grained quartz sandstone. The Prairie du Chien Group in the NB/AH Site area consists of a finely crystalline dolomite of the Oneota Formation, as well as quartz sandstone and dolomite members of the Shakopee Formation. A more detailed description of the bedrock geology can be found in the Remedial Investigation Report (Argonne National Laboratory, 1991).

In order to identify the hydrogeologic unit in which each well is completed, the United States Army Environmental Center (USAEC), formerly the United States Army Toxic and Hazardous Materials Agency (USATHAMA), developed a standardized identification system for wells at the NB/AH Site (referred to as the Army Designation or IRDMIS number). Well designations consist of six characters, such as 03U093. The first two characters represent the hydrogeologic unit in which the well is completed, as follows:

01	-	Unit 1
03	-	Unit 3
04	-	Unit 4: Prairie du Chien Group or Jordan Formation
PJ	-	Unit 4: Prairie du Chien Group and Jordan Formation

The third character represents the relative position of the well screen or open hole within the specified hydrogeologic unit, as follows:

U	-	upper portion
M	-	middle portion
L	-	lower portion
J	-	Jordan Sandstone
F	-	fully penetrating Unit 3
#	-	open hole (total or partial thickness)

The remaining three characters represent the well number, as follows:

001 thru 500	USAEC wells and additional wells installed by others adjacent to an existing well with the 001-500 designation.
501 thru 600	NB/AH Site wells.
601 thru 800	OU2 Alliant Techsystems wells.
801 thru 999	OU1/OU3 Alliant Techsystems wells.

OU1/OU3 wells installed by parties other than USAEC, the Army, or Northrop Grumman (Formerly Alliant Techsystems/Orbital ATK) are designated by their Minnesota unique number. Table B-1 is sorted by unique number, but includes the IRDMIS number and any other name(s) the wells may have. The well type in this table is abbreviated as follows:

UN	-	Unknown
MUNI	-	Municipal
MON	-	Monitoring
DOM	-	Domestic
IND	-	Industrial
P.S.	-	Public Supply
COM	-	Commercial
IRR	-	Irrigation
ABAND	-	Abandoned
PIEZ.	-	Piezometer
REM	-	Remedial

In recent years, as property transfer of the remaining land that is still identified as TCAAP has progressed (and is now nearing completion), it became apparent that an updated well index with more information concerning each well would be of importance to pass on to future landowners. In addition, as groundwater quality continues to improve and contaminant plumes continue to shrink in vertical and horizontal extent, the index will function as a check to make sure that all Army owned wells are sealed and that all traces of the wells are removed from the area.

The FY 2020 Appendix B Table B-1 shows the most current well index. The well index continues to be a work in progress. Additional records regarding individual wells continue to become available as new wells are drilled and older unneeded wells are sealed and removed.

Figures B-2 and B-3 show the location of wells identified in Table B-1. With a known well name, the location of that well can be identified using the "Edit, Find" or "Edit, Search" function and then typing in the desired well name, which will highlight this well name on the figure.

The Appendix B Attachment contains available documentation for each well, including boring logs (if available). The attachment is sorted by Minnesota unique number. To view the information concerning a well, click on the desired well number in the bookmarks.

FY 2020 Update

The newly constructed source control wells at TCAAP, SC-6 through SC-10, have been added to the database as part of the FY 2020 update.

The well type for 45 wells was changed from "TEST" to "MON" to align with the previously described well types.

Seven (7) wells were updated as "sealed", based on information provided in the FY 2019 Well Inventory Main Database, included in Appendix E. No further documentation was found to support the sealing of these wells.

These updates resulted in a total of 442 unsealed wells. Of the unsealed wells, 60 wells were not inspected due to well type (abandoned, commercial, domestic, industrial, irrigation, municipal, and public supply wells were not inspected), 19 wells were not inspected due to location (wells outside of the inventory area were not inspected), and 4 wells were not inspected due to classification (Categories 1E, 3, or 5 are not recommended for inspection). Additionally, 11 unsealed wells have not been sampled or sounded in more than 5 years and are recommended for abandonment.

Ongoing Efforts to Update Appendix B

- The well index, Table B-1, has been compared with the wells identified in Appendix D, which contains historical water quality and groundwater elevation data. A number of wells were identified in Appendix D that do not exist in the well index. Ongoing efforts will be made to add information, as possible, concerning the location and status of these wells to the well index in Appendix B.

- The repository at the TCAAP office will continue to be utilized to obtain additional well information, where possible.

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Appendix B Table B-1 contains a summary of all information available concerning a certain well, and is sorted by Minnesota unique well number.

To search for detailed records regarding a well, open the appropriate file below and select the bookmark corresponding to the Minnesota unique well number of the well being searched. If the unique number is unknown for a well, it is included and sorted in the Appendix B Attachment by IRDMIS name or OTHER. Records included in the Appendix B Attachment that may or may not be available for each well include:

- The County Well Index well log,
- Access agreement(s),
- Correspondence related to the well,
- Field notes and boring logs,
- Well construction diagrams,
- Documentation of well modifications, and
- Sealing records.

Appendix B Attachment

1. Wells Numbered 104772 through 194772
2. Wells Numbered 200070 through 225906
3. Wells Numbered 231741 through 235753
4. Wells Numbered 236066 through 257443
5. Wells Numbered 265735 through 482709
6. Wells Numbered 500248 through IRDMIS and OTHER

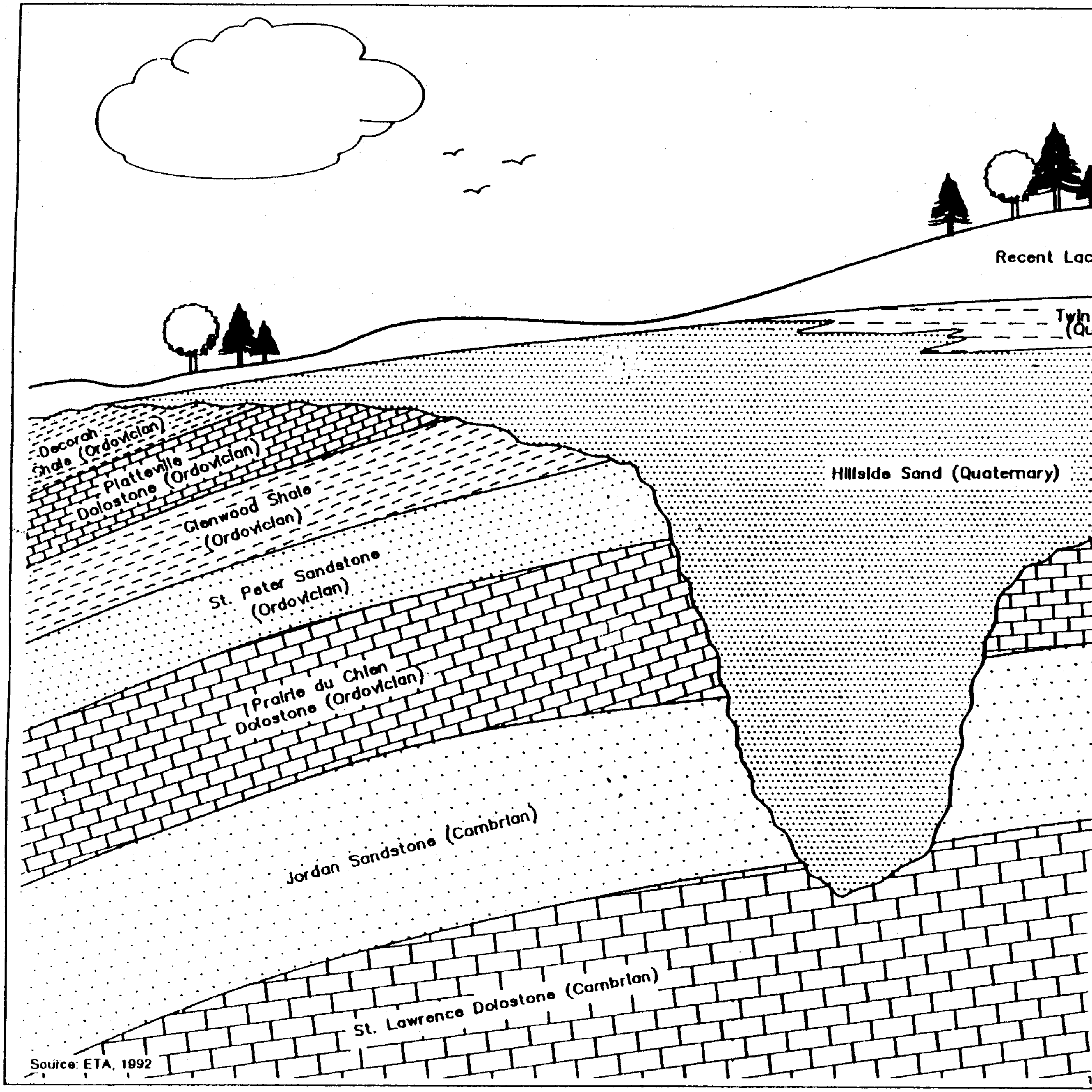

Figure B-1

Conceptual Illustration of Site Geology

ANNUAL PERFORMANCE REPORT	PIKA ARCADIS a joint venture	FY 2020
OU1 & OU3 Well Location		Figure B-2

ANNUAL PERFORMANCE REPORT	PIKA ARCADIS a joint venture	FY 2020
OU2 Well Location		Figure B-3

Appendix C

Data Collection, Management and Presentation

1.0 INTRODUCTION

A groundwater monitoring program was initiated in January 1984 to obtain water level and water quality data at OU1, OU2 and OU3. Each year has been divided into quarters with each quarter assigned a number. Accordingly, FY 2020 was comprised of Quarter 145 (October through December), Quarter 146 (January through March), Quarter 147 (April through June), and Quarter 148 (July through September). Water sampling, water level measurements, and laboratory analyses were conducted in accordance with the "Quality Assurance Project Plan (QAPP) for Performance Monitoring" (PIKA-Arcadis JV, Revision 18, June 22, 2020), which covers all sites.

Prior to November 1, 2001, data collected from OU1, OU2 and OU3 was stored in the U.S. Army Environmental Command (USAEC) Installation Restoration Data Management Information System (IRDMIS). USAEC replaced the IRDMIS System on November 1, 2001, with a new system, the Environmental Restoration Information System (ERIS), which incorporated all the data that had previously been entered into IRDMIS. The Army has continued to enter data into ERIS; however, ERIS is not being used as the primary database for the OU1, OU2 and OU3 data. The historical databases in Appendix D.1 are the primary databases.

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2.0 GROUNDWATER LEVELS AND GROUNDWATER QUALITY

2.1 Data Collection and Management

Groundwater level and groundwater quality data were collected in accordance with the FY 2020 Annual Monitoring Plan (Appendix A), which established the monitoring responsibilities for both the Army and Northrop Grumman (formerly Orbital ATK). In response to the discovery of 1,4-dioxane in the area, a “major” sampling event was conducted in June of FY 2016 as indicated in the FY 2016 Annual Monitoring Plan. The sampling event for FY 2016 would otherwise have been a “minor” event. Additionally, the Army conducted a “major” well inventory sampling event in FY 2016. Due to these changes, the monitoring plan for future years was modified accordingly to include a “major” well inventory sampling event once every four years and maintain a biennial trend of “major” sampling events at all other sites. The FY 2020 was therefore a major sampling event. As of FY 2020 sampling only included 1,4-dioxane analyses at OU1 and OU2 deep groundwater locations after determining it was not a contaminant of concern at the Building 102 Site.

Water level monitoring and water sampling were conducted by JV for the Army and by GHD (formerly CRA) for Northrop Grumman (formerly Orbital ATK). Laboratory analysis for all sites was performed by Pace Analytical National Center for Testing & Innovation Laboratory, Mt Juliet, Tennessee. Appendix A.4 contains lists of required analytes, as referenced by the monitoring plans in Appendix A. The lists are site-specific, based on the chemicals of concern. At sites other than Site C, halogenated volatile organic compounds are the parameters of primary interest, though some of the sites (or specific wells at a site) are sampled for aromatic volatile organic compounds and/or metals. At Site C, dissolved lead is the only chemical of concern. Appendix C.2 presents deviations from the FY 2020 Annual Monitoring Plan.

Data verification and validation was conducted in accordance with procedures and requirements outlined in the QAPP and Addendum #1. Data qualifiers assigned to data through data verification and/or data validation appear in the data tables included within the individual sections of this report, with qualifier definitions given in footnotes to the tables. Data qualifiers are also included in the historical databases (Appendix D.1), which include a database of organic water quality, a database of inorganic water quality (excluding Site C), and a database for Site C water quality (for both groundwater and surface water). Data verification was performed by JV for the JV-collected data and by GHD for the GHD-collected data. Data validation was performed by Diane Short & Associates for the JV-collected data and by GHD for the GHD-collected data. Data verification and validation information from the two sampling firms was compiled into quarterly Data Usability Reports (DURs) that were submitted to the Minnesota Pollution Control Agency (MCPA) and United States Environmental Protection Agency (USEPA) for review. If any MPCA/USEPA-requested revisions were necessary, a final DUR was resubmitted. The final MPCA/USEPA approval letter has not yet been received for the FY 2020 DURs, but will be included in Appendix C.3.

For water level measurements, the depth to water from the surveyed top of the well casing elevation was measured. Groundwater elevations were calculated by subtracting the depths to water from the surveyed top of the well casing elevations and are included in the historical water elevation database (Appendix D.1).

2.2 Groundwater Elevation Contour Maps

The most extensive water level monitoring event performed during FY 2020 was in June (Quarter 147). This data was used to prepare groundwater elevation contour maps for deep groundwater at OU1/OU3 and OU2 (OU3 is shown on the same figure as OU1 in the OU1 section of this report), and for shallow groundwater at Sites A, C, K and Building 102. Groundwater elevation contour maps are included within the individual sections of this report. There is not a comprehensive water level event for shallow groundwater at Site I, given the well sealing that has been done.

2.3 Groundwater Quality Contour Maps and Cross-Sections

The most extensive sampling event performed during FY 2020 was in June and July (Quarter 147 and 148). This data was used to prepare updated groundwater quality isoconcentration contour maps and/or cross-sections for deep groundwater at OU1/OU3 and OU2 (OU3 is shown with OU1 on Section 3 Figures) and shallow groundwater at Site A, Site C, Site K, and Building 102. Site I is excluded, given the well sealing that has been done. Contour maps were generated by hand, based on the observed contaminant concentrations and the extent of past site contamination. These maps are included in the corresponding Figures Section of this report.

For deep groundwater at OU1/OU3 and OU2, isoconcentration maps and cross-sections are provided for trichloroethene and 1,4-dioxane, since these are the primary chemicals of concern on a concentration basis. These isoconcentration maps include individual maps for Upper and Lower Unit 3 Combined, Upper Unit 4, and Lower Unit 4. To complement the isoconcentration maps, cross-sections were prepared to illustrate the vertical distribution of trichloroethene and 1,4-dioxane. One section line passes through the source area at Site G in OU2 and follows the north plume (OU1) through well 582628 (NBM#15) of the New Brighton Contaminated Groundwater Recovery System (NBCGRS). A second section lines passes through the source area at Site I and follows the north plume (OU1) south to well 04U852, drawn further east but running roughly parallel with the first section line.

Contaminant concentrations for Middle Unit 3 wells and wells that fully penetrate Unit 3 (03F) (including any recovery wells that fully penetrate Unit 3 and that are being sampled as a monitoring well) are shown in parentheses on the Lower Unit 3 isoconcentration maps, but were not used for contouring purposes except when no Lower Unit 3 wells are located in the vicinity.

For Site A shallow groundwater, an isoconcentration map is provided for cis-1,2-dichloroethene, since this is the chemical of concern with the largest aerial extent at Site A, and for tetrachloroethene, which illustrates the source area and contaminant degradation. Cross-sections were also prepared for Site A to illustrate the vertical distribution of cis-1,2-dichloroethene. The isoconcentration maps for Site A were prepared only for Unit 1, since this is the only contaminated aquifer.

For Site C shallow groundwater, an isoconcentration map is provided for dissolved lead, since this is the only chemical of concern at Site C. Results for surface water monitoring are also shown on the same map to show impacts to surface water are not occurring as a result of the shallow groundwater contamination. Cross-sections were also prepared for Site C to illustrate the vertical distribution of dissolved lead. The isoconcentration map for Site C was prepared only for Unit 1, since this is the only contaminated aquifer.

For Site K shallow groundwater, an isoconcentration map is provided for trichloroethene, since this is the primary chemical of concern on a concentration basis. The isoconcentration map for Site K was prepared only for Unit 1, since this is the only contaminated aquifer.

For Building 102 shallow groundwater, a concentration map is provided for vinyl chloride, since this is the chemical of concern that has historically had the largest aerial extent at Building 102, and for trichloroethene and cis-1,2-dichloroethene, to illustrate the source area and contaminant degradation. The isoconcentration maps for Building 102 were prepared only for Unit 1, since this is the only contaminated aquifer.

Contaminant concentrations for recovery wells that are actively pumping are shown in parentheses on the isoconcentration maps. These values were considered, but were generally not used alone to prepare the isoconcentration contours. Concentrations of recovery wells generally represent an average contaminant value for all groundwater being drawn to the well; hence, the concentrations do not necessarily represent a discrete location or depth. Contaminant concentrations for recovery wells that are not actively pumping are fully utilized for purposes of contouring.

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Deep Groundwater VOC Sites

2020: As of FY 2020, 1,4-dioxane is considered a COC for OU1 and OU2 deep groundwater; monitoring for 1,4-dioxane has been discontinued at all other sites.

OU1: Deep Groundwater

June and July 2020: Sample VOCs and 1,4-dioxane. Reset hydrasleeves for 2021 sampling; no deviations occurred.

OU2: Site A Shallow Groundwater

All Wells: Sample VOCs and Antimony; Sample lead; Pace National ran dissolved-antimony by method 6010 versus 6020.

June 2020:

01U108: An obstruction prevented the sampling pump from being deployed in the well; therefore, the well could not be sampled.

01U350: Sampled as an alternative to well 01U108.

August 2020:

01U108 This well was properly sealed and abandoned; 01U350 will continue to serve as the alternative sampling location.

OU2: Site C Shallow Groundwater

All Wells: Sample lead; Pace National ran dissolved-lead by method 6010 versus 6020. Reporting limits still remain below the site cleanup level.

OU2: Site C Surface Water

All Wells: Sample lead at surface water points; Pace National ran dissolved-lead by method 6010 versus 6020. Reporting limits still remain below the site cleanup level.

OU2: Building 102 Shallow Groundwater

All Wells: Sample VOCs; as per the 2020 QAPP (rev18) update, the project laboratory could not provide reporting limits as low as the Building 102 cleanup level.

OU2: Site K Shallow Groundwater

June 2020:

01U608: The well was intended to be reinstalled in 2017, but reinstallation was pushed back due to delays associated with redevelopments of the Site; therefore, the well could not be sampled.

01U609: The well was intended to be reinstalled in 2017, but reinstallation was pushed back due to delays associated with redevelopments of the Site; therefore, the well could not be sampled.

01U611: The well was intended to be reinstalled in 2017, but reinstallation was pushed back due to delays associated with redevelopments of the Site; therefore, the well could not be sampled.

OU2: Site I Shallow Groundwater

June 2020:

01U667: The well was intended to be reinstalled in 2017, but reinstallation was pushed back due to delays associated with redevelopments of the Site; therefore, the well could not be sampled.

Appendix D

Comprehensive Groundwater Quality and Groundwater Level Database

D.1 Comprehensive Groundwater Quality and Groundwater Level Database

The historical groundwater databases are located on this CD in a folder named Appendix D.1. This folder contains four Microsoft Excel files:

File	Contents
Compelev_FY20	Groundwater elevations
Comporwq_FY20	Groundwater quality: organic data
Compinwq_FY20	Groundwater quality: inorganic data (excluding Site C)
Site C wq_FY20	Groundwater quality: inorganic data (Site C only)

D.2 Operable Unit 1 Statistical Analysis

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Group 1 – Downgradient of TGRS

03U806	04U806	03L802	03U801
03M806	PJ#806	04U802	03U711
03L806	03M802	PJ#802*	04U711

Group 2 – Areal Extent of Plume

03U805	409557	04U841	04U875
03U672 abandoned	04U673	04U843	04U877
03L848	04U832	04U833	206688 out of service
03L673	04U845	04U846	04U849
03L833	04U854	04U861 abandoned	04U821
03L859	04U859	409549	191942 abandoned

Group 3 ** – Downgradient Sentinel

04U871	04U875	04U851	

Group 4 – Lateral Sentinel

03U831 abandoned	03L846	409556	409548
03U811	03L832	04U855	04U839
03U804	03L861 abandoned	04U879	04U838
03U673	03L854	04U860	04U848
03U672 abandoned	03L841	409547	04J839
03M843	03L811	04U863	03U677

Group 5 – Global Plume

04J077	04U702	04U848	04U877
04J702	04U709	04U851	04U879
04J708	04U711	04U852 abandoned	04U880
04J713	04U713	04U855	04U881
04J834	04U802	04U859	04U882
04J864 abandoned	04U806	04U860	200154
04J866	04U832	04U861 abandoned	234546
04J882	04U833	04U863	234549 out of service
04U002	04U834	04U864 abandoned	409547
04U020	04U841	04U865 abandoned	409548
04U027abandoned	04U843	04U866	409549
04U077	04U844	04U871	409555
04U673	04U845	04U872	512761
04U701	04U846	04U875	PJ#318

Group 5 Unit 3 wells (evaluated as individual trends)

03L822	03U821	03U822	03L822
409550	409596 abandoned	409597 abandoned	03U831 abandoned

Group 6 – Jordan Aquifer

04J077	04J838	04U713	04U882
04J702	04J839	04U834	NBM#3
04J708	04J882	04U836	NBM#4
04J713	04J847	04U837	NBM#5
04J822	04J849	04U838	NBM#6
04J834	04U077	04U839	
04J836	04U702	04U847	
04J837	04U708	04U849	

* PJ#802 will not be monitored or used for evaluation unless 04U802 shows TCE concentrations greater than 1 ppb.

** Group 3 is analyzed as a rectangular area taken from the Group 5 contouring.

Table 3-3
Group 1, 2, 3, 5, and 6 Mann-Kendall Summary for OU1
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Twin Cities Army Ammunitions Plant
Arden Hills, Minnesota

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Notes and Abbreviations on Page 2.

Group	S Value	P Value	R^2 Value	Fraction of Detections	Results Trend	Threshold Triggered?	Comments
Group 1 NP							
Group 1 SP							
Group 2 Wells:							
409549	-2	0.443	0.0508	7 / 7	No Significant Trend	Yes	Near plume center, plume shifted slightly
409557	11	0.0680	0.0499	7 / 7	Probably Increasing Trend	Yes	Between north & south plume, lateral dispersion
03L673	-11	0.0280	0.644	6 / 6	Decreasing Trend	No	
03L833	-5	0.235	0.0328	6 / 6	No Significant Trend	Yes	
03L848	-5	0.235	0.186	6 / 6	No Significant Trend	Yes	
03L859	-9	0.0680	0.585	6 / 6	Probably Decreasing Trend	No	
03U805	11	0.0280	0.828	6 / 6	Increasing Trend	Yes	Southern edge of north plume, plume shifted slightly
04U673	-13	0.00830	0.712	6 / 6	Decreasing Trend	No	Near south plume center, plume shifted slightly
04U821	-12	0.0515	0.482	7 / 7	Probably Decreasing Trend	No	
04U833	-14	0.0900	0.241	8 / 9	Probably Decreasing Trend	No	
04U841	-16	0.0102	0.853	7 / 7	Decreasing Trend	No	
04U843	19	0.0116	0.666	8 / 8	Increasing Trend	Yes	Near plume center
04U845	-3	0.360	0.0202	6 / 6	No Significant Trend	Yes	
04U846	10	0.0935	0.356	7 / 7	Probably Increasing Trend	Yes	Near plume center, historically erratic
04U849	-6	0.274	0.00222	8 / 8	No Significant Trend	Yes	See Group 6 summary.
04U854	-9	0.0680	0.531	6 / 6	Probably Decreasing Trend	No	
04U859	-14	0.00490	0.853	6 / 6	Decreasing Trend	No	
04U875	-11	0.114	0.302	2 / 8	No Significant Trend	Yes	
04U877	5	0.391	0.0105	12 / 12	No Significant Trend	Yes	On east plume boundary, raw trend decreasing
Group 3							
Group 5							
Group 5 Unit 3 Wells:							
409550	-11	0.114	0.164	8 / 8	No Significant Trend	Yes	Raw trend is decreasing
03L822	-19	0.0116	0.657	8 / 8	Decreasing Trend	No	
03U821	-18	0.00340	0.769	7 / 7	Decreasing Trend	No	
03U822	-6	0.236	0.458	7 / 7	No Significant Trend	Yes	Between 120 and 160 µg/L since 2003
Group 6 OU1 Jordan Wells:							
04J077	-22	0.0120	0.545	9 / 9	Decreasing Trend	No	
04J702	-12	0.0182	0.835	6 / 6	Decreasing Trend	No	
04J708	15	0.00140	0.977	6 / 6	Increasing Trend	Yes	Southern edge of north plume, plume shifted slightly
04J713	0	0.577	2010	0 / 6	--	No	All ND
04J822	-48	<0.001	0.800	12 / 12	Decreasing Trend	No	

Notes and Abbreviations on Page 2.

Group	S Value	P Value	R^2 Value	Fraction of Detections	Results Trend	Threshold Triggered?	Comments
Group 6 OU1 Jordan Wells Continued:							
04J834	-3	0.386	0.0164	3 / 7	No Significant Trend	Yes	
04J836	12	0.0890	0.167	8 / 8	Probably Increasing Trend	Yes	Close proximity to NBCGRS wells, likely influenced by shutdown
04J837	-9	0.169	0.00263	8 / 8	No Significant Trend	Yes	Close proximity to NBCGRS wells, likely influenced by shutdown
04J838	3	0.386	0.000992	7 / 7	No Significant Trend	Yes	Close proximity to NBCGRS wells, likely influenced by shutdown
04J839	12	0.0890	0.396	8 / 8	Probably Increasing Trend	Yes	Below 5 µg/L
04J847	-24	0.0803	0.286	13 / 13	Probably Decreasing Trend	No	Near plume center
04J849	45	0.00227	0.0461	7 / 13	Increasing Trend	Yes	Below 1 µg/L
04J882	0	--	--	0 / 7	--	No	All ND
Group 6 Nested Unit 4 Wells:							
04U077	-15	0.00140	0.885	6 / 6	Decreasing Trend	No	
04U702	-13	0.00830	0.921	6 / 6	Decreasing Trend	No	Below 3 µg/L
04U708	-9	0.0680	0.659	2 / 6	Probably Decreasing Trend	No	
04U713	-5	0.235	0.264	4 / 6	No Significant Trend	Yes	
04U834	-2	0.443	0.112	5 / 7	No Significant Trend	Yes	
04U836	-13	0.110	0.236	8 / 9	No Significant Trend	Yes	Close proximity to NBCGRS wells, likely influenced by shutdown
04U837	1	0.500	0.00371	8 / 8	Probably Increasing Trend	Yes	Raw trend is decreasing
04U838	8	0.155	0.165	7 / 7	No Significant Trend	Yes	Below 3 µg/L since 2009
04U839	21	0.0170	0.635	9 / 9	Increasing Trend	Yes	Close proximity to NBCGRS wells, likely influenced by shutdown
04U847	-14	0.0540	0.301	8 / 8	Probably Decreasing Trend	No	Raw trend is decreasing
04U882	-10	0.0935	0.204	6 / 7	Probably Decreasing Trend	No	

General Notes:

Response Threshold triggers are defined in Table D.2.1.3.

Acronyms and Abbreviations:

NA = not applicable; trend analysis not performed at this location
ND = non-detect
NBCGRS = New Brighton Contaminated Groundwater Recovery System
OU = Operable Unit
P Value = represents uncertainty in the trend
R^2 Value = represents the fit of the data to the regression
S Value = indicates increasing (positive S) or decreasing (negative S) trend
µg/L = micrograms per liter

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Mann-Kendall S	Mann-Kendall P	Trend Conclusion
S > 0	P < / = 0.05	Increasing
S > 0	P < / = 0.10	Probably Increasing
S = 0	P < / = 0.05	Stable
S < 0	P < / = 0.10	Probably Decreasing
S < 0	P < / = 0.05	Decreasing
Any 'S'	P > 0.05	No Significant Trend

Appendix D.2.1.3
Response Thresholds by Group
FY 2020 Annual Performance Report
Twin Cities Army Ammunitions Plant
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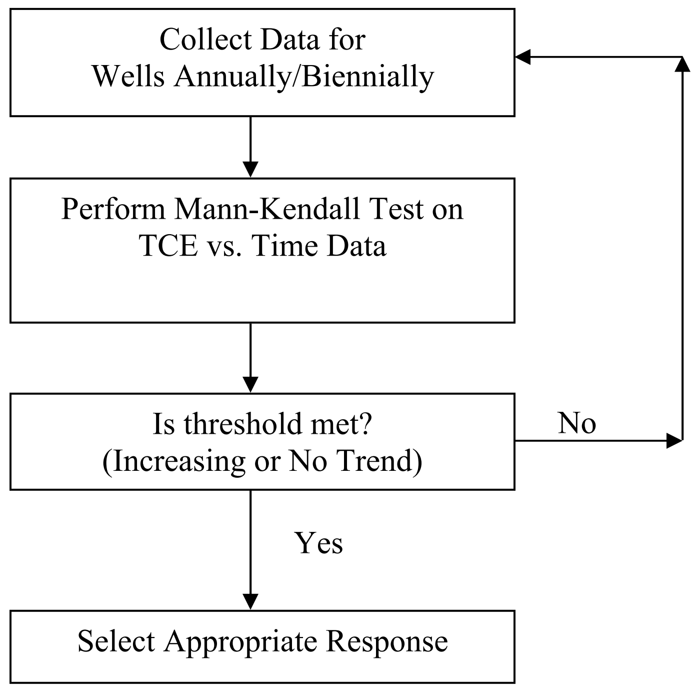
Well Group	Purpose	Measure	Time Window/ Monitoring Frequency	Test	Response Threshold
Group 1	AWC Immediately Downgradient of TGRS	AWC Trend	6 years/annual	Mann-Kendall	Stable, Increasing, or No Trend
Group 2	Defining Plume Size (Low Concentration Edges)	Individual Well Trend for TCE	12 years/biennial	Mann-Kendall	Increasing or No Trend
Group 3	AWC Immediately Downgradient of NBCGRS	AWC Trend	12 years/biennial	Mann-Kendall	Stable, Increasing, or No Trend
Group 4	Lateral (Clean) Sentinel Wells	Individual Well Concentration	12 years/biennial	Individual Concentrations	Greater than ROD goals
Group 5	Global Plume Mass Reduction	AWC Trend	12 years/biennial	Mann-Kendall	Stable, Increasing, or No Trend
Group 6	Evaluating and comparing trends in Jordan Aquifer	Individual Well Trend for TCE	12 years/biennial	Mann-Kendall	Stable, Increasing or No Trend

General Notes:
A Response Threshold is the test result(s) that triggers further response. See text for additional explanation of response process.
Acronyms and Abbreviations:
AWC = Area-Weighted Concentration


Collect Data for Wells Annually/Biennially
Perform Mann-Kendall Test on TCE vs. Time Data
Is threshold met? (Increasing or No Trend)
No
Yes
Select Appropriate Response

Appendix D.2.1.5
Responses to Threshold Indicators Fiscal Year 2020
FY 2020 Annual Performance Report
Twin Cities Army Ammunitions Plant
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FACTORS TO CONSIDER

- Contaminant concentrations
- Location (vertical and horizontal)
- Surrounding data
- Risks to human health or the environment
- Need for urgency in response

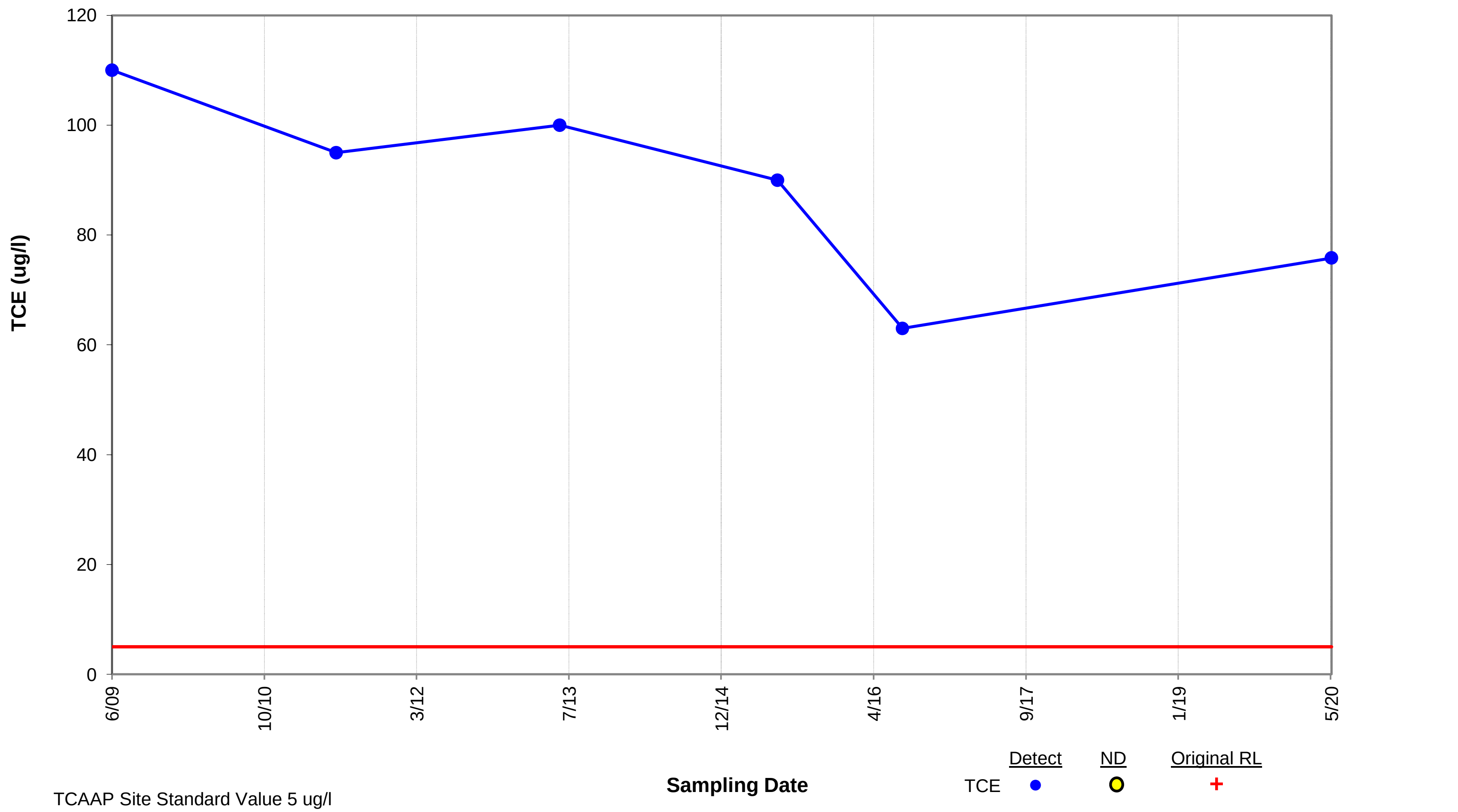
POSSIBLE EVALUATION RESPONSES

- Perform additional or confirmation sampling
- Write up in the Annual Performance Report
- Perform separate evaluation and write-up (Tech Memo)

POSSIBLE LONG-TERM RESPONSES

- Increase sampling frequency
- Modify operation of remedial system(s)
- Perform new remedy evaluation
- Install additional monitoring well(s)
- Modify the Special Well Construction Area
- Control risk at the receptors

Note: Threshold responses to be described and evaluated in the Annual Performance Reports.



Mann-Kendall Test Result: **DECREASING TREND**
p-value = 0.028

H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).

Theil-Sen Trend Line Result: **DECREASING TREND**
Median Slope Estimate = -9.2E-03 ug/l per day
95% Confidence Interval = -2.9E-02 to -4.1E-03 ug/l per day

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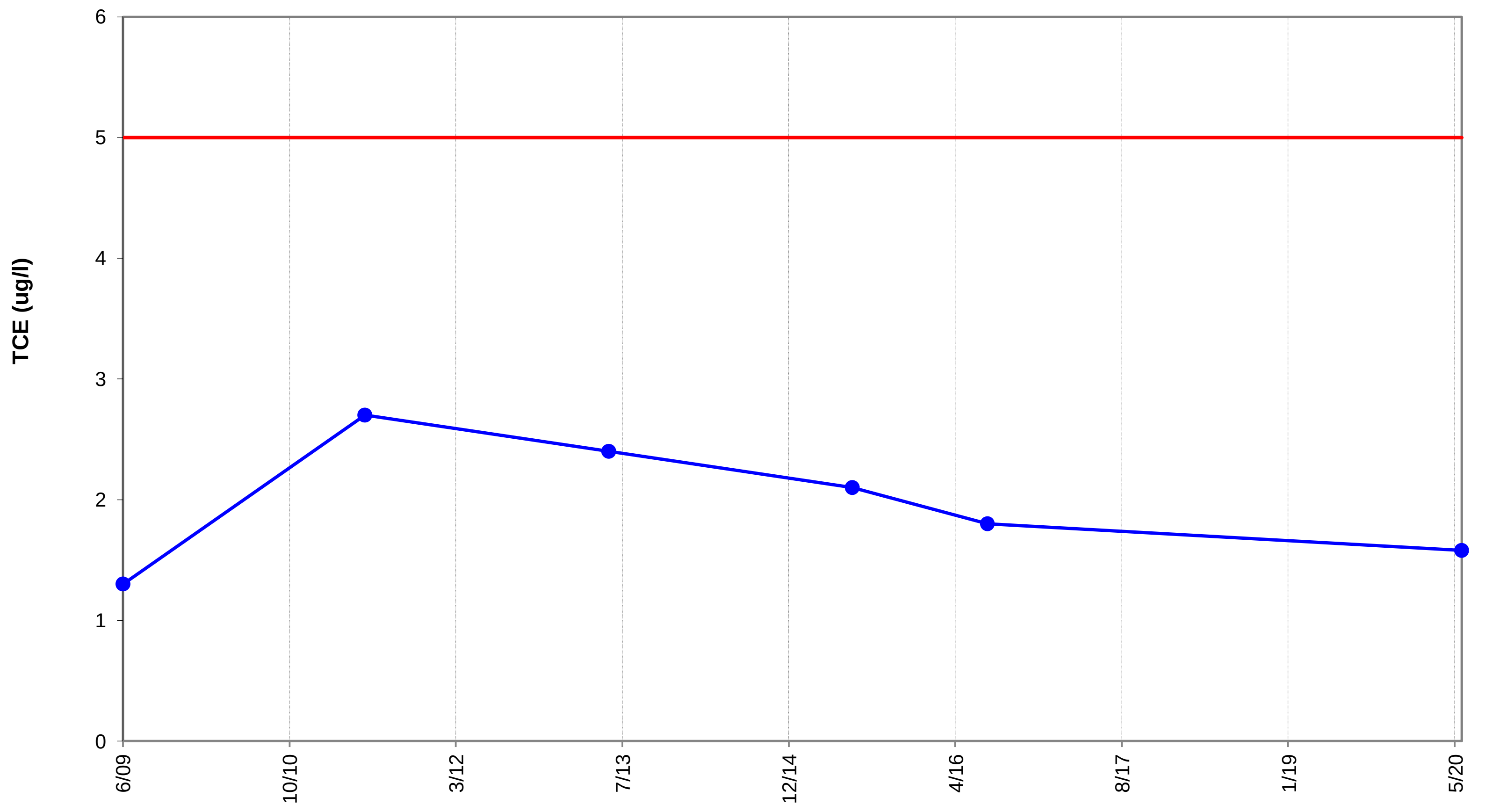
Concentration vs. Time Plot – TCE in Well 03L673Twin Cities Army Ammunition Plant

Figure D.2.2-1



TCAAP Site Standard Value 5 ug/l

Mann-Kendall Test Result: **No Significant Trend**
p-value = 0.235

H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).

Theil-Sen Trend Line Result: **No Significant Trend**
Median Slope Estimate = -3.2E-04 ug/l per day
95% Confidence Interval = -5.1E-04 to 3.2E-04 ug/l per day

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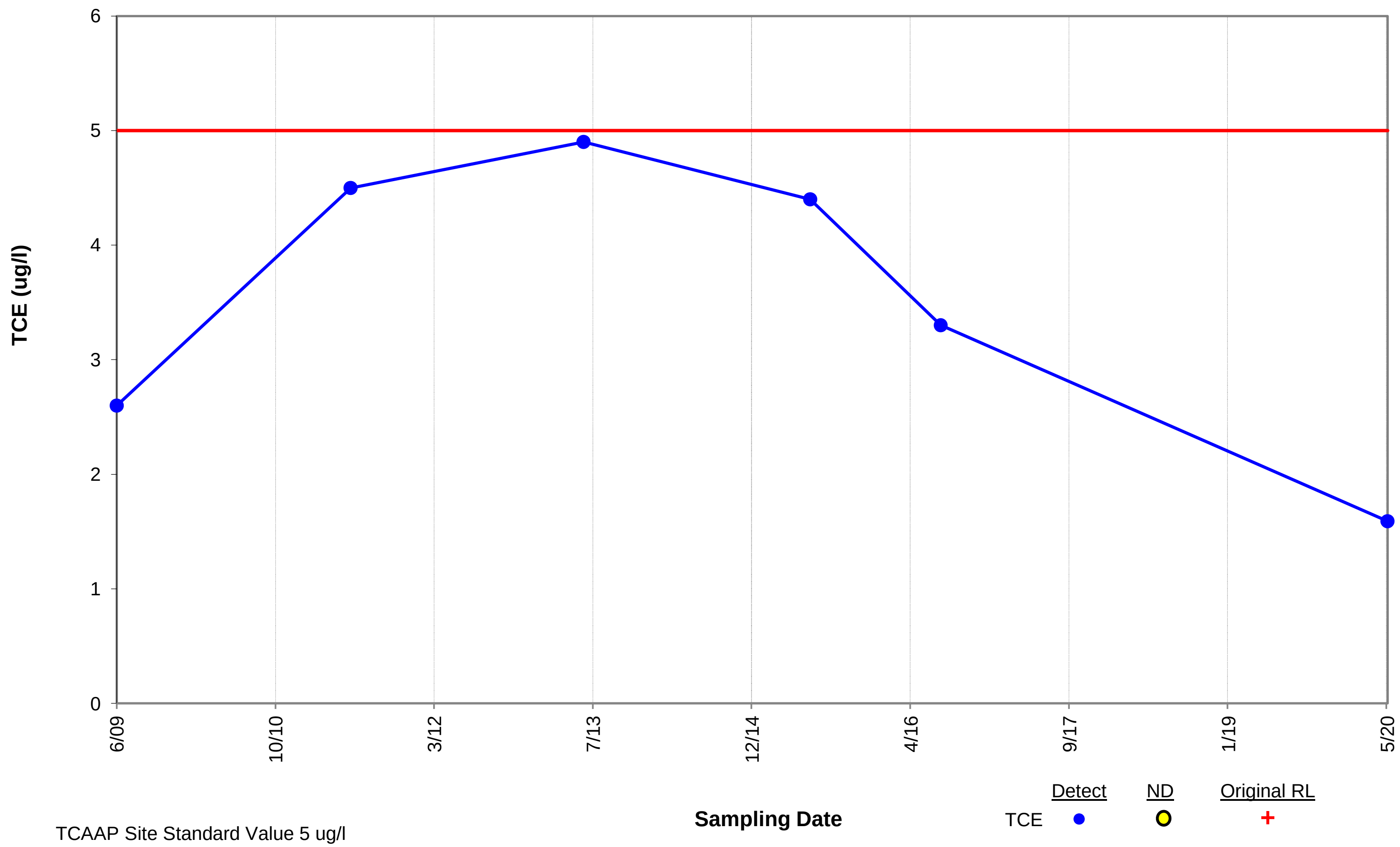
Concentration vs. Time Plot – TCE in Well 03L833Twin Cities Army Ammunition Plant

Figure D.2.2-2



Mann-Kendall Test Result: **No Significant Trend**
p-value = 0.235

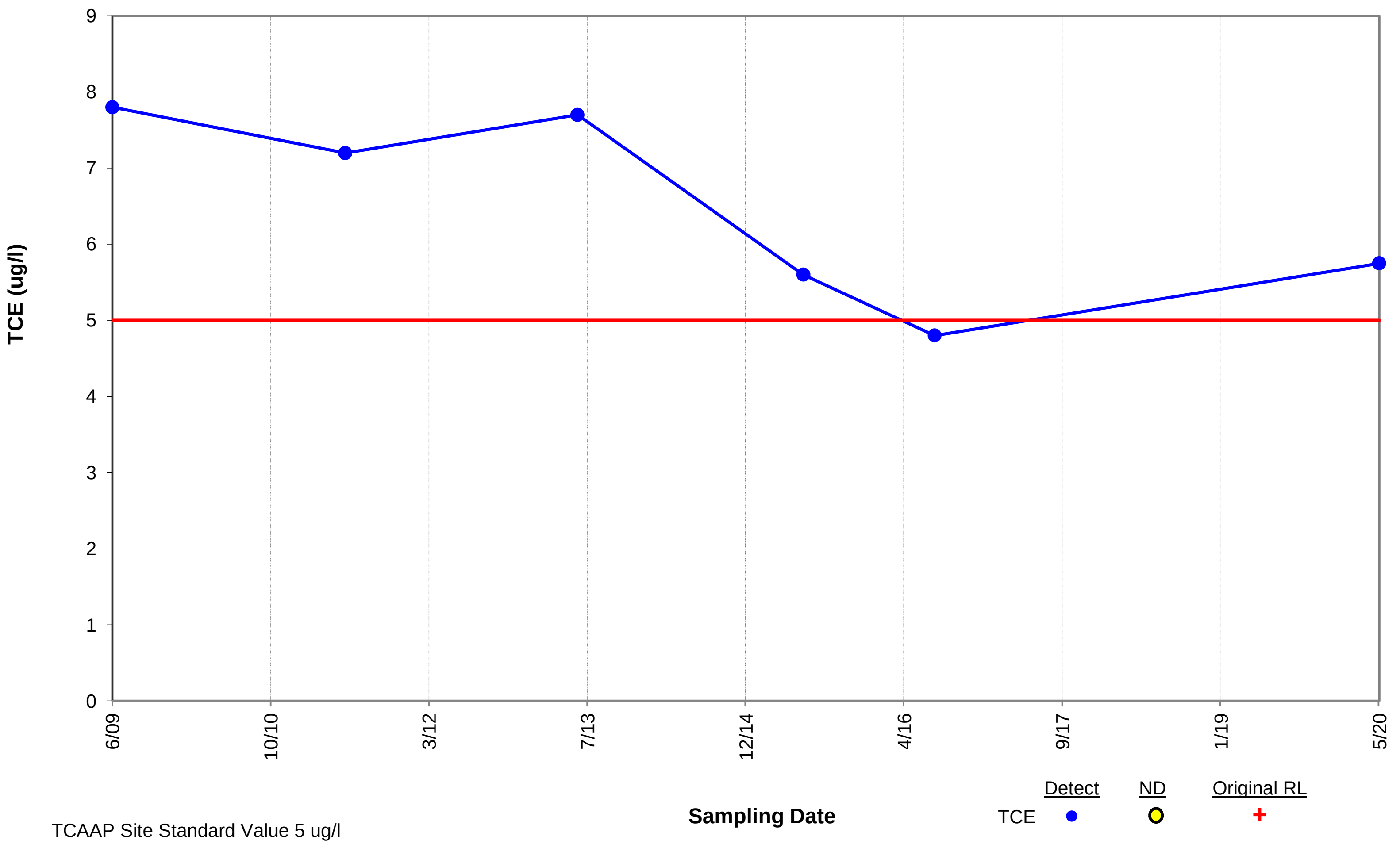
H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).

Theil-Sen Trend Line Result: **No Significant Trend**
Median Slope Estimate = -6.5E-04 ug/l per day
95% Confidence Interval = -1.5E-03 to 7.4E-04 ug/l per day

PIKA ARCADIS a joint venture

Concentration vs. Time Plot – TCE in Well 03L848Twin Cities Army Ammunition Plant

Figure D.2.2-3



TCAAP Site Standard Value 5 ug/l

Mann-Kendall Test Result: **No Significant Trend**
p-value = 0.068

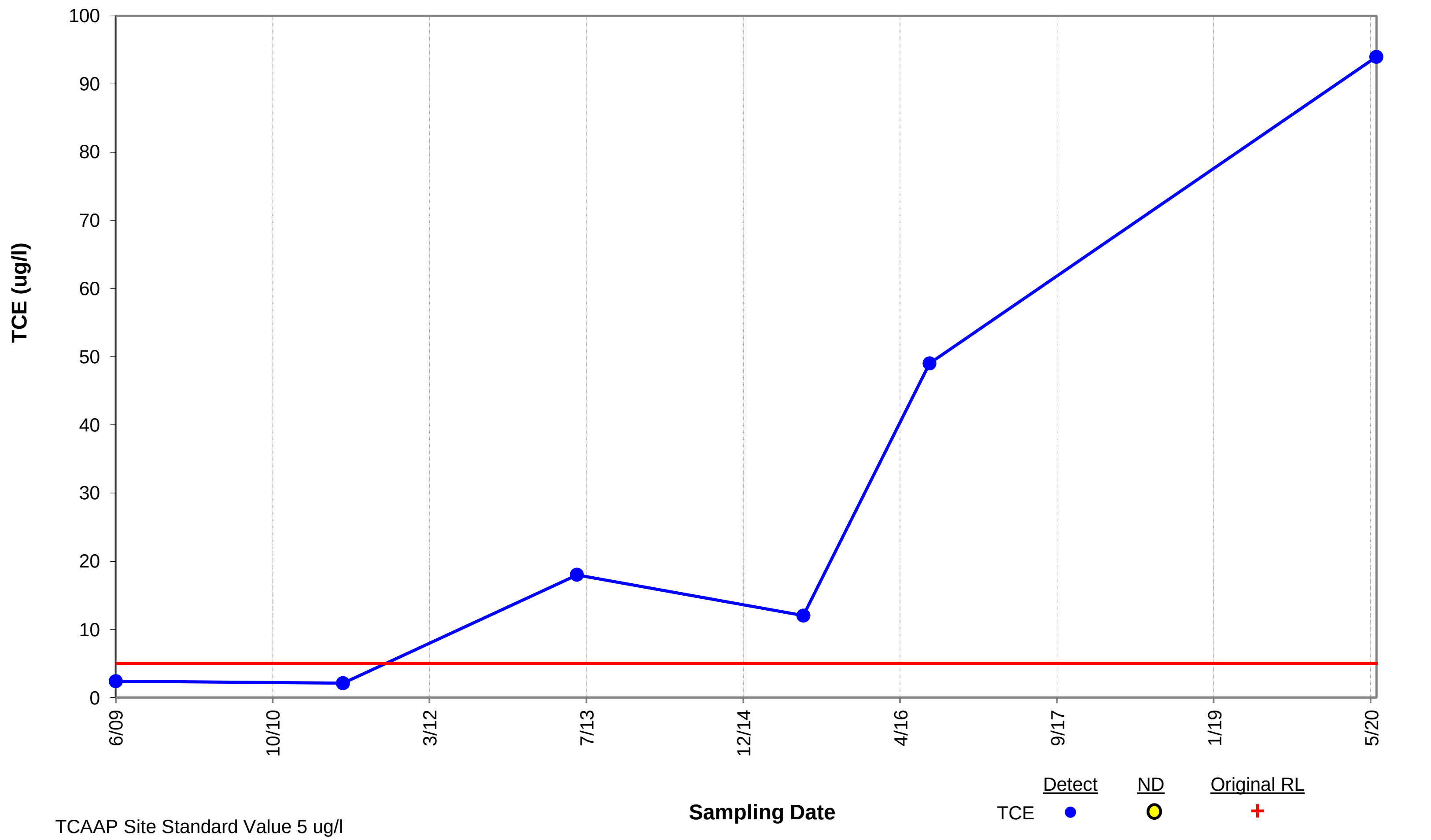
H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).

Theil-Sen Trend Line Result: **No Significant Trend**
Median Slope Estimate = -8.2E-04 ug/l per day
95% Confidence Interval = -2.4E-03 to 4.0E-05 ug/l per day

PIKA
ARCADIS
a joint venture

Concentration vs. Time Plot – TCE in Well 03L859Twin Cities Army Ammunition Plant

Figure D.2.2-4



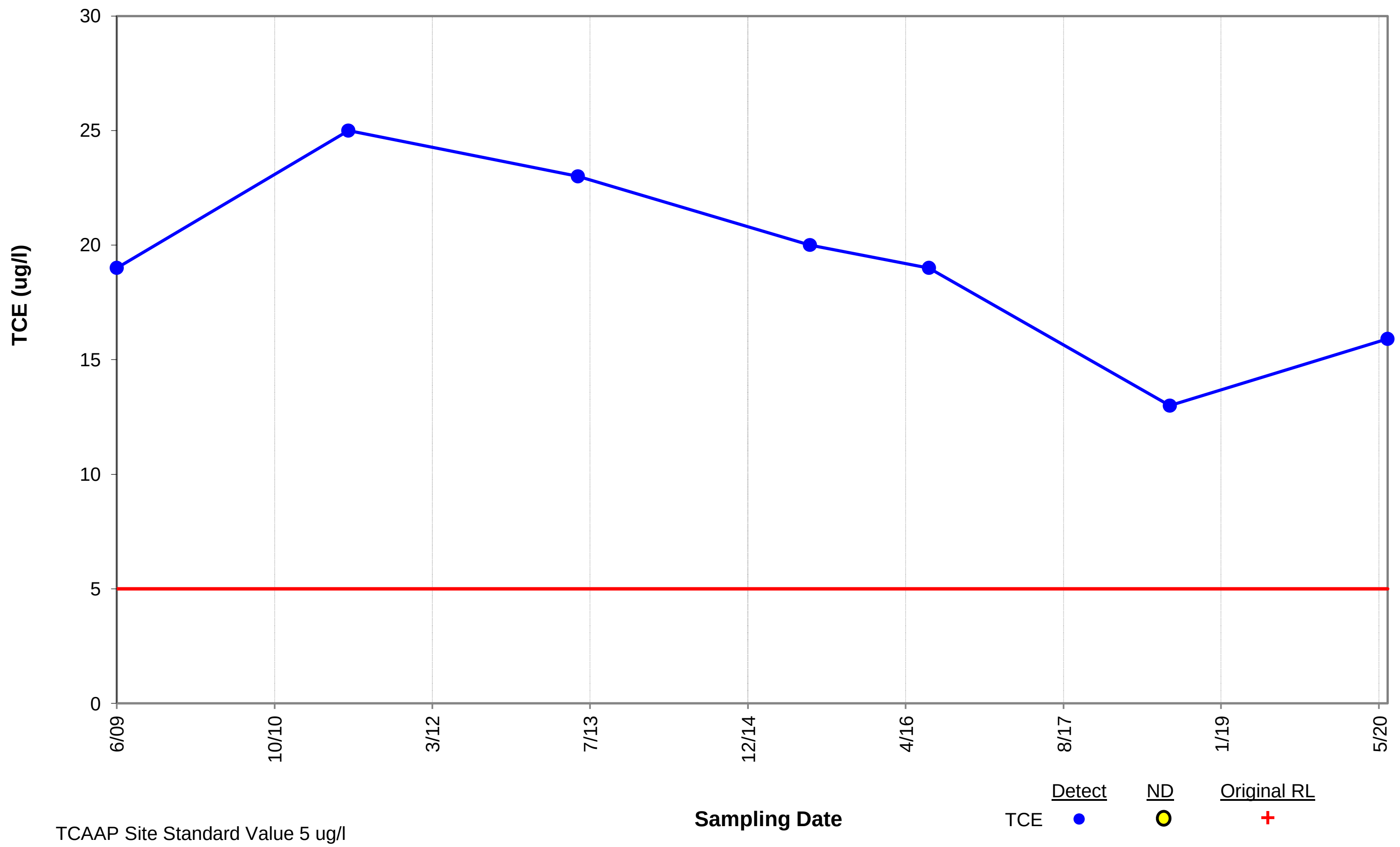
Mann-Kendall Test Result: INCREASING TREND
p-value = 0.028
H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).

Theil-Sen Trend Line Result: INCREASING TREND
Median Slope Estimate = 2.3E-02 ug/l per day
95% Confidence Interval = 9.5E-04 to 3.1E-02 ug/l per day

PIKA
ARCADIS
a joint venture

Concentration vs. Time Plot – TCE in Well 03U805Twin Cities Army Ammunition Plant

Figure D.2.2-5

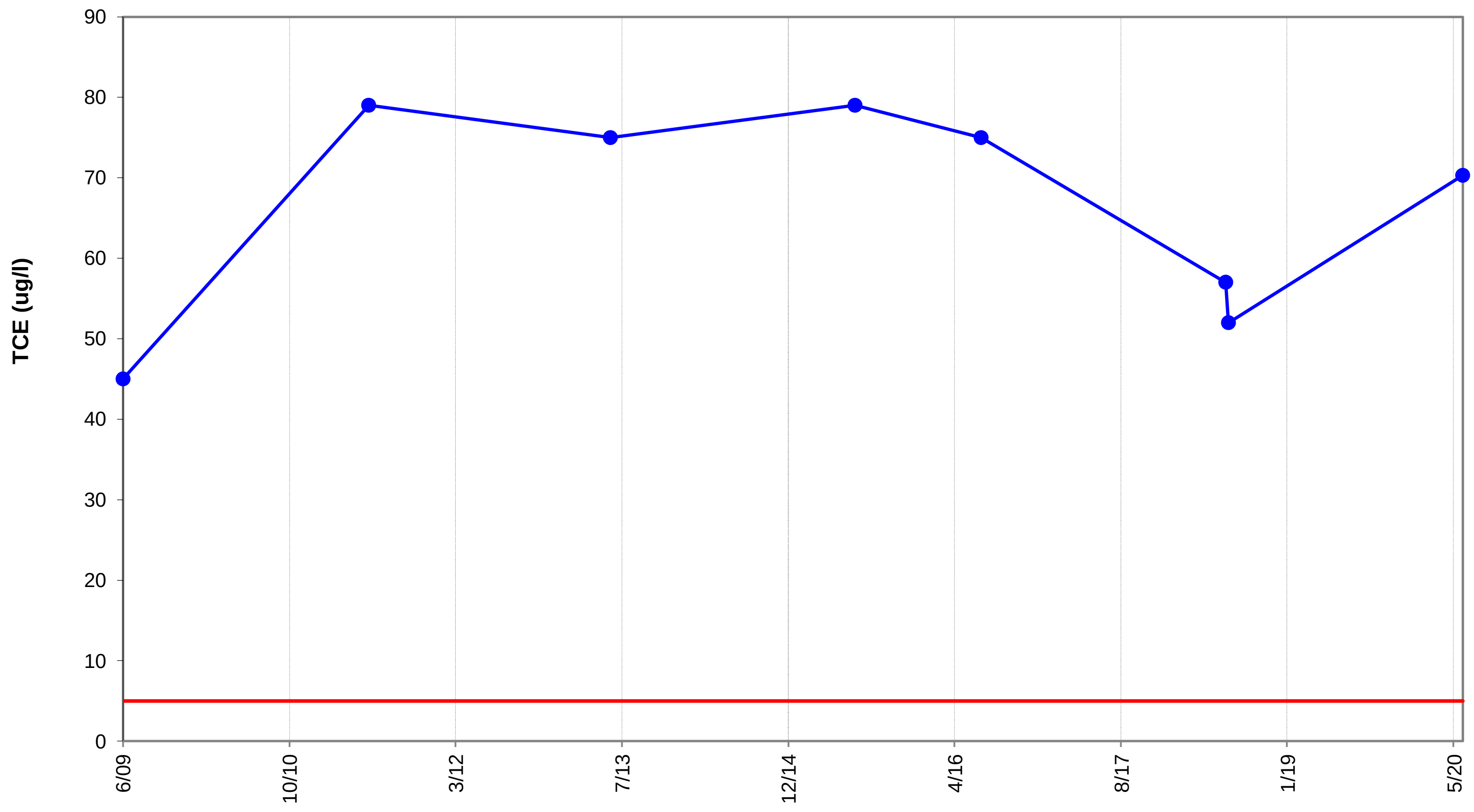


Mann-Kendall Test Result:	**No Significant Trend**			H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).
	p-value =	0.052		
Theil-Sen Trend Line Result:	**DECREASING TREND**			
	Median Slope Estimate =	-2.7E-03	ug/l per day	
	95% Confidence Interval =	-4.6E-03	to	-3.8E-05 ug/l per day

PIKA ARCADIS a joint venture

Concentration vs. Time Plot – TCE in Well 04U821Twin Cities Army Ammunition Plant

Figure D.2.2-6

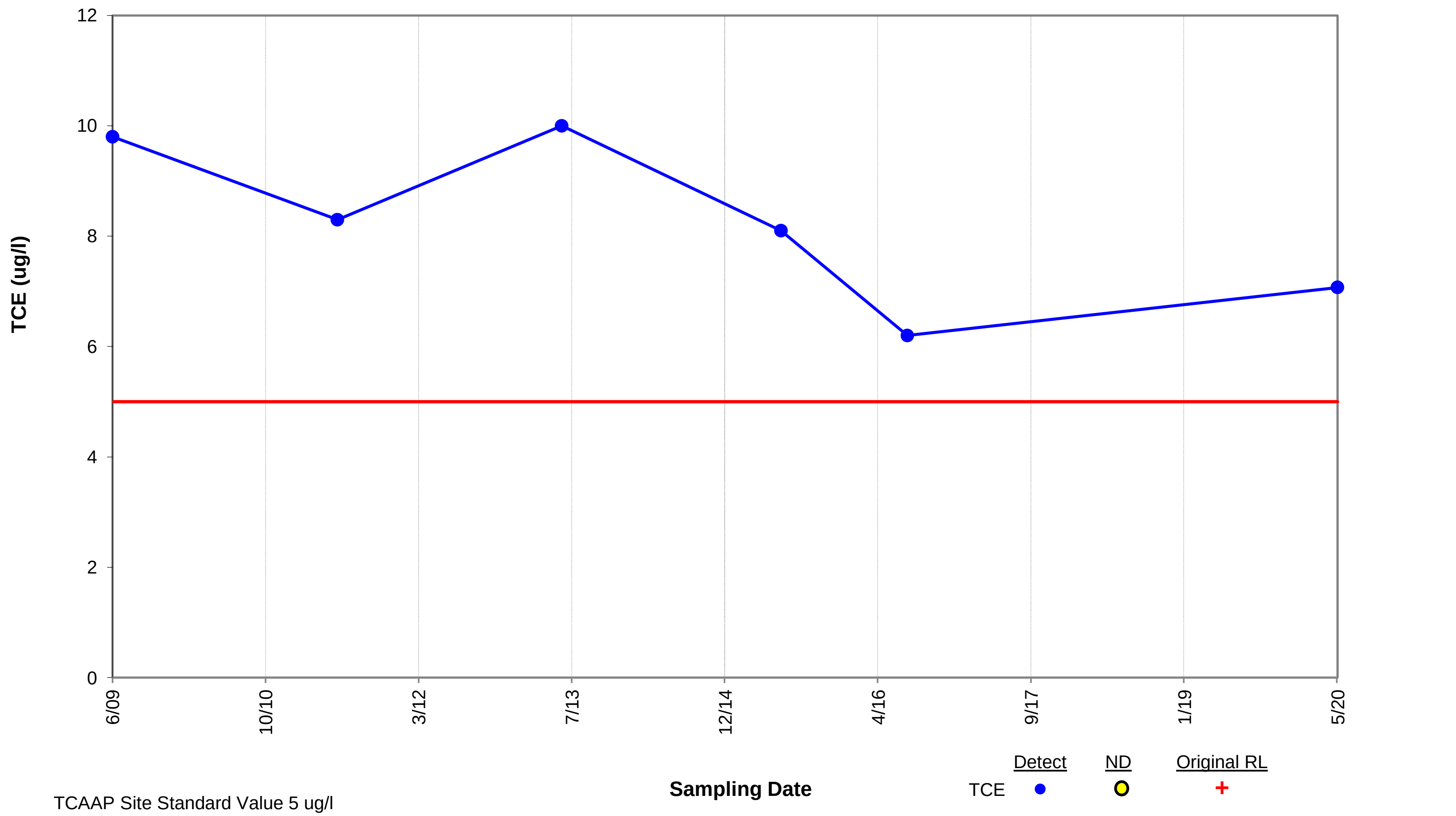


Mann-Kendall Test Result:	**No Significant Trend** p-value = 0.274	H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).
Theil-Sen Trend Line Result:	**No Significant Trend** Median Slope Estimate = -2.4E-03 ug/l per day 95% Confidence Interval = -1.2E-02 to 6.1E-03 ug/l per day	

PIKA ARCADIS a joint venture

Concentration vs. Time Plot – TCE in Well 04U849Twin Cities Army Ammunition Plant

Figure D.2.2-7



Mann-Kendall Test Result: **No Significant Trend**
p-value = 0.068

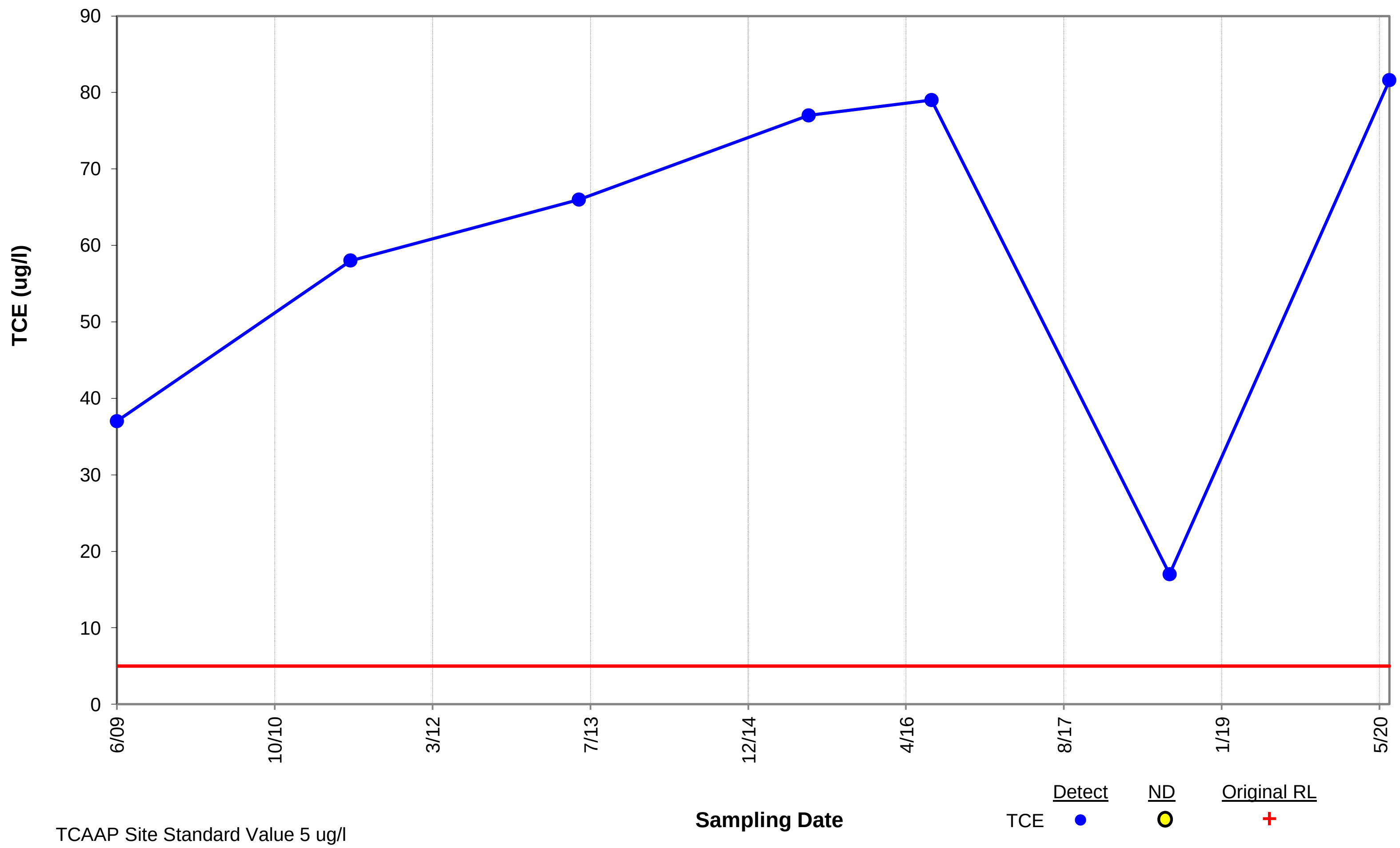
H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).

Theil-Sen Trend Line Result: **No Significant Trend**
Median Slope Estimate = -7.8E-04 ug/l per day
95% Confidence Interval = -3.2E-03 to 5.8E-05 ug/l per day

PIKA ARCADIS a joint venture

Concentration vs. Time Plot – TCE in Well 04U854Twin Cities Army Ammunition Plant

Figure D.2.2-8



TCAAP Site Standard Value 5 ug/l

Mann-Kendall Test Result: **No Significant Trend**
p-value = 0.068

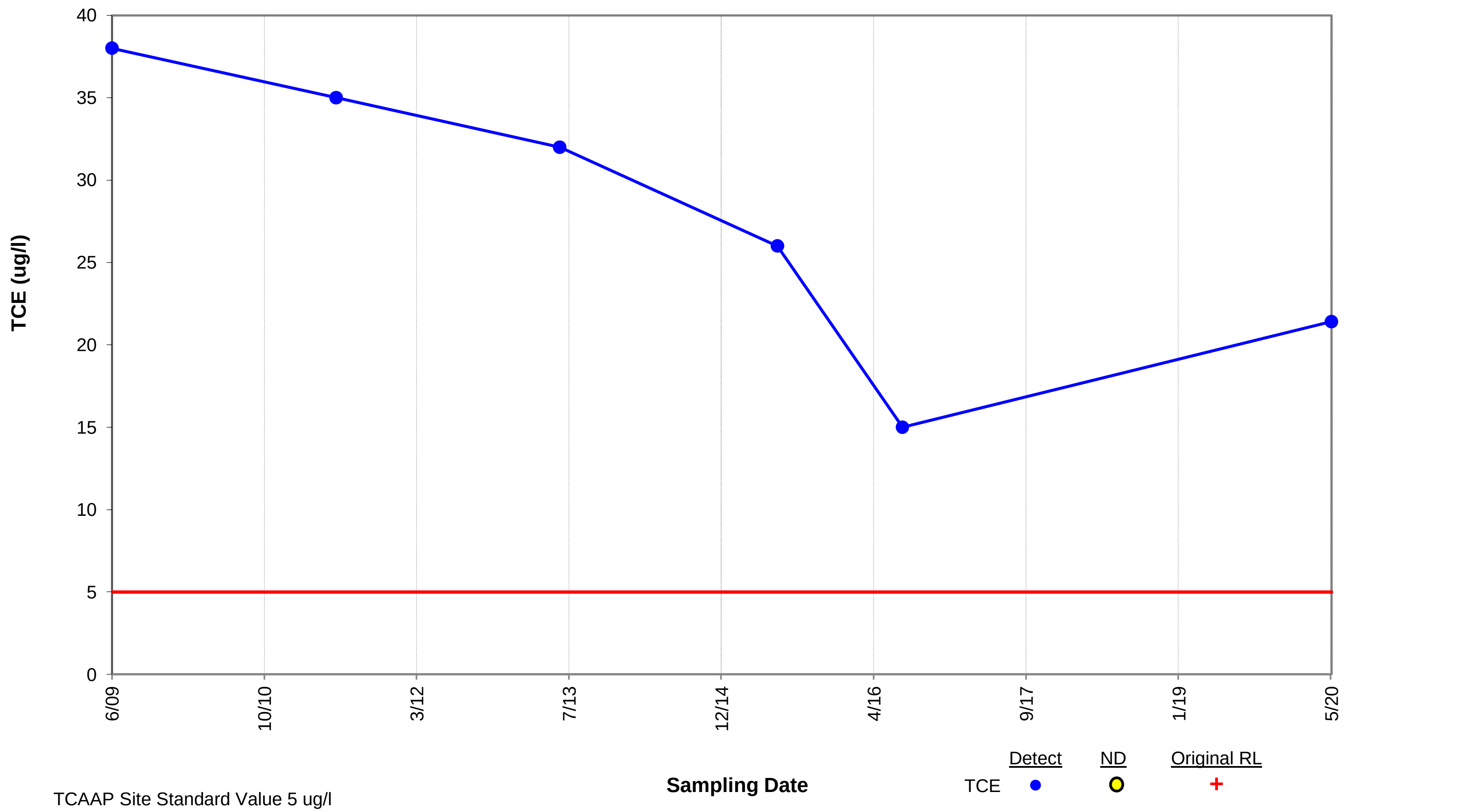
H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).

Theil-Sen Trend Line Result: **No Significant Trend**
Median Slope Estimate = 1.1E-02 ug/l per day
95% Confidence Interval = -1.6E-02 to 1.6E-02 ug/l per day

PIKA ARCADIS a joint venture

Concentration vs. Time Plot – TCE in Well 409557Twin Cities Army Ammunition Plant

Figure D.2.2-9



TCAAP Site Standard Value 5 ug/l

Mann-Kendall Test Result: DECREASING TREND

p-value = 0.008

H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).

Theil-Sen Trend Line Result: DECREASING TREND

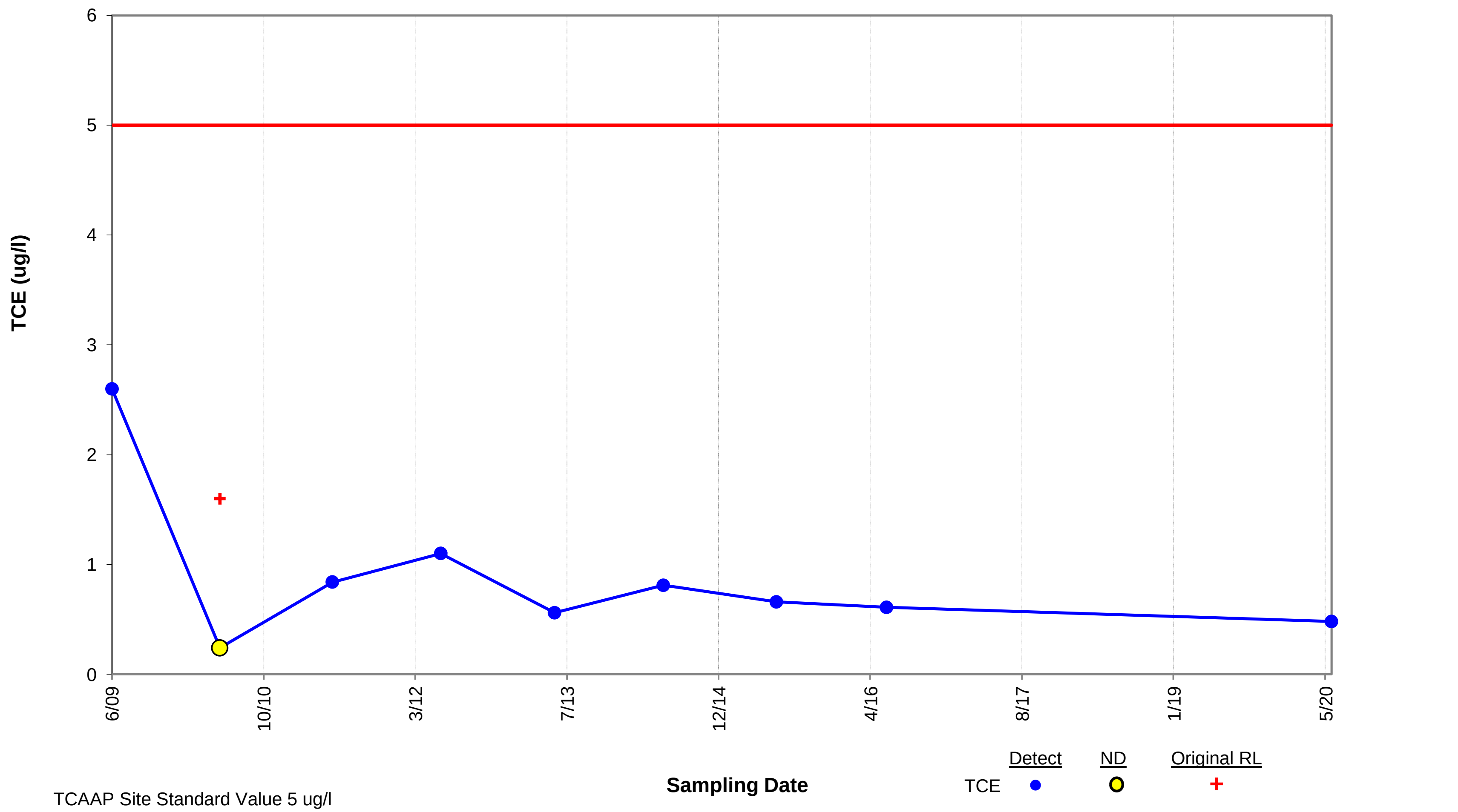
Median Slope Estimate = -4.2E-03 ug/l per day

95% Confidence Interval = -1.4E-02 to -4.1E-03 ug/l per day

PIKA ARCADIS a joint venture

Concentration vs. Time Plot – TCE in Well 04U673Twin Cities Army Ammunition Plant

Figure D.2.2-10



Mann-Kendall Test Result: **No Significant Trend**
p-value = 0.090

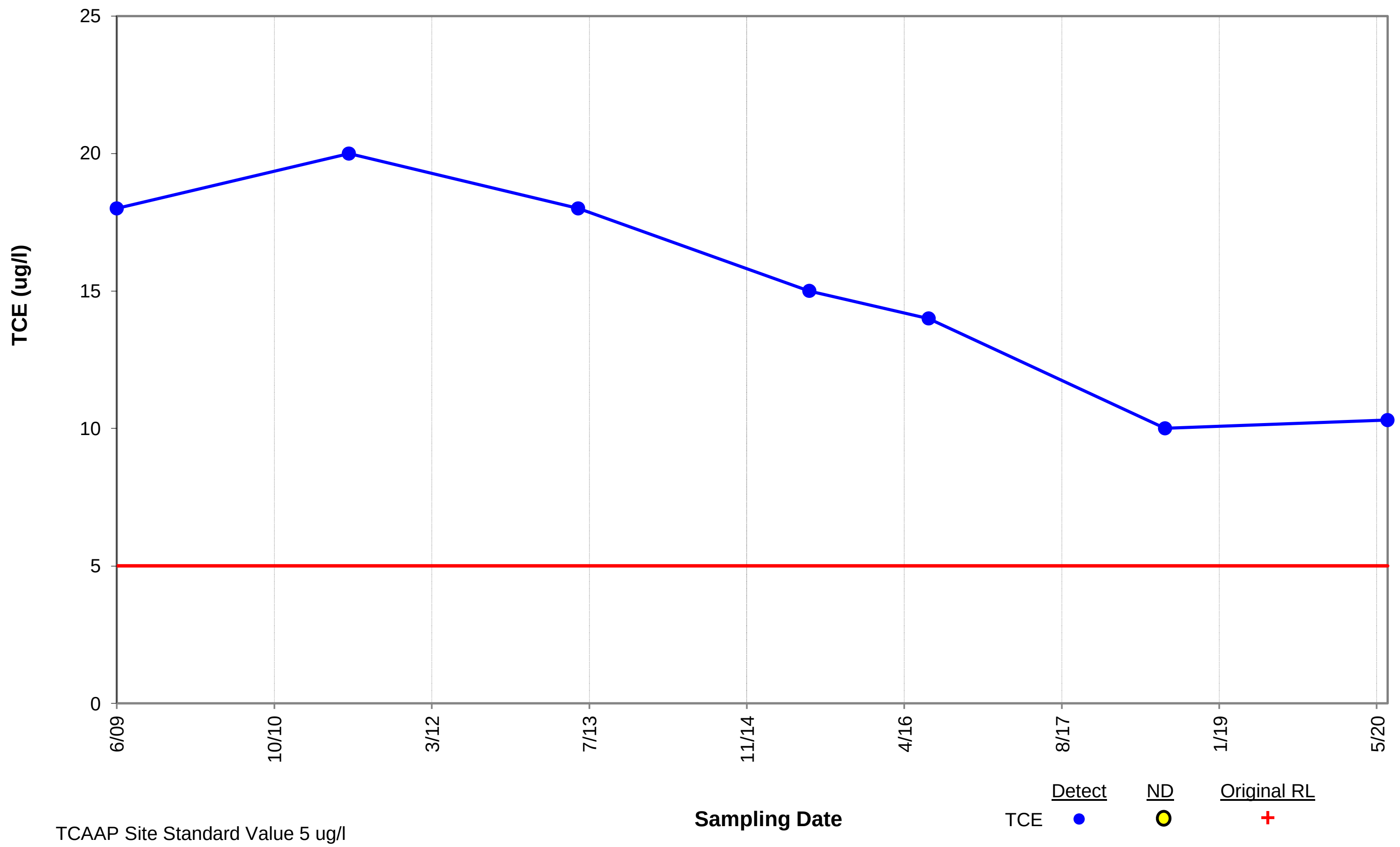
H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).

Theil-Sen Trend Line Result: **No Significant Trend**
Median Slope Estimate = -1.3E-04 ug/l per day
95% Confidence Interval = -6.3E-04 to 9.4E-05 ug/l per day

PIKA ARCADIS a joint venture

Concentration vs. Time Plot – TCE in Well 04U833Twin Cities Army Ammunition Plant

Figure D.2.2-11



Mann-Kendall Test Result: DECREASING TREND

p-value = 0.010

H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).

Theil-Sen Trend Line Result: DECREASING TREND

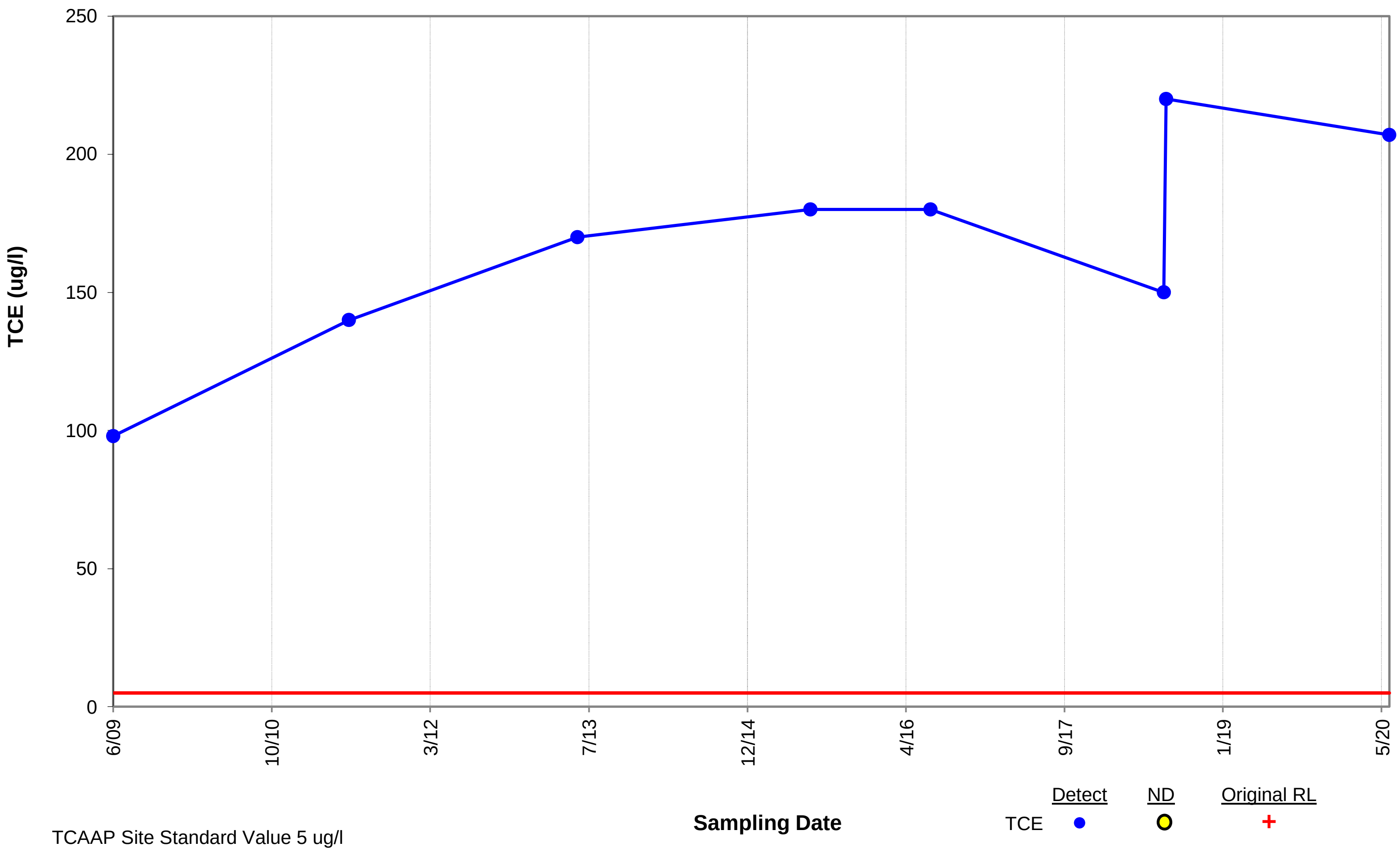
Median Slope Estimate = -2.7E-03 ug/l per day

95% Confidence Interval = -4.1E-03 to -1.6E-03 ug/l per day

PIKA ARCADIS a joint venture

Concentration vs. Time Plot – TCE in Well 04U841Twin Cities Army Ammunition Plant

Figure D.2.2-12



Mann-Kendall Test Result: INCREASING TREND
p-value = 0.012

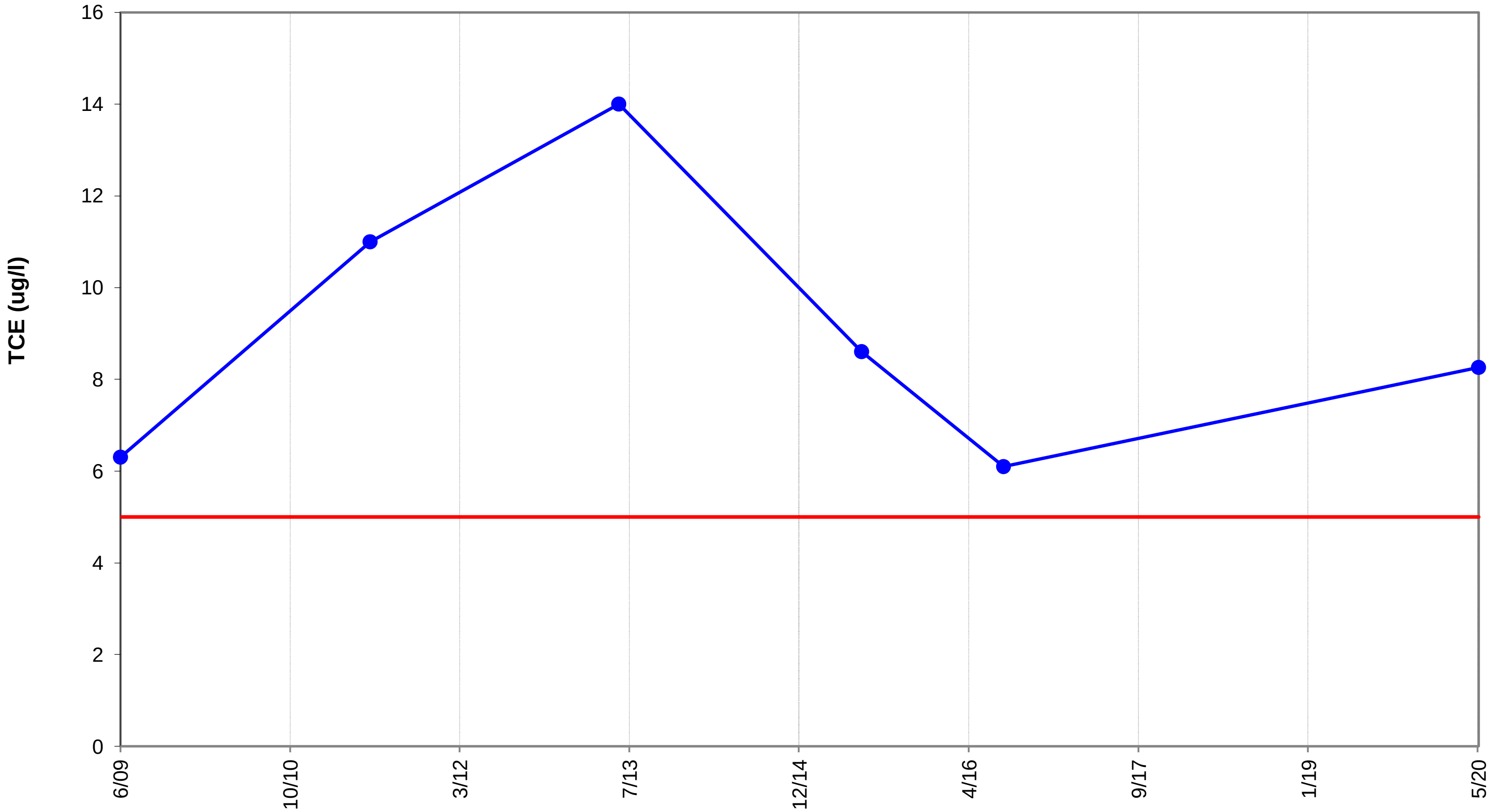
H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).

Theil-Sen Trend Line Result: INCREASING TREND
Median Slope Estimate = 2.4E-02 ug/l per day
95% Confidence Interval = 4.6E-03 to 3.7E-02 ug/l per day

PIKA ARCADIS a joint venture

Concentration vs. Time Plot – TCE in Well 04U843Twin Cities Army Ammunition Plant

Figure D.2.2-13



Mann-Kendall Test Result: **No Significant Trend**
p-value = 0.360

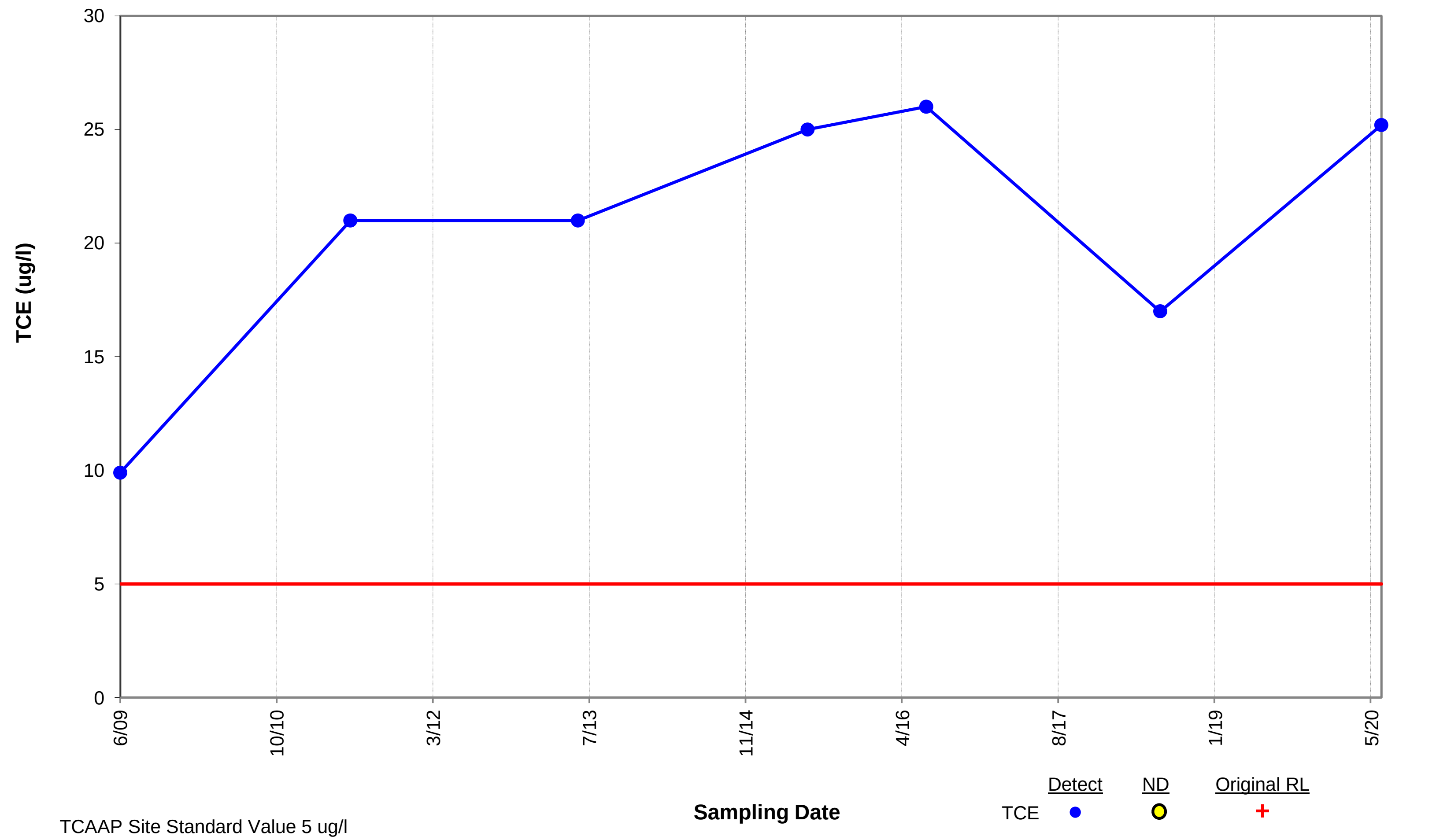
H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).

Theil-Sen Trend Line Result: **No Significant Trend**
Median Slope Estimate = -1.9E-04 ug/l per day
95% Confidence Interval = -6.7E-03 to 3.4E-03 ug/l per day

PIKA ARCADIS a joint venture

Concentration vs. Time Plot – TCE in Well 04U845Twin Cities Army Ammunition Plant

Figure D.2.2-14

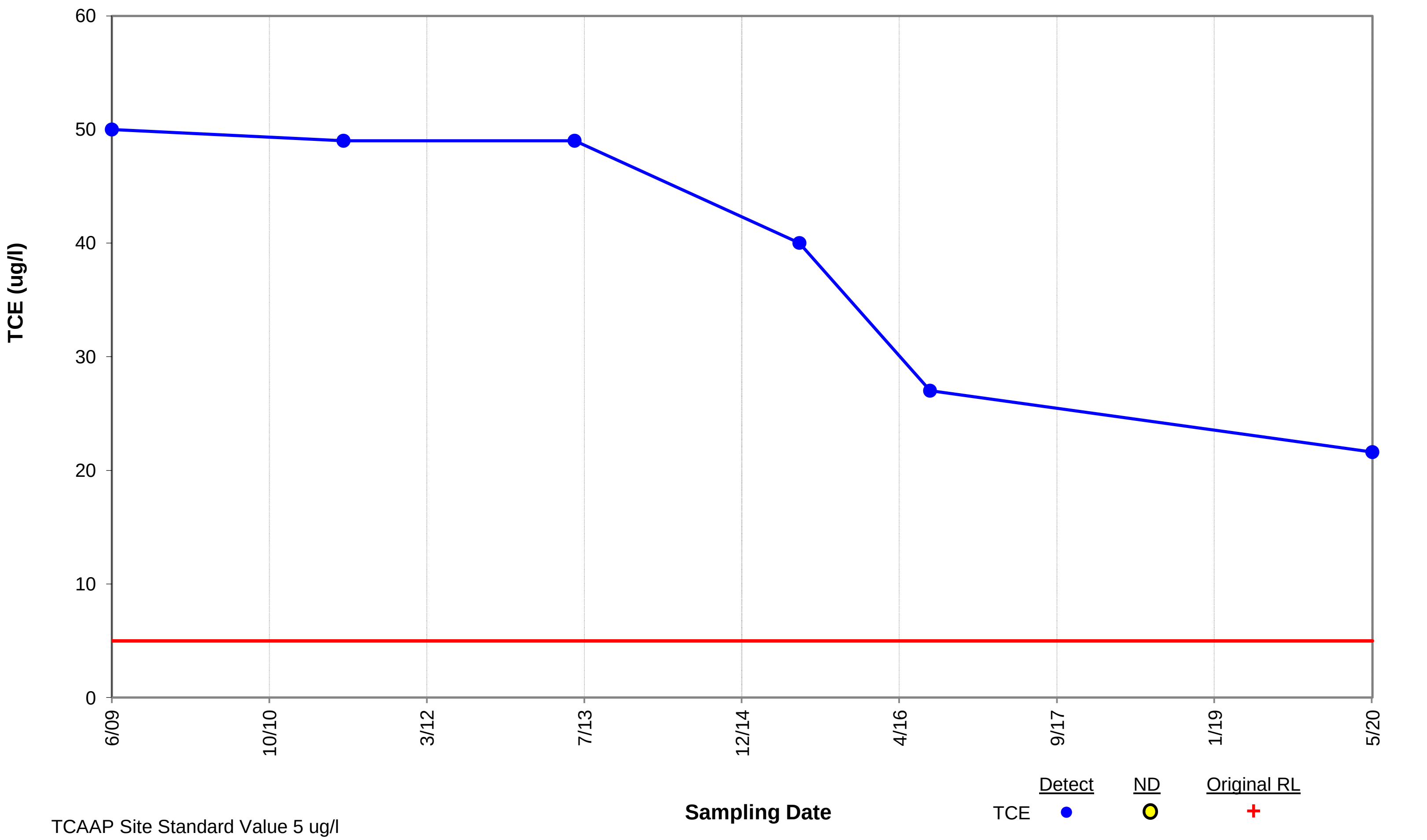


Mann-Kendall Test Result:	**No Significant Trend**				H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).
	p-value =	0.094			
Theil-Sen Trend Line Result:	**No Significant Trend**				
	Median Slope Estimate =	2.6E-03	ug/l per day		
	95% Confidence Interval =	-1.5E-03	to	6.2E-03	ug/l per day

PIKA ARCADIS a joint venture

Concentration vs. Time Plot – TCE in Well 04U846Twin Cities Army Ammunition Plant

Figure D.2.2-15



Mann-Kendall Test Result: DECREASING TREND

p-value = 0.005

H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).

Theil-Sen Trend Line Result: DECREASING TREND

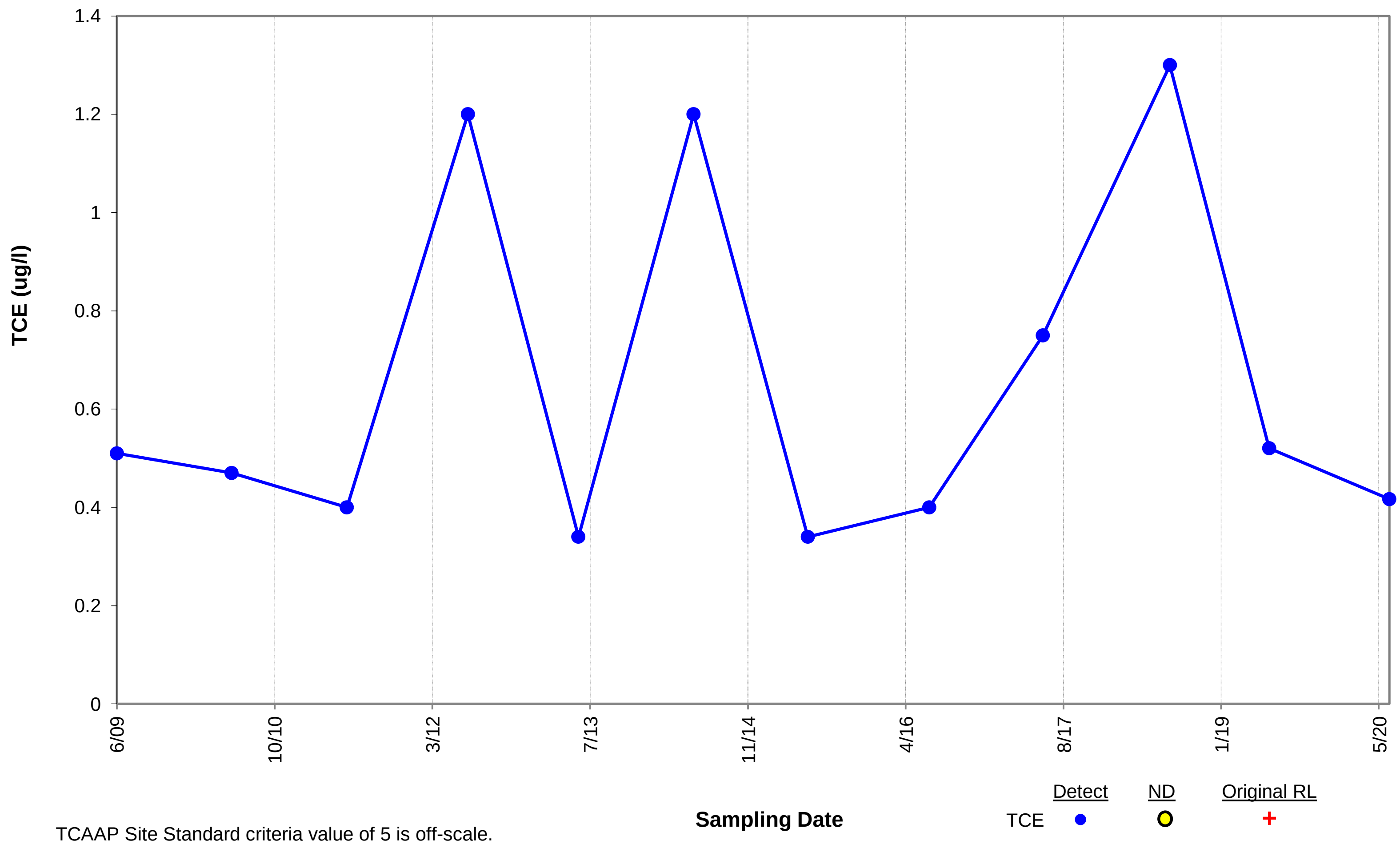
Median Slope Estimate = -8.4E-03 ug/l per day

95% Confidence Interval = -1.7E-02 to -2.3E-03 ug/l per day

PIKA ARCADIS a joint venture

Concentration vs. Time Plot – TCE in Well 04U859Twin Cities Army Ammunition Plant

Figure D.2.2-16



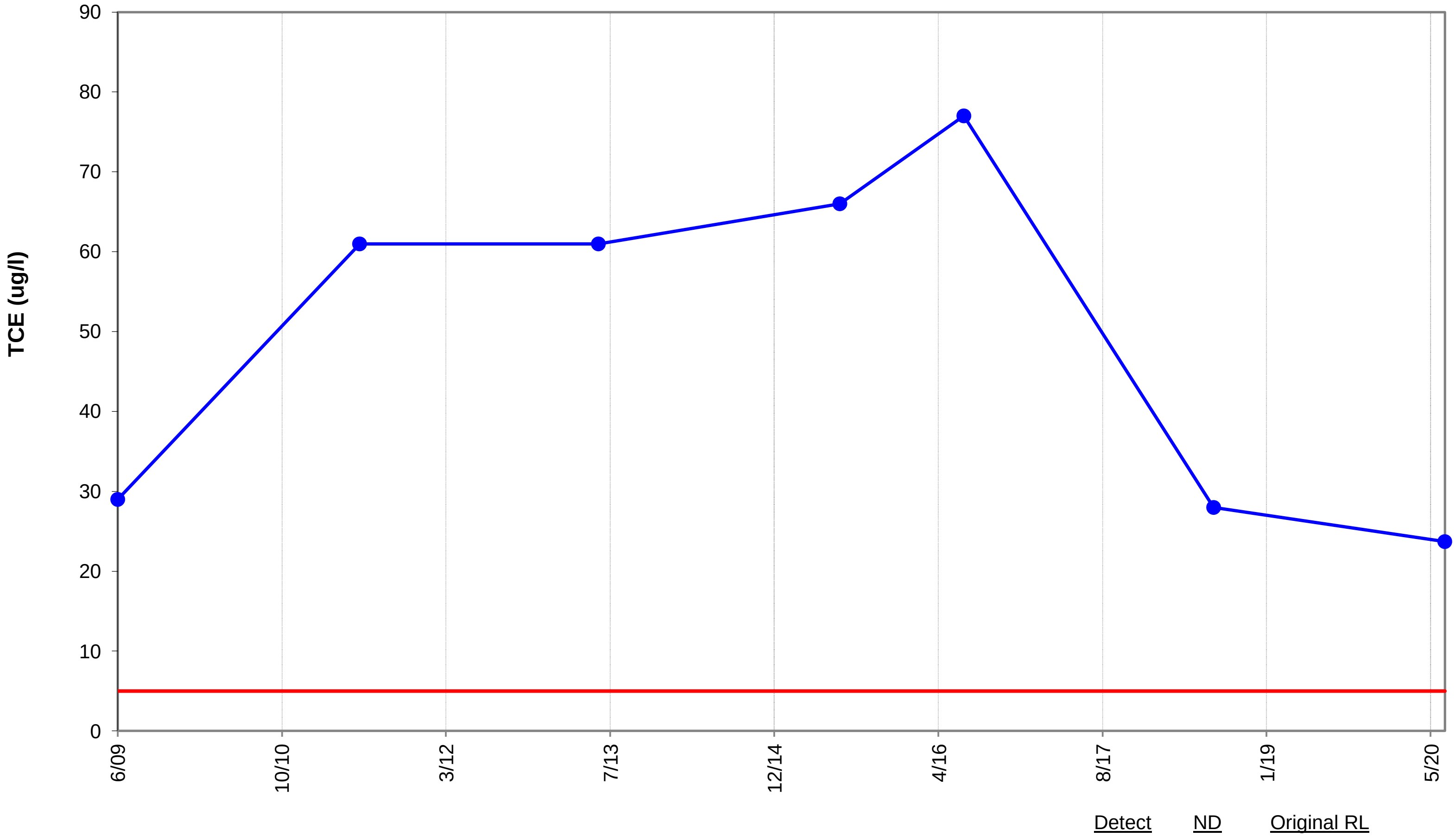
TCAAP Site Standard criteria value of 5 is off-scale.

Mann-Kendall Test Result:	**No Significant Trend**				H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).
	p-value =	0.391			
Theil-Sen Trend Line Result:	**No Significant Trend**				
	Median Slope Estimate =	3.9E-06	ug/l per day		
	95% Confidence Interval =	-1.2E-04	to	1.3E-04	ug/l per day

PIKA ARCADIS a joint venture

Concentration vs. Time Plot – TCE in Well 04U877Twin Cities Army Ammunition Plant

Figure D.2.2-17



TCAAP Site Standard Value 5 ug/l

Mann-Kendall Test Result: **No Significant Trend**
p-value = 0.443

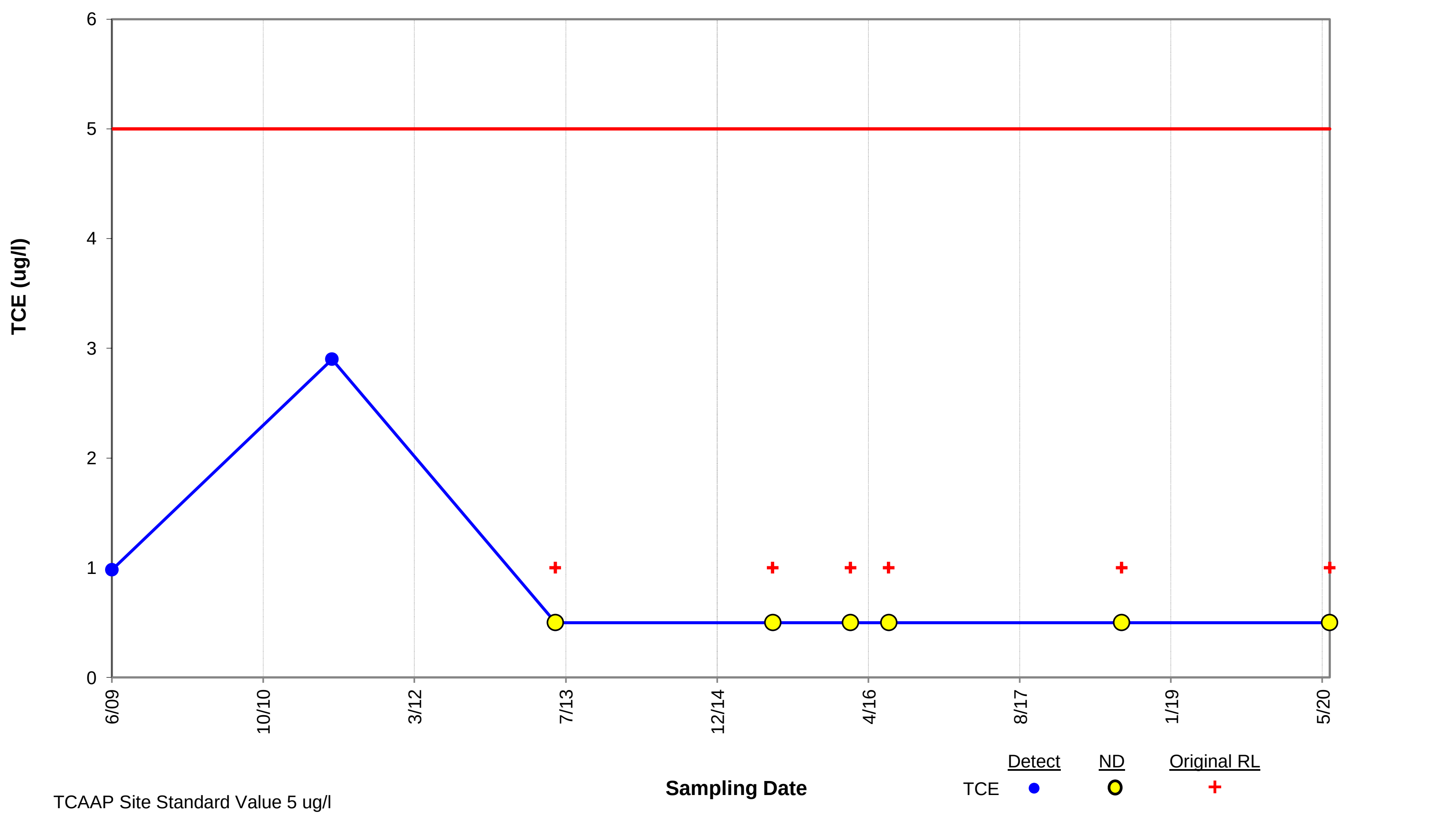
H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).

Theil-Sen Trend Line Result: **No Significant Trend**
Median Slope Estimate = -3.0E-04 ug/l per day
95% Confidence Interval = -2.3E-02 to 1.7E-02 ug/l per day

PIKA ARCADIS a joint venture

Concentration vs. Time Plot – TCE in Well 409549Twin Cities Army Ammunition Plant

Figure D.2.2-18



Mann-Kendall Test Result: **No Significant Trend**
p-value = 0.114

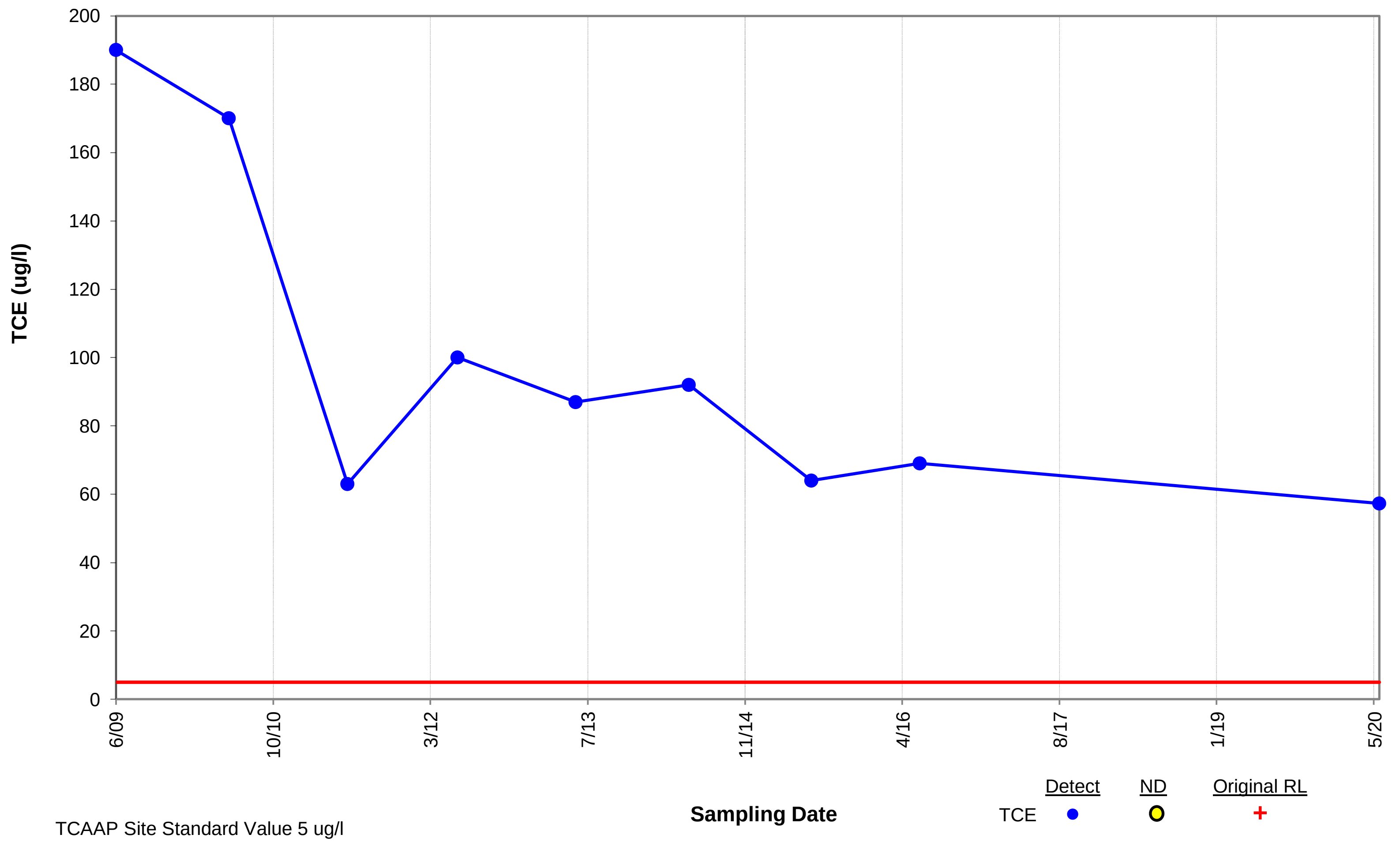
H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).

Theil-Sen Trend Line Result: **No Significant Trend**
Median Slope Estimate = 0.0E+00 ug/l per day
95% Confidence Interval = -2.2E-04 to 0.0E+00 ug/l per day

PIKA ARCADIS a joint venture

Concentration vs. Time Plot – TCE in Well 04U875Twin Cities Army Ammunition Plant

Figure D.2.2-19



Mann-Kendall Test Result: DECREASING TREND

p-value = 0.012

H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).

Theil-Sen Trend Line Result: DECREASING TREND

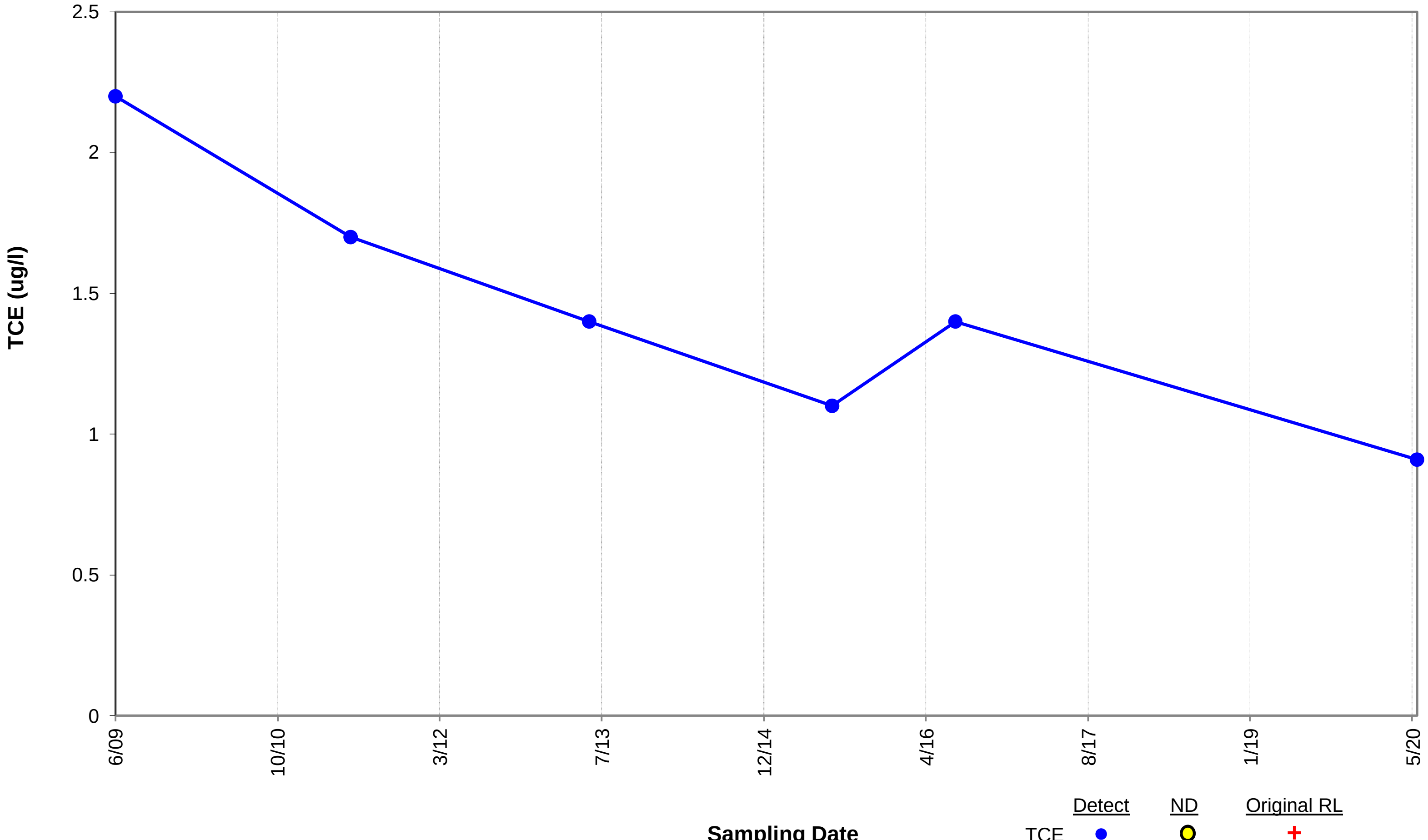
Median Slope Estimate = -3.1E-02 ug/l per day

95% Confidence Interval = -5.7E-02 to -6.3E-03 ug/l per day

PIKA ARCADIS a joint venture

Concentration vs. Time Plot – TCE in Well 04J077Twin Cities Army Ammunition Plant

Figure D.2.2-20



TCAAP Site Standard criteria value of 5 is off-scale.

Mann-Kendall Test Result: DECREASING TREND
p-value = 0.018

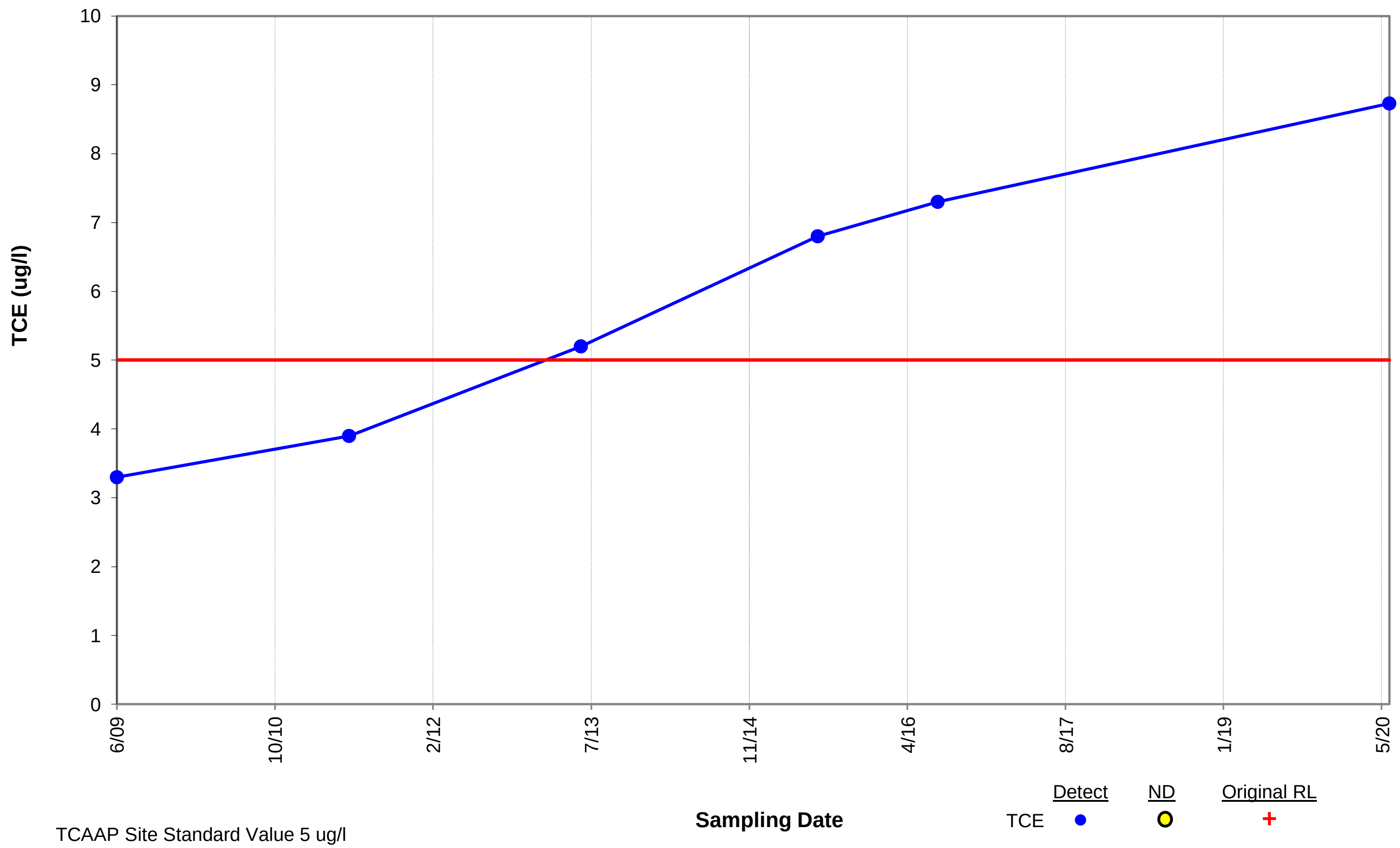
H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).

Theil-Sen Trend Line Result: DECREASING TREND
Median Slope Estimate = -3.2E-04 ug/l per day
95% Confidence Interval = -5.3E-04 to -1.3E-04 ug/l per day

PIKA ARCADIS a joint venture

Concentration vs. Time Plot – TCE in Well 04J702Twin Cities Army Ammunition Plant

Figure D.2.2-21



Mann-Kendall Test Result: INCREASING TREND

p-value = 0.001

H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).

Theil-Sen Trend Line Result: INCREASING TREND

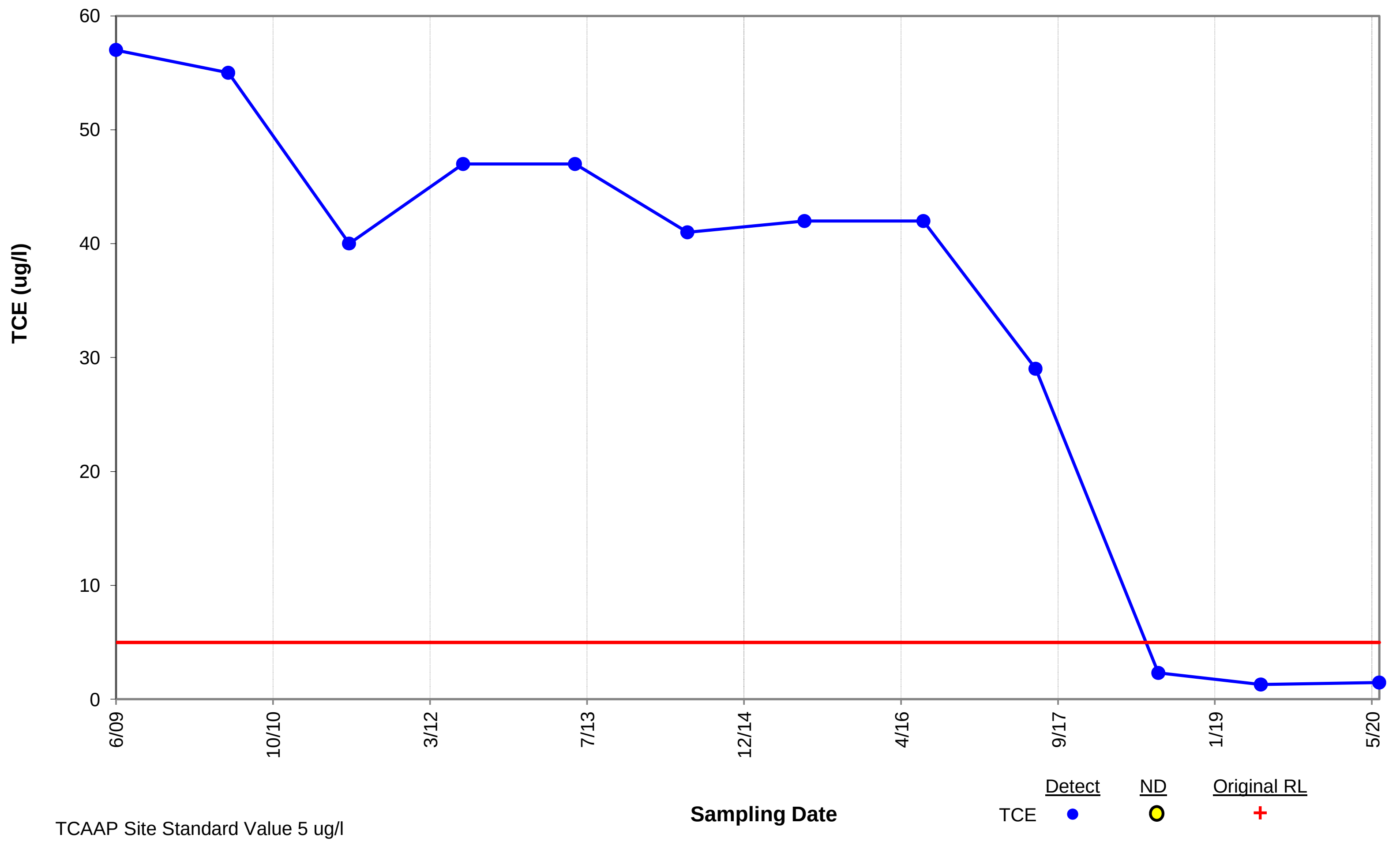
Median Slope Estimate = 1.5E-03 ug/l per day

95% Confidence Interval = 1.0E-03 to 1.9E-03 ug/l per day

PIKA ARCADIS a joint venture

Concentration vs. Time Plot – TCE in Well 04J708Twin Cities Army Ammunition Plant

Figure D.2.2-22

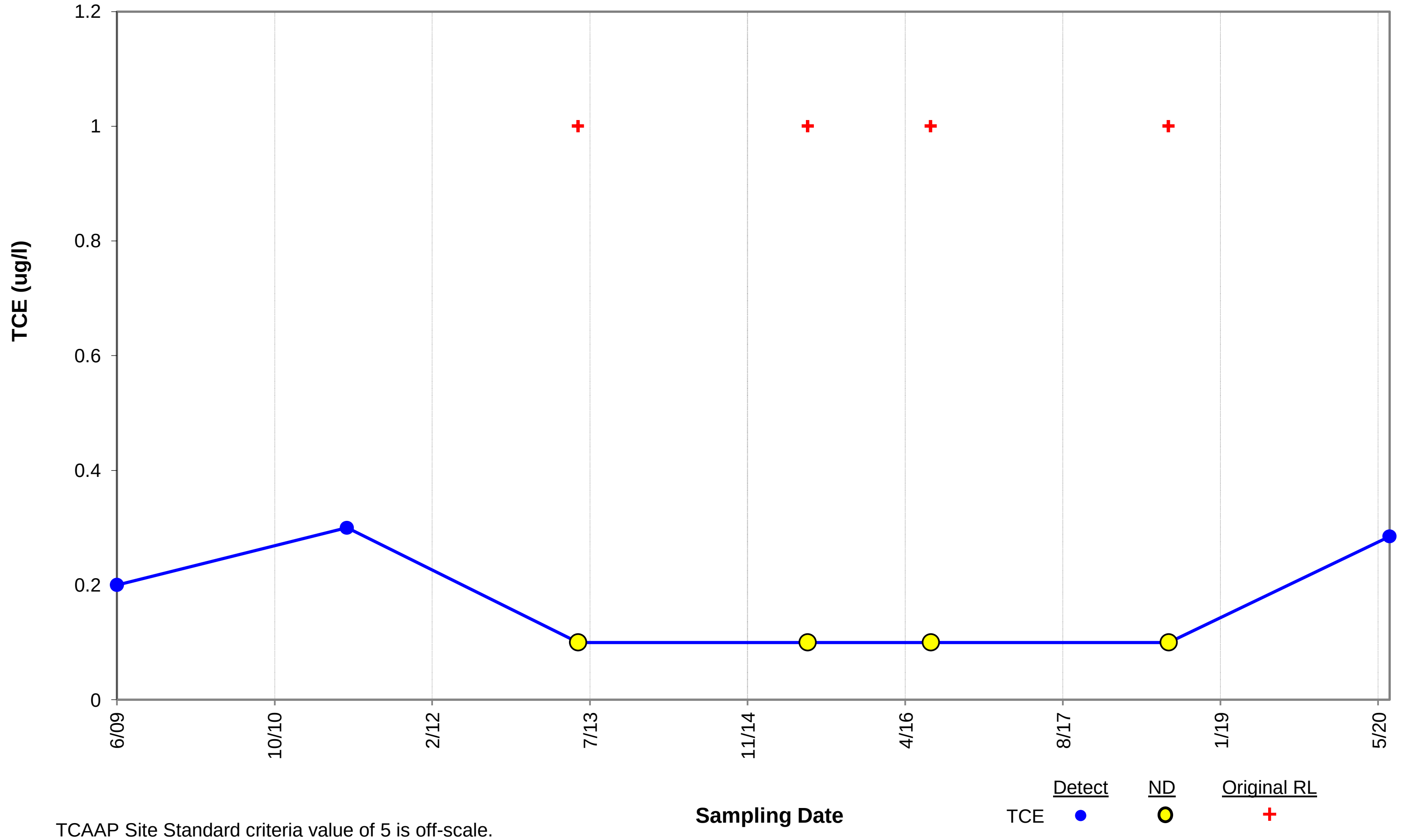


Mann-Kendall Test Result:	**DECREASING TREND**		H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).	
	p-value =	<0.001		
Theil-Sen Trend Line Result:	**DECREASING TREND**			
	Median Slope Estimate =	-1.1E-02	ug/l per day	
	95% Confidence Interval =	-1.8E-02	to	-6.6E-03 ug/l per day

PIKA ARCADIS a joint venture

Concentration vs. Time Plot – TCE in Well 04J822Twin Cities Army Ammunition Plant

Figure D.2.2-23



TCAAP Site Standard criteria value of 5 is off-scale.

Mann-Kendall Test Result: **No Significant Trend**
p-value = 0.386

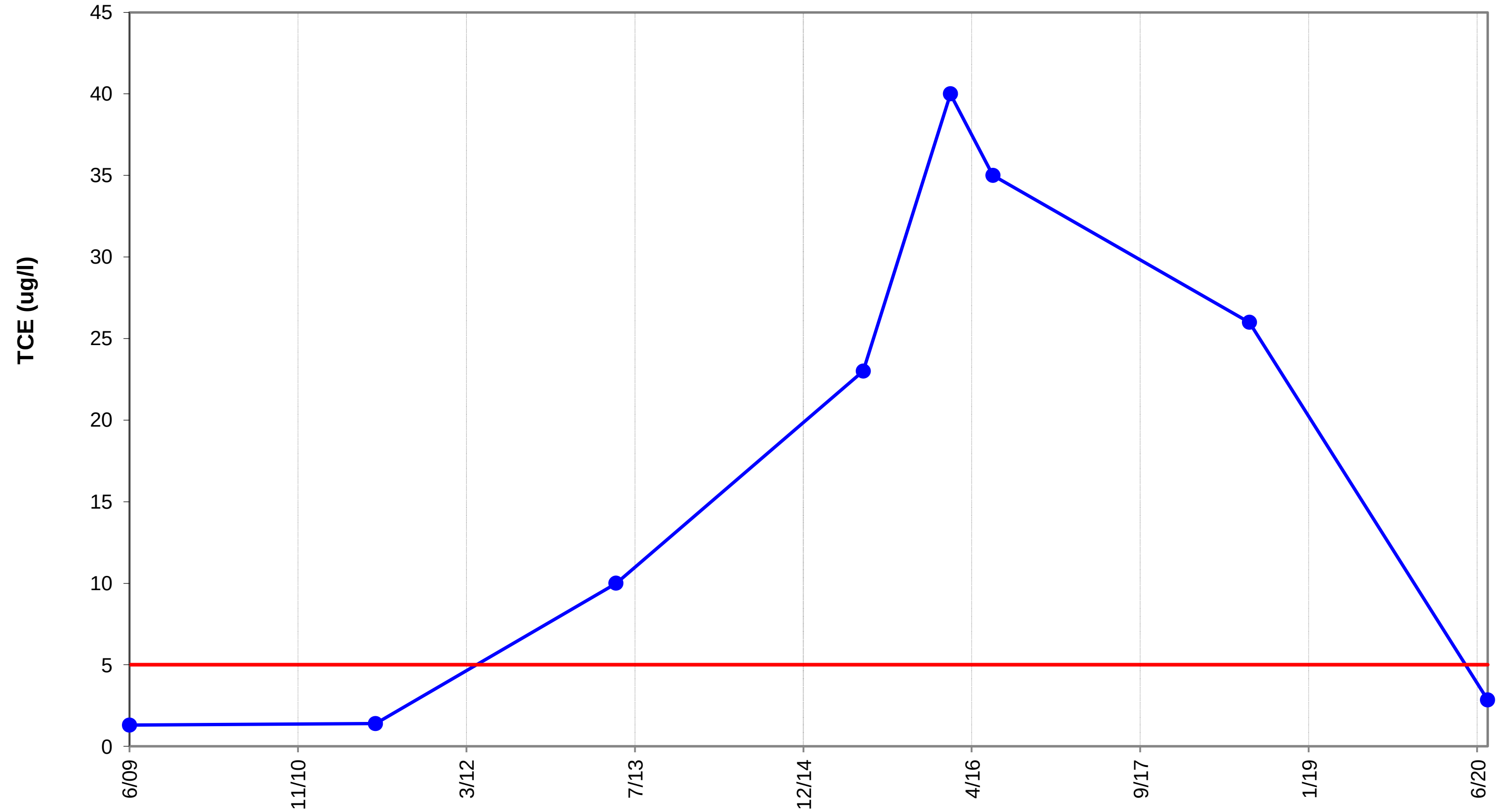
H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).

Theil-Sen Trend Line Result: **No Significant Trend**
Median Slope Estimate = 0.0E+00 ug/l per day
95% Confidence Interval = -7.1E-05 to 3.9E-05 ug/l per day

PIKA ARCADIS a joint venture

Concentration vs. Time Plot – TCE in Well 04J834Twin Cities Army Ammunition Plant

Figure D.2.2-24



TCAAP Site Standard Value 5 ug/l

Mann-Kendall Test Result: **No Significant Trend**
p-value = 0.089

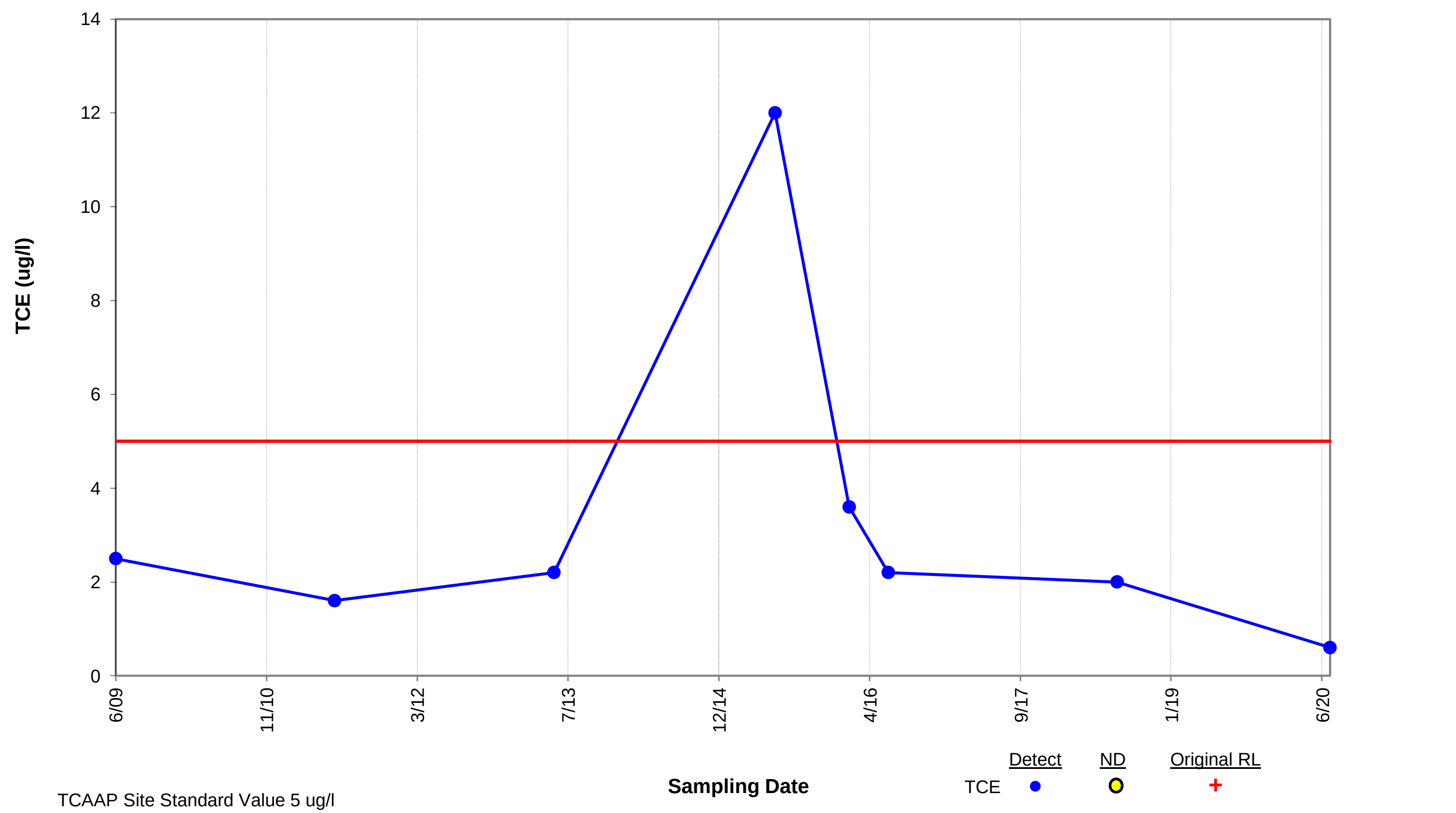
H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).

Theil-Sen Trend Line Result: **No Significant Trend**
Median Slope Estimate = 8.0E-03 ug/l per day
95% Confidence Interval = -1.2E-02 to 1.8E-02 ug/l per day

PIKA ARCADIS a joint venture

Concentration vs. Time Plot – TCE in Well 04J836Twin Cities Army Ammunition Plant

Figure D.2.2-25

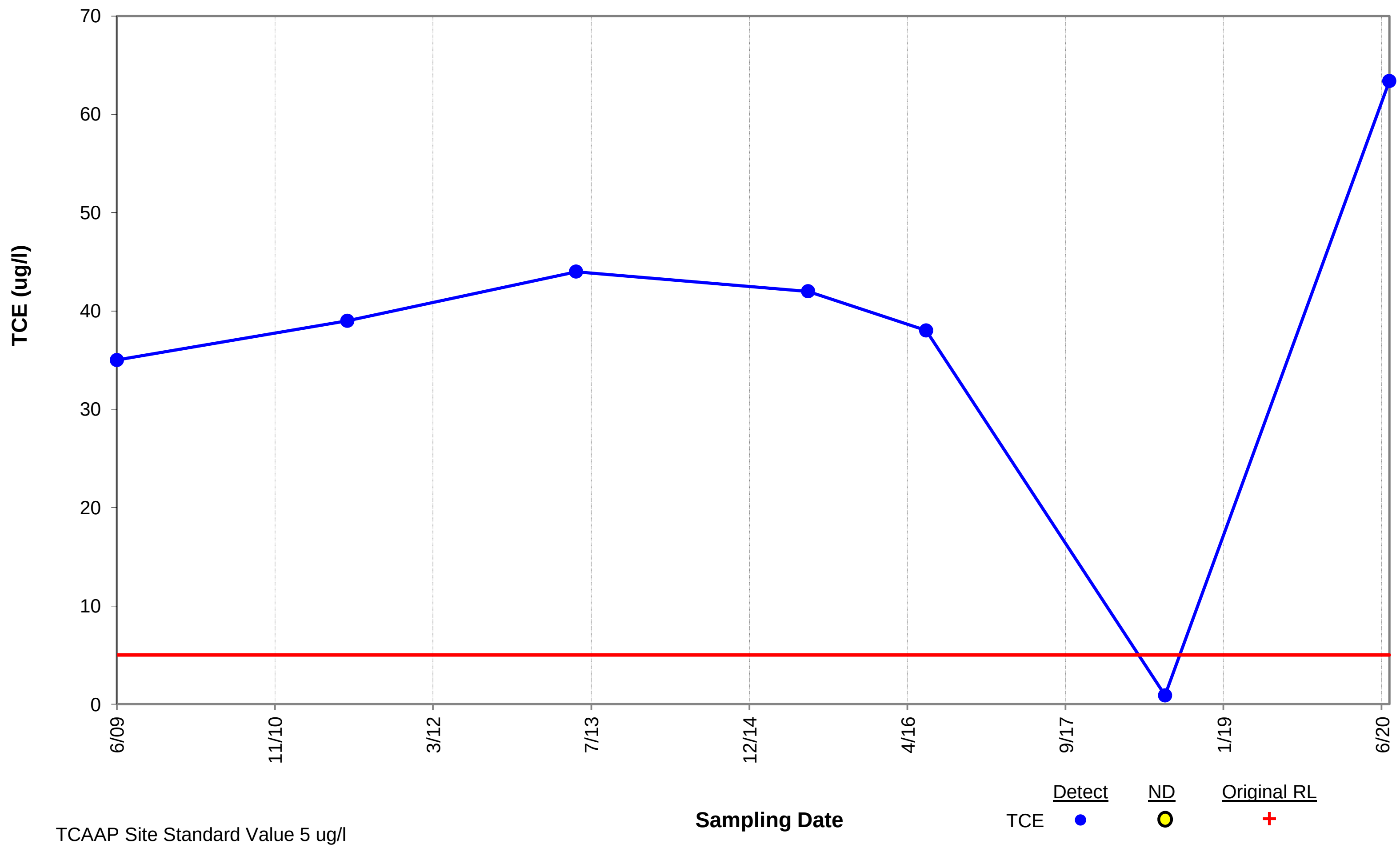


Mann-Kendall Test Result:	**No Significant Trend** p-value = 0.169	H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).
Theil-Sen Trend Line Result:	**No Significant Trend** Median Slope Estimate = -2.3E-04 ug/l per day	
	95% Confidence Interval = -2.0E-03 to 4.3E-04 ug/l per day	

PIKA ARCADIS a joint venture

Concentration vs. Time Plot – TCE in Well 04J837Twin Cities Army Ammunition Plant

Figure D.2.2-26

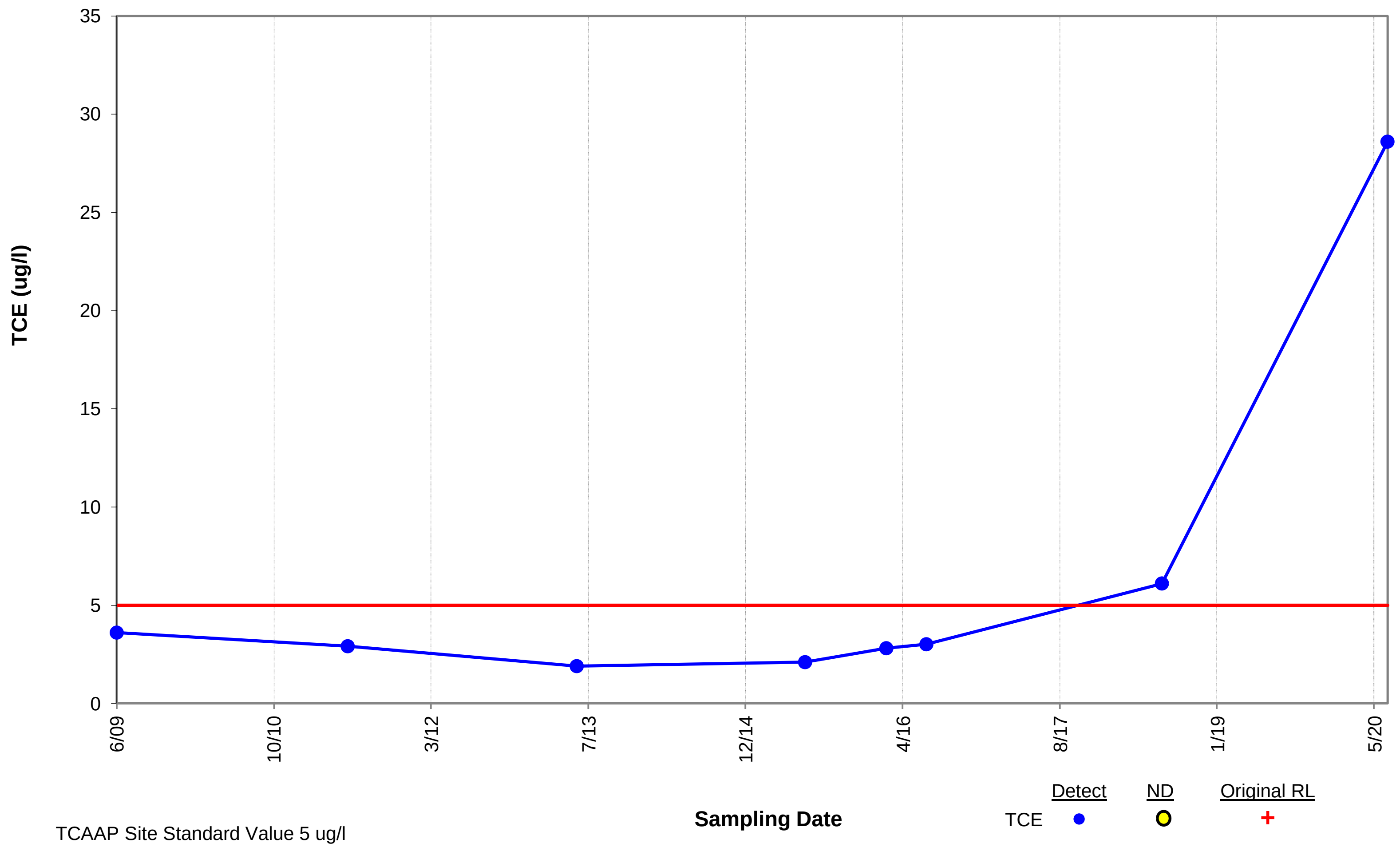


Mann-Kendall Test Result:	**No Significant Trend** p-value = 0.386	H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).
Theil-Sen Trend Line Result:	**No Significant Trend** Median Slope Estimate = 2.1E-03 ug/l per day 95% Confidence Interval = -1.5E-02 to 7.4E-03 ug/l per day	

PIKA ARCADIS a joint venture

Concentration vs. Time Plot – TCE in Well 04J838Twin Cities Army Ammunition Plant

Figure D.2.2-27

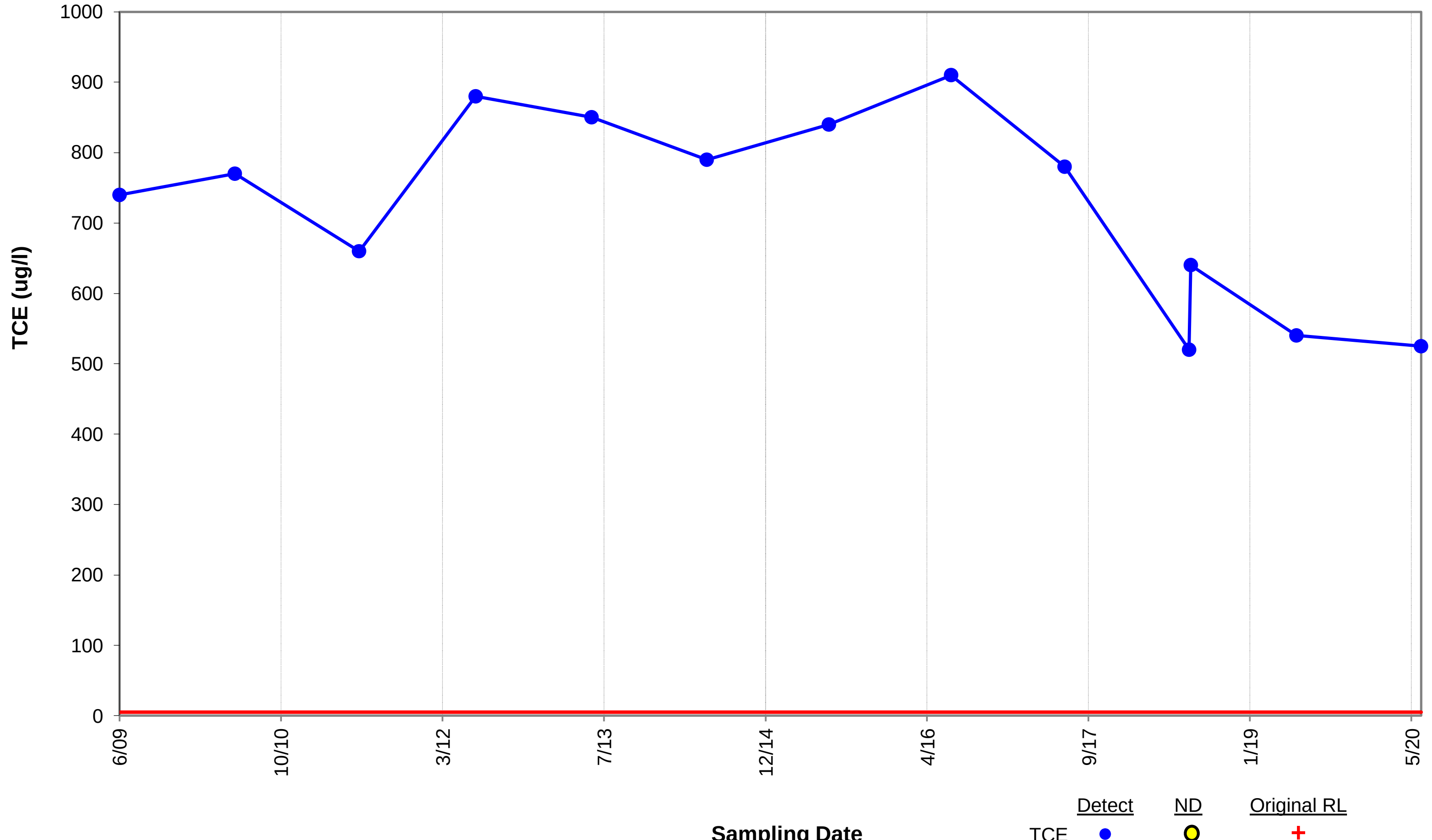


Mann-Kendall Test Result:	**No Significant Trend** p-value = 0.089	H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).
Theil-Sen Trend Line Result:	**No Significant Trend** Median Slope Estimate = 1.4E-03 ug/l per day 95% Confidence Interval = -3.2E-04 to 6.0E-03 ug/l per day	

PIKA ARCADIS a joint venture

Concentration vs. Time Plot – TCE in Well 04J839Twin Cities Army Ammunition Plant

Figure D.2.2-28



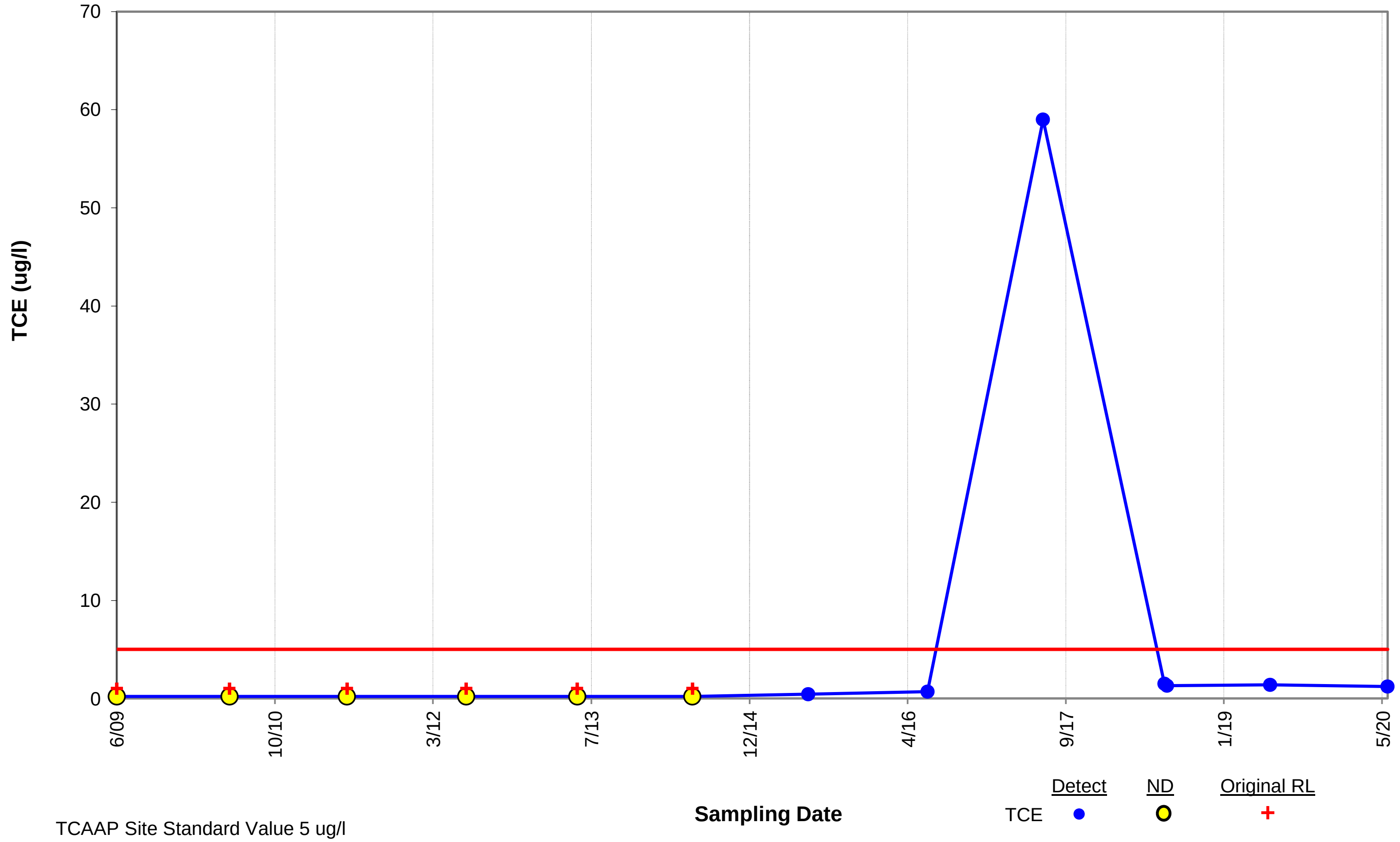
TCAAP Site Standard Value 5 ug/l

Mann-Kendall Test Result:	**No Significant Trend** p-value = 0.080	H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).
Theil-Sen Trend Line Result:	**No Significant Trend** Median Slope Estimate = -5.5E-02 ug/l per day; 95% Confidence Interval = -1.3E-01 to 1.4E-02 ug/l per day	

PIKA ARCADIS a joint venture

Concentration vs. Time Plot – TCE in Well 04J847Twin Cities Army Ammunition Plant

Figure D.2.2-29



Mann-Kendall Test Result: INCREASING TREND
p-value = 0.002

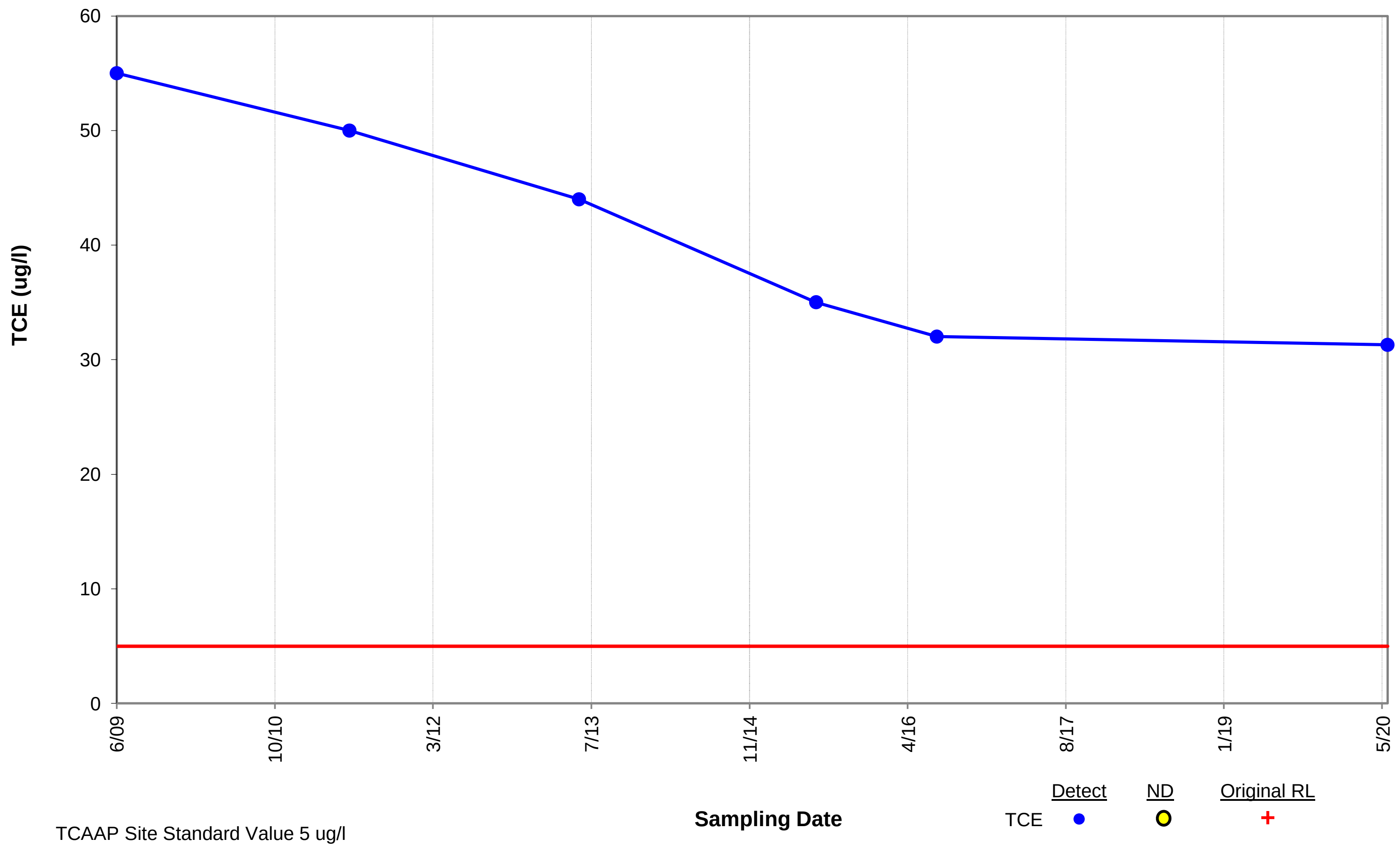
H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).

Theil-Sen Trend Line Result: **No Significant Trend**
Median Slope Estimate = 3.4E-04 ug/l per day
95% Confidence Interval = 0.0E+00 to 5.1E-04 ug/l per day

PIKA ARCADIS a joint venture

Concentration vs. Time Plot – TCE in Well 04J849Twin Cities Army Ammunition Plant

Figure D.2.2-30



Mann-Kendall Test Result: DECREASING TREND

p-value = 0.001

H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).

Theil-Sen Trend Line Result: DECREASING TREND

Median Slope Estimate = -7.9E-03 ug/l per day

95% Confidence Interval = -1.0E-02 to -5.2E-03 ug/l per day

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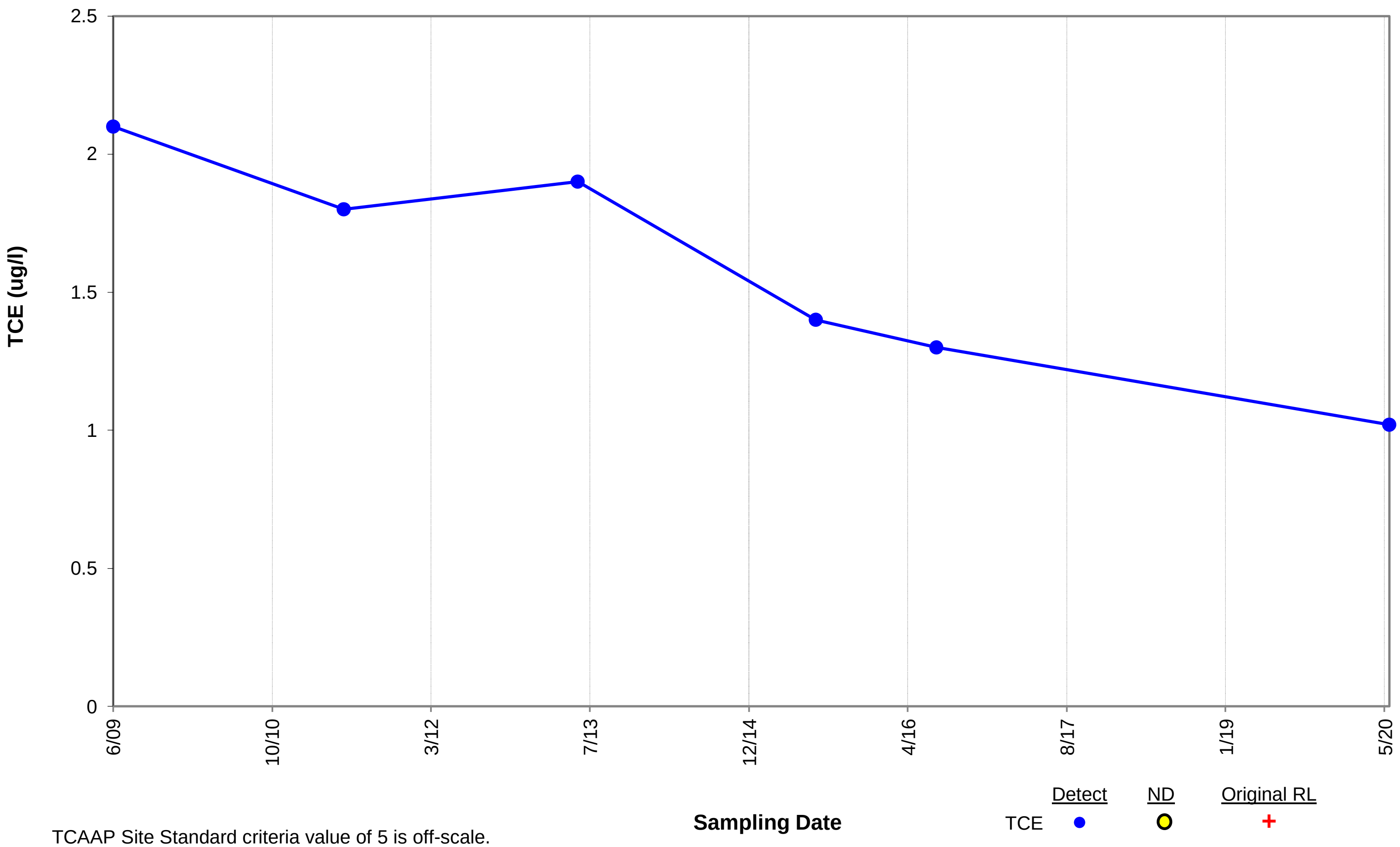
Concentration vs. Time Plot – TCE in Well 04U077Twin Cities Army Ammunition Plant

Figure D.2.2-31



TCAAP Site Standard criteria value of 5 is off-scale.

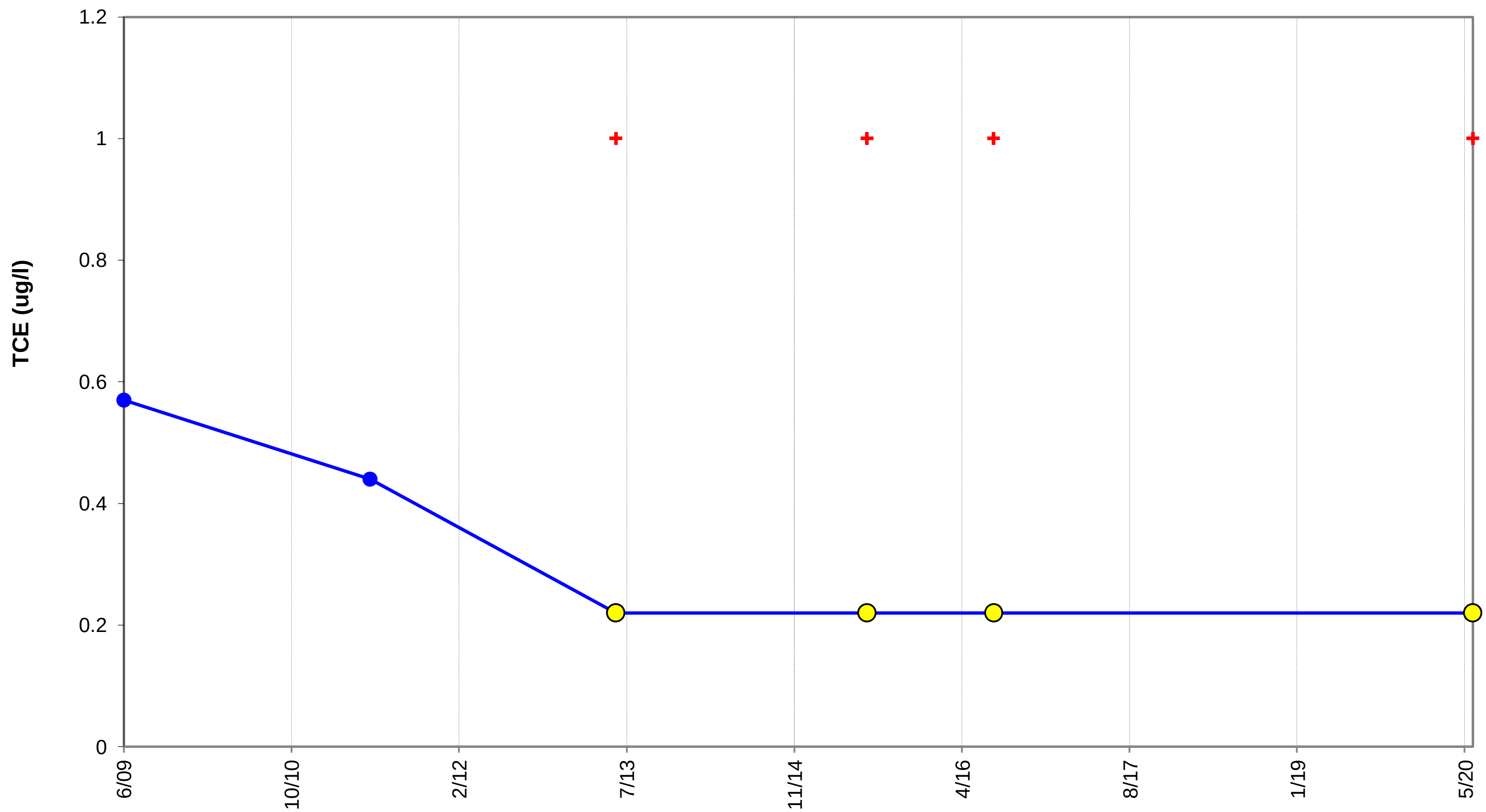
Mann-Kendall Test Result: DECREASING TREND
p-value = 0.008
H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).

Theil-Sen Trend Line Result: DECREASING TREND
Median Slope Estimate = -2.7E-04 ug/l per day
95% Confidence Interval = -5.0E-04 to -2.0E-04 ug/l per day

PIKA ARCADIS a joint venture

Concentration vs. Time Plot – TCE in Well 04U702Twin Cities Army Ammunition Plant

Figure D.2.2-32



TCAAP Site Standard criteria value of 5 is off-scale.

Mann-Kendall Test Result:	**No Significant Trend**		H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).
	p-value =	0.068	
Theil-Sen Trend Line Result:	**No Significant Trend**		
	Median Slope Estimate =	-8.7E-05	ug/l per day
	95% Confidence Interval =	-1.7E-04 to 0.0E+00	ug/l per day

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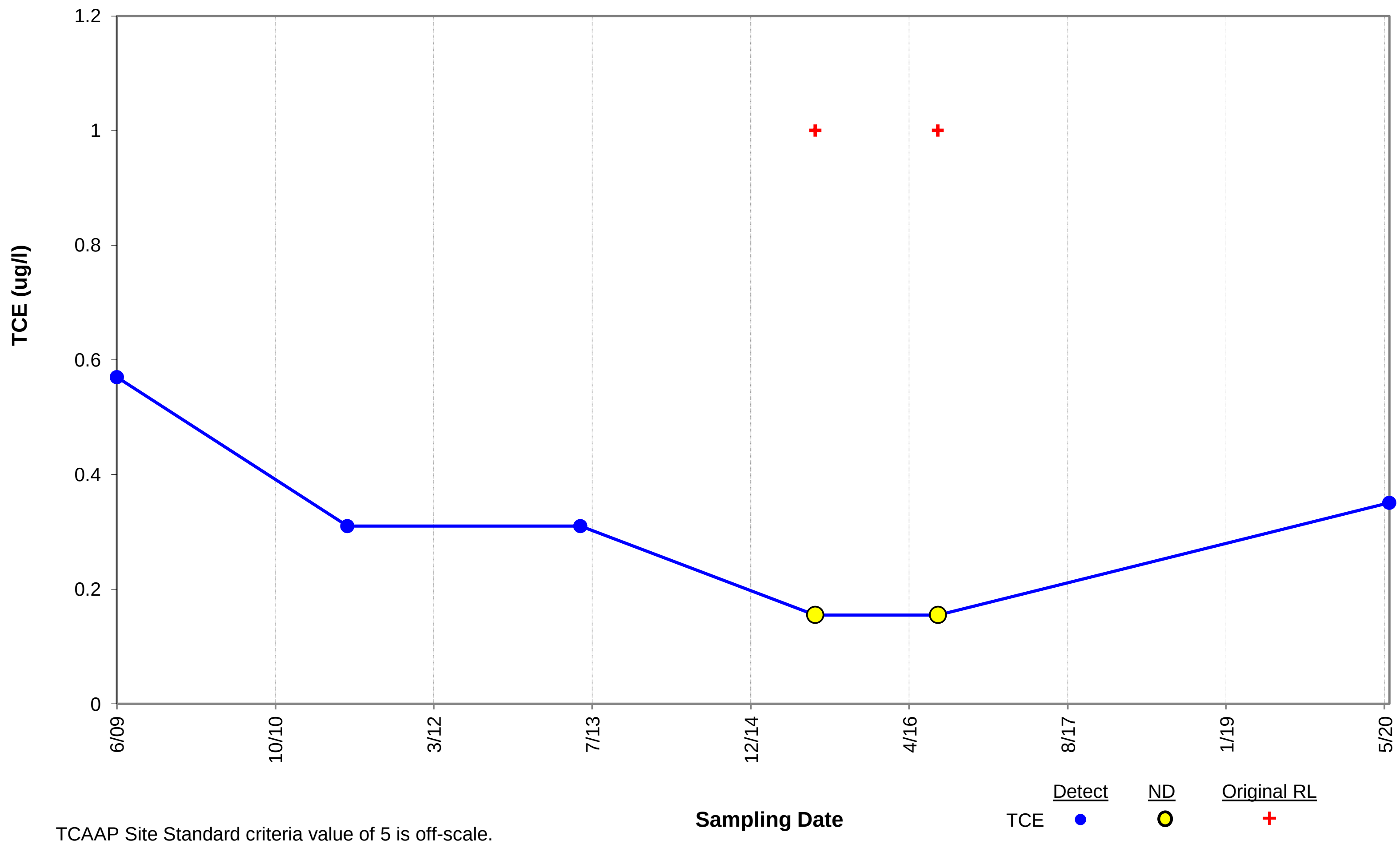
Concentration vs. Time Plot – TCE in Well 04U708Twin Cities Army Ammunition Plant

Figure D.2.2-33



TCAAP Site Standard criteria value of 5 is off-scale.

Mann-Kendall Test Result: **No Significant Trend**
p-value = 0.235

H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).

Theil-Sen Trend Line Result: **No Significant Trend**
Median Slope Estimate = -8.3E-05 ug/l per day
95% Confidence Interval = -2.0E-04 to 1.4E-05 ug/l per day

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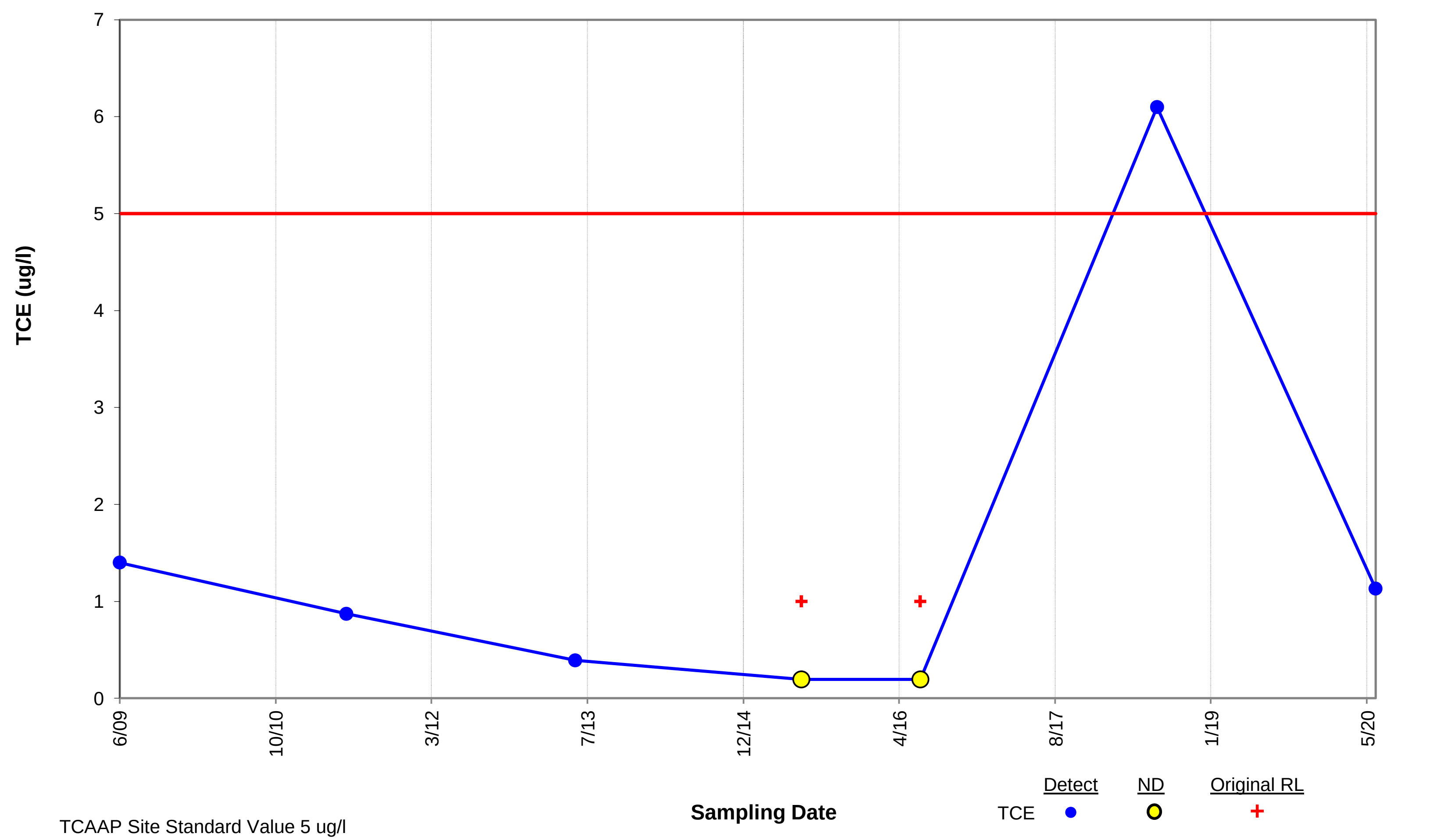
Concentration vs. Time Plot – TCE in Well 04U713Twin Cities Army Ammunition Plant

Figure D.2.2-34



Mann-Kendall Test Result: **No Significant Trend**
p-value = 0.443

H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).

Theil-Sen Trend Line Result: **No Significant Trend**
Median Slope Estimate = -6.7E-05 ug/l per day
95% Confidence Interval = -6.5E-04 to 1.4E-03 ug/l per day

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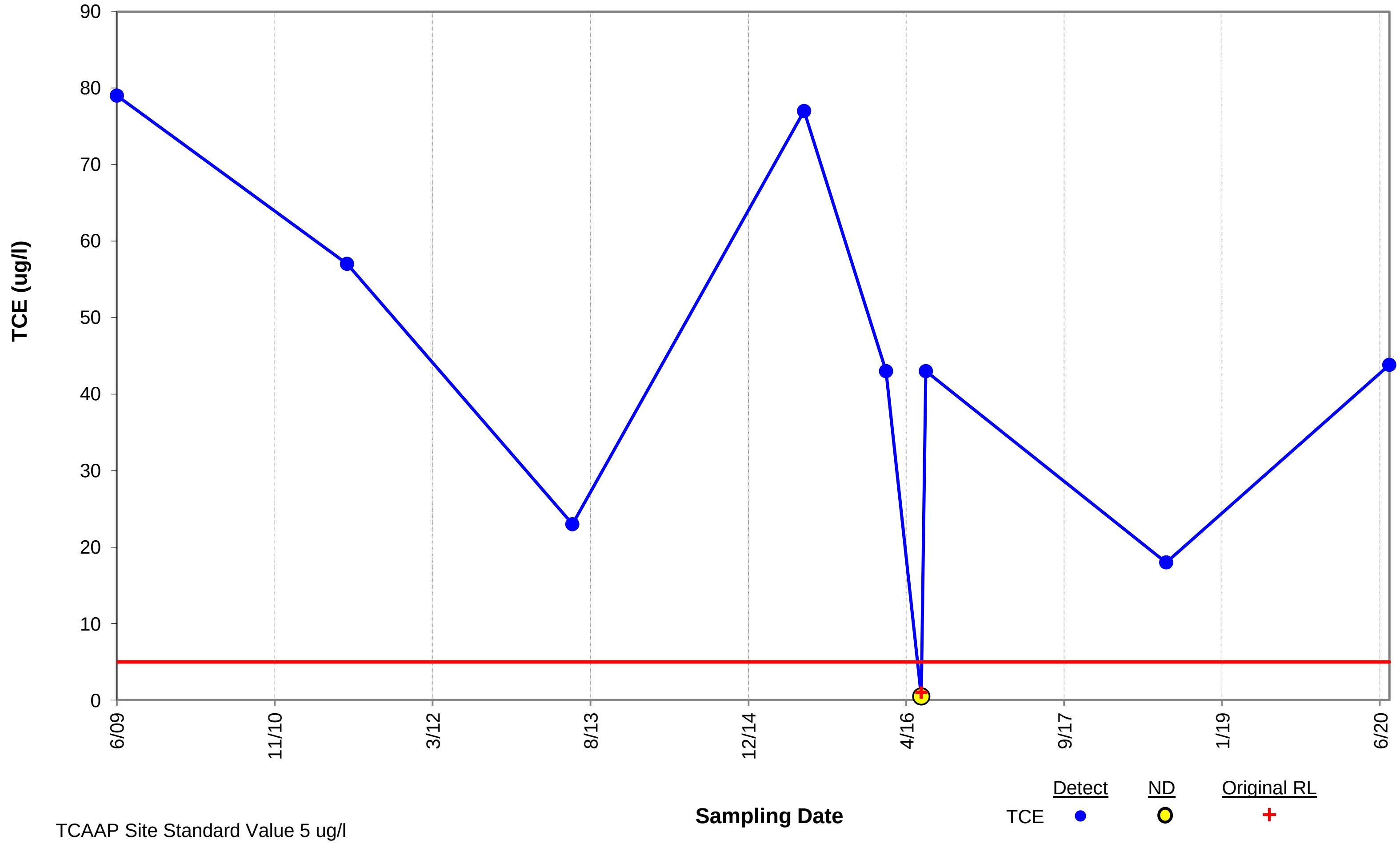
Concentration vs. Time Plot – TCE in Well 04U834Twin Cities Army Ammunition Plant

Figure D.2.2-35



Mann-Kendall Test Result: **No Significant Trend**
p-value = 0.110

H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).

Theil-Sen Trend Line Result: **No Significant Trend**
Median Slope Estimate = -1.1E-02 ug/l per day
95% Confidence Interval = -3.2E-02 to 3.2E-03 ug/l per day

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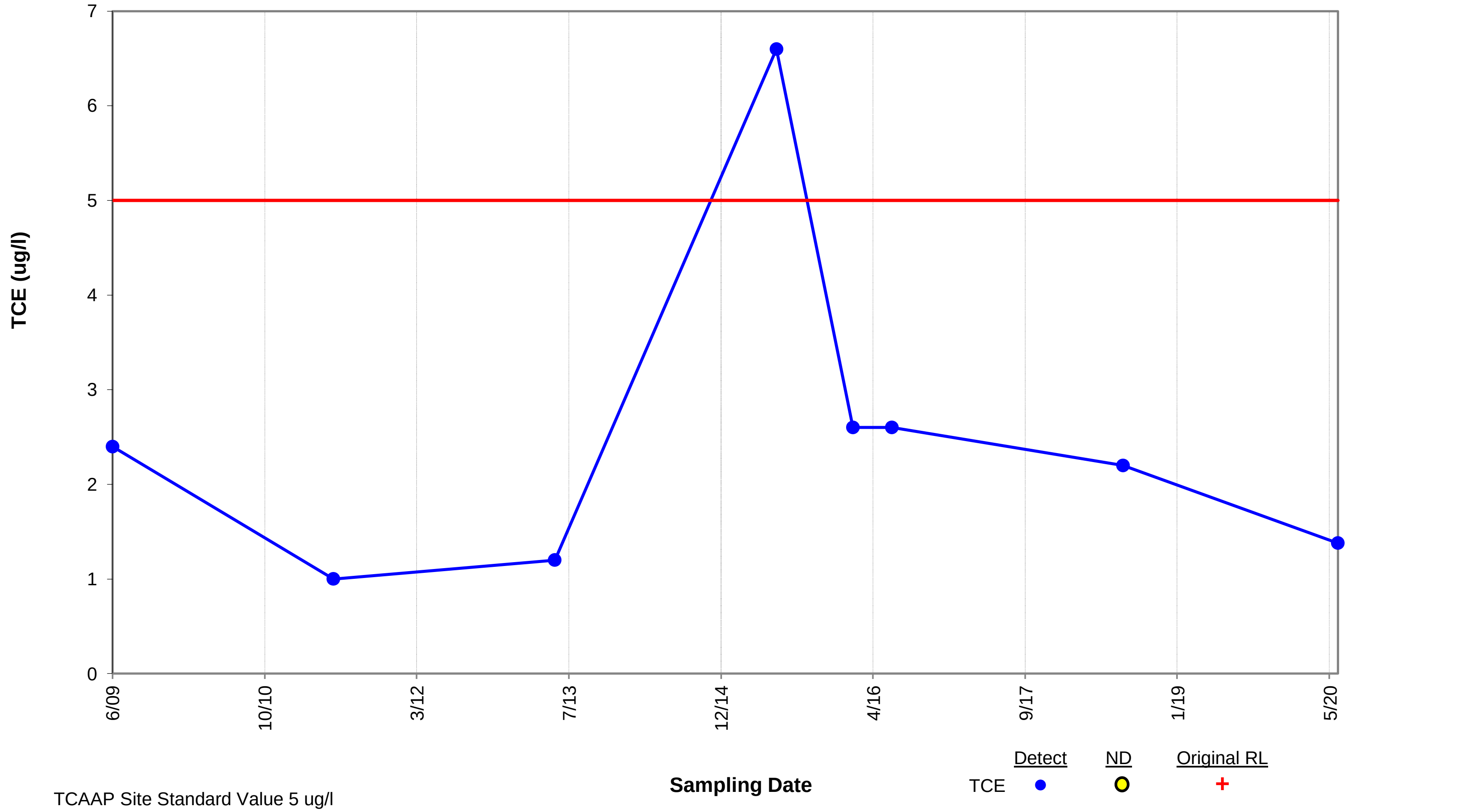
Concentration vs. Time Plot – TCE in Well 04U836Twin Cities Army Ammunition Plant

Figure D.2.2-36



Mann-Kendall Test Result: **No Significant Trend**
p-value = 0.500

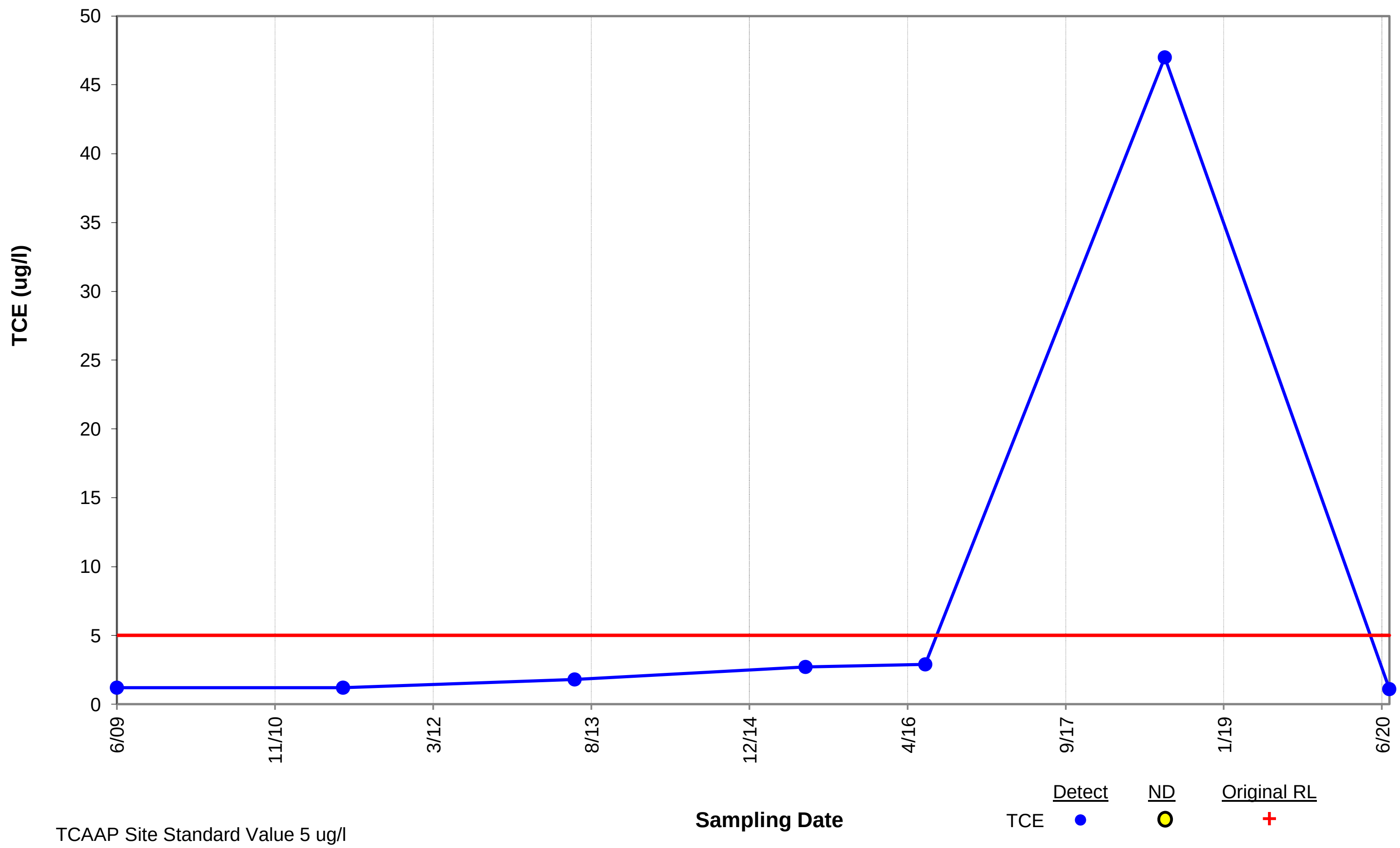
H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).

Theil-Sen Trend Line Result: **No Significant Trend**
Median Slope Estimate = 3.5E-05 ug/l per day
95% Confidence Interval = -1.1E-03 to 8.2E-04 ug/l per day

PIKA ARCADIS a joint venture

Concentration vs. Time Plot – TCE in Well 04U837Twin Cities Army Ammunition Plant

Figure D.2.2-37



Mann-Kendall Test Result: **No Significant Trend**
p-value = 0.155

H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).

Theil-Sen Trend Line Result: **No Significant Trend**
Median Slope Estimate = 6.9E-04 ug/l per day
95% Confidence Interval = -2.6E-04 to 1.3E-02 ug/l per day

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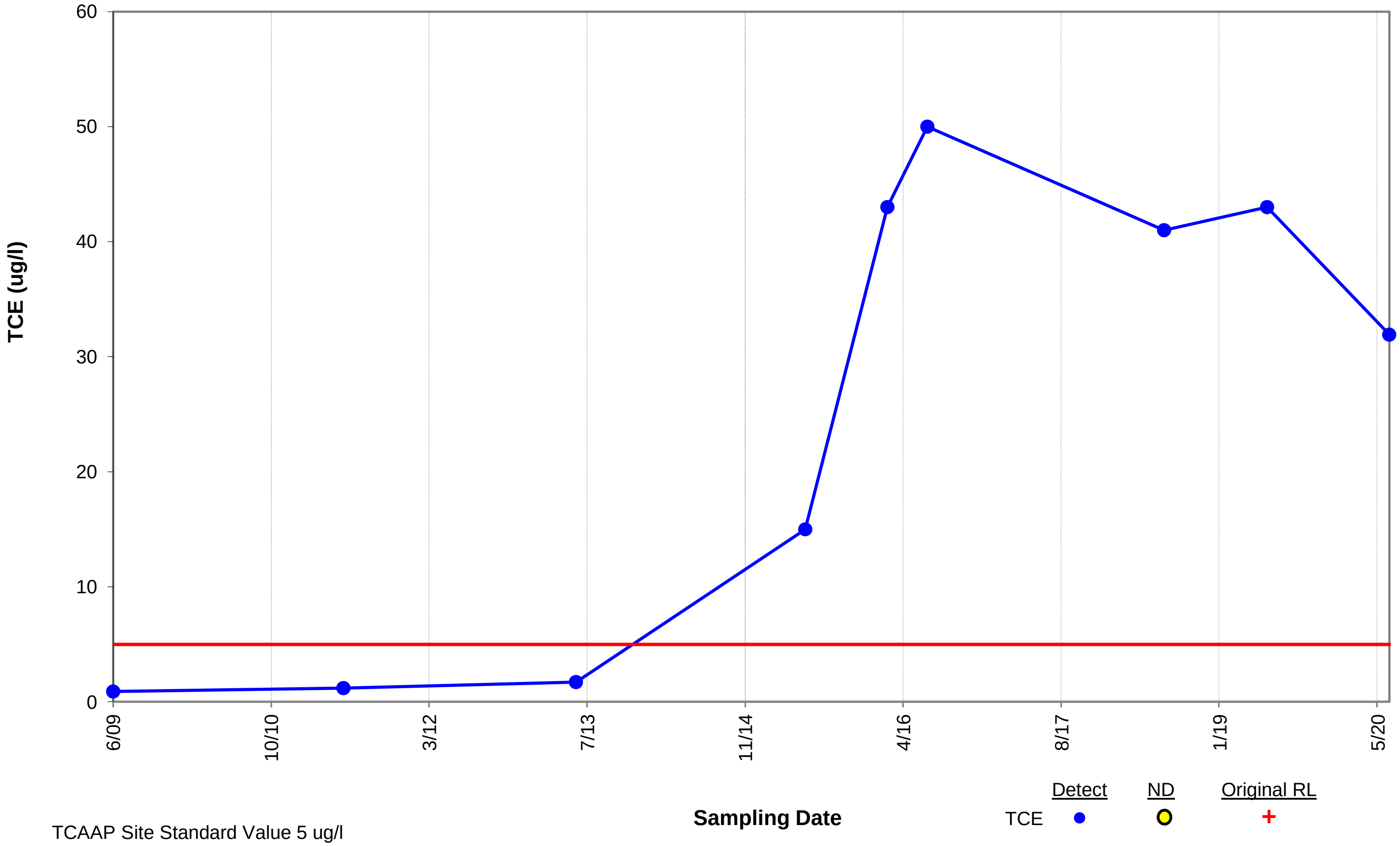
Concentration vs. Time Plot – TCE in Well 04U838Twin Cities Army Ammunition Plant

Figure D.2.2-38



Mann-Kendall Test Result:	INCREASING TREND		H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).	
	p-value =	0.017		
Theil-Sen Trend Line Result:	INCREASING TREND			
	Median Slope Estimate =	1.2E-02	ug/l per day	
	95% Confidence Interval =	2.8E-04	to 2.0E-02	ug/l per day

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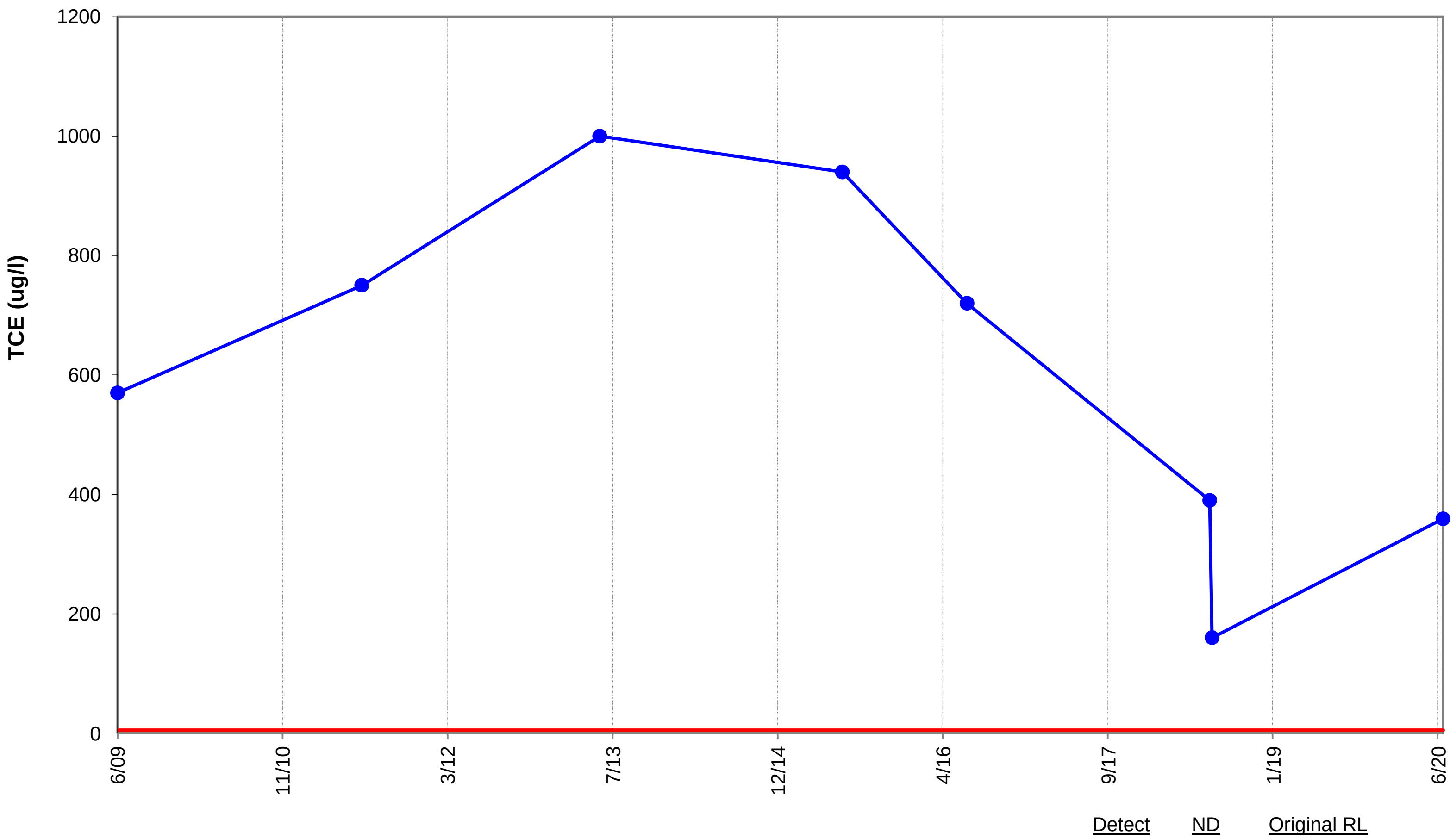
Concentration vs. Time Plot – TCE in Well 04U839Twin Cities Army Ammunition Plant

Figure D.2.2-39



TCAAP Site Standard Value 5 ug/l

Mann-Kendall Test Result: **No Significant Trend**
p-value = 0.054
H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).

Theil-Sen Trend Line Result: **No Significant Trend**
Median Slope Estimate = -1.3E-01 ug/l per day
95% Confidence Interval = -4.5E-01 to 5.2E-02 ug/l per day

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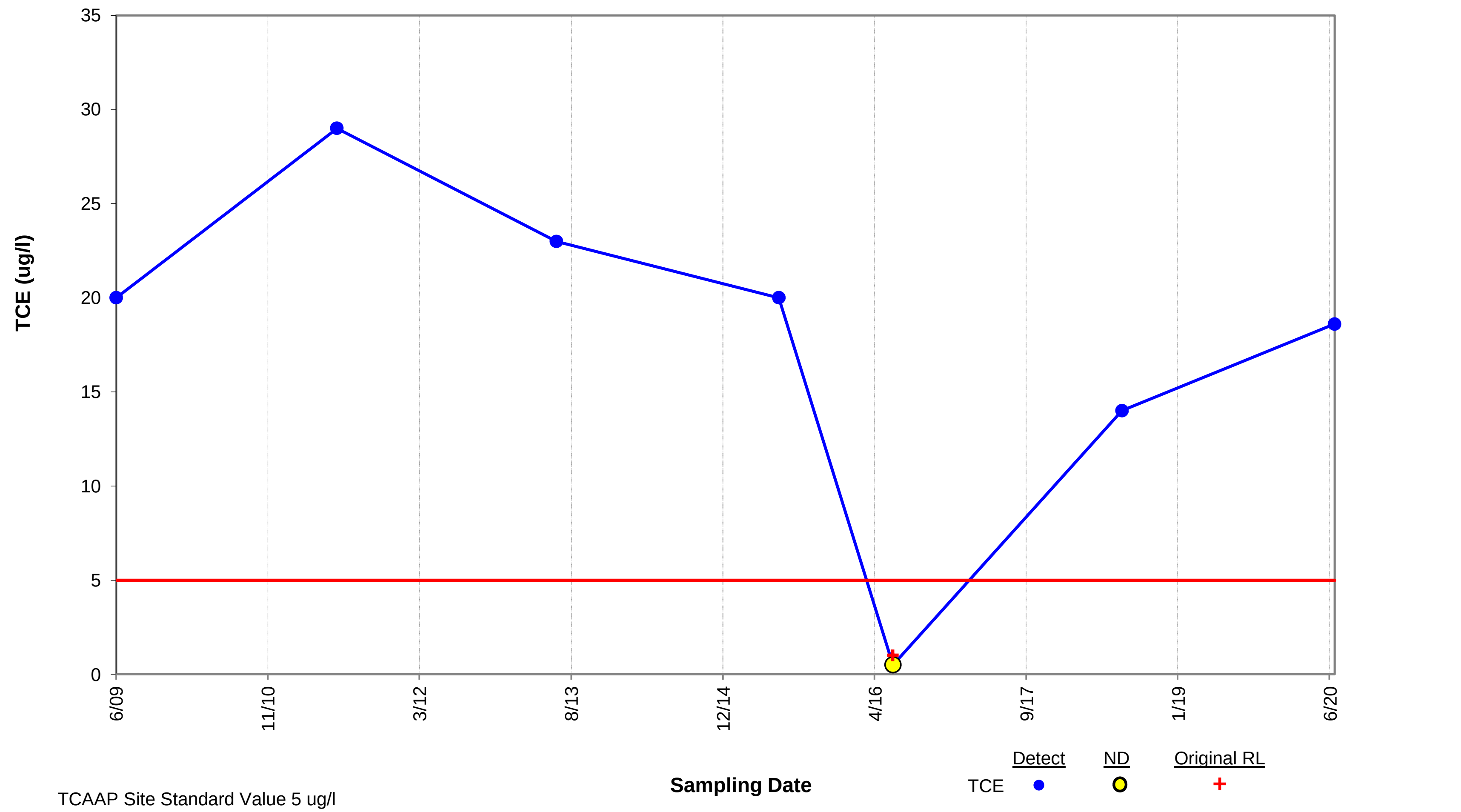
Concentration vs. Time Plot – TCE in Well 04U847Twin Cities Army Ammunition Plant

Figure D.2.2-40



Mann-Kendall Test Result:	**No Significant Trend**	H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).	
	p-value =	0.094	
Theil-Sen Trend Line Result:	**No Significant Trend**		
	Median Slope Estimate =	-3.2E-03	ug/l per day
	95% Confidence Interval =	-8.3E-03 to 2.0E-03	ug/l per day

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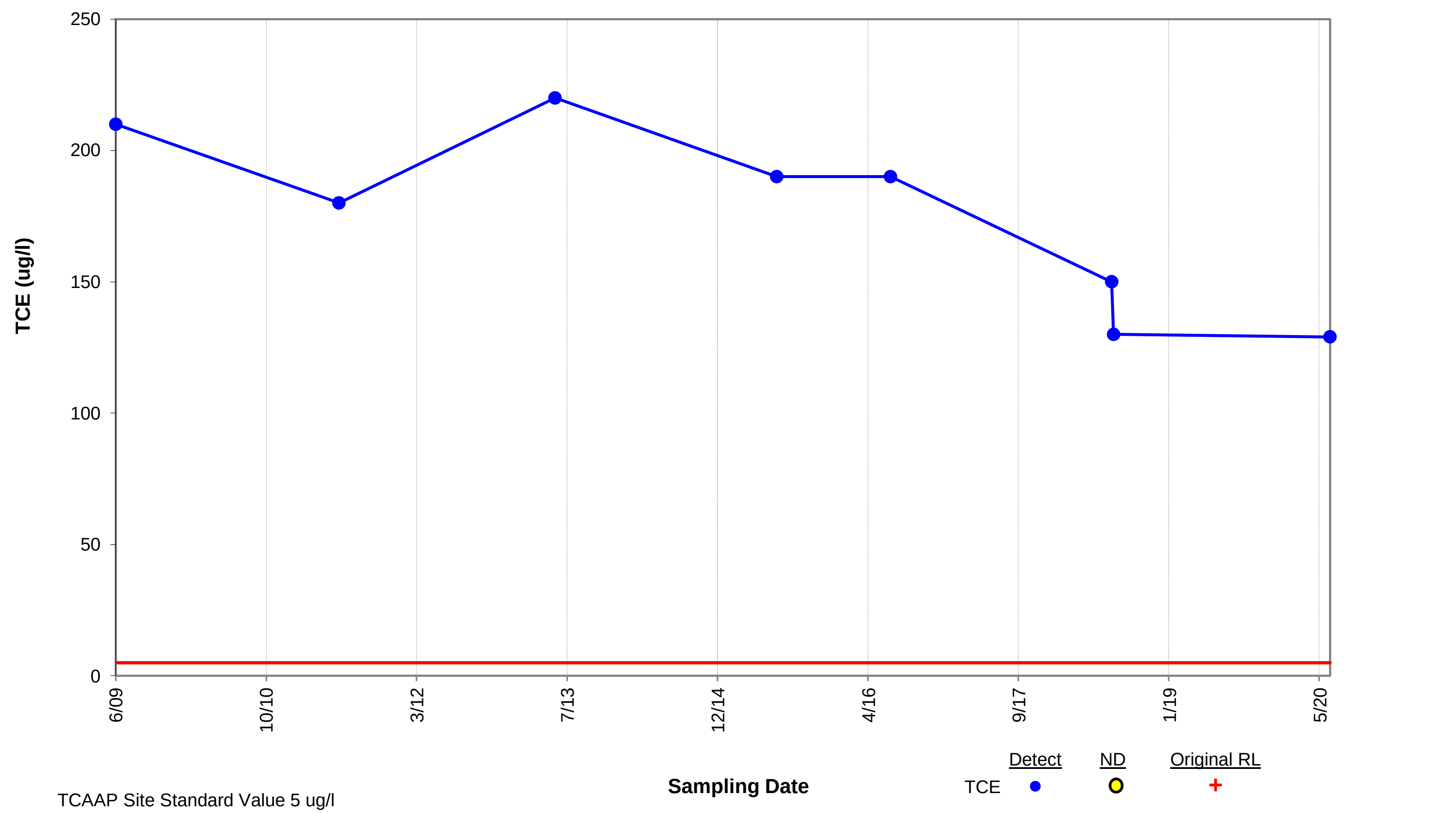
Concentration vs. Time Plot – TCE in Well 04U882Twin Cities Army Ammunition Plant

Figure D.2.2-41



Mann-Kendall Test Result: DECREASING TREND

p-value = 0.012

H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).

Theil-Sen Trend Line Result: DECREASING TREND

Median Slope Estimate = -2.6E-02 ug/l per day

95% Confidence Interval = -4.2E-02 to -8.0E-03 ug/l per day

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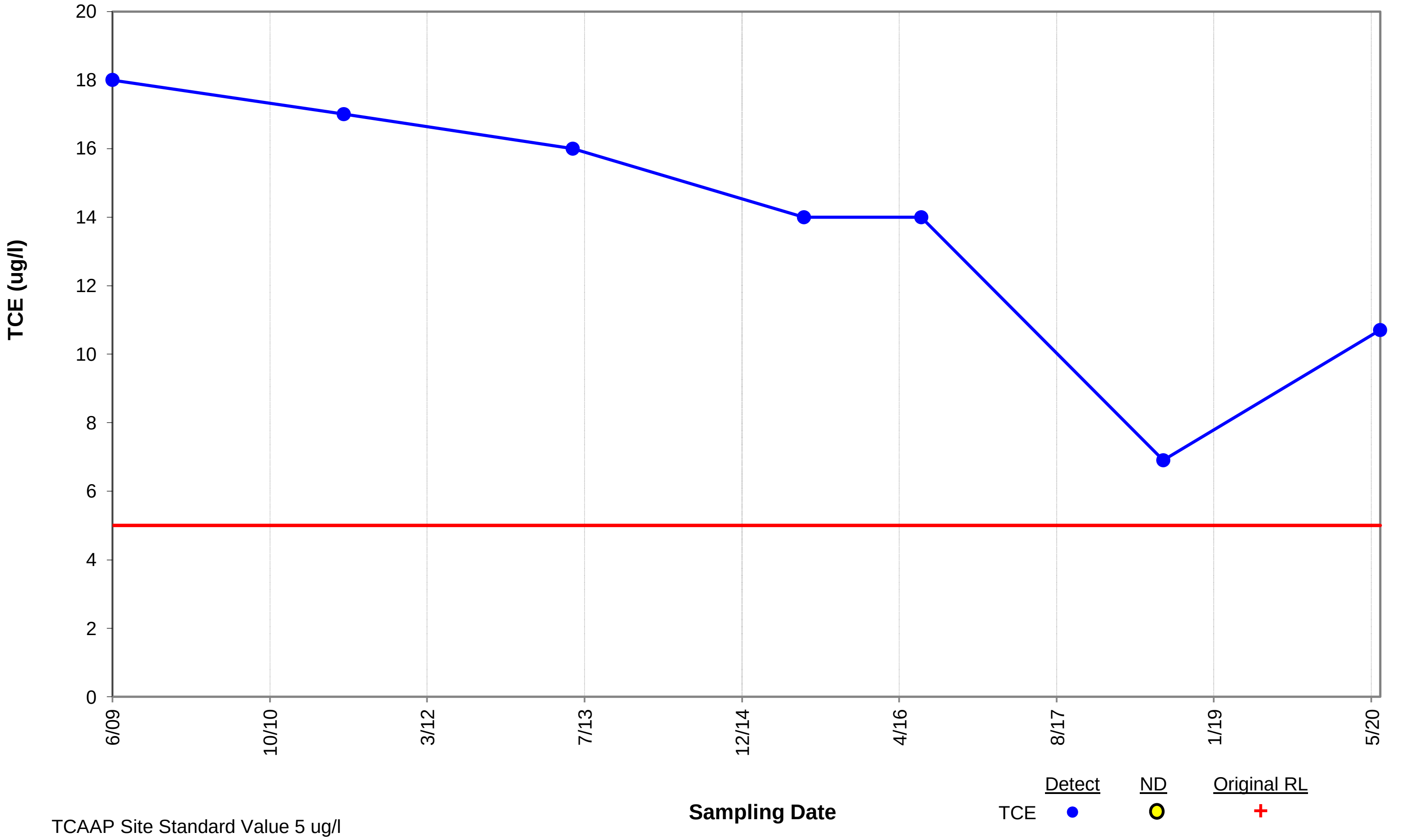
Concentration vs. Time Plot – TCE in Well 03L822Twin Cities Army Ammunition Plant

Figure D.2.2-42



Mann-Kendall Test Result: DECREASING TREND
p-value = 0.003

H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).

Theil-Sen Trend Line Result: DECREASING TREND
Median Slope Estimate = -1.8E-03 ug/l per day
95% Confidence Interval = -3.9E-03 to -1.4E-03 ug/l per day

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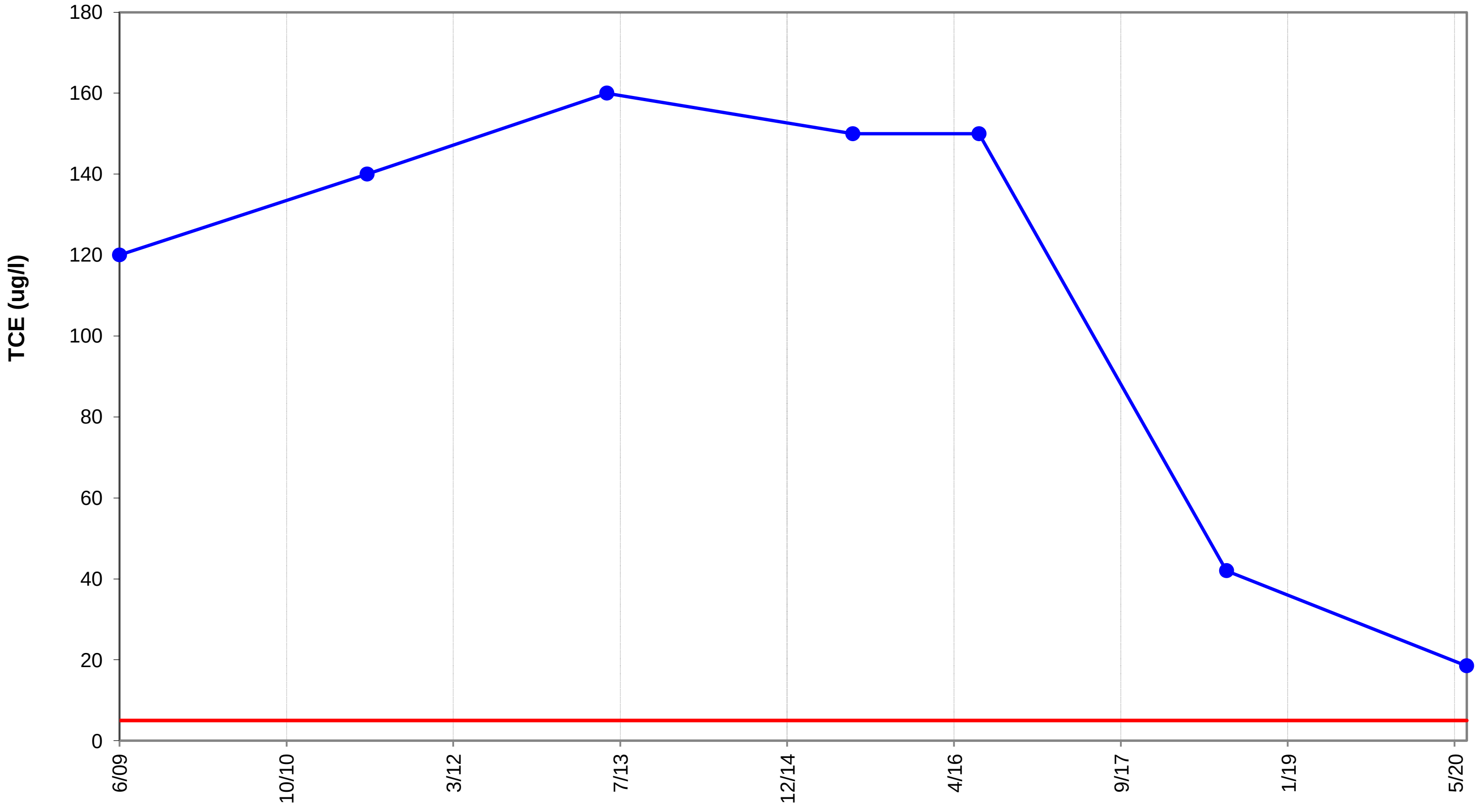
Concentration vs. Time Plot – TCE in Well 03U821Twin Cities Army Ammunition Plant

Figure D.2.2-43



Mann-Kendall Test Result:	**No Significant Trend**	H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).
	p-value = 0.236	
Theil-Sen Trend Line Result:	**No Significant Trend**	
	Median Slope Estimate = -2.4E-02 ug/l per day	
	95% Confidence Interval = -7.1E-02 to 1.1E-02 ug/l per day	

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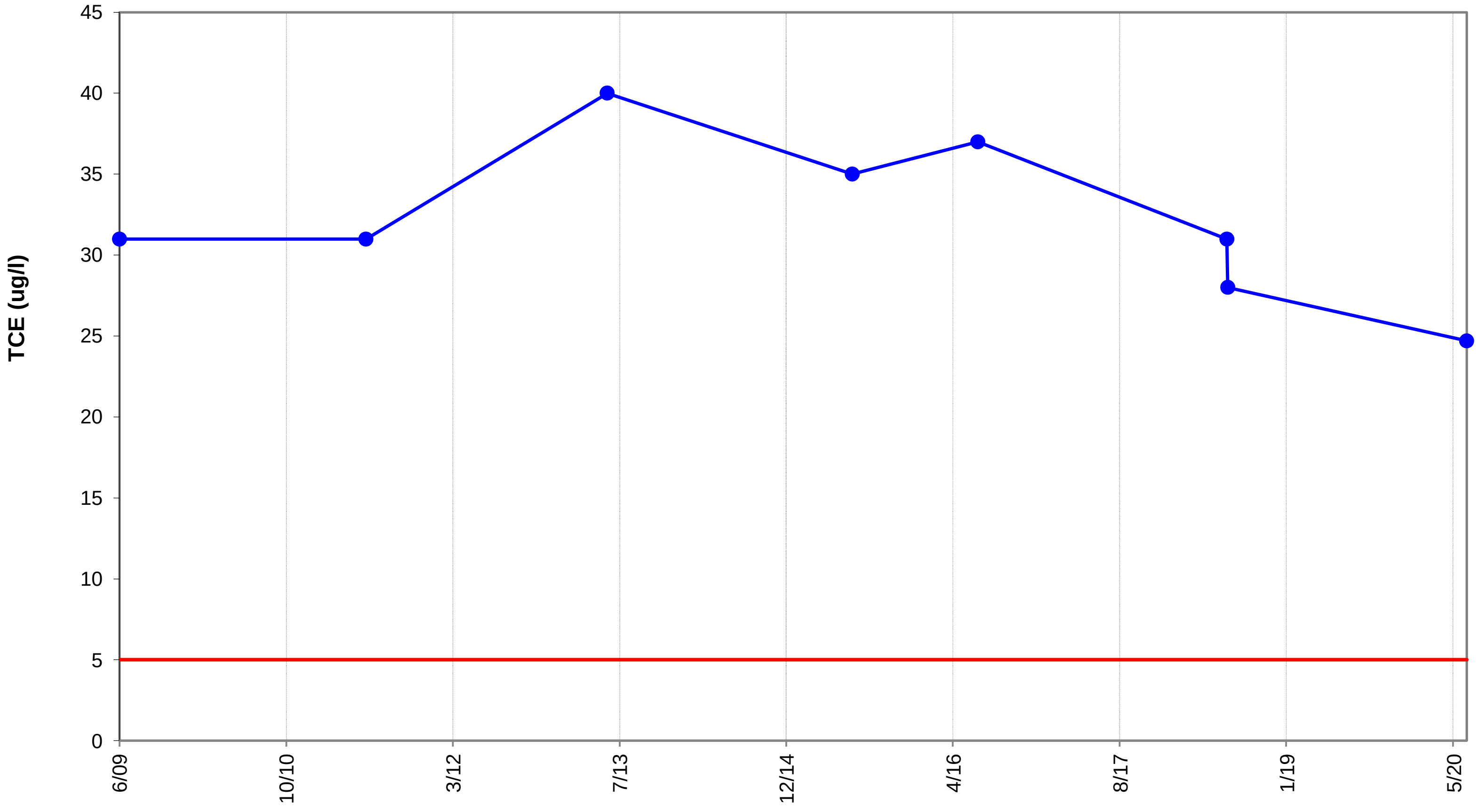
Concentration vs. Time Plot – TCE in Well 03U822Twin Cities Army Ammunition Plant

Figure D.2.2-44



TCAAP Site Standard Value 5 ug/l

Mann-Kendall Test Result: **No Significant Trend**
p-value = 0.114

H0: No Trend vs. H1: Up Or Down Trend. (Note: A p-value < 0.05 indicates a statistically significant trend for a one-tailed test).

Theil-Sen Trend Line Result: **No Significant Trend**
Median Slope Estimate = -2.3E-03 ug/l per day
95% Confidence Interval = -6.7E-03 to 1.3E-03 ug/l per day

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Concentration vs. Time Plot – TCE in Well 409550Twin Cities Army Ammunition Plant

Figure D.2.2-45

Figure D.2.3-1
New Brighton Municipal Wells: Regression Analysis Since 1998: Trichloroethene

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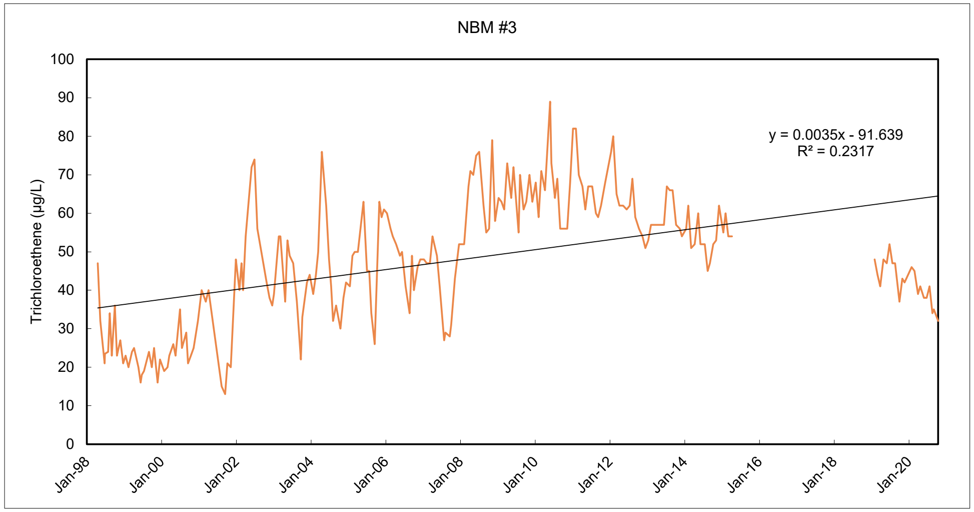
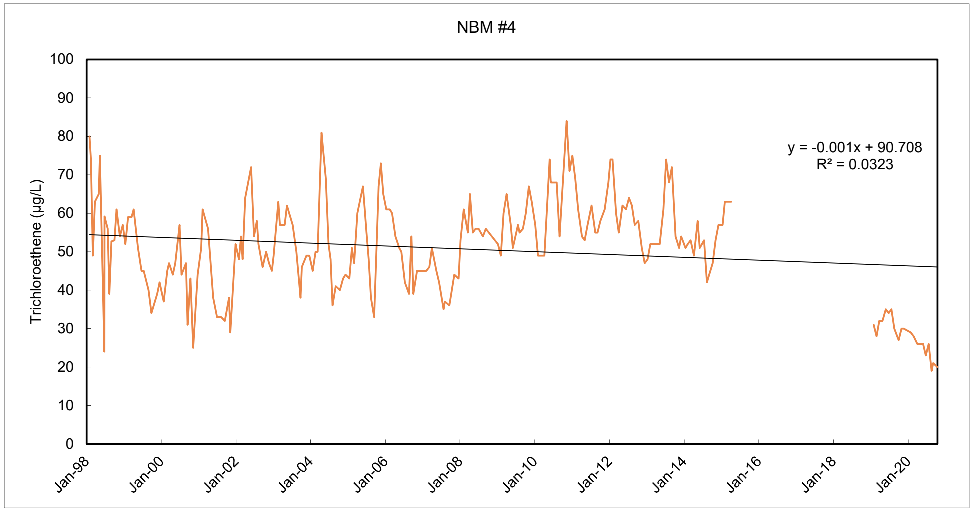
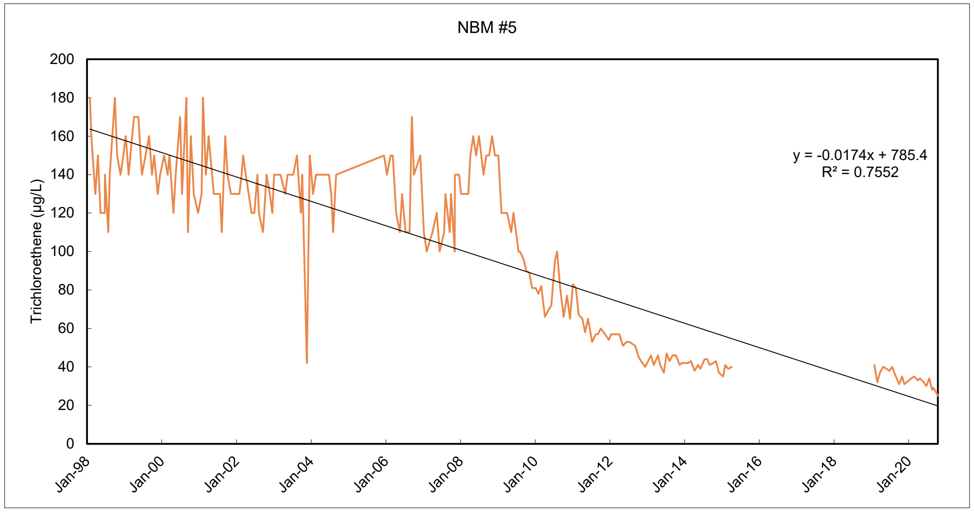
Arden Hills, MN







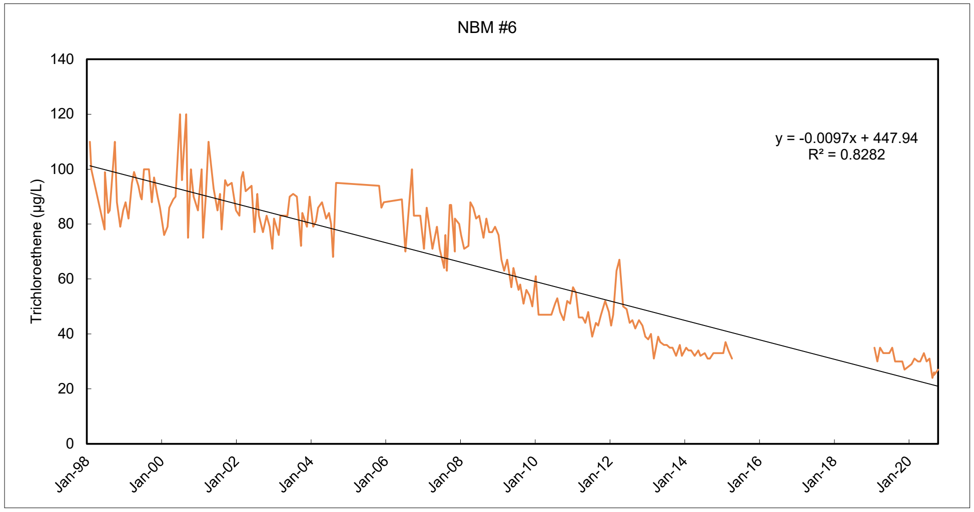


Figure D.2.3-2
New Brighton Municipal Wells: Regression Analysis Since 1998: Trichloroethene

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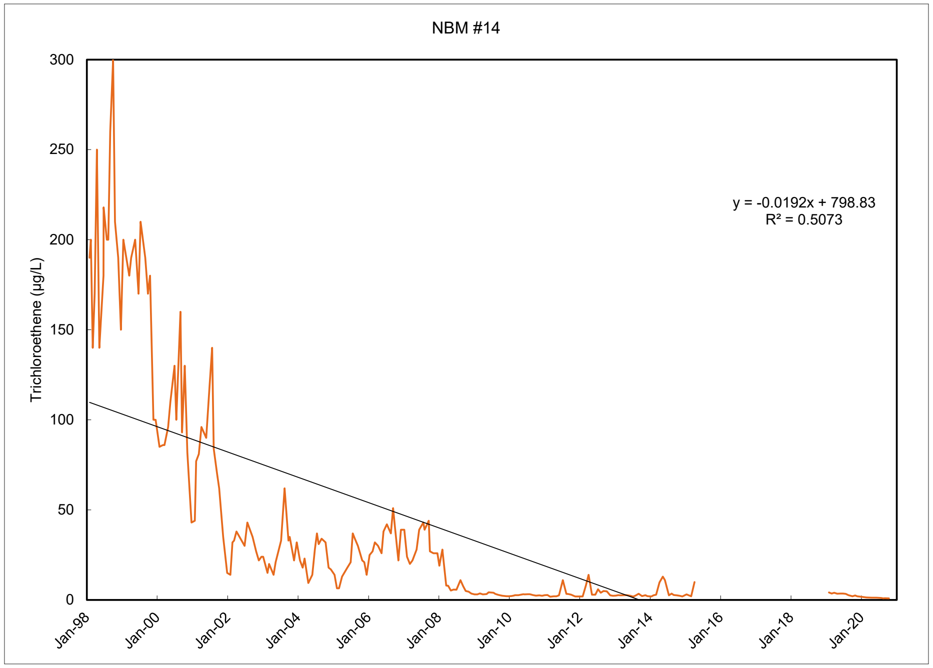

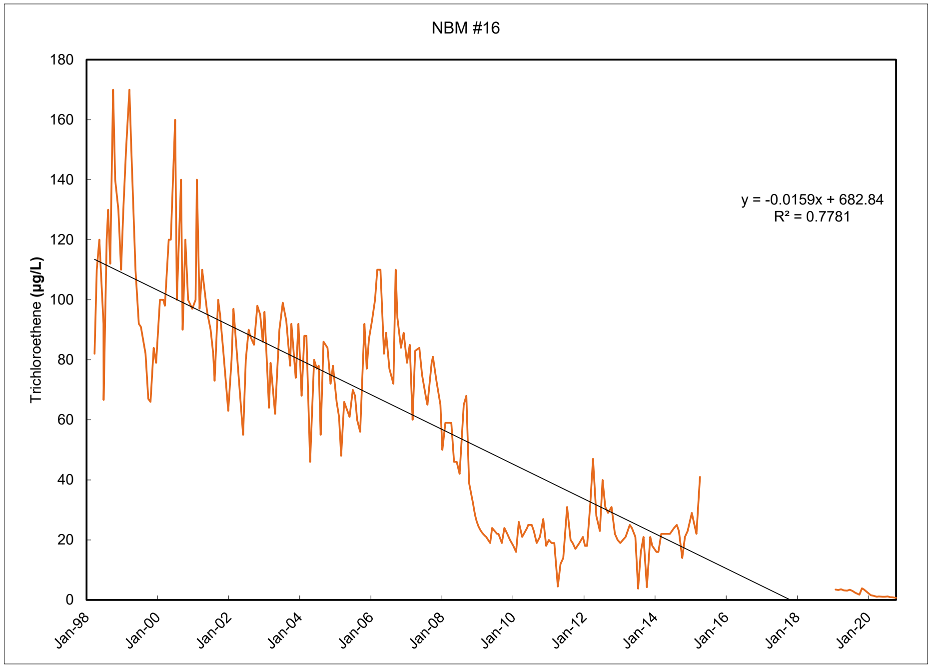

Appendix E

Well Inventory

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1.0 PURPOSE

The purpose of well inventory is to identify wells that have been impacted or could potentially be impacted by contaminants from the New Brighton/Arden Hills Superfund Site.

2.0 BACKGROUND

Developing and maintaining the well inventory is a process that was initiated in 1991, with the work efforts documented in several update reports since that time. Beginning in FY 1999, the update reporting was incorporated into the Annual Performance Reports.

The well inventory “study area,” as defined by the Minnesota Pollution Control Agency, is shown on Figure E-1, and coincides with the Minnesota Department of Health (MDH) Special Well Construction Area.

The aquifers of concern are defined by the 5 µg/L trichloroethene contour for the Unit 3 and Unit 4 aquifers, and the 1 µg/L cis-1,2-dichloroethene contour for the Unit 1 aquifer at the north end of OU2.

The “area of concern” for the Unit 3 and Unit 4 aquifers is created by adding a quarter mile buffer area outside the 5 µg/L trichloroethene (TCE) contour. The area of concern for the Unit 3 and Unit 4 aquifers is shown on Figure E-2.

The area of concern for the Unit 1 aquifer on the north side of OU2 is delineated by city streets. The area of concern for the Unit 1 aquifer is shown on Figure E-3.

Wells within the study area are categorized based on location, depth/aquifer, and use. Well categories for the well inventory are described in Table E-1.

3.0 PROGRAM REQUIREMENTS

The well inventory program requirements have evolved over time, with changes documented through the update reports. A flowchart that describes the annual requirements for maintaining the well inventory database is shown on Figure E-4. Requirements are summarized below.

Near the beginning of each fiscal year, a database of study area wells is acquired from the MDH. This MDH database query is limited to study area wells that were constructed, sealed, or disclosed in the previous fiscal year. The MDH database consists of three lists:

- Constructed Wells (generated through drillers submitting Well and Boring Records);
- Sealed Wells (generated through drillers submitting Well Sealing Records); and
- Disclosed Wells (made known through property transfer).

With the new MDH information, the well inventory database is updated by recategorizing wells, as necessary, and by adding any new wells that are within the study area. Any new wells found in Categories 1a, 1b, 1c, 2a, 2b, 2c, or 4a are targeted for sampling in that fiscal year; however, an attempt to reclassify any new category 4a wells will be made prior to sampling. Wells that are not sampled due to non-responsive well owners are targeted for sampling in the next major sampling event.

Category 4 wells are those with an unknown depth or unknown location, or both. Ideally, there should be no wells in Category 4. Each year, an attempt is made to reclassify Category 4 wells into one of the other categories. This is accomplished through phone calls, letters, and/or site visits to obtain additional information. Any wells which are re-classified as Category 1a, 1b, 1c, 2a, 2b, or 2c are targeted for sampling in that fiscal year.

"Major" well inventory sampling events occur every four years and are shown in Appendix A.1. The major sampling events are scheduled to coincide with the biennial sampling events for performance purposes as delineated in the APR. For each major event, all wells in Categories 1a, 1b, 1c, 2a, 2b, 2c, and 4a are targeted for sampling. After every sampling event, each well owner is mailed a copy of their testing results. Wells that are not sampled due to non-responsive well owners are targeted for sampling in the next major sampling event.

For each sampling event, if any well has a detection which exceeds the applicable New Brighton/Arden Hills Superfund Site groundwater cleanup level for that contaminant (or an additivity of 1.0, similar to the MDH Hazard Index calculation), the well is evaluated using the flow chart presented in Figure E-4 to determine the timing of additional sampling. Wells that are used for drinking water are sampled again within one month of data validation. Wells that are not used for drinking water, but have possible contact exposure risks, are sampled the next fiscal year. If a cleanup level exceedance is confirmed (two consecutive events), and the contaminant concentrations in the well are proportional to contaminant concentrations of the New Brighton/Arden Hills Superfund Site OU1 plume, the Army offers to abandon the well and/or provide an alternate water supply.

The annual reporting requirements for the New Brighton/Arden Hills Superfund Site well inventory will include:

- A list of any wells found or reclassified.
- Analytical results and a summary of sampling efforts from that fiscal year.
- Recommendations for participation in the Well Abandonment/Alternate Water Supply Program.
- An updated well inventory database that lists wells by well category.
- An updated database listing water quality of wells.

4.0 FY 2020 UPDATE

The updated MDH database was provided to Arcadis on December 21, 2020. MDH generates the database from specific Township, Range, and Section data. This comprehensive database was screened to extract the lists of wells that were constructed, disclosed, or sealed between October 1, 2019 and September 30, 2020. Further investigative efforts were primarily focused on determining each well's location (inside or outside the study area and/or area of concern), status (active, inactive, or sealed), and water use (supply/non-supply).

Newly constructed active and inactive wells, and wells of unknown status that were determined to be located within the study area, are presented in Table E-3. Thirteen wells were identified within the study area, 12 of them classified as environmental wells and placed into Category 6. Well 847062 was installed as a commercial well in the far south edge of the study area. This well has been classified as a category 3 as it is screened in the Jordan Aquifer far beyond the delineated edge of the OU1 Lower Unit 4 Plume. MDH approval for the installation of well 847062, and supplemental testing results, are presented in Appendix E.1.

Disclosed wells that were identified as being in use, inactive, sealed, or of unknown status and that were determined to be located within the study area are identified in Table E-4. Disclosed wells that were located within the area of concern and that the MDH identified as having a change in status from active or inactive to sealed were further investigated for confirmation of their sealed status. There were 47 wells disclosed during FY20 that are located within the study area. Of the 47 wells disclosed within the study area one well was categorized as 2a (drinking water well in the buffer lines and aquifer of concern), six wells were supply wells within the Study area but outside of the area of concern (Category 3), six wells were categorized as 4a (unknown depth or aquifer and in the area of concern), one well was categorized as 4b (unknown locations), and 33 wells were categorized as 7b (undocumented as sealed or improperly abandoned).

Sealed wells were found by reviewing the MDH sealed well list. The 119 wells identified as sealed are shown in Table E-5. Wells identified as sealed in the MDH database updates were assigned to Category 7a.

FY 2020 was a “major” well inventory sampling event, which occur every four years and which target the wells in Categories 1a, 1b, 1c, 2a, 2b, 2c, and 4a. Thirteen wells were sampled in FY 2020. Any wells in the above categories that were not sampled were due to one of the following reasons: the well owner refused the offer to sample; the well owner did not respond to the request for access to sample; or the well was found to be abandoned, non-existent, or inoperable. The analytical data from the FY 2020 sampling effort are summarized in Table E-2. The locations of the wells sampled in FY 2020 are shown on Figure E-5.

Of the 13 wells sampled, 11 had no TCE detections and three had no 1,4-dioxane detections. One well (234544) had a detection of TCE detection above the cleanup level. Ten of the wells had detections of 1,4-dioxane with six of the wells having detections that were below the MDH HRL of 1 µg/L and the other four having detections above the MDH HRL. One of the wells that was reported as exceeding the MDH HRL for 1,4-dioxane in FY 2016, well 234421, exceeded the MDH HRL again in FY 2020.

Information contained in Tables E-2 through E-5 has been updated in the well inventory database (Filename “Well Inventory Main Database FY 2020”, an Excel file included on this CD).

5.0 RECOMMENDATIONS

At this time, it is recommended for the Army to offer alternate water supply and well abandonment for well 234421, due to exceedances of the MDH HRL for 1,4-dioxane.

It is also recommended for the Army to offer well abandonment for wells 234338 and UNK0553071, due to their current status as a category 1d well (drinking water well not in operation).

With several exceedances of 1,4-dioxane detected in well inventory wells above the MDH HRL, it is recommended that the Army attempt to sample all 14 of the accessible Well Inventory wells in FY 2021. This sampling event will be in concurrence with the alternate water supply plan and will also be used as a form of data verification.

Wells to be sampled in FY 2021 after being newly disclosed and added to the well inventory, categorized in category 2a, are:

- UNK0573104.

The next “major” sampling event will be in FY 2024. Wells to be sampled in FY 2024 are:

- All wells in Categories 1a, 1b, 1c, 2a, 2b, 2c, and 4a,
- Any Category 4b wells that are determined, from further investigation, to be in Category 1a, 1b, 1c, 2a, 2b, 2c, or 4a.

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WELL INVENTORY DATABASE

The Well Inventory Database is located on this CD in the following Microsoft Excel file:

Well Inventory Main Database FY 2020.xls

Table E-1
Well Inventory Category Descriptions
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Arden Hills, Minnesota

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Category	Subcategory	Explanation
1		Water supply wells screened in an aquifer of concern, inside the area of concern. Wells are divided into the following subcategories:
	1a	Drinking water well
	1b	Nondrinking but possible contact water
	1c	Nondrinking, noncontact water
	1d	Well is inoperable or has not been used for several years
	1e	Well for which the owner has refused (or has been unresponsive to) an Army offer for abandonment, or for which the water use has been deemed acceptable
2		Water supply wells in an area of concern or inside the buffer lines but outside the area of concern, screened in an aquifer of concern. Wells are divided into the following subcategories:
	2a	Drinking water well
	2b	Nondrinking but possible contact water
	2c	Nondrinking, noncontact water
	2d	Well is inoperable or has not been used for several years
3		Water supply wells within the Study Area that are either outside the area of concern, or are within the area of concern but are not screened in an aquifer of concern.
4		Water supply wells with missing information, divided into the following subcategories:
	4a	Unknown depth or aquifer, but located in the area of concern.
	4b	Unknown location, but potentially located within the Study Area. Wells with both an unknown depth and an unknown location are included in 4b.
5		Wells that are in the study area, but that have been field checked and not located. No further action is recommended for these wells.
6		Nonsupply wells (primarily monitoring wells).
7		Sealed or abandoned wells. Wells are divided into the following subcategories:
	7a	Documented as sealed/abandoned
	7b	Undocumented as sealed, or improperly abandoned

Table E-2
OU1 Groundwater Quality Data - Well Inventory
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Twin Cities Army Ammunitions Plant
Arden Hills, Minnesota

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Sample Location		Date	COCs				Other Analytes [a]				
			TCE	1,1,1-TCA	1,4-Dioxane	cis-1,2-DCE	1,1-Dichloroethane	1,1-Dichloroethene	Acetone	PCE	Toluene
Well I.D.	Common Name		ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
OU1 Cleanup Level [b]			5	200	---	70	70	6	---	---	---
MDH HRL [c]			---	---	1	---	---	---	4000	5	200
200076	Old Dutch Foods, Inc	07/09/20	< 1.00 U	< 1.00 U	**0.211 JB**	< 1.00 U	< 1.00 U	< 1.00 U	< 50.0 U	< 1.00 U	< 1.00 U
200176	Waldorf Paper Products	07/20/20	< 1.00 U	< 1.00 U	< 0.408 U	**0.192 J**	< 1.00 U	< 1.00 U	< 50.0 U	< 1.00 U	< 1.00 U
200180	Town & Country Golf Course	07/07/20	< 1.00 U	< 1.00 U	< 0.952 U	**1.84**	< 1.00 U	< 1.00 U	< 50.0 U	< 1.00 U	< 1.00 U
200522	Windsor Green	07/08/20	< 1.00 U	< 1.00 U	**0.179 JB**	< 1.00 U	< 1.00 U	< 1.00 U	< 50.0 U	< 1.00 U	< 1.00 U
200523	Windsor Green	07/08/20	< 1.00 U	< 1.00 U	**0.169 JB**	< 1.00 U	< 1.00 U	< 1.00 U	< 50.0 U	< 1.00 U	< 1.00 U
234421	BioClean (BioChem)	07/09/20	< 1.00 U	< 1.00 U	**15.5**	< 1.00 U	< 1.00 U	< 1.00 U	< 50.0 U	< 1.00 U	< 1.00 U
234421	BioClean (BioChem) (DUP)	07/09/20	< 1.00 U	< 1.00 U	**15.9**	< 1.00 U	< 1.00 U	< 1.00 U	< 50.0 U	< 1.00 U	< 1.00 U
234544	R&D Systems	07/10/20	**6.54**	< 1.00 U	**1.42 B**	**0.956 J**	**0.589 J**	**0.350 J**	< 50.0 U	**1.27**	< 1.00 U
236439	Waldorf Paper Products	07/20/20	< 1.00 U	< 1.00 U	**0.162 J**	**0.889 J**	< 1.00 U	< 1.00 U	< 50.0 U	< 1.00 U	< 1.00 U
249007	Walton, Toni	07/08/20	< 1.00 U	< 1.00 U	**0.265 JB**	< 1.00 U	< 1.00 U	< 1.00 U	< 50.0 U	< 1.00 U	< 1.00 U
249632	Montzka, Harold	07/07/20	< 1.00 U	< 1.00 U	< 0.952 U	< 1.00 U	< 1.00 U	< 1.00 U	< 50.0 U	< 1.00 U	< 1.00 U
S00002	Midland Hills Country Club	07/08/20	**0.988 J**	< 1.00 U	**0.476 B**	**1.67**	**0.264 J**	< 1.00 U	< 50.0 U	< 1.00 U	< 1.00 U
509052	Shriners Hospital	07/06/20	< 1.00 U	< 1.00 U	**2.22**	**0.223 J**	**0.146 J**	< 1.00 U	< 50.0 U	< 1.00 U	< 1.00 U
537801	Midway Industrial (DUP)	07/08/20	< 1.00 U	< 1.00 U	**15.5**	< 1.00 U	< 1.00 U	< 1.00 U	**15.8 J**	< 1.00 U	**2.65**
537801	Midway Industrial	07/08/20	< 1.00 U	< 1.00 U	**16.6**	< 1.00 U	< 1.00 U	< 1.00 U	**19.0 J**	< 1.00 U	**1.99**

Footnotes:

a. Only analytes that have at least one detected concentration above the laboratory reporting limit are shown. Other VOCs not shown are non-detect.

b. The cleanup level for OU1 Groundwater is from page 18 of OU1 Record of Decision. Gray shading indicates exceedance of the cleanup level.

c. No OU1 cleanup level has been established. For reference, the Minnesota Department of Health (MDH) Health Risk Limit (HRL) is provided.
Gray shading indicates exceedance of the HRL.

Bold = Detection above the reporting limit

Acronyms and Abbreviations:

--- = no relevant cleanup level or HRL for this compound.
< X.X U = analyte was not detected above the Reporting Limit (RL)
B = The same analyte is found in the associated blank.
COC = Contaminant of concern
DCE = Dichloroethene
DUP = duplicate
J = reported value is between the Method Detection Limit and the RL
OU = Operable Unit
µg/L = micrograms per liter

Table E-3
Constructed Wells
FY 2020 Annual Report
Twin Cities Army Ammunitions Plant
Arden Hills, Minnesota

PIKA ARCADIS
a joint venture

Unique Number	Category	Last Name or Business Name	Street	City	Use	Depth	Date Drilled	Well in Database?
844696	6	US Army	4761 Hamline Avenue N	Arden Hills	Environmental Well	145	10/25/2019	Y
844697	6	US Army	4761 Hamline Avenue	Arden Hills	Environmental Well	145	10/23/2019	Y
844698	6	US Army	4761 Hamline Avenue	Arden Hills	Environmental Well	145	10/30/2019	Y
839630	6	MPCA	Fourth Street E	Minneapolis	Environmental Well	50	12/3/2019	Y
834629	6	MN PCA Closed Landfill Program	2200 Old Highway 8 Nw	New Brighton	Environmental Well	40	5/6/2020	Y
834630	6	MN PCA Closed Landfill Program	2200 Old Highway 8 Nw	New Brighton	Environmental Well	34	5/5/2020	Y
834631	6	MN PCA Closed Landfill Program	2200 Old Highway 8 Nw	New Brighton	Environmental Well	28	5/4/2020	Y
847062	3	Oshaughnessy Distillery	600 Malcom Avenue Se	Minneapolis	Commercial	467	6/12/2020	Y
847674	6	US Army Environmental Command	4761 Hamline Avenue N	Arden Hills	Environmental Well	145	8/5/2020	Y
847675	6	US Army Environmental Command	4761 Hamline Avenue N	Arden Hills	Environmental Well	145	8/7/2020	Y
847676	6	US Army Environmental Command	4761 Hamline Avenue N	Arden Hills	Environmental Well	145	8/12/2020	Y
850448	6	Shaw Stewart Lumber Co.	645 Johnson Street Ne	Minneapolis	Environmental Well	56	9/24/2020	Y
850446	6	Shaw Stewart Lumber Co.	645 Johnson Street Ne	Minneapolis	Environmental Well	56	9/23/2020	Y

Table E-4
Wells Disclosed through Property Transfer
FY 2020 Annual Report
Twin Cities Army Ammunitions Plant
Arden Hills, Minnesota

PIKA ARCADIS
a joint venture

Unique Number	Category	Last Name or Business Name	Street	City	Status	Date Completed	Depth	Date Drilled
UNK0573104	2a	Murlowski	1589 26Th Avenue NW	New Brighton	Not In Use	10/10/2019	NA	NA
UNK0575619	3	Malong	1474 Floral Drive W	Arden Hills	In Use	1/3/2020	NA	NA
UNK0575955	3	Lee Homes Corp.	1991 Eldridge Avenue W	Roseville	In Use	1/14/2020	NA	NA
UNK0577331	3	Witt	1900 Tatum Street	Falcon Heights	Not In Use	2/27/2020	NA	NA
UNK0579084	3	B9 Polar Arden Hills, LLC	4440 W Round Lake Road	Arden Hills	In Use	4/10/2020	NA	NA
UNK0579339	3	Larson	3199 Lake Johanna Boulevard	Arden Hills	In Use	4/20/2020	NA	NA
UNK0580656	3	Cochran	5636 Aldine Street	Shoreview	Not In Use	5/29/2020	NA	NA
UNK0573372	4a	Mandyck	2525 Pahl Avenue	St. Anthony	Not In Use	10/17/2019	NA	NA
UNK0582519	4a	Target Corporation	2600 Winter Street NE	Minneapolis	In Use	7/28/2020	NA	NA
UNK0582520	4a	Target Corporation	2600 Winter Street NE	Minneapolis	In Use	7/28/2020	NA	NA
UNK0582522	4a	Target Corporation	2600 Winter Street NE	Minneapolis	In Use	7/28/2020	NA	NA
UNK0582523	4a	Target Corporation	2600 Winter Street NE	Minneapolis	In Use	7/28/2020	NA	NA
UNK0582524	4a	Target Corporation	2600 Winter Street NE	Minneapolis	In Use	7/28/2020	NA	NA
UNK0582521	4b	Target Corporation	NA	NA	In Use	7/28/2020	NA	NA
H000052046	7b	Reeder	1995 Fairview Avenue N	Roseville	Sealed	5/5/2020	NA	NA
H000070164	7b	Stukel	1963 Eustis Street	Lauderdale	Sealed	6/11/2020	NA	NA
H000167013	7b	Larson	3199 Lake Johanna Boulevard	Arden Hills	Sealed	4/20/2020	NA	NA
H000313333	7b	Schwanki	1508 Gardena Avenue NE	Fridley	Sealed	4/8/2020	NA	NA
H000318924	7b	Calvin E. Wall Trst	5425 Quincy Street	Mounds View	Sealed	3/30/2020	NA	NA
H000330640	7b	Long	2564 Herschel Avenue	Roseville	Sealed	4/3/2020	NA	NA
H000330659	7b	Medina	4309 Main Street NE	Columbia Heights	Sealed	3/12/2020	NA	NA
H000333030	7b	Orellana	5041 Washington Street NE	Columbia Heights	Sealed	3/3/2020	NA	NA
H000333412	7b	Koppy	1789 Hillview Road	Shoreview	Sealed	4/20/2020	NA	NA
H000335003	7b	Randall	1210 Mississippi Street NE	Fridley	Sealed	4/17/2020	NA	NA
H000335344	7b	Johnston	2501 County Road C2 W	Roseville	Sealed	3/30/2020	NA	NA
H000335345	7b	Johnston	2501 County Road C2 W	Roseville	Sealed	3/30/2020	NA	NA
H000335410	7b	Anthony M. Fox Frth	3163 Lake Johanna Boulevard	Arden Hills	Sealed	4/20/2020	NA	NA
H000338135	7b	Biermaier	5053 Greenwood Drive	Mounds View	Sealed	7/10/2020	NA	NA
H000339885	7b	Lujan	4336 Quincy Street NE	Columbia Heights	Sealed	6/27/2020	NA	NA
H000355387	7b	Palma	3655 Hamline Avenue N	Arden Hills	Sealed	5/15/2020	NA	NA
UNK0573562	7b	Elvehjem	2201 Eustis Street	Roseville	Sealed	10/24/2019	NA	NA
UNK0574245	7b	Costco Wholesale Corp.	3311 Broadway Street NE	Minneapolis	Sealed	11/14/2019	NA	NA
UNK0574246	7b	Costco Wholesale Corp.	3312 Broadway Street NE	Minneapolis	Sealed	11/14/2019	NA	NA
UNK0574247	7b	Costco Wholesale Corp.	3313 Broadway Street NE	Minneapolis	Sealed	11/14/2019	NA	NA
UNK0576528	7b	Yang	553 66Th Avenue NE	Fridley	Sealed	2/4/2020	NA	NA
UNK0577704	7b	Ctw Group, Inc.	236 Cleveland Avenue Sw	New Brighton	Sealed	3/3/2020	NA	NA
UNK0581636	7b	Sheahan	2233 St. Croix Street	Roseville	Sealed	6/30/2020	NA	NA

Table E-4
Wells Disclosed through Property Transfer
FY 2020 Annual Report
Twin Cities Army Ammunitions Plant
Arden Hills, Minnesota

PIKA ARCADIS
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Unique Number	Category	Last Name or Business Name	Street	City	Status	Date Completed	Depth	Date Drilled
UNK0582525	7b	Target Corporation	2600 Winter Street NE	Minneapolis	Sealed	7/28/2020	NA	NA
UNK0582526	7b	Target Corporation	2601 Winter Street NE	Minneapolis	Sealed	7/28/2020	NA	NA
UNK0582527	7b	Target Corporation	2602 Winter Street NE	Minneapolis	Sealed	7/28/2020	NA	NA
UNK0582528	7b	Target Corporation	2603 Winter Street NE	Minneapolis	Sealed	7/28/2020	NA	NA
UNK0582529	7b	Target Corporation	2604 Winter Street NE	Minneapolis	Sealed	7/28/2020	NA	NA
UNK0582530	7b	Target Corporation	2605 Winter Street NE	Minneapolis	Sealed	7/28/2020	NA	NA
UNK0582531	7b	Target Corporation	2606 Winter Street NE	Minneapolis	Sealed	7/28/2020	NA	NA
UNK0582532	7b	Target Corporation	2607 Winter Street NE	Minneapolis	Sealed	7/28/2020	NA	NA
UNK0582533	7b	Target Corporation	2608 Winter Street NE	Minneapolis	Sealed	7/28/2020	NA	NA
UNK0583717	7b	Dockry	1865 Larpendeur Avenue W	Falcon Heights	Sealed	9/1/2020	NA	NA

Table E-5
Sealed Wells
FY 2020 Annual Report
Twin Cities Army Ammunitions Plant
Arden Hills, Minnesota

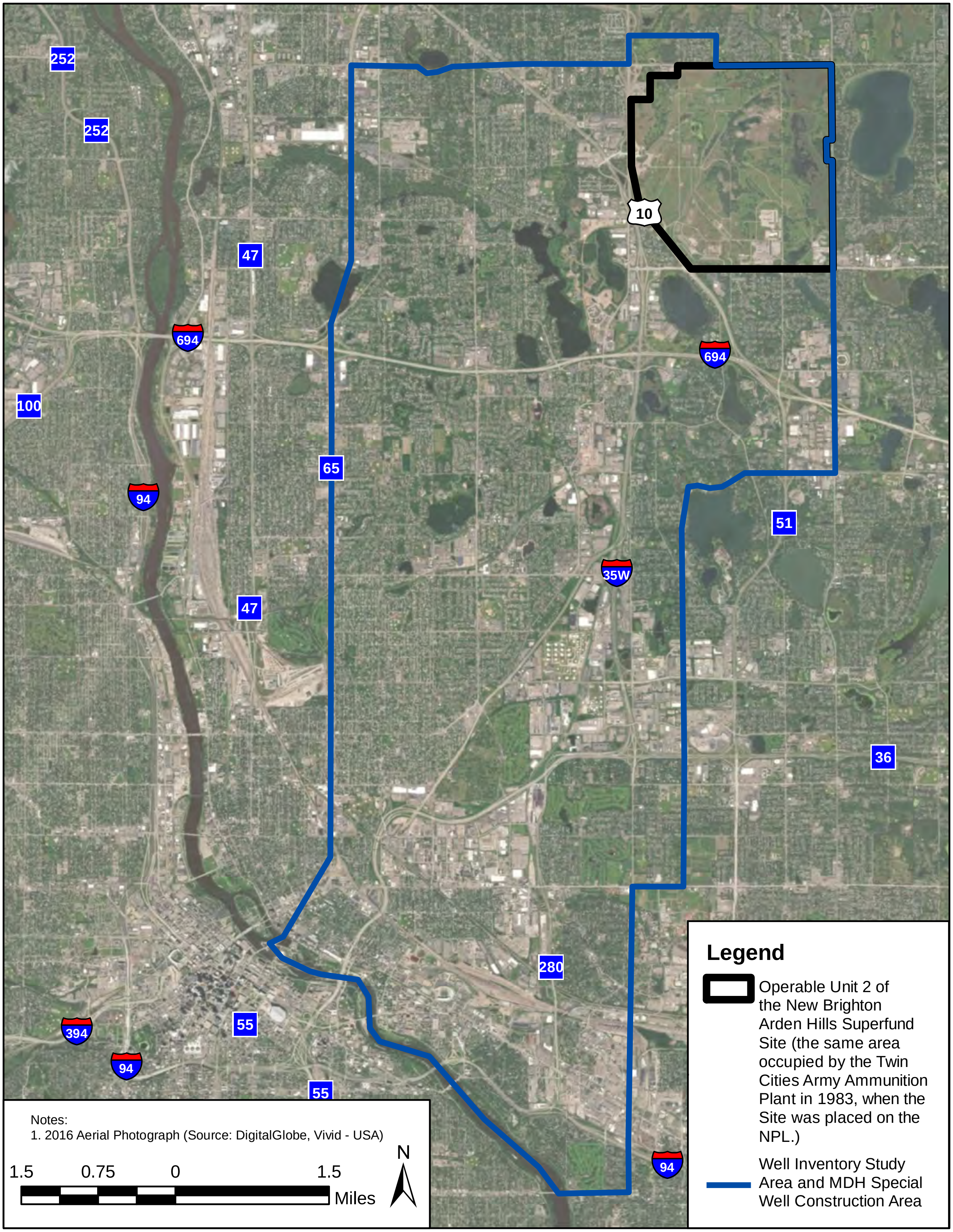
PIKA ARCADIS a joint venture

Unique Number	Category	Last Name or Business Name	Street	City	Use	Date Sealed
200066	7a	Thompson	2814 Cleveland Avenue N	Roseville	Water Supply	10/8/2019
200078	7a	Manns	2233 St. Croix Street	Roseville	Water Supply	3/18/2020
208319	7a	Revision	550 N Vandalia Avenue	St. Paul	Water Supply	8/25/2020
236505	7a	Us Army Environmental Command	4761 Hamline Avenue N	Arden Hills	WMEW	8/12/2020
483710	7a	Minneapolis, City Of	Malcolm Avenue Se	Minneapolis	WMEW	4/7/2020
778188	7a	Mn Chemical	2285 W Hampden Avenue	St. Paul	WMEW	8/6/2020
833725	7a	Odm Smith	36½ Avenue Ne	Minneapolis	WMEW	7/1/2020
833726	7a	Odm Smith	NA	Minneapolis	WMEW	7/1/2020
833727	7a	Odm Smith	NA	Minneapolis	WMEW	7/1/2020
844695	7a	Us Army	4761 Hamline Avenue N	Arden Hills	WMEW	10/30/2019
844696	7a	Us Army	4761 Hamline Avenue N	Arden Hills	WMEW	10/30/2019
844697	7a	Us Army	4761 Hamline Avenue	Arden Hills	WMEW	10/30/2019
844698	7a	Us Army	4761 Hamline Avenue	Arden Hills	WMEW	10/30/2019
847674	7a	Us Army Environmental Command	4761 Hamline Avenue N	Arden Hills	WMEW	8/5/2020
847675	7a	Us Army Environmental Command	4761 Hamline Avenue N	Arden Hills	WMEW	8/7/2020
847676	7a	Us Army Environmental Command	4761 Hamline Avenue N	Arden Hills	WMEW	8/12/2020
1000025187	7a	Roseville Investment Partners, Llc	1743 County Road C W	Roseville	Water Supply	7/24/2020
H000356088	7a	Bethel University	3900 Bethel Drive	St. Paul	Other	12/12/2019
H000359912	7a	Bethel University	3900 Bethel Drive	Arden Hills	WMEW	12/19/2019
H000362778	7a	Hrbek	2508 27Th Avenue Ne	St. Anthony	Water Supply	7/6/2020
H000363032	7a	Wenck Associates, Inc.	6522 University Avenue Ne	Fridley	WMEW	5/29/2020
H000363280	7a	Columbia Heights, City Of	NA	Columbia Heights	WMEW	12/27/2019
H000363281	7a	Wildeman Inquiry, Inc.	808 14Th Avenue Se	Minneapolis	WMEW	1/23/2020
H000364091	7a	Mn Dot	NA	NA	WMEW	3/17/2020
H000366778	7a	Albing	2020 County Road B W	Roseville	Water Supply	10/29/2019
H000366792	7a	Hemming	2559 Herschel Avenue	Roseville	Water Supply	2/24/2020
H000366793	7a	Hemming	2559 Herschel Avenue	Roseville	Water Supply	2/24/2020
H000367360	7a	Mn Pca	2200 Old Highway 8	New Brighton	WMEW	3/9/2020
H000367970	7a	Northern Technologies, Llc	6341 University Avenue Ne	Fridley	WMEW	10/1/2019
H000367977	7a	North Bay	1121 Fourth Street Se	Minneapolis	WMEW	1/30/2020
H000368364	7a	Turner	6860 Siverts Lane Ne	Fridley	Water Supply	10/18/2019
H000368386	7a	Gatts	1865 Larpenteur Avenue W	Falcon Heights	Water Supply	6/4/2020
H000368812	7a	Roberts Management	1878 Gateway Boulevard	Arden Hills	WMEW	3/19/2020

Table E-5
Sealed Wells
FY 2020 Annual Report
Twin Cities Army Ammunitions Plant
Arden Hills, Minnesota

PIKA ARCADIS a joint venture

Unique Number	Category	Last Name or Business Name	Street	City	Use	Date Sealed
H000368869	7a	Senior Housing Partners	1910 County Road D W	Roseville	WMEW	11/20/2019
H000368871	7a	Reuter Walton Development	2720 Fairview Avenue N	Roseville	WMEW	1/14/2020
H000368875	7a	Ramsey County	Lexington Avenue	Arden Hills	WMEW	11/13/2019
H000368924	7a	Paces Lodging Corp.	2525 Mounds View Boulevard	Mounds View	WMEW	10/3/2019
H000369279	7a	Fbs Properties Management	2383 University Avenue W	St. Paul	WMEW	10/2/2019
H000369353	7a	Minneapolis, City Of, Public Works Dept.	NA	Minneapolis	WMEW	10/23/2019
H000369388	7a	Minneapolis, City Of	NA	Minneapolis	WMEW	11/13/2019
H000369389	7a	Minneapolis, City Of	NA	Minneapolis	WMEW	11/16/2019
H000369395	7a	Isd 621, Mounds View School District	5100 Edgewood Drive	Mounds View	WMEW	11/14/2019
H000369418	7a	Fbs Properties Management	2383 University Avenue	St. Paul	WMEW	12/3/2019
H000369424	7a	U Of M	51 E River Parkway	Minneapolis	WMEW	11/23/2019
H000369907	7a	Wellington Management	2505 Franklin Avenue	St. Paul	WMEW	4/8/2020
H000369908	7a	Wellington Management	792 Curfew Street	St. Paul	WMEW	4/8/2020
H000370595	7a	Oakcrest 1985 Llc	1985 Oakcrest Avenue	Roseville	WMEW	10/22/2019
H000370968	7a	Black And Veatch	1803 Parkview Drive	Shoreview	WMEW	6/24/2020
H000371486	7a	Lowen	2258 St. Croix Street	Roseville	Water Supply	4/30/2020
H000371530	7a	Patrick Miller Construction	1340 Hillcrest Drive Ne	Fridley	Water Supply	10/1/2019
H000371600	7a	Wall Development	501 30Th Avenue Se	Minneapolis	Other	1/27/2020
H000372082	7a	Mn Chemical Co.	2285 Hampden Avenue N	St. Paul	WMEW	10/29/2019
H000372083	7a	Mn Chemical Co.	Hampden Avenue	St. Paul	WMEW	10/29/2019
H000372304	7a	Cortrust Bank	2340 Capp Road	St. Paul	WMEW	10/24/2019
H000372319	7a	Streams Edge Properties, Llc	2560 Long Lake Road	Roseville	WMEW	11/6/2019
H000372447	7a	Arnoldy	5925 Sixth Street Ne	Fridley	Water Supply	8/10/2020
H000372504	7a	Go Gopher Rentals	2624 Essex Street Sw	Minneapolis	WMEW	10/2/2019
H000372604	7a	Gammell	5080 Longview Drive	Mounds View	Water Supply	12/10/2019
H000372671	7a	Helin	1831 Eustis Street	Lauderdale	Water Supply	12/3/2019
H000372673	7a	Mumbleau	5107 Fourth Street Ne	Columbia Heights	Water Supply	12/3/2019
H000372713	7a	Anderson	1748 Lake Valentine Road	Arden Hills	Water Supply	12/20/2019
H000372850	7a	Scott	1983 Sharondale Avenue	Roseville	Water Supply	7/20/2020
H000372909	7a	Independent Refuse System	2401 Main Street Ne	Minneapolis	WMEW	12/12/2019
H000372910	7a	Independent Refuse System	2401 Main Street Ne	Minneapolis	WMEW	12/12/2019
H000372911	7a	Independent Refuse System	2401 Main Street Ne	Minneapolis	WMEW	12/12/2019
H000372916	7a	Clockwork	1501 E Hennepin Avenue	Minneapolis	WMEW	1/16/2020
H000372920	7a	Clockwork	1153 16Th Avenue Sw	Minneapolis	WMEW	1/16/2020



ANNUAL PERFORMANCE REPORT

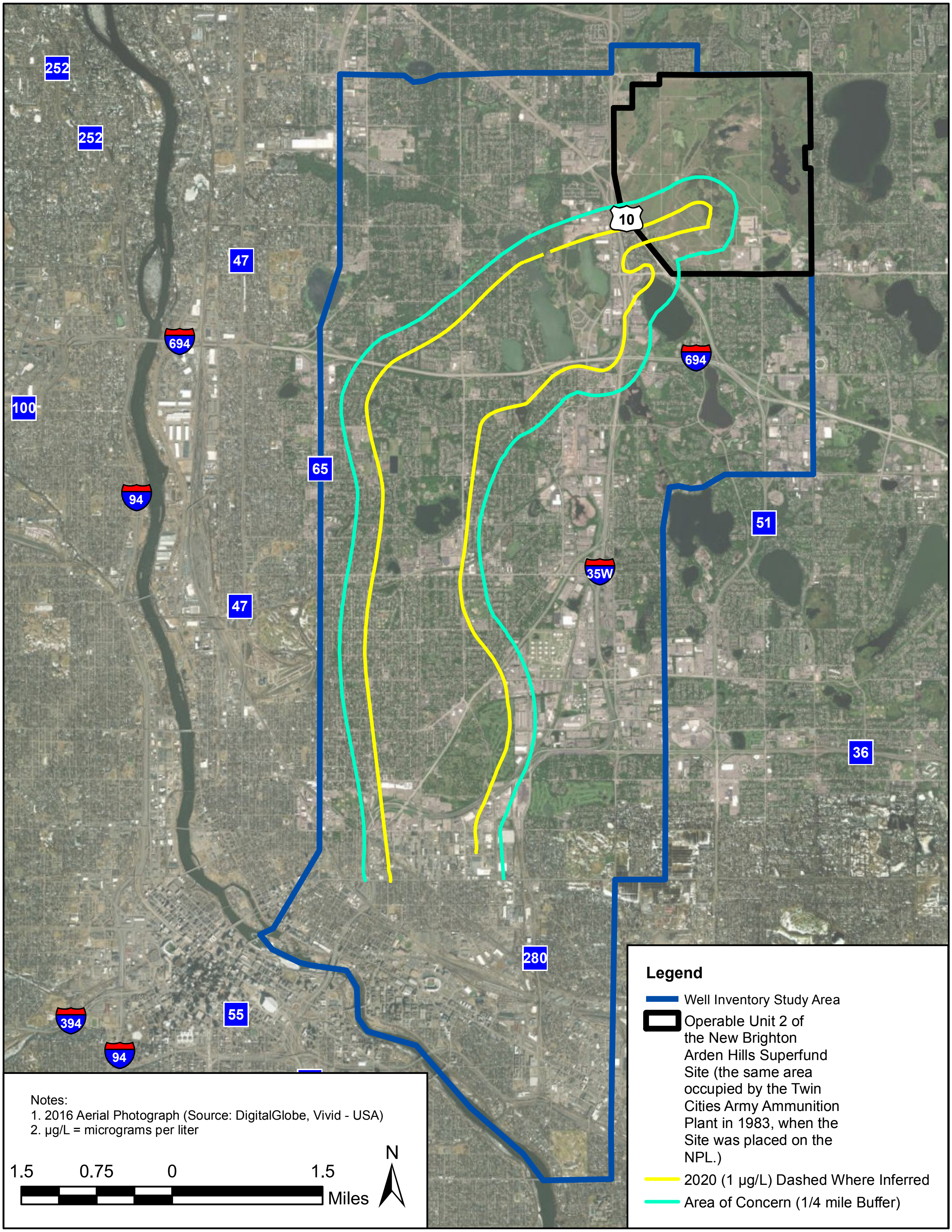
Well Inventory Study Area

PIKA ARCADIS a joint venture

FY 2020

Figure E-1

Path: Z:\GISProjects_ENV\TCAAP_Arden_Hills_MN\MXD\2019-01\Figure_E-1_Well Inventory Study Area_FY2018.mxd
Date: 1/30/2019 Time: 9:54:37 AM User: kgpeters



ANNUAL PERFORMANCE REPORT

Areas of Concern (Upper Unit 4)

PIKA ARCADIS a joint venture

FY 2020

Figure E-2

Path: F:\TCAAP\RegEdits\2020_12\Figure_E-2_Areas of Concern (Unit 3 and Unit 4)_FY2020.mxd
Date: 1/28/2021 Time: 4:09:59 PM User: KGPeters

ANNUAL PERFORMANCE REPORT

Area of Concern (Unit 1)

PIKA ARCADIS a joint venture

FY 2020

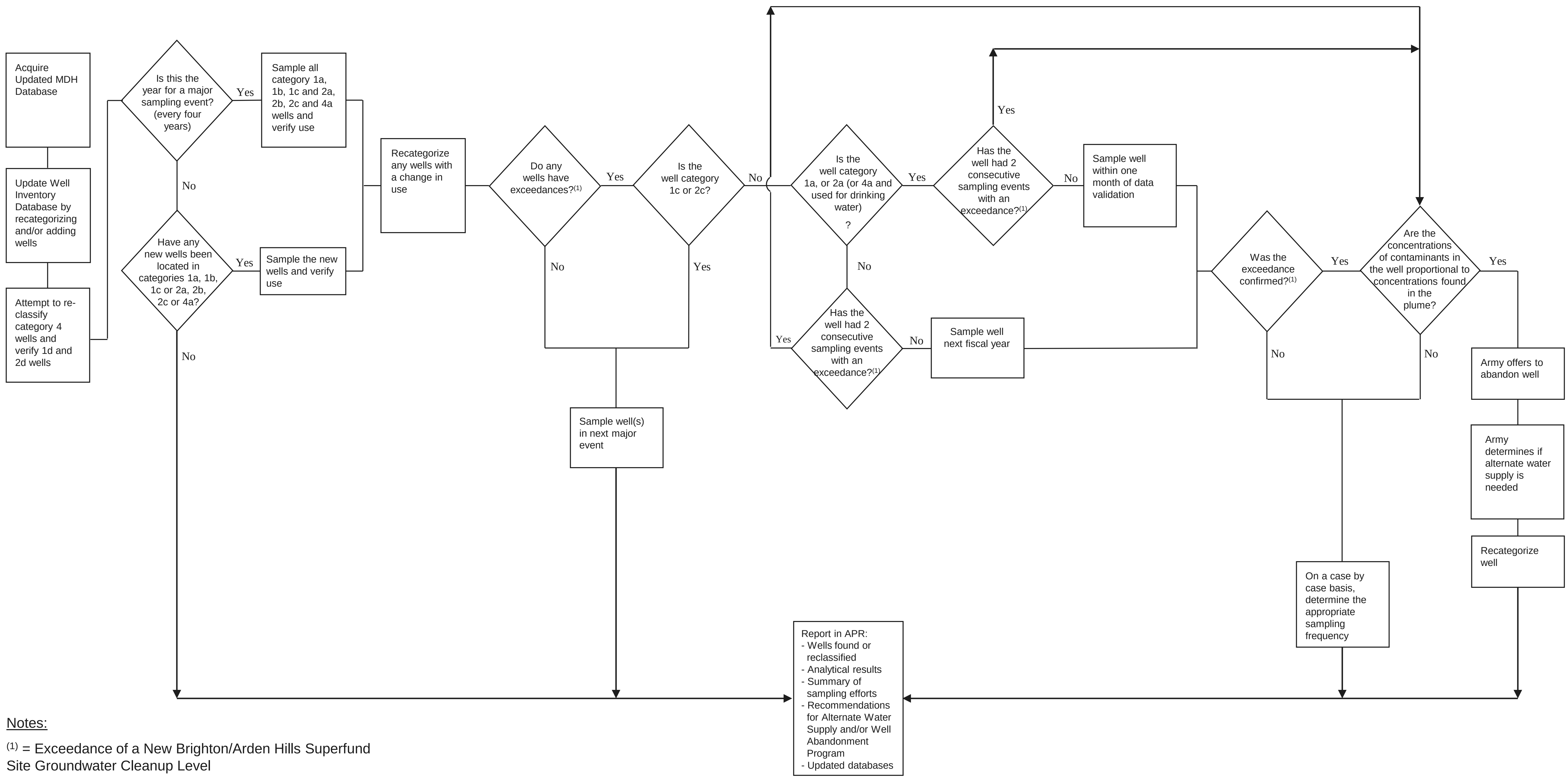
Figure E-3

Path: F:\TCAAP\RegEdits\2020_12\Figure_E-3_Areas of Concern (Unit 1)_FY2020.mxd
Date: 1/22/2021 Time: 3:41:54 PM User: KGPeters

Figure E-4
Annual Requirements for Maintaining Well Inventory Database

Twin Cities Army Ammunitions Plant
Arden Hills, Minnesota

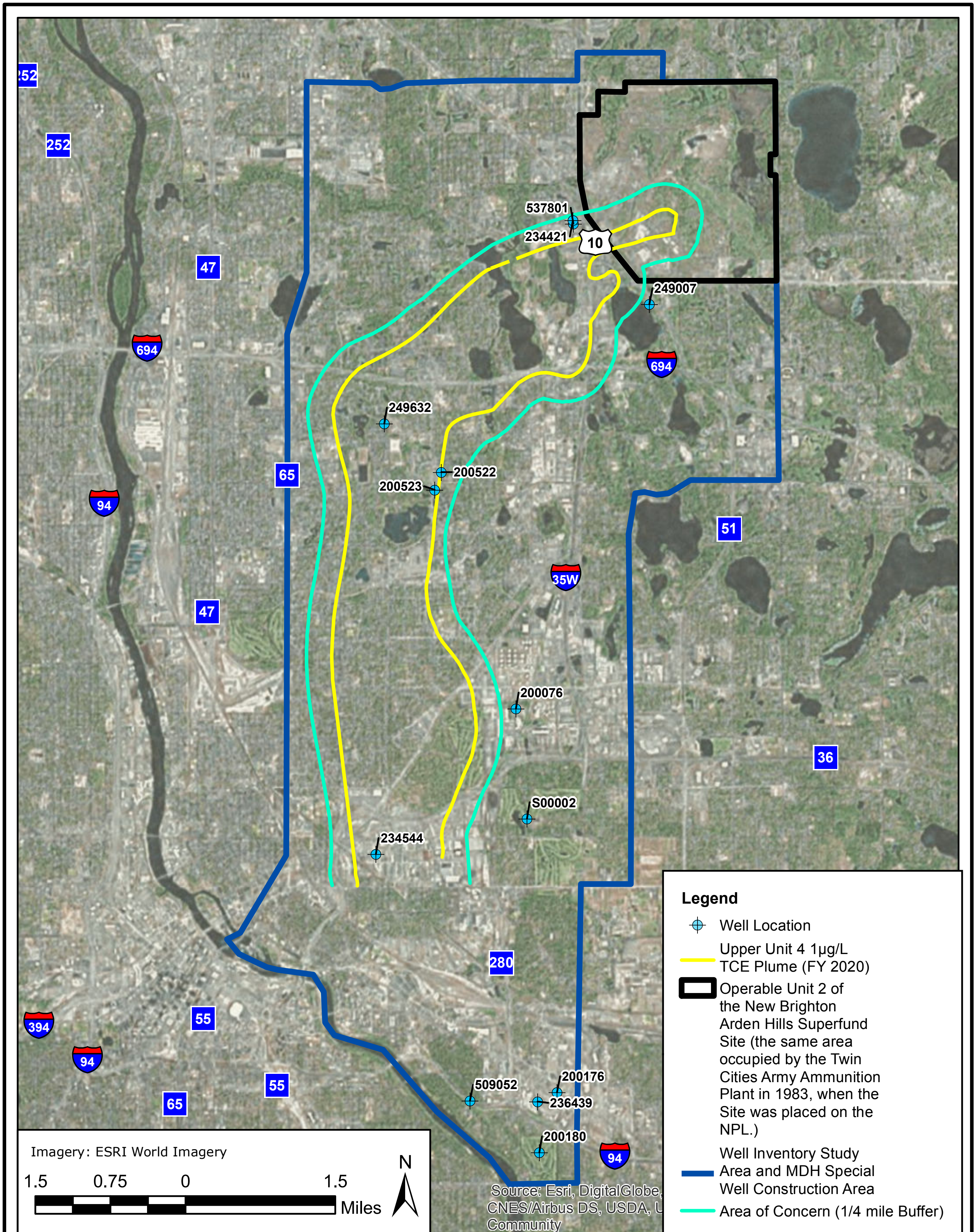
PIKA ARCADIS a joint venture



Notes:

(1) = Exceedance of a New Brighton/Arden Hills Superfund Site Groundwater Cleanup Level

Figure generated by Wenck Associates, Inc.



ANNUAL PERFORMANCE REPORT

FY 2020 Well Inventory Sampling Locations

PIKA ARCADIS a joint venture

FY 2020

Figure E-5

Path: F:\TCAAP\RegEdits\2020_12\Figure_E-5_Well Inventory Sampling Locations_FY2020.mxd
Date: 1/29/2021 Time: 8:14:32 AM User: KGPeters

E.1 MDH Industrial Well Disclosure

March 12, 2020

Mr. Patrick O'Shaughnessy
O'Shaughnessy Distillery
510 First Avenue North, Suite 200
Minneapolis, Minnesota 55403

Mr. David Traut
Mark J. Traut Wells, Inc. (License #1404)
P.O. Box 547
Waite Park, Minnesota 56387

Dear Mr. O'Shaughnessy and Mr. Traut:

Subject: Request to Construct an Industrial Water-Supply Well for O'Shaughnessy Distillery, Minnesota Unique Well Number 847062, at 600 Malcolm Avenue Southeast, Minneapolis, Hennepin County, Minnesota

The Minnesota Department of Health (MDH) has received your letter requesting permission to construct a new industrial water-supply well identified as Minnesota Unique Well Number 847062, for O'Shaughnessy Distillery at 600 Malcolm Avenue Southeast, Minneapolis, Minnesota. You propose to complete the well in the Jordan sandstone aquifer. The well will be located within the boundaries of the Twin Cities Army Ammunition Plant (TCAAP), Special Well and Boring Construction Area (SWBCA).

MDH first established the TCAAP SWBCA on July 1, 1996, after learning that groundwater in the area had become contaminated with volatile organic compounds (VOCs) from solvents used and disposed of at the TCAAP in Arden Hills, Minnesota. The contamination extends several miles to the south and west of TCAAP into Minneapolis and St. Paul, to depths of several hundred feet. Portions of the buried sand aquifer (Hillside Sand formation) and the Prairie du Chien dolomite and Jordan sandstone bedrock aquifers have been contaminated with VOCs, principally trichloroethene (TCE). TCE was most commonly used as a degreaser for washing metal parts and also as a dry cleaning solvent. Exposure to high levels of TCE in drinking water can damage the liver, kidneys, immune system, and the nervous system. Exposure to low levels of TCE over a long period of time may be linked to an increased risk of several types of cancer. TCE may also harm a developing fetus if an expecting mother consumes water that contains high levels of it.

MDH has reviewed your well construction plan which indicates that the well will be constructed with 16-inch and 10-inch diameter steel well casings and will be drilled with a dual rotary drilling rig. Please note that TCE or other VOCs may be encountered in the water now, or in the future.

MDH approves your construction plan to complete well 847062 in the Jordan sandstone aquifer with the following conditions:

1. Mark J. Traut Wells, Inc., must notify Mr. Patrick Sarafolean at the MDH (651-201-3962) at least 24 hours prior to starting well construction activities, so that arrangements to inspect, and if necessary, collect drill cuttings and/or gamma log the well, may be made.

2. The 16-inch diameter casing must be set no further than 10 feet into the first bedrock formation encountered. When advancing the 16-inch casing, a cone-shaped depression, filled with bentonite grout, bentonite powder, or granular bentonite, must be maintained around the outside of the casing at all times. The 15 ¼-inch diameter bore hole must be drilled at least 5 feet into the Jordan sandstone aquifer and the 10-inch diameter casing must be set at least 5 feet into the Jordan sandstone aquifer. The annular space surrounding the 10-inch casing must be filled with neat-cement grout in accordance with Minnesota Rules, chapter 4725. Any open hole drilled below the bottom of the 10-inch casing must be entirely within the Jordan sandstone aquifer.

3. Mark J. Traut Wells, Inc., must notify Mr. Sarafolean at 651-201-3962, at least 24 hours before grouting begins so that arrangements for inspection may be made.

4. When drilling and grouting are completed, the well must be test pumped using a submersible pump and drop-pipe which have been steam cleaned. At least three well volumes of water must be pumped from the well prior to water sample collection. In addition to the normal water testing requirements for coliform bacteria, nitrate-nitrogen and arsenic; water from the well must also be analyzed for VOCs by the MDH laboratory at the well owner's expense. Mr. Sarafolean will collect the VOC water sample and deliver it to the MDH laboratory for analysis. The well may not be placed into service until after the analytical results have been reviewed by MDH, and reported to you and your well contractor. If VOCs are detected at levels exceeding health risk limits or health based values, you may be required to take remedial action to use the well.

5. Any deviation from this plan must first be approved by the MDH in writing.

6. All other provisions of Minnesota Rules, chapter 4725, shall be in effect.

7. You must comply with all applicable ordinance, permit, and notification requirements of the city of Minneapolis delegated well program.

Please be advised that the water quality of the well cannot be guaranteed and that the water quality may change over time. The MDH recommends that the well be tested periodically for VOCs. Please visit our website at: *www.health.state.mn.us/communities/environment/water/wells/swbca* for the most up-to-date information about the TCAAP SWBCA.

If you have questions about the groundwater contamination investigation, please contact Ms. Amy Hadiaris with the MPCA at 651-757-2402. If you have questions about city of Minneapolis' regulations, please contact Mr. Tom Frame at 612-673-5807. If you have any questions about well construction or the SWBCA, you may call Mr. Sarafolean at 651-201-3962, or me at 651-201-3658.

Sincerely,

Jennifer Weier

Jennifer Weier, Supervisor
Metro Compliance and Inspection
Well Management Section
P.O. Box 64975
St. Paul, Minnesota 55164-0975

JW:PTS:mj
cc: Tom Frame, City of Minneapolis
Amy Hadiaris, Minnesota Pollution Control Agency

I have read the provisions regarding well construction and water testing requirements listed above and agree to abide by them. I understand that the water quality of the proposed well is not guaranteed and that I may have to take remedial action to be able to use the water; and, under the worst case scenario, I may be required to have the well permanently sealed by a licensed well contractor or limited well sealing contractor at my own expense if I fail to comply with the conditions set forth in this letter.

____________________ ____________________

Date Patrick O'Shaughnessy

Note: Applicant must sign and return a signed copy of this document to the MDH, Well Management Section, before construction of the well may begin.

DEPARTMENT OF HEALTH

PROTECTING, MAINTAINING & IMPROVING THE HEALTH OF ALL MINNESOTANS

September 15, 2020

Mr. Patrick O'Shaughnessy
510 First Avenue North, Suite 200
Minneapolis, Minnesota 55403

Dear Mr. O'Shaughnessy:

Subject: Volatile Organic Chemical (VOC) Water Sample Results for New Water-Supply Well, Minnesota Unique Well Number 847062, Located at 600 Malcolm Avenue Southeast, Minneapolis, Hennepin County, Minnesota

The results of analyses conducted on water samples collected from your new well, Minnesota Unique Well Number 847062, located at 600 Malcolm Avenue Southeast, Minneapolis, Minnesota, are enclosed for your review. The well is located within the boundaries of the Twin Cities Army Ammunition Plant Special Well and Boring Construction Area (SWBCA), where groundwater contamination is present. I collected the water samples on August 11, 2020. The water samples were analyzed for the presence of 68 volatile organic chemicals (VOCs) by the Minnesota Department of Health's (MDH's) Public Health Laboratory. No VOCs were detected in the water samples. A copy of the VOC analytical report is enclosed for your review. The MDH recommends that you continue to have the water tested for VOCs on a periodic basis.

If you have any questions about your VOC water test results or the SWBCA, you may call me at 651-335-7208, or Ms. Jennifer Weier at 651-201-3658. If you have any questions about the groundwater contamination in the area, you may contact Ms. Amy Hadiaris at the Minnesota Pollution Control Agency at 651-757-2703.

Sincerely,

Patrick Sarafolean Digitally signed by Patrick Sarafolean
Date: 2020.09.15 14:26:35 -05'00'

Patrick T. Sarafolean, Hydrologist
Well Management Section
P.O. Box 64975
St. Paul, Minnesota 55164-0975

PTS:mj
Enclosures
cc: Tom Frame, City of Minneapolis
Amy Hadiaris, Minnesota Pollution Control Agency (electronic copy)
Virginia Yingling, MDH
Jennifer Weier, MDH
Lowell Urban, Minnesota Department of Agriculture
Dylan Siem, Minnesota Department of Agriculture

Minnesota Department of Health
Public Health Laboratory
Environmental Laboratory Section
601 Robert St. N., P.O. Box 64899
St. Paul, MN 55164-0899
651-201-5300

Final Report
Analytical Results

MDH Sample Number Range: 20H0757-01 - 20H0757-02

Project: IP
Project Name: Env Health - Well Drillers
Well Owner: P. Sarafolean

Received: 08/11/20 14:03
Generated: 08/27/20 9:48

MDH Sample Number: 20H0757-01

Unique Well Number: 847062
Sampling Point: Well Head Faucet

Matrix: Drinking Water
Collect Date: 08/11/20
Collect Time: 13:00

Results were produced by the Minnesota Department of Health, except where noted.

Bold-faced type indicates a result that is at or above the report level.

VOCs by GCMS

Analyte	Result	Report Limit	Units	Analyzed	Method
1,1,1,2-Tetrachloroethane	<	0.20	ug/L	08/20/20 00:43	EPA 524.3
1,1,1-Trichloroethane	<	0.20	ug/L	08/20/20 00:43	EPA 524.3
1,1,2,2-Tetrachloroethane	<	0.20	ug/L	08/20/20 00:43	EPA 524.3
1,1,2-Trichloroethane	<	0.20	ug/L	08/20/20 00:43	EPA 524.3
1,1,2-Trichlorotrifluoroethane	<	0.20	ug/L	08/20/20 00:43	EPA 524.3
1,1-Dichloroethane	<	0.20	ug/L	08/20/20 00:43	EPA 524.3
1,1-Dichloroethene	<	0.50	ug/L	08/20/20 00:43	EPA 524.3
1,1-Dichloropropene	<	0.20	ug/L	08/20/20 00:43	EPA 524.3
1,2,3-Trichlorobenzene	<	1.0	ug/L	08/20/20 00:43	EPA 524.3
1,2,3-Trichloropropane	<	0.50	ug/L	08/20/20 00:43	EPA 524.3
1,2,4-Trichlorobenzene	<	0.50	ug/L	08/20/20 00:43	EPA 524.3
1,2,4-Trimethylbenzene	<	0.50	ug/L	08/20/20 00:43	EPA 524.3
1,2-Dibromo-3-chloropropane (DBCP)	<	2.0	ug/L	08/20/20 00:43	EPA 524.3
1,2-Dibromoethane (EDB)	<	0.50	ug/L	08/20/20 00:43	EPA 524.3
1,2-Dichlorobenzene	<	0.20	ug/L	08/20/20 00:43	EPA 524.3
1,2-Dichloroethane	<	0.20	ug/L	08/20/20 00:43	EPA 524.3
1,2-Dichloropropane	<	0.20	ug/L	08/20/20 00:43	EPA 524.3
1,3,5-Trimethylbenzene	<	0.50	ug/L	08/20/20 00:43	EPA 524.3
1,3-Dichlorobenzene	<	0.20	ug/L	08/20/20 00:43	EPA 524.3
1,3-Dichloropropane	<	0.20	ug/L	08/20/20 00:43	EPA 524.3
1,4-Dichlorobenzene	<	0.20	ug/L	08/20/20 00:43	EPA 524.3
2,2-Dichloropropane	<	0.50	ug/L	08/20/20 00:43	EPA 524.3
2-Chlorotoluene	<	0.50	ug/L	08/20/20 00:43	EPA 524.3
4-Chlorotoluene	<	0.50	ug/L	08/20/20 00:43	EPA 524.3
Acetone	<	20	ug/L	08/20/20 00:43	EPA 524.3
Allyl chloride	<	0.50	ug/L	08/20/20 00:43	EPA 524.3
Benzene	<	0.20	ug/L	08/20/20 00:43	EPA 524.3

Authorized by:

The results in this report apply only to the samples analyzed.
Disclaimer: This report is incomplete in that it does not display the qualifiers, comments, or quality control parameters. A complete report is available upon request.

Paul Moyer, Environmental Laboratory Manager
Public Health Laboratory, Minnesota Department of Health

Minnesota Department of Health
Public Health Laboratory
Environmental Laboratory Section
601 Robert St. N., P.O. Box 64899
St. Paul, MN 55164-0899
651-201-5300

Final Report
Analytical Results

MDH Sample Number Range: 20H0757-01 - 20H0757-02

Project: IP	Received: 08/11/20 14:03
Project Name: Env Health - Well Drillers	Generated: 08/27/20 9:48
Well Owner: P. Sarafolean	

MDH Sample Number: 20H0757-01

Unique Well Number: 847062
Sampling Point: Well Head Faucet

Matrix: Drinking Water
Collect Date: 08/11/20
Collect Time: 13:00

Results were produced by the Minnesota Department of Health, except where noted.

Bold-faced type indicates a result that is at or above the report level.

VOCs by GCMS - Continued

Analyte	Result	Report Limit	Units	Analyzed	Method
Bromobenzene	<	0.20	ug/L	08/20/20 00:43	EPA 524.3
Bromochloromethane	<	0.50	ug/L	08/20/20 00:43	EPA 524.3
Bromodichloromethane	<	0.20	ug/L	08/20/20 00:43	EPA 524.3
Bromoform	<	0.50	ug/L	08/20/20 00:43	EPA 524.3
Bromomethane	<	1.0	ug/L	08/20/20 00:43	EPA 524.3
Carbon tetrachloride	<	0.20	ug/L	08/20/20 00:43	EPA 524.3
Chlorobenzene	<	0.20	ug/L	08/20/20 00:43	EPA 524.3
Chlorodibromomethane	<	0.50	ug/L	08/20/20 00:43	EPA 524.3
Chloroethane	<	0.50	ug/L	08/20/20 00:43	EPA 524.3
Chloroform	<	0.10	ug/L	08/20/20 00:43	EPA 524.3
Chloromethane	<	1.0	ug/L	08/20/20 00:43	EPA 524.3
cis-1,2-Dichloroethene	<	0.20	ug/L	08/20/20 00:43	EPA 524.3
cis-1,3-Dichloropropene	<	0.20	ug/L	08/20/20 00:43	EPA 524.3
Dibromomethane	<	0.50	ug/L	08/20/20 00:43	EPA 524.3
Dichlorodifluoromethane	<	1.0	ug/L	08/20/20 00:43	EPA 524.3
Dichlorofluoromethane	<	0.50	ug/L	08/20/20 00:43	EPA 524.3
Ethyl ether	<	2.0	ug/L	08/20/20 00:43	EPA 524.3
Ethylbenzene	<	0.50	ug/L	08/20/20 00:43	EPA 524.3
Hexachlorobutadiene	<	1.0	ug/L	08/20/20 00:43	EPA 524.3
Isopropylbenzene	<	0.50	ug/L	08/20/20 00:43	EPA 524.3
Methyl ethyl ketone (MEK)	<	10	ug/L	08/20/20 00:43	EPA 524.3
Methyl isobutyl ketone (MIBK)	<	5.0	ug/L	08/20/20 00:43	EPA 524.3
Methyl tertiary butyl ether (MTBE)	<	2.0	ug/L	08/20/20 00:43	EPA 524.3
Methylene chloride	<	0.50	ug/L	08/20/20 00:43	EPA 524.3
Naphthalene	<	1.0	ug/L	08/20/20 00:43	EPA 524.3
n-Butylbenzene	<	0.50	ug/L	08/20/20 00:43	EPA 524.3
n-Propylbenzene	<	0.50	ug/L	08/20/20 00:43	EPA 524.3

Authorized by:

The results in this report apply only to the samples analyzed.
Disclaimer: This report is incomplete in that it does not display the qualifiers, comments, or quality control parameters.
A complete report is available upon request.

Paul Moyer, Environmental Laboratory Manager
Public Health Laboratory, Minnesota Department of Health

Minnesota Department of Health
Public Health Laboratory
Environmental Laboratory Section
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Final Report
Analytical Results

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Project:	IP	Received:	08/11/20 14:03
Project Name:	Env Health - Well Drillers	Generated:	08/27/20 9:48
Well Owner: P. Sarafolean			

MDH Sample Number: 20H0757-01

Unique Well Number: 847062

Sampling Point: Well Head Faucet

Matrix: Drinking Water

Collect Date: 08/11/20

Collect Time: 13:00

Results were produced by the Minnesota Department of Health, except where noted.

Bold-faced type indicates a result that is at or above the report level.

VOCs by GCMS - Continued

Analyte	Result	Report Limit	Units	Analyzed	Method
o-Xylene	<	0.20	ug/L	08/20/20 00:43	EPA 524.3
p and m-Xylene	<	0.30	ug/L	08/20/20 00:43	EPA 524.3
p-Isopropyltoluene	<	0.50	ug/L	08/20/20 00:43	EPA 524.3
sec-Butylbenzene	<	0.50	ug/L	08/20/20 00:43	EPA 524.3
Styrene	<	0.50	ug/L	08/20/20 00:43	EPA 524.3
tert-Butylbenzene	<	0.50	ug/L	08/20/20 00:43	EPA 524.3
Tetrachloroethene	<	0.20	ug/L	08/20/20 00:43	EPA 524.3
Tetrahydrofuran (THF)	<	10	ug/L	08/20/20 00:43	EPA 524.3
Toluene	<	0.20	ug/L	08/20/20 00:43	EPA 524.3
trans-1,2-Dichloroethene	<	0.10	ug/L	08/20/20 00:43	EPA 524.3
trans-1,3-Dichloropropene	<	0.20	ug/L	08/20/20 00:43	EPA 524.3
Trichloroethene (TCE)	<	0.10	ug/L	08/20/20 00:43	EPA 524.3
Trichlorofluoromethane	<	0.50	ug/L	08/20/20 00:43	EPA 524.3
Vinyl chloride	<	0.20	ug/L	08/20/20 00:43	EPA 524.3

Authorized by:

The results in this report apply only to the samples analyzed.
Disclaimer: This report is incomplete in that it does not display the qualifiers, comments, or quality control parameters.
A complete report is available upon request.

Paul Moyer

Paul Moyer, Environmental Laboratory Manager
Public Health Laboratory, Minnesota Department of Health

Appendix F

Annual Site Inspection Checklist for Land Use Controls

ANNUAL SITE INSPECTION CHECKLIST FOR LAND USE CONTROLS

Operable Unit 2, New Brighton/Arden Hills Superfund Site

Date: 8/11/2020

Inspected by: Mary Lee, Bryan Zinda, Katy Grant

Period Covered: From prior annual inspection (6/19/2019) to above date

	BLANKET LUCs				OTHER LUC AREAS	SITES WITH ADDITIONAL LUCs FOR SOIL COVERS						
					Area w/Restricted Commercial Use	C	D	E	G	H	129-15	Outdoor Firing Range
Property owner:	BRAC	N.G.	Reserve	R.C.	N.G.	BRAC	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.
Soil LUCs												
Are there any land uses that result in a non-compliant exposure versus the exposure assumptions described in the LUCRD?	No	No	No	No	No	(Soil LUCs are covered under the Blanket LUCs)						
Soil Cover LUCs												
Has there been any excavation activity or any other man-made soil disturbance at the site?	N/A	**Yes**	N/A	N/A	N/A	No	No	No	No	No	No	**Yes**
Are there any areas of the soil cover that have inadequate vegetative cover?	N/A	N/A	N/A	N/A	N/A	No	No	No	No	No	No	No
Has there been any damage to run-on/runoff controls (swales, berms, riprap, etc.)?	N/A	N/A	N/A	N/A	N/A	No	No	No	No	No	No	No
Has there been any damage to or removal of the signs marking the edge of the soil cover?	N/A	N/A	N/A	N/A	N/A	No	No	No	No	No	No	No
If the soil cover has a permeability requirement, is there any woody vegetation present that exceeds 2-inch diameter?	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	**Yes**	N/A	N/A	N/A
Has there been any damage to or removal of the concrete slab that serves as a protective cover?	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Groundwater LUCs												
Have any wells been installed that withdraw water from a contaminated aquifer, without MDH/MPCA/USEPA approval?	No	No	No	No	(Groundwater LUCs are covered under the Blanket LUCs)							
Has there been any damage to or interference with any groundwater remedy infrastructure (wells, piping, treatment systems, etc.)?	No	No	No	No								

Comments (Attach additional pages as necessary):

BRAC = Base Realignment and Closure Division   N.G. = MN Army National Guard/National Guard Bureau   Reserve = U.S. Army Reserve   R.C. = Ramsey County

N.G. Blanket LUCs - Excavation, there was excavation at the construction site, NEPA was completed. Construction completed in early August 2020.
Outdoor Firing Range LUC - Excavation, there was excavation as part of the construction of the division headquarters building. Construction completed in early August 2020.
Site G LUC - there were three (3) small trees, approximately 2 inches in diameter, around the south perimeter of the soil cap. The trees appeared to be just outside of the soil cap, but will be removed.
Site C Institutional Controls - north fence removed by Ramsey County

Certification:

Based on the annual site inspection, the undersigned hereby certifies that the above-named property owners and above-described land use controls have been complied with for the period noted. Alternatively, any known deficiencies and completed or planned actions to address such deficiencies are described in the attached Explanation of Deficiency(ies).

Hoa Voscott, Arcadis US Inc.

Description of Deficiency(ies) attached? x **Yes, above** ☐ No (none were identified)

Appendix G

Groundwater Monitoring Report – May 2020 Sampling Event

Rice Creek Remeander Project, Bay West, 2020

Bay West
Customer-Focused Environmental & Industrial Solutions

July 30, 2020

Amy Hadiaris
Minnesota Pollution Control Agency
520 Lafayette Road North
Saint Paul, Minnesota 55155
amy.hadiaris@pca.state.mn.us

Re: Groundwater Monitoring Report - April 2020 Sampling Event
Rice Creek Remeander Project
Twin Cities Army Ammunition Plant Redevelopment
MPCA Site ID: VP22892/PB4687
Bay West Project No. J130147

Dear Amy:

Bay West has prepared this letter report to present groundwater monitoring results in association with Ramsey County's Rice Creek remeander project at the Twin Cities Army Ammunition Plant (TCAAP – the Site). Groundwater sampling at the Site is being completed in accordance with the following documents:

- Bay West Technical Memorandum entitled "Proposed Groundwater Monitoring Plan; Building 102 Chlorinated VOC Plume", dated September 16, 2015, as approved by the MPCA in an email dated October 7, 2015; and
- The No Association Determination (NAD) issued by the Minnesota Pollution Control Agency (MPCA) for the Rice Creek remeander project dated December 30, 2015.

These documents outlined the proposed well locations and groundwater elevation monitoring and sampling frequency to establish baseline groundwater conditions prior to the remeander and provide for continued groundwater monitoring post-remeander. The sampling described in this report documents groundwater quality and elevations between the chlorinated volatile organic compound (VOC) plume originating from former Building 102 and the remeander of Rice Creek west of the Building 102 VOC groundwater plume.

Figure 1 attached, illustrates the Site and includes the monitoring well locations, the inferred extent of the Building 102 VOC contaminant plume and the alignment of the Rice Creek remeander. Construction of the remeander was completed in early May 2016 and Rice Creek was rerouted through the remeander on June 28, 2016.

This letter report presents a summary of field and sampling activities through April 30, 2020 and includes cumulative groundwater elevation monitoring and groundwater quality data.

1.0 GROUNDWATER ELEVATION MONITORING

Bay West has collected groundwater elevation data at the site periodically since December 2015 just prior to construction activities associated with the remeander project. **Table 1** presents a summary of depth to water data collected through April 30, 2020.

Bay West plotted groundwater elevations vs. time to create the hydrograph presented as **Figure 2**. Groundwater elevations fluctuated greatly during dewatering and construction activities associated with the remeander (January 2016 through February 2016) but have remained stable and consistent during the subsequent monitoring events.

During the April 2020 sampling event, Bay West collected groundwater elevation data at the 10 wells used by the Army to monitor the Building 102 VOC plume as well as the four Ramsey County wells. Groundwater elevations from the two shallow Ramsey County wells and the shallow Building 102 wells were used to generate groundwater elevation contours. The groundwater contours, depicted on **Figure 1**, show a north-northwesterly groundwater flow direction toward Rice Creek under a hydraulic gradient of approximately 0.018 feet per foot. This groundwater flow direction and gradient are consistent with historical data from the area.

2.0 GROUNDWATER QUALITY SAMPLING

To document groundwater quality between the Building 102 VOC plume and the Rice Creek remeander Bay West has completed ten groundwater sampling events; December 2015, January 2016, April 2016, June 2016, October 2016, March 2017, February 2018, and August 2018, May 2019, and April 2020.

The wells were purged prior to sampling using the low flow sampling methodology. Stabilization parameters were collected at each well to ensure that representative aquifer water was being collected and not stagnant water within the well casing.

The groundwater samples were placed in laboratory-supplied sample containers and submitted to Eurofins TestAmerica for analysis of VOCs by EPA method 8260D SIM.

Bay West compared the groundwater analytical data to the recommended remediation goals (RRGs) for the Building 102 groundwater plume documented in the Operable Unit 2 (OU2) Record of Decision (ROD) Amendment #4. The contaminants of concern (COCs) listed in the ROD include trichloroethene, cis-1,2-dichloroethene, 1,1-dichloroethene, and vinyl chloride. Because the Unit 1 groundwater in this area of TCAAP discharges to Rice Creek, the RRGs are based on the lower of the MPCA's surface water quality standards or the Minnesota Department of Health – Health Risk Limit (MDH-HRL). The table below presents the RRGs for the Building 102 chlorinated solvent plume.

Building 102 Recommended Remediation Goals

Chemical	Groundwater Standard (MDH-HRL) (µg/L)	Surface Water Standard (µg/L)	RRG for Building 102 Groundwater Plume (µg/L)
Trichloroethene	5	25	5
cis-1,2-Dichloroethene	70	Not Established	70
1,1-Dichloroethene	6	Not Established	6
Vinyl Chloride	0.2	0.18	0.18

Groundwater analytical results for the April 2020 sampling event, presented in **Table 2**, indicated the presence of cis-1,2-dichloroethene at concentrations of 0.961 micrograms per liter (µg/L) at O1URC1S and 2.22 µg/L at O1URC1D. These concentrations are well below the RRG for this compound of 70 µg/L. No other VOCs were detected in the four groundwater samples. A copy of the laboratory analytical report for the April 2020 sampling event is contained in **Appendix A**.

3.0 CONCLUSIONS AND RECOMMENDATIONS

The April 2020 sampling event represents the tenth consecutive sampling event required under the approved groundwater monitoring plan. Through the course of the monitoring activities, none of the COCs have been detected in the Ramsey County wells exceeding the RRGs established in the ROD (amendment #4).

Based on the ten sampling events since 2015 consistently showing the target analytes below the RRGs Bay West recommends ceasing groundwater monitoring of the Rice Creek remeander wells. Ramsey County will continue to maintain the wells should sampling be required in the future.

If you have any questions regarding this letter report, please contact me at (651) 291-3441.

Sincerely,

Rick Van Allen, PG
Senior Project Manager/Geologist

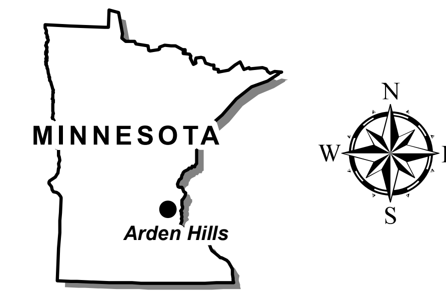
Figures

Figure 1

Rice Creek Remeander Groundwater Flow Map (4/30/2020)

Ramsey County - TCAAP

Arden Hills, MN 55126



Map Projection: NAD 1983 UTM Zone 15 N
Basemap: ESRI World Imagery WMS

0 150 300 Feet
0 50 100 Meters

- Ramsey County Well Location
- Well Location
- Rice Creek Remeander
- Proposed Spine Road
- Approximate Plume Boundary
- Approximate Groundwater Flow Direction
- Groundwater Elevation Contour (4/30/2020 - Feet MSL)
- *(886.72)* Groundwater Elevation At Well (4/30/2020)

Note: Shallow wells screened to intersect the water table were used to generate groundwater contours

Bay West
Customer-Focused Environmental & Industrial Solutions

Drawn By: N.J. Date Drawn/Revised:6/12/2020 Project No.J130147

Y:\Clients\RAMSEY_COUNTY\TCAAP\MapDocs\J130147 FIG 1 Rice Creek Remeander Groundwater Flow Map_20200430.mxd

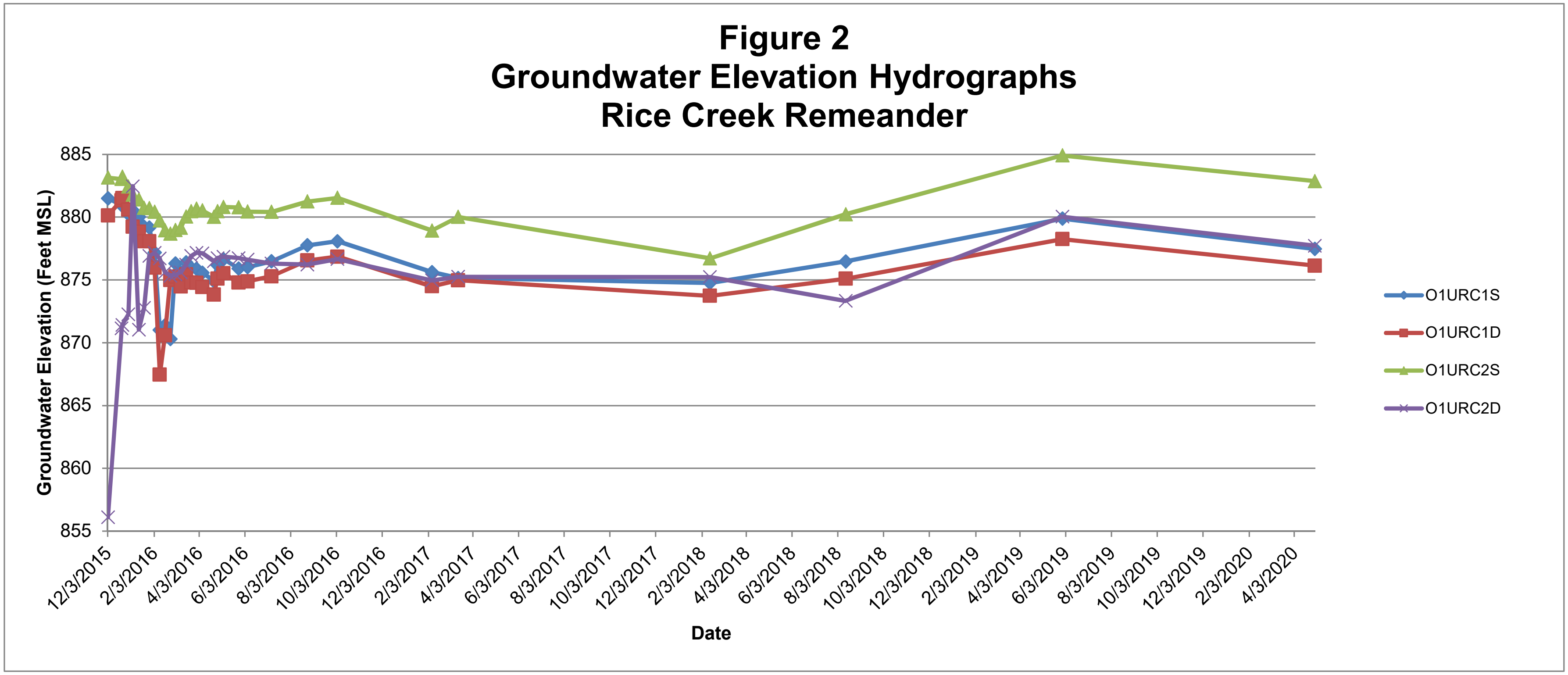


Figure 2
Groundwater Elevation Hydrographs
Rice Creek Remeander
Groundwater Elevation (Feet MSL)
885
880
875
870
865
860
855
12/3/2015
2/3/2016
4/3/2016
6/3/2016
8/3/2016
10/3/2016
12/3/2016
2/3/2017
4/3/2017
6/3/2017
8/3/2017
10/3/2017
12/3/2017
2/3/2018
4/3/2018
6/3/2018
8/3/2018
10/3/2018
12/3/2018
2/3/2019
4/3/2019
6/3/2019
8/3/2019
10/3/2019
12/3/2019
2/3/2020
4/3/2020
Date
O1URC1S
O1URC1D
O1URC2S
O1URC2D

Tables

Table 1
Groundwater Elevations
Rice Creek Remeander

Well	Date	Inner Casing Elevation	Depth to Water	Groundwater Elevation
O1URC1S	12/3/2015	887.76	6.27	881.49
O1URC1S	12/21/2015	887.76	6.81	880.95
O1URC1S	12/22/2015	887.76	6.71	881.05
O1URC1S	12/30/2015	887.76	7.52	880.24
O1URC1S	1/5/2016	887.76	7.23	880.53
O1URC1S	1/13/2016	887.76	7.73	880.03
O1URC1S	1/20/2016	887.76	8.52	879.24
O1URC1S	1/27/2016	887.76	8.59	879.17
O1URC1S	2/3/2016	887.76	10.57	877.19
O1URC1S	2/10/2016	887.76	16.75	871.01
O1URC1S	2/17/2016	887.76	16.36	871.4
O1URC1S	2/24/2016	887.76	dry	-
O1URC1S	3/2/2016	887.76	11.45	876.31
O1URC1S	3/9/2016	887.76	12.17	875.59
O1URC1S	3/16/2016	887.76	11.35	876.41
O1URC1S	3/23/2016	887.76	11.81	875.95
O1URC1S	3/30/2016	887.76	11.87	875.89
O1URC1S	4/7/2016	887.76	12.18	875.58
O1URC1S	4/22/2016	887.76	12.85	874.91
O1URC1S	4/27/2016	887.76	11.59	876.17
O1URC1S	5/5/2016	887.76	11.11	876.65
O1URC1S	5/25/2016	887.76	11.85	875.91
O1URC1S	6/6/2016	887.76	11.75	876.01
O1URC1S	7/8/2016	887.76	11.28	876.48
O1URC1S	8/25/2016	887.76	10.00	877.76
O1URC1S	10/4/2016	887.76	9.68	878.08
O1URC1S	2/7/2017	887.76	12.14	875.62
O1URC1S	3/14/2017	887.76	12.61	875.15
O1URC1S	2/13/2018	887.76	13.00	874.76
O1URC1S	8/13/2018	887.76	11.29	876.47
O1URC1S	5/29/2019	887.76	7.88	879.88
O1URC1S	4/30/2020	887.76	10.29	877.47
O1URC1D	12/3/2015	887.29	7.15	880.14
O1URC1D	12/21/2015	887.29	5.95	881.34
O1URC1D	12/22/2015	887.29	5.78	881.51
O1URC1D	12/30/2015	887.29	6.68	880.61
O1URC1D	1/5/2016	887.29	8.04	879.25
O1URC1D	1/13/2016	887.29	8.46	878.83
O1URC1D	1/20/2016	887.29	9.21	878.08
O1URC1D	1/27/2016	887.29	9.22	878.07
O1URC1D	2/3/2016	887.29	11.31	875.98
O1URC1D	2/10/2016	887.29	19.84	867.45
O1URC1D	2/17/2016	887.29	16.69	870.6
O1URC1D	2/24/2016	887.29	12.3	874.99
O1URC1D	3/2/2016	887.29	12.03	875.26
O1URC1D	3/9/2016	887.29	12.82	874.47
O1URC1D	3/16/2016	887.29	11.84	875.45
O1URC1D	3/23/2016	887.29	12.49	874.8
O1URC1D	3/30/2016	887.29	12.51	874.78
O1URC1D	4/7/2016	887.29	12.86	874.43
O1URC1D	4/22/2016	887.29	13.46	873.83
O1URC1D	4/27/2016	887.29	12.19	875.1
O1URC1D	5/5/2016	887.29	11.76	875.53
O1URC1D	5/25/2016	887.29	12.50	874.79
O1URC1D	6/6/2016	887.29	12.40	874.89
O1URC1D	7/8/2016	887.29	12.00	875.29
O1URC1D	8/25/2016	887.29	10.74	876.55
O1URC1D	10/4/2016	887.29	10.44	876.85
O1URC1D	2/7/2017	887.29	12.79	874.5
O1URC1D	3/14/2017	887.29	12.31	874.98
O1URC1D	2/13/2018	887.29	13.56	873.73
O1URC1D	8/13/2018	887.29	12.19	875.1
O1URC1D	5/29/2019	887.29	9.04	878.25
O1URC1D	4/30/2020	887.29	11.15	876.14

Table 1, continued

Well	Date	Inner Casing Elevation	Depth to Water	Groundwater Elevation
O1URC2S	12/3/2015	887.64	4.50	883.14
	12/21/2015		4.61	883.03
	12/22/2015		4.42	883.22
	12/30/2015		5.21	882.43
	1/5/2016		5.86	881.78
	1/13/2016		6.24	881.40
	1/20/2016		6.91	880.73
	1/27/2016		6.93	880.71
	2/3/2016		7.21	880.43
	2/10/2016		7.90	879.74
	2/17/2016		8.69	878.95
	2/24/2016		8.95	878.69
	3/2/2016		8.66	878.98
	3/9/2016		8.49	879.15
	3/16/2016		7.59	880.05
	3/23/2016		7.18	880.46
	3/30/2016		6.98	880.66
	4/7/2016		7.11	880.53
	4/22/2016		7.61	880.03
	4/27/2016		7.17	880.47
	5/5/2016		6.83	880.81
	5/25/2016		6.87	880.77
	6/6/2016		7.20	880.44
	7/8/2016		7.22	880.42
	8/25/2016		6.40	881.24
	10/4/2016		6.11	881.53
	2/7/2017		8.71	878.93
	3/14/2017		7.62	880.02
	2/13/2018		10.92	876.72
	8/13/2018		7.41	880.23
	5/29/2019		2.73	884.91
	4/30/2020		4.77	882.87
O1URC2D	12/3/2015	887.73	31.62	856.11
	12/21/2015		16.59	871.14
	12/22/2015		16.31	871.42
	12/30/2015		15.46	872.27
	1/5/2016		5.27	882.46
	1/13/2016		16.69	871.04
	1/20/2016		14.95	872.78
	1/27/2016		10.82	876.91
	2/3/2016		10.57	877.16
	2/10/2016		11.02	876.71
	2/17/2016		12.11	875.62
	2/24/2016		12.40	875.33
	3/2/2016		12.30	875.43
	3/9/2016		12.13	875.60
	3/16/2016		11.50	876.23
	3/23/2016		10.82	876.91
	3/30/2016		10.56	877.17
	4/7/2016		10.61	877.12
	4/22/2016		11.24	876.49
	4/27/2016		10.99	876.74
	5/5/2016		10.88	876.85
	5/25/2016		10.99	876.74
	6/6/2016		11.11	876.62
	7/8/2016		11.42	876.31
	8/25/2016		11.50	876.23
	10/4/2016		11.07	876.66
	2/7/2017		12.76	874.97
	3/14/2017		12.48	875.25
	2/13/2018		12.50	875.23
	8/13/2018		14.40	873.33
	5/29/2019		7.69	880.04
	4/30/2020		10.01	877.72

Table 1, continued

Well	Date	Inner Casing Elevation	Depth to Water	Groundwater Elevation
01U579	12/3/2015	892.60	4.03	888.57
	2/3/2016		5.20	887.40
	4/7/2016		4.15	888.45
	6/6/2016		5.02	887.58
	10/4/2016		4.33	888.27
	3/14/2017		4.71	887.89
	2/13/2018		7.65	884.95
	8/13/2018		6.14	886.46
	5/29/2019		3.21	889.39
	4/30/2020		3.49	889.11
01U580	12/3/2015	892.58	4.22	888.36
	2/3/2016		5.39	887.19
	4/7/2016		4.36	888.22
	6/6/2016		5.17	887.41
	10/4/2016		4.51	888.07
	3/14/2017		4.86	887.72
	2/13/2018		7.94	884.64
	8/13/2018		6.35	886.23
	5/29/2019		3.58	889.00
	4/30/2020		3.77	888.81
01U581	12/3/2015	891.10	3.25	887.85
	2/3/2016		-	dry
	4/7/2016		3.32	887.78
	6/6/2016		4.31	886.79
	10/4/2016		3.51	887.59
	3/14/2017		3.02	888.08
	2/13/2018		7.27	883.83
	8/13/2018		6.78	884.32
	5/29/2019		3.01	888.09
	4/30/2020		3.00	888.10
01L581	12/3/2015	891.07	3.29	887.78
	2/3/2016		-	dry
	4/7/2016		3.40	887.67
	6/6/2016		4.31	886.76
	10/4/2016		3.49	887.58
	3/14/2017		3.17	887.90
	2/13/2018		7.28	883.79
	8/13/2018		6.81	884.26
	5/29/2019		2.78	888.29
	4/30/2020		2.89	888.18
01U582	12/3/2015	888.51	4.78	883.73
	2/3/2016		7.27	881.24
	4/7/2016		6.51	882.00
	6/6/2016		7.01	881.50
	10/4/2016		5.19	883.32
	3/14/2017		7.31	881.20
	2/13/2018		10.29	878.22
	8/13/2018		7.63	880.88
	5/29/2019		3.6	884.91
	4/30/2020		4.65	883.86
01L582	12/3/2015	888.33	4.61	883.72
	2/3/2016		7.09	881.24
	4/7/2016		6.35	881.98
	6/6/2016		6.85	881.48
	10/4/2016		5.01	883.32
	3/14/2017		7.14	881.19
	2/13/2018		10.13	878.20
	8/13/2018		7.46	880.87
	5/29/2019		3.29	885.04
	4/30/2020		4.45	883.88
01U583	12/3/2015	890.61	2.71	887.90
	2/3/2016		4	886.61
	4/7/2016		2.8	887.81
	6/6/2016		3.89	886.72
	10/4/2016		2.91	887.70
	3/14/2017		3.55	887.06
	2/13/2018		6.8	883.81
	8/13/2018		5.18	885.43
	5/29/2019		1.91	888.70
	4/30/2020		2.00	888.61

Table 1, continued

Well	Date	Inner Casing Elevation	Depth to Water	Groundwater Elevation
01L583	12/3/2015	891.42	3.39	888.03
	2/3/2016		5.87	885.55
	4/7/2016		3.68	887.74
	6/6/2016		4.75	886.67
	10/4/2016		3.78	887.64
	3/14/2017		4.65	886.77
	2/13/2018		7.85	883.57
	8/13/2018		6.26	885.16
	5/29/2019		2.99	888.43
	4/30/2020		3.12	888.30
01U584	12/3/2015	890.90	3.15	887.75
	2/3/2016		-	dry
	4/7/2016		3.25	887.65
	6/6/2016		3.83	887.07
	10/4/2016		3.32	887.58
	3/14/2017		3.16	887.74
	2/13/2018		7.05	883.85
	8/13/2018		5.6	885.30
	5/29/2019		2.89	888.01
	4/30/2020		2.98	887.92
01L584	12/3/2015	890.70	3.00	887.70
	2/3/2016		3.97	886.73
	4/7/2016		3.13	887.57
	6/6/2016		3.87	886.83
	10/4/2016		3.20	887.50
	3/14/2017		3.62	887.08
	2/13/2018		7.05	883.65
	8/13/2018		5.45	885.25
	5/29/2019		2.67	888.03
	4/30/2020		2.72	887.98

Elevations in feet above mean sea level

Table 2
Groundwater Analytical Results
Rice Creek Remeander

Analyte	Building 102 RRGs (ug/L)	01URC1S									
		12/3/2015	1/5/2016	4/7/2016	6/6/2016	10/4/2016	3/14/2017	2/13/2018	8/13/2018	5/29/2019	4/30/2020
1,1,1,2-Tetrachloroethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,1,1-Trichloroethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,1,2,2-Tetrachloroethane		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.500
1,1,2-Trichloroethane		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.500
1,1,2-Trichlorotrifluoroethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,1-Dichloroethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,1-Dichloroethene	**6**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,1-Dichloropropene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,2,3-Trichlorobenzene		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<0.500
1,2,3-Trichloropropane		<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.00500
1,2,4-Trichlorobenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,2,4-Trimethylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,2-Dibromo-3-chloropropane		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<2.5	<2.5	<2.5	<0.0500
1,2-Dibromoethane (EDB)		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.20	<0.20	<0.20	<0.00500
1,2-Dichlorobenzene		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.500
1,2-Dichloroethane		<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.100
1,2-Dichloropropane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,3,5-Trimethylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,3-Dichlorobenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,3-Dichloropropane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,4-Dichlorobenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
2,2-Dichloropropane		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<0.500
2-Butanone		<20	<20	<20	<20	<20	<20	<20	<20	<20	<0.500
2-Chlorotoluene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
4-Chlorotoluene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Acetone		<20	<20	<20	<20	<20	<20	<20	<20	<20	<5.00
Allyl chloride		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<0.500
Benzene		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.500
Bromobenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Bromochloromethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Bromodichloromethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Bromoform		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<0.500
Bromomethane		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<1.00
Carbon tetrachloride		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.100
Chlorobenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Chloroethane		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<0.500
Chloroform		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Chloromethane		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<1.00
cis-1,2-Dichloroethene	**70**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	**1.1**	<1.0	**0.961**
cis-1,3-Dichloropropene		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.500
Dibromochloromethane		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.500
Dibromomethane		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<0.500
Dichlorodifluoromethane		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<0.500
Dichlorofluoromethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Ethyl ether		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<0.500
Ethylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Hexachlorobutadiene		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<0.250
Isopropylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
m,p-Xylene		<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.00
Methyl isobutyl ketone		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<0.500
Methyl tert-butyl ether		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Methylene chloride		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<1.00
Naphthalene		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<1.00
n-Butylbenzene		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<0.500
n-Propylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
o-Xylene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.00
p-Isopropyltoluene		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<0.500
sec-Butylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Styrene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
tert-Butylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Tetrachloroethene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Tetrahydrofuran		<20	<20	<20	<20	<20	<20	<20	<20	<20	<0.500
Toluene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
trans-1,2-Dichloroethene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
trans-1,3-Dichloropropene		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.500
Trichloroethene	**5**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.100
Trichlorofluoromethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Vinyl chloride	**0.18**	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.0400

Units in micrograms per liter (ug/L).
RRGs: recommended remediation goals
BOLD: Building 102 contaminants of concern

Analyte	Building 102 RRGs (ug/L)	01URC1D									
		12/3/2015	1/5/2016	4/7/2016	6/6/2016	10/4/2016	3/14/2017	2/13/2018	8/13/2018	5/29/2019	4/30/2020
1,1,1,2-Tetrachloroethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,1,1-Trichloroethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,1,2,2-Tetrachloroethane		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.500
1,1,2-Trichloroethane		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.500
1,1,2-Trichlorotrifluoroethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,1-Dichloroethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,1-Dichloroethene	**6**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,1-Dichloropropene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,2,3-Trichlorobenzene		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<0.500
1,2,3-Trichloropropane		<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.00500
1,2,4-Trichlorobenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,2,4-Trimethylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,2-Dibromo-3-chloropropane		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<2.5	<2.5	<2.5	<0.0500
1,2-Dibromoethane (EDB)		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.20	<0.20	<0.20	<0.00500
1,2-Dichlorobenzene		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.500
1,2-Dichloroethane		<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.100
1,2-Dichloropropane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,3,5-Trimethylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,3-Dichlorobenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,3-Dichloropropane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,4-Dichlorobenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
2,2-Dichloropropane		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<0.500
2-Butanone		<20	<20	<20	<20	<20	<20	<20	<20	<20	<0.500
2-Chlorotoluene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
4-Chlorotoluene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Acetone		<20	<20	<20	<20	<20	<20	<20	<20	<20	<5.00
Allyl chloride		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<0.500
Benzene		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.500
Bromobenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Bromochloromethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Bromodichloromethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Bromoform		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<0.500
Bromomethane		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<1.00
Carbon tetrachloride		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.100
Chlorobenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Chloroethane		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<0.500
Chloroform		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Chloromethane		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<1.00
cis-1,2-Dichloroethene	**70**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	**5.7**	**2.9**	**1.9**	**2.22**
cis-1,3-Dichloropropene		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.500
Dibromochloromethane		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.500
Dibromomethane		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<0.500
Dichlorodifluoromethane		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<0.500
Dichlorofluoromethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Ethyl ether		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<0.500
Ethylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Hexachlorobutadiene		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<0.250
Isopropylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
m,p-Xylene		<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.00
Methyl isobutyl ketone		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<0.500
Methyl tert-butyl ether		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Methylene chloride		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<1.00
Naphthalene		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<1.00
n-Butylbenzene		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<0.500
n-Propylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
o-Xylene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.00
p-Isopropyltoluene		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<0.500
sec-Butylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Styrene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
tert-Butylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Tetrachloroethene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Tetrahydrofuran		<20	<20	<20	<20	<20	<20	<20	<20	<20	<0.500
Toluene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
trans-1,2-Dichloroethene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
trans-1,3-Dichloropropene		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.500
Trichloroethene	**5**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.100
Trichlorofluoromethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Vinyl chloride	**0.18**	<0.050	<0.050	<0.050	<0.050	<0.050	**0.058**	<0.050	**0.086**	<0.050	<0.0400

Units in micrograms per liter (ug/L).
RRGs: recommended remediation goals
BOLD: Building 102 contaminants of concern

Analyte	Building 102 RRGs (ug/L)	01URC2S									
		12/3/2015	1/6/2016	4/7/2016	6/6/2016	10/4/2016	3/14/2017	2/13/2018	8/13/2018	5/29/2019	4/30/2020
1,1,1,2-Tetrachloroethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,1,1-Trichloroethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,1,2,2-Tetrachloroethane		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.500
1,1,2-Trichloroethane		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.500
1,1,2-Trichlorotrifluoroethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,1-Dichloroethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,1-Dichloroethene	**6**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,1-Dichloropropene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,2,3-Trichlorobenzene		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<0.500
1,2,3-Trichloropropane		<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.00500
1,2,4-Trichlorobenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,2,4-Trimethylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,2-Dibromo-3-chloropropane		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<2.5	<2.5	<2.5	<0.0500
1,2-Dibromoethane (EDB)		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.20	<0.20	<0.20	<0.00500
1,2-Dichlorobenzene		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.500
1,2-Dichloroethane		<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.100
1,2-Dichloropropane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,3,5-Trimethylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,3-Dichlorobenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,3-Dichloropropane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,4-Dichlorobenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
2,2-Dichloropropane		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<0.500
2-Butanone		<20	<20	<20	<20	<20	<20	<20	<20	<20	<0.500
2-Chlorotoluene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
4-Chlorotoluene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Acetone		<20	<20	<20	<20	<20	<20	<20	<20	<20	<5.00
Allyl chloride		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<0.500
Benzene		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.500
Bromobenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Bromochloromethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Bromodichloromethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Bromoform		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<0.500
Bromomethane		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<1.00
Carbon tetrachloride		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.100
Chlorobenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Chloroethane		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<0.500
Chloroform		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Chloromethane		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<1.00
cis-1,2-Dichloroethene	**70**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
cis-1,3-Dichloropropene		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.500
Dibromochloromethane		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.500
Dibromomethane		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<0.500
Dichlorodifluoromethane		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<0.500
Dichlorofluoromethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Ethyl ether		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<0.500
Ethylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Hexachlorobutadiene		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<0.250
Isopropylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
m,p-Xylene		<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.00
Methyl isobutyl ketone		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<0.500
Methyl tert-butyl ether		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Methylene chloride		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<1.00
Naphthalene		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<1.00
n-Butylbenzene		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<0.500
n-Propylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
o-Xylene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.00
p-Isopropyltoluene		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<0.500
sec-Butylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Styrene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
tert-Butylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Tetrachloroethene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Tetrahydrofuran		<20	<20	<20	<20	<20	<20	<20	<20	<20	<0.500
Toluene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
trans-1,2-Dichloroethene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
trans-1,3-Dichloropropene		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.500
Trichloroethene	**5**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.100
Trichlorofluoromethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Vinyl chloride	**0.18**	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.0400

Units in micrograms per liter (ug/L).
RRGs: recommended remediation goals
BOLD: Building 102 contaminants of concern

	Building 102 RRGs	01URC2D									
Analyte	**(ug/L)**	**12/3/2015**	**1/6/2016**	**4/7/2016**	**6/6/2016**	**10/4/2016**	**3/14/2017**	**2/13/2018**	**8/13/2018**	**5/29/2019**	**4/30/2020**
1,1,1,2-Tetrachloroethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,1,1-Trichloroethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,1,2,2-Tetrachloroethane		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.500
1,1,2-Trichloroethane		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.500
1,1,2-Trichlorotrifluoroethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,1-Dichloroethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,1-Dichloroethene	**6**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,1-Dichloropropene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,2,3-Trichlorobenzene		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<0.500
1,2,3-Trichloropropane		<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.00500
1,2,4-Trichlorobenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,2,4-Trimethylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,2-Dibromo-3-chloropropane		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<2.5	<2.5	<2.5	<0.0500
1,2-Dibromoethane (EDB)		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.20	<0.20	<0.20	<0.00500
1,2-Dichlorobenzene		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.500
1,2-Dichloroethane		<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.100
1,2-Dichloropropane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,3,5-Trimethylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,3-Dichlorobenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,3-Dichloropropane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
1,4-Dichlorobenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
2,2-Dichloropropane		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<0.500
2-Butanone		<20	<20	<20	<20	<20	<20	<20	<20	<20	<0.500
2-Chlorotoluene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
4-Chlorotoluene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Acetone		<20	<20	<20	<20	<20	<20	<20	<20	<20	<5.00
Allyl chloride		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<0.500
Benzene		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.500
Bromobenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Bromochloromethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Bromodichloromethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Bromoform		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<0.500
Bromomethane		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<1.00
Carbon tetrachloride		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.100
Chlorobenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Chloroethane		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<0.500
Chloroform		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Chloromethane		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<1.00
cis-1,2-Dichloroethene	**70**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
cis-1,3-Dichloropropene		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.500
Dibromochloromethane		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.500
Dibromomethane		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<0.500
Dichlorodifluoromethane		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<0.500
Dichlorofluoromethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Ethyl ether		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<0.500
Ethylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Hexachlorobutadiene		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<0.250
Isopropylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
m,p-Xylene		<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.00
Methyl isobutyl ketone		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<0.500
Methyl tert-butyl ether		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Methylene chloride		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<1.00
Naphthalene		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<1.00
n-Butylbenzene		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<0.500
n-Propylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
o-Xylene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.00
p-Isopropyltoluene		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<0.500
sec-Butylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Styrene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
tert-Butylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Tetrachloroethene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Tetrahydrofuran		<20	<20	<20	<20	<20	<20	<20	<20	<20	<0.500
Toluene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
trans-1,2-Dichloroethene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
trans-1,3-Dichloropropene		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.500
Trichloroethene	**5**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.100
Trichlorofluoromethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.500
Vinyl chloride	**0.18**	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.0400

Units in micrograms per liter (ug/L).
RRGs: recommended remediation goals
BOLD: Building 102 contaminants of concern

Appendix A

Laboratory Analytical Report

eurofins | Environment Testing America

ANALYTICAL REPORT

Eurofins TestAmerica, Cedar Falls
3019 Venture Way
Cedar Falls, IA 50613
Tel: (319)277-2401

Laboratory Job ID: 310-180876-1
Client Project/Site: J130147.9, Twin Cities Army Ammunition P

For:
Bay West Inc.
5 Empire Drive
St Paul, Minnesota 55103

Attn: Rick Van Allen

Authorized for release by:
5/11/2020 3:54:31 PM

Zach Bindert, Project Manager I
(319)277-2401
zach.bindert@testamericainc.com

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

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Job ID: 310-180876-1

Laboratory: Eurofins TestAmerica, Cedar Falls

Narrative

Job Narrative
310-180876-1

Receipt
The samples were received on 5/1/2020 9:00 AM; the samples arrived in good condition, properly preserved, and where required, on ice. The temperature of the cooler at receipt time was 0.0°C

Department GC/MS VOA
Method 8260D_SIM: The RPD of the laboratory control sample (LCS) and laboratory control sample duplicate (LCSD) for analytical batch 310-277822 recovered outside control limits for the following analytes: Acetone

Method 8260D_SIM: The laboratory control sample (LCS) for analytical batch 310-278043 recovered outside control limits for the following analytes: chloroethane and chloroform. These analytes were biased high in the LCS and were not detected in the associated samples; therefore, the data have been reporte

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Sample Summary

Client: Bay West Inc.
Job ID: 310-180876-1
Project/Site: J130147.9, Twin Cities Army Ammunition P

Lab Sample ID	Client Sample ID	Matrix	Collected	Received	Asset ID
310-180876-1	TCAAP-01URC2S	Ground Water	04/30/20 12:00	05/01/20 09:00	
310-180876-2	TCAAP-01URC2S-D	Ground Water	04/30/20 12:05	05/01/20 09:00	
310-180876-3	TCAAP-01URC2D	Ground Water	04/30/20 12:35	05/01/20 09:00	
310-180876-4	TCAAP-01URC1S	Ground Water	04/30/20 14:15	05/01/20 09:00	
310-180876-5	TCAAP-01URC1D	Ground Water	04/30/20 13:40	05/01/20 09:00	
310-180876-6	Trip Blank	Water	04/30/20 09:00	05/01/20 09:00	

Client: Bay West Inc. Job ID: 310-180876-1
Project/Site: J130147.9, Twin Cities Army Ammunition P

Client Sample ID: TCAAP-01URC2S Lab Sample ID: 310-180876-1

No Detections.

Client Sample ID: TCAAP-01URC2S-D Lab Sample ID: 310-180876-2

No Detections.

Client Sample ID: TCAAP-01URC2D Lab Sample ID: 310-180876-3

No Detections.

Client Sample ID: TCAAP-01URC1S Lab Sample ID: 310-180876-4

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
cis-1,2-Dichloroethene	0.961		0.500		ug/L	1		8260D SIM	Total/NA

Client Sample ID: TCAAP-01URC1D Lab Sample ID: 310-180876-5

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
cis-1,2-Dichloroethene	2.22		0.500		ug/L	1		8260D SIM	Total/NA

Client Sample ID: Trip Blank Lab Sample ID: 310-180876-6

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Tetrahydrofuran	0.591		0.500		ug/L	1		8260D SIM	Total/NA

This Detection Summary does not include radiochemical test results.

Client Sample Results

Client: Bay West Inc.
Job ID: 310-180876-1
Project/Site: J130147.9, Twin Cities Army Ammunition P

Client Sample ID: TCAAP-01URC2S
Lab Sample ID: 310-180876-1

Date Collected: 04/30/20 12:00
Matrix: Ground Water
Date Received: 05/01/20 09:00

Method: 8260D SIM - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	<5.00	*1	5.00		ug/L			05/05/20 12:30	1
Allyl chloride	<0.500		0.500		ug/L			05/05/20 12:30	1
Benzene	<0.500		0.500		ug/L			05/05/20 12:30	1
Bromobenzene	<0.500		0.500		ug/L			05/05/20 12:30	1
Bromochloromethane	<0.500		0.500		ug/L			05/05/20 12:30	1
Bromodichloromethane	<0.500		0.500		ug/L			05/05/20 12:30	1
Bromoform	<0.500		0.500		ug/L			05/05/20 12:30	1
Bromomethane	<1.00		1.00		ug/L			05/05/20 12:30	1
2-Butanone (MEK)	<0.500		0.500		ug/L			05/05/20 12:30	1
Carbon tetrachloride	<0.100		0.100		ug/L			05/05/20 12:30	1
Chlorobenzene	<0.500		0.500		ug/L			05/05/20 12:30	1
Chloroethane	<0.500		0.500		ug/L			05/05/20 12:30	1
Chloroform	<0.500		0.500		ug/L			05/05/20 12:30	1
Chloromethane	<1.00		1.00		ug/L			05/05/20 12:30	1
2-Chlorotoluene	<0.500		0.500		ug/L			05/05/20 12:30	1
4-Chlorotoluene	<0.500		0.500		ug/L			05/05/20 12:30	1
cis-1,2-Dichloroethene	<0.500		0.500		ug/L			05/05/20 12:30	1
cis-1,3-Dichloropropene	<0.500		0.500		ug/L			05/05/20 12:30	1
Dibromochloromethane	<0.500		0.500		ug/L			05/05/20 12:30	1
1,2-Dibromo-3-chloropropane	<0.0500		0.0500		ug/L			05/05/20 12:30	1
1,2-Dibromoethane (EDB)	<0.00500		0.00500		ug/L			05/05/20 12:30	1
Dibromomethane	<0.500		0.500		ug/L			05/05/20 12:30	1
1,2-Dichlorobenzene	<0.500		0.500		ug/L			05/05/20 12:30	1
1,3-Dichlorobenzene	<0.500		0.500		ug/L			05/05/20 12:30	1
1,4-Dichlorobenzene	<0.500		0.500		ug/L			05/05/20 12:30	1
Dichlorodifluoromethane	<0.500		0.500		ug/L			05/05/20 12:30	1
1,1-Dichloroethane	<0.500		0.500		ug/L			05/05/20 12:30	1
1,2-Dichloroethane	<0.100		0.100		ug/L			05/05/20 12:30	1
1,1-Dichloroethene	<0.500		0.500		ug/L			05/05/20 12:30	1
Dichlorofluoromethane	<0.500		0.500		ug/L			05/05/20 12:30	1
1,2-Dichloropropane	<0.500		0.500		ug/L			05/05/20 12:30	1
1,3-Dichloropropane	<0.500		0.500		ug/L			05/05/20 12:30	1
2,2-Dichloropropane	<0.500		0.500		ug/L			05/05/20 12:30	1
1,1-Dichloropropene	<0.500		0.500		ug/L			05/05/20 12:30	1
Diethyl ether	<0.500		0.500		ug/L			05/05/20 12:30	1
Ethylbenzene	<0.500		0.500		ug/L			05/05/20 12:30	1
Hexachlorobutadiene	<0.250		0.250		ug/L			05/05/20 12:30	1
Isopropylbenzene	<0.500		0.500		ug/L			05/05/20 12:30	1
4-Isopropyltoluene	<0.500		0.500		ug/L			05/05/20 12:30	1
Methylene chloride	<1.00		1.00		ug/L			05/05/20 12:30	1
4-Methyl-2-pentanone (MIBK)	<0.500		0.500		ug/L			05/05/20 12:30	1
Methyl tert-butyl ether	<0.500		0.500		ug/L			05/05/20 12:30	1
Naphthalene	<1.00		1.00		ug/L			05/05/20 12:30	1
n-Butylbenzene	<0.500		0.500		ug/L			05/05/20 12:30	1
n-Propylbenzene	<0.500		0.500		ug/L			05/05/20 12:30	1
sec-Butylbenzene	<0.500		0.500		ug/L			05/05/20 12:30	1
Styrene	<0.500		0.500		ug/L			05/05/20 12:30	1
tert-Butylbenzene	<0.500		0.500		ug/L			05/05/20 12:30	1
1,1,1,2-Tetrachloroethane	<0.500		0.500		ug/L			05/05/20 12:30	1

Client Sample ID: TCAAP-01URC2S **Lab Sample ID: 310-180876-1**
Date Collected: 04/30/20 12:00 **Matrix: Ground Water**
Date Received: 05/01/20 09:00

Method: 8260D SIM - Volatile Organic Compounds (GC/MS) (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
1,1,2,2-Tetrachloroethane	<0.500		0.500		ug/L			05/05/20 12:30	1
Tetrachloroethene	<0.500		0.500		ug/L			05/05/20 12:30	1
Tetrahydrofuran	<0.500		0.500		ug/L			05/05/20 12:30	1
Toluene	<0.500		0.500		ug/L			05/05/20 12:30	1
trans-1,2-Dichloroethene	<0.500		0.500		ug/L			05/05/20 12:30	1
trans-1,3-Dichloropropene	<0.500		0.500		ug/L			05/05/20 12:30	1
1,2,3-Trichlorobenzene	<0.500		0.500		ug/L			05/05/20 12:30	1
1,2,4-Trichlorobenzene	<0.500		0.500		ug/L			05/05/20 12:30	1
1,1,1-Trichloroethane	<0.500		0.500		ug/L			05/05/20 12:30	1
1,1,2-Trichloroethane	<0.500		0.500		ug/L			05/05/20 12:30	1
Trichloroethene	<0.100		0.100		ug/L			05/05/20 12:30	1
Trichlorofluoromethane	<0.500		0.500		ug/L			05/05/20 12:30	1
1,2,3-Trichloropropane	<0.00500		0.00500		ug/L			05/05/20 12:30	1
1,1,2-Trichloro-1,2,2-trifluoroethane	<0.500		0.500		ug/L			05/06/20 13:46	1
1,2,4-Trimethylbenzene	<0.500		0.500		ug/L			05/05/20 12:30	1
1,3,5-Trimethylbenzene	<0.500		0.500		ug/L			05/05/20 12:30	1
Vinyl chloride	<0.0400		0.0400		ug/L			05/05/20 12:30	1
Xylenes, Total	<1.00		1.00		ug/L			05/05/20 12:30	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
4-Bromofluorobenzene (Surr)	*101*		*80 - 120*		*05/05/20 12:30*	*1*
4-Bromofluorobenzene (Surr)	*100*		*80 - 120*		*05/06/20 13:46*	*1*
Dibromofluoromethane (Surr)	*103*		*80 - 120*		*05/05/20 12:30*	*1*
Dibromofluoromethane (Surr)	*105*		*80 - 120*		*05/06/20 13:46*	*1*
Toluene-d8 (Surr)	*98*		*80 - 120*		*05/05/20 12:30*	*1*
Toluene-d8 (Surr)	*98*		*80 - 120*		*05/06/20 13:46*	*1*

Client Sample Results

Client: Bay West Inc.
Job ID: 310-180876-1
Project/Site: J130147.9, Twin Cities Army Ammunition P

Client Sample ID: TCAAP-01URC2S-D
Lab Sample ID: 310-180876-2
Date Collected: 04/30/20 12:05
Matrix: Ground Water
Date Received: 05/01/20 09:00

Method: 8260D SIM - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	<5.00	*1	5.00		ug/L			05/05/20 12:53	1
Allyl chloride	<0.500		0.500		ug/L			05/05/20 12:53	1
Benzene	<0.500		0.500		ug/L			05/05/20 12:53	1
Bromobenzene	<0.500		0.500		ug/L			05/05/20 12:53	1
Bromochloromethane	<0.500		0.500		ug/L			05/05/20 12:53	1
Bromodichloromethane	<0.500		0.500		ug/L			05/05/20 12:53	1
Bromoform	<0.500		0.500		ug/L			05/05/20 12:53	1
Bromomethane	<1.00		1.00		ug/L			05/05/20 12:53	1
2-Butanone (MEK)	<0.500		0.500		ug/L			05/05/20 12:53	1
Carbon tetrachloride	<0.100		0.100		ug/L			05/05/20 12:53	1
Chlorobenzene	<0.500		0.500		ug/L			05/05/20 12:53	1
Chloroethane	<0.500		0.500		ug/L			05/05/20 12:53	1
Chloroform	<0.500		0.500		ug/L			05/05/20 12:53	1
Chloromethane	<1.00		1.00		ug/L			05/05/20 12:53	1
2-Chlorotoluene	<0.500		0.500		ug/L			05/05/20 12:53	1
4-Chlorotoluene	<0.500		0.500		ug/L			05/05/20 12:53	1
cis-1,2-Dichloroethene	<0.500		0.500		ug/L			05/05/20 12:53	1
cis-1,3-Dichloropropene	<0.500		0.500		ug/L			05/05/20 12:53	1
Dibromochloromethane	<0.500		0.500		ug/L			05/05/20 12:53	1
1,2-Dibromo-3-chloropropane	<0.0500		0.0500		ug/L			05/05/20 12:53	1
1,2-Dibromoethane (EDB)	<0.00500		0.00500		ug/L			05/05/20 12:53	1
Dibromomethane	<0.500		0.500		ug/L			05/05/20 12:53	1
1,2-Dichlorobenzene	<0.500		0.500		ug/L			05/05/20 12:53	1
1,3-Dichlorobenzene	<0.500		0.500		ug/L			05/05/20 12:53	1
1,4-Dichlorobenzene	<0.500		0.500		ug/L			05/05/20 12:53	1
Dichlorodifluoromethane	<0.500		0.500		ug/L			05/05/20 12:53	1
1,1-Dichloroethane	<0.500		0.500		ug/L			05/05/20 12:53	1
1,2-Dichloroethane	<0.100		0.100		ug/L			05/05/20 12:53	1
1,1-Dichloroethene	<0.500		0.500		ug/L			05/05/20 12:53	1
Dichlorofluoromethane	<0.500		0.500		ug/L			05/05/20 12:53	1
1,2-Dichloropropane	<0.500		0.500		ug/L			05/05/20 12:53	1
1,3-Dichloropropane	<0.500		0.500		ug/L			05/05/20 12:53	1
2,2-Dichloropropane	<0.500		0.500		ug/L			05/05/20 12:53	1
1,1-Dichloropropene	<0.500		0.500		ug/L			05/05/20 12:53	1
Diethyl ether	<0.500		0.500		ug/L			05/05/20 12:53	1
Ethylbenzene	<0.500		0.500		ug/L			05/05/20 12:53	1
Hexachlorobutadiene	<0.250		0.250		ug/L			05/05/20 12:53	1
Isopropylbenzene	<0.500		0.500		ug/L			05/05/20 12:53	1
4-Isopropyltoluene	<0.500		0.500		ug/L			05/05/20 12:53	1
Methylene chloride	<1.00		1.00		ug/L			05/05/20 12:53	1
4-Methyl-2-pentanone (MIBK)	<0.500		0.500		ug/L			05/05/20 12:53	1
Methyl tert-butyl ether	<0.500		0.500		ug/L			05/05/20 12:53	1
Naphthalene	<1.00		1.00		ug/L			05/05/20 12:53	1
n-Butylbenzene	<0.500		0.500		ug/L			05/05/20 12:53	1
n-Propylbenzene	<0.500		0.500		ug/L			05/05/20 12:53	1
sec-Butylbenzene	<0.500		0.500		ug/L			05/05/20 12:53	1
Styrene	<0.500		0.500		ug/L			05/05/20 12:53	1
tert-Butylbenzene	<0.500		0.500		ug/L			05/05/20 12:53	1
1,1,1,2-Tetrachloroethane	<0.500		0.500		ug/L			05/05/20 12:53	1

Client Sample ID: TCAAP-01URC2S-D

Lab Sample ID: 310-180876-2

Date Collected: 04/30/20 12:05
Matrix: Ground Water
Date Received: 05/01/20 09:00

Method: 8260D SIM - Volatile Organic Compounds (GC/MS) (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
1,1,2,2-Tetrachloroethane	<0.500		0.500		ug/L			05/05/20 12:53	1
Tetrachloroethene	<0.500		0.500		ug/L			05/05/20 12:53	1
Tetrahydrofuran	<0.500		0.500		ug/L			05/05/20 12:53	1
Toluene	<0.500		0.500		ug/L			05/05/20 12:53	1
trans-1,2-Dichloroethene	<0.500		0.500		ug/L			05/05/20 12:53	1
trans-1,3-Dichloropropene	<0.500		0.500		ug/L			05/05/20 12:53	1
1,2,3-Trichlorobenzene	<0.500		0.500		ug/L			05/05/20 12:53	1
1,2,4-Trichlorobenzene	<0.500		0.500		ug/L			05/05/20 12:53	1
1,1,1-Trichloroethane	<0.500		0.500		ug/L			05/05/20 12:53	1
1,1,2-Trichloroethane	<0.500		0.500		ug/L			05/05/20 12:53	1
Trichloroethene	<0.100		0.100		ug/L			05/05/20 12:53	1
Trichlorofluoromethane	<0.500		0.500		ug/L			05/05/20 12:53	1
1,2,3-Trichloropropane	<0.00500		0.00500		ug/L			05/05/20 12:53	1
1,1,2-Trichloro-1,2,2-trifluoroethane	<0.500		0.500		ug/L			05/06/20 14:09	1
1,2,4-Trimethylbenzene	<0.500		0.500		ug/L			05/05/20 12:53	1
1,3,5-Trimethylbenzene	<0.500		0.500		ug/L			05/05/20 12:53	1
Vinyl chloride	<0.0400		0.0400		ug/L			05/05/20 12:53	1
Xylenes, Total	<1.00		1.00		ug/L			05/05/20 12:53	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
4-Bromofluorobenzene (Surr)	*100*		*80 - 120*		*05/05/20 12:53*	*1*
4-Bromofluorobenzene (Surr)	*100*		*80 - 120*		*05/06/20 14:09*	*1*
Dibromofluoromethane (Surr)	*103*		*80 - 120*		*05/05/20 12:53*	*1*
Dibromofluoromethane (Surr)	*104*		*80 - 120*		*05/06/20 14:09*	*1*
Toluene-d8 (Surr)	*97*		*80 - 120*		*05/05/20 12:53*	*1*
Toluene-d8 (Surr)	*97*		*80 - 120*		*05/06/20 14:09*	*1*

Client Sample ID: TCAAP-01URC2D **Lab Sample ID: 310-180876-3**

Date Collected: 04/30/20 12:35 **Matrix: Ground Water**

Date Received: 05/01/20 09:00

Method: 8260D SIM - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	<5.00	*1	5.00		ug/L			05/05/20 13:16	1
Allyl chloride	<0.500		0.500		ug/L			05/05/20 13:16	1
Benzene	<0.500		0.500		ug/L			05/05/20 13:16	1
Bromobenzene	<0.500		0.500		ug/L			05/05/20 13:16	1
Bromochloromethane	<0.500		0.500		ug/L			05/05/20 13:16	1
Bromodichloromethane	<0.500		0.500		ug/L			05/05/20 13:16	1
Bromoform	<0.500		0.500		ug/L			05/05/20 13:16	1
Bromomethane	<1.00		1.00		ug/L			05/05/20 13:16	1
2-Butanone (MEK)	<0.500		0.500		ug/L			05/05/20 13:16	1
Carbon tetrachloride	<0.100		0.100		ug/L			05/05/20 13:16	1
Chlorobenzene	<0.500		0.500		ug/L			05/05/20 13:16	1
Chloroethane	<0.500		0.500		ug/L			05/05/20 13:16	1
Chloroform	<0.500		0.500		ug/L			05/05/20 13:16	1
Chloromethane	<1.00		1.00		ug/L			05/05/20 13:16	1
2-Chlorotoluene	<0.500		0.500		ug/L			05/05/20 13:16	1
4-Chlorotoluene	<0.500		0.500		ug/L			05/05/20 13:16	1
cis-1,2-Dichloroethene	<0.500		0.500		ug/L			05/05/20 13:16	1
cis-1,3-Dichloropropene	<0.500		0.500		ug/L			05/05/20 13:16	1
Dibromochloromethane	<0.500		0.500		ug/L			05/05/20 13:16	1
1,2-Dibromo-3-chloropropane	<0.0500		0.0500		ug/L			05/05/20 13:16	1
1,2-Dibromoethane (EDB)	<0.00500		0.00500		ug/L			05/05/20 13:16	1
Dibromomethane	<0.500		0.500		ug/L			05/05/20 13:16	1
1,2-Dichlorobenzene	<0.500		0.500		ug/L			05/05/20 13:16	1
1,3-Dichlorobenzene	<0.500		0.500		ug/L			05/05/20 13:16	1
1,4-Dichlorobenzene	<0.500		0.500		ug/L			05/05/20 13:16	1
Dichlorodifluoromethane	<0.500		0.500		ug/L			05/05/20 13:16	1
1,1-Dichloroethane	<0.500		0.500		ug/L			05/05/20 13:16	1
1,2-Dichloroethane	<0.100		0.100		ug/L			05/05/20 13:16	1
1,1-Dichloroethene	<0.500		0.500		ug/L			05/05/20 13:16	1
Dichlorofluoromethane	<0.500		0.500		ug/L			05/05/20 13:16	1
1,2-Dichloropropane	<0.500		0.500		ug/L			05/05/20 13:16	1
1,3-Dichloropropane	<0.500		0.500		ug/L			05/05/20 13:16	1
2,2-Dichloropropane	<0.500		0.500		ug/L			05/05/20 13:16	1
1,1-Dichloropropene	<0.500		0.500		ug/L			05/05/20 13:16	1
Diethyl ether	<0.500		0.500		ug/L			05/05/20 13:16	1
Ethylbenzene	<0.500		0.500		ug/L			05/05/20 13:16	1
Hexachlorobutadiene	<0.250		0.250		ug/L			05/05/20 13:16	1
Isopropylbenzene	<0.500		0.500		ug/L			05/05/20 13:16	1
4-Isopropyltoluene	<0.500		0.500		ug/L			05/05/20 13:16	1
Methylene chloride	<1.00		1.00		ug/L			05/05/20 13:16	1
4-Methyl-2-pentanone (MIBK)	<0.500		0.500		ug/L			05/05/20 13:16	1
Methyl tert-butyl ether	<0.500		0.500		ug/L			05/05/20 13:16	1
Naphthalene	<1.00		1.00		ug/L			05/05/20 13:16	1
n-Butylbenzene	<0.500		0.500		ug/L			05/05/20 13:16	1
n-Propylbenzene	<0.500		0.500		ug/L			05/05/20 13:16	1
sec-Butylbenzene	<0.500		0.500		ug/L			05/05/20 13:16	1
Styrene	<0.500		0.500		ug/L			05/05/20 13:16	1
tert-Butylbenzene	<0.500		0.500		ug/L			05/05/20 13:16	1
1,1,1,2-Tetrachloroethane	<0.500		0.500		ug/L			05/05/20 13:16	1

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Client Sample ID: TCAAP-01URC2D **Lab Sample ID: 310-180876-3**
Date Collected: 04/30/20 12:35 **Matrix: Ground Water**
Date Received: 05/01/20 09:00

Method: 8260D SIM - Volatile Organic Compounds (GC/MS) (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
1,1,2,2-Tetrachloroethane	<0.500		0.500		ug/L			05/05/20 13:16	1
Tetrachloroethene	<0.500		0.500		ug/L			05/05/20 13:16	1
Tetrahydrofuran	<0.500		0.500		ug/L			05/05/20 13:16	1
Toluene	<0.500		0.500		ug/L			05/05/20 13:16	1
trans-1,2-Dichloroethene	<0.500		0.500		ug/L			05/05/20 13:16	1
trans-1,3-Dichloropropene	<0.500		0.500		ug/L			05/05/20 13:16	1
1,2,3-Trichlorobenzene	<0.500		0.500		ug/L			05/05/20 13:16	1
1,2,4-Trichlorobenzene	<0.500		0.500		ug/L			05/05/20 13:16	1
1,1,1-Trichloroethane	<0.500		0.500		ug/L			05/05/20 13:16	1
1,1,2-Trichloroethane	<0.500		0.500		ug/L			05/05/20 13:16	1
Trichloroethene	<0.100		0.100		ug/L			05/05/20 13:16	1
Trichlorofluoromethane	<0.500		0.500		ug/L			05/05/20 13:16	1
1,2,3-Trichloropropane	<0.00500		0.00500		ug/L			05/05/20 13:16	1
1,1,2-Trichloro-1,2,2-trifluoroethane	<0.500		0.500		ug/L			05/06/20 14:32	1
1,2,4-Trimethylbenzene	<0.500		0.500		ug/L			05/05/20 13:16	1
1,3,5-Trimethylbenzene	<0.500		0.500		ug/L			05/05/20 13:16	1
Vinyl chloride	<0.0400		0.0400		ug/L			05/05/20 13:16	1
Xylenes, Total	<1.00		1.00		ug/L			05/05/20 13:16	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
4-Bromofluorobenzene (Surr)	*100*		*80 - 120*		*05/05/20 13:16*	*1*
4-Bromofluorobenzene (Surr)	*100*		*80 - 120*		*05/06/20 14:32*	*1*
Dibromofluoromethane (Surr)	*103*		*80 - 120*		*05/05/20 13:16*	*1*
Dibromofluoromethane (Surr)	*104*		*80 - 120*		*05/06/20 14:32*	*1*
Toluene-d8 (Surr)	*97*		*80 - 120*		*05/05/20 13:16*	*1*
Toluene-d8 (Surr)	*98*		*80 - 120*		*05/06/20 14:32*	*1*

Client: Bay West Inc. Job ID: 310-180876-1
Project/Site: J130147.9, Twin Cities Army Ammunition P

Client Sample ID: TCAAP-01URC1S **Lab Sample ID: 310-180876-4**
Date Collected: 04/30/20 14:15 **Matrix: Ground Water**
Date Received: 05/01/20 09:00

Method: 8260D SIM - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	<5.00	*1	5.00		ug/L			05/05/20 13:39	1
Allyl chloride	<0.500		0.500		ug/L			05/05/20 13:39	1
Benzene	<0.500		0.500		ug/L			05/05/20 13:39	1
Bromobenzene	<0.500		0.500		ug/L			05/05/20 13:39	1
Bromochloromethane	<0.500		0.500		ug/L			05/05/20 13:39	1
Bromodichloromethane	<0.500		0.500		ug/L			05/05/20 13:39	1
Bromoform	<0.500		0.500		ug/L			05/05/20 13:39	1
Bromomethane	<1.00		1.00		ug/L			05/05/20 13:39	1
2-Butanone (MEK)	<0.500		0.500		ug/L			05/05/20 13:39	1
Carbon tetrachloride	<0.100		0.100		ug/L			05/05/20 13:39	1
Chlorobenzene	<0.500		0.500		ug/L			05/05/20 13:39	1
Chloroethane	<0.500		0.500		ug/L			05/05/20 13:39	1
Chloroform	<0.500		0.500		ug/L			05/05/20 13:39	1
Chloromethane	<1.00		1.00		ug/L			05/05/20 13:39	1
2-Chlorotoluene	<0.500		0.500		ug/L			05/05/20 13:39	1
4-Chlorotoluene	<0.500		0.500		ug/L			05/05/20 13:39	1
cis-1,2-Dichloroethene	**0.961**		0.500		ug/L			05/05/20 13:39	1
cis-1,3-Dichloropropene	<0.500		0.500		ug/L			05/05/20 13:39	1
Dibromochloromethane	<0.500		0.500		ug/L			05/05/20 13:39	1
1,2-Dibromo-3-chloropropane	<0.0500		0.0500		ug/L			05/05/20 13:39	1
1,2-Dibromoethane (EDB)	<0.00500		0.00500		ug/L			05/05/20 13:39	1
Dibromomethane	<0.500		0.500		ug/L			05/05/20 13:39	1
1,2-Dichlorobenzene	<0.500		0.500		ug/L			05/05/20 13:39	1
1,3-Dichlorobenzene	<0.500		0.500		ug/L			05/05/20 13:39	1
1,4-Dichlorobenzene	<0.500		0.500		ug/L			05/05/20 13:39	1
Dichlorodifluoromethane	<0.500		0.500		ug/L			05/05/20 13:39	1
1,1-Dichloroethane	<0.500		0.500		ug/L			05/05/20 13:39	1
1,2-Dichloroethane	<0.100		0.100		ug/L			05/05/20 13:39	1
1,1-Dichloroethene	<0.500		0.500		ug/L			05/05/20 13:39	1
Dichlorofluoromethane	<0.500		0.500		ug/L			05/05/20 13:39	1
1,2-Dichloropropane	<0.500		0.500		ug/L			05/05/20 13:39	1
1,3-Dichloropropane	<0.500		0.500		ug/L			05/05/20 13:39	1
2,2-Dichloropropane	<0.500		0.500		ug/L			05/05/20 13:39	1
1,1-Dichloropropene	<0.500		0.500		ug/L			05/05/20 13:39	1
Diethyl ether	<0.500		0.500		ug/L			05/05/20 13:39	1
Ethylbenzene	<0.500		0.500		ug/L			05/05/20 13:39	1
Hexachlorobutadiene	<0.250		0.250		ug/L			05/05/20 13:39	1
Isopropylbenzene	<0.500		0.500		ug/L			05/05/20 13:39	1
4-Isopropyltoluene	<0.500		0.500		ug/L			05/05/20 13:39	1
Methylene chloride	<1.00		1.00		ug/L			05/05/20 13:39	1
4-Methyl-2-pentanone (MIBK)	<0.500		0.500		ug/L			05/05/20 13:39	1
Methyl tert-butyl ether	<0.500		0.500		ug/L			05/05/20 13:39	1
Naphthalene	<1.00		1.00		ug/L			05/05/20 13:39	1
n-Butylbenzene	<0.500		0.500		ug/L			05/05/20 13:39	1
n-Propylbenzene	<0.500		0.500		ug/L			05/05/20 13:39	1
sec-Butylbenzene	<0.500		0.500		ug/L			05/05/20 13:39	1
Styrene	<0.500		0.500		ug/L			05/05/20 13:39	1
tert-Butylbenzene	<0.500		0.500		ug/L			05/05/20 13:39	1
1,1,1,2-Tetrachloroethane	<0.500		0.500		ug/L			05/05/20 13:39	1

Client Sample ID: TCAAP-01URC1S **Lab Sample ID: 310-180876-4**
Date Collected: 04/30/20 14:15 **Matrix: Ground Water**
Date Received: 05/01/20 09:00

Method: 8260D SIM - Volatile Organic Compounds (GC/MS) (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
1,1,2,2-Tetrachloroethane	<0.500		0.500		ug/L			05/05/20 13:39	1
Tetrachloroethene	<0.500		0.500		ug/L			05/05/20 13:39	1
Tetrahydrofuran	<0.500		0.500		ug/L			05/05/20 13:39	1
Toluene	<0.500		0.500		ug/L			05/05/20 13:39	1
trans-1,2-Dichloroethene	<0.500		0.500		ug/L			05/05/20 13:39	1
trans-1,3-Dichloropropene	<0.500		0.500		ug/L			05/05/20 13:39	1
1,2,3-Trichlorobenzene	<0.500		0.500		ug/L			05/05/20 13:39	1
1,2,4-Trichlorobenzene	<0.500		0.500		ug/L			05/05/20 13:39	1
1,1,1-Trichloroethane	<0.500		0.500		ug/L			05/05/20 13:39	1
1,1,2-Trichloroethane	<0.500		0.500		ug/L			05/05/20 13:39	1
Trichloroethene	<0.100		0.100		ug/L			05/05/20 13:39	1
Trichlorofluoromethane	<0.500		0.500		ug/L			05/05/20 13:39	1
1,2,3-Trichloropropane	<0.00500		0.00500		ug/L			05/05/20 13:39	1
1,1,2-Trichloro-1,2,2-trifluoroethane	<0.500		0.500		ug/L			05/06/20 14:56	1
1,2,4-Trimethylbenzene	<0.500		0.500		ug/L			05/05/20 13:39	1
1,3,5-Trimethylbenzene	<0.500		0.500		ug/L			05/05/20 13:39	1
Vinyl chloride	<0.0400		0.0400		ug/L			05/05/20 13:39	1
Xylenes, Total	<1.00		1.00		ug/L			05/05/20 13:39	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
4-Bromofluorobenzene (Surr)	*100*		*80 - 120*		*05/05/20 13:39*	*1*
4-Bromofluorobenzene (Surr)	*99*		*80 - 120*		*05/06/20 14:56*	*1*
Dibromofluoromethane (Surr)	*103*		*80 - 120*		*05/05/20 13:39*	*1*
Dibromofluoromethane (Surr)	*104*		*80 - 120*		*05/06/20 14:56*	*1*
Toluene-d8 (Surr)	*97*		*80 - 120*		*05/05/20 13:39*	*1*
Toluene-d8 (Surr)	*98*		*80 - 120*		*05/06/20 14:56*	*1*

Client Sample ID: TCAAP-01URC1D

Lab Sample ID: 310-180876-5

Date Collected: 04/30/20 13:40
Matrix: Ground Water
Date Received: 05/01/20 09:00

Method: 8260D SIM - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	<5.00	*1	5.00		ug/L			05/05/20 14:03	1
Allyl chloride	<0.500		0.500		ug/L			05/05/20 14:03	1
Benzene	<0.500		0.500		ug/L			05/05/20 14:03	1
Bromobenzene	<0.500		0.500		ug/L			05/05/20 14:03	1
Bromochloromethane	<0.500		0.500		ug/L			05/05/20 14:03	1
Bromodichloromethane	<0.500		0.500		ug/L			05/05/20 14:03	1
Bromoform	<0.500		0.500		ug/L			05/05/20 14:03	1
Bromomethane	<1.00		1.00		ug/L			05/05/20 14:03	1
2-Butanone (MEK)	<0.500		0.500		ug/L			05/05/20 14:03	1
Carbon tetrachloride	<0.100		0.100		ug/L			05/05/20 14:03	1
Chlorobenzene	<0.500		0.500		ug/L			05/05/20 14:03	1
Chloroethane	<0.500		0.500		ug/L			05/05/20 14:03	1
Chloroform	<0.500		0.500		ug/L			05/05/20 14:03	1
Chloromethane	<1.00		1.00		ug/L			05/05/20 14:03	1
2-Chlorotoluene	<0.500		0.500		ug/L			05/05/20 14:03	1
4-Chlorotoluene	<0.500		0.500		ug/L			05/05/20 14:03	1
cis-1,2-Dichloroethene	**2.22**		0.500		ug/L			05/05/20 14:03	1
cis-1,3-Dichloropropene	<0.500		0.500		ug/L			05/05/20 14:03	1
Dibromochloromethane	<0.500		0.500		ug/L			05/05/20 14:03	1
1,2-Dibromo-3-chloropropane	<0.0500		0.0500		ug/L			05/05/20 14:03	1
1,2-Dibromoethane (EDB)	<0.00500		0.00500		ug/L			05/05/20 14:03	1
Dibromomethane	<0.500		0.500		ug/L			05/05/20 14:03	1
1,2-Dichlorobenzene	<0.500		0.500		ug/L			05/05/20 14:03	1
1,3-Dichlorobenzene	<0.500		0.500		ug/L			05/05/20 14:03	1
1,4-Dichlorobenzene	<0.500		0.500		ug/L			05/05/20 14:03	1
Dichlorodifluoromethane	<0.500		0.500		ug/L			05/05/20 14:03	1
1,1-Dichloroethane	<0.500		0.500		ug/L			05/05/20 14:03	1
1,2-Dichloroethane	<0.100		0.100		ug/L			05/05/20 14:03	1
1,1-Dichloroethene	<0.500		0.500		ug/L			05/05/20 14:03	1
Dichlorofluoromethane	<0.500		0.500		ug/L			05/05/20 14:03	1
1,2-Dichloropropane	<0.500		0.500		ug/L			05/05/20 14:03	1
1,3-Dichloropropane	<0.500		0.500		ug/L			05/05/20 14:03	1
2,2-Dichloropropane	<0.500		0.500		ug/L			05/05/20 14:03	1
1,1-Dichloropropene	<0.500		0.500		ug/L			05/05/20 14:03	1
Diethyl ether	<0.500		0.500		ug/L			05/05/20 14:03	1
Ethylbenzene	<0.500		0.500		ug/L			05/05/20 14:03	1
Hexachlorobutadiene	<0.250		0.250		ug/L			05/05/20 14:03	1
Isopropylbenzene	<0.500		0.500		ug/L			05/05/20 14:03	1
4-Isopropyltoluene	<0.500		0.500		ug/L			05/05/20 14:03	1
Methylene chloride	<1.00		1.00		ug/L			05/05/20 14:03	1
4-Methyl-2-pentanone (MIBK)	<0.500		0.500		ug/L			05/05/20 14:03	1
Methyl tert-butyl ether	<0.500		0.500		ug/L			05/05/20 14:03	1
Naphthalene	<1.00		1.00		ug/L			05/05/20 14:03	1
n-Butylbenzene	<0.500		0.500		ug/L			05/05/20 14:03	1
n-Propylbenzene	<0.500		0.500		ug/L			05/05/20 14:03	1
sec-Butylbenzene	<0.500		0.500		ug/L			05/05/20 14:03	1
Styrene	<0.500		0.500		ug/L			05/05/20 14:03	1
tert-Butylbenzene	<0.500		0.500		ug/L			05/05/20 14:03	1
1,1,1,2-Tetrachloroethane	<0.500		0.500		ug/L			05/05/20 14:03	1

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Client Sample ID: TCAAP-01URC1D **Lab Sample ID: 310-180876-5**
Date Collected: 04/30/20 13:40 **Matrix: Ground Water**
Date Received: 05/01/20 09:00

Method: 8260D SIM - Volatile Organic Compounds (GC/MS) (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
1,1,2,2-Tetrachloroethane	<0.500		0.500		ug/L			05/05/20 14:03	1
Tetrachloroethene	<0.500		0.500		ug/L			05/05/20 14:03	1
Tetrahydrofuran	<0.500		0.500		ug/L			05/05/20 14:03	1
Toluene	<0.500		0.500		ug/L			05/05/20 14:03	1
trans-1,2-Dichloroethene	<0.500		0.500		ug/L			05/05/20 14:03	1
trans-1,3-Dichloropropene	<0.500		0.500		ug/L			05/05/20 14:03	1
1,2,3-Trichlorobenzene	<0.500		0.500		ug/L			05/05/20 14:03	1
1,2,4-Trichlorobenzene	<0.500		0.500		ug/L			05/05/20 14:03	1
1,1,1-Trichloroethane	<0.500		0.500		ug/L			05/05/20 14:03	1
1,1,2-Trichloroethane	<0.500		0.500		ug/L			05/05/20 14:03	1
Trichloroethene	<0.100		0.100		ug/L			05/05/20 14:03	1
Trichlorofluoromethane	<0.500		0.500		ug/L			05/05/20 14:03	1
1,2,3-Trichloropropane	<0.00500		0.00500		ug/L			05/05/20 14:03	1
1,1,2-Trichloro-1,2,2-trifluoroethane	<0.500		0.500		ug/L			05/07/20 14:00	1
1,2,4-Trimethylbenzene	<0.500		0.500		ug/L			05/05/20 14:03	1
1,3,5-Trimethylbenzene	<0.500		0.500		ug/L			05/05/20 14:03	1
Vinyl chloride	<0.0400		0.0400		ug/L			05/05/20 14:03	1
Xylenes, Total	<1.00		1.00		ug/L			05/05/20 14:03	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
4-Bromofluorobenzene (Surr)	*102*		*80 - 120*		*05/05/20 14:03*	*1*
4-Bromofluorobenzene (Surr)	*99*		*80 - 120*		*05/07/20 14:00*	*1*
Dibromofluoromethane (Surr)	*104*		*80 - 120*		*05/05/20 14:03*	*1*
Dibromofluoromethane (Surr)	*106*		*80 - 120*		*05/07/20 14:00*	*1*
Toluene-d8 (Surr)	*98*		*80 - 120*		*05/05/20 14:03*	*1*
Toluene-d8 (Surr)	*98*		*80 - 120*		*05/07/20 14:00*	*1*

Client Sample ID: Trip Blank

Lab Sample ID: 310-180876-6

Date Collected: 04/30/20 09:00
Matrix: Water
Date Received: 05/01/20 09:00

Method: 8260D SIM - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	<5.00	*1	5.00		ug/L			05/05/20 10:57	1
Allyl chloride	<0.500		0.500		ug/L			05/05/20 10:57	1
Benzene	<0.500		0.500		ug/L			05/05/20 10:57	1
Bromobenzene	<0.500		0.500		ug/L			05/05/20 10:57	1
Bromochloromethane	<0.500		0.500		ug/L			05/05/20 10:57	1
Bromodichloromethane	<0.500		0.500		ug/L			05/05/20 10:57	1
Bromoform	<0.500		0.500		ug/L			05/05/20 10:57	1
Bromomethane	<1.00		1.00		ug/L			05/05/20 10:57	1
2-Butanone (MEK)	<0.500		0.500		ug/L			05/05/20 10:57	1
Carbon tetrachloride	<0.100		0.100		ug/L			05/05/20 10:57	1
Chlorobenzene	<0.500		0.500		ug/L			05/05/20 10:57	1
Chloroethane	<0.500		0.500		ug/L			05/05/20 10:57	1
Chloroform	<0.500		0.500		ug/L			05/05/20 10:57	1
Chloromethane	<1.00		1.00		ug/L			05/05/20 10:57	1
2-Chlorotoluene	<0.500		0.500		ug/L			05/05/20 10:57	1
4-Chlorotoluene	<0.500		0.500		ug/L			05/05/20 10:57	1
cis-1,2-Dichloroethene	<0.500		0.500		ug/L			05/05/20 10:57	1
cis-1,3-Dichloropropene	<0.500		0.500		ug/L			05/05/20 10:57	1
Dibromochloromethane	<0.500		0.500		ug/L			05/05/20 10:57	1
1,2-Dibromo-3-chloropropane	<0.0500		0.0500		ug/L			05/05/20 10:57	1
1,2-Dibromoethane (EDB)	<0.00500		0.00500		ug/L			05/05/20 10:57	1
Dibromomethane	<0.500		0.500		ug/L			05/05/20 10:57	1
1,2-Dichlorobenzene	<0.500		0.500		ug/L			05/05/20 10:57	1
1,3-Dichlorobenzene	<0.500		0.500		ug/L			05/05/20 10:57	1
1,4-Dichlorobenzene	<0.500		0.500		ug/L			05/05/20 10:57	1
Dichlorodifluoromethane	<0.500		0.500		ug/L			05/05/20 10:57	1
1,1-Dichloroethane	<0.500		0.500		ug/L			05/05/20 10:57	1
1,2-Dichloroethane	<0.100		0.100		ug/L			05/05/20 10:57	1
1,1-Dichloroethene	<0.500		0.500		ug/L			05/05/20 10:57	1
Dichlorofluoromethane	<0.500		0.500		ug/L			05/05/20 10:57	1
1,2-Dichloropropane	<0.500		0.500		ug/L			05/05/20 10:57	1
1,3-Dichloropropane	<0.500		0.500		ug/L			05/05/20 10:57	1
2,2-Dichloropropane	<0.500		0.500		ug/L			05/05/20 10:57	1
1,1-Dichloropropene	<0.500		0.500		ug/L			05/05/20 10:57	1
Diethyl ether	<0.500		0.500		ug/L			05/05/20 10:57	1
Ethylbenzene	<0.500		0.500		ug/L			05/05/20 10:57	1
Hexachlorobutadiene	<0.250		0.250		ug/L			05/05/20 10:57	1
Isopropylbenzene	<0.500		0.500		ug/L			05/05/20 10:57	1
4-Isopropyltoluene	<0.500		0.500		ug/L			05/05/20 10:57	1
Methylene chloride	<1.00		1.00		ug/L			05/05/20 10:57	1
4-Methyl-2-pentanone (MIBK)	<0.500		0.500		ug/L			05/05/20 10:57	1
Methyl tert-butyl ether	<0.500		0.500		ug/L			05/05/20 10:57	1
Naphthalene	<1.00		1.00		ug/L			05/05/20 10:57	1
n-Butylbenzene	<0.500		0.500		ug/L			05/05/20 10:57	1
n-Propylbenzene	<0.500		0.500		ug/L			05/05/20 10:57	1
sec-Butylbenzene	<0.500		0.500		ug/L			05/05/20 10:57	1
Styrene	<0.500		0.500		ug/L			05/05/20 10:57	1
tert-Butylbenzene	<0.500		0.500		ug/L			05/05/20 10:57	1
1,1,1,2-Tetrachloroethane	<0.500		0.500		ug/L			05/05/20 10:57	1

Client Sample ID: Trip Blank — Lab Sample ID: 310-180876-6

Date Collected: 04/30/20 09:00 **Matrix: Water**
Date Received: 05/01/20 09:00

Method: 8260D SIM - Volatile Organic Compounds (GC/MS) (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
1,1,2,2-Tetrachloroethane	<0.500		0.500		ug/L			05/05/20 10:57	1
Tetrachloroethene	<0.500		0.500		ug/L			05/05/20 10:57	1
Tetrahydrofuran	**0.591**		0.500		ug/L			05/06/20 11:04	1
Toluene	<0.500		0.500		ug/L			05/05/20 10:57	1
trans-1,2-Dichloroethene	<0.500		0.500		ug/L			05/05/20 10:57	1
trans-1,3-Dichloropropene	<0.500		0.500		ug/L			05/05/20 10:57	1
1,2,3-Trichlorobenzene	<0.500		0.500		ug/L			05/05/20 10:57	1
1,2,4-Trichlorobenzene	<0.500		0.500		ug/L			05/05/20 10:57	1
1,1,1-Trichloroethane	<0.500		0.500		ug/L			05/05/20 10:57	1
1,1,2-Trichloroethane	<0.500		0.500		ug/L			05/05/20 10:57	1
Trichloroethene	<0.100		0.100		ug/L			05/05/20 10:57	1
Trichlorofluoromethane	<0.500		0.500		ug/L			05/05/20 10:57	1
1,2,3-Trichloropropane	<0.00500		0.00500		ug/L			05/05/20 10:57	1
1,1,2-Trichloro-1,2,2-trifluoroethane	<0.500		0.500		ug/L			05/06/20 11:04	1
1,2,4-Trimethylbenzene	<0.500		0.500		ug/L			05/05/20 10:57	1
1,3,5-Trimethylbenzene	<0.500		0.500		ug/L			05/05/20 10:57	1
Vinyl chloride	<0.0400		0.0400		ug/L			05/05/20 10:57	1
Xylenes, Total	<1.00		1.00		ug/L			05/05/20 10:57	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
4-Bromofluorobenzene (Surr)	*100*		*80 - 120*		*05/05/20 10:57*	*1*
4-Bromofluorobenzene (Surr)	*100*		*80 - 120*		*05/06/20 11:04*	*1*
Dibromofluoromethane (Surr)	*103*		*80 - 120*		*05/05/20 10:57*	*1*
Dibromofluoromethane (Surr)	*103*		*80 - 120*		*05/06/20 11:04*	*1*
Toluene-d8 (Surr)	*98*		*80 - 120*		*05/05/20 10:57*	*1*
Toluene-d8 (Surr)	*98*		*80 - 120*		*05/06/20 11:04*	*1*

Qualifiers

GC/MS VOA

Qualifier	Qualifier Description
*	LCS or LCSD is outside acceptance limits.
*1	LCS/LCSD RPD exceeds control limits.
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
MQL	Method Quantitation Limit
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

Client: Bay West Inc. Job ID: 310-180876-1
Project/Site: J130147.9, Twin Cities Army Ammunition P

Method: 8260D SIM - Volatile Organic Compounds (GC/MS)

Matrix: Ground Water **Prep Type: Total/NA**

		Percent Surrogate Recovery (Acceptance Limits)		
		BFB	DBFM	TOL
Lab Sample ID	Client Sample ID	(80-120)	(80-120)	(80-120)
310-180876-1	TCAAP-01URC2S	101	103	98
310-180876-1	TCAAP-01URC2S	100	105	98
310-180876-2	TCAAP-01URC2S-D	100	103	97
310-180876-2	TCAAP-01URC2S-D	100	104	97
310-180876-3	TCAAP-01URC2D	100	103	97
310-180876-3	TCAAP-01URC2D	100	104	98
310-180876-4	TCAAP-01URC1S	100	103	97
310-180876-4	TCAAP-01URC1S	99	104	98
310-180876-5	TCAAP-01URC1D	102	104	98
310-180876-5	TCAAP-01URC1D	99	106	98

Surrogate Legend

BFB = 4-Bromofluorobenzene (Surr)
DBFM = Dibromofluoromethane (Surr)
TOL = Toluene-d8 (Surr)

Method: 8260D SIM - Volatile Organic Compounds (GC/MS)

Matrix: Water **Prep Type: Total/NA**

		Percent Surrogate Recovery (Acceptance Limits)		
		BFB	DBFM	TOL
Lab Sample ID	Client Sample ID	(80-120)	(80-120)	(80-120)
310-180876-6	Trip Blank	100	103	98
310-180876-6	Trip Blank	100	103	98
LCS 310-277822/7	Lab Control Sample	99	99	99
LCS 310-277920/7	Lab Control Sample	100	104	99
LCS 310-278043/7	Lab Control Sample	98	105	99
LCSD 310-277822/8	Lab Control Sample Dup	100	104	99
MB 310-277822/6	Method Blank	100	104	98
MB 310-277920/6	Method Blank	101	102	103
MB 310-278043/6	Method Blank	100	105	97

Surrogate Legend

BFB = 4-Bromofluorobenzene (Surr)
DBFM = Dibromofluoromethane (Surr)
TOL = Toluene-d8 (Surr)

Method: 8260D SIM - Volatile Organic Compounds (GC/MS)

Lab Sample ID: MB 310-277822/6
Client Sample ID: Method Blank
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 277822

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	<5.00		5.00		ug/L			05/05/20 09:24	1
Allyl chloride	<0.500		0.500		ug/L			05/05/20 09:24	1
Benzene	<0.500		0.500		ug/L			05/05/20 09:24	1
Bromobenzene	<0.500		0.500		ug/L			05/05/20 09:24	1
Bromochloromethane	<0.500		0.500		ug/L			05/05/20 09:24	1
Bromodichloromethane	<0.500		0.500		ug/L			05/05/20 09:24	1
Bromoform	<0.500		0.500		ug/L			05/05/20 09:24	1
Bromomethane	<1.00		1.00		ug/L			05/05/20 09:24	1
2-Butanone (MEK)	<0.500		0.500		ug/L			05/05/20 09:24	1
Carbon tetrachloride	<0.100		0.100		ug/L			05/05/20 09:24	1
Chlorobenzene	<0.500		0.500		ug/L			05/05/20 09:24	1
Chloroethane	<0.500		0.500		ug/L			05/05/20 09:24	1
Chloroform	<0.500		0.500		ug/L			05/05/20 09:24	1
Chloromethane	<1.00		1.00		ug/L			05/05/20 09:24	1
2-Chlorotoluene	<0.500		0.500		ug/L			05/05/20 09:24	1
4-Chlorotoluene	<0.500		0.500		ug/L			05/05/20 09:24	1
cis-1,2-Dichloroethene	<0.500		0.500		ug/L			05/05/20 09:24	1
cis-1,3-Dichloropropene	<0.500		0.500		ug/L			05/05/20 09:24	1
Dibromochloromethane	<0.500		0.500		ug/L			05/05/20 09:24	1
1,2-Dibromo-3-chloropropane	<0.0500		0.0500		ug/L			05/05/20 09:24	1
1,2-Dibromoethane (EDB)	<0.00500		0.00500		ug/L			05/05/20 09:24	1
Dibromomethane	<0.500		0.500		ug/L			05/05/20 09:24	1
1,2-Dichlorobenzene	<0.500		0.500		ug/L			05/05/20 09:24	1
1,3-Dichlorobenzene	<0.500		0.500		ug/L			05/05/20 09:24	1
1,4-Dichlorobenzene	<0.500		0.500		ug/L			05/05/20 09:24	1
Dichlorodifluoromethane	<0.500		0.500		ug/L			05/05/20 09:24	1
1,1-Dichloroethane	<0.500		0.500		ug/L			05/05/20 09:24	1
1,2-Dichloroethane	<0.100		0.100		ug/L			05/05/20 09:24	1
1,1-Dichloroethene	<0.500		0.500		ug/L			05/05/20 09:24	1
Dichlorofluoromethane	<0.500		0.500		ug/L			05/05/20 09:24	1
1,2-Dichloropropane	<0.500		0.500		ug/L			05/05/20 09:24	1
1,3-Dichloropropane	<0.500		0.500		ug/L			05/05/20 09:24	1
2,2-Dichloropropane	<0.500		0.500		ug/L			05/05/20 09:24	1
1,1-Dichloropropene	<0.500		0.500		ug/L			05/05/20 09:24	1
Diethyl ether	<0.500		0.500		ug/L			05/05/20 09:24	1
Ethylbenzene	<0.500		0.500		ug/L			05/05/20 09:24	1
Hexachlorobutadiene	<0.250		0.250		ug/L			05/05/20 09:24	1
Isopropylbenzene	<0.500		0.500		ug/L			05/05/20 09:24	1
4-Isopropyltoluene	<0.500		0.500		ug/L			05/05/20 09:24	1
Methylene chloride	<1.00		1.00		ug/L			05/05/20 09:24	1
4-Methyl-2-pentanone (MIBK)	<0.500		0.500		ug/L			05/05/20 09:24	1
Methyl tert-butyl ether	<0.500		0.500		ug/L			05/05/20 09:24	1
Naphthalene	<1.00		1.00		ug/L			05/05/20 09:24	1
n-Butylbenzene	<0.500		0.500		ug/L			05/05/20 09:24	1
n-Propylbenzene	<0.500		0.500		ug/L			05/05/20 09:24	1
sec-Butylbenzene	<0.500		0.500		ug/L			05/05/20 09:24	1
Styrene	<0.500		0.500		ug/L			05/05/20 09:24	1
tert-Butylbenzene	<0.500		0.500		ug/L			05/05/20 09:24	1

Method: 8260D SIM - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: MB 310-277822/6 **Client Sample ID: Method Blank**
Matrix: Water **Prep Type: Total/NA**
Analysis Batch: 277822

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
1,1,1,2-Tetrachloroethane	<0.500		0.500		ug/L			05/05/20 09:24	1
1,1,2,2-Tetrachloroethane	<0.500		0.500		ug/L			05/05/20 09:24	1
Tetrachloroethene	<0.500		0.500		ug/L			05/05/20 09:24	1
Tetrahydrofuran	<0.500		0.500		ug/L			05/05/20 09:24	1
Toluene	<0.500		0.500		ug/L			05/05/20 09:24	1
trans-1,2-Dichloroethene	<0.500		0.500		ug/L			05/05/20 09:24	1
trans-1,3-Dichloropropene	<0.500		0.500		ug/L			05/05/20 09:24	1
1,2,3-Trichlorobenzene	<0.500		0.500		ug/L			05/05/20 09:24	1
1,2,4-Trichlorobenzene	<0.500		0.500		ug/L			05/05/20 09:24	1
1,1,1-Trichloroethane	<0.500		0.500		ug/L			05/05/20 09:24	1
1,1,2-Trichloroethane	<0.500		0.500		ug/L			05/05/20 09:24	1
Trichloroethene	<0.100		0.100		ug/L			05/05/20 09:24	1
Trichlorofluoromethane	<0.500		0.500		ug/L			05/05/20 09:24	1
1,2,3-Trichloropropane	<0.00500		0.00500		ug/L			05/05/20 09:24	1
1,1,2-Trichloro-1,2,2-trifluoroethane	<0.500		0.500		ug/L			05/05/20 09:24	1
1,2,4-Trimethylbenzene	<0.500		0.500		ug/L			05/05/20 09:24	1
1,3,5-Trimethylbenzene	<0.500		0.500		ug/L			05/05/20 09:24	1
Vinyl chloride	<0.0400		0.0400		ug/L			05/05/20 09:24	1
Xylenes, Total	<1.00		1.00		ug/L			05/05/20 09:24	1

Surrogate	*MB %Recovery*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
4-Bromofluorobenzene (Surr)	*100*		*80 - 120*		*05/05/20 09:24*	*1*
Dibromofluoromethane (Surr)	*104*		*80 - 120*		*05/05/20 09:24*	*1*
Toluene-d8 (Surr)	*98*		*80 - 120*		*05/05/20 09:24*	*1*

Lab Sample ID: LCS 310-277822/7 **Client Sample ID: Lab Control Sample**
Matrix: Water **Prep Type: Total/NA**
Analysis Batch: 277822

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Acetone	1.00	0.7842	J	ug/L		78	50 - 150
Allyl chloride	1.00	0.8161		ug/L		82	50 - 150
Benzene	1.00	0.9960		ug/L		100	77 - 120
Bromobenzene	1.00	0.9378		ug/L		94	70 - 120
Bromochloromethane	1.00	0.9298		ug/L		93	73 - 132
Bromodichloromethane	1.00	0.9582		ug/L		96	73 - 120
Bromoform	1.00	0.8426		ug/L		84	57 - 120
Bromomethane	1.00	1.053		ug/L		105	38 - 150
2-Butanone (MEK)	1.00	0.9476		ug/L		95	50 - 150
Carbon tetrachloride	1.00	0.9396		ug/L		94	68 - 130
Chlorobenzene	1.00	0.9873		ug/L		99	74 - 120
Chloroethane	1.00	1.181		ug/L		118	69 - 129
Chloroform	1.00	1.053		ug/L		105	78 - 121
Chloromethane	1.00	1.195		ug/L		119	50 - 150
2-Chlorotoluene	1.00	0.9736		ug/L		97	71 - 120
4-Chlorotoluene	1.00	0.9431		ug/L		94	71 - 120
cis-1,2-Dichloroethene	1.00	0.9403		ug/L		94	77 - 120
cis-1,3-Dichloropropene	1.00	1.046		ug/L		105	70 - 120

Method: 8260D SIM - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: LCS 310-277822/7 **Client Sample ID: Lab Control Sample**
Matrix: Water **Prep Type: Total/NA**
Analysis Batch: 277822

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Dibromochloromethane	1.00	0.8479		ug/L		85	66 - 120
1,2-Dibromo-3-chloropropane	1.00	0.7604		ug/L		76	50 - 150
1,2-Dibromoethane (EDB)	1.00	0.9267		ug/L		93	71 - 127
Dibromomethane	1.00	0.9996		ug/L		100	76 - 125
1,2-Dichlorobenzene	1.00	0.8839		ug/L		88	66 - 120
1,3-Dichlorobenzene	1.00	0.9138		ug/L		91	67 - 120
1,4-Dichlorobenzene	1.00	0.9532		ug/L		95	68 - 120
Dichlorodifluoromethane	1.00	1.005		ug/L		100	50 - 150
1,1-Dichloroethane	1.00	0.9891		ug/L		99	75 - 125
1,2-Dichloroethane	1.00	1.040		ug/L		104	72 - 129
1,1-Dichloroethene	1.00	0.7883		ug/L		79	75 - 124
Dichlorofluoromethane	1.00	0.9092		ug/L		91	70 - 131
1,2-Dichloropropane	1.00	1.012		ug/L		101	75 - 123
1,3-Dichloropropane	1.00	0.9838		ug/L		98	75 - 123
2,2-Dichloropropane	1.00	0.9893		ug/L		99	50 - 150
1,1-Dichloropropene	1.00	0.9662		ug/L		97	77 - 124
Diethyl ether	1.00	0.7523		ug/L		75	71 - 122
Ethylbenzene	1.00	0.9682		ug/L		97	73 - 120
Hexachlorobutadiene	1.00	0.7792		ug/L		78	50 - 150
Isopropylbenzene	1.00	0.9394		ug/L		94	69 - 120
4-Isopropyltoluene	1.00	0.8901		ug/L		89	68 - 120
Methylene chloride	1.00	1.022		ug/L		102	50 - 150
4-Methyl-2-pentanone (MIBK)	1.00	0.8638		ug/L		86	59 - 126
Methyl tert-butyl ether	1.00	0.9204		ug/L		92	72 - 121
Naphthalene	1.00	0.8829	J	ug/L		88	50 - 150
n-Butylbenzene	1.00	0.8305		ug/L		83	63 - 120
n-Propylbenzene	1.00	0.9228		ug/L		92	70 - 120
sec-Butylbenzene	1.00	0.8984		ug/L		90	64 - 120
Styrene	1.00	0.9092		ug/L		91	70 - 120
tert-Butylbenzene	1.00	0.8289		ug/L		83	64 - 120
1,1,1,2-Tetrachloroethane	1.00	0.9373		ug/L		94	72 - 120
1,1,2,2-Tetrachloroethane	1.00	0.9219		ug/L		92	63 - 122
Tetrachloroethene	1.00	0.9652		ug/L		97	72 - 129
Tetrahydrofuran	1.00	0.9129		ug/L		91	63 - 128
Toluene	1.00	1.002		ug/L		100	74 - 120
trans-1,2-Dichloroethene	1.00	0.9368		ug/L		94	75 - 122
trans-1,3-Dichloropropene	1.00	1.055		ug/L		106	69 - 120
1,2,3-Trichlorobenzene	1.00	0.7346		ug/L		73	50 - 150
1,2,4-Trichlorobenzene	1.00	0.7242		ug/L		72	59 - 120
1,1,1-Trichloroethane	1.00	0.9026		ug/L		90	76 - 127
1,1,2-Trichloroethane	1.00	0.9720		ug/L		97	69 - 127
Trichloroethene	1.00	1.017		ug/L		102	63 - 137
Trichlorofluoromethane	1.00	0.9445		ug/L		94	68 - 146
1,2,3-Trichloropropane	1.00	0.9058		ug/L		91	72 - 128
1,2,4-Trimethylbenzene	1.00	0.8805		ug/L		88	67 - 120
1,3,5-Trimethylbenzene	1.00	0.9316		ug/L		93	68 - 120
Vinyl chloride	1.00	1.043		ug/L		104	72 - 124
Xylenes, Total	2.00	1.889		ug/L		94	69 - 120

Method: 8260D SIM - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: LCS 310-277822/7
Client Sample ID: Lab Control Sample
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 277822

Surrogate	LCS %Recovery	LCS Qualifier	Limits
4-Bromofluorobenzene (Surr)	*99*		*80 - 120*
Dibromofluoromethane (Surr)	*99*		*80 - 120*
Toluene-d8 (Surr)	*99*		*80 - 120*

Lab Sample ID: LCSD 310-277822/8
Client Sample ID: Lab Control Sample Dup
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 277822

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Acetone	1.00	1.133	J *1	ug/L		113	50 - 150	36	24
Allyl chloride	1.00	0.9746		ug/L		97	50 - 150	18	35
Benzene	1.00	1.029		ug/L		103	77 - 120	3	21
Bromobenzene	1.00	0.9719		ug/L		97	70 - 120	4	23
Bromochloromethane	1.00	0.9894		ug/L		99	73 - 132	6	24
Bromodichloromethane	1.00	0.9639		ug/L		96	73 - 120	1	21
Bromoform	1.00	0.8422		ug/L		84	57 - 120	0	24
Bromomethane	1.00	1.077		ug/L		108	38 - 150	2	35
2-Butanone (MEK)	1.00	1.016		ug/L		102	50 - 150	7	20
Carbon tetrachloride	1.00	0.9767		ug/L		98	68 - 130	4	30
Chlorobenzene	1.00	1.004		ug/L		100	74 - 120	2	21
Chloroethane	1.00	1.053		ug/L		105	69 - 129	11	20
Chloroform	1.00	1.127		ug/L		113	78 - 121	7	20
Chloromethane	1.00	1.245		ug/L		124	50 - 150	4	25
2-Chlorotoluene	1.00	0.9947		ug/L		99	71 - 120	2	23
4-Chlorotoluene	1.00	0.9706		ug/L		97	71 - 120	3	24
cis-1,2-Dichloroethene	1.00	1.004		ug/L		100	77 - 120	7	22
cis-1,3-Dichloropropene	1.00	1.053		ug/L		105	70 - 120	1	22
Dibromochloromethane	1.00	0.8465		ug/L		85	66 - 120	0	23
1,2-Dibromo-3-chloropropane	1.00	0.7681		ug/L		77	50 - 150	1	33
1,2-Dibromoethane (EDB)	1.00	0.9486		ug/L		95	71 - 127	2	35
Dibromomethane	1.00	1.025		ug/L		103	76 - 125	3	21
1,2-Dichlorobenzene	1.00	0.9086		ug/L		91	66 - 120	3	23
1,3-Dichlorobenzene	1.00	0.9466		ug/L		95	67 - 120	4	25
1,4-Dichlorobenzene	1.00	0.9797		ug/L		98	68 - 120	3	22
Dichlorodifluoromethane	1.00	1.014		ug/L		101	50 - 150	1	25
1,1-Dichloroethane	1.00	1.052		ug/L		105	75 - 125	6	23
1,2-Dichloroethane	1.00	1.119		ug/L		112	72 - 129	7	33
1,1-Dichloroethene	1.00	0.8756		ug/L		88	75 - 124	11	24
Dichlorofluoromethane	1.00	0.9493		ug/L		95	70 - 131	4	25
1,2-Dichloropropane	1.00	1.031		ug/L		103	75 - 123	2	21
1,3-Dichloropropane	1.00	1.020		ug/L		102	75 - 123	4	25
2,2-Dichloropropane	1.00	1.050		ug/L		105	50 - 150	6	22
1,1-Dichloropropene	1.00	1.005		ug/L		100	77 - 124	4	22
Diethyl ether	1.00	0.8855		ug/L		89	71 - 122	16	24
Ethylbenzene	1.00	0.9930		ug/L		99	73 - 120	3	23
Hexachlorobutadiene	1.00	0.8056		ug/L		81	50 - 150	3	27
Isopropylbenzene	1.00	0.9594		ug/L		96	69 - 120	2	22
4-Isopropyltoluene	1.00	0.9104		ug/L		91	68 - 120	2	27

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Method: 8260D SIM - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: LCSD 310-277822/8
Matrix: Water
Analysis Batch: 277822

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Methylene chloride	1.00	1.160		ug/L		116	50 - 150	13	23
4-Methyl-2-pentanone (MIBK)	1.00	0.8851		ug/L		89	59 - 126	2	20
Methyl tert-butyl ether	1.00	0.9904		ug/L		99	72 - 121	7	21
Naphthalene	1.00	0.9065	J	ug/L		91	50 - 150	3	34
n-Butylbenzene	1.00	0.8465		ug/L		85	63 - 120	2	23
n-Propylbenzene	1.00	0.9454		ug/L		95	70 - 120	2	24
sec-Butylbenzene	1.00	0.9180		ug/L		92	64 - 120	2	23
Styrene	1.00	0.9256		ug/L		93	70 - 120	2	25
tert-Butylbenzene	1.00	0.8535		ug/L		85	64 - 120	3	23
1,1,1,2-Tetrachloroethane	1.00	0.9447		ug/L		94	72 - 120	1	21
1,1,2,2-Tetrachloroethane	1.00	0.9411		ug/L		94	63 - 122	2	20
Tetrachloroethene	1.00	0.9711		ug/L		97	72 - 129	1	21
Tetrahydrofuran	1.00	0.9339		ug/L		93	63 - 128	2	24
Toluene	1.00	1.010		ug/L		101	74 - 120	1	23
trans-1,2-Dichloroethene	1.00	1.017		ug/L		102	75 - 122	8	23
trans-1,3-Dichloropropene	1.00	1.071		ug/L		107	69 - 120	1	25
1,2,3-Trichlorobenzene	1.00	0.7658		ug/L		77	50 - 150	4	27
1,2,4-Trichlorobenzene	1.00	0.7626		ug/L		76	59 - 120	5	27
1,1,1-Trichloroethane	1.00	0.9481		ug/L		95	76 - 127	5	21
1,1,2-Trichloroethane	1.00	0.9919		ug/L		99	69 - 127	2	22
Trichloroethene	1.00	1.033		ug/L		103	63 - 137	2	28
Trichlorofluoromethane	1.00	0.9742		ug/L		97	68 - 146	3	20
1,2,3-Trichloropropane	1.00	0.9297		ug/L		93	72 - 128	3	35
1,2,4-Trimethylbenzene	1.00	0.9116		ug/L		91	67 - 120	3	26
1,3,5-Trimethylbenzene	1.00	0.9537		ug/L		95	68 - 120	2	25
Vinyl chloride	1.00	1.069		ug/L		107	72 - 124	3	24
Xylenes, Total	2.00	1.924		ug/L		96	69 - 120	2	34

Surrogate	*LCSD %Recovery*	*LCSD Qualifier*	*Limits*
4-Bromofluorobenzene (Surr)	*100*		*80 - 120*
Dibromofluoromethane (Surr)	*104*		*80 - 120*
Toluene-d8 (Surr)	*99*		*80 - 120*

Lab Sample ID: MB 310-277920/6
Matrix: Water
Analysis Batch: 277920

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	<5.00		5.00		ug/L			05/06/20 09:30	1
Allyl chloride	<0.500		0.500		ug/L			05/06/20 09:30	1
Benzene	<0.500		0.500		ug/L			05/06/20 09:30	1
Bromobenzene	<0.500		0.500		ug/L			05/06/20 09:30	1
Bromochloromethane	<0.500		0.500		ug/L			05/06/20 09:30	1
Bromodichloromethane	<0.500		0.500		ug/L			05/06/20 09:30	1
Bromoform	<0.500		0.500		ug/L			05/06/20 09:30	1
Bromomethane	<1.00		1.00		ug/L			05/06/20 09:30	1
2-Butanone (MEK)	<0.500		0.500		ug/L			05/06/20 09:30	1
Carbon tetrachloride	<0.100		0.100		ug/L			05/06/20 09:30	1

Method: 8260D SIM - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: MB 310-277920/6 **Client Sample ID: Method Blank**

Matrix: Water **Prep Type: Total/NA**

Analysis Batch: 277920

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chlorobenzene	<0.500		0.500		ug/L			05/06/20 09:30	1
Chloroethane	<0.500		0.500		ug/L			05/06/20 09:30	1
Chloroform	<0.500		0.500		ug/L			05/06/20 09:30	1
Chloromethane	<1.00		1.00		ug/L			05/06/20 09:30	1
2-Chlorotoluene	<0.500		0.500		ug/L			05/06/20 09:30	1
4-Chlorotoluene	<0.500		0.500		ug/L			05/06/20 09:30	1
cis-1,2-Dichloroethene	<0.500		0.500		ug/L			05/06/20 09:30	1
cis-1,3-Dichloropropene	<0.500		0.500		ug/L			05/06/20 09:30	1
Dibromochloromethane	<0.500		0.500		ug/L			05/06/20 09:30	1
1,2-Dibromo-3-chloropropane	<0.0500		0.0500		ug/L			05/06/20 09:30	1
1,2-Dibromoethane (EDB)	<0.00500		0.00500		ug/L			05/06/20 09:30	1
Dibromomethane	<0.500		0.500		ug/L			05/06/20 09:30	1
1,2-Dichlorobenzene	<0.500		0.500		ug/L			05/06/20 09:30	1
1,3-Dichlorobenzene	<0.500		0.500		ug/L			05/06/20 09:30	1
1,4-Dichlorobenzene	<0.500		0.500		ug/L			05/06/20 09:30	1
Dichlorodifluoromethane	<0.500		0.500		ug/L			05/06/20 09:30	1
1,1-Dichloroethane	<0.500		0.500		ug/L			05/06/20 09:30	1
1,2-Dichloroethane	<0.100		0.100		ug/L			05/06/20 09:30	1
1,1-Dichloroethene	<0.500		0.500		ug/L			05/06/20 09:30	1
Dichlorofluoromethane	<0.500		0.500		ug/L			05/06/20 09:30	1
1,2-Dichloropropane	<0.500		0.500		ug/L			05/06/20 09:30	1
1,3-Dichloropropane	<0.500		0.500		ug/L			05/06/20 09:30	1
2,2-Dichloropropane	<0.500		0.500		ug/L			05/06/20 09:30	1
1,1-Dichloropropene	<0.500		0.500		ug/L			05/06/20 09:30	1
Diethyl ether	<0.500		0.500		ug/L			05/06/20 09:30	1
Ethylbenzene	<0.500		0.500		ug/L			05/06/20 09:30	1
Hexachlorobutadiene	<0.250		0.250		ug/L			05/06/20 09:30	1
Isopropylbenzene	<0.500		0.500		ug/L			05/06/20 09:30	1
4-Isopropyltoluene	<0.500		0.500		ug/L			05/06/20 09:30	1
Methylene chloride	<1.00		1.00		ug/L			05/06/20 09:30	1
4-Methyl-2-pentanone (MIBK)	<0.500		0.500		ug/L			05/06/20 09:30	1
Methyl tert-butyl ether	<0.500		0.500		ug/L			05/06/20 09:30	1
Naphthalene	<1.00		1.00		ug/L			05/06/20 09:30	1
n-Butylbenzene	<0.500		0.500		ug/L			05/06/20 09:30	1
n-Propylbenzene	<0.500		0.500		ug/L			05/06/20 09:30	1
sec-Butylbenzene	<0.500		0.500		ug/L			05/06/20 09:30	1
Styrene	<0.500		0.500		ug/L			05/06/20 09:30	1
tert-Butylbenzene	<0.500		0.500		ug/L			05/06/20 09:30	1
1,1,1,2-Tetrachloroethane	<0.500		0.500		ug/L			05/06/20 09:30	1
1,1,2,2-Tetrachloroethane	<0.500		0.500		ug/L			05/06/20 09:30	1
Tetrachloroethene	<0.500		0.500		ug/L			05/06/20 09:30	1
Tetrahydrofuran	<0.500		0.500		ug/L			05/06/20 09:30	1
Toluene	<0.500		0.500		ug/L			05/06/20 09:30	1
trans-1,2-Dichloroethene	<0.500		0.500		ug/L			05/06/20 09:30	1
trans-1,3-Dichloropropene	<0.500		0.500		ug/L			05/06/20 09:30	1
1,2,3-Trichlorobenzene	<0.500		0.500		ug/L			05/06/20 09:30	1
1,2,4-Trichlorobenzene	<0.500		0.500		ug/L			05/06/20 09:30	1
1,1,1-Trichloroethane	<0.500		0.500		ug/L			05/06/20 09:30	1
1,1,2-Trichloroethane	<0.500		0.500		ug/L			05/06/20 09:30	1

Method: 8260D SIM - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: MB 310-277920/6 **Client Sample ID: Method Blank**
Matrix: Water **Prep Type: Total/NA**
Analysis Batch: 277920

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Trichloroethene	<0.100		0.100		ug/L			05/06/20 09:30	1
Trichlorofluoromethane	<0.500		0.500		ug/L			05/06/20 09:30	1
1,2,3-Trichloropropane	<0.00500		0.00500		ug/L			05/06/20 09:30	1
1,1,2-Trichloro-1,2,2-trifluoroethane	<0.500		0.500		ug/L			05/06/20 09:30	1
1,2,4-Trimethylbenzene	<0.500		0.500		ug/L			05/06/20 09:30	1
1,3,5-Trimethylbenzene	<0.500		0.500		ug/L			05/06/20 09:30	1
Vinyl chloride	<0.0400		0.0400		ug/L			05/06/20 09:30	1
Xylenes, Total	<1.00		1.00		ug/L			05/06/20 09:30	1

Surrogate	*MB %Recovery*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
4-Bromofluorobenzene (Surr)	*101*		*80 - 120*		*05/06/20 09:30*	*1*
Dibromofluoromethane (Surr)	*102*		*80 - 120*		*05/06/20 09:30*	*1*
Toluene-d8 (Surr)	*103*		*80 - 120*		*05/06/20 09:30*	*1*

Lab Sample ID: LCS 310-277920/7 **Client Sample ID: Lab Control Sample**
Matrix: Water **Prep Type: Total/NA**
Analysis Batch: 277920

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Acetone	1.00	1.187	J	ug/L		119	50 - 150
Allyl chloride	1.00	1.152		ug/L		115	50 - 150
Benzene	1.00	1.053		ug/L		105	77 - 120
Bromobenzene	1.00	0.9786		ug/L		98	70 - 120
Bromochloromethane	1.00	0.9789		ug/L		98	73 - 132
Bromodichloromethane	1.00	1.059		ug/L		106	73 - 120
Bromoform	1.00	0.8880		ug/L		89	57 - 120
Bromomethane	1.00	1.204		ug/L		120	38 - 150
2-Butanone (MEK)	1.00	1.172		ug/L		117	50 - 150
Carbon tetrachloride	1.00	1.064		ug/L		106	68 - 130
Chlorobenzene	1.00	1.009		ug/L		101	74 - 120
Chloromethane	1.00	1.149		ug/L		115	50 - 150
2-Chlorotoluene	1.00	1.039		ug/L		104	71 - 120
4-Chlorotoluene	1.00	1.038		ug/L		104	71 - 120
cis-1,2-Dichloroethene	1.00	1.057		ug/L		106	77 - 120
cis-1,3-Dichloropropene	1.00	1.133		ug/L		113	70 - 120
Dibromochloromethane	1.00	0.9179		ug/L		92	66 - 120
1,2-Dibromo-3-chloropropane	1.00	0.9160		ug/L		92	50 - 150
1,2-Dibromoethane (EDB)	1.00	1.005		ug/L		100	71 - 127
Dibromomethane	1.00	1.057		ug/L		106	76 - 125
1,2-Dichlorobenzene	1.00	0.9447		ug/L		94	66 - 120
1,3-Dichlorobenzene	1.00	0.9698		ug/L		97	67 - 120
1,4-Dichlorobenzene	1.00	1.019		ug/L		102	68 - 120
Dichlorodifluoromethane	1.00	1.056		ug/L		106	50 - 150
1,1-Dichloroethane	1.00	1.110		ug/L		111	75 - 125
1,2-Dichloroethane	1.00	1.169		ug/L		117	72 - 129
1,1-Dichloroethene	1.00	0.9668		ug/L		97	75 - 124
Dichlorofluoromethane	1.00	1.183		ug/L		118	70 - 131
1,2-Dichloropropane	1.00	1.093		ug/L		109	75 - 123

Method: 8260D SIM - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: LCS 310-277920/7 **Client Sample ID: Lab Control Sample**

Matrix: Water **Prep Type: Total/NA**

Analysis Batch: 277920

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
1,3-Dichloropropane	1.00	1.063		ug/L		106	75 - 123
2,2-Dichloropropane	1.00	1.233		ug/L		123	50 - 150
1,1-Dichloropropene	1.00	1.074		ug/L		107	77 - 124
Diethyl ether	1.00	1.096		ug/L		110	71 - 122
Hexachlorobutadiene	1.00	0.9081		ug/L		91	50 - 150
Isopropylbenzene	1.00	1.034		ug/L		103	69 - 120
4-Isopropyltoluene	1.00	0.9933		ug/L		99	68 - 120
Methylene chloride	1.00	1.087		ug/L		109	50 - 150
4-Methyl-2-pentanone (MIBK)	1.00	1.004		ug/L		100	59 - 126
Naphthalene	1.00	1.014		ug/L		101	50 - 150
n-Butylbenzene	1.00	0.9562		ug/L		96	63 - 120
n-Propylbenzene	1.00	1.003		ug/L		100	70 - 120
sec-Butylbenzene	1.00	0.9933		ug/L		99	64 - 120
Styrene	1.00	0.9960		ug/L		100	70 - 120
tert-Butylbenzene	1.00	0.9121		ug/L		91	64 - 120
1,1,1,2-Tetrachloroethane	1.00	1.021		ug/L		102	72 - 120
1,1,2,2-Tetrachloroethane	1.00	0.9825		ug/L		98	63 - 122
Tetrachloroethene	1.00	1.009		ug/L		101	72 - 129
Tetrahydrofuran	1.00	1.074		ug/L		107	63 - 128
Toluene	1.00	1.168		ug/L		117	74 - 120
trans-1,2-Dichloroethene	1.00	1.013		ug/L		101	75 - 122
trans-1,3-Dichloropropene	1.00	1.177		ug/L		118	69 - 120
1,2,3-Trichlorobenzene	1.00	0.9036		ug/L		90	50 - 150
1,2,4-Trichlorobenzene	1.00	0.8964		ug/L		90	59 - 120
1,1,1-Trichloroethane	1.00	1.076		ug/L		108	76 - 127
1,1,2-Trichloroethane	1.00	1.028		ug/L		103	69 - 127
Trichloroethene	1.00	1.048		ug/L		105	63 - 137
Trichlorofluoromethane	1.00	1.136		ug/L		114	68 - 146
1,2,3-Trichloropropane	1.00	0.9865		ug/L		99	72 - 128
1,1,2-Trichloro-1,2,2-trifluoroethane	1.00	0.9780		ug/L		98	76 - 131
1,2,4-Trimethylbenzene	1.00	0.9775		ug/L		98	67 - 120
1,3,5-Trimethylbenzene	1.00	1.019		ug/L		102	68 - 120
Vinyl chloride	1.00	1.233		ug/L		123	72 - 124

Surrogate	*LCS %Recovery*	*LCS Qualifier*	*Limits*
4-Bromofluorobenzene (Surr)	*100*		*80 - 120*
Dibromofluoromethane (Surr)	*104*		*80 - 120*
Toluene-d8 (Surr)	*99*		*80 - 120*

Lab Sample ID: MB 310-278043/6 **Client Sample ID: Method Blank**

Matrix: Water **Prep Type: Total/NA**

Analysis Batch: 278043

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	<5.00		5.00		ug/L			05/07/20 11:41	1
Allyl chloride	<0.500		0.500		ug/L			05/07/20 11:41	1
Benzene	<0.500		0.500		ug/L			05/07/20 11:41	1
Bromobenzene	<0.500		0.500		ug/L			05/07/20 11:41	1

Client: Bay West Inc. Job ID: 310-180876-1
Project/Site: J130147.9, Twin Cities Army Ammunition P

Method: 8260D SIM - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: MB 310-278043/6 **Client Sample ID: Method Blank**
Matrix: Water **Prep Type: Total/NA**
Analysis Batch: 278043

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Bromochloromethane	<0.500		0.500		ug/L			05/07/20 11:41	1
Bromodichloromethane	<0.500		0.500		ug/L			05/07/20 11:41	1
Bromoform	<0.500		0.500		ug/L			05/07/20 11:41	1
Bromomethane	<1.00		1.00		ug/L			05/07/20 11:41	1
2-Butanone (MEK)	<0.500		0.500		ug/L			05/07/20 11:41	1
Carbon tetrachloride	<0.100		0.100		ug/L			05/07/20 11:41	1
Chlorobenzene	<0.500		0.500		ug/L			05/07/20 11:41	1
Chloroethane	<0.500		0.500		ug/L			05/07/20 11:41	1
Chloroform	<0.500		0.500		ug/L			05/07/20 11:41	1
Chloromethane	<1.00		1.00		ug/L			05/07/20 11:41	1
2-Chlorotoluene	<0.500		0.500		ug/L			05/07/20 11:41	1
4-Chlorotoluene	<0.500		0.500		ug/L			05/07/20 11:41	1
cis-1,2-Dichloroethene	<0.500		0.500		ug/L			05/07/20 11:41	1
cis-1,3-Dichloropropene	<0.500		0.500		ug/L			05/07/20 11:41	1
Dibromochloromethane	<0.500		0.500		ug/L			05/07/20 11:41	1
1,2-Dibromo-3-chloropropane	<0.0500		0.0500		ug/L			05/07/20 11:41	1
1,2-Dibromoethane (EDB)	<0.00500		0.00500		ug/L			05/07/20 11:41	1
Dibromomethane	<0.500		0.500		ug/L			05/07/20 11:41	1
1,2-Dichlorobenzene	<0.500		0.500		ug/L			05/07/20 11:41	1
1,3-Dichlorobenzene	<0.500		0.500		ug/L			05/07/20 11:41	1
1,4-Dichlorobenzene	<0.500		0.500		ug/L			05/07/20 11:41	1
Dichlorodifluoromethane	<0.500		0.500		ug/L			05/07/20 11:41	1
1,1-Dichloroethane	<0.500		0.500		ug/L			05/07/20 11:41	1
1,2-Dichloroethane	<0.100		0.100		ug/L			05/07/20 11:41	1
1,1-Dichloroethene	<0.500		0.500		ug/L			05/07/20 11:41	1
Dichlorofluoromethane	<0.500		0.500		ug/L			05/07/20 11:41	1
1,2-Dichloropropane	<0.500		0.500		ug/L			05/07/20 11:41	1
1,3-Dichloropropane	<0.500		0.500		ug/L			05/07/20 11:41	1
2,2-Dichloropropane	<0.500		0.500		ug/L			05/07/20 11:41	1
1,1-Dichloropropene	<0.500		0.500		ug/L			05/07/20 11:41	1
Diethyl ether	<0.500		0.500		ug/L			05/07/20 11:41	1
Ethylbenzene	<0.500		0.500		ug/L			05/07/20 11:41	1
Hexachlorobutadiene	<0.250		0.250		ug/L			05/07/20 11:41	1
Isopropylbenzene	<0.500		0.500		ug/L			05/07/20 11:41	1
4-Isopropyltoluene	<0.500		0.500		ug/L			05/07/20 11:41	1
Methylene chloride	<1.00		1.00		ug/L			05/07/20 11:41	1
4-Methyl-2-pentanone (MIBK)	<0.500		0.500		ug/L			05/07/20 11:41	1
Methyl tert-butyl ether	<0.500		0.500		ug/L			05/07/20 11:41	1
Naphthalene	<1.00		1.00		ug/L			05/07/20 11:41	1
n-Butylbenzene	<0.500		0.500		ug/L			05/07/20 11:41	1
n-Propylbenzene	<0.500		0.500		ug/L			05/07/20 11:41	1
sec-Butylbenzene	<0.500		0.500		ug/L			05/07/20 11:41	1
Styrene	<0.500		0.500		ug/L			05/07/20 11:41	1
tert-Butylbenzene	<0.500		0.500		ug/L			05/07/20 11:41	1
1,1,1,2-Tetrachloroethane	<0.500		0.500		ug/L			05/07/20 11:41	1
1,1,2,2-Tetrachloroethane	<0.500		0.500		ug/L			05/07/20 11:41	1
Tetrachloroethene	<0.500		0.500		ug/L			05/07/20 11:41	1
Tetrahydrofuran	<0.500		0.500		ug/L			05/07/20 11:41	1
Toluene	<0.500		0.500		ug/L			05/07/20 11:41	1

Method: 8260D SIM - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: MB 310-278043/6
Client Sample ID: Method Blank
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 278043

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
trans-1,2-Dichloroethene	<0.500		0.500		ug/L			05/07/20 11:41	1
trans-1,3-Dichloropropene	<0.500		0.500		ug/L			05/07/20 11:41	1
1,2,3-Trichlorobenzene	<0.500		0.500		ug/L			05/07/20 11:41	1
1,2,4-Trichlorobenzene	<0.500		0.500		ug/L			05/07/20 11:41	1
1,1,1-Trichloroethane	<0.500		0.500		ug/L			05/07/20 11:41	1
1,1,2-Trichloroethane	<0.500		0.500		ug/L			05/07/20 11:41	1
Trichloroethene	<0.100		0.100		ug/L			05/07/20 11:41	1
Trichlorofluoromethane	<0.500		0.500		ug/L			05/07/20 11:41	1
1,2,3-Trichloropropane	<0.00500		0.00500		ug/L			05/07/20 11:41	1
1,1,2-Trichloro-1,2,2-trifluoroethane	<0.500		0.500		ug/L			05/07/20 11:41	1
1,2,4-Trimethylbenzene	<0.500		0.500		ug/L			05/07/20 11:41	1
1,3,5-Trimethylbenzene	<0.500		0.500		ug/L			05/07/20 11:41	1
Vinyl chloride	<0.0400		0.0400		ug/L			05/07/20 11:41	1
Xylenes, Total	<1.00		1.00		ug/L			05/07/20 11:41	1

Surrogate	*MB %Recovery*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
4-Bromofluorobenzene (Surr)	*100*		*80 - 120*		*05/07/20 11:41*	*1*
Dibromofluoromethane (Surr)	*105*		*80 - 120*		*05/07/20 11:41*	*1*
Toluene-d8 (Surr)	*97*		*80 - 120*		*05/07/20 11:41*	*1*

Lab Sample ID: LCS 310-278043/7
Client Sample ID: Lab Control Sample
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 278043

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Acetone	1.00	1.188	J	ug/L		119	50 - 150
Allyl chloride	1.00	1.046		ug/L		105	50 - 150
Benzene	1.00	1.026		ug/L		103	77 - 120
Bromobenzene	1.00	0.9610		ug/L		96	70 - 120
Bromochloromethane	1.00	0.9827		ug/L		98	73 - 132
Bromodichloromethane	1.00	1.028		ug/L		103	73 - 120
Bromoform	1.00	0.8679		ug/L		87	57 - 120
Bromomethane	1.00	1.038		ug/L		104	38 - 150
2-Butanone (MEK)	1.00	1.040		ug/L		104	50 - 150
Carbon tetrachloride	1.00	1.068		ug/L		107	68 - 130
Chlorobenzene	1.00	1.013		ug/L		101	74 - 120
Chloroethane	1.00	1.363	*	ug/L		136	69 - 129
Chloroform	1.00	1.217	*	ug/L		122	78 - 121
Chloromethane	1.00	1.287		ug/L		129	50 - 150
2-Chlorotoluene	1.00	1.021		ug/L		102	71 - 120
4-Chlorotoluene	1.00	1.001		ug/L		100	71 - 120
cis-1,2-Dichloroethene	1.00	1.012		ug/L		101	77 - 120
cis-1,3-Dichloropropene	1.00	1.090		ug/L		109	70 - 120
Dibromochloromethane	1.00	0.8891		ug/L		89	66 - 120
1,2-Dibromo-3-chloropropane	1.00	0.8049		ug/L		80	50 - 150
1,2-Dibromoethane (EDB)	1.00	0.9592		ug/L		96	71 - 127
Dibromomethane	1.00	1.038		ug/L		104	76 - 125
1,2-Dichlorobenzene	1.00	0.9140		ug/L		91	66 - 120

Client: Bay West Inc.   Job ID: 310-180876-1
Project/Site: J130147.9, Twin Cities Army Ammunition P

Method: 8260D SIM - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: LCS 310-278043/7   **Client Sample ID: Lab Control Sample**
Matrix: Water   **Prep Type: Total/NA**
Analysis Batch: 278043

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
1,3-Dichlorobenzene	1.00	0.9499		ug/L		95	67 - 120
1,4-Dichlorobenzene	1.00	1.003		ug/L		100	68 - 120
Dichlorodifluoromethane	1.00	1.042		ug/L		104	50 - 150
1,1-Dichloroethane	1.00	1.096		ug/L		110	75 - 125
1,2-Dichloroethane	1.00	1.170		ug/L		117	72 - 129
1,1-Dichloroethene	1.00	1.032		ug/L		103	75 - 124
Dichlorofluoromethane	1.00	1.232		ug/L		123	70 - 131
1,2-Dichloropropane	1.00	1.067		ug/L		107	75 - 123
1,3-Dichloropropane	1.00	1.031		ug/L		103	75 - 123
2,2-Dichloropropane	1.00	1.129		ug/L		113	50 - 150
1,1-Dichloropropene	1.00	1.038		ug/L		104	77 - 124
Diethyl ether	1.00	1.127		ug/L		113	71 - 122
Ethylbenzene	1.00	1.011		ug/L		101	73 - 120
Hexachlorobutadiene	1.00	0.8444		ug/L		84	50 - 150
Isopropylbenzene	1.00	0.9823		ug/L		98	69 - 120
4-Isopropyltoluene	1.00	0.9537		ug/L		95	68 - 120
Methylene chloride	1.00	1.139		ug/L		114	50 - 150
4-Methyl-2-pentanone (MIBK)	1.00	0.8782		ug/L		88	59 - 126
Methyl tert-butyl ether	1.00	1.135		ug/L		113	72 - 121
Naphthalene	1.00	0.9302	J	ug/L		93	50 - 150
n-Butylbenzene	1.00	0.9000		ug/L		90	63 - 120
n-Propylbenzene	1.00	0.9769		ug/L		98	70 - 120
sec-Butylbenzene	1.00	0.9588		ug/L		96	64 - 120
Styrene	1.00	0.9290		ug/L		93	70 - 120
tert-Butylbenzene	1.00	0.8783		ug/L		88	64 - 120
1,1,1,2-Tetrachloroethane	1.00	1.002		ug/L		100	72 - 120
1,1,2,2-Tetrachloroethane	1.00	0.9477		ug/L		95	63 - 122
Tetrachloroethene	1.00	1.004		ug/L		100	72 - 129
Tetrahydrofuran	1.00	0.9558		ug/L		96	63 - 128
Toluene	1.00	1.014		ug/L		101	74 - 120
trans-1,2-Dichloroethene	1.00	1.014		ug/L		101	75 - 122
trans-1,3-Dichloropropene	1.00	1.117		ug/L		112	69 - 120
1,2,3-Trichlorobenzene	1.00	0.8078		ug/L		81	50 - 150
1,2,4-Trichlorobenzene	1.00	0.8058		ug/L		81	59 - 120
1,1,1-Trichloroethane	1.00	1.055		ug/L		105	76 - 127
1,1,2-Trichloroethane	1.00	0.9999		ug/L		100	69 - 127
Trichloroethene	1.00	1.053		ug/L		105	63 - 137
Trichlorofluoromethane	1.00	1.158		ug/L		116	68 - 146
1,2,3-Trichloropropane	1.00	0.9498		ug/L		95	72 - 128
1,1,2-Trichloro-1,2,2-trifluoroethane	1.00	1.038		ug/L		104	76 - 131
1,2,4-Trimethylbenzene	1.00	0.9403		ug/L		94	67 - 120
1,3,5-Trimethylbenzene	1.00	0.9879		ug/L		99	68 - 120
Vinyl chloride	1.00	1.156		ug/L		116	72 - 124
Xylenes, Total	2.00	1.959		ug/L		98	69 - 120

Surrogate	*LCS %Recovery*	*LCS Qualifier*	*Limits*
4-Bromofluorobenzene (Surr)	*98*		*80 - 120*

Method: 8260D SIM - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: LCS 310-278043/7
Client Sample ID: Lab Control Sample
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 278043

Surrogate	LCS %Recovery	LCS Qualifier	Limits
Dibromofluoromethane (Surr)	*105*		*80 - 120*
Toluene-d8 (Surr)	*99*		*80 - 120*

Client: Bay West Inc.
Job ID: 310-180876-1
Project/Site: J130147.9, Twin Cities Army Ammunition P

GC/MS VOA

Analysis Batch: 277822

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-180876-1	TCAAP-01URC2S	Total/NA	Ground Water	8260D SIM	
310-180876-2	TCAAP-01URC2S-D	Total/NA	Ground Water	8260D SIM	
310-180876-3	TCAAP-01URC2D	Total/NA	Ground Water	8260D SIM	
310-180876-4	TCAAP-01URC1S	Total/NA	Ground Water	8260D SIM	
310-180876-5	TCAAP-01URC1D	Total/NA	Ground Water	8260D SIM	
310-180876-6	Trip Blank	Total/NA	Water	8260D SIM	
MB 310-277822/6	Method Blank	Total/NA	Water	8260D SIM	
LCS 310-277822/7	Lab Control Sample	Total/NA	Water	8260D SIM	
LCSD 310-277822/8	Lab Control Sample Dup	Total/NA	Water	8260D SIM	

Analysis Batch: 277920

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-180876-1	TCAAP-01URC2S	Total/NA	Ground Water	8260D SIM	
310-180876-2	TCAAP-01URC2S-D	Total/NA	Ground Water	8260D SIM	
310-180876-3	TCAAP-01URC2D	Total/NA	Ground Water	8260D SIM	
310-180876-4	TCAAP-01URC1S	Total/NA	Ground Water	8260D SIM	
310-180876-6	Trip Blank	Total/NA	Water	8260D SIM	
MB 310-277920/6	Method Blank	Total/NA	Water	8260D SIM	
LCS 310-277920/7	Lab Control Sample	Total/NA	Water	8260D SIM	

Analysis Batch: 278043

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-180876-5	TCAAP-01URC1D	Total/NA	Ground Water	8260D SIM	
MB 310-278043/6	Method Blank	Total/NA	Water	8260D SIM	
LCS 310-278043/7	Lab Control Sample	Total/NA	Water	8260D SIM	

Client Sample ID: TCAAP-01URC2S **Lab Sample ID: 310-180876-1**
Date Collected: 04/30/20 12:00 **Matrix: Ground Water**
Date Received: 05/01/20 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260D SIM		1	277822	05/05/20 12:30	TRZ	TAL CF
Total/NA	Analysis	8260D SIM		1	277920	05/06/20 13:46	TRZ	TAL CF

Client Sample ID: TCAAP-01URC2S-D **Lab Sample ID: 310-180876-2**
Date Collected: 04/30/20 12:05 **Matrix: Ground Water**
Date Received: 05/01/20 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260D SIM		1	277822	05/05/20 12:53	TRZ	TAL CF
Total/NA	Analysis	8260D SIM		1	277920	05/06/20 14:09	TRZ	TAL CF

Client Sample ID: TCAAP-01URC2D **Lab Sample ID: 310-180876-3**
Date Collected: 04/30/20 12:35 **Matrix: Ground Water**
Date Received: 05/01/20 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260D SIM		1	277822	05/05/20 13:16	TRZ	TAL CF
Total/NA	Analysis	8260D SIM		1	277920	05/06/20 14:32	TRZ	TAL CF

Client Sample ID: TCAAP-01URC1S **Lab Sample ID: 310-180876-4**
Date Collected: 04/30/20 14:15 **Matrix: Ground Water**
Date Received: 05/01/20 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260D SIM		1	277822	05/05/20 13:39	TRZ	TAL CF
Total/NA	Analysis	8260D SIM		1	277920	05/06/20 14:56	TRZ	TAL CF

Client Sample ID: TCAAP-01URC1D **Lab Sample ID: 310-180876-5**
Date Collected: 04/30/20 13:40 **Matrix: Ground Water**
Date Received: 05/01/20 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260D SIM		1	277822	05/05/20 14:03	TRZ	TAL CF
Total/NA	Analysis	8260D SIM		1	278043	05/07/20 14:00	TRZ	TAL CF

Client Sample ID: Trip Blank **Lab Sample ID: 310-180876-6**
Date Collected: 04/30/20 09:00 **Matrix: Water**
Date Received: 05/01/20 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260D SIM		1	277822	05/05/20 10:57	TRZ	TAL CF
Total/NA	Analysis	8260D SIM		1	277920	05/06/20 11:04	TRZ	TAL CF

Laboratory References:

TAL CF = Eurofins TestAmerica, Cedar Falls, 3019 Venture Way, Cedar Falls, IA 50613, TEL (319)277-2401

Accreditation/Certification Summary

Client: Bay West Inc.
Job ID: 310-180876-1
Project/Site: J130147.9, Twin Cities Army Ammunition P

Laboratory: Eurofins TestAmerica, Cedar Falls

Unless otherwise noted, all analytes for this laboratory were covered under each accreditation/certification below.

Authority	Program	Identification Number	Expiration Date
Minnesota	NELAP	019-999-319	12-31-20

The following analytes are included in this report, but the laboratory is not certified by the governing authority. This list may include analytes for which the agency does not offer certification.

Analysis Method	Prep Method	Matrix	Analyte
8260D SIM		Ground Water	Dichlorofluoromethane
8260D SIM		Water	Dichlorofluoromethane

Method Summary

Client: Bay West Inc.
Project/Site: J130147.9, Twin Cities Army Ammunition P

Job ID: 310-180876-1

Method	Method Description	Protocol	Laboratory
8260D SIM	Volatile Organic Compounds (GC/MS)	SW846	TAL CF
5030B	Purge and Trap	SW846	TAL CF

Protocol References:

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

TAL CF = Eurofins TestAmerica, Cedar Falls, 3019 Venture Way, Cedar Falls, IA 50613, TEL (319)277-2401 eurofins | Environment Testing TestAmerica

310-180876 Chain of Custody

Cooler/Sample Receipt and Temperature Log Form

Client Information			
Client: BayWest			
City/State: CITY St Paul	STATE MN	Project: Twin Cities Army	
Receipt Information			
Date/Time Received: DATE 5/1/20	TIME 0900	Received By: DM	

Delivery Type: ☐ UPS ☒ FedEx ☐ FedEx Ground ☐ US Mail ☐ Spee-Dee ☐ Lab Courier ☐ Lab Field Services ☐ Client Drop-off ☐ Other:___________

Condition of Cooler/Containers

Sample(s) received in Cooler?	☒ Yes ☐ No	*If yes:* Cooler ID:	
Multiple Coolers?	☐ Yes ☒ No	*If yes:* Cooler # _____ of _____	
Cooler Custody Seals Present?	☒ Yes ☐ No	*If yes:* Cooler custody seals intact?	☒ Yes ☐ No
Sample Custody Seals Present?	☐ Yes ☒ No	*If yes:* Sample custody seals intact?	☐ Yes ☐ No
Trip Blank Present?	☒ Yes ☐ No	*If yes:* Which VOA samples are in cooler? ↓	

All vials

Temperature Record

Coolant: ☒ Wet ice ☐ Blue ice ☐ Dry ice ☐ Other:___________ ☐ NONE

Thermometer ID: 0	Correction Factor (°C): +0.1

• Temp Blank Temperature – If no temp blank, or temp blank temperature above criteria, proceed to Sample Container Temperature

Uncorrected Temp (°C): -0.1	Corrected Temp (°C): 0.0

• Sample Container Temperature

	CONTAINER 1	CONTAINER 2
Container(s) used:		
Uncorrected Temp (°C):		
Corrected Temp (°C):		

Exceptions Noted

1) If temperature exceeds criteria, was sample(s) received same day of sampling? ☐ Yes ☐ No
   a) *If yes:* Is there evidence that the chilling process began? ☐ Yes ☐ No

2) If temperature is <0°C, are there obvious signs that the integrity of sample containers is compromised? (e.g., bulging septa, broken/cracked bottles, frozen solid?) ☐ Yes ☐ No

NOTE: If yes, contact PM before proceeding. If no, proceed with login

Additional Comments

Eurofins TestAmerica, Cedar Falls
3019 Venture Way
Cedar Falls, IA 50613
Phone (319) 277-2401 Fax (319) 277-2425

Chain of Custody Record

TestAmerica Minneapolis SC
213

eurofins | Environment Testing
TestAmerica

Client Information	Sampler: S. MAYER	Lab PM: Bindert, Zach T	Carrier Tracking No(s):	COC No: 310-49512-15261.1
Client Contact: Rick Van Allen	Phone: 657 226 6159	E-Mail: zach.bindert@testamericainc.com		Page: Page 1 of 1
Company: Bay West Inc.		Analysis Requested		Job #:
Address: 5 Empire Drive	Due Date Requested: NORMAL			Preservation Codes:
City: St Paul	TAT Requested (days):			
State, Zip: MN, 55103				
Phone: 651-291-3441	PO #: 110811			
Email: rickv@baywest.com	WO #:			
Project Name: J130147.9, Twin Cities Army Ammunition Plant	Eurofins Project #: 31012333			
Site:	SSOW#:			Other:

Preservation Codes:
A - HCL, B - NaOH, C - Zn Acetate, D - Nitric Acid, E - NaHSO4, F - MeOH, G - Amchlor, H - Ascorbic Acid, I - Ice, J - DI Water, K - EDTA, L - EDA
M - Hexane, N - None, O - AsNaO2, P - Na2O4S, Q - Na2SO3, R - Na2S2O3, S - H2SO4, T - TSP Dodecahydrate, U - Acetone, V - MCAA, W - pH 4-5, Z - other (specify)

Sample Identification	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	8260D_SIM - Volatile Minnesota List	Total Number of containers	Special Instructions/Note:
				Preservation Code:			A		
TCAAP-01URC2S	043020	1200	G	Water	N	N	X	3	
TCAAP-01URC2S-D	043020	1205	G	Water	N	N	X	3	
TCAAP-01URC2D	043020	1235	G	Water	N	N	X	3	
TCAAP-01URC1S	043020	1415	G	Water	N	N	X	3	
TCAAP-01URC1D	043020	1340	G	Water	N	N	X	3	
Trip Blank	043020	0900	—	Water	N	N	X	3	

Possible Hazard Identification
☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☒ Disposal By Lab ☐ Archive For ______ Months

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements:

Empty Kit Relinquished by:	Date:	Time:	Method of Shipment:	
Relinquished by: STEF MAYER	Date/Time: 043020 1630	Company: BAYWEST	Received by: [signature]	Date/Time: 4-30-20 1630	Company: [illegible]
Relinquished by: [signature]	Date/Time: 4-30-20 1700	Company: [illegible]	Received by:	Date/Time:	Company:
Relinquished by:	Date/Time:	Company:	Received by: [signature]	Date/Time: 5/1/20 0855	Company:
Custody Seals Intact: Δ Yes Δ No	Custody Seal No.:		Cooler Temperature(s) °C and Other Remarks:		

Ver: 01/16/2019

Login Sample Receipt Checklist

Client: Bay West Inc.

Job Number: 310-180876-1
SDG Number:

Login Number: 180876
List Number: 1
Creator: Homolar, Dana J

List Source: Eurofins TestAmerica, Cedar Falls

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	N/A	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

The requested project specific reporting limits listed below were less than laboratory standard quantitation limits (PQL) but greater than or equal to the laboratory method detection limits (MDL). It must be noted that results reported below lab standard quantitation limits may result in false positive/false negative values and less accurate quantitation. Routine laboratory procedures do not indicate corrective action for detections below the laboratory's PQL.

Method	Analyte	Matrix	Prep Type	Unit	Client RL	Lab PQL
8260D SIM	Hexachlorobutadiene	Ground Water	Total/NA	ug/L	0.250	0.50
8260D SIM	Hexachlorobutadiene	Water	Total/NA	ug/L	0.250	0.50

Appendix H

Site K and TGRS Operational Data

Appendix H.1

Inspection and Maintenance Activities
Fiscal Year 2020
Site K, OU2
Arden Hills, Minnesota

October 2019

10/1/2019	Increased the influent flow rate slightly. Down time: None.
10/5/2019	Increased the influent flow rate slightly. Down time: None.
10/8/2019	Increased the influent flow rate slightly. Down time: None.
10/13/2019	Increased the influent flow rate slightly. Down time: None.
10/15/2019	The system was off and the high water level alarm light was lit. Restarted the system. Flushed the influent and effluent lines and exercised and reset the influent and effluent flow valves. Cleaned the sump sight glass. Observed normal operation. Down time: 18.3 hours.
10/23/2019	The system was off and the high water level alarm light was lit. Restarted the system and exercised the influent and effluent flow control valves. Observed normal operation. Down time: 28 hours.
10/26/2019	The flow rate slowed overnight. Reset the flow rate and observed normal operation. Down time: 4.5 hours.

November 2019

11/4/2019	Increased the influent flow rate slightly. Down time: None.
11/5/2019	Increased the influent flow rate slightly. Down time: None.
11/7/2019	Increased the influent flow rate slightly. Down time: None.
11/13/2019	Increased the influent flow rate slightly. Down time: None.

Appendix H.1

Inspection and Maintenance Activities
Fiscal Year 2020
Site K, OU2
Arden Hills, Minnesota

November 2019

11/21/2019	Increased the influent flow rate slightly. Down time: None.
11/25/2019	Increased the influent flow rate slightly. Down time: None.
11/28/2019	Thanksgiving Day. No inspection. Meter reading was estimated. Down time: None.

December 2019

12/1/2019	Increased the influent flow rate slightly. Down time: None.
12/3/2019	Increased the influent flow rate slightly. Down time: None.
12/5/2019	Increased the influent flow rate slightly. Down time: None.
12/8/2019	Increased the influent flow rate slightly. Down time: None.
12/9/2019	The system was off and the high water level alarm light was lit. Restarted the system. Flushed the influent and effluent lines and exercised and reset the influent and effluent flow valves. Cleaned the sump sight glass. Observed normal operation. Down time: 24.2 hours.
12/10/2019	The system was off and the low airflow alarm light was lit. Troubleshooting indicated that the fault occurred from too high airflow. Closed the influent air damper slightly and restarted the system. Observed normal operation. Down time: 5.5 hours.
12/12/2019	Increased the influent flow rate slightly. Down time: None.
12/15/2019	Increased the influent flow rate slightly. Down time: None.

Appendix H.1

Inspection and Maintenance Activities
Fiscal Year 2020
Site K, OU2
Arden Hills, Minnesota

December 2019

12/17/2019	Increased the influent flow rate slightly. Down time: None.
12/18/2019	Increased the influent flow rate slightly. Down time: None.
12/26/2019	Increased the influent flow rate slightly. Down time: None.

January 2020

1/2/2020	Increased the influent flow rate slightly. Down time: None.
1/6/2020	Increased the influent flow rate slightly. Down time: None.
1/7/2020	Increased the influent flow rate slightly. Down time: None.
1/9/2020	Increased the influent flow rate slightly. Down time: None.
1/10/2020	Increased the influent flow rate slightly. Down time: None.
1/12/2020	Increased the influent flow rate slightly. Down time: None.
1/16/2020	Increased the influent flow rate slightly. Down time: None.
1/17/2020	Increased the influent flow rate slightly. Down time: None.
1/20/2020	Increased the influent flow rate slightly. Down time: None.

Appendix H.1

Inspection and Maintenance Activities
Fiscal Year 2020
Site K, OU2
Arden Hills, Minnesota

January 2020

1/23/2020	Increased the influent flow rate slightly. Down time: None.
1/26/2020	Increased the influent flow rate slightly. Down time: None.
1/27/2020	Increased the influent flow rate slightly. Down time: None.
1/30/2020	Flushed the system, exercised the control valves and cleaned the sump sight glass. Increased the influent flow rate slightly. Down time: None.

February 2020

2/2/2020	The flow rate slowed between inspections. Increased the influent flow rate slightly. Down time: 1.7 hours.
2/3/2020	Increased the influent flow rate slightly. Down time: None.
2/8/2020	Increased the influent flow rate slightly. Down time: None.
2/9/2020	Increased the influent flow rate slightly. Down time: None.
2/10/2020	The flow rate slowed between inspections. Increased the influent flow rate slightly. Down time: 1.4 hours.
2/11/2020	Increased the influent flow rate slightly. Down time: None.
2/14/2020	The inspection was not performed. The meter reading was estimated. Down time: None.
2/16/2020	Increased the influent flow rate slightly. Down time: None.

Appendix H.1

Inspection and Maintenance Activities
Fiscal Year 2020
Site K, OU2
Arden Hills, Minnesota

February 2020

2/19/2020	Increased the influent flow rate slightly. Down time: None.
2/20/2020	Increased the influent flow rate slightly. Down time: None.
2/21/2020	The flow rate slowed between inspections. Increased the influent flow rate slightly. Down time: 1 hour.
2/23/2020	The system was off on arrival. The "Flow meter water flow rate" alarm light was on. The system was restarted, the influent and effluent flow control valves were exercised and flushed and the influent and effluent flow rates were reset. Normal operation was observed. Down time: 20.7 hours.
2/24/2020	The flow rate slowed between inspections. Increased the influent flow rate. Down time: 9.6 hours.
2/25/2020	Increased the influent flow rate slightly. Down time: None.
2/26/2020	The treatment system cycled normally between inspections due to low groundwater infiltration. Increased the influent flow rate slightly. Down time: None.
2/27/2020	The treatment system cycled normally between inspections due to low groundwater infiltration. Increased the influent flow rate slightly. Down time: None.
2/28/2020	The treatment system cycled normally between inspections due to low groundwater infiltration. Increased the influent flow rate slightly. Down time: None.
2/29/2020	The treatment system cycled normally between inspections due to low groundwater infiltration. Increased the influent flow rate slightly. Down time: None.

March 2020

3/1/2020	The flow rate slowed between inspections. Increased the influent flow rate slightly. Down time: None.

Appendix H.1

Inspection and Maintenance Activities
Fiscal Year 2020
Site K, OU2
Arden Hills, Minnesota

March 2020

3/2-7/2020	The system cycled normally between inspections due to a low water table. Down time: None.
3/13/2020	The system cycled normally between inspections due to a low water table. Down time: None.
3/17/2020	Increased the influent flow rate slightly. Down time: None.
3/21/2020	The flow rate slowed between inspections. Increased the influent flow rate slightly. Down time: None.
3/22/2020	Increased the influent flow rate slightly. Down time: None.
3/26/2020	Increased the influent flow rate slightly. Flushed the tower and performed quarterly maintenance. Down time: None.
3/30/2020	Increased the influent flow rate slightly. Down time: None.

April 2020

4/4/2020	The flow rate slowed between inspections. Increased the influent flow rate slightly. Down time: None.
4/6/2020	The flow rate slowed between inspections. Increased the influent flow rate slightly. Down time: None.
4/9/2020	The flow rate slowed between inspections. Increased the influent flow rate slightly. Down time: None.
4/15/2020	Increased the influent flow rate slightly. Down time: None.
4/20/2020	The flow rate slowed between inspections. Increased the influent flow rate slightly. Down time: None.
4/26/2020	Increased the influent flow rate slightly. Down time: None.

Appendix H.1

Inspection and Maintenance Activities
Fiscal Year 2020
Site K, OU2
Arden Hills, Minnesota

Appendix H.1

Inspection and Maintenance Activities
Fiscal Year 2020
Site K, OU2
Arden Hills, Minnesota

May 2020

5/10/2020	The flow rate slowed between inspections. Increased the influent flow rate slightly. Down time: None.
5/14/2020	The flow rate slowed between inspections. Increased the influent flow rate slightly. Down time: None.
5/20/2020	Increased the influent flow rate, exercised the influent and effluent valves and cleaned the sump sight glass. Down time: None.
5/23/2020	Increased the influent flow rate slightly. Down time: None.
5/24/2020	The flow rate slowed between inspections. Increased the influent flow rate slightly. Down time: None.
5/25/2020	Memorial Day. The inspection was not performed. Meter readings were estimated. Down time: None.
5/27/2020	Flushed the tower and performed the monthly preventive maintenance work. Down time: None.
5/28/2020	The flow rate slowed between inspections. Increased the influent flow rate slightly. Down time: None.

June 2020

6/4/2020	Increased the influent flow rate. Down time: 2.7 hours.
6/10/2020	The system was off on arrival and the high/high water level light was lit. Exercised the influent and effluent flow control valves and restarted the system. Set the influent and effluent flow valves and observed normal operation. Down time: 7.8 hours.
6/11/2020	The system was off again on arrival and the high/high water level light was lit. The effluent flow control valve was set too slow yesterday and the water level increased to the sensor. Restarted the system and reset the influent and effluent flow control valves. Normal operation observed. Down time: 18 hours.

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Inspection and Maintenance Activities
Fiscal Year 2020
Site K, OU2
Arden Hills, Minnesota

June 2020

6/18/2020 — Increased the influent flow rate slightly.

Down time: None.

6/28/2020 — The system was off on arrival and the high/high water level light was lit. Exercised the influent and effluent flow control valves and restarted the system. Set the influent and effluent flow valves and observed normal operation.

Down time: 3 hours.

July 2020

7/2-4/2020 — The treatment system was off on arrival due to a site wide power outage. Contacted Xcel Energy and they responded and restored power to the treatment system. Turned the treatment system on and observed normal operation.

Down time: 44 hours.

7/8/2020 — The transformer in the control panel was not working properly. Turned the treatment system off and contacted Preferred Electric. They installed a new transformer. Following the work, restarted the treatment system and observed normal operation.

Down time: 27 hours.

7/13-31/2020 — The treatment system cycled normally due to a low groundwater elevation.

Down time: None.

August 2020

8/4/2020 — Exercised the influent and effluent flow control valves. Reset the flow valves and reset the flow rates.

Down time: 44 hours.

8/11/2020 — The high/high water level light was on. Reset the system and exercised and reset the influent and effluent flow rates. Normal operation was observed.

Down time: 17.6 hours.

September 2020

9/2/2020 — Upon arrival, the system was off and the flow meter low water flow rate light was lit. Reset the alarm and restarted the system. Exercised the influent and effluent flow control valves and reset the flow rates. Observed normal operation.

Down time: 8.5 hours.

9/7/2020 — Labor Day Holiday. The inspection was not performed. Meter readings were estimated.

Down time: None.

Appendix H.2

Maintenance Activities

Fiscal Year 2020
TGRS, OU2

Arden Hills, Minnesota

October 2019

10/1-2/2019	Pumphouse SC1. The flow meter stopped totaling. Removed, cleaned and replaced the flow meter. The flow meter began totaling normally. Down time: None. Estimated the meter readings.
10/5-25/2019	Treatment System. Turned the pumps in B3, B8 and B9 off to decrease the influent flow volume to the treatment system during the cleaning of Towers 3 and 4. Following the cleaning of the towers, turned the pumps on for normal service. Down time: 486 hours each at B3, B8 and B9.
10/9/2019	Treatment System and Well Field. Turned the TGRS off so Jayhawk Mechanical could install temporary piping in pumphouse SC2. Following the work, turned the TGRS back on and observed normal operation. Down time: None.
10/16/2019	Pumphouses B1. The ARV was leaking. Replaced the ARV with one from inventory. Down time: None.
10/26-29/2019	Pumphouse B3. The RPZ was leaking. Water was spraying out a pinhole leak in the downstream elbow. Contacted Jayhawk Mechanical and they replaced the elbow with one from inventory. Following the work, turned the pump on and observed normal operation. Down time: 82.5 hours.
10/30/2019	Treatment System. Turned the TGRS off to pressure wash the inside of the treatment system. Following the work, turned the TGRS on and observed normal operation. Down time: 2.5 hours each at B6 and B13.

November 2019

11/4/2019	Pumphouse B5. Closed the ECV slightly to decrease the flow rate. Down time: None.
11/4/2019	Pumphouse B4. The flow meter was totaling more slowly with time. Replaced the flow meter with one from inventory. Down time: None.

Appendix H.2

Maintenance Activities

Fiscal Year 2020
TGRS, OU2

Arden Hills, Minnesota

November 2019

11/6/2019	Pumphouse B13. The flow meter was totaling too quickly. Turned the pump off, removed, cleaned and reinstalled the flow meter. Restarted the pump and observed normal operation. Down time: None.
11/7/2019	Pumphouse B13. Following the meter cleaning, the flow rate dropped. Opened the ECV to increase the flow rate. Down time: 7 hours.
11/7/2019	Pumphouse B1. Closed the ECV slightly to decrease the flow rate. Down time: None.
11/7/2019	Pumphouse B9. Closed the ECV slightly to decrease the flow rate. Down time: None.
11/19/2019	Treatment System. Cleaned the inside of the treatment system building. Down time: None.
11/26/2019	Pumphouse B4. Replaced the ARV with one from inventory. Down time: None.

December 2019

12/4-5/2019	Pumphouse B5. The RPZ backflow preventer was leaking. Attempted to stop the leak but was unsuccessful. Turned the pump off and turned the pumps in B1, B3, B8 and B9 to their maximum flow rates to make up for the loss of flow from B5. Contacted Jayhawk Mechanical and they repaired the leak. Turned the pump on and observed normal operation. Returned the flow rates in B1, B3, B8 and B9 to their normal operating flow rates. Down time: 22 hours.
12/5/2019	Pumphouse B4. The ARV was leaking. Replaced the ARV with a new one from inventory. Down time: None.
12/5/2019	Pumphouse B8. The ARV was leaking. Installed a new drip hose from the ARV. Down time: None.

Appendix H.2

Maintenance Activities

Fiscal Year 2020
TGRS, OU2

Arden Hills, Minnesota

December 2019

12/11/2019 Pumphouse SC5. The RPZ backflow preventer was leaking. Flushed and exercised the valve. Restarted the pump and the RPZ did not leak. Normal operation observed.

Down time: None.

12/12/2019 Treatment System. The lower bearings in Pump 4 were making a whining noise. Greased the lower bearings and the whining noised stopped. Normal operation observed.

Down time: None.

12/25/2019 Christmas Day. The inspection was not performed. The meter readings were estimated.

Down time: None.

12/31/2019 Five inches of snow fell yesterday and today. The site roads were plowed.

Down time: None.

January 2020

1/1/2020 New Year's Day. The daily inspection was not performed. Meter readings were estimated.

Down time: None.

1/16/2020 Pumphouse B5. The flow meter flow rate was declining slowly with time. Turned the pump off and replaced the flow meter with one from inventory. Restarted the pump and observed normal operation.

Down time: None.

1/17-22/2020 Pumphouse B1. The RPZ was leaking. Exercised and flushed the control valves and was able to stop the majority of the leak. Contacted Jayhawk Mechanical and they repaired the problem. Restarted the pump and observed normal operation.

Down time: None.

1/20-22/2019 Pumphouse B9. The RPZ was leaking. Exercised and flushed the control valves and was able to stop the majority of the leak. Informed Jayhawk of the B9 RPZ leak and they repaired the problem. Restarted the pump and observed normal operation.

Down time: None.

Appendix H.2

Maintenance Activities

Fiscal Year 2020
TGRS, OU2

Arden Hills, Minnesota

January 2020

1/21-31/2020 — Pumphouse B1. The flow meter flow rate was declining slowly with time. Turned the pump off and replaced the flow meter with the flow meter from B3. The B3 flow meter read 225 gpm. The flow meter will be replaced when the vendor repairs one of the flow meters from inventory. Meter readings estimated.

Down time: None.

1/24/2020 — Treatment System. Turned Pump 4 off to change the oil. Turned B4 and B5 off to minimize well field cycling with only Pump 3 operating. Following the work, turned Pump 4 on and observed normal operation. Turned B4 and B5 back on.

Down time: None.

1/24/2020 — Treatment System. Call from Time Communication - TGRS fail. Pump 4 failed to open on command. Changed the filter and flushed the control piping and reset the speed control valves on ECV 4. Cycled the valve and observed normal operation.

Down time: None.

1/25/2020 — Pumphouse B8. The heater stopped working. Installed a temporary electric heater and scheduled repair.

Down time: None.

1/29/2020 — Pumphouse B1. The ECV would not close properly. Removed, cleaned and replaced portions of the piping as necessary for the ECV to actuate. Following the work, the ECV opened and closed normally.

Down time: None.

February 2020

2/4-17/2020 — Pumphouse B1. Turned the pump off and removed the flow meter. Cleaned the flow meter and reinstalled it. Turned the pump on but the flow meter did not total correctly. We are waiting for the vendor to rebuild three of our old flow meters. Meter readings estimated.

Down time: None.

2/4/2020 — Pumphouse B4. The flow meter flow rate was declining slowly with time. Turned the pump off and removed and cleaned the flow meter. Reinstalled the flow meter and restarted the pump. The flow rate was within an acceptable range of normal operation.

Down time: None.

Appendix H.2

Maintenance Activities

Fiscal Year 2020
TGRS, OU2

Arden Hills, Minnesota

February 2020

2/4/2020	Pumphouse B4. Turned the pump off and removed the ECV from the pumphouse piping. Reinstalled a new ECV from inventory. Turned the pump on and observed normal operation. Down time: None.
2/9/2020	Snow storm overnight. DK Concrete plowed the site roads. Down time: None.
2/11/2020	Treatment System. ECV 4 would not close on command. Turned off the pumps in B5 and B8 to minimize well field cycling. Removed and replaced portions of the control piping. Following the work, turned Pump 4 on and actuated the ECV. The ECV closed but slowly. Additional work will be necessary. Down time: None.
2/14/2020	Treatment System. Turned Pump 4 off to work on the ECV 4 closing issue. Turned B3 and B5 off to minimize well field cycling with only Pump 3 operating. Replaced the solenoid valve and a check valve and restarted Pump 4. The ECV closed but only slightly faster. Additional work will be necessary. Turned B3 and B5 back on for normal operation. Down time: 1 hour at B3.
2/17/2020	Pumphouse SC1. The flow meter was not totaling. Turned the pump off and removed the flow meter. Cleaned and reinstalled the flow meter. Turned the pump on and observed normal operation. Down time: 1 hour.
2/17/2020	Pumphouse B1. The flow meter was not totaling correctly. Turned the pump off and removed the flow meter. Installed a new flow meter from inventory. Turned the pump on and observed normal operation. Down time: None.
2/17/2020	Pumphouse B3. The downstream valve on the ECV control piping was leaking. Removed and replaced the downstream valve. Down time: None.

Appendix H.2

Maintenance Activities

Fiscal Year 2020
TGRS, OU2

Arden Hills, Minnesota

February 2020

2/20/2020 Pumphouses B1, B13, B3, B4 and B8. Checked the flow rate of the existing flow meter against the flow rate of a calibrated flow meter.
Down time: None.

2/26/2020 Pumphouse B8. The flow meter stopped totaling. Turned the pump off and removed the flow meter. Installed a new flow meter from inventory. Turned the pump on and observed normal operation.
Down time: None.

2/26/2020 Treatment System. Turned Pump 4 off to work on the ECV 4 closing issue. Turned B9 off to minimize well field cycling. Removed and replaced the emergency solenoid valve from the closing portion of the control piping. Following the work, turned Pump 4 on and actuated the ECV. The ECV closed slowly. Additional work will be necessary. Turned B9 back on for normal service.
Down time: 5.5 hours at B9.

2/26/2020 Pumphouse B9. Checked the flow rate of the existing meter against the flow rate of a calibrated meter.
Down time: None.

2/27/2020 Pumphouse SC5. Checked the flow rate of the existing meter against the flow rate of a calibrated meter. The flow rate of the existing meter was faster than the calibrated meter. Cleaned and reinstalled the existing meter. The flow rate was within an acceptable range of normal operation.
Down time: 1.5 hours.

March 2020

3/1/2020 Pumphouse SC5. The ECV closed slightly between inspections which slowed the flow rate. Flushed the control pipes and reset the pressure. Observed normal operation.

Down time: 4 hours.

3/8/2020 Treatment System. Turned the TGRS off to inspect the demister pads and water distribution systems in Towers 3 and 4. Following the work, turned the TGRS back on. Normal operation observed.
Down time: 1 hour at B1 and B13; 1.5 hours at SC5 and 2 hours at B6.

Appendix H.2

Maintenance Activities

Fiscal Year 2020
TGRS, OU2

Arden Hills, Minnesota

March 2020

3/11/2020 Pumphouse SC5. Turned the pump off and removed the flow meter. Removed a piece of mineral build-up from the impeller and reinstalled the flow meter. Turned the pump on and measured the flow rate. Observed normal operation.

Down time: 1.5 hours.

3/20/2020 Treatment System. Turned off Pump 4 at the treatment system and turned off B6 and B9 to estimate the maximum flow rate that Pump 3 in the treatment system could produce. The maximum flow rate for Pump 3 is approximately 1425 gallons per minute.

Down time: 3.5 hours at B9 and 4 hours at B6.

3/27/2020 Pumphouse SC5. The flow rate was fluctuating due to the pressure reducing pilot on the ECV control piping. Turned the pump off and removed the pilot from the control piping. Disassembled the pilot and replaced the diaphragm. Reassembled the pilot and reinstalled it on the control piping. Restarted the pump and reset the flow rate. Normal operation observed.

Down time: 3 hours.

April 2020

4/6/2020 Pumphouses B4 and B8. There are garter snakes living under the pumphouses and they often enter the pumphouses. Removed 10 snakes from B4 and 7 snakes from B8. Attempted to flood out the areas under the pumphouses.

Down time: None.

4/16/2020 Pumphouse SC5. Turned the pump off and removed the flow meter. Cleaned the flow meter by removing mineral build-up from the impellers and the meter body. Reinstalled the flow meter and turned the pump on and measured the flow rate. Observed normal operation.

Down time: 4 hours.

4/20/2020 Treatment System. Turned the TGRS off and performed annual maintenance activities on the treatment system items. Following the work, turned the TGRS back on. Observed normal operation.

Down time: 2.5 hours at B4; 3.5 hours at B8; 6 hours at B1, B6, B9 and SC5; 7 hours at B13 and SC1.

Appendix H.2

Maintenance Activities

Fiscal Year 2020
TGRS, OU2

Arden Hills, Minnesota

April 2020

4/23/2020 Pumphouse B13. Turned the pump off and replaced the reducer bushing on the pressure gauge piping. Following the work, turned the pump back on and observed normal operation.
Down time: 1 hour.

4/28-30/2020 Pumphouse SC1. The flow meter stopped totaling. Removed the flow meter and cleaned it. Reinstalled the flow meter and observed normal operation.
Down time: None. Meter readings were estimated.

May 2020

5/1/2020 Pumphouse B9. Repaired the RPZ backflow preventer drain.
Down time: None.

5/4/2020 Treatment System and Well Field. Turned the TGRS off to inspect and exercise the TGRS forcemain butterfly valves as part of the annual maintenance inspection. Following the work, the TGRS was turned back on and normal operation was observed.
Down time: 2 hours at B3; 3.5 hours at B1, B13 and B9; 4 hours at B6 and 5 hours at SC5.

5/6/2020 Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Compared the pumphouse pressure gauges to a calibrated pressure gauge. Replaced pressure gauges that were not accurate.
Down time: None.

5/6/2020 Treatment System. Pressure washed the demister pads from Towers 3 and 4.
Down time: None.

5/20/2020 Treatment System. Turned the TGRS off to reinstall the demister pads in Towers 3 and 4. Also, cleaned the blower inlet screens to blowers 3 and 4.
Down time: 2 hours at B3; 2.5 hours at B6, B9 and SC5; 3 hours at B1 and B13.

5/26/2020 Pumphouse B3. Turned the pump off and replaced a valve on the control piping. Following the work, reset the ECV too much which slowed the average flow rate between inspections. Reset the ECV the following day.
Down time: 5 hours.

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Maintenance Activities

Fiscal Year 2020
TGRS, OU2

Arden Hills, Minnesota

June 2020

6/1/2020	Pumphouse B3. The ECV closed slightly between inspections which slowed the flow rate. Cleaned the strainer screen, flushed the control piping and reset the ECV. Observed normal operation. Down time: 1.5 hours.
6/3/2020	Pumphouses B13 and SC5. There was a thunderstorm last night and the lights were flashing on the well field panel. Reset the PLC and the lights came back on steady. At the pumphouses, the pumps were running normally. Down time: 14.5 hours at B13 and 14 hours at SC5.
6/10/2020	Pumphouse B9. The vent fan motor failed. Preferred Electric replaced with new. Down time: None.
6/10/2020	Treatment System and Pumphouses. Preferred Electric performed the annual electrical maintenance inspection. Down time: None.
6/13/2020	Pumphouse B3. The ECV fluctuated slightly between inspections causing the average flow rate to be below the minimum target flow rate. Down time: 1 hour.
6/14/2020	Pumphouse B3. The ECV closed slightly between inspections which slowed the flow rate. Cleaned the strainer screen, flushed the control piping and reset the ECV. Observed normal operation. Down time: 1.5 hours.
6/28/2020	Pumphouse B8. The low light was lit on the control panel in the pumphouse. Turned the pump to off and back to auto and reset the panel. The pump started normally. Down time: 3 hours.
6/29/2020	Pumphouse SC5. The light was flashing on the well field panel. Reset the PLC and the light came back on steady. At the pumphouse, the pump was running normally but the flow meter had stopped totaling. Replaced the flow meter with one from inventory. The meter reading was estimated for the day. Down time: None.

Appendix H.2

Maintenance Activities

Fiscal Year 2020
TGRS, OU2

Arden Hills, Minnesota

June 2020

6/30/2020	Pumphouse B9. The RPZ backflow preventer check valve failed. Turned the pump off and scheduled Jayhawk Mechanical. Down time will be reported following the repair in the July 2020 flow report. Down time: None.

July 2020

7/1-2/2020	Pumphouse B9. Water was flowing out the backflow preventer drain. Turned the pump off and contacted Jayhawk Mechanical. Increased the flow rates at B3, B6 and B8 while B9 was off. Jayhawk repaired the problem. The following day, turned the pump on and observed normal operation. Down time: 44.5 hours.
7/2-4/2020	Treatment System and Well Field. Call from Time Communication - TGRS fail. At the site, there was only 2 phases of power to the treatment system. Contacted Xcel Energy. They inspected the power lines and found an untagged jumper on a power pole in the marsh to the west of Building 116. They acquired the appropriate equipment, repaired the jumper and restored power to the treatment system and well field. Following the work, restarted the TGRS and observed normal operation. Down time: 37 hours at B5; 42.5 hours at B4, B8 and SC5; 43.5 hours at SC1; 45.5 hours at B6; 46.5 hours at B1; 47.5 hours at B13 and B9; 49 hours at B3.
7/10/2020	Treatment System. Performed maintenance on Pump 4 in the treatment center. Turned B6 and B9 off to minimize well field cycling with only Pump 3 in operation. Following the work, turned Pump 4, B6 and B9 on for normal service. Down time: 3 hours at B6 and 3.5 hours at B9.
7/14/2020	Pumphouse B3. Increased the flow rate slightly. Down time: None.
7/16/2020	Pumphouse SC5. Turned the pump off and replaced the flow meter with one from inventory. Following the work, turned the pump on and observed normal operation. Down time: None.
7/17/2020	Pumphouse B5. The flow meter was totaling slower than the calibrated flow meter. Replaced the flow meter with one from inventory. Following the work, turned the pump on and observed normal operation. Down time: None.

Appendix H.2

Maintenance Activities

Fiscal Year 2020
TGRS, OU2

Arden Hills, Minnesota

July 2020

7/19/2020 Treatment System and Well Field. Call from Time Communication - TGRS fail. At the site, there was only 2 phases of power to the treatment system. Contacted Xcel Energy. They found two locations where fuses had opened. One on the power pole to the west of Building 116 and one near Gate 4. They reinstalled the fuses and restored power to the treatment system and well field. Following the work, restarted the TGRS and observed normal operation.

Down time: 10 hours at B5; 13 hours at B3; 14 hours at B4, B8 and SC5; 15.5 hours at B1, B6, B9 and SC1; 18 hours at B13.

7/16/2020 Pumphouse SC1. The pump was off. Inspected the controls at pumphouse B11 and found the I/O adapter card had blown. Replaced the I/O adapter card with one from inventory and restarted the SC1 pump. Normal operation observed.
Down time: 25 hours.

August 2020

8/3/2020 Pumphouses B6 and B9. Xcel Energy upsized the transformers at the power pole adjacent to B5. The pumphouses were turned off during the work.
Down time: 4.5 hours at B6 and 5 hours at B9.

8/3/2020 Pumphouse B9. The flow meter was slowing with time. Removed the old flow meter and replaced it with a flow meter from inventory. Meter readings were estimated.
Down time: None.

8/10/2020 Pumphouse B4. The light was flashing on the well field panel. Reset the PLC and the light came on steady. At the pumphouse, the pump was operating normally.
Down time: 10 hours.

8/12/2020 Pumphouse B3. The ECV closed slightly. Adjusted the pilot on the ECV to reduce the pressure and increase the flow rate.

Down time: 1.5 hours.

8/15-17/2020 Pumphouse SC1. The flow meter stopped totaling. Removed and cleaned the flow meter and reinstalled it. Observed normal operation. Meter readings were estimated.

Down time: None.

Appendix H.2

Maintenance Activities

Fiscal Year 2020
TGRS, OU2

Arden Hills, Minnesota

August 2020

8/17-18/2020	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Turned off the TGRS. Decommissioned the old pump director PLC and electrical and installed the new pump director PLC and electrical. Down time: 32.5 hours at B1; 33 hours at B13; 30.5 hours at B3; 27.5 hours at B4, B5, B8 and SC5; 30 hours at B6; 29 hours at B9; 3.5 hours at SC1.
8/24-28/2020	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Turned the TGRS off to decommission the old well field PLC and electrical and install the new well field PLC and electrical. The new pump control cabinets were installed at B4, B5, B6, B8 and B9. Thein Well installed a new 50 horesepower pump and motor at B4. Down time: 28 hours at B1, B13 and SC5; 54.5 hours at B3; 98.5 hours at B4; 102.5 hours at B5; 77 hours at B6; 51.5 hours at B8; 34 hours at B9; 57.5 hours at SC1.
8/29-31/2020	Pumphouse B6. The flow rate was set too low with the new control system. Increased the flow rate to the target flow rate and observed normal operation. Down time: 14.5 hours.
8/30/2020	Pumphouse SC1. The electricians were working in the B8 pumphouse and disconnected the communication wires to SC1. Following the work, they reconnected the communication wires and restarted SC1. Down time: 1.5 hours.
8/31/2020	Pumphouse B1; The electricians turned the pump off to install the new control cabinet and controls in the pumphouse. Following the work, they turned the pump back on. Normal operation observed. Down time: 2 hours.

September 2020

9/1-5/2020	Pumphouse B1. Installed a new control panel. Also installed new mechanical piping. Following the work, turned the pump on and observed normal operation. Down time: 106 hours.
9/1-2/2020	Pumphouse B6. Turned the pump off to troubleshoot the new control panel and to install new mechanical piping. Following the work, turned the pump back on and observed normal operation. Down time: 22 hours.

Appendix H.2

Maintenance Activities

Fiscal Year 2020
TGRS, OU2

Arden Hills, Minnesota

September 2020

9/2-5/2020	Pumphouse B13. Turned the pump off to install a new control panel. Following the work, turned the pump on and observed normal operation. Down time: 29 hours.
9/2/2020	Pumphouses B3, SC1 and SC5. Turned the pumps off to begin installing mechanical piping in pumphouse SC5 and begin the installation of the new control panels in B11 (for SC1) and B3. Down time: 19.5 hours at B3. 19 hours at SC1 and SC5.
9/3-4/2020	Pumphouses B4 and B5. Turned the pumps off to replace the mechanical piping in the pumphouses. Following the work, turned the pumps on and observed normal operation. Down time: 50.5 hours at B4 and 27 hours at B5.
9/8-9/2020	Pumphouses B8, SC1 and SC5. Turned the pumps off to replace the mechanical piping in pumphouses B8 and SC5. Also, installed new control panels in B11 (for SC1) and SC5. Following the work, turned the pumps on and observed normal operation. Down time: 4.5 hours at B8, 25.5 hours at SC1 and 38 hours at SC5.
9/11/2020	Pumphouses B13 and B3. Turned the pumps off to install the new wiring in the control cabinets to communicate with the main control panel in Building 116. Following the work, turned the pumps on for normal operation. Down time: 6.5 hours at B13 and 3 hours at B3.
9/22/2020	Pumphouses B1, B13, B3, B6, B8, B9 and SC1. Call from Time Communications - TGRS Fail. Upon arrival, Pump 3 in the treatment system failed to open ECV 3. Troubleshooting indicated a failure in the motor control center or a bad pump and/or motor. Turned Pump 3 off pending additional troubleshooting. Operated the TGRS at a flow rate that Pump 4 could maintain. Down time: 5 hours at B1, B13, B3, B6 and SC1. 2.5 hours at B8 and 1.5 hours at B9.

Appendix H.3

Maintenance Activities By Location
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

Pumphouse B1

10/16/2019 Pumphouses B1. The ARV was leaking. Replaced the ARV with one from inventory.
Down time: None.

11/7/2019 Pumphouse B1. Closed the ECV slightly to decrease the flow rate.
Down time: None.

12/4-5/2019 Pumphouse B5. The RPZ backflow preventer was leaking. Attempted to stop the leak but was unsuccessful. Turned the pump off and turned the pumps in B1, B3, B8 and B9 to their maximum flow rates to make up for the loss of flow from B5. Contacted Jayhawk Mechanical and they repaired the leak. Turned the pump on and observed normal operation. Returned the flow rates in B1, B3, B8 and B9 to their normal operating flow rates.
Down time: 22 hours.

1/17-22/2020 Pumphouse B1. The RPZ was leaking. Exercised and flushed the control valves and was able to stop the majority of the leak. Contacted Jayhawk Mechanical and they repaired the problem. Restarted the pump and observed normal operation.
Down time: None.

1/21-31/2020 Pumphouse B1. The flow meter flow rate was declining slowly with time. Turned the pump off and replaced the flow meter with the flow meter from B3. The B3 flow meter read 225 gpm. The flow meter will be replaced when the vendor repairs one of the flow meters from inventory. Meter readings estimated.
Down time: None.

1/29/2020 Pumphouse B1. The ECV would not close properly. Removed, cleaned and replaced portions of the piping as necessary for the ECV to actuate. Following the work, the ECV opened and closed normally.
Down time: None.

2/4-17/2020 Pumphouse B1. Turned the pump off and removed the flow meter. Cleaned the flow meter and reinstalled it. Turned the pump on but the flow meter did not total correctly. We are waiting for the vendor to rebuild three of our old flow meters. Meter readings estimated.
Down time: None.

Appendix H.3

Maintenance Activities By Location
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

2/17/2020	Pumphouse B1. The flow meter was not totaling correctly. Turned the pump off and removed the flow meter. Installed a new flow meter from inventory. Turned the pump on and observed normal operation. Down time: None.
2/20/2020	Pumphouses B1, B13, B3, B4 and B8. Checked the flow rate of the existing flow meter against the flow rate of a calibrated flow meter. Down time: None.
3/8/2020	Treatment System. Turned the TGRS off to inspect the demister pads and water distribution systems in Towers 3 and 4. Following the work, turned the TGRS back on. Normal operation observed. Down time: 1 hour at B1 and B13; 1.5 hours at SC5 and 2 hours at B6.
4/20/2020	Treatment System. Turned the TGRS off and performed annual maintenance activities on the treatment system items. Following the work, turned the TGRS back on. Observed normal operation. Down time: 2.5 hours at B4; 3.5 hours at B8; 6 hours at B1, B6, B9 and SC5; 7 hours at B13 and SC1.
5/4/2020	Treatment System and Well Field. Turned the TGRS off to inspect and exercise the TGRS forcemain butterfly valves as part of the annual maintenance inspection. Following the work, the TGRS was turned back on and normal operation was observed. Down time: 2 hours at B3; 3.5 hours at B1, B13 and B9; 4 hours at B6 and 5 hours at SC5.
5/6/2020	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Compared the pumphouse pressure gauges to a calibrated pressure gauge. Replaced pressure gauges that were not accurate. Down time: None.
5/20/2020	Treatment System. Turned the TGRS off to reinstall the demister pads in Towers 3 and 4. Also, cleaned the blower inlet screens to blowers 3 and 4. Down time: 2 hours at B3; 2.5 hours at B6, B9 and SC5; 3 hours at B1 and B13.

Appendix H.3

Maintenance Activities By Location
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

7/2-4/2020	Treatment System and Well Field. Call from Time Communication - TGRS fail. At the site, there was only 2 phases of power to the treatment system. Contacted Xcel Energy. They inspected the power lines and found an untagged jumper on a power pole in the marsh to the west of Building 116. They acquired the appropriate equipment, repaired the jumper and restored power to the treatment system and well field. Following the work, restarted the TGRS and observed normal operation. Down time: 37 hours at B5; 42.5 hours at B4, B8 and SC5; 43.5 hours at SC1; 45.5 hours at B6; 46.5 hours at B1; 47.5 hours at B13 and B9; 49 hours at B3.
7/19/2020	Treatment System and Well Field. Call from Time Communication - TGRS fail. At the site, there was only 2 phases of power to the treatment system. Contacted Xcel Energy. They found two locations where fuses had opened. One on the power pole to the west of Building 116 and one near Gate 4. They reinstalled the fuses and restored power to the treatment system and well field. Following the work, restarted the TGRS and observed normal operation. Down time: 10 hours at B5; 13 hours at B3; 14 hours at B4, B8 and SC5; 15.5 hours at B1, B6, B9 and SC1; 18 hours at B13.
8/17-18/2020	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Turned off the TGRS. Decommissioned the old pump director PLC and electrical and installed the new pump director PLC and electrical. Down time: 32.5 hours at B1; 33 hours at B13; 30.5 hours at B3; 27.5 hours at B4, B5, B8 and SC5; 30 hours at B6; 29 hours at B9; 3.5 hours at SC1.
8/24-28/2020	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Turned the TGRS off to decommission the old well field PLC and electrical and install the new well field PLC and electrical. The new pump control cabinets were installed at B4, B5, B6, B8 and B9. Thein Well installed a new 50 horesepower pump and motor at B4. Down time: 28 hours at B1, B13 and SC5; 54.5 hours at B3; 98.5 hours at B4; 102.5 hours at B5; 77 hours at B6; 51.5 hours at B8; 34 hours at B9; 57.5 hours at SC1.
8/31/2020	Pumphouse B1; The electricians turned the pump off to install the new control cabinet and controls in the pumphouse. Following the work, they turned the pump back on. Normal operation observed. Down time: 2 hours.

Appendix H.3

Maintenance Activities By Location
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

9/1-5/2020	Pumphouse B1. Installed a new control panel. Also installed new mechanical piping. Following the work, turned the pump on and observed normal operation. Down time: 106 hours.
9/22/2020	Pumphouses B1, B13, B3, B6, B8, B9 and SC1. Call from Time Communications - TGRS Fail. Upon arrival, Pump 3 in the treatment system failed to open ECV 3. Troubleshooting indicated a failure in the motor control center or a bad pump and/or motor. Turned Pump 3 off pending additional troubleshooting. Operated the TGRS at a flow rate that Pump 4 could maintain. Down time: 5 hours at B1, B13, B3, B6 and SC1. 2.5 hours at B8 and 1.5 hours at B9.

Pumphouse B3

10/5-25/2019	Treatment System. Turned the pumps in B3, B8 and B9 off to decrease the influent flow volume to the treatment system during the cleaning of Towers 3 and 4. Following the cleaning of the towers, turned the pumps on for normal service. Down time: 486 hours each at B3, B8 and B9.
10/26-29/2019	Pumphouse B3. The RPZ was leaking. Water was spraying out a pinhole leak in the downstream elbow. Contacted Jayhawk Mechanical and they replaced the elbow with one from inventory. Following the work, turned the pump on and observed normal operation. Down time: 82.5 hours.
12/4-5/2019	Pumphouse B5. The RPZ backflow preventer was leaking. Attempted to stop the leak but was unsuccessful. Turned the pump off and turned the pumps in B1, B3, B8 and B9 to their maximum flow rates to make up for the loss of flow from B5. Contacted Jayhawk Mechanical and they repaired the leak. Turned the pump on and observed normal operation. Returned the flow rates in B1, B3, B8 and B9 to their normal operating flow rates. Down time: 22 hours.
1/21-31/2020	Pumphouse B1. The flow meter flow rate was declining slowly with time. Turned the pump off and replaced the flow meter with the flow meter from B3. The B3 flow meter read 225 gpm. The flow meter will be replaced when the vendor repairs one of the flow meters from inventory. Meter readings estimated. Down time: None.

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Maintenance Activities By Location
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

2/14/2020	Treatment System. Turned Pump 4 off to work on the ECV 4 closing issue. Turned B3 and B5 off to minimize well field cycling with only Pump 3 operating. Replaced the solenoid valve and a check valve and restarted Pump 4. The ECV closed but only slightly faster. Additional work will be necessary. Turned B3 and B5 back on for normal operation. Down time: 1 hour at B3.
2/17/2020	Pumphouse B3. The downstream valve on the ECV control piping was leaking. Removed and replaced the downstream valve. Down time: None.
2/20/2020	Pumphouses B1, B13, B3, B4 and B8. Checked the flow rate of the existing flow meter against the flow rate of a calibrated flow meter. Down time: None.
5/4/2020	Treatment System and Well Field. Turned the TGRS off to inspect and exercise the TGRS forcemain butterfly valves as part of the annual maintenance inspection. Following the work, the TGRS was turned back on and normal operation was observed. Down time: 2 hours at B3; 3.5 hours at B1, B13 and B9; 4 hours at B6 and 5 hours at SC5.
5/6/2020	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Compared the pumphouse pressure gauges to a calibrated pressure gauge. Replaced pressure gauges that were not accurate. Down time: None.
5/20/2020	Treatment System. Turned the TGRS off to reinstall the demister pads in Towers 3 and 4. Also, cleaned the blower inlet screens to blowers 3 and 4. Down time: 2 hours at B3; 2.5 hours at B6, B9 and SC5; 3 hours at B1 and B13.
5/26/2020	Pumphouse B3. Turned the pump off and replaced a valve on the control piping. Following the work, reset the ECV too much which slowed the average flow rate between inspections. Reset the ECV the following day. Down time: 5 hours.

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Maintenance Activities By Location
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

6/1/2020	Pumphouse B3. The ECV closed slightly between inspections which slowed the flow rate. Cleaned the strainer screen, flushed the control piping and reset the ECV. Observed normal operation. Down time: 1.5 hours.
6/13/2020	Pumphouse B3. The ECV fluctuated slightly between inspections causing the average flow rate to be below the minimum target flow rate. Down time: 1 hour.
6/14/2020	Pumphouse B3. The ECV closed slightly between inspections which slowed the flow rate. Cleaned the strainer screen, flushed the control piping and reset the ECV. Observed normal operation. Down time: 1.5 hours.
7/1-2/2020	Pumphouse B9. Water was flowing out the backflow preventer drain. Turned the pump off and contacted Jayhawk Mechanical. Increased the flow rates at B3, B6 and B8 while B9 was off. Jayhawk repaired the problem. The following day, turned the pump on and observed normal operation. Down time: 44.5 hours.
7/2-4/2020	Treatment System and Well Field. Call from Time Communication - TGRS fail. At the site, there was only 2 phases of power to the treatment system. Contacted Xcel Energy. They inspected the power lines and found an untagged jumper on a power pole in the marsh to the west of Building 116. They acquired the appropriate equipment, repaired the jumper and restored power to the treatment system and well field. Following the work, restarted the TGRS and observed normal operation. Down time: 37 hours at B5; 42.5 hours at B4, B8 and SC5; 43.5 hours at SC1; 45.5 hours at B6; 46.5 hours at B1; 47.5 hours at B13 and B9; 49 hours at B3.
7/14/2020	Pumphouse B3. Increased the flow rate slightly. Down time: None.

Appendix H.3

Maintenance Activities By Location
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

7/19/2020	Treatment System and Well Field. Call from Time Communication - TGRS fail. At the site, there was only 2 phases of power to the treatment system. Contacted Xcel Energy. They found two locations where fuses had opened. One on the power pole to the west of Building 116 and one near Gate 4. They reinstalled the fuses and restored power to the treatment system and well field. Following the work, restarted the TGRS and observed normal operation. Down time: 10 hours at B5; 13 hours at B3; 14 hours at B4, B8 and SC5; 15.5 hours at B1, B6, B9 and SC1; 18 hours at B13.
8/12/2020	Pumphouse B3. The ECV closed slightly. Adjusted the pilot on the ECV to reduce the pressure and increase the flow rate. Down time: 1.5 hours.
8/17-18/2020	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Turned off the TGRS. Decommissioned the old pump director PLC and electrical and installed the new pump director PLC and electrical. Down time: 32.5 hours at B1; 33 hours at B13; 30.5 hours at B3; 27.5 hours at B4, B5, B8 and SC5; 30 hours at B6; 29 hours at B9; 3.5 hours at SC1.
8/24-28/2020	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Turned the TGRS off to decommission the old well field PLC and electrical and install the new well field PLC and electrical. The new pump control cabinets were installed at B4, B5, B6, B8 and B9. Thein Well installed a new 50 horesepower pump and motor at B4. Down time: 28 hours at B1, B13 and SC5; 54.5 hours at B3; 98.5 hours at B4; 102.5 hours at B5; 77 hours at B6; 51.5 hours at B8; 34 hours at B9; 57.5 hours at SC1.
9/2/2020	Pumphouses B3, SC1 and SC5. Turned the pumps off to begin installing mechanical piping in pumphouse SC5 and begin the installation of the new control panels in B11 (for SC1) and B3. Down time: 19.5 hours at B3. 19 hours at SC1 and SC5.
9/11/2020	Pumphouses B13 and B3. Turned the pumps off to install the new wiring in the control cabinets to communicate with the main control panel in Building 116. Following the work, turned the pumps on for normal operation. Down time:6.5 hours at B13 and 3 hours at B3.

Appendix H.3

Maintenance Activities By Location
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

9/22/2020	Pumphouses B1, B13, B3, B6, B8, B9 and SC1. Call from Time Communications - TGRS Fail. Upon arrival, Pump 3 in the treatment system failed to open ECV 3. Troubleshooting indicated a failure in the motor control center or a bad pump and/or motor. Turned Pump 3 off pending additional troubleshooting. Operated the TGRS at a flow rate that Pump 4 could maintain. Down time: 5 hours at B1, B13, B3, B6 and SC1. 2.5 hours at B8 and 1.5 hours at B9.

Pumphouse B4

11/4/2019	Pumphouse B4. The flow meter was totaling more slowly with time. Replaced the flow meter with one from inventory. Down time: None.
11/26/2019	Pumphouse B4. Replaced the ARV with one from inventory. Down time: None.
12/5/2019	Pumphouse B4. The ARV was leaking. Replaced the ARV with a new one from inventory. Down time: None.
1/24/2020	Treatment System. Turned Pump 4 off to change the oil. Turned B4 and B5 off to minimize well field cycling with only Pump 3 operating. Following the work, turned Pump 4 on and observed normal operation. Turned B4 and B5 back on. Down time: None.
2/4/2020	Pumphouse B4. The flow meter flow rate was declining slowly with time. Turned the pump off and removed and cleaned the flow meter. Reinstalled the flow meter and restarted the pump. The flow rate was within an acceptable range of normal operation. Down time: None.
2/4/2020	Pumphouse B4. Turned the pump off and removed the ECV from the pumphouse piping. Reinstalled a new ECV from inventory. Turned the pump on and observed normal operation. Down time: None.

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Maintenance Activities By Location
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

2/20/2020	Pumphouses B1, B13, B3, B4 and B8. Checked the flow rate of the existing flow meter against the flow rate of a calibrated flow meter. Down time: None.
4/6/2020	Pumphouses B4 and B8. There are garter snakes living under the pumphouses and they often enter the pumphouses. Removed 10 snakes from B4 and 7 snakes from B8. Attempted to flood out the areas under the pumphouses. Down time: None.
4/20/2020	Treatment System. Turned the TGRS off and performed annual maintenance activities on the treatment system items. Following the work, turned the TGRS back on. Observed normal operation. Down time: 2.5 hours at B4; 3.5 hours at B8; 6 hours at B1, B6, B9 and SC5; 7 hours at B13 and SC1.
5/6/2020	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Compared the pumphouse pressure gauges to a calibrated pressure gauge. Replaced pressure gauges that were not accurate. Down time: None.
7/2-4/2020	Treatment System and Well Field. Call from Time Communication - TGRS fail. At the site, there was only 2 phases of power to the treatment system. Contacted Xcel Energy. They inspected the power lines and found an untagged jumper on a power pole in the marsh to the west of Building 116. They acquired the appropriate equipment, repaired the jumper and restored power to the treatment system and well field. Following the work, restarted the TGRS and observed normal operation. Down time: 37 hours at B5; 42.5 hours at B4, B8 and SC5; 43.5 hours at SC1; 45.5 hours at B6; 46.5 hours at B1; 47.5 hours at B13 and B9; 49 hours at B3.
8/10/2020	Pumphouse B4. The light was flashing on the well field panel. Reset the PLC and the light came on steady. At the pumphouse, the pump was operating normally. Down time: 10 hours.
8/17-18/2020	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Turned off the TGRS. Decommissioned the old pump director PLC and electrical and installed the new pump director PLC and electrical. Down time: 32.5 hours at B1; 33 hours at B13; 30.5 hours at B3; 27.5 hours at B4, B5, B8 and SC5; 30 hours at B6; 29 hours at B9; 3.5 hours at SC1.

Appendix H.3

Maintenance Activities By Location
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

8/24-28/2020 Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Turned the TGRS off to decommission the old well field PLC and electrical and install the new well field PLC and electrical. The new pump control cabinets were installed at B4, B5, B6, B8 and B9. Thein Well installed a new 50 horesepower pump and motor at B4.

Down time: 28 hours at B1, B13 and SC5; 54.5 hours at B3; 98.5 hours at B4; 102.5 hours at B5; 77 hours at B6; 51.5 hours at B8; 34 hours at B9; 57.5 hours at SC1.

9/3-4/2020 Pumphouses B4 and B5. Turned the pumps off to replace the mechanical piping in the pumphouses. Following the work, turned the pumps on and observed normal operation.

Down time: 50.5 hours at B4 and 27 hours at B5.

Pumphouse B5

11/4/2019 Pumphouse B5. Closed the ECV slightly to decrease the flow rate.

Down time: None.

12/4-5/2019 Pumphouse B5. The RPZ backflow preventer was leaking. Attempted to stop the leak but was unsuccessful. Turned the pump off and turned the pumps in B1, B3, B8 and B9 to their maximum flow rates to make up for the loss of flow from B5. Contacted Jayhawk Mechanical and they repaired the leak. Turned the pump on and observed normal operation. Returned the flow rates in B1, B3, B8 and B9 to their normal operating flow rates.

Down time: 22 hours.

1/16/2020 Pumphouse B5. The flow meter flow rate was declining slowly with time. Turned the pump off and replaced the flow meter with one from inventory. Restarted the pump and observed normal operation.

Down time: None.

1/24/2020 Treatment System. Turned Pump 4 off to change the oil. Turned B4 and B5 off to minimize well field cycling with only Pump 3 operating. Following the work, turned Pump 4 on and observed normal operation. Turned B4 and B5 back on.

Down time: None.

Appendix H.3

Maintenance Activities By Location
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

2/11/2020 Treatment System. ECV 4 would not close on command. Turned off the pumps in B5 and B8 to minimize well field cycling. Removed and replaced portions of the control piping. Following the work, turned Pump 4 on and actuated the ECV. The ECV closed but slowly. Additional work will be necessary.

Down time: None.

2/14/2020 Treatment System. Turned Pump 4 off to work on the ECV 4 closing issue. Turned B3 and B5 off to minimize well field cycling with only Pump 3 operating. Replaced the solenoid valve and a check valve and restarted Pump 4. The ECV closed but only slightly faster. Additional work will be necessary. Turned B3 and B5 back on for normal operation.

Down time: 1 hour at B3.

5/6/2020 Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Compared the pumphouse pressure gauges to a calibrated pressure gauge. Replaced pressure gauges that were not accurate.

Down time: None.

7/2-4/2020 Treatment System and Well Field. Call from Time Communication - TGRS fail. At the site, there was only 2 phases of power to the treatment system. Contacted Xcel Energy. They inspected the power lines and found an untagged jumper on a power pole in the marsh to the west of Building 116. They acquired the appropriate equipment, repaired the jumper and restored power to the treatment system and well field. Following the work, restarted the TGRS and observed normal operation.

Down time: 37 hours at B5; 42.5 hours at B4, B8 and SC5; 43.5 hours at SC1; 45.5 hours at B6; 46.5 hours at B1; 47.5 hours at B13 and B9; 49 hours at B3.

7/17/2020 Pumphouse B5. The flow meter was totaling slower than the calibrated flow meter. Replaced the flow meter with one from inventory. Following the work, turned the pump on and observed normal operation.

Down time: None.

Appendix H.3

Maintenance Activities By Location
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

7/19/2020	Treatment System and Well Field. Call from Time Communication - TGRS fail. At the site, there was only 2 phases of power to the treatment system. Contacted Xcel Energy. They found two locations where fuses had opened. One on the power pole to the west of Building 116 and one near Gate 4. They reinstalled the fuses and restored power to the treatment system and well field. Following the work, restarted the TGRS and observed normal operation. Down time: 10 hours at B5; 13 hours at B3; 14 hours at B4, B8 and SC5; 15.5 hours at B1, B6, B9 and SC1; 18 hours at B13.
8/3/2020	Pumphouses B6 and B9. Xcel Energy upsized the transformers at the power pole adjacent to B5. The pumphouses were turned off during the work. Down time: 4.5 hours at B6 and 5 hours at B9.
8/17-18/2020	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Turned off the TGRS. Decommissioned the old pump director PLC and electrical and installed the new pump director PLC and electrical. Down time: 32.5 hours at B1; 33 hours at B13; 30.5 hours at B3; 27.5 hours at B4, B5, B8 and SC5; 30 hours at B6; 29 hours at B9; 3.5 hours at SC1.
8/24-28/2020	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Turned the TGRS off to decommission the old well field PLC and electrical and install the new well field PLC and electrical. The new pump control cabinets were installed at B4, B5, B6, B8 and B9. Thein Well installed a new 50 horesepower pump and motor at B4. Down time: 28 hours at B1, B13 and SC5; 54.5 hours at B3; 98.5 hours at B4; 102.5 hours at B5; 77 hours at B6; 51.5 hours at B8; 34 hours at B9; 57.5 hours at SC1.
9/3-4/2020	Pumphouses B4 and B5. Turned the pumps off to replace the mechanical piping in the pumphouses. Following the work, turned the pumps on and observed normal operation. Down time: 50.5 hours at B4 and 27 hours at B5.

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Maintenance Activities By Location
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

Pumphouse B6

10/30/2019	Treatment System. Turned the TGRS off to pressure wash the inside of the treatment system. Following the work, turned the TGRS on and observed normal operation. Down time: 2.5 hours each at B6 and B13.
3/8/2020	Treatment System. Turned the TGRS off to inspect the demister pads and water distribution systems in Towers 3 and 4. Following the work, turned the TGRS back on. Normal operation observed. Down time: 1 hour at B1 and B13; 1.5 hours at SC5 and 2 hours at B6.
3/20/2020	Treatment System. Turned off Pump 4 at the treatment system and turned off B6 and B9 to estimate the maximum flow rate that Pump 3 in the treatment system could produce. The maximum flow rate for Pump 3 is approximately 1425 gallons per minute. Down time: 3.5 hours at B9 and 4 hours at B6.
4/20/2020	Treatment System. Turned the TGRS off and performed annual maintenance activities on the treatment system items. Following the work, turned the TGRS back on. Observed normal operation. Down time: 2.5 hours at B4; 3.5 hours at B8; 6 hours at B1, B6, B9 and SC5; 7 hours at B13 and SC1.
5/4/2020	Treatment System and Well Field. Turned the TGRS off to inspect and exercise the TGRS forcemain butterfly valves as part of the annual maintenance inspection. Following the work, the TGRS was turned back on and normal operation was observed. Down time: 2 hours at B3; 3.5 hours at B1, B13 and B9; 4 hours at B6 and 5 hours at SC5.
5/6/2020	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Compared the pumphouse pressure gauges to a calibrated pressure gauge. Replaced pressure gauges that were not accurate. Down time: None.
5/20/2020	Treatment System. Turned the TGRS off to reinstall the demister pads in Towers 3 and 4. Also, cleaned the blower inlet screens to blowers 3 and 4. Down time: 2 hours at B3; 2.5 hours at B6, B9 and SC5; 3 hours at B1 and B13.

Appendix H.3

Maintenance Activities By Location
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

7/1-2/2020	Pumphouse B9. Water was flowing out the backflow preventer drain. Turned the pump off and contacted Jayhawk Mechanical. Increased the flow rates at B3, B6 and B8 while B9 was off. Jayhawk repaired the problem. The following day, turned the pump on and observed normal operation. Down time: 44.5 hours.
7/2-4/2020	Treatment System and Well Field. Call from Time Communication - TGRS fail. At the site, there was only 2 phases of power to the treatment system. Contacted Xcel Energy. They inspected the power lines and found an untagged jumper on a power pole in the marsh to the west of Building 116. They acquired the appropriate equipment, repaired the jumper and restored power to the treatment system and well field. Following the work, restarted the TGRS and observed normal operation. Down time: 37 hours at B5; 42.5 hours at B4, B8 and SC5; 43.5 hours at SC1; 45.5 hours at B6; 46.5 hours at B1; 47.5 hours at B13 and B9; 49 hours at B3.
7/10/2020	Treatment System. Performed maintenance on Pump 4 in the treatment center. Turned B6 and B9 off to minimize well field cycling with only Pump 3 in operation. Following the work, turned Pump 4, B6 and B9 on for normal service. Down time: 3 hours at B6 and 3.5 hours at B9.
7/19/2020	Treatment System and Well Field. Call from Time Communication - TGRS fail. At the site, there was only 2 phases of power to the treatment system. Contacted Xcel Energy. They found two locations where fuses had opened. One on the power pole to the west of Building 116 and one near Gate 4. They reinstalled the fuses and restored power to the treatment system and well field. Following the work, restarted the TGRS and observed normal operation. Down time: 10 hours at B5; 13 hours at B3; 14 hours at B4, B8 and SC5; 15.5 hours at B1, B6, B9 and SC1; 18 hours at B13.
8/3/2020	Pumphouses B6 and B9. Xcel Energy upsized the transformers at the power pole adjacent to B5. The pumphouses were turned off during the work. Down time: 4.5 hours at B6 and 5 hours at B9.
8/17-18/2020	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Turned off the TGRS. Decommissioned the old pump director PLC and electrical and installed the new pump director PLC and electrical. Down time: 32.5 hours at B1; 33 hours at B13; 30.5 hours at B3; 27.5 hours at B4, B5, B8 and SC5; 30 hours at B6; 29 hours at B9; 3.5 hours at SC1.

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8/24-28/2020	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Turned the TGRS off to decommission the old well field PLC and electrical and install the new well field PLC and electrical. The new pump control cabinets were installed at B4, B5, B6, B8 and B9. Thein Well installed a new 50 horesepower pump and motor at B4. Down time: 28 hours at B1, B13 and SC5; 54.5 hours at B3; 98.5 hours at B4; 102.5 hours at B5; 77 hours at B6; 51.5 hours at B8; 34 hours at B9; 57.5 hours at SC1.
8/29-31/2020	Pumphouse B6. The flow rate was set too low with the new control system. Increased the flow rate to the target flow rate and observed normal operation. Down time: 14.5 hours.
9/1-2/2020	Pumphouse B6. Turned the pump off to troubleshoot the new control panel and to install new mechanical piping. Following the work, turned the pump back on and observed normal operation. Down time: 22 hours.
9/22/2020	Pumphouses B1, B13, B3, B6, B8, B9 and SC1. Call from Time Communications - TGRS Fail. Upon arrival, Pump 3 in the treatment system failed to open ECV 3. Troubleshooting indicated a failure in the motor control center or a bad pump and/or motor. Turned Pump 3 off pending additional troubleshooting. Operated the TGRS at a flow rate that Pump 4 could maintain. Down time: 5 hours at B1, B13, B3, B6 and SC1. 2.5 hours at B8 and 1.5 hours at B9.

Pumphouse B8

10/5-25/2019	Treatment System. Turned the pumps in B3, B8 and B9 off to decrease the influent flow volume to the treatment system during the cleaning of Towers 3 and 4. Following the cleaning of the towers, turned the pumps on for normal service. Down time: 486 hours each at B3, B8 and B9.
12/4-5/2019	Pumphouse B5. The RPZ backflow preventer was leaking. Attempted to stop the leak but was unsuccessful. Turned the pump off and turned the pumps in B1, B3, B8 and B9 to their maximum flow rates to make up for the loss of flow from B5. Contacted Jayhawk Mechanical and they repaired the leak. Turned the pump on and observed normal operation. Returned the flow rates in B1, B3, B8 and B9 to their normal operating flow rates. Down time: 22 hours.

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12/5/2019	Pumphouse B8. The ARV was leaking. Installed a new drip hose from the ARV. Down time: None.
1/25/2020	Pumphouse B8. The heater stopped working. Installed a temporary electric heater and scheduled repair. Down time: None.
2/11/2020	Treatment System. ECV 4 would not close on command. Turned off the pumps in B5 and B8 to minimize well field cycling. Removed and replaced portions of the control piping. Following the work, turned Pump 4 on and actuated the ECV. The ECV closed but slowly. Additional work will be necessary. Down time: None.
2/20/2020	Pumphouses B1, B13, B3, B4 and B8. Checked the flow rate of the existing flow meter against the flow rate of a calibrated flow meter. Down time: None.
2/26/2020	Pumphouse B8. The flow meter stopped totaling. Turned the pump off and removed the flow meter. Installed a new flow meter from inventory. Turned the pump on and observed normal operation. Down time: None.
4/6/2020	Pumphouses B4 and B8. There are garter snakes living under the pumphouses and they often enter the pumphouses. Removed 10 snakes from B4 and 7 snakes from B8. Attempted to flood out the areas under the pumphouses. Down time: None.
4/20/2020	Treatment System. Turned the TGRS off and performed annual maintenance activities on the treatment system items. Following the work, turned the TGRS back on. Observed normal operation. Down time: 2.5 hours at B4; 3.5 hours at B8; 6 hours at B1, B6, B9 and SC5; 7 hours at B13 and SC1.
5/6/2020	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Compared the pumphouse pressure gauges to a calibrated pressure gauge. Replaced pressure gauges that were not accurate. Down time: None.

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6/28/2020	Pumphouse B8. The low light was lit on the control panel in the pumphouse. Turned the pump to off and back to auto and reset the panel. The pump started normally. Down time: 3 hours.
7/1-2/2020	Pumphouse B9. Water was flowing out the backflow preventer drain. Turned the pump off and contacted Jayhawk Mechanical. Increased the flow rates at B3, B6 and B8 while B9 was off. Jayhawk repaired the problem. The following day, turned the pump on and observed normal operation. Down time: 44.5 hours.
7/2-4/2020	Treatment System and Well Field. Call from Time Communication - TGRS fail. At the site, there was only 2 phases of power to the treatment system. Contacted Xcel Energy. They inspected the power lines and found an untagged jumper on a power pole in the marsh to the west of Building 116. They acquired the appropriate equipment, repaired the jumper and restored power to the treatment system and well field. Following the work, restarted the TGRS and observed normal operation. Down time: 37 hours at B5; 42.5 hours at B4, B8 and SC5; 43.5 hours at SC1; 45.5 hours at B6; 46.5 hours at B1; 47.5 hours at B13 and B9; 49 hours at B3.
7/19/2020	Treatment System and Well Field. Call from Time Communication - TGRS fail. At the site, there was only 2 phases of power to the treatment system. Contacted Xcel Energy. They found two locations where fuses had opened. One on the power pole to the west of Building 116 and one near Gate 4. They reinstalled the fuses and restored power to the treatment system and well field. Following the work, restarted the TGRS and observed normal operation. Down time: 10 hours at B5; 13 hours at B3; 14 hours at B4, B8 and SC5; 15.5 hours at B1, B6, B9 and SC1; 18 hours at B13.
8/17-18/2020	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Turned off the TGRS. Decommissioned the old pump director PLC and electrical and installed the new pump director PLC and electrical. Down time: 32.5 hours at B1; 33 hours at B13; 30.5 hours at B3; 27.5 hours at B4, B5, B8 and SC5; 30 hours at B6; 29 hours at B9; 3.5 hours at SC1.

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8/24-28/2020 Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Turned the TGRS off to decommission the old well field PLC and electrical and install the new well field PLC and electrical. The new pump control cabinets were installed at B4, B5, B6, B8 and B9. Thein Well installed a new 50 horesepower pump and motor at B4.

Down time: 28 hours at B1, B13 and SC5; 54.5 hours at B3; 98.5 hours at B4; 102.5 hours at B5; 77 hours at B6; 51.5 hours at B8; 34 hours at B9; 57.5 hours at SC1.

9/8-9/2020 Pumphouses B8, SC1 and SC5. Turned the pumps off to replace the mechanical piping in pumphouses B8 and SC5. Also, installed new control panels in B11 (for SC1) and SC5. Following the work, turned the pumps on and observed normal operation.

Down time: 4.5 hours at B8, 25.5 hours at SC1 and 38 hours at SC5.

9/22/2020 Pumphouses B1, B13, B3, B6, B8, B9 and SC1. Call from Time Communications - TGRS Fail. Upon arrival, Pump 3 in the treatment system failed to open ECV 3. Troubleshooting indicated a failure in the motor control center or a bad pump and/or motor. Turned Pump 3 off pending additional troubleshooting. Operated the TGRS at a flow rate that Pump 4 could maintain.

Down time: 5 hours at B1, B13, B3, B6 and SC1. 2.5 hours at B8 and 1.5 hours at B9.

Pumphouse B9

10/5-25/2019 Treatment System. Turned the pumps in B3, B8 and B9 off to decrease the influent flow volume to the treatment system during the cleaning of Towers 3 and 4. Following the cleaning of the towers, turned the pumps on for normal service.

Down time: 486 hours each at B3, B8 and B9.

11/7/2019 Pumphouse B9. Closed the ECV slightly to decrease the flow rate.

Down time: None.

12/4-5/2019 Pumphouse B5. The RPZ backflow preventer was leaking. Attempted to stop the leak but was unsuccessful. Turned the pump off and turned the pumps in B1, B3, B8 and B9 to their maximum flow rates to make up for the loss of flow from B5. Contacted Jayhawk Mechanical and they repaired the leak. Turned the pump on and observed normal operation. Returned the flow rates in B1, B3, B8 and B9 to their normal operating flow rates.

Down time: 22 hours.

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1/20-22/2019	Pumphouse B9. The RPZ was leaking. Exercised and flushed the control valves and was able to stop the majority of the leak. Informed Jayhawk of the B9 RPZ leak and they repaired the problem. Restarted the pump and observed normal operation. Down time: None.
2/26/2020	Treatment System. Turned Pump 4 off to work on the ECV 4 closing issue. Turned B9 off to minimize well field cycling. Removed and replaced the emergency solenoid valve from the closing portion of the control piping. Following the work, turned Pump 4 on and actuated the ECV. The ECV closed slowly. Additional work will be necessary. Turned B9 back on for normal service. Down time: 5.5 hours at B9.
2/26/2020	Pumphouse B9. Checked the flow rate of the existing meter against the flow rate of a calibrated meter. Down time: None.
3/20/2020	Treatment System. Turned off Pump 4 at the treatment system and turned off B6 and B9 to estimate the maximum flow rate that Pump 3 in the treatment system could produce. The maximum flow rate for Pump 3 is approximately 1425 gallons per minute. Down time: 3.5 hours at B9 and 4 hours at B6.
4/20/2020	Treatment System. Turned the TGRS off and performed annual maintenance activities on the treatment system items. Following the work, turned the TGRS back on. Observed normal operation. Down time: 2.5 hours at B4; 3.5 hours at B8; 6 hours at B1, B6, B9 and SC5; 7 hours at B13 and SC1.
5/1/2020	Pumphouse B9. Repaired the RPZ backflow preventer drain. Down time: None.
5/4/2020	Treatment System and Well Field. Turned the TGRS off to inspect and exercise the TGRS forcemain butterfly valves as part of the annual maintenance inspection. Following the work, the TGRS was turned back on and normal operation was observed. Down time: 2 hours at B3; 3.5 hours at B1, B13 and B9; 4 hours at B6 and 5 hours at SC5.

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5/6/2020	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Compared the pumphouse pressure gauges to a calibrated pressure gauge. Replaced pressure gauges that were not accurate. Down time: None.
5/20/2020	Treatment System. Turned the TGRS off to reinstall the demister pads in Towers 3 and 4. Also, cleaned the blower inlet screens to blowers 3 and 4. Down time: 2 hours at B3; 2.5 hours at B6, B9 and SC5; 3 hours at B1 and B13.
6/10/2020	Pumphouse B9. The vent fan motor failed. Preferred Electric replaced with new. Down time: None.
6/30/2020	Pumphouse B9. The RPZ backflow preventer check valve failed. Turned the pump off and scheduled Jayhawk Mechanical. Down time will be reported following the repair in the July 2020 flow report. Down time: None.
7/1-2/2020	Pumphouse B9. Water was flowing out the backflow preventer drain. Turned the pump off and contacted Jayhawk Mechanical. Increased the flow rates at B3, B6 and B8 while B9 was off. Jayhawk repaired the problem. The following day, turned the pump on and observed normal operation. Down time: 44.5 hours.
7/2-4/2020	Treatment System and Well Field. Call from Time Communication - TGRS fail. At the site, there was only 2 phases of power to the treatment system. Contacted Xcel Energy. They inspected the power lines and found an untagged jumper on a power pole in the marsh to the west of Building 116. They acquired the appropriate equipment, repaired the jumper and restored power to the treatment system and well field. Following the work, restarted the TGRS and observed normal operation. Down time: 37 hours at B5; 42.5 hours at B4, B8 and SC5; 43.5 hours at SC1; 45.5 hours at B6; 46.5 hours at B1; 47.5 hours at B13 and B9; 49 hours at B3.
7/10/2020	Treatment System. Performed maintenance on Pump 4 in the treatment center. Turned B6 and B9 off to minimize well field cycling with only Pump 3 in operation. Following the work, turned Pump 4, B6 and B9 on for normal service. Down time: 3 hours at B6 and 3.5 hours at B9.

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7/19/2020	Treatment System and Well Field. Call from Time Communication - TGRS fail. At the site, there was only 2 phases of power to the treatment system. Contacted Xcel Energy. They found two locations where fuses had opened. One on the power pole to the west of Building 116 and one near Gate 4. They reinstalled the fuses and restored power to the treatment system and well field. Following the work, restarted the TGRS and observed normal operation. Down time: 10 hours at B5; 13 hours at B3; 14 hours at B4, B8 and SC5; 15.5 hours at B1, B6, B9 and SC1; 18 hours at B13.
8/3/2020	Pumphouses B6 and B9. Xcel Energy upsized the transformers at the power pole adjacent to B5. The pumphouses were turned off during the work. Down time: 4.5 hours at B6 and 5 hours at B9.
8/3/2020	Pumphouse B9. The flow meter was slowing with time. Removed the old flow meter and replaced it with a flow meter from inventory. Meter readings were estimated. Down time: None.
8/17-18/2020	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Turned off the TGRS. Decommissioned the old pump director PLC and electrical and installed the new pump director PLC and electrical. Down time: 32.5 hours at B1; 33 hours at B13; 30.5 hours at B3; 27.5 hours at B4, B5, B8 and SC5; 30 hours at B6; 29 hours at B9; 3.5 hours at SC1.
8/24-28/2020	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Turned the TGRS off to decommission the old well field PLC and electrical and install the new well field PLC and electrical. The new pump control cabinets were installed at B4, B5, B6, B8 and B9. Thein Well installed a new 50 horesepower pump and motor at B4. Down time: 28 hours at B1, B13 and SC5; 54.5 hours at B3; 98.5 hours at B4; 102.5 hours at B5; 77 hours at B6; 51.5 hours at B8; 34 hours at B9; 57.5 hours at SC1.
9/22/2020	Pumphouses B1, B13, B3, B6, B8, B9 and SC1. Call from Time Communications - TGRS Fail. Upon arrival, Pump 3 in the treatment system failed to open ECV 3. Troubleshooting indicated a failure in the motor control center or a bad pump and/or motor. Turned Pump 3 off pending additional troubleshooting. Operated the TGRS at a flow rate that Pump 4 could maintain. Down time: 5 hours at B1, B13, B3, B6 and SC1. 2.5 hours at B8 and 1.5 hours at B9.

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Pumphouse B13

10/30/2019	Treatment System. Turned the TGRS off to pressure wash the inside of the treatment system. Following the work, turned the TGRS on and observed normal operation. Down time: 2.5 hours each at B6 and B13.
11/6/2019	Pumphouse B13. The flow meter was totaling too quickly. Turned the pump off, removed, cleaned and reinstalled the flow meter. Restarted the pump and observed normal operation. Down time: None.
11/7/2019	Pumphouse B13. Following the meter cleaning, the flow rate dropped. Opened the ECV to increase the flow rate. Down time: 7 hours.
2/20/2020	Pumphouses B1, B13, B3, B4 and B8. Checked the flow rate of the existing flow meter against the flow rate of a calibrated flow meter. Down time: None.
3/8/2020	Treatment System. Turned the TGRS off to inspect the demister pads and water distribution systems in Towers 3 and 4. Following the work, turned the TGRS back on. Normal operation observed. Down time: 1 hour at B1 and B13; 1.5 hours at SC5 and 2 hours at B6.
4/20/2020	Treatment System. Turned the TGRS off and performed annual maintenance activities on the treatment system items. Following the work, turned the TGRS back on. Observed normal operation. Down time: 2.5 hours at B4; 3.5 hours at B8; 6 hours at B1, B6, B9 and SC5; 7 hours at B13 and SC1.
4/23/2020	Pumphouse B13. Turned the pump off and replaced the reducer bushing on the pressure gauge piping. Following the work, turned the pump back on and observed normal operation. Down time: 1 hour.

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5/4/2020	Treatment System and Well Field. Turned the TGRS off to inspect and exercise the TGRS forcemain butterfly valves as part of the annual maintenance inspection. Following the work, the TGRS was turned back on and normal operation was observed. Down time: 2 hours at B3; 3.5 hours at B1, B13 and B9; 4 hours at B6 and 5 hours at SC5.
5/6/2020	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Compared the pumphouse pressure gauges to a calibrated pressure gauge. Replaced pressure gauges that were not accurate. Down time: None.
5/20/2020	Treatment System. Turned the TGRS off to reinstall the demister pads in Towers 3 and 4. Also, cleaned the blower inlet screens to blowers 3 and 4. Down time: 2 hours at B3; 2.5 hours at B6, B9 and SC5; 3 hours at B1 and B13.
6/3/2020	Pumphouses B13 and SC5. There was a thunderstorm last night and the lights were flashing on the well field panel. Reset the PLC and the lights came back on steady. At the pumphouses, the pumps were running normally. Down time: 14.5 hours at B13 and 14 hours at SC5.
7/2-4/2020	Treatment System and Well Field. Call from Time Communication - TGRS fail. At the site, there was only 2 phases of power to the treatment system. Contacted Xcel Energy. They inspected the power lines and found an untagged jumper on a power pole in the marsh to the west of Building 116. They acquired the appropriate equipment, repaired the jumper and restored power to the treatment system and well field. Following the work, restarted the TGRS and observed normal operation. Down time: 37 hours at B5; 42.5 hours at B4, B8 and SC5; 43.5 hours at SC1; 45.5 hours at B6; 46.5 hours at B1; 47.5 hours at B13 and B9; 49 hours at B3.
7/19/2020	Treatment System and Well Field. Call from Time Communication - TGRS fail. At the site, there was only 2 phases of power to the treatment system. Contacted Xcel Energy. They found two locations where fuses had opened. One on the power pole to the west of Building 116 and one near Gate 4. They reinstalled the fuses and restored power to the treatment system and well field. Following the work, restarted the TGRS and observed normal operation. Down time: 10 hours at B5; 13 hours at B3; 14 hours at B4, B8 and SC5; 15.5 hours at B1, B6, B9 and SC1; 18 hours at B13.

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TGRS, OU2
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8/17-18/2020 Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Turned off the TGRS. Decommissioned the old pump director PLC and electrical and installed the new pump director PLC and electrical.

Down time: 32.5 hours at B1; 33 hours at B13; 30.5 hours at B3; 27.5 hours at B4, B5, B8 and SC5; 30 hours at B6; 29 hours at B9; 3.5 hours at SC1.

8/24-28/2020 Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Turned the TGRS off to decommission the old well field PLC and electrical and install the new well field PLC and electrical. The new pump control cabinets were installed at B4, B5, B6, B8 and B9. Thein Well installed a new 50 horesepower pump and motor at B4.

Down time: 28 hours at B1, B13 and SC5; 54.5 hours at B3; 98.5 hours at B4; 102.5 hours at B5; 77 hours at B6; 51.5 hours at B8; 34 hours at B9; 57.5 hours at SC1.

9/2-5/2020 Pumphouse B13. Turned the pump off to install a new control panel. Following the work, turned the pump on and observed normal operation.

Down time: 29 hours.

9/11/2020 Pumphouses B13 and B3. Turned the pumps off to install the new wiring in the control cabinets to communicate with the main control panel in Building 116. Following the work, turned the pumps on for normal operation.

Down time:6.5 hours at B13 and 3 hours at B3.

9/22/2020 Pumphouses B1, B13, B3, B6, B8, B9 and SC1. Call from Time Communications - TGRS Fail. Upon arrival, Pump 3 in the treatment system failed to open ECV 3. Troubleshooting indicated a failure in the motor control center or a bad pump and/or motor. Turned Pump 3 off pending additional troubleshooting. Operated the TGRS at a flow rate that Pump 4 could maintain.

Down time: 5 hours at B1, B13, B3, B6 and SC1. 2.5 hours at B8 and 1.5 hours at B9.

Pumphouse SC1

10/1-2/2019 Pumphouse SC1. The flow meter stopped totaling. Removed, cleaned and replaced the flow meter. The flow meter began totaling normally.

Down time: None. Estimated the meter readings.

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Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

2/17/2020	Pumphouse SC1. The flow meter was not totaling. Turned the pump off and removed the flow meter. Cleaned and reinstalled the flow meter. Turned the pump on and observed normal operation. Down time: 1 hour.
4/20/2020	Treatment System. Turned the TGRS off and performed annual maintenance activities on the treatment system items. Following the work, turned the TGRS back on. Observed normal operation. Down time: 2.5 hours at B4; 3.5 hours at B8; 6 hours at B1, B6, B9 and SC5; 7 hours at B13 and SC1.
4/28-30/2020	Pumphouse SC1. The flow meter stopped totaling. Removed the flow meter and cleaned it. Reinstalled the flow meter and observed normal operation. Down time: None. Meter readings were estimated.
5/6/2020	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Compared the pumphouse pressure gauges to a calibrated pressure gauge. Replaced pressure gauges that were not accurate. Down time: None.
7/2-4/2020	Treatment System and Well Field. Call from Time Communication - TGRS fail. At the site, there was only 2 phases of power to the treatment system. Contacted Xcel Energy. They inspected the power lines and found an untagged jumper on a power pole in the marsh to the west of Building 116. They acquired the appropriate equipment, repaired the jumper and restored power to the treatment system and well field. Following the work, restarted the TGRS and observed normal operation. Down time: 37 hours at B5; 42.5 hours at B4, B8 and SC5; 43.5 hours at SC1; 45.5 hours at B6; 46.5 hours at B1; 47.5 hours at B13 and B9; 49 hours at B3.
7/19/2020	Treatment System and Well Field. Call from Time Communication - TGRS fail. At the site, there was only 2 phases of power to the treatment system. Contacted Xcel Energy. They found two locations where fuses had opened. One on the power pole to the west of Building 116 and one near Gate 4. They reinstalled the fuses and restored power to the treatment system and well field. Following the work, restarted the TGRS and observed normal operation. Down time: 10 hours at B5; 13 hours at B3; 14 hours at B4, B8 and SC5; 15.5 hours at B1, B6, B9 and SC1; 18 hours at B13.

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TGRS, OU2
Arden Hills, Minnesota

7/16/2020	Pumphouse SC1. The pump was off. Inspected the controls at pumphouse B11 and found the I/O adapter card had blown. Replaced the I/O adapter card with one from inventory and restarted the SC1 pump. Normal operation observed. Down time: 25 hours.
8/15-17/2020	Pumphouse SC1. The flow meter stopped totaling. Removed and cleaned the flow meter and reinstalled it. Observed normal operation. Meter readings were estimated. Down time: None.
8/17-18/2020	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Turned off the TGRS. Decommissioned the old pump director PLC and electrical and installed the new pump director PLC and electrical. Down time: 32.5 hours at B1; 33 hours at B13; 30.5 hours at B3; 27.5 hours at B4, B5, B8 and SC5; 30 hours at B6; 29 hours at B9; 3.5 hours at SC1.
8/24-28/2020	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Turned the TGRS off to decommission the old well field PLC and electrical and install the new well field PLC and electrical. The new pump control cabinets were installed at B4, B5, B6, B8 and B9. Thein Well installed a new 50 horesepower pump and motor at B4. Down time: 28 hours at B1, B13 and SC5; 54.5 hours at B3; 98.5 hours at B4; 102.5 hours at B5; 77 hours at B6; 51.5 hours at B8; 34 hours at B9; 57.5 hours at SC1.
8/30/2020	Pumphouse SC1. The electricians were working in the B8 pumphouse and disconnected the communication wires to SC1. Following the work, they reconnected the communication wires and restarted SC1. Down time: 1.5 hours.
9/2/2020	Pumphouses B3, SC1 and SC5. Turned the pumps off to begin installing mechanical piping in pumphouse SC5 and begin the installation of the new control panels in B11 (for SC1) and B3. Down time: 19.5 hours at B3. 19 hours at SC1 and SC5.
9/8-9/2020	Pumphouses B8, SC1 and SC5. Turned the pumps off to replace the mechanical piping in pumphouses B8 and SC5. Also, installed new control panels in B11 (for SC1) and SC5. Following the work, turned the pumps on and observed normal operation. Down time: 4.5 hours at B8, 25.5 hours at SC1 and 38 hours at SC5.

Appendix H.3

Maintenance Activities By Location
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

9/22/2020 Pumphouses B1, B13, B3, B6, B8, B9 and SC1. Call from Time Communications - TGRS Fail. Upon arrival, Pump 3 in the treatment system failed to open ECV 3. Troubleshooting indicated a failure in the motor control center or a bad pump and/or motor. Turned Pump 3 off pending additional troubleshooting. Operated the TGRS at a flow rate that Pump 4 could maintain.

Down time: 5 hours at B1, B13, B3, B6 and SC1. 2.5 hours at B8 and 1.5 hours at B9.

Pumphouse SC5

12/11/2019 Pumphouse SC5. The RPZ backflow preventer was leaking. Flushed and exercised the valve. Restarted the pump and the RPZ did not leak. Normal operation observed.

Down time: None.

2/27/2020 Pumphouse SC5. Checked the flow rate of the existing meter against the flow rate of a calibrated meter. The flow rate of the existing meter was faster than the calibrated meter. Cleaned and reinstalled the existing meter. The flow rate was within an acceptable range of normal operation.

Down time: 1.5 hours.

3/1/2020 Pumphouse SC5. The ECV closed slightly between inspections which slowed the flow rate. Flushed the control pipes and reset the pressure. Observed normal operation.

Down time: 4 hours.

3/8/2020 Treatment System. Turned the TGRS off to inspect the demister pads and water distribution systems in Towers 3 and 4. Following the work, turned the TGRS back on. Normal operation observed.

Down time: 1 hour at B1 and B13; 1.5 hours at SC5 and 2 hours at B6.

3/11/2020 Pumphouse SC5. Turned the pump off and removed the flow meter. Removed a piece of mineral build-up from the impeller and reinstalled the flow meter. Turned the pump on and measured the flow rate. Observed normal operation.

Down time: 1.5 hours.

Appendix H.3

Maintenance Activities By Location
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

3/27/2020	Pumphouse SC5. The flow rate was fluctuating due to the pressure reducing pilot on the ECV control piping. Turned the pump off and removed the pilot from the control piping. Disassembled the pilot and replaced the diaphragm. Reassembled the pilot and reinstalled it on the control piping. Restarted the pump and reset the flow rate. Normal operation observed. Down time: 3 hours.
4/16/2020	Pumphouse SC5. Turned the pump off and removed the flow meter. Cleaned the flow meter by removing mineral build-up from the impellers and the meter body. Reinstalled the flow meter and turned the pump on and measured the flow rate. Observed normal operation. Down time: 4 hours.
4/20/2020	Treatment System. Turned the TGRS off and performed annual maintenance activities on the treatment system items. Following the work, turned the TGRS back on. Observed normal operation. Down time: 2.5 hours at B4; 3.5 hours at B8; 6 hours at B1, B6, B9 and SC5; 7 hours at B13 and SC1.
5/4/2020	Treatment System and Well Field. Turned the TGRS off to inspect and exercise the TGRS forcemain butterfly valves as part of the annual maintenance inspection. Following the work, the TGRS was turned back on and normal operation was observed. Down time: 2 hours at B3; 3.5 hours at B1, B13 and B9; 4 hours at B6 and 5 hours at SC5.
5/6/2020	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Compared the pumphouse pressure gauges to a calibrated pressure gauge. Replaced pressure gauges that were not accurate. Down time: None.
5/20/2020	Treatment System. Turned the TGRS off to reinstall the demister pads in Towers 3 and 4. Also, cleaned the blower inlet screens to blowers 3 and 4. Down time: 2 hours at B3; 2.5 hours at B6, B9 and SC5; 3 hours at B1 and B13.
6/3/2020	Pumphouses B13 and SC5. There was a thunderstorm last night and the lights were flashing on the well field panel. Reset the PLC and the lights came back on steady. At the pumphouses, the pumps were running normally. Down time: 14.5 hours at B13 and 14 hours at SC5.

Appendix H.3

Maintenance Activities By Location
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

6/29/2020	Pumphouse SC5. The light was flashing on the well field panel. Reset the PLC and the light came back on steady. At the pumphouse, the pump was running normally but the flow meter had stopped totaling. Replaced the flow meter with one from inventory. The meter reading was estimated for the day. Down time: None.
7/2-4/2020	Treatment System and Well Field. Call from Time Communication - TGRS fail. At the site, there was only 2 phases of power to the treatment system. Contacted Xcel Energy. They inspected the power lines and found an untagged jumper on a power pole in the marsh to the west of Building 116. They acquired the appropriate equipment, repaired the jumper and restored power to the treatment system and well field. Following the work, restarted the TGRS and observed normal operation. Down time: 37 hours at B5; 42.5 hours at B4, B8 and SC5; 43.5 hours at SC1; 45.5 hours at B6; 46.5 hours at B1; 47.5 hours at B13 and B9; 49 hours at B3.
7/16/2020	Pumphouse SC5. Turned the pump off and replaced the flow meter with one from inventory. Following the work, turned the pump on and observed normal operation. Down time: None.
7/19/2020	Treatment System and Well Field. Call from Time Communication - TGRS fail. At the site, there was only 2 phases of power to the treatment system. Contacted Xcel Energy. They found two locations where fuses had opened. One on the power pole to the west of Building 116 and one near Gate 4. They reinstalled the fuses and restored power to the treatment system and well field. Following the work, restarted the TGRS and observed normal operation. Down time: 10 hours at B5; 13 hours at B3; 14 hours at B4, B8 and SC5; 15.5 hours at B1, B6, B9 and SC1; 18 hours at B13.
8/17-18/2020	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Turned off the TGRS. Decommissioned the old pump director PLC and electrical and installed the new pump director PLC and electrical. Down time: 32.5 hours at B1; 33 hours at B13; 30.5 hours at B3; 27.5 hours at B4, B5, B8 and SC5; 30 hours at B6; 29 hours at B9; 3.5 hours at SC1.
8/24-28/2020	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, SC1 and SC5. Turned the TGRS off to decommission the old well field PLC and electrical and install the new well field PLC and electrical. The new pump control cabinets were installed at B4, B5, B6, B8 and B9. Thein Well installed a new 50 horesepower pump and motor at B4. Down time: 28 hours at B1, B13 and SC5; 54.5 hours at B3; 98.5 hours at B4; 102.5 hours at B5; 77 hours at B6; 51.5 hours at B8; 34 hours at B9; 57.5 hours at SC1.

Appendix H.3

Maintenance Activities By Location
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

9/2/2020	Pumphouses B3, SC1 and SC5. Turned the pumps off to begin installing mechanical piping in pumphouse SC5 and begin the installation of the new control panels in B11 (for SC1) and B3. Down time: 19.5 hours at B3. 19 hours at SC1 and SC5.
9/8-9/2020	Pumphouses B8, SC1 and SC5. Turned the pumps off to replace the mechanical piping in pumphouses B8 and SC5. Also, installed new control panels in B11 (for SC1) and SC5. Following the work, turned the pumps on and observed normal operation. Down time: 4.5 hours at B8, 25.5 hours at SC1 and 38 hours at SC5.

Treatment System

10/5-25/2019	Treatment System. Turned the pumps in B3, B8 and B9 off to decrease the influent flow volume to the treatment system during the cleaning of Towers 3 and 4. Following the cleaning of the towers, turned the pumps on for normal service. Down time: 486 hours each at B3, B8 and B9.
10/9/2019	Treatment System and Well Field. Turned the TGRS off so Jayhawk Mechanical could install temporary piping in pumphouse SC2. Following the work, turned the TGRS back on and observed normal operation. Down time: None.
10/30/2019	Treatment System. Turned the TGRS off to pressure wash the inside of the treatment system. Following the work, turned the TGRS on and observed normal operation. Down time: 2.5 hours each at B6 and B13.
11/19/2019	Treatment System. Cleaned the inside of the treatment system building. Down time: None.
12/12/2019	Treatment System. The lower bearings in Pump 4 were making a whining noise. Greased the lower bearings and the whining noised stopped. Normal operation observed. Down time: None.
1/24/2020	Treatment System. Turned Pump 4 off to change the oil. Turned B4 and B5 off to minimize well field cycling with only Pump 3 operating. Following the work, turned Pump 4 on and observed normal operation. Turned B4 and B5 back on. Down time: None.

Appendix H.3

Maintenance Activities By Location
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

1/24/2020	Treatment System. Call from Time Communication - TGRS fail. Pump 4 failed to open on command. Changed the filter and flushed the control piping and reset the speed control valves on ECV 4. Cycled the valve and observed normal operation. Down time: None.
2/11/2020	Treatment System. ECV 4 would not close on command. Turned off the pumps in B5 and B8 to minimize well field cycling. Removed and replaced portions of the control piping. Following the work, turned Pump 4 on and actuated the ECV. The ECV closed but slowly. Additional work will be necessary. Down time: None.
2/14/2020	Treatment System. Turned Pump 4 off to work on the ECV 4 closing issue. Turned B3 and B5 off to minimize well field cycling with only Pump 3 operating. Replaced the solenoid valve and a check valve and restarted Pump 4. The ECV closed but only slightly faster. Additional work will be necessary. Turned B3 and B5 back on for normal operation. Down time: 1 hour at B3.
2/26/2020	Treatment System. Turned Pump 4 off to work on the ECV 4 closing issue. Turned B9 off to minimize well field cycling. Removed and replaced the emergency solenoid valve from the closing portion of the control piping. Following the work, turned Pump 4 on and actuated the ECV. The ECV closed slowly. Additional work will be necessary. Turned B9 back on for normal service. Down time: 5.5 hours at B9.
3/8/2020	Treatment System. Turned the TGRS off to inspect the demister pads and water distribution systems in Towers 3 and 4. Following the work, turned the TGRS back on. Normal operation observed. Down time: 1 hour at B1 and B13; 1.5 hours at SC5 and 2 hours at B6.
3/20/2020	Treatment System. Turned off Pump 4 at the treatment system and turned off B6 and B9 to estimate the maximum flow rate that Pump 3 in the treatment system could produce. The maximum flow rate for Pump 3 is approximately 1425 gallons per minute. Down time: 3.5 hours at B9 and 4 hours at B6.
4/20/2020	Treatment System. Turned the TGRS off and performed annual maintenance activities on the treatment system items. Following the work, turned the TGRS back on. Observed normal operation. Down time: 2.5 hours at B4; 3.5 hours at B8; 6 hours at B1, B6, B9 and SC5; 7 hours at B13 and SC1.

Appendix H.3

Maintenance Activities By Location
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

5/4/2020	Treatment System and Well Field. Turned the TGRS off to inspect and exercise the TGRS forcemain butterfly valves as part of the annual maintenance inspection. Following the work, the TGRS was turned back on and normal operation was observed. Down time: 2 hours at B3; 3.5 hours at B1, B13 and B9; 4 hours at B6 and 5 hours at SC5.
5/6/2020	Treatment System. Pressure washed the demister pads from Towers 3 and 4. Down time: None.
5/20/2020	Treatment System. Turned the TGRS off to reinstall the demister pads in Towers 3 and 4. Also, cleaned the blower inlet screens to blowers 3 and 4. Down time: 2 hours at B3; 2.5 hours at B6, B9 and SC5; 3 hours at B1 and B13.
6/10/2020	Treatment System and Pumphouses. Preferred Electric performed the annual electrical maintenance inspection. Down time: None.
7/2-4/2020	Treatment System and Well Field. Call from Time Communication - TGRS fail. At the site, there was only 2 phases of power to the treatment system. Contacted Xcel Energy. They inspected the power lines and found an untagged jumper on a power pole in the marsh to the west of Building 116. They acquired the appropriate equipment, repaired the jumper and restored power to the treatment system and well field. Following the work, restarted the TGRS and observed normal operation. Down time: 37 hours at B5; 42.5 hours at B4, B8 and SC5; 43.5 hours at SC1; 45.5 hours at B6; 46.5 hours at B1; 47.5 hours at B13 and B9; 49 hours at B3.
7/10/2020	Treatment System. Performed maintenance on Pump 4 in the treatment center. Turned B6 and B9 off to minimize well field cycling with only Pump 3 in operation. Following the work, turned Pump 4, B6 and B9 on for normal service. Down time: 3 hours at B6 and 3.5 hours at B9.
7/19/2020	Treatment System and Well Field. Call from Time Communication - TGRS fail. At the site, there was only 2 phases of power to the treatment system. Contacted Xcel Energy. They found two locations where fuses had opened. One on the power pole to the west of Building 116 and one near Gate 4. They reinstalled the fuses and restored power to the treatment system and well field. Following the work, restarted the TGRS and observed normal operation. Down time: 10 hours at B5; 13 hours at B3; 14 hours at B4, B8 and SC5; 15.5 hours at B1, B6, B9 and SC1; 18 hours at B13.

Appendix H.3

Maintenance Activities By Location
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

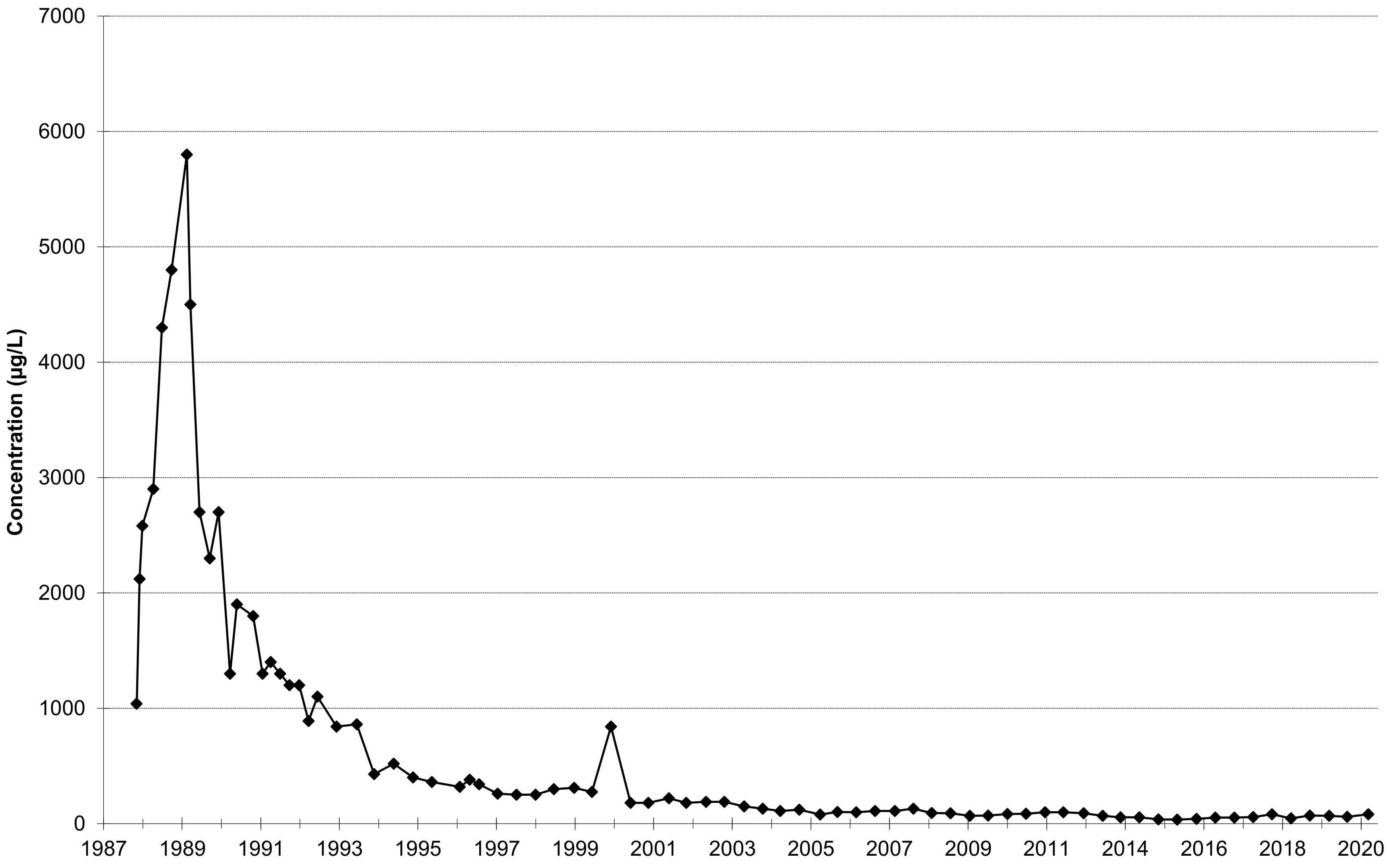
9/22/2020	Pumphouses B1, B13, B3, B6, B8, B9 and SC1. Call from Time Communications - TGRS Fail. Upon arrival, Pump 3 in the treatment system failed to open ECV 3. Troubleshooting indicated a failure in the motor control center or a bad pump and/or motor. Turned Pump 3 off pending additional troubleshooting. Operated the TGRS at a flow rate that Pump 4 could maintain. Down time: 5 hours at B1, B13, B3, B6 and SC1. 2.5 hours at B8 and 1.5 hours at B9.

Appendix I

TGRS Chemical Data

APPENDIX I.1

EXTRACTION WELL B1 - TCE VS.TIME

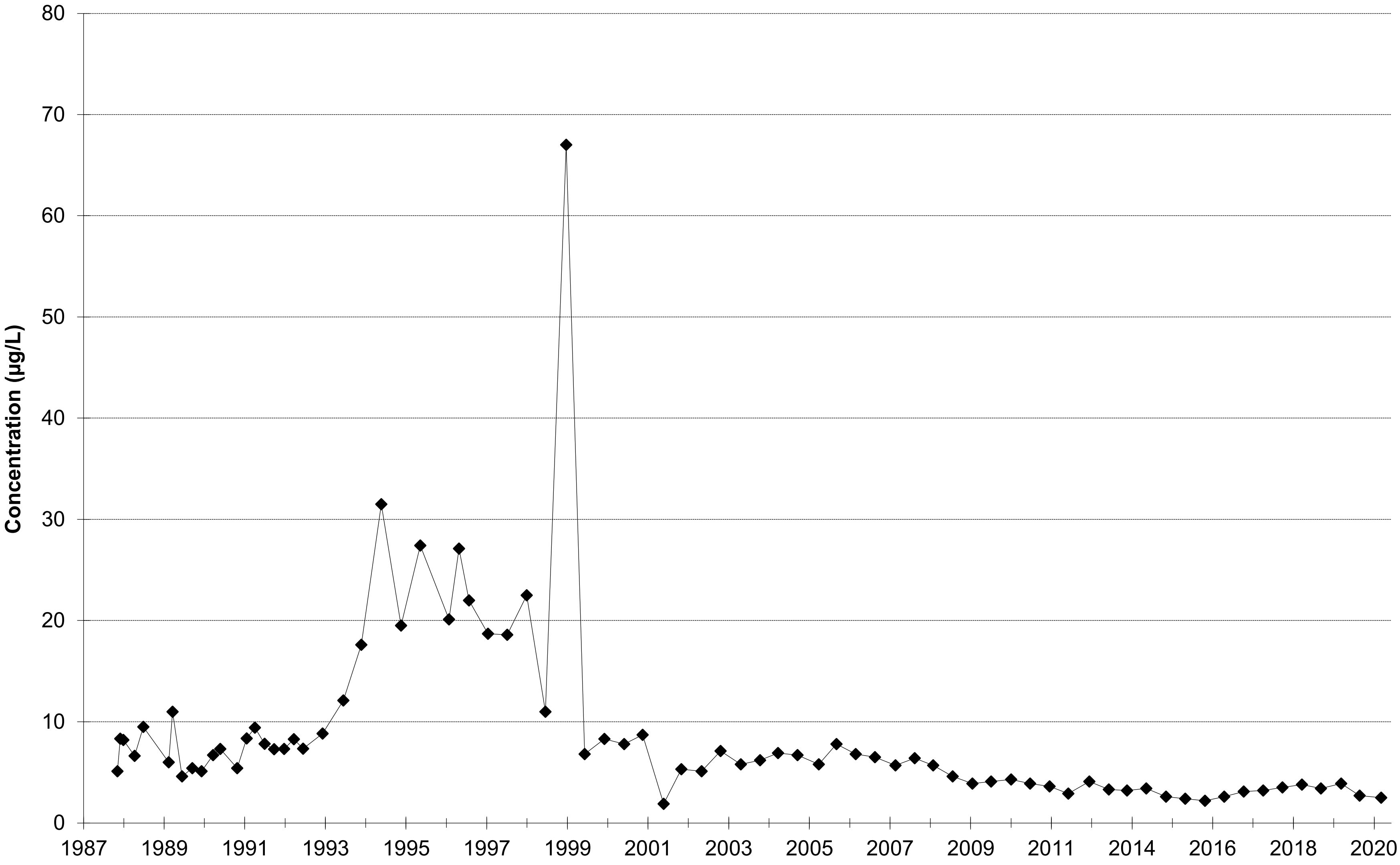


Note: Samples reporting concentrations less than the detection limit were plotted as zero.

GHD 11221407 (1)

APPENDIX I.1

EXTRACTION WELL B3 - TCE VS. TIME

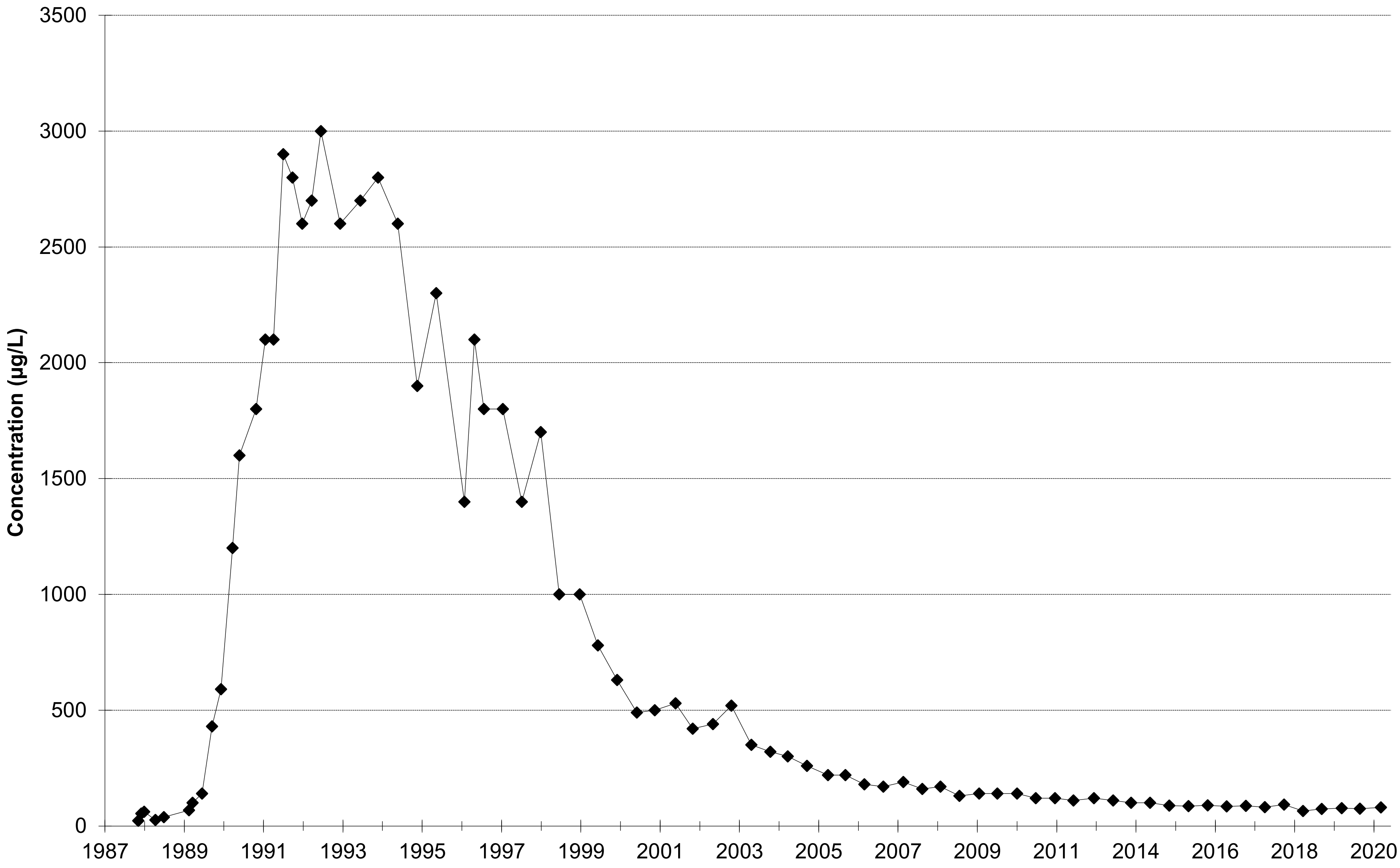


Note: Samples reporting concentrations less than the detection limit were plotted as zero.

GHD 11221407 (1)

APPENDIX I.1

EXTRACTION WELL B4 - TCE VS. TIME

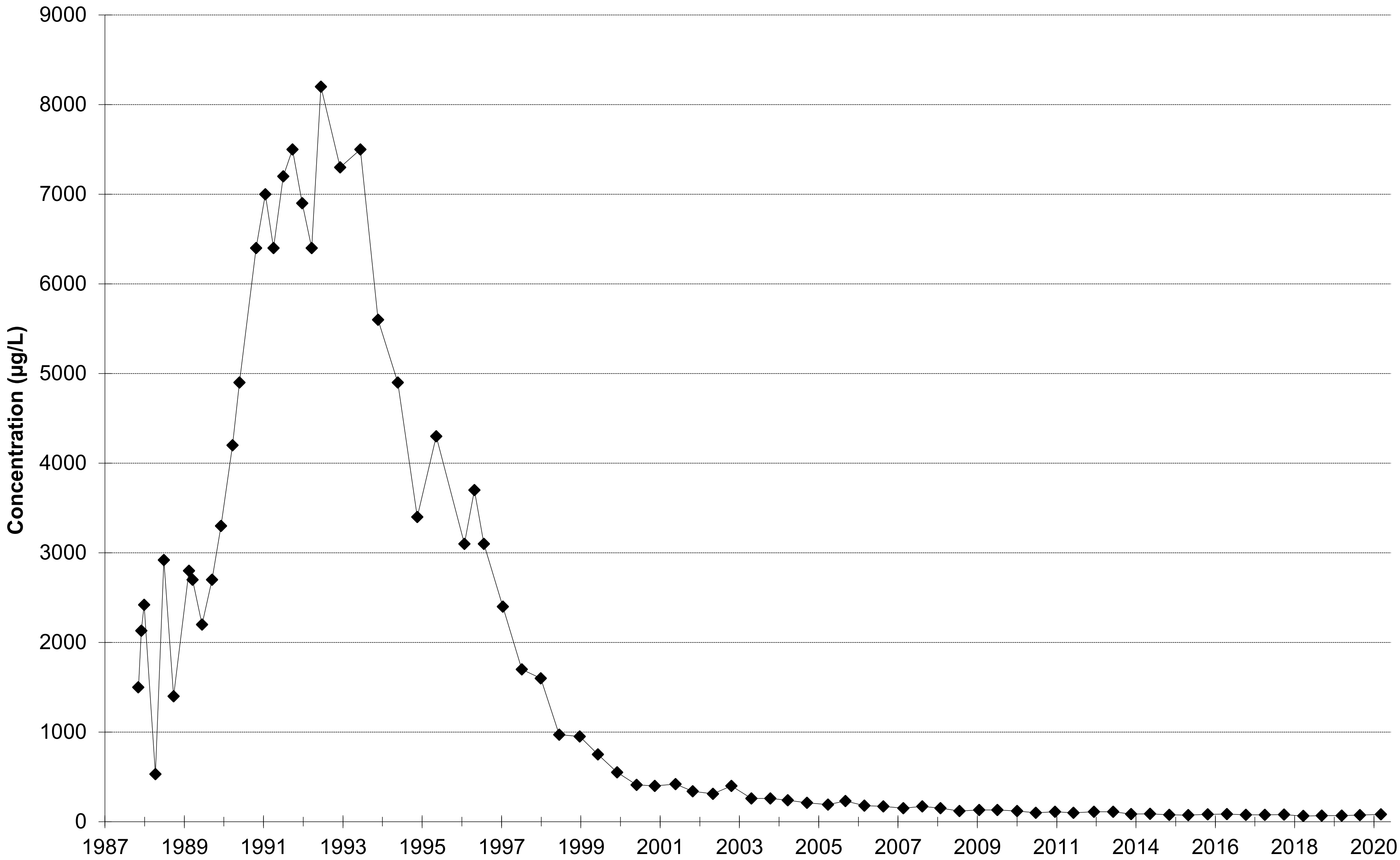


Note: Samples reporting concentrations less than the detection limit were plotted as zero.

GHD 11221407 (1)

APPENDIX I.1

EXTRACTION WELL B5 - TCE VS. TIME

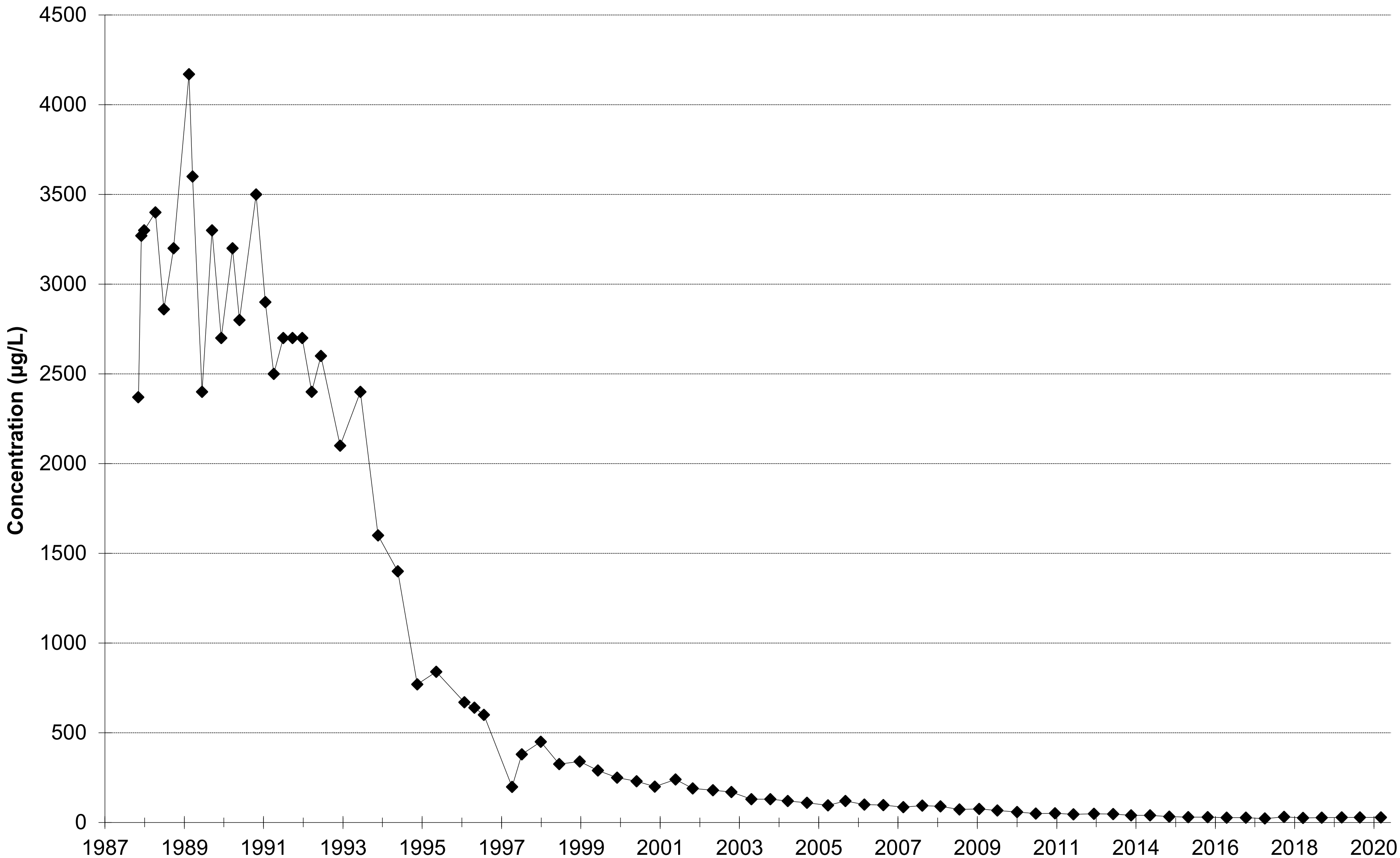


Note: Samples reporting concentrations less than the detection limit were plotted as zero.

GHD 11221407 (1)

APPENDIX I.1

EXTRACTION WELL B6 - TCE VS. TIME

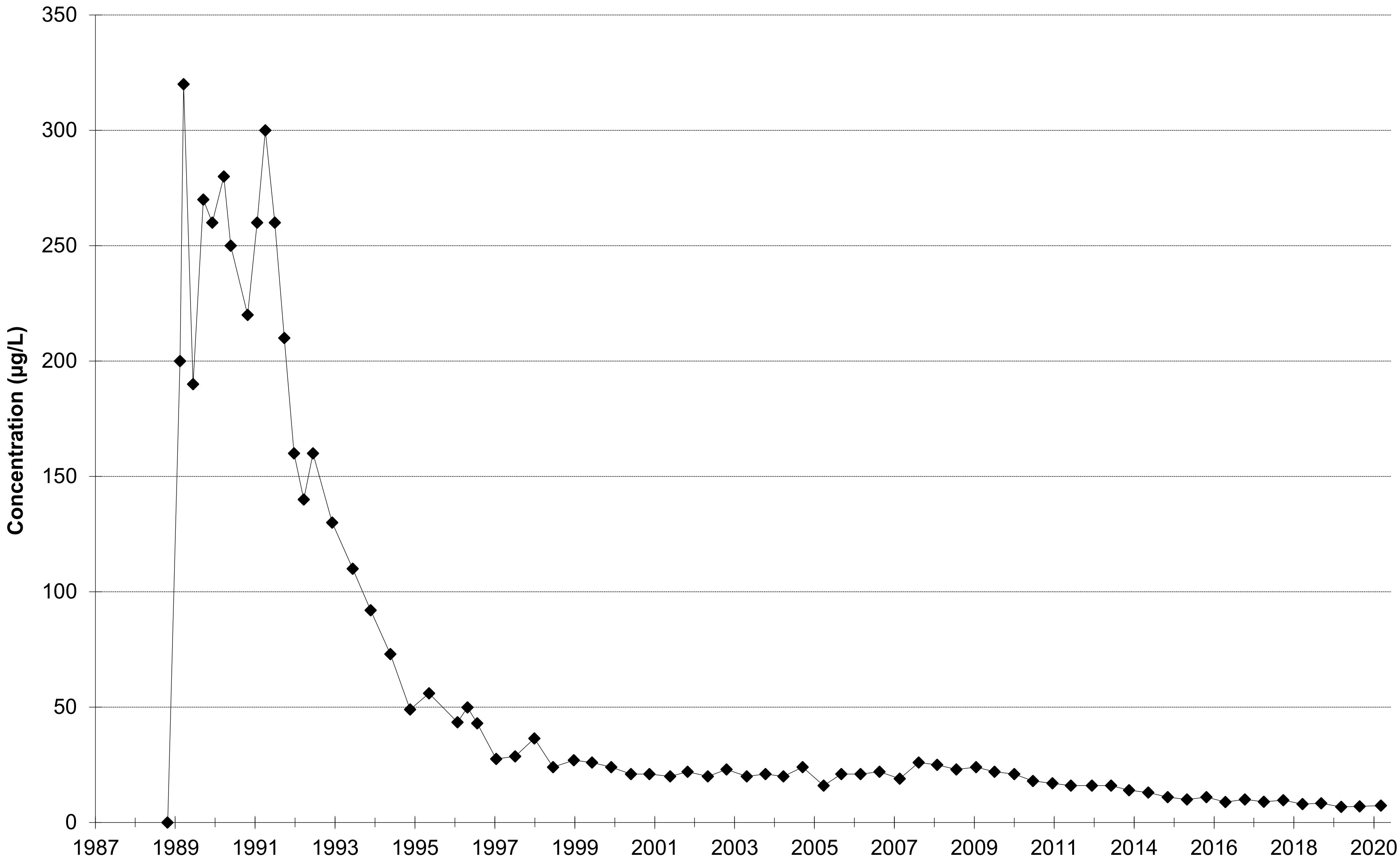


Note: Samples reporting concentrations less than the detection limit were plotted as zero.

GHD 11221407 (1)

APPENDIX I.1

EXTRACTION WELL B8 - TCE VS. TIME

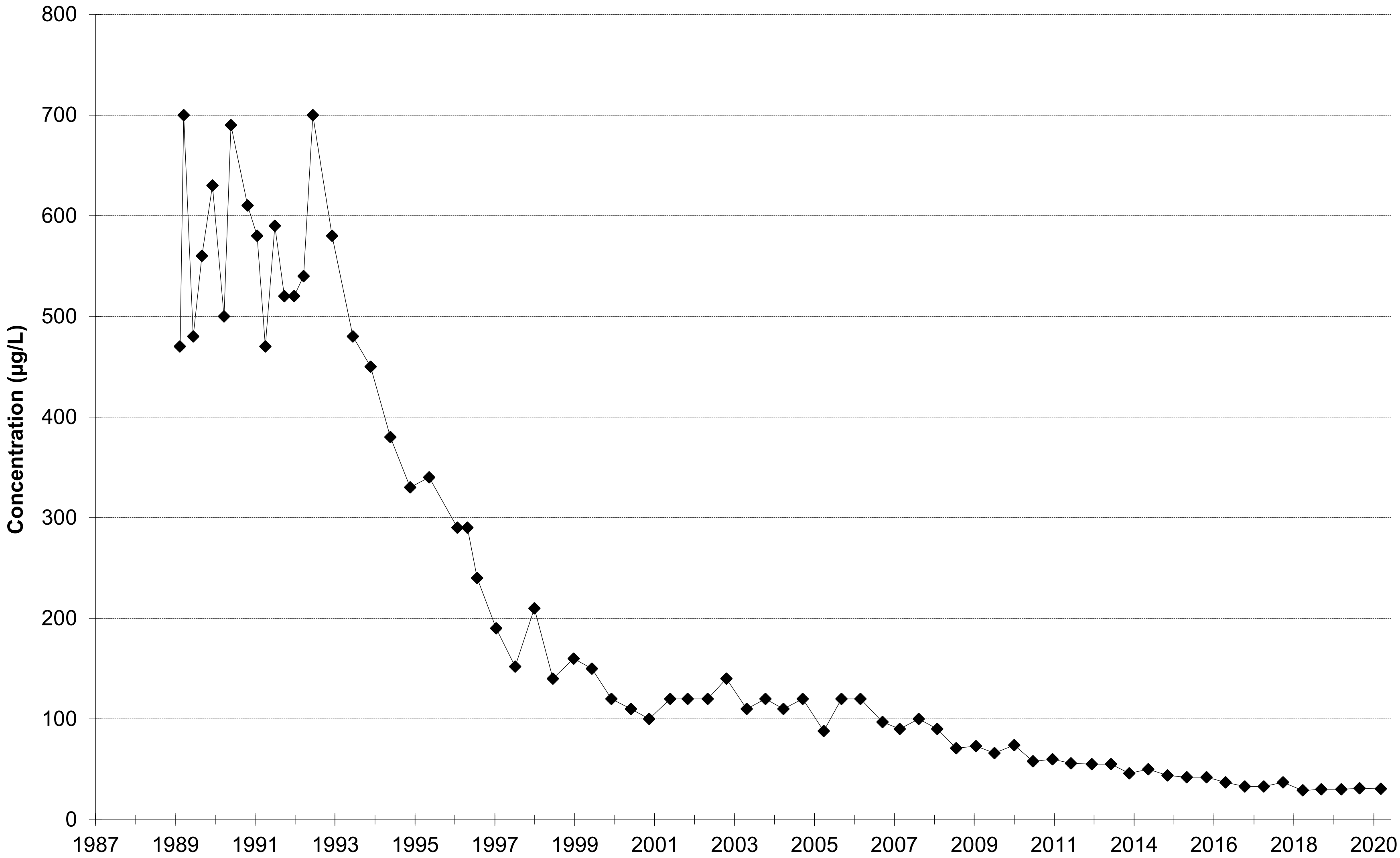


Note: Samples reporting concentrations less than the detection limit were plotted as zero.

GHD 11221407 (1)

APPENDIX I.1

EXTRACTION WELL B9 - TCE VS. TIME

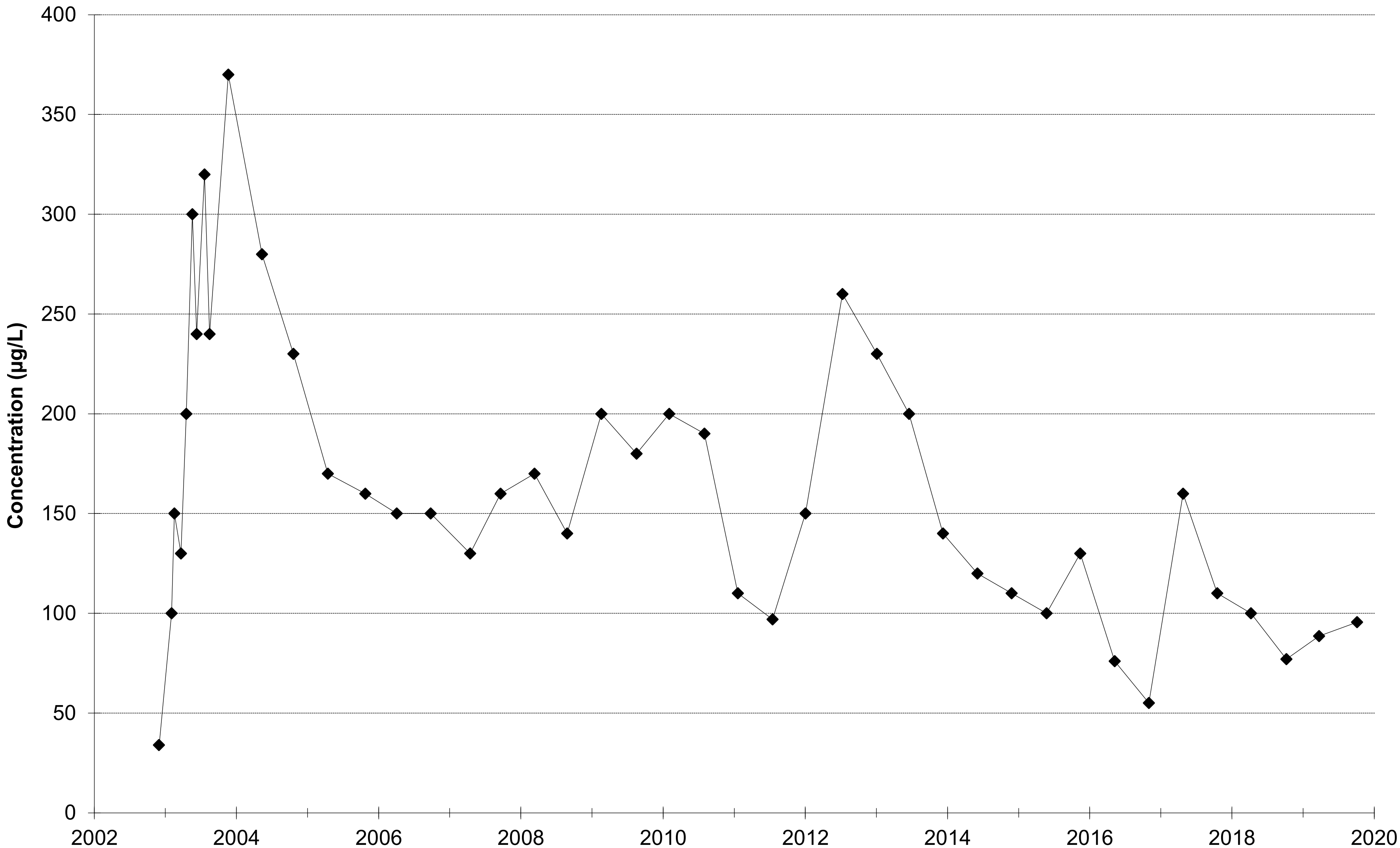


Note: Samples reporting concentrations less than the detection limit were plotted as zero.

GHD 11221407 (1)

APPENDIX I.1

EXTRACTION WELL B13 - TCE VS. TIME

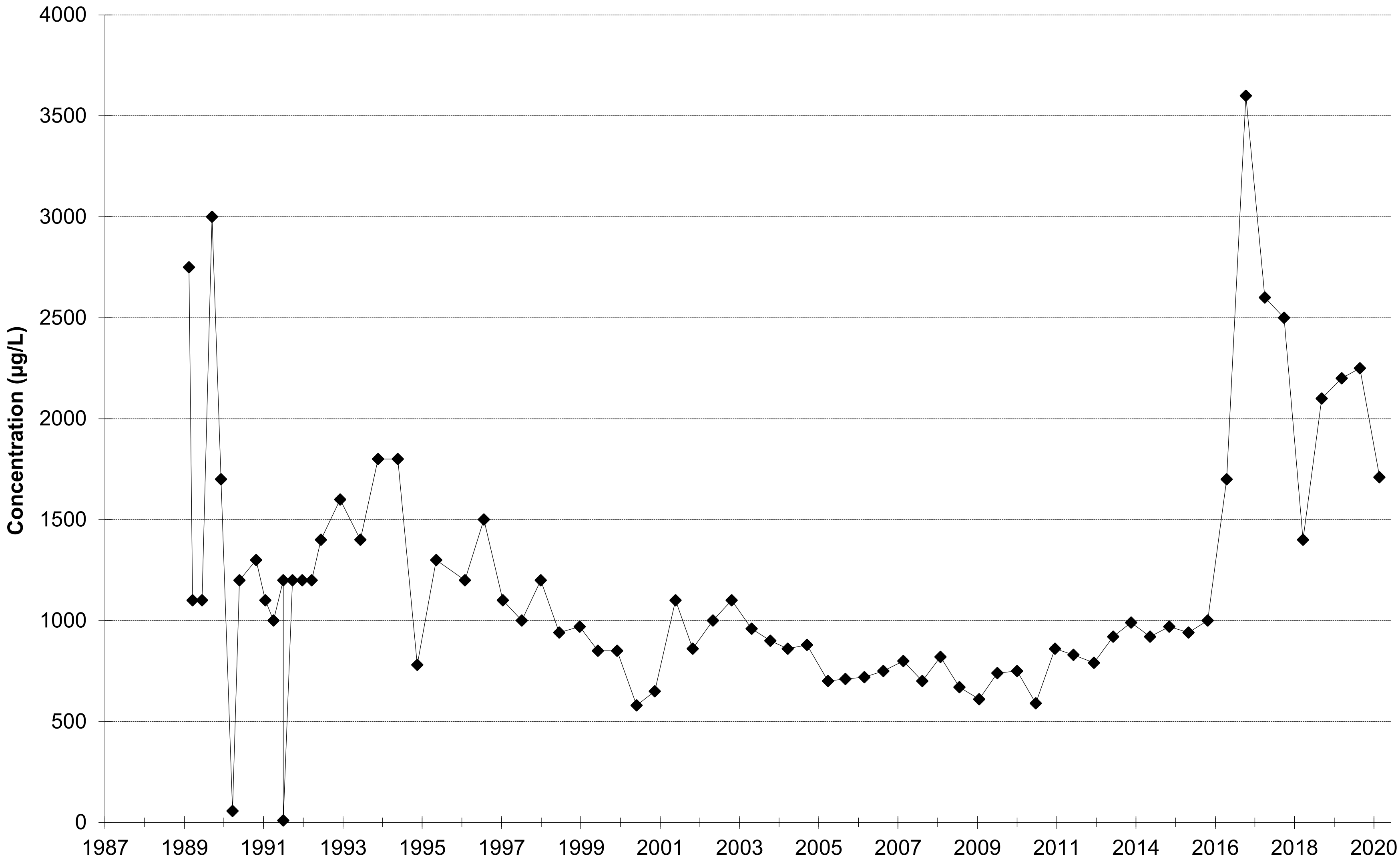


Note: Samples reporting concentrations less than the detection limit were plotted as zero.

GHD 11221407 (1)

APPENDIX I.1

EXTRACTION WELL SC1 - TCE VS. TIME

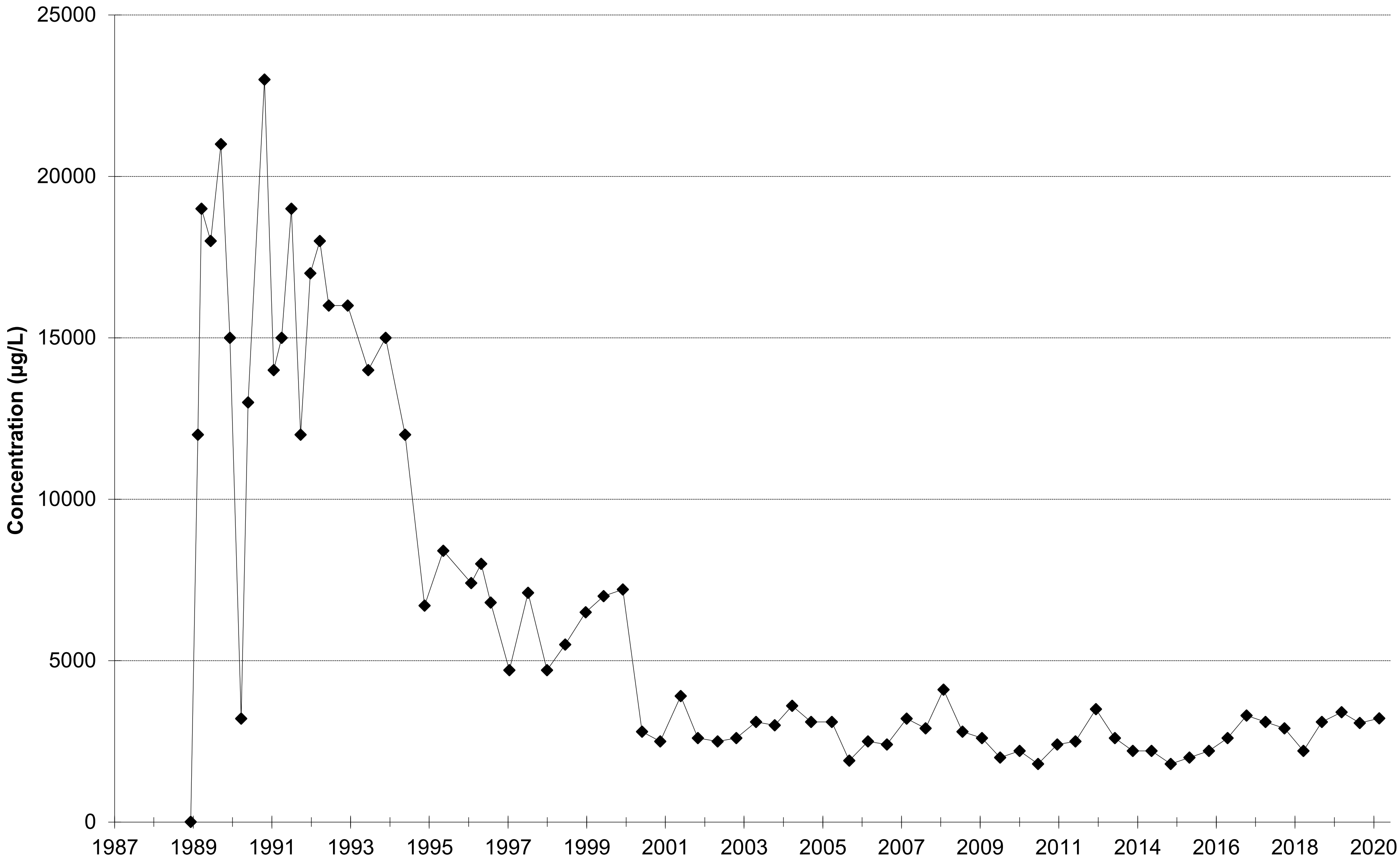


Note: Samples reporting concentrations less than the detection limit were plotted as zero.

GHD 11221407 (1)

APPENDIX I.1

EXTRACTION WELL SC5 - TCE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as zero.

GHD 11221407 (1)

Appendix I.2

Influent/Effluent Database
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

			1,1,1-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene
	TGRS Cleanup Level (1)		200	70	6.0	4.0	7.0	5.0	5.0
Location	Date		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
TGRSE	10/28/2019		0.415 JP	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	2.90
TGRSE	10/28/2019	D	0.423 JP	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	2.92
TGRSE	11/12/2019		< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	2.26
TGRSE	11/12/2019	D	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	2.23
TGRSE	12/04/2019		< 4.00	< 1.00	< 4.00	< 1.00	< 1.00	< 1.00	2.60
TGRSE	12/04/2019	D	< 4.00	< 1.00	< 4.00	< 1.00	< 1.00	< 1.00	2.60
TGRSE	01/07/2020		0.471 JP	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	2.71
TGRSE	01/07/2020	D	0.475 JP	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	3.08
TGRSE	02/03/2020		0.408 JP	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	2.53
TGRSE	03/16/2020		0.396 JP	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	2.54
TGRSE	03/16/2020	D	0.394 JP	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	2.49
TGRSE	04/07/2020		0.412 JP	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	3.29
TGRSE	04/07/2020	D	0.397 JP	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	3.17
TGRSE	05/12/2020		0.317 JP	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	2.15
TGRSE	05/12/2020	D	0.319 JP	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	2.25
TGRSE	06/24/2020		0.374 JP	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	2.43
TGRSE	07/08/2020		0.329 JP	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	2.94 JP
TGRSE	07/08/2020	D	0.337 JP	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	2.93 JP
TGRSE	08/04/2020		0.273 JP	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	2.16
TGRSE	08/04/2020	D	0.307 JP	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	2.25
TGRSE	09/15/2020		0.315 JP	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	2.28
TGRSE	09/15/2020	D	0.330 JP	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	2.09

Appendix I.2

Influent/Effluent Database
Fiscal Year 2020
TGRS, OU2
Arden Hills, Minnesota

			1,1,1-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene
	TGRS Cleanup Level (1)		200	70	6.0	4.0	7.0	5.0	5.0
Location	Date		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
TGRSI	10/28/2019		54.5	2.33	4.26	< 1.00	3.13	1.52	239
TGRSI	11/12/2019		42.4	1.97	3.07	< 1.00	3.15	0.979 JP	230
TGRSI	12/04/2019		45.0	2.30	5.00	< 1.00	3.40	1.40	244
TGRSI	01/07/2020		57.3	2.47	4.52	< 1.00	3.49	1.62	181
TGRSI	02/03/2020		49.1	2.23	4.28	< 1.00	3.07	1.32	186
TGRSI	02/03/2020	D	46.0	2.31	3.75	< 1.00	2.94	1.38	210
TGRSI	03/16/2020		48.8	2.31	4.18	< 1.00	3.02	1.23	211
TGRSI	04/07/2020		52.3	< 10.0	< 10.0	< 10.0	4.49 JP	< 10.0	247
TGRSI	05/12/2020		41.4	2.15 JP	3.07 JP	< 5.00	3.12 JP	1.51 JP	205
TGRSI	06/24/2020		41.8	2.08	2.47	< 1.00	2.62	< 1.61 UB0.394	207
TGRSI	06/24/2020	D	42.8	1.95	2.39	< 1.00	2.93	< 1.88 UB0.394	212
TGRSI	07/08/2020		29.6	1.54 JP	2.83 JP	< 5.00	2.80 JP	< 5.00	209 JP
TGRSI	08/04/2020		32.7	1.94 JP	2.97 JP	< 5.00	3.03 JP	< 5.00	177
TGRSI	09/15/2020		34.8	1.65 JP	2.07 JP	< 5.00	2.59 JP	< 5.00	188

Notes:

(1) Cleanup levels for TGRS are from the OU2 ROD
D - Field Duplicate

JP - Result is qualified as estimated since the detection is below the laboratory reporting limit.

UB# - Result is qualified as non-detect based on a associated blank detection.
The following numerical value is the blank concentration.

Appendix J

Maros Decision Matrix

Appendix J

Table J.1
Maros Decision Matrix

Kendall S	Confidence	Coefficient of Varience	Trend
S > 0	> 95%	NA	Definitely Increasing
S > 0	90-95%	NA	Probably Increasing
S > 0	< 90%	NA	No Trend
S</= 0	< 90%	>/= 1	No Trend
S </= 0	< 90%	< 1	Stable
S < 0	90-95%	NA	Probably Decreasing
S < 0	>95%	NA	Definitely Decreasing

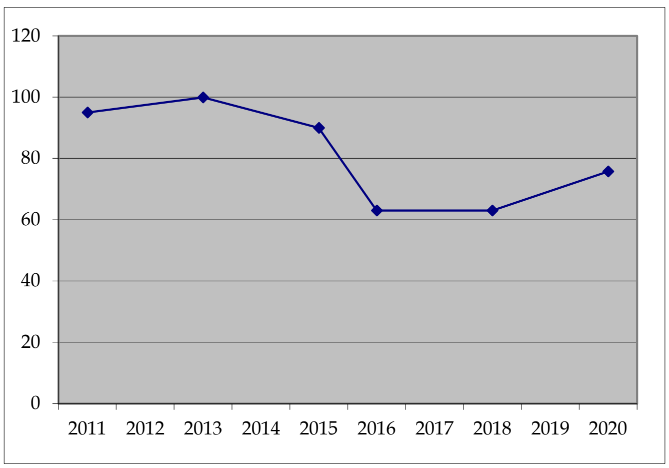
Table J.2
Confidence Values for Six Data Pairs

Kendall S	Confidence
1	50.00%
3	64.00%
5	76.50%
7	86.40%
9	93.20%
11	97.20%
13	99.17%
15	99.86%

WELL 03L673
MANN-KENDALL STATISTICAL ANALYSIS
OU3 - 2020

Date	TCE (µg/l)	Mann-Kendall Calculation:							
6/24/2011	**95**	1							
6/27/2013	**100**	1	1						
6/12/2015	**90**	1	-1	-1					
7/26/2016	**63**	1	-1	-1	-1				
8/29/2018	**63**	1	-1	-1	-1	0			
6/4/2020	**75.8**	1	-1	-1	-1	1	1		
	N	6	5	4	3	2	1	0	15
	sum		-3	-4	-3	1	1	0	Kendall S -8
	Possibles	15							
									Kendall tau -0.533

Mean	81.13
STNDEV	16.2045
COV	0.1997
Trend:	Negative
Confidence (lookup)	89.81%



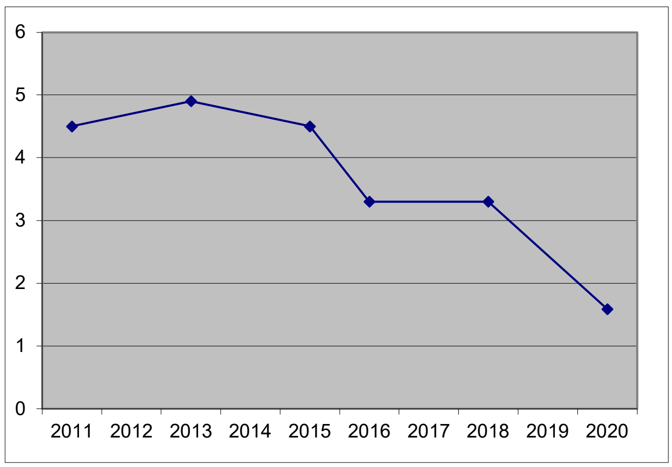
Raw Data

03L673	Date	TCE	Date	TCE
	11/12/1987	1200	6/21/2007	110
	5/2/1990	3200	6/18/2009	110
	3/11/1991	2000	6/24/2011	95
	3/11/1991	1900 D	6/27/2013	100
	6/17/1991	5500	6/27/2013	100 D
	3/12/1992	3900	6/12/2015	90
	3/3/1993	2100	7/26/2016	63
	3/4/1994	3300	6/29/2018	63
	6/6/1994	2000	6/4/2020	75.8
	6/6/1994	2000 D		
	9/14/1994	1600		
	12/8/1994	1400		
	3/15/1995	910		
	6/12/1996	650		
	6/12/1997	240		
	6/25/1998	270		
	6/4/1999	280		
	6/12/2001	24		
	6/1/2003	6.3		
	6/1/2004	180		
	6/22/2005	150		

WELL 03L848
MANN-KENDALL STATISTICAL ANALYSIS
OU3 - 2020

Date	TCE (µg/l)	Mann-Kendall Calculation:								
6/24/2011	**4.5**	1								
6/27/2013	**4.9**	1	1							
6/11/2015	**4.5**	1	0	-1						
7/27/2016	**3.3**	1	-1	-1	-1					
6/28/2018	**3.3**	1	-1	-1	-1	0				
6/4/2020	**1.59**	1	-1	-1	-1	-1	-1			
	N	6	5	4	3	2	1	0		15
	sum		-2	-4	-3	-1	-1	0	Kendall S	-11
	Possibles	15								
									Kendall tau	-0.733

Mean	3.68
STNDEV	1.2239
COV	0.3324
Trend:	Negative
Confidence (lookup)	97.20%



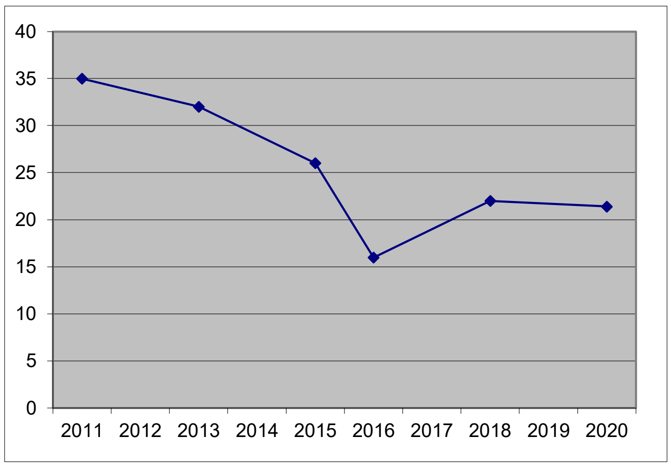
Raw Data
03L848

Date	TCE	Date	TCE
12/2/1987	570	6/21/2007	5.4
5/3/1989	270	6/21/2007	5.3 D
7/20/1989	130	6/17/2009	4.8
10/19/1989	610	6/17/2009	2.6 D
4/19/1990	460	6/24/2011	4.5
7/19/1990	260	6/27/2013	4.9
3/18/1991	250	6/11/2015	4.4
3/18/1992	92	6/11/2015	4.5 D
3/9/1993	52.9	7/27/2016	3.3
6/6/1994	27	6/28/2018	3.3
9/15/1994	27.1	6/4/2020	1.59
12/8/1994	22		
3/10/1995	16.6		
6/3/1996	11.3		
6/5/1997	9.34		
6/5/1997	8.57 D		
6/29/1998	10.7		
6/4/1999	7.3		
6/12/2001	3.5		
6/1/2003	3.8		
6/21/2005	5.8		

WELL 04U673
MANN-KENDALL STATISTICAL ANALYSIS
OU3 - 2020

Date	TCE (µg/l)	Mann-Kendall Calculation:								
6/24/2011	**35**	1								
6/24/2013	**32**	1	-1							
6/12/2015	**26**	1	-1	-1						
7/26/2016	**16**	1	-1	-1	-1					
6/29/2018	**22**	1	-1	-1	-1	1				
6/4/2020	**21.4**	1	-1	-1	-1	1	-1			
	N	6	5	4	3	2	1	0		15
	sum		-5	-4	-3	2	-1	0	Kendall S	-11
	Possibles	15								
									Kendall tau	-0.733

Mean	25.40
STNDEV	7.0993
COV	0.2795
Trend:	Negative
Confidence (lookup)	97.20%



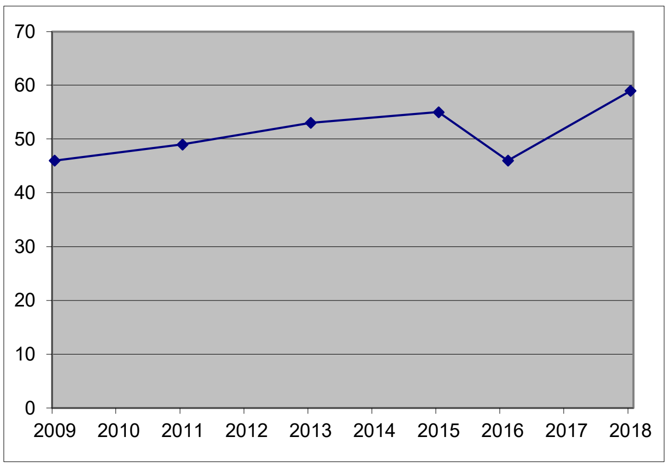
Raw Data
04U673

Date	TCE	Date	TCE
11/24/1987	145	3/15/1995	160
1/21/1988	580	3/15/1995	140
5/16/1988	560	9/12/1995	260
8/4/1988	253	6/12/1996	125
11/1/1988	1700	6/12/1997	60.4
5/3/1989	700	6/25/1998	81.9
7/21/1989	1200	6/4/1999	74
10/19/1989	1100	6/12/2001	2.9
5/1/1990	3100	6/1/2003	15
3/11/1991	990	6/1/2004	51
3/11/1991	940	6/22/2005	49
6/17/1991	410	6/21/2007	42
3/12/1992	460	6/18/2009	38
6/4/1992	430	6/24/2011	35
9/8/1992	540	6/27/2013	32
3/3/1993	280	6/12/2015	26
9/13/1993	190	7/26/2016	15
3/3/1994	270	7/26/2016	16 D
6/6/1994	210	6/29/2018	22
9/8/1994	170	6/4/2020	21.4
12/8/1994	190		

WELL 04U832
MANN-KENDALL STATISTICAL ANALYSIS
OU3 - 2018

Date	TCE (µg/l)	Mann-Kendall Calculation:								
6/19/2009	**46**	1								
6/23/2011	**49**	1	1							
6/27/2013	**53**	1	1	1						
6/10/2015	**55**	1	1	1	1					
7/27/2016	**46**	1	0	-1	-1	-1				
6/28/2018	**59**	1	1	1	1	1	1			
	N	6	5	4	3	2	1	0		15
	sum		4	2	1	0	1	0	Kendall S	8
	Possibles	15								
									Kendall tau	0.533

Mean	51.33
STNDEV	5.2409
COV	0.1021
Trend:	Positive
Confidence (lookup)	89.81%



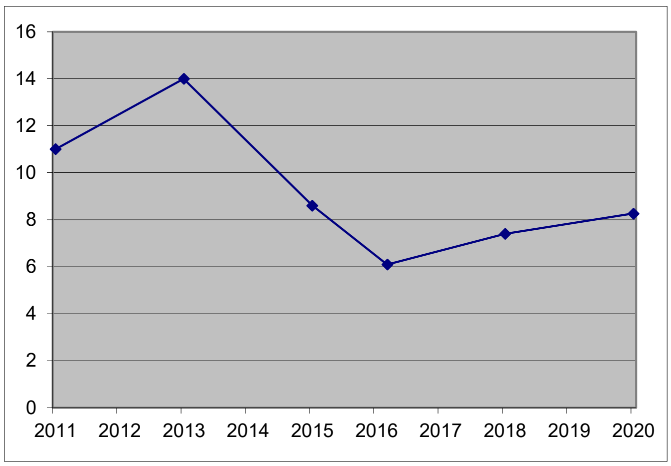
Raw Data
04U832

Date	TCE	Date	TCE
11/24/1987	100	6/17/2008	48
12/16/1988	65	6/19/2009	46
4/25/1990	69.53	6/23/2011	49
3/19/1991	47.6	6/27/2013	53
3/25/1992	52.5	6/10/2015	55
3/16/1993	42	7/27/2016	46
3/16/1993	45.9	6/28/2018	59
6/10/1994	49		
9/13/1994	49.5		
12/7/1994	43.3		
12/7/1994	47.1		
3/10/1995	56		
6/3/1996	41		
6/4/1997	35.2		
6/25/1998	36.4		
6/7/1999	29		
6/14/2001	3.5		
6/1/2003	4.1		
6/23/2005	41		
6/13/2006	54		
6/22/2007	56		

WELL 04U845
MANN-KENDALL STATISTICAL ANALYSIS
OU3 - 2020

Date	TCE (µg/l)		Mann-Kendall Calculation:							
6/23/2011	**11**	1								
6/25/2013	**14**	1	1							
6/11/2015	**8.6**	1	-1	-1						
8/2/2016	**6.1**	1	-1	-1	-1					
6/27/2018	**7.4**	1	-1	-1	-1	1				
6/3/2020	**8.26**	1	-1	-1	-1	1	1			
	N	6	5	4	3	2	1	0		15
	sum		-3	-4	-3	2	1	0	Kendall S	-7
	Possibles	15								
									Kendall tau	-0.467

Mean	9.23
STNDEV	2.84
COV	0.3080
Trend:	Negative
Confidence (lookup)	86.40%



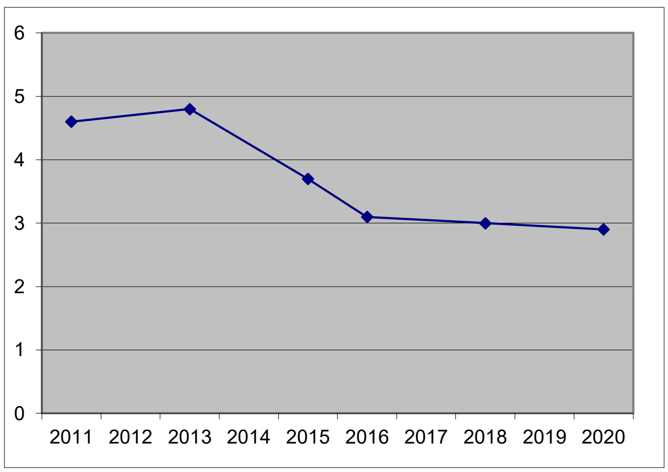
Raw Data
04U845

Date	TCE	Date	TCE
12/1/1987	59	6/13/2006	14
12/16/1988	155	6/13/2006	14
5/4/1989	100	6/22/2007	15
7/20/1989	160	6/17/2008	15
10/20/1989	62	6/17/2009	6.3
4/26/1990	38	6/23/2011	11
3/20/1991	100	6/25/2013	14
3/23/1992	>50.10	6/11/2015	8.6
3/23/1992	100	8/2/2016	6.1
3/15/1993	84	6/27/2018	7.4
6/8/1994	64	6/3/2020	8.26
9/13/1994	70		
12/7/1994	54		
3/10/1995	39.5		
6/4/1996	51.2		
6/5/1997	30.8		
6/25/1998	32.9		
6/7/1999	35		
6/13/2001	4.3		
6/1/2003	4		
6/22/2005	20		

WELL 04U848
MANN-KENDALL STATISTICAL ANALYSIS
OU3 - 2020

Date	TCE (µg/l)	Mann-Kendall Calculation:							
6/24/2011	**4.6**	1							
6/27/2013	**4.8**	1	1						
6/11/2015	**3.7**	1	-1	-1					
7/27/2016	**3.1**	1	-1	-1	-1				
6/28/2018	**3**	1	-1	-1	-1	-1			
6/4/2020	**2.90**	1	-1	-1	-1	-1	-1		
N		6	5	4	3	2	1	0	15
sum			-3	-4	-3	-2	-1	0	Kendall S -13
Possibles		15							
									Kendall tau -0.867

Mean	3.68
STNDEV	0.8377
COV	0.2274
Trend:	Negative
Confidence (lookup)	99.17%



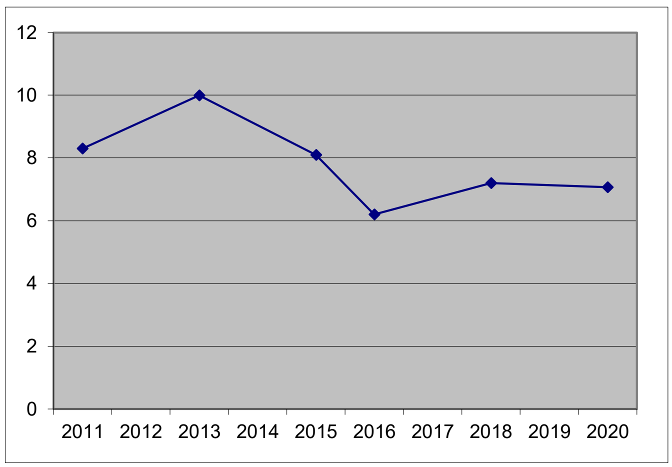
Raw Data
04U848

Date	TCE	Date	TCE
12/2/1987	700	6/1/2003	0.46 JP
8/24/1988	470	6/21/2005	5.6
5/3/1989	150	6/21/2007	5.3
7/20/1989	700	6/17/2009	4.3
10/19/1989	280	6/24/2011	4.6
4/19/1990	240	6/27/2013	4.8
7/19/1990	140	6/11/2015	3.7
9/17/1990	150	7/27/2016	3.1
3/18/1991	64	6/28/2018	3.0
3/18/1992	22.5	6/4/2020	2.90
3/18/1992	23.4		
3/10/1993	26		
6/6/1994	12.2		
9/15/1994	16.8		
12/8/1994	15.6		
3/10/1995	9.94		
6/3/1996	6.15		
6/5/1997	3.3		
6/29/1998	4.19		
6/4/1999	3.6		
6/12/2001	0.49 J		

WELL 04U854
MANN-KENDALL STATISTICAL ANALYSIS
OU3 - 2020

Date	TCE (µg/l)	Mann-Kendall Calculation:								
6/23/2011	**8.3**	1								
6/25/2013	**10**	1	1							
6/11/2015	**8.1**	1	-1	-1						
7/28/2016	**6.2**	1	-1	-1	-1					
6/28/2018	**7.2**	1	-1	-1	-1	1				
6/3/2020	**7.07**	1	-1	-1	-1	1	-1			
	N	6	5	4	3	2	1	0		15
	sum		-3	-4	-3	2	-1	0	Kendall S	-9
	Possibles	15								
									Kendall tau	-0.6

Mean	7.81
STNDEV	1.3139
COV	0.1682
Trend:	Negative
Confidence (lookup)	93.20%



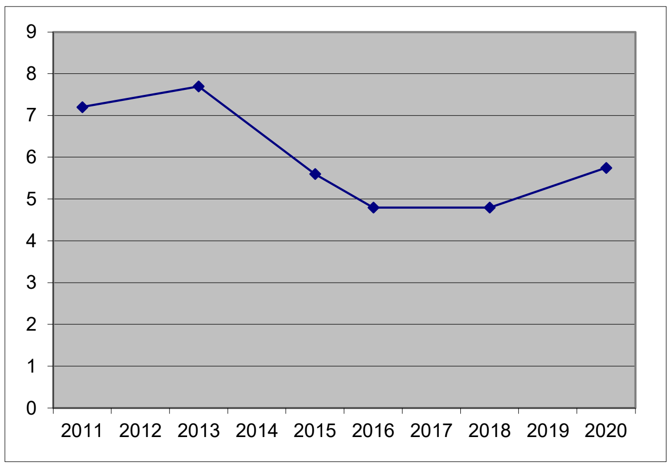
Raw Data

04U854	Date	TCE		Date	TCE	
	10/20/1987	48.4		6/23/2011	8.3	
	11/13/1987	50.7		6/25/2013	10	
	12/16/1988	140		6/11/2015	8.1	
	5/4/1989	27.3		7/28/2016	6.2	
	7/20/1989	360		7/28/2016	6.0	D
	10/17/1989	89		6/28/2018	7.2	
	4/30/1990	67		6/3/2020	7.07	
	3/13/1992	83				
	3/15/1993	70				
	6/8/1994	35.3				
	9/14/1994	36.6				
	12/7/1994	32				
	3/9/1995	25				
	6/4/1996	26.7				
	6/5/1997	17.6	D			
	6/5/1997	16.5				
	6/1/2004	<1.0	D			
	6/1/2004	14				
	6/23/2005	11				
	6/21/2007	11				
	6/18/2009	9.8				

WELL 03L859
MANN-KENDALL STATISTICAL ANALYSIS
OU3 - 2020

Date	TCE (µg/l)	Mann-Kendall Calculation:								
6/24/2011	**7.2**	1								
6/27/2013	**7.7**	1	1							
6/10/2015	**5.6**	1	-1	-1						
7/29/2016	**4.8**	1	-1	-1	-1					
6/28/2018	**4.8**	1	-1	-1	-1	0				
6/3/2020	**5.75**	1	-1	-1	1	1	1			
	N	6	5	4	3	2	1	0		15
	sum		-3	-4	-1	1	1	0	Kendall S	-6
	Possibles	15								
									Kendall tau	-0.4

Mean	5.98
STNDEV	1.2189
COV	0.2040
Trend:	Negative
Confidence (lookup)	81.46%



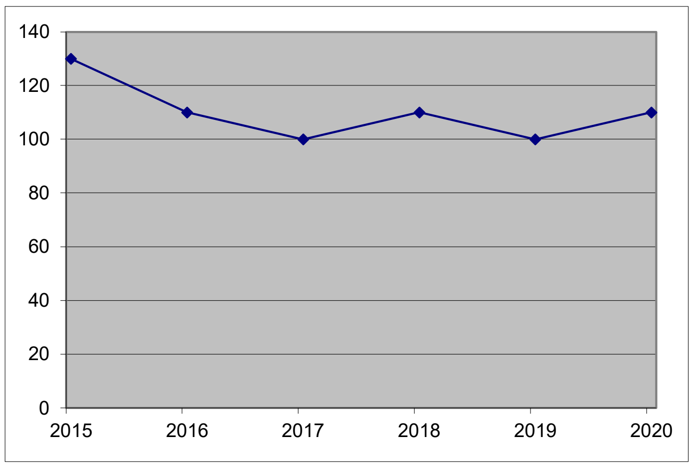
Raw Data

03L859	Date	TCE		Date	TCE
	11/13/1987	<0.2		7/29/2016	4.8
	12/15/1988	<1		6/28/2018	4.8
	4/30/1990	<0.5		6/3/2020	5.75
	3/19/1991	<0.5			
	3/20/1992	2.14			
	3/11/1993	3.5			
	3/18/1994	2.98			
	6/9/1994	6.27			
	9/14/1994	5.67	D		
	9/14/1994	5.67			
	12/7/1994	4.75			
	3/10/1995	4.55			
	6/3/1996	5.96			
	6/4/1997	2.86			
	6/1/2004	10			
	6/22/2005	8.9			
	6/21/2007	9			
	6/18/2009	7.8			
	6/24/2011	7.2			
	6/27/2013	7.7			
	6/10/2015	5.6			

WELL 03M848
MANN-KENDALL STATISTICAL ANALYSIS
OU3 - 2020

Date	TCE (µg/l)	Mann-Kendall Calculation:								
6/11/2015	**130**	1								
6/14/2016	**110**	1	-1							
6/8/2017	**100**	1	-1	-1						
6/28/2018	**110**	1	-1	0	1					
6/20/2019	**100**	1	-1	-1	0	-1				
6/4/2020	**110**	1	-1	0	1	0	1			
	N	6	5	4	3	2	1	0		15
	sum		-5	-2	2	-1	1	0	Kendall S	-5
	Possibles	15								
									Kendall tau	-0.333

Mean	110.00
STNDEV	10.9545
COV	0.0996
Trend:	Negative
Confidence (lookup)	76.50%



Raw Data
03M848

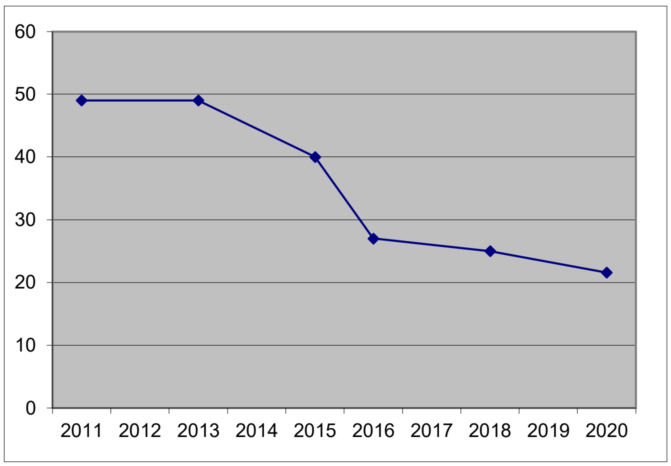
Date	TCE	Date	TCE
12/2/1987	440	6/1/2003	450
4/19/1990	190	6/21/2005	230
7/19/1990	190	6/13/2006	190
9/17/1990	330	6/21/2007	150
3/18/1991	310	6/18/2008	130
6/4/1991	730	6/17/2009	130
9/3/1991	700	6/8/2010	130
3/18/1992	640	6/24/2011	150
6/3/1992	>50.10	6/24/2011	160 D
6/3/1992	570 D	6/1/2012	190
9/3/1992	>50.10	6/1/2012	180 D
3/9/1993	1300	6/27/2013	160
3/9/1993	970 D	6/9/2014	150
3/17/1994	910	6/9/2014	150 D
3/16/1995	59	6/11/2015	130
6/21/1996	1400	6/14/2016	110
6/26/1997	510	6/14/2016	110 D
6/29/1998	660	6/8/2017	100
6/4/1999	700	6/28/2018	110
6/4/1999	650 D	6/20/2019	100
6/12/2001	370	6/4/2020	110

WELL 04U859
MANN-KENDALL STATISTICAL ANALYSIS
OU3 - 2020

Date	TCE (µg/l)	Mann-Kendall Calculation:							
6/24/2011	**49**	1							
6/27/2013	**49**	1	0						
6/10/2015	**40**	1	-1	-1					
7/29/2016	**27**	1	-1	-1	-1				
6/28/2018	**25**	1	-1	-1	-1	-1			
6/3/2020	**21.6**	1	-1	-1	-1	-1	-1		

N	6	5	4	3	2	1	0		15
sum		-4	-4	-3	-2	-1	0	Kendall S	-14
Possibles	15								
								Kendall tau	-0.933

Mean	35.27
STNDEV	12.3299
COV	0.3496
Trend:	Negative
Confidence (lookup)	99.51%



Raw Data
04U859

Date	TCE	Date	TCE
11/13/1987	0.3	6/18/2009	50
12/15/1988	8.5	6/24/2011	49
4/30/1990	5.59	6/27/2013	49
3/19/1991	5.24	6/10/2015	40
3/20/1992	9.29	7/29/2016	27
3/11/1993	40.5	6/28/2018	25
3/18/1994	47	6/3/2020	21.6
3/18/1994	49.5		
6/9/1994	48.9		
9/14/1994	64		
12/7/1994	52.5		
3/10/1995	43.8		
6/3/1996	50.8		
6/4/1997	31.9		
6/25/1998	42		
6/25/1998	46.8		
6/7/1999	75		
6/13/2001	8.4		
6/1/2003	4.4		
6/22/2005	71		
6/21/2007	60		

APPENDIX A

FY 2020 – FY 2024 Monitoring Plan

APPENDIX B

Monitoring Well Index

APPENDIX C

Data Collection, Management, and Presentation

APPENDIX D

Comprehensive Groundwater Quality and Groundwater Level Database

APPENDIX E

Well Inventory

APPENDIX F

Annual Site Inspection Checklist for Land Use Controls

APPENDIX G

Groundwater Monitoring Report – April 2020 Sampling Event, Rice Creek Remeander Project, Bay West, 2020

APPENDIX H

Site K and TGRS Operational Data

APPENDIX I

TGRS Chemical Data

APPENDIX J

Maros Decision Matrix

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