FINAL

EXPLANATION OF SIGNIFICANT DIFFERENCES #3
CHANGE IN GROUNDWATER TREATMENT SYSTEM AND ADDITION OF 1,4-DIOXANE AS A CONTAMINANT OF CONCERN

NEW BRIGHTON/ARDEN HILLS SUPERFUND SITE

Twin Cities Army Ammunition Plant *September 19, 2019*

1.0 INTRODUCTION AND STATEMENT OF PURPOSE

An Explanation of Significant Differences (ESD) is required for Operable Unit (OU) 2 at the New Brighton/Arden Hills Superfund Site ("NB/AH Superfund Site", also referred to as the former Twin Cities Army Ammunition Plant or "TCAAP") to modify the Record of Decision (ROD) due to a change in the groundwater treatment technology used in the extraction and treatment system for deep groundwater. The change does not alter the overall cleanup approach documented in the ROD. This ESD also documents the addition of 1,4-dioxane to the list of contaminants of concern (COCs). This ESD was prepared in accordance with Section 117 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 and Section 300.435(c)(2) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

The ROD was originally signed on September 25, 1987 and was amended in 2007, 2009, 2012, 2014, and 2018. This ESD will become part of the Administrative Record (AR) for TCAAP and will be available to the public at the following location(s):

Location	Address	Phone Number	Hours of Operation
TCAAP	4761 Hamline Ave N Arden Hills, MN 55112	651-356-4466	Access can be arranged by contacting Mary Lee at mary.l.lee.civ@mail.mil, or 651-356-4466
Ramsey County Library, New Brighton Branch	400 10th St NW, New Brighton, MN	651-724-6002	Mon: 10 a.m. - 5 p.m. Tue: 10 a.m. - 8 p.m. Wed: 1 p.m. - 8 p.m. Thu-Sat: 10 a.m. - 5 p.m. Sun: Closed

1.1 Site Name and Location

The New Brighton/Arden Hills (NB/AH) Superfund Site includes TCAAP in Arden Hills, Minnesota, as well as portions of several surrounding communities. The NB/AH Superfund Site is subdivided into three OUs (OU1 through OU3) as shown in Figure 1. OU2, the subject of this ESD, includes soil, sediment, surface water, and groundwater contamination in the area that comprised the TCAAP in 1983, when the NB/AH Site was placed on the NPL. OU2 also

includes the shallow Site A groundwater plume that extends off the north end of TCAAP. OU1 and OU3 encompass deep groundwater contamination located outside the OU2 boundary (e.g., off-TCAAP). OU1 and OU3 are sometimes referred to as the “North Plume” and “South Plume”, respectively.

1.2 Identification of Lead and Support Agencies

Cleanup of TCAAP is conducted by the Army as the lead agency under the Federal Facility Agreement (FFA) signed in 1987 by the Army, United States Environmental Protection Agency (USEPA), and Minnesota Pollution Control Agency (MPCA). Environmental investigations and remedial actions at TCAAP are conducted under the structure of the CERCLA. Specifically, Section 117 of CERCLA, as well as Section 300.435(c)(2) of the NCP.

Remedial actions at OU2 are described in the ROD signed in 1997 and amended in 2007, 2009, 2012, 2014, and 2018, as well as in two previous ESDs signed in 2009. Of these, only the original ROD (1997) and ESD #1 (2009) pertain to deep groundwater at OU2. The deep groundwater remedial actions were chosen in accordance with CERCLA as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) (Title 42, United States Code, sections 9601 to 9675) and, to the extent practicable, the NCP (Title 40 of the Code of Federal Regulations [CFR], Part 300).

1.3 Summary of Circumstance Requiring an Explanation of Significant Differences

The Army has prepared this ESD to address the following:

- Addition of secondary remedial technologies to the selected remedy to treat an additional COC: 1,4-dioxane.
- Addition of liquid phase granular activated carbon (LGAC) for groundwater treatment of VOCs as a supplement or alternative to the existing air stripping treatment

This ESD was prepared in accordance with the guidelines presented in *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents* (United States Environmental Protection Agency [USEPA] 1999), and includes all items listed in Highlight 7-2 of that document: Sample Outline and Checklist for ESDs and ROD Amendments (see Table 1 for a summary of this checklist).

Table 1. USEPA Checklist for ESDs

Component	ESD Checklist Item	Where Item is Addressed in the SD032 ESD
Introduction to the Site and Statement of Purpose	Site name and location.	Section 1.1, "Site Name and Location"
	Identification of lead and support agencies.	Section 1.2, "Lead and Supporting Agencies"
	Citation of CERCLA §117(c) and NCP §300.435(c)(2)(i)	Section 1.2, "Lead and Supporting Agencies"
	Include date of ROD signature.	Section 1.2, "Lead and Supporting Agencies"

Table 1. USEPA Checklist for ESDs

Component	ESD Checklist Item	Where Item is Addressed in the SD032 ESD
	Summary of circumstances that led to the need for an ESD.	Section 1.3, "Summary of Circumstances Requiring an Explanation of Significant Differences"
	Statement that ESD will become a part of the Administrative Record file (NCP 300.825(a)(2)).	Section 1.3, "Summary of Circumstances Requiring an Explanation of Significant Differences"
	Address of location where the files is available and hours of availability.	Section 1.3, "Summary of Circumstances Requiring an Explanation of Significant Differences"
Site History, Contamination, and Selected Remedy	Brief summary of contamination problems and site history.	Section 2.1, "Site and Contamination History"
	Present the Selected Remedy, as originally described in the ROD.	Section 2.2, "Selected Remedy"
Basis for the Document	Summarize information that prompted and supports significant differences from the Selected Remedy, including the results of the treatability studies or other information developed or provided during the remedial design process.	Section 3, "Basis for the Explanation of Significant Differences"
	Reference any information in the Administrative Record that supports the need for the change.	Section 3, "Basis for the Explanation of Significant Differences"
Description of Significant Differences or New Alternatives	Describe the significant differences between the remedy as presented in the ROD and the action now proposed, highlighting scope, performance, and cost.	Section 4.1, "Significant Differences"
	Describe any changes in Expected Outcomes that will result from the ESD.	Section 4.2, "Changes in Expected Outcomes"
Support Agency Comments	Include a summary of support agency comments on the ESD.	Section 5, "Support Agency Comments"
Statutory Determinations	State that the modified remedy satisfies CERCLA §121.	Section 6, "Affirmation of Statutory Determinations"
Public Participation Compliance	Document that the public participation requirements set out in NCP §300.435(c)(2)(i) have been met.	Section 7, "Public Participation"

Notes:

Components and checklist items are from highlight 7-2 of A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents (USEPA 1999)
§ - Section
CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act
ESD - Explanation of Significant Differences
NCP - National Oil and Hazardous Substances Pollution Contingency Plan
ROD - Record of Decision
USEPA - United States Environmental Protection Agency

2.0 SITE HISTORY, CONTAMINATION, AND SELECTED REMEDY

This section describes site history and contamination, specifically the deep groundwater impacts at OU2. The remedy for OU2 deep groundwater is also summarized.

2.1 Site and Contamination History

TCAAP was constructed between August 1941 and January 1943 in the northern portion of the Minneapolis – St. Paul metropolitan area, in Ramsey County, Minnesota, surrounded by the cities of New Brighton, Arden Hills, Mounds View, and Shoreview. TCAAP primarily produced and 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 periods of activity, solvents were used as part of some manufacturing operations. Disposal of solvents and other wastes at the TCAAP property resulted in on-site soil impacts and groundwater contamination that migrated beyond the original TCAAP boundary. Groundwater impacts were first discovered in July 1981, leading to soil and groundwater investigations on and off-TCAAP. It was determined that TCAAP was the source of contamination, and the TCAAP property and area of affected groundwater contamination was placed on the National Priorities List (NPL) in 1983 as the NB/AH Superfund Site.

2.2 Selected Remedy for OU2

The 1997 OU2 ROD was amended in 2007, 2009, 2012, 2014, and 2018. The remedial action requirements for OU2 soil and groundwater were set forth in the 1997 OU2 ROD and amendments:

- ROD Amendment #1 related to Site C-2 (2007),
- ROD Amendment #2 related to Site I groundwater (2009),
- ROD Amendment #3 related to various soil sites (2009),
- ESD #1 related to groundwater (2009),
- ESD #2 related to various soil sites (2009),
- ROD Amendment #4 related to Building 102 shallow groundwater, aquatic sites, and various soil sites (2012), and
- ROD Amendment #5 related to various soil sites (2014).
- ROD Amendment #6 related to Site A groundwater (2018)

The selected remedy for Deep Groundwater in the 1997 OU2 ROD consists of five remedial components that include continued use of the TCAAP Groundwater Recovery System (TGRS), with modifications to improve VOC contaminant removal from the source area. It also includes an annual review of new and emerging technologies potentially applicable to the Deep Groundwater. ESD #1 (2009) added land use controls to the selected remedy to protect groundwater monitoring, extraction, and treatment system infrastructure and to prohibit groundwater use. Figure 2 presents the remedy selected in the OU2 ROD.

As summarized in the 1997 ROD, an Interim Response Action Plan for TCAAP (USEPA 1987) was prepared providing specific criteria for the Boundary Groundwater Recovery System, (BGRS) which started on October 19, 1987. Initially operated as six extraction wells on the southwest OU2 boundary, the BGRS was later expanded between 1987 and 1989 to include six

additional extraction and five source control wells and was renamed as the TCAAP Groundwater Recovery System (TGRS) . The TGRS has largely hydraulically contained contaminated groundwater at the southwest boundary of TCAAP, capturing contaminated groundwater that originated at the OU2 source areas (Sites D, G and I) and minimizing the migration of TCE-impacted groundwater into OU1. Since the TCE plume has narrowed since the start of operation, select wells positioned outside the current plume footprint or that did not contribute substantive capture benefit have been turned off. As of 2017, the TGRS operates with 11 wells including eight boundary extraction wells and three source control wells. Since 1986, TCE-impacted groundwater has been effectively treated by air stripping to meet the cleanup requirements. Treated effluent is then discharged to the Arsenal Sand and Gravel Pit where it recharges overburden sands. 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.

Operation of the TGRS remedy has been effective in reducing the original COC concentrations at nearly all OU2 monitoring wells by 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 as anticipated.

3.0 BASIS FOR THE EXPLANATION OF SIGNIFICANT DIFFERENCES

Since the ROD and amendments were signed, Annual Performance Reviews (APRs) and five-year reviews (1999, 2004, 2009, 2014) have been issued showing groundwater impacts of dissolved phase TCE in OU2. In early 2015, the City of New Brighton was notified by the Minnesota Department of Health (MDH) 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]), where all of New Brighton Contaminated Groundwater Recovery System (NBCGRS) wells extract groundwater from the Prairie du Chien (PdC) and/or Jordan Aquifers. However, concentrations of 1,4-dioxane in samples collected from deeper municipal wells (Mount Simon Aquifer) were non-detect. No federal drinking water standard exists for 1,4-dioxane; however, a Minnesota Department of Health (MDH) Health Risk Limit (HRL) of 1 µg/L is in place based on a Cancer HRL calculation. The majority of the 1,4-dioxane concentrations in samples collected from the NBCGRS exceed the MDH HRL. A 'remedy time-out' was placed ceasing NBCGRS operation on April 15, 2015. The City initially switched to preferential extraction from non-impacted deeper aquifer wells while evaluating removal technologies and later connected to the City of Minneapolis water distribution system until a 1,4-dioxane remedy had been added to the NBCGRS.

In 2017, the City of New Brighton selected a new treatment technology for removing 1,4-dioxane from NBCGRS effluent–Ultraviolet (UV)/Peroxide Advanced Oxidation (AO). Upgrades to the New Brighton water treatment plant were completed and implemented in November 2018 and pumping from the six municipal wells that comprise the NBCGRS was restarted with AO treatment.

A supplemental, full groundwater sampling round at OU1, OU2 and OU3 monitoring wells was completed in 2015 and 2016 for 1,4-dioxane. Since then, detections of 1,4-dioxane in groundwater continues to be monitored on an annual basis and reporting has been expanded to include 1,4-dioxane concentrations and contours. Flow from overburden to bedrock and within bedrock is complex and is the basis for TCE and 1,4-dioxane groundwater plume distributions within overburden and bedrock downgradient of historical sources. The highest 1,4-dioxane concentrations were observed in wells near Site G which exceed the current MDH HRL of 1 µg/L by over two orders of magnitude. Because the existing TGRS treatment system is not capable of removing 1,4-dioxane, a new extraction well and supplemental AO system will be completed near Site G to remove the most concentrated 1,4-dioxane.

Pretreated groundwater from Site G will be combined with extracted groundwater from the existing TGRS network, conveyed, treated and pumped to the gravel pit. Direct discharge of AO treatment system effluent to gravel pit may also be considered to reduce flow to the TGRS.

In 2018, the MPCA informed the Army that MDH did not consider the previous acute air concentration standard for TCE of 2000 micrograms per cubic meter (µg/m3) and chronic criterion of 2 $\mu g/m^3$ to be adequately protective but a new acute standard for TCE has not been promulgated. In order to minimize the potential for receptors to be exposed to unacceptable TCE concentrations in outdoor air, it is proposed to add liquid phase granular activated carbon (LGAC) to supplement or replace the existing air stripping treatment. LGAC is a proven technology to remove TCE and other Site VOCs in water to acceptable concentrations for discharge. VOC emissions using LGAC are almost completely eliminated. The LGAC will be installed, tested and made operational when the standard is promulgated.

4.0 DESCRIPTION OF SIGNIFICANT DIFFERENCES

The Army prepared this ESD to address the following:

- Addition of secondary remedial technologies to treat an additional COC: 1,4-dioxane.
- Addition of liquid phase granular activated carbon (LGAC) for groundwater treatment of VOCs as a supplement or alternative to the existing air stripping treatment.

4.1 Significant Differences

The OU2 ROD states the remedial action objective for TCAAP is to mitigate the potential risk of exposure of human and ecological receptors to onsite COCs in soil, groundwater, and surface water. The selected remedy for deep groundwater was groundwater extraction and treatment via the TGRS.

To date, operation of the OU2 remedy via the TGRS has been effective in reducing the concentrations of TCE and other chlorinated VOCs in groundwater at OU2 monitoring wells over time. These declines were immediately evident during the early 1990s in overburden and bedrock OU2 monitoring wells and have been correlated with reductions in TCE concentrations at OU1 monitoring wells beyond the OU2 southwestern boundary. Analyses of groundwater contours, pumping rates and water quality trends completed in each CERCLA-required Annual Performance Report and five-year review from 1999 onward have concluded the TGRS

achieves TCE containment at the southwestern OU2 boundary relative to the 5 ug/L contour. However, data have also shown that 1,4-dioxane is a key contaminant of concern originating from Site G that is not currently being treated by the existing treatment system. The assessment performed as part of the TGRS optimization review served to evaluate the overall containment remedy relative to both source removal and OU2 boundary control and identify optimization steps to enhance TCE mass removal, focus groundwater containment, and provide supplemental 1,4-dioxane treatment. For 1,4-dioxane, the findings of this review indicated that AO treatment for groundwater extracted from Site G can be used to reduce 1,4-dioxane concentrations at OU2 such that 1,4-dioxane already present in OU1 groundwater remains within the design range of the existing NBCGRS OU1 treatment system. To achieve target 1,4-dioxane concentration reductions, a dedicated AO treatment system will be installed at Site G to treat extracted groundwater at a design flow rate of 100 gpm. Removal of fouling constituents (i.e., iron, manganese, calcium) upstream of the AO treatment system via chemical/physical processes (e.g., aeration, precipitation, and/or separation) will minimize fouling of the AO system and components. Final AO treatment system design along with ancillary unit operations will depend on the presence of fouling constituents (i.e., iron, manganese) that are readily oxidized, and concentrations of hydroxyl radical scavengers present in the groundwater, such as non-target organic carbon, alkalinity, bromide, and chloride.

The effluent from the Site G AO treatment system will be mixed with the extracted, untreated groundwater from the existing TGRS extraction wells (and other new extraction wells) and conveyed to the modified groundwater treatment system using air stripping and/or LGAC. Direct discharge of AO treatment system effluent to the Arsenal Sand and Gravel may also be considered to reduce flow to the TGRS.

Routine influent and effluent sampling from the AO treatment system will be performed to monitor influent 1,4-dioxane (and other constituent) concentration trends and verify AO treatment system efficiency. Analytical data will be used to optimize extraction rates as part of the adaptive design approach described below.

An adaptive design approach will be used to incorporate flexibility in the volume of water that is processed through the AO treatment system (e.g., variable frequency drives on system motors, AO system bypass piping, etc.). System equipment and control infrastructure will be designed to allow for system modifications and/or upgrades based on future influent flow and concentration conditions. Additionally, an adaptive operation and management approach (e.g., routine AO system monitoring and sampling, extraction well and system flow tracking) will be used to allow for changes to system operation that will optimize AO treatment system operation while still achieving all required regulatory treatment and discharge criteria.

4.2 Changes in Expected Outcomes

Implementation of targeted 1,4-dioxane treatment will reduce 1,4-dioxane concentrations in groundwater extracted from Site G to less than the MDH HRL before conveyance with other TGRS extracted groundwater. VOC concentrations will also be reduced. Improvements in groundwater quality data will be leveraged to continuously refine capture operations to maximize mass recovery throughout OU2 (e.g., discontinue redundant or unnecessary

extraction wells, manipulate current monitoring infrastructure and refine primary extraction well locations). Supplemental source control is expected to support continued COC concentration reduction within OU2 groundwater and data will be used to assess when TGRS operations can be further reduced or eventually discontinued – with source zone extraction serving for stand-alone OU2 COC control.

The use of LGAC and AO for groundwater treatment will also substantially reduce TCE air emissions compared to the current air-stripping treatment system.

5.0 SUPPORT AGENCY COMMENTS

USEPA and MPCA have had ongoing involvement in the decision-making process associated with the modification to the remedy for OU2. The Army has obtained concurrence from USEPA and MPCA on the Work Plan modification to the treatment system to address 1,4-dioxane on January 29, 2019 and March 3, 2019, respectively.

6.0 AFFIRMATION OF STATUTORY DETERMINATIONS

The proposed change to the selected remedy will continue to satisfy the requirements under Section 121 of CERCLA. The modified remedy will remain protective of human health and the environment and will continue to comply with federal and state Applicable or Relevant and Appropriate Requirements and be cost effective. Figure 3 presents the modified remedy.

7.0 PUBLIC PARTICIPATION

A notification to the public concerning this ESD will be made in the local newspaper after signature. The ROD and this ESD are available to the public at the following locations, as part of the Administrative Record:

- TCAAP, 470 West Highway 96 – Suite 100, Shoreview, MN 55126-3218, 651-294-4930
- Ramsey County Library – New Brighton Branch, 400 10th St NW, New Brighton, MN 55112, 651-724-6002

8.0 REFERENCES

USEPA. 1987. Interim Response Action Plan. 1987.

USEPA. 1999. A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents. EPA 540-R-98-031. Washington, D.C. July.

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Date

Douglas Ballotti
Director
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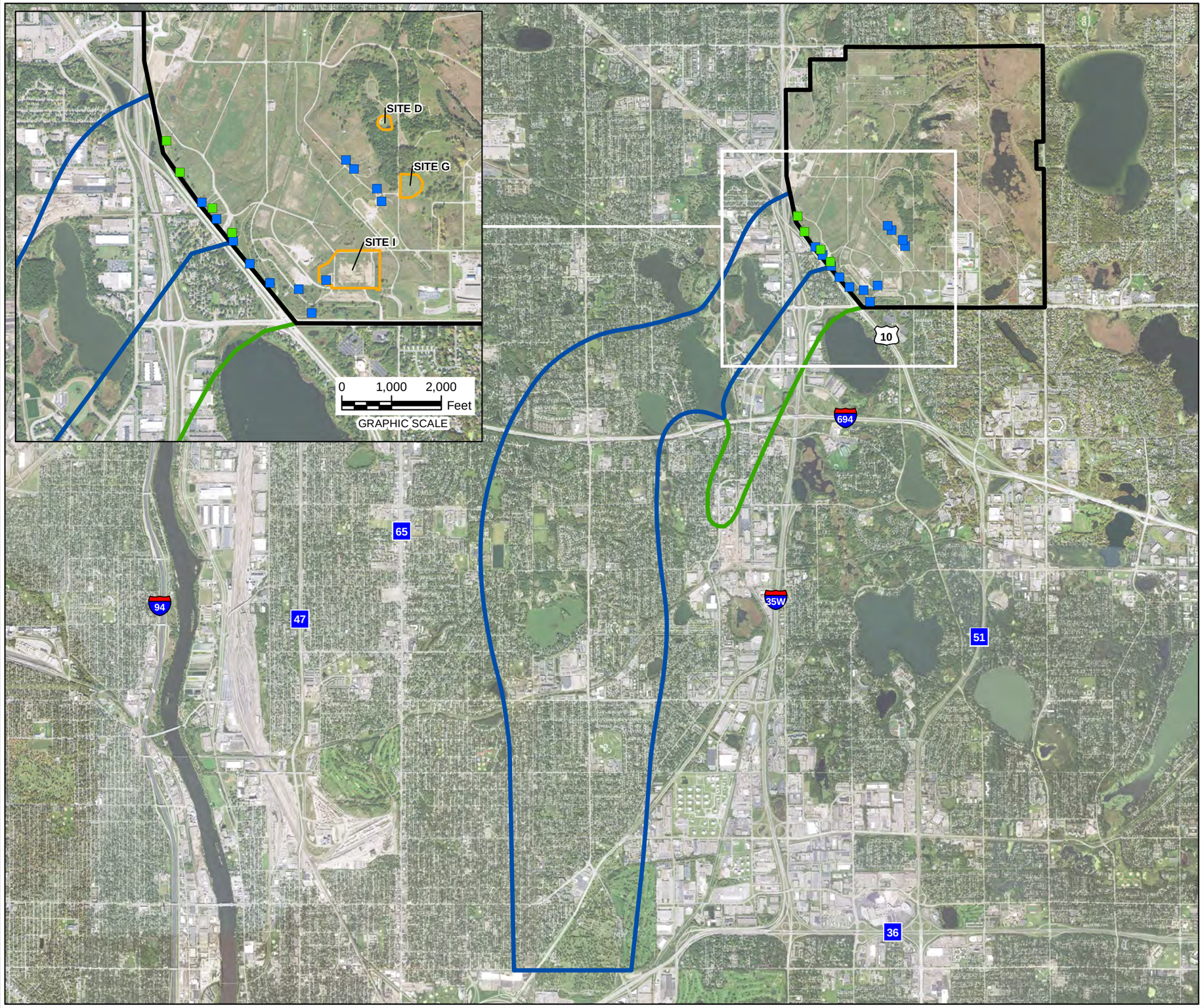
U.S. Environmental Protection Agency
Region 5

Date

Kathryn J. Sather, Director
Remediation Division
Minnesota Pollution Control Agency

Date

LIST OF FIGURES



LEGEND:

- TGRS BEDROCK EXTRACTION WELL
- TGRS OVERBURDEN EXTRACTION WELL
- OPERABLE UNIT 1
- OPERABLE UNIT 2
- OPERABLE UNIT 3
- SITE BOUNDARIES

0 4,000 8,000
Feet
GRAPHIC SCALE

NOTES:

1. ALL LOCATIONS ARE APPROXIMATE
2. 2015 AERIAL PHOTOGRAPH (SOURE: NAIP)

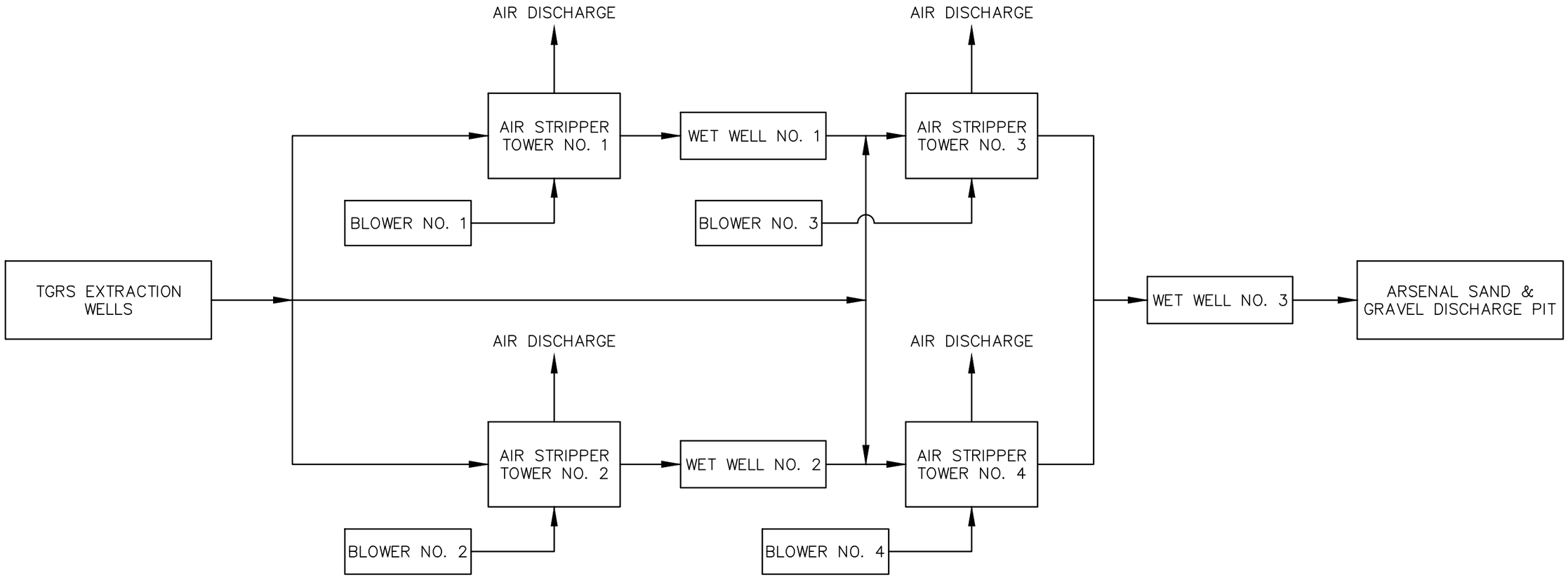
TWIN CITIES ARMY AMMUNITION PLANT
ARDEN HILLS, MINNESOTA

SITE LOCATION MAP

PIKA ARCADIS a joint venture

FIGURE 1

City: Minneapolis Div/Group: IMDV Created By: MG Last Saved By: mgress
TCAAP
Z:\GISProjects_ENV\TCAAP_Arden_Hills_MN\MXD\2017-12\Optimization_Report\OU1_OU2_SiteMap_20171220.mxd 12/20/2017 11:23:31 AM

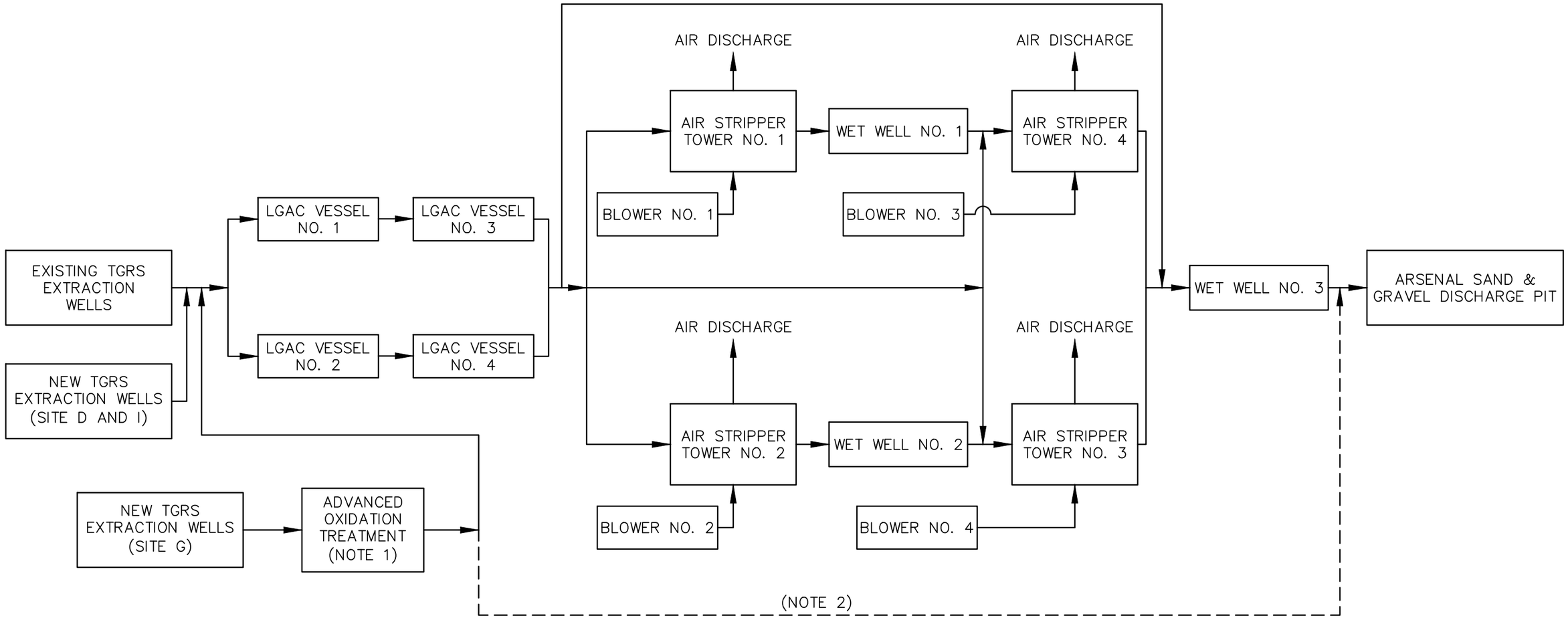


TWIN CITIES ARMY AMMUNITION PLANT
ARDEN HILLS, MN

SELECTED REMEDY

PIKA ARCADIS a joint venture

FIGURE
2



LEGEND:

LGAC – LIQUID GRANULAR ACTIVATED CARBON

TGRS – TCAAP GROUNDWATER RECOVERY SYSTEM

NOTES:

1. REMOVAL OF FOULING CONSTITUENTS (E.G., IRON, MANGANESE, CALCIUM) MAY BE REQUIRED PRIOR TO AO TREATMENT. ANALYSIS OF GROUNDWATER FROM NEW SITE G EXTRACTION WELL WILL BE REQUIRED TO FINALIZE AO PRE–TREATMENT PROCESSES. ASSUMED AO TREATMENT PROCESS USES ULTRAVIOLET LIGHT AND HYDROGEN PEROXIDE.

2. DIRECT DISCHARGE OF AO TREATED WATER TO THE ARSENAL SAND & GRAVEL DISCHARGE PIT WILL BE EVALUATED.

TWIN CITIES ARMY AMMUNITION PLANT
ARDEN HILLS, MN

MODIFIED REMEDY

PIKA ARCADIS a joint venture

FIGURE **3**