BECHTEL PARSONS BLUE GRASS
A Joint Venture of Bechtel National, Inc. and Parsons Government Services Inc.

Blue Grass Chemical Agent-Destruction Pilot Plant (BGCAPP)

Closure Document

Quality Assurance Project Plan for Closure Verification Groundwater Sampling

Contract W52P1J-09-C-0013

24915-GEN-5PL-00-00018

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Approval

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Record of Revision

Revision No.	Effective Date of Revision	Brief Revision Description
2	18 APR 2024	Revised to address informal KDEP comments and corrections
1	28 MAR 2024	Revised to address KDEP NOD comments.
0	11 JAN 2024	Initial issue

List of Changes

Change No.	Effective Date of Change	Brief Change Description
3	11 JUL 2024	Added well abandonment conditions per KDEP comments.
2	18 JUN 2024	Added thiodiglycol per KDEP comments.
1	08 MAY 2024	Terminology revised from “non-residential clean closure” to “industrial clean closure.”
0	18 APR 2024	See Record of Revision description.

Table of Contents

1.0 PURPOSE

This document supplements 24915-GEN-5PL-00-00014, *Closure Verification Sampling and Analysis Quality Assurance Project Plan (CVQAPP),* by defining the field sampling design and Quality Assurance/Quality Control (QA/QC) requirements designed to achieve the data quality goals associated with groundwater sampling.

2.0 SCOPE

The scope of this document is to define the field sampling design and QA/QC requirements associated with closure verification groundwater sampling. As such, this document supplements and should be reviewed in conjunction with 24915-GEN-5PL-00-00014, *Closure Verification Sampling and Analysis Quality Assurance Project Plan (CVQAPP).*

Groundwater sampling will be performed as part of closure verification sampling (CVS) in support of final closure of the Blue Grass Chemical Agent-Destruction Pilot Plant (BGCAPP) Main Plant and the two Static Detonation Chamber (SDC) Facilities. Groundwater sampling will be executed following completion of initial closure decontamination efforts at the SDC facilities (i.e., after fluids are drained from the SDC Offgas Treatment System (OTS) units and secondary containment systems).

3.0 DEFINITIONS

For a complete summary of definitions, please see 24915-GEN-5PL-00-00014, *Closure Verification Sampling and Analysis Quality Assurance Project Plan (CVQAPP).* The following definitions are specific to groundwater sampling.

Drawdown	Drawdown is the reduction in hydraulic head observed within a well typically due to pumping a well as part of an aquifer test or well test, or purging a well prior to sampling
Indicator Field Parameters	U.S. EPA's *Standard Operating Procedure for Low-Stress (Low-Flow) / Minimal Drawdown Ground-Water Sample Collection* uses field measurements of turbidity, dissolved oxygen, specific conductance, temperature, pH, and oxidation/reduction potential (ORP) as indicators of well stabilization and sufficient purging
Low-flow	Low-flow refers to the velocity with which water enters the pump intake from the surrounding formation in the immediate vicinity of the well screen. It does not necessarily refer to the flow rate of water discharged at the surface, which can be affected by flow regulators or restrictions

Stabilization	A condition that is achieved when all indicator field parameter measurements are sufficiently stable to allow sample collection to begin

4.0 PROJECT/TASK ORGANIZATION

Refer to Section 4.0 of 24915-GEN-5PL-00-00014, *Main Plant Closure Verification Sampling and Analysis Quality Assurance Project Plan.*

5.0 PROBLEM DEFINITION

Groundwater sampling will be performed as part of closure verification sampling (CVS) in support of final closure, which will demonstrate that permitted hazardous waste storage and treatment units have not contaminated the underlying soils or groundwater above the risk-based closure performance standards (or background levels, whichever are higher). Refer to 24915-GEN-5PL-00-00014, *Main Plant Closure Verification Sampling and Analysis Quality Assurance Project Plan*, for a detailed conceptual model of the site. As per Section 5.1.2.6 of 24915-GEN-5PL-00-00014, *Main Plant Closure Verification Sampling and Analysis Quality Assurance Project Plan*, quarterly groundwater sampling was conducted to establish a pre-operational background of groundwater concentrations. As indicated in Table 1, sporadic detections of organics and metals were observed during sampling, though results were less than maximum groundwater contaminant levels as defined in 401 Kentucky Administrative Record (KAR) 39:090.

6.0 QUALITY OBJECTIVES

The rigorous design features of BGCAPP minimizes the potential for groundwater contamination from chemical agents or other contaminants due to releases from permitted Hazardous Waste Management Units (HWMUs). Operational controls, maintenance of spill containment, expeditious cleanup of spills, spill tracking and documentation further reduces the potential for groundwater contamination. As further discussed in 24915-GEN-5PL-00-00014, *Main Plant Closure Verification Sampling and Analysis Quality Assurance Project Plan,* the objective of BGCAPP closure is to verify the permitted HWMUs are closed in a manner that obviates the need for further maintenance. The data quality objective (DQO) process, defined in the U.S. EPA's *Systematic Planning Using the Data Quality Objectives Process*, was used to develop performance and acceptance criteria (or data quality objectives) for Main Plant Closure. Established DQOs define the appropriate type, quality, and quantity of data required to satisfy sampling objectives. The results of the DQO process for groundwater sampling are provided in Table 2.

Groundwater sampling will provide additional confirmation that operations, decontamination, and demolition of BGCAPP facilities has not resulted in release of contaminants to underlying groundwater. Groundwater sampling will demonstrate concentrations of contaminants of potential concern (COPCs) do not exceed acceptable levels by sampling six (6) groundwater wells located within the BGCAPP site drainage zones. Contaminants of Potential Concern (COPCs) were established in 24915-GEN-5PL-00-00014, *Main Plant Closure Verification Sampling and Analysis Quality Assurance Project Plan* and are summarized in Table 4.

The action levels for groundwater sampling are the acceptable levels established by the U.S. Army, State of Kentucky, or US EPA for groundwater and tap water as appropriate. Specifically, the project action levels have been established as the Military Field Drinking Water Standards (MFWS), EPA Maximum Contaminant Levels (MCL), or Regional Screening Levels (RSL) for tap water as shown in Table 4. Excluding ethylmethyl phosphonic acid (EMPA) and S-(2-diisopropylaminoethyl) methyl phosphonothioate (EA-2192), a MFWS, MCL or tap water RSL is available for each BGCAPP COPC. For EMPA, the RSL for the structurally similar compound, isopropylmethyl phosphonic acid (IMPA) will be applied. For EA-2192, the MFWS established for VX is applied. Though available toxicity data suggests EA2192 toxicity is lower than that of VX, the U.S. Army recommends applying the toxicity values for VX for EA2192 (US Army Center for Health Promotion and Preventive Medicine (CHPPM), 1999).

Prior background studies (Section 5.0 and Table 1) have demonstrated that, excluding explosives in MW-17, although contaminants may be detectable within groundwater their concentrations remain below these established concentrations. Detections of explosives within MW-17 will be assessed against background concentrations observed during prior studies (Table 1). These studies have also demonstrated that samples collected per U.S. EPA's *Standard Operating Procedure, Low-Stress (Low Flow) / Minimal Drawdown Ground-Water Sample Collection* provide a representative assessment of groundwater concentrations. If groundwater samples collected from drainage monitoring wells (MW-17 through MW-22) are below the action levels, then the site will have successfully demonstrated groundwater has not been impacted in support of industrial clean closure and will take no further action. With concurrence from Kentucky Department for Environmental Protection (KDEP) and Blue Grass Army Depot (BGAD), the BGCAPP monitoring wells will be abandoned in accordance with 401 KAR 6:350, Section 11. If results are not below action levels, the project will establish a groundwater investigation program including comparison of observed levels with background measurements collected prior to hazardous waste operations to identify the extent of potential contamination. Those monitoring wells identified within the groundwater investigation program will be maintained, while wells considered no longer necessary will be abandoned with concurrence from KDEP and BGAD.

Measurement Performance Criteria established to support the decision are defined in Section 6.3 of 24915-GEN-5PL-00-00014, *Main Plant Closure Verification Sampling and Analysis Quality Assurance Project Plan* and Section 11.0.

7.0 PROJECT/TASK DESCRIPTION

This project entails the sampling and analysis of groundwater wells located at BGCAPP. Sampling and analysis techniques to support this effort are consistent with U.S. EPA methodologies and State of Kentucky regulations. Figure 1 shows the location of monitoring wells in place at BGCAPP and highlights wells pertinent for CVS. As indicated, six (6) existing wells were selected within BGCAPP drainage systems (MW-17, MW-18, MW-19, MW-20, MW-21 and MW-22). Details for the six (6) wells selected for CVS are provided in Table 3 with further discussion provided in Section 8.1.

The six (6) groundwater wells will be sampled in accordance with 24915-00-3PS-HXYG-0002, *Engineering Specification for Collection and Analysis of Groundwater Samples* and US EPA's *Standard Operating Procedure, Low-Stress (Low Flow) / Minimal Drawdown Ground-Water Sample Collection* (see Section 8.0 for additional details). Samples will be submitted for analysis for chemicals of potential concern identified in Table 4 in accordance with standard methods (see Section 9.0 for additional details). Results will be submitted for data validation with results reported in accordance with Section 14.0.

8.0 SAMPLING TASKS

Groundwater sampling will provide final verification that operations, decontamination, demolition, and HWMU closure have not resulted in potential release to the environment. The specific tasks required for groundwater sampling are provided in Sections 8.1 and 8.2. Field health and safety requirements are defined in Section 8.3. Decontamination, Investigative Derived Waste (IDW) handling, and field documentation are described in Sections 8.4, 8.5, and 8.6, respectively. Sample analysis is discussed in Section 9.0. Field quality samples to be collected are discussed in Section 11.0.

8.1 Sampling Tasks

Prior site grading inspection and geologic mapping of the plant site performed in 2006 and documented in 24915-00-30R-G01-00037, *Review of Existing Site Information and Geotechnical Recommendations for Project Design*, indicated groundwater seepage in a thin (3-12 in) weathered rock zone. The general site gradient is from north to south. During site grading, two large French drains were constructed at the bedrock contact to allow existing groundwater flow to continue to the south. The first French drain, which represents the main subsurface flowpath, passes from north to south through the center of the plant site and empties into the sedimentation basin. The second French drain collects groundwater from the northeast corner of the site and drains to a tributary flowing to Muddy Creek (see Figure 1).

The monitoring wells to be used for CVS were constructed with screens and sand pack in the upper rock extending into the overlying weathered bedrock and base of the alluvium. Soil sampling and rock coring during installation confirmed that groundwater flow occurred in the weathered bedrock and upper 12 inches of rock as marked by iron staining and weathering. Excluding MW-20, the wells have screens in the contact zone of soil, weathered bedrock and upper rock. MW-20 is screened above bedrock as discussed further below.

Monitoring wells MW-19, MW-20, and MW-21 were located to intercept the approximate center of the site French drains and monitoring well MW-18 was placed to intercept flow onto the Main Plant property from the north, as shown in Figure 1. Subsequent to installation and background sampling, the SDC 2000 was constructed and operated upgradient of MW-18. Monitoring wells MW-20 and MW-21 were placed to intercept the first French drain, downgradient of the MDB, SPB, and surrounding areas, passing through the center of the drain. Because the French drain at the well location does not reach bedrock, the wells are screened at different depths with MW-20 screened above the rock and MW-21 screened across the contact. Monitoring well MW-19 was placed to intercept the second French drain, downgradient of the Waste Transfer Station and surrounding areas, with screen across the contact. The remaining wells (MW-17 and MW-22) were located to monitor local gradients from the site to the south.

The groundwater wells will be sampled according to 24915-00-3PS-HXYG-0002, *Engineering Specification for Collection and Analysis of Groundwater Samples* and U.S. EPA's *Standard Operating Procedure for Low-Stress (Low-Flow) / Minimal Drawdown Ground-Water Sample Collection*. This EPA procedure provides a method which minimizes the impact on ground water chemistry during sample collection to provide a representative sample and minimizes the volume of water purged and disposed. A site-specific sampling procedure will not be developed. Instead, personnel will complete sampling and documentation in accordance with these two documents. Consistent with method requirements, the six (6) CVS monitoring wells have a screen interval of 10 feet optimally located to intercept the groundwater flow path.

Prior to executing well sampling, the project will investigate the status of existing wells to confirm the wells remain intact, undamaged, and bear water. It is anticipated wells will require purging sometime before sampling to reduce silt deposits and confirm acceptable recharge.

Prior site sampling has demonstrated insufficient recharge or poor stabilization at several wells (see 24915-000-GRR-GGEN-00007, *Background Soil and Water Investigation Report*). During these prior sampling events, the project developed a decision diagram which was applied for subsequent sampling events to supplement 24915-00-3PS-HXYG-00002, *Engineering Specification for Collection and Analysis of Groundwater Samples*, and will be applied for CVS. The decision diagram is included as Figure 2.

Consistent with method requirements, water-quality indicator parameters will be measured during purging conducted immediately prior to sampling to assess well stabilization. The project will use the recommended water-quality indicator parameters of conductivity, dissolved oxygen (DO), turbidity, oxidation-reduction potential (ORP), pH, and temperature. The field instruments to be used will be provided by the contractor with performance verified in accordance with Section 8.2.

8.2 Instrument Performance Verification

Field equipment will be inspected daily to ensure functionality and safety. Items inspected and maintained include but are not limited to the following:

- Ensuring portable equipment is charging when not in use
- Ensuring instrument calibration is complete and valid
- Ensuring spare parts and supplies for field and sampling equipment such as batteries, sample containers, decontamination solvents, distilled water, etc. are available
- Ensuring required health and safety equipment is available and operational

Routine and non-routine maintenance activities will be documented.

Calibration methods for field instruments used for measurement of temperature, specific conductivity, pH, ORP, DO, and nephelometric turbidity units (NTU) will follow the specific instrument manufacturers' recommendations. National Institute of Standards and Technology (NIST) traceable standards will be utilized as available. Field instruments will be calibrated before deployment to the field, and a calibration check will be performed at the end of each day to verify that the instrument remained in good working condition throughout the day. If the calibration check at the end of the day does not meet acceptance criteria then that day's data will be flagged, and the instrument calibration checks will increase until the operator is satisfied that the instrument remains true to the initial calibration and the end-of-day calibration checks confirm the instrument can maintain calibration throughout the day. All calibration activities will be documented.

8.3 Field Health and Safety Procedures

Field operations will be conducted in accordance with 24915-00-2HY-H03-00012, *Accident Prevention Plan*, and supporting plans and procedures. The sampling team will exercise the authority to stop work due to health or safety concerns. In the event of a stop work or safety incident, the Field Sampling Team Leader (FSTL) will contact safety personnel and provide a complete summary of the event. Personnel will support subsequent safety reviews as required.

Mobilization will include installation of barricades, including caution tape, traffic cones, traffic stands, and signs as required surrounding the well sampling location to ensure the safety of sampling personnel from surrounding traffic and ensure the sampling team can maintain control of the sampling area.

8.4 Decontamination Procedures

After obtaining each sample, repair activities, and/or before equipment re-use, non-dedicated sampling tools will be decontaminated using a non-phosphate detergent (e.g., Alconox®) followed by a distilled water rinse. Liquids from the decontamination process will be collected during the fieldwork in appropriate containers provided by Waste Management and disposed per Section 8.5. Effective decontamination will be verified through collection of equipment rinsate blanks daily during sampling (see Section 11.0). Decontamination activities will be documented.

8.5 Investigative Derived Waste

The primary liquid wastes/residuals from sampling are anticipated to include purge water, used calibration standards, and decontamination water. Solid wastes will include disposable sampling equipment, disposable gloves, and plastic sheeting or bags. Wastes will be accumulated on site in appropriate containers and properly labeled. Consistent with 24915-OPS-5PR-00-00023, *Hazardous Waste Management and Hazardous Material Reporting Procedure*, the FSTL, as the waste generator, is responsible for proper management of waste generated until the waste is turned over to Waste Management for proper storage and disposal.

Prior to sampling, the FSTL will contact Waste Management personnel to obtain appropriate waste collection containers and to define appropriate labeling and turn-in procedures for each waste stream. Prior to use, the FSTL will visually inspect containers (including lids) to ensure containers have maintained their integrity and will discard any containers that are considered unacceptable. The FSTL will mix the liquid waste streams (i.e., purge water, used calibration standards, and decontamination water) to minimize container usage. This activity will not be considered dilution.

The FSTL is responsible for providing Waste Management with the analytical results of groundwater sampling, which will provide Waste Management the data to characterize the IDW for proper disposal.

Unexpected waste streams will be handled on a case-by-case basis.

8.6 Field Documentation

This section discusses field documentation but excludes sample documentation which is discussed in Section 10.0. Field documentation will include a field log (Section 8.6.1), well development and purge logs (Section 8.6.2), and field equipment calibration logs (Section 8.6.3). Appendix A provides example forms that may be used for sampling. Field documentation will be completed using waterproof ink. If an error is made on a field document, a correction will be made by drawing a single line through the error and entering the correct information. Corrections will be initialed and dated. Should a field document become damaged, lost, or destroyed, the disposition of the document must be recorded in the project files. Field documents that are voided will not be discarded; they will be maintained in the project files for accountability.

8.6.1 Field Log

A field log will be used to record the activities of the sampling team to be able to reconstruct any given sampling event later and to record field observations and quantitative information associated with each physical sample taken. The sampling team may choose to use a bound field logbook and/or a field log worksheet (see example in Appendix A) for documentation.

The field log contains a record of the sampling team's activities. Specifically, the field log will contain, on each page, the names of the team members present, the signature(s) of the sampling team member(s) recording the activities, and the date. The log will contain a chronological narrative of the sampling team's activities throughout the day, including times and locations of events noted. Descriptions of any general problems encountered will be recorded along with the names of site personnel contacted for permits, logistical support, security, and technical or other information. The general meteorological conditions at the site will be recorded throughout the day with at least a qualitative description of the wind speed (e.g., calm, steady, gusty) and precipitation.

The field log will provide specific information about each physical sample taken. For each sample, the field log shall provide relevant field observations, including problems encountered in collecting the sample, or any evidence of contamination of the sample as well as a description of any deviations from established sampling procedures.

8.6.2 Well Development and Purge Logs

Well development and purge logs (see example in Appendix A) will be used to document the equipment, well parameters, and water-quality indicator parameter results during the pre-sampling purge time. These documents will provide confirmation of proper well purge and/or provide support for collection of samples in accordance with the decision diagram provided in Figure 2.

8.6.3 Calibration Field Log

A field calibration log (see example in Appendix A) will be used to document daily calibration of field equipment used for analysis of water-quality indicator parameters. The log will identify the equipment and the standards used for calibration.

9.0 ANALYTICAL TASKS

Industrial clean closure will be supported by analysis of COPCs identified in Table 4 by analyte class. Analyses will be performed using validated methods for each constituent. For common environmental contaminants, standard methods defined in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (U.S. EPA SW-846, Third Edition, and its first, second, third, and fourth updates) will be used. For the agents and agent degradation products, validated methods developed by Battelle laboratories will be used. Table 5 defines the analytical methods to be used for each analyte class. For additional information on each method and instrument performance verification requirements, refer to Section 9.0 of 24915-GEN-5PL-00-00014, *Main Plant Closure Verification Sampling and Analysis Quality Assurance Project Plan*.

10.0 SAMPLE HANDLING AND CUSTODY

Refer to Section 10 of 24915-GEN-5PL-00-00014, *Main Plant Closure Verification Sampling and Analysis Quality Assurance Project Plan* for information on sample numbering, samples labels, chain of custody, and sample packaging and shipping requirements.

Table 6 presents sample container, holding time, and preservation requirements for the listed analytical parameters based on U.S. EPA SW-846 requirements for soil and water, respectively. New, pre-cleaned sample containers supplied by the laboratory will be used. Where required, preservatives will be pre-added to containers by the laboratory. Certifications received with containers will be maintained in the project record.

11.0 QUALITY CONTROL REQUIREMENTS

As further discussed in Section 11 of 24915-GEN-5PL-00-00014, *Main Plant Closure Verification Sampling and Analysis Quality Assurance Project Plan*, Field QC is accomplished using field QC samples and field measurements checks. Four types of field QC samples will be used as part of groundwater sampling: trip blanks (VOCs only), field duplicates, field blanks, and equipment blanks. Analytical results for these samples will become the quantitative focus of the field activities. Refer to Section 11.1 of 24915-GEN-5PL-00-00014, *Main Plant Closure Verification Sampling and Analysis Quality Assurance Project Plan*, for detailed descriptions of each type of quality sample. The following samples will be collected during groundwater sampling:

- One field blank will be collected for each source water used for sampling. Because sampling is expected to be conducted during a single mobilization event, it is anticipated, only one field blank will be collected during groundwater sampling.
- An equipment blank will be collected daily during groundwater sampling.
- A trip blank will be collected daily during groundwater sampling.
- One field duplicate will be collected during groundwater sampling.
- Sufficient volume to support matrix spike and matrix spike duplicate analysis will be collected from one well during sampling.

Table 7 provides a summary of quality sample collection for groundwater sampling.

Measurement performance criteria for laboratory and quality samples during groundwater sampling are provided in Table 8, Table 9, and Table 10.

Refer to Sections 11.2, 11.3, and 11.4 of 24915-GEN-5PL-00-00014, *Main Plant Closure Verification Sampling and Analysis Quality Assurance Project Plan* for additional information about quality surveillances to be performed during groundwater sampling, corrective actions and assessments that may be required during groundwater sampling, as well as requirements for procurement of items and services during groundwater sampling.

12.0 DATA MANAGEMENT

Refer to Section 12.0 of 24915-GEN-5PL-00-00014, *Main Plant Closure Verification Sampling and Analysis Quality Assurance Project Plan.*

13.0 DATA REDUCTION, VERIFICATION, AND VALIDATION

Refer to Section 13.0 of 24915-GEN-5PL-00-00014, *Main Plant Closure Verification Sampling and Analysis Quality Assurance Project Plan.*

14.0 DOCUMENTATION AND RECORDS

This section describes the process for ensuring project personnel have the most current approved version of documents relevant to groundwater sampling (Section 14.1) and discusses the records to be generated by this sampling effort (Section 14.2) and reporting requirements (Sections 14.3 and 14.4).

14.1 Document Control

The principal documents used by the sampling and analysis team include:

- 24915-GEN-5PL-00-00018, Quality Assurance Project Plan for Closure Verification Groundwater Sampling
- 24915-GEN-5PL-00-00014, Main Plant Closure Verification Sampling and Analysis Quality Assurance Project Plan
- 24915-00-3PS-HXYG-0002, Engineering Specification for Collection and Analysis of Groundwater Samples
- U.S. EPA's Standard Operating Procedure for Low-Stress (Low-Flow) / Minimal Drawdown Ground-Water Sample Collection
- Activity Hazard Analysis (AHA) or Job Safety Analysis (JSA) performed in support of groundwater sampling
- 24915-H95-V15-HAZW-00029, Shield Well Installation Logs
- 24915-SK-CE-00068, Location of Spring Inventory Area

It is the responsibility of the FSTL to ensure that sampling team members have the current version of these documents prior to execution of work. Sampling team members will verify they have read and understood these documents prior to the generating data or conducting work on the study. Internal processes/procedures will be used to ensure revisions are reviewed by sampling team members. Document control of these documents is maintained in accordance with 24915-00-2KP-A03-50000, *Development, Review, and Control of Documents*.

Deviations required either prior to, during, or following sampling will be documented using 24915-TEMPLATE-01519, *CVQAPP Change/Deviation Form* and must be approved by the Closure Manager. The Closure Manager will submit deviations to the Environmental Manager for submission to KDEP for information at the time of generation and project approval. If the deviation includes the following, the deviation will be submitted as a Class 1 modification requiring approval prior to implementation:

- Changes to analytes
- Change of project action level
- Analytical capabilities do not support quantification at the project action level

The FSTL will be responsible for maintaining approved deviations with the CVQAPP for project personnel review and for including deviations within the final report (Section 14.4)

14.2 Records

The following records will be generated as part of this sampling effort:

- CVQAPP Deviation Forms (24915-TEMPLATE-01519, *CVQAPP Change/Deviation Form*)
- Field Logs
- Well Development and Purge Logs
- Field Calibration Logs
- Chain of Custody Forms (e.g., 24915-TEMPLATE-01191, *Chain of Custody Record*)
- Sample Analysis Data Packages
- Corrective Action Reports
- Data verification and validation summaries
- Final Reports

Field records will be maintained in accordance with Section 14.0 of 24915-GEN-5PL-00-00014, *Main Plant Closure Verification Sampling and Analysis Quality Assurance Project Plan*. Field records and laboratory data will be maintained in a secure site repository (R-drive) accessible by project personnel until they are incorporated into the final report that will be uploaded into the site document repository for retention in accordance with 24915-000-2KP-A03-00012, *Records Retention and Turnover*. Original hardcopies of field logs will be maintained in a secure site location (e.g., Laboratory Quality Control Trailer or Environmental Department) until final report approval, at which point they will be turned over for retention in accordance with 24915-000-2KP-A03-00012, *Records Retention and Turnover.*

14.3 Reports to Management

The FSTL will provide the Closure Manager (or designee) with task status updates weekly prior to and following execution of groundwater sampling and daily during execution of sampling. Status updates will be provided electronically. The Closure Manager will use these status updates to notify project management and ensure stakeholders are maintained aware of any significant items impacting execution. The Environmental Manager (or designee) will conduct all interface with regulatory agencies.

An evaluation of the analysis results for every batch of samples will be conducted by the project team as soon as the data are available. This assessment will be transmitted to the Closure and Environmental Manager and will include results of the sample analyses and quality of the data. The report will also include any recommendations for additional sample collection and a discussion of any problems noted during the assessment of the batch of samples.

14.4 Closure Verification Sampling Report

A CVS Report will be prepared for groundwater sampling and submitted to ACWA and KDEP following project approval. The report will evaluate the results with respect to the project action levels and will contain:

- A summary of sampling and analytical methods used and any deviations from referenced methods

- Analyses results for field samples and QC samples
- A compilation and evaluation of analytical and QA/QC data, with a summary of problems encountered and the solutions implemented. The report will include complete data packages and a QA/QC evaluation which will include the following: 1) estimates of data precision, accuracy, and completeness, 2) reports of performance and system audits, 3) any quality problems found, and 4) any corrective actions taken

Upon acceptance, the final report is submitted for retention in the site project document control center in accordance with project specific procedures.

15.0 REFERENCES

- 24915-000-2KP-A03-00012, *Records Retention and Turnover*
- 24915-000-GRR-GGEN-00003, *First Quarter Background Groundwater Interim Report*
- 24915-000-GRR-GGEN-00007, Background Soil and Water Investigation Report
- 24915-00-2HY-H03-00012, Accident Prevention Plan
- 24915-00-2KP-A03-50000, *Development, Review, and Control of Documents*
- 24915-00-30R-G01-00037, Review of Existing Site Information and Geotechnical Recommendations for Project Design
- 24915-00-3PS-HXYG-0002, Engineering Specification for Collection and Analysis of Groundwater Samples
- 24915-GEN-5PL-00-00014, Closure Verification Sampling and Analysis Quality Assurance Project Plan (CVQAPP)
- 24915-H95-V15-HAZW-00029, Shield Well Installation Logs
- 24915-OPS-5PR-00-00023, Hazardous Waste Management and Hazardous Material Reporting Procedure
- 24915-SK-CE-00068, Location of Spring Inventory Area
- 24915-TEMPLATE-01191, Chain of Custody Record
- 24915-TEMPLATE-01519, CVQAPP Change/Deviation Form
- Kentucky Administrative Record Title 401, Chapter 047, Regulation 030, Environmental Performance Standards, https://apps.legislature.ky.gov/law/kar/titles/401/047/030/
- US Army Center for Health Promotion and Preventive Medicine, March 1999, *Derivation of Health-Based Environmental Screening Levels for Chemical Warfare Agents.*
- US Army Public Health Command, July 2011, *Chemical Agent Health-Based Standards and Guidelines Summary*, *Table 2: Criteria for Water, Soil, Waste as of July 2011*
- U.S. EPA, February 2006, *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4
- U.S. EPA, November 2021, *Regional Screening Level (RSL) Generic Tables, https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables*

- US EPA, *Standard Operating Procedure Low-Stress (Low Flow) / Minimal Drawdown Ground-Water Sample Collection*, https://www.epa.gov/quality/standard-operating-procedure-low-stress-low-flow-minimal-drawdown-ground-water-sample
- U.S. EPA Region 1. January 19, 2010. *Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells*. Revision 3. EQASOP-GW 001
- U.S. EPA, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (SW-846), The SW-846 Compendium | US EPA.

Table 1 – Background groundwater sampling detections

Analyte	Carbon Disulfide, ug/L	Chloroform, ug/L	Chloromethane, ug/L	Trichloroethylene, ug/L	bis(2-ethylhexyl) phthalate, ug/L	2,4,6-trinitrotoluene ug/L	HMX, ug/L	RDX, ug/L	Arsenic, ug/L	Barium, ug/L	Chromium, ug/L	Lead, ug/L
Q1 MW-17	--	--	--	0.68 B[u]	No Sample							
Q2 MW-17	--	--	0.61 U[b]	--	--	--	--	--	--	80 J,D	--	4.5 J,D
Q3 MW-17	--	--	--	--	--	0.67	--	--	--	54 D	--	
Q4 MW-17	--	--	--	--	--	--	14	9.7	--	44 J,D	11 U[b]	2.4 U[b]
Q1 MW-18	0.7 J[a]	--	--	--	--	--	--	--	--	140	--	7.1 J
Q2 MW-18	--	--	0.65 U[b]	--	--	--	--	--	--	120	--	8.3 J
Q3 MW-18	--	--	--	--	--	--	--	--	--	60 D	--	0.5 J,D
Q4 MW-18	--	--	--	--	--	--	--	--	--	39 J,D,Q	12 U[b]	7.8 U[b]
Q1 MW-19	--	--	--	--	--	--	--	--	--	80 J,D	--	--
Q2 MW-19	--	--	--	--	--	--	--	--	2.1 U[b]	91	--	5.6 U[b]
Q3 MW-19	--	--	--	--	--	--	--	--	--	75 D	--	--
Q4 MW-19	--	--	--	--	--	--	--	--	--	79 J,D	7.2 U[b]	3.6 U[b]
Q1 MW-20	--	--	--	0.85 U[b]	--	--	--	--	--	88	--	2.8 U[b]
Q2 MW-20	--	--	--	--	--	--	--	--	--	87	--	3.4 U[b]
Q3 MW-20	--	--	--	--	--	--	--	--	--	110 D	--	--
Q4 MW-20	--	--	--	--	--	--	--	--	--	90	--	--
Q1 MW-21	--	--	--	0.49 U[b]	--	--	--	--	2.1 U[b]	40 J	--	6.3 U[b]
Q2 MW-21	--	--	--	--	--	--	--	--	--	37 J	--	--
Q3 MW-21	--	--	--	--	--	--	--	--	--	46 D	--	--
Q4 MW-21	--	--	--	--	--	--	--	--	--	39 J	--	0.7 J
Q1 MW-22	--	1.8 J	--	0.52 U[b]	--	--	--	--	--	62	--	6.8 U[b]
Q2 MW-22	--	--	--	--	2.7 U[b]	--	--	--	--	87	--	7.9 J
Q3 MW-22	--	--	--	--	--	--	--	--	--	91 D	--	--
Q4 MW-22	--	--	--	--	--	--	--	--	--	65 J,D,Q	14 U[b]	1.6 U[b]

Source: 24915-000-GRR-GGEN-00007, *Background Soil and Groundwater Report*

D = The reported value is from a dilution; J = The result is an estimated value; Q1 = First quarter sampling event (July 2015), Q2 = Second quarter sampling event (November 2015), Q3 = Third quarter sampling event (February and March 2016), Q4 = Fourth quarter sampling event (April 2016); U = the analyte is not detected at the concentration shown

Note: For the First and Second quarter, samples were analyzed for dissolved metals using Method 6010C. Third quarter metals analysis was performed using Method 6020A.

[a] Result qualified as an estimate based on quality control criteria outside control limits.

[b] Result qualified as non-detect at the concentration detected in the sample based on detection in the method blank or rinsate blank.

Table 2 – Summary of Groundwater CVS Data Quality Objectives

State the Problem	Identify the Goals of the Study	Identify Information Inputs	Define the Boundaries of the Study	Develop the Analytical Approach	Specific Performance or Acceptance Criteria	Develop the Plan for Obtaining Data
Primary Problem: Provide confirmation that operations, decontamination of the BGCAPP facilities, and demolition of Main Plant facilities has not resulted in release of contaminants to underlying groundwater. *Planning Team:* See 24915-GEN-5PL-00-00014, Section 4.1 *Conceptual Model:* 24915-GEN-5PL-00-00014, Section 5.0	*Principal Study Question:* Does the concentration of contaminants in groundwater exceed acceptable levels? *Alternative Actions:* - Take no action - Perform additional soil and groundwater sampling to define extent of contamination. *Decision Statement:* Determine if concentrations of contaminants in groundwater exceed acceptable levels or if site can be turned over for industrial use.	Acceptable levels are maximum contaminant levels (MCL), regional screening levels (RSL) for tap water, or background concentrations. Operational history and site hydrogeology define COPCs and pertinent sampling locations. Standard methods for sampling analysis	The study area is the BGCAPP footprint (see Figure 1 and Table 3) with six (6) wells within site drainage (MW-17, MW-18, MW-19, MW-20, MW-21 and MW-22). Samples collected per U.S. EPA's *Standard Operating Procedure, Low-Stress (Low Flow) / Minimal Drawdown Ground-Water Sample Collection* Total volume per sample is 5.37 L Single sampling event (< 14 days)	*Action Level:* MFWS, MCL, tap water RSL, or background *Theoretical Decision Rule:* *If* groundwater sample collected from monitoring wells (MW-17 through MW-22) is below the action level, *then* take no further action, *else* establish groundwater investigation program.	False acceptance decision will result in unnecessary sampling and clean-up activities. False rejection decision could result in residual contamination with potential impacts to human health and environment. The sampling design (Section 8.0) procedures ensure representative sampling and assessment of potential site impacts.	See Section 8.0

Figure 1 – Location of Closure Verification Groundwater Wells relative to site drainage.

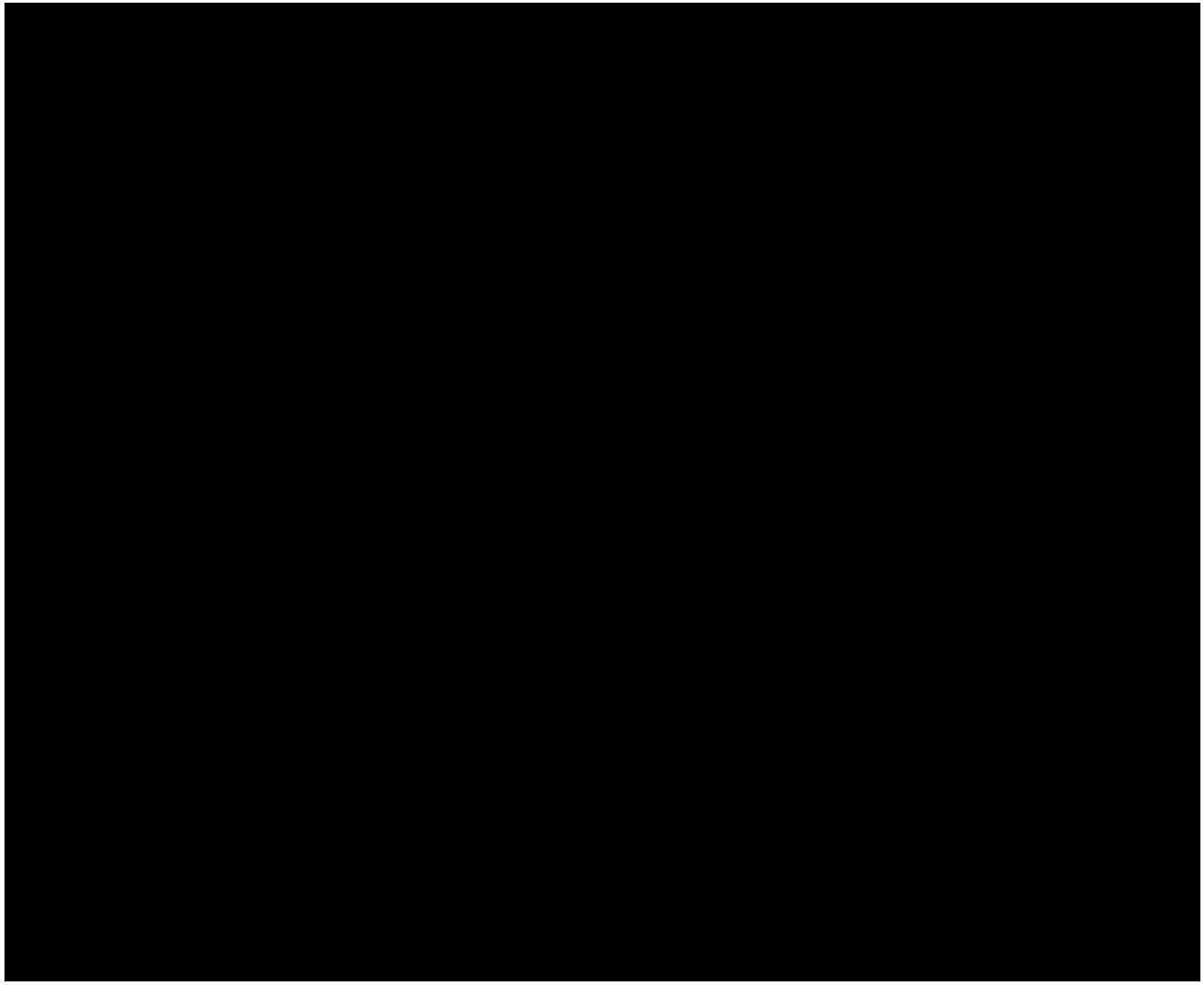


Table 3 – CVS Monitoring Wells

Well ID	Northing[a]	Easting[a]	Elevation[b]	Top of casing, ft bgs	Top of Screen, ft bgs	Top of Bedrock, ft bgs	Bottom of Screen, ft bgs	Bottom of well, ft bgs	Description
[redacted]									
[redacted]									
[redacted]									
[redacted]									
[redacted]									
[redacted]									

[redacted]

Table 4 – Chemicals of Potential Concern

Chemicals of Potential Concern	CAS No.	Tap Water Carcinogenic RSL, ug/L	Tap Water Non-carcinogenic RSL, ug/L	MCL, ug/L	401 KAR 47:030 Max Groundwater Concentration, ug/L	Project Action Limit, ug/L	Source
Agents							
Propan-2-yl methylphosphonofluoridate (GB)	107-44-8	NA	NA	NA	NA	4.00E+00	MFWS
S-(2-[Di(propan-2-yl) amino]ethyl) O-ethyl methylphosphonothioate (VX)	50782-69-9	NA	NA	NA	NA	4.00E+00	MFWS
Agent Degradation Products							
S-(2-diisopropylaminoethyl) methyl phosphonothioate (EA2192)	73207-98-4	NA	NA	NA	NA	4.00E+00	VX MFWS[a]
ethyl methylphosphonic acid (EMPA)	1832-53-7	NA	NA	NA	NA	2.00E+02	IMPA RSL[b]
isopropyl methylphosphonic acid (IMPA)	1832-54-8	NA	2.00E+02	NA	NA	2.00E+02	RSL
methylphosphonic acid (MPA)	993-13-5	NA	1.20E+02	NA	NA	1.20E+02	RSL
diisopropyl methylphosphonate (DIMP)	1445-75-6	NA	1.60E+02	NA	NA	1.60E+02	RSL
Thiodiglycol (TDG)	111-48-8	NA	1.40E+02	NA	NA	1.40E+02	RSL
Metals							
arsenic	7440-38-2	5.20E-02	6.00E-01	1.00E+01	5.00E+01	1.00E+01	MCL
barium	7440-39-3	NA	3.80E+02	2.00E+03	2.00E+03	2.00E+03	MCL
cadmium	7440-43-9	NA	1.80E-01	5.00E+00	5.00E+00	5.00E+00	MCL
chromium	7440-47-3	NA	2.20E+03	1.00E+02	1.00E+02	1.00E+02	MCL
lead	7439-92-1	NA	1.50E+01	1.50E+01	5.00E+01	1.50E+01	MCL
mercury	7439-97-6	NA	6.30E-02	2.00E+00	2.00E+00	2.00E+00	MCL
selenium	7782-49-2	NA	1.00E+01	5.00E+01	5.00E+01	5.00E+01	MCL
silver	7440-22-4	NA	9.40E+00	NA	5.00E+01	9.40E+00	RSL
Volatile Organic Compounds							
1,1-dichloroethylene	75-35-4	NA	2.80E+01	7.00E+00	7.00E+00	7.00E+00	MCL
1,2-dichloroethane	107-06-2	1.70E-01	1.30E+00	5.00E+00	5.00E+00	5.00E+00	MCL
2-butanone	78-93-3	NA	5.60E+02	NA	NA	5.60E+02	RSL
2-propanone (acetone)	67-64-1	NA	1.80E+03	NA	NA	1.80E+03	RSL

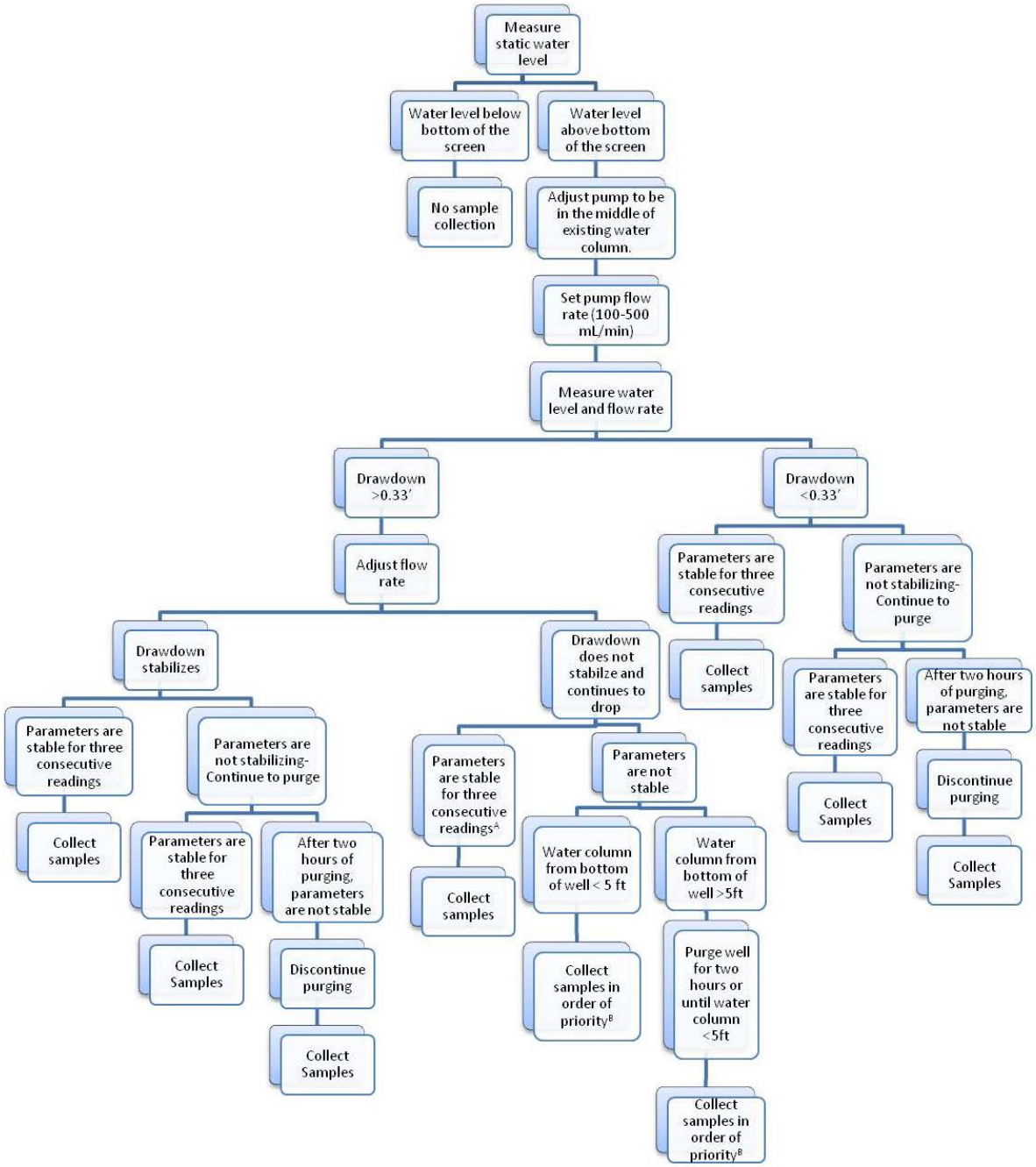
Chemicals of Potential Concern	CAS No.	Tap Water Carcinogenic RSL, ug/L	Tap Water Non-carcinogenic RSL, ug/L	MCL, ug/L	401 KAR 47:030 Max Groundwater Concentration, ug/L	Project Action Limit, ug/L	Source
acetonitrile	75-05-8	NA	1.30E+01	NA	NA	1.30E+01	RSL
benzene	71-43-2	4.60E-01	3.30E+00	5.00E+00	5.00E+00	5.00E+00	MCL
carbon disulfide	75-15-0	NA	8.10E+01	NA	NA	8.10E+01	RSL
carbon tetrachloride	56-23-5	4.60E-01	4.90E+00	5.00E+00	5.00E+00	5.00E+00	MCL
chloroform	67-66-3	2.20E-01	9.70E+00	8.00E+01	NA	8.00E+01	MCL
ethylbenzene	100-41-4	1.50E+00	5.00E+01	7.00E+02	NA	7.00E+02	MCL
Methane, dichloro- (methylene chloride)	75-09-2	1.10E+01	1.10E+01	5.00E+00	NA	5.00E+00	MCL
methyl isobutyl ketone	108-10-1	NA	6.30E+02	NA	NA	6.30E+02	RSL
tetrachloroethylene	127-18-4	1.10E+01	4.10E+00	5.00E+00	NA	5.00E+00	MCL
tetrahydrofuran	109-99-9	NA	3.40E+02	NA	NA	3.40E+02	RSL
toluene	108-88-3	NA	1.10E+02	1.00E+03	NA	1.00E+03	MCL
Total xylenes	1330-20-7T	NA	1.90E+01	1.00E+04	NA	1.00E+04	MCL
trichloroethylene	79-01-6	4.90E-01	2.80E-01	5.00E+00	5.00E+00	5.00E+00	MCL
Semi-Volatile Organic Compounds							
1,2-dichlorobenzene	95-50-1	NA	3.00E+01	6.00E+02	NA	6.00E+02	MCL
1,4-dichlorobenzene	106-46-7	4.80E-01	5.70E+01	7.50E+01	7.50E+01	7.50E+01	MCL
2-methylphenol	95-48-7	NA	9.30E+01	NA	NA	9.30E+01	RSL
2,4-dinitrotoluene	121-14-2	2.40E-01	3.80E+00	NA	NA	3.80E+00	RSL-non-carcinogenic
3&4 methylphenol	1319-77-3	NA	1.50E+02	NA	NA	1.50E+02	RSL
pentachlorophenol	87-86-5	4.10E-02	2.30E+00	1.00E+00	NA	1.00E+00	MCL
phenol	108-95-2	NA	5.80E+02	NA	NA	5.80E+02	RSL
pyridine	110-86-1	NA	2.00E+00	NA	NA	2.00E+00	RSL
Polychlorinated Biphenyls							
PCB-1254	11097-69-1	7.80E-03	4.00E-02	NA	NA	4.00E-02	RSL-non-carcinogenic
Explosives							
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	9.70E-01	8.00E+00	NA	NA	9.70E-01	RSL-carcinogenic

Chemicals of Potential Concern	CAS No.	Tap Water Carcinogenic RSL, ug/L	Tap Water Non-carcinogenic RSL, ug/L	MCL, ug/L	401 KAR 47:030 Max Groundwater Concentration, ug/L	Project Action Limit, ug/L	Source
nitroglycerin	55-63-0	4.50E+00	2.00E-01	NA	NA	4.50E+00	RSL-non-carcinogenic
Trinitrotoluene, 2,4,6	118-96-7	2.50E+00	9.80E-01	NA	NA	2.50E+00	RSL-non-carcinogenic
Tetryl (trinitrophenylmethylnitramine)	479-45-8	NA	3.90E+00	NA	NA	3.90E+00	RSL

MCL = Maximum Contaminant Level; MFWS = Military Field Water Standards; NA – Not available; the corresponding value is not established;
RSL = Regional Screening Level; ug/L = micrograms per liter
References:
1. US Army PHC Notice 0711-03, Chemical Agent Health-Based Standards and Guidelines Summary, Table 2: Criteria for Water, Soil, Waste as of July 2011.
2. US EPA Regional Screening Level (RSL) Resident Tapwater Table (TR=1E-06, HQ=0.1), November 2023

[a] An RSL for EA2192 has not been established. In accordance with army guidance the MFWS for VX is applied as the action level for EA2192.
[b] An RSL for EMPA has not been established. Based on compound similarities, the RSL for IMPA is applied as the action level for EMPA.

Figure 2 – BGCAPP Groundwater Sampling Decision Tree.



B. Site specific occurrence where sample collection is required. Derived from the volume of a cylinder ($\pi r^2 h$) where the diameter of well is 4inches, resulting in 150.72 in^3 per foot of water column or 2.469 L/ft. Since approximately 12 L of water is required for each sample, a minimum water column of 4.87 ft is required for sampling

*Flow chart flows U.S. EPA's Low Stress (Low Flow) Purging and Sampling Procedure for the collection of Groundwater Samples from Monitoring Wells (2010), unless otherwise noted.

Source: 24915-000-GRR-GGEN-00003, *First Quarter Background Groundwater Interim Report*

Table 5 – Analytical Methods

Compounds	Analytical Method
Agents	Battelle SOP
Agent Degradation Products	Battelle SOP
Volatile Organics	EPA SW-846 8260
Semivolatile organics	EPA SW-846 8270
Polychlorinated biphenyls	EPA SW-846 8082
Explosives	EPA SW-846 8330
Metals	EPA SW-846 6010/7470/7471

Table 6 – Groundwater Sample Containers, Hold Times, and Preservation Methods

Analyte Type	Method	Sample Container	Preservation	Holding Time
Agent and ADP	Battelle SOPs	1 x 1-L amber glass	Cool to 6°C	7 days
VOCs	Method 8260	3 x 40mL vials	Cool to 6°C; pH < 2 with HCl	7 Days
SVOCs	Method 8270	1 x 1-L amber glass*	Cool to 6°C	7 days until extraction/analyzed within 40 days after extraction
Metals	Method 6010C/7470A	1 x 250-mL HDPE	Cool to 6°C; pH < 2 with HNO_3	6 months except mercury which is 28 days
PCBs	Method 8082	2 x 1-L amber glass	Cool to 6°C	30 days until extraction/analyzed within 45 days after extraction
Explosives	Method 8330A	1 x 1-L amber glass	Cool to 6°C	7 days until extraction/analyzed within 40 days after extraction

* Sample containers shown are standard commercial practice. Specific laboratories selected to complete analyses may be able to perform analyses using smaller sample volumes.

Table 7 – Field QC Summary (Worksheet #20)

Sample Location	Analyte Group	Matrix	Field Samples	Field Duplicates	Matrix Spikes	Field Blanks	Equipment Blanks	Trip Blanks	Total
MW-17	Agent and ADP	Aqueous	1	0	0	0	1	0	2
	VOC	Aqueous	1	0	0	0	1	1	3
	SVOC	Aqueous	1	0	0	0	1	0	2
	PCB	Aqueous	1	0	0	0	1	0	2
	Explosives	Aqueous	1	0	0	0	1	0	2
	Metals	Aqueous	1	0	0	0	1	0	2
MW-18	Agent and ADP	Aqueous	1	0	0	1	1	0	3
	VOC	Aqueous	1	0	0	1	1	1	4
	SVOC	Aqueous	1	0	0	1	1	0	3
	PCB	Aqueous	1	0	0	1	1	0	3
	Explosives	Aqueous	1	0	0	1	1	0	3
	Metals	Aqueous	1	0	0	1	1	0	3
MW-19	Agent and ADP	Aqueous	1	0	0	0	1	0	2
	VOC	Aqueous	1	0	0	0	1	1	3
	SVOC	Aqueous	1	0	0	0	1	0	2
	PCB	Aqueous	1	0	0	0	1	0	2
	Explosives	Aqueous	1	0	0	0	1	0	2
	Metals	Aqueous	1	0	0	0	1	0	2
MW-20	Agent and ADP	Aqueous	1	1	2	0	1	0	5
	VOC	Aqueous	1	1	2	0	1	1	6
	SVOC	Aqueous	1	1	2	0	1	0	5
	PCB	Aqueous	1	1	2	0	1	0	5
	Explosives	Aqueous	1	1	2	0	1	0	5
	Metals	Aqueous	1	1	2	0	1	0	5

Sample Location	Analyte Group	Matrix	Field Samples	Field Duplicates	Matrix Spikes	Field Blanks	Equipment Blanks	Trip Blanks	Total
MW-21	Agent and ADP	Aqueous	1	0	0	0	1	0	6
	VOC	Aqueous	1	0	0	0	1	1	7
	SVOC	Aqueous	1	0	0	0	1	0	6
	PCB	Aqueous	1	0	0	0	1	0	6
	Explosives	Aqueous	1	0	0	0	1	0	6
	Metals	Aqueous	1	0	0	0	1	0	2
MW-22	Agent and ADP	Aqueous	1	0	0	0	0	0	1
	VOC	Aqueous	1	0	0	0	0	0	1
	SVOC	Aqueous	1	0	0	0	0	0	1
	PCB	Aqueous	1	0	0	0	0	0	1
	Explosives	Aqueous	1	0	0	0	0	0	1
	Metals	Aqueous	1	0	0	0	0	0	1

Note – MW-17 and MW-22 assumed to be sampled on the same day.

Table 8 – Measurement Performance Criteria (QAPP Worksheet #12)

Method	Data Quality Indicator	QC Sample/Measurement Activity	Measurement Performance Criteria
All	Overall Precision	Field Duplicates	RPD ≤ 50% when concentration is greater than lower limit of quantification (LLOQ)
Agents and ADP	Analytical Accuracy/Bias (Laboratory)	LCS	Analyte-Specific (see Table 9)
	Analytical Precision (Laboratory)	LCS Duplicates	RPD ≤ 35%
	Analytical Accuracy/Bias (Matrix interference)	Matrix Spike Recovery	Analyte-Specific (see Table 9)
	Analytical Precision (Matrix interference)	MS Duplicates	RPD ≤ 35%
	Sensitivity	LLOQ Verification Sample (spiked at LLOQ)	Analyte-Specific (see Table 10)
Metals	Analytical Accuracy/Bias (Laboratory)	LCS	Percent recovery of 80-120%
	Analytical Precision (Laboratory)	LCS Duplicates	RPD ≤ 20%
	Analytical Accuracy/Bias (Matrix interference)	Matrix Spike Recovery	Percent recovery of 80-120%
	Analytical Precision (Matrix interference)	MS Duplicates	RPD ≤ 20%
	Sensitivity	LLOQ Verification Sample (spiked at LLOQ)	± 25% of LLOQ (see Table 10)
VOC	Analytical Accuracy/Bias (Laboratory)	LCS	Analyte-Specific (see Table 9)
	Analytical Precision (Laboratory)	LCS Duplicates	RPD ≤ 30%
	Analytical Accuracy/Bias (Matrix interference)	Matrix Spike Recovery	Analyte-Specific (see Table 9)
	Analytical Precision (Matrix interference)	MS Duplicates	RPD ≤ 30%
	Sensitivity	LLOQ Verification Sample (spiked at LLOQ)	Analyte-Specific (see Table 10)
SVOC	Analytical Accuracy/Bias (Laboratory)	LCS	Analyte-Specific (see Table 9)
	Analytical Precision (Laboratory)	LCS Duplicates	RPD ≤ 30%
	Analytical Accuracy/Bias (Matrix interference)	Matrix Spike Recovery	Analyte-Specific (see Table 9)
	Analytical Precision (Matrix interference)	MS Duplicates	RPD ≤ 30%
	Sensitivity	LLOQ Verification Sample (spiked at LLOQ)	Analyte-Specific (see Table 10)
PCBs	Analytical Accuracy/Bias (Laboratory)	LCS	Analyte-Specific (see Table 9)
	Analytical Precision (Laboratory)	LCS Duplicates	RPD ≤ 30%
	Analytical Accuracy/Bias (Matrix interference)	Matrix Spike Recovery	Analyte-Specific (see Table 9)
	Analytical Precision (Matrix interference)	MS Duplicates	RPD ≤ 30%
	Sensitivity	LLOQ Verification Sample (spiked at LLOQ)	Analyte-Specific (see Table 10)

Method	Data Quality Indicator	QC Sample/Measurement Activity	Measurement Performance Criteria
Explosives	Analytical Accuracy/Bias (Laboratory)	LCS	Analyte-Specific (see Table 9)
	Analytical Precision (Laboratory)	LCS Duplicates	RPD ≤ 30%
	Analytical Accuracy/Bias (Matrix interference)	Matrix Spike Recovery	Analyte-Specific (see Table 9)
	Analytical Precision (Matrix interference)	MS Duplicates	RPD ≤ 30%
	Sensitivity	LLOQ Verification Sample (spiked at LLOQ)	Analyte-Specific (see Table 10)

Table 9 – Analyte-Specific Measurement Performance Criteria

Chemicals of Potential Concern	CAS No.	LCS Recovery, %	MS Recovery, %	LLOQ Sample, %
Agents				
Propan-2-yl methylphosphonofluoridate (GB)	107-44-8	50-200	50-200	TBD
S-(2-[Di(propan-2-yl)amino]ethyl) O-ethyl methylphosphonothioate (VX)	50782-69-9	50-200	50-200	TBD
Agent Degradation Products				
S-(2-diisopropylaminoethyl) methyl phosphonothioate (EA2192)	73207-98-4	50-200	50-200	TBD
ethyl methylphosphonic acid (EMPA)	1832-53-7	50-200	50-200	TBD
isopropyl methylphosphonic acid (IMPA)	1832-54-8	50-200	50-200	TBD
methylphosphonic acid (MPA)	993-13-5	50-200	50-200	TBD
diisopropyl methylphosphonate (DIMP)	1445-75-6	50-150	50-150	TBD
thiodiglycol (TDG)	111-48-8	40-160	40-160	TBD
Volatile Organic Compounds				
1,1-dichloroethylene	75-35-4	70-130	70-130	TBD
1,2-dichloroethane	107-06-2	70-135	70-135	TBD
2-butanone	78-93-3	30-150	30-150	TBD
2-propanone (acetone)	67-64-1	40-140	40-140	TBD
benzene	71-43-2	75-125	75-125	TBD
carbon disulfide	75-15-0	45-160	35-160	TBD
carbon tetrachloride	56-23-5	65-135	65-140	TBD
chloroform	67-66-3	70-125	65-135	TBD
ethylbenzene	100-41-4	75-125	75-125	TBD
methane, dichloro- (methylene chloride)	75-09-2	55-140	55-140	TBD
methyl isobutyl ketone	108-10-1	60-135	60-135	TBD
tetrachloroethylene	127-18-4	65-140	45-150	TBD
toluene	108-88-3	70-125	75-120	TBD
Total xylenes	1330-20-7T	70-130	70-130	TBD
trichloroethylene	79-01-6	75-125	70-125	TBD
Semi-Volatile Organic Compounds				
1,2-dichlorobenzene	95-50-1	45-95	45-95	TBD
1,4-dichlorobenzene	106-46-7	45-95	45-95	TBD
2-methylphenol	95-48-7	40-105	40-105	TBD
2,4-dinitrotoluene	121-14-2	50-115	50-115	TBD
3&4 methylphenol	1319-77-3	40-105	40-105	TBD
pentachlorophenol	87-86-5	25-125	25-125	TBD
phenol	108-95-2	40-100	40-100	TBD
Polychlorinated Biphenyls				
PCB-1254	11097-69-1	40-140	40-140	TBD
Explosives				

Chemicals of Potential Concern	CAS No.	LCS Recovery, %	MS Recovery, %	LLOQ Sample, %
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	70-135	70-135	TBD
nitroglycerin	55-63-3	70-130	70-130	TBD
Trinitrotoluene, 2,4,6	118-96-7	55-140	55-140	TBD

* Requirements for acetonitrile, pyridine, tetryl, and tetrahydrofuran are to be determined (TBD). Lower Limits of Quantification Sample recovery limits will be defined in associated SOPs.

Table 10 – Project Action Limits and Laboratory-Specific Quantitation Limits for Groundwater (QAPP Worksheet#15)

Chemicals of Potential Concern	CAS No.	Project Action Limit, ug/L	Desired Project Quantitation Limit, ug/L	Achievable Laboratory Quantitation Limit, ug/L
Agents				
Propan-2-yl methylphosphonofluoridate (GB)	107-44-8	4.00E+00	**2.00E+00**	**4.00E+00**
S-(2-[Di(propan-2-yl)amino]ethyl) O-ethyl methylphosphonothioate (VX)	50782-69-9	4.00E+00	**2.00E+00**	**4.00E+00**
Agent Degradation Products				
S-(2-diisopropylaminoethyl) methyl phosphonothioate (EA2192)	73207-98-4	4.00E+00	**2.00E+00**	**4.00E+00**
ethyl methylphosphonic acid (EMPA)	1832-53-7	2.00E+02	2.00E+01[a]	5.00E-01
isopropyl methylphosphonic acid (IMPA)	1832-54-8	2.00E+02	2.00E+01	5.00E-01
methylphosphonic acid (MPA)	993-13-5	1.20E+02	1.20E+01	**2.50E-00**
diisopropyl methylphosphonate (DIMP)	1445-75-6	1.60E+02	1.60E+01	5.00E-01
Thiodiglycol (TDG)	111-48-8	1.40E+02	1.40E+01	2.00E+00
Metals				
arsenic	7440-38-2	1.00E+01	**1.00E+00**	**1.00E+01**
barium	7440-39-3	2.00E+03	2.00E+02	2.00E+00
cadmium	7440-43-9	5.00E+00	5.00E-01	5.00E-01
chromium	7440-47-3	1.00E+02	1.00E+01	1.00E+01
lead	7439-92-1	1.50E+01	**1.50E+00**	**3.00E+00**
mercury	7439-97-6	2.00E+00	2.00E-01	2.00E-01
selenium	7782-49-2	5.00E+01	5.00E+00	5.00E+00
silver	7440-22-4	9.40E+00	**9.40E-01**	**2.00E+00**
Volatile Organic Compounds				
1,1-dichloroethylene	75-35-4	7.00E+00	**7.00E-01**	**5.00E+00**
1,2-dichloroethane	107-06-2	5.00E+00	**5.00E-01**	**5.00E+00**
2-butanone	78-93-3	5.60E+02	5.60E+01	2.00E+01
2-propanone (acetone)	67-64-1	1.80E+03	**1.80E+02**	**2.00E+01**
acetonitrile	75-05-8	1.30E+01	1.30E+00	TBD
benzene	71-43-2	5.00E+00	**5.00E-01**	**5.00E+00**
carbon disulfide	75-15-0	8.10E+01	8.10E+00	5.00E+00
carbon tetrachloride	56-23-5	5.00E+00	**5.00E-01**	**5.00E+00**
chloroform	67-66-3	8.00E+01	8.00E+00	5.00E+00
ethylbenzene	100-41-4	7.00E+02	7.00E+01	5.00E+00
Methane, dichloro- (methylene chloride)	75-09-2	5.00E+00	**5.00E-01**	**7.50E+00**
methyl isobutyl ketone	108-10-1	6.30E+02	6.30E+01	2.00E+01
tetrachloroethylene	127-18-4	5.00E+00	**5.00E-01**	**5.00E+00**

Chemicals of Potential Concern	CAS No.	Project Action Limit, ug/L	Desired Project Quantitation Limit, ug/L	Achievable Laboratory Quantitation Limit, ug/L
tetrahydrofuran	109-99-9	3.40E+02	3.40E+01	TBD
toluene	108-88-3	1.00E+03	1.00E+02	5.00E+00
Total xylenes	1330-20-7T	1.00E+04	1.00E+03	1.00E+01
trichloroethylene	79-01-6	5.00E+00	**5.00E-01**	**5.00E+00**
Semi-Volatile Organic Compounds				
1,2-dichlorobenzene	95-50-1	6.00E+02	6.00E+01	9.90E+00
1,4-dichlorobenzene	106-46-7	7.50E+01	**7.50E+00**	**9.90E+00**
2-methylphenol	95-48-7	9.30E+01	**9.30E+00**	**9.90E+00**
2,4-dinitrotoluene	121-14-2	3.80E+00	**3.80E-01**	**9.90E+00**
3&4 methylphenol	1319-77-3	1.50E+02	**1.50E+01**	**9.90E+00**
pentachlorophenol	87-86-5	1.00E+00	**1.00E-01**	**5.00E+01**
phenol	108-95-2	5.80E+02	5.80E+01	1.50E+01
pyridine	110-86-1	2.00E+00	**2.00E-01**	**9.90E+00**
Polychlorinated Biphenyls				
PCB-1254	11097-69-1	4.00E-02	**4.00E-03**	**9.90E-01**
Explosives				
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	9.70E-01	**9.70E-02**	**1.00E+00**
nitroglycerin	55-63-3	4.50E+00	**4.50E-01**	**1.00E+00**
Trinitrotoluene, 2,4,6	118-96-7	2.50E+00	**2.50E-01**	**1.00E+00**
Tetryl (trinitrophenylmethylnitramine)	479-45-8	3.90E+00	**3.90E-01**	**1.00E+00**

TBD = to be determined; laboratory method performance to be verified prior to sampling
Note - Desired project quantitation limits incorporate a 2 to 10-fold dilution factor that may be required should matrix interferences be observed during sample analysis. Failure to meet desired project quantitation limits (identified in bold) does not indicate an inability for the method to be used for CVS as detection limits will be applied if quantitation fails. If, following analysis, it is determined detection and quantitation limits exceed the action level for a specific constituent, reanalysis and/or resampling with alternative analytical methodology (if available) may be considered. If all other COPCs are below the corresponding action levels, BGCAPP may provide justification to KDEP why industrial clean closure should be considered based on an overall evaluation of sampling and analysis, analytical capabilities, and generator knowledge.

Appendix A – Example Data Collection Forms

BATTELLE

CALIBRATION FIELD LOG

Project Name: _____ Sample Location: _____

Project No: _____ Date/Time: _____

Recorded By: _____

Sampling Team (Print Name):

_____

_____

_____

Equipment:

Equipment type: _____

Equipment ID No: _____

Analyte	Calibration Standard	Spike Amount	Acceptance Criteria	Measured Value	Recalibration Required (Y/N)	Post-Calibration Value
Turbidity						

Equipment type: _____

Equipment ID No: _____

Analyte	Calibration Standard	Spike Amount	Acceptance Criteria	Measured Value	Recalibration Required (Y/N)	Post-Calibration Value
Conductivity						
Turbidity						
ORP						
pH						
DO						
	Note the DO (mg/L) here after calibrating to 100%					

Comments: _____

_____

_____

_____

BATTELLE

Well Development / Purge Log

Location:	Well No:	Date:	Project No.:	Page ___ of ___

Equipment: Hach Turbidity Meter ☐ Horiba U52 ☐ S/N: _____ S/N: _____ FIP/Photo Vac ☐ ORION 290A ☐ Interface Probe ☐ OVA128 ☐ Horiba ORP ☐ Water Level ☐	**Personnel:** **Exposure Monitoring:** Background _____ppm Reading: _____ppm **Well Condition:** Good ☐ Fair ☐ Poor ☐
Total Well Depth: **Static Water Level:**	**Pump Type:** Peristaltic ☐ Submersible ☐ Hand ☐ Bladder ☐
Well Casing Diameter:	**Pump Rate:**
Borehole Diameter:	**Purge Start Time**
One Well Volume:	**Purge Stop Time:**
Three Well Volumes:	**Total Volume Purged:**
Criteria used to stop purging/development: Required volume: ☐ Parameters Stabilization ☐ Dry Well ☐	

Time	Water Depth (btoc)	Volume Recovered (unit ____)	pH (±__)	Conductivity (mS/cm)	Turbidity (NTU) (±____)	DO (mg/L) (±____)	Temp (°____) (±____)	Salinity (%)	ORP (mV) (±__)	Comments

Field Team Leader Signature:_____

BATTELLE

Field Log Worksheet

Location:	Well No:	Date:	Project No.:	Page ___ of ___
Personnel:			Meteorological Conditions (temperature, wind, precipitation):	
Sample Information				
Sample IDs:			Sample Matrix:	
Sample Depth:			Sample Appearance:	
Type/Number of Containers:			Deviations:	
Problems or issues encountered and resolution:				

Narrative of Events		
Time	Location	Description of Task

Field Team Signature/Date: _____

DOCUMENT EDITORIAL CORRECTION, CHANGE, OR DEACTIVATION (DECOD) FORM

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Clara Galbis-Reig	NA	11 JUL 2024

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Changed to add well abandonment conditions per KDEP comments.

Changes, Deactivations, and Document Flag Updates Only

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