LABORATORY DATA QUALITY ASSESSMENT AND VALIDATION

The electronic data deliverables (EDDs) from the laboratory (Eurofins) are entered into the former York Naval Ordnance Plant (fYNOP) database during the process of managing environmental chemistry data at the fYNOP. Groundwater Sciences Corporation (GSC) reviewed the data packages provided by the laboratory for 2025 groundwater and surface water samples in accordance with the Quality Assurance Project Plan (QAPP) (GSC, 2020) and qualified individual sample results as necessary in the fYNOP database.

Data Quality Assessment

The data quality assessment (DQA) was performed by GSC on laboratory analytical data generated for samples from January through December 2025 as follows:

- One annual comprehensive groundwater sampling event.
- Three quarterly Technical Impracticability (TI) Area 1 perimeter groundwater sampling events.
- Three quarterly Southern Property Boundary Area (SPBA) groundwater sampling events.
- Twelve monthly surface water sampling events.

Twenty-seven (27) sample delivery groups (SDGs) were generated for 301 samples collected from January 24 through December 23, 2025. The total includes 45 quality control (QC) blank samples consisting of five equipment rinse blanks, five field blanks, 21 trip blanks, and 14 duplicate samples. All samples were analyzed for volatile organic compounds (VOCs) by SW-846 Method 8260D and one sample from MW-2 was analyzed for total and available cyanide using United States Environmental Protection Agency (USEPA) Method 9014 and OIA-1677, respectively.

GSC systematically reviewed the 27 SDGs for compliance with QC criteria in accordance with Section B.2.8 of the QAPP. The GSC data validator conducted a complete data validation on these SDGs using USEPA National Functional Guidelines for Organic Superfund Methods Data Review (USEPA-540-R-2017-002) and the validation and verification methods described in Section D.2 of the QAPP. The following criteria were reviewed:

- Laboratory case narrative.
- Sample reanalysis and secondary dilutions.
- Holding time limits.

- Surrogate (System Monitoring Compound) percent recoveries (%R) for organic methods.
- Internal standard (IS) area counts and retention times for organic methods.
- Blank contamination (in method, field, equipment rinse, and trip blanks).
- Relative response factors (RRFs) in initial calibration and continuing calibrations, percent relative standard deviation (%RSD) in initial calibrations, and percent difference (%D) in continuing calibrations.
- Matrix spike and matrix spike duplicate (MS/MSD), %R, and relative percent difference (RPD).
- Laboratory control sample and laboratory control sample duplicate (LCS/LCSD), %R, and RPD.

The laboratory case narratives were also reviewed for the SDGs. The contents of the data packages and quality assurance/quality control (QA/QC) results were compared to the requirements of the analytical methods. QC data reported by the laboratory were evaluated against required precision and accuracy limits established in Table A-2 of the QAPP. The data validation report that was generated is attached and includes qualifiers added by the data validator.

Consistent with the data quality requirements as defined by the data quality indicators (DQIs) described in Section A.7.2 of the QAPP, project data and associated QC data were evaluated on these categories and qualified according to the outcome of the review. During the review, laboratory-applied data qualifiers were evaluated and explained. During verification, individual sample results were qualified as necessary to designate usability of the data toward meeting project objectives. The qualifiers are defined as follows:

U – The analyte was analyzed for but was not detected above the reported sample quantitation limit. These results are qualitatively acceptable.

J – The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample. Although estimated, these results are qualitatively acceptable.

UJ – The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to measure accurately and precisely the analyte in the sample. Although estimated, these results are qualitatively acceptable.

R – The analyte result was rejected due to serious deficiencies in the ability to analyze the sample and/or meet QC criteria. The presence or absence of the analyte cannot be verified.

Data qualifiers were applied based on deviations from the measurement performance criteria identified in USEPA-540-R-2017-002 and Table A-2 of the QAPP.

A secondary stage of validation occurred following completion of the initial validation for a discrete sampling event. Equipment rinse blanks, trip blanks, and field blanks were associated with specific environmental samples. These field QC blanks were evaluated using the same criteria as method blanks, and the associated environmental samples were qualified accordingly.

The following sections address the laboratory chemical analysis program implemented for the 2025 sampling events. The project DQIs are summarized in the following sections and include a review of precision, bias, representativeness, comparability, completeness, and sensitivity.

Precision

Precision was assessed using the analysis of LCS/LCSDs and duplicate samples. The MS/MSDs were also evaluated but data was not qualified based solely on MS/MSD results, except for the specific environmental sample that was spiked for the MS/MSD analysis.

LCS/LCSDs were evaluated based on %R results. The %R for 14 reported analytes was outside LCS/LCSD control limits, and a portion of the results for 37 surface water samples, four extraction/treatment system samples, and 30 monitoring well samples were qualified as estimated ("J" or "UJ") based on LCS/LCSD %R acceptance criteria.

MS/MSD results greater than the upper control limit (UCL) or less than the lower control limit (LCL) affected four different analytes in three surface water samples. The results were qualified as estimated ("J"); however, as noted above, data for this project was not qualified based solely on MS/MSD results.

Field duplicate samples were used to assess intralaboratory precision and were collected by filling multiple sample containers from the same sampling device during sampling events at a frequency of at least one duplicate sample per 20 media samples. Twelve (12) duplicate surface water samples were collected from location COD-SW-17, which represents approximately eight percent of the 142 unique surface water samples that were collected from January through December 2025. Duplicate groundwater samples were collected from wells CW-1A and MW-112, approximately four percent of the 46 unique groundwater samples that were collected during the comprehensive sampling

event in September and October 2025. The duplicate samples were assigned blind field identification numbers by the sampler and were analyzed by SW-846 Method 8260D.

Comparative results for tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (cis12DCE), and 1,1,1-trichloroethane (TCA) in the 14 duplicate samples are shown on the following table. In accordance with Section A.7.2.1 of the QAPP, RPDs between the results for the primary sample and duplicate sample were calculated. None of the calculated RPD results exceed the data quality objective (DQO) for precision (<50 RPD) in the volatile organics analysis of a field duplicate sample. This DQO is specified on Table A-2 of the QAPP.

Comparison of Intralaboratory Duplicate Sample Results (for PCE, TCE, cis12DCE and TCA)

Location	Date	Parameter	Primary Result, S (µg/L)	Duplicate Result, D (µg/L)	Absolute Difference (µg/L)	Relative Percent Difference
COD-SW-17	1/24/2025	PCE	140	150	10	7%
		TCE	3.6	3.4	0.2	6%
		cis12DCE	2.1	2	0.1	5%
		TCA	12	11	1	9%
COD-SW-17	2/27/2025	PCE	160	180	20	12%
		TCE	4.8	4.7	0.1	2%
		cis12DCE	3.1	2.7	0.4	14%
		TCA	14	14	0	0%
COD-SW-17	3/27/2025	PCE	150	180	30	18%
		TCE	6	5.4	0.6	11%
		cis12DCE	2.8	2.7	0.1	4%
		TCA	13	13	0	0%
COD-SW-17	4/24/2025	PCE	140	140	0	0%
		TCE	3.7	3.7	0	0%
		cis12DCE	2.1	2.1	0	0%
		TCA	12	12	0	0%
COD-SW-17	5/27/2025	PCE	150	150	0	0%
		TCE	4.4	4.6	0.2	4%
		cis12DCE	2.3	2.3	0	0%
		TCA	12	12	0	0%
COD-SW-17	6/25/2025	PCE	130	120	10	8%
		TCE	3.7	3.6	0.1	3%
		cis12DCE	2.4	2.4	0	0%
		TCA	10	11	1	10%
COD-SW-17	7/29/2025	PCE	130	130	0	0%
		TCE	3.2	3.2	0	0%
		cis12DCE	2.3	2.3	0	0%
		TCA	9.6	9.5	0.1	1%

Comparison of Intralaboratory Duplicate Sample Results (for PCE, TCE, cis12DCE and TCA)						
COD-SW-17	8/28/2025	PCE	130	140	10	7%
		TCE	4.5	4.5	0	0%
		cis12DCE	2.5	2.5	0	0%
		TCA	11	11	0	0%
COD-SW-17	9/22/2025	PCE	140	140	0	0%
		TCE	3.9	4.1	0.2	5%
		cis12DCE	2.4	2.3	0.1	4%
		TCA	11	11	0	0%
COD-SW-17	10/24/2025	PCE	170	170	0	0%
		TCE	5.3	5.2	0.1	2%
		cis12DCE	3	3	0	0%
		TCA	15	14	1	7%
COD-SW-17	11/24/2025	PCE	130	150	20	14%
		TCE	4.6	4.7	0.1	2%
		cis12DCE	2.8	2.8	0	0%
		TCA	12	12	0	0%
COD-SW-17	12/23/2025	PCE	150	150	0	0%
		TCE	4.7	4.6	0.1	2%
		cis12DCE	3	2.9	0.1	3%
		TCA	12	11	1	9%
CW-1A	9/30/2025	PCE	1.9	1.9	0	0%
		TCE	26	25	1	4%
		cis12DCE	1 U	0.31 J	NA	NA
		TCA	1 U	1 U	NA	NA
MW-112	10/6/2025	PCE	1.1	1.2	0.1	9%
		TCE	1.1	1.1	0	0%
		cis12DCE	1 U	1 U	NA	NA
		TCA	1 U	1 U	NA	NA

Absolute Difference = |S - D|
Relative Percent Difference = (|S - D| / (S + D)/2) x 100
NA = Not applicable; cannot be calculated due to one result being a non-detect ("U" or "UJ").
µg/L = micrograms per liter

Based on criteria including the results of the calculations, the parameters analyzed and reported, the absolute differences given sample dilutions, concentration levels, and professional judgment, the duplicate results do not show variations that indicate a lack of precision in the analytical results.

Based on an evaluation of %R for LCS/LCSDs and RPDs for duplicate samples, the overall precision of samples collected for the project appears to be acceptable. As a result, the laboratory DQO for precision was met.

Bias

Bias is the systematic or persistent distortion of a measurement process causing errors in one direction. Data conditions that imply a potential for high bias in the sample result include:

- Detection of a target compound in an associated method blank, trip blank, field blank, or equipment rinse blank.
- Surrogate recovery (%R) greater than the acceptable range for a specific compound's analytical analogue.
- Continuing calibration verification (CCV) sample recovery greater than the acceptable range for a specific compound.
- LCS/LCSD or MS/MSD recovery greater than the acceptable range for a specific compound.

Similarly, data conditions that imply a potential for low bias in the sample result include:

- Analysis of the sample outside the holding time (i.e., 14 days for preserved VOCs).
- CCV sample recovery less than the acceptable range for a specific compound.
- LCS/LCSD or MS/MSD recovery less than the acceptable range for a specific compound.

High analytical bias was evaluated by reviewing blank detections, low analytical bias was evaluated by reviewing holding times, and both high and low analytical biases were evaluated by analysis of LCS/LCSD and MS/MSD samples, CCV sample recoveries, and surrogate recoveries. The laboratory analyzed LCS/LCSD samples for each SDG and analyzed MS/MSD samples at a frequency of at least one per 20 unique groundwater and surface water samples (QAPP, Section B.1.5). Acceptance criteria for LCS/LCSD and MS/MSD measurements are expressed as a %R and are specified in Table A-2 of the QAPP.

Results for carbon disulfide in two surface water samples were qualified "U" (not detected) due to trip blank contamination with the potential for high bias.

Results for PCE in one surface water sample and one groundwater sample were qualified "J" (estimated) or "UJ" (estimated and not detected) due to analysis of the diluted sample outside the holding time.

As noted above in the discussion of precision, the LCS/LCSD results were within the QC limits except for 14 analytes in 71 environmental samples that were qualified as estimated. (Note: The maximum number of analytes qualified for this reason in any sample was six.) MS/MSD results outside the QC

limits for VOCs resulted in the qualification of four analytes in three surface water samples (i.e., three analytes in the first sample, two analytes in the second sample, and one analyte in the third sample) due to the potential for high bias where the MS/MSD results were greater than the UCL, and the potential for low bias where the MS/MSD results were less than the LCL.

Results for three ketones and several chlorinated VOCs in one surface water sample and in 12 groundwater samples were qualified as not detected and estimated ("UJ") based on CCV criteria with the potential for high bias. Results for two groundwater samples were qualified as estimated ("J") for the same reason.

Based on a review of the results, the data conditions implying a potential for low or high bias in a sample have been addressed by validation and resulting qualification of the analytical data using the following flags: "U", "J", and "UJ". Note: "UJ" is a unique validation qualifier whereas "U" and "J" can be either laboratory qualifiers or validation qualifiers.

Representativeness

Representativeness was satisfied by verifying that the QAPP was properly followed, that proper sampling techniques were used, that proper analytical procedures were followed, and that analytical holding times of the samples were not exceeded. If holding times are greater than two times the method-required holding time, then the sample results are rejected ("R") for non-detects and are qualified as estimated ("J") for detects. As noted above in the discussion of bias, results for PCE in one surface water sample and one groundwater sample were qualified as estimated ("J") due to holding time exceedances, but no sample result was rejected due to missed holding times. Based on an evaluation of sample precision and accuracy, the samples are representative of the environmental conditions at the time of sampling.

Comparability

Comparability expresses the confidence with which one data set can be compared to another data set measuring the same property. Comparability is achieved by using established and approved sample collection techniques and analytical methods, consistency in the basis of analysis (wet weight vs. dry

weight, volume vs. mass, etc.), consistency in reporting units, and analysis of standard reference materials.

Data comparability is achieved by using standard measurement units. The use of USEPA-approved methods to collect and analyze samples, along with instruments calibrated against Standard Analytical Reference Materials (SARM), which are National Institute for Standards and Technology (NIST)-traceable standards, also aids comparability.

Based on the precision and accuracy assessment presented above and the use of USEPA-approved methods, the data collected during the sampling events are comparable to data collected using similar USEPA-approved methods.

Completeness

Completeness measures the quantity of valid data generated from the laboratory analysis and sampling processes. For data to be valid, all acceptance criteria must be fulfilled, including accuracy and precision, analytical methods must be followed, and each data point must be validated satisfactorily. None of the results from the sampling events have been qualified for reasons of completeness. The DQOs (Table A-2 of the QAPP) were set at 90 percent for analytical laboratory completeness. Based on the evaluation of the laboratory QC results, the data exceeded 90 percent completeness and are deemed useful for assessing results and developing recommendations.

Results that have been flagged or qualified "U", "UJ", or "J" for various reasons encountered minor analytical problems and have limited impact on the data quality.

Sensitivity

Sensitivity requirements were specified as the minimum required reporting levels for VOCs listed in Table A-4 of the QAPP. Some environmental samples required serial dilution due to elevated concentrations of target compounds. Accordingly, a review of non-detect reporting limit data for surface water COCs (PCE, TCE, cis12DCE, and vinyl chloride [VC]) indicates that applicable water quality criteria did not exceed the target compound reporting limits. Consequently, the reporting limit criteria and the analytical DQI for sensitivity were met.

Summary

The analytical results for 2025 samples were acceptable as reported by the analytical laboratory with exceptions as follows:

- The %R for 14 reported analytes was outside LCS/LCSD control limits, and a portion of the results for 37 surface water samples, four extraction/treatment system samples, and 30 monitoring well samples were qualified as estimated ("J" or "UJ") based on LCS/LCSD %R acceptance criteria.
- MS/MSD results outside the QC limits for VOCs resulted in the qualification of four different analytes in three surface water samples due to the potential for high bias where the MS/MSD results were greater than the UCL, and the potential for low bias where the MS/MSD results were less than the LCL.
- Results for carbon disulfide in two surface water samples were qualified "U" due to trip blank contamination with the potential for high bias.
- Results for PCE in one surface water sample and one groundwater sample were qualified "J" or "UJ" due to analysis of the diluted sample outside the holding time.
- Results for three ketones and several chlorinated VOCs in one surface water sample and in 12 groundwater samples were qualified "UJ" based on CCV criteria with the potential for high bias. Results for two groundwater samples were qualified "J" for the same reason.

References

Groundwater Sciences Corporation. Quality Assurance Project Plan, Former York Naval Ordnance Plant, 1425 Eden Road, Springettsbury Township, York, Pennsylvania, Rev.2. November 2020.