CARDINAL
RESOURCES

Report – Emerging Contaminants Sampling Program

Carroll and Dubies Superfund Site 336015
Town of Deerpark, Orange County, New York

Prepared for:

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Project No. 104-0012-0300

July 2019

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1.0 Introduction

1.1 Purpose of Report

This report describes the sampling methodology, tabulates the results, and provides a data usability review for the emerging contaminants program for the Carroll and Dubies Superfund site in Deerpark, New York. The emerging contaminants program was implemented at the request of the New York State Department of Environmental Conservation (NYSDEC). Mr. Scott Deyette, Project Manager for NYSDEC Remedial Bureau C, sent a letter dated March 1, 2019 to the potentially responsible party (PRP) representative, Mr. Jonathan Murphy, outlining the request. The letter explained that NYSDEC is undertaking an evaluation of remediation sites to better understand the risks posed by 1,4-dioxane and per- and polyfluoroalkyl substances (PFAS). Further, the letter said that PFAS have not been historically evaluated at remediation sites, and 1,4-dioxane has not been evaluated at levels that are now thought to represent health concerns. PFAS are synthetic chemicals manufactured and used in a variety of industries and are persistent in the environment. The synthetic chemical 1,4-dioxane has been used as a stabilizer in chlorinated solvents and has been found in groundwater at some sites where chlorinated volatile organic compounds (VOCs) are detected. Samples for emerging contaminants were collected concurrently with the regularly scheduled groundwater sampling program required by the U.S. Environmental Protection Agency (U.S. EPA) on June 4, 5, and 6, 2019.

The sampling and analysis program was conducted in accordance with the approved Work Plan submitted to NYSDEC on April 22, 2019 and approved on May 13, 2019, with minor modifications as noted in this report.

1.2 Site History

The three-acre Carroll and Dubies Superfund site is located in the Town of Deerpark in Orange County, New York, which is approximately 3,000 feet northeast of the City of Port Jervis, New York (Figure 1). The site is situated on the northwestern flank of the Neversink Valley. Gold Creek lies approximately 1,500 feet to the east, and the Neversink River is located approximately 2,500 feet beyond Gold Creek.

The site is underlain by sand and gravel deposits of glacial and glaciofluvial origin. Groundwater monitoring wells have been completed in the outwash unit, found above a low-permeability till zone that functions as an aquitard. The outwash unit consists of fine to coarse sand with fine to coarse gravel. The direction of groundwater flow is generally toward the southeast.

In 1971, the Carroll and Dubies sewage disposal business began operating as a series of lagoons. The majority of wastes disposed in the lagoons were septic waste, municipal sewage sludge, and solid waste. The site also received liquid industrial wastes from approximately 1971 to 1979.

Over time, waste constituents in the lagoons leached into groundwater and affected the outwash aquifer. Benzene, vinyl chloride, and other VOCs were found through a series of investigations to exceed state and federal limits in site monitoring wells. The U.S. EPA placed the site on the National Priorities List (NPL) in 1990.

The remedies selected for the site were defined by two operable units (OU), the waste lagoons themselves (OU-1), and impacted groundwater (OU-2). Remedies were selected and executed to remove wastes from the lagoons, restore the site to a safe and stable condition, and promote and track improvements in groundwater quality.

The OU-1 remedy was conducted in 1999 to prevent further leaching of contaminants into groundwater and to eliminate direct contact risks. The steps in this process were:

- Excavation of all wastes from Lagoons 1, 2, 3, 4, 6, 7, and 8, along with surrounding soils that exceeded specified levels for indicator chemicals.
- Appropriate offsite management of all excavated wastes and soils.
- Placement of imported clean fill in the excavations, followed by grading for drainage control and vegetation.

The OU-2 remedy was initiated in 1999 and continues today. It is a monitoring program to verify source removal and site stability, while allowing natural attenuation to reduce or eliminate the risks associated with historic impacts to the outwash aquifer.

1.3 Summary of Findings

Samples were collected from three monitoring wells, OW-5, OW-13R, and OW-24, representative of variable site groundwater conditions. Six PFAS constituents were detected in OW-5 in parts per trillion concentrations, with the highest detection of 9.7 ng/L for PFOA. 1,4-Dioxane was detected in OW-5 at 3.9 ug/L. Chlorinated VOCs are also detected in this monitoring well, which was once adjacent to a waste lagoon. No PFAS were detected in the other two monitoring wells. 1,4-Dioxane was detected in estimated concentrations (2.8 J ug/L; 4.2 J ug/L) in OW-24 and its duplicate sample. Field and equipment blanks were nondetectable for emerging contaminants. Complete data packages, including raw data, QC results, and calibration information, document the usability of the results provided by Pace Analytical.

The detection of PFAS and 1,4-dioxane in low concentrations in two of the three wells sampled as part of the program is not unexpected, considering the site history. The presence of these emerging contaminants at these levels does not change the protective conditions that are in place. Groundwater associated with the Carroll & Dubies site is not a source of drinking water. U.S. EPA's review of site conditions in 2005, 2010, and 2015 found that with stable to declining groundwater concentrations and institutional controls in place, conditions continue to be protective of human health and the environment, with no exposure pathways that could result in unacceptable risks. In addition, detected concentrations were close to or below recommended limits developed by NYSDEC and U.S. EPA.

2.0 Wells Sampled

The monitoring wells sampled for this program were OW-5, OW-13R, and OW-24, shown on Figure 2. OW-6 was proposed for sampling in the Work Plan, but nearby OW-5 was sampled instead because the dedicated downhole pump (Well Wizard) could be more readily removed. Removal of the dedicated pump was necessary so that the well could be sampled with a pump known to be free of polytetrafluoroethylene (PTFE, or Teflon™) or low-density polyethylene (LDPE) components, which can interfere with PFAS analysis and yield false positives. OW-5 is similar in location and contaminant profile to OW-6. The three monitoring wells selected for the emerging contaminants program represent a variety of conditions:

- OW-5 is downgradient of the location of historic lagoons and has detectable chlorinated VOCs.
- OW-13R is downgradient of the location of historic lagoons and sidegradient of the closed local landfill. Benzene is detected in this well; historically chlorinated VOCs were detected.
- OW-24 is farther downgradient and is nondetectable for VOCs.

NYSDEC recommended that one of the selected monitoring wells be upgradient of the site. There is not a true upgradient monitoring well remaining at this site. OW-24 was selected in lieu of an upgradient monitoring well. VOCs have not been detected at the reporting limits in this monitoring well since it was installed in 2006.

3.0 Sample Collection Methods

Sample collection methods were consistent with the approved U.S. EPA sampling protocols that have been in place for this site. In addition, the PFAS guidelines provided by NYSDEC in a letter dated March 1, 2019 were followed, along with PFAS sampling recommendations from Pace Analytical, the selected laboratory. Specifically:

- Sampling equipment and sample containers were made of stainless steel, high density polyethylene (HDPE), and polypropylene. This included a stainless-steel body QED Sample Pro bladder pump; QED HDPE disposable pump bladders; and air and sample HDPE tubing (fresh pump bladder and tubing for each sample location).
- Sampling equipment and sample containers were protected from contact with aluminum foil, LDPE, glass, or Teflon™.
- Equipment was decontaminated with a tap water and nonphosphate detergent wash, tap water rinse, and deionized water rinse.
- No food or drink containers were allowed near sampling equipment or samples.
- Sampling personnel put on clean nitrile gloves when filling and sealing the sample bottles.
- Sampling personnel avoided GORE-TEX clothing or other clothing such as rainwear that may have been treated with PFAS-containing waterproof materials.
- Cotton clothing that had been laundered without fabric softener was worn by sampling personnel.
- Sampling personnel avoided sunscreen, insect repellent, cosmetics, moisturizers, hand creams, or similar products on the days of the PFAS sampling.
- All PFAS samples were collected first, sealed, and placed in coolers before collecting samples for 1,4-dioxane, to avoid having glass and Teflon™ containers used for 1,4-dioxane in the vicinity during PFAS sample collection.

Monitoring wells OW-13R and OW-24 have never been fitted with dedicated sampling equipment. OW-5 is an older monitoring well that was fitted with a dedicated Well Wizard sampling device several years ago. For the emerging contaminants sampling program, the Well Wizard and all associated tubing were removed completely from the monitoring well.

All monitoring wells were purged using low-flow techniques with the bladder pump (between 100 and 200 milliliters per minute [mL/min]) to stability for pH, temperature, dissolved oxygen, and specific conductance, oxidation/reduction potential (redox), and turbidity. Turbidity readings were determined using a field turbidimeter, and a flow-through multiparameter instrument was used for the other parameters. The goal was to obtain three consecutive readings of the field parameters within the following ranges:

- ±1.0 degree centigrade (°C) for temperature
- ±10 percent (%) for dissolved oxygen
- ±10 millivolts (mV) for redox potential
- ±3% for conductivity
- ±0.1 for pH
- ±10% or ±2 nephelometric turbidity units (NTUs) for turbidity

Groundwater samples were collected directly from the HDPE tubing, not from the flow-through cell used to monitor groundwater stabilization. Samples were collected into sample containers provided by the laboratory, capped, labeled, recorded on the chain of custody, and placed in a cooler with ice to maintain 4± 2° Celsius.

4.0 Selected Laboratory and Analysis

Pace Analytical Services was selected to perform the emerging contaminants analysis using 8260 SIM for 1,4-dioxane and a modified version of DoD Method QSM 5.1.1 for PFAS that uses isotope dilution quantitation. This method detects the NYSDEC compound list and three additional PFAS compounds.

The laboratory Practical Quantitation Limits (PQLs) for PFOA and PFOS met the reporting limit goal established by NYSDEC of 2 ng/L except for OW-13R, where matrix interferences elevated the PQL to 10 ng/L and 9.5 ng/L, respectively. The method detection limits (MDLs) for these compounds in OW-13R were 3.2 ng/L and 1.7 ng/L, respectively, and an examination of the raw data showed that there were no detections at these MDLs. The PQL for 1,4-dioxane was 3.0 ug/L. The laboratory met the NYSDEC MDL goal of 0.35 ug/L for 1,4-dioxane, with an MDL of 0.26 ug/L. 1,4-Dioxane results were reported at the MDL.

5.0 Results and Discussion

5.1 Results

The laboratory report for 1,4-dioxane analyses is provided in Appendix A; the PFAS laboratory report is in Appendix B. These printed versions are the basic results only, and include the hand-marked pages that were qualified for data review. The data packages with full backup are provided electronically on a CD (Appendix C). The results are presented in two ways. Table 1 shows the detected and nondetectable results, and includes the samples, a sample duplicate, field blank, and rinsate blank. The NYSDEC Full PFAS Analyte List (July 2018) includes 21 analytes; the Pace Analytical analyte list included three additional analytes, as indicated with asterisks on Table 1, all of which were nondetectable. Table 2 shows detected emerging contaminants only for the field samples, along with VOCs detected during the concurrent U.S. EPA sampling round.

PFAS were only detected in OW-5, which is consistent with the history of this well as having been the most impacted by chemical contaminants. During this sampling round, cis-1,2-dichloroethene, tetrachloroethene, and trichloroethene were detected in low concentrations in OW-5. Concentrations for individual PFAS compounds were below the NYSDEC-recommended level 10 ng/L for PFOA and PFOS. The detected analytes were:

PFBA	2.6 ng/L
PFHxA	2.1 ng/L
PFHpA	2.2 ng/L
PFOA	9.7 ng/L
PFHxS	2.5 ng/L
PFOS	8.4 ng/L

OW-13R was historically located downgradient of a sewage lagoon and is typically more turbid with a yellow-brown color, higher in organic matter, and higher in specific conductance than other monitoring wells. When received in the laboratory, the appearance of the sample prompted the technician to reduce the sample volume

extracted (49 mL extracted compared to 265 mL extracted for OW-5), to mitigate matrix interference. The reduction in the extract volume resulted in elevated reporting limits of 9.1 to 10 ng/L, as discussed in Section 4.0. However, MDLs for this monitoring well were close to the 2 ng/L goal, and there were no detections at the MDL levels.

There were no PFAS detections in OW-24, with reporting limits for individual compounds of 1.7 to 1.8 ng/L.

1,4-Dioxane was detected in OW-5 at 3.9 ug/L. 1,4-Dioxane was detected at 2.8 J ug/L (estimated value below the PQL of 3.0 ug/L) in OW-24, and 4.2 ug/L in its duplicate. Based on data validation protocols, the 4.2 ug/L result was qualified with a J, as estimated, during the Tier II data review process (Section 6.0).

5.2 Discussion

Groundwater associated with the Carroll & Dubies site is not a source of drinking water. U.S. EPA's review of site conditions during five-year reviews in 2005, 2010, and 2015 found that with stable to declining groundwater concentrations and institutional controls in place, conditions continue to be protective of human health and the environment, with no exposure pathways that could result in unacceptable risks.

PFAS and/or 1,4-dioxane were detected in low concentrations in two of the three wells sampled as part of the program. This is not unexpected, considering the site history, but the presence of these emerging contaminants at low levels does not change the protective conditions that are in place.

In addition, detected concentrations were close to or below recommended limits. In December 2018 the New York State Drinking Water Council recommended adoption of a Maximum Contaminant Level (MCL) of 10 ppt (ng/L) for PFOA and 10 ppt for PFOS. An MCL of 1.0 ug/L for 1,4-dioxane was also recommended. In comparison, U.S. EPA's April 2019 interim recommendations for groundwater that is a current or potential source of drinking water is 70 ppt or PFOA and 70 ppt for PFOS; U.S. EPA's lifetime advisory for 1,4-dioxane in drinking water (2012) is 200 ug/L. PFAS were not detected above New York or U.S. EPA recommended levels for drinking water, and 1,4-dioxane was not found above recommended U.S. EPA levels, as summarized in this table:

Source	PFOA (ng/L)	PFOS (ng/L)	1,4-Dioxane (ug/L)
NYS Drinking Water Council Recommended MCLs, 2018	10	10	1.0
U.S. EPA draft interim recommendations to address PFAS in groundwater, 2019; U.S. EPA lifetime advisory for 1,4-dioxane in drinking water, 2012	70	70	200
OW-5	9.7	8.4	3.9
OW-13R	10 U	9.5 U	0.26 U
OW-24/OW-24 DUP	1.8 U/1.9 U	1.7 U/1.7 U	2.8 J/4.2 J

U indicates not detected at reporting limit
J indicates estimated result

6.0 Quality Assurance and Quality Control

6.1 Introduction

Complete data packages, including raw data, QC results, and calibration information, document the usability of the PFAS and 1,4-dioxane results provided by Pace Analytical.

For the three groundwater samples collected, these quality assurance / quality control samples were also collected:

- One equipment blank (bladder pump rinsate)
- One field duplicate
- One matrix spike/matrix spike duplicate
- One field blank

In addition, a laboratory-prepared trip blank was collected for 1,4-dioxane, since it is a volatile chemical and there is a potential for cross-contamination during shipping by volatilization. A trip blank for PFAS and was not prepared by the laboratory.

Full data packages with backup were provided for the two separate analyses. Because the analytical methods are different, the two data reports are different and are discussed separately. Tier II data quality reviews of the sample data packages were completed. The Tier II data evaluation consists of a review of data package completeness and a quality control (QC) review, as summarized in the QC forms provided by the laboratory, covering, as applicable:

- Signed transmittal page
- Data package narrative with qualifiers
- Sample transmittal documentation and other sample management information
- Reagent traceability summary
- Sample analysis summary and raw sample data
- Blank, laboratory control sample, and MS/MSD results
- Initial calibration, continuing calibration, and internal calibration results
- Summary forms and raw data for field and QC samples
- Field duplicates and field, trip, and equipment rinsate blanks

6.2 1,4-Dioxane Data Review

1,4-Dioxane was analyzed using 8260 Selected Ion Monitoring (SIM) mode. The same forms for 8260 regular VOC analyses were generated, and the same data review methods were applied. The data package was complete and appropriately organized, and all relevant supporting information was provided.

The one QC exceedance noted by the laboratory was for the matrix spike/matrix spike duplicate samples (OW-13R). The spike recoveries for these samples were 130% and 136%, exceeding the upper QC limit of 128%. The batch was accepted based on the acceptable laboratory control sample (LSC) recovery. No qualifiers were placed on the results by this Tier II review; the unspiked OW-13R sample was nondetectable for 1,4-dioxane.

The data qualifier placed on the data set by the Tier II review is J, estimated result. This qualifier was added to OW-24 DUP based on field duplicate results, as described in Section 6.2.1.

6.2.1 Field QC Samples

Sample Collection Blanks: Three blanks related to sample collection (different from the method blank prepared by the laboratory for internal QA/QC) were analyzed as part of this sampling round, and all were nondetectable at the laboratory reporting limits:

- Field Blank (FB): One field blank was collected; it was nondetectable for 1,4-dioxane. A field blank is prepared at the sampling site by pouring deionized water provided by the laboratory into laboratory-prepared volatile organic analyte (VOA) bottles, shipping the bottles with field samples, and having the samples analyzed along with field samples. These blanks are used as an indicator of airborne or other type of contamination occurring during the sampling process that could compromise sample quality.

- Trip Blank (TB): One trip blank was shipped with the samples; it was nondetectable for 1,4-dioxane. Trip blanks are prepared in the laboratory by pouring deionized water into laboratory-prepared VOA bottles. The filled containers are shipped with the sample containers to the site, remain in the sample cooler throughout the sampling process, are shipped back to the laboratory along with the field samples, and are analyzed along with the field samples. A trip blank is used as an indicator of airborne or other type of

contamination that could occur during the shipping process to compromise sample quality.

- Pump Blank (equipment rinsate blank): One pump rinsate blank was collected; it was nondetectable for 1,4-dioxane. This blank was collected to check cleaning methods for the bladder pump used to sample OW-5, OW-13R, and OW-24, to verify that sampling equipment and methods do not compromise sample quality. The pump was cleaned initially and after sampling each of the wells. After sampling, deionized water was poured through and onto the pump body, then collected in VOA bottles. The samples were then stored, shipped, and analyzed along with the other field samples.

Field Duplicate: Field duplicates were collected for OW-24 (OW-24 and OW-24 DUP).

The field duplicate is checked for relative percent difference (RPD) as:

$$\frac{|A - B| \times 100}{\frac{1}{2}(A + B)},$$ *where A is sample value and B is duplicate value, with a target RPD for aqueous samples of 30%.*

In OW-24 the 1,4-dioxane result was reported by the laboratory as estimated at 2.8 J ug/L, detectable above the MDL but below the PQL of 3.0 ug/L. In OW-24 DUP the 1,4-dioxane result was 4.2 ug/L. The RPD between OW-24 and OW-24 DUP was 40%, greater than the 30% limit. In accordance with data review protocols, the OW-24 DUP result was qualified as J for estimated.

Field MS/MSD Samples: Field matrix spike/matrix spike duplicate (MS/MSD) samples were collected for OW-13R. With a matrix spike, a compound of known concentration is added to the sample, and the sample is analyzed. The detected concentration is compared to the amount added. This procedure provides an indication about how the sample matrix (physical/chemical properties inherent to the sample) could affect the ability to detect the target compound. The spike recoveries for these samples were 130% and 136%, exceeding the upper QC limit of 128%. The batch was accepted based on the acceptable laboratory control sample (LSC) recovery. No qualifiers were placed on the data by this Tier II review; the unspiked OW-13R sample was nondetectable for 1,4-dioxane. The data review protocol indicates that no qualification is required for a nondetectable result when the spike recovery is greater than the upper QC limit.

6.2.2 Other Data Qualification

No other data qualifiers were applied to the data, based in this Tier II review.

6.2.3 Data Quality and Usability

Based on this Tier II review, the analytical results are usable and of acceptable quality; no results have been rejected. The results of the review are summarized in the table below.

Tier II Data Review Summary - 1,4-Dioxane

SDG No./Matrix: 0478608/groundwater	**Completion Date**: 6/24/2019	
Project No.: 104-0012	**Reviewer**: Barbara Jones	
Laboratory: Pace Analytical Services, Minneapolis, MN		
Review Criteria	**Data Qualified** **Yes / No**	**Samples Qualified**
1. Data completeness	No	125-page analytical data package was provided.
2. Preservation/holding time	No	All analyses were completed within the required; preservative (HCl) was provided in sample containers.
3. BFB Performance Check – **Form V**	No	BFB ion abundance criteria were met; all associated standards, samples, and QC samples were listed.
4. Calibration:		
4A – Initial – **Form VI**	No	Form VIs provided for 6-level SIM calibration, along with backup information.
4B – Continuing – **Form VII**	No	Form VIIs provided for continuing calibration. RRF was greater than 0.05, D was less than 25%, therefore there were no qualifications.

Review Criteria	Data Qualified Yes / No	Samples Qualified
5. Blanks:		
5A - Laboratory blanks – **Form IV**	No	The method (lab) blank association summary Form **IV** shows all field and QC samples and the LCS/LCS duplicate. The method blank was nondetectable for 1,4-dioxane.
5B - Trip blanks	No	The trip blank was nondetectable for 1,4-dioxane.
5C - Equipment rinsates	No	The pump blank was nondetectable for 1,4-dioxane.
6. Surrogate recovery – **Form II**	No	Toluene-d8 surrogate recovery was within QC limits for all field samples and blanks.
7. Lab-control sample – **Form III**	No	Lab control sample (LCS) and LCS duplicate were within recovery limits. Relative percent difference (RPD) was within limits.
8. Matrix spike/matrix spike duplicates – **Form III**	No	Matrix spike recovery (130% and 136%) exceeded QC upper limit of 128%. RPD was within limits. Batch accepted based on LCS recovery.
9. Field duplicates	Yes	The RPD between OW-24 and OW-24 DUP was greater than 30%. OW-24 DUP was qualified J as estimated. (The laboratory reported OW-24 as J because the result was below the PQL.)
10. Internal standards performance - **Form VIII**	No	Field and QC samples were all within the specified area counts and retention times.
11. Compound quantitation and reporting	No	Raw data was provided for each compound, along with Form Is.

6.3 PFAS Data Review

PFAS (24 perfluorinated compounds) were analyzed by Pace Analytical using an isotope dilution based on DoD QSM 5.1.1. Pace Analytical's qualifications and certifications were provided in the approved work plan. The data report states that Pace

Analytical is in the process of completing the certification process for some of the analytes in this method and marked results as N2. Reporting limits were set to the quantitation limits. The data package was complete, and all relevant supporting information was provided.

One qualifier placed on this data set by the Tier II review process is UJ, for FTS4:2 in OW-5, due to high recovery of an internal surrogate, as discussed in 6.3.2. The UJ qualifier indicates that the analyte was not detected above the reporting limit, but the reporting limit is approximate. No other qualifications were made.

6.3.1 Field QC Samples

The field QC samples collected for PFAS analysis were the same type that were collected for the 1,4-dioxane analysis:

- Field blank, labeled Field Reagent Blank
- Pump rinsate blank, labeled Equipment Blank
- Duplicate samples (OW-24; OW-24 DUP)
- Matrix spike/matrix spike duplicate (OW-13R ; OW-13R MS/MSD)

The Field Reagent Blank, Equipment Blank, and OW-24 duplicate samples were all free of PFAS at the reporting limits. In the OW-13R MS/MSD pair, some recoveries were high, likely due to matrix interferences, although relative percent differences (RPDs) were within QC limits. Results were nondetectable in the unspiked sample, therefore no data qualification was necessary.

6.3.2 Other Data Qualification

No other data qualifiers were applied to the data, based in this Tier II review.

6.3.3 Data Quality and Usability

Based on this Tier II review, the analytical results are usable and of acceptable quality; no results have been rejected. The results of the review are summarized in the table below.

Tier II Data Review Summary - PFAS

SDG No./Matrix: 10478022 / groundwater	**Completion Date**: 7/8/2019	
Project No.: 104-0012	**Reviewer**: Barbara Jones	
Laboratory: Pace Analytical Services, Minneapolis, MN		
Review Criteria	**Data Qualified** **Yes / No**	**Samples Qualified**
1. Data completeness **(Case Narrative, Certifications, Appendices A-F)**	No	576-page analytical data package was provided with narrative summary, back-up for sample management, calibration results, QC results, and raw data.
2. Preservation/holding time **(Appendix A, Sample Management)**	No	Coolers arrived at the lab chilled and extraction/analysis were completed within the holding time window.
3. Internal injection standards **(Appendix B, Sample Analysis Summary; Appendix D, Raw Sample Data)**	No	13C4 PFOA and 13C4 PFOS were internal injection standards, both of which passed for each injection in the batch.
4. Calibration **(Appendix C, QC and Calibration Results Summary; Appendix E, Calibration Raw Data):**	No	Initial calibration (ICal), continuing calibration(CCal), and isotope dilution calibration verification (ICV) reports were provided along with raw data; run logs (Appendix A) documented when ICal was done and that field and QC samples were properly bracketed by CCal and ICV.
5. Blanks		
5A - Laboratory blank **(Appendix C, QC and Calibration Results Summary; Appendix F, QC Raw Data):**	No	A method blank was analyzed with the sample batch and was free of PFAS at the reporting limits.
5B – Field reagent blank **(Appendix B, Sample Analysis Summary; Appendix D, Raw Sample Data)**	No	A field reagent blank, prepared by pouring deionized water into a PFAS container in the field, was free of PFAS at the reporting limits.
5C - Equipment rinsate **(Appendix B, Sample Analysis Summary; Appendix D, Raw Sample Data)**	No	A pump rinsate blank, prepared by pouring deionized water over the cleaned pump into a PFAS container in the field, was free of PFAS at the reporting limits.

Review Criteria	Data Qualified Yes / No	Samples Qualified
6. Surrogate recovery **(Appendix B, Sample Analysis Summary; Appendix D, Raw Sample Data)**	Yes	Sample OW-5 had an elevated internal surrogate standard recovery for 4:2FTS (nondetectable result). This is an estimated result, and has been qualified as UJ, indicating that this compound is nondetectable at the reporting limit, but the reporting limit is approximate.
7. Lab-control sample **(Appendix C, QC and Calibration Results Summary; Appendix F, QC Raw Data):**	No	Recovery was high for 8:2 FTS in the lab-control sample. This compound was not detected in any field samples and the recovery was above the method limit, therefore no qualification was necessary.
8. Matrix spike/matrix spike duplicate **(Appendix C, QC and Calibration Results Summary; Appendix F, QC Raw Data):**	No	OW-13R was used for the MS/MSD. Some recoveries were high in both the MS and MSD, likely due to matrix interferences, although relative percent differences (RPDs) were within QC limits. Results were nondetectable in the unspiked sample, therefore no data qualification was necessary.
9. Field duplicates **(Appendix B, Sample Analysis Summary; Appendix D, Raw Sample Data):**	No	OW-24 was used for the field duplicate. No PFAS compounds were detected in either sample.
10. Compound quantitation and reporting **(Appendix B, Sample Analysis Summary; Appendix D, Raw Sample Data):**	No	Results for OW-5 and OW-24 for some analytes were taken from the secondary dilutions of the extract to reduce the impact of matrix effects, which resulted in higher reporting limits. These results were qualified by the laboratory as D, and the D designation is indicated on summary tables. For OW-13R, due to color and turbidity in the sample, a reduced sample volume was extracted (49 mL), elevating reporting limits by about 5X compared to OW-5 and OW-24. This was done to mitigate matrix interference. No other qualification was placed on these results by this Tier II review.

7.0 References

Cardinal Resources, April 2019. *Emerging Contaminants Sampling Plan, Carroll and Dubies Superfund Site 336015, Town of Deerpark, Orange County, New York.* Prepared for New York State Department of Environmental Conservation, Division of Environmental Remediation, Albany, New York 12233-7014 .

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U.S. EPA, November 2017. *Technical Fact Sheet – 1,4-Dioxane.* Office of Land and Emergency Management, EPA 505-F-17-011.

Tables

Table 2
Summary of Detected TCL Volatile Organic Compounds and Emerging Contaminants in Groundwater
June 2019
Carroll and Dubies Superfund Site
Town of Deerpark, Orange County, New York

Compound	Units	OW-5	OW-13R	OW-24	OW-24 DUP
SW-846 Method 8260B VOCs					
Benzene	ug/L	1.0 U	**2.4**	1.0 U	NA
Cis-1,2-Dichloroethene	ug/L	**4.5**	1.0 U	1.0 U	NA
Tetrachloroethene	ug/L	**6.5**	1.0 U	1.0 U	NA
Trichloroethene	ug/L	**1.6**	1.0 U	1.0 U	NA
Emerging Contaminants					
1,4-Dioxane ug/L	ug/L	**3.9**	3.0 U	3.0 UJ	**4.2 J**
PFBA	ng/L	**2.6**	10 U	1.8 U	1.9 U
PFHxA	ng/L	**2.1**	10 U	1.8 U	1.9 U
PFHpA	ng/L	**2.2**	10 U	1.8 U	1.9 U
PFOA	ng/L	**9.7**	10 U	1.8 U	1.9 U
PFHxS	ng/L	**2.5**	9.4 U	1.7 U	1.7 U
PFOS	ng/L	**8.4**	9.5 U	1.7 U	1.7 U

Notes:

TCL = Target Compound List

UJ = Nondetectable at the reporting limit, but the reporting limit is approximate.

U = The analyte was analyzed for, but was not detected above the reported quantitation limit.

J = Estimated value.

Blue = Analyte detected at or above the Practical Quantitation Limit (PQL), also called the reporting limit.

All PFAS samples were collected on 6/4/2019; VOC and 1,4-dioxane samples were collected on 6/4 to 6/6/2019.

Figures

Table 1 - Emerging Contaminants in Groundwater
June 2019 - Carroll and Dubies Superfund Site
Town of Deerpark, Orange County, New York

Compound	Units	CAS Number	OW-5	OW-13R	OW-24	OW-24 DUP	Pump Blank	Field Blank
1.4-Dioxane ug/L	ug/L	123-91-1	**3.9**	0.26 U	**2.8 J**	**4.2 J**	0.26 U	0.26 U/0.26 U**
PFBA	ng/L	375-22-4	**2.6**	10 U	1.8 U	1.9 U	2.7 U	2.0 U
PFPeA	ng/L	2706-90-3	1.9 U	10 U	1.8 U	1.9 U	2.7 U	2.0 U
PFHxA	ng/L	307-24-4	**2.1**	10 U	1.8 U	1.9 U	2.7 U	2.0 U
PFHpA	ng/L	375-85-9	**2.2**	10 U	1.8 U	1.9 U	2.7 U	2.0 U
PFOA	ng/L	335-67-1	**9.7**	10 U	1.8 U	1.9 U	2.7 U	2.0 U
PFNA	ng/L	375-95-1	1.9 U	10 U	1.8 U	1.9 U	2.7 U	2.0 U
PFDA	ng/L	335-76-2	19 U (D)	10 U	1.8 U	1.9 U	2.7 U	2.0 U
PFUdA	ng/L	2058-94-8	1.9 U	10 U	1.8 U	19 U (D)	2.7 U	2.0 U
PFDoA	ng/L	307-55-1	19 U (D)	10 U	1.8 U	19 U (D)	2.7 U	2.0 U
PFTrDA	ng/L	72629-94-8	19 U (D)	10 U	1.8 U	19 U (D)	2.7 U	2.0 U
PFTeDA	ng/L	376-06-7	19 U (D)	10 U	18 U (D)	19 U (D)	27 U (D)	2.0 U
PFOSA (FOSA)	ng/L	754-91-6	1.9 U	10 U	1.8 U	1.9 U	2.7 U	2.0 U
N-EtFOSAA	ng/L	2991-50-6	19 U (D)	10 U	1.8 U	1.9 U	2.7 U	2.0 U
N-MeFOSAA	ng/L	2355-31-9	19 U (D)	10 U	1.8 U	1.9 U	2.7 U	2.0 U
PFBS	ng/L	375-73-5	1.7 U	9.1 U	1.6 U	1.7 U	2.4 U	1.7 U
PFPeS*	ng/L	2706-91-4	1.8 U	9.6 U	1.7 U	1.8 U	2.5 U	1.9 U
PFHxS	ng/L	355-46-4	**2.5**	9.4 U	1.7 U	1.7 U	2.5 U	1.8 U
PFHpS	ng/L	375-92-8	1.8 U	9.7 U	1.8 U	1.8 U	2.6 U	1.9 U
PFOS	ng/L	1763-23-1	**8.4**	9.5 U	1.7 U	1.7 U	2.5 U	1.8 U
PFNS*	ng/L	68259-12-1	1.9 U	10 U	1.8 U	1.9 U	2.7 U	2.0 U
PFDS	ng/L	335-77-3	1.9 U	10 U	1.8 U	1.9 U	2.7 U	2.0 U
4:2FTS*	ng/L	757124-72-4	19 UJ (D)	10 U	1.8 U	1.9 U	2.7 U	2.0 U
6:2FTS	ng/L	27619-97-2	1.9 U	10 U	1.8 U	1.9 U	27 U (D)	2.0 U
8:2FTS	ng/L	39108-34-4	19 U (D)	10 U	1.8 U	1.9 U	27 U (D)	2.0 U

* These compounds are in addition to those on the NYSDEC Full PFAS Target Analyte List

**A field blank and trip blank were analyzed for 1,4-dioxane; both were nondetectable.

J = Estimated value.

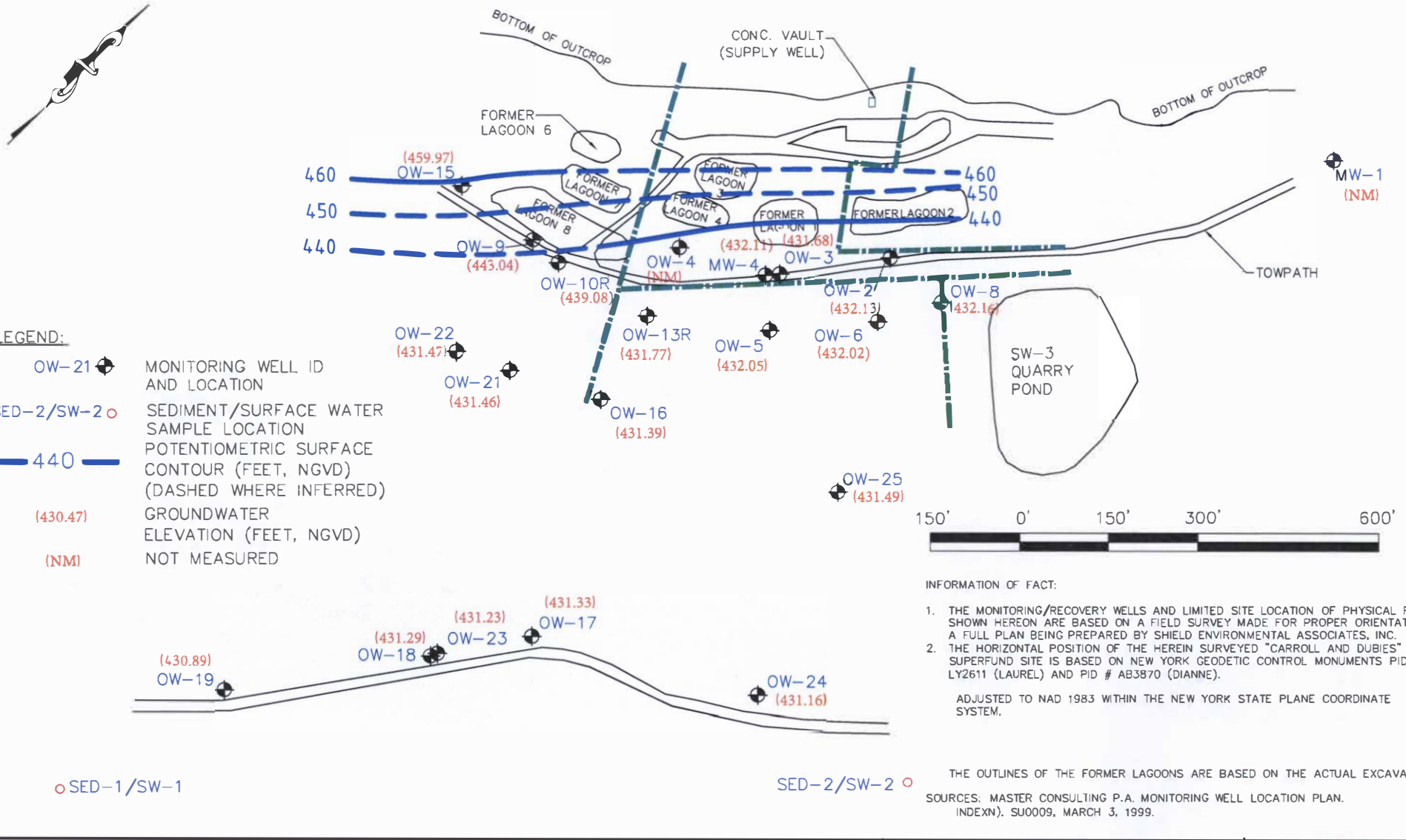
UJ = Nondetectable at the reporting limit, but the reporting limit is approximate.

U = The analyte was analyzed for, but was not detected above the reporting limit, which was the Practical Quantitation Limit (PQL) for PFAS and the Method Detection Limit (MDL) for 1,4-diox

(D) = Results for selected analytes were taken from secondary dilutions of the sample extracts to reduce the impact of matrix effects. The PQL (reporting limit) or PQL reflects the dilution.

All PFAS samples were collected on 6/4/2019; 1,4-dioxane samples were collected on 6/4 to 6/6/2019.

Blue = Analyte detected at or above the reporting limit.



INFORMATION OF FACT:

1. THE MONITORING/RECOVERY WELLS AND LIMITED SITE LOCATION OF PHYSICAL FEATURES SHOWN HEREON ARE BASED ON A FIELD SURVEY MADE FOR PROPER ORIENTATION WITH A FULL PLAN BEING PREPARED BY SHIELD ENVIRONMENTAL ASSOCIATES, INC.
2. THE HORIZONTAL POSITION OF THE HEREIN SURVEYED "CARROLL AND DUBIES" SUPERFUND SITE IS BASED ON NEW YORK GEODETIC CONTROL MONUMENTS PID # LY2611 (LAUREL) AND PID # AB3870 (DIANNE).

   ADJUSTED TO NAD 1983 WITHIN THE NEW YORK STATE PLANE COORDINATE SYSTEM.

THE OUTLINES OF THE FORMER LAGOONS ARE BASED ON THE ACTUAL EXCAVATION.

SOURCES: MASTER CONSULTING P.A. MONITORING WELL LOCATION PLAN. INDEXN). SU0009, MARCH 3, 1999.

NO	DRN	DATE	REVISION	CHKD	DATE	APPVD	DATE
3	BJ	6/20/19	GW CONTOURS AND ELEVATION UPDATE	KJ	6/21/19		
2	LK	6/23/14	GW CONTOURS AND ELEVATIONS UPDATE	BJ	6/24/14		
1	LK	2/18/13	GW CONTOURS AND ELEVATIONS UPDATE				

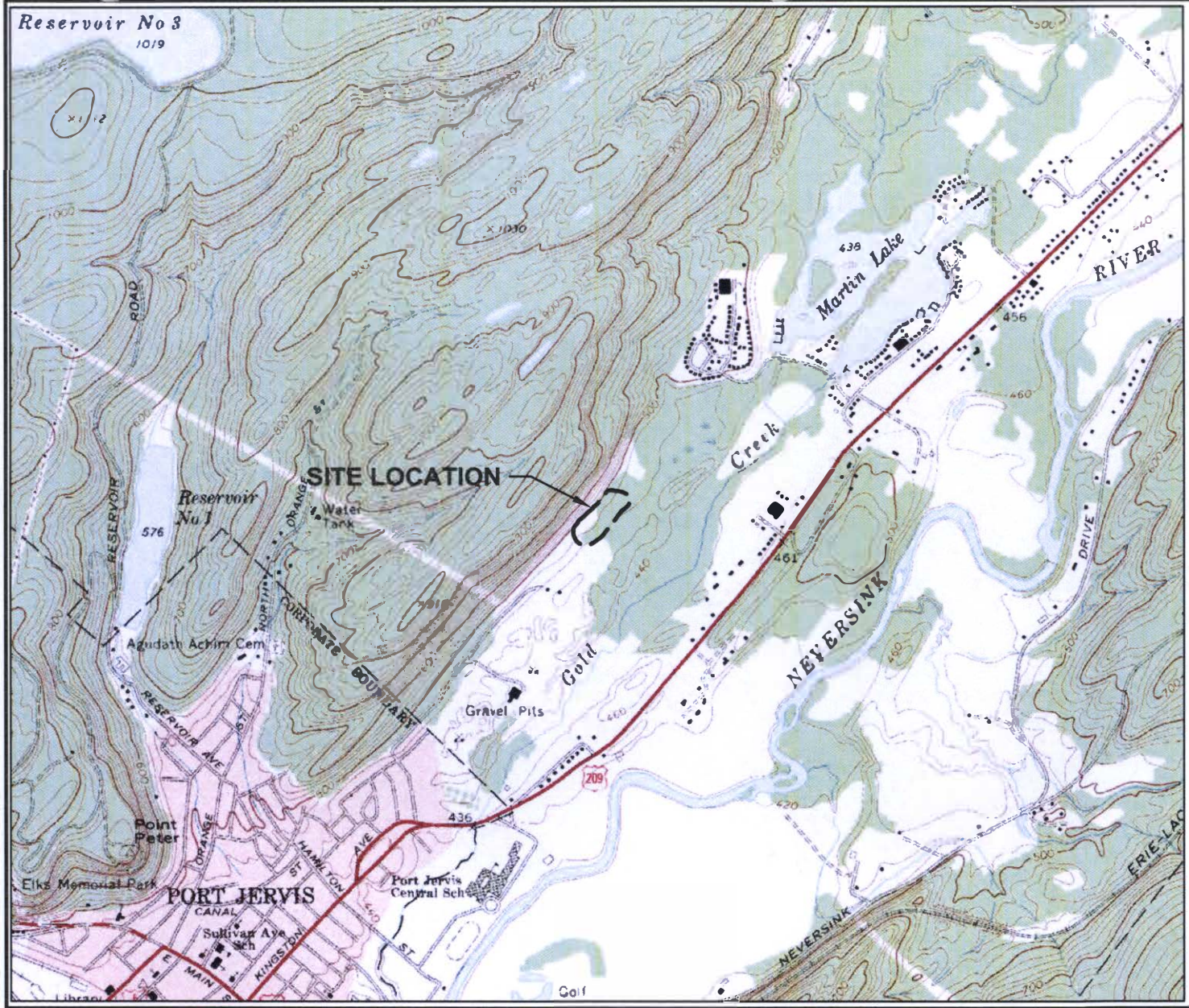
CARROLL AND DUBIES SUPERFUND SITE
TOWN OF DEERPARK, ORANGE COUNTY, NEW YORK
104-0012

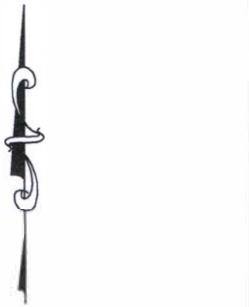
CURRENT DATE 6/21/19

FIGURE 2
GROUNDWATER CONTOURS, JUNE 2019
JUNE 2019

DRAWING NO. 104-0012 - C&D OU2 | SCALE AS NOTED | REVISION 3

CARDINAL





LEGEND:

APPROXIMATE SITE BOUNDARY

SOURCE:
USGS TOPOGRAPHIC QUADRANGLE MAP
PORT JERVIS NORTH, NEW YORK, DATED 1991.

CARDINAL RESOURCES

CARROLL AND DUBIES SUPERFUND SITE
TOWN OF DEERPARK, ORANGE COUNTY, NEW YORK

105-0035

NO	D RWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
1							
0	ECM						

FIGURE 1

SITE LOCATION MAP

CADD FILE	9005	SCALE	AS NOTED	CURRENT DATE:	03-07-2005
DRAWING NO.	105-0035-0300-01			REVISION	0

Appendix A

1,4-Dioxane Laboratory Data Report (results only)

Pace Analytical Services, LLC
1700 Elm Street - Suite 200
Minneapolis, MN 55414
(612)607-1700

July 15, 2019

Barbara Jones
Cardinal Resources, Inc.
4410 Broadway Blvd.
Monroeville, PA 15146

RE: Project: 104-0012 NY Superfund-Revised Report
Pace Project No.: 10478608

Dear Barbara Jones:
Enclosed are the analytical results for sample(s) received by the laboratory on June 07, 2019. The results relate only to the samples included in this report. Results reported herein conform to the most current, applicable TNI/NELAC standards and the laboratory's Quality Assurance Manual, where applicable, unless otherwise noted in the body of the report.

This report was revised on July 15, 2019 to report all samples to the method detection limit.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Timothy Sandager
timothy.sandager@pacelabs.com
(612)607-6456
Project Manager

Enclosures

cc: J. O'Connor, Cardinal Resources

Pace Analytical Services, LLC
1700 Elm Street - Suite 200
Minneapolis, MN 55414
(612)607-1700

CERTIFICATIONS

Project: 104-0012 NY Superfund-Revised Report
Pace Project No.: 10478608

Minnesota Certification IDs

1700 Elm Street SE, Minneapolis, MN 55414-2485
A2LA Certification #: 2926.01
Alabama Certification #: 40770
Alaska Contaminated Sites Certification #: 17-009
Alaska DW Certification #: MN00064
Arizona Certification #: AZ0014
Arkansas DW Certification #: MN00064
Arkansas WW Certification #: 88-0680
California Certification #: 2929
CNMI Saipan Certification #: MP0003
Colorado Certification #: MN00064
Connecticut Certification #: PH-0256
EPA Region 8+Wyoming DW Certification #: via MN 027-053-137
Florida Certification #: E87605
Georgia Certification #: 959
Guam EPA Certification #: MN00064
Hawaii Certification #: MN00064
Idaho Certification #: MN00064
Illinois Certification #: 200011
Indiana Certification #: C-MN-01
Iowa Certification #: 368
Kansas Certification #: E-10167
Kentucky DW Certification #: 90062
Kentucky WW Certification #: 90062
Louisiana DEQ Certification #: 03086
Louisiana DW Certification #: MN00064
Maine Certification #: MN00064
Maryland Certification #: 322
Massachusetts Certification #: M-MN064
Michigan Certification #: 9909
Minnesota Certification #: 027-053-137
Minnesota Dept of Ag Certifcation #: via MN 027-053-137
Minnesota Petrofund Certification #: 1240
Mississippi Certification #: MN00064
Missouri Certification #: 10100
Montana Certification #: CERT0092
Nebraska Certification #: NE-OS-18-06
Nevada Certification #: MN00064
New Hampshire Certification #: 2081
New Jersey Certification #: MN002
New York Certification #: 11647
North Carolina DW Certification #: 27700
North Carolina WW Certification #: 530
North Dakota Certification #: R-036
Ohio DW Certification #: 41244
Ohio VAP Certification #: CL101
Oklahoma Certification #: 9507
Oregon Primary Certification #: MN300001
Oregon Secondary Certification #: MN200001
Pennsylvania Certification #: 68-00563
Puerto Rico Certification #: MN00064
South Carolina Certification #:74003001
Tennessee Certification #: TN02818
Texas Certification #: T104704192
Utah Certification #: MN00064
Vermont Certification #: VT-027053137
Virginia Certification #: 460163
Washington Certification #: C486
West Virginia DEP Certification #: 382
West Virginia DW Certification #: 9952 C
Wisconsin Certification #: 999407970
Wyoming UST Certification #: via A2LA 2926.01

Pace Analytical Services, LLC
1700 Elm Street - Suite 200
Minneapolis, MN 55414
(612)607-1700

SAMPLE SUMMARY

Project: 104-0012 NY Superfund-Revised Report
Pace Project No.: 10478608

Lab ID	Sample ID	Matrix	Date Collected	Date Received
10478608001	OW-5	Water	06/04/19 16:15	06/07/19 10:00
10478608002	OW-13R	Water	06/05/19 15:25	06/07/19 10:00
10478608003	OW-24	Water	06/06/19 08:50	06/07/19 10:00
10478608004	OW-24 DUP	Water	06/06/19 08:50	06/07/19 10:00
10478608005	Pump Blank	Water	06/06/19 12:00	06/07/19 10:00
10478608006	Field Blank	Water	06/06/19 13:15	06/07/19 10:00
10478608007	LAB PREPARED TRIP BLANK	Water	06/04/19 00:00	06/07/19 10:00

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SAMPLE ANALYTE COUNT

Project: 104-0012 NY Superfund-Revised Report
Pace Project No.: 10478608

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
10478608001	OW-5	EPA 8260B Mod.	DS2	2	PASI-M
10478608002	OW-13R	EPA 8260B Mod.	DS2	2	PASI-M
10478608003	OW-24	EPA 8260B Mod.	DS2	2	PASI-M
10478608004	OW-24 DUP	EPA 8260B Mod.	DS2	2	PASI-M
10478608005	Pump Blank	EPA 8260B Mod.	DS2	2	PASI-M
10478608006	Field Blank	EPA 8260B Mod.	DS2	2	PASI-M
10478608007	LAB PREPARED TRIP BLANK	EPA 8260B Mod.	DS2	2	PASI-M

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ANALYTICAL RESULTS

Project: 104-0012 NY Superfund-Revised Report
Pace Project No.: 10478608

Sample: OW-5 **Lab ID: 10478608001** Collected: 06/04/19 16:15 Received: 06/07/19 10:00 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
8260 MSV SIM	Analytical Method: EPA 8260B Mod.								
1,4-Dioxane (SIM)	**3.9**	ug/L	3.0	0.26	1		06/16/19 17:55	123-91-1	
Surrogates									
Toluene-d8 (S)	92	%.	75-132		1		06/16/19 17:55	2037-26-5	

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 104-0012 NY Superfund-Revised Report
Pace Project No.: 10478608

Sample: OW-13R **Lab ID: 10478608002** Collected: 06/05/19 15:25 Received: 06/07/19 10:00 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
8260 MSV SIM	Analytical Method: EPA 8260B Mod.								
1,4-Dioxane (SIM)	**<0.26**	ug/L	3.0	0.26	1		06/16/19 16:43	123-91-1	M1
Surrogates									
Toluene-d8 (S)	85	%.	75-132		1		06/16/19 16:43	2037-26-5	

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, LLC
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Minneapolis, MN 55414
(612)607-1700

ANALYTICAL RESULTS

Project: 104-0012 NY Superfund-Revised Report
Pace Project No.: 10478608

Sample: OW-24 **Lab ID: 10478608003** Collected: 06/06/19 08:50 Received: 06/07/19 10:00 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
8260 MSV SIM	Analytical Method: EPA 8260B Mod.								
1,4-Dioxane (SIM)	**2.8J**	ug/L	3.0	0.26	1		06/16/19 18:14	123-91-1	
Surrogates									
Toluene-d8 (S)	87	%.	75-132		1		06/16/19 18:14	2037-26-5	

REPORT OF LABORATORY ANALYSIS

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Pace Analytical Services, LLC
1700 Elm Street - Suite 200
Minneapolis, MN 55414
(612)607-1700

ANALYTICAL RESULTS

Project: 104-0012 NY Superfund-Revised Report
Pace Project No.: 10478608

Sample: OW-24 DUP **Lab ID: 10478608004** Collected: 06/06/19 08:50 Received: 06/07/19 10:00 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
8260 MSV SIM	Analytical Method: EPA 8260B Mod.								
1,4-Dioxane (SIM)	4.2	ug/L	3.0	0.26	1		06/16/19 18:32	123-91-1	
Surrogates									
Toluene-d8 (S)	91	%.	75-132		1		06/16/19 18:32	2037-26-5	

4.2 J ug/L
based on RPD >30%

REPORT OF LABORATORY ANALYSIS

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Minneapolis, MN 55414
(612)607-1700

ANALYTICAL RESULTS

Project: 104-0012 NY Superfund-Revised Report
Pace Project No.: 10478608

Sample: Pump Blank **Lab ID: 10478608005** Collected: 06/06/19 12:00 Received: 06/07/19 10:00 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
8260 MSV SIM	Analytical Method: EPA 8260B Mod.								
1,4-Dioxane (SIM)	**<0.26**	ug/L	3.0	0.26	1		06/16/19 16:24	123-91-1	
Surrogates									
Toluene-d8 (S)	92	%.	75-132		1		06/16/19 16:24	2037-26-5	

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, LLC
1700 Elm Street - Suite 200
Minneapolis, MN 55414
(612)607-1700

ANALYTICAL RESULTS

Project: 104-0012 NY Superfund-Revised Report
Pace Project No.: 10478608

Sample: Field Blank **Lab ID: 10478608006** Collected: 06/06/19 13:15 Received: 06/07/19 10:00 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
8260 MSV SIM	Analytical Method: EPA 8260B Mod.								
1,4-Dioxane (SIM)	**<0.26**	ug/L	3.0	0.26	1		06/16/19 16:06	123-91-1	
Surrogates									
Toluene-d8 (S)	95	%.	75-132		1		06/16/19 16:06	2037-26-5	

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, LLC
1700 Elm Street - Suite 200
Minneapolis, MN 55414
(612)607-1700

ANALYTICAL RESULTS

Project: 104-0012 NY Superfund-Revised Report
Pace Project No.: 10478608

Sample: LAB PREPARED TRIP BLANK **Lab ID: 10478608007** Collected: 06/04/19 00:00 Received: 06/07/19 10:00 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
8260 MSV SIM	Analytical Method: EPA 8260B Mod.								
1,4-Dioxane (SIM)	**<0.26**	ug/L	3.0	0.26	1		06/16/19 15:48	123-91-1	
Surrogates									
Toluene-d8 (S)	94	%.	75-132		1		06/16/19 15:48	2037-26-5	

Pace Analytical Services, LLC
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QUALITY CONTROL DATA

Project: 104-0012 NY Superfund- Revised Report
Pace Project No.: 10478608

QC Batch: 613273 Analysis Method: EPA 8260B Mod.
QC Batch Method: EPA 8260B Mod. Analysis Description: 8260 MSV SIM
Associated Lab Samples: 10478608001, 10478608002, 10478608003, 10478608004, 10478608005, 10478608006, 10478608007

METHOD BLANK: 3314110 Matrix: Water
Associated Lab Samples: 10478608001, 10478608002, 10478608003, 10478608004, 10478608005, 10478608006, 10478608007

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
1,4-Dioxane (SIM)	ug/L	<0.26	3.0	0.26	06/16/19 14:53	
Toluene-d8 (S)	%.	98	75-132		06/16/19 14:53	

LABORATORY CONTROL SAMPLE & LCSD: 3314111 3314112

Parameter	Units	Spike Conc.	LCS Result	LCSD Result	LCS % Rec	LCSD % Rec	% Rec Limits	RPD	Max RPD	Qualifiers
1,4-Dioxane (SIM)	ug/L	10	8.4	7.8	84	78	75-125	8	20	
Toluene-d8 (S)	%.				94	89	75-132			

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 3314113 3314114

Parameter	Units	10478608002 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
1,4-Dioxane (SIM)	ug/L	<0.26	10	10	13.0	13.6	130	136	65-128	5	30	M1
Toluene-d8 (S)	%.						90	96	75-132			

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, LLC
1700 Elm Street - Suite 200
Minneapolis, MN 55414
(612)607-1700

QUALIFIERS

Project: 104-0012 NY Superfund-Revised Report
Pace Project No.: 10478608

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to dilution of the sample aliquot.

ND - Not Detected at or above adjusted reporting limit.

TNTC - Too Numerous To Count

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PQL - Practical Quantitation Limit.

RL - Reporting Limit - The lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix.

S - Surrogate

1,2-Diphenylhydrazine decomposes to and cannot be separated from Azobenzene using Method 8270. The result for each analyte is a combined concentration.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

LABORATORIES

PASI-M Pace Analytical Services - Minneapolis

ANALYTE QUALIFIERS

M1 Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS) recovery.

Pace Analytical Services, LLC
1700 Elm Street - Suite 200
Minneapolis, MN 55414
(612)607-1700

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: 104-0012 NY Superfund-Revised Report
Pace Project No.: 10478608

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
10478608001	OW-5	EPA 8260B Mod.	613273		
10478608002	OW-13R	EPA 8260B Mod.	613273		
10478608003	OW-24	EPA 8260B Mod.	613273		
10478608004	OW-24 DUP	EPA 8260B Mod.	613273		
10478608005	Pump Blank	EPA 8260B Mod.	613273		
10478608006	Field Blank	EPA 8260B Mod.	613273		
10478608007	LAB PREPARED TRIP BLANK	EPA 8260B Mod.	613273		

Pace Analytical
www.pacelabs.com

WO# : 10478608

10478608

/ Analytical Request Document

MENT. All relevant fields must be completed accurately.

Attn: Tim Sandeger

Page: of

2285477

Section A Required Client Information:	Section B Required Project Information:	Invoice Information:
Company: Cardinal Resources	Report To: Barbara Jones	Attention: Barbara Jones
Address: 4410 Broadway Blvd. Monroeville, PA 15146	Copy To:	Company Name: Cardinal Resources
Email To: bjones@cardinalres.com	Purchase Order No.:	Address: 4410 Broadway Blvd, Monroeville PA 15146
Phone: 412-374-0984 Fax:	Project Name: NY Superfund	Pace Quote Reference:
Requested Due Date/TAT: STANDARD	Project Number: 104-0012	Pace Project Manager: Hogberg, Kirsten
		Pace Profile #: 40672

REGULATORY AGENCY

☐ NPDES ☐ GROUND WATER ☐ DRINKING WATER

☐ UST ☐ RCRA ☐ OTHER

Site Location STATE: NY

Section D Required Client Information

Matrix Codes MATRIX / CODE: Drinking Water DW; Water WT; Waste Water WW; Product P; Soil/Solid SL; Oil OL; Wipe WP; Air AR; Tissue TS; Other OT

SAMPLE ID (A-Z, 0-9 / ,-) Sample IDs MUST BE UNIQUE

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED COMPOSITE START / Grab DATE	COLLECTED COMPOSITE START / Grab TIME	COMPOSITE END/GRAB DATE	COMPOSITE END/GRAB TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test Y/N: 1,4-Dioxane ONLY	Residual Chlorine (Y/N)	Pace Project No./ Lab I.D.
1	OW-5	WT	G	6-4-19	16:15				3				✓					✓		001
2	OW-13R	WT	G	6-5-19	15:25				3				✓					✓		002
3	OW-13R MS	WT	G	6-5-19	15:26				3				✓					✓		"
4	OW-13R MSD	WT	G	6-5-19	15:26				3				✓					✓		"
5	OW-24	WT	G	6-6-19	8:50				3				✓					✓		003
6	OW-24 DUP	WT	G	6-6-19	8:50				3				✓					✓		004
7	OW-16	WT	G	6-6-19	11:40				3				✓					✓		
8	Pump Blank	WT	G	6-6-19	12:00				3				✓					✓		005
9	Field Blank	WT	G	6-6-19	13:15				3				✓					✓		006
10	LAB PREPARED TRIP BLANK							→	2											007
11																				
12																				

Requested Analysis Filtered (Y/N)

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS: Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)
	RELINQUISHED TO FEDEX 1PM 6/6/2019			PACE Barbara N. Jones	6.7.19	1200	2.2	Y	Y	Y
						1000	2.2	Y	Y	Y

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER:

SIGNATURE of SAMPLER: DATE Signed (MM/DD/YY):

ORIGINAL

*Important Note: By signing this form you are accepting Pace's NET 30 day payment terms and agreeing to late charges of 1.5% per month for any invoices not paid within 30 days.

Pace Analytical	Document Name: Sample Condition Upon Receipt Form	Document Revised: 09May2019 Page 1 of 1
	Document No.: F-MN-L-213-rev.28	Issuing Authority: Pace Minnesota Quality Office

Sample Condition Upon Receipt

Client Name: Cardinal Resources

Project #: WO#: 10478608

PM: TJS Due Date: 06/21/19

CLIENT: Cardinal Res

Courier: ☒Fed Ex ☐UPS ☐USPS ☐Client ☐Pace ☐SpeeDee ☐Commercial See Exception ☐

Tracking Number: 7077 3027 1137

Custody Seal on Cooler/Box Present? ☒Yes ☐No **Seals Intact?** ☒Yes ☐No **Biological Tissue Frozen?** ☐Yes ☐No ☒N/A

Packing Material: ☐Bubble Wrap ☑Bubble Bags ☐None ☐Other:_____ **Temp Blank?** ☒Yes ☐No

Thermometer: ☐T1(0461) ☒T2(1336) ☐T3(0459) ☐T4(0254) ☐T5(0489) **Type of Ice:** ☑Wet ☐Blue ☐None ☐Dry ☐Melted

Note: Each West Virginia Sample must have temp taken (no temp blanks)

Temp should be above freezing to 6°C **Cooler Temp Read w/temp blank:** 2.1 °C **Average Corrected Temp (no temp blank only):** _____ °C See Exceptions ☐

Correction Factor: +0.1 **Cooler Temp Corrected w/temp blank:** 2.2 °C

USDA Regulated Soil: (☒N/A, water sample/Other:_____)

Date/Initials of Person Examining Contents: GNZ 6.7.19

Did samples originate in a quarantine zone within the United States: AL, AR, CA, FL, GA, ID, LA. MS, NC, NM, NY, OK, OR, SC, TN, TX or VA (check maps)? ☐Yes ☐No

Did samples originate from a foreign source (internationally, including Hawaii and Puerto Rico)? ☐Yes ☐No

If Yes to either question, fill out a Regulated Soil Checklist (F-MN-Q-338) and include with SCUR/COC paperwork.

				COMMENTS:
Chain of Custody Present and Filled Out?	☒Yes	☐No		1.
Chain of Custody Relinquished?	☑Yes	☐No		2.
Sampler Name and/or Signature on COC?	☐Yes	☒No	☐N/A	3.
Samples Arrived within Hold Time?	☒Yes	☐No		4.
Short Hold Time Analysis (<72 hr)?	☐Yes	☒No		5. ☐Fecal Coliform ☐HPC ☐Total Coliform/E coli ☐BOD/cBOD ☐Hex Chrome ☐Turbidity ☐Nitrate ☐Nitrite ☐Orthophos ☐Other
Rush Turn Around Time Requested?	☐Yes	☒No		6.
Sufficient Volume?	☒Yes	☐No		7.
Correct Containers Used? -Pace Containers Used?	☒Yes ☒Yes	☐No ☐No		8.
Containers Intact?	☒Yes	☐No		9.
Field Filtered Volume Received for Dissolved Tests?	☐Yes	☐No	☒N/A	10. Is sediment visible in the dissolved container? ☐Yes ☐No
Is sufficient information available to reconcile the samples to the COC? Matrix: ☒Water ☐Soil ☐Oil ☐Other_____	☒Yes	☐No		11. If no, write ID/ Date/Time on Container Below: See Exception ☐
All containers needing acid/base preservation have been checked?	☐Yes	☐No	☒N/A	12. Sample #
All containers needing preservation are found to be in compliance with EPA recommendation? (HNO_3, H_2SO_4, <2pH, NaOH>9 Sulfide, NaOH>12 Cyanide)	☐Yes	☐No	☒N/A	☐NaOH ☐HNO_3 ☐H_2SO_4 ☐Zinc Acetate
Exceptions (VOA) Coliform, TOC/DOC Oil and Grease, DRO/8015 (water) and Dioxin/PFAS	☒Yes	☐No	☐N/A	Positive for Res. Chlorine? ☐Yes ☐No pH Paper Lot# See Exception ☐
				Res. Chlorine | 0-6 Roll | 0-6 Strip | 0-14 Strip
Headspace in VOA Vials (greater than 6mm)?	☑Yes	☐No	☐N/A	13. See Exception ☐
Trip Blank Present?	☑Yes	☐No	☐N/A	14.
Trip Blank Custody Seals Present?	☐Yes	☐No	☐N/A	Pace Trip Blank Lot # (if purchased): 210586

CLIENT NOTIFICATION/RESOLUTION **Field Data Required?** ☐Yes ☐No

Person Contacted: _____ Date/Time: _____

Comments/Resolution: _____

Project Manager Review: _____ **Date:** 06/11/19

Note: Whenever there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEHNR Certification Office(i.e. out of hold, incorrect preservative, out of temp, incorrect containers).

Labeled by: CM1

Pace Analytical	Document Name: **Headspace Exception**	Document Revised: 17Dec2018 Page 1 of 1
	Document No.: **F-MN-C-276-Rev.01**	Issuing Authority: Pace Minnesota Quality Office

Sample ID	Headspace greater than 6mm	Headspace less than 6mm	No Headspace	Total Vials	Sediment Present?
OW-5	0	0	3	3	NO
OW-13R	0	0	3	3	NO
OW-13R MS	0	0	3	3	NO
OW-13R MSD	0	0	3	3	NO
OW-24	0	0	3	3	NO
OW-24 DUP	0	0	3	3	NO
Dump Blank	0	0	3	3	NO
Field blank	0	0	3	3	NO
Lab Prepared Trip Blank	1	1	0	2	NO

Appendix B

PFAS Laboratory Data Report (results only)

Pace Analytical Services, LLC
1700 Elm Street - Suite 200
Minneapolis, MN 55414
(612)607-1700

July 08, 2019

Barbara Jones
Cardinal Resources, Inc.
4410 Broadway Blvd.
Monroeville, PA 15146

RE: Project: 104-0012 NY Superfund
Pace Project No.: 10478022

Dear Barbara Jones:
Enclosed are the analytical results for sample(s) received by the laboratory on June 06, 2019. The results relate only to the samples included in this report. Results reported herein conform to the most current, applicable TNI/NELAC standards and the laboratory's Quality Assurance Manual, where applicable, unless otherwise noted in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Keith Sturgeon for
Kirsten Hogberg
kirsten.hogberg@pacelabs.com
(612)607-1700
Project Manager

Enclosures

cc: J. O'Connor, Cardinal Resources

Pace Analytical Services, LLC
1700 Elm Street - Suite 200
Minneapolis, MN 55414
(612)607-1700

SAMPLE SUMMARY

Project: 104-0012 NY Superfund
Pace Project No.: 10478022

Lab ID	Sample ID	Matrix	Date Collected	Date Received
10478022001	OW-24	Water	06/04/19 10:00	06/06/19 09:40
10478022002	OW-24 DUP	Water	06/04/19 10:00	06/06/19 09:40
10478022003	OW-13R	Water	06/04/19 11:40	06/06/19 09:40
10478022005	OW-5	Water	06/04/19 14:45	06/06/19 09:40
10478022006	Field Reagent Blank	Water	06/04/19 11:52	06/06/19 09:40
10478022007	Equipment Blank	Water	06/04/19 13:05	06/06/19 09:40

Pace Analytical
www.pacelabs.com

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Page: of 2285478

Section A Required Client Information:	Section B Required Project Information:	Section C Invoice Information:
Company: Cardinal Resources	Report To: Barbara Jones	Attention: Barbara Jones
Address: 4410 Broadway Blvd. Monroeville PA 15146	Copy To:	Company Name: Cardinal Resources
Email To: bjones@cardinalres.com	Purchase Order No.:	Address: 4410 Broadway Blvd., Monroeville PA 15146
Phone: 412-374-0989 Fax:	Project Name: NY SuperFund	Pace Quote Reference:
Requested Due Date/TAT: Standard	Project Number: 104-0012	Pace Project Manager: Hogberg, Kirsten
		Pace Profile #: 40072

REGULATORY AGENCY: ☐ NPDES ☐ GROUND WATER ☐ DRINKING WATER ☐ UST ☐ RCRA ☐ OTHER ✓

Site Location STATE: NY

Requested Analysis Filtered (Y/N)

WO#: 10478022

10478022

ITEM #	Section D Required Client Information — SAMPLE ID (A-Z, 0-9 / ,-) Sample IDs MUST BE UNIQUE	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED DATE	COLLECTED TIME	COMPOSITE END/GRAB DATE	COMPOSITE END/GRAB TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test ↓ Y/N	PFAS	Residual Chlorine (Y/N)	Pace Project No./ Lab I.D.
1	OW-24	WT	G	6-4-19	10 AM				2	✓								✓	✓		001
2	OW-24 DUP	WT	G	6-4-19	10AM				2	✓								✓	✓		002
3	OW-13R	WT	G	6-4-19	11:40				2	✓								✓	✓		003
4	OW-13R MS	WT	G	6-4-19	11:42				2	✓								✓	✓		~~004~~ 6/7/19
5	OW-5	WT	G	6-4-19	14:45				2	✓								✓	✓		005
6	Field Reagent Blank	WT	G	6-4-19	11:52				1	✓								✓	✓		006
7	Equipment Blank	W	G	6-4-19	13:05				1	✓								✓	✓		007
8																					
9																					
10																					
11																					
12																					

Matrix Codes (MATRIX / CODE): Drinking Water DW; Water WT; Waste Water WW; Product P; Soil/Solid SL; Oil OL; Wipe WP; Air AR; Tissue TS; Other OT

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS			
	Barbara M. Jones TO FEDEX	6-5-19	10 AM	CourierPace	6.6.19	940	3.9	Y	N	Y

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Barbara Jones

SIGNATURE of SAMPLER: Barbara M Jones DATE Signed (MM/DD/YY): 06/05/2019

Temp in °C | Received on Ice (Y/N) | Custody Sealed Cooler (Y/N) | Samples Intact (Y/N)

ORIGINAL

*Important Note: By signing this form you are accepting Pace's NET 30 day payment terms and agreeing to late charges of 1.5% per month for any invoices not paid within 30 days.

Pace Analytical	Document Name: Sample Condition Upon Receipt Form	Document Revised: 09May2019 Page 1 of 1
	Document No.: F-MN-L-213-rev.28	Issuing Authority: Pace Minnesota Quality Office

Sample Condition Upon Receipt **Client Name:** Cardinal Resources **Project #:** WO#: 10478022

PM: KNH Due Date: 06/27/19

CLIENT: Cardinal Res

Courier: ☒ Fed Ex ☐ UPS ☐ USPS ☐ Client ☐ Pace ☐ SpeeDee ☐ Commercial See Exception ☐

Tracking Number: 7475 9398 2404

Custody Seal on Cooler/Box Present? ☐ Yes ☒ No **Seals Intact?** ☐ Yes ☒ No **Biological Tissue Frozen?** ☐ Yes ☐ No ☒ N/A

Packing Material: ☐ Bubble Wrap ☒ Bubble Bags ☐ None ☒ Other: PB **Temp Blank?** ☐ Yes ☒ No

Thermometer: ☐ T1(0461) ☐ T2(1336) ☐ T3(0459) ☒ T4(0254) ☐ T5(0489) **Type of Ice:** ☒ Wet ☐ Blue ☐ None ☐ Dry ☐ Melted

Note: Each West Virginia Sample must have temp taken (no temp blanks)

Temp should be above freezing to 6°C	Cooler Temp Read w/temp blank: ____ °C	Average Corrected Temp (no temp blank only): 3.9 °C See Exceptions ☒
Correction Factor: ____	Cooler Temp Corrected w/temp blank: ____ °C	

USDA Regulated Soil: (☒ N/A, water sample/Other: ____) **Date/Initials of Person Examining Contents:** GNZ 6.6.19

Did samples originate in a quarantine zone within the United States: AL, AR, CA, FL, GA, ID, LA. MS, NC, NM, NY, OK, OR, SC, TN, TX or VA (check maps)? ☐ Yes ☐ No

Did samples originate from a foreign source (Internationally, including Hawaii and Puerto Rico)? ☐ Yes ☐ No

If Yes to either question, fill out a Regulated Soil Checklist (F-MN-Q-338) and include with SCUR/COC paperwork.

				COMMENTS:
Chain of Custody Present and Filled Out?	☒ Yes	☐ No		1.
Chain of Custody Relinquished?	☒ Yes	☐ No		2.
Sampler Name and/or Signature on COC?	☒ Yes	☐ No	☐ N/A	3.
Samples Arrived within Hold Time?	☒ Yes	☐ No		4.
Short Hold Time Analysis (<72 hr)?	☐ Yes	☒ No		5. ☐ Fecal Coliform ☐ HPC ☐ Total Coliform/E coli ☐ BOD/cBOD ☐ Hex Chrome ☐ Turbidity ☐ Nitrate ☐ Nitrite ☐ Orthophos ☐ Other
Rush Turn Around Time Requested?	☐ Yes	☒ No		6.
Sufficient Volume?	☒ Yes	☐ No		7.
Correct Containers Used? -Pace Containers Used?	☒ Yes ☒ Yes	☐ No ☐ No		8.
Containers Intact?	☒ Yes	☐ No		9.
Field Filtered Volume Received for Dissolved Tests?	☐ Yes	☐ No	☒ N/A	10. Is sediment visible in the dissolved container? ☐ Yes ☐ No
Is sufficient information available to reconcile the samples to the COC? Matrix: ☒ Water ☐ Soil ☐ Oil ☐ Other	☒ Yes	☐ No		11. If no, write ID/ Date/Time on Container Below: See Exception ☐ For sample #3 we recieved triple the volume, aside from differing collection time, it would appear that sample 40W13RMS is MS/MSD for sample 40W-13R.
All containers needing acid/base preservation have been checked?	☐ Yes	☐ No	☒ N/A	12. Sample #
All containers needing preservation are found to be in compliance with EPA recommendation? (HNO_3, H_2SO_4, <2pH, NaOH >9 Sulfide, NaOH>12 Cyanide)	☐ Yes	☐ No	☒ N/A	☐ NaOH ☐ HNO_3 ☐ H_2SO_4 ☐ Zinc Acetate
Exceptions: VOA, Coliform, TOC/DOC Oil and Grease, DRO/8015 (water) and Dioxin/PFAS 6/6/19 LJ	☒ Yes	☐ No	☐ N/A	Positive for Res. Chlorine? ☐ Yes ☐ No pH Paper Lot# See Exception ☐
				Res. Chlorine / 0-6 Roll / 0-6 Strip / 0-14 Strip
Headspace in VOA Vials (greater than 6mm)?	☐ Yes	☐ No	☒ N/A	13. See Exception ☐
Trip Blank Present?	☐ Yes	☐ No	☒ N/A	14.
Trip Blank Custody Seals Present?	☐ Yes	☐ No	☒ N/A	Pace Trip Blank Lot # (if purchased):

CLIENT NOTIFICATION/RESOLUTION **Field Data Required?** ☐ Yes ☐ No

Person Contacted: ____ Date/Time: ____

Comments/Resolution: ____

Project Manager Review: Kimberly Hathorn Date: 6/7/2019

Note: Whenever there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEHNR Certification Office (i.e out of hold, incorrect preservative, out of temp, incorrect containers).

Labeled by: GNZ

Pace Analytical	Document Name: SCUR Exception Form – Coolers Above 6°C	Document Revised: 08Apr2019 Page 1 of 1
	Document No.: F-MN-C-298-Rev.02	Issuing Authority: Pace Minnesota Quality Office

During sample triage, this form is to be placed in each cooler that arrives above 6.0 degrees Celsius

SCUR Exceptions:

Workorder #:

Out of Temp Sample IDs	Container Type	# of Containers

PM Notified? ☐Yes ☐No

If yes, indicate who was contacted/date/time.
If no, indicate reason why.

Multiple Cooler Project? ☐Yes ☐No
If you answered yes, fill out information to the left.

No Temp Blank

Read Temp	Corrected Temp	Average Temp
2.9	2.9	3.9
4.5	4.5	
5.0	5.0	
3.1	3.1	

Tracking Number/Temperature	

Other Issues

Issue Type: Sample ID	Container Type	# of Containers

pH Adjustment Log for Preserved Samples

Sample ID	Type of Preserv.	pH Upon Receipt	Date Adjusted	Time Adjusted	Amount Added (mL)	Lot # Added	pH After	In Compliance after addition?	Initials
								☐Yes ☐No	
								☐Yes ☐No	
								☐Yes ☐No	
								☐Yes ☐No	

Pace Analytical Services, LLC.
1700 Elm Street
Minneapolis, MN 55414
Phone: 612.607.1700
Fax: 612.607.6444

www.pacelabs.com

Report Prepared for:

Barbara Jones
Cardinal Resources
4410 Broadway Blvd.
Monroeville PA 15146

REPORT OF LABORATORY ANALYSIS FOR PFAAs

Report Prepared Date:
July 2, 2019

Report Information:

Pace Project #: 10478022
Sample Receipt Date: 06/06/2019
Client Project #: 104-0012
Client Sub PO #: N/A
State Cert #: N/A

Invoicing & Reporting Options:

The report provided has been invoiced as a Level 4 PFAA Report. If an upgrade of this report package is requested, an additional charge may be applied.

Please review the attached invoice for accuracy and forward any questions to Kirsten Hogberg, your Pace Project Manager.

This report has been reviewed by:

July 08, 2019

Kirsten Hogberg, Project Manager
(612) 607-6407
(612) 607-6444 (fax)
kirsten.hogberg@pacelabs.com

Report of Laboratory Analysis

DISCUSSION

This report presents the results from the analyses performed on six samples and two matrix spikes submitted by a representative of Cardinal Resources. The samples were analyzed for the presence or absence of twenty-four perfluorinated compounds using an isotope dilution based on DoD QSM 5.1.1. Reporting limits were set to the quantitation limits.

A laboratory method blank was prepared and analyzed with the sample batch as part of our routine quality control procedures. The results show the blank was free of the target perfluorinated compounds at the reporting limits. This indicates that the sample processing procedures did not significantly contribute to the analyte content determined for the sample material.

A Laboratory spike sample was also prepared with the sample batch using clean reference matrix that had been fortified with native standards. With the exception of 8:2 FTS in LCS-71172, flagged "R", the recovery results were within the method limits. Since 8:2 FTS was not detected in the sample material and the recovery was above the method limit, which biases the result high, the results were accepted.

The RPDs (relative percent differences) between one designated Matrix Spike and its duplicate were within the method limits. However, a number of compounds were above the method limit in the MS and MSD. These deviations may be due to the presence of impacting sample matrix or sample inhomogeneity.

13C4 PFOA and 13C4 PFOS are the injection internal standards, of which both passed for each injection in the batch. The passing injection internal standards proves that the instrument detector is working as expected. However, with both elevated and diminished internal surrogate standard (IS) recoveries (outside the suggested limits), the use of the isotope dilution method generally precludes any adverse impact on those individual native compounds that have a directly associated standard.

Sample 1047802005 had elevated recovery standards (IS) recoveries (outside the suggested limits) for 13C2_4:2FTS. While the use of the isotope dilution method generally precludes any adverse impact on those individual native compounds that have a directly associated standard, in the case of the FTS compounds, the recoveries are anomalously high, and are adversely impacted by matrix. The results for these native compounds should be considered estimated only.

Results for selected analytes were taken from secondary dilutions of the sample extracts in order to reduce the impact of matrix effects. The affected values were

DISCUSSION

flagged "D" on the results tables.

It should be noted that Pace Analytical has not yet completed the certification process for all analytes in this method. Therefore, the results have been marked "N2" as qualified.

Pace Analytical Services, LLC
1700 Elm Street - Suite 200
Minneapolis, MN 55414

Tel: 612-607-1700
Fax: 612-607-6444

Minnesota Laboratory Certifications

Authority	Certificate #	Authority	Certificate #
A2LA	2926.01	Minnesota - Pet	1240
Alabama	40770	Mississippi	MN00064
Alaska - DW	MN00064	Missouri - DW	10100
Alaska - UST	17-009	Montana	CERT0092
Arizona	AZ0014	Nebraska	NE-OS-18-06
Arkansas - DW	MN00064	Nevada	MN00064
Arkansas - WW	88-0680	New Hampshire	2081
CNMI Saipan	MP0003	New Jersey (NE	MN002
California	2929	New York	11647
Colorado	MN00064	North Carolina	27700
Connecticut	PH-0256	North Carolina -	27700
EPA Region 8+	via MN 027-053	North Carolina -	530
Florida (NELAP	E87605	North Dakota	R-036
Georgia	959	Ohio - DW	41244
Guam	17-001r	Ohio - VAP	CL101
Hawaii	MN00064	Oklahoma	9507
Idaho	MN00064	Oregon - Primar	MN300001
Illinois	200011	Oregon - Secon	MN200001
Indiana	C-MN-01	Pennsylvania	68-00563
Iowa	368	Puerto Rico	MN00064
Kansas	E-10167	South Carolina	74003
Kentucky - DW	90062	South Dakota	NA
Kentucky - WW	90062	Tennessee	TN02818
Louisiana - DE	03086	Texas	T104704192
Louisiana - DW	MN00064	Utah (NELAP)	MN00064
Maine	MN00064	Virginia	460163
Maryland	322	Washington	C486
Massachusetts	M-MN064	West Virginia -	382
Michigan	9909	West Virginia -	9952C
Minnesota	027-053-137	Wisconsin	999407970
Minnesota - De	via MN 027-053	Wyoming - UST	2926.01

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, LLC
1700 Elm Street - Suite 200
Minneapolis, MN 55414

Tel: 612-607-1700
Fax: 612-607-6444

Reporting Flags

A = Reporting Limit based on signal to noise

B = Less than 10x higher than method blank level

C = Result obtained from confirmation analysis

D = Result obtained from analysis of diluted sample

E = Exceeds calibration range

I = Interferencepresent

J = Estimated value

L = Suppressive interference, analyte may be biased low

Nn = Value obtained from additional analysis

P = PCDEInterference

R = Recovery outside target range

S = Peak saturated

U = Analyte not detected

V = Result verified by confirmation analysis

X = %D Exceeds limits

Y = Calculated using average of daily RFs

* = SeeDiscussion

REPORTOFLABORATORYANALYSIS

Appendix A

Sample Management

Pace Analytical Services, Inc.
1700 Elm Street - Suite 200
Minneapolis, MN 55414

Tel: 612-607-1700
Fax: 612-607-6444

Sample ID Cross Reference

Client Sample ID	Pace Sample ID	Date Received	Sample Type
OW-24	10478022001	06/06/2019	Water
OW-24 DUP	10478022002	06/06/2019	Water
OW-13R	10478022003	06/06/2019	Water
OW-13R-MS	10478022003-MS	06/06/2019	Water
OW-13R-MSD	10478022003-MSD	06/06/2019	Water
OW-5	10478022005	06/06/2019	Water
Field Reagent Blank	10478022006	06/06/2019	Water
Equipment Blank	10478022007	06/06/2019	Water

REPORT OF LABORATORY ANALYSIS

Report No.....10478022_PFAA_DFR

Page 8 of 576

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Pace Analytical

Page: of 2285478

Section A Requi

Company: Cardinal Resources
Address: 4410 Broadway Blvd. Monroeville PA 15146
Email To: bjones@cardinalres.com
Phone: 412-374-0989 Fax:
Requested Due Date/TAT: Standard

Section B

Report To: Barbara Jones
Copy To:
Purchase Order No.:
Project Name: NY Superfund
Project Number: 104-0012

Section C Invoice Information:

Attention: Barbara Jones
Company Name: Cardinal Resources
Address: 4410 Broadway Blvd. Monroeville PA 15146
Pace Quote Reference:
Pace Project Manager: Hogberg, Kirsten
Pace Profile #: 40072

REGULATORY AGENCY
☐ NPDES ☐ GROUND WATER ☐ DRINKING WATER
☐ UST ☐ RCRA ☐ OTHER ✓
Site Locadon STATE: NY

Requested Analysis Filtered (Y/N)

WO#: 10478022

10478022

Section D Required Client Information

Matrix Codes MATRIX / CODE: Drinking Water DW; Water WT; Waste Water WW; Product P; Soil/Solid SL; Oil OL; Wipe WP; Air AR; Tissue TS; Other OT

ITEM #	SAMPLE ID (A-Z, 0-9 / ,-) Sample IDs MUST BE UNIQUE	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED DATE	COLLECTED TIME	COMPOSITE END/GRAB DATE	COMPOSITE END/GRAB TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test ▼	Residual Chlorine (Y/N)	Pace Project No./ Lab I.D.
1	OW-24	WT	G	6-4-19	10 AM				2	✓								PFAS		061
2	OW-24 DUP	WT	G	6-4-19	10AM				2	✓								✓		062
3	OW-13R	WT	G	6-4-19	11:40				2	✓								✓		063
4	OW-13R MS	WT	G	6-4-19	11:...				2	✓								✓		064
5	OW-5	WT	G	6-4-19	14:45				2	✓								✓		065
6	Field Reagent Blank	WT	G	6-4-19	11:53				1	✓								✓		066
7	Equipment Blank	WT	G	6-4-19	13:05				1	✓								✓		067
8																				
9																				
10																				
11																				
12																				

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS: Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)
	Barbara J. Jones TO FEDEX	6-5-19	10AM	Collected	6.6.19	940	3.9	Y	N	Y

SAMPLER NAME AND SIGNATURE
PRINT Name of SAMPLER: Barbara Jones
SIGNATURE of SAMPLER: Barbara Jones DATE Signed (MM/DD/YY): 06/05/2019

ORIGINAL

*Important Note: By signing this form you are accepting Pace's NET 30 day payment terms and agreeing to late charges of 1.5% per month for any invoices not paid within 30 days.

F-ALL-C-010-rev.00, 09Nov2017

Pace Analytical	Document Name: Sample Condition Upon Receipt Form	Document Revised: 09May2019 Page 1 of 1
	Document No.: F-MN-L-213-rev.28	Issuing Authority: Pace Minnesota Quality Office

Sample Condition Upon Receipt

Client Name: Cardinal Resources

Project #: WO#: 10478022

PM: KNH Due Date: 06/27/19

CLIENT: Cardinal Res

Courier: ☒Fed Ex ☐UPS ☐USPS ☐Client ☐Pace ☐SpeeDee ☐Commercial See Exception ☐

Tracking Number: 7475 9398 2404

Custody Seal on Cooler/Box Present? ☐Yes ☒No **Seals Intact?** ☐Yes ☒No **Biological Tissue Frozen?** ☐Yes ☐No ☒N/A

Packing Material: ☐Bubble Wrap ☒Bubble Bags ☐None ☒Other: PB **Temp Blank?** ☐Yes ☒No

Thermometer: ☐T1(0461) ☐T2(1336) ☐T3(0459) ☒T4(0254) ☐T5(0489) **Type of Ice:** ☒Wet ☐Blue ☐None ☐Dry ☐Melted

Note: Each West Virginia Sample must have temp taken (no temp blanks)

Temp should be above freezing to 6°C	Cooler Temp Read w/temp blank: ____ °C	Average Corrected Temp (no temp blank only): 3.9 °C See Exceptions ☒
Correction Factor: ____	Cooler Temp Corrected w/temp blank: ____ °C	

USDA Regulated Soil: (☒N/A, water sample/Other: ____) **Date/Initials of Person Examining Contents:** GNZ 6.6.19

Did samples originate in a quarantine zone within the United States: AL, AR, CA, FL, GA, ID, LA. MS, NC, NM, NY, OK, OR, SC, TN, TX or VA (check maps)? ☐Yes ☐No

Did samples originate from a foreign source (internationally, including Hawaii and Puerto Rico)? ☐Yes ☐No

If Yes to either question, fill out a Regulated Soil Checklist (F-MN-Q-338) and include with SCUR/COC paperwork.

				COMMENTS:
Chain of Custody Present and Filled Out?	☒Yes	☐No		1.
Chain of Custody Relinquished?	☒Yes	☐No		2.
Sampler Name and/or Signature on COC?	☒Yes	☐No	☐N/A	3.
Samples Arrived within Hold Time?	☒Yes	☐No		4.
Short Hold Time Analysis (<72 hr)?	☐Yes	☒No		5. ☐Fecal Coliform ☐HPC ☐Total Coliform/E coli ☐BOD/cBOD ☐Hex Chrome ☐Turbidity ☐Nitrate ☐Nitrite ☐Orthophos ☐Other____
Rush Turn Around Time Requested?	☐Yes	☒No		6.
Sufficient Volume?	☒Yes	☐No		7.
Correct Containers Used? -Pace Containers Used?	☒Yes ☒Yes	☐No ☐No		8.
Containers Intact?	☒Yes	☐No		9.
Field Filtered Volume Received for Dissolved Tests?	☐Yes	☐No	☒N/A	10. Is sediment visible in the dissolved container? ☐Yes ☐No
Is sufficient information available to reconcile the samples to the COC? Matrix: ☒Water ☐Soil ☐Oil ☐Other	☒Yes	☐No	VK 6/7/19	11. If no, write ID/ Date/Time on Container Below: See Exception ☐ For sample #3 we recieved triple the volume - aside from differing collection time,
All containers needing acid/base preservation have been checked?	☐Yes	☐No	☒N/A	12. Sample # It would appear that sample 10W13RMS is MS/MSD for sample 10W-13R;
All containers needing preservation are found to be in compliance with EPA recommendation? (HNO_3, H_2SO_4, <2pH, NaOH >9 Sulfide, NaOH>12 Cyanide)	☐Yes	☐No	☒N/A	☐ NaOH ☐ HNO_3 ☐ H_2SO_4 ☐ Zinc Acetate
Exceptions: VOA, Coliform, TOC/DOC Oil and Grease, DRO/8015 (water) and Dioxin/PFAS 6/6/19 LJ	☒Yes	☐No	☐N/A	Positive for Res. Chlorine? ☐Yes ☐No pH Paper Lot# See Exception ☐
				Res. Chlorine | 0-6 Roll | 0-6 Strip | 0-14 Strip
Headspace in VOA Vials (greater than 6mm)?	☐Yes	☐No	☒N/A	13. See Exception ☐
Trip Blank Present?	☐Yes	☐No	☒N/A	14.
Trip Blank Custody Seals Present?	☐Yes	☐No	☒N/A	Pace Trip Blank Lot # (if purchased):

CLIENT NOTIFICATION/RESOLUTION **Field Data Required?** ☐Yes ☐No

Person Contacted: ____ Date/Time: ____

Comments/Resolution: ____

Project Manager Review: Kimberly Hodges **Date:** 6/7/2019

Note: Whenever there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEHNR Certification Office (i.e out of hold, incorrect preservative, out of temp, incorrect containers).

Labeled by: GNZ

Pace Analytical	Document Name: SCUR Exception Form – Coolers Above 6°C	Document Revised: 08Apr2019 Page 1 of 1
	Document No.: F-MN-C-298-Rev.02	Issuing Authority: Pace Minnesota Quality Office

During sample triage, this form is to be placed in each cooler that arrives above 6.0 degrees Celsius

SCUR Exceptions: **Workorder #:**

Out of Temp Sample IDs	Container Type	# of Containers

PM Notified? ☐Yes ☐No

If yes, indicate who was contacted/date/time.
If no, indicate reason why.

Multiple Cooler Project? ☐Yes ☐No
If you answered yes, fill out information to the left.

No Temp Blank

Read Temp	Corrected Temp	Average Temp
2.9	2.9	3.9
4.5	4.5	
5.0	5.0	
3.1	3.1	

Tracking Number/Temperature	

Other Issues

Issue Type: Sample ID	Container Type	# of Containers

pH Adjustment Log for Preserved Samples

Sample ID	Type of Preserv.	pH Upon Receipt	Date Adjusted	Time Adjusted	Amount Added (mL)	Lot # Added	pH After	In Compliance after addition?	Initials
								☐Yes ☐No	
								☐Yes ☐No	
								☐Yes ☐No	
								☐Yes ☐No	

QC Matric lot #: 187814
Time of Spiking: 06/17/19 00:00
SPE Cartridge: S322-0024
Balance: 10BALQ

TRIZMA Lot #: N/A
Optima H2O Lot #: 187814
Methanol Lot #: 187805

Extract Start: 06/17/19 00:00
Extract End: 06/17/19 00:00
Setup By: QL

	Lot Number	Amount	Initials	Expiration	Dispenser	Witness
Internal		0				
Surrogate	19206-008	100	QL	12/18/19	Q503	NH
Native Lo						
Native Mid	12332-181	100	QL	08/20/19	Q503	NH
Native Hi						
GenX IS						

#	Sample ID	GenX IS	Surrogate	Natives	Full Bottle Weight	Empty Bottle Weight	Amount Extracted	Comments
1	BLANK-71171		X		277.0	36.6	240.4	
2	LCS-71172		X	X	285.2	36.1	249.1	
3	LCSD-71173		X	X	284.4	36.5	247.8	
4	10478022003-MS		X	X	61.7	13.0	48.8	
5	10478022003-MSD		X	X	62.1	12.8	49.3	
6	92431940001		X		283.6	37.1	246.5	
7	92431940002		X		292.7	37.1	255.6	
8	92431940003		X		287.0	36.9	250.0	
9	50227529001		X		299.3	37.2	262.1	
10	50227529002		X		300.7	36.8	263.9	
11	10478022001		X		308.1	36.9	271.2	
12	10478022002		X		304.2	37.0	267.2	
13	10478022003		X		61.7	12.9	48.8	
14	10478022005		X		302.3	37.2	265.1	
15	10478022006		X		290.6	37.0	253.6	
16	10478022007		X		221.8	37.1	184.7	

EB-24808

Instrument Run Log

Instrument: 10LCMS01
Analysis Sequence: Q190620A
Injection Volume: 5uL

Start: 06/20/2019 16:24
End: 06/20/2019 19:58

Type	Lab Sample ID	Client Sample ID	Datafile	Analyzed	DF	Analyst
CCal	CAL-19206-006-01		Q190620A_004	06/20/2019 16:24	1	QL
CCal	CAL-19206-006-02		Q190620A_005	06/20/2019 16:51	1	QL
CCal	CAL-19206-006-03		Q190620A_006	06/20/2019 17:18	1	QL
CCal	CAL-19206-006-04		Q190620A_007	06/20/2019 17:44	1	QL
CCal	CAL-19206-006-05		Q190620A_008	06/20/2019 18:11	1	QL
CCal	CAL-19206-006-06		Q190620A_009	06/20/2019 18:38	1	QL
CCal	CAL-19206-006-07		Q190620A_010	06/20/2019 19:04	1	QL
ICV	ICV-19206-007		Q190620A_012	06/20/2019 19:58	1	QL

Instrument Run Log

Instrument: 10LCMS01
Analysis Sequence: Q190621C
Injection Volume: 5uL

Start: 06/21/2019 19:12
End: 06/22/2019 11:12

Type	Lab Sample ID	Client Sample ID	Datafile	Analyzed	DF	Analyst
CCal	CAL-19206-006-01		Q190621C_002	06/21/2019 19:12	1	QL
Sample	40188156002	XXXXXXXXXX	Q190621C_003	06/21/2019 19:38	0	QL
Sample	50226517001	XXXXXXXXXX	Q190621C_004	06/21/2019 20:05	10	QL
Sample	50226517002	XXXXXXXXXX	Q190621C_005	06/21/2019 20:32	10	QL
Sample	50226517003	XXXXXXXXXX	Q190621C_006	06/21/2019 20:58	10	QL
Sample	50226517001-DUP	XXXXXXXXXX	Q190621C_007	06/21/2019 21:25	10	QL
Sample	92430962001	XXXXXXXXXX	Q190621C_008	06/21/2019 21:52	10	QL
Sample	92430962002	XXXXXXXXXX	Q190621C_009	06/21/2019 22:18	10	QL
Sample	92431256001	XXXXXXXXXX	Q190621C_010	06/21/2019 22:45	10	QL
Sample	92431256003	XXXXXXXXXX	Q190621C_011	06/21/2019 23:12	10	QL
Sample	92431256004	XXXXXXXXXX	Q190621C_012	06/21/2019 23:38	10	QL
CCal	CAL-19206-006-04		Q190621C_013	06/22/2019 00:05	1	QL
Sample	35472994002	XXXXXXXXXX	Q190621C_014	06/22/2019 00:32	10	QL
Sample	40188156002	XXXXXXXXXX	Q190621C_015	06/22/2019 00:58	0	QL
Sample	50226517001	XXXXXXXXXX	Q190621C_016	06/22/2019 01:25	50	QL
Sample	50226517002	XXXXXXXXXX	Q190621C_017	06/22/2019 01:52	50	QL
Sample	50226517003	XXXXXXXXXX	Q190621C_018	06/22/2019 02:18	50	QL
Sample	50226517001-DUP	XXXXXXXXXX	Q190621C_019	06/22/2019 02:45	50	QL
CCal	CAL-19206-006-01		Q190621C_020	06/22/2019 03:12	1	QL
Method Blan	BLANK-71171	BLKCT	Q190621C_021	06/22/2019 03:39	1	QL
LCS	LCS-71172	LCSOT	Q190621C_022	06/22/2019 04:05	1	QL
Sample	92431940001	XXXXXXXXXX	Q190621C_026	06/22/2019 05:52	1	QL
Sample	92431940002	XXXXXXXXXX	Q190621C_027	06/22/2019 06:19	1	QL
Sample	92431940003	XXXXXXXXXX	Q190621C_028	06/22/2019 06:45	1	QL
Sample	50227529001	XXXXXXXXXX	Q190621C_029	06/22/2019 07:12	1	QL
Sample	50227529002	XXXXXXXXXX	Q190621C_030	06/22/2019 07:39	1	QL
Sample	10478022001	OW-24	Q190621C_031	06/22/2019 08:05	1	QL
Sample	10478022002	OW-24 DUP	Q190621C_032	06/22/2019 08:32	1	QL
CCal	CAL-19206-006-04		Q190621C_033	06/22/2019 08:59	1	QL
Sample	10478022003	OW-13R	Q190621C_034	06/22/2019 09:25	1	QL
Sample	10478022005	OW-5	Q190621C_035	06/22/2019 09:52	1	QL
Sample	10478022006	Field Reagent Blank	Q190621C_036	06/22/2019 10:19	1	QL
Sample	10478022007	EquipmentBlank	Q190621C_037	06/22/2019 10:46	1	QL
CCal	CAL-19206-006-01		Q190621C_038	06/22/2019 11:12	1	QL

Instrument Run Log

Instrument: 10LCMS01
Analysis Sequence: Q190624A
Injection Volume: 5uL

Start: 06/24/2019 11:31
End: 06/25/2019 08:52

Type	Lab Sample ID	Client Sample ID	Datafile	Analyzed	DF	Analyst
CCal	CAL-19206-006-01		Q190624A_003	06/24/2019 11:31	1	QL
Sample	10478022001	OW-24	Q190624A_007	06/24/2019 13:18	10	QL
Sample	10478022002	OW-24 DUP	Q190624A_008	06/24/2019 13:45	10	QL
Sample	10478022005	OW-5	Q190624A_009	06/24/2019 14:11	10	QL
Sample	10478022007	EquipmentBlank	Q190624A_010	06/24/2019 14:38	10	QL
Method Blan	BLANK-71223	BLKDK	Q190624A_011	06/24/2019 15:05	1	QL
LCS	LCS-71224	LCSPQ	Q190624A_012	06/24/2019 15:31	1	QL
LCSD	LCSD-71225	LCSPR	Q190624A_013	06/24/2019 15:58	1	QL
Sample	92432241001	XXXXXXXXXX	Q190624A_014	06/24/2019 16:25	1	QL
Sample	92432241002	XXXXXXXXXX	Q190624A_015	06/24/2019 16:51	1	QL
Sample	92432241003	XXXXXXXXXX	Q190624A_016	06/24/2019 17:18	1	QL
Sample	92432241004	XXXXXXXXXX	Q190624A_017	06/24/2019 17:45	1	QL
CCal	CAL-19206-006-04		Q190624A_018	06/24/2019 18:12	1	QL
Sample	92432241005	XXXXXXXXXX	Q190624A_019	06/24/2019 18:38	1	QL
Sample	92432241006	XXXXXXXXXX	Q190624A_020	06/24/2019 19:05	1	QL
Sample	92432241007	XXXXXXXXXX	Q190624A_021	06/24/2019 19:32	1	QL
Field Blank	92432241008	XXXXXXXXXX	Q190624A_022	06/24/2019 19:58	1	QL
Sample	92432241009	XXXXXXXXXX	Q190624A_023	06/24/2019 20:25	1	QL
Sample	92432241010	XXXXXXXXXX	Q190624A_024	06/24/2019 20:52	1	QL
Sample	92432241011	XXXXXXXXXX	Q190624A_025	06/24/2019 21:18	1	QL
Sample	92432241012	XXXXXXXXXX	Q190624A_026	06/24/2019 21:45	1	QL
Sample	92432241013	XXXXXXXXXX	Q190624A_027	06/24/2019 22:12	1	QL
Sample	92432241014	XXXXXXXXXX	Q190624A_028	06/24/2019 22:38	1	QL
CCal	CAL-19206-006-01		Q190624A_029	06/24/2019 23:05	1	QL
Sample	92432241015	XXXXXXXXXX	Q190624A_030	06/24/2019 23:32	1	QL
Sample	92432241016	XXXXXXXXXX	Q190624A_031	06/24/2019 23:58	1	QL
Sample	92432241017	XXXXXXXXXX	Q190624A_032	06/25/2019 00:25	1	QL
Sample	92432241018	XXXXXXXXXX	Q190624A_033	06/25/2019 00:52	1	QL
Method Blan	BLANK-70932	BLKAM	Q190624A_034	06/25/2019 01:18	1	QL
LCS	LCS-70933	LCSJI	Q190624A_035	06/25/2019 01:45	1	QL
LCSD	LCSD-70934	LCSJJ	Q190624A_036	06/25/2019 02:12	1	QL
Sample	92431256005	XXXXXXXXXX	Q190624A_037	06/25/2019 02:39	1	QL
Sample	92431256006	XXXXXXXXXX	Q190624A_038	06/25/2019 03:05	1	QL
Sample	92431256007	XXXXXXXXXX	Q190624A_039	06/25/2019 03:32	1	QL
Sample	92431256008	XXXXXXXXXX	Q190624A_040	06/25/2019 03:59	1	QL
Sample	92431256009	XXXXXXXXXX	Q190624A_041	06/25/2019 04:25	1	QL
Sample	92431256010	XXXXXXXXXX	Q190624A_042	06/25/2019 04:52	1	QL
CCal	CAL-19206-006-04		Q190624A_043	06/25/2019 05:19	1	QL
Sample	92431256011	XXXXXXXXXX	Q190624A_044	06/25/2019 05:45	1	QL
Sample	92431256012	XXXXXXXXXX	Q190624A_045	06/25/2019 06:12	1	QL
Sample	92431256013	XXXXXXXXXX	Q190624A_046	06/25/2019 06:39	1	QL
Sample	92431256014	XXXXXXXXXX	Q190624A_047	06/25/2019 07:05	1	QL
Sample	92431256015	XXXXXXXXXX	Q190624A_048	06/25/2019 07:32	1	QL
Sample	92431256016	XXXXXXXXXX	Q190624A_049	06/25/2019 07:59	1	QL
Sample	92431256017	XXXXXXXXXX	Q190624A_050	06/25/2019 08:26	1	QL
CCal	CAL-19206-006-01		Q190624A_051	06/25/2019 08:52	1	QL

Instrument Run Log

Instrument: 10LCMS01
Analysis Sequence: Q190625A
Injection Volume: 5uL

Start: 06/25/2019 09:46
End: 06/25/2019 23:06

Type	Lab Sample ID	Client Sample ID	Datafile	Analyzed	DF	Analyst
Sample	92432241001	XXXXXXXXXX	Q190625A_001	06/25/2019 09:46	10	QL
Sample	92432241003	XXXXXXXXXX	Q190625A_002	06/25/2019 10:12	10	QL
Sample	92432241006	XXXXXXXXXX	Q190625A_003	06/25/2019 10:39	10	QL
Sample	92432241009	XXXXXXXXXX	Q190625A_004	06/25/2019 11:06	10	QL
Sample	92432241010	XXXXXXXXXX	Q190625A_005	06/25/2019 11:32	10	QL
Sample	92432241011	XXXXXXXXXX	Q190625A_006	06/25/2019 11:59	10	QL
Sample	92432241012	XXXXXXXXXX	Q190625A_007	06/25/2019 12:26	10	QL
Sample	92432241013	XXXXXXXXXX	Q190625A_008	06/25/2019 12:52	10	QL
MS	10478022003-MS	OW-13R-MS	Q190625A_009	06/25/2019 13:19	1	QL
MSD	10478022003-MSD	OW-13R-MSD	Q190625A_010	06/25/2019 13:46	1	QL
CCal	CAL-19206-006-04		Q190625A_011	06/25/2019 14:12	1	QL
Sample	92432241014	XXXXXXXXXX	Q190625A_012	06/25/2019 14:39	10	QL
Sample	92432241016	XXXXXXXXXX	Q190625A_013	06/25/2019 15:06	10	QL
Sample	92432241017	XXXXXXXXXX	Q190625A_014	06/25/2019 15:32	10	QL
Sample	92432241001	XXXXXXXXXX	Q190625A_015	06/25/2019 15:59	100	QL
Sample	92431256005	XXXXXXXXXX	Q190625A_016	06/25/2019 16:26	10	QL
Sample	92431256006	XXXXXXXXXX	Q190625A_017	06/25/2019 16:52	10	QL
Sample	92431256007	XXXXXXXXXX	Q190625A_018	06/25/2019 17:19	10	QL
Sample	92431256008	XXXXXXXXXX	Q190625A_019	06/25/2019 17:46	10	QL
Sample	92431256009	XXXXXXXXXX	Q190625A_020	06/25/2019 18:12	10	QL
Sample	92431256010	XXXXXXXXXX	Q190625A_021	06/25/2019 18:39	10	QL
CCal	CAL-19206-006-01		Q190625A_022	06/25/2019 19:06	1	QL
Sample	92431256011	XXXXXXXXXX	Q190625A_023	06/25/2019 19:33	10	QL
Sample	92431256012	XXXXXXXXXX	Q190625A_024	06/25/2019 19:59	10	QL
Sample	92431256013	XXXXXXXXXX	Q190625A_025	06/25/2019 20:26	10	QL
Sample	92431256014	XXXXXXXXXX	Q190625A_026	06/25/2019 20:53	10	QL
Sample	92431256015	XXXXXXXXXX	Q190625A_027	06/25/2019 21:19	10	QL
Sample	92431256016	XXXXXXXXXX	Q190625A_028	06/25/2019 21:46	10	QL
Sample	92431256017	XXXXXXXXXX	Q190625A_029	06/25/2019 22:13	10	QL
CCal	CAL-19206-006-04		Q190625A_030	06/25/2019 22:39	1	QL
Sample	92432241017	XXXXXXXXXX	Q190625A_031	06/25/2019 23:06	100	QL

Instrument Run Log

Instrument: 10LCMS01
Analysis Sequence: Q190628A
Injection Volume: 5uL

Start: 06/28/2019 11:21
End: 06/28/2019 14:55

Type	Lab Sample ID	Client Sample ID	Datafile	Analyzed	DF	Analyst
CCal	CAL-19206-006-01		Q190628A_003	06/28/2019 11:21	1	QL
CCal	CAL-19206-006-02		Q190628A_004	06/28/2019 11:48	1	QL
CCal	CAL-19206-006-03		Q190628A_005	06/28/2019 12:15	1	QL
CCal	CAL-19206-006-04		Q190628A_006	06/28/2019 12:42	1	QL
CCal	CAL-19206-006-05		Q190628A_007	06/28/2019 13:08	1	QL
CCal	CAL-19206-006-06		Q190628A_008	06/28/2019 13:35	1	QL
CCal	CAL-19206-006-07		Q190628A_009	06/28/2019 14:02	1	QL
ICV	ICV-19206-007		Q190628A_011	06/28/2019 14:55	1	QL

Instrument Run Log

Instrument: 10LCMS01
Analysis Sequence: Q190701A
Injection Volume: 5uL

Start: 07/01/2019 13:06
End: 07/01/2019 15:46

Type	Lab Sample ID	Client Sample ID	Datafile	Analyzed	DF	Analyst
CCal	CAL-19206-006-01		Q190701A_003	07/01/2019 13:06	1	QL
LCSD	LCSD-71225	LCSPR	Q190701A_004	07/01/2019 13:33	1	QL
Sample	10478022006	Field Reagent Blank	Q190701A_005	07/01/2019 14:00	1	QL
Sample	10478022007	EquipmentBlank	Q190701A_006	07/01/2019 14:26	1	QL
Sample	35474777003	XXXXXXXXXX	Q190701A_007	07/01/2019 14:53	1	QL
Sample	35474777004	XXXXXXXXXX	Q190701A_008	07/01/2019 15:20	1	QL
CCal	CAL-19206-006-04		Q190701A_009	07/01/2019 15:46	1	QL

Appendix B

Sample Analysis Summary

Pace Analytical Services, LLC
1700 Elm Street, Suite 200
Minneapolis, MN 55414
(612) 607-1700

PFAS by Isotope Dilution
Sample Analysis Summary

Client's Sample ID	OW-24	Date Extracted	06/17/2019
Lab Sample ID	10478022001	Total Amount Extracted	271 mL
Filename	Q190621C_031	ICAL ID	190620A01
Matrix	Ground_Water	Starting CCal	Q190621C_020
Collected	06/04/2019	Ending CCal	Q190621C_033
Received	06/06/2019	Method Blank Filename	Q190621C_021

Compound	Concentration (ng/L)		PQL (ng/L)	MDL (ng/L)	Dilution	Analyzed	CAS No.	Qual.
PFBA	ND		1.8	0.20	1	06/22/201908:05	375-22-4	N2
PFPeA	ND		1.8	0.25	1	06/22/201908:05	2706-90-3	N2
PFHxA	ND		1.8	0.44	1	06/22/201908:05	307-24-4	N2
PFHpA	ND		1.8	0.13	1	06/22/201908:05	375-85-9	N2
PFOA	ND		1.8	0.57	1	06/22/201908:05	335-67-1	N2
PFNA	ND		1.8	0.59	1	06/22/201908:05	375-95-1	N2
PFDA	ND		1.8	0.79	1	06/22/201908:05	335-76-2	N2
PFUdA	ND		1.8	0.80	1	06/22/201908:05	2058-94-8	N2
PFDoA	ND		1.8	0.67	1	06/22/201908:05	307-55-1	N2
PFTrDA	ND		1.8	0.65	1	06/22/201908:05	72629-94-8	N2
PFTeDA	ND	D	18	3.5	10	06/24/201913:18	376-06-7	N2
PFOSA	ND		1.8	0.37	1	06/22/201908:05	754-91-6	N2
N-EtFOSAA	ND		1.8	0.85	1	06/22/201908:05	2991-50-6	N2
N-MeFOSAA	ND		1.8	0.45	1	06/22/201908:05	2355-31-9	N2
PFBS	ND		1.6	0.17	1	06/22/201908:05	375-73-5	N2
PFPeS	ND		1.7	0.17	1	06/22/201908:05	2706-91-4	N2
PFHxS	ND		1.7	0.32	1	06/22/201908:05	355-46-4	N2
PFHpS	ND		1.8	0.78	1	06/22/201908:05	375-92-8	N2
PFOS	ND		1.7	0.30	1	06/22/201908:05	1763-23-1	N2
PFNS	ND		1.8	0.61	1	06/22/201908:05	68259-12-1	N2
PFDS	ND		1.8	0.49	1	06/22/201908:05	335-77-3	N2
4:2FTS	ND		1.8	0.32	1	06/22/201908:05	757124-72-4	N2
6:2FTS	ND		1.8	0.86	1	06/22/201908:05	27619-97-2	N2
8:2FTS	ND		1.8	0.70	1	06/22/201908:05	39108-34-4	N2

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PFAS by Isotope Dilution
Sample Analysis Summary

Client's Sample ID	OW-24	Date Extracted	06/17/2019
Lab Sample ID	10478022001	Total Amount Extracted	271 mL
Filename	Q190621C_031	ICAL ID	190620A01
Matrix	Ground_Water	Starting CCal	Q190621C_020
Collected	06/04/2019	Ending CCal	Q190621C_033
Received	06/06/2019	Method Blank Filename	Q190621C_021

Internal Standards Compound	Known Conc.	Conc. Found	%Recovery	Recovery Limits	Pass/Fail	Area
13C4_PFBA	18	19	104	50-150	Pass	1288708
13C5_PFPeA	18	20	111	50-150	Pass	977867
13C5_PFHxA	18	21	112	50-150	Pass	970772
13C4_PFHpA	18	21	114	50-150	Pass	1110351
13C8_PFOA	18	21	112	50-150	Pass	798720
13C9_PFNA	18	26	142	50-150	Pass	804823
13C6_PFDA	18	27	145	50-150	Pass	481470
13C7_PFUdA	18	26	142	50-150	Pass	523073
13C2_PFDoA	18	28	149	50-150	Pass	746937
13C2_PFTeDA	18	22	119	50-150	Pass	40646
d5-EtFOSAA	18	24	130	50-150	Pass	86800
d3-MeFOSAA	18	23	125	50-150	Pass	94298
13C3_PFBS	18	21	113	50-150	Pass	727569
13C3_PFHxS	18	23	124	50-150	Pass	678363
13C8_PFOS	18	23	126	50-150	Pass	495157
13C8_FOSA	18	14	74	50-150	Pass	641821
13C2_4:2FTS	18	26	140	50-150	Pass	153622
13C6_6:2FTS	18	23	124	50-150	Pass	129440
13C6_8:2FTS	18	23	125	50-150	Pass	108218

Injection Internal Standards

IS Compound	Area	Ical Limits	CCV Limits	Pass/Fail
13C4_PFOA	937969	457003 - 1371008	513524 - 1540572	Pass
13C4_PFOS	466597	246073 - 738220	267452 - 802356	Pass

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PFAS by Isotope Dilution
Sample Analysis Summary

Client's Sample ID	OW-24 DUP	Date Extracted	06/17/2019
Lab Sample ID	10478022002	Total Amount Extracted	267 mL
Filename	Q190621C_032	ICAL ID	190620A01
Matrix	Ground_Water	Starting CCal	Q190621C_020
Collected	06/04/2019	Ending CCal	Q190621C_033
Received	06/06/2019	Method Blank Filename	Q190621C_021

Compound	Concentration (ng/L)		PQL (ng/L)	MDL (ng/L)	Dilution	Analyzed	CAS No.	Qual.
PFBA	ND		1.9	0.21	1	06/22/2019 08:32	375-22-4	N2
PFPeA	ND		1.9	0.25	1	06/22/2019 08:32	2706-90-3	N2
PFHxA	ND		1.9	0.44	1	06/22/2019 08:32	307-24-4	N2
PFHpA	ND		1.9	0.13	1	06/22/2019 08:32	375-85-9	N2
PFOA	ND		1.9	0.58	1	06/22/2019 08:32	335-67-1	N2
PFNA	ND		1.9	0.59	1	06/22/2019 08:32	375-95-1	N2
PFDA	ND		1.9	0.80	1	06/22/2019 08:32	335-76-2	N2
PFUdA	ND	D	19	8.2	10	06/24/2019 13:45	2058-94-8	N2
PFDoA	ND	D	19	6.8	10	06/24/2019 13:45	307-55-1	N2
PFTrDA	ND	D	19	6.6	10	06/24/2019 13:45	72629-94-8	N2
PFTeDA	ND	D	19	3.5	10	06/24/2019 13:45	376-06-7	N2
PFOSA	ND		1.9	0.37	1	06/22/2019 08:32	754-91-6	N2
N-EtFOSAA	ND		1.9	0.86	1	06/22/2019 08:32	2991-50-6	N2
N-MeFOSAA	ND		1.9	0.45	1	06/22/2019 08:32	2355-31-9	N2
PFBS	ND		1.7	0.18	1	06/22/2019 08:32	375-73-5	N2
PFPeS	ND		1.8	0.17	1	06/22/2019 08:32	2706-91-4	N2
PFHxS	ND		1.7	0.33	1	06/22/2019 08:32	355-46-4	N2
PFHpS	ND		1.8	0.80	1	06/22/2019 08:32	375-92-8	N2
PFOS	ND		1.7	0.31	1	06/22/2019 08:32	1763-23-1	N2
PFNS	ND		1.9	0.62	1	06/22/2019 08:32	68259-12-1	N2
PFDS	ND		1.9	0.49	1	06/22/2019 08:32	335-77-3	N2
4:2FTS	ND		1.9	0.32	1	06/22/2019 08:32	757124-72-4	N2
6:2FTS	ND		1.9	0.87	1	06/22/2019 08:32	27619-97-2	N2
8:2FTS	ND		1.9	0.71	1	06/22/2019 08:32	39108-34-4	N2

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PFAS by Isotope Dilution
Sample Analysis Summary

Client's Sample ID	OW-24 DUP	Date Extracted	06/17/2019
Lab Sample ID	10478022002	Total Amount Extracted	267 mL
Filename	Q190621C_032	ICAL ID	190620A01
Matrix	Ground_Water	Starting CCal	Q190621C_020
Collected	06/04/2019	Ending CCal	Q190621C_033
Received	06/06/2019	Method Blank Filename	Q190621C_021

Internal Standards Compound	Known Conc.	Conc. Found	%Recovery	Recovery Limits	Pass/Fail	Area
13C4_PFBA	19	20	106	50-150	Pass	1274431
13C5_PFPeA	19	21	113	50-150	Pass	978072
13C5_PFHxA	19	21	115	50-150	Pass	967168
13C4_PFHpA	19	22	117	50-150	Pass	1116372
13C8_PFOA	19	22	120	50-150	Pass	838445
13C9_PFNA	19	27	145	50-150	Pass	775509
13C6_PFDA	19	28	150	50-150	Pass	469866
13C7_PFUdA	19	20	108	50-150	Pass	55505
13C2_PFDoA	19	19	99	50-150	Pass	68793
13C2_PFTeDA	19	21	115	50-150	Pass	39470
d5-EtFOSAA	19	25	136	50-150	Pass	85890
d3-MeFOSAA	19	26	138	50-150	Pass	97991
13C3_PFBS	19	21	113	50-150	Pass	710856
13C3_PFHxS	19	24	129	50-150	Pass	666882
13C8_PFOS	19	24	130	50-150	Pass	482964
13C8_FOSA	19	17	90	50-150	Pass	740367
13C2_4:2FTS	19	27	143	50-150	Pass	153492
13C6_6:2FTS	19	23	123	50-150	Pass	125192
13C6_8:2FTS	19	25	135	50-150	Pass	110326

Injection Internal Standards

IS Compound	Area	Ical Limits	CCV Limits	Pass/Fail
13C4_PFOA	917345	457003 - 1371008	513524 - 1540572	Pass
13C4_PFOS	440673	246073 - 738220	267452 - 802356	Pass

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PFAS by Isotope Dilution
Sample Analysis Summary

Client's Sample ID	OW-13R	Date Extracted	06/17/2019
Lab Sample ID	10478022003	Total Amount Extracted	49 mL
Filename	Q190621C_034	ICAL ID	190620A01
Matrix	Ground_Water	Starting CCal	Q190621C_033
Collected	06/04/2019	Ending CCal	Q190621C_038
Received	06/06/2019	Method Blank Filename	Q190621C_021

Compound	Concentration (ng/L)	PQL (ng/L)	MDL (ng/L)	Dilution	Analyzed	CAS No.	Qual.
PFBA	ND	10	1.1	1	06/22/201909:25	375-22-4	N2
PFPeA	ND	10	1.4	1	06/22/201909:25	2706-90-3	N2
PFHxA	ND	10	2.4	1	06/22/201909:25	307-24-4	N2
PFHpA	ND	10	0.70	1	06/22/201909:25	375-85-9	N2
PFOA	ND	10	3.2	1	06/22/201909:25	335-67-1	N2
PFNA	ND	10	3.3	1	06/22/201909:25	375-95-1	N2
PFDA	ND	10	4.4	1	06/22/201909:25	335-76-2	N2
PFUdA	ND	10	4.5	1	06/22/201909:25	2058-94-8	N2
PFDoA	ND	10	3.7	1	06/22/201909:25	307-55-1	N2
PFTrDA	ND	10	3.6	1	06/22/201909:25	72629-94-8	N2
PFTeDA	ND	10	1.9	1	06/22/201909:25	376-06-7	N2
PFOSA	ND	10	2.1	1	06/22/201909:25	754-91-6	N2
N-EtFOSAA	ND	10	4.7	1	06/22/201909:25	2991-50-6	N2
N-MeFOSAA	ND	10	2.5	1	06/22/201909:25	2355-31-9	N2
PFBS	ND	9.1	0.97	1	06/22/201909:25	375-73-5	N2
PFPeS	ND	9.6	0.94	1	06/22/201909:25	2706-91-4	N2
PFHxS	ND	9.4	1.8	1	06/22/201909:25	355-46-4	N2
PFHpS	ND	9.7	4.4	1	06/22/201909:25	375-92-8	N2
PFOS	ND	9.5	1.7	1	06/22/201909:25	1763-23-1	N2
PFNS	ND	10	3.4	1	06/22/201909:25	68259-12-1	N2
PFDS	ND	10	2.7	1	06/22/201909:25	335-77-3	N2
4:2FTS	ND	10	1.8	1	06/22/201909:25	757124-72-4	N2
6:2FTS	ND	10	4.8	1	06/22/201909:25	27619-97-2	N2
8:2FTS	ND	10	3.9	1	06/22/201909:25	39108-34-4	N2

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PFAS by Isotope Dilution
Sample Analysis Summary

Client's Sample ID	OW-13R	Date Extracted	06/17/2019
Lab Sample ID	10478022003	Total Amount Extracted	49 mL
Filename	Q190621C_034	ICAL ID	190620A01
Matrix	Ground_Water	Starting CCal	Q190621C_033
Collected	06/04/2019	Ending CCal	Q190621C_038
Received	06/06/2019	Method Blank Filename	Q190621C_021

Internal Standards Compound	Known Conc.	Conc. Found	%Recovery	Recovery Limits	Pass/Fail	Area
13C4_PFBA	100	110	107	50-150	Pass	1249989
13C5_PFPeA	100	110	110	50-150	Pass	917094
13C5_PFHxA	100	120	113	50-150	Pass	919041
13C4_PFHpA	100	120	116	50-150	Pass	1060784
13C8_PFOA	100	110	109	50-150	Pass	737635
13C9_PFNA	100	130	127	50-150	Pass	671428
13C6_PFDA	100	130	129	50-150	Pass	400286
13C7_PFUdA	100	150	145	50-150	Pass	499857
13C2_PFDoA	100	140	133	50-150	Pass	622666
13C2_PFTeDA	100	150	146	50-150	Pass	337292
d5-EtFOSAA	100	140	132	50-150	Pass	82183
d3-MeFOSAA	100	130	129	50-150	Pass	90618
13C3_PFBS	100	120	117	50-150	Pass	711392
13C3_PFHxS	100	130	129	50-150	Pass	662155
13C8_PFOS	100	130	126	50-150	Pass	463585
13C8_FOSA	100	91	89	50-150	Pass	720703
13C2_4:2FTS	100	120	116	50-150	Pass	120214
13C6_6:2FTS	100	120	118	50-150	Pass	115784
13C6_8:2FTS	100	140	137	50-150	Pass	110566

Injection Internal Standards

IS Compound	Area	Ical Limits	CCV Limits	Pass/Fail
13C4_PFOA	885302	457003 - 1371008	462036 - 1386109	Pass
13C4_PFOS	435469	246073 - 738220	256408 - 769225	Pass

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PFAS by Isotope Dilution
Sample Analysis Summary

Client's Sample ID	OW-5	Date Extracted	06/17/2019
Lab Sample ID	10478022005	Total Amount Extracted	265 mL
Filename	Q190621C_035	ICAL ID	190620A01
Matrix	Ground_Water	Starting CCal	Q190621C_033
Collected	06/04/2019	Ending CCal	Q190621C_038
Received	06/06/2019	Method Blank Filename	Q190621C_021

Compound	Concentration (ng/L)		PQL (ng/L)	MDL (ng/L)	Dilution	Analyzed	CAS No.	Qual.
PFBA	2.6		1.9	0.21	1	06/22/201909:52	375-22-4	N2
PFPeA	ND		1.9	0.25	1	06/22/201909:52	2706-90-3	N2
PFHxA	2.1		1.9	0.45	1	06/22/201909:52	307-24-4	N2
PFHpA	2.2		1.9	0.13	1	06/22/201909:52	375-85-9	N2
PFOA	9.7		1.9	0.59	1	06/22/201909:52	335-67-1	N2
PFNA	ND		1.9	0.60	1	06/22/201909:52	375-95-1	N2
PFDA	ND	D	19	8.1	10	06/24/201914:11	335-76-2	N2
PFUdA	ND		1.9	0.82	1	06/22/201909:52	2058-94-8	N2
PFDoA	ND	D	19	6.9	10	06/24/201914:11	307-55-1	N2
PFTrDA	ND	D	19	6.6	10	06/24/201914:11	72629-94-8	N2
PFTeDA	ND	D	19	3.6	10	06/24/201914:11	376-06-7	N2
PFOSA	ND		1.9	0.38	1	06/22/201909:52	754-91-6	N2
N-EtFOSAA	ND	D	19	8.7	10	06/24/201914:11	2991-50-6	N2
N-MeFOSAA	ND	D	19	4.6	10	06/24/201914:11	2355-31-9	N2
PFBS	ND		1.7	0.18	1	06/22/201909:52	375-73-5	N2
PFPeS	ND		1.8	0.17	1	06/22/201909:52	2706-91-4	N2
PFHxS	2.5		1.7	0.33	1	06/22/201909:52	355-46-4	N2
PFHpS	ND		1.8	0.80	1	06/22/201909:52	375-92-8	N2
PFOS	8.4		1.7	0.31	1	06/22/201909:52	1763-23-1	N2
PFNS	ND		1.9	0.62	1	06/22/201909:52	68259-12-1	N2
PFDS	ND		1.9	0.50	1	06/22/201909:52	335-77-3	N2
4:2FTS	ND	D	19	3.3	10	06/24/201914:11	757124-72-4	N2
6:2FTS	ND		1.9	0.88	1	06/22/201909:52	27619-97-2	N2
8:2FTS	ND	D	19	7.2	10	06/24/201914:11	39108-34-4	N2

UJ
BW 7/8/2019
surrogate recovery

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PFAS by Isotope Dilution
Sample Analysis Summary

Client's Sample ID	OW-5	Date Extracted	06/17/2019
Lab Sample ID	10478022005	Total Amount Extracted	265 mL
Filename	Q190621C_035	ICAL ID	190620A01
Matrix	Ground_Water	Starting CCal	Q190621C_033
Collected	06/04/2019	Ending CCal	Q190621C_038
Received	06/06/2019	Method Blank Filename	Q190621C_021

Internal Standards Compound	Known Conc.	Conc. Found	%Recovery	Recovery Limits	Pass/Fail	Area
13C4_PFBA	19	19	99	50-150	Pass	1339534
13C5_PFPeA	19	21	112	50-150	Pass	1078177
13C5_PFHxA	19	21	112	50-150	Pass	1053692
13C4_PFHpA	19	22	114	50-150	Pass	1214124
13C8_PFOA	19	22	115	50-150	Pass	898466
13C9_PFNA	19	28	146	50-150	Pass	853227
13C6_PFDA	19	21	112	50-150	Pass	36425
13C7_PFUdA	19	26	140	50-150	Pass	532313
13C2_PFDoA	19	21	113	50-150	Pass	55151
13C2_PFTeDA	19	25	133	50-150	Pass	32430
d5-EtFOSAA	19	25	130	50-150	Pass	8514
d3-MeFOSAA	19	25	130	50-150	Pass	9610
13C3_PFBS	19	20	108	50-150	Pass	761462
13C3_PFHxS	19	23	123	50-150	Pass	692901
13C8_PFOS	19	22	117	50-150	Pass	471578
13C8_FOSA	19	14	74	50-150	Pass	662697
13C2_4:2FTS	19	32	168	50-150	Fail	16294
13C6_6:2FTS	19	27	142	50-150	Pass	162294
13C6_8:2FTS	19	22	117	50-150	Pass	9910

Injection Internal Standards

IS Compound	Area	Ical Limits	CCV Limits	Pass/Fail
13C4_PFOA	1026376	457003 - 1371008	462036 - 1386109	Pass
13C4_PFOS	478812	246073 - 738220	256408 - 769225	Pass

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PFAS by Isotope Dilution
Sample Analysis Summary

Client's Sample ID	Field Reagent Blank	Date Extracted	06/17/2019
Lab Sample ID	10478022006	Total Amount Extracted	254 mL
Filename	Q190701A_005	ICAL ID	190628A01
Matrix	Ground_Water	Starting CCal	Q190701A_003
Collected	06/04/2019	Ending CCal	Q190701A_009
Received	06/06/2019	Method Blank Filename	Q190621C_021

Compound	Concentration (ng/L)	PQL (ng/L)	MDL (ng/L)	Dilution	Analyzed	CAS No.	Qual.
PFBA	ND	2.0	0.82	1	07/01/2019 14:00	375-22-4	N2
PFPeA	ND	2.0	0.50	1	07/01/2019 14:00	2706-90-3	N2
PFHxA	ND	2.0	0.51	1	07/01/2019 14:00	307-24-4	N2
PFHpA	ND	2.0	0.54	1	07/01/2019 14:00	375-85-9	N2
PFOA	ND	2.0	0.55	1	07/01/2019 14:00	335-67-1	N2
PFNA	ND	2.0	0.57	1	07/01/2019 14:00	375-95-1	N2
PFDA	ND	2.0	0.60	1	07/01/2019 14:00	335-76-2	N2
PFUdA	ND	2.0	0.43	1	07/01/2019 14:00	2058-94-8	N2
PFDoA	ND	2.0	0.57	1	07/01/2019 14:00	307-55-1	N2
PFTrDA	ND	2.0	0.59	1	07/01/2019 14:00	72629-94-8	N2
PFTeDA	ND	2.0	0.40	1	07/01/2019 14:00	376-06-7	N2
PFOSA	ND	2.0	0.34	1	07/01/2019 14:00	754-91-6	N2
N-EtFOSAA	ND	2.0	0.57	1	07/01/2019 14:00	2991-50-6	N2
N-MeFOSAA	ND	2.0	0.66	1	07/01/2019 14:00	2355-31-9	N2
PFBS	ND	1.7	0.53	1	07/01/2019 14:00	375-73-5	N2
PFPeS	ND	1.9	0.65	1	07/01/2019 14:00	2706-91-4	N2
PFHxS	ND	1.8	0.58	1	07/01/2019 14:00	355-46-4	N2
PFHpS	ND	1.9	0.69	1	07/01/2019 14:00	375-92-8	N2
PFOS	ND	1.8	0.40	1	07/01/2019 14:00	1763-23-1	N2
PFNS	ND	2.0	0.97	1	07/01/2019 14:00	68259-12-1	N2
PFDS	ND	2.0	0.88	1	07/01/2019 14:00	335-77-3	N2
4:2FTS	ND	2.0	0.72	1	07/01/2019 14:00	757124-72-4	N2
6:2FTS	ND	2.0	0.96	1	07/01/2019 14:00	27619-97-2	N2
8:2FTS	ND	2.0	0.74	1	07/01/2019 14:00	39108-34-4	N2

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PFAS by Isotope Dilution
Sample Analysis Summary

Client's Sample ID	Field Reagent Blank	Date Extracted	06/17/2019
Lab Sample ID	10478022006	Total Amount Extracted	254 mL
Filename	Q190701A_005	ICAL ID	190628A01
Matrix	Ground_Water	Starting CCal	Q190701A_003
Collected	06/04/2019	Ending CCal	Q190701A_009
Received	06/06/2019	Method Blank Filename	Q190621C_021

Internal Standards Compound	Known Conc.	Conc. Found	%Recovery	Recovery Limits	Pass/Fail	Area
13C4_PFBA	20	22	111	50-150	Pass	1181564
13C5_PFPeA	20	22	112	50-150	Pass	832853
13C5_PFHxA	20	22	113	50-150	Pass	791006
13C4_PFHpA	20	21	109	50-150	Pass	856260
13C8_PFOA	20	24	123	50-150	Pass	672373
13C9_PFNA	20	22	110	50-150	Pass	500944
13C6_PFDA	20	20	104	50-150	Pass	260306
13C7_PFUdA	20	19	94	50-150	Pass	279411
13C2_PFDoA	20	24	121	50-150	Pass	461593
13C2_PFTeDA	20	22	109	50-150	Pass	194220
d5-EtFOSAA	20	19	98	50-150	Pass	46387
d3-MeFOSAA	20	20	99	50-150	Pass	58978
13C3_PFBS	20	23	115	50-150	Pass	543203
13C3_PFHxS	20	25	127	50-150	Pass	496950
13C8_PFOS	20	20	104	50-150	Pass	250311
13C8_FOSA	20	9.1	46	50-150	Fail	210861
13C2_4:2FTS	20	23	114	50-150	Pass	77423
13C6_6:2FTS	20	25	127	50-150	Pass	64961
13C6_8:2FTS	20	20	101	50-150	Pass	41600

Injection Internal Standards

IS Compound	Area	Ical Limits	CCV Limits	Pass/Fail
13C4_PFOA	701346	385075 - 1155225	428276 - 1284829	Pass
13C4_PFOS	303211	169716 - 509148	191489 - 574466	Pass

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PFAS by Isotope Dilution
Sample Analysis Summary

Client's Sample ID	Equipment Blank	Date Extracted	06/17/2019
Lab Sample ID	10478022007	Total Amount Extracted	185 mL
Filename	Q190701A_006	ICAL ID	190628A01
Matrix	Ground_Water	Starting CCal	Q190701A_003
Collected	06/04/2019	Ending CCal	Q190701A_009
Received	06/06/2019	Method Blank Filename	Q190621C_021

Compound	Concentration (ng/L)		PQL (ng/L)	MDL (ng/L)	Dilution	Analyzed	CAS No.	Qual.
PFBA	ND		2.7	1.1	1	07/01/2019 14:26	375-22-4	N2
PFPeA	ND		2.7	0.69	1	07/01/2019 14:26	2706-90-3	N2
PFHxA	ND		2.7	0.70	1	07/01/2019 14:26	307-24-4	N2
PFHpA	ND		2.7	0.74	1	07/01/2019 14:26	375-85-9	N2
PFOA	ND		2.7	0.76	1	07/01/2019 14:26	335-67-1	N2
PFNA	ND		2.7	0.78	1	07/01/2019 14:26	375-95-1	N2
PFDA	ND		2.7	0.83	1	07/01/2019 14:26	335-76-2	N2
PFUdA	ND		2.7	0.59	1	07/01/2019 14:26	2058-94-8	N2
PFDoA	ND		2.7	0.79	1	07/01/2019 14:26	307-55-1	N2
PFTrDA	ND		2.7	0.81	1	07/01/2019 14:26	72629-94-8	N2
PFTeDA	ND	D	27	5.1	10	06/24/2019 14:38	376-06-7	N2
PFOSA	ND		2.7	0.47	1	07/01/2019 14:26	754-91-6	N2
N-EtFOSAA	ND		2.7	0.79	1	07/01/2019 14:26	2991-50-6	N2
N-MeFOSAA	ND		2.7	0.90	1	07/01/2019 14:26	2355-31-9	N2
PFBS	ND		2.4	0.73	1	07/01/2019 14:26	375-73-5	N2
PFPeS	ND		2.5	0.90	1	07/01/2019 14:26	2706-91-4	N2
PFHxS	ND		2.5	0.80	1	07/01/2019 14:26	355-46-4	N2
PFHpS	ND		2.6	0.94	1	07/01/2019 14:26	375-92-8	N2
PFOS	ND		2.5	0.55	1	07/01/2019 14:26	1763-23-1	N2
PFNS	ND		2.7	1.3	1	07/01/2019 14:26	68259-12-1	N2
PFDS	ND		2.7	1.2	1	07/01/2019 14:26	335-77-3	N2
4:2FTS	ND		2.7	0.99	1	07/01/2019 14:26	757124-72-4	N2
6:2FTS	ND	D	27	13	10	06/24/2019 14:38	27619-97-2	N2
8:2FTS	ND	D	27	10	10	06/24/2019 14:38	39108-34-4	N2

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PFAS by Isotope Dilution
Sample Analysis Summary

Client's Sample ID	Equipment Blank	Date Extracted	06/17/2019
Lab Sample ID	10478022007	Total Amount Extracted	185 mL
Filename	Q190701A_006	ICAL ID	190628A01
Matrix	Ground_Water	Starting CCal	Q190701A_003
Collected	06/04/2019	Ending CCal	Q190701A_009
Received	06/06/2019	Method Blank Filename	Q190621C_021

Internal Standards Compound	Known Conc.	Conc. Found	%Recovery	Recovery Limits	Pass/Fail	Area
13C4_PFBA	27	27	100	50-150	Pass	1186311
13C5_PFPeA	27	28	104	50-150	Pass	857321
13C5_PFHxA	27	29	106	50-150	Pass	816872
13C4_PFHpA	27	29	109	50-150	Pass	951739
13C8_PFOA	27	34	127	50-150	Pass	768394
13C9_PFNA	27	26	97	50-150	Pass	584970
13C6_PFDA	27	30	109	50-150	Pass	364409
13C7_PFUdA	27	24	90	50-150	Pass	355747
13C2_PFDoA	27	31	113	50-150	Pass	574157
13C2_PFTeDA	27	48	179	50-150	Fail	422444
d5-EtFOSAA	27	41	150	50-150	Pass	94199
d3-MeFOSAA	27	36	133	50-150	Pass	105350
13C3_PFBS	27	32	120	50-150	Pass	625761
13C3_PFHxS	27	29	108	50-150	Pass	558807
13C8_PFOS	27	33	123	50-150	Pass	393365
13C8_FOSA	27	23	86	50-150	Pass	521962
13C2_4:2FTS	27	32	118	50-150	Pass	88647
13C6_6:2FTS	27	36	133	50-150	Pass	16258
13C6_8:2FTS	27	30	112	50-150	Pass	11476

Injection Internal Standards

IS Compound	Area	Ical Limits	CCV Limits	Pass/Fail
13C4_PFOA	777220	385075 - 1155225	428276 - 1284829	Pass
13C4_PFOS	403187	169716 - 509148	191489 - 574466	Pass

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