August 2019 Mercury Speciation
Soil Investigation Report

Olin Buffalo Avenue North Parcels I and II
AOC Index No. R9-4171-94-08
NYSDEC Site No. 932051A
Niagara Falls, New York

Prepared for:

Olin Corporation
Environmental Remediation
3855 N. Ocoee Road, Suite 200
Cleveland, Tennessee 37312

Prepared by:

Wood Environment & Infrastructure Solutions, Inc.
1075 Big Shanty Road NW, Suite 100
Kennesaw, Georgia 30144
Project Number 6107-19-0002

December 11, 2019

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List of Abbreviations

Abbreviation	Definition
95%UCL	95 Percent Upper Confidence Limit on the Arithmetic Mean
DI	Deionized
Hg	Mercury
Hg^0	Elemental Mercury
mg/kg	milligram/kilogram
North Parcels	Buffalo Avenue North Parcels I and II
NYSDEC	New York Department of Environmental Conservation
NYSDOH	New York Department of Health
Olin	Olin Corporation
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SCO	Soil Cleanup Objective
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey

1.0 Introduction

Olin Corporation (Olin) conducted a soil investigation at the Buffalo Avenue North Parcels I and II (North Parcels) in August 2019 to evaluate elemental mercury (Hg) concentrations in surface soils (0-6 inches). The investigation was performed as part of ongoing site characterization and in accordance with the March 22, 2019 *Revised Mercury Speciation Soil Investigation Work Plan – Revision 02* (Wood, 2019). The objective of the work plan was to analyze samples for total Hg and elemental Hg at locations where Hg was detected previously in soils. This report details the site investigation history, activities, results, regulatory discussions and conclusions.

The investigation results show that volatile elemental Hg is not present in site surface soils which indicates that no inhalation risk for Hg exists at the site. These results are also consistent with an earlier finding that the form of Hg in soil is highly insoluble and does not pose a leaching threat to groundwater (AFW, 2017). Hg present in site soils is inorganic and non-volatile, and concentrations should be compared against Commercial Soil Cleanup Objectives (SCOs) based on inorganic Hg salt ingestion risks. Current and historical results are below the inorganic Hg salt SCOs, and Olin recommends no further action at the North Parcels based on these results.

2.0 History

The North Parcels are located north of Buffalo Avenue, across from Olin's Niagara Falls, Chlor-Alkali Plant (Figure 2.1). Several investigations have been performed in this area to evaluate Hg soil concentrations that are thought to be associated with brine muds generated in the chlor-alkali process and used to repair North Parcel potholes in the 1950s or 1960s.

Four soil samples were collected from the North Parcels around 1982 by the United States Geological Survey (USGS). The four sample locations and results are documented in the *Preliminary Evaluation of Chemical Migration to Groundwater and the Niagara River from Selected Waste Disposal Sites* (USGS, 1985) and shown on Figure 2.1. An additional sample (OSB3) was collected during the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) (WC, 1994), and the results are also included on Figure 2.1. The North Parcels were included in the in the 1996 *Remedial Plan* (CRA, 1996). Based on these historical results, Hg surface soil concentrations were not fully characterized.

Olin conducted a North Parcel surface soil investigation in 2014 to further characterize the Hg surface soil concentrations. Fifty surface soil samples were collected and analyzed for total Hg. The investigation results showed that Hg was detected at all fifty sample locations and are detailed in the August 15, 2014 *North Parking Lot Soil Investigation Report* (AMEC, 2014). The 95 percent upper confidence limit on the arithmetic mean (95%UCL) of the 2014 results was calculated to be 9.0 milligrams per kilogram (mg/kg). The results are included in this report on Figure 2.2.

In that report, Olin recommended comparing the 2014 surface soil results to the New York State Department of Environmental Conservation (NYSDEC) Protection of Public Commercial SCO because Olin had placed a restrictive covenant on the North Parcels in 2012 to restrict the land use to commercial and/or industrial purposes (Appendix A). The 2014 95%UCL result was above the Commercial SCO of 2.8 mg/kg (NYSDEC, 2006a), but the NYSDEC SCO Technical Support Document (NYSDEC, 2006b) indicated that the Protection of Public Health Commercial SCO was based on elemental Hg inhalation risks to adults. Olin did not believe elemental Hg to be present and that the inhalation specific SCO was not appropriate for the site based on analytical results and the brine mud generation process.

When the 2014 results were compared to the exposure pathway specific SCOs for inorganic Hg salts, the 95%UCL result and all but one individual result were below the exposure pathway specific SCO of 47 mg/kg based on inorganic salt Hg ingestion risks to children. All 2014 surface soil results were below the exposure pathway specific SCO of 130 mg/kg based on inorganic salt Hg ingestion risks to adults. Based on the 2014 surface soil results and the exposure pathway specific SCOs for inorganic Hg salts, Olin recommended no further action at the North Parcels.

NYSDEC indicated in its December 14, 2014 response letter that it must assume that the Hg detected in site soils is all in the elemental from unless shown otherwise by analytical data. Olin submitted to NYSDEC a Hg speciation work plan on January 9, 2015 (AMEC, 2015). The work plan detailed procedures for evaluating mercury speciation and quantifying the presence of elemental Hg in site soils.

NYSDEC subsequently indicated in a September 19, 2016 letter that the site soil Hg concentrations should be compared against the Protection of Groundwater SCO of 0.73 mg/kg. The 2014 95%UCL and 44 individual sample results were above 0.73 mg/kg. NYSDEC also required that Olin further delineate Hg soil concentrations and evaluate site groundwater. Olin proposed to perform a mercury leaching evaluation using the synthetic precipitation leaching procedure (SPLP) on site soils to evaluate the risk posed to groundwater in a November 3, 2016 work plan (AFW, 2016). NYSDEC approved the work plan on November 8, 2016.

Olin performed the SPLP investigation in April 2017. The investigation results indicated that the Hg

present in North Parcel soils has a very low leaching potential and is not a threat to site groundwater. The results are detailed in the August 18, 2016 *April 2017 Mercury Investigation Report* (AFW, 2017) and are included in this report on Figure 2.3.

These investigations and correspondence resolved the questions concerning protection of groundwater and no further action was required for groundwater. The remaining question NYSDEC requested Olin address was the nature of site soil concentrations above the Commercial SCO of 2.8 mg/kg. NYSDEC did not have an approved speciation method; therefore, Olin worked with NYSDEC and NYS Department of Health (NYSDOH) to develop and submit a revised Hg speciation work plan in 2019 (Wood, 2019) that addressed their questions and provided additional quality control and quality assurance documentation on the speciation analytical procedure. The work plan included an analytical method that can reliably and quantitatively differentiate various mercury species. NYSDEC accepted the work plan in an April 26, 2019 letter. The following sections of this report detail the investigation performed in accordance with the approved March 22, 2019 *Revised Mercury Speciation Soil Investigation Work Plan – Revision 02* (Wood, 2019).

3.0 Investigation Activities

The Hg speciation soil investigation was performed on August 20, 2019. Soil samples were collected from the following ten locations in accordance with the March 22, 2019 *Revised Mercury Speciation Soil Investigation Work Plan – Revision 02* (Wood, 2019):

- PLS-SS-3
- PLS-SS-7
- PLS-SS-10
- PLS-SS-16
- PLS-SS-19
- PLS-SS-24
- PLS-SS-29
- PLS-SS-31
- PLS-SS-42
- PLS-SS-49

A duplicate sample was collected from boring PLS-SS-19.

Soil borings were advanced with a stainless-steel hand auger to six inches below the ground surface. Soil was removed from the hand auger using a disposable, stainless-steel trowel and placed directly into a clean, laboratory supplied, four-ounce glass container.

The hand auger was decontaminated between soil borings using the following steps:

- Soap (phosphate free) and water wash
- Deionized (DI) water rinse
- Nitric acid rinse
- DI water rinse

A rinsate blank sample was collected by rinsing the cleaned hand auger with DI water and collecting the rinsate in a laboratory provided container.

The soil samples were preserved with dry ice. The rinsate blank was packed in a separate cooler and preserved with regular ice. The two sample coolers were shipped to Eurofins in Bothell, Washington under chain-of-custody protocol.

The soil samples were analyzed for total Hg and volatile elemental mercury (Hg^0). Total Hg was analyzed using United States Environmental Protection Agency (USEPA) method 1631B. Hg^0 was analyzed using a modified USEPA method 1631B as described in the *Revised Mercury Speciation Soil Investigation Work Plan* (Wood, 2019).

4.0 Investigation Results

The analytical data was reported by Eurofins on November 20, 2019. The analytical laboratory report is provided as Appendix B. Table 4.1 summarizes the results, and Figure 4.1 presents the results graphically. The data was validated and found to be usable as reported with minor qualification. A Data Usability Summary Report (DUSR) is provided as Appendix C.

No volatile elemental Hg^0 was detected in site surface soils. The total Hg surface soil concentrations range from 2.1 milligrams per kilogram (mg/kg) to 57.3 mg/kg which is consistent with the range of total mercury detected from the fifty samples collected in 2014 (0.43 mg/kg to 53.5 mg/kg).

The 95%UCL was calculated for the 2014 and 2019 total Hg combined results using USEPA's ProUCL Software Version 5.1. The ProUCL output is included in Appendix D. The results are shown below and compared against the 95%UCL of the 2014 total Hg data set.

- 2014 and 2019 Total Hg 95%UCL (60 samples) – **15.1 mg/kg**
- 2014 Total Hg 95%UCL (50 samples) – **9.0 mg/kg** (AMEC, 2014)

5.0 Conclusions

The results show that Hg^0 is not present in site surface soils which indicates that no inhalation risks for Hg exist at the site. The total Hg concentrations were then compared to the exposure pathway specific SCOs for inorganic Hg salts. Based on the 2014 and combined 2014 / 2019 data sets, the 95%UCL is below the exposure pathway specific SCO of 47 mg/kg based on inorganic salt Hg ingestion risks to children. All 2014 and 2019 surface soil results were below the exposure pathway specific SCO of 130 mg/kg based on inorganic salt Hg ingestion risks to adults. Olin recommends no further action at the North Parcels based on the cumulative results from this and previous investigations which indicate no unacceptable risk to human health or groundwater receptors.

6.0 References

AFW, 2016. *North Parcels Mercury Investigation Work Plan.* Amec Foster Wheeler Environment & Infrastructure, Inc. Kennesaw, GA. November 3, 2016.

AFW, 2017. *April 2017 Mercury Investigation Report.* Amec Foster Wheeler Environment & Infrastructure, Inc. Kennesaw, GA. August 18, 2017.

AMEC, 2014. *North Parking Lot Soil Investigation.* AMEC Environment & Infrastructure, Inc. Kennesaw, GA. August 15, 2014.

AMEC, 2015. *North Parking Lot Mercury Speciation Soil Investigation Work Plan.* AMEC Environment & Infrastructure, Inc. Kennesaw, GA. January 9, 2015.

CRA, 1996. *Remedial Plan – Olin Chemicals Corp. Niagara Falls, New York.* Conestoga-Rovers & Associates. Niagara Falls, NY. February 1996.

NYSDEC, 2006a. *6NYCRR Part 375. Environmental Remediation Programs.* New York State Department of Environmental Conservation. Albany, NY. December 14, 2006.

NYSDEC, 2006b. *New York State Brownfield Cleanup Program – Development of Soil Cleanup Objectives – Technical Support Document.* New York State Department of Environmental Conservation. Albany, NY. September 2006.

USGS, 1985. *Preliminary Evaluation of Chemical Migration to Groundwater and the Niagara River from Selected Waste Disposal Sites.* United States Geological Survey. EPA-905/4-85-001, pp 346-350. March 1985.

WC, 1994. *RCRA Facility Investigation Report for the Olin Buffalo Avenue Plant – RCRA-89-3013-0208.* Woodward-Clyde Consultants, Inc. Amherst, NY. August 5, 1994.

Wood, 2019. *Revised Mercury Speciation Soil Investigation Work Plan – Revision 02.* Wood Environment & Infrastructure Solutions, Inc. Kennesaw, GA. March 22, 2019

Tables

Table 4.1: Mercury Analytical Results

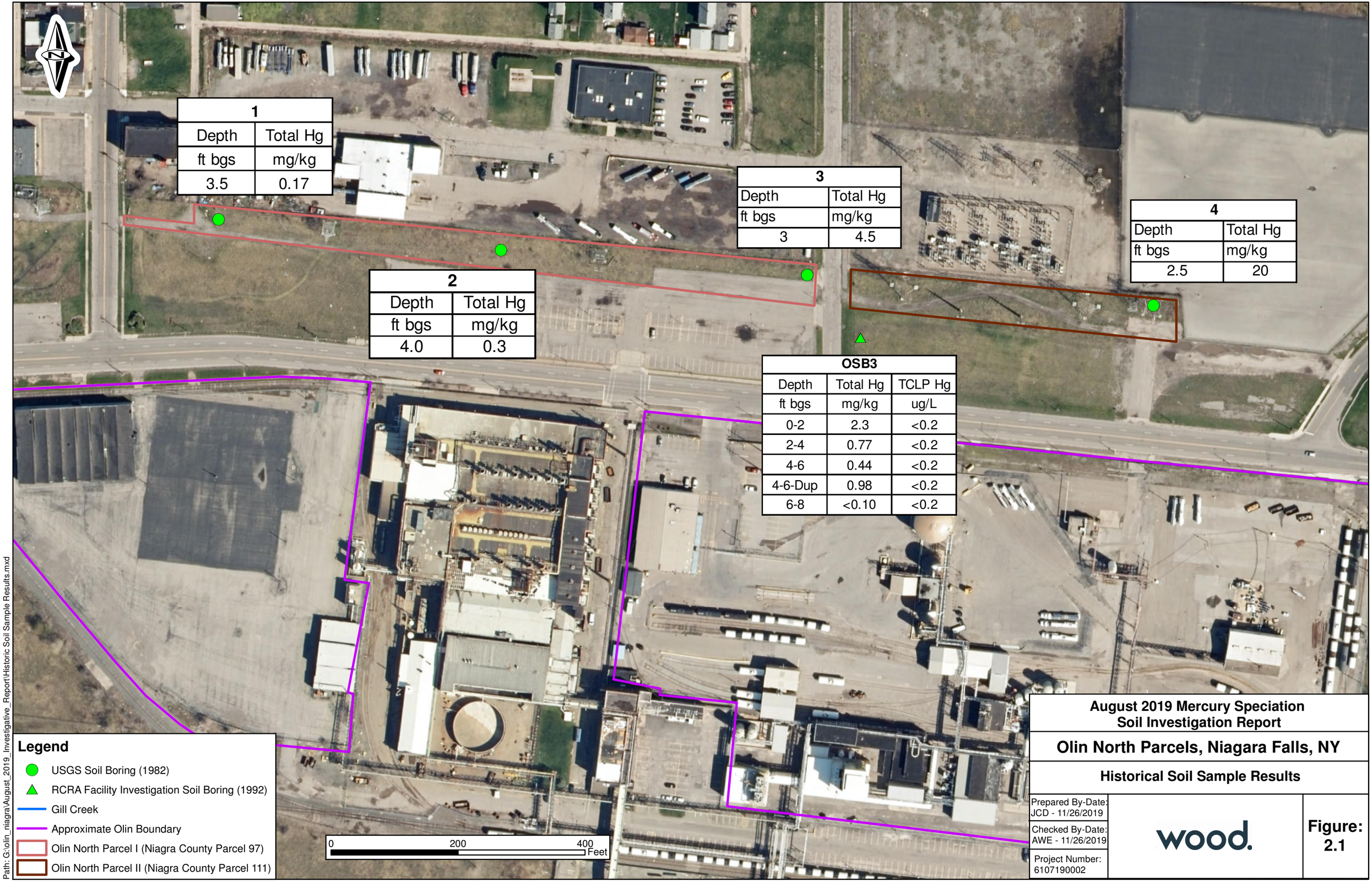
	Sample	Sample	Sample	Sample	Sample	Duplicate	Sample	Sample	Sample	Sample	Sample
Boring ID:	PLS-SS-3	PLS-SS-7	PLS-SS-10	PLS-SS-16	PLS-SS-19	PLS-SS-19	PLS-SS-24	PLS-SS-29	PLS-SS-31	PLS-SS-42	PLS-SS-49
Sample Interval ft bgs):	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5
Sample Date:	8/20/2019	8/20/2019	8/20/2019	8/20/2019	8/20/2019	8/20/2019	8/20/2019	8/20/2019	8/20/2019	8/20/2019	8/20/2019
Total Mercury Concentrations - SW846 1631B mg/kg											
Total Mercury	13.6	3.22	26.5	49.2	12.7 J	18.6 J	57.3	7.35	2.1	3.75	7.19
Volatile Elemental Mercury Concentrations - SW846 1631 Modified mg/kg											
Elemental Mercury	0.00161 U	0.00164 U	0.00175 U	0.00175 U	0.00189 U	0.00188 U	0.00173 U	0.00343 U	0.0034 U	0.00322 U	0.00317 U

Notes:
mg/kg - milligrams per kilogram
ft bgs - feet below ground surface

Prepared by: AWE 11/20/2019
Checked By: EIWP 11/21/2019

Data Qualifier Definitions:
U - Constituent not detected above the Reporting Limit shown.
J - The compound was positively identified, but the associated numerical value is an estimated concentration.

Figures



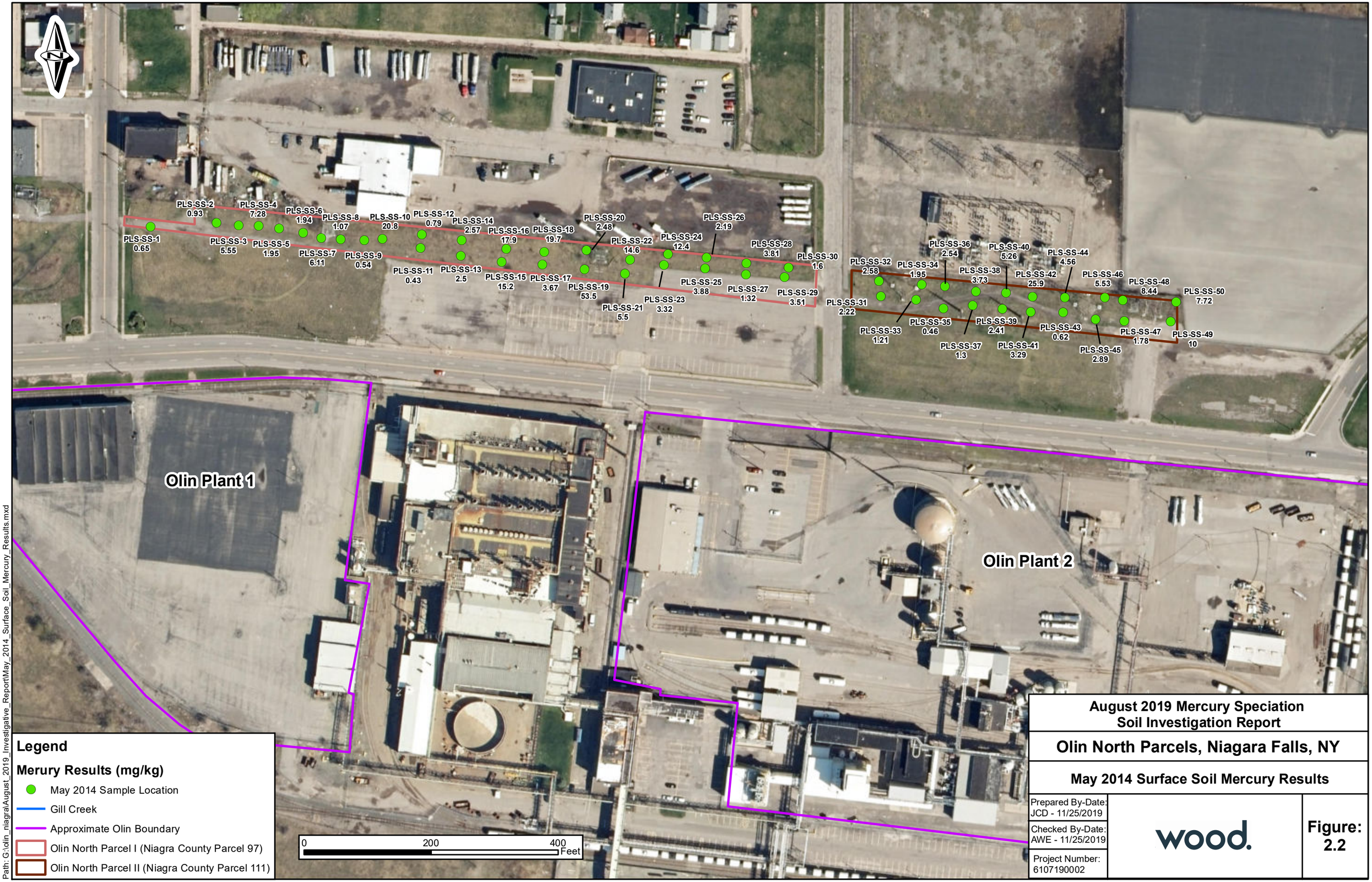
Path: G:\olin_niagra\August_2019_Investigative_Report\Historic Soil Sample Results.mxd

August 2019 Mercury Speciation Soil Investigation Report

Olin North Parcels, Niagara Falls, NY

Historical Soil Sample Results

Prepared By-Date: JCD - 11/26/2019	wood.	Figure: 2.1
Checked By-Date: AWE - 11/26/2019		
Project Number: 6107190002		

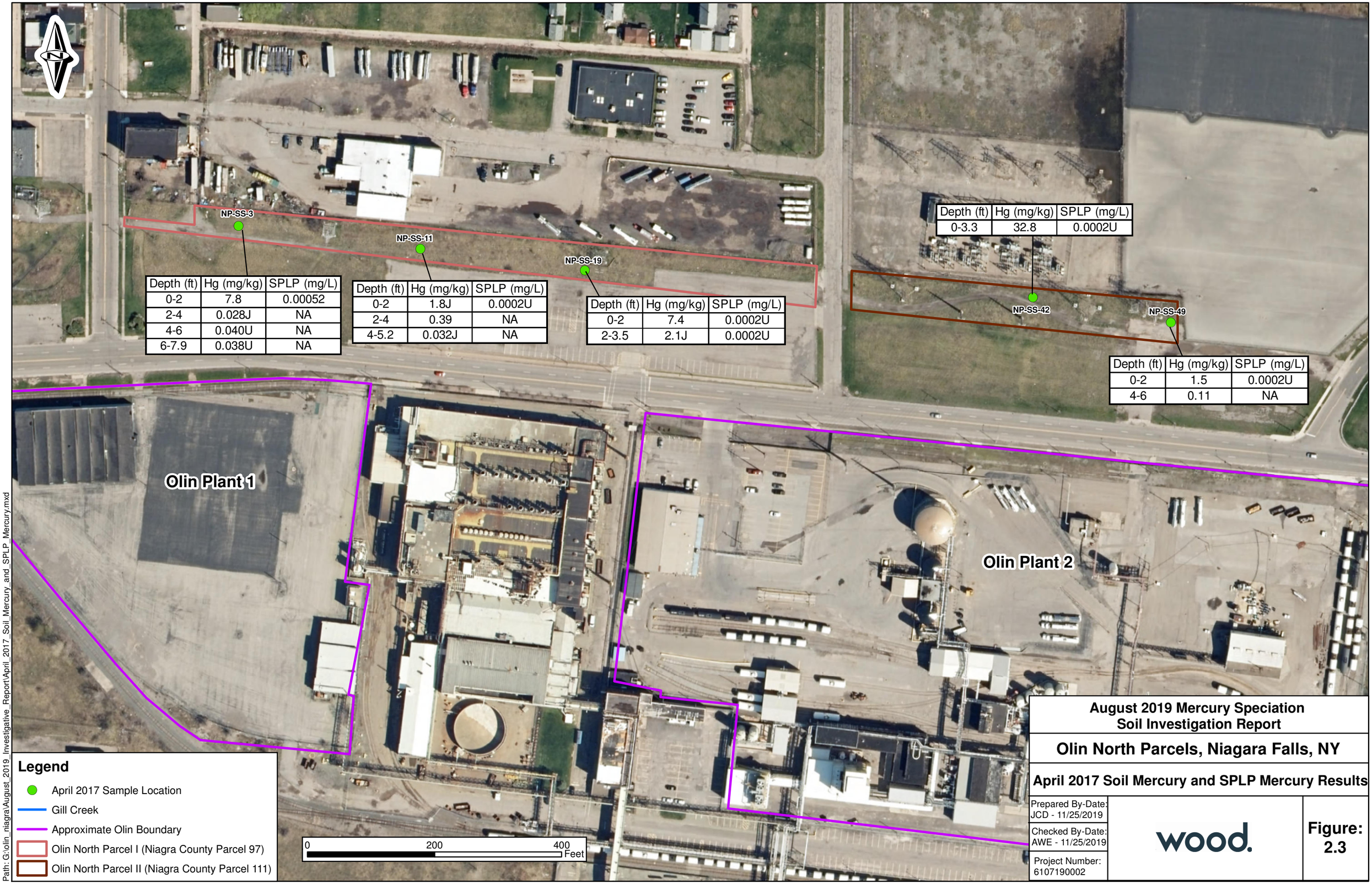


August 2019 Mercury Speciation Soil Investigation Report

Olin North Parcels, Niagara Falls, NY

May 2014 Surface Soil Mercury Results

Prepared By-Date: JCD - 11/25/2019	wood.
Checked By-Date: AWE - 11/25/2019	**Figure: 2.2**
Project Number: 6107190002	



Depth (ft)	Hg (mg/kg)	SPLP (mg/L)
0-2	7.8	0.00052
2-4	0.028J	NA
4-6	0.040U	NA
6-7.9	0.038U	NA

Depth (ft)	Hg (mg/kg)	SPLP (mg/L)
0-2	1.8J	0.0002U
2-4	0.39	NA
4-5.2	0.032J	NA

Depth (ft)	Hg (mg/kg)	SPLP (mg/L)
0-2	7.4	0.0002U
2-3.5	2.1J	0.0002U

Depth (ft)	Hg (mg/kg)	SPLP (mg/L)
0-3.3	32.8	0.0002U

Depth (ft)	Hg (mg/kg)	SPLP (mg/L)
0-2	1.5	0.0002U
4-6	0.11	NA

Legend

- April 2017 Sample Location
- Gill Creek
- Approximate Olin Boundary
- Olin North Parcel I (Niagra County Parcel 97)
- Olin North Parcel II (Niagra County Parcel 111)

Path: G:\olin_niagra\August_2019_Investigative_Report\April_2017_Soil_Mercury_and_SPLP_Mercury.mxd

August 2019 Mercury Speciation Soil Investigation Report

Olin North Parcels, Niagara Falls, NY

April 2017 Soil Mercury and SPLP Mercury Results

Prepared By-Date: JCD - 11/25/2019

Checked By-Date: AWE - 11/25/2019

Project Number: 6107190002

wood.

Figure: 2.3

Notes:
U - Constituent not detected above the Reporting Limit shown
J - The compound was positively identified, but the associated numerical value is an estimated concentration.

Depth (ft)	Total Hg (mg/kg)	Elemental Hg (mg/kg)
0 - 0.5	13.6	0.00161 U

PLS-SS-3

Depth (ft)	Total Hg (mg/kg)	Elemental Hg (mg/kg)
0 - 0.5	3.22	0.00164 U

PLS-SS-7

Depth (ft)	Total Hg (mg/kg)	Elemental Hg (mg/kg)
0 - 0.5	26.5	0.00175 U

PLS-SS-10

Depth (ft)	Total Hg (mg/kg)	Elemental Hg (mg/kg)
0 - 0.5	49.2	0.00175 U

PLS-SS-16

Depth (ft)	Total Hg (mg/kg)	Elemental Hg (mg/kg)
0 - 0.5	12.7 J	0.00189 U

PLS-SS-19

Depth (ft)	Total Hg (mg/kg)	Elemental Hg (mg/kg)
0 - 0.5	57.3	0.00173 U

PLS-SS-24

Depth (ft)	Total Hg (mg/kg)	Elemental Hg (mg/kg)
0 - 0.5	7.35	0.00343 U

PLS-SS-29

Depth (ft)	Total Hg (mg/kg)	Elemental Hg (mg/kg)
0 - 0.5	3.75	0.00322 U

PLS-SS-31

Depth (ft)	Total Hg (mg/kg)	Elemental Hg (mg/kg)
0 - 0.5	2.1	0.0034 U

PLS-SS-42

Depth (ft)	Total Hg (mg/kg)	Elemental Hg (mg/kg)
0 - 0.5	7.19	0.00317 U

PLS-SS-49

Olin Plant 1

Olin Plant 2

Legend

Mercury Results (mg/kg)

- August 2019 Sample Locations
- Gill Creek
- Approximate Olin Boundary
- Olin North Parcel I (Niagra County Parcel 97)
- Olin North Parcel II (Niagra County Parcel 111)

0 200 400 Feet

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August 2019 Mercury Speciation Soil Investigation Report

Olin North Parcels, Niagara Falls, NY

August 2019 Surface Soil Mercury Results

Prepared By-Date: JCD - 12/11/2019

Checked By-Date: AWE - 12/11/2019

Project Number: 6107190002

wood.

Figure: 4.1

Appendix A
Declaration of Restrictive Covenants

NOTICE AND DECLARATION OF RESTRICTIVE COVENANTS

THIS DECLARATION is made as of the 30TH day of NOVEMBER, 2012 by OLIN CORPORATION, a Virginia corporation ("Declarant"), with a place of business at 3855 North Ocoee Street, Suite 200, Cleveland, Tennessee 37312.

RECITALS

A. The Declarant owns fee simple title to the real estate and improvements known as the 2400 Buffalo Avenue, located in the City of Niagara Falls in Niagara County, New York (the "Plant"). Such real property includes two parcels of land referred to as the "Parking Lot Parcels" being legally described on Exhibit A attached hereto and incorporated herein by this reference (the "Property").

B. **From 1897 through the present, Declarant has operated various chemical manufacturing facilities at the Plant.**

C. **As of the date hereof, Declarant is investigating and evaluating the environmental conditions of the Plant and the Property.**

D. In order to limit possible exposure pathways, Declarant desires to impose upon and subject the Property to this Declaration, which shall become effective upon the recording of this Declaration in the land records of Niagara County, New York.

NOTICE AND DECLARATION

NOW, THEREFORE, the Declarant hereby declares that the Property and any portion thereof is and shall be held, transferred, sold, conveyed, used and occupied subject to the perpetual restrictive covenants hereinafter set forth, which restrictive covenants shall run with the Property and be binding upon all parties having any right, title or interest in the Property or any part thereof, their successors and assigns, and shall inure to the benefit of each owner thereof, and which are for the purpose of protecting the value and desirability of the Property.

1. Notice. Declarant has entered into an Order on Consent ("Order") with the New York State Department of Environmental Conservation ("DEC") to implement a Resource Conservation and Recovery Act ("RCRA") corrective action program to remediate soil and groundwater contamination in the vicinity of the Property. A copy of this Order may be obtained from Declarant or DEC. The terms and conditions of this Order are incorporated herein by reference.

2. Presence of Hazardous Wastes. The potential Declarant-derived hazardous waste constituents are listed in Exhibit B, attached hereto and incorporated herein by this reference, and are found in various concentrations throughout the soil and groundwater of the Property.

3. Restricted Uses. Notwithstanding any laws, rules, regulations, ordinances or orders of any governmental or quasi-governmental entity, including, without limitation, local municipal and zoning

ordinances, the Property, or any portion thereof, shall be used solely for commercial and/or industrial purposes.

4. General Restriction. Notwithstanding the commercial and/or industrial use limitation set forth above, no groundwater shall be extracted from beneath the Property for any purpose other than those commercial/industrial purposes involving non-contact uses, water treatment, or environmental sampling and testing. In addition, soils shall be extracted from beneath the Property only when consistent with industrial/commercial uses and with protocols that maintain adequate protection to human health and safety.

5. Runs with the Land. The perpetual restrictive covenants created in this Declaration are appurtenant to the Property and are (i) made for the direct benefit of the Property; (ii) shall run with the land; (iii) may be enforced as either equitable servitudes or real covenants; and (iv) shall bind and inure to the benefit of every person or entity having any property interest in the Property or any portion thereof.

6. Severability. If any portion of this Declaration shall to any extent be invalid or unenforceable, the remaining provisions of this Declaration shall not be affected thereby, and each provision of this Declaration shall be valid and enforceable to the fullest extent permitted by law.

7. Successors and Assigns Bound. This Declaration shall be perpetual and shall be binding upon and shall inure to the benefit of Declarant, any subsidiary of Declarant, division, parent or wholly owned corporation or affiliate now or hereafter existing, and their respective successors and assigns with respect to the Property and the tenants, subtenants, licensees, vendees, concessionaires and successors and assigns of any of them with any fee, leasehold, license or other interest in the Property.

8. Removal of Restriction. In the event that the DEC or its successor provides Declarant with a written determination that this deed restriction is no longer necessary to protect the public health or the environment, and Declarant is the then owner of record of the Property, Declarant shall file such documents with the Niagara County, New York Recorder of Deeds as are necessary to remove the restrictions contained in this Declaration from the Property.

9. Governing Law. This Declaration shall be governed by and construed in accordance with the laws of the State of New York.

IN WITNESS WHEREOF, the Declarant has executed this Declaration as of the day and year first above written.

OLIN CORPORATION,
a Virginia corporation

By: Curtis M Richards
Name: Curtis M. Richards
Title: Corporate Vice President
Environment, Health & Safety

STATE OF Tennessee)
) SS.
COUNTY OF Bradley)

On the 30th day of November in the year 2012 before me, the undersigned, personally appeared Curtis M. Richards, personally known to me or proved to me on the basis of satisfactory evidence to be the individual whose name is subscribed to the within instrument and acknowledged to me that he executed the same in his capacity, and that by his signature on the instrument, the individual, or the person upon behalf of which the individual acted, executed the instrument.

BETH A. BALTIMORE
STATE OF TENNESSEE NOTARY PUBLIC
BRADLEY COUNTY

Beth A. Baltimore
Notary Public

Beth A. Baltimore
Printed Name

My Commission expires: 1/16/2013

EXHIBIT A

Parcel I: All that tract or parcel of land, situate in the City of Niagara Falls, County of Niagara and State of New York and being part of Lot 4 Stedman Farm, bounded and described as follows: Beginning at the point of intersection of the west line of Packard Road with the north line of lands of the Erie Railroad Company; thence westerly along said north line of the railroad company's land to the east line of an alleged public highway, known and designated as Twenty-seventh Street, a distance of 771.08 feet, more or less; thence northerly along the east line of said highway or street a distance of 60.27 feet; thence east and parallel with said north line of the railroad company's land and distant 60 feet therefrom, measured at right angles thereto, a distance of 826.70 feet, more or less, to the west line of Packard Road; thence south along the west line of Packard Road to said point of beginning a distance of 81.11 feet, more or less
Excepting therefrom that portion conveyed by Olin Mathieson Chemical Corporation to Industrial Welding Corporation by Deed dated May 7 1964 and recorded in liber 1425 of Deeds page 117

Parcel II: All that tract or parcel of land, situate in said City of Niagara Falls and being a part of Lot 3 of Lot 4 Stedman Farm, bounded and described as follows: Beginning at the point of intersection of the east line of Twenty-fourth Street with the north line of lands of the Erie Railroad Company; thence easterly a distance of 1087.67 feet, more or less, to the west line of said alleged public highway referred to and designated as Twenty-seventh Street; thence northerly along said west line of said alleged highway or street, a distance of 60.27 feet; thence westerly and parallel with the north line of said railroad company's lands and distant therefrom 60 feet measured at right angles thereto, a distance of 971.14 feet; thence southerly and parallel to the east line of Twenty-fourth Street and distant therefrom 116.52 feet, a distance of 40.18 feet; thence westerly and parallel with said north line of Erie Railroad Company's land and distant therefrom 20.09 feet, measured parallel to the east line of Twenty-fourth Street, a distance of 116.52 feet to the east line of Twenty-fourth Street; thence southerly along the east line of Twenty-fourth Street, a distance of 20.09 feet to the place of beginning

EXHIBIT B

POTENTIAL OLIN-DERIVED CONSTITUENTS MEASURED IN SOIL AND GROUNDWATER
PARKING LOT PARCELS

Parameter	*CAS No.*
Volatile Organic Compounds	
Benzene	71-43-2
Acid/Base/Neutral/Pesticides Compounds	
Phenol	108-95-2
2,4,5-Trichlorophenol	95-95-4
2,3,4,6-Tetrachlorophenol	58-90-2
2-Chlorophenol	95-57-8
Chlorobenzene	108-90-7
1,2,4-Trichlorobenzene	120-82-1
m-Dichlorobenzene	541-73-1
o-Dichlorobenzene	95-50-1
p-Dichlorobenzene	106-46-7
α-BHC	319-84-6
β-BHC	319-85-7
δ-BHC	319-86-8
Alcohols	
Methanol	67-56-1
Inorganics	
Mercury (total)	

Appendix B
Laboratory Data Report

eurofins | Frontier Global Sciences

11720 Northcreek Pkwy N, Suite 400
Bothell, WA 98011
425.686.1996 Phone
425.686.3096 Fax

19 November 2019

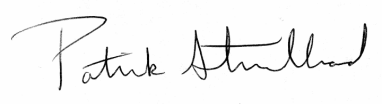
Andrew Nelson, PE
Wood E&IS, Inc
271 Mill Road
Chelmsford, MA 01824

RE: Niagara Falls GW System O&M

Enclosed are the analytical results for samples received by Eurofins Frontier Global Sciences. All quality control measurements are within established control limits and there were no analytical difficulties encountered with the exception of those listed in the case narrative section of this report.

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

Sincerely,



Patrick Garcia-Strickland
Senior Director

eurofins | Frontier Global Sciences

5755 8th Street East
Tacoma, WA 98424
Phone: (253) 922-2310

Wood E&IS, Inc	Project: Niagara Falls GW System O&M	
271 Mill Road	Project Number: Niagara Falls GW System O&M	**Reported:**
Chelmsford MA, 01824	Project Manager: Andrew Nelson, PE	19-Nov-19 16:34

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
PLS-SS-49-08202019	9H00246-01	Soil/Sediment	20-Aug-19 10:00	21-Aug-19 10:00
PLS-SS-RINSATE BLANK 08202019	9H00246-02	Water	20-Aug-19 10:13	21-Aug-19 10:00
PLS-SS-42-08202019	9H00246-03	Soil/Sediment	20-Aug-19 10:25	21-Aug-19 10:00
PLS-SS-31-08202019	9H00246-04	Soil/Sediment	20-Aug-19 10:33	21-Aug-19 10:00
PLS-SS-29-08202019	9H00246-05	Soil/Sediment	20-Aug-19 10:51	21-Aug-19 10:00
PLS-SS-24-08202019	9H00246-06	Soil/Sediment	20-Aug-19 11:03	21-Aug-19 10:00
PLS-SS-19-08202019	9H00246-07	Soil/Sediment	20-Aug-19 11:20	21-Aug-19 10:00
PLS-SS-16-08202019	9H00246-08	Soil/Sediment	20-Aug-19 11:31	21-Aug-19 10:00
PLS-SS-10-08202019	9H00246-09	Soil/Sediment	20-Aug-19 11:42	21-Aug-19 10:00
PLS-SS-7-08202019	9H00246-10	Soil/Sediment	20-Aug-19 11:54	21-Aug-19 10:00
PLS-SS-3-08202019	9H00246-11	Soil/Sediment	20-Aug-19 12:04	21-Aug-19 10:00
DUP01-SS-08202019	9H00246-12	Soil/Sediment	20-Aug-19 00:00	21-Aug-19 10:00

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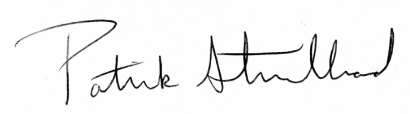

Patrick Garcia-Strickland, Senior Director

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5755 8th Street East
Tacoma, WA 98424
Phone: (253) 922-2310

Wood E&IS, Inc	Project: Niagara Falls GW System O&M	
271 Mill Road	Project Number: Niagara Falls GW System O&M	**Reported:**
Chelmsford MA, 01824	Project Manager: Andrew Nelson, PE	19-Nov-19 16:34

SAMPLE RECEIPT

Samples were received at Eurofins Frontier Global Sciences (EFGS) on 21-Aug-19 10:00. The samples were received intact, on-ice within a sealed cooler at

Cooler	Temp C°
Default Cooler	-21.8

SAMPLE PREPARATION AND ANALYSIS

Total solids analysis was performed in accordance with method SM2540B. Total solids are prepared at the same time as the preparation for the analyte(s) of interest in order to provide the most accurate dry mass correction which may be outside of the method recommended holding time of 7 days from sample collection.

Total mercury preparation and analysis was performed by flow injection atomic fluorescence spectrometry (FI-AFS) in accordance with EPA 1631B.

Elemental mercury analysis (F-0) was prepared by purging samples for a 3 hour period with inert gas and collecting on a sorbent trap. The sorbent trap was then digested and analyzed by flow injection atomic fluorescence spectrometry (FI-AFS) in accordance with EPA 1631B.

ANALYTICAL AND QUALITY CONTROL ISSUES

Method blanks were prepared for every preparation to assess possible blank contribution from the sample preparation procedure. The method blanks were carried through the entire analytical procedure. All blanks fell within the established acceptance criteria with the exception of any items narrated above or flagged and described in the notes and definitions section of the report.

Liquid spikes, certified reference material (CRM) or a quality control samples (QCS) were prepared for every preparation as a measure of accuracy. All liquid spikes, CRMs and/or QCS samples fell within the established acceptance criteria with the exception of any items narrated above or flagged and described in the notes and definitions section of the report.

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Wood E&IS, Inc	Project: Niagara Falls GW System O&M	
271 Mill Road	Project Number: Niagara Falls GW System O&M	**Reported:**
Chelmsford MA, 01824	Project Manager: Andrew Nelson, PE	19-Nov-19 16:34

As an additional measure of the accuracy of the methods used and to check for matrix interference, matrix spikes (MS) and matrix spike duplicates (MSD) were digested and analyzed. All of the matrix spike recoveries fell within the established acceptance criteria with the exception of any items flagged and described in the notes and definitions section of the report.

A reasonable measure of the precision of the analytical methods is the relative percent difference (RPD) between a matrix spike recovery and a matrix spike duplicate recovery and between laboratory control sample recovery and laboratory control sample duplicate recoveries. All of the relative percent differences fell within established acceptance criteria with the exception of any items flagged and described in the notes and definitions section of the report.

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Sample Receipt Checklist

Client: Olin Corp Date & Time Received: 8-21-19 1000 Date Labeled: 8/21/19 Labeled By: ~~ZKH~~

Matrix: Water, Soil Received By: UFL/ZKH Label Verified By: UFL

# of Coolers Received: 1 Samples Arrived By: _____ Shipping Service _____ Courier _____ Hand _____ Other (Specify:_____)

Coolant: ☐ None/Ambient ☒ Loose Ice ☐ Gel Ice ☐ Dry Ice Coolant Required: Y / N Temp Blank Used: ~~Y~~/N for Cooler(s):_____

Notify Project Manager if packages/coolers are received without coolant or with thawed coolant and at a temperature in excess of 6°C. PM notified: Y/N

Cooler Information:	Y/N/NA	Comments
The coolers do not appear to be tampered with:	Y	
Custody Seals are present and intact:	Y	
Custody seals signed:	Y	

TID: 12240~~5~~ CF: +0.3 °C Date/time: 8-21-19 ~~1010~~ 1000 By: UFL 8-21-19

Cooler 1:	-0.3 °C	w/ CF:	0.0 °C	Cooler 4:	°C	w/ CF:	°C
Cooler 2:	°C	w/ CF:	°C	Cooler 5:	°C	w/ CF:	°C
Cooler 3:	°C	w/ CF:	°C	Cooler 6:	°C	w/ CF:	°C

Chain of Custody:	Y/N/NA	Comments
Sample ID/Description:	Y	
Date and time of collection:	Y	
Sampled by:	Y	
Preservation type:	N	
Requested analyses:	Y	
Required signatures:	Y	
Internal COC required:	N	

Sample Condition/Integrity:	Y/N/NA	Comments
Sample containers intact/present:	Y	
Sample labels are present and legible:	Y	
Sample ID on container/bag matches COC:	Y	
Correct sample containers used:	Y	
Samples received within holding times:	Y	
Sample volume sufficient for requested analyses:	Y	
Correct preservative used for requested analyses:	Y	

Anomalies/Non-conformances (attach additional pages if needed):

*Shipped in two containers, 1 dry ice, 1 water UFL 8-21-19

Dry Ice Temp: Therm ID 170404186 CF: +0.1°C 8/21/19 1025
Cooler temp: -21.76 w/CF: -21.66

9H00246

9H00246

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Chain of Custody Record & Laboratory Analysis Request: Air, Water, Sediments, Plant and Animal Tissue, Hydrocarbon & Other Samples

11720 Northcreek Pkwy N, Suite 400
Bothell, WA 98011
Phone: 425-686-1996
Fax: 425-686-3096
info@frontiergs.com
http://www.frontiergs.com

Page 1 of 1

Client: OLIN CORP	Contact: RICK MCCLURE
Address: 3855 NORTH OCOEE ST CLEVELAND TN 37312	Phone: 423 336 4000 Fax:
Project Name: ~~OE~~ NIAGARA SITE Hg	E-mail: RWMcClure@Olin.com
Report To: RICK MCCLURE	Contract/PO:
Address: SAME	Invoice To: OLIN CORP
Phone: 423 336 4000 Fax:	Address:
E-mail: RWMcClure@Olin.com	Phone: 423 336 4000 Fax:
	E-mail: RWMcClure@Olin

No.	Engraved Bottle ID	Sample ID	# of Bottles	Matrix	Date & Time	Sampled By	Field Filtered (Y/N)	Field Preserved: HNO_3 HCl BrCl Other (%)	Analyses Requested: TOT MERCURY	Analyses Requested: ELEMENTAL MERCURY
1		PLS-SS-49-08202019	3	SS	8/20/19 1000	CJ	N	Ø	X	X
2		PLS-SS-RINSATE BLANK 08202019	2	FW	1013					
3		PLS-SS-42-08202019	1	SS	1025					
4		PLS-SS-31-08202019	1		1033					
5		PLS-SS-29-08202019	1		1051					
6		PLS-SS-24-08202019	1		1103					
7		PLS-SS-19-08202019	1		1120					
8		PLS-SS-16-08202019	1		1131					
9		PLS-SS-10-08202019	1		1142					
10		PLS-SS-7-08202019	1		1154					
11		PLS-SS-3-08202019	1		1204					
12		DUP01-SS-08202019	1		—					

EFGS PM:
Date:
TAT (business days): 20 (std)
15 10 5 4 3 2 24 hrs.
(For TAT < 10 days, contact PM. Surcharges apply for expedited TAT)
Saturday delivery? ☐ Y ☒ N
(If yes, please contact PM)
EDD ☒ Y ☐ N
QA ☒ Standard ☐ High

Comments

SHIPPED IN 2 CONTAINERS
RINSATE BLANK ON ICE
SOIL SAMPLES ON DRY ICE
MS/MSD VOLUME PROVIDED AT PLS-SS-49-08202019

For Laboratory Use Only

COC Seal: YES
Cooler Temp:
Carrier: UPS
VTSR: 1000
# of Coolers: 2
Comments:

Matrix Codes:
FW: Fresh Water
WW: Waste Water
SB: Sea and Brackish Water
SS: Soil and Sediment
TS: Plant and Animal Tissue
HC: Hydrocarbons
TR: Trap
OT: Other

Relinquished By:	Received By:	Received By:
	UPS	ZH
Name: CHRIS JONES	Name:	Name: Zahra Hannani
Organization: SES	Organization:	Organization: EFGS
Date & Time: 8/20/19 1600	Date & Time:	Date & Time: 8/21/19 1000

Tracking number: 12F09 4770 1479 0 07163

Sample Disposal:
☐ Return (shipping fees may apply)
☐ Standard Disposal – 30 Days after report
☐ Retain for ____ weeks after report (storage fees may apply)

By signing, you declare that you agree with EFGS' terms and conditions, and that you authorize EFGS to perform the specified analyses.

Customer Approval: _____ Date: 8/20/19

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Chain of Custody Record & Laboratory Analysis Request: Air, Water, Sediments, Plant and Animal Tissue, Hydrocarbon & Other Samples

11720 Northcreek Pkwy N, Suite 400
Bothell, WA 98011
Phone: 425-686-1996
Fax: 425-686-3096
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Page 1 of 1

Client: OLIN CORP	Contact: RICK MCCLURE
Address: 3855 NORTH OCOEE ST CLEVELAND TN 37312	Phone: 423 336 4000 Fax:
Project Name: ~~OE~~ NIAGWA SITE HG	E-mail: RWMcClure@Olin.com
Report To: RICK MCCLURE	Contract/PO:
Address: SAME	Invoice To: OLIN CORP
Phone: 423 336 4000 Fax:	Address:
E-mail: RWMcClure@Olin.com	Phone: 423 336 4000 Fax:
	E-mail: RWMcClure@Olin

No.	Engraved Bottle ID	Sample ID	# of Bottles	Matrix	Date & Time	Sampled By	Field Filtered (Y/N)	Field Preserved: HNO_3 HCl BrCl Other (%)	Analyses Requested: TOT MERCURY	Analyses Requested: ELEMENTAL MERCURY
1		PLS-SS-49-08202019	3	SS	8/20/19 1000	CJ	N	Ø	X	X
2		PLS-SS-RINSATE BLANK 08202019	2	FW	1013					
3		PLS-SS-42-08202019	1	SS	1025					
4		PLS-SS-31-08202019	1		1033					
5		PLS-SS-29-08202019	1		1051					
6		PLS-SS-24-08202019	1		1103					
7		PLS-SS-19-08202019	1		1120					
8		PLS-SS-16-08202019	1		1131					
9		PLS-SS-10-08202019	1		1142					
10		PLS-SS-7-08202019	1		1154					
11		PLS-SS-3-08202019	1		1204					
12		DUP01-SS-08202019	1	↓	—	↓	↓	↓	↓	↓

EFGS PM:
Date:
TAT (business days): 20 (std) **15 10 5 4 3 2 24 hrs.**
(For TAT < 10 days, contact PM. Surcharges apply for expedited TAT)
Saturday delivery? ☐ Y ☒ N (If yes, please contact PM)
EDD ☒ Y ☐ N
QA ☒ Standard ☐ High

Comments:
SHIPPED IN 2 CONTAINERS
RINSATE BLANK ON ICE
SOIL SAMPLES ON DRY ICE
MS/MSD VOLUME PROVIDED AT PLS-SS-49-08202019

For Laboratory Use Only

COC Seal: Y	Comments:
Cooler Temp: Cold	
Carrier: UPS	
VTSR: 1000	
# of Coolers: 1	

Matrix Codes:
FW: Fresh Water
WW: Waste Water
SB: Sea and Brackish Water
SS: Soil and Sediment
TS: Plant and Animal Tissue
HC: Hydrocarbons
TR: Trap
OT: Other

Relinquished By:	Received By:	Received By:
Name: CHRIS JONES	Name: UPS	Name: Lilly-Anna Lacount
Organization: SES	Organization:	Organization: EFGS
Date & Time: 8/20/19 1600	Date & Time:	Date & Time: 8-21-19 0955

Tracking number: 1Z F09 4701 4737 7577

Sample Disposal:
☐ Return (shipping fees may apply)
☐ Standard Disposal – 30 Days after report
☐ Retain for ____ weeks after report (storage fees may apply)

By signing, you declare that you agree with EFGS' terms and conditions, and that you authorize EFGS to perform the specified analyses.

Customer Approval: _____ Date: 8/20/19

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5755 8th Street East
Tacoma, WA 98424
Phone: (253) 922-2310

Wood E&IS, Inc	Project: Niagara Falls GW System O&M	
271 Mill Road	Project Number: Niagara Falls GW System O&M	**Reported:**
Chelmsford MA, 01824	Project Manager: Andrew Nelson, PE	19-Nov-19 16:34

PLS-SS-49-08202019

9H00246-01

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
Sample Preparation: EFGS SOP2807 Cold Aqua Regia Digestion for Hg											
Mercury	**7190**	-	1990	ng/g dry	50000	F911173	04-Nov-19	9K18011	15-Nov-19	EPA 1631B	
Sample Preparation: EFGS SOP5133 Solids Analysis											
% Solids	**94.7**	-	0.1	% by Weight	1	F911177	13-Nov-19		19-Nov-19	SM 2540B	O-04, O-09
Sample Preparation: Miscellaneous Preparation AFS											
Mercury F-0	ND	-	3.17	ng/g dry	100	F911174	05-Nov-19	9K15008	15-Nov-19	EPA 1631 Mod	U

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Patrick Garcia-Strickland, Senior Director

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5755 8th Street East
Tacoma, WA 98424
Phone: (253) 922-2310

Wood E&IS, Inc	Project: Niagara Falls GW System O&M	
271 Mill Road	Project Number: Niagara Falls GW System O&M	**Reported:**
Chelmsford MA, 01824	Project Manager: Andrew Nelson, PE	19-Nov-19 16:34

PLS-SS-RINSATE BLANK 08202019

9H00246-02

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
Sample Preparation: EFGS SOP2796 EPA 1631 Oxidation											
Mercury	**1.68**	-	0.50	ng/L	1	F910225	13-Oct-19	9J23012	13-Oct-19	EPA 1631E	

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Patrick Garcia-Strickland, Senior Director

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Phone: (253) 922-2310

Wood E&IS, Inc	Project: Niagara Falls GW System O&M	
271 Mill Road	Project Number: Niagara Falls GW System O&M	**Reported:**
Chelmsford MA, 01824	Project Manager: Andrew Nelson, PE	19-Nov-19 16:34

PLS-SS-42-08202019

9H00246-03

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
Sample Preparation: EFGS SOP2807 Cold Aqua Regia Digestion for Hg											
Mercury	**3750**	-	665	ng/g dry	10000	F911173	04-Nov-19	9K15008	15-Nov-19	EPA 1631B	
Sample Preparation: EFGS SOP5133 Solids Analysis											
% Solids	**92.8**	-	0.1	% by Weight	1	F911177	13-Nov-19		19-Nov-19	SM 2540B	O-04, O-09
Sample Preparation: Miscellaneous Preparation AFS											
Mercury F-0	ND	-	3.22	ng/g dry	100	F911174	05-Nov-19	9K15008	15-Nov-19	EPA 1631 Mod	U

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Wood E&IS, Inc	Project: Niagara Falls GW System O&M	
271 Mill Road	Project Number: Niagara Falls GW System O&M	**Reported:**
Chelmsford MA, 01824	Project Manager: Andrew Nelson, PE	19-Nov-19 16:34

PLS-SS-31-08202019

9H00246-04

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
Sample Preparation: EFGS SOP2807 Cold Aqua Regia Digestion for Hg											
Mercury	**2100**	-	704	ng/g dry	10000	F911173	04-Nov-19	9K15008	15-Nov-19	EPA 1631B	
Sample Preparation: EFGS SOP5133 Solids Analysis											
% Solids	**90.5**	-	0.1	% by Weight	1	F911177	13-Nov-19		19-Nov-19	SM 2540B	O-04, O-09
Sample Preparation: Miscellaneous Preparation AFS											
Mercury F-0	ND	-	3.40	ng/g dry	100	F911174	05-Nov-19	9K15008	15-Nov-19	EPA 1631 Mod	U

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Patrick Garcia-Strickland, Senior Director

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Wood E&IS, Inc	Project: Niagara Falls GW System O&M	
271 Mill Road	Project Number: Niagara Falls GW System O&M	**Reported:**
Chelmsford MA, 01824	Project Manager: Andrew Nelson, PE	19-Nov-19 16:34

PLS-SS-29-08202019

9H00246-05

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
Sample Preparation: EFGS SOP2807 Cold Aqua Regia Digestion for Hg											
Mercury	**7350**	-	1100	ng/g dry	10000	F911173	04-Nov-19	9K15008	15-Nov-19	EPA 1631B	
Sample Preparation: EFGS SOP5133 Solids Analysis											
% Solids	**87.7**	-	0.1	% by Weight	1	F911177	13-Nov-19		19-Nov-19	SM 2540B	O-04, O-09
Sample Preparation: Miscellaneous Preparation AFS											
Mercury F-0	ND	-	3.43	ng/g dry	100	F911174	05-Nov-19	9K15008	15-Nov-19	EPA 1631 Mod	U

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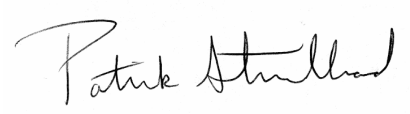
Wood E&IS, Inc	Project: Niagara Falls GW System O&M	
271 Mill Road	Project Number: Niagara Falls GW System O&M	**Reported:**
Chelmsford MA, 01824	Project Manager: Andrew Nelson, PE	19-Nov-19 16:34

PLS-SS-24-08202019

9H00246-06

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
Sample Preparation: EFGS SOP2807 Cold Aqua Regia Digestion for Hg											
Mercury	**57300**	-	2700	ng/g dry	50000	F911173	04-Nov-19	9K18011	15-Nov-19	EPA 1631B	
Sample Preparation: EFGS SOP5133 Solids Analysis											
% Solids	**91.7**	-	0.1	% by Weight	1	F911177	13-Nov-19		19-Nov-19	SM 2540B	O-04, O-09
Sample Preparation: Miscellaneous Preparation AFS											
Mercury F-0	ND	-	1.73	ng/g dry	100	F911174	05-Nov-19	9K18011	15-Nov-19	EPA 1631 Mod	U

Eurofins Frontier Global Sciences, LLC



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Tacoma, WA 98424
Phone: (253) 922-2310

Wood E&IS, Inc	Project: Niagara Falls GW System O&M	
271 Mill Road	Project Number: Niagara Falls GW System O&M	**Reported:**
Chelmsford MA, 01824	Project Manager: Andrew Nelson, PE	19-Nov-19 16:34

PLS-SS-19-08202019

9H00246-07

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
Sample Preparation: EFGS SOP2807 Cold Aqua Regia Digestion for Hg											
Mercury	**12700**	-	509	ng/g dry	10000	F911173	04-Nov-19	9K18011	15-Nov-19	EPA 1631B	
Sample Preparation: EFGS SOP5133 Solids Analysis											
% Solids	**85.6**	-	0.1	% by Weight	1	F911177	13-Nov-19		19-Nov-19	SM 2540B	O-04, O-09
Sample Preparation: Miscellaneous Preparation AFS											
Mercury F-0	ND	-	1.89	ng/g dry	100	F911174	05-Nov-19	9K18011	15-Nov-19	EPA 1631 Mod	U

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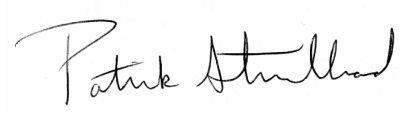
Wood E&IS, Inc	Project: Niagara Falls GW System O&M	
271 Mill Road	Project Number: Niagara Falls GW System O&M	**Reported:**
Chelmsford MA, 01824	Project Manager: Andrew Nelson, PE	19-Nov-19 16:34

PLS-SS-16-08202019

9H00246-08

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
Sample Preparation: EFGS SOP2807 Cold Aqua Regia Digestion for Hg											
Mercury	**49200**	-	1910	ng/g dry	50000	F911173	04-Nov-19	9K18011	15-Nov-19	EPA 1631B	
Sample Preparation: EFGS SOP5133 Solids Analysis											
% Solids	**90.3**	-	0.1	% by Weight	1	F911177	13-Nov-19		19-Nov-19	SM 2540B	O-04, O-09
Sample Preparation: Miscellaneous Preparation AFS											
Mercury F-0	ND	-	1.75	ng/g dry	100	F911174	05-Nov-19	9K18011	15-Nov-19	EPA 1631 Mod	U

Eurofins Frontier Global Sciences, LLC



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Wood E&IS, Inc	Project: Niagara Falls GW System O&M	
271 Mill Road	Project Number: Niagara Falls GW System O&M	**Reported:**
Chelmsford MA, 01824	Project Manager: Andrew Nelson, PE	19-Nov-19 16:34

PLS-SS-10-08202019

9H00246-09

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
Sample Preparation: EFGS SOP2807 Cold Aqua Regia Digestion for Hg											
Mercury	**26500**	-	1920	ng/g dry	50000	F911173	04-Nov-19	9K18011	15-Nov-19	EPA 1631B	
Sample Preparation: EFGS SOP5133 Solids Analysis											
% Solids	**89.8**	-	0.1	% by Weight	1	F911177	13-Nov-19		19-Nov-19	SM 2540B	O-04, O-09
Sample Preparation: Miscellaneous Preparation AFS											
Mercury F-0	ND	-	1.75	ng/g dry	100	F911174	05-Nov-19	9K18011	15-Nov-19	EPA 1631 Mod	U

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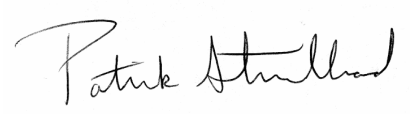

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Wood E&IS, Inc	Project: Niagara Falls GW System O&M	
271 Mill Road	Project Number: Niagara Falls GW System O&M	**Reported:**
Chelmsford MA, 01824	Project Manager: Andrew Nelson, PE	19-Nov-19 16:34

PLS-SS-7-08202019

9H00246-10

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
Sample Preparation: EFGS SOP2807 Cold Aqua Regia Digestion for Hg											
Mercury	**3220**	-	266	ng/g dry	10000	F911173	04-Nov-19	9K18011	15-Nov-19	EPA 1631B	
Sample Preparation: EFGS SOP5133 Solids Analysis											
% Solids	**95.4**	-	0.1	% by Weight	1	F911177	13-Nov-19		19-Nov-19	SM 2540B	O-04, O-09
Sample Preparation: Miscellaneous Preparation AFS											
Mercury F-0	ND	-	1.64	ng/g dry	100	F911174	05-Nov-19	9K18011	15-Nov-19	EPA 1631 Mod	U

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Wood E&IS, Inc	Project: Niagara Falls GW System O&M	
271 Mill Road	Project Number: Niagara Falls GW System O&M	**Reported:**
Chelmsford MA, 01824	Project Manager: Andrew Nelson, PE	19-Nov-19 16:34

PLS-SS-3-08202019

9H00246-11

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
Sample Preparation: EFGS SOP2807 Cold Aqua Regia Digestion for Hg											
Mercury	**13600**	-	834	ng/g dry	10000	F911173	04-Nov-19	9K15008	15-Nov-19	EPA 1631B	
Sample Preparation: EFGS SOP5133 Solids Analysis											
% Solids	**94.2**	-	0.1	% by Weight	1	F911177	13-Nov-19		19-Nov-19	SM 2540B	O-04, O-09
Sample Preparation: Miscellaneous Preparation AFS											
Mercury F-0	ND	-	1.61	ng/g dry	100	F911174	05-Nov-19	9K18011	15-Nov-19	EPA 1631 Mod	U

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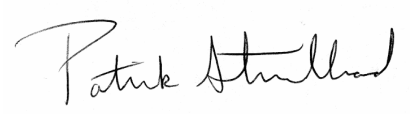

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271 Mill Road	Project Number: Niagara Falls GW System O&M	**Reported:**
Chelmsford MA, 01824	Project Manager: Andrew Nelson, PE	19-Nov-19 16:34

DUP01-SS-08202019

9H00246-12

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
Sample Preparation: EFGS SOP2807 Cold Aqua Regia Digestion for Hg											
Mercury	**18600**	-	993	ng/g dry	10000	F911173	04-Nov-19	9K15008	15-Nov-19	EPA 1631B	
Sample Preparation: EFGS SOP5133 Solids Analysis											
% Solids	**85.1**	-	0.1	% by Weight	1	F911177	13-Nov-19		19-Nov-19	SM 2540B	O-04, O-09
Sample Preparation: Miscellaneous Preparation AFS											
Mercury F-0	ND	-	1.88	ng/g dry	100	F911174	05-Nov-19	9K18011	15-Nov-19	EPA 1631 Mod	U

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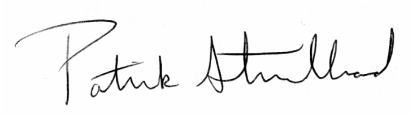

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271 Mill Road	Project Number: Niagara Falls GW System O&M	**Reported:**
Chelmsford MA, 01824	Project Manager: Andrew Nelson, PE	19-Nov-19 16:34

Quality Control Data

Analyte	Result	Detection Limit	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch F910225 - EFGS SOP2796 EPA 1631 Oxidation											
Blank (F910225-BLK1)					Prepared & Analyzed: 13-Oct-19						
Mercury	ND	-	0.50	ng/L							U
Blank (F910225-BLK2)					Prepared & Analyzed: 13-Oct-19						
Mercury	ND	-	0.50	ng/L							U
Blank (F910225-BLK3)					Prepared & Analyzed: 13-Oct-19						
Mercury	ND	-	0.50	ng/L							U
LCS (F910225-BS1)					Prepared & Analyzed: 13-Oct-19						
Mercury	6.06	-	0.50	ng/L	5.0350		120	77-123			
LCS Dup (F910225-BSD1)					Prepared & Analyzed: 13-Oct-19						
Mercury	6.13	-	0.50	ng/L	5.0350		122	77-123	1.05	24	
Duplicate (F910225-DUP1)		**Source: 9H00246-02**			Prepared & Analyzed: 13-Oct-19						
Mercury	1.58	-	0.50	ng/L		1.68			6.14	24	
Matrix Spike (F910225-MS1)		**Source: 9H00246-02**			Prepared & Analyzed: 13-Oct-19						
Mercury	6.91	-	0.50	ng/L	5.0000	1.68	105	71-125			
Matrix Spike (F910225-MS2)		**Source: 9H00294-03**			Prepared & Analyzed: 13-Oct-19						
Mercury	6.27	-	0.50	ng/L	5.0000	1.42	97.1	71-125			
Matrix Spike Dup (F910225-MSD1)		**Source: 9H00246-02**			Prepared & Analyzed: 13-Oct-19						
Mercury	6.81	-	0.50	ng/L	5.0000	1.68	103	71-125	1.38	24	
Matrix Spike Dup (F910225-MSD2)		**Source: 9H00294-03**			Prepared & Analyzed: 13-Oct-19						
Mercury	6.43	-	0.50	ng/L	5.0000	1.42	100	71-125	2.42	24	

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271 Mill Road	Project Number: Niagara Falls GW System O&M	**Reported:**
Chelmsford MA, 01824	Project Manager: Andrew Nelson, PE	19-Nov-19 16:34

Quality Control Data

Analyte	Result	Detection Limit	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch F911173 - EFGS SOP2807 Cold Aqua Regia Digestion for Hg											
Blank (F911173-BLK1)					Prepared: 04-Nov-19 Analyzed: 15-Nov-19						
Mercury	ND	-	1.00	ng/g wet							U
Blank (F911173-BLK2)					Prepared: 04-Nov-19 Analyzed: 15-Nov-19						
Mercury	ND	-	1.00	ng/g wet							U
Blank (F911173-BLK3)					Prepared: 04-Nov-19 Analyzed: 15-Nov-19						
Mercury	ND	-	1.00	ng/g wet							U
LCS (F911173-BS1)					Prepared: 04-Nov-19 Analyzed: 15-Nov-19						
Mercury	7.20	-	1.00	ng/g wet	8.0000		90.0	75-125			
LCS Dup (F911173-BSD1)					Prepared: 04-Nov-19 Analyzed: 15-Nov-19						
Mercury	7.03	-	1.00	ng/g wet	8.0000		87.8	75-125	2.40	24	
Duplicate (F911173-DUP2)		**Source: 9H00184-05RE2**			Prepared: 04-Nov-19 Analyzed: 15-Nov-19						
Mercury	1162	-	122	ng/g dry		5245			127	24	QR-07
Matrix Spike (F911173-MS1)		**Source: 9H00184-05RE2**			Prepared: 04-Nov-19 Analyzed: 15-Nov-19						
Mercury	1081	-	128	ng/g dry	408.06	5245	-1020	71-125			QM-02
Matrix Spike (F911173-MS2)		**Source: 9H00246-01RE1**			Prepared: 04-Nov-19 Analyzed: 15-Nov-19						
Mercury	6589	-	1020	ng/g dry	408.73	7176	-144	71-125			QM-02
Matrix Spike (F911173-MS3)		**Source: 9H00246-01RE2**			Prepared: 04-Nov-19 Analyzed: 15-Nov-19						
Mercury	7632	-	2550	ng/g dry	408.73	7192	108	71-125			QM-02
Matrix Spike Dup (F911173-MSD1)		**Source: 9H00184-05RE2**			Prepared: 04-Nov-19 Analyzed: 15-Nov-19						
Mercury	1372	-	220	ng/g dry	703.40	5245	-551	71-125	-59.8	24	QM-02, QR-08

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271 Mill Road	Project Number: Niagara Falls GW System O&M	**Reported:**
Chelmsford MA, 01824	Project Manager: Andrew Nelson, PE	19-Nov-19 16:34

Quality Control Data

Analyte	Result	Detection Limit	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch F911173 - EFGS SOP2807 Cold Aqua Regia Digestion for Hg											
Matrix Spike Dup (F911173-MSD2)		**Source: 9H00246-01RE1**			Prepared: 04-Nov-19 Analyzed: 15-Nov-19						
Mercury	5696	-	681	ng/g dry	272.30	7176	-543	71-125	-116	24	QM-02, QR-08
Matrix Spike Dup (F911173-MSD3)		**Source: 9H00246-01RE2**			Prepared: 04-Nov-19 Analyzed: 15-Nov-19						
Mercury	4942	-	1700	ng/g dry	272.30	7192	-826	71-125	-260	24	QM-02
Batch F911174 - Miscellaneous Preparation AFS											
Blank (F911174-BLK1)					Prepared: 05-Nov-19 Analyzed: 15-Nov-19						
Mercury F-0	ND	-	5.00	ng/g wet							U
LCS (F911174-BS1)					Prepared: 05-Nov-19 Analyzed: 15-Nov-19						
Mercury F-0	124.9	-	5.00	ng/g wet	100.00		125	77-123			QM-12
LCS Dup (F911174-BSD1)					Prepared: 05-Nov-19 Analyzed: 15-Nov-19						
Mercury F-0	126.8	-	5.00	ng/g wet	100.00		127	77-123	1.52	25	QM-12
Duplicate (F911174-DUP1)		**Source: 9H00246-01**			Prepared: 05-Nov-19 Analyzed: 15-Nov-19						
Mercury F-0	0.40	-	3.21	ng/g dry		ND				25	U
Matrix Spike (F911174-MS1)		**Source: 9H00246-01**			Prepared: 05-Nov-19 Analyzed: 15-Nov-19						
Mercury F-0	77.53	-	3.06	ng/g dry	61.109	ND	127	75-125			QM-12
Matrix Spike Dup (F911174-MSD1)		**Source: 9H00246-01**			Prepared: 05-Nov-19 Analyzed: 15-Nov-19						
Mercury F-0	101.9	-	3.29	ng/g dry	65.768	ND	155	75-125	19.9	25	QM-12

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271 Mill Road	Project Number: Niagara Falls GW System O&M	**Reported:**
Chelmsford MA, 01824	Project Manager: Andrew Nelson, PE	19-Nov-19 16:34

Quality Control Data

Analyte	Result	Detection Limit	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch F911177 - EFGS SOP5133 Solids Analysis											
Duplicate (F911177-DUP1)		**Source: 9H00246-01**			Prepared: 14-Nov-19 Analyzed: 19-Nov-19						
% Solids	94.1	-	0.1	% by Weight		94.7			0.636	10	O-04, O-09
Duplicate (F911177-DUP2)		**Source: 9H00184-05**			Prepared: 14-Nov-19 Analyzed: 19-Nov-19						
% Solids	51.1	-	0.1	% by Weight		53.8			5.15	10	O-04, O-09

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271 Mill Road	Project Number: Niagara Falls GW System O&M	**Reported:**
Chelmsford MA, 01824	Project Manager: Andrew Nelson, PE	19-Nov-19 16:34

Notes and Definitions

U	Analyte was not detected and is reported as less than the LOD or as defined by the client. The LOD has been adjusted for any dilution or concentration of the sample.
QR-08	The RPD value for the MS/MSD was outside of acceptance limits. Batch QC acceptable based on matrix duplicate and/or LCS/LCSD RPD values within control limits.
QR-07	The RPD/RSD value for the matrix duplicate/triplicate was outside of acceptance limits. Batch QC acceptable based on MS/MSD and/or LCS/LCSD RPD values within control limits.
QM-12	Continuing calibration verification (CCV) and/or blank spike/blank spike duplicate (BS/BSD) recoveries above upper control limits. All reported sample concentrations were below the reporting limit.
QM-02	The MS and/or MSD recoveries outside acceptance limits, due to spike concentration less than 1 times the sample concentration. The batch was accepted based on LCS and LCSD recoveries within control limits and, when analysis permits, acceptable AS/ASD.
O-09	Total Solids are prepared at the same time as the preparation for the analyte(s) of interest in order to provide the most accurate dry mass correction.
O-04	This sample was analyzed outside of the recommended holding time.
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the method detection limit if reported to the MDL or above the reporting limit if reported to the MRL.
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

Appendix C
Data Usability Summary Report

OLIN NIAGARA FALLS SOIL SAMPLING EVENT
DATA USABILITY SUMMARY REPORT (DUSR)
SDG 9H00246
AUGUST 2019 SAMPLING EVENT

The quality assurance program established for the groundwater sampling and analyses program at the Olin-Niagara Falls, New York Site is designed so that data produced during this investigation are of known precision, accuracy and completeness for the intended data use. The data were assessed using the "Revised Mercury Speciation Soil Investigation Work Plan, Revision 02" (Wood, 2019), "Contract Laboratory Program Guidelines for Inorganic Superfund Data Review (USEPA, 2014) and its updates as guidance. RCRA performance standards (per SW-846, Update III) and USEPA drinking water method standards have been used where applicable. A Data Usability Summary Report (DUSR) review was completed and included the following activities for the data obtained during this sampling event:

- Case Narrative
- Review of Chain of Custody documentation;
- Evaluation of sample holding times;
- Evaluation of the reported analyses to confirm that approved analytical methods were performed;
- Evaluation of detection and reporting limits (RLs);
- Assessment of the presence of field and laboratory contamination (instrument, method, calibration, and equipment rinsate blanks, as applicable);
- Assessment of field and analytical precision (relative percent difference [RPD]) between field and laboratory duplicates, and matrix/matrix spike duplicates (MS/MSD);
- Assessment of analytical accuracy and laboratory performance criteria including: initial and continuing calibrations, low calibration standards, laboratory control sample (LCS) recoveries, and MS/MSD recoveries; and
- Raw data review and recalculation of results in 10% of samples.

This data quality evaluation applies to the August 2019, soil sampling event at the Niagara Falls Site. Soil samples from ten locations were collected on August 20, 2019. The samples and associated QC samples were delivered to the Eurofins Frontier Global Sciences, LLC. (Eurofins) laboratory in Tacoma, Washington. Samples were received by the laboratory and login numbers applied to the batch, hereafter referred to as sample delivery group (SDG). The SDG number for this sampling event is 9H00246. The DUSR for this SDG follows the listing of the soil sample field identifications. The topics of each section are ordered to first assess issues affecting the entire data set.

Soil samples were analyzed for total and elemental mercury (Hg) by the following USEPA Methods:

Total Hg	**Elemental Hg**
EPA 1631B	EPA 1631Mod

The samples were prepared for total Hg by modified cold aqua-regia digestion (EFAFS-T-AFS-SOP2807) and for elemental Hg by selective sequential extraction (EFAFS-T-AFS-SOP2813), as specified in the project Work Plan.

Deliverables (SDG 9H00246)

Laboratory deliverables included Category B deliverables as defined in the NYSDEC Analytical Services Protocols (NYSDEC, 2005). The reporting of results by Eurofins included a summary of the samples in the SDG, a brief narrative noting any problems encountered in the analytical process, batch quality control reports (calibrations, blanks, LCS recoveries, and MS/MSD results where applicable) and copies of the custody records.

The soil samples collected at the Niagara Falls Site in August 2019 are presented in **Table 1** below as listed on the Chain of Custody (COC).

Table 1 – Summary of Samples

SDG	Sample ID	Sample Date	Media	Sample Type
9H00246	PLS-SS-49-08202019	8/20/19	SO	FS
9H00246	PLS-SS-RINSATE BLANK 08202019	8/20/19	BW	EB
9H00246	PLS-SS-42-08202019	8/20/19	SO	FS
9H00246	PLS-SS-31-08202019	8/20/19	SO	FS
9H00246	PLS-SS-29-08202019	8/20/19	SO	FS
9H00246	PLS-SS-24-08202019	8/20/19	SO	FS
9H00246	PLS-SS-19-08202019	8/20/19	SO	FS
9H00246	PLS-SS-16-08202019	8/20/19	SO	FS
9H00246	PLS-SS-10-08202019	8/20/19	SO	FS
9H00246	PLS-SS-7-08202019	8/20/19	SO	FS
9H00246	PLS-SS-3-08202019	8/20/19	SO	FS
9H00246	DUP01-SS-08202019	8/20/19	SO	FD

Notes

BW =Blank Water, EB = Equipment Blank, FD = Field Duplicate, FS = Field Sample, SO = Soil
Soil sample PLS-49-08202019 was designated on the COC for MS/MSD analyses.

Sample Integrity

The samples were collected on August 20, 2019 and Eurofins received the sample-shipping containers on August 21, 2019. The soil sample containers were packed in dry ice with a temperature measuring -21.8°C, and the blank water sample was packed using wet ice with a temperature of 0.0 °C. The laboratory noted all samples were received intact, therefore, no qualification of the data is necessary due to sample temperature. The proper bottles and preservatives were used, and the Chain of Custody was properly relinquished. There were no discrepancies noted by the laboratory.

The laboratory employed Method 1631E for the blank water sample (PLS-SS-RINSATE BLANK 08202019) as listed in the work plan. However, the laboratory employed analytical Method 1631B for total mercury and 1631 Modified for elemental mercury for the analyses of soil samples which varies from Method 1631E as referenced in the work plan. Method 1631E differentiates between bubbler and flow-injection techniques and requires the addition of system and method blanks. Review of the data package indicates that the laboratory analyzed the required extra blanks per method 1631E and followed the flow-injection techniques as outlined in the method and/or per the laboratory's SOP.

Total Mercury (EPA 1631B)

Each sample in this SDG was submitted to Eurofins for total mercury analysis by EPA Method 1631B, with preparation by modified cold aqua-regia digestion. The method listed in the work plan was 1631E, however the use of Method 1631B is acceptable. A level IV DQE was performed on this method and each of the components were within the QC limits with the exception of MS/MSD recoveries and RPDs, and field duplicate precision.

Holding Times

The method specific hold times of 180 days for analysis were met for all samples submitted for total mercury.

Reporting Limits

The laboratory's method reporting limits (MRLs) were compliant with the project work plan target RL of 1.0 nanograms per gram (ng/g), however dilutions were necessary for each sample which resulted in elevated MRLs. Any result reported between the method detection limit (MDL) and MRL is considered a quantitative estimate, however there were none in this SDG.

Initial and Continuing Calibrations

The initial and continuing calibration standards met method criteria for the analysis of total Hg.

Blank Summary

The analytical results of the laboratory instrument and method blanks indicate that total mercury was not present and that system blanks met the method criteria.

Low Calibration Point Check

The low calibration standard check recovered with acceptable QC limits.

Laboratory Control Sample

The percent recoveries for the LCS and LCSD were within QC limits, and the RPD between them acceptable.

Matrix Spike/Matrix Spike Duplicate

Project sample PLS-SS-RINSATE BLANK 08202019 was selected for the water batch MS/MSD analysis, and the recoveries and RPD were within QC limits. Project sample PLS-SS-49-08202019 was submitted for soil MS/MSD analysis, and the recoveries and relative percent differences (RPDs) were outside of the QC limits.

> *Action: No qualification was necessary for total mercury in sample PLS-SS-49-08202019 because the sample result was greater than 4x the spike amount.*

Sampling Accuracy

Field accuracy was measured through the collection of an equipment blank. The equipment blank, PLS-SS-RINSATE BLANK 08202019, contained measurable levels of total mercury, and associated results less than 5x the blank value should be considered estimated.

> *Action: No qualification was necessary because the associated results were greater than 5x the blank value.*

Field Duplicate Samples
One duplicate pair (PLS-SS-19-08202019/DUP01-SS-08201019) was collected and analyzed for total mercury and the RPD was above the QC limit.

Action: The total mercury results for samples PLS-SS-19-08202019 and DUP01-SS-08201019 were qualified as estimated and flagged "J".

Raw Data Review and Re-Calculation of Results
The total Hg results reported for samples PLS-RINSATE BLANK 08202019 and PLS-SS-49-08202019 were reviewed and re-calculated, and the reported results were confirmed.

Elemental Mercury (EPA 1631 Mod)
Each soil sample in this SDG was submitted to Eurofins for elemental mercury analysis by Method 1631 Modified, with preparation by selective sequential extraction. A level IV DQE was performed on this method and each of the components were within the QC limits with the exception of LCS and MS/MSD recoveries.

Holding Times
The method specific hold times of 180 days for analysis were met for all samples submitted for elemental mercury.

Reporting Limits
The laboratory MRLs were generally compliant with the project work plan target RL for elemental mercury of 2 ng/g, adjusted for the percent moisture for each sample. Results were reported to the MRL and evaluated down to the MDL. Any result reported between the MDL and RL is considered a quantitative estimate, however there were none in this SDG.

Initial and Continuing Calibrations
The initial and continuing calibration standards met method criteria for the analysis of elemental Hg.

Blank Summary
The analytical results of the laboratory method blanks indicate that elemental mercury was not present and that system blanks met the method criteria.

Low Calibration Point Check
The low calibration standard check recovered with acceptable QC limits.

Laboratory Control Sample
The percent recoveries for the LCS and LCSD were above the upper QC limit, indicating a possible high bias.

Action: No qualification was necessary because the bias was high and elemental mercury was not detected in the associated samples.

Matrix Spike/Matrix Spike Duplicate

Project sample PLS-SS-49-08202019 was submitted for MS/MSD analysis, and the recoveries were above the upper QC limit indicating possibly high biased results.

> *Action: No qualification was necessary because the recoveries were high and elemental mercury was not detected in the associated sample.*

Sampling Accuracy

Field accuracy was measured through the collection of an equipment blanks, however the equipment blank sample (PLS-SS-RINSATE BLANK 08202019) was not analyzed for elemental Hg.

Field Duplicate Samples

One duplicate pair (PLS-SS-19-08202019/DUP01-SS-08201019) was collected and analyzed for elemental Hg, and the RPDs could not be calculated because both samples did not contain measurable levels of elemental Hg.

Raw Data Review and Re-Calculation of Results

The elemental Hg result reported for sample PLS-SS-49-08202019 was reviewed and re-calculated, and the reported not detected result was confirmed.

Summary of Data Usability

Based on the preceding criteria, this data set representing the August 2019 sampling event at the Olin Niagara Falls site is useable with minor qualifications. The data qualifiers are represented in this narrative. Additionally, completeness, which is the percentage of analytical results judged to be valid (including estimated values), was 100 percent for the sampling event. Typically, project objectives are met when completeness is 90 percent or better. A summary of qualifiers applied to the data is listed in **Table 2**.

References

NYSDEC, 2005. New York State Department of Environmental Conservation (NYSDEC), 2005. "Analytical Services Protocols"; June 2005.

Wood, 2019. "Revised Mercury Speciation Soil Investigation Work Plan, Revision 02", Olin North Parcels I and II, AOC Index No. R9-4171-94-08, NYSDEC Site No. 932051A, Niagara Falls, New York; Wood Environment & Infrastructure Solutions, Inc., March 22, 2019.

USEPA, 2014. EPA *Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review*, Final, EPA-540-R-013-001, August 2014.

Prepared by/Date: DWK 12/10/19
Checked by/Date: JAH 12/10/19

TABLE 2 – SUMMARY OF DATA QUALIFIERS

TABLE 2
SUMMARY OF DATA QUALIFIERS
DATA USABILITY SUMMARY REPORT
AUGUST 2019 MERCURY SPECIATION SAMPLING
OLIN-NIAGARA

Field Sample ID	Location ID	Type	SDG	Method	Parameter Name	Lab Result	Lab Qual	Val Qual	Reason Codes	Units
PLS-SS-19-08202019	PLS-SS19	FS	9H00246	1631B	Total Mercury	12700		J	FD	ng/g
DUP01-SS-08202019	PLS-SS19	FD	9H00246	1631B	Total Mercury	18600		J	FD	ng/g

Notes:

Reason Codes:

FD = Field duplicate precision exceeds QC limit

Validation Qualifiers:

J = The compound was positively identified; however, the associated numerical value is an estimated concentration only.

Prepared by/Date: DWK 12/10/19
Checked by/Date: JAH 12/10/19

DQE CHECKLISTS

Initial Review by: D. Knaub Date: 12/09/19 SDG# 9H00246
Senior Review by: J. Hartness Date: 12/10/19 Matrix Soil/Water

DATA QUALITY EVALUATION
Olin-Niagara Falls
EPA 1631E
(Mercury)

1.0 Sample Integrity

	Yes	No	N/A		Notes
1.1	_X_	___	___	Were the following holding times met for Hg? Hold time is calculated as time elapsed from sampling to analysis. If not, flag sample results as J (for positive) or UJ (for non-detect). Soil/Sediment: 180 days to analysis (@ -11°C)	Coll: 08/20/19 Water Prep: 10/13/19 Anal: 10/13/19 (total Hg only) Total / Elemental Soil Prep: 11/04/19 / 11/05/19 Soil Anal: 11/15/19 / 11/15/19
1.2	_X_	___	___	Were the correct bottles and preservatives used upon collection of Hg samples? Note discrepancies. [soil/sediment – glass jar w/ Teflon lined cap or 125ml or 250ml HDPE jars shipped on dry ice @ -11°C]	Temps: Waters: 0.0°C Soils: -21.8°C

2.0 Laboratory Method

	Yes	No	N/A		
2.1	_X_	___	___	Was the correct method used for preparation of samples? Total Hg: Eurofins EFGS-SOP-066R06 (Modified Cold Aqua-Regia Digestion) Elemental Hg: Eurofins EFGS-SOP-090-R04 (Selective Sequential Extraction)	
2.2	_X_	___	___	Was the correct method used for analysis of samples? Soil/Sediment: EPA 1631E	Waters: 1631E (total) Soils: 1631B (total) 1631 Mod (elemental)

3.0 Initial Calibration

	Yes	No	N/A		
3.1	_X_	___	___	Were all instruments calibrated daily with a blank and 5 standards for Hg with an RSD of < 15%? If any instrument was not calibrated daily or criteria were not met, reject (R) all associated data.	p. 42 ICAL 10/13/19 Inst Hg2600-3 RSD = 10.5% p. 103 ICAL 11/14/19 Inst Hg2600-3 RSD = 4.3% p. 161 ICAL 11/15/19 Inst Hg2600-3 RSD = 4.5%
3.2	_X_	___	___	Was a low level standard check performed with the lowest calibration standard and recovered within 75-125%	p. 42 ICAL 10/13/19 Cal 1 = 85.8% rec p. 103 ICAL 11/14/19 Cal 1 = 98.7% rec p. 161 ICAL 11/15/19 Cal 1 = 95.1% rec

Initial Review by: D. Knaub Date: 12/09/19 SDG# 9H00246
Senior Review by: J. Hartness Date: 12/10/19 Matrix Soil/Water

4.0 Calibration Verification

					Notes
4.1	Yes _X_	No ___	N/A ___	Was an ICV/CCV/OPR analyzed at the beginning and end of every 10 environmental samples or as necessary?	p. 22 ICV 10/13/19 Hg = 109% p. 26 ICV 11/15/19 Hg = 100% p. 28 ICV 11/15/19 Hg = 107%
4.2	Yes _X_	No ___	N/A ___	Were the ICVs/CCVs/OPRs within 77-123% of the true value? If the ICV/CCV/OPR recovery is outside the QC limits, flag both positive and non-detect results "J"/"UJ".	p. 21 CCVs 10/13/19 CCV1 = 108% ok p. 24 – 25 CCVs 11/14/19 – All OK p. 27 – 28 CCVs 11/15/19 – All OK

5.0 Method, Instrument, and Calibration Blanks

5.1	Yes _X_	No ___	N/A ___	Were instrument blank analyzed for total Hg for each SDG or every 20 samples of similar matrix?	p. 42 SEQ-IBL 10/13/19 Mean = 0.1 ng/L Std Dev = ± 0.01 p. 29 F910225-BLK-1,2,3 = All ND (< 0.5ng/L)
5.2	Yes _X_	No ___	N/A ___	Were the instrument blanks (typically 3 per batch) < 0.50 ng/L, with a mean of < 0.25 ng/L and a standard deviation of < 0.1ng/L? If the sample concentration is <5x the blank value, flag "UB" If the sample concentration is >5x the blank value, no flag required.	p. 161 SEQ-IBL 11/15/19 Mean = 0.12 ng/L Std Dev = ± 0.06 p. 30 F911173-BLK-1,2,3 = All ND (<1.0 ng/g) p. 31 MB F911174-BLK1 = ND (<5.0 ng/g)
5.3	Yes _X_	No ___	N/A ___	Was a 1%BrCl reagent blank analyzed as necessary with Hg <0.2ng/L?	
5.5	Yes _X_	No ___	N/A ___	Were initial and continuing calibration blanks analyzed as necessary?	10/13/19 ICBs = IBL

5.6	Yes ___	No _X_	N/A ___	Were the method and calibration blanks < 0.5 ng/L,? If the sample concentration is <5x the blank value, flag "UB" If the sample concentration is >5x the blank value, no flag required.	10/13/19 ICBs = MB p. 28 ICB 11/15/19 Hg = -0.01 ng/L p. 20-21 CCBs 10/13/19 – All < 0.5 OK p. 26 – 27 CCBs 11/15/19 – All <0.5, ,mean <0.25 - OK

6.0 Laboratory Control Standard

6.1	Yes _X_	No ___	N/A ___	Was a Laboratory Control Standard (LCS) analyzed with each SDG or every 20 samples of similar matrix? (Note: The LCS is sometimes referred to as an QCS sample – quality control standard.)	p. 29 LCS/LCSD F910225-BS1/BSD1 Hg = 120, 122% RPD = 1.05 p. 30 LCS/LCSD F911173-BS1/BSD1 Hg = 90.0, 87.8% RPD = 2.4 p. 31 LCS/LCSD F911174-BS1/BSD1 Hg F-0 = 125, 127% RPD = 1.52 *No flags necessary, bias high and assoc. results ND*
6.2	Yes ___	No _X_	N/A ___	Are spiked recoveries in the LCS within 80-120% and have an RSD < 24%? If not, flag associated samples "J" / "UJ". *Note: Lab used 75-125% for total Hg and 71-123% for elemental Hg.*	
6.3	Yes _X_	No ___	N/A ___	Was a Certified Reference Material (CRM) check analyzed with each matrix? May be the same as the LCS/QCS.	See LCS
6.4	Yes ___	No _X_	N/A ___	Are spiked recoveries in the CRM within 80-120%? If not, flag associated samples "J" / "UJ".	

7.0 Matrix Spikes

Notes

7.1	Yes _X_	No ___	N/A ___	Was a Matrix Spike/Matrix Spike Duplicate (MS/MSD) analyzed at a frequency of 1 per 20 samples as designated by project team? List samples that were spiked.	p. 29 PLS-SS-RINSATE BLANK 08202019 Hg = 105, 103% RPD = 1.38
7.2	Yes ___	No _X_	N/A ___	Were the recoveries of the MS/MSD within 71-125%? No calculation of recovery necessary if element is present in parent sample ≥ 4x the spike amount and no flags are applied. If recoveries are high, flag positive results in the parent sample "J". If recoveries are low, flag positive and non-detect results in the parent sample "J/UJ". *Note: Lab used 75-125% for elemental Hg.*	p. 30 PLS-SS-49-08202019 (2x re-anal) Hg = -144, -543% RPD = -116% Hg = 108, -826% RPD = -260% *No flags necessary, sample result > 4x spike amt.* p. 31 PLS-SS-49-08202019 Hg F-0 = 127, 155% RPD = 19.9% *No flags necessary, bias high and assoc. result ND*

7.3	Yes ___	No _X_	N/A ___	Was the RPD between the MS and MSD <24% for total Hg and <25% for elemental Hg? If RPD is exceeded, qualify the associated sample as estimated and flag "J".	

8.0 Duplicates

8.1	Yes _X_	No ___	N/A ___	Were any intra-laboratory sample or field duplicates analyzed? At times the laboratory will choose samples at random for duplicate analysis as part of internal QA/QC. Record and cross-reference sample ID.	DUP01-SS-08202019 = PLS-SS-19-08202019 Hg 18600 12700 RPD = ***37.7 Flag "J"*** Hg F-0 ND (<1.88) ND (<1.89) RPD NC %Solids 85.1 85.6 RPD = 0.5
8.2	Yes ___	No _X_	N/A ___	Is RPD between sample and duplicate <24%? If RPD exceeds limits flag as estimated (J).	Lab dups: p. 29 PLS-SS-RINSATE BLANK 08202019 Hg RPD = 6.14 ok p. 31 PLS-SS-49-08202019 Hg F-0 RPD NA (both ND) ok

9.0 Compound Quantitation and Reported Detection Limits

9.1	Yes _X_	No ___	N/A ___	Are results present for all samples sent to the lab for Hg? Compare COC with lab reports on a sample by sample basis.	
9.2	Yes _X_	No ___	N/A ___	Have PQLs been adjusted to properly reflect sample dilutions and for soil, sample moisture and weight?	
9.3	Yes _X_	No ___	N/A ___	Were the MDLs and MRLs listed in the Work Plan met? Total Hg: MDL = 0.11 ng/g MRL = 1.0 ng/g Elemental Hg: MDL = 0.344 ng/g MRL = 2.00 ng/g	
9.4	Yes _X_	No ___	N/A ___	Have the results been manually calculated from the raw data provided by the lab? Check at least 10% of the results, and document using the supplemental notes page below.	See Supplemental sheet All OK

10.0 Field QA/QC

10.1	Yes _X_	No ___	N/A ___	Were any field or rinsate blanks collected?	PLS-SS-RINSATE BLANK 08202019

					Notes
10.2	Yes ___	No _X_	N/A ___	Are target analytes non-detect in the rinsate blank? If not, list compounds present with concentration and apply the following rule. If sample concentration is < 5x the blank value, assign a "U". If sample concentration is > 5x the blank value, no flag is necessary.	tot. Hg = 1.68 ng/L *No flags, assoc. results > 5x*

11.0 Application of Validation Qualifiers

Validation qualifiers should now be applied to any result pertaining to this method. A project narrative should be written upon completion of the data quality evaluation, to address all qualifiers associated with each method.

Data Usable With Qualification

J	Associated value is an estimated quantitation
U	Analyte was analyzed for but not detected
JQ	Result is less than the project reporting limit but greater than or equal to the method detection limit
UB	Results was considered a non-detect based on blank contamination

Unusable Data

R	Data rejected based upon QC data

Flagging Hierarchy

R > U, UJ > J > B

If at any time the reviewer is uncertain of the proper course of action when evaluating data, then that reviewer should consult with the Project Chemist or a Senior Chemist.

REFERENCES

"Innovative Approaches to Data Validation, United States Environmental Protection Agency Region III," June 1995.
"Guidance on Environmental Data Verification and Data Validation (EPA QA/G-8)," Peer Review, United States Environmental Protection Agency, June 15, 2000.
"Revised Mercury Speciation Soil Investigation Work Plan Revision 01", Wood Environment & Infrastructure Solutions, Inc. July 13, 2018.

Initial Review by: D. Knaub Date: 12/09/19 SDG# 9H00246
Senior Review by: J. Hartness Date: 12/10/19 Matrix Soil/Water

SUPPLEMENTAL NOTES

This page is to be used for supplemental information from the DQE evaluation form, where space was insufficient to elaborate on a specific item. Make extra copies of this blank page as necessary.

Section 9.4 – Data Calculations
See SOP for formula
p. 42 ICAL

PLS-RINSATE BLANK 08202019 Hg (ng/L) = $\left(\left(\left((345.54 - 21.1)/195.30\right) \times 1\right) - (-0.02 \times 1)\right)/1$

Hg = 1.66 – (-0.02) = 1.68 ng/L

Reported: PLS-RINSATE BLANK 08202019 tot Hg = 1.68 ng/L

p. 161 ICAL: RF mean = 279.48, SEQ-IBL mean = 35.37
PLS-SS-49-08202019

p. 162 raw response=667.42 tot Hg (ng/L) = $\left(\left(\left((667.42 - 35.27)/279.48\right) \times 50000\right) - (25.27 \times 20)\right)/50000$
Dilution = 50,000

Tot Hg = (113093.96 - 505.4) / 50000
Tot Hg = 2.25 ng/L

p. 88 g extracted=0.6642 Tot Hg (ng/g wet) = (2.25 ng/L x 50000 x 40 ml) / (0.6642 x 1000)
Final Volume = 40 mL Final Hg (wet) = 6780 ng/g

tot Hg (ng/g dry) = 6780 ng/g / 0.947 = 7159.8 ng/g

Reported: PLS-SS-49-08202019 tot Hg = 7190 ng/g

p. 103 ICAL

PLS-SS-49-08202019 p. 162 raw response elemental Hg (ng/L) = $\left(\left(\left((69.50 - 23.6)/339.48\right) \times 100\right) - (23.4 \times 1)\right) / 100$

ele Hg = (13.52 – 23.40) / 100
ele Hg = -0.0988

Reported: PLS-SS-49-08202019 ele. Hg = ND @ 3.17 ng/g

Appendix D
ProUCL Output

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.111/22/2019 12:49:26 PM
From File	2014 and 2019 SO tHg.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

tHg

General Statistics

Total Number of Observations	60	Number of Distinct Observations	59
		Number of Missing Observations	0
Minimum	0.43	Mean	8.25
Maximum	57.3	Median	3.59
SD	12.15	Std. Error of Mean	1.569
Coefficient of Variation	1.473	Skewness	2.809

Normal GOF Test

Shapiro Wilk Test Statistic	0.615	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.267	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.114	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	10.87	95% Adjusted-CLT UCL (Chen-1995)	11.44
		95% Modified-t UCL (Johnson-1978)	10.97

Gamma GOF Test

A-D Test Statistic	1.902	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.788	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.172	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.119	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.827	k star (bias corrected MLE)	0.797
Theta hat (MLE)	9.979	Theta star (bias corrected MLE)	10.36
nu hat (MLE)	99.21	nu star (bias corrected)	95.58
MLE Mean (bias corrected)	8.25	MLE Sd (bias corrected)	9.244
		Approximate Chi Square Value (0.05)	74.03
Adjusted Level of Significance	0.046	Adjusted Chi Square Value	73.57

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	10.65	95% Adjusted Gamma UCL (use when n<50)	10.72

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.969	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.275	Data appear Lognormal at 5% Significance Level

54	Lilliefors Test Statistic					0.0967	**Lilliefors Lognormal GOF Test**					
55	5% Lilliefors Critical Value					0.114	Data appear Lognormal at 5% Significance Level					
56	**Data appear Lognormal at 5% Significance Level**											
57												
58	**Lognormal Statistics**											
59	Minimum of Logged Data					-0.844	Mean of logged Data					1.395
60	Maximum of Logged Data					4.048	SD of logged Data					1.181
61												
62	**Assuming Lognormal Distribution**											
63	95% H-UCL					12.27	90% Chebyshev (MVUE) UCL					12.48
64	95% Chebyshev (MVUE) UCL					14.52	97.5% Chebyshev (MVUE) UCL					17.36
65	99% Chebyshev (MVUE) UCL					22.95						
66												
67	**Nonparametric Distribution Free UCL Statistics**											
68	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
69												
70	**Nonparametric Distribution Free UCLs**											
71	95% CLT UCL					10.83	95% Jackknife UCL					10.87
72	95% Standard Bootstrap UCL					10.79	95% Bootstrap-t UCL					11.76
73	95% Hall's Bootstrap UCL					11.26	95% Percentile Bootstrap UCL					10.87
74	95% BCA Bootstrap UCL					11.31						
75	90% Chebyshev(Mean, Sd) UCL					12.96	95% Chebyshev(Mean, Sd) UCL					15.09
76	97.5% Chebyshev(Mean, Sd) UCL					18.05	99% Chebyshev(Mean, Sd) UCL					23.86
77												
78	**Suggested UCL to Use**											
79	95% H-UCL					12.27						
80												
81	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
82	Recommendations are based upon data size, data distribution, and skewness.											
83	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
84	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
85												
86	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
87	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
88	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
89	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
90												