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CASE NARRATIVE

**Monthly Data Pall Life Sciences
Project: 1,4-Dioxane Remediation
Date: November 2018**

With the exceptions noted as flags or footnotes, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. In addition all laboratory quality control samples were within established control limits, with any exceptions noted below. Each sample was analyzed to achieve the lowest possible reporting limit within the constraints of the method. In some cases, due to interference or analytes present at high concentrations, samples were diluted. For diluted samples, the reporting limits are adjusted relative to the dilution required.

Gelman Sciences, Inc. d/b/a Pall Life Sciences (PLS) attests to the validity of the laboratory data generated by PLS's Ann Arbor, Michigan Environmental Laboratory facilities reported herein. All analyses performed by PLS's Environmental Laboratory facilities were done using established laboratory SOPs that incorporate QA/QC procedures described in the application methods. PLS's Environmental group has reviewed the data for compliance with the laboratory QA/QC plan, and data have been found to be compliant with laboratory protocols unless otherwise noted below.

Eight Outfall001 samples were sent to Ann Arbor Technical Services (ATS) for 1,4-dioxane daily analysis. ATS is a certified drinking water laboratory. The balance of the 1,4-dioxane and all bromate samples were analyzed by Pall Corporation's Environmental Laboratory. The test results in this report meet all NELAP requirements for parameters for which accreditation are required or available. Any exceptions to NELAP requirements are noted in this report. All exceptions are noted per laboratory standard operating procedure based on EPA Method 1624c. Pursuant to NELAP, this report may not be reproduced, except in full, without the written approval of the laboratory.

Calculations are performed before rounding to avoid round-off errors in calculated results. The odd even rule is used for rounding. Holding times were met for all samples analyzed. Proper preservation was observed on all samples unless otherwise detailed in the individual sections below.

RECEIPT/ STORAGE

The samples were received on the days noted in the report for the Month; the samples arrived in good condition, properly preserved and on ice when necessary. Samples that require 1,4-dioxane analysis are collected in hydrochloric HCl acid-preserved vials to a pH of ≤ 2 , with the exception of the Pall ozone treatment samples. These samples have chemicals that, when mixed with the HCl acid, cause interferences and trap damage. Every attempt is made to analyze these samples within 24 hours of receipt.

Samples that require Bromate analysis are collected and preserved in the laboratory with ethylene diamine and refrigerated.

The barium sample was taken as a composite sample, preserved with nitric acid, and refrigerated before and after being sent to ATS for analysis. This sample is preserved with nitric acid and refrigeration.

Samples that are delivered to the laboratory the same day as they are collected are likely not to have reached a fully chilled temperature. This is acceptable as long as there is evidence that chilling has begun. All samples are iced or refrigerated at 4°C ($\pm 2^\circ\text{C}$) from the time of collection until sample preparation or analysis.

1,4-Dioxane (GC-MS)

All ground water and treated water samples were analyzed for 1,4-Dioxane (GC-MS) in accordance with EPA 1624C, which has been modified to enhance detection limits. Samples that were diluted to bring them within the calibrated range of the instrument are noted with a "D" under the Qualifier Code section of the data report. Reporting limits were adjusted based on each dilution.

Reporting limit for undiluted samples is 1ppb (part per billion, micrograms per liter, µg/L). All quality control parameters were within the acceptance limits.

Bromate (Ion Chromatography)

All surface water and treated samples were analyzed for Bromate (Ion Chromatography) in accordance with EPA 300.1. Surrogates are added to all samples. All quality control parameters were within the acceptance limits with the balance of sample analyzed. Samples are preserved with ethylene diamine per EPA 300.1.

The reporting limit for treated samples is 5.0ppb and for surface samples is 2.0ppb.

Qualifiers

1,4-Dioxane Qualifier Codes:

<u>Qualifier Code</u>	<u>Description</u>
nd:	The compound was analyzed for, but was not detected at or above the detection limit indicated.
D:	Analyte value quantified from a dilution, reporting limit is raised to reflect dilution.
E:	The compound result is greater than the upper quantitation limit in the associated calibration curve, reported as estimate.
B:	The sample vials contained air bubbles larger than 5mm, which may affect compound results.
J:	The compound was positively identified; the associated numerical value is the approximate concentration.
M:	Matrix effects, sample required dilution.
R:	The reported value is unusable and rejected due to variance from quality control criteria.
V:	The reported value is considered estimated due to variance from quality control criteria.
H:	Sample was analyzed past 14 day hold time, but within 28 days.
O:	Samples analyzed in outside laboratory.
S:	Samples split with DEQ.

Bromate Qualifier Codes:

<u>Qualifier Code</u>	<u>Description</u>
nd:	The compound was analyzed for, but was not detected at or above the detection limit indicated.
E:	The compound result is greater than the upper quantitation limit in the associated calibration curve.
J:	The compound was positively identified; the associated numerical value is the approximate concentration.
R:	The reported value is unusable and rejected due to variance from quality control criteria.
V:	The reported value is considered estimated due to variance from quality control criteria.
H:	Sample was analyzed past 28 day hold time

Analyst: Susan E.O. Peters Susan E.O. Peters Date: 12-10-18

Report Checked by: Laurel Beyer Laurel Beyer Date: 12/10/18

Sample Analysis Report

November, 2018

642 South Wagner Road
Ann Arbor, MI 48103-9019 US
734.436.4025 phone

Analyst Initials: SEOD
Date: 12-10-18

Sample Name - Date/Time Sampled	1,4-Dioxane Results (ppb)	R.L. (ppb)	Bromate Results (ppb)	R.L. (ppb)	Bromide Results (ppb)	R.L. (ppb)	Comments	Qualifier(s)
Residential Wells								
D0								
4601 Park 4 inch-11-08-18-10:04-1	nd	1.0						
4601 Park 6 inch-11-08-18-11:24-1	nd	1.0						
Extraction Wells								
C3								
DOLPH-11-09-18-08:33-1	130	1.0						
TW-20-11-09-18-08:26-1	1100	10.0						D, H
TW-6-11-08-18-17:11-1	68	1.0						
D2								
LB-4-11-09-18-09:07-1	490	10.0						D
TW-21-11-09-18-08:45-1	210	10.0						D, H
E								
TW-18-11-09-18-08:40-1	250	10.0						D
TW-19-11-09-18-09:20-1	470	10.0						D
TW-23-11-09-18-09:04-1	450	10.0						D
Marshy								
PW-1-11-09-18-08:35-1	950	10.0						D
SW								
TW-22-11-09-18-08:12-1	460	10.0						D

Sample Name - Date/Time Sampled	1,4-Dioxane Results (ppb)	R.L. (ppb)	Bromate Results (ppb)	R.L. (ppb)	Bromide Results (ppb)	R.L. (ppb)	Comments	Qualifier(s)
TW-8-11-09-18-08:10-1	730	10.0						D
Monitoring Wells								
C3								
MW-125-11-14-18-09:56-1	91	10.0						D
MW-127s-11-13-18-10:03-1	nd	1.0						
MW-128s-11-13-18-12:38-1	nd	1.0						
D0								
A2 Cleaning Supply-11-12-18-10:11-1	66	1.0						
MW-137s-11-09-18-10:39-1	nd	1.0						
MW-139i-11-28-18-10:57-1	nd	1.0						
MW-139s-11-28-18-12:09-1	nd	1.0						
MW-140s-11-28-18-14:45-1	nd	1.0						
MW-53d-11-07-18-09:31-1	nd	1.0						
MW-53i-11-07-18-11:58-1	42	1.0						
MW-53s-11-07-18-10:45-1	nd	1.0						
MW-61d-11-08-18-14:22-1	7.0	1.0						
MW-61s-11-08-18-15:40-1	7.2	1.0						
D2								
MW-107-11-29-18-15:34-1	740	10.0						D
MW-113-11-09-18-16:28-1	86	1.0						
MW-117-11-12-18-12:42-1	nd	1.0						
MW-122s-11-29-18-14:07-1	210	5.0						D
MW-54d-11-16-18-11:04-1	52	1.0						
MW-54s-11-16-18-09:46-1	nd	1.0						
MW-92-11-09-18-15:04-1	49	1.0						
E								

Sample Name - Date/Time Sampled	1,4-Dioxane Results (ppb)	R.L. (ppb)	Bromate Results (ppb)	R.L. (ppb)	Bromide Results (ppb)	R.L. (ppb)	Comments	Qualifier(s)
MW-101-11-29-18-09:28-1	110	5.0						D
MW-103s-11-07-18-13:24-1	83	1.0						
MW-104-11-09-18-13:35-1	15	1.0						
MW-110-11-29-18-10:54-1	89	1.0						
MW-112i-11-05-18-15:27-1	9.4	1.0						
MW-112s-11-05-18-14:06-1	nd	1.0						
MW-116-11-21-18-13:29-1	340	10.0						D
MW-122d-11-29-18-12:46-1	nd	1.0						
MW-127d-11-13-18-08:48-1	nd	1.0						
MW-128d-11-13-18-11:22-1	nd	1.0						
MW-137d-11-09-18-09:26-1	nd	1.0						
MW-139d-11-28-18-09:44-1	nd	1.0						
MW-140d-11-28-18-13:31-1	nd	1.0						
MW-141d-11-08-18-12:56-1	3.4	1.0						
MW-30d-11-21-18-09:21-1	200	10.0						D
MW-65d-11-30-18-12:30-1	20	1.0						
MW-65i-11-30-18-09:53-1	2.6	1.0						
MW-65s-11-30-18-11:08-1	12	1.0						
MW-68-11-15-18-08:49-1	nd	1.0						
MW-71-11-30-18-14:01-1	290	50.0						D
MW-72d-11-21-18-10:48-1	850	25.0						D
MW-72s-11-21-18-12:05-1	1.9	1.0						
MW-76i-11-07-18-14:42-1	110	1.0						
MW-76s-11-07-18-15:56-1	300	10.0						D
MW-83s-11-21-18-14:51-1	420	10.0						D
MW-84s-11-09-18-12:15-1	29	1.0						
MW-91-11-16-18-13:14-1	190	10.0						D

Sample Name - Date/Time Sampled	1,4-Dioxane Results (ppb)	R.L. (ppb)	Bromate Results (ppb)	R.L. (ppb)	Bromide Results (ppb)	R.L. (ppb)	Comments	Qualifier(s)
MW-98d-11-12-18-14:07-1	17	1.0						
Saginaw Forest Cabin #1-11-13-18-15:19-1	nd	1.0						
Saginaw Forest Cabin #2-11-13-18-13:59-1	nd	1.0						
SW								
MW-45d-11-27-18-14:28-1	970	10.0						D
MW-45s-11-27-18-09:54-1	4.4	1.0						
MW-48-11-15-18-10:20-1	30	1.0						
MW-49-11-14-18-15:20-1	nd	1.0						
MW-52s-11-15-18-14:08-1	240	10.0						D
MW-58d-11-14-18-12:37-1	15	1.0						
MW-58s-11-14-18-11:23-1	210	10.0						D
MW-78-11-14-18-08:43-1	27	1.0						
Surface Water								
Not Applicable								
HC/HR-11-01-18-07:50-1			nd	2.0				
HC/HR-11-02-18-08:10-1			nd	2.0				
HC/HR-11-05-18-09:30-1			nd	2.0				
HC/HR-11-06-18-09:00-1			nd	2.0				
HC/HR-11-07-18-08:00-1			nd	2.0				
HC/HR-11-08-18-07:45-1			nd	2.0				
HC/HR-11-09-18-08:50-1			nd	2.0				
HC/HR-11-13-18-08:10-1			nd	2.0				
HC/HR-11-14-18-08:30-1			nd	2.0				
HC/HR-11-15-18-08:00-1			nd	2.0				
HC/HR-11-16-18-08:45-1			nd	2.0				
HC/HR-11-19-18-08:10-1			nd	2.0				

Sample Name - Date/Time Sampled	1,4-Dioxane Results (ppb)	R.L. (ppb)	Bromate Results (ppb)	R.L. (ppb)	Bromide Results (ppb)	R.L. (ppb)	Comments	Qualifier(s)
HC/HR-11-20-18-07:35-1			nd	2.0				
HC/HR-11-21-18-07:34-1			nd	2.0				
HC/HR-11-26-18-08:15-1			nd	2.0				
HC/HR-11-27-18-07:50-1			nd	2.0				
HC/HR-11-28-18-07:40-1			nd	2.0				
HC/HR-11-29-18-07:44-1			nd	2.0				
HC/HR-11-30-18-08:45-1			nd	2.0				
Treatment System								
OUTFALL-11-01-18-1	6.3	1.0						
OUTFALL-11-01-18-2			nd	5.0				
OUTFALL-11-04-18-1	9.8	1.0						
OUTFALL-11-04-18-2			nd	5.0				
OUTFALL-11-05-18-1	7.9	1.0						
OUTFALL-11-05-18-2			5.1	5.0				
OUTFALL-11-06-18-1	6.2	1.0						
OUTFALL-11-06-18-2			6.5	5.0				
OUTFALL-11-07-18-1	6.2	1.0						
OUTFALL-11-07-18-2			6.4	5.0				
OUTFALL-11-08-18-1	5.6	1.0						H
OUTFALL-11-08-18-2			7.9	5.0				
OUTFALL-11-11-18-1	6.4	1.0						
OUTFALL-11-11-18-2			6.9	5.0				
OUTFALL-11-12-18-1	5.8	1.0						
OUTFALL-11-12-18-2			7.3	5.0				
OUTFALL-11-13-18-1	8.4	1.0						
OUTFALL-11-13-18-2			6.3	2.0				
OUTFALL-11-14-18-1	7.6	1.0						

Sample Name - Date/Time Sampled	1,4-Dioxane Results (ppb)	R.L. (ppb)	Bromate Results (ppb)	R.L. (ppb)	Bromide Results (ppb)	R.L. (ppb)	Comments	Qualifier(s)
OUTFALL-11-14-18-2			5.8	5.0				
OUTFALL-11-15-18-1	6.1	1.0						
OUTFALL-11-15-18-2			6.1	5.0				
OUTFALL-11-18-18-1	8	1.0					ATS	O
OUTFALL-11-18-18-02			7.0	5.0				
OUTFALL-11-19-18-1	7	1.0					ATS	O
OUTFALL-11-19-18-02			7.4	5.0				
OUTFALL-11-20-18-1	6	1.0					ATS	O
OUTFALL-11-20-18-02			7.4	5.0				
OUTFALL-11-21-18-1	6	1.0					ATS	O
OUTFALL-11-21-18-02			7.9	5.0				
OUTFALL-11-22-18-1	7	1.0					ATS	O
OUTFALL-11-22-18-02			8.0	5.0				
OUTFALL-11-25-18-1	6	1.0					ATS	O
OUTFALL-11-25-18-02			7.6	5.0				
OUTFALL-11-26-18-1	7	1.0					ATS	O
OUTFALL-11-26-18-02			7.4	5.0				
OUTFALL-11-27-18-1	6	1.0					ATS	O
OUTFALL-11-27-18-02			8.2	5.0				
OUTFALL-11-28-18-1	5.8	1.0						
OUTFALL-11-28-18-2			7.8	5.0				
OUTFALL-11-29-18-1	5.3	1.0						
OUTFALL-11-29-18-2			8.6	5.0				
Red Pond-11-05-18-08:30-1	320	10.0						D
Red Pond-11-13-18-07:45-1	290	10.0						D
Red Pond-11-19-18-08:00-1	340	10.0						D
Red Pond-11-26-18-07:43-1	260	10.0						D

PLS Qualifier Codes:

- nd: The compound was analyzed for, but was not detected at or above the detection limit indicated.
- D: Analyte value quantified from a dilution, reporting limit is raised to reflect dilution.
- H: Sample was analyzed past 14 day hold time, but within 28 days used by ATS for same method with EPA approval.
- O: Samples analyzed in outside laboratory.

ANN ARBOR TECHNICAL SERVICES, INC.
for PALL / GELMAN SCIENCES

1,4-Dioxane Analysis

Bromate Analysis

Sample ID	Sample Date	Result (mg/L)	Sample ID	Sample Date	Result (mg/L)
Outfall 001	11/18/18	0.008	HC/HR	11/19/18 8:10 AM	<0.005
Outfall	11/19/18	0.007	HC/HR	11/20/18 7:35 AM	<0.005
Outfall	11/20/18	0.006	HC/HR	11/21/18 7:34 AM	<0.005
Outfall	11/21/18	0.006	HC/HR	11/26/18 8:20 AM	<0.005
Outfall	11/22/18	0.007	HC/HR	11/27/18 7:50 AM	<0.005
Outfall	11/25/18	0.006	HC/HR		
Outfall	11/26/18	0.007			
EFFOC1A	11/27/18	0.004			
EFFOC2A	11/27/18	0.006			

