

CASE NARRATIVE**Monthly Data Pall Life Sciences****Project: 1,4-Dioxane Remediation****Date: May 2016**

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 instrumentation. 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.

Samples were sent to Ann Arbor Technical Services, Inc. (ATS) for analysis for two reasons: drinking water samples and replicates of split samples with the state and city of Ann Arbor Laboratory. ATS is a Michigan DEQ Drinking Water Accredited Laboratory. In addition they have extensive experience analyzing 1,4-dioxane samples.

The data that has been received as of this writing can be found in the Sample Analysis report. Samples were split with the City of Ann Arbor, DEQ, ATS and PLS. The results thus far show excellent agreement between laboratories. No data has been received from the City of Ann Arbor as yet. The EPA Methods used by each laboratory are as follows: PLS- EPA1624c modified, ATS- EPA1624, DEQ- EPA8260 modified, and the City of Ann Arbor- EPA522. *Please note all DEQ data in this report less than or equal to 5ppb is to be considered an estimate due to analysis constraints within their laboratory.* ATS and PLS have lower limits of detection and data reported here are not estimates.

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 at PLS 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 PLS 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 di-amine and refrigerated.

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.

PLS 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.

PLS 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.

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

Qualifiers

1,4-Dioxane Qualifier Codes:

<i>Qualifier Code</i>	<i>Description</i>
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:

<i>Qualifier Code</i>	<i>Description</i>
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
O:	Samples analyzed in outside laboratory.

Analyst: Susan E.O. Peters Susan E.O. Peters Date: 06-06-16

Report Checked by: Laurel Beyer Laurel Beyer Date: 6-6-16



Sample Analysis Report

May, 2016

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Analyst Initials: SECP
Date: 06-06-16

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								
Not Determined								
505 Lakeview Ave-05-18-16-10:46-1	nd	1.0						
505 Lakeview Ave-05-18-16-10:46-2	nd	1.0					ATS	O
524 Lakeview Ave-05-18-16-10:58-1	nd	1.0						
524 Lakeview Ave-05-18-16-10:58-2	nd	1.0					ATS	O
541 Lakeview Ave-05-18-16-11:25-1	nd	1.0						
541 Lakeview Ave-05-18-16-11:25-2	nd	1.0					ATS	O
557 Lakeview Ave-05-18-16-11:13-1	nd	1.0						
557 Lakeview Ave-05-18-16-11:13-2	nd	1.0					ATS	O
572 Lakeview Ave-05-23-16-15:36-1	nd	1.0						
572 Lakeview Ave-05-23-16-15:36-2	nd	1.0					ATS	O
577 Lakeview Ave-05-18-16-11:34-1	nd	1.0						
577 Lakeview Ave-05-18-16-11:34-2	nd	1.0					ATS	O
592 Lakeview Ave-05-18-16-11:40-1	nd	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)
592 Lakeview Ave-05-18-16-11:40-2	nd	1.0					ATS	O
597 Lakeview Ave-05-18-16-11:48-1	nd	1.0						
597 Lakeview Ave-05-18-16-11:48-2	nd	1.0					ATS	O
602 Lakeview Ave-05-18-16-11:56-1	nd	1.0						
602 Lakeview Ave-05-18-16-11:56-2	nd	1.0					ATS	O
617 Lakeview Ave-05-18-16-13:26-1	nd	1.0						
617 Lakeview Ave-05-18-16-13:26-2	nd	1.0					ATS	O
637 Lakeview Ave-05-18-16-13:34-1	nd	1.0						
637 Lakeview Ave-05-18-16-13:34-2	nd	1.0					ATS	O
647 Lakeview Ave-05-18-16-13:42-1	nd	1.0						
647 Lakeview Ave-05-18-16-13:42-2	nd	1.0					ATS	O
665 Lakeview Ave-05-18-16-13:49-1	nd	1.0						
665 Lakeview Ave-05-18-16-13:49-2	nd	1.0					ATS	O
707 Lakeview Ave-05-18-16-13:57-1	nd	1.0						
707 Lakeview Ave-05-18-16-13:57-2	nd	1.0					ATS	O
712 Lakeview Ave-05-18-16-14:13-2	nd	1.0					712 Lakeview and 732 Lakeview share a well ATS	O
712 Lakeview Ave-05-18-16-14:13-1	nd	1.0					712 Lakeview and 732 Lakeview share a well	
731 Lakeview Ave-05-18-16-14:05-1	nd	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)
731 Lakeview Ave-05-18-16-14:05-2	nd	1.0					ATS	O
751 Lakeview Ave-05-18-16-14:24-1	nd	1.0						
751 Lakeview Ave-05-18-16-14:24-2	nd	1.0					ATS	O
752 Lakeview Ave-05-18-16-14:32-1	nd	1.0						
752 Lakeview Ave-05-18-16-14:32-2	nd	1.0					ATS	O

Extraction Wells

C3

DOLPH-05-02-16-07:43-1	110	10.0						D
TW-20-05-02-16-08:05-1	900	25.0						D

D2

LB-4-05-02-16-09:16-1	490	10.0						D
TW-21-05-02-16-10:30-1	160	5.0						D

E

TW-12-05-25-16-10:48-1	23	1.0						
TW-16-05-02-16-10:18-1	850	25.0						D
TW-18-05-02-16-07:56-1	300	10.0						D
TW-19-05-02-16-10:16-1	680	10.0						D

Marshy

PW-1-05-02-16-07:53-1	690	10.0						D
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SW

TW-22-05-02-16-10:48-1	550	25						D
TW-8-05-02-16-10:50-1	710	25.0						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)
Monitoring Wells								
C3								
MW-105s-05-11-16-15:48-1	560	10.0						D
MW-20-05-02-16-16:06-1	nd	1.0						
MW-28-05-23-16-11:10-1	nd	1.0						
MW-39s-05-02-16-15:16-1	2.2	1.0						
D0								
A2 Cleaning Supply-05-02-16-11:50-1	54	1.0						
MW-141s-05-06-16-11:36-1	2.9	1.0						
MW-51-05-04-16-12:00-1	nd	1.0						
MW-53d-05-02-16-14:26-1	nd	1.0						
MW-53l-05-02-16-14:47-1	61	1.0						
MW-53s-05-02-16-13:54-1	nd	1.0						
MW-61d-05-19-16-11:09-1	3.4	1.0						
MW-61s-05-19-16-11:32-1	14	1.0						
MW-93-05-19-16-14:24-1	4.7	1.0						
D2								
MW-113-05-10-16-13:49-1	66	1.0						
MW-120s-05-16-16-15:27-1	nd	1.0						S
MW-120s-05-16-16-15:27-2	nd	1.0					Split Sample, ATS,	O
MW-120s-05-16-16-15:27-3	nd	1.0					Split Sample, DEQ	O, S
MW-121s-05-16-16-10:03-1	nd	1.0						S
MW-121s-05-16-16-10:03-2	nd	1.0					Split Sample, ATS,	O
MW-121s-05-16-16-10:03-3	nd	1.0					Split Sample, DEQ	O, S
MW-123s-05-20-16-11:00-1	nd	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)
MW-123s-05-20-16-11:00-2	nd	1.0					Split Sample, ATS	O
MW-126s-05-04-16-10:44-1	nd	1.0						
MW-129i-05-16-16-11:50-1	nd	1.0						S
MW-129i-05-16-16-11:50-2	nd	1.0					Split Sample, ATS,	O
MW-129i-05-16-16-11:50-3	nd	1.0					Split Sample, DEQ	O, S
MW-129s-05-16-16-12:17-1	nd	1.0						S
MW-129s-05-16-16-12:17-2	nd	1.0					Split Sample, ATS,	O
MW-129s-05-16-16-12:17-3	nd	1.0					Split Sample, DEQ	O, S
MW-130i-05-17-16-12:37-1	3	1.0					Split Sample, ATS,	O
MW-130i-05-17-16-12:37-2	3.3	1.0						
MW-130i-05-17-16-12:37-3	2.8	1.0					Split Sample, DEQ	O, S
MW-130s-05-17-16-11:26-1	nd	1.0						
MW-130s-05-17-16-11:26-2	nd	1.0					Split Sample, ATS,	O
MW-130s-05-17-16-11:26-3	nd	1.0					Split Sample, DEQ	O, S
MW-131s-05-04-16-13:58-1	nd	1.0						
MW-133i-05-17-16-14:47-1	2.2	1.0						
MW-133i-05-17-16-14:47-2	2	1.0					Split Sample, ATS,	O
MW-133i-05-17-16-14:47-3	1.8	1.0					Split Sample, DEQ	O, S
MW-133s-05-17-16-14:19-1	2.2	1.0						
MW-133s-05-17-16-14:19-2	2	1.0					Split Sample, ATS,	O
MW-133s-05-17-16-14:19-3	1.8	1.0					Split Sample, DEQ	O, S
MW-39d-05-02-16-15:32-1	49	2.5						D
MW-44-05-23-16-12:33-1	nd	1.0						
MW-54d-05-20-16-14:02-1	44	1.0						
MW-54d-05-20-16-14:02-2	43	1.0					Split Sample, ATS	O
MW-54s-05-20-16-13:17-1	nd	1.0						
MW-54s-05-20-16-13:17-2	nd	1.0					Split Sample, ATS	O

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-56s-05-24-16-14:48-1	92	1.0						
MW-56s-05-24-16-14:48-2	86	1.0					Split Sample, ATS,	O
MW-62i-05-23-16-14:06-1	nd	1.0						
MW-62s-05-23-16-14:22-1	nd	1.0						
MW-63i-05-24-16-14:15-1	nd	1.0						
MW-63i-05-24-16-14:15-2	nd	1.0					Split Sample, ATS,	O
MW-63s-05-24-16-10:50-1	nd	1.0						
MW-63s-05-24-16-10:50-2	nd	1.0					Split Sample, ATS,	O
MW-92-05-06-16-13:48-1	28	1.0						
MW-94s-05-09-16-15:44-1	350	5.0						D
MW-BE-1d-05-10-16-14:28-1	730	10.0						D
MW-BE-1s-05-10-16-14:57-1	860	10.0						D
MW-KD-1d-05-10-16-11:19-1	220	5.0						D
MW-KD-1s-05-10-16-10:52-1	63	1.0						
E								
MW-103d-05-03-16-15:06-1	10	1.0						
MW-103s-05-03-16-15:24-1	66	1.0						
MW-105d-05-11-16-15:19-1	260	5.0						D
MW-106s-05-11-16-14:32-1	240	5.0						D
MW-112d-05-03-16-11:44-1	nd	1.0						
MW-112i-05-03-16-12:16-1	8.3	1.0						
MW-112s-05-03-16-11:01-1	nd	1.0						
MW-115-05-09-16-12:11-1	410	10.0						D
MW-116-05-06-16-15:22-1	400	10.0						D
MW-120d-05-16-16-14:56-1	nd	1.0						S
MW-120d-05-16-16-14:56-2	nd	1.0					Split Sample, ATS	O

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-120d-05-16-16-14:56-3	nd	1.0					Split Sample, , DEQ	O, S
MW-121d-05-16-16-10:50-1	1.3	1.0						
MW-121d-05-16-16-10:50-2	1	1.0					Split Sample, ATS	O
MW-121d-05-16-16-10:50-3	1.0	1.0					Split Sample, , DEQ	O, S
MW-123d-05-20-16-12:33-1	nd	1.0						
MW-123d-05-20-16-12:33-2	nd	1.0					Split Sample, ATS	O
MW-126d-05-04-16-11:22-1	nd	1.0						
MW-129d-05-16-16-12:58-1	1.4	1.0						
MW-129d-05-16-16-12:58-2	1	1.0					Split Sample, ATS,	O
MW-129d-05-16-16-12:58-3	1.1	1.0					Split Sample, DEQ	O, S
MW-130d-05-17-16-12:05-1	nd	1.0						
MW-130d-05-17-16-12:05-2	nd	1.0					Split Sample, ATS,	O
MW-130d-05-17-16-12:05-3	nd	1.0					Split Sample, DEQ	O, S
MW-131d-05-04-16-14:42-1	nd	1.0						
MW-133d-05-17-16-15:02-1	4.5	1.0						
MW-133d-05-17-16-15:02-2	4	1.0					Split Sample, ATS,	O
MW-133d-05-17-16-15:02-3	4.1	1.0					Split Sample, DEQ	O, S
MW-141d-05-06-16-11:15-1	4.2	1.0						
MW-30d-05-09-16-11:20-1	320	10.0						D
MW-56d-05-24-16-11:41-1	nd	1.0						
MW-56d-05-24-16-11:41-2	nd	1.0					Split Sample, ATS,	O,
MW-62d-05-23-16-13:40-1	nd	1.0						
MW-63d-05-24-16-13:40-1	nd	1.0						
MW-63d-05-24-16-13:40-2	nd	1.0					Split Sample, ATS,	O,
MW-65d-05-25-16-15:02-1	27	1.0						
MW-65d-05-25-16-15:02-2	25	1.0						O
MW-65i-05-25-16-11:16-1	2.8	1.0						

[illegible]

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-05-02-16-08:50-1			nd	2.0				
HC/HR-05-03-16-08:45-1			nd	2.0				
HC/HR-05-04-16-08:15-1			nd	2.0				
HC/HR-05-05-16-08:10-1			nd	2.0				
HC/HR-05-06-16-08:20-1			nd	2.0				
HC/HR-05-09-16-08:35-1			nd	2.0				
HC/HR-05-10-16-08:30-1			nd	2.0				
HC/HR-05-11-16-08:40-1			nd	2.0				
HC/HR-05-12-16-08:20-1			nd	2.0				
HC/HR-05-13-16-08:25-1			nd	2.0				
HC/HR-05-16-16-08:25-1			nd	2.0				
HC/HR-05-17-16-08:45-1			nd	2.0				
HC/HR-05-18-16-08:45-1			nd	2.0				
HC/HR-05-19-16-08:45-1			nd	2.0				
HC/HR-05-20-16-08:30-1			nd	2.0				
HC/HR-05-23-16-08:40-1			nd	2.0				
HC/HR-05-24-16-08:20-1			nd	2.0				
HC/HR-05-25-16-08:35-1			nd	2.0				
HC/HR-05-26-16-08:22-1			nd	2.0				
HC/HR-05-27-16-08:15-1			nd	2.0				
HC/HR-05-31-16-08:30-1			nd	2.0				
Treatment System								
OUTFALL-05-01-16-1	4.2	1.0						
OUTFALL-05-01-16-2			6.1	5.0				
OUTFALL-05-02-16-1	4.3	1.0						
OUTFALL-05-02-16-2			6.2	5.0				

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-05-03-16-1	4.3	1.0						
OUTFALL-05-03-16-2			6.0	5.0				
OUTFALL-05-04-16-1	4.4	1.0						
OUTFALL-05-04-16-2			7.0	5.0				
OUTFALL-05-05-16-1	4.6	1.0						
OUTFALL-05-05-16-2			5.6	5.0				
OUTFALL-05-08-16-1	4.2	1.0						
OUTFALL-05-08-16-2			6.1	5.0				
OUTFALL-05-09-16-1	4.6	1.0						
OUTFALL-05-09-16-2			6.7	5.0				
OUTFALL-05-10-16-1	4.6	1.0						
OUTFALL-05-10-16-2			6.0	5.0				
OUTFALL-05-11-16-1	4.5	1.0						
OUTFALL-05-11-16-2			6.1	5.0				
OUTFALL-05-12-16-1	4.5	1.0						
OUTFALL-05-12-16-2			6.2	5.0				
OUTFALL-05-15-16-1	4.7	1.0						
OUTFALL-05-15-16-2			6.6	5.0				
OUTFALL-05-16-16-2			6.3	5.0				
OUTFALL-05-16-16-1	5.5	1.0						
OUTFALL-05-17-16-2			7.3	5.0				
OUTFALL-05-17-16-1	5.9	1.0						
OUTFALL-05-18-16-1	5.3	1.0						
OUTFALL-05-18-16-2			6.6	5.0				
OUTFALL-05-19-16-1	5.3	1.0						
OUTFALL-05-19-16-2			6.0	5.0				
OUTFALL-05-22-16-2			5.3	5.0				

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-05-22-16-1	5.2	1.0						
OUTFALL-05-23-16-2			5.3	5.0				
OUTFALL-05-23-16-1	5.1	1.0						
OUTFALL-05-24-16-1	5.4	1.0						
OUTFALL-05-24-16-2			6.6	5.0				
OUTFALL-05-25-16-1	5.4	1.0						
OUTFALL-05-25-16-2			5.8	5.0				
OUTFALL-05-26-16-1	6.2	1.0						
OUTFALL-05-26-16-2			7.4	5.0				
OUTFALL-05-29-16-2			5.3	5.0				
OUTFALL-05-29-16-1	5.7	1.0						
OUTFALL-05-30-16-2			6.8	5.0				
OUTFALL-05-30-16-1	6.1	1.0						
OUTFALL-05-31-16-1	6.0	1.0						
OUTFALL-05-31-16-2			nd	5.0				
Red Pond-05-02-16-06:35-1	450	10.0						D
Red Pond-05-09-16-06:50-1	460	10.0						D
Red Pond-05-16-16-08:30-1	500	10.0						D
Red Pond-05-23-16-08:15-1	510	10.0						D
Red Pond-05-31-16-06:20-1	470	10.0						D
Not Applicable								
Second Sister Lake-05-11-16-10:39-1	nd	1.0					Sample Taken at South End of Lake	

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

O: Sample analyzed by and outside laboratory specified in the comment section

S: Samples split with DEQ

DEQ Qualifier Code that is different from PLS

Y28: 1,4-dioxane analysis is performed using selective ion monitoring (SIM). Results reported below 5µg/L(aqueous) or 1000µg/Kg(solid) are estimates