kas
environmental science & engineering

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802 383.0486 p
802 383.0490 f

March 20, 2017

Ms. Kasey Kathan
Vermont Department of Environmental Conservation
Waste Management & Prevention Division
One National Life Drive, Davis 1
Montpelier, VT 05620-3704

Via Email to Kasey.Kathan@vtdec.gov

RE: **Perfluorinated Compound Sampling Report – October/December 2016**
Halifax Landfill, Halifax, Vermont

Dear Ms. Kathan:

This letter report presents the results of the October/December 2016 sampling of two monitoring wells (MW-3 and MW-4) and one private drinking water well (Rafus Well) for perfluorinated compounds (PFCs) at the Halifax Landfill located in Halifax, Vermont (see Site Location Map, Attachment A). KAS, Inc. (KAS) performed this work for the Town of Halifax (landfill owner). All work was conducted in accordance with KAS' work plans dated September 14, 2016 and November 15, 2016.

Background

The Town owns and maintains a closed landfill that is currently certified for post-closure care/monitoring under Certification #WH280/NS95-0165, which expires in December 2017. An application to transition the closed landfill to custodial care was submitted on September 22, 2016 and is currently under consideration by the Vermont Department of Environmental Conservation (VTDEC). PFCs, an emerging contaminant in soil and groundwater, have recently been detected in groundwater at landfill and manufacturing sites in southern Vermont. Given the close proximity of the Halifax Landfill to these sites, the VTDEC, in letter correspondence to the Town dated September 1, 2016, requested the collection of a groundwater sample from the most impacted and directly downgradient well (MW-3) for PFC analysis. The sampling was completed on October 19, 2016 and preliminary results were submitted to the VTDEC via electronic mail correspondence on November 1, 2016 ahead of this report due to the sensitive nature of the sampling. Analytical testing of MW-3 detected PFCs in excess of applicable standards. In response, the VTDEC, in letter dated November 7, 2016, requested additional groundwater and private well sampling be performed. The additional sampling efforts were completed on December 7, 2016 and the preliminary results were relayed to the VTDEC via electronic mail correspondence on December 29, 2016. A detailed presentation of the October and December sampling events are presented herein.

Groundwater Monitoring

On October 19, 2016, KAS collected a groundwater sample from monitoring well MW-3 for PFC analysis. A sample was collected from MW-4 on December 7, 2016. Monitoring well locations are shown on the attached Site Map (Attachment A). Prior to collecting the groundwater samples, a Geotech™ interface probe was used to measure depth-to-liquid in the monitoring wells. Depth to liquid measurements collected were within range

of historical levels observed and are tabulated and included in Attachment B. Groundwater has previously been shown to flow to the east/southeast towards the Branch Brook.

In accordance with the approved work plans, the monitoring wells were sampled with PVC bailers. The samples were placed in laboratory provided containers, stored on ice and submitted under proper chain of custody to Northern Lake Service, Inc. in Crandon, Wisconsin for PFC analysis via EPA Method 537 (short list). These results are provided in tabulated form as Attachment B and compared to the Preventative Action Levels (PALs)/ Vermont Groundwater Enforcement Standards (VGES) published in the Groundwater Protection Rule and Strategy (GWPRS) dated December 16, 2016. The laboratory reports are provided as Attachment C.

Analytical testing indicated the presence of one or more PFCs in the groundwater samples collected from MW-3 and MW-4. A combined concentration of perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS) in MW-3 was reported at 28.2 parts per trillion (ng/l) which exceeds the VGES of 20 ng/l. No exceedances of PAL or VGES were reported in the sample collected from MW-4.

For each sampling event, one trip blank and one duplicate sample were collected for quality assurance/quality control and were analyzed for PFCs via EPA Method 537 (short list). The results of the duplicate sample analysis were analyzed using a relative percent difference (RPD) method. The RPD is defined as 100 times the difference between the sample result and the duplicate result, divided by the mean of the sample and duplicate result. The RPD calculations are included in Attachment B. The overall RPD value for the October 19, 2016 sampling event was calculated as 6.6%, which is considered excellent precision. An overall RPD could not be calculated for the December 7, 2016 event due to non-detectable values reported in the duplicate sample. No PFCs were detected in the trip blank samples.

Private Drinking Water Well Sampling

In a letter dated November 7, 2016, the VTDEC requested private drinking water well sampling at the two closest residential properties:

1. Rafus Well - 637 Hubbard Hill Road in Halifax, VT (SPAN# 276-087-10260; Parcel# hub.0627; Town Dump Road)
2. Boyko Well - 1636 Branch Road in Halifax VT (SPAN# 276-087-10030; Parcel# brn.1636; Branch Road)

On December 7, 2016, KAS collected a drinking water sample from the Rafus well. A sample could not be collected from the Boyko well as Ms. Kristine Boyko (property owner), in telephone call with KAS on December 5, 2016, declined to grant access to the property for the sampling.

The Rafus well drinking water sample was collected from an outdoor spigot located a few feet away from the pressure tank in accordance with the work plan. The sample was placed in laboratory provided containers, stored on ice, and submitted under proper chain of custody to Northern Lake Service, Inc. in Crandon, Wisconsin for PFC analysis via EPA Method 537 (short list). One duplicate and one field blank sample were also submitted in accordance with work plan. A copy of the laboratory report is provided as Attachment C.

No PFCs were detected above laboratory method detection limits in the Rafus well drinking water sample or the duplicate sample. The field blank sample was not analyzed due to the non-detectable results reported in the drinking water sample.

Sensitive Receptor Survey

A sensitive receptor risk assessment of the area surrounding the landfill is provided below, and a determination of the potential risk to identified receptors has been made based on proximity to the PFC plume, groundwater flow direction, PFC mobility and volatility, and PFC concentration levels in subsurface soils and groundwater. To date only two sensitive receptors (soil and groundwater) have been identified as being impacted from the subsurface PFC impacts originating from the landfill.

No municipal supply wells have been identified in close proximity to the landfill. According to the Vermont Agency of Natural Resources Atlas online mapping tool, six private wells are located within a ¼ mile radius of the landfill. Based on the non-detectable PFC levels reported in the drinking water sample collected from the Rafus well in December 2016, private wells in the immediate vicinity are not currently considered to be at significant risk from off-site migration of the PFC plume.

The nearest surface water body is the Branch Brook located approximately 250 feet east of the landfill. The Branch Brook discharges to the East Branch North River which is located approximately 700 feet south of the landfill. No wetlands have been identified in close proximity to the landfill. Given the VGES exceedances reported in MW-3 and the relatively short distance the well is from the Branch Brook (<100 feet), the potential risk of impact to the brook from off-site migration of the PFC plume cannot be ruled out at this time. However, based on the relatively low concentrations detected in MW-3 significant impact to the brook is unlikely.

There are no known underground utility corridors in close proximity of the landfill. Given the rural nature of the area, underground utilities that could act as a preferential pathway for the migration of the PFC plume are unlikely.

The Town currently operates a Town Garage adjacent to the capped landfill. The structures associated with the facility do not have basements. Given the facilities construction and the low volatility of PFCs, the risk to indoor air is considered low.

Conclusions & Recommendations

Based on the results of the groundwater sampling, there appears to have been a release of PFCs related to the historic use of the property as a municipal landfill. PFC concentrations above VGES were detected in one of the two monitoring wells tested. No PFCs were detected in the drinking water sample collected from a nearby private well. The nature of the release (on-site waste disposal) coupled with the absence of known receptors (other than soil and groundwater) indicates further investigation and/or remedial action is not warranted at this time.

Based on a review of VTDEC guidance documents, transitioning the landfill to custodial care may no longer be a viable approach based on the regulatory exceedances (PFCs) along the compliance boundary (MW-3). KAS and the Town are eager to work with the VTDEC to address concerns related to the PFC detections and develop an appropriate

plan moving forward. If continued post-closure monitoring is required, KAS hopes the VTDEC will take into account the considerable amount of capital expenditure the Town has put towards the custodial care application. Additionally, post-closure monitoring, if necessary, should focus solely on PFC impacts as long term declining trends for other constituents of concern have been demonstrated.

Please feel free to contact me should you have any questions or comments regarding this report.

Sincerely,

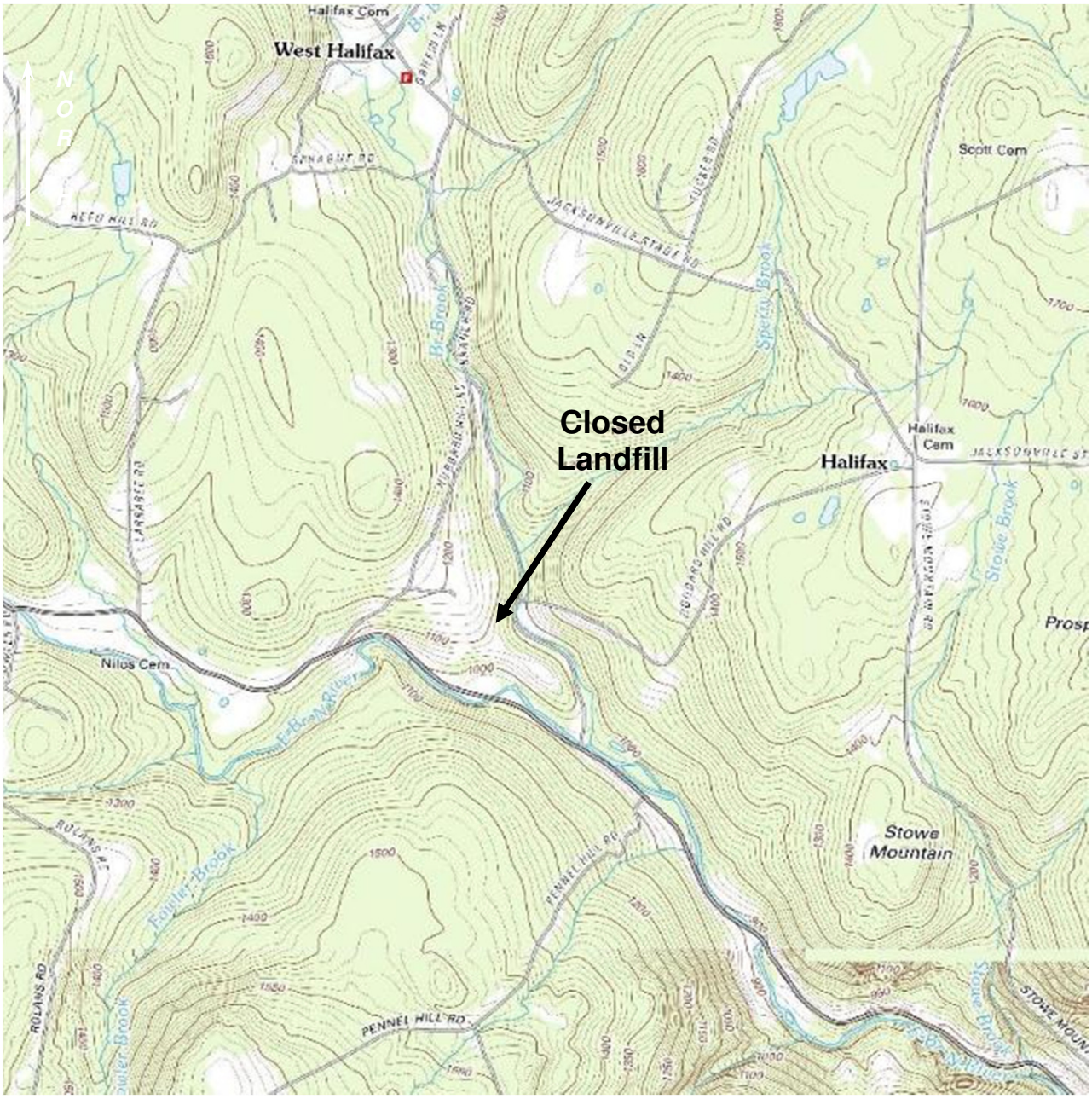
Rebecca Treat
Project Geologist

Attachments

cc: Mr. Lewis Sumner
KAS #610110045

Attachment A

Site Location Map
Site Map



KAS Job Number: 610110045

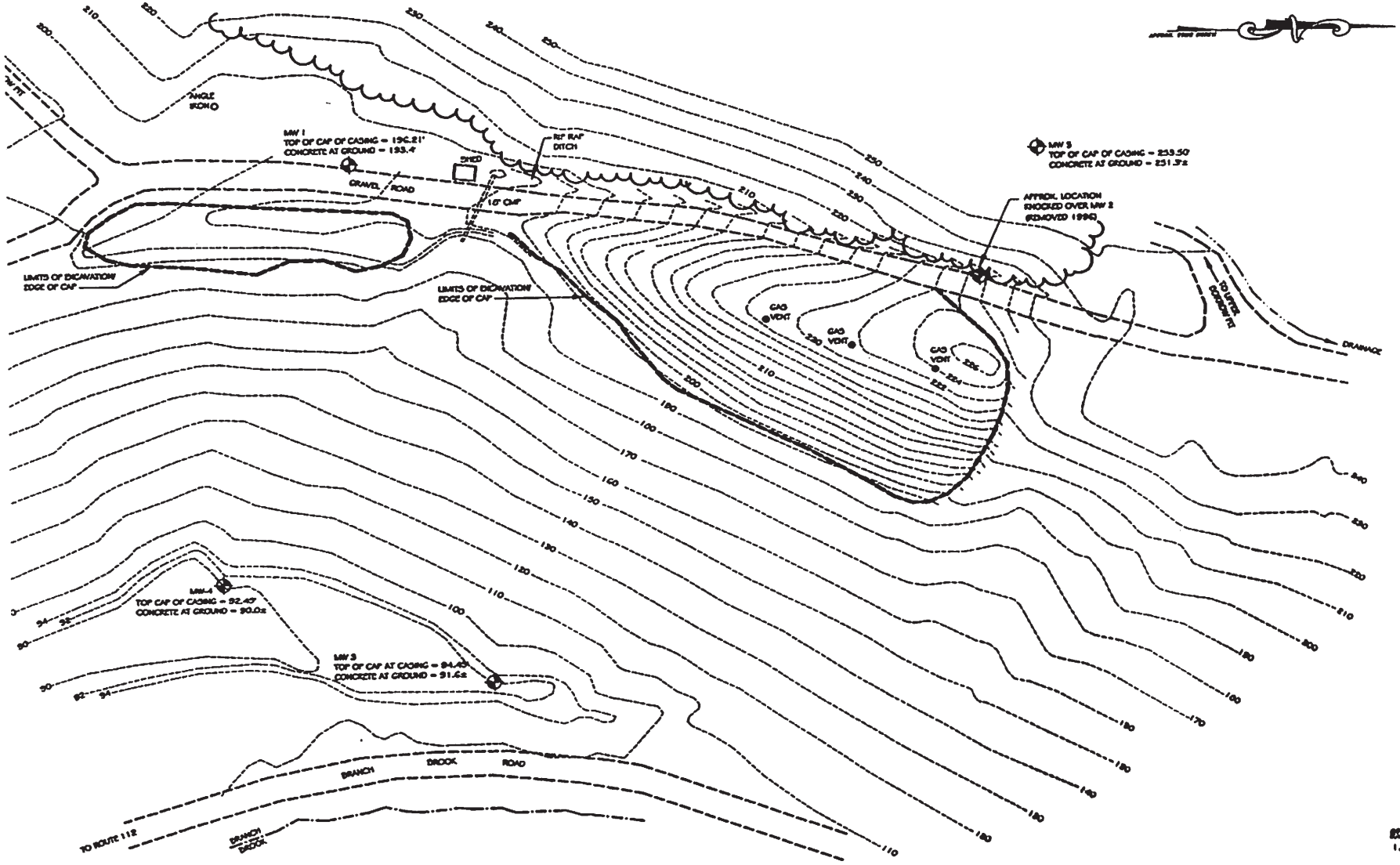
Source: http://anrmaps.vermont.gov/websites/anra5/

TOWN OF HALIFAX CLOSED LANDFILL

2044 Branch Road, Halifax, VT

Site Location Map

Date: 05/25/16	Drawing No. 0	Scale: NTS	By: CS



LEGEND:

---------- 10' CONTOUR

GENERAL NOTES:

1. THIS PLAN IS A COMPILATION PLAN OF THE BUILT E HALIFAX SANITARY LANDFILL CLOSURE, NOV. 9, 1992 BY AN AND AN OVERALL SITE PLAN BY OTHERS. THE BASEMAP TOPOGRAPHIC SURVEY PLAN INCLUDED THE EXISTING CAPPED LANDFILL AND MONITORING WELL LOCATIONS. TOPOGRAPHY OTHER THAN LANDFILL CLOSURE CONSTRUCTION 1991 SURVEY BY MERIDIAN ENGINEERING.

Attachment B

Groundwater Quality Summary

Halifax Landfill
Halifax, Vermont

GROUNDWATER QUALITY SUMMARY

Monitoring Well *Sample Date:*	MW-3 *10/19/16*	MW-4 *12/7/16*	VGES	PAL
Perfluorobutanesulfonic acid (PFBS)	ND<11	ND<7.2	NA	NA
Perfluorohexanesulfonic acid (PFHxS)	ND<3.8	**3.66**	NA	NA
Perfluoroheptanioic acid (PFHpA)	**2.06**	**1.59**	NA	NA
Perfluorooctanoic acid (PFOA)	**11.5**	**4.8**	20	10
Perfluorooctanesulfonic acid (PFOS)	**16.7**	ND<2.2		
Perfluorononanoic acid (PFNA)	ND<2.3	ND<1.1	NA	NA
Depth to Water (btoc)	6.87	2.32*	NA	NA

NOTES:
btoc = below top of casing
All values reported in ng/L, unless otherwise indicated.
Analytical method is PFCs via EPA Method 537 (short list).
ND<xx = Not Detected< Detection Limit
VGES = Vermont Groundwater Enforcement Standard (December 2016)
PAL = Preventative Action Level (December 2016)
NA = No VGES/PAL available
Results reported above detection limits are indicated in bold.
Compounds greater than the VGES are shaded >VGES
Compounds greater than the PAL are underlined >PAL
* Depth to water below grade. Casing bent so measurement from top of casing not taken.

KAS # 610110045

Halifax Landfill
Halifax, Vermont

GROUNDWATER QUALITY SUMMARY

QUALITY ASSURANCE / QUALITY CONTROL (QA/QC) SAMPLES

Sample ID: / *Sample Date:*	*Trip Blank* *10/19/16*	*Duplicate* *10/19/16*	*MW-3* *10/19/16*	*RPD %*	VGES	PAL
Perfluorobutanesulfonic acid (PFBS)	ND<11	ND<11	ND<11	-	NA	NA
Perfluorohexanesulfonic acid (PFHxS)	ND<3.8	ND<3.8	ND<3.8	-	NA	NA
Perfluoroheptanoic acid (PFHpA)	ND<1.0	**2.21**	**2.06**	**7.0%**	NA	NA
Perfluorooctanoic acid (PFOA)	ND<2.3	**12.4**	**11.5**	**7.5%**	20	10
Perfluorooctanesulfonic acid (PFOS)	ND<3.8	**17.7**	**16.7**	**5.8%**		
Perfluorononanoic acid (PFNA)	ND<2.3	ND<2.3	ND<2.3	-	NA	NA
Total PFCs	ND	**32.3**	**30.3**	**6.6%**	NA	NA

Sample ID: / *Sample Date:*	*Trip Blank* *12/7/16*	*Duplicate* *12/7/16*	*MW-4* *12/7/16*	*RPD %*	VGES	PAL
Perfluorobutanesulfonic acid (PFBS)	ND<7.2	ND<7.2	ND<7.2	-	NA	NA
Perfluorohexanesulfonic acid (PFHxS)	ND<1.4	ND<1.4	**3.66**	-	NA	NA
Perfluoroheptanoic acid (PFHpA)	ND<1.0	ND<1.0	**1.59**	-	NA	NA
Perfluorooctanoic acid (PFOA)	ND<2.2	ND<2.2	**4.8**	-	20	10
Perfluorooctanesulfonic acid (PFOS)	ND<2.2	ND<2.2	ND<2.2	-		
Perfluorononanoic acid (PFNA)	ND<1.1	ND<1.1	ND<1.1	-	NA	NA
Total PFCs	ND	ND	**10.1**	-	NA	NA

NOTES:

All values reported in ng/L, unless otherwise indicated.

Analytical method is PFCs via EPA Method 537 (short list).

ND<xx = Not Detected< Detection Limit

VGES = Vermont Groundwater Enforcement Standard (December 2016)

PAL = Preventative Action Level (December 2016)

NA = No VGES/PAL available

Results reported above detection limits are indicated in bold.

Compounds greater than the VGES are shaded >VGES

Compounds greater than the PAL are underlined >PAL

RPD = The results of the laboratory analysis of the duplicate sample were analyzed using a relative percent difference (RPD) analysis. The RPD is defined as 100 times the difference in reported concentration between sample and duplicate, divided by the mean of the two samples. A small RPD indicates good correlation between sample and duplicate.

Attachment C

Analytical Laboratory Reports

NORTHERN LAKE SERVICE, INC.
Analytical Laboratory and Environmental Services
400 North Lake Avenue - Crandon, WI 54520
Ph: (715)-478-2777 Fax: (715)-478-3060

ANALYTICAL REPORT

WDNR Laboratory ID No. 721026460
WDATCP Laboratory Certification No. 105-330
EPA Laboratory ID No. WI00034

Client: **KAS**
Attn: Rebecca Treat
589 Avenue D, Suite 10
PO Box 787
Williston, VT 05495

NLS Project: 269830
NLS Customer: 108400
Phone: 802 383 0486
PO # 610110045

Project: **Halifax GWM Landfill**

MW-3 NLS ID: 954983
COC: 189434:1 Matrix: GW
Collected: 10/19/16 18:20 Received: 10/21/16

Parameter	Result	Units	Dilution	LOD	LOQ	Analyzed	Method	Lab
Perfluorinated Chemicals by EPA Method 537 Rev 1.1	see attached					10/31/16	EPA 537 Rev 1.1	721026460
Solid Phase Extraction by EPA Method 537	yes					10/31/16	EPA 537	721026460

Duplicate NLS ID: 954984
COC: 189434:2 Matrix: GW
Collected: 10/19/16 18:20 Received: 10/21/16

Parameter	Result	Units	Dilution	LOD	LOQ	Analyzed	Method	Lab
Perfluorinated Chemicals by EPA Method 537 Rev 1.1	see attached					10/31/16	EPA 537 Rev 1.1	721026460
Solid Phase Extraction by EPA Method 537	yes					10/31/16	EPA 537	721026460

Trip Blank NLS ID: 954985
COC: 189434:3 Matrix: GW
Collected: 10/19/16 18:20 Received: 10/21/16

Parameter	Result	Units	Dilution	LOD	LOQ	Analyzed	Method	Lab
Perfluorinated Chemicals by EPA Method 537 Rev 1.1	see attached					10/31/16	EPA 537 Rev 1.1	721026460
Solid Phase Extraction by EPA Method 537	yes					10/31/16	EPA 537	721026460

Values in brackets represent results greater than or equal to the LOD but less than the LOQ and are within a region of "Less-Certain Quantitation". Results greater than or equal to the LOQ are considered to be in the region of "Certain Quantitation". LOD and/or LOQ tagged with an asterisk(*) are considered Reporting Limits. All LOD/LOQs adjusted to reflect dilution and/or solids content.
ND = Not Detected (< LOD) LOD = Limit of Detection LOQ = Limit of Quantitation NA = Not Applicable
DWB = Dry Weight Basis %DWB = (mg/kg DWB) / 10000 1000 ug/L = 1 mg/L
MCL = Maximum Contaminant Levels for Drinking Water Samples. Shaded results indicate >MCL.

Reviewed by:

Authorized by:
R. T. Krueger
President

ANALYTICAL RESULTS: Perfluorinated Chemicals by EPA 537 Rev 1.1 Safe Drinking Water Analysis

Customer: KAS NLS Project: 269830 PO # 610110045

Project Description: Halifax GWM Landfill

Project Title: Template: 537PPT Printed: 11/01/2016 14:00

Sample: 954983 MW-3 Collected: 10/19/16 Analyzed: 10/31/16 - Analytes: 6

ANALYTE NAME	RESULT	UNITS WWB	DIL	LOD	LOQ	Note
perfluorobutanesulfonic acid (PFBS)	ND	ppt	1	11	37	
perfluoroheptanoic acid (PFHpA)	[2.06]	ppt	1	1.0	3.3	J
perfluorohexanesulfonic acid (PFHxS)	ND	ppt	1	3.8	13	
perfluorooctanoic acid (PFOA)	11.5	ppt	1	2.3	7.6	
perfluorononanoic acid (PFNA)	ND	ppt	1	2.3	7.7	
perfluorooctanesulfonic acid (PFOS)	16.7	ppt	1	3.8	13	
C13-PFHxA (SURR)	84.198%					S
C13-PFDA (SURR)	81.752%					S

NOTES APPLICABLE TO THIS ANALYSIS:

J = Result enclosed in brackets is between LOD and LOQ, a region of less certain quantitation.

S = This compound is a surrogate used to evaluate the quality control of a method.

Sample: 954984 Duplicate Collected: 10/19/16 Analyzed: 10/31/16 - Analytes: 6

ANALYTE NAME	RESULT	UNITS WWB	DIL	LOD	LOQ	Note
perfluorobutanesulfonic acid (PFBS)	ND	ppt	1	11	37	
perfluoroheptanoic acid (PFHpA)	[2.21]	ppt	1	1.0	3.3	J
perfluorohexanesulfonic acid (PFHxS)	ND	ppt	1	3.8	13	
perfluorooctanoic acid (PFOA)	12.4	ppt	1	2.3	7.6	
perfluorononanoic acid (PFNA)	ND	ppt	1	2.3	7.7	
perfluorooctanesulfonic acid (PFOS)	17.7	ppt	1	3.8	13	
C13-PFHxA (SURR)	80.981%					S
C13-PFDA (SURR)	82.101%					S

NOTES APPLICABLE TO THIS ANALYSIS:

J = Result enclosed in brackets is between LOD and LOQ, a region of less certain quantitation.

S = This compound is a surrogate used to evaluate the quality control of a method.

Sample: 954985 Trip Blank Collected: 10/19/16 Analyzed: 10/31/16 - Analytes: 6

ANALYTE NAME	RESULT	UNITS WWB	DIL	LOD	LOQ	Note
perfluorobutanesulfonic acid (PFBS)	ND	ppt	1	11	37	
perfluoroheptanoic acid (PFHpA)	ND	ppt	1	1.0	3.3	
perfluorohexanesulfonic acid (PFHxS)	ND	ppt	1	3.8	13	
perfluorooctanoic acid (PFOA)	ND	ppt	1	2.3	7.6	
perfluorononanoic acid (PFNA)	ND	ppt	1	2.3	7.7	
perfluorooctanesulfonic acid (PFOS)	ND	ppt	1	3.8	13	
C13-PFHxA (SURR)	81.786%					S
C13-PFDA (SURR)	95.221%					S

NOTES APPLICABLE TO THIS ANALYSIS:

S = This compound is a surrogate used to evaluate the quality control of a method.

The PFOA branch isotope peak is included in the PFOA calculation per EPA directive.

SAMPLE COLLECTION AND CHAIN OF CUSTODY RECORD

NORTHERN LAKE SERVICE, INC.

Analytical Laboratory and Environmental Services

400 North Lake Avenue • Crandon, WI 54520-1298

Tel: (715) 478-2777 • Fax: (715) 478-3060

Wisconsin DNR cert ID
721026460 (Cran) / 268533760 (Wauk)
Wisconsin DATCP ID
105-000330 (Cran) / 105-000479 (Wauk)

NO. 189434

CLIENT	KAS, INC.
ADDRESS	P.O. BOX 787
CITY / STATE / ZIP	WILLISTON / VT / 05495
PROJECT DESCRIPTION / NO.	HALIFAX GWM LANDFILL
QUOTATION NO.	
DNR FID #	
DNR LICENSE #	
CONTACT	REBECCA TREAT
PHONE	802-383-0486
PURCHASE ORDER NO.	610110045
FAX	802-383-0490

MATRIX:
SW = surface water
WW = waste water
GW = groundwater
DW = drinking water
TIS = tissue
AIR = air
SOIL = soil
SED = sediment
PROD = product
SL = sludge
OTHER

ANALYZE PER ORDER OF ANALYSIS

USE BOXES BELOW: Indicate Y or N if GW Sample is field filtered.
Indicate G or C if WW Sample is Grab or Composite.

ITEM NO.	NLS LAB. NO.	SAMPLE ID	COLLECTION DATE	COLLECTION TIME	MATRIX (See above)		PFCs V14 EPA METHOD 537												COLLECTION REMARKS (i.e. DNR Well ID #)
1.	954983	MW-3	10/19/16	1820	GW		X		G										
2.	954984	DUPLICATE	↓	1820	↓		↓												
3.	954985	TRIP BLANK	LAB PREPARED		BLANK WATER		↓												
4.																			
5.																			
6.																			
7.																			
8.																			
9.																			
10.																			

ONE SAMPLE PER LINE

COLLECTED BY (signature)	CUSTODY SEAL NO. (IF ANY)	DATE/TIME 10/19/16 1900
RELINQUISHED BY (signature)	RECEIVED BY (signature)	DATE/TIME
DISPATCHED BY (signature)	METHOD OF TRANSPORT: UPS – OVERNIGHT AIR	DATE/TIME 10/20/16 1100
RECEIVED AT NLS BY (signature)	DATE/TIME 10/21/16 1030	CONDITION ok / TEMP. 2.2
COOLER #	REMARKS/& OTHER INFORMATION	
	WDNR FACILITY NUMBER	E-MAIL ADDRESS

REPORT TO: KAS, INC.

INVOICE TO: KAS, INC.

PRESERVATIVE:
NP = no preservative
S = sulfuric acid
N = nitric acid
Z = zinc acetate
M = methanol
OH = sodium hydroxide
HA = hydrochloric & ascorbic acid
H = hydrochloric acid

IMPORTANT:

1. TO MEET REGULATORY REQUIREMENTS, THIS FORM **MUST** BE COMPLETED IN DETAIL AND INCLUDED IN THE COOLER CONTAINING THE SAMPLES DESCRIBED.
2. PLEASE USE ONE LINE PER SAMPLE, **NOT** PER BOTTLE.
3. RETURN THIS FORM WITH SAMPLES - CLIENT MAY KEEP YELLOW COPY.
4. PARTIES COLLECTING SAMPLE LISTED AS **REPORT TO** AND LISTED AS **INVOICE TO** AGREE TO STANDARD TERMS & CONDITIONS ON REVERSE

Rev. 7/20/15

NORTHERN LAKE SERVICE, INC.
Analytical Laboratory and Environmental Services
400 North Lake Avenue - Crandon, WI 54520
Ph: (715)-478-2777 Fax: (715)-478-3060

ANALYTICAL REPORT

WDNR Laboratory ID No. 721026460
WDATCP Laboratory Certification No. 105-330
EPA Laboratory ID No. WI00034

Client: **KAS**
Attn: Rebecca Treat
589 Avenue D, Suite 10
PO Box 787
Williston, VT 05495

NLS Project: 272346
NLS Customer: 108400
Phone: 802 383 0486
PO # 610110045

Project: Halifax Landfill

MW-4 NLS ID: 966096

COC: 196361:1 Matrix: GW
Collected: 12/07/16 15:56 Received: 12/13/16

Parameter	Result	Units	Dilution	MRL		Analyzed	Method	Lab
Perfluorinated Chemicals by EPA Method 537 Rev 1.1	see attached					12/17/16	EPA 537 Rev 1.1	721026460
Solid Phase Extraction by EPA Method 537	yes					12/15/16	EPA 537	721026460

Duplicate NLS ID: 966097

COC: 196361:2 Matrix: GW
Collected: 12/07/16 15:18 Received: 12/13/16

Parameter	Result	Units	Dilution	MRL		Analyzed	Method	Lab
Perfluorinated Chemicals by EPA Method 537 Rev 1.1	see attached					12/17/16	EPA 537 Rev 1.1	721026460
Solid Phase Extraction by EPA Method 537	yes					12/15/16	EPA 537	721026460

Rafus Well NLS ID: 966098

COC: 196361:3 Matrix: DW
Collected: 12/07/16 15:16 Received: 12/13/16

Parameter	Result	Units	Dilution	MRL		Analyzed	Method	Lab
Perfluorinated Chemicals by EPA Method 537 Rev 1.1	see attached					12/17/16	EPA 537 Rev 1.1	721026460
Solid Phase Extraction by EPA Method 537	yes					12/15/16	EPA 537	721026460

Rafus Well FB NLS ID: 966099

COC: 196361:3 Matrix: DW
Collected: 12/07/16 15:16 Received: 12/13/16

Parameter	Result	Units	Dilution	MRL		Analyzed	Method	Lab
Perfluorinated Chemicals by EPA Method 537 Rev 1.1	not analyzed					12/17/16	EPA 537 Rev 1.1	721026460
Solid Phase Extraction by EPA Method 537	not analyzed					12/17/16	EPA 537	721026460

Trip Blank NLS ID: 966100

COC: 196361 Matrix: TB
Collected: 12/07/16 00:00 Received: 12/13/16

Parameter	Result	Units	Dilution	MRL		Analyzed	Method	Lab
Perfluorinated Chemicals by EPA Method 537 Rev 1.1	see attached					12/21/16	EPA 537 Rev 1.1	721026460
Solid Phase Extraction by EPA Method 537	yes					12/19/16	EPA 537	721026460

Values in brackets represent results greater than or equal to the LOD but less than the LOQ and are within a region of "Less-Certain Quantitation". Results greater than or equal to the LOQ are considered to be in the region of "Certain Quantitation". LOD and/or LOQ tagged with an asterisk(*) are considered Reporting Limits. All LOD/LOQs adjusted to reflect dilution and/or solids content.

ND = Not Detected (< LOD) LOD = Limit of Detection LOQ = Limit of Quantitation NA = Not Applicable
DWB = Dry Weight Basis %DWB = (mg/kg DWB) / 10000 1000 ug/L = 1 mg/L
MCL = Maximum Contaminant Levels for Drinking Water Samples. Shaded results indicate >MCL.

Reviewed by:

Authorized by:
R. T. Krueger
President

ANALYTICAL RESULTS: Perfluorinated Chemicals by EPA 537 Rev 1.1 Safe Drinking Water Analysis

Customer: KAS NLS Project: 272346 PO # 610110045

Project Description: Halifax Landfill

Project Title: Template: 537PPT2 Printed: 12/22/2016 15:14

Sample: 966096 MW-4 Collected: 12/07/16 Analyzed: 12/17/16 - Analytes: 6

ANALYTE NAME	RESULT	UNITS WWB	DIL	LOD	LOQ	Note
perfluorobutanesulfonic acid (PFBS)	ND	ppt	1	7.2	23	
perfluoroheptanoic acid (PFHpA)	[1.59]	ppt	1	1.0	3.2	J
perfluorohexanesulfonic acid (PFHxS)	[3.66]	ppt	1	1.4	4.4	J
perfluorooctanoic acid (PFOA)	[4.8]	ppt	1	2.2	7.1	J
perfluorononanoic acid (PFNA)	ND	ppt	1	1.1	3.5	
perfluorooctanesulfonic acid (PFOS)	ND	ppt	1	2.2	7.0	
C13-PFHxA (SURR)	94.343%					S
C13-PFDA (SURR)	85.181%					S

NOTES APPLICABLE TO THIS ANALYSIS:

J = Result enclosed in brackets is between LOD and LOQ, a region of less certain quantitation.

S = This compound is a surrogate used to evaluate the quality control of a method.

Sample: 966097 Duplicate Collected: 12/07/16 Analyzed: 12/17/16 - Analytes: 6

ANALYTE NAME	RESULT	UNITS WWB	DIL	LOD	LOQ	Note
perfluorobutanesulfonic acid (PFBS)	ND	ppt	1	7.2	23	
perfluoroheptanoic acid (PFHpA)	ND	ppt	1	1.0	3.2	
perfluorohexanesulfonic acid (PFHxS)	ND	ppt	1	1.4	4.4	
perfluorooctanoic acid (PFOA)	ND	ppt	1	2.2	7.1	
perfluorononanoic acid (PFNA)	ND	ppt	1	1.1	3.5	
perfluorooctanesulfonic acid (PFOS)	ND	ppt	1	2.2	7.0	
C13-PFHxA (SURR)	90.556%					S
C13-PFDA (SURR)	83.793%					S

NOTES APPLICABLE TO THIS ANALYSIS:

S = This compound is a surrogate used to evaluate the quality control of a method.

Sample: 966098 Rafus Well Collected: 12/07/16 Analyzed: 12/17/16 - Analytes: 6

ANALYTE NAME	RESULT	UNITS WWB	DIL	LOD	LOQ	MCL	Note
perfluorobutanesulfonic acid (PFBS)	ND	ppt	1	7.2	23		
perfluoroheptanoic acid (PFHpA)	ND	ppt	1	1.0	3.2		
perfluorohexanesulfonic acid (PFHxS)	ND	ppt	1	1.4	4.4		
perfluorooctanoic acid (PFOA)	ND	ppt	1	2.2	7.1		
perfluorononanoic acid (PFNA)	ND	ppt	1	1.1	3.5		
perfluorooctanesulfonic acid (PFOS)	ND	ppt	1	2.2	7.0		
C13-PFHxA (SURR)	99.893%						S
C13-PFDA (SURR)	87.437%						S

NOTES APPLICABLE TO THIS ANALYSIS:

S = This compound is a surrogate used to evaluate the quality control of a method.

The PFOA branch isotope peak is included in the PFOA calculation per EPA directive.

ANALYTICAL RESULTS: Perfluorinated Chemicals by EPA 537 Rev 1.1 Safe Drinking Water Analysis

Customer: KAS NLS Project: 272346 PO # 610110045

Project Description: Halifax Landfill

Project Title: Template: 537PPT2 Printed: 12/22/2016 15:14

Sample: 966100 Trip Blank Collected: 12/07/16 Analyzed: 12/21/16 - Analytes: 6

ANALYTE NAME	RESULT	UNITS	WWB	DIL	LOD	LOQ	Note
perfluorobutanesulfonic acid (PFBS)	ND	ppt		1	7.2	23	
perfluoroheptanoic acid (PFHpA)	ND	ppt		1	1.0	3.2	
perfluorohexanesulfonic acid (PFHxS)	ND	ppt		1	1.4	4.4	
perfluorooctanoic acid (PFOA)	ND	ppt		1	2.2	7.1	
perfluorononanoic acid (PFNA)	ND	ppt		1	1.1	3.5	
perfluorooctanesulfonic acid (PFOS)	ND	ppt		1	2.2	7.0	
C13-PFHxA (SURR)	86.708%						S
C13-PFDA (SURR)	83.34%						S

NOTES APPLICABLE TO THIS ANALYSIS:

S = This compound is a surrogate used to evaluate the quality control of a method.

SAMPLE COLLECTION AND CHAIN OF CUSTODY RECORD

NORTHERN LAKE SERVICE, INC.

Analytical Laboratory and Environmental Services

400 North Lake Avenue • Crandon, WI 54520-1298

Tel: (715) 478-2777 • Fax: (715) 478-3060

Wisconsin DNR cert ID
721026460 (Cran) / 268533760 (Wauk)
Wisconsin DATCP ID
105-000330 (Cran) / 105-000479 (Wauk)

NO. 196361

CLIENT	KAS, Inc.
ADDRESS	PO Box 787
CITY / STATE / ZIP	Williston / VT / 05495
PROJECT DESCRIPTION / NO.	Halifax Landfill
QUOTATION NO.	
DNR FID #	
DNR LICENSE #	
CONTACT	Rebecca Treat
PHONE	802-383-0486
PURCHASE ORDER NO.	610110045
FAX	802-383-0490

MATRIX:
SW = surface water
WW = waste water
GW = groundwater
DW = drinking water
TIS = tissue
AIR = air
SOIL = soil
SED = sediment
PROD = product
SL = sludge
OTHER

ANALYZE PER ORDER OF ANALYSIS: PFCs U.S. EPA METHOD 537

USE BOXES BELOW: Indicate Y or N if GW Sample is field filtered.
Indicate G or C if WW Sample is Grab or Composite.

ITEM NO.	NLS LAB. NO.	SAMPLE ID	COLLECTION DATE	COLLECTION TIME	MATRIX (See above)	G	PFCs	COLLECTION REMARKS (i.e. DNR Well ID #)
1.	960096	MW-4	12/7/16	1556	GW		X	
2.	097	Duplicate	↓	1558	GW		↓	
3.	098-099	Refus well	↓	1516	DW		↓	FB
4.	100							TB
5.								
6.								
7.								
8.								
9.								
10.								

ONE SAMPLE PER LINE

COLLECTED BY (signature) — CUSTODY SEAL NO. (IF ANY) — DATE/TIME 12/7/16

RELINQUISHED BY (signature) — RECEIVED BY (signature) — DATE/TIME

DISPATCHED BY (signature) — METHOD OF TRANSPORT: UPS - overnight — DATE/TIME 12/12/16 0850

RECEIVED AT NLS BY (signature) — DATE/TIME 12/13/16 1240 — CONDITION — TEMP. 1.1 °C

COOLER #

REMARKS & OTHER INFORMATION: Analyze field blank only if associated sample has a positive result for PFCs

WDNR FACILITY NUMBER

E-MAIL ADDRESS

REPORT TO: KAS, Inc.

INVOICE TO: KAS, Inc.

PRESERVATIVE:
NP = no preservative
S = sulfuric acid
N = nitric acid
Z = zinc acetate
M = methanol
OH = sodium hydroxide
HA = hydrochloric & ascorbic acid
H = hydrochloric acid

IMPORTANT:

1. TO MEET REGULATORY REQUIREMENTS, THIS FORM **MUST** BE COMPLETED IN DETAIL AND INCLUDED IN THE COOLER CONTAINING THE SAMPLES DESCRIBED.
2. PLEASE USE ONE LINE PER SAMPLE, **NOT** PER BOTTLE.
3. RETURN THIS FORM WITH SAMPLES - CLIENT MAY KEEP YELLOW COPY.
4. PARTIES COLLECTING SAMPLE LISTED AS **REPORT TO** AND LISTED AS **INVOICE TO** AGREE TO STANDARD TERMS & CONDITIONS ON REVERSE.

Rev. 7/20/15