UV Absorbance Index	Abbrev-iation	Equation	Correlated with	Reference
Specific UV absorbance	$SUVA_{254}$	$\frac{Abs_{254nm}}{[Carbon]}$	Positive to molecular weight, positively to aromaticity, negatively to aliphatics	Rodriguez et al., 2016; et al., 1994; Croue et al al., 2002; Kim et al., 2 Korshin et al., 1999, 20 Coudrier et al., 2010; P al., 1997; Swietlik et al Weishaar et al., 2003; 2016; Bekbolet, 2005
Specific UV absorbance	$SUVA_{280}$	$\frac{Abs_{280nm}}{[Carbon]}$	Positive to molecular weight, positively to aromaticity, negatively to aliphatics	Rodriguez et al., 2016; al, 1997; Uyguner et al et al., 2016
Spectral Slope Ratio	S_R	$\frac{Slope(LN(Abs_{275-295nm}))\ (nm^{-1})}{Slope(LN(Abs_{350-400nm}))\ (nm^{-1})}$	Negatively to molecular weight, increases with irradiation,	Hansen et al., 2016; He 2016; Li and Hur, 2017
Absorbance Ratio	E2:E3	$\frac{Abs_{250nm}}{Abs_{365nm}}$	Negatively to molecular weight	Rodriguez et al., 2016; 2008; Li et al., 2009; P 2009; Brown et al., 197 Santos et al., 2016
Absorbance Ratio	E2:E4	$\frac{Abs_{254nm}}{Abs_{436nm}}$	Positively correlated with soil humic acid of high lignin type compounds,	Rodriguez et al., 2016; 1995; Hur et al., 2006; 2017; Cieslewicz and
Absorbance Ratio	E2:E6	$\frac{Abs_{280nm}}{Abs_{665nm}}$	Positively correlated with soil humic acid of high lignin type compounds, degree of humification	Cieslewicz and Gonet, Rodriguez et al., 2016,
Absorbance Ratio	E4:E6	$\frac{Abs_{465nm}}{Abs_{665nm}}$	Negatively to molecular weight, positively to sediment humic acids, negatively with humification	Rodriguez et al., 2016; 1994; Claret et al., 200 al., 1997; Senesi et al., Uyguner et al., 2004; B 1987; Kiss et al., 2014;

Table 1.1: Optical Indices Informational Table for UV-Vis

Compiled optical indices equations and correlations utilized to interpret UV-Vis spectrum of leachate composition, along with references.

Abouleish and Wells, 2012; Chin l., 1999; Fram et al., 1999; Imai et)06, 2007; Kitis et al., 2002, 2004;)09; Müller et al., 2004; Pernet- 'etterson et al., 1994; Peuravuori et l., 2006; Uyguner et al., 2005; Wong et al., 2007; Hansen et al.,
Chin et al., 1994; Peuravuori et ., 2005; Wang et al., 2009; Hansen
:lms et al., 2008; Rodriguez et al.,
Duarte et al., 2003; Helms et al., euravuori et al., 1997; Wang et al., '7; Guo and Chorover 2003;
Battin et al., 1998; Blough et al., Jaffé et al., 2004; Li and Hur, ;onet, 2004
2004 and Chen et al., 1977; Li and Hur, 2017;
Chen et al., 1977; Chin et al., 5; Ma et al., 2001; Peuravuori et 1989; Stevenson et al., 1994; 3rown et al., 1977; Summers et al., You et al., 1999;

Fluorescence Index	**Abbrev -iation**	**Equation**	**Correlated w**
Fluorescence Index	FI	$\frac{Em_{470nm}@Ex_{370nm}}{Em_{520nm}@Ex_{370nm}}$	Source determin of microbial and terrestrial input.
Humification Index	HIX	$\frac{Area(Em_{435-480nm})@Ex_{254nm}}{Area(Em_{300-354nm}+Em_{435-480nm})@Ex_{254nm}}$	Indication of humification ext
Freshness Index	$\alpha{:}\beta$	$\frac{Em_{380nm}@Ex_{310nm}}{MAX(Em_{410-435nm})@Ex_{310nm}}$	How recently N(was produced th recent degradati(
Biological Index	BIX	$\frac{Em_{380nm}@Ex_{310nm}}{Em_{430nm}@Ex_{310nm}}$	How recently N(was produced th recent degradati(

Table 1.2: Optical Indices Informational Table for Fluorescence

Optical indices equations for correlations for interpretation of fluorescence excitation – emission matrices, along with references.

ith	Reference
ation .	Rodriguez et al., 2016; Kim et al., 2006; McKnight et al., 2001; Rodríguez et al., 2014a; Hansen et al., 2016; Cory et al., 2010
ent	Hansen et al., 2016; Ohno et al., 2002; Gabor et al., 2015
OM rough on.	Hansen et al., 2016; Parlanti et al., 2000; Wilson and Xenopoulos, 2009
OM rough on.	Hansen et al., 2016; Huguet et al., 2009

Sample Name	Radio Carbon Date	Radio Carbon Date Error	Moisture Percentage	Depth (cm)	Layer Type
BNZ1.6	7200	40	52%	120	P
BNZ1.5	6880	30	46%	N/A	P
BNZ1.4	6270	30	48%	60	P/T
BNZ1.3	N/A	N/A	39%	N/A	T
BNZ1.2	N/A	N/A	29%	N/A	A
BNZ1.1	2520	25	52%	N/A	A
Average					
STD					
BNZ2.6	7160	35	75%	120	P
BNZ2.5	6630	30	65%	60	P/T
BNZ2.4	5990	30	N/A	N/A	T
BNZ2.3	4580	20	N/A	N/A	A
BNZ2.2	1550	15	N/A	N/A	A
Average					
STD					
CPC1.5	1590	20	58%	76	T
CPC1.4	1460	15	57%	66	A
CPC1.3	1330	20	52%	43	A
CPC1.2	75	15	48%	22	A
Average					
STD					
CPC2.4	1400	15	51%	90	T
CPC2.3	N/A	N/A	54%	59	A
CPC2.2	865	15	45%	29	A
Average					
STD					

Table 1.3: General Soil Characterization

General soil characterization including radiocarbon dating, depth, and soil layer type. Carbon to Nitro
Elemental Analyzer and the percent leachable carbon was determined through the comparison of soi
leachate carbon concentration (Equation 4). Determination of pH followed EPA method 9045D. Deptl
to the core structure failure during freeze drying.

C:N	C:N STD	Percent Leachable Carbon	Percent Leachable Carbon Error	pH	pH Error
10.46	0.23	3%	1%	5.87	0.01
11.23	0.62	9%	2%	5.60	0.01
19.71	0.11	1%	1%	5.50	0.01
22.67	0.03	0%	2%	5.38	0.04
9.27	0.63	53%	2%	N/A	N/A
9.46	1.36	86%	1%	5.22	N/A
13.80	**0.50**	**25%**	**1%**	**5.51**	**0.02**
5.84	**0.49**	**36%**	**1%**	**0.24**	**0.02**
17.24	0.00	3%	1%	5.40	0.04
22.47	0.16	2%	1%	N/A	N/A
23.73	0.10	1%	1%	5.40	0.01
15.71	0.37	3%	2%	5.11	N/A
13.79	0.33	16%	1%	4.88	0.02
18.59	**0.19**	**5%**	**1%**	**5.20**	**0.02**
4.32	**0.16**	**6%**	**0%**	**0.25**	**0.02**
33.38	0.13	0%	2%	5.67	0.01
24.51	0.24	1%	1%	5.54	0.02
18.98	0.00	0%	4%	5.45	0.03
24.50	0.34	1%	1%	5.59	0.11
25.34	**0.18**	**1%**	**2%**	**5.56**	**0.04**
5.96	**0.15**	**0%**	**2%**	**0.09**	**0.04**
44.41	0.97	0%	1%	5.36	N/A
21.63	0.17	1%	3%	5.29	0.04
24.31	0.17	1%	6%	5.02	0.01
30.12	**0.44**	**1%**	**3%**	**5.22**	**0.02**
12.46	**0.46**	**0%**	**2%**	**0.18**	**0.02**

gen ratio was determined by
l carbon concentration and
hs that have "N/A" were due

	Al ppm Sh.Carb	+/- ppm Sh.Carb	Ca ppm Sh.Carb	+/- ppm Sh.Carb	K ppm Sh.Carb
BNZ1.6	4425.6	1.6	845.2	0.7	1107.1
BNZ1.5	3786.6	1.4	850.8	0.6	1111.6
BNZ1.4	4984.2	1.8	1040.2	0.8	1389.3
BNZ1.3	4059.6	1.5	832.9	0.6	1157.3
BNZ1.2	1812.5	1.0	1361.8	0.8	659.0
BNZ1.1	715.3	0.6	1898.2	0.8	276.3
Average	3297.3	1.3	1138.2	0.7	950.1
STD	1661.9	0.5	424.0	0.1	406.3
BNZ2.6	3282.9	1.3	893.0	0.7	1060.7
BNZ2.5	N/A	N/A	N/A	N/A	N/A
BNZ2.4	3753.7	1.4	830.1	0.6	1112.4
BNZ2.3	3467.4	1.4	877.2	0.6	1076.7
BNZ2.2	2740.4	1.2	1006.0	0.7	918.4
BNZ2.1	773.2	0.6	1401.2	0.7	310.2
Average	2803.5	1.2	1001.5	0.7	895.7
STD	1193.7	0.4	232.6	0.0	335.5
CPC1.5	3041.8	1.1	588.0	0.5	683.5
CPC1.4	3838.5	1.5	828.6	0.6	870.9
CPC1.3	3835.5	1.5	798.4	0.6	843.6
CPC1.2	3802.8	1.5	864.1	0.6	863.2
Average	3629.7	1.4	769.8	0.6	815.3
STD	392.2	0.2	124.1	0.1	88.6
CPC2.4	4161.8	1.5	722.6	0.6	953.2
CPC2.3	3699.3	1.4	834.7	0.6	859.8
CPC2.2	3680.2	1.4	760.6	0.6	828.8
Average	3847.1	1.5	772.6	0.6	880.6
STD	272.7	0.1	57.0	0.0	64.8

	Cr ppm ProTrace	+/- ppm ProTrace	Fe ppm ProTrace	+/- ppm ProTrace	Co ppm ProTrace
BNZ1.6	16.5	0.1	2191.5	1.0	0.5
BNZ1.5	7.4	0.1	1473.8	0.8	0.5
BNZ1.4	9.5	0.1	1972.9	1.0	0.7
BNZ1.3	6.1	0.1	1447.4	0.8	0.5
BNZ1.2	2.4	0.0	657.0	0.4	0.3
BNZ1.1	1.4	0.0	1024.7	0.4	0.5

Average	7.2	0.1	1461.2	0.7	0.5
STD	5.5	0.0	571.5	0.3	0.1
BNZ2.6	4.9	0.1	1061.2	0.6	0.5
BNZ2.5	N/A	N/A	N/A	N/A	N/A
BNZ2.4	5.5	0.1	1293.4	0.7	0.5
BNZ2.3	5.4	0.1	1185.8	0.7	0.5
BNZ2.2	3.8	0.0	879.1	0.5	0.4
BNZ2.1	1.1	0.0	506.6	0.3	0.3
Average	4.1	0.0	985.2	0.6	0.4
STD	1.8	0.0	308.8	0.2	0.1
CPC1.5	7.6	0.1	2143.6	0.8	0.9
CPC1.4	7.9	0.1	2406.7	1.0	1.1
CPC1.3	6.4	0.1	2417.7	1.0	1.0
CPC1.2	6.6	0.1	2577.3	1.0	1.1
Average	7.1	0.1	2386.3	1.0	1.0
STD	0.7	0.0	179.6	0.1	0.1
CPC2.4	6.9	0.1	3009.3	1.1	0.9
CPC2.3	7.1	0.1	2581.5	1.0	0.9
CPC2.2	6.4	0.1	2444.4	1.0	0.8
Average	6.8	0.1	2678.4	1.1	0.9
STD	0.3	0.0	294.7	0.1	0.1

Table 1.4: Soil XRF Metals

XRF results for the metal concentrations in soil samples. BDL indicates the metal co

+/- ppm Sh.Carb	Mg ppm Sh.Carb	+/- ppm Sh.Carb	Na ppm Sh.Carb	+/- ppm Sh.Carb	P ppm Sh.Carb	+/- ppm Sh.Carb
266.3	856.3	90.9	642.3	129.2	48.9	11.8
265.2	574.2	90.5	528.3	128.7	48.4	11.8
331.8	766.8	113.2	698.4	161.0	60.3	14.7
266.3	572.0	90.9	575.8	129.2	50.4	11.8
265.1	186.7	90.5	335.6	128.6	81.9	11.8
221.8	121.0	75.7	229.4	107.6	58.6	9.8
269.4	512.8	92.0	501.6	130.7	58.1	12.0
35.2	299.9	12.0	182.5	17.1	12.7	1.6
266.7	384.6	91.0	437.2	129.4	48.7	11.8
N/A	N/A	N/A	N/A	N/A	N/A	N/A
264.9	507.0	90.4	509.2	128.5	49.2	11.8
264.8	457.3	90.4	461.4	128.5	53.5	11.8
265.0	310.6	90.4	430.5	128.6	65.4	11.8
197.1	113.8	67.3	202.6	95.7	61.7	8.8
251.7	354.7	85.9	408.2	122.1	55.7	11.2
30.5	153.8	10.4	119.0	14.8	7.5	1.4
197.2	551.6	67.3	375.1	95.7	43.2	8.8
265.5	665.1	90.6	537.1	128.8	58.2	11.8
265.4	689.3	90.6	563.9	128.8	53.3	11.8
265.5	697.7	90.6	517.9	128.9	56.9	11.8
248.4	650.9	84.8	498.5	120.5	52.9	11.0
34.1	67.7	11.7	84.4	16.6	6.8	1.5
266.4	722.0	90.9	552.5	129.3	53.8	11.8
265.4	649.9	90.6	511.4	128.8	55.2	11.8
265.7	669.7	90.7	518.5	128.9	56.4	11.8
265.8	680.5	90.7	527.5	129.0	55.1	11.8
0.5	37.2	0.2	22.0	0.3	1.3	0.0

+/- ppm ProTrace	Ni ppm ProTrace	+/- ppm ProTrace	Cu ppm ProTrace	+/- ppm ProTrace	Zn ppm ProTrace	+/- ppm ProTrace
0.1	2.1	0.3	1.1	0.2	5.1	0.0
0.1	1.7	0.3	1.4	0.2	3.7	0.0
0.2	2.1	0.4	1.5	0.2	4.8	0.0
0.1	1.6	0.3	1.4	0.2	3.6	0.0
0.1	1.2	0.3	1.5	0.2	1.0	0.0
0.1	1.0	0.3	0.7	0.1	2.0	0.0

0.1	1.6	0.3	1.3	0.2	3.4	0.0
0.0	0.5	0.0	0.3	0.0	1.6	0.0
0.1	1.4	0.3	1.5	0.2	2.4	0.0
N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.1	1.5	0.3	1.3	0.2	3.2	0.0
0.1	1.6	0.3	1.7	0.2	3.1	0.0
0.1	1.4	0.3	1.6	0.2	2.0	0.0
0.1	0.8	0.2	0.7	0.1	1.0	0.0
0.1	1.4	0.3	1.4	0.1	2.3	0.0
0.0	0.3	0.0	0.4	0.0	0.9	0.0
0.1	1.9	0.2	2.0	0.1	4.5	0.0
0.1	2.3	0.3	2.2	0.2	5.2	0.0
0.1	2.2	0.3	2.2	0.2	4.8	0.0
0.1	2.2	0.3	1.9	0.2	5.3	0.0
0.1	2.1	0.3	2.1	0.1	5.0	0.0
0.0	0.2	0.0	0.1	0.0	0.4	0.0
0.1	2.2	0.3	2.0	0.2	5.3	0.0
0.1	2.3	0.3	2.1	0.2	4.8	0.0
0.1	2.1	0.3	2.2	0.2	4.7	0.0
0.1	2.2	0.3	2.1	0.2	4.9	0.0
0.0	0.1	0.0	0.1	0.0	0.3	0.0

ncentrations were below detection limits.

Si ppm Sh.Carb	+/- ppm Sh.Carb	Ti ppm Sh.Carb	+/- ppm Sh.Carb	Mn ppm Sh.Carb	+/- ppm Sh.Carb	Ba ppm Sh.Carb
16359.0	3.6	299.6	54.2	21.4	6.1	47.1
14120.5	3.2	303.6	53.9	17.8	6.0	50.1
18153.5	4.1	400.8	67.5	22.1	7.5	63.2
14818.6	3.3	326.7	54.2	16.9	6.1	53.0
6530.8	2.1	200.2	53.9	10.9	6.0	45.0
2898.5	1.3	73.5	45.1	52.4	5.0	29.2
12146.8	2.9	267.4	54.8	23.6	6.1	47.9
6032.1	1.0	114.7	7.2	14.7	0.8	11.2
11970.6	3.0	301.2	54.3	15.4	6.1	53.4
N/A	N/A	N/A	N/A	N/A	N/A	N/A
13318.2	3.1	306.8	53.9	16.3	6.0	54.6
11550.2	2.9	301.1	53.9	14.7	6.0	55.3
9652.0	2.6	272.1	53.9	12.2	6.0	52.0
3318.1	1.3	89.1	40.1	19.5	4.5	25.7
9961.8	2.6	254.1	51.2	15.6	5.7	48.2
3938.9	0.7	93.2	6.2	2.7	0.7	12.7
10915.4	2.5	245.4	40.1	56.1	4.5	34.8
14901.0	3.4	329.5	54.0	47.7	6.0	47.0
15621.7	3.4	331.7	54.0	36.3	6.0	42.4
14323.1	3.3	342.0	54.0	57.0	6.0	44.7
13940.3	3.2	312.2	50.5	49.3	5.6	42.2
2085.4	0.4	44.9	6.9	9.6	0.8	5.3
15640.0	3.5	339.3	54.2	32.8	6.1	46.8
14017.3	3.3	321.1	54.0	43.4	6.0	45.9
14372.6	3.3	334.9	54.0	34.4	6.0	42.8
14676.6	3.3	331.8	54.1	36.9	6.0	45.2
853.0	0.1	9.5	0.1	5.7	0.0	2.1

As ppm ProTrace	+/- ppm ProTrace	Se ppm ProTrace	+/- ppm ProTrace	Br ppm ProTrace	+/- ppm ProTrace	Sr ppm ProTrace
0.5	2.2	0.3	0.2	0.2	0.1	13.3
BDL	2.2	0.2	0.2	0.4	0.1	11.6
BDL	2.7	0.3	0.2	0.3	0.2	14.9
BDL	2.2	0.2	0.2	0.3	0.1	11.4
BDL	2.2	0.1	0.2	0.8	0.1	6.3
2.0	1.8	BDL	0.1	0.5	0.1	5.1

1.2	2.2	0.2	0.2	0.4	0.1	10.4
1.1	0.3	0.1	0.0	0.2	0.0	3.9
BDL	2.2	0.2	0.2	0.4	0.1	9.2
N/A	N/A	N/A	N/A	N/A	N/A	N/A
BDL	2.2	0.2	0.2	0.3	0.1	10.4
BDL	2.2	0.2	0.2	0.4	0.1	9.5
BDL	2.2	0.1	0.2	0.5	0.1	7.4
BDL	1.6	BDL	0.1	0.4	0.1	4.4
	2.1	0.2	0.2	0.4	0.1	8.2
	0.2	0.0	0.0	0.1	0.0	2.4
0.5	1.6	0.2	0.1	0.2	0.1	7.7
0.8	2.2	0.3	0.2	0.3	0.1	10.6
BDL	2.2	0.3	0.2	0.2	0.1	10.2
0.9	2.2	0.3	0.2	0.4	0.1	8.9
0.7	2.0	0.3	0.2	0.3	0.1	9.3
0.2	0.3	0.0	0.0	0.1	0.0	1.3
1.4	2.2	0.3	0.2	0.3	0.1	9.9
0.6	2.2	0.3	0.2	0.2	0.1	9.9
BDL	2.2	BDL	0.2	0.1	0.1	9.4
1.0	2.2	0.3	0.2	0.2	0.1	9.7
0.6	0.0	0.0	0.0	0.1	0.0	0.3

+/- ppm Sh.Carb	S ppm Sh.Carb	+/- ppm Sh.Carb	Ti ppm ProTrace	+/- ppm ProTrace	V ppm ProTrace	+/- ppm ProTrace
0.2	24.1	3.2	304.3	0.2	8.1	0.1
0.2	219.2	3.2	267.6	0.2	6.0	0.1
0.2	172.3	4.0	359.1	0.3	8.1	0.1
0.2	158.7	3.2	278.0	0.2	6.2	0.1
0.2	441.4	3.2	97.7	0.1	2.7	0.0
0.1	200.0	2.7	40.2	0.1	1.3	0.0
0.2	202.6	3.3	224.5	0.2	5.4	0.1
0.0	135.7	0.4	125.9	0.1	2.8	0.0
0.2	423.6	3.3	212.8	0.2	5.2	0.1
N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.2	223.0	3.2	246.0	0.2	5.8	0.1
0.2	252.8	3.2	218.0	0.2	5.7	0.1
0.2	308.5	3.2	158.6	0.1	4.2	0.0
0.1	217.0	2.4	45.3	0.1	1.3	0.0
0.2	285.0	3.1	176.1	0.1	4.4	0.0
0.0	85.5	0.4	79.7	0.1	1.8	0.0
0.1	32.0	2.4	231.5	0.2	6.7	0.1
0.2	55.5	3.2	303.4	0.2	8.0	0.1
0.2	39.7	3.2	322.6	0.2	8.4	0.1
0.2	59.0	3.2	301.5	0.2	8.0	0.1
0.2	46.6	3.0	289.7	0.2	7.8	0.1
0.0	12.8	0.4	40.0	0.0	0.8	0.0
0.2	32.8	3.2	319.9	0.2	9.1	0.1
0.2	74.7	3.2	292.0	0.2	8.4	0.1
0.2	76.5	3.2	301.6	0.2	7.9	0.1
0.2	61.3	3.2	304.5	0.2	8.5	0.1
0.0	24.7	0.0	14.2	0.0	0.6	0.0

+/- ppm ProTrace	Mo ppm ProTrace	+/- ppm ProTrace	Pb ppm ProTrace	+/- ppm ProTrace
0.0	0.1	0.1	1.0	0.0
0.0	BDL	0.1	1.0	0.0
0.0	0.0	0.1	1.1	0.0
0.0	0.0	0.1	0.9	0.0
0.0	BDL	0.1	0.5	0.0
0.0	BDL	0.0	0.5	0.0

0.0	0.1	0.1	0.8	0.0
0.0	0.0	0.0	0.3	0.0
0.0	BDL	0.1	0.9	0.0
N/A	N/A	N/A	N/A	N/A
0.0	BDL	0.1	0.9	0.0
0.0	BDL	0.1	1.0	0.0
0.0	BDL	0.1	0.8	0.0
0.0	BDL	0.0	1.5	0.0
0.0		0.1	1.0	0.0
0.0		0.0	0.3	0.0
0.0	0.1	0.0	0.7	0.0
0.0	0.1	0.1	0.9	0.0
0.0	0.1	0.1	0.8	0.0
0.0	0.0	0.1	0.9	0.0
0.0	0.1	0.0	0.8	0.0
0.0	0.0	0.0	0.1	0.0
0.0	0.0	0.1	0.9	0.0
0.0	0.0	0.1	0.8	0.0
0.0	BDL	0.1	0.8	0.0
0.0	0.0	0.1	0.8	0.0
0.0	0.0	0.0	0.1	0.0

Soil Sample	190-220 ppm	190-160 ppm	160-140 ppm	140-120 ppm	120-90 ppm
BNZ1.6	2%	8%	6%	10%	14%
BNZ1.4	5%	9%	6%	8%	10%
BNZ1.3	1%	6%	5%	8%	10%
BNZ1.2	1%	6%	5%	8%	14%
BNZ1.1	5%	10%	6%	8%	13%
Average	**3%**	**8%**	**6%**	**9%**	**12%**
STD	**2%**	**2%**	**1%**	**1%**	**2%**

Table 1.5: Soil NMR Percentages

Soil NMR binning percentages for ^{13}C CP-MAS NMR analysis of HF washed soil to removed paramagnetic metals. Percentage determined based on area underneath the curve in specified chemical shifts; 0-45 ppm alkyl-C, 45-60 ppm methoxyl, 60-90 ppm carbohydrates, 90-120 ppm proton substituted aromatics, 120-140 ppm carbon substituted aromatics, 140-160 ppm oxygen substituted aromatics, 160-190 ppm carboxyl/aliphatic amides, 190-220 ppm aldehydes and ketones (Mao et al., 2012; Zhou et al., 2015; Kaiser et al., 2003). 90-160 ppm is classified as total aromatics.

um 160-90 pp	90-60 ppm	60-45 ppm	45-0 ppm
31%	19%	11%	30%
25%	15%	8%	40%
23%	17%	8%	45%
27%	24%	11%	30%
28%	23%	8%	26%
27%	**20%**	**9%**	**34%**
3%	**4%**	**2%**	**8%**

Sample	TOC	TOC +/-	TDN	TDN +/-	Percent Carbon in NOM
BNZ1.4 H_2O	4.534	0.040	0.222	0.009	32%
BNZ2.5 H_2O	7.127	0.087	0.506	0.017	50%
Average	**5.830**	**0.063**	**0.364**	**0.013**	**41%**
STD	**1.833**	**0.033**	**0.201**	**0.006**	**13%**
BNZ1.4 K_2SO_4	4.998	0.126	0.306	0.016	8%
BNZ2.5 K_2SO_4	1.714	0.034	0.061	0.008	15%
Average	**3.356**	**0.080**	**0.184**	**0.012**	**11%**
STD	**2.323**	**0.065**	**0.174**	**0.005**	**5%**
BNZ1.4 pH10	8.467	0.056	0.460	0.015	19%
BNZ2.5 pH10	4.415	0.055	0.218	0.031	18%
Average	**6.441**	**0.055**	**0.339**	**0.023**	**18%**
STD	**2.866**	**0.001**	**0.171**	**0.012**	**1%**
PLFA	N/A	N/A	N/A	N/A	67%
SRFA	N/A	N/A	N/A	N/A	56%

Table 1.6: Optical Indices for Media Leachates

Optical indices of media leachate samples determined from UV-Vis spectrum and Fluorescence E
diameter quartz cuvette. Standard deviation is denoted as (±) in this table. Values are based on calcul
Total organic carbon concentration. TDN = Total dissolved nitrogen cc

NOM pH	ABS254	ABS280	$SR_{275/350}$	$SUVA_{254}$ (L mg C^{-1} cm^{-1})	$SUVA_{280}$ (L mg C^{-1} cm^{-1})	E4:E6
4.210	0.167	0.124	0.884	3.680	2.735	4.793
4.240	0.237	0.175	0.889	3.319	2.458	10.254
4.225	**0.202**	**0.150**	**0.886**	**3.500**	**2.597**	**7.523**
0.021	**0.049**	**0.036**	**0.003**	**0.255**	**0.196**	**3.861**
4.110	0.120	0.084	0.879	2.395	1.688	7.663
4.230	0.173	0.122	0.882	10.086	7.141	7.805
4.170	**0.146**	**0.103**	**0.881**	**6.240**	**4.415**	**7.734**
0.085	**0.038**	**0.027**	**0.002**	**5.438**	**3.855**	**0.101**
2.890	0.426	0.337	0.883	5.034	3.976	10.977
4.340	0.693	0.550	0.899	15.700	12.463	10.694
3.615	**0.560**	**0.443**	**0.891**	**10.367**	**8.219**	**10.836**
1.025	**0.189**	**0.151**	**0.011**	**7.541**	**6.001**	**0.200**
4.050	0.286	0.229	1.035	2.148	1.718	6.089
4.230	0.423	0.327	0.812	4.164	3.216	8.188

EMs on a Horiba Fluorimeter in a 1 cm
lations found in Table 1.1 and 1.2. TOC =
ncentration.

BIX	FI	Freshness	HIX
0.444	1.304	0.431	0.922
0.445	1.268	0.427	0.922
0.444	**1.286**	**0.429**	**0.922**
0.001	**0.026**	**0.003**	**0.000**
0.709	1.275	0.607	0.868
0.568	1.466	0.555	0.903
0.639	**1.370**	**0.581**	**0.885**
0.100	**0.135**	**0.037**	**0.025**
0.398	1.119	0.373	0.969
0.368	1.077	0.348	0.948
0.383	**1.098**	**0.361**	**0.958**
0.022	**0.030**	**0.017**	**0.015**
0.776	1.549	0.756	0.793
0.427	1.314	0.408	0.868

Sample	TOC	TOC +/-	TDN	TDN +/-	ABS254
BNZ1.6	10.164	0.033	0.507	0.015	0.494
BNZ1.5	9.381	0.225	0.493	0.021	0.493
BNZ1.4	8.392	0.192	0.403	0.025	0.411
BNZ1.3	7.341	0.144	0.294	0.019	0.433
BNZ1.2	9.829	0.081	0.474	0.019	0.330
BNZ1.1	9.569	0.173	0.370	0.017	0.269
Average	9.113	0.141	0.424	0.019	0.405
STD	1.054	0.072	0.083	0.004	0.090
BNZ2.6	9.098	0.051	0.431	0.013	0.405
BNZ2.5	10.028	0.169	0.556	0.007	0.426
BNZ2.4	8.439	0.061	0.393	0.016	0.388
BNZ2.3	8.715	0.069	0.446	0.007	0.391
BNZ2.2	9.644	0.108	0.491	0.022	0.371
Average	9.185	0.092	0.463	0.013	0.396
STD	0.653	0.048	0.062	0.007	0.021
CPC1.5	9.924	0.115	0.569	0.012	0.298
CPC1.4	9.660	0.106	0.513	0.010	0.332
CPC1.3	9.107	0.094	0.379	0.013	0.344
CPC1.2	9.650	0.136	0.542	0.014	0.345
Average	9.585	0.113	0.501	0.012	0.330
STD	0.343	0.018	0.085	0.002	0.022
PLFA	13.303	0.036	N/A	N/A	0.410
SRFA	10.160	0.040	N/A	N/A	0.271

Table 1.7 Optical Indices for Reconstituted NOM

UV-Vis and Fluorescence optical indices for reconstituted NOM at a 10 mg C L^{-1} concentration. All samples were pH adjusted to circumneutral. Standard deviation is denoted as (±) in this table. Values are based on calculations found in Table 1.1 and 1.2. TOC = Total organic carbon concentration. TDN = Total dissolved nitrogen concentration.

ABS280	S_R	$SUVA_{254}$ (L mg C^{-1} cm^{-1})	$SUVA_{280}$ (L mg C^{-1} cm^{-1})	E4:E6	BIX	FI
0.377	0.800	4.856	3.710	14.634	0.398	1.208
0.374	0.808	5.253	3.987	29.672	0.406	1.193
0.311	0.818	4.903	3.706	17.371	0.415	1.319
0.327	0.803	5.895	4.455	23.890	N/A	N/A
0.257	0.709	3.359	2.610	25.211	0.381	1.175
0.219	0.643	2.806	2.285	19.861	0.383	1.305
0.311	0.764	4.512	3.459	21.773	0.397	1.240
0.063	0.071	1.181	0.836	5.526	0.015	0.067
0.311	0.794	4.455	3.418	32.576	0.419	1.201
0.328	0.849	4.250	3.266	14.672	0.400	1.165
0.298	0.823	4.601	3.533	14.045	0.404	1.159
0.299	0.785	4.482	3.434	18.823	0.412	1.161
0.288	0.742	3.842	2.989	16.634	0.410	1.191
0.305	0.798	4.326	3.328	19.350	0.409	1.175
0.015	0.040	0.299	0.212	7.626	0.007	0.019
0.218	0.820	3.004	2.195	12.936	0.417	1.320
0.248	0.746	3.434	2.572	20.173	0.423	1.267
0.256	0.780	3.781	2.813	12.916	0.416	1.244
0.259	0.777	3.576	2.685	12.828	0.359	1.260
0.245	0.781	3.449	2.567	14.713	0.404	1.273
0.019	0.030	0.329	0.266	3.640	0.030	0.033
0.306	0.700	3.082	2.299	12.807	0.780	0.422
0.206	0.798	2.668	2.024	5.486	0.427	0.380

Freshness	HIX
0.380	0.945
0.390	0.980
0.392	0.961
N/A	N/A
0.367	0.930
0.378	0.870
0.382	0.937
0.010	0.042
0.404	0.961
0.383	0.964
0.385	0.946
0.395	0.961
0.391	0.951
0.392	0.957
0.008	0.008
0.410	0.949
0.414	0.929
0.404	0.951
0.343	0.949
0.393	0.944
0.033	0.011
0.529	1.514
0.616	1.343

	Na / 23 #2 ppb	Na / 23 #2 +/-	Mg / 24 #2 ppb	Mg / 24 #2 +/-
BNZ2.5 H_2O	BDL	0.00	246.40	12.88
BNZ2.5 K_2SO_4	1009.35	19.26	1347.02	14.40
BNZ2.5 pH10	7597.86	20.59	40.73	1.85
Average	4303.61	13.28	544.72	9.71
STD	4658.78	11.52	702.39	6.85
BNZ1.4 H_2O	86.92	27.18	197.06	6.00
BNZ1.4 K_2SO_4	---	---	---	---
BNZ1.4 pH10	---	---	---	---
Average	86.92	27.18	197.06	6.00
STD				

	Ni / 60 #2 ppb	Ni / 60 #2 +/-	Cu / 63 #2 ppb	Cu / 63 #2 +/-
BNZ2.5 H_2O	0.2	0.0	1.2	0.0
BNZ2.5 K_2SO_4	6.8	0.2	0.7	0.2
BNZ2.5 pH10	0.6	0.0	3.0	0.1
Average	2.53	0.09	1.65	0.08
STD	3.70	0.10	1.22	0.08
BNZ1.4 H_2O	BDL	BDL	1.0	0.0
BNZ1.4 K_2SO_4	3.1	0.1	0.5	0.0
BNZ1.4 pH10	BDL	BDL	3.1	0.0
Average	3.10	0.05	1.54	0.02
STD			1.34	0.01

Table 1.8: Media Leachate Trace Metal Concentrations

Media leachate samples were obtained prior to NOM isolation and filtered to 0.45 μm
HNO_3 and analyzed by ICP-MS. Samples with the denoted with --- we not run for that m
limits and N/A are associated lack of error associated with BDL samples. **denote
concentrations observed above the calibration curve.

Al / 27 #3 ppb	Al / 27 #3 +/-	K / 39 #2 ppb	K / 39 #2 +/-	Ca / 43 #1 ppb	Ca / 43 #1 +/-	Ti / 47 #3 ppb
137.89	0.17	618.56	27.51	BDL	0.00	3.88
861.5	7.79	--	--	--	--	6.07
937.58	11.30	417.29	35.23	BDL	0.00	14.13
645.66	6.42	517.92	31.37			8.02
	5.69	142.32	5.46			5.40
70.18	0.12	BDL	0	210.43	4.01	1.36
775.37	11.77	--	--	--	--	1.84
562.46	4.96	--	--	--	--	BDL
469.34	5.61			210.43	4.01	1.60
361.70	5.85					0.34

Zn / 66 #3 ppb	Zn / 66 #3 +/-	As / 75 #2 ppb	As / 75 #2 +/-	Se / 82 #1 ppb	Se / 82 #1 +/-	Sr / 88 #3 ppb
BDL	0.00	2.65	0.09	0.38	0.09	4.24
21.69	0.71	2.68	0.20	11.35	1.42	82.36
BDL	0.00	3.86	0.15	0.18	0.03	0.77
21.69	0.24	3.07	0.14	3.97	0.51	29.13
		0.69	0.05	6.39	0.79	46.14
BDL	0.00	2.19	0.03	0.09	0.03	3.75
22.86	0.31	2.69	0.10	6.71	0.16	51.72
BDL	0.00	BDL	0.00	BDL	0.00	55.22
22.86	0.10	2.44	0.04	3.40	0.06	36.89
		0.35	0.05	4.68	0.09	28.76

filters and acidified to 2%
etal. BDL = below detection
:d samples are sample

Ti / 47 #3 +/-	V / 51 #2 ppb	V / 51 #2 +/-	Cr / 52 #2 ppb	Cr / 52 #2 +/-	Mn / 55 #3 ppb	Mn / 55 #3 +/-
0.1	11.9	0.2	0.4	0.0	3.5	0.0
0.2	4.5	0.1	3.4	0.0	65.1	0.4
0.1	29.7	0.5	1.1	0.0	1.2	0.0
0.14	15.34	0.24	1.65	0.02	23.25	0.15
0.07	12.96	0.21	1.54	0.01	36.24	0.23
0.08	5.66	0.03	0.12	0.01	0.82	0.01
1.8	2.2	0.1	1.3	0.0	26.2	0.4
0.2	BDL	0.1	BDL	0.0	50.2	0.0
0.69	3.91	0.05	0.69	0.02	25.75	0.15
1.00	2.47	0.02	0.81	0.02	24.70	0.26

Sr / 88 #3 +/-	Mo / 95 #3 ppb	Mo / 95 #3 +/-	Sb / 121 #3 ppb	Sb / 121 #3 +/-	Ba / 137 #3 ppb	Ba / 137 #3 +/-
0.03	0.10	0.00	0.30	0.00	2.95	0.01
0.34	26.43	1.11	0.45	0.01	226.79	1.25
0.01	0.18	0.00	0.44	0.00	2.86	0.01
0.13	8.90	0.37	0.40	0.00	77.53	0.42
0.19	15.18	0.64	0.09	0.00	129.26	0.71
0.02	0.03	0.00	0.17	0.00	0.51	0.01
0.29	10.82	0.48	0.19	0.00	94.62	0.15
0.00	3.72	0.00	0.13	0.01	27.47	0.02
0.11	4.86	0.16	0.16	0.00	40.87	0.06
0.16	5.48	0.27	0.03	0.00	48.46	0.08

Fe /56 #1 ppb	Fe / 56 #1 +/-	Co / 59 #3 ppb	Co / 59 #3 +/-
188.6	1.4	0.1	0.0
425.3	1.8	3.2	0.0
224.9	2.6	0.1	0.0
279.61	1.94	1.15	0.01
127.47	0.64	1.78	0.01
46.0	0.9	0.1	0.0
--	--	2.2	0.0
--	--	2.9	0.0
45.96	0.92	1.74	0.01
		1.47	0.01

Pb / 208 #3 ppb	Pb / 208 #3 +/-	Bi / 209 #3 ppb	Bi / 209 #3 +/-
0.17	0.00	0.32	0.01
0.46	0.03	0.31	0.00
0.29	0.00	0.33	0.00
0.30	0.01	0.32	0.01
0.15	0.01	0.01	0.00
BDL	0.00	BDL	0.00
BDL	0.00	BDL	0.00
BDL	0.00	BDL	0.00

Sample	190-220 ppm	190-160 ppm	160-140 ppm	140-120 ppm
BNZ1.4 Soil	0.83%	5.83%	4.06%	7.55%
BNZ1.4 H_2O NOM	0.97%	6.89%	7.33%	10.74%
Difference	**-0.14%**	**-1.06%**	**-3.27%**	**-3.19%**
BNZ1.4 Soil	0.83%	5.83%	4.06%	7.55%
BNZ1.4 K_2SO_4 NOM	1.76%	7.03%	5.12%	7.85%
Difference	**-0.93%**	**-1.19%**	**-1.06%**	**-0.30%**
BNZ1.4 Soil	0.83%	5.83%	4.06%	7.55%
BNZ1.4 pH10 NOM	0.92%	6.98%	6.54%	15.23%
Difference	**-0.09%**	**-1.15%**	**-2.48%**	**-7.68%**
BNZ2.5 Soil	0.95%	5.32%	4.61%	7.92%
BNZ2.5 H_2O NOM	1.49%	9.97%	7.27%	11.11%
Difference	**-0.54%**	**-4.65%**	**-2.66%**	**-3.19%**
BNZ2.5 Soil	0.95%	5.32%	4.61%	7.92%
BNZ2.5 K_2SO_4 NOM	1.62%	9.16%	6.87%	10.19%
Difference	**-0.67%**	**-3.84%**	**-2.26%**	**-2.28%**
BNZ2.5 Soil	0.95%	5.32%	4.61%	7.92%
BNZ2.5 pH10 NOM	1.26%	10.37%	8.27%	13.43%
Difference	**-0.31%**	**-5.05%**	**-3.66%**	**-5.52%**

Table 1.9: Media Leached Soil ^{13}C NMR Percentages

Unleached soil compared to leached soil NMR differences in binning percentages were formula MAS NMR analysis. Percentage determined based on area underneath the curve in specified alkyl-C, 45-60 ppm methoxyl, 60-90 ppm carbohydrates, 90-120 ppm proton substituted arom substituted aromatics, 140-160 ppm oxygen substituted aromatics, 160-190 ppm carboxyl/alipl aldehydes and ketones (Mao et al., 2012; Zhou et al., 2015; Kaiser et al., 2003). 90-160 ppm is

120-90 ppm	Sum 160-90 ppm	90-60 ppm	60-45 ppm	45-0 ppm
8.33%	19.93%	15.24%	7.97%	50.20%
18.38%	36.45%	27.93%	11.25%	16.50%
-10.05%	**-16.52%**	**-12.69%**	**-3.28%**	**33.70%**
8.33%	19.93%	15.24%	7.97%	50.20%
12.77%	25.73%	24.01%	9.55%	31.92%
-4.44%	**-5.80%**	**-8.77%**	**-1.58%**	**18.28%**
8.33%	19.93%	15.24%	7.97%	50.20%
14.93%	36.70%	21.13%	11.85%	22.42%
-6.61%	**-16.77%**	**-5.89%**	**-3.88%**	**27.78%**
10.63%	23.16%	16.86%	8.61%	45.11%
17.54%	35.91%	25.83%	9.52%	17.28%
-6.91%	**-12.75%**	**-8.97%**	**-0.91%**	**27.82%**
10.63%	23.16%	16.86%	8.61%	45.11%
16.26%	33.33%	24.67%	10.76%	20.47%
-5.63%	**-10.17%**	**-7.81%**	**-2.15%**	**24.64%**
10.63%	23.16%	16.86%	8.61%	45.11%
17.05%	38.76%	21.20%	9.47%	18.95%
-6.42%	**-15.60%**	**-4.35%**	**-0.86%**	**26.16%**

ated from solid state ^{13}C CP-
chemical shifts; 0-45 ppm
atics, 120-140 ppm carbon
hatic amides, 190-220 ppm
classified as total aromatics.

Sample	190-220 ppm	190-160 ppm	160-140 ppm	140-120 ppm	120-90 ppm
BNZ1.4 Soil	0.83%	5.83%	4.06%	7.55%	8.33%
BNZ2.5 Soil	0.95%	5.32%	4.61%	7.92%	10.63%
Average	**0.89%**	**5.58%**	**4.33%**	**7.73%**	**9.48%**
STD	**0.08%**	**0.36%**	**0.39%**	**0.26%**	**1.63%**
BNZ1.4 H_2O NO	0.97%	6.89%	7.33%	10.74%	18.38%
BNZ2.5 H_2O NO	1.49%	9.97%	7.27%	11.11%	17.54%
Average	**1.23%**	**8.43%**	**7.30%**	**10.92%**	**17.96%**
STD	**0.37%**	**2.18%**	**0.05%**	**0.26%**	**0.59%**
BNZ1.4 K_2SO_4 NO	1.76%	7.03%	5.12%	7.85%	12.77%
BNZ2.5 K_2SO_4 NO	1.62%	9.16%	6.87%	10.19%	16.26%
Average	**1.69%**	**8.09%**	**5.99%**	**9.02%**	**14.52%**
STD	**0.10%**	**1.51%**	**1.24%**	**1.66%**	**2.47%**
BNZ1.4 pH10 NO	0.92%	6.98%	6.54%	15.23%	14.93%
BNZ2.5 pH10 NO	1.26%	10.37%	8.27%	13.43%	17.05%
Average	**1.09%**	**8.67%**	**7.40%**	**14.33%**	**15.99%**
STD	**0.24%**	**2.40%**	**1.23%**	**1.27%**	**1.50%**
SRFA	2.03%	9.63%	6.71%	9.67%	15.90%
PLFA	0.44%	8.25%	5.26%	8.21%	9.58%

Table 1.10: Media Isolated NOM ^{13}C NMR Percentages

PPL isolated NOM NMR binning percentages for solid state ^{13}C CP-MAS NMR analysis. Percentage determined based on area underneath the curve in specified chemical shifts; 0-45 ppm alkyl-C, 45-60 ppm methoxyl, 60-90 ppm carbohydrates, 90-120 ppm proton substituted aromatics, 120-140 ppm carbon substituted aromatics, 140-160 ppm oxygen substituted aromatics, 160-190 ppm carboxyl/aliphatic amides, 190-220 ppm aldehydes and ketones (Mao et al., 2012; Zhou et al., 2015; Kaiser et al., 2003). 90-160 ppm is classified as total aromatics.

Sum 160-90 ppm	90-60 ppm	60-45 ppm	45-0 ppm
19.93%	15.24%	7.97%	50.20%
23.16%	16.86%	8.61%	45.11%
21.54%	**16.05%**	**8.29%**	**47.66%**
2.28%	**1.14%**	**0.45%**	**3.60%**
36.45%	27.93%	11.25%	16.50%
35.91%	25.83%	9.52%	17.28%
36.18%	**26.88%**	**10.38%**	**16.89%**
0.38%	**1.49%**	**1.22%**	**0.55%**
25.73%	24.01%	9.55%	31.92%
33.33%	24.67%	10.76%	20.47%
29.53%	**24.34%**	**10.15%**	**26.20%**
5.37%	**0.47%**	**0.86%**	**8.10%**
36.70%	21.13%	11.85%	22.42%
38.76%	21.20%	9.47%	18.95%
37.73%	**21.17%**	**10.66%**	**20.68%**
1.46%	**0.05%**	**1.69%**	**2.46%**
32.27%	20.40%	11.56%	24.11%
23.05%	16.83%	14.65%	36.79%

	8.4-6.5 ppm	4.5-3.2 ppm	3.2-1.6 ppm	1.6-0.6 ppm
BNZ1.4 H_2O	8.37%	47.46%	26.69%	17.48%
BNZ2.5 H_2O	10.21%	32.57%	35.50%	21.73%
Average	9.29%	40.02%	31.09%	19.60%
STD	**1.30%**	**10.53%**	**6.23%**	**3.00%**
BNZ1.4 K_2SO_4	6.62%	50.83%	22.24%	20.32%
BNZ2.5 K_2SO_4	9.42%	40.27%	29.72%	20.59%
Average	8.02%	45.55%	25.98%	20.45%
STD	**1.98%**	**7.47%**	**5.29%**	**0.19%**
BNZ1.4 pH10	11.57%	40.07%	31.80%	16.55%
BNZ2.5 pH10	12.09%	31.18%	36.54%	20.19%
Average	11.83%	35.62%	34.17%	18.37%
STD	**0.37%**	**6.29%**	**3.35%**	**2.57%**

Table 1.11: Media Isolated NOM ^{1}H NMR Percentages

1 mg of PPL isolated NOM reconstituted in 18 MΩ H_2O with a TSP/D_2O insert was run on a 600 MHz Bruker ^{1}H NMR with NMR SPR-WATERGATE water suppression technique. Percentages were obtained from the comparison of the area underneath of the spectra with specified chemical shifts; 0.6-1.6 ppm material derived from linear terpenoids (MDLT), 1.6-3.2 ppm carboxyl rich alicyclic molecules (CRAM), 3.2-4.5 ppm carbohydrates, and 6.5-8.4 ppm aromatics (Lam & Simpson, 2008).

Sample Name	Plain SF	Methanol SF	Iron SF	Plain Rate 254 nm
BNZ1.4	8.63E-01	8.60E-01	8.48E-01	2.14E-03
BNZ1.4 K_2SO_4	8.35E-01	9.60E-01	9.37E-01	6.87E-03
BNZ1.4 pH10	8.35E-01	8.29E-01	9.63E-01	2.77E-03
BNZ2.5	8.56E-01	8.58E-01	8.29E-01	1.95E-03
BNZ2.5 K_2SO_4	9.76E-01	9.76E-01	9.43E-01	6.67E-03
BNZ2.5 pH10	8.19E-01	8.18E-01	7.95E-01	1.97E-03
PLFA	9.07E-01	9.07E-01	8.79E-01	1.26E-03
SRFA	8.70E-01	8.66E-01	8.46E-01	1.09E-03

Table 1.12: Media isolated NOM Photolysis Rates with Rate Differences

Reconstituted of 10 mg C L^{-1} NOM in 18 MΩ H_2O and pH adjusted to circumneutral with the addition of chemical probes for photolysis experiments. Screening factors are included and determined from equation 2 and the •OH photolysis rates of decay (ROD) were determined based off of equation 1. The difference in unamended sample with amended sample is included with unamended versus iron (P-I) and unamended versus methanol (P-M). the absolute value of TMP ROD is the rate of production for $^3NOM^*$ through equation 3.

	Methanol		Iron		Plain -	
+/-	**Rate 254 nm**	**+/-**	**Rate 254 nm**	**+/-**	**Iron**	**+/-**
1.56E-04	1.84E-03	6.73E-04	3.79E-03	3.39E-04	-1.65E-03	3.73E-04
1.24E-03	5.41E-03	7.31E-05	1.21E-02	7.99E-04	-5.23E-03	1.47E-03
1.13E-04	1.91E-03	2.50E-04	4.71E-03	2.97E-03	-1.94E-03	2.97E-03
1.78E-05	1.64E-03	5.68E-05	7.57E-03	2.30E-04	-5.62E-03	2.31E-04
2.04E-04	4.50E-03	5.42E-04	1.08E-02	1.52E-03	-4.15E-03	1.53E-03
1.56E-04	1.40E-03	5.01E-05	5.56E-03	3.06E-04	-3.59E-03	3.44E-04
N/A	1.20E-03	N/A	1.53E-03	N/A	-2.75E-04	N/A
N/A	1.02E-03	N/A	1.77E-03	N/A	-6.84E-04	N/A

Plain - Methanol	+/-	^{3}NOM* Rate	+/-	R^2
3.05E-04	6.91E-04	3.84E-03	2.25E-04	9.82E-01
1.46E-03	1.24E-03	7.77E-03	5.91E-04	9.76E-01
8.64E-04	2.75E-04	5.25E-03	4.07E-04	9.67E-01
3.16E-04	5.96E-05	1.82E-03	1.65E-04	9.47E-01
2.17E-03	5.79E-04	2.33E-03	1.90E-04	9.66E-01
5.72E-04	1.64E-04	1.79E-03	3.21E-05	9.98E-01
5.71E-05	N/A	1.21E-03	7.31E-05	9.84E-01
6.52E-05	N/A	1.25E-03	9.13E-05	9.93E-01

Sample Name	Plain SF	Methanol SF	Iron SF	Plain Rate 254 nm	+/-
BNZ1.6	8.38E-01	8.42E-01	8.14E-01	1.64E-03	2.02E-04
BNZ1.5	8.42E-01	8.43E-01	8.20E-01	1.90E-03	1.21E-04
BNZ1.4	8.63E-01	8.60E-01	8.48E-01	2.14E-03	1.56E-04
BNZ1.3	8.58E-01	8.44E-01	8.58E-01	2.49E-03	1.10E-04
BNZ1.2	8.87E-01	8.86E-01	8.60E-01	1.60E-03	1.12E-04
BNZ1.1	9.05E-01	9.05E-01	8.78E-01	1.08E-03	9.09E-05
Average	**8.66E-01**	**8.63E-01**	**8.46E-01**	**1.81E-03**	**1.32E-04**
STD	**2.62E-02**	**2.64E-02**	**2.46E-02**	**4.87E-04**	**4.05E-05**
BNZ2.6	8.64E-01	8.64E-01	8.38E-01	2.33E-03	1.16E-04
BNZ2.5	8.56E-01	8.58E-01	8.29E-01	1.95E-03	1.78E-05
BNZ2.4	8.68E-01	8.69E-01	8.42E-01	2.49E-03	2.09E-04
BNZ2.3	8.68E-01	8.64E-01	8.36E-01	1.35E-03	8.43E-05
BNZ2.2	8.72E-01	8.70E-01	8.46E-01	1.40E-03	2.60E-04
Average	**8.66E-01**	**8.65E-01**	**8.38E-01**	**1.91E-03**	**1.37E-04**
STD	**6.34E-03**	**4.88E-03**	**6.43E-03**	**5.22E-04**	**9.72E-05**
CPC1.5	9.05E-01	9.06E-01	8.84E-01	1.71E-03	9.58E-05
CPC1.4	8.94E-01	8.94E-01	8.65E-01	1.65E-03	1.03E-04
CPC1.3	8.89E-01	8.89E-01	8.65E-01	2.27E-03	2.93E-04
CPC1.2	8.89E-01	8.90E-01	8.63E-01	2.34E-03	9.47E-05
Average	**8.94E-01**	**8.95E-01**	**8.69E-01**	**1.99E-03**	**1.47E-04**
STD	**7.68E-03**	**8.01E-03**	**9.92E-03**	**3.63E-04**	**9.76E-05**
CPC2.4	N/A	N/A	N/A	N/A	N/A
CPC2.3	8.93E-01	9.00E-01	8.66E-01	1.91E-03	1.07E-04
CPC2.2	N/A	N/A	N/A	N/A	N/A
Average	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
STD	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
PLFA	9.07E-01	9.07E-01	8.79E-01	1.26E-03	N/A
SRFA	8.70E-01	8.66E-01	8.46E-01	1.09E-03	N/A

Table 1.13: Optical Indices for Water Leachates

Optical indices of water leachate samples determined from UV-Vis spectrum and Fluorescence EEMs on a Horiba Fluorimeter in a 1 cm diameter quartz cuvette. Values are based on calculations found in Table 1.1 and 1.2.

Methanol		Iron		Plain -		Plain -
Rate 254 nm	+/-	Rate 254 nm	+/-	Iron	+/-	Methanol
1.52E-03	6.17E-05	2.15E-03	1.65E-04	-5.15E-04	2.61E-04	1.17E-04
1.38E-03	7.77E-05	2.19E-03	8.94E-05	-2.83E-04	1.50E-04	5.27E-04
1.84E-03	6.73E-04	3.79E-03	3.39E-04	-1.65E-03	3.73E-04	3.05E-04
1.97E-03	3.11E-04	2.56E-03	3.36E-04	-6.62E-05	3.54E-04	5.23E-04
1.24E-03	1.48E-04	2.24E-03	8.67E-05	-6.38E-04	1.41E-04	3.60E-04
1.00E-03	9.47E-05	2.17E-03	8.66E-05	-1.09E-03	1.26E-04	8.25E-05
1.49E-03	**2.28E-04**	**2.52E-03**	**1.84E-04**	**-7.06E-04**	**2.34E-04**	**3.19E-04**
3.65E-04	**2.36E-04**	**6.42E-04**	**1.23E-04**	**5.76E-04**	**1.11E-04**	**1.92E-04**
1.79E-03	1.51E-04	2.01E-03	2.61E-04	3.17E-04	2.86E-04	5.45E-04
1.64E-03	5.68E-05	7.57E-03	2.30E-04	-5.62E-03	2.31E-04	3.16E-04
1.97E-03	3.66E-05	2.30E-03	1.95E-04	1.89E-04	2.86E-04	5.22E-04
1.11E-03	3.22E-06	1.62E-03	1.00E-04	-2.74E-04	1.31E-04	2.44E-04
1.42E-03	1.50E-04	1.57E-03	7.30E-05	-1.73E-04	2.70E-04	-2.01E-05
1.58E-03	**7.96E-05**	**3.02E-03**	**1.72E-04**	**-1.11E-03**	**2.41E-04**	**3.21E-04**
3.35E-04	**6.76E-05**	**2.56E-03**	**8.20E-05**	**2.53E-03**	**6.53E-05**	**2.31E-04**
1.47E-03	9.45E-05	2.38E-03	2.50E-04	-6.73E-04	2.68E-04	2.37E-04
1.65E-03	1.19E-04	2.18E-03	4.08E-05	-5.26E-04	1.11E-04	3.99E-06
1.81E-03	1.07E-04	2.23E-03	3.12E-07	4.31E-05	2.93E-04	4.61E-04
1.71E-03	9.56E-05	3.03E-03	3.34E-04	-6.95E-04	3.48E-04	6.32E-04
1.66E-03	**1.04E-04**	**2.46E-03**	**1.56E-04**	**-4.63E-04**	**2.55E-04**	**3.34E-04**
1.44E-04	**1.17E-05**	**3.94E-04**	**1.61E-04**	**3.46E-04**	**1.02E-04**	**2.73E-04**
N/A	N/A	N/A	N/A	N/A	N/A	N/A
1.72E-03	2.61E-04	2.20E-03	1.42E-04	-2.89E-04	1.78E-04	1.91E-04
N/A	N/A	N/A	N/A	N/A	N/A	N/A
N/A	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
N/A	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
1.20E-03	N/A	1.53E-03	N/A	-2.75E-04	N/A	5.71E-05
1.02E-03	N/A	1.77E-03	N/A	-6.84E-04	N/A	6.52E-05

	^{3}NOM*		
+/-	**Rate**	**+/-**	**R^2**
2.11E-04	1.31E-03	1.84E-04	8.99E-01
1.44E-04	1.35E-03	8.35E-05	9.79E-01
6.91E-04	3.84E-03	2.25E-04	9.82E-01
3.30E-04	1.39E-03	1.44E-04	9.44E-01
1.85E-04	7.90E-04	1.13E-04	9.07E-01
1.31E-04	9.51E-04	6.64E-05	9.77E-01
2.82E-04	**1.60E-03**	**1.36E-04**	
2.12E-04	**1.12E-03**	**6.07E-05**	
1.90E-04	1.91E-03	1.68E-04	9.51E-01
5.96E-05	1.82E-03	1.65E-04	9.47E-01
2.12E-04	1.69E-03	1.21E-04	9.67E-01
8.44E-05	2.66E-03	2.07E-04	9.61E-01
3.01E-04	1.77E-03	8.61E-05	9.85E-01
1.69E-04	**1.97E-03**	**1.49E-04**	
9.84E-05	**3.93E-04**	**4.65E-05**	
1.35E-04	2.43E-03	1.24E-04	9.84E-01
1.58E-04	2.01E-03	1.26E-04	9.81E-01
3.12E-04	2.10E-03	1.47E-04	9.70E-01
1.35E-04	2.75E-03	1.94E-04	9.69E-01
1.85E-04	**2.32E-03**	**1.48E-04**	
8.56E-05	**3.35E-04**	**3.28E-05**	
N/A	2.52E-03*	2.76E-04	9.43E-01
2.82E-04	2.54E-03	1.16E-04	9.87E-01
N/A	7.05E-04*	4.82E-05	9.77E-01
N/A	**1.92E-03**	**1.47E-04**	
N/A	**1.28E-03**	**1.17E-04**	
N/A	1.21E-03	7.31E-05	9.84E-01
N/A	1.25E-03	9.13E-05	9.93E-01

	Na / 23 #2 mg	Na / 23 #2 +/-	Mg / 24 #2 mg	Mg / 24 #2 +/-	Al / 27 #3 mg
BNZ1.6	6188.1	106.6	330.0	8.5	62.7
BNZ1.5	6189.1	37.4	399.2	5.8	59.4
BNZ1.4	86.9	27.2	197.1	6.0	70.2
BNZ1.3	6316.2	54.2	282.2	11.0	73.4
BNZ1.2	6306.6	82.3	612.2	16.5	184.4
BNZ1.1	6180.3	46.4	775.9	8.3	65.4
Average	5211.2	59.0	432.7	9.3	85.9
STD	2511.1	29.9	219.0	4.0	48.5
BNZ2.6	BDL	N/A	335.1	8.6	87.1
BNZ2.5	BDL	N/A	246.4	12.9	137.9
BNZ2.4	5386.8	48.1	262.0	9.7	59.5
BNZ2.3	BDL	N/A	307.7	6.3	95.9
BNZ2.2	BDL	N/A	350.9	12.8	196.9
BNZ2.1	BDL	N/A	708.9	6.1	134.2
Average	5386.8	48.1	368.5	9.4	118.6
STD			171.6	3.0	48.5
CPC1.5	BDL	N/A	181.3	5.8	51.7
CPC1.4	BDL	N/A	111.3	2.0	49.1
CPC1.3	BDL	N/A	100.5	3.9	44.8
CPC1.2	BDL	N/A	95.2	1.7	49.3
Average			122.1	3.4	48.7
STD			40.1	1.9	2.9
CPC2.4	BDL	N/A	155.3	5.9	101.1
CPC2.3	BDL	N/A	BDL	N/A	62.7
CPC2.2	BDL	N/A	BDL	N/A	50.9
Average			155.3	5.9	71.6
STD					26.2

	Ni / 60 #2 mg	Ni / 60 #2 +/-	Cu / 63 #2 mg	Cu / 63 #2 +/-	Zn / 66 #3 mg
BNZ1.6	BDL	N/A	1.5	0.0	BDL
BNZ1.5	BDL	N/A	1.1	0.2	35.8
BNZ1.4	BDL	N/A	1.0	0.0	BDL
BNZ1.3	BDL	N/A	1.1	0.0	BDL
BNZ1.2	BDL	N/A	1.1	0.0	BDL

BNZ1.1	0.5	0.0	1.0	0.0	1.3
Average	0.5	0.0	1.2	0.1	18.6
STD			0.2	0.1	24.4
BNZ2.6	BDL	N/A	0.9	0.0	BDL
BNZ2.5	0.2	0.0	1.2	0.0	BDL
BNZ2.4	BDL	N/A	0.8	0.0	BDL
BNZ2.3	BDL	N/A	1.1	0.1	BDL
BNZ2.2	0.3	0.0	1.3	0.0	BDL
BNZ2.1	0.9	0.0	0.7	0.0	1.6
Average	0.5	0.0	1.0	0.0	1.6
STD	0.4	0.0	0.2	0.0	
CPC1.5	2.0	0.1	1.8	0.0	BDL
CPC1.4	0.2	0.0	1.5	0.0	0.5
CPC1.3	BDL	N/A	1.6	0.1	0.8
CPC1.2	BDL	N/A	0.7	0.0	0.3
Average	1.1	0.0	1.4	0.0	0.6
STD	1.3	0.0	0.5	0.0	0.3
CPC2.4	0.4	0.0	1.7	0.0	8.1
CPC2.3	0.3*	0.0	BDL	N/A	BDL
CPC2.2	BDL	N/A	BDL	N/A	BDL
Average	0.4	0.0	1.7	0.0	8.1
STD		0.0			

Table 1.14: Trace Metal Concentrations for Water Leachates

Water leachate samples were obtained prior to NOM isolation and filtered to 0.45 μm filters and acidified to 2% HNO_3 and analyzed by ICP-MS. Samples with the denoted with --- we not run for that metal. BDL = below detection limits and N/A are associated lack of error associated with BDL samples. *denotes samples NIST or SLRS did not pass during run time.

Al / 27 #3 +/-	K / 39 #2 mg	K / 39 #2 +/-	Ca / 43 #1 mg	Ca / 43 #1 +/-	Ti / 47 #3 mg	Ti / 47 #3 +/-
0.1	675.4	36.5	BDL	N/A	2.7	0.1
0.0	624.9	74.5	525.9	111.0	2.1	0.0
0.1	BDL	N/A	210.4	4.0	1.4	0.1
0.0	632.0	22.6	BDL	N/A	2.5	0.0
0.1	646.9	32.1	264.6	50.4	4.5	0.1
0.0	1120.6	33.4	2100.6	132.0	1.9	0.0
0.1	739.9	39.8	775.4	74.3	2.5	0.1
0.0	213.6	20.1	894.2	58.3	1.1	0.0
1.0	189.5	20.9	BDL	N/A	3.9	0.1
0.2	618.6	27.5	BDL	N/A	3.9	0.1
0.0	294.3	36.6	BDL	N/A	2.7	0.1
0.0	50.5	37.3	BDL	N/A	3.6	0.2
0.5	200.8	31.1	BDL	N/A	5.8	0.1
4.6	1557.8	22.9	988.5	44.7	3.8	0.1
1.1	485.2	29.4	988.5	44.7	4.0	0.1
1.8	558.9	6.8			1.0	0.1
2.0	154.4	29.6	BDL	N/A	2.1	0.1
0.4	152.5	24.8	BDL	N/A	1.1	0.1
2.6	82.2	43.8	BDL	N/A	0.7	0.1
0.2	BDL	N/A	BDL	N/A	0.6	0.1
1.3	129.7	32.7			1.1	0.1
1.2	41.1	9.9			0.7	0.0
3.1	BDL	N/A	BDL	N/A	0.5	0.1
0.2	BDL	N/A	BDL	N/A	1.0	0.0
0.0	BDL	N/A	BDL	N/A	0.6	0.0
1.1					0.7	0.0
1.7					0.3	0.0

Zn / 66 #3 +/-	As / 75 #2 mg	As / 75 #2 +/-	Se / 82 #1 mg	Se / 82 #1 +/-	Sr / 88 #3 mg	Sr / 88 #3 +/-
N/A	1.1	0.0	BDL	N/A	3.4	0.0
0.0	2.1	0.0	0.0	0.0	4.6	0.0
N/A	2.2	0.0	0.1	0.0	3.7	0.0
N/A	1.5	0.0	BDL	N/A	3.8	0.0
N/A	3.0	0.0	0.2	0.1	9.8	0.0

0.2	9.2	0.0	0.5	0.1	13.1	0.0
0.1	3.2	0.0	0.2	0.0	6.4	0.0
0.1	3.0	0.0	0.2	0.0	4.1	0.0
N/A	4.3	0.1	0.2	0.0	4.9	0.0
N/A	2.7	0.1	0.4	0.1	4.2	0.0
N/A	2.7	0.0	BDL	N/A	3.4	0.0
N/A	2.9	0.0	0.1	0.1	4.9	0.0
N/A	2.7	0.1	0.1	0.0	6.9	0.0
0.2	4.7	0.1	0.1	0.0	11.8	0.4
0.2	3.3	0.1	0.2	0.0	6.0	0.1
	0.9	0.1	0.1	0.0	3.1	0.2
N/A	3.4	0.1	0.3	0.0	6.3	0.1
0.0	2.2	0.0	0.2	0.0	5.2	0.1
0.1	0.5	0.0	0.4	0.0	3.0	0.1
0.0	0.2	0.0	BDL	N/A	2.7	0.0
0.1	1.6	0.0	0.3	0.0	4.3	0.1
0.0	1.5	0.1	0.1	0.0	1.7	0.1
0.2	0.5	0.0	BDL	N/A	3.4	0.1
N/A	3.8	0.1	0.2	0.0	4.8	0.0
N/A	0.5	0.0	BDL	N/A	2.3	0.0
0.2	1.6	0.1	0.2	0.0	3.5	0.0
	1.9	0.1			1.3	0.0

V / 51 #2 mg	V / 51 #2 +/-	Cr / 52 #2 mg	Cr / 52 #2 +/-	Mn / 55 #3 mg	Mn / 55 #3 +/-	Fe /56 #1 mg
5.6	0.0	0.6	0.0	3.9	0.0	52.6
7.6	0.0	0.4	0.0	3.7	0.0	30.0
5.7	0.0	0.1	0.0	0.8	0.0	46.0
8.2	0.0	0.2	0.0	0.3	0.0	35.0
12.6	0.0	0.2	0.0	2.2	0.0	105.8
1.9	0.0	0.1	0.0	90.8	0.0	261.2
6.9	0.0	0.3	0.0	16.9	0.0	88.4
3.5	0.0	0.2	0.0	36.2	0.0	88.9
19.1	0.1	0.4	0.0	5.8	0.1	66.1
11.9	0.2	0.4	0.0	3.5	0.0	188.6
12.3	0.0	0.1	0.0	1.8	0.0	BDL
15.1	0.0	0.1	0.0	1.3	0.0	21.0
9.9	0.1	0.3	0.0	0.5	0.0	99.8
3.6	0.1	1.8	0.1	42.8	1.3	197.6
12.0	0.1	0.5	0.0	9.3	0.2	114.6
5.2	0.1	0.6	0.0	16.5	0.5	77.0
4.0	0.1	3.6	0.1	60.3	1.2	147.3
5.0	0.1	0.3	0.0	105.9	1.4	141.0
1.5	0.1	0.2	0.0	41.6	1.5	40.0
0.2	0.0	0.1	0.0	29.1	0.4	31.3
2.7	0.1	1.1	0.0	59.2	1.1	89.9
2.2	0.0	1.7	0.0	33.7	0.5	62.8
0.3	0.0	0.3	0.0	20.4	1.5	106.5
3.5	0.0	0.7	0.0	47.3	0.2	131.1
0.5	0.0	BDL	0.0	24.2	0.1	96.8
1.4	0.0	0.5	0.0	30.6	0.6	111.5
1.8	0.0	0.2	0.0	14.6	0.8	17.7

Mo / 95 #3 mg	Mo / 95 #3 +/-	Sb / 121 #3 mg	Sb / 121 #3 +/-	Ba / 137 #3 mg	Ba / 137 #3 +/-	Pb / 208 #3 mg
0.2	0.0	0.1	0.0	1.6*	0.0	BDL
0.1	0.0	0.2	0.0	1.7*	0.0	BDL
0.0	0.0	0.2	0.0	0.5	0.0	BDL
0.0	0.0	0.2	0.0	1.6	0.0	BDL
0.1	0.0	0.2	0.0	4.1	0.0	BDL

1.0	0.0	0.2	0.0	4.4	0.0	BDL
0.3	0.0	0.2	0.0	2.3	0.0	
0.4	0.0	0.0	0.0	1.9	0.0	
0.4	0.0	0.5	0.0	2.1	0.0	0.1
0.1	0.0	0.3	0.0	2.9	0.0	0.2
0.1	0.0	0.4	0.0	1.7*	0.0	BDL
0.1	0.0	0.3	0.1	2.4*	0.0	BDL
0.1	0.0	0.2	0.0	3.7	0.0	0.1
0.4	0.0	0.1	0.0	4.0	0.1	0.2
0.2	0.0	0.3	0.0	2.8	0.0	
0.2	0.0	0.1	0.0	0.9	0.1	
0.5	0.0	0.1	0.0	3.8	0.1	0.1
0.3	0.0	0.1	0.0	3.6	0.0	0.0
0.1	0.0	0.0	0.0	2.1	0.1	0.1
0.0	0.0	BDL	N/A	1.8	0.0	0.0
0.2	0.0	0.1	0.0	2.8	0.1	0.1
0.2	0.0	0.0	0.0	1.0	0.0	0.0
0.1	0.0	0.0	0.0	2.7	0.1	0.1
0.5	0.0	0.2	0.0	3.8	0.0	0.0
0.1	0.0	0.1	0.0	4.0	0.0	0.0
0.2	0.0	0.1	0.0	3.5	0.0	0.0
0.2	0.0	0.1	0.0	0.7	0.0	0.0

Fe / 56 #1 +/-	Co / 59 #3 mg	Co / 59 #3 +/-
0.8	0.1	0.0
0.1	0.1	0.0
0.9	0.1	0.0
0.7	0.1	0.0
1.8	0.2	0.0
3.2	1.0	0.0
1.3	0.3	0.0
1.1	0.4	0.0
1.5	0.1	0.0
1.4	0.1	0.0
N/A	0.1	0.0
0.8	0.2	0.0
6.7	0.2	0.0
2.7	0.4	0.0
2.6	0.2	0.0
2.4	0.1	0.0
5.4	0.5	0.0
2.0	0.6	0.0
1.5	0.5	0.0
1.4	0.3	0.0
2.6	0.4	0.0
1.9	0.1	0.0
1.6	0.3	0.0
6.9	0.3*	0.0
6.2	0.2*	0.0
4.9	0.3	0.0
2.9		0.0

Pb / 208 #3 +/-	Bi / 209 #3 mg	Bi / 209 #3 +/-
N/A	0.0*	116.6
N/A	0.1*	15.4
N/A	BDL	N/A
N/A	0.2	70.0
N/A	0.1	152.9

N/A	0.1	190.3
	0.1	109.0
	0.1	68.7
0.0	0.1	0.0
0.0	0.3	0.0
N/A	0.1*	49.6
N/A	0.1*	300.4
0.0	0.1	0.0
0.0	0.1	0.0
	0.1	58.3
	0.1	120.2
0.0	0.1	0.0
0.0	BDL	N/A
0.0	0.1	0.0
0.0	BDL	N/A
0.0	0.1	0.0
0.0	0.0	0.0
0.0	0.1	0.0
0.0	BDL	N/A
0.0	BDL	N/A
0.0	0.1	0.0
0.0		

Sample Name	190-220 ppm	190-160 ppm	160-140 ppm	140-120 ppm	120-90 ppm
BNZ1.6	0.32%	7.42%	7.07%	11.02%	19.92%
BNZ1.5	0.82%	9.24%	7.77%	11.25%	17.92%
BNZ1.4	0.97%	6.89%	7.33%	10.74%	18.38%
BNZ1.3	0.32%	9.83%	8.83%	13.02%	18.83%
BNZ1.2	1.80%	8.84%	6.62%	8.56%	17.27%
BNZ1.1	0.95%	6.33%	5.30%	6.69%	15.77%
Average	**0.86%**	**8.09%**	**7.15%**	**10.21%**	**18.02%**
STD	**0.55%**	**1.41%**	**1.18%**	**2.24%**	**1.42%**
BNZ2.6	1.98%	10.93%	8.23%	11.54%	16.98%
BNZ2.5	1.49%	9.97%	7.27%	11.11%	17.54%
BNZ2.4	0.95%	9.09%	7.11%	10.20%	18.02%
BNZ2.3	0.63%	8.95%	7.71%	10.92%	18.80%
BNZ2.2	1.93%	6.16%	4.88%	7.64%	17.77%
Average	**1.40%**	**9.02%**	**7.04%**	**10.28%**	**17.82%**
STD	**0.59%**	**1.78%**	**1.28%**	**1.55%**	**0.67%**
CPC1.5	2.36%	11.66%	6.84%	8.96%	17.85%
CPC1.4	2.06%	10.90%	6.97%	8.81%	18.64%
CPC1.3	1.64%	11.38%	7.22%	9.15%	18.25%
CPC1.2	1.61%	10.72%	7.04%	8.42%	18.94%
Average	**1.92%**	**11.16%**	**7.02%**	**8.83%**	**18.42%**
STD	**0.36%**	**0.43%**	**0.16%**	**0.31%**	**0.48%**
CPC2.4	1.41%	10.30%	7.14%	11.43%	16.82%
CPC2.3	0.18%	8.54%	6.52%	8.43%	17.55%
CPC2.2	2.19%	7.90%	7.04%	9.62%	17.49%
Average	**1.26%**	**8.91%**	**6.90%**	**9.83%**	**17.29%**
STD	**1.01%**	**1.24%**	**0.34%**	**1.51%**	**0.41%**
PLFA	0.44%	8.25%	5.26%	8.21%	9.58%
SRFA	2.03%	9.63%	6.71%	9.67%	15.90%

Table 1.15: Water Isolated NOM ^{13}C NMR Percentages

PPL isolated NOM NMR binning percentages for solid state ^{13}C CP-MAS NMR analysis. Percentage determined based on area underneath the curve in specified chemical shifts; 0-45 ppm alkyl-C, 45-60 ppm methoxyl, 60-90 ppm carbohydrates, 90-120 ppm proton substituted aromatics, 120-140 ppm carbon substituted aromatics, 140-160 ppm oxygen substituted aromatics, 160-190 ppm carboxyl/aliphatic amides,

ım 160-90 pp	90-60 ppm	60-45 ppm	45-0 ppm
38.01%	28.02%	10.64%	15.60%
36.94%	21.59%	10.15%	21.27%
36.45%	27.93%	11.25%	16.50%
40.68%	22.02%	9.97%	17.18%
32.45%	33.29%	8.35%	15.26%
27.76%	29.69%	10.08%	25.19%
35.38%	**27.09%**	**10.07%**	**18.50%**
4.59%	**4.53%**	**0.97%**	**3.92%**
36.75%	23.45%	9.02%	17.88%
35.91%	25.83%	9.52%	17.28%
35.33%	25.85%	9.22%	19.55%
37.44%	26.78%	9.38%	16.83%
30.29%	35.14%	9.37%	17.10%
35.15%	**27.41%**	**9.30%**	**17.73%**
2.83%	**4.50%**	**0.19%**	**1.09%**
33.64%	29.75%	8.16%	14.42%
34.42%	29.82%	8.24%	14.56%
34.62%	28.83%	8.52%	15.01%
34.40%	30.32%	8.29%	14.66%
34.27%	**29.68%**	**8.30%**	**14.66%**
0.43%	**0.62%**	**0.15%**	**0.25%**
35.39%	25.99%	9.71%	17.20%
32.50%	34.23%	9.37%	15.18%
34.16%	20.38%	13.46%	21.90%
34.01%	**26.87%**	**10.85%**	**18.09%**
1.45%	**6.97%**	**2.27%**	**3.45%**
31.30%	16.83%	14.65%	36.79%
41.90%	20.40%	11.56%	24.11%

Sample Name	0.6-1.6 ppm	1.6-3.2 ppm	3.2-4.5 ppm	6.5-8.4 ppm
BNZ1.6	20.05%	30.68%	33.63%	15.64%
BNZ1.5	22.18%	37.65%	28.81%	11.36%
BNZ1.4	17.48%	26.69%	47.46%	8.37%
BNZ1.3	18.20%	38.90%	31.13%	11.77%
BNZ1.2	22.87%	27.36%	40.01%	9.76%
BNZ1.1	21.98%	24.22%	44.64%	9.16%
Average	**20.46%**	**30.92%**	**37.61%**	**11.01%**
STD	**2.24%**	**6.08%**	**7.58%**	**2.61%**
BNZ2.6	24.83%	36.05%	29.75%	9.37%
BNZ2.5	20.30%	31.18%	33.20%	15.32%
BNZ2.4	20.23%	32.36%	35.61%	11.80%
BNZ2.3	20.86%	27.97%	42.75%	8.42%
BNZ2.2	26.07%	25.53%	42.02%	6.37%
Average	**22.46%**	**30.62%**	**36.67%**	**10.25%**
STD	**2.78%**	**4.05%**	**5.63%**	**3.44%**
CPC1.5	17.49%	29.93%	44.04%	8.54%
CPC1.4	17.64%	28.73%	42.76%	10.86%
CPC1.3	18.02%	29.89%	43.56%	8.53%
CPC1.2	20.87%	31.41%	43.56%	4.15%
Average	**18.51%**	**29.99%**	**43.48%**	**8.02%**
STD	**1.59%**	**1.10%**	**0.53%**	**2.80%**
CPC2.4	18.79%	35.06%	36.37%	9.79%
CPC2.3	17.23%	30.00%	43.87%	8.89%
CPC2.2	11.07%	17.79%	56.26%	14.88%
Average	**15.70%**	**27.62%**	**45.50%**	**11.19%**
STD	**4.08%**	**8.88%**	**10.05%**	**3.23%**
PLFA	7.66%	16.68%	46.09%	29.57%
SRFA	10.28%	24.72%	43.85%	21.15%

Table 1.16: Water Isolated NOM ^{1}H NMR Percentages

1 mg of PPL isolated NOM reconstituted in 18 MΩ H_2O with a TSP/D_2O insert was run on a 600 MHz Bruker ^{1}H NMR with NMR SPR-WATERGATE water suppression technique. Percentages were obtained from the comparison of the area underneath of the spectra with specified chemical shifts: 0.6-1.6 ppm material derived from linear

	Iron ppb	+/-
GSL Epi.	1255.7	1616.4
GSL Hypo.	3331.5	1696.0
OCT Epi.	5478.1	5737.8
OCT Hypo.	8011.5	5549.6
DNL Epi.	513.4	612.7
DNL Hypo.	739.6	589.6
GSBA	889.7	454.6
GSSC	1055.6	241.0
OCC	621.1	296.4

Table 1.17: Iron Concentrations from Surface Water

Average surface water iron concentrations collected over a three-year seasonality study from surface waters in a near-by watershed. Iron concentrations were determined through ICPMS analysis. +/- is the error determined through standard deviation from the average. Further, information and analysis of these samples can be found in Gagné, Section 3.3.2. and 3.4.3

Sample Name	Plain SF	Methanol SF	Iron SF	Plain Rate 254 nm	+/-
BNZ1.6	8.38E-01	8.42E-01	8.14E-01	1.64E-03	2.02E-04
BNZ1.5	8.42E-01	8.43E-01	8.20E-01	1.90E-03	1.21E-04
BNZ1.4	8.63E-01	8.60E-01	8.48E-01	2.14E-03	1.56E-04
BNZ1.3	8.58E-01	8.44E-01	8.58E-01	2.49E-03	1.10E-04
BNZ1.2	8.87E-01	8.86E-01	8.60E-01	1.60E-03	1.12E-04
BNZ1.1	9.05E-01	9.05E-01	8.78E-01	1.08E-03	9.09E-05
Average	**8.66E-01**	**8.63E-01**	**8.46E-01**	**1.81E-03**	**1.32E-04**
STD	**2.62E-02**	**2.64E-02**	**2.46E-02**	**4.87E-04**	**4.05E-05**
BNZ2.6	8.64E-01	8.64E-01	8.38E-01	2.33E-03	1.16E-04
BNZ2.5	8.56E-01	8.58E-01	8.29E-01	1.95E-03	1.78E-05
BNZ2.4	8.68E-01	8.69E-01	8.42E-01	2.49E-03	2.09E-04
BNZ2.3	8.68E-01	8.64E-01	8.36E-01	1.35E-03	8.43E-05
BNZ2.2	8.72E-01	8.70E-01	8.46E-01	1.40E-03	2.60E-04
Average	**8.66E-01**	**8.65E-01**	**8.38E-01**	**1.91E-03**	**1.37E-04**
STD	**6.34E-03**	**4.88E-03**	**6.43E-03**	**5.22E-04**	**9.72E-05**
CPC1.5	9.05E-01	9.06E-01	8.84E-01	1.71E-03	9.58E-05
CPC1.4	8.94E-01	8.94E-01	8.65E-01	1.65E-03	1.03E-04
CPC1.3	8.89E-01	8.89E-01	8.65E-01	2.27E-03	2.93E-04
CPC1.2	8.89E-01	8.90E-01	8.63E-01	2.34E-03	9.47E-05
Average	**8.94E-01**	**8.95E-01**	**8.69E-01**	**1.99E-03**	**1.47E-04**
STD	**7.68E-03**	**8.01E-03**	**9.92E-03**	**3.63E-04**	**9.76E-05**
CPC2.4	N/A	N/A	N/A	N/A	N/A
CPC2.3	8.93E-01	9.00E-01	8.66E-01	1.91E-03	1.07E-04
CPC2.2	N/A	N/A	N/A	N/A	N/A
Average	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
STD	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
PLFA	9.07E-01	9.07E-01	8.79E-01	1.26E-03	N/A
SRFA	8.70E-01	8.66E-01	8.46E-01	1.09E-03	N/A

Table 1.18: Hydroxyl Radical Photolysis Rates of Absorbance Decay with Rate Differe

Reconstituted of 10 mg C L^{-1} NOM in 18 MΩ H_2O and pH adjusted to circumneutral with the additio
probes for photolysis experiments. Screening factors are included and determined from equation 2 a

Methanol		Iron		Plain -		Plain -
Rate 254 nm	+/-	Rate 254 nm	+/-	Iron	+/-	Methanol
1.52E-03	6.17E-05	2.15E-03	1.65E-04	-5.15E-04	2.61E-04	1.17E-04
1.38E-03	7.77E-05	2.19E-03	8.94E-05	-2.83E-04	1.50E-04	5.27E-04
1.84E-03	6.73E-04	3.79E-03	3.39E-04	-1.65E-03	3.73E-04	3.05E-04
1.97E-03	3.11E-04	2.56E-03	3.36E-04	-6.62E-05	3.54E-04	5.23E-04
1.24E-03	1.48E-04	2.24E-03	8.67E-05	-6.38E-04	1.41E-04	3.60E-04
1.00E-03	9.47E-05	2.17E-03	8.66E-05	-1.09E-03	1.26E-04	8.25E-05
1.49E-03	**2.28E-04**	**2.52E-03**	**1.84E-04**	**-7.06E-04**	**2.34E-04**	**3.19E-04**
3.65E-04	**2.36E-04**	**6.42E-04**	**1.23E-04**	**5.76E-04**	**1.11E-04**	**1.92E-04**
1.79E-03	1.51E-04	2.01E-03	2.61E-04	3.17E-04	2.86E-04	5.45E-04
1.64E-03	5.68E-05	7.57E-03	2.30E-04	-5.62E-03	2.31E-04	3.16E-04
1.97E-03	3.66E-05	2.30E-03	1.95E-04	1.89E-04	2.86E-04	5.22E-04
1.11E-03	3.22E-06	1.62E-03	1.00E-04	-2.74E-04	1.31E-04	2.44E-04
1.42E-03	1.50E-04	1.57E-03	7.30E-05	-1.73E-04	2.70E-04	-2.01E-05
1.58E-03	**7.96E-05**	**3.02E-03**	**1.72E-04**	**-1.11E-03**	**2.41E-04**	**3.21E-04**
3.35E-04	**6.76E-05**	**2.56E-03**	**8.20E-05**	**2.53E-03**	**6.53E-05**	**2.31E-04**
1.47E-03	9.45E-05	2.38E-03	2.50E-04	-6.73E-04	2.68E-04	2.37E-04
1.65E-03	1.19E-04	2.18E-03	4.08E-05	-5.26E-04	1.11E-04	3.99E-06
1.81E-03	1.07E-04	2.23E-03	3.12E-07	4.31E-05	2.93E-04	4.61E-04
1.71E-03	9.56E-05	3.03E-03	3.34E-04	-6.95E-04	3.48E-04	6.32E-04
1.66E-03	**1.04E-04**	**2.46E-03**	**1.56E-04**	**-4.63E-04**	**2.55E-04**	**3.34E-04**
1.44E-04	**1.17E-05**	**3.94E-04**	**1.61E-04**	**3.46E-04**	**1.02E-04**	**2.73E-04**
N/A	N/A	N/A	N/A	N/A	N/A	N/A
1.72E-03	2.61E-04	2.20E-03	1.42E-04	-2.89E-04	1.78E-04	1.91E-04
N/A	N/A	N/A	N/A	N/A	N/A	N/A
N/A	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
N/A	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
1.20E-03	N/A	1.53E-03	N/A	-2.75E-04	N/A	5.71E-05
1.02E-03	N/A	1.77E-03	N/A	-6.84E-04	N/A	6.52E-05

nces

n of chemical
ınd the •OH

+/-	^{3}NOM* Rate	+/-	R^2
2.11E-04	1.31E-03	1.84E-04	8.99E-01
1.44E-04	1.35E-03	8.35E-05	9.79E-01
6.91E-04	3.84E-03	2.25E-04	9.82E-01
3.30E-04	1.39E-03	1.44E-04	9.44E-01
1.85E-04	7.90E-04	1.13E-04	9.07E-01
1.31E-04	9.51E-04	6.64E-05	9.77E-01
2.82E-04	**1.60E-03**	**1.36E-04**	
2.12E-04	**1.12E-03**	**6.07E-05**	
1.90E-04	1.91E-03	1.68E-04	9.51E-01
5.96E-05	1.82E-03	1.65E-04	9.47E-01
2.12E-04	1.69E-03	1.21E-04	9.67E-01
8.44E-05	2.66E-03	2.07E-04	9.61E-01
3.01E-04	1.77E-03	8.61E-05	9.85E-01
1.69E-04	**1.97E-03**	**1.49E-04**	
9.84E-05	**3.93E-04**	**4.65E-05**	
1.35E-04	2.43E-03	1.24E-04	9.84E-01
1.58E-04	2.01E-03	1.26E-04	9.81E-01
3.12E-04	2.10E-03	1.47E-04	9.70E-01
1.35E-04	2.75E-03	1.94E-04	9.69E-01
1.85E-04	**2.32E-03**	**1.48E-04**	
8.56E-05	**3.35E-04**	**3.28E-05**	
N/A	2.52E-03*	2.76E-04	9.43E-01
2.82E-04	2.54E-03	1.16E-04	9.87E-01
N/A	7.05E-04*	4.82E-05	9.77E-01
N/A	**1.92E-03**	**1.47E-04**	
N/A	**1.28E-03**	**1.17E-04**	
N/A	1.21E-03	7.31E-05	9.84E-01
N/A	1.25E-03	9.13E-05	9.93E-01

Year Range	Cores	% Difference Between Cores
1,400 - 1,460 Years	*CPC1.4 vs. CPC2.4*	22.4%
5,990 - 6,270 years	*BNZ1.4 vs BNZ2.4*	78.0%
6,630 - 6,880 years	*BNZ1.5 vs BNZ2.5*	30.1%
7,160 - 7,200 years	*BNZ1.6 vs BNZ2.6*	37.4%

Table 1.19: ^{3}NOM* Photolysis Rates Compared with Age

Percent difference of ^{3}NOM* photolysis rates were determined between cores in the same watershed at complimentary carbon ages determined by radiocarbon dating.

Name	Condensed Name	Latitude (ºN)	Longitude (ºW)	Surface Area (m²)	Max Depth (m)
Goldstream La	GSL	64.916	-147.847	10,000*	4.7*
Octopus Lake	OCT	64.907	-147.860	22,000	2
Doughnut Lak	DNL	64.899	-147.908	34,000*	3.8*
Blacksheep Po	BSP	64.888	-147.920	540	0.5
Residential W	BSGW	undisclosed	undisclosed	N/A	72.5
Goldstream Active	GSP	64.920	-147.830		0.19-0.26
Fox Tunnel Perma	FTP1	64.951	-147.621		20
	FTP2	64.951	-147.621		54
	FTP3	64.951	-147.621		81

Table 2.1: General Sampling Locations Information

General information about sampling soils and sampling waters collected for NOM isol radiocarbon age. Values denoted with an asterisks (*) were obtained from Elder et a asterisks (**) were obtained from Mackelprang et al., 2017. BSGW has undisclosed residential home.

Permafrost Degradation Classification	Estimated Age of Lake in Calendar Years	Radiocarbon Age of Soil Carbon	Sampling Dates	
Closed	>120*		Jan 2017	June 2017
Transitional			Aug 2018	
Open	1,000*		Jan 2017	Aug 2018
nd Gen. Closed			Mar 2017	
			July 2016	
			Apr 2018	
		19,000**	Apr 2018	
		27,000**	Apr 2018	
		33,000**	Apr 2018	

lation, including sampling time period and
l., 2019. Values denoted with a double-
location due to privacy reasons as it is a

Sample	190-220 ppm	160-190 ppm	140-160 ppm	120-140 ppm	90-120 ppm
GSL SUMMER	1.25%	12.12%	6.43%	8.56%	13.66%
OCT SUMMER	1.23%	12.86%	5.87%	9.04%	12.64%
DNL SUMMER	1.47%	13.14%	4.75%	7.30%	10.37%
GSL WINTER	2.26%	11.48%	6.31%	9.41%	12.48%
DNL WINTER	1.88%	13.20%	6.28%	8.65%	12.26%
BSP	1.99%	11.08%	6.22%	9.42%	13.46%
BSGW	0.82%	11.89%	5.87%	11.19%	9.44%
GSP1	1.94%	9.88%	6.48%	10.27%	16.57%
GSP2	1.24%	5.98%	3.93%	6.96%	14.96%
FTP1	1.34%	6.04%	9.11%	20.86%	8.11%
FTP2	1.45%	13.43%	5.29%	8.96%	10.90%
FTP3	2.13%	11.44%	7.44%	13.56%	9.74%
SRFA	2.03%	9.63%	6.71%	9.67%	15.90%
PLFA	0.44%	8.25%	5.26%	8.21%	9.58%

Table 2.2: ^{13}C NMR Binning Percentages

^{13}C NMR binning percentages determined for isolated NOM using CP-MAS ^{13}C NMR
60-90 ppm carbohydrates, 90-120 ppm proton substituted aromatics, 120-140 ppm ca
oxygen substituted aromatics, 160-190 ppm carboxyl/aliphatic amides, 190-220 ppm
Zhou et al., 2015; Kaiser et al., 2003). 90-160 ppm is classified as total aromatics. Abb
2.1.

Sum 90-160 ppm	60-90 ppm	45-60 ppm	0-45 ppm
28.65%	21.22%	13.02%	23.75%
27.56%	20.80%	12.33%	25.22%
22.42%	20.61%	13.55%	28.80%
28.20%	19.71%	14.89%	23.47%
27.19%	19.60%	13.19%	24.93%
29.10%	20.36%	14.00%	23.47%
26.50%	14.80%	13.31%	32.66%
33.32%	29.58%	7.42%	17.86%
25.84%	34.88%	8.96%	23.10%
38.08%	14.57%	9.83%	30.13%
25.14%	21.83%	12.55%	25.60%
30.74%	21.38%	10.22%	24.09%
32.27%	20.40%	11.56%	24.11%
23.05%	16.83%	14.65%	36.79%

.. 0-45 ppm alkyl-C, 45-60 ppm methoxyl,
rbon substituted aromatics, 140-160 ppm
aldehydes and ketones (Mao et al., 2012;
reviations for samples are denoted in Table

	6.5-8.4 ppm	3.2-4.5 ppm	1.6-3.2 ppm	0.6-1.6 ppm
GSL SUMMER	5.89%	22.21%	43.36%	28.54%
OCT SUMMER	5.58%	19.93%	44.70%	29.80%
DNL SUMMER	7.44%	24.24%	42.25%	26.06%
GSL WINTER	4.14%	27.87%	40.50%	27.49%
DNL WINTER	4.29%	21.18%	44.47%	29.76%
BSP	4.23%	25.16%	42.84%	27.76%
BSGW	7.69%	24.64%	42.41%	25.27%
GSP1	11.48%	39.71%	28.66%	20.15%
GSP2	10.87%	39.90%	27.67%	21.56%
FTP1	11.62%	34.25%	33.48%	20.65%
FTP2	10.02%	25.13%	36.92%	27.93%
FTP3	8.90%	32.13%	34.61%	24.35%
PLFA	6.92%	16.19%	46.61%	30.29%
SRFA	9.36%	24.81%	44.52%	21.31%
NAFA	15.40%	30.17%	37.21%	17.22%

Table 2.3 ^{1}H NMR Binning Percentages

1 mg of PPL isolated NOM reconstituted in 18 MΩ H_2O with a TSP/D_2O insert was r MHz Bruker ^{1}H NMR with NMR SPR-WATERGATE water suppression technique. were obtained from the comparison of the area underneath of the spectra with specifi shifts; 0.6-1.6 ppm material derived from linear terpenoids (MDLT), 1.6-3.2 ppm ca alicyclic molecules (CRAM), 3.2-4.5 ppm carbohydrates, and 6.5-8.4 ppm aromatic Simpson, 2008). Abbreviations for samples are denoted in Table 2.1.

un on a 600
Percentages
ed chemical
rboxyl rich
s (Lam &

Sample	Comparison Sample	190-220 ppm	160-190 ppm	Sum 90-160 ppm	60-90 ppm
GSL SUMMER	PLFA	0.81%	3.87%	5.60%	4.39%
OCT SUMMER	PLFA	0.79%	4.61%	4.51%	3.97%
DNL SUMMER	PLFA	1.03%	4.89%	0.63%	3.78%
GSL WINTER	PLFA	1.82%	3.23%	5.15%	2.88%
DNL WINTER	PLFA	1.44%	4.95%	4.14%	2.77%
BSP	PLFA	1.55%	2.83%	6.05%	3.53%
BSGW	PLFA	0.38%	3.64%	3.45%	2.03%
GSP1	PLFA	1.50%	1.63%	10.27%	12.75%
GSP2	PLFA	0.80%	2.27%	2.79%	18.05%
FTP1	PLFA	0.90%	2.21%	15.03%	2.26%
FTP2	PLFA	1.01%	5.18%	2.09%	5.00%
FTP3	PLFA	1.69%	3.19%	7.69%	4.55%
GSL SUMMER	SRFA	0.78%	2.49%	3.62%	0.82%
OCT SUMMER	SRFA	0.80%	3.23%	4.71%	0.40%
DNL SUMMER	SRFA	0.56%	3.51%	9.85%	0.21%
GSL WINTER	SRFA	0.23%	1.85%	4.07%	0.69%
DNL WINTER	SRFA	0.15%	3.57%	5.08%	0.80%
BSP	SRFA	0.04%	1.45%	3.17%	0.04%
BSGW	SRFA	1.21%	2.26%	5.77%	5.60%
GSP1	SRFA	0.09%	0.25%	1.05%	9.18%
GSP2	SRFA	0.79%	3.65%	6.43%	14.48%
FTP1	SRFA	0.69%	3.59%	5.81%	5.83%
FTP2	SRFA	0.58%	3.80%	7.13%	1.43%
FTP3	SRFA	0.10%	1.81%	1.53%	0.98%

Table 2.4 ^{13}C Chemical Shift Comparison to Reference Material

Isolated water and soil NOM ^{13}C NMR spectra were compared to PLFA and SRFA spe equation 1 to determine similarities in carbon functional groups to microbial and terres reference materials, with total difference representing the summation of difference i integration. Abbreviations for samples are denoted in Table 2.1.

45-60 ppm	0-45 ppm	Total Difference
1.63%	13.04%	29.34%
2.32%	11.57%	27.77%
1.10%	7.99%	19.42%
0.24%	13.32%	26.64%
1.46%	11.86%	26.62%
0.65%	13.32%	27.93%
1.34%	4.13%	14.97%
7.23%	18.93%	52.31%
5.69%	13.69%	43.29%
4.82%	6.66%	31.88%
2.10%	11.19%	26.57%
4.43%	12.70%	34.25%
1.46%	0.36%	9.53%
0.77%	1.11%	11.02%
1.99%	4.69%	20.81%
3.33%	0.64%	10.81%
1.63%	0.82%	12.05%
2.44%	0.64%	7.78%
1.75%	8.55%	25.14%
4.14%	6.25%	20.96%
2.60%	1.01%	28.96%
1.73%	6.02%	23.67%
0.99%	1.49%	15.42%
1.34%	0.02%	5.78%

ectra utilizing
strial sourced
in relative

Sample	Comparison Sample	6.5-8.4 ppm	3.2-4.5 ppm	1.6-3.2 ppm	0.6-1.6 ppm
GSL SUMMER	PLFA	1.03%	6.03%	3.24%	1.75%
OCT SUMMER	PLFA	1.34%	3.74%	1.91%	0.49%
DNL SUMMER	PLFA	0.53%	8.06%	4.36%	4.23%
GSL WINTER	PLFA	2.78%	11.68%	6.11%	2.80%
DNL WINTER	PLFA	2.62%	4.99%	2.14%	0.53%
BSP	PLFA	2.68%	8.98%	3.77%	2.53%
BSGW	PLFA	0.77%	8.45%	4.20%	5.02%
GSP1	PLFA	4.56%	23.52%	17.95%	10.14%
GSP2	PLFA	3.95%	23.71%	18.94%	8.73%
FTP1	PLFA	4.70%	18.07%	13.13%	9.63%
FTP2	PLFA	3.10%	8.94%	9.68%	2.36%
FTP3	PLFA	1.98%	15.94%	11.99%	5.94%
GSL SUMMER	SRFA	3.48%	2.60%	1.15%	7.23%
OCT SUMMER	SRFA	3.78%	4.89%	0.18%	8.49%
DNL SUMMER	SRFA	1.92%	0.57%	2.27%	4.75%
GSL WINTER	SRFA	5.22%	3.06%	4.01%	6.18%
DNL WINTER	SRFA	5.07%	3.63%	0.05%	8.45%
BSP	SRFA	5.13%	0.35%	1.68%	6.45%
BSGW	SRFA	1.67%	0.17%	2.11%	3.96%
GSP1	SRFA	2.12%	14.89%	15.85%	1.16%
GSP2	SRFA	1.51%	15.09%	16.85%	0.25%
FTP1	SRFA	2.25%	9.44%	11.04%	0.65%
FTP2	SRFA	0.65%	0.32%	7.59%	6.62%
FTP3	SRFA	0.46%	7.32%	9.90%	3.04%
GSL SUMMER	NAFA	9.52%	7.95%	6.16%	11.32%
OCT SUMMER	NAFA	9.83%	10.24%	7.49%	12.58%
DNL SUMMER	NAFA	7.96%	5.92%	5.04%	8.84%
GSL WINTER	NAFA	11.26%	2.30%	3.30%	10.26%
DNL WINTER	NAFA	11.11%	8.99%	7.26%	12.54%
BSP	NAFA	11.17%	5.00%	5.64%	10.54%
BSGW	NAFA	7.72%	5.53%	5.20%	8.05%
GSP1	NAFA	3.93%	9.54%	8.54%	2.93%
GSP2	NAFA	4.53%	9.73%	9.54%	4.34%
FTP1	NAFA	3.79%	4.09%	3.73%	3.43%
FTP2	NAFA	5.39%	5.04%	0.28%	10.71%
FTP3	NAFA	6.50%	1.96%	2.59%	7.13%

Table 2.5 ^{1}H NMR Chemical Shift Comparison to Reference Material

Isolated water and soil NOM ^{1}H NMR spectra were compared to PLFA and SRFA spectra utilizing equation 1 to determine similarities in proton functional groups to microbial and terrestrial sourced reference materials, with total difference representing the summation of difference in relative integration. Abbreviations for samples are denoted in Table 2.1.

Total Difference
12.05%
7.48%
17.17%
23.37%
10.28%
17.95%
18.44%
56.16%
55.34%
45.53%
24.08%
35.86%
14.46%
17.34%
9.51%
18.47%
17.20%
13.61%
7.92%
34.02%
33.70%
23.39%
15.19%
20.73%
34.94%
40.13%
27.77%
27.12%
39.90%
32.35%
26.49%
24.94%
28.14%
15.04%
21.41%
18.19%

Sample	Comparison Sample	190-220 ppm	160-190 ppm	140-160 ppm
GSL SUMMER	GSP1	0.69%	2.25%	0.05%
OCT SUMMER	GSP1	0.71%	2.98%	0.61%
DNL SUMMER	GSP1	0.47%	3.27%	1.73%
GSL WINTER	GSP1	0.31%	1.61%	0.17%
DNL WINTER	GSP1	0.06%	3.33%	0.20%
BSP	GSP1	0.05%	1.20%	0.26%
BSGW	GSP1	1.12%	2.02%	0.61%
GSL SUMMER	GSP2	0.01%	6.15%	2.50%
OCT SUMMER	GSP2	0.01%	6.89%	1.94%
DNL SUMMER	GSP2	0.23%	7.17%	0.83%
GSL WINTER	GSP2	1.01%	5.51%	2.38%
DNL WINTER	GSP2	0.64%	7.23%	2.36%
BSP	GSP2	0.74%	5.10%	2.30%
BSGW	GSP2	0.42%	5.92%	1.94%
GSL SUMMER	FTP1	0.09%	6.08%	2.68%
OCT SUMMER	FTP1	0.11%	6.82%	3.24%
DNL SUMMER	FTP1	0.13%	7.10%	4.36%
GSL WINTER	FTP1	0.91%	5.44%	2.80%
DNL WINTER	FTP1	0.54%	7.16%	2.83%
BSP	FTP1	0.64%	5.04%	2.89%
BSGW	FTP1	0.52%	5.85%	3.24%
GSL SUMMER	FTP2	0.20%	1.31%	1.15%
OCT SUMMER	FTP2	0.22%	0.57%	0.59%
DNL SUMMER	FTP2	0.02%	0.29%	0.53%
GSL WINTER	FTP2	0.81%	1.95%	1.03%
DNL WINTER	FTP2	0.43%	0.23%	1.00%
BSP	FTP2	0.54%	2.35%	0.94%
BSGW	FTP2	0.63%	1.54%	0.59%
GSL SUMMER	FTP3	0.88%	0.68%	1.00%
OCT SUMMER	FTP3	0.90%	1.42%	1.56%
DNL SUMMER	FTP3	0.66%	1.70%	2.68%
GSL WINTER	FTP3	0.13%	0.04%	1.12%
DNL WINTER	FTP3	0.25%	1.76%	1.15%
BSP	FTP3	0.14%	0.37%	1.21%
BSGW	FTP3	1.30%	0.45%	1.56%

Table 2.6 ^{13}C NMR Chem

Isolated water NOM ^{13}C NMR spectra were compared to active layer and pe
observe potential influence from soil leaching into the waters from thaw, w
san

120-140 ppm	90-120 ppm	Sum 90-160 ppm	60-90 ppm	45-60 ppm	0-45 ppm
1.71%	2.91%	4.67%	8.36%	5.60%	5.88%
1.22%	3.93%	5.76%	8.78%	4.91%	7.36%
2.97%	6.20%	10.90%	8.97%	6.13%	10.94%
0.85%	4.09%	5.11%	9.88%	7.47%	5.60%
1.62%	4.31%	6.13%	9.98%	5.77%	7.07%
0.85%	3.10%	4.21%	9.22%	6.58%	5.61%
0.92%	7.13%	6.81%	14.78%	5.89%	14.80%
1.60%	1.30%	2.81%	13.66%	4.05%	0.65%
2.09%	2.32%	1.71%	14.08%	3.37%	2.12%
0.34%	4.59%	3.42%	14.26%	4.58%	5.70%
2.46%	2.48%	2.36%	15.17%	5.92%	0.37%
1.70%	2.70%	1.35%	15.28%	4.23%	1.84%
2.46%	1.49%	3.26%	14.52%	5.03%	0.37%
4.23%	5.52%	0.66%	20.08%	4.35%	9.56%
12.30%	5.55%	9.43%	6.64%	3.19%	6.39%
11.82%	4.53%	10.53%	6.23%	2.51%	4.91%
13.56%	2.26%	15.66%	6.04%	3.72%	1.33%
11.45%	4.37%	9.88%	5.13%	5.06%	6.67%
12.21%	4.15%	10.89%	5.03%	3.37%	5.20%
11.44%	5.35%	8.98%	5.79%	4.17%	6.67%
9.67%	1.33%	11.58%	0.23%	3.49%	2.53%
0.40%	2.76%	3.51%	0.61%	0.47%	1.86%
0.09%	1.74%	2.42%	1.03%	0.22%	0.38%
1.66%	0.53%	2.72%	1.21%	1.00%	3.20%
0.46%	1.58%	3.07%	2.12%	2.34%	2.14%
0.30%	1.36%	2.05%	2.23%	0.64%	0.67%
0.46%	2.57%	3.97%	1.46%	1.45%	2.14%
2.23%	1.46%	1.37%	7.03%	0.76%	7.06%
5.01%	3.92%	2.09%	0.16%	2.79%	0.34%
4.52%	2.90%	3.18%	0.58%	2.11%	1.13%
6.26%	0.63%	8.32%	0.76%	3.33%	4.71%
4.15%	2.74%	2.53%	1.67%	4.66%	0.62%
4.91%	2.52%	3.55%	1.78%	2.97%	0.84%
4.15%	3.73%	1.63%	1.02%	3.78%	0.62%
2.37%	0.30%	4.24%	6.58%	3.09%	8.57%

ical Shift Comparison of Water NOM to Soil NOM

rmafrost layer NOM spectra utilizing equation 1 to determine similarities in carbon functio
/ith total difference representing the summation of difference in relative integration. Abbre
nples are denoted in Table 2.1.

Total Difference
32.12%
36.27%
51.57%
35.10%
38.47%
31.08%
54.08%
32.73%
34.53%
41.13%
37.67%
37.31%
35.28%
52.69%
52.36%
50.70%
54.16%
51.71%
51.37%
50.97%
38.44%
12.27%
7.26%
11.15%
15.49%
8.92%
15.88%
22.66%
16.88%
18.31%
29.05%
17.68%
19.74%
16.63%
28.47%

›nal groups to
viations for

Sample	Comparison Sample	6.5-8.4 ppm	3.2-4.5 ppm	1.6-3.2 ppm
GSL SUMMER	GSP1	5.59%	17.49%	14.70%
OCT SUMMER	GSP1	5.90%	19.78%	16.04%
DNL SUMMER	GSP1	4.03%	15.46%	13.59%
GSL WINTER	GSP1	7.34%	11.84%	11.84%
DNL WINTER	GSP1	7.18%	18.53%	15.81%
BSP	GSP1	7.25%	14.54%	14.18%
BSGW	GSP1	3.79%	15.07%	13.74%
GSL SUMMER	GSP2	4.99%	17.69%	15.70%
OCT SUMMER	GSP2	5.29%	19.97%	17.03%
DNL SUMMER	GSP2	3.43%	15.66%	14.58%
GSL WINTER	GSP2	6.73%	12.03%	12.83%
DNL WINTER	GSP2	6.58%	18.72%	16.80%
BSP	GSP2	6.64%	14.74%	15.17%
BSGW	GSP2	3.18%	15.26%	14.74%
GSL SUMMER	FTP1	5.73%	12.04%	9.89%
OCT SUMMER	FTP1	6.04%	14.33%	11.22%
DNL SUMMER	FTP1	4.17%	10.01%	8.77%
GSL WINTER	FTP1	7.47%	6.38%	7.03%
DNL WINTER	FTP1	7.32%	13.08%	10.99%
BSP	FTP1	7.38%	9.09%	9.37%
BSGW	FTP1	3.93%	9.61%	8.93%
GSL SUMMER	FTP2	4.13%	2.92%	6.44%
OCT SUMMER	FTP2	4.44%	5.20%	7.77%
DNL SUMMER	FTP2	2.57%	0.88%	5.33%
GSL WINTER	FTP2	5.87%	2.74%	3.58%
DNL WINTER	FTP2	5.72%	3.95%	7.54%
BSP	FTP2	5.78%	0.03%	5.92%
BSGW	FTP2	2.33%	0.49%	5.48%
GSL SUMMER	FTP3	3.01%	9.92%	8.75%
OCT SUMMER	FTP3	3.32%	12.20%	10.08%
DNL SUMMER	FTP3	1.46%	7.88%	7.64%
GSL WINTER	FTP3	4.76%	4.26%	5.89%
DNL WINTER	FTP3	4.61%	10.95%	9.86%
BSP	FTP3	4.67%	6.97%	8.23%
BSGW	FTP3	1.21%	7.49%	7.79%

Table 2.7 ^{1}H NMR Chemical Shift Comparison of Water NO

Isolated water NOM ^{1}H NMR spectra were compared to active layer and pe
utilizing equation 1 to determine similarities in proton functional groups to o
functional group composition from soil leaching, with total difference repr

0.6-1.6 ppm	Total Difference
8.38%	46.17%
9.64%	51.36%
5.91%	38.99%
7.33%	38.34%
9.61%	51.13%
7.61%	43.58%
5.12%	37.72%
6.98%	45.35%
8.24%	50.53%
4.50%	38.17%
5.92%	37.52%
8.20%	50.30%
6.20%	42.75%
3.71%	36.89%
7.88%	35.54%
9.14%	40.73%
5.41%	28.36%
6.83%	27.71%
9.11%	40.49%
7.11%	32.94%
4.61%	27.09%
0.61%	14.10%
1.87%	19.28%
1.87%	10.65%
0.45%	12.64%
1.83%	19.05%
0.17%	11.91%
2.66%	10.96%
4.18%	25.87%
5.44%	31.05%
1.71%	18.69%
3.13%	18.04%
5.41%	30.82%
3.41%	23.27%
0.92%	17.41%

M to Soil NOM

rmafrost layer NOM spectra
bserve potential influence on
esenting the summation of

Sample	190-220 ppm	160-190 ppm	140-160 ppm	120-140 ppm	90-120 ppm
GSL SUMMER	1.25%	12.12%	6.43%	8.56%	13.66%
DNL SUMMER	1.47%	13.14%	4.75%	7.30%	10.37%
Difference Summ	0.22%	1.02%			
GSL WINTER	2.26%	11.48%	6.31%	9.41%	12.48%
DNL WINTER	1.88%	13.20%	6.28%	8.65%	12.26%
Difference Win	0.38%	1.72%			

Table 2.8 ^{13}C Seasonality Variability

^{13}C NMR spectra seasonality variability determined via equation 1 for the comparison winter and summer. A decreased percentage indicates a decrease in variability in the ca Differences were determined by the difference in relative integration found in equatio summation of difference in relative integration. Abbreviations for sampl

Sum 90-160 ppm	60-90 ppm	45-60 ppm	0-45 ppm	Total Difference
28.65%	21.22%	13.02%	23.75%	
22.42%	20.61%	13.55%	28.80%	
6.23%	0.60%	0.53%	5.06%	13.66%
28.20%	19.71%	14.89%	23.47%	
27.19%	19.60%	13.19%	24.93%	
1.01%	0.11%	1.69%	1.47%	6.38%

ι of Closed and Open thermokarsts during
arbon functional groups during the season.
n 1, with total difference representing the
es are denoted in Table 2.1.

	6.5-8.4 ppm	3.2-4.5 ppm	1.6-3.2 ppm	0.6-1.6 ppm	Total Difference
GSL SUMMEI	5.89%	22.21%	43.36%	28.54%	
DNL SUMMEI	7.44%	24.24%	42.25%	26.06%	
Difference Sumi	1.56%	2.03%	1.11%	2.48%	7.18%
GSL WINTEF	4.14%	27.87%	40.50%	27.49%	
DNL WINTEF	4.29%	21.18%	44.47%	29.76%	
Difference Win	0.15%	6.69%	3.97%	2.28%	13.09%

Table 2.9 ^{1}H Seasonality Variability

^{1}H NMR spectra seasonality variability determined via equation 1 for the comparison c Open thermokarsts during winter and summer. A decreased percentage indicates a d variability in the carbon functional groups during the season. Abbreviations for sample in Table 2.1.

ɔf Closed and
lecrease in
:s are denoted

Statistical Test	S_R	S_R (p-value)
ANOVA Lakes Top (GSL,OCT,DNL,BSP)	53	<0.0001
ANOVA Lakes Top (GSL,OCT,DNL)	46	<0.0001
T-Test GSL Top Vs Bottom	16/18	0.035
T-Test OCT Top Vs Bottom	12/13	0.0309
T-Test DNL Top Vs Bottom	13/15***	0.1556***
T-Test GSL Top Vs BSP	18/7	0.0136
P-Value Legend	**<0.0001**	**<0.0010**

Table 2.10 Statistical Results for Epilimnion versu

T-Tests were utilized to determine if the epilimnion (top) and hypolimnion (bott
between samples was determined to be statistically different and thus, required a W
were completed on only the epilimnion, one with and without BSP. The darker the
sample amount is found within each box as (top sample number/bottom sample num
are denoted in Tal

Statistical Test	S_R	E2:E3
ANOVA Lakes Top (GSL,OCT,DNL,BSP)	<0.0001	<0.0001
ANOVA Lakes Top (GSL,OCT,DNL)	<0.0001	<0.0001
T-Test GSL Top Vs Bottom	0.035	0.7562
T-Test OCT Top Vs Bottom	0.0309	0.1465
T-Test DNL Top Vs Bottom	0.1556***	0.684
T-Test GSL Top Vs BSP	0.0136	0.0389
P-Value Legend	**<0.0001**	**<0.0010**

Statistical Test	S_R	E2:E3
ANOVA Lakes Top (GSL,OCT,DNL,BSP)	53	52
ANOVA Lakes Top (GSL,OCT,DNL)	46	45
T-Test GSL Epi. Vs. Hypo.	16/18	16/17
T-Test OCT Epi. Vs. Hypo.	12/13	11/13
T-Test DNL Epi. Vs. Hypo.	13/15***	14/15
T-Test GSL Epi. Vs. Hypo.	18/7	17/7
P-Value Legend	**<0.0001**	**<0.0010**

E2:E3	E2:E3 (p-value)	BIX	BIX (p-value)	FI	FI (p-value)	Freshness
52	<0.0001	53	<0.0001	50	0.0020	53
45	<0.0001	46	<0.0001	44	0.0024	46
16/17	0.7562	16/18	0.4828	16/17***	0.0095***	16/18***
11/13	0.1465	12/14	0.7055	12/12	0.493	12/14
14/15	0.684	14/14	0.1186	14/15	0.0832	14/14
17/7	0.0389	18/7	0.0031	17/6***	0.4075***	18/7
<0.0100	<0.0500					

ıs Hypolimnion and ANOVA's between Thermokarst

om) were statistically different. A Welch's T-Test was completed when the variance elch T-Test to be utilized are denoted with *** in the table. Additionally, ANOVA tests shading in the box (decreased p-value) the more statistically different the results. The nber). Sample abbreviations for samples are denoted in Table 2.1 and data abbreviations ble 1.1 and Table 1.2.

BIX	FI	Freshness	HIX	$SUVA_{254}$	$SUVA_{280}$
<0.0001	0.0020	<0.0001	0.7224	0.0007	<0.0001
<0.0001	0.0024	<0.0001	0.5547	<0.0001	<0.0001
0.4828	0.0095***	0.2155***	0.718	0.1965	0.2034***
0.7055	0.493	0.6423	0.9658	0.1245	0.1427
0.1186	0.0832	0.4113	0.9659	0.9893	0.9975
0.0031	0.4075***	0.0137	0.8286***	0.6869	0.6779
			***Welch T-Test		
<0.0100	<0.0500		Number of samples located within cell		

BIX	FI	Freshness	HIX	$SUVA_{254}$	$SUVA_{280}$
53	50	53	53	31	47
46	44	46	47	40	40
16/18	16/17***	16/18***	16/18***	15/16	15/16***
12/14	12/12	12/14	12/14	12/13	12/13
14/14	14/15	14/14	14/15	11/11	11/11
18/7	17/6***	18/7	18/6***	16/7	16/7
			***Welch T-Test		
<0.0100	<0.0500		Number of samples located within cell		

Freshness (p-value)	HIX	HIX (p-value)	$SUVA_{254}$	$SUVA_{254}$ (p-value)	$SUVA_{280}$	$SUVA_{280}$ (p-value)
<0.0001	53	0.7224	31	0.0007	47	<0.0001
<0.0001	47	0.5547	40	<0.0001	40	<0.0001
0.2155***	16/18***	0.718	15/16	0.1965	15/16***	0.2034***
0.6423	12/14	0.9658	12/13	0.1245	12/13	0.1427
0.4113	14/15	0.9659	11/11	0.9893	11/11	0.9975
0.0137	18/6***	0.8286***	16/7	0.6869	16/7	0.6779

*****Welch T-Test**

Number of samples located within cell

Sample	S_R	+/-	E2:E3	+/-	FI
GSL Epi.	0.856	0.050	8.553	1.133	1.626
OCT Epi.	0.799	0.026	4.998	0.415	1.543
DNL Epi.	0.964	0.076	8.190	1.241	1.563
BSP	0.924	0.065	7.398	0.828	1.607

Table 2.11 Optical Indices Averages over a Three-Year Span

Optical Indices determined by Table 1.1 and Table 1.2 for thermokarst lakes sampled a summer and winter from 2016 to 2018. Standard deviation is denoted as (±) in this tal denoted in Table 2.1 and data abbreviations are denoted in Tabl

+/-	HIX	+/-	Freshness	+/-	BIX	+/-
0.049	0.932	0.014	0.709	0.015	0.744	0.023
0.105	0.958	0.033	0.576	0.052	0.600	0.049
0.087	0.941	0.065	0.679	0.018	0.710	0.021
0.024	0.945	0.009	0.659	0.024	0.673	0.024

nd isolated for NOM. These averages span
ɔle. Sample abbreviations for samples are
e 1.1 and Table 1.2.

$SUVA_{254}$	+/-	$SUVA_{280}$	+/-
0.996	0.256	0.980	0.250
2.429	1.125	2.392	1.142
1.061	0.328	1.051	0.324
1.139	0.421	1.123	0.417

	pH	TOC (mg C L^{-1})	+/-	TDN (mg N L-1)	+/-
GSL SUMMEI	8.2	55.723	1.088	2.726	0.031
OCT SUMMEI	8.46	36.257	0.647	0.155	0.003
DNL SUMMEI	8.43	58.040	0.306	0.174	0.012
GSL WINTER	6.3	124.393	1.295	5.988	0.075
DNL WINTER	5.09	60.164	0.161	2.902	0.054
BSP	N/A	215.791	3.937	16.569	0.300
BSGW	6.93	N/A		N/A	
GSP1	5.2	N/A		N/A	
GSP2	5.15	26.080	0.802	-0.028	0.008
FTP1	8.05	2.927	0.177	0.492	0.011
FTP2	7.72	11.683	0.107	1.279	0.053
FTP3	8.3	23.650	0.300	1.868	0.042
PLFA	N/A	N/A	N/A	N/A	N/A
SRFA	N/A	N/A	N/A	N/A	N/A
GSL Average	7.250	90.058	1.192	4.357	0.053
+/-	1.344	48.557	0.146	2.306	0.031
DNL Average	6.760	59.102	0.233	1.538	0.033
+/-	2.362	1.502	0.103	1.929	0.030
GSP Average	5.175	26.080	0.802	-0.028	0.008
+/-	0.035	N/A	N/A	N/A	N/A

Table 2.12 Optical Indices for Individual Samples

Optical indices collected during the sampling day of NOM isolation, including soil leac
*SUVA values are iron corrected (Poulin et al. 2014). Standard deviation is denoted as
and 280 nm were multiplied by dilution factor to obtain the corrected absorbance of gre
have values determined. Sample abbreviations for samples are denoted in Table 2.1 and
and Table 1.2. TOC = Total organic carbon concentration. TDN = Total dis

254 nm (A.U)	280 nm (A.U.)	S_R	E2:E3	BIX	FI	Freshness
3.007	2.047	0.860	7.900	0.704	1.618	0.688
2.289	1.655	0.867	5.867	0.600	1.535	0.582
2.285	1.497	1.013	9.818	0.723	1.516	0.690
3.142	2.080	0.824	8.553	0.741	1.699	0.713
1.495	0.984	0.893	8.394	0.700	1.564	0.657
6.414	4.304	0.928	8.115	0.695	1.634	0.680
0.342	0.243	0.927	6.547	0.687	1.664	0.676
0.565	0.453	0.590	4.688	0.415	1.337	0.395
0.487	0.399	0.590	4.660	0.419	1.322	0.386
0.058	0.042	0.943	5.238	0.583	1.506	0.569
0.201	0.140	0.888	6.261	0.576	1.530	0.573
0.539	0.372	0.913	6.178	N/A	N/A	N/A
0.286	0.229	1.035	4.843	0.776	1.549	0.756
0.423	0.327	0.812	4.979	0.427	1.314	0.408
3.075	2.063	0.842	8.227	0.723	1.659	0.700
0.095	0.023	0.025	0.462	0.026	0.057	0.017
1.890	1.241	0.953	9.106	0.711	1.540	0.674
0.558	0.363	0.085	1.007	0.016	0.034	0.023
0.526	0.426	0.590	4.674	0.417	1.329	0.391
0.055	0.038	0.000	0.020	0.003	0.011	0.007

hate from active layer and permafrost layer.
(±) in this table. The absorbance at 254 nm
:ater than 1 A.U. Samples with N/A did not
data abbreviations are denoted in Table 1.1
:solved nitrogen concentration.

HIX	$SUVA_{254}$	$SUVA_{280}$
0.937	1.960*	1.924*
0.920	2.487*	2.458*
0.887	1.381*	1.375*
0.953	1.115*	1.101*
1.025	0.961*	0.960*
0.952	1.039*	1.020*
0.924	N/A	N/A
0.882	N/A	N/A
0.901	1.868	1.531
0.946	1.978	1.431
0.927	1.718	1.195
N/A	2.279	1.571
0.793	2.148	1.718
0.868	4.164	3.216
0.945	1.538	1.513
0.011	0.598	0.582
0.956	1.171	1.168
0.097	0.296	0.293
0.892	1.868	1.531
0.013	N/A	N/A

	Total Iron ppb	+/-
GSL SUMMER	502.8	2.0
OCT SUMMER	1470.2	32.5
DNL SUMMER	115.5	1.1
GSL WINTER	2964.6	16.7
DNL WINTER	1242.8	2.3
BSP	72.1	2.8
BSGW	430.0	3.9
GSP1	187.9	4.1
GSP2	112.0	2.4
FTP1	13.1	2.0
FTP2	347.7	2.5
FTP3	376.8	3.4

Table 2.13 Iron Concentration Utilized for $SUVA_{254}$/SUVA

Iron concentrations obtained from ICP-MS (Gagne et al., unpubli.) utili correction factor for $SUVA_{254}$/$SUVA_{280}$ based on Poulin et al. (2014). Total I due to not collected or analyzed in anoxic conditions. Correction Factor wa Abbreviations for samples are denoted in Table 2.

$_{280}$ Correction

zed in determining to the
Fe was assumed to be all Fe^{+3}
s determined by Equation 2.
.1.

Summer vs. Winter T-Test Sample	S_R	E2:E3
GSL Top	10/8	10/7***
GSL Bottom	8/8	8/8
OCT Top	9/4***	9/4
OCT Bottom	8/4	7/4***
DNL Top	8/7***	8/7***
DNL Bottom	8/5***	8/6
Increased in Winter (P-Value Legend)	<0.0001	<0.0010
Increased in Summer (P-Value Legend)	<0.0001	<0.0010

Table 2.14 Statistical Results Determining for Seasonality b

T-Tests were utilized to determine if the epilimnion (top) and hypolimnion (completed when the variance between samples was determined to be statist the table. The darker the shading in the box (decreased p-value) the more sta sample number/winter sample number). Orange gradient indicates that the higher in the winter. Sample abbreviations for samples are denote

Summer vs. Winter T-Test Sample	S_R	E2:E3
GSL Epi.	0.0008	0.2777***
GSL Hypo.	0.0009	0.7708
OCT Epi.	0.4146***	0.6703
OCT Hypo.	0.0569	0.3059***
DNL Epi.	0.0517***	0.0817***
DNL Hypo.	0.0082***	0.2681
Increased in Winter (P-Value Legend)	<0.0001	<0.0010
Increased in Summer (P-Value Legend)	<0.0001	<0.0010

Summer vs. Winter T-Test Sample	S_R	S_R (p-value)
GSL Epi.	10/8	0.0008
GSL Hypo.	8/8	0.0009
OCT Epi.	9/4***	0.4146***
OCT Hypo.	8/4	0.0569
DNL Epi.	8/7***	0.0517***
DNL Hypo.	8/5***	0.0082***
Increased in Winter (P-Value Legend)	<0.0001	<0.0010
Increased in Summer (P-Value Legend)	<0.0001	<0.0010

Summer vs. Winter T-Test Sample	S_R	E2:E3
GSL Epi.	10/8	10/7***
GSL Hypo.	8/8	8/8
OCT Epi.	9/4***	9/4
OCT Hypo.	8/4	7/4***
DNL Epi.	8/7***	8/7***
DNL Hypo.	8/5***	8/6
Increased in Winter (P-Value Legend)	**<0.0001**	**<0.0010**
Increased in Summer (P-Value Legend)	**<0.0001**	**<0.0010**

BIX	FI	Freshness	HIX	$SUVA_{254}$	$SUVA_{280}$
10/8***	9/8	10/8	10/8	8/8***	8/8***
8/8	8/8	8/8	8/8	7/8***	7/8***
9/5	7/5***	9/5	9/5	9/4	9/4
8/4	8/4	8/4	8/4	8/4	8/4
7/7	8/7	7/7	8/7	6/5	6/5
8/6	8/6	8/6	8/6	6/5***	6/5***
<0.0100	**<0.0500**		*****Welch T-Test**		
<0.0100	**<0.0500**		**Number of samples located within cell**		

etween Samples

(bottom) summer and winter samples were statistically different. A Welch's T-Test was ically different and thus, required a Welch T-Test to be utilized are denoted with *** in atistically different the results. The sample amount is found within each box as (summer average was higher in summer, while the blue gradient indicates that the average was d in Table 2.1 and data abbreviations are denoted in Table 1.1 and Table 1.2.

BIX	FI	Freshness	HIX	$SUVA_{254}$	$SUVA_{280}$
0.2556***	0.0255	0.0767	0.4265	0.3514***	0.3371***
0.9928	0.5484	0.756	0.2682***	0.2264***	0.2275***
0.4598	0.2819***	0.5257	0.0017	0.2989	0.2836
0.0309	0.1688	0.0272	0.4256	0.444	0.4316
0.3462	0.0531	0.2484	0.0802***	0.1876	0.0959
0.5132	0.901	0.2245	0.1212***	0.0875***	0.0904***
<0.0100	**<0.0500**		*****Welch T-Test**		
<0.0100	**<0.0500**		**Number of samples located within cell**		

E2:E3	E2:E3 (p-value)	BIX	BIX (p-value)	FI	FI (p-value)	Freshness
10/7***	0.2777***	10/8***	0.2556***	9/8	0.0255	10/8
8/8	0.7708	8/8	0.9928	8/8	0.5484	8/8
9/4	0.6703	9/5	0.4598	7/5***	0.2819***	9/5
7/4***	0.3059***	8/4	0.0309	8/4	0.1688	8/4
8/7***	0.0817***	7/7	0.3462	8/7	0.0531	7/7
8/6	0.2681	8/6	0.5132	8/6	0.901	8/6
<0.0100	**<0.0500**					
<0.0100	**<0.0500**					

BIX	FI	Freshness	HIX	$SUVA_{254}$	$SUVA_{280}$
10/8***	9/8	10/8	10/8	8/8***	8/8***
8/8	8/8	8/8	8/8	7/8***	7/8***
9/5	7/5***	9/5	9/5	9/4	9/4
8/4	8/4	8/4	8/4	8/4	8/4
7/7	8/7	7/7	8/7	6/5	6/5
8/6	8/6	8/6	8/6	6/5***	6/5***
<0.0100	**<0.0500**		*****Welch T-Test**		
<0.0100	**<0.0500**		**Number of samples located within cell**		

Freshness (p-value)	HIX	HIX (p-value)	$SUVA_{254}$	$SUVA_{254}$ (p-value)	$SUVA_{280}$	$SUVA_{280}$ (p-value)
0.0767	10/8	0.4265	8/8***	0.3514***	8/8***	0.3371***
0.756	8/8	0.2682***	7/8***	0.2264***	7/8***	0.2275***
0.5257	9/5	0.0017	9/4	0.2989	9/4	0.2836
0.0272	8/4	0.4256	8/4	0.444	8/4	0.4316
0.2484	8/7	0.0802***	6/5	0.1876	6/5	0.0959
0.2245	8/6	0.1212***	6/5***	0.0875***	6/5***	0.0904***

*****Welch T-Test**

Number of samples located within cell

	Unamended SF	+/-	Iron SF	+/-
GSL Summe	9.24E-01	5.49E-04	9.08E-01	4.10E-04
OCT Summe	8.68E-01	1.13E-06	8.42E-01	1.28E-04
DNL Summe	8.98E-01	5.15E-05	8.76E-01	8.95E-05
GSL Winter	9.23E-01	6.01E-03	8.94E-01	7.35E-03
DNL Winter	8.74E-01	4.31E-02	8.88E-01	1.88E-02
BSP	9.35E-01		9.14E-01	
BSGW	8.71E-01	1.35E-02	8.57E-01	7.31E-03
GSP1	8.84E-01		8.58E-01	
GSP2	8.82E-01		8.54E-01	
FTP1	9.42E-01		9.16E-01	
FTP2	9.04E-01		8.80E-01	
FTP3	9.15E-01		9.02E-01	
SRFA	8.70E-01		8.46E-01	
PLFA	9.07E-01		8.79E-01	

Table 2.15 NOM Photolysis Rate of Absorbance I

Reconstituted of 10 mg C L^{-1} NOM in 18 MΩ H_2O and pH adjusted to circ
determined from equation 4 and the absorbance rate of decay at 254 nm were
associated with these values are standard deviations and represented by ± ir

	Unamended SF	+/-	Iron SF	+/-
GSL Summe	0.924	$5.49x10^{-4}$	0.908	$4.10x10^{-4}$
OCT Summe	0.868	$1.13x10^{-6}$	0.842	$1.28x10^{-4}$
DNL Summe	0.898	$5.15x10^{-5}$	0.876	$8.59x10^{-5}$
GSL Winter	0.923	$6.01x10^{-3}$	0.894	$7.25x10^{-3}$
DNL Winter	0.874	$4.31x10^{-2}$	0.888	$1.88x10^{-2}$
BSP	0.935		0.914	
BSGW	0.871	$1.35x10^{-2}$	0.857	$7.31x10^{-3}$

GSP1	0.884	0.858
GSP2	0.882	0.854
FTP1	0.942	0.916
FTP2	0.904	0.880
FTP3	0.915	0.902
SRFA	0.870	0.846
PLFA	0.907	0.879

Methanol SF	+/-	Unamended Rate 254nm	+/-	Iron Rate 254nm	+/-
9.24E-01	2.19E-04	1.15E-03	4.01E-06	3.22E-03	4.72E-05
8.69E-01	1.62E-04	1.93E-03	2.86E-04	1.56E-03	4.94E-05
8.99E-01	6.25E-05	1.25E-03	6.34E-06	1.44E-03	6.86E-07
9.24E-01	5.89E-03	1.40E-03	2.75E-04	6.54E-03	1.36E-04
9.16E-01	1.57E-02	1.48E-03	2.43E-04	4.42E-03	9.52E-04
9.35E-01		1.68E-03		6.89E-03	
8.83E-01	3.47E-03	2.16E-03	5.11E-04	4.43E-03	8.50E-04
8.84E-01		1.11E-03	1.20E-04	1.23E-03	6.41E-05
8.83E-01		1.16E-03	7.54E-05	1.51E-03	8.89E-05
9.43E-01		1.83E-03	2.94E-04	2.44E-03	2.84E-04
9.04E-01		1.26E-03	1.05E-04	1.68E-03	1.45E-04
9.28E-01		1.68E-03	5.97E-05	2.27E-03	1.29E-04
8.66E-01		1.09E-03		1.77E-03	
9.07E-01		1.26E-03		1.53E-03	

)ecay

umneutral with the addition of chemical probes for photolysis experiments. Screening facto
e determined based off of equation 3 with the units of hr^{-1} mg C^{-1} L based on pseudo-first or
n the table. Samples without errors were not run in duplicate and an error could not be deter
samples are denoted in Table 2.1.

Methanol SF	+/-	Unamended Rate 254nm	+/-	Iron Rate 254nm	+/-
0.924	$2.19x10^{-4}$	$1.15x10^{-3}$	$4.01x10^{-6}$	$3.22x10^{-3}$	$4.72x10^{-5}$
0.869	$1.62x10^{-4}$	$1.93x10^{-3}$	$2.86x10^{-4}$	$1.56x10^{-3}$	$4.94x10^{-5}$
0.899	$6.25x10^{-5}$	$1.25x10^{-3}$	$6.34x10^{-6}$	$1.44x10^{-3}$	$6.86x10^{-7}$
0.924	$5.89x10^{-3}$	$1.40x10^{-3}$	$2.75x10^{-4}$	$6.54x10^{-3}$	$1.36x10^{-4}$
0.916	$1.57x10^{-2}$	$1.48x10^{-3}$	$2.43x10^{-4}$	$1.11x10^{-3}$	$9.52x10^{-4}$
0.935		$1.68x10^{-3}$		$6.89x10^{-3}$	
0.883	$3.47x10^{-3}$	$2.16x10^{-3}$	$5.11x10^{-4}$	$4.43x10^{-3}$	$8.50x10^{-4}$

0.884	$1.11x10^{-3}$	$1.20x10^{-4}$	$1.23x10^{-3}$	$6.41x10^{-5}$
0.883	$1.16x10^{-3}$	$7.54x10^{-5}$	$1.51x10^{-3}$	$8.89x10^{-5}$
0.943	$1.83x10^{-3}$	$2.94x10^{-4}$	$2.44x10^{-3}$	$2.84x10^{-4}$
0.904	$1.26x10^{-3}$	$1.05x10^{-4}$	$1.68x10^{-3}$	$1.45x10^{-4}$
0.928	$1.68x10^{-3}$	$5.97x10^{-5}$	$2.27x10^{-3}$	$1.29x10^{-4}$
0.866	$1.09x10^{-3}$		$1.77x10^{-3}$	
0.907	$126x10^{-3}$		$1.53x10^{-3}$	

Methanol Rate 254nm	+/-
8.36E-04	1.50E-05
1.18E-03	1.40E-04
1.14E-03	3.58E-05
1.32E-03	5.13E-05
1.23E-03	3.92E-05
1.57E-03	
1.71E-03	4.00E-04
9.25E-04	8.88E-05
8.87E-04	6.54E-05
1.27E-03	7.87E-05
1.10E-03	1.21E-04
1.56E-03	1.06E-04
1.02E-03	
1.20E-03	

ors (SF) are included and
der rate kinetics. The error
mined. Abbreviations for

Methanol Rate 254nm	+/-
$8.36x10^{-4}$	$1.50x10^{-5}$
$1.18x10^{-3}$	$1.40x10^{-4}$
$1.14x10^{-3}$	$3.58x10^{-5}$
$1.32x10^{-3}$	$5.13x10^{-5}$
$1.23x10^{-3}$	$3.92x10^{-5}$
$1.57x10^{-3}$	
$1.71x10^{-3}$	$4.00x10^{-4}$

$9.25x10^{-4}$	$8.88x10^{-5}$
$8.87x10^{-4}$	$6.54x10^{-5}$
$1.27x10^{-3}$	$7.87x10^{-5}$
$1.10x10^{-3}$	$1.21x10^{-4}$
$1.56x10^{-3}$	$1.06x10^{-4}$
$1.02x10^{-3}$	
$1.20x10^{-3}$	

Unamended	% Difference from PLFA	% Difference from SRFA	% Difference from GSP1	% Difference from GSP2	Average Active Layer
GSL Summe	-8.83%	5.79%	3.61%	-0.73%	**1.44%**
OCT Summe	42.33%	56.06%	54.04%	50.00%	**52.02%**
DNL Summe	-0.13%	14.47%	12.30%	7.97%	**10.14%**
GSL Winter	10.58%	25.08%	22.93%	18.64%	**20.79%**
DNL Winter	16.36%	30.77%	28.64%	24.38%	**26.51%**
BSP	28.72%	42.87%	40.78%	36.61%	**38.70%**
BSGW	53.11%	66.42%	64.47%	60.56%	**62.52%**
GSP1	-12.43%	2.18%		-4.34%	**4.34%**
GSP2	-8.10%	6.52%	4.34%		**4.34%**
FTP1	37.20%	51.11%	49.06%	44.97%	**47.01%**
FTP2	0.62%	15.22%	13.05%	8.72%	**10.89%**
FTP3	28.60%	42.75%	40.67%	36.49%	**38.58%**

Table 2.16 Percent Difference in Unamended Photobleaching Rates

The percent difference was determined from the rates of absorbance decay determine found in Table 2.15 for unamended photolysis rates to compare to reference material, a rates in order to observe similarities associated with NOM in this watershed from p infiltration. Abbreviations for samples are den

% Difference from FTP1	% Difference from FTP2	% Difference from FTP3	Average Permafrost Layers	% Difference BSGW
-45.66%	-9.45%	-37.19%	**30.77%**	-61.22%
5.33%	41.73%	14.16%	**20.41%**	-11.42%
-37.33%	-0.75%	-28.73%	**22.27%**	-53.23%
-26.89%	9.96%	-18.16%	**18.33%**	-43.13%
-21.17%	15.74%	-12.39%	**16.43%**	-37.57%
-8.72%	28.11%	0.12%	**6.50%**	-25.36%
16.73%	52.53%	25.48%	**31.58%**	0.00%
-49.06%	-13.05%	-40.67%	**34%**	-64.47%
-44.97%	-8.72%	-36.49%	**30%**	-60.56%
	36.60%	8.84%	**22.72%**	-16.73%
-36.60%		-27.99%	**32.29%**	-52.53%
-8.84%	27.99%		**12.28%**	-25.48%

d by equation 3 based on pseudo-first order rate kinetics
ctive layer, permafrost layer, and ground water photolysis
otential influx through soil leaching and groundwater
oted in Table 2.1.

	Plain - Iron	+/-	% Difference	Plain - Methanol	+/-
GSL Summe	-2.07E-03	4.74E-05	94.75%	3.13E-04	1.55E-05
OCT Summe	3.73E-04	2.90E-04	21.37%	7.52E-04	3.18E-04
DNL Summe	-1.83E-04	6.38E-06	13.60%	1.13E-04	3.64E-05
GSL Winter	-5.14E-03	3.06E-04	129.63%	7.47E-05	2.79E-04
DNL Winter	-2.94E-03	9.83E-04	99.75%	2.54E-04	2.47E-04
BSP	-5.21E-03		121.69%	1.07E-04	
BSGW	-2.27E-03	9.92E-04	68.72%	4.58E-04	6.49E-04
GSP1	-1.23E-04	1.36E-04	10.47%	1.84E-04	1.50E-04
GSP2	-3.49E-04	1.17E-04	26.21%	2.71E-04	9.98E-05
FTP1	-6.07E-04	4.08E-04	28.45%	5.63E-04	3.04E-04
FTP2	-4.13E-04	1.79E-04	28.10%	1.68E-04	1.60E-04
FTP3	-5.92E-04	1.42E-04	30.05%	1.19E-04	1.22E-04
SRFA	-6.84E-04		47.92%	6.52E-05	
PLFA	-2.75E-04		19.73%	5.71E-05	

Table 2.17 Difference in Absorbance Decay Rates

The difference in unamended sample with amended sample is included with unamende and unamended versus methanol determined from comparing photolysis rates within NOM found in Table 2.15 using equation 6 units of hr^{-1} mg C^{-1} L. Additionally, the perc was determined through the use of the same photolysis rates. Error was propagated fron deviation of each rate used in determining the difference and denoted as ±. Abbreviatio are denoted in Table 2.1.

	Plain - Iron	+/-	% Difference	Plain - Methanol	+/-
GSL Summe	$-2.07x10^{-3}$	$4.74x10^{-5}$	94.75%	$3.13x10^{-4}$	$1.55x10^{-5}$
OCT Summe	$3.73x10^{-4}$	$2.90x10^{-4}$	21.37%	$7.52x10^{-4}$	$3.18x10^{-4}$
DNL Summe	$-1.83x10^{-4}$	$6.38x10^{-6}$	13.60%	$1.13x10^{-4}$	$3.64x10^{-5}$
GSL Winter	$-5.14x10^{-3}$	$3.06x10^{-4}$	129.63%	$7.47x10^{-5}$	$2.79x10^{-4}$
DNL Winter	$-2.94x10^{-3}$	$9.83x10^{-4}$	99.75%	$2.54x10^{-4}$	$2.47x10^{-4}$
BSP	$-5.21x10^{-3}$		121.69%	$1.07x10^{-4}$	
BSGW	$-2.27x10^{-3}$	$9.92x10^{-4}$	68.72%	$4.58x10^{-4}$	$6.49x10^{-4}$
GSP1	$-1.23x10^{-4}$	$1.36x10^{-4}$	10.47%	$1.84x10^{-4}$	$1.50x10^{-4}$

GSP2	$-3.49x10^{-4}$	$1.17x10^{-4}$	26.21%	$2.71x10^{-4}$	$9.98x10^{-5}$
FTP1	$-6.07x10^{-4}$	$4.08x10^{-4}$	28.45%	$5.63x10^{-4}$	$3.04x10^{-4}$
FTP2	$-4.13x10^{-4}$	$1.79x10^{-4}$	28.10%	$1.68x10^{-4}$	$1.60x10^{-4}$
FTP3	$-5.92x10^{-4}$	$1.42x10^{-4}$	30.05%	$1.19x10^{-4}$	$1.22x10^{-4}$
SRFA	$-6.84x10^{-4}$		47.92%	$6.52x10^{-5}$	
PLFA	$-2.75x10^{-4}$		19.73%	$5.71x10^{-5}$	

% Difference
31.56%
48.36%
9.44%
5.50%
18.76%
6.57%
23.64%
18.07%
26.48%
36.34%
14.25%
7.34%
6.20%
4.65%

:d versus iron
sample type
:ent difference
n the standard
ıs for samples

% Difference
31.56%
48.36%
9.44%
5.50%
18.76%
6.57%
23.64%
18.07%

26.48%
36.34%
14.25%
7.34%
6.20%
4.65%

	^{3}NOM* Rate	+/-	R^2
GSL Summe	1.98E-03	1.10E-04	9.88E-01
OCT Summe	2.15E-03	8.01E-05	9.97E-01
DNL Summe	1.75E-03	1.24E-04	9.90E-01
GSL Winter	1.84E-03	1.91E-04	9.59E-01
DNL Winter	1.45E-03	3.02E-04	8.52E-01
BSP	1.99E-03	4.32E-04	8.41E-01
BSGW	1.77E-03	2.96E-04	8.99E-01
GSP1	8.41E-04	1.30E-04	8.93E-01
GSP2	7.82E-04	4.26E-05	9.88E-01
FTP1	2.36E-03	2.15E-04	9.60E-01
FTP2	1.53E-03	2.72E-04	8.63E-01
FTP3	1.44E-03	3.10E-04	8.11E-01
SRFA	1.09E-03	9.13E-05	9.66E-01
PLFA	1.10E-03	7.31E-05	9.78E-01

Table 2.18 ^{3}NOM* Photolysis Rates

Reconstituted of 10 mg C L^{-1} NOM in 18 MΩ H_2O and pH adjusted to circumneutral with the addition of TMP were run for 4-6 hours and the rate of TMP degradation was converted to the rate of ^{3}NOM* production with equation 7, with units of min^{-1} mg C^{-1} L. Error within this table is the standard deviation of duplicate photolysis runs and denoted as ±. R^2 was determined based on the best fit line for TMP degradation plots found in Figure 2.9. Abbreviations for samples are denoted in Table 2.1.

	^{3}NOM* Rate	+/-	R^2
GSL Summe	1.98×10^{-3}	1.10×10^{-4}	0.988
OCT Summe	2.15×10^{-3}	8.01×10^{-5}	0.997
DNL Summe	1.75×10^{-3}	1.24×10^{-4}	0.990
GSL Winter	1.84×10^{-3}	1.91×10^{-4}	0.959
DNL Winter	1.45×10^{-3}	3.02×10^{-4}	0.852
BSP	1.99×10^{-3}	4.32×10^{-4}	0.841
BSGW	1.77×10^{-3}	2.96×10^{-4}	0.899

GSP1	8.41×10^{-4}	1.30×10^{-4}	0.893
GSP2	7.82×10^{-4}	4.26×10^{-5}	0.988
FTP1	2.36×10^{-3}	2.15×10^{-4}	0.960
FTP2	1.53×10^{-3}	2.72×10^{-4}	0.863
FTP3	1.44×10^{-3}	3.10×10^{-4}	0.811
SRFA	1.09×10^{-3}	9.13×10^{-5}	0.966
PLFA	1.10×10^{-3}	7.31×10^{-5}	0.978

3NOM*	% Difference from PLFA	% Difference from SRFA	% Difference from GSP1	% Difference from GSP2	Average Active Layer
GSL Summe	57.24%	58.06%	80.89%	86.94%	**83.92%**
OCT Summe	64.58%	65.38%	87.55%	93.39%	**90.47%**
DNL Summe	45.59%	46.44%	70.20%	76.56%	**73.38%**
GSL Winter	50.44%	51.27%	74.67%	80.90%	**77.79%**
DNL Winter	27.14%	28.02%	52.93%	59.69%	**56.31%**
BSP	57.53%	58.36%	81.16%	87.20%	**84.18%**
BSGW	46.33%	47.18%	70.89%	77.22%	**74.06%**
GSP1	-26.75%	-25.87%		7.34%	**7.34%**
GSP2	-33.92%	-33.05%	-7.34%		**7.34%**
FTP1	72.71%	73.49%	94.85%	100.44%	**97.65%**
FTP2	32.31%	33.18%	57.81%	64.47%	**61.14%**
FTP3	26.41%	27.29%	52.24%	59.01%	**55.63%**

Table 2.19 Percent Differences in ^{3}NOM* Rates

The percent difference was determined from the rates of ^{3}NOM* production determir TMP photolysis rates to compare to reference material, active layer, permafrost layer, a observe similarities associated with NOM in this watershed from potential influx t infiltration. Abbreviations for samples are denoted in '

% Difference from FTP1	% Difference from FTP2	% Difference from FTP3	Average Permafrost Layers	% Difference BSGW
-17.27%	26.13%	32.03%	**25.15%**	11.68%
-9.21%	34.04%	39.87%	**27.71%**	19.72%
-29.57%	13.79%	19.78%	**21.04%**	-0.78%
-24.52%	18.89%	24.85%	**22.76%**	4.36%
-47.94%	-5.29%	0.74%	**17.99%**	-19.82%
-16.95%	26.45%	32.35%	**25.25%**	12.00%
-28.80%	14.57%	20.55%	**21.31%**	0.00%
-94.85%	-57.81%	-52.24%	**68.30%**	-70.89%
-100.44%	-64.47%	-59.01%	**74.64%**	-77.22%
	42.92%	48.63%	**45.78%**	28.80%
-42.92%		6.03%	**24.47%**	-14.57%
-48.63%	-6.03%		**27.33%**	-20.55%

ıed by equation 7 found in Table 2.18 for
nd ground water photolysis rates in order to
:hrough soil leaching and groundwater
Table 2.1.

GSL Winter	Screening Factor			
	0.88831956	F1T0		
	0.89871028	F2T0	0.89351492	0.00734735
	0.91956383	M1T0		
	0.92789904	M2T0	0.92373143	0.00589388
	0.91908344	X1T0		
	0.92758339	X2T0	0.92333341	0.00601037
	10.0411467	0.10141184	0.36035	0.00645765
	10.1978133	0.11380259	0.34241667	0.05239919
	Iron	254	280	STD 254
	Average	0.00654075	0.00732448	0.00013583
	t1	0.00644471	0.00703073	
	t2	0.0066368	0.00761822	
	Methanol	254	280	STD 254
	Average	0.00132161	0.00188287	5.12728E-05
	t1	0.00135786	0.00193077	
	t2	0.00128535	0.00183498	
	Plain	254	280	STD 254
	Average	0.00139629	0.00189168	0.00027465
	t1	0.0015905	0.00213938	
	t2	0.00120208	0.00164398	

	Date	TOC	TOC STD	TDN	TDN STD
GSL Winter		10.0411467	0.10141184	0.36035	0.00645765
		10.1978133	0.11380259	0.34241667	0.05239919
DNL Winter	5/29/2017	**12.7541592**	**0.21588281**	**0.39126833**	**0.01497692**
	6/10/2017	**11.4953433**	**0.18895808**	**0.30308333**	**0.01387832**
GSL Summer		13.6677333	0.0307802	0.46066363	0.00630405
BSGW	22-Jun	9.52501	0.09303846	0.30008333	0.00938019
	16-Jun	10.4743833	0.10379115	0.3358225	0.01298384
BSP		8.84034333	0.09028929	0.24203333	0.01092068
SRFA		10.16	0.04		
PLFA		13.3026667	0.03601851		
DNL Summer		11.47	0.05656854	0.37756667	0.00870192
OCT Summer		11.5325	0.0917878	0.5275	0.00746414
2Y		8.96825	0.13806852	0.179425	0.01858303
2X		9.0195	0.06700498	0.1678	0.02312546
FTP1		5.292	0.05400926	0.300796	0.00857791
FTP2		11.5625	0.14568802	0.877525	0.04773897
FTP3		7.9075	0.00494975	0.41443333	0.00855823

GSL Winter		10.0411467	0.10141184	0.36035	0.00645765
		10.1978133	0.11380259	0.34241667	0.05239919
DNL Winter	5/29/2017	**12.7541592**	**0.21588281**	**0.39126833**	**0.01497692**
	6/10/2017	**11.4953433**	**0.18895808**	**0.30308333**	**0.01387832**
GSL Summer		13.6677333	0.0307802	0.46066363	0.00630405
BSGW	22-Jun	9.52501	0.09303846	0.30008333	0.00938019
	16-Jun	10.4743833	0.10379115	0.3358225	0.01298384
BSP		8.84034333	0.09028929	0.24203333	0.01092068
SRFA		10.16	0.04		
PLFA		13.3026667	0.03601851		
DNL Summer		11.47	0.05656854	0.37756667	0.00870192
OCT Summer		11.5325	0.0917878	0.5275	0.00746414
2Y		8.96825	0.13806852	0.179425	0.01858303
2X		9.0195	0.06700498	0.1678	0.02312546
FTP1		5.292	0.05400926	0.300796	0.00857791
FTP2		11.5625	0.14568802	0.877525	0.04773897
FTP3		7.9075	0.00494975	0.41443333	0.00855823

GSL Summer	13.6677333	0.0307802	0.46066363	0.00630405
DNL Summer	11.47	0.05656854	0.37756667	0.00870192
OCT Summer	11.5325	0.0917878	0.5275	0.00746414
GSL Winter	10.11948	0.10760721	0.35138333	0.02942842
DNL Winter	12.1247513	0.20242045	0.34717583	0.01442762
BSP	8.84034333	0.09028929	0.24203333	0.01092068
BSGW	9.99969667	0.09841481	0.31795292	0.01118201
GSP1	9.0195	0.06700498	0.1678	0.02312546
GSP2	8.96825	0.13806852	0.179425	0.01858303
FTP1	5.292	0.05400926	0.300796	0.00857791
FTP2	11.5625	0.14568802	0.877525	0.04773897
FTP3	7.9075	0.00494975	0.41443333	0.00855823

	TOC	**TOC STD**	**TDN**	**TDN STD**
GSL Winter	10.119	0.111	0.351	0.013
DNL Winter	12.125	0.890	0.347	0.062

GSL Summer	13.668	0.031	0.461	0.006
BSGW	10.000	0.671	0.318	0.025
BSP	8.840	0.090	0.242	0.011
SRFA	10.160	0.040		
PLFA	13.303	0.036		
DNL Summer	11.470	0.057	0.378	0.009
OCT Summer	11.533	0.092	0.528	0.007
2Y	8.968	0.138	0.179	0.019
2X	9.020	0.067	0.168	0.023
FTP1	5.292	0.054	0.301	0.009
FTP2	11.563	0.146	0.878	0.048
FTP3	7.908	0.005	0.414	0.009

	TOC	**Error**	**TDN**	**Error**
GSL Summer	13.668	0.031	0.461	0.006
OCT Summer	11.533	0.092	0.528	0.007
DNL Summer	11.470	0.057	0.378	0.009
GSL Winter	10.119	0.111	0.351	0.013
DNL Winter	12.125	0.890	0.347	0.062
BSP	8.840	0.090	0.242	0.011
BSGW	10.000	0.671	0.318	0.025
GSP1	9.020	0.067	0.168	0.023
GSP2	8.968	0.138	0.179	0.019
FTP1	5.292	0.054	0.301	0.009
FTP2	11.563	0.146	0.878	0.048
FTP3	7.908	0.005	0.414	0.009
SRFA	10.160	0.040		
PLFA	13.303	0.036		

	DNL Winter	Screening Factor			
		0.90124195	F1T0		
		0.87469854	F2T0	0.887970246	0.01876903
		0.9271407	M1T0		
		0.90498792	M2T0	0.9160643105	0.01566438
		0.84379662	X1T0		
		0.90475374	X2T0	0.8742751785	0.04310319
		12.7541592	**0.21588281**	**0.391268333**	**0.01497692**
		11.4953433	**0.18895808**	**0.303083333**	**0.01387832**
STD 280		Iron	254	280	STD 254
0.00041542		Average	0.00442424	0.0050087875	0.00095243
		t1	0.0050977	0.005669988	
		t2	0.00375077	0.0043475869	
STD 280		Methanol	254	280	STD 254
6.77339E-05		Average	0.00122597	0.0017546107	3.92395E-05
		t1	0.00119822	0.0017471004	
		t2	0.00125372	0.0017621209	
STD 280		Plain	254	280	STD 254
0.0003503		Average	0.00147972	0.0020423079	0.0002434
		t1	0.00165183	0.00225282	
		t2	0.00130761	0.0018317959	

Screening Factor

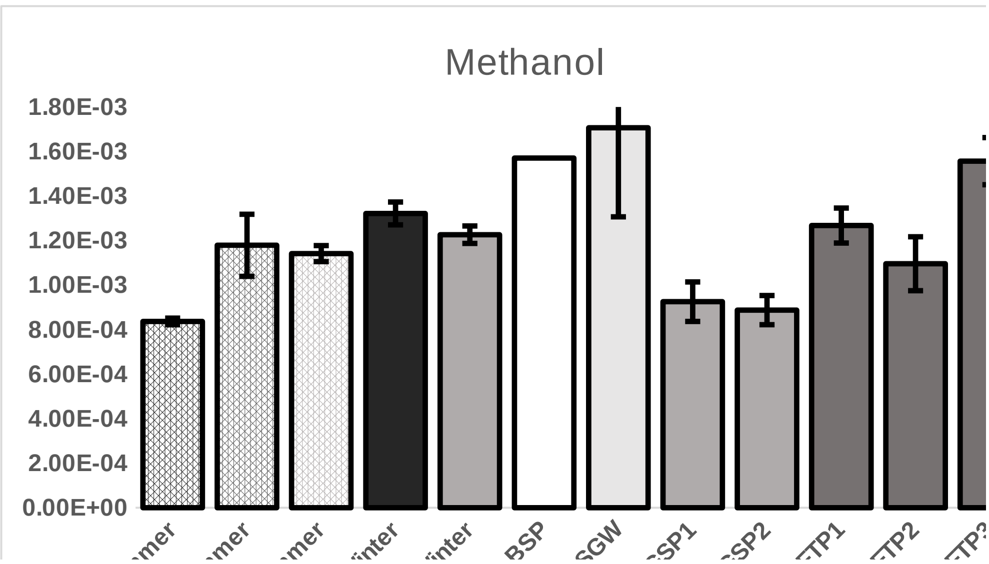
Iron	Iron STD	Methanol	Methanol ST	Plain	Plain STD
0.89351492	0.00734735	0.92373143	0.00589388	0.923333414	0.00601037
0.88797025	0.01876903	0.91606431	0.01566438	0.8742751785	0.04310319
0.90783569	0.00041	0.92431334	0.00021893	0.9239800065	0.00054926
0.85655473	0.00730975	0.88283359	0.00346612	0.8712674846	0.01349815
0.91370727		0.93498704		0.9350794473	
0.84631611		0.86555484		0.8702658587	
0.87939033		0.90697391		0.9066698403	
0.87550286	8.95381E-05	0.89898945	6.25153E-05	0.898196517	5.1524E-05
0.84154071	0.00012786	0.86874919	0.00016208	0.86840897	1.12854E-06
0.85392946		0.8827046		0.882073909	
0.85760331		0.88445428		0.883820239	
0.91625641		0.9432689		0.942370094	
0.87955744		0.90376403		0.903833766	
0.90194359		0.9278499		0.915235402	

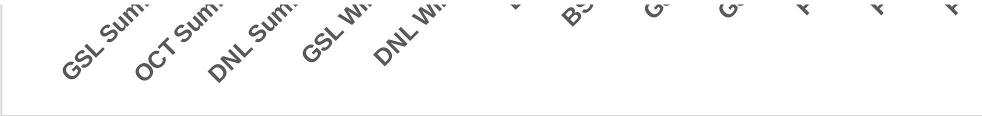
10.11948	0.10760721	0.35138333	0.02942842
12.1247513	0.20242045	0.34717583	0.01442762
9.99969667	0.09841481	0.31795292	0.01118201

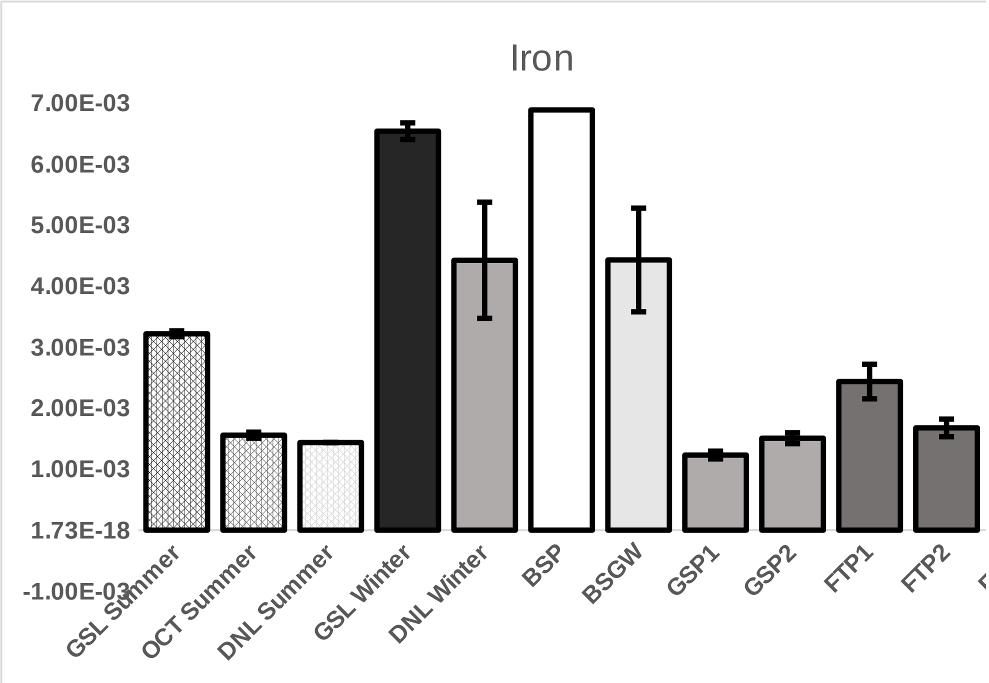
Plain SF	**Plain STD**	**Iron SF**	**Iron STD**	**Methanol SF**	**Methanol STD**
0.923	0.006	0.894	0.007	0.924	0.006
0.874	0.043	0.888	0.019	0.916	0.016

0.924	0.001	0.908	0.000	0.924	0.000
0.871	0.013	0.857	0.007	0.883	0.003
0.935		0.914		0.935	
0.870		0.846		0.866	
0.907		0.879		0.907	
0.898	0.000	0.876	0.000	0.899	0.000
0.868	0.000	0.842	0.000	0.869	0.000
0.882		0.854		0.883	
0.884		0.858		0.884	
0.942		0.916		0.943	
0.904		0.880		0.904	
0.915		0.902		0.928	

Plain SF	Error	Iron SF	Error	Methanol SF	Error
0.924	0.001	0.908	0.000	0.924	0.000
0.868	0.000	0.842	0.000	0.869	0.000
0.898	0.000	0.876	0.000	0.899	0.000
0.923	0.006	0.894	0.007	0.924	0.006
0.874	0.043	0.888	0.019	0.916	0.016
0.935		0.914		0.935	
0.871	0.013	0.857	0.007	0.883	0.003
0.884		0.858		0.884	
0.882		0.854		0.883	
0.942		0.916		0.943	
0.904		0.880		0.904	
0.915		0.902		0.928	
0.870		0.846		0.866	
0.907		0.879		0.907	







Iron
7.00E-03
6.00E-03
5.00E-03
4.00E-03
3.00E-03
2.00E-03
1.00E-03
1.73E-18
-1.00E-03
GSL Summer
OCT Summer
DNL Summer
GSL Winter
DNL Winter
BSP
BSGW
GSP1
GSP2
FTP1
FTP2

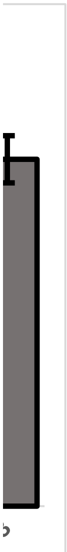
	GSL Summer	Screening Factor			
		0.90812561	F1T0		
		0.90754578	F2T0	0.9078356905	0.00041
		0.92446815	M1T0		
		0.92415854	M2T0	0.9243133445	0.00021893
		0.92359162	X1T0		
		0.9243684	X2T0	0.9239800065	0.00054926
5/29/2017		13.6677333	0.0307802	0.46066363	0.00630405
6/10/2017					
STD 280		Iron	254	280	STD 254
0.0009350788		Average	0.00321982	0.00338141215	4.72104E-05
		t1	0.0032532	0.00347207505	
		t2	0.00318643	0.00329074924	
STD 280		Methanol	254	280	STD 254
1.0621077E-05		Average	0.0008364	0.00124609183	1.49652E-05
		t1	0.00084698	0.00126017164	
		t2	0.00082582	0.00123201202	
STD 280		Plain	254	280	STD 254
0.00029770898		Average	0.00114977	0.00157695799	4.01269E-06
		t1	0.00114693	0.00158123858	
		t2	0.0011526	0.0015726774	

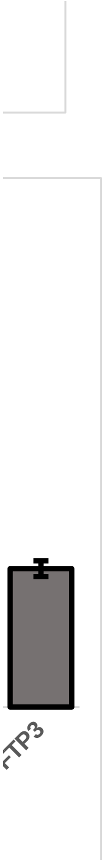
Iron Rates 254 nm				Methanol Rat	
Average	STD	T1	T2	Average	STD
0.00654075202	0.00013583	0.00644471	0.0066368	0.00132160699	5.12728E-05
0.00442423649	0.00095243	0.0050977	0.00375077	0.00122596897	3.92395E-05
0.00321981511	4.72104E-05	0.0032532	0.00318643	0.00083639724	1.49652E-05
0.00443006665	0.00084962	0.00503084	0.00382929	0.00170662517	0.00040031
0.00688913959				0.00157052689	
0.00176884902				0.00101987446	
0.00153093186				0.00119884791	
0.00143742812	6.8568E-07	0.00143791	0.00143694	0.00114130867	3.58236E-05
0.00155764463	4.93832E-05	0.00159256	0.00152273	0.00117862127	0.00013957
0.001507578	8.89253E-05			0.000887374	6.53941E-05
0.001231586	6.41216E-05			0.000925203	8.87852E-05
0.002436993	0.00028359			0.001267224	7.86529E-05
0.001677069	0.00014499			0.001095702	0.00012112
0.002267418	0.00012894			0.001556573	0.00010585

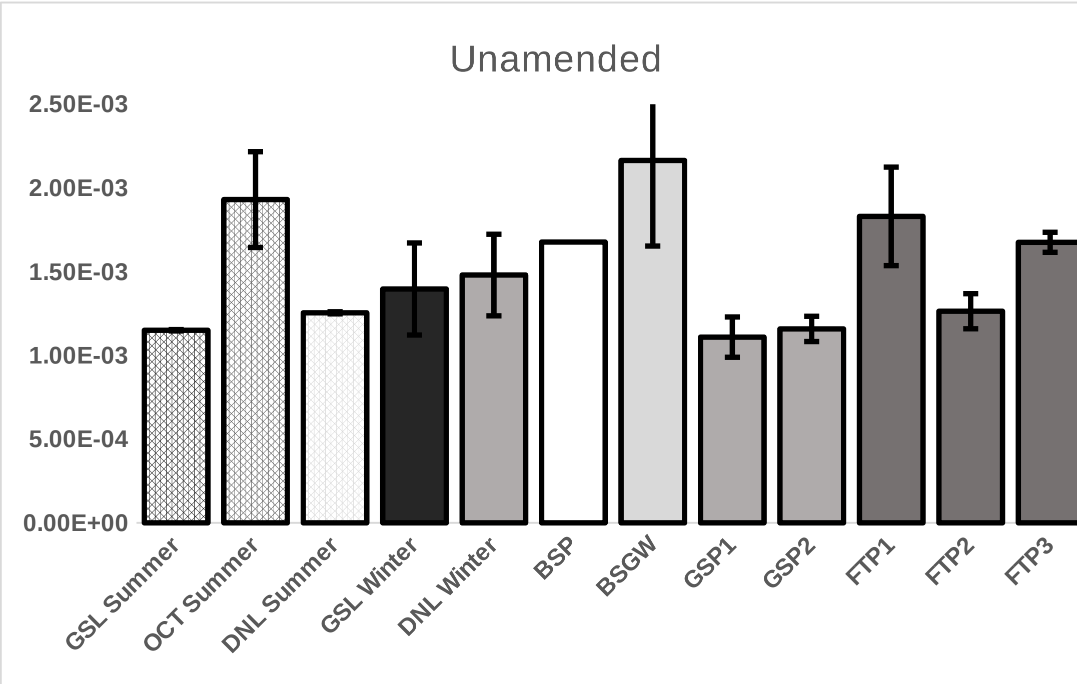
Unamended Rate 254nm	STD	Iron Rate 254nm	STD	Methanol Rate 254nm	STD
1.40E-03	2.75E-04	6.54E-03	1.36E-04	1.32E-03	5.13E-05
1.48E-03	2.43E-04	4.42E-03	9.52E-04	1.23E-03	3.92E-05

1.15E-03	4.01E-06	3.22E-03	4.72E-05	8.36E-04	1.50E-05
2.16E-03	5.11E-04	4.43E-03	8.50E-04	1.71E-03	4.00E-04
2.04E-03		6.89E-03		1.57E-03	
1.09E-03		1.77E-03		1.02E-03	
1.26E-03		1.53E-03		1.20E-03	
1.25E-03	6.34E-06	1.44E-03	6.86E-07	1.14E-03	3.58E-05
2.07E-03	2.23E-04	1.56E-03	4.94E-05	1.18E-03	1.40E-04
1.16E-03	7.54E-05	1.51E-03	8.89E-05	8.87E-04	6.54E-05
1.11E-03	1.20E-04	1.23E-03	6.41E-05	9.25E-04	8.88E-05
1.83E-03	2.94E-04	2.44E-03	2.84E-04	1.27E-03	7.87E-05
1.26E-03	1.05E-04	1.68E-03	1.45E-04	1.10E-03	1.21E-04
1.68E-03	5.97E-05	2.27E-03	1.29E-04	1.56E-03	1.06E-04

Unamended Rate 254nm	**Error**	**Iron Rate 254nm**	**Error**	**Methanol Rate 254nm**	**Error**
1.15E-03	4.01E-06	3.22E-03	4.72E-05	8.36E-04	1.50E-05
1.93E-03	2.86E-04	1.56E-03	4.94E-05	1.18E-03	1.40E-04
1.25E-03	6.34E-06	1.44E-03	6.86E-07	1.14E-03	3.58E-05
1.40E-03	2.75E-04	6.54E-03	1.36E-04	1.32E-03	5.13E-05
1.48E-03	2.43E-04	4.42E-03	9.52E-04	1.23E-03	3.92E-05
1.68E-03		6.89E-03		1.57E-03	
2.16E-03	5.11E-04	4.43E-03	8.50E-04	1.71E-03	4.00E-04
1.11E-03	1.20E-04	1.23E-03	6.41E-05	9.25E-04	8.88E-05
1.16E-03	7.54E-05	1.51E-03	8.89E-05	8.87E-04	6.54E-05
1.83E-03	2.94E-04	2.44E-03	2.84E-04	1.27E-03	7.87E-05
1.26E-03	1.05E-04	1.68E-03	1.45E-04	1.10E-03	1.21E-04
1.68E-03	5.97E-05	2.27E-03	1.29E-04	1.56E-03	1.06E-04
1.09E-03		1.77E-03		1.02E-03	
1.26E-03		1.53E-03		1.20E-03	






Unamended
2.50E-03
2.00E-03
1.50E-03
1.00E-03
5.00E-04
0.00E+00
GSL Summer
OCT Summer
DNL Summer
GSL Winter
DNL Winter
BSP
BSGW
GSP1
GSP2
FTP1
FTP2
FTP3

	BSGW		Screening Factor		
			0.8617235	F1T0	
			0.85138596	F2T0	0.85655473
			0.88528451	M1T0	
			0.88038267	M2T0	0.882833588
			0.86172285	X1T0	
			0.88081211	X2T0	0.871267485
		22-Jun	9.52501	0.093038461	0.300083333
		16-Jun	10.4743833	0.103791152	0.3358225
STD 280		Iron	254	280	STD 254
0.00012822		Average	0.00443007	0.004843169	0.000849621
		t1	0.00503084	0.005219736	
		t2	0.00382929	0.004466603	
STD 280		Methanol	254	280	STD 254
1.99119E-05		Average	0.00170663	0.00215275	0.000400308
		t1	0.00198969	0.002356475	
		t2	0.00142356	0.001949025	
STD 280		Plain	254	280	STD 254
6.05367E-06		Average	0.00216418	0.00262414	0.000511446
		t1	0.00252582	0.002900696	
		t2	0.00180253	0.002347584	

es 254 nm		Plain Rates 254 nm			
T1	T2	Average	STD	T1	T2
0.00135786	0.00128535	0.00139629	0.00027465	0.001590502	0.001202082
0.00119822	0.00125372	0.00147972	0.0002434	0.001651834	0.001307614
0.00084698	0.00082582	0.00114977	4.01269E-06	0.001146929	0.001152604
0.00198969	0.00142356	0.00216418	0.00051145	0.002525824	0.001802531
		0.00203996			
		0.00108508			
		0.00125596			
0.00111598	0.00116664	0.00125435	6.34001E-06	0.00125883	0.001249864
0.00107993	0.00127731	0.0020701	0.00022278	0.002227633	0.001912571
		0.00115817	7.5398E-05		
		0.00110901	0.00012044		
		0.00183018	0.00029358		
		0.00126383	0.00010488		
		0.0016751	5.97464E-05		

Unamended Rate 280nm	STD	Iron Rate 280nm	STD	Methanol Rate 280nm	STD
1.89E-03	3.50E-04	7.32E-03	4.15E-04	1.88E-03	6.77E-05
2.04E-03	2.98E-04	5.01E-03	9.35E-04	1.75E-03	1.06E-05

1.58E-03	6.05E-06	3.38E-03	1.28E-04	1.25E-03	1.99E-05
2.62E-03	3.91E-04	4.84E-03	5.33E-04	2.15E-03	2.88E-04
2.68E-03		7.57E-03		2.31E-03	
1.70E-03		2.21E-03		1.58E-03	
1.75E-03		1.87E-03		1.78E-03	
1.73E-03	1.42E-05	1.80E-03	3.43E-06	1.70E-03	8.26E-05
2.72E-03	2.44E-04	1.92E-03	5.30E-05	1.70E-03	1.97E-04
1.92E-03	7.68E-05	2.07E-03	1.09E-04	1.53E-03	1.14E-04
1.88E-03	1.88E-04	1.76E-03	6.88E-05	1.66E-03	1.68E-04
2.96E-03	2.59E-04	2.91E-03	2.59E-04	2.45E-03	1.23E-04
1.75E-03	1.44E-04	1.99E-03	1.75E-04	1.61E-03	1.68E-04
2.51E-03	4.06E-05	2.66E-03	1.19E-04	2.42E-03	1.47E-04

3NOM* Rate	Error	R2
1.98E-03	1.10E-04	9.88E-01
2.15E-03	8.01E-05	9.97E-01
1.75E-03	1.24E-04	9.90E-01
1.84E-03	1.91E-04	9.59E-01
1.45E-03	3.02E-04	8.52E-01
1.99E-03	4.32E-04	8.41E-01
1.77E-03	2.96E-04	8.99E-01
8.41E-04	1.30E-04	8.93E-01
7.82E-04	4.26E-05	9.88E-01
2.36E-03	2.15E-04	9.60E-01
1.53E-03	2.72E-04	8.63E-01
1.44E-03	3.10E-04	8.11E-01
1.09E-03	9.13E-05	9.66E-01
1.10E-03	7.31E-05	9.78E-01

^{3}NOM*	% Difference from PLFA
GSL Summer	57.24%
OCT Summer	64.58%
DNL Summer	45.59%
GSL Winter	50.44%
DNL Winter	27.14%
BSP	57.53%
BSGW	46.33%
GSP1	-26.75%
GSP2	-33.92%
FTP1	72.71%
FTP2	32.31%
FTP3	26.41%

Unamended	% Difference from PLFA
GSL Summer	-8.83%
OCT Summer	42.33%
DNL Summer	-0.13%
GSL Winter	10.58%
DNL Winter	16.36%
BSP	28.72%

BSGW	53.11%
GSP1	-12.43%
GSP2	-8.10%
FTP1	37.20%
FTP2	0.62%
FTP3	28.60%

•OH Promoted	% Difference from PLFA
GSL Summer	71.10%
OCT Summer	1.73%
DNL Summer	-6.30%
GSL Winter	124.13%
DNL Winter	97.17%
BSP	127.27%
BSGW	97.27%
GSP1	-21.67%
GSP2	-1.54%
FTP1	45.67%
FTP2	9.11%
FTP3	38.78%

•OH Quenched	% Difference from PLFA
GSL Summer	-35.62%
OCT Summer	-1.70%
DNL Summer	-4.92%
GSL Winter	9.74%
DNL Winter	2.24%
BSP	26.84%
BSGW	34.95%
GSP1	-25.77%
GSP2	-29.86%

FTP1	5.55%
FTP2	-8.99%
FTP3	25.97%

	BSP	0.913707267	F1T0
		0	F2T0
0.00730975		0.934987036	M1T0
		0	M2T0
0.003466124		0.935079447	X1T0
		0	X2T0
0.013498146			
		8.840343334	0.090289287
0.009380187			
0.012983839			
STD 280	Iron	254	280
0.000532545	Average	0.00688914	0.007565209
STD 280	Methanol	254	280
0.00028811	Average	0.001570527	0.002311481
STD 280	Plain	254	280
0.000391109	Average	0.002039958	0.002680747

Iron Rates 280 nm				Methanol Ra	
Average	STD	T1	T2	Average	STD
0.007324475	0.000415418	0.00703073	0.00761822	0.001882871	6.77339E-05
0.005008787	0.000935079	0.005669988	0.004347587	0.001754611	1.062108E-05
0.003381412	0.000128217	0.003472075	0.003290749	0.001246092	1.991185E-05
0.004843169	0.000532545	0.005219736	0.004466603	0.00215275	0.00028811
0.007565209				0.002311481	
0.002209644				0.001575333	
0.001871942				0.001778959	
0.001802578	3.42675E-06	0.001800155	0.001805001	0.001700294	8.259651E-05
0.001921949	5.300742E-05	0.001959431	0.001884467	0.001702497	0.000196775
0.002065722	0.000109111			0.001533184	0.000113521
0.001761365	6.8804E-05			0.001661953	0.000167562
0.00290512	0.000258864			0.002454214	0.000122876
0.001988726	0.000174735			0.001612947	0.000168256
0.002658073	0.000119324			0.002418921	0.000147231

TMP Rate of Decay	TMP Rate Error	R2	3NOM* Rate
-1.84E-03	1.91E-04	9.59E-01	1.84E-03
-1.45E-03	3.02E-04	8.52E-01	1.45E-03

-1.98E-03	1.10E-04	9.88E-01	1.98E-03
-1.77E-03	2.96E-04	8.99E-01	1.77E-03
-1.99E-03	4.32E-04	8.41E-01	1.99E-03
-1.09E-03	9.13E-05	9.66E-01	1.09E-03
-1.10E-03	7.31E-05	9.78E-01	1.10E-03
-1.75E-03	1.24E-04	9.90E-01	1.75E-03
-2.15E-03	8.01E-05	9.97E-01	2.15E-03
-7.82E-04	4.26E-05	9.88E-01	7.82E-04
-8.41E-04	1.30E-04	8.93E-01	8.41E-04
-2.36E-03	2.15E-04	9.60E-01	2.36E-03
-1.53E-03	2.72E-04	8.63E-01	1.53E-03
-1.44E-03	3.10E-04	8.11E-01	1.44E-03

% Difference from SRFA	% Difference from GSP1	% Difference from GSP2	Average Active Layer	% Difference from FTP1	% Difference from FTP2
58.06%	80.89%	86.94%	**83.92%**	-17.27%	26.13%
65.38%	87.55%	93.39%	**90.47%**	-9.21%	34.04%
46.44%	70.20%	76.56%	**73.38%**	-29.57%	13.79%
51.27%	74.67%	80.90%	**77.79%**	-24.52%	18.89%
28.02%	52.93%	59.69%	**56.31%**	-47.94%	-5.29%
58.36%	81.16%	87.20%	**84.18%**	-16.95%	26.45%
47.18%	70.89%	77.22%	**74.06%**	-28.80%	14.57%
-25.87%		7.34%	**7.34%**	-94.85%	-57.81%
-33.05%	-7.34%		**7.34%**	-100.44%	-64.47%
73.49%	94.85%	100.44%	**97.65%**		42.92%
33.18%	57.81%	64.47%	**61.14%**	-42.92%	
27.29%	52.24%	59.01%	**55.63%**	-48.63%	-6.03%

% Difference from SRFA	% Difference from GSP1	% Difference from GSP2	Average Active Layer	% Difference from FTP1	% Difference from FTP2
5.79%	3.61%	-0.73%	**1.44%**	-45.66%	-9.45%
56.06%	54.04%	50.00%	**52.02%**	5.33%	41.73%
14.47%	12.30%	7.97%	**10.14%**	-37.33%	-0.75%
25.08%	22.93%	18.64%	**20.79%**	-26.89%	9.96%
30.77%	28.64%	24.38%	**26.51%**	-21.17%	15.74%
42.87%	40.78%	36.61%	**38.70%**	-8.72%	28.11%

66.42%	64.47%	60.56%	**62.52%**	16.73%	52.53%
2.18%		-4.34%	**4.34%**	-49.06%	-13.05%
6.52%	4.34%		**4.34%**	-44.97%	-8.72%
51.11%	49.06%	44.97%	**47.01%**		36.60%
15.22%	13.05%	8.72%	**10.89%**	-36.60%	
42.75%	40.67%	36.49%	**38.58%**	-8.84%	27.99%

% Difference from SRFA	% Difference from GSP1	% Difference from GSP2	Average Active Layer	% Difference from FTP1	% Difference from FTP2
58.17%	89.33%	72.44%	**80.88%**	27.68%	63.01%
-12.70%	23.38%	3.27%	**13.32%**	-44.03%	-7.38%
-20.67%	15.42%	-4.76%	**10.09%**	-51.60%	-15.39%
114.85%	136.62%	125.07%	**130.85%**	91.42%	118.37%
85.75%	112.90%	98.34%	**105.62%**	57.93%	90.05%
118.28%	139.34%	128.18%	**133.76%**	95.48%	121.69%
85.86%	112.99%	98.44%	**105.71%**	58.05%	90.16%
-35.81%		-20.15%	**20.15%**	-65.72%	-30.63%
-15.95%	20.15%		**20.15%**	-47.12%	-10.64%
31.77%	65.72%	47.12%	**56.42%**		36.94%
-5.33%	30.63%	10.64%	**20.64%**	-36.94%	
24.70%	59.21%	40.26%	**49.73%**	-7.21%	29.93%

% Difference from SRFA	% Difference from GSP1	% Difference from GSP2	Average Active Layer	% Difference from FTP1	% Difference from FTP2
-21.94%	-10.08%	-5.91%	**8.00%**	-40.96%	-26.84%
15.76%	24.09%	28.19%	**26.14%**	-7.25%	7.29%
12.28%	20.92%	25.03%	**22.97%**	-10.46%	4.08%
27.96%	35.29%	39.32%	**37.30%**	4.20%	18.69%
19.99%	27.96%	32.04%	**30.00%**	-3.31%	11.22%
45.76%	51.71%	55.59%	**53.65%**	21.38%	35.62%
54.01%	59.38%	63.17%	**61.27%**	29.55%	43.60%
-10.75%		4.17%	**4.17%**	-31.20%	-16.87%
-15.37%	-4.17%		**4.17%**	-35.26%	-21.01%

23.52%	31.20%	35.26%	**33.23%**		14.52%
7.85%	16.87%	21.01%	**18.94%**	-14.52%	
44.86%	50.88%	54.76%	**52.82%**	20.49%	34.75%

SRFA	creening Factor				
	0.846316108	**F1T0**			
	#VALUE!	**F2T0**	#VALUE!	#VALUE!	
	0.865554842	**M1T0**			
	#VALUE!	**M2T0**	#VALUE!	#VALUE!	
	0.870265859	**X1T0**			
	#VALUE!	**X2T0**	#VALUE!	#VALUE!	
	10.16	**0.04**			
	Iron	**254**	280	STD 254	STD 280
	Average				
	t1	**0.001768849**	0.00220964		
	t2				
	Methanol	**254**	280	STD 254	STD 280
	Average				
	t1	**0.001019874**	0.00157533		
	t2				
	Plain	**254**	280	STD 254	STD 280
	Average				
	t1	**0.001085079**	0.00170063		
	t2				

ates 280 nm		Plain Rates 280 nm			
T1	T2	**Average**	STD	T1	T2
0.001930767	0.001834976	**0.001891679**	0.0003503	0.00213938	0.00164398
0.0017471	0.001762121	**0.002042308**	0.00029771	0.00225282	0.0018318
0.001260172	0.001232012	**0.001576958**	6.05367E-06	0.00158124	0.00157268
0.002356475	0.001949025	**0.00262414**	0.00039111	0.0029007	0.00234758
		0.002680747			
		0.001700626			
		0.001751459			
0.00164189	0.001758699	**0.001727998**	1.42338E-05	0.00173806	0.00171793
0.001563356	0.001841638	**0.002724296**	0.00024377	0.00289667	0.00255193
		0.001921366	7.67522E-05		
		0.001881775	0.00018847		
		0.002963034	0.00025888		
		0.001745717	0.00014388		
		0.002506031	4.05931E-05		

% Difference from FTP3	Average Permafrost Layers	% Difference BSGW
32.03%	**25.15%**	11.68%
39.87%	**27.71%**	19.72%
19.78%	**21.04%**	-0.78%
24.85%	**22.76%**	4.36%
0.74%	**17.99%**	-19.82%
32.35%	**25.25%**	12.00%
20.55%	**21.31%**	0.00%
-52.24%	**68.30%**	-70.89%
-59.01%	**74.64%**	-77.22%
48.63%	**45.78%**	28.80%
6.03%	**24.47%**	-14.57%
	27.33%	-20.55%

% Difference from FTP3	Average Permafrost Layers	% Difference BSGW
-37.19%	**30.77%**	-61.22%
14.16%	**20.41%**	-11.42%
-28.73%	**22.27%**	-53.23%
-18.16%	**18.33%**	-43.13%
-12.39%	**16.43%**	-37.57%
0.12%	**6.50%**	-25.36%

25.48%	**31.58%**	0.00%
-40.67%	**34%**	-64.47%
-36.49%	**30%**	-60.56%
8.84%	**22.72%**	-16.73%
-27.99%	**32.29%**	-52.53%
	12.28%	-25.48%

% Difference from FTP3	Average Permafrost Layers	% Difference BSGW
34.71%	**41.80%**	-31.64%
-37.11%	**29.51%**	-95.94%
-44.81%	**37.26%**	-102.01%
97.03%	**102.27%**	38.48%
64.46%	**70.81%**	-0.13%
100.95%	**106.04%**	43.45%
64.58%	**70.93%**	0.00%
-59.21%	**51.85%**	-112.99%
-40.26%	**32.67%**	-98.44%
7.21%	**22.08%**	-58.05%
-29.93%	**33.44%**	-90.16%
	18.57%	-64.58%

% Difference from FTP3	Average Permafrost Layers	% Difference BSGW
-60.19%	**42.66%**	-68.44%
-27.64%	**14.06%**	-36.60%
-30.78%	**15.11%**	-39.70%
-16.33%	**13.07%**	-25.43%
-23.76%	**12.76%**	-32.78%
0.89%	**19.30%**	-8.31%
9.20%	**27.45%**	0.00%
-50.88%	**32.98%**	-59.38%
-54.76%	**37.01%**	-63.17%

-20.49%	**17.51%**	-29.55%
-34.75%	**24.64%**	-43.60%
	27.62%	-9.20%

PLFA	Screening Factor				
	0.879390326286	F1T0			
	#VALUE!	F2T0	#VALUE!	#VALUE!	
	0.906973909117	M1T0			
	#VALUE!	M2T0	#VALUE!	#VALUE!	
	0.906669840306	X1T0			
	#VALUE!	X2T0	#VALUE!	#VALUE!	
	13.30266667	0.03601851			
	Iron	254	280	STD 254	STD 280
	Average				
	t1	0.00153093	0.00187194		
	t2				
	Methanol	254	280	STD 254	STD 280
	Average				
	t1				
	t2				
	Plain	254	280	STD 254	STD 280
	Average				
	t1	0.00125596	0.00175146		
	t2				

TMP Rate	TMP Rate Error	R2	ABS Rate
-0.00184401	0.000191245899	0.95875021	0.00184401
-0.00144703	0.000301748349	0.85183321	0.00144703
-0.00198428	0.000109940432	0.98786975	0.00198428
-0.00176537	0.000295807566	0.89903241	0.00176537
-0.00199076	0.000432151361	0.84140157	0.00199076
-0.00109144	9.134578879E-05	0.96616272	0.00109144
-0.00110127	7.313466176E-05	0.97842462	0.00110127
-0.00175162	0.000124497884	0.98999747	0.00175162
-0.00215158	8.005454527E-05	0.99723888	0.00215158
-0.00078185	4.263127475E-05	0.9882474	0.00078185
-0.00084141	0.000130208746	0.8930647	0.00084141
-0.0023594	0.000214973272	0.96014578	0.0023594
-0.00152567	0.000271814944	0.86303104	0.00152567
-0.0014364	0.000309755454	0.81134654	0.0014364

	Unamended SF	+/-	Iron SF	+/-	Methanol SF
GSL Summe	9.24E-01	5.49E-04	9.08E-01	4.10E-04	9.24E-01
OCT Summe	8.68E-01	1.13E-06	8.42E-01	1.28E-04	8.69E-01
DNL Summe	8.98E-01	5.15E-05	8.76E-01	8.95E-05	8.99E-01
GSL Winter	9.23E-01	6.01E-03	8.94E-01	7.35E-03	9.24E-01
DNL Winter	8.74E-01	4.31E-02	8.88E-01	1.88E-02	9.16E-01
BSP	9.35E-01		9.14E-01		9.35E-01
BSGW	8.71E-01	1.35E-02	8.57E-01	7.31E-03	8.83E-01
GSP1	8.84E-01		8.58E-01		8.84E-01
GSP2	8.82E-01		8.54E-01		8.83E-01
FTP1	9.42E-01		9.16E-01		9.43E-01
FTP2	9.04E-01		8.80E-01		9.04E-01
FTP3	9.15E-01		9.02E-01		9.28E-01
SRFA	8.70E-01		8.46E-01		8.66E-01
PLFA	9.07E-01		8.79E-01		9.07E-01

	Plain - Iron	Error	% Difference	lain - Methan	Error
GSL Summe	-2.07E-03	4.74E-05	95%	3.13E-04	1.55E-05
OCT Summe	5.12E-04	2.28E-04	28%	8.91E-04	2.63E-04
DNL Summe	-1.83E-04	6.38E-06	14%	1.13E-04	3.64E-05
GSL Winter	-5.14E-03	3.06E-04	130%	7.47E-05	2.79E-04
DNL Winter	-2.94E-03	9.83E-04	100%	2.54E-04	2.47E-04

BSP	-5.21E-03		122%	1.07E-04	
BSGW	-2.27E-03	9.92E-04	69%	4.58E-04	6.49E-04
GSP1	-1.23E-04	1.36E-04	10%	1.84E-04	1.50E-04
GSP2	-3.49E-04	1.17E-04	26%	2.71E-04	9.98E-05
FTP1	-5.07E-04	4.03E-04	23%	6.63E-04	2.97E-04
FTP2	-4.13E-04	1.79E-04	28%	1.68E-04	1.60E-04
FTP3	-5.92E-04	1.42E-04	30%	1.19E-04	1.22E-04
SRFA	-0.000683769959525		0.479178128110909	6.52046009501086E-05	
PLFA	-0.00027496951		0.19733043	5.71144E-05	

DNL Summe	Screening Factor				
	0.87543955	F1T0			
	0.87556618	F2T0	0.87550286	8.95381E-05	
	0.89894525	M1T0			
	0.89903366	M2T0	0.89898945	6.25153E-05	
	0.89816008	X1T0			
	0.89823295	X2T0	0.89819652	5.1524E-05	
	11.47	0.05656854	0.37756667	0.00870192	
	Iron	254	280	STD 254	STD 280
	Average	0.00143743	0.00180258	6.8568E-07	3.4268E-06
	t1	0.00143791	0.00180016		
	t2	0.00143694	0.001805		
	Methanol	254	280	STD 254	STD 280
	Average	0.00114131	0.00170029	3.58236E-05	8.2597E-05
	t1	0.00111598	0.00164189		
	t2	0.00116664	0.0017587		
	Plain	254	280	STD 254	STD 280
	Average	0.00125435	0.001728	6.34001E-06	1.4234E-05
	t1	0.00125883	0.00173806		
	t2	0.00124986	0.00171793		

+/-	Unamende d Rate 254nm	+/-	Iron Rate 254nm	+/-	Methanol Rate 254nm
2.19E-04	1.15E-03	4.01E-06	3.22E-03	4.72E-05	8.36E-04
1.62E-04	1.93E-03	2.86E-04	1.56E-03	4.94E-05	1.18E-03
6.25E-05	1.25E-03	6.34E-06	1.44E-03	6.86E-07	1.14E-03
5.89E-03	1.40E-03	2.75E-04	6.54E-03	1.36E-04	1.32E-03
1.57E-02	1.48E-03	2.43E-04	4.42E-03	9.52E-04	1.23E-03
	1.68E-03		6.89E-03		1.57E-03
3.47E-03	2.16E-03	5.11E-04	4.43E-03	8.50E-04	1.71E-03
	1.11E-03	1.20E-04	1.23E-03	6.41E-05	9.25E-04
	1.16E-03	7.54E-05	1.51E-03	8.89E-05	8.87E-04
	1.83E-03	2.94E-04	2.44E-03	2.84E-04	1.27E-03
	1.26E-03	1.05E-04	1.68E-03	1.45E-04	1.10E-03
	1.68E-03	5.97E-05	2.27E-03	1.29E-04	1.56E-03
	1.09E-03		1.77E-03		1.02E-03
	1.26E-03		1.53E-03		1.20E-03

% Difference
32%
55%
9%
5%
19%

7%
24%
18%
26%
41%
14%
7%

0.061953482670618

0.04653267

OCT Summe	Screening Factor				
	0.8414503	F1T0			
	0.84163112	F2T0	0.8415407075	0.00012786	
	0.86863458	M1T0			
	0.86886381	M2T0	0.868749194	0.00016208	
	0.86840817	X1T0			
	0.86840977	X2T0	0.86840897	1.1285E-06	
	11.5325	0.0917878	0.5275	0.00746414	
	Iron	254	280	STD 254	STD 280
	Average	0.00155764	0.0019219492	4.9383E-05	5.3007E-05
	t1	0.00159256	0.0019594311		
	t2	0.00152273	0.0018844673		
	Methanol	254	280	STD 254	STD 280
	Average	0.00117862	0.0017024969	0.00013957	0.00019677
	t1	0.00107993	0.0015633562		
	t2	0.00127731	0.0018416377		
	Plain	254	280	STD 254	STD 280
	Average	0.0020701	0.0027242961	0.00022278	0.00024377
	t1	0.00222763	0.0028966656		
	t2	0.00191257	0.0025519267		

+/-
1.50E-05
1.40E-04
3.58E-05
5.13E-05
3.92E-05
4.00E-04
8.88E-05
6.54E-05
7.87E-05
1.21E-04
1.06E-04

	Plain - Iron	+/-	% Difference
GSL Summe	-2.07E-03	4.74E-05	94.75%
OCT Summe	3.73E-04	2.90E-04	21.37%
DNL Summe	-1.83E-04	6.38E-06	13.60%
GSL Winter	-5.14E-03	3.06E-04	129.63%
DNL Winter	-2.94E-03	9.83E-04	99.75%
BSP	-5.21E-03		121.69%
BSGW	-2.27E-03	9.92E-04	68.72%
GSP1	-1.23E-04	1.36E-04	10.47%
GSP2	-3.49E-04	1.17E-04	26.21%
FTP1	-6.07E-04	4.08E-04	28.45%
FTP2	-4.13E-04	1.79E-04	28.10%
FTP3	-5.92E-04	1.42E-04	30.05%
SRFA	-6.84E-04		47.92%
PLFA	-2.75E-04		19.73%

BSP	-4.85E-03		109%
BSP	-0.00521199		1.21686047

Plain - Methanol	+/-	% Difference
3.13E-04	1.55E-05	31.56%
7.52E-04	3.18E-04	48.36%
1.13E-04	3.64E-05	9.44%
7.47E-05	2.79E-04	5.50%
2.54E-04	2.47E-04	18.76%
1.07E-04		6.57%
4.58E-04	6.49E-04	23.64%
1.84E-04	1.50E-04	18.07%
2.71E-04	9.98E-05	26.48%
5.63E-04	3.04E-04	36.34%
1.68E-04	1.60E-04	14.25%
1.19E-04	1.22E-04	7.34%
6.52E-05		6.20%
5.71E-05		4.65%

	[3]NOM* Rate
GSL Summer	1.98E-03
OCT Summer	2.15E-03
DNL Summer	1.75E-03
GSL Winter	1.84E-03
DNL Winter	1.45E-03
BSP	1.99E-03
BSGW	1.77E-03
GSP1	8.41E-04
GSP2	7.82E-04
FTP1	2.36E-03
FTP2	1.53E-03
FTP3	1.44E-03
SRFA	1.09E-03
PLFA	1.10E-03

+/-

4.69E-04 26%

0.00010662 0.06566116

+/-	R^2
1.10E-04	9.88E-01
8.01E-05	9.97E-01
1.24E-04	9.90E-01
1.91E-04	9.59E-01
3.02E-04	8.52E-01
4.32E-04	8.41E-01
2.96E-04	8.99E-01
1.30E-04	8.93E-01
4.26E-05	9.88E-01
2.15E-04	9.60E-01
2.72E-04	8.63E-01
3.10E-04	8.11E-01
9.13E-05	9.66E-01
7.31E-05	9.78E-01

Name	Condensed Name	Latitude (ºN)	Longitude (ºW)	Surface Area (m^2)
Goldstream Lake	GSL	64.916	-147.847	10,000
Octopus Lake	OCT	64.907	-147.860	22,000
Doughnut Lake	DNL	64.899	-147.908	34,000
Blacksheep Pond	BSP	64.888	-147.920	540
Goldstream Creek	GSBA	64.912	-147.832	N/A
	GSSC	64.909	-147.948	N/A
O'Connor Creek	OCC	64.915	-147.899	N/A

Table 3.1 Sampling Site Location Details

General information about sampling locations and permafrost underlain percentage based on AEM data discussed in detail in Section 3.3.1. Map of sampling location is located in Figure 2.1.

Max Depth (m)	Permafrost Degradation (%)
4.7	75-100%
2	25-75%
3.8	0-25%
0.5	100%
N/A	50%
N/A	50-75%
N/A	100%

Summer	pH	+/-	Water Temperature (ºC)	+/-	Average Daily Temp (ºC)
GSL Epi.	7.70	0.85	14.49	5.89	8.97
GSL Hypo.	7.10	0.45	8.35	3.24	10.54
OCT Epi.	7.34	1.02	13.69	6.62	9.72
OCT Hypo.	7.01	0.29	11.33	4.11	10.54
DNL Epi.	7.74	1.07	14.91	5.99	9.66
DNL Hypo.	6.98	0.53	13.41	5.56	9.66
BSP	7.62	0.07	15.80	3.54	8.30
GSBA	7.71	0.34	11.21	3.96	11.07
GSSC	7.10	0.49	9.71	5.94	8.28
OCC	7.71	0.25	4.86	3.10	9.15
Winter					
GSL Epi.	6.76	0.92	1.14	1.10	-12.53
GSL Hypo.	6.65	0.76	2.73	1.99	-11.95
OCT Epi.	7.31	0.34	1.27	1.05	-6.35
OCT Hypo.	7.19	0.18	3.03	2.19	-7.55
DNL Epi.	6.69	0.91	0.77	0.73	-14.37
DNL Hypo.	6.80	0.48	2.08	1.26	-14.73
BSP	7.14	N/A	-0.10	N/A	-17.64
GSBA	6.75	1.71	1.21	1.33	-6.94
GSSC	7.01	0.62	0.77	0.97	-7.12
OCC	7.06	0.93	-0.13	0.15	-7.12

Table 3.2 YSI Probe Data Compiled Averages

General water chemistry obtained through the use of a YSI probe. Averages were compiled on samples (Table 3.1) that utilized the probe, as some weather conditions limited the ability to measure. Average daily temperature was obtained at a weather station adjacent to GSL (Liljedahl, A., 2019). Error for each measurement was obtained from the standard deviation of probe measurements and denoted as ± values.

+/-	Specific Conductivity ($\mu S\ cm^{-1}\ ^oC^{-1}$)	+/-	Conductivity ($\mu S\ cm^{-1}$)	+/-	DO ($mg\ L^{-1}$)	+/-
4.17	281.88	426.08	208.59	315.05	6.09	2.43
2.84	318.48	587.42	221.28	410.28	1.46	2.53
3.64	77.05	117.12	58.80	94.57	5.47	1.67
2.84	117.47	229.66	87.26	169.08	0.61	0.61
3.31	149.71	219.35	111.42	156.69	5.40	2.51
3.31	170.66	240.02	124.88	174.22	2.66	5.67
6.07	1.02	0.36	0.84	0.31	2.31	1.88
3.41	168.08	393.35	127.25	296.51	9.41	2.03
6.16	181.93	390.14	133.22	295.20	10.00	2.23
5.37	186.42	444.53	129.69	269.33	11.28	3.15
11.28	513.59	640.97	360.67	399.89	14.82	17.78
12.02	595.89	663.09	433.00	423.64	7.08	12.79
6.52	14.73	28.84	145.00	306.09	5.70	5.08
6.86	284.39	491.56	296.31	346.73	2.09	2.06
10.53	367.13	337.35	177.43	166.70	21.53	23.25
11.49	367.73	338.43	239.36	188.44	16.12	16.98
N/A	0.08	N/A	0.15	N/A	1.76	N/A
6.16	76.83	132.65	39.76	68.63	49.50	52.60
7.53	5.51	9.09	2.84	4.47	13.33	N/A
7.53	19.19	32.74	9.77	16.66	13.40	N/A

DO (%)	+/-
61%	26%
5%	7%
53%	19%
5%	6%
54%	28%
5%	5%
22%	17%
89%	6%
85%	10%
96%	1%
28%	30%
13%	13%
34%	26%
16%	16%
9%	3%
21%	37%
13%	N/A
78%	15%
94%	N/A
92%	N/A

PCA O	PCA OM			PC
Mn	Mn	Na	Zn	TOC
Mw	Mw	Mg	As	TDN
TOC	TOC	Al	Se78	Na
TDN	TDN	K	Se82	Mg
SR	SR	Ca43#1	Sr	Al
E4:E6	E4:E6	Ca43#3	SrDil	K
E2:E3	E2:E3	Ca44#3	Mo	Ca43#1
E2:E4	E2:E4	Ti	Ag	Ca43#3
E2:E6	E2:E6	V	Cd	Ca44#3
E3:E4	E3:E4	Cr52	Sb	Ti
Log400/600	Log400/600	Cr53	Ba	V
BIX	BIX	Mn 2	Pb	Cr52
C:A	C:A	MnDil	Bi	Cr53
C:M	C:M	Fe 56#1	U	Mn 2
FI	FI	Fe56#2	Cl	MnDil
Freshness	Freshness	Fe57	SO4	Fe 56#1
HIX	HIX	Co		Fe56#2
SUVA254	SUVA254	Ni		Fe57
SUVA280	SUVA280	Cu		Co

Table 3.3 Principal Component Analysis Data Points Analyz

Data obtained through instrumentation that was utilized in each Principal Analysis model after obtaining z-scores for all concentrations and values Number Average Molecular Weight (Mn.w),Weight Average Molecular W total organic carbon (TOC), total dissolved nitrogen (TDN), metals denoted diluted 100 times, and the rest of abbreviations are found in Table 1.1 an Numbers are associated with ICPMS mode utilized for metal anal

A M
Ni
Cu
Zn
As
Se78
Se82
Sr
SrDil
Mo
Ag
Cd
Sb
Ba
Pb
Bi
U
Cl

zed

Component
Equation 1.
Veight (Mw),
with Dil were
d Table 1.2.
ysis.

Component	PCA O	PCA OM	PCA M
1	21.8%	24.3%	31.7%
2	15.1%	10.4%	13.3%
3	13.5%	9.5%	11.0%
4	11.1%	6.9%	7.4%

Table 3.4 Principal Component Eigenvalues

The percentage of how much of the data is explained by each component in each individual PCA model. All components listed were deemed statistically significant through a Barlett Test run by JMP statistical software. The first 4 principal components were used to observed close to 50% data explained.

Sample	Na ppb	+/-	Mg ppb	+/-	Al ppb
N	45*		47*		35*
GSL Epi.	37485.5	19982.3	49905.9	25917.3	36.2
OCT Epi.	8425.4	3314.9	16729.6	9263.3	46.2
DNL Epi.	14521.4	8018.8	25001.6	13478.8	9.2

Sample	V ppb	+/-	Cr ppb	+/-	Mn ppb
N	43		47*		46
GSL Epi.	0.8	0.8	2.5	1.7	602.5
OCT Epi.	1.1	0.9	1.3	1.3	380.2
DNL Epi.	0.2	0.2	0.6	0.3	325.9

Sample	Cu ppb	+/-	Zn ppb	+/-	As ppb
N	38		22		47*
GSL Epi.	0.5	0.4	127.6	395.0	6.0
OCT Epi.	0.4	0.3	3.0	4.0	19.2
DNL Epi.	0.4	0.8	7.8	9.5	3.1

Sample	Mo ppb	+/-	Ag ppb	+/-	Cd ppb
N	40*		24		25
GSL Epi.	0.4	0.2	0.1	0.1	0.0
OCT Epi.	0.2	0.1	0.1	0.1	0.0
DNL Epi.	0.1	0.1	0.1	0.1	0.0

Sample	Bi ppb	+/-	U ppb	+/-
N	30		28*	
GSL Epi.	0.2	0.3	0.7	0.3
OCT Epi.	0.1	0.2	0.1	0.0
DNL Epi.	0.2	0.2	0.1	0.1

Table 3.5 ANOVA Results and Epilimnion Averages

Statistical comparison of metals with comparison to thermokarst lake permafrost degradation in the epilimnions through an ANOVA statistical test. With a p-value of <0.0500 as statistically significant with the average metal concentrations denoted in

+/-	K ppb	+/-	Ca ppb	+/-	Ti ppb	+/-
	43		45		46	
62.6	5080.3	5012.8	61264.7	29877.5	4.1	2.8
29.6	4141.5	8342.5	27291.3	16932.3	3.7	2.9
10.0	2694.6	1580.2	38440.7	20235.8	1.1	0.9

+/-	Fe ppb	+/-	Co ppb	+/-	Ni ppb	+/-
	47*		43		43*	
722.3	1255.7	1616.4	0.6	0.3	7.2	3.9
515.7	5478.1	5737.8	0.6	0.3	1.9	0.5
439.5	513.4	612.7	0.2	0.1	1.5	1.0

+/-	Se78 ppb	+/-	Se82 ppb	+/-	Sr ppb	+/-
	33*		40*		46*	
5.3	0.8	1.5	52.6	37.2	323.2	164.6
19.2	0.9	1.9	8.5	4.3	155.1	101.6
1.5	0.2	0.1	27.3	19.0	165.0	100.7

+/-	Sb ppb	+/-	Ba ppb	+/-	Pb ppb	+/-
	39*		45		17	
0.0	0.5	0.2	74.3	42.5	0.1	0.3
0.0	0.2	0.1	48.3	23.2	0.1	0.0
0.0	0.2	0.1	41.6	28.7	0.1	0.2

P-Value	Concentration
<0.0001	High
<0.0010	Medium
<0.0100	Low
<0.0500	

Sample	Na ppb	+/-	Mg ppb	+/-
N	41		41	
GSL Hypo.	57823.5	19306.2	79102.4	27650.3
OCT Hypo.	9680.3	4543.6	21814.4	11132.6
DNL Hypo.	14141.8	6196.6	27452.8	9512.7

	V ppb	+/-	Cr ppb	+/-
N	39		41*	
GSL Hypo.	1.2	0.4	3.5	0.9
OCT Hypo.	1.6	1.0	1.4	0.7
DNL Hypo.	0.5	0.3	0.6	0.2

	Cu ppb	+/-	Zn ppb	+/-
N	32		28	
GSL Hypo.	0.2	0.1	595.0	2050.7
OCT Hypo.	0.3	0.2	1.7	2.1
DNL Hypo.	0.1	0.1	4.0	4.6

	Mo ppb	+/-	Ag ppb	+/-
N	36		21	
GSL Hypo.	0.5	0.3	0.0	0.0
OCT Hypo.	0.3	0.2	0.1	0.2
DNL Hypo.	0.2	0.2	0.1	0.1

	Bi ppb	+/-	U ppb	+/-
N	25*		30	
GSL Hypo.	0.1	0.1	0.8	0.4
OCT Hypo.	0.3	0.3	0.2	0.3
DNL Hypo.	0.1	0.1	0.1	0.1

Table 3.6 ANOVA Results and Hypolimnion Averages

Statistical comparison of metals with comparison to thermokarst lake p
degradation in the hypolimnions through an ANOVA statistical test. With

Al ppb	+/-	K ppb	+/-	Ca ppb	+/-	Ti ppb
35		41		40		42
9.9	10.9	7408.3	7206.7	95851.6	29036.7	5.7
57.0	98.0	2999.5	2211.6	35120.2	17137.7	5.1
7.7	7.2	2771.3	1108.1	40799.6	13776.2	1.6

Mn ppb	+/-	Fe ppb	+/-	Co ppb	+/-	Ni ppb
40*		42*		42*		40
1870.8	701.8	3331.5	1696.0	1.0	0.2	9.8
769.3	435.9	8011.5	5549.6	1.0	0.3	2.2
493.7	393.3	739.6	589.6	0.3	0.1	1.9

As ppb	+/-	Se78 ppb	+/-	Se82 ppb	+/-	Sr ppb
40*		31*		39*		41
9.5	6.0	0.6	0.2	69.5	29.8	532.6
29.3	17.3	0.2	0.2	9.7	5.8	212.5
5.8	4.2	0.2	0.1	31.6	16.0	180.1

Cd ppb	+/-	Sb ppb	+/-	Ba ppb	+/-	Pb ppb
21		38		42		16
0.0	0.0	0.8	0.5	104.5	41.8	0.1
0.0	0.0	0.2	0.1	62.0	19.6	0.2
0.0	0.0	0.4	0.4	58.7	24.1	0.0

P-Value	Concentration
<0.0001	High
<0.0010	Medium
<0.0100	Low
<0.0500	

permafrost

+/-
2.4
2.4
1.1

+/-
1.4
1.4
0.9

+/-
187.5
107.2
67.8

+/-
0.1
0.2
0.0

Sample	Na ppb	+/-	Mg ppb	+/-	Al ppb
N	53*		55*		43*
BSP	70617.4	39592.0	66911.1	44908.0	34.4
GSL Epi.	37485.5	19982.3	49905.9	25917.3	36.2
OCT Epi.	8425.4	3314.9	16729.6	9263.3	46.2
DNL Epi.	14521.4	8018.8	25001.6	13478.8	9.2

	V ppb	+/-	Cr ppb	+/-	Mn ppb
N	51		55		54
BSP	0.7	0.6	2.1	1.4	222.8
GSL Epi.	0.8	0.8	2.5	1.7	602.5
OCT Epi.	1.1	0.9	1.3	1.3	380.2
DNL Epi.	0.2	0.2	0.6	0.3	325.9

	Cu ppb	+/-	Zn ppb	+/-	As ppb
N	44		28		55*
BSP	0.8	1.3	6.2	8.0	5.2
GSL Epi.	0.5	0.4	127.6	395.0	6.0
OCT Epi.	0.4	0.3	3.0	4.0	19.2
DNL Epi.	0.4	0.8	7.8	9.5	3.1

	Mo ppb	+/-	Ag ppb	+/-	Cd ppb
N	48		24		30
BSP	0.2	0.2	0.0	N/A	0.0
GSL Epi.	0.4	0.2	0.1	0.1	0.0
OCT Epi.	0.2	0.1	0.1	0.1	0.0
DNL Epi.	0.1	0.1	0.1	0.1	0.0

	Bi ppb	+/-	U ppb	+/-
N	34		36*	
BSP	0.1	0.1	0.6	0.3
GSL Epi.	0.2	0.3	0.7	0.3
OCT Epi.	0.1	0.2	0.1	0.0
DNL Epi.	0.2	0.2	0.1	0.1

Table 3.7 ANOVA Results and Epilimnion Averages with BSP

+/-	K ppb	+/-	Ca ppb	+/-	Ti ppb	+/-
	50		53*		54	
33.9	6675.0	6914.3	59292.1	35739.7	6.1	5.1
62.6	5080.3	5012.8	61264.7	29877.5	4.1	2.8
29.6	4141.5	8342.5	27291.3	16932.3	3.7	2.9
10.0	2694.6	1580.2	38440.7	20235.8	1.1	0.9

+/-	Fe ppb	+/-	Co ppb	+/-	Ni ppb	+/-
	55*		51		51*	
219.0	216.1	128.3	0.6	0.4	6.0	3.1
722.3	1255.7	1616.4	0.6	0.3	7.2	3.9
515.7	5478.1	5737.8	0.6	0.3	1.9	0.5
439.5	513.4	612.7	0.2	0.1	1.5	1.0

+/-	Se78 ppb	+/-	Se82 ppb	+/-	Sr ppb	+/-
	41		52*		54	
3.1	0.5	0.3	67.7	67.8	271.1	140.3
5.3	0.8	1.5	52.6	37.2	323.2	164.6
19.2	0.9	1.9	8.5	4.3	155.1	101.6
1.5	0.2	0.1	27.3	19.0	165.0	100.7

+/-	Sb ppb	+/-	Ba ppb	+/-	Pb ppb	+/-
	47*		53*		23	
0.0	0.7	0.4	133.1	114.7	0.1	0.1
0.0	0.5	0.2	74.3	42.5	0.1	0.3
0.0	0.2	0.1	48.3	23.2	0.1	0.0
0.0	0.2	0.1	41.6	28.7	0.1	0.2

P-Value	Concentration
<0.0001	High
<0.0010	Medium
<0.0100	Low
<0.0500	Lowest

Sample	Na ppb	+/-	Mg ppb	+/-	Al ppb
N	40		42		38
GSBA	4527.8	2939.1	8265.9	2825.6	28.8
GSSC	5152.9	2970.4	10062.3	2100.1	28.4
OCC	21813.2	46891.2	22014.3	6321.2	39.1

Sample	V ppb	+/-	Cr ppb	+/-	Mn ppb
N	42		40		42
GSBA	0.7	0.6	0.8	1.4	113.6
GSSC	0.9	0.6	0.7	1.4	109.9
OCC	1.2	0.6	0.7	1.2	80.5

Sample	Cu ppb	+/-	Zn ppb	+/-	As ppb
N	36		17		40
GSBA	1.7	0.6	4.0	5.9	5.7
GSSC	1.6	0.6	2.7	2.4	6.6
OCC	1.9	1.1	7.4	7.9	3.9

Sample	Mo ppb	+/-	Ag ppb	+/-	Cd ppb
N	39		22		24
GSBA	1.2	0.3	0.1	0.3	0.0
GSSC	1.0	0.3	0.1	0.2	0.0
OCC	0.3	0.2	0.1	0.1	0.0

Sample	Bi ppb	+/-	U ppb	+/-
N	18		32	
GSBA	0.2	0.3	0.3	0.2
GSSC	0.1	0.1	0.3	0.3
OCC	0.2	0.2	0.4	0.3

Table 3.8 ANOVA Results and Stream Averages

Statistical comparison of metals with comparison to stream sampling locations through an ANOVA statistical test. With a p-value of <0.0500 as statistically significant with the average metal concentrations denoted in ppb for each metal. Colors determines which thermokarst lake has the highest (red), medium (yellow), and low (green) concentration for metals that observed statistical difference between streams. Asterisk (*) denotes Welch ANOVA p-values used, when Brown-Forsythe test determined the

	K		Ca		Ti	
+/-	ppb	+/-	ppb	+/-	ppb	+/-
	38		42		42	
23.8	1754.5	679.8	23135.2	4831.9	2.1	0.9
28.4	2126.6	2026.2	24154.8	5517.9	2.3	0.9
34.0	3035.4	5417.3	19992.4	5784.2	2.9	1.1

	Fe		Co		Ni	
+/-	ppb	+/-	ppb	+/-	ppb	+/-
	41		38		37	
52.1	889.7	454.6	0.5	0.3	2.2	1.2
59.3	1055.6	241.0	0.4	0.2	1.8	1.2
34.4	621.1	297.4	0.4	0.2	1.7	0.9

	Se78		Se82		Sr	
+/-	ppb	+/-	ppb	+/-	ppb	+/-
	21		45		40	
5.0	1.0	2.1	2.5	1.4	146.8	38.3
5.0	1.0	2.1	2.9	1.7	149.0	42.5
6.1	0.6	1.7	3.6	3.4	95.7	30.4

	Sb		Ba		Pb	
+/-	ppb	+/-	ppb	+/-	ppb	+/-
	39		39		16	
0.0	0.4	0.1	31.5	5.6	0.2	0.2
0.0	0.4	0.1	31.8	9.1	0.2	0.1
0.0	0.4	0.2	24.0	4.9	0.2	0.1

P-Value	Concentration
<0.0001	High
<0.0010	Medium
<0.0100	Low
<0.0500	

	Na	Mg	Al	K
DNL Epi. Vs. Hypo.	14/14	14/15	12/11	14/14
GSL Epi. Vs. Hypo.	15/17*	15/18*	13/11	15/16*
OCT Epi. Vs. Hypo.	12/14	12/14	10/13*	12/13*
GSL Epi. Vs. BSP	17/8*	18/8	11/8*	16/7

	Zn	As	Se	Sr
DNL Epi. Vs. Hypo.	8/7	13/15	9/10	14/15
GSL Epi. Vs. Hypo.	10/9*	15/18*	13/14	15/17*
OCT Epi. Vs. Hypo.	10/6*	12/14	9/9	12/14
GSL Epi. v BSP	9/6*	18/8	14/8	17/8

Table 3.9 T-Test to Determine Differences Between Epilimnio

Statistical T-Test to determine which metals observed concentration differences bet three years of sample collection; 2016-2018. P-Values < 0.0500 were deemed s concentrations as observed in gradient coloration, the darker the color the increase between epilimnion and hypolimnion. Numbers within the table denote the number (epi./hypo.). Asterisk (*) denotes Welch t-test p-values used, when the standard devi through an F-test to compare variance. Sample abbreviat

Ca	Ti	V	Cr	Mn	Fe	Co
14/14	14/15	13/13	14/15	14/15	14/15	14/15
15/17*	16/17	14/17*	15/18*	14/17*	16/18	16/17
11/14	12/14	12/13	12/14*	12/14	12/14	12/11
17/8	17/8*	17/8	18/8	17/8*	18/8*	17/8

Mo	Ag	Cd	Sb	Ba	Pb	Bi
9/11	4/6	5/7	12/12	14/15	5/6*	8/8
15/17	9/9	8/11*	15/16	16/17	6/6*	9/13
12/12	8/9*	8/7*	11/11	12/13	5/5*	8/9
17/8	N/A	11/5	16/8	17/8*	6/6*	13/4

n and Hypolimnion for Trace Metals

ween the epilimnion (epi.) and hypolimnion (hypo.) over
tatistically different, observing stratification of metal
in statistical difference observed in metal concentrations
· of samples observed in the epilimnion and hypolimnion
ation variance between samples were statistically different
:ions are denoted in Table 3.1.

Ni	Cu
13/14	11/13
15/17*	13/14*
12/12*	8/11*
17/8*	14/6*

U	Legend
7/7	<0.0001
16/14	<0.0010
7/7	<0.0100
14/8	<0.0500

	Na	Mg	Al	K	Ca
GSL Epi.	10/7	10/8	6/5	9/7	10/7
GSL Hypo.	9/6	9/6	8/5	8/7*	9/6
OCT Epi.	9/5	9/5*	9/4	8/5*	9/5*
OCT Hypo.	8/4	8/4	6/4	8/4*	7/4*
DNL Epi.	7/7	8/7	4/7	7/7	7/7*
DNL Hypo.	8/6	8/6	6/6	8/6	8/6
	Zn	**As**	**Se**	**Sr**	**Mo**
GSL Epi.	4/5	10/8*	6/6	10/7	10/7
GSL Hypo.	5/5	9/6	6/5	9/6	8/7*
OCT Epi.	*4/2*	9/5*	*4/3*	9/5*	8/4
OCT Hypo.	6/4	8/4*	*5/3*	8/4	8/4
DNL Epi.	*2/5*	8/7	*3/6*	8/7	5/6*
DNL Hypo.	*3/5*	7/6	*3/5**	8/6	4/5

Table 3.10 T-Test Results Comparing Summer and Winter Metal Conc

Statistical T-Test to observe seasonal differences in individual thermokarst lake sampl and summer over three years of sample collection; 2016-2018. Color gradient indicate maximum cut off for statistical differences of p-value > 0.05000. Blue gradient indica Orange gradient indicates the average was higher in summer time. Numbers within observed in summer and winter (summer/winter). Asterisk (*) denotes Welch t-test p- variance between samples were statistically different through an F-test to compare varia were the sample number is less than or equal to 3, and interpretations should be mad denoted in Table 3.1.

Ti	V	Cr	Mn	Fe	Co	Ni
9/8*	9/8*	10/8	9/8*	10/8*	10/7	10/7
9/7	9/5*	9/6	8/6	9/7	9/7	9/6
9/5*	8/5*	9/5*	9/5*	9/5*	7/4*	8/4
8/4	8/4	8/4*	8/4	8/4*	8/4	8/4
8/7*	6/7	8/7	8/7*	8/7*	8/7	7/7
8/6	7/6	8/6	8/6	8/6	8/6	7/6

Ag	Cd	Sb	Ba	Pb	Bi	U
7/2	5/6*	9/7	10/7	*4/2*	7/6*	7/7
*6/3**	4/4*	9/6	9/7	*4/2*	4/5*	9/7
*6/3**	*4/3*	7/4	9/4*	*4/1*	*6/3**	*5/2*
5/3	*5/3*	7/4	8/4	*4/1*	*5/3*	*5/2*
5/1	*3/4**	6/6	8/7*	*3/3*	4/4	*4/3*
3/1	*2/3*	6/6	8/6	*3/2*	*5/3**	*4/3**

entrations Thermokarst Lakes

es for metal concentrations between winter
s p-value, with the lightest representing the
tes the average was higher in winter time.
the table denote the number of samples
-values used, when the standard deviation
nce. Numbers in italics and red are samples
e with caution. Sample abbreviations are

Cu
77
7/6
7/4
*5/3**
7/6
6/5

Legend
<0.0001
<0.0010
<0.0100
<0.0500

	C		N
	#/#		#/#
3 Year ANOVA	137		127*
T-Test 2016 Vs. 2017	44/40		32/41
T-Test 2016 Vs. 2018	44/53		32/54*
T-Test 2017 Vs.2018	40/53		41/54*
	ppm	**+/-**	**ppm**
2016 Avg. Concentration	46.3	39.6	2.6
2017 Avg. Concentration	59.0	48.1	2.6
2018 Avg. Concentration	58.8	45.9	0.6
	Ti		**V**
	#/#		#/#
3 Year ANOVA	149		143
T-Test 2016 Vs. 2017	45/42		43/41
T-Test 2016 Vs. 2018	45/62		43/59
T-Test 2017 Vs.2018	42/62		41/59
	ppb	**+/-**	**ppb**
2016 Avg. Concentration	3.1	2.4	0.8
2017 Avg. Concentration	2.7	2.2	0.9
2018 Avg. Concentration	4.1	2.8	1.0
	Zn		**As**
	#/#		#/#
3 Year ANOVA	80		149
T-Test 2016 Vs. 2017	17/26*		45/42
T-Test 2016 Vs. 2018	17/37*		45/62
T-Test 2017 Vs.2018	26/37		42/62
	ppb	**+/-**	**ppb**
2016 Avg. Concentration	77.0	302.8	9.6
2017 Avg. Concentration	3.9	4.9	9.9
2018 Avg. Concentration	3.6	4.4	9.1
	Sb		**Ba**
	#/#		#/#
3 Year ANOVA	135		144
T-Test 2016 Vs. 2017	36/42*		45/42*
T-Test 2016 Vs. 2018	36/57		45/57
T-Test 2017 Vs.2018	42/57*		42/57*
	ppb	**+/-**	**ppb**
2016 Avg. Concentration	0.3	0.2	55.8
2017 Avg. Concentration	0.6	0.4	66.0
2018 Avg. Concentration	0.4	0.2	57.6

Table 3.11 Determination of Year to Year Statist

An overall ANOVA for determining statistical differences between samp
Underneath the ANOVA denoted by the years utilized are the T-test to determ
The grey gradation is an indicator of p-value strength with the lightest grey rep
statistically different at a p-value > 0.0500. Sample number are found within t
each year in the T-Tests (early year/later year). Additionally, asterisks (*) denc
tests that utilized the Welch's version, after determining the standard deviation
different through Brown-Forsythe test for ANOVA and the F-Test for T-Tests
averages and standard deviation (±) for each metal concentration throughout
indicate which year was statistically different overall with blue being 2016, o
Samples without values did not have enough samples above detection limits
denoted in Table 3.1.

	Li		Na		Mg	
	#/#		#/#		#/#	
			148		149	
			44/42*		45/42	
			44/62		45/62	
			42/62		42/62	
+/-	**ppb**	**+/-**	**ppb**	**+/-**	**ppb**	**+/-**
2.7			19729.0	31443.0	29802.0	30616.0
3.0			23173.0	21893.0	32140.0	26273.0
0.9	1.6	1.2	23762.0	29058.0	31091.0	28921.0

	Cr		Mn		Fe	
	#/#		#/#		#/#	
	146*		149		149	
	45/41		45/42		45/42	
	45/60*		45/62		45/62	
	41/60		42/62		42/62	
+/-	**ppb**	**+/-**	**ppb**	**+/-**	**ppb**	**+/-**
0.7	1.1	1.1	522.6	763.9	2236.0	3496.0
0.6	1.2	1.3	571.1	650.9	2022.0	3617.0
0.8	1.7	1.7	495.2	619.0	2027.0	3158.0

	Se78		Se82		Sr	
	#/#		#/#		#/#	
	91*		149*		148	
	7/22		45/41*		45/42	
	7/62*		45/62*		45/61	
	22/62*		42/62*		42/61	
+/-	**ppb**	**+/-**	**ppb**	**+/-**	**ppb**	**+/-**
13.0	0.2	0.2	22.1	29.5	239.0	196.4
11.6	0.3	0.3	39.7	48.3	247.8	157.0
10.2	0.7	1.4	19.3	20.2	234.7	163.4

	Pb		Bi		U	
	#/#		#/#		#/#	
			89*		105*	
			27/32*		22/26*	
			27/30		22/57	
	3/56		32/30		26/57*	
+/-	**ppb**	**+/-**	**ppb**	**+/-**	**ppb**	**+/-**
35.0			0.0	0.1	0.6	0.6
64.4	0.2	0.1	0.2	0.2	0.6	0.3
38.4	0.1	0.2	0.2	0.3	0.3	0.2

tical Differences

ling seasons of 2016, 2017, and 2018.
nine which year was significantly different.
resenting the maximum p-value considered
he cells as an overall in the ANOVA or for
ted sample numbers are for those statistical
variance between samples was statistically
. Underneath statistical tests results are the
that sample year are found. Colored boxes
range being 2017, and purple being 2018.
or were not run. Sample abbreviations are

Al		K		Ca	
#/#		#/#		#/#	
122		147		165	
34/35*		43/42*		61/42	
34/53		43/62*		61/62	
35/53		42/62*		42/62	
ppb	**+/-**	**ppb**	**+/-**	**ppb**	**+/-**
22.1	21.2	4492.0	7582.0	47629.0	32504.0
26.6	32.8	3497.0	2277.0	42039.0	26567.0
21.6	24.7	3443.0	3649.0	44414.0	29286.0

Co		Ni		Cu	
#/#		#/#		#/#	
143		139		124	
45/42		44/37		42/42*	
45/56		44/58		41/41*	
42/56		37/58		42/41	
ppb	**+/-**	**ppb**	**+/-**	**ppb**	**+/-**
0.5	0.3	3.4	3.4	0.7	0.6
0.6	0.4	3.4	3.5	0.9	1.0
0.5	0.3	4.0	3.4	0.8	1.0

Mo		Ag		Cd	
#/#		#/#		#/#	
135		78*		83*	
36/42*		34/13*		9/42*	
36/57*		34/31*		9/32	
42/57		13/31		42/32	
ppb	**+/-**	**ppb**	**+/-**	**ppb**	**+/-**
0.6	0.8	0.19	0.21	0.01	0.00
0.5	0.4	0.02	0.02	0.02	0.01
0.5	0.5	0.02	0.04	0.01	0.01

Cl		Legend	
#/#			
123		2016 Different	**<0.0001**
32/39*		2017 Different	**<0.0010**
32/52		2018 Different	**<0.0100**
39/52*			**<0.0500**
ppb	**+/-**		
12.2	16.0		
9.6	10.5		
15.2	21.6	*Welch ANOVA or T-Test utilized	

Sample Location	Na	Mg	Al	K
GSSC	11/3	11/3	10/2	10/3
GSBA	10/4	10/4*	10/3	10/4
OCC	9/3*	11/3	11/2	8/3

Sample Location	Zn	As	Se	Sr
GSSC	6/1	11/3*	4/3*	9/3*
GSBA	4/3*	10/4*	4/4*	10/4
OCC	n/a	9/3*	7/3*	11/3

Table 3.12 T-Test Results Comparing Summer and Winter Meta

Statistical T-Test to observe seasonal differences in metal concentrations for indi
summer over three-year water collection; 2016-2018. Color gradient indicates p
maximum cut off for statistical differences of p-value > 0.05000. Blue gradient i
time. Numbers in the cells are those of the sample number (summer/winter) and a
utilized, when the standard deviation variance was determined to be statistically d
Red italicized cells are samples with a sample number less than or equal to 3 and
the statistics. Sample abbreviations denoted in T

Ca	Ti	V	Cr	Mn	Fe	Co
11/3	*11/3**	*11/3**	*10/3**	*11/3*	*11/3*	*10/2*
10/4*	10/4*	10/4*	9/4*	10/4	9/4	*10/3*
11/3	*11/3*	*11/3**	*11/3**	*11/3*	*11/3*	*11/2*

Mo	Ag	Cd	Sb	Ba	Pb	Bi
11/2	n/a	*6/2*	*11/2*	*11/2*	n/a	*7/1*
10/3	n/a	*5/3*	*10/3*	*10/3*	*4/1*	*4/1*
11/2	*8/1*	*6/2*	*11/2*	*11/2*	n/a	*4/1*

ıl Concentrations in Streams

vidual stream samples between winter and
›-value, with the lightest representing the
ndicates the average was higher in winter
asterisks (*) indicates Welch's T-Test was
lifferent between samples using an F-Test.
thus, care should be taken when observing
Γable 3.1.

Ni	Cu
11/2	*10/2*
10/3	*9/3*
10/1	*10/2*

U	Legend
9/2	<0.0001
7/2	<0.0010
10/2	<0.0100
	<0.0500

Sample Location	C/Cl ppm/ppm	Li/Cl ppb/ppm	Na/Cl ppb/ppm	Mg/Cl ppb/ ppm
GSL Epi.	8/6*	*3/2*	9/6*	9/6*
GSL Hypo.	8/5*	*4/2*	9/5*	9/5*
OCT Epi.	*9/3*	*4/1*	*9/3*	*9/3*
OCT Hypo.	*8/2*	*4/1*	*8/2*	*8/2*
DNL Epi.	8/5	*3/2*	7/4*	8/5
DNL Hypo.	7/4	*3/2*	8/4	7/4

Sample Location	Cu/Cl ppb/ppm	Zn/Cl ppb/ppm	As/Cl ppb/ppm	Se/Cl ppb/ppm
GSL Epi.	6/5	*4/3*	9/6*	5/6*
GSL Hypo.	7/5*	5/4*	9/5*	6/4*
OCT Epi.	*7/2*	*4/1*	*9/3*	*4/2*
OCT Hypo.	*6/2*	*6/2*	*8/2*	*5/2*
DNL Epi.	7/4*	*2/3*	8/5	*3/4**
DNL Hypo.	*6/3*	*3/3**	7/4	*3/3**

Table 3.13 Seasonality of Metal to Chloride Ratio Values for Ind

Statistical T-Test to observe seasonal differences in individual thermokarst lake s and summer for a three-year period from 2016-2018. Color gradient indicates p-v for statistical differences of p-value > 0.05000. Blue gradient indicates the average of the sample number (summer/winter) and asterisks (*) indicates Welch's T-T deviation variance of samples were statistically different. Red italicized cells are s thus, care should be taken when observing the statistics. Sample

Al/Cl ppb/ppm	K/Cl ppb/ppm	Ca/Cl ppb/ppm	Ti/Cl ppb/ppm	V/Cl ppb/ppm	Cr/Cl ppb/ppm	Mn/Cl ppb/ppm
5/4	8/6*	9/6*	8/6*	8/6*	9/6*	7/6*
8/3	8/5*	9/5*	9/5*	9/4*	9/4*	9/5*
8/2	*8/3*	*9/3*	*9/3*	*8/3*	*9/3*	*9/3**
6/2	*8/2*	*8/2*	*8/2*	*8/2*	*8/2*	*8/2*
4/5	7/5	7/4*	8/5	6/5	8/5	7/4*
6/4	8/4	8/4	7/4	6/4	8/4	7/4*

Sr/Cl ppb/ppm	Mo/Cl ppb/ppm	Ag/Cl ppb/ppm	Cd/Cl ppb/ppm	Sb/Cl ppb/ppm	Ba/Cl ppb/ppm	Pb/Cl ppb/ppm
9/6*	8/5	*6/1*	5/5*	8/5*	9/5*	*3/2*
9/5*	9/5*	*6/2*	4/5	9/5*	9/5*	*4/2*
9/3	*8/2*	*6/2*	*4/2*	*7/2*	*9/2*	*4/1*
8/2	*8/2*	*5/2*	*4/2*	*7/2*	*8/2*	*4/1*
8/4*	5/4*	*5/1*	*3/2*	6/4	8/5	*3/2*
6/4*	*4/3*	*3/1*	*2/1*	6/4	7/4	*3/2*

lividual Thermokarst Lakes

samples for metal to chloride ratio values between winter
value, with the lightest representing the maximum cut off
e was higher in winter time. Numbers in the cells are those
Test was utilized when F-Test determined the standard
samples with a sample number less than or equal to 3 and
abbreviations are denoted in Table 3.1.

Fe/Cl ppb/ppm	**Co/Cl ppb/ppm**	**Ni/Cl ppb/ppm**	**N/Cl ppb/ppm**
9/6*	9/5*	9/6*	7/5
8/5*	9/5*	9/4*	7/5*
9/3	*8/2*	*8/2*	*8/3*
8/2	*8/2*	*8/2*	*7/2*
8/5*	8/5	6/5*	7/4
7/4*	8/4	6/4*	*7/3*

Bi/Cl ppb/ppm	**U/Cl ppb/ppm**	**Legend**
7/4	6/5*	**<0.0001**
4/4*	9/5*	**<0.0010**
*6/2**	*5/2*	**<0.0100**
5/2	*5/2*	**<0.0500**
4/4	*4/2*	
5/2	*4/3*	

C/Cl ppm/ppm	**N/Cl ppm/ppm**	**Li/Cl ppb/ppm**	**Na/Cl ppb/ppm**	**Mg/Cl ppb/ ppm**	**Al/Cl ppb/ppm**
86/33	77/31*	36/11*	87/32*	85/33	70/25*
Cr/Cl ppb/ppm	**Mn/Cl ppb/ ppm**	**Fe/Cl ppb/ppm**	**Co/Cl ppb/ppm**	**Ni/Cl ppb/ppm**	**Cu/Cl ppb/ppm**
88/32*	86/32*	86/33*	89/28	85/28	74/26*
Sr/Cl ppb/ppm	**Mo/Cl ppb/ ppm**	**Ag/Cl ppb/ppm**	**Cd/Cl ppb/ppm**	**Sb/Cl** ppb/ppm	**Ba/Cl ppb/ppm**
85/32*	80/26*	54/10*	40/22	81/27*	87/28*

Table 3.14 Seasonality of Metal to Chloride Ratio Values of Overall

Statistical T-Test to observe seasonal differences in total watershed (thermokarst la
compilation for metal to chloride ratio values between winter and summer for three-
observe overall seasonality observed for chloride normalized metal concentrations. Col
with the lightest representing the maximum cut off for statistical differences of p-valu
indicates the average was higher in winter time. Orange gradient indicates the average
Numbers in the cells are those of the sample number (summer/winter) and asterisks (*
was utilized when F-test determined the standard deviation variance between samples

K/Cl ppb/ppm	Ca/Cl ppb/ppm	Ti/Cl ppb/ppm	V/Cl ppb/ppm
86/33*	88/32*	88/33	84/32
Zn/Cl ppb/ppm	**As/Cl ppb/ppm**	**Se78/Cl ppb/ppm**	**Se82/Cl ppb/ppm**
41/19*	86/33*	44/27*	82/33*
Pb/Cl ppb/ppm	**Bi/Cl ppb/ppm**	**U/Cl ppb/ppm**	**Legend**
37/11*	54/22*	62/24*	**<0.0100**
			<0.0500

Ratio Values

ıke and stream samples)
years from 2016-2018, to
ɔr gradient indicates p-value,
.e > 0.05000. Blue gradient
was higher in summer time.
*) indicates Welch's T-Test
; was statistically different.

	C/Cl				
	n	Minimum ppm/ppm	Maximum ppm/ppm	Variance +/-	n
Summer	86	0.9	31.8	5.9	77
Winter	33	2.0	29.6	7.6	31

	Mg/Cl				
	n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-	n
Summer	85	773.8	41537.0	6218.0	70
Winter	33	102.7	19106.0	4899.0	25

	Ti/Cl				
	n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-	n
Summer	88	0.0	5.3	1.0	84
Winter	33	0.0	4.0	0.9	32

	Fe/Cl				
	n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-	n
Summer	86	4.1	4138.0	728.3	89
Winter	33	1.4	7778.0	1363.0	28

	Zn/Cl				
	n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-	n
Summer	41	0.0	4.1	0.9	86
Winter	19	0.0	1.6	0.4	33

	Sr/Cl				
	n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-	n
Summer	85	3.6	500.9	74.4	80
Winter	32	2.3	131.8	37.2	26

	Sb/Cl***				
	n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-	n
Summer	81	0.0	1.0	0.2	87
Winter	27	0.0	0.3	0.1	28

	U/Cl				
	n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-	n
Summer	62	0.0	1.4	0.2	90
Winter	24	0.0	0.4	0.1	33

Table 3.15 Seasonal Variability in Metal to Chloride Ratio Values

Variability between metal – chloride relationships was determined based on the ma standard deviation from the average of all the samples during the winter or summer. T and minimum for a certain sample number is represented for each ratio. The samples d triple asterisks (***) represent the metals that were determined to have a seasonal diffe a T-Test, results found in Table 3.14. Yellow indicates a decreased standard deviation o thus, variability in summer time samples. Meanwhile, green indicates a decreased stanc or variance and thus, variability in winter samples.

N/Cl				Li/Cl***		
Minimum ppm/ppm	Maximum ppm/ppm	Variance +/-	n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-
0.0	3.8	0.6	36	0.0	2.9	0.7
0.0	1.5	0.3	11	0.0	0.3	0.1

Al/Cl				K/Cl		
Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-	n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-
0.0	142.8	19.3	86	30.4	5129.0	736.7
0.1	22.5	5.7	33	18.0	1728.0	409.5

V/Cl				Cr/Cl***		
Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-	n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-
0.0	3.4	0.5	88	0.0	1.5	0.2
0.0	2.2	0.5	32	0.1	4.1	0.9

Co/Cl				Ni/Cl		
Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-	n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-
0.0	1.4	0.2	85	0.0	3.2	0.6
0.0	0.7	0.2	28	0.0	2.8	0.8

As/Cl				Se78/Cl		
Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-	n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-
0.1	12.6	3.1	44	0.0	0.5	0.1
0.1	23.0	5.4	27	0.0	4.5	1.0

Mo/Cl***				Ag/Cl		
Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-	n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-
0.0	4.0	0.6	54	0.0	0.7	0.1
0.0	0.7	0.1	10	0.0	0.1	0.0

Ba/Cl				Pb/Cl***		
Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-	n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-
1.3	94.6	16.4	37	0.0	0.3	0.1
0.4	34.8	8.7	11	0.0	0.0	0.0

Cl			
Minimum ppb/ppm	**Maximum ppb/ppm**	**Variance +/-**	
0.6	73.5	17.9	Variablity Decreased in Summer
1.2	79.5	16.1	Variability Decreased in Winter
			***Statisitically Different See Table 3.14

gnitude of
he maximum
enoted with a
rence through
r variance and
lard deviation

Na/Cl***			
n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-
87	367.0	23022.0	2635.0
32	115.8	13796.0	3548.0

Ca/Cl			
n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-
88	1017.0	88718.0	14089.0
32	417.7	22084.0	6461.0

Mn/Cl			
n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-
86	0.4	1579.0	188.3
32	0.7	480.6	131.7

Cu/Cl***			
n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-
74	0.0	2.8	0.6
26	0.0	1.8	0.4

Se82/Cl***			
n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-
82	0.1	7.5	1.6
33	0.6	28.0	5.7

Cd/Cl***			
n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-
40	0.0	0.0	0.0
22	0.0	0.0	0.0

Bi/Cl			
n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-
54	0.0	0.5	0.1
22	0.0	0.2	0.1

Sample	C/Cl ppm/ppm	+/-	N/Cl ppm/ppm	+/-	Li/Cl ppb/ppm
N	39		31		15
GSL Epi.	4.44	8.96	0.07	0.14	0.05
OCT Epi.	8.67	5.69	0.11	0.24	0.24
DNL Epi.	7.65	3.54	0.09	0.21	0.11

	Ti/Cl ppb/ppm	+/-	V/Cl ppb/ppm	+/-	Cr/Cl ppb/ppm
N	39		36		40
GSL Epi.	0.03	0.53	0.11	0.11	8.34
OCT Epi.	0.23	0.40	0.22	0.11	34.66
DNL Epi.	0.04	0.13	0.10	0.02	4.37

	Zn/Cl ppb/ppm	+/-	As/Cl ppb/ppm	+/-	Se78/Cl ppb/ppm
N	17		40*		24
GSL Epi.	0.18	0.23	0.02	0.70	3.13
OCT Epi.	2.29	1.78	0.07	2.83	1.25
DNL Epi.	0.56	0.66	0.02	0.23	3.68

	Sb/Cl ppb/ppm	+/-	Ba/Cl ppb/ppm	+/-	Pb/Cl ppb/ppm
N	32		38		15
GSL Epi.	0.03	0.05	2.40	9.57	0.00
OCT Epi.	0.05	0.03	10.21	8.00	0.02
DNL Epi.	0.04	0.02	5.73	3.22	0.00

Table 3.16 ANOVA Results of Metal to Chloride Ratio in Thermokarst

Statistical comparison of metal to chloride ratio with comparison to thermokarst lake p epilimnion (epi.) through an ANOVA statistical test. With a p-value of <0.0500 as stat average metal to chloride ratio values for each location, with the number of samples fo which the color gradient determines the p-value obtained. Colors determines which the the highest (red), medium (yellow), and low (green) concentration for metal chloride statistical difference between streams. Asterisk (*) denotes Welch ANOVA p-values u test determined the standard deviation variance between samples were different req ANOVA. Sample average was determined for ratio values over three-year period from the average was determined through standard deviation of all sample values averaged ar abbreviations are denoted in Table 3.1.

+/-	Na/Cl ppb/ppm	+/-	Mg/Cl ppb/ ppm	+/-	Al/Cl ppb/ppm	+/-
	38		40		28	
0.11	1807.00	4055.00	2384.00	5435.00	1.19	2.53
0.20	1690.00	1264.00	3041.00	2261.00	6.78	4.72
0.04	2605.00	1001.00	4331.00	1726.00	0.53	2.41

+/-	Mn/Cl ppb/ ppm	+/-	Fe/Cl ppb/ppm	+/-	Co/Cl ppb/ppm	+/-
	36		40*		37*	
0.29	17.41	137.10	0.03	314.70	0.34	0.07
0.16	601.20	46.67	0.11	870.40	0.39	0.07
0.04	33.20	54.41	0.03	79.63	0.17	0.02

+/-	Se82/Cl ppb/ppm	+/-	Sr/Cl ppb/ppm	+/-	Mo/Cl ppb/ ppm	+/-
	40		39		32*	
0.05	3.13	7.02	16.16	39.82	0.02	0.02
0.17	1.25	1.23	30.46	24.00	0.05	0.05
0.03	3.68	2.61	33.65	12.54	0.01	0.02

+/-	Bi/Cl ppb/ppm	+/-	U/Cl ppb/ppm	+/-
	27		24	
0.02	0.01	0.01	0.03	0.04
0.02	0.01	0.02	0.02	0.01
0.02	0.02	0.06	0.02	0.01

lake Epilimnion

ermafrost degradation in the
istically significant with the
ınd in the box denoted N for
rmokarst lake epilimnion has
ratio values that observed
ısed, when Brown-Forsythe
uiring the use of a Welch
ı 2016-2018. Where error in
ıd is denoted with ±. Sample

K/Cl ppb/ppm	+/-	Ca/Cl ppb/ppm	+/-
37		36	
210.90	343.30	2871.00	6491.00
371.40	393.30	7659.00	4974.00
417.20	226.20	5992.00	2352.00

Ni/Cl ppb/ppm	+/-	Cu/Cl ppb/ppm	+/-
36		31	
0.03	0.63	0.23	0.03
0.07	0.34	0.15	0.09
0.01	0.08	0.15	0.05

Ag/Cl ppb/ppm	+/-	Cd/Cl ppb/ppm	+/-
21		21	
0.00	0.00	0.00	0.00
0.01	0.01	0.00	0.00
0.02	0.04	0.00	0.01

P-Value	Concentration
<0.0001	High
<0.0010	Medium
<0.0100	Low
<0.0500	

Sample	C/Cl ppm/ppm	+/-	N/Cl ppm/ppm	+/-	Li/Cl ppb/ppm
N	34		28		16
GSL Hypo.	4.55	9.02	0.11	0.28	0.06
OCT Hypo.	8.41	4.39	0.24	0.46	0.21
DNL Hypo.	8.12	3.99	0.12	0.26	0.11

	Ti/Cl ppb/ppm	+/-	V/Cl ppb/ppm	+/-	Cr/Cl ppb/ppm
N	35*		33*		35
GSL Hypo.	0.13	0.58	0.03	0.11	0.10
OCT Hypo.	1.23	0.84	0.39	0.35	0.33
DNL Hypo.	0.17	0.13	0.05	0.04	0.06

	Zn/Cl ppb/ppm	+/-	As/Cl ppb/ppm	+/-	Se78/Cl ppb/ppm
N	23		35*		23
GSL Hypo.	0.10	0.16	0.24	0.68	0.02
OCT Hypo.	0.24	0.14	6.61	6.50	0.05
DNL Hypo.	0.09	0.46	0.46	0.35	0.02

	Sb/Cl ppb/ppm	+/-	Ba/Cl ppb/ppm	+/-	Pb/Cl ppb/ppm
N	33		35		16
GSL Hypo.	0.03	0.04	3.15	7.83	0.00
OCT Hypo.	0.05	0.04	15.15	8.97	0.03
DNL Hypo.	0.03	0.02	4.36	3.55	0.00

Table 3.17 ANOVA Results of Metal to Chloride Ratio in Thermokarst l

Statistical comparison of metal to chloride ratio with comparison to thermokarst lake p hypolimnion (hypo.) through an ANOVA statistical test. With a p-value of <0.0500 as the average metal to chloride ratio values for each location, with the number of samples for which the color gradient determines the p-value obtained. Colors determines hypolimnion has the highest (red), medium (yellow), and low (green) concentration fo that observed statistical difference between streams. Asterisk (*) denotes Welch AN Brown-Forsythe test determined the standard deviation variance between samples were a Welch ANOVA. Sample average was determined for ratio values over three-year per error in the average was determined through standard deviation of all sample values ave Sample abbreviations are denoted in Table 3.1.

+/-	Na/Cl ppb/ppm	+/-	Mg/Cl ppb/ppm	+/-	Al/Cl ppb/ppm	+/-
	36		35		29*	
0.12	1916.00	3683.00	2504.00	4828.00	0.18	0.51
0.06	2279.00	1878.00	4818.00	3228.00	5.68	3.40
0.06	1102.00	1050.00	2245.00	1509.00	0.92	0.54

+/-	Mn/Cl ppb/ppm	+/-	Fe/Cl ppb/ppm	+/-	Co/Cl ppb/ppm	+/-
	35		34*		36*	
0.29	69.24	118.80	61.97	324.40	0.04	0.07
0.27	183.30	143.30	1501.00	2248.00	0.24	0.15
0.04	33.25	56.96	53.52	82.81	0.03	0.02

+/-	Se82/Cl ppb/ppm	+/-	Sr/Cl ppb/ppm	+/-	Mo/Cl ppb/ppm	+/-
	34		34		31*	
0.04	1.86	5.02	16.64	36.81	0.02	0.03
0.06	1.36	2.16	48.10	30.53	0.08	0.05
0.01	2.99	2.63	13.63	12.75	0.02	0.01

+/-	Bi/Cl ppb/ppm	+/-	U/Cl ppb/ppm	+/-
	22*		28	
0.01	0.00	0.01	0.03	0.04
0.08	0.11	0.12	0.02	0.10
0.00	0.01	0.03	0.02	0.01

ake Hypolimnion

ermafrost degradation in the
statistically significant with
; found in the box denoted N
which thermokarst lake
r metal chloride ratio values
OVA p-values used, when
different requiring the use of
iod from 2016-2018. Where
raged and is denoted with ±.

K/Cl ppb/ppm	+/-	Ca/Cl ppb/ppm	+/-
35		32	
183.10	375.80	2656.00	4504.00
699.90	431.10	6078.00	5947.00
305.60	207.30	3998.00	19397.00

Ni/Cl ppb/ppm	+/-	Cu/Cl ppb/ppm	+/-
33		29*	
0.31	0.75	0.01	0.01
0.50	0.51	0.07	0.06
0.16	0.10	0.01	0.01

Ag/Cl ppb/ppm	+/-	Cd/Cl ppb/ppm	+/-
19		18	
0.00	0.00	0.00	0.00
0.00	0.02	0.00	0.00
0.01	0.01	0.00	0.01

P-Value	Concentration
<0.0001	High
<0.0010	Medium
<0.0100	Low
<0.0500	

Sample	C/Cl ppm/ppm	+/-	N/Cl ppm/ppm	+/-	Li/Cl ppb/ppm
N	31*		25*		9
GSBA	6.80	2.65	0.24	0.18	0.05
GSSC	5.45	2.35	0.24	0.17	0.24
OCC	9.66	9.78	0.81	0.45	0.11

	Ti/Cl ppb/ppm	+/-	V/Cl ppb/ppm	+/-	Cr/Cl ppb/ppm
N	31*		31*		29
GSBA	1.01	0.41	0.38	0.31	0.16
GSSC	0.81	0.38	0.27	0.32	0.14
OCC	2.44	1.47	0.85	0.76	0.32

	Zn/Cl ppb/ppm	+/-	As/Cl ppb/ppm	+/-	Se78/Cl ppb/ppm
N	10		29		13
GSBA	1.31	0.54	2.26	2.53	0.04
GSSC	0.44	0.31	1.84	2.51	0.03
OCC	1.50	0.00	1.27	6.76	0.23

	Sb/Cl ppb/ppm	+/-	Ba/Cl ppb/ppm	+/-	Pb/Cl ppb/ppm
N	28		26*		9
GSBA	0.20	0.13	15.21	5.77	0.09
GSSC	0.15	0.13	10.30	2.50	0.05
OCC	0.22	0.10	16.01	12.13	0.09

Table 3.18 ANOVA Results of Metal to Chloride Ratio in Streams

Statistical comparison of metal to chloride ratio with comparison to stream sampling lo an ANOVA statistical test. With a p-value of <0.0500 as statistically significant with metal to chloride ratio values for each location, with the number of samples found in th N for which the color gradient determines the p-value obtained. Colors determines whi the highest (red), medium (yellow), and low (green) concentration for metal-Chlorid observed statistical difference between streams. Asterisk (*) denotes Welch ANOVA p when Brown-Forsythe test determined the standard deviation variance between sampl different requiring the use of a Welch ANOVA. Sample average was determined for rat year period from 2016-2018. Where error in the average was determined through stand of all ratio values averaged and is denoted with ±. Sample abbreviations are denoted i

+/-	Na/Cl ppb/ppm	+/-	Mg/Cl ppb/ppm	+/-	Al/Cl ppb/ppm	+/-
	29		28*		28*	
0.52	1643.00	1919.00	3744.00	1983.00	9.90	10.52
0.27	1689.00	787.80	3210.00	501.90	6.43	4.88
1.36	1598.00	871.50	6955.00	5255.00	25.39	49.94

+/-	Mn/Cl ppb/ppm	+/-	Fe/Cl ppb/ppm	+/-	Co/Cl ppb/ppm	+/-
	31		30		28	
0.68	58.32	34.77	377.20	212.80	0.24	0.19
0.62	35.36	19.24	333.60	238.20	0.14	0.05
1.36	32.27	48.03	459.60	423.00	0.20	0.23

+/-	Se82/Cl ppb/ppm	+/-	Sr/Cl ppb/ppm	+/-	Mo/Cl ppb/ppm	+/-
	27		28		28	
1.02	0.83	0.87	59.04	27.67	0.68	0.27
0.99	0.82	0.76	46.10	10.25	0.38	0.29
2.19	1.14	3.26	45.15	36.68	0.09	0.08

+/-	Bi/Cl ppb/ppm	+/-	U/Cl ppb/ppm	+/-
	17		21	
0.10	0.05	0.18	0.14	0.18
0.01	0.01	0.05	0.11	0.06
0.03	0.06	0.04	0.15	0.06

cation through
the average
e box denoted
ch stream has
e ratio that
-values used,
e ratios were
ios over three-
lard deviation
in Table 3.1.

K/Cl ppb/ppm	+/-	Ca/Cl ppb/ppm	+/-
30		36	
894.50	545.60	9187.00	4524.00
646.10	772.40	8021.00	6236.00
548.30	485.30	8988.00	7644.00

Ni/Cl ppb/ppm	+/-	Cu/Cl ppb/ppm	+/-
28*		26	
1.13	0.70	0.81	0.54
0.81	0.35	0.58	0.41
1.52	1.17	0.46	1.07

Ag/Cl ppb/ppm	+/-	Cd/Cl ppb/ppm	+/-
18		14	
0.00	0.01	0.01	0.00
0.01	0.08	0.01	0.01
0.01	0.12	0.00	0.00

P-Value	Concentration
<0.0001	High
<0.0010	Medium
<0.0100	Low
<0.0500	

	Carbon				
	n	Minimum ppm	Maximum ppm	Variance +/-	n
Summer	92	5.7	143.9	36.1	83
Winter	47	0.7	215.8	50.6	42
P-Value	<0.0001*				

Table 3.19 Overall Carbon and Nitrogen Seasonal Variability

Variability between carbon and nitrogen concentrations in summer and winter samples based on the magnitude of standard deviation from the average of all the samples during the winter or summer for a three-year study from 2016-2018. The samples denoted with an asterisk (*) represent that carbon and nitrogen required a Welch's T-test to determine the p-value showcased within the table that denotes seasonal differences, due to the standard deviation between winter and summer having a statistically different variance through an F-Test. Yellow indicates a decreased standard deviation (±) or variance and thus, variability in summer time samples.

Nitrogen		
Minimum ppm	Maximum ppm	Variance +/-
0.0	6.0	1.3
0.0	16.6	3.6
0.0158*		

	C ppm	C +/-	N ppm	N +/-
n	9/8*		8/8	
GSL Epi. Summer	70.6	32.9	1.9	1.5
GSL Epi. Winter	124.6	13.8	4.1	3.3
n	8/7		7/6	
GSL Hypo. Summer	123.9	21.6	3.0	2.3
GSL Hypo. Winter	128.1	13.7	3.4	3.2
n	8/4		8/4	
OCT Epi. Summer	38.1	8.1	0.9	0.9
OCT Epi. Winter	49.1	5.5	1.8	1.4
n	8/4		*8/3**	
OCT Hypo. Summer	38.8	9.0	1.8	1.8
OCT Hypo. Winter	42.5	8.3	5.3	7.0
n	8/5*		7/5	
DNL Epi. Summer	40.8	18.1	1.0	0.9
DNL Epi. Winter	65.3	5.2	2.1	1.7
n	7/6		7/5	
DNL Hypo. Summer	57.3	18.9	1.7	1.2
DNL Hypo. Winter	66.8	4.4	1.8	1.6
n	*5/2*		*4/2*	
BSP Summer	92.7	32.2	0.4	0.2
BSP Winter	185.9	42.2	8.8	11.0
n	*10/3*		*10/3*	
GSBA Summer	13.7	3.4	0.4	0.3
GSBA Winter	10.8	5.6	0.4	0.3
n	*9/3*		*9/3*	
GSSC Summer	14.8	2.7	0.6	0.3
GSSC Winter	13.5	7.3	0.6	0.5
n	*9/3*		*9/3**	
OCC Summer	15.5	6.7	0.9	0.3
OCC Winter	10.5	10.8	0.4	0.6
	P-Value	<0.0010	<0.0100	<0.0500

Table 3.20 Carbon and Nitrogen Seasonal Variability in Individual Sam

Statistical T-Test to observe seasonal differences in individual samples for carbon a
concentrations between winter and summer from 2016-2018 sample collection for epi
and hypolimnion (hypo.) separated. Color gradient indicates p-value, with the lightest
the maximum cut off for statistical differences of p-value > 0.05000. Blue gradient i
average was higher in winter time. Numbers in the cells are those of the sample
(summer/winter) and asterisks (*) indicates Welch's T-Test was utilized for when tl
deviation or variance was deemed statistically different through an F-Test. Red italici
samples with a sample number less than or equal to 3 and thus, care should be taken w
the statistics. Averages and the associated standard deviations (±) were included for
winter. Samples highlighted in green are samples with a decreased variability in wint
samples highlighted in yellow were samples with a decreased variability in summert
abbreviations are denoted in Table 3.1.

ples

nd nitrogen
limnion (epi.)
t representing
ndicates the
number
he standard
ized cells are
hen observing
summer and
ertime, while
ime. Sample

	C	N
GSL Epi. Vs. Hypo.	15/17*	12/15
OCT Epi. Vs. Hypo.	12/14	10/11*
DNL Epi. Vs. Hypo.	13/13	11/12
GSL Epi. Vs. BSP	17/7	15/5*
	P-Value	<0.0100

Table 3.21 T-Test to Determine Differences Epilimnion and Hypolim

Statistical T-Test to determine Carbon and Nitrogen concentration differences betw (hypo.). P-Values < 0.0500 were deemed statistically different, observing stratificat for those samples with grey coloration. Numbers in the cells are those of the samp indicates Welch's T-Test was utilized for when the standard deviation or variance w F-Test. Sample abbreviations were denoted in Ta

nion for Carbon and Nitrogen

een the epilimnion (epi.) and hypolimnion
:ion of carbon and nitrogen concentrations
le number (Epi./Hypo.) and asterisks (*)
as deemed statistically different through an
ble 3.1.

	C ppm	+/-	N ppm	+/-	P-Value
N	44*		38*		<0.0001
GSL Epi.	96.0	37.4	2.6	2.3	<0.0010
OCT Epi.	42.1	8.9	1.1	1.1	<0.0100
DNL Epi.	50.2	18.8	1.4	1.3	<0.0500
N	40		33		
GSL Hypo.	125.8	17.9	3.1	2.7	
OCT Hypo.	40.0	8.6	2.8	4.0	
DNL Hypo.	61.7	14.5	1.6	1.3	

Table 3.22 ANOVA Results for Carbon and Nitrogen for Thermokarst L

Statistical comparison of carbon and nitrogen with comparison to thermokarst lake p degradation in the epilimnion (epi.) and hypolimnion (hypo.) through an ANOVA sta With a p-value of <0.0500 as statistically significant with the average concentration location, with the number of samples found in the box denoted N for which the colo determines the p-value obtained. Colors determines which thermokarst lake epilim hypolimnion has the highest (red), medium (yellow), and low (green) concentration th statistical difference between thermokarst lake epilimnion and hypolimnion. Asterisk Welch ANOVA p-values used, when Brown-Forsythe test determined the standard devi between sample ratios were different requiring the use of a Welch ANOVA. Sample a determined for ratios over three-year period from 2016-2018. Where error in the av determined through standard deviation of all ratio values averaged and is denoted with abbreviations are denoted in Table 3.1.

Legend
High
Medium
Low

ake

ɔermafrost
ıtistical test.
ıs for each
ɔr gradient
ınion and
ıat observed
(*) denotes
ation variance
ıverage was
erage was
ı ±. Sample

	C ppm	+/-	N ppm	+/-	P-Value
N	37		33		<0.0001
GSBA	13.0	3.9	0.3	0.3	<0.0010
GSSC	14.5	4.0	0.6	0.3	<0.0100
OCC	14.2	7.7	0.9	0.4	<0.0500

Table 3.23 ANOVA Results for Carbon and Nitrogen for Streams

Statistical comparison of stream location concentration in nitrogen and carbon through statistical test. With a p-value of <0.0500 as statistically significant with the average co for each location, with the number of samples found in the box denoted N for which gradient determines the p-value obtained. Colors determines which stream has the hi medium (yellow), and low (green) concentration that observed statistical difference betw Asterisk (*) denotes Welch ANOVA p-values used, when Brown-Forsythe test dete standard deviation variance between sample ratios were different requiring the use o ANOVA. Sample average was determined for ratios over three-year period from 2016- error in the average was determined through standard deviation of all ratio values ave denoted with ±. Sample abbreviations are denoted in Table 3.1.

Legend
High
Medium
Low

ı an ANOVA
ɔncentrations
ı the color
ghest (red),
ween streams.
rmined the
ɔf a Welch
-2018. Where
raged and is

WINTER	C	N	Li	Na
N	45	40	13	47
	Cu	Zn	As	Se78
N	40	31	47	35
SUMMER	C	N	Li	Na
N	92	84	44	98
	Cu	Zn	As	Se78
N	81	47	99	53
ALL YEARS	C	N	Li	Na
N	137	124	57	145
	Cu	Zn	As	Se78
N	121	78	146	88

Table 3.24 Linear Regression for Metal – Carbon Relationsh

Linear regression statistics for metal – carbon relationship with the carbon represented on the independent variable axis. The number within the box r total number of samples from 2016-2018 that was used to conduct the line with carbon. Which was split between summer, winter, and overall linear Coloration gradient provides information on the strength of the p-value and line (R^2). The darker the color the stronger the fitness to the line with a cu linear regressions with an $R^2 > 0.8$; Orange gradation indicates a statistica linear slope with a P-value between 0.0500 and 0.001, Yellow gradation statistically positive linear slope with a P-value < 0.0001, Blue gradation statistically negative linear slope with a P-value between 0.0500 and 0.0 gradation indicates a statistically negative linear slope with a P-value < 0. yellow and dark green are the strongest linear regressions.

Mg	Al	K	Ca	Ti	V	Cr
47	39	47	47	47	46	46

Se82	Sr	Mo	Ag	Cd	Sb	Ba
47	47	40	16	32	41	42

Mg	Al	K	Ca	Ti	V	Cr
99	80	97	98	99	94	97

Se82	Sr	Mo	Ag	Cd	Sb	Ba
99	99	92	62	48	91	99

Mg	Al	K	Ca	Ti	V	Cr
146	119	144	145	146	140	143

Se82	Sr	Mo	Ag	Cd	Sb	Ba
146	146	132	78	80	132	141

Positive Slope		Negative Slope	
p-Value <0.0	p-Value <0.0	p-Value <0.0	p-Value <0.001
< 0.5	< 0.5	< 0.5	< 0.5
0.5 to 0.8	0.5 to 0.8	0.5 to 0.8	0.5 to 0.8
> 0.8	> 0.8	> 0.8	> 0.8

ıip

concentration
epresents the
ar regression
· regression.
. fitness of the
ıt off of any
ılly positive
indicates a
indicates a
)01, Green
.0001. Dark

Mn	Fe	Co	Ni
47	47	42	42
Pb	**Bi**	**U**	**Cl**
13	28	30	32

Mn	Fe	Co	Ni
99	99	98	95
Pb	**Bi**	**U**	**Cl**
46	60	72	90

Mn	Fe	Co	Ni
146	146	140	137
Pb	**Bi**	**U**	**Cl**
59	88	102	122

	Total Fe Leached ppb	Total Fe Complexed ppb	Percent Fe Complexed (ppb/ppb)%
GSL Epi.	597.4	72.2	12.1%
GSL Hypo.	4339.7	160.6	3.7%
OCT Epi.	1615.9	92.6	5.7%
OCT Hypo.	3337.0	57.1	1.7%
DNL Epi.	151.5	BDL	N/A
DNL Hypo.	239.8	36.6	15.2%
BSP	220.6	113.0	51.2%
GSBA	2356.3	52.7	2.2%
GSSC	1292.3	148.4	11.5%
OCC	906.5	504.8	55.7%

Table 3.25 Percentage of Iron Complexed to the Organic Ca

Iron concentrations of individual samples from thermokarst lake and stream samples whole water analysis and fractions taken from field-flow fractionation analysis. Field- were obtained when organic matter passed through the membrane and through the c considered complexed to the organic matter. A percentage was determined for the perc the organic matter sample for each individual sample. Sample abbreviations denoted in and hypolimnion (hypo.).

ırbon

; collected in May through
-flow fractionation fractions
letector, thus samples are
:entage of iron complexed to
. Table 3.1, epilimnion (epi.),

	N/C ppm/ppm	Li/C ppb/ppm	Na/C ppb/ppm	Mg/C ppb/ppm
GSL Epi. Vs. Hypo.	13/16	5/5	14/16*	14/16
OCT Epi. Vs. Hypo.	11/12*	5/5	12/14	12/14
DNL Epi. Vs. Hypo.	12/12	4/5*	13/13	12/14
GSL Epi. Vs. BSP	16/6	5/5	16/7	16/7*

	Zn/C ppb/ppm	As/C ppb/ppm	Se78/C ppb/ppm	Se82/C ppb/ppm
GSL Epi. Vs. Hypo.	10/8	14/17*	10/11	14/17
OCT Epi. Vs. Hypo.	10/6*	12/14	8/7*	12/14
DNL Epi. Vs. Hypo.	8/6	12/14	7/8*	13/14
GSL Epi. Vs. BSP	8/5	17/7	11/6	17/7

Table 3.26 T-Test to Determine Differences Between Epilimnion an

Statistical T-Test to determine which metal to carbon ratios observed concentration d (hypo.) over three years of sample collection; 2016-2018. P-Values < 0.0500 were metal concentrations as observed in gradient coloration, the darker the color th concentrations between epilimnion and hypolimnion. Numbers within the table denc hypolimnion (epi./hypo.). Asterisk (*) denotes Welch t-test p-values used, when statistically different through an F-test to compare variance. Sampl

Al/C ppb/ppm	K/C ppb/ppm	Ca/C ppb/ppm	Ti/C ppb/ppm	V/C ppb/ppm	Cr/C ppb/ppm	Mn/C ppb/ppm
12/11*	12/15*	13/16	14/17	14/16*	14/17*	14/15
10/13*	12/13*	12/14	11/14	12/13	12/14*	12/14
11/9*	13/13	13/13	13/14	12/12*	13/14*	13/13
11/7*	15/6*	16/7*	17/7	16/7	17/7*	15/7*

Sr/C ppb/ppm	Mo/C ppb/ppm	Ag/C ppb/ppm	Cd/C ppb/ppm	Sb/C ppb/ppm	Ba/C ppb/ppm	Pb/C ppb/ppm
12/15	15/15	7/8*	8/10*	14/15*	14/16	5/5
12/14	12/12	8/9*	7/7	11/11	12/13	5/5*
11/13	8/10*	4/6	5/6	11/11	12/13	4/5*
15/6	15/6*	N/A	10/4*	15/7*	16/7	5/5

d Hypolimnion for Metal to Carbon Ratio

ifferences between the epilimnion (epi.) and hypolimnion
deemed statistically different, observing stratification of
e increase in statistical difference observed in metal
te the number of samples observed in the epilimnion and
the standard deviation variance between samples were
abbreviations are denoted in Table 3.1.

Fe/C ppb/ppm	Co/C ppb/ppm	Ni/C ppb/ppm	Cu/C ppb/ppm
14/17	15/16*	14/17*	12/13*
12/14	12/13	12/12*	9/11*
13/14	13/13*	12/13	10/11
17/7*	16/7*	17/7*	13/5*

Bi/C ppb/ppm	U/C ppb/ppm	Cl/C ppm/ppm	Legend
9/13	15/13	13/14	<0.0001
8/10*	7/7*	10/12*	<0.0010
7/7	6/6*	11/13	<0.0100
13/4	13/7	14/7	<0.0500

Sample Location	N/C ppm/ppm	Li/C ppb/ppm	Na/C ppb/ppm	Mg/C ppb/ppm
GSL Epi.	8/8	*3/2*	9/7	9/7
GSL Hypo.	7/6	*3/2*	7/7	7/7
OCT Epi.	8/4	*4/1*	9/5	9/5*
OCT Hypo.	*8/3**	*4/1*	8/4	8/4
DNL Epi.	7/5	*3/2*	7/6*	8/6
DNL Hypo.	7/5	*2/2*	7/6	6/6

Sample Location	Zn/C ppb/ppm	As/C ppb/ppm	Se78/C ppb/ppm	Se82/C ppb/ppm
GSL Epi.	*3/5*	9/8*	5/6	9/8
GSL Hypo.	4/6	7/7	5/5	7/7
OCT Epi.	*4/2*	9/5*	*4/3**	9/5
OCT Hypo.	6/4	8/4	*5/3**	8/4
DNL Epi.	*2/4*	8/6	*3/5**	8/6
DNL Hypo.	*3/5*	6/6	*2/5*	7/6

Table 3.27 Seasonality of Metal to Carbon Ratios for Individual

Statistical T-Test to observe seasonal differences in individual thermokarst lake
between winter and summer for a three-year period from 2016-2018. Color gra
representing the maximum cut off for statistical differences of p-value > 0.0500
higher in winter time. Numbers in the cells are those of the sample number (su
Welch's T-Test was utilized when F-Test determined the standard deviation varia
Red italicized cells are samples with a sample number less than or equal to 3 and
the statistics. Sample abbreviations are denoted in Table 3.1, epilimnion

Al/C ppb/ppm	K/C ppb/ppm	Ca/C ppb/ppm	Ti/C ppb/ppm	V/C ppb/ppm	Cr/C ppb/ppm	Mn/C ppb/ppm
6/5*	8/7*	9/7	9/8	8/8	9/8	7/8*
6/6	6/6	7/6	7/7	7/7	7/7	7/7*
9/4	8/5	9/5	9/5*	8/5*	9/5*	9/5*
6/4	8/4	8/4	7/4	8/4	8/4	8/4
4/5*	7/6*	7/6*	8/6	6/6	8/6*	7/6*
5/6	7/6*	7/6	7/6	6/6	7/6	7/6

Sr/C ppb/ppm	Mo/C ppb/ppm	Ag/C ppb/ppm	Cd/C ppb/ppm	Sb/C ppb/ppm	Ba/C ppb/ppm	Pb/C ppb/ppm
9/6*	8/7	*6/2*	4/6*	8/7	9/7	*3/2*
7/5	7/8	*3/4*	*3/5**	7/7	7/7	*3/2*
9/5*	8/4*	*6/3**	*4/3*	7/4	9/4	*4/1*
8/4	8/4	*5/3*	*4/3*	7/4	8/4	*4/1*
8/5	5/5*	*5/1*	*3/3**	6/5	7/6	*3/2*
7/4	*3/5*	*3/1*	*2/3*	5/6	6/6	*2/2*

Thermokarst Lake Samples

: samples for metal to carbon ratio values
ıdient indicates p-value, with the lightest
. Blue gradient indicates the average was
mmer/winter) and asterisks (*) indicates
ınce of samples were statistically different.
thus, care should be taken when observing
ı (epi.), and hypolimnion (hypo.).

Fe/C ppb/ppm	Co/C ppb/ppm	Ni/C ppb/ppm	Cu/C ppb/ppm
9/8*	9/7*	9/8	6/7*
7/7	7/8	7/7	5/7
9/5*	9/4	8/4	7/4
8/4	8/4	8/4	*6/3*
8/6*	7/6*	7/6	6/5
7/6	7/6	6/6	5/5*

Bi/C ppb/ppm	U/C ppb/ppm	Cl/C ppm/ppm	Legend
7/6	6/7	8/6	
3/6	7/8	7/6	<0.0001
7/3	*5/2*	*9/3*	<0.0010
5/3	*5/2*	*8/2*	<0.0100
*4/3**	*4/2*	8/5	<0.0500
*4/3**	*3/3**	7/4	

Sample	Cl/C ppm/ppm	+/-	Li/C ppb/ppm	+/-	Na/C ppb/ppm
N	39*		15		43
GSL Epi.	0.28	0.19	0.01	0.00	411.90
OCT Epi.	0.13	0.07	0.02	0.01	197.10
DNL Epi.	0.16	0.07	0.01	0.00	241.90
	V/C ppb/ppm	**+/-**	**Cr/C ppb/ppm**	**+/-**	**Mn/C ppb/ppm**
N	41*		45		42
GSL Epi.	0.01	0.01	0.02	0.01	5.53
OCT Epi.	0.03	0.02	0.03	0.03	8.43
DNL Epi.	0.00	0.00	0.01	0.00	4.64
	As/C ppb/ppm	**+/-**	**Se78/C ppb/ppm**	**+/-**	**Se82/C ppb/ppm**
N	45*		26		45*
GSL Epi.	0.06	0.04	0.00	0.00	0.55
OCT Epi.	0.42	0.37	0.02	0.04	0.20
DNL Epi.	0.06	0.01	0.00	0.00	0.51
	Ba/C ppb/ppm	**+/-**	**Pb/C ppb/ppm**	**+/-**	**Bi/C ppb/ppm**
N	42		15		30
GSL Epi.	0.81	0.22	0.00	0.00	0.00
OCT Epi.	1.15	0.44	0.00	0.00	0.00
DNL Epi.	0.78	0.37	0.00	0.00	0.00

Table 3.28 ANOVA Results for Metal to Carbon Ratio for Thermokarst

Statistical comparison of metal to carbon ratio with comparison to thermokarst lake pe epilimnions (epi.) through an ANOVA statistical test. With a p-value of <0.0500 as stat average metal to carbon ratio values for each location, with the number of samples fou which the color gradient determines the p-value obtained. Colors determines which the the highest (red), medium (yellow), and low (green) concentration for metal to carbor statistical difference between streams. Asterisk (*) denotes Welch ANOVA p-values u test determined the standard deviation variance between samples were different requ ANOVA. Sample average was determined for ratio values over three-year period from the average was determined through standard deviation of all sample values averaged ar abbreviations are denoted in Table 3.1

+/-	Mg/C ppb/ppm	+/-	Al/C ppb/ppm	+/-	K/C ppb/ppm	+/-
	44		33*		41	
74.69	539.20	83.98	0.30	0.50	54.60	36.37
57.37	374.00	187.30	1.14	0.87	48.19	26.63
70.53	465.60	97.57	0.16	0.24	49.25	28.23

+/-	Fe/C ppb/ppm	+/-	Co/C ppb/ppm	+/-	Ni/C ppb/ppm	+/-
	45*		42*		42	
5.52	11.27	11.63	0.01	0.00	0.08	0.04
9.98	120.50	106.20	0.01	0.01	0.04	0.01
5.81	8.51	9.22	0.00	0.00	0.03	0.01

+/-	Sr/C ppb/ppm	+/-	Mo/C ppb/ppm	+/-	Ag/C ppb/ppm	+/-
	42*		37		23	
0.26	3.62	0.72	0.00	0.00	0.00	0.00
0.08	3.63	2.07	0.00	0.00	0.00	0.00
0.26	2.97	1.00	0.00	0.00	0.01	0.01

+/-	U/C ppb/ppm	+/-	N/C ppm/ppm	+/-
	26*		40	
0.00	0.01	0.00	0.03	0.02
0.00	0.00	0.00	0.03	0.02
0.01	0.00	0.00	0.03	0.02

Lake Epilimnion

:rmafrost degradation in the
tistically significant with the
nd in the box denoted N for
rmokarst lake epilimnion has
ı ratio values that observed
ısed, when Brown-Forsythe
ıiring the use of a Welch
ı 2016-2018. Where error in
ıd is denoted with ±. Sample

Ca/C ppb/ppm	+/-	Ti/C ppb/ppm	+/-
43*		45	
671.80	83.61	0.04	0.02
637.30	340.40	0.08	0.05
659.10	179.00	0.02	0.01

Cu/C ppb/ppm	+/-	Zn/C ppb/ppm	+/-
35		20	
0.01	0.02	0.03	0.03
0.01	0.01	0.10	0.16
0.00	0.00	0.14	0.15

Cd/C ppb/ppm	+/-	Sb/C ppb/ppm	+/-
23		37	
0.00	0.00	0.01	0.00
0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00

P-Value	Legend
<0.0001	High
<0.0010	Medium
<0.0100	Low
<0.0500	

Sample	Cl/C ppm/ppm	+/-	Li/C ppb/ppm	+/-
N	34*		14	
GSL Hypo.	0.24	0.16	0.01	0.00
OCT Hypo.	0.10	0.04	0.02	0.01
DNL Hypo.	0.16	0.08	0.01	0.00

Sample	V/C ppb/ppm	+/-	Cr/C ppb/ppm	+/-
N	38*		39*	
GSL Hypo.	0.01	0.00	0.03	0.01
OCT Hypo.	0.04	0.02	0.03	0.01
DNL Hypo.	0.01	0.00	0.01	0.00

Sample	As/C ppb/ppm	+/-	Se78/C ppb/ppm	+/-
N	38*		25	
GSL Hypo.	0.06	0.01	0.00	0.00
OCT Hypo.	0.72	0.36	0.01	0.01
DNL Hypo.	0.08	0.02	0.00	0.00

Sample	Ba/C ppb/ppm	+/-	Pb/C ppb/ppm	+/-
N	38		14	
GSL Hypo.	0.81	0.31	0.00	0.00
OCT Hypo.	1.58	0.52	0.01	0.01
DNL Hypo.	0.92	0.36	0.00	0.00

Table 3.29 ANOVA Results for Metal to Carbon Ratios for T

Statistical comparison of metal to carbon ratio with comparison to therm hypolimnion (hypo.) through an ANOVA statistical test. With a p-value the average metal to carbon ratio values for each location, with the numbe which the color gradient determines the p-value obtained. Colors determ has the highest (red), medium (yellow), and low (green) concentration fo statistical difference between streams. Asterisk (*) denotes Welch ANOV determined the standard deviation variance between samples were differ Sample average was determined for ratio values over three-year period fr was determined through standard deviation of all sample values ave abbreviations are denoted in Table

Na/C ppb/ppm	+/-	Mg/C ppb/ppm	+/-	Al/C ppb/ppm	+/-	K/C ppb/ppm
39		38*		33*		37*
424.60	33.40	562.20	88.90	0.05	0.04	40.44
242.30	96.30	547.60	258.10	0.54	0.22	77.94
239.50	83.52	481.70	108.50	0.11	0.11	45.61

Mn/C ppb/ppm	+/-	Fe/C ppb/ppm	+/-	Co/C ppb/ppm	+/-	Ni/C ppb/ppm
39*		39*		40*		38
13.66	3.67	25.37	12.35	0.01	0.00	0.08
19.23	10.65	195.10	110.70	0.02	0.01	0.05
8.22	6.60	11.98	8.90	0.00	0.00	0.03

Se82/C ppb/ppm	+/-	Sr/C ppb/ppm	+/-	Mo/C ppb/ppm	+/-	Ag/C ppb/ppm
39		35*		35*		19
0.57	0.25	3.98	0.49	0.00	0.00	0.00
0.24	0.11	5.38	2.66	0.01	0.00	0.00
0.55	0.24	3.22	1.00	0.00	0.00	0.00

Bi/C ppb/ppm	+/-	U/C ppb/ppm	+/-	N/C ppm/ppm	+/-
24*		28		36	
0.00	0.00	0.01	0.00	0.03	0.02
0.01	0.01	0.00	0.01	0.07	0.08
0.00	0.00	0.00	0.00	0.03	0.03

'hermokarst Lake Hypolimnion

ıokarst lake permafrost degradation in the
of <0.0500 as statistically significant with
r of samples found in the box denoted N for
ıines which thermokarst lake hypolimnion
: metal to carbon ratio values that observed
A p-values used, when Brown-Forsythe test
ent requiring the use of a Welch ANOVA.
om 2016-2018. Where error in the average
raged and is denoted with ±. Sample
3.1.

+/-	Ca/C ppb/ppm	+/-	Ti/C ppb/ppm	+/-
	38*		38*	
3.41	710.70	68.01	0.04	0.02
52.74	896.80	444.80	0.12	0.06
19.33	695.90	181.30	0.02	0.01

+/-	Cu/C ppb/ppm	+/-	Zn/C ppb/ppm	+/-
	31		28*	
0.02	0.00	0.00	0.03	0.03
0.03	0.01	0.00	0.03	0.01
0.01	0.00	0.00	0.07	0.08

+/-	Cd/C ppb/ppm	+/-	Sb/C ppb/ppm	+/-
	20		36*	
0.00	0.00	0.00	0.01	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00

P-Value	Legend
<0.0001	High
<0.0010	Medium
<0.0100	Low
<0.0500	

Sample	Cl/C ppm/ppm	+/-	Li/C ppb/ppm	+/-	Na/C ppb/ppm
N	31		12		37
GSBA	0.15	0.06	0.22	0.12	361.40
GSSC	0.19	0.06	0.21	0.16	314.50
OCC	0.13	0.09	0.31	0.22	19768.00
	V/C ppb/ppm	+/-	Cr/C ppb/ppm	+/-	Mn/C ppb/ppm
N	39		36		39
GSBA	0.07	0.08	0.08	0.19	9.28
GSSC	0.07	0.07	0.07	0.16	7.13
OCC	0.12	0.12	0.06	0.15	13.06
	As/C ppb/ppm	+/-	Se78/C ppb/ppm	+/-	Se82/C ppb/ppm
N	39		19		39
GSBA	0.56	0.71	0.14	0.29	0.23
GSSC	0.54	0.64	0.12	0.25	0.23
OCC	0.38	0.73	0.08	0.20	0.46
	Ba/C ppb/ppm	+/-	Pb/C ppb/ppm	+/-	Bi/C ppb/ppm
N	36		13		20
GSBA	2.62	1.17	0.02	0.01	0.01
GSSC	2.32	1.40	0.01	0.00	0.00
OCC	5.43	13.35	0.01	0.01	0.01

Table 3.30 ANOVA Results for Metal to Carbon Ratios for Streams

Statistical comparison of metal to carbon ratio with comparison between streams throug statistical test. With a p-value of <0.0500 as statistically significant with the average m ratio values for each location, with the number of samples found in the box denoted N color gradient determines the p-value obtained. Colors determines which stream has the medium (yellow), and low (green) concentration for metal to carbon ratio values tha statistical difference between streams. Asterisk (*) denotes Welch ANOVA p-values Brown-Forsythe test determined the standard deviation variance between samples we requiring the use of a Welch ANOVA. Sample average was determined for ratio value year period from 2016-2018. Where error in the average was determined through stand of all sample values averaged and is denoted with ±. Sample abbreviations are denoted

+/-	Mg/C ppb/ppm	+/-	Al/C ppb/ppm	+/-	K/C ppb/ppm	+/-
	39		36		37	
261.50	606.30	349.70	1.92	1.48	134.80	62.58
166.40	650.80	314.70	1.46	0.95	108.60	55.52
67763.00	2831.00	7134.00	2.98	2.37	193.60	392.40

+/-	Fe/C ppb/ppm	+/-	Co/C ppb/ppm	+/-	Ni/C ppb/ppm	+/-
	39		36		34	
4.92	72.12	27.60	0.04	0.02	0.16	0.07
3.61	72.19	24.43	0.02	0.01	0.12	0.07
28.59	61.48	63.94	0.05	0.09	0.09	0.05

+/-	Sr/C ppb/ppm	+/-	Mo/C ppb/ppm	+/-	Ag/C ppb/ppm	+/-
	39		36		19	
0.20	12.10	5.66	0.10	0.05	0.00	0.00
0.20	10.33	4.79	0.08	0.04	0.01	0.01
0.88	22.07	56.11	0.03	0.05	0.01	0.01

+/-	U/C ppb/ppm	+/-	N/C ppm/ppm	+/-
	29		32	
0.02	0.03	0.02	0.04	0.02
0.00	0.02	0.02	0.04	0.03
0.01	0.06	0.10	0.06	0.04

h an ANOVA
etal to carbon
for which the
highest (red),
t observed
used, when
re different
s over three-
ard deviation
l in Table 3.1.

Ca/C ppb/ppm	+/-	Ti/C ppb/ppm	+/-
39		39	
1896.00	777.10	0.18	0.14
1719.00	790.10	0.16	0.11
4498.00	10994.00	0.32	0.39

Cu/C ppb/ppm	+/-	Zn/C ppb/ppm	+/-
33		14	
0.13	0.05	0.14	0.09
0.10	0.03	0.11	0.07
0.19	0.32	0.26	0.17

Cd/C ppb/ppm	+/-	Sb/C ppb/ppm	+/-
20		36	
0.00	0.00	0.03	0.02
0.00	0.00	0.03	0.02
0.00	0.00	0.07	0.15

P-Value	Legend
<0.0001	High
<0.0010	Medium
<0.0100	Low
<0.0500	

N/C ppm/ppm	**Li/C ppb/ppm**	**Na/C ppb/ppm**	**Mg/C ppb/ppm**	**Al/C ppb/ppm**	**K/C ppb/ppm**
82/52*	39/11*	91/46*	93/46*	76/38	87/46*
Mn/C ppb/ppm	**Fe/C ppb/ppm**	**Co/C ppb/ppm**	**Ni/C ppb/ppm**	**Cu/C ppb/ppm**	**Zn/C ppb/ppm**
91/47	94/48	93/43*	89/42*	75/40*	41/31
Mo/C ppb/ppm	**Ag/C ppb/ppm**	**Cd/C ppb/ppm**	**Sb/C ppb/ppm**	**Ba/C ppb/ppm**	**Pb/C ppb/ppm**
84/41*	53/15*	43/31*	85/41*	92/43*	41/11*

**Table 3.31 Seasonality of Metal to Chloride Ratio Values of Overall Ratio **

Statistical T-Test to observe seasonal differences in total watershed (thermokarst and str compilation for metal to carbon ratio values between winter and summer for three-year 2018, to observe overall seasonality observed for chloride normalized metal concentra gradient indicates p-value, with the lightest representing the maximum cut off for s differences of p-value > 0.05000. Blue gradient indicates the average was higher in w Orange gradient indicates the average was higher in summer time. Numbers in the cells the sample number (summer/winter) and asterisks (*) indicates Welch's T-Test was uti test determined the standard deviation variance between samples was statistically d

Ca/C ppb/ppm 93/46*	**Ti/C ppb/ppm** 93/48*	**V/C ppb/ppm** 89/47*	**Cr/C ppb/ppm** 91/47*
As/C ppb/ppm 93/47*	**Se78/C ppb/ppm** 48/35*	**Se82/C ppb/ppm** 94/48*	**Sr/C ppb/ppm** 94/40*
Bi/C ppb/ppm 57/28*	**U/C ppb/ppm** 68/31*	**Cl/C ppb/ppm** 85/34	**Legend** <0.0001 <0.0010 <0.0100 <0.0500

/alues

ream samples)
:s from 2016-
ations. Color
statistical
vinter time.
s are those of
lized when F-
different.

	N/C				
	n	Minimum ppm/ppm	Maximum ppm/ppm	Variance +/-	n
Summer	82	0.00	0.51	0.07	39
Winter	52	0.00	0.84	0.13	11

	Al/C				
	n	Minimum ppm/ppm	Maximum ppm/ppm	Variance +/-	n
Summer	76	0.00	6.40	1.31	87
Winter	38	0.01	8.42	1.41	46

	V/C				
	n	Minimum ppm/ppm	Maximum ppm/ppm	Variance +/-	n
Summer	89	0.00	0.21	0.05	91
Winter	47	0.00	0.44	0.09	47

	Co/C				
	n	Minimum ppm/ppm	Maximum ppm/ppm	Variance +/-	n
Summer	93	0.00	0.07	0.02	89
Winter	43	0.00	0.35	0.05	42

	As/C				
	n	Minimum ppm/ppm	Maximum ppm/ppm	Variance +/-	n
Summer	93	0.03	2.53	0.43	48
Winter	47	0.02	2.85	0.71	35

	Mo/C***				
	n	Minimum ppm/ppm	Maximum ppm/ppm	Variance +/-	n
Summer	84	0.00	0.53	0.07	53
Winter	41	0.00	0.22	0.05	15

	Ba/C				
	n	Minimum ppm/ppm	Maximum ppm/ppm	Variance +/-	n
Summer	92	0.26	12.50	1.84	41
Winter	43	0.07	47.75	7.17	11

	Cl/C			
	n	Minimum ppm/ppm	Maximum ppm/ppm	Variance +/-
Summer	85	0.03	0.63	0.14
Winter	34	0.03	0.51	0.11

Table 3.32 Overall Metal – Carbon Relationship Seasonal Variability

Variability between metal – carbon relationships was determined based on the magnitu deviation from the average of all the samples during the winter or summer from 2016 maximum and minimum for a certain sample number is represented for each ratio. T denoted with a triple asterisks (***) represent the metals that were determined to hav difference through a T-Test, results found in Table 3.31. Yellow indicates a decrease deviation or variance and thus, variability in summer time samples. Meanwhile, green decreased standard deviation or variance and thus, variability in winter samp

Li/C***				Na/C		
Minimum ppm/ppm	Maximum ppm/ppm	Variance +/-	n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-
0.01	0.52	0.14	91	34.97	1037.00	196.00
0.01	0.03	0.01	46	99.62	234944.00	34585.00

K/C				Ca/C		
Minimum ppm/ppm	Maximum ppm/ppm	Variance +/-	n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-
1.47	289.50	61.58	93	200.500	6328.000	1335.000
7.58	1414.00	205.20	46	85.600	41001.000	5938.000

Cr/C				Mn/C		
Minimum ppm/ppm	Maximum ppm/ppm	Variance +/-	n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-
0.00	0.09	0.02	91	0.10	65.95	13.48
0.01	0.67	0.14	47	0.15	108.00	16.55

Ni/C***				Cu/C		
Minimum ppm/ppm	Maximum ppm/ppm	Variance +/-	n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-
0.00	0.25	0.06	75	0.00	0.19	0.05
0.00	0.22	0.04	40	0.00	1.15	0.18

Se78/C				Se83/C**		
Minimum ppm/ppm	Maximum ppm/ppm	Variance +/-	n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-
0.00	0.04	0.01	94	0.04	0.91	0.19
0.00	0.65	0.17	48	0.11	3.15	0.49

Ag/C				Cd/C		
Minimum ppm/ppm	Maximum ppm/ppm	Variance +/-	n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-
0.00	0.07	0.01	43	0.00	0.00	0.00
0.00	0.02	0.01	31	0.00	0.01	0.00

Pb/C***				Bi/C		
Minimum ppm/ppm	Maximum ppm/ppm	Variance +/-	n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-
0.00	0.03	0.01	57	0.00	0.05	0.01
0.00	0.00	0.00	28	0.00	0.01	0.00

Variability Decreased in Summer
Variability Decreased in Winter
***Statistically Different See Table 3.31

de of standard
5-2018. The
he samples
e a seasonal
ed standard
n indicates a
les.

Mg/C			
n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-
93	123.90	2742.00	521.50
46	28.43	26518.00	3828.00

Ti/C			
n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-
93	0.00	0.46	0.10
48	0.01	1.53	0.24

Fe/C			
n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-
94	1.37	666.10	96.58
48	0.33	453.30	106.60

Zn/C			
n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-
41	0.00	0.42	0.10
31	0.00	0.40	0.09

Sr/C			
n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-
94	1.00	29.85	6.83
40	0.47	208.60	32.40

Sb/C			
n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-
85	0.00	0.10	0.02
41	0.00	0.53	0.08

U/C			
n	Minimum ppb/ppm	Maximum ppb/ppm	Variance +/-
68	0.00	0.19	0.03
31	0.00	0.35	0.06