

Alan R. Langenfeld
1308 Parkland Ct.
Champaign, IL 61821
10/03/2018

Brent Pooler
Senior Hydrogeologist
PO Box 60295
Lafayette, LA 70596-0295

Dear Brent Pooler :

On behalf of everyone at Isotech Laboratories, thank you for choosing us for your analytical needs. Attached with this document are the reports you requested. These documents relate to project Indigo / 8060.00 (Job 39489). We will hold your sample material until 11/05/2018. If you would like us to hold it longer please let us know.

Note that we were unable to obtain some requested isotopic values due to insufficient concentration.

We are committed to providing you with the highest level of customer satisfaction possible. If for any reason you have questions or comments, we are delighted to hear from you.

Again, thank you for your patronage. We look forward to serving you again in the future.

Best Regards,



Alan R. Langenfeld
Lab Manager



www.isotechlabs.com

Isotech Gas Data
 Job: 39489
 CoreTrac ID: 78329

All gas component carbon isotope values are reported on a scale defined by a two point calibration of LVEC and NBS 19
 nd = not detected, na = not analyzed
 * Analysis is of gas extracted from water by headspace equilibration. Analysis has been corrected for helium added to create headspace.
 * Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.
 Samples without He dilution factor had sufficient headspace to be extracted directly.
 ** Indicates if vacuum distillation was utilized for hydrogen and oxygen isotopic analysis of water

Isotech Lab No.	Sample Name	Sample Date	Sample Time	Field Name	GC Date	He %	H ₂ %	Ar %	O ₂ %	CO ₂ %	N ₂ %	CO %	C ₁ %	C ₂ %	C ₂ H ₄ %	C ₁ %	C ₂ H ₆ %	nC ₄ %	iC ₄ %	nC ₅ %	C ₆ + %	MS Date	δ ¹³ C ₁ ‰	δDC ₁ ‰	δ ¹³ C ₂ ‰	δD H ₂ O ‰	δ ¹⁸ O H ₂ O ‰	Vacuum Distilg**	Dissolved CH ₄ col.	Dissolved CH ₄ mg/L	Dissolved C ₂ H ₆ col.	Dissolved C ₂ H ₆ mg/L	Dissolved C ₂ H ₄ col.	Dissolved C ₂ H ₄ mg/L	Dissolved N ₂ col.	Dissolved N ₂ mg/L	Dissolved Ar col.	Dissolved Ar mg/L	Dissolved O ₂ col.	Dissolved O ₂ mg/L	Helium dilution factor*	Headspace Volume (ml)	Weight of Water (g)	Atmospheric Pressure (atm)	Sample Temperature (°C)	Comments	
683196	Bagley Rig Supply Well	9/11/2018	11:50	Indigo / 8060.00	9/20/2018	na	nd	1.91	6.26	0.45	89.72	nd	1.66	0.0014	nd	nd	nd	nd	nd	nd	nd	nd	9/22/2018				-26.9	-5.13	No	0.41	0.27	0.00036	0.00045	<0.0002	<0.0003	20	23	0.47	0.79	1.5	2.0	0.85	45	345.3	0.974	21.4	
683197	ROM Rig Supply Well	9/11/2018	14:55	Indigo / 8060.00	9/20/2018	na	nd	1.79	6.30	0.50	85.23	nd	6.18	0.0045	nd	nd	nd	nd	nd	nd	nd	nd	9/22/2018				-25.9	-5.00	No	1.6	1.1	0.0012	0.0016	<0.0002	<0.0004	20	23	0.47	0.78	1.6	2.2	0.86	44	278.7	0.974	21.6	
683198	Derbonne Relief Well	9/11/2018	16:00	Indigo / 8060.00	9/21/2018	na	nd	0.343	7.79	0.29	13.65	nd	77.04	0.853	nd	0.0305	0.0003	0.0028	0.0012	nd	nd	nd	9/25/2018	-34.71	-143.8	-21.9	-26.1	-5.01	No	49	33	0.58	0.72	0.020	0.036	7.8	9.1	0.22	0.36	4.8	6.5	0.68	51	317.3	0.972	22.6	ethane carbon isotope data obtained online via GC-C-IRMS

Lowest Quantifiable limits		
C ₁	2 ppm	0.0002%
C ₂ -C ₆	1 ppm	0.0001%
Ar	50 ppm	0.0050%
O ₂	100 ppm	0.0100%
N ₂	100 ppm	0.0100%
He	50 ppm	0.0050%
H ₂	100 ppm	0.0100%
CO ₂	50 ppm	0.0050%
CO	100 ppm	0.0100%

Lab #: 683196 Job #: 39489 IS-78329 Co. Job#: _____
 Sample Name: Bagley Rig Supply Well Co. Lab#: _____
 Company: Hydro-Environmental Technology, Inc.

API/Well:

Container: Isoflask & Plastic Bottle

Field/Site Name: Indigo / 8060.00

Location:

Formation/Depth:

Sampling Point:

Date Sampled: 9/11/2018 11:50 Date Received: 9/14/2018 Date Reported: 10/03/2018

Component	Chemical mol. %	$\delta^{13}\text{C}$ ‰	δD ‰	$\delta^{18}\text{O}$ ‰	Dissolved gas cc/L	Dissolved gas ppm
Carbon Monoxide -----	nd					
Helium -----	na					
Hydrogen -----	nd					
Argon -----	1.91				0.47	0.79
Oxygen -----	6.26				1.5	2.0
Nitrogen -----	89.72				20	23
Carbon Dioxide -----	0.45					
Methane -----	1.66				0.41	0.27
Ethane -----	0.0014				0.00036	0.00045
Ethylene -----	nd					
Propane -----	nd				< 0.0002	< 0.0003
Propylene -----	nd					
Iso-butane -----	nd					
N-butane -----	nd					
Iso-pentane -----	nd					
N-pentane -----	nd					
Hexanes + -----	nd					
Water -----			-26.9	-5.13		

Vacuum Distilled? ----- No

Remarks:

Analysis is of gas extracted from water by headspace equilibration. Analysis has been corrected for helium added to create headspace. Helium dilution factor = 0.85

*Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

nd = not detected. na = not analyzed. Isotopic composition of hydrogen is relative to VSMOW. Isotopic composition of carbon is relative to VPDB. All gas component carbon isotope values are reported on a scale defined by a two point calibration of LSVEC and NBS 19. Isotopic composition of oxygen is relative to VSMOW, except for carbon dioxide which is relative to VPDB. Chemical compositions are normalized to 100%. Mol. % is approximately equal to vol. %.

Lab #: 683197 Job #: 39489 IS-78329 Co. Job#: _____
 Sample Name: ROM Rig Supply Well Co. Lab#: _____
 Company: Hydro-Environmental Technology, Inc.
 API/Well: _____
 Container: Isoflask & Plastic Bottle
 Field/Site Name: Indigo / 8060.00
 Location: _____
 Formation/Depth: _____
 Sampling Point: _____
 Date Sampled: 9/11/2018 14:55 Date Received: 9/14/2018 Date Reported: 10/03/2018

Component	Chemical mol. %	$\delta^{13}\text{C}$ ‰	δD ‰	$\delta^{18}\text{O}$ ‰	Dissolved gas cc/L	Dissolved gas ppm
Carbon Monoxide -----	nd					
Helium -----	na					
Hydrogen -----	nd					
Argon -----	1.79				0.47	0.78
Oxygen -----	6.30				1.6	2.2
Nitrogen -----	85.23				20	23
Carbon Dioxide -----	0.50					
Methane -----	6.18				1.6	1.1
Ethane -----	0.0045				0.0012	0.0016
Ethylene -----	nd					
Propane -----	nd				< 0.0002	< 0.0004
Propylene -----	nd					
Iso-butane -----	nd					
N-butane -----	nd					
Iso-pentane -----	nd					
N-pentane -----	nd					
Hexanes + -----	nd					
Water -----			-25.9	-5.00		

Vacuum Distilled? ----- No

Remarks:

Analysis is of gas extracted from water by headspace equilibration. Analysis has been corrected for helium added to create headspace. Helium dilution factor = 0.86

*Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

nd = not detected. na = not analyzed. Isotopic composition of hydrogen is relative to VSMOW. Isotopic composition of carbon is relative to VPDB. All gas component carbon isotope values are reported on a scale defined by a two point calibration of LSVEC and NBS 19. Isotopic composition of oxygen is relative to VSMOW, except for carbon dioxide which is relative to VPDB. Chemical compositions are normalized to 100%. Mol. % is approximately equal to vol. %.

Lab #: 683198 Job #: 39489 IS-78329 Co. Job#: _____
 Sample Name: Derbonne Relief Well Co. Lab#: _____
 Company: Hydro-Environmental Technology, Inc.
 API/Well: _____
 Container: Isoflask & Plastic Bottle
 Field/Site Name: Indigo / 8060.00
 Location: _____
 Formation/Depth: _____
 Sampling Point: _____
 Date Sampled: 9/11/2018 16:00 Date Received: 9/14/2018 Date Reported: 10/03/2018

Component	Chemical mol. %	$\delta^{13}\text{C}$ ‰	δD ‰	$\delta^{18}\text{O}$ ‰	Dissolved gas cc/L	Dissolved gas ppm
Carbon Monoxide -----	nd					
Helium -----	na					
Hydrogen -----	nd					
Argon -----	0.343				0.22	0.36
Oxygen -----	7.79				4.8	6.5
Nitrogen -----	13.65				7.8	9.1
Carbon Dioxide -----	0.29					
Methane -----	77.04	-34.71	-143.8		49	33
Ethane -----	0.853	-21.9			0.58	0.72
Ethylene -----	nd					
Propane -----	0.0305				0.020	0.036
Propylene -----	0.0003					
Iso-butane -----	0.0028					
N-butane -----	0.0012					
Iso-pentane -----	nd					
N-pentane -----	nd					
Hexanes + -----	nd					
Water -----			-26.1	-5.01		

Vacuum Distilled? ----- No

Remarks:

Analysis is of gas extracted from water by headspace equilibration. Analysis has been corrected for helium added to create headspace. Helium dilution factor = 0.68

*Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.
 ethane carbon isotope data obtained online via GC-C-IRMS

nd = not detected. na = not analyzed. Isotopic composition of hydrogen is relative to VSMOW. Isotopic composition of carbon is relative to VPDB. All gas component carbon isotope values are reported on a scale defined by a two point calibration of LSVEC and NBS 19. Isotopic composition of oxygen is relative to VSMOW, except for carbon dioxide which is relative to VPDB. Chemical compositions are normalized to 100%. Mol. % is approximately equal to vol. %.

Job 39489

Results of Daily Instrument Check

Delta Q: Dual Inlet Hydrogen Isotope Analysis

<i>Date</i>	<i>zero enrichment</i>	<i>ck std expected</i>	<i>ck std measured</i>
9/24/2018	0.314	-173.70	-172.806
9/24/2018	0.314	-173.70	-173.155

Delta R: Dual Inlet Carbon Isotope Analysis

<i>Date</i>	<i>zero enrichment</i>	<i>ck std expected</i>	<i>ck std measured</i>
9/24/2018	-0.047	-11.31	-11.308
9/24/2018	-0.047	-11.31	-11.321

Orca Standards Gamma 3053

Date Ran	C ₁
9/24/2018	-41.530

Expected Value -41.60

Date Ran	2C ₁
9/24/2018	-173.409

Expected Value -175.28

GPA Standards Gamma 2233

Date Ran	C ₁
09/24/18	-43.537

Expected Value -43.57

Date Ran	2C ₁
09/24/18	-193.167

Expected Value -189.78

Online Analyses QAQC Data
Company Code: HYE
Job: 39489

Delta F: IRMS System - Carbon Isotope Analyses

zero enrichment

Date	Mean	Std. Dev
9/24/2018	0.014	0.035

13C2-13C3 Carbon Isotope Analyses

Analysis	Identifier 1	Identifier 2	Preparation	Ampl. 44	d 13C/12C	Component	Date	Time	Comment	Area All	c2 std diff	c3 std diff
f-26812	I-966	Frog 160X	0.75cc at 20	1440	-35.367	C2	9/25/2018	1:00:50		8.31	0.47	
f-26812	I-966	Frog 160X	0.75cc at 20	637	-33.571	C3	9/25/2018	1:00:50		3.04		0.23
f-26813	I-967	golf 172X	0.75cc at 10	1692	-31.605	C2	9/25/2018	1:10:05		13.72	0.07	
f-26813	I-967	golf 172X	0.75cc at 10	702	-29.433	C3	9/25/2018	1:10:05		3.46		-0.17
f-26814	gpa	gpa 140X	0.5cc at 10	2158	-29.246	C2	9/25/2018	1:19:20		16.66	-0.24	
f-26814	gpa	gpa 140X	0.5cc at 10	1062	-32.487	C3	9/25/2018	1:19:20		5.22		-0.18
f-26815	I-966	Frog 160X	2.5cc at 10	2637	-36.122	C2	9/25/2018	1:28:38		26.18	-0.28	
f-26815	I-966	Frog 160X	2.5cc at 10	1901	-33.869	C3	9/25/2018	1:28:38		9.86		-0.07
f-26816	I-967	golf 172X	2.5cc at 10	2289	-31.783	C2	9/25/2018	1:37:56		22.35	-0.11	
f-26816	I-967	golf 172X	2.5cc at 10	1111	-29.258	C3	9/25/2018	1:37:56		5.61		0.01
f-26817	gpa	gpa 140X	2.5cc at 20	2742	-29.214	C2	9/25/2018	1:47:14		19.60	-0.21	
f-26817	gpa	gpa 140X	2.5cc at 20	1254	-32.468	C3	9/25/2018	1:47:14		6.13		-0.16
f-26818	I-966	Frog 4X	0.25cc at 50	10971	-35.884	C2	9/25/2018	1:56:29		58.58	-0.04	
f-26818	I-966	Frog 4X	0.25cc at 50	3862	-33.986	C3	9/25/2018	1:56:29		21.71		-0.18
f-26819	I-967	golf 4X	0.4cc at 50	11223	-31.311	C2	9/25/2018	2:05:44		60.31	0.37	
f-26819	I-967	golf 4X	0.4cc at 50	2724	-29.150	C3	9/25/2018	2:05:44		14.42		0.12
f-26820	gpa	gpa 4X	50uL at 50	10832	-28.889	C2	9/25/2018	2:14:59		57.73	0.12	
f-26820	gpa	gpa 4X	50uL at 50	3375	-32.228	C3	9/25/2018	2:14:59		18.44		0.08
f-26826	I-967	golf 172X	2.5cc at 10	2352	-31.870	C2	9/25/2018	3:03:12		23.44	-0.19	
f-26826	I-967	golf 172X	2.5cc at 10	1140	-29.270	C3	9/25/2018	3:03:12		5.81		0.00
f-26828	683198	Derbonne Relief Well	1.5cc at 50	5130	-21.926	C2	9/25/2018	3:16:53	Job 39489	27.14		
f-26829	I-967	golf 172X	0.75cc at 10	1786	-31.547	C2	9/25/2018	3:26:02		14.65	0.13	
f-26829	I-967	golf 172X	0.75cc at 10	746	-29.257	C3	9/25/2018	3:26:02		3.69		0.01
f-26830	gpa	gpa 140X	0.5cc at 10	2287	-29.242	C2	9/25/2018	3:35:18		18.11	-0.24	
f-26830	gpa	gpa 140X	0.5cc at 10	1152	-32.113	C3	9/25/2018	3:35:18		5.87		0.19
f-26831	I-966	Frog 160X	2.5cc at 10	2872	-36.001	C2	9/25/2018	3:44:36		28.44	-0.16	
f-26831	I-966	Frog 160X	2.5cc at 10	2036	-33.833	C3	9/25/2018	3:44:36		10.85		-0.03
f-26832	gpa	gpa 140X	2.5cc at 20	2893	-29.118	C2	9/25/2018	3:53:54		20.68	-0.11	
f-26832	gpa	gpa 140X	2.5cc at 20	1315	-32.248	C3	9/25/2018	3:53:54		6.65		0.06
f-26833	I-967	golf 4X	0.4cc at 50	11111	-31.351	C2	9/25/2018	4:03:10		59.57	0.33	
f-26833	I-967	golf 4X	0.4cc at 50	2624	-29.252	C3	9/25/2018	4:03:10		14.30		0.01
f-26834	gpa	gpa 4X	50uL at 50	10642	-28.839	C2	9/25/2018	4:12:26		56.63	0.17	
f-26834	gpa	gpa 4X	50uL at 50	3265	-32.226	C3	9/25/2018	4:12:26		18.22		0.08

mean:	0.00	0.00
st. dev.:	0.24	0.13

Online STDS Values

STD	13C2
gpa	-29.00
I-967	-31.68
golf	-31.68
I-966	-35.84

STD	13C3
gpa	-32.30
I-967	-29.27
golf	-29.27
I-966	-33.80

Isotech QA/QC Data

39489 HYE

Date Ran	Calibration Standards				Check Standard	
	DI-5		LT-2		MID	
	$\delta^{18}\text{O H}_2\text{O}$ ‰	$\delta\text{D H}_2\text{O}$ ‰	$\delta^{18}\text{O H}_2\text{O}$ ‰	$\delta\text{D H}_2\text{O}$ ‰	$\delta^{18}\text{O H}_2\text{O}$ ‰	$\delta\text{D H}_2\text{O}$ ‰
2018/09/21 17:17:50	-6.768	-41.830	-18.708	-141.739	-12.003	-90.882
2018/09/22 02:02:33	-6.775	-42.020	-18.955	-141.992	-12.053	-90.751
2018/09/22 11:33:55	-6.734	-41.842	-18.920	-141.936	-12.050	-90.744
2018/09/22 21:08:32	-6.773	-42.081	-18.962	-142.072	-12.052	-90.809
2018/09/23 06:46:14	-6.761	-42.246	-18.842	-141.764	-12.039	-90.780
2018/09/23 16:26:52	-6.752	-41.983	-18.889	-141.895	-12.029	-90.777
Average	-6.76	-42.0	-18.88	-141.9	-12.04	-90.8
Standard Deviation	0.02	0.16	0.10	0.13	0.02	0.05
Lit (MS) Value	-6.76	-42.0	-18.88	-141.9	-11.99	-90.9

Duplicates

I-Number	Sample ID	$\delta^{18}\text{O}$	$\delta^2\text{H}$
n/a	n/a	n/a	n/a



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 Phone (337) 261-1963 FAX (337) 261-1953

SAMPLE CHAIN-OF-CUSTODY RECORD

Project Name: _____	Laboratory: _____
Project Number: _____	Collected By: _____
Project Location: _____	Company: _____
	Date: _____

Sample I.D.	Type	Date/Time Sampled	Containers	Analysis Requested/Method	Comments
Bagley Rig Supply Well	AQ	9/11/2018 11:50	(1) Isoflask (1) Liter Plastic	Dissolved Gases DG-2 Hydrogen (2H/1H), Oxygen-18O/16O	
ROM Rig Supply Well	AQ	9/11/2018 14:55	(1) Isoflask (1) Liter Plastic	Dissolved Gases DG-2 Hydrogen (2H/1H), Oxygen-18O/16O	
Derbonne Relief Well	AQ	9/11/2018 16:00	(1) Isoflask (1) Liter Plastic	Dissolved Gases DG-2 Hydrogen (2H/1H), Oxygen-18O/16O	

Note: Report concentrations of all fixed gases & where possible both mol ratios & aqueous concentrations of all gases.
 For the DG2 analyses, please include dD for C2 and C3 gases.

Relinquished By: <i>Waldo A. Piquet</i> Date/Time: <i>9-13-2018 / 9:00</i>	Received By: Abby L. Skube / Isotech Laboratories Date/Time: SEP 14 2018 9:15
Relinquished By: Date/Time:	Received By: Date/Time:
Analysis Due: Verbal:	Written: