

Leach Study Cape CORAL

Forestry Suppliers, Inc.

1-800-647-5368

49354 Level Book

Plotting Data + Tables

* If $\overset{(2)}{DL} = \overset{(2)}{< DL}$ use $\overset{(1)}{\frac{1}{2} \text{ detect}}$

If ~~DL~~ ^{Sample} is diluted $< 10 \times 100 \times$
1000x

then keep $< 10 \times 100 \times 1000 \times$

and DO NOT use ^{Diluted Samp.} in Stats etc.

Plot $\frac{1}{2}$ detects when $< DL$

Do not plot if diluted.

Diluted Samples Qualify
with a J for As in GW

STS

3-2

3-4

4

1

01

3-2

3-4

3-4

core

-4

ore

* Need to
Convert
Photos
Act Lab
T.S. etc.

NSTS

* W-18852
CPS-2
* W-18852
CPS-4

↓

Vacuum pump failed
while holding preserved
core samples. Failure
occurred after core
samples were completely
dry, but before 1st Protocol

Protocol 1

W#	min Depth	max Depth	SPL WT	Vessel #	
18878	840	841	230.41	1	NSTS
18878	851.5	852.5	290.88	2	↓
18848	837.5	838.5	279.97	3	CPS-2
18848	842.5	843	305.21	4	↓
18849	830	830.75	312.02	5	CPS-4
18849	832	833	307.43	6	↓
BLANK	—	—	—	7	CPS-4 water
18849 (D)	834	835	282.91	8	↓
18849	834	835	275.96	9	

Waters Collected 1-28-09

Shipped & Stored in Refrigerator

Ground water = ASR-NSTS-CPS-2
CPS-4

Surface water = CPS-2 + CPS-4

* use CPS-2 For CPS-2 core

* use CPS-4 For NSTS + CPS-4
Core

* I think the Field Cond. Readings

Parameters when Collected:

NSTS Groundwater

Temp 27.12

pH 7.21

S.C. 4.194 $\mu\text{S}/\text{cm}$

CPS-2 Groundwater

Temp 29.58

pH 7.79

SC 48.230 $\mu\text{S}/\text{cm}$

CPS-4 Groundwater

Temp 29.05

pH 6.97

SC 2.013 $\mu\text{S}/\text{cm}$

CPS-2 Surface Water Canal Pump

Temp 30.24

pH 6.95

SC 6.23 $\mu\text{S}/\text{cm}$

CPS-4 Surface Water Canal Pump

Temp 21.53

pH 6.92

SC 1.153 $\mu\text{S}/\text{cm}$

Field Parameter
Cond should be
MS Not μS ?

should be mS NOT μS

Groundwaters Sparged
with H_2S on 4-10-09 for
3min. NSTS, CPS-2, CPS-4
(ASR) Left in room to
do initial H_2S fill.

GW Sampled For Anions
Cations + Alkalinity
on 4-10-09 Pre- H_2S

NSTS & CPS-2 turned Grayish Color
after Sparging w/ H_2S

CPS-4 still Gray after
Sparging w/ H_2S

4-13-09 NSTS still Gray Color
+ CPS-2 Lighter gray color.
Photos taken, NSTS has
Black streaks on Bottom +
Side near bottom of Carboy.

Post H_2S	4-13-09	3:50			
DO	ORP	pH	Temp	Cond ms	
NSTS	1.10	-260.8	6.87	24.2	4.73ms
CPS-2	1.3	-254.3	6.71	24.1	55.4ms
CPS-4	1.00	-261.9	7.28	24.1	2043ms

4-13-09 Samples taken Post H_2S

Cations - unfiltered & filtered

Anions "

Alkalinity

Cations filtered were centrifuged

Fill Vessels on 4-14-09

first Sampling event will be
4-15-09

Vessels filled w/ 1L of NGW
from ASR well where core was
taken.

NSTS + CPS - still Gray colored

Start filling at 9:00 AM 4-14-09
Hungate 1L cylinder w/ N_2 while filling
" N_2 vessel when filling Hungate
NGW After filling then store in
Refrigerator. All Hungate 1-2 minutes

NSTS ASR	Post H_2S	W-18778
CPS-2 ASR	Post H_2S	W-18852
CPS-4 ASR	Post H_2S	W-18849

NSTS-L-1028 W-18778

N^o CPS-4 ASR L-1036 W-18849

CPS-2 ASR L-1031 - Given
* wrong W# originally
W-18849 the correct
W# is W-18852

→ Apply Vacuum 1-2 min per
Vessel. Then Hungate
all vessels w/ N_2

Sample #	4-15-09	8:00			
	DO	ORP	pH	Temp	Cond ^{ms} _{us}
001	0.25	-295.0	7.29	22.9	484ms
002	0.20	-337.6	7.33	22.9	492ms
003	0.27	-363.3	7.32	22.2	56.0ms
004	0.15	-367.1	7.49	22.9	56.2ms
005	0.14	-338.3	7.95	22.6	2.20ms
006	0.21	-353.3	7.99	22.6	2167ms
007	0.26	-369.4	7.87	22.9	2037ms
008	0.26	-354.1	7.85	22.9	2158ms
009	0.27	-348.0	7.81	22.9	2157ms

Precipitate in Bottom of
NGW NSTS W-18878

Vessel #	W #	min Depth	max Depth	SPL WT	
1	18878	840	841	230.41	sample
2	18878	851.5	852.5	290.88	
3	18852	837.5	838.5	299.97	
4	18852	842.5	843	305.21	
5	18878	830	830.75	312.02	
6	18878	832	833	307.43	
7	BLANK	-	-	-	CPS-4 Water
8	18849	834	835	282.91	D
9	18849	834	835	275.96	

Sample #	DO	ORP	pH	Temp	Cond
10	0.17	341.9	7.27	22.8	4.73 ms
11	0.15	313.6	7.33	23.2	4.83 ms
12	0.17	353.0	7.30	23.0	55.5 ms
13	0.19	351.4	7.24	23.3	55.6 ms
14	0.17	305.9	7.78	23.3	2110 μ s
15	0.14	282.1	7.75	23.3	2098 μ s
16	0.12	369.2	8.10	23.4	2011 ms
17	0.14	325.5	7.86	23.3	2098 μ s
18	0.13	351.9	7.82	23.4	2103 μ s

Vessel #

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Vessel #9 appears to
have a light film over
it.

4-20-09 7:30 Am

Sample #	DO	ORP	pH	Temp	Cond.
19	0.18	-254.5	7.00	23.3	4.74ms
20	0.13	-310.9	7.29	23.2	4.82ms
21	0.14	-352.6	7.34	23.7	55.5ms
22	0.15	-350.8	7.41	23.2	55.8ms
23	0.15	-266.7	7.78	23.4	212 μ s
24	0.12	-265.3	7.68	23.3	2088 μ s
25	0.15	-347.3	8.15	24.0	2000 μ s
26	0.14	-325.4	7.97	23.8	2077 μ s
* 27	0.16	-253.3	7.87	24.0	2086 μ s

Vessel #

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Sample #	DO	ORP	pH	Temp	Cond
28	0.19	-259.1	7.07	23.4	5.44 ms
29	0.15	-274.2	7.26	23.8	5.42 ms
30	0.15	-333.8	7.36	23.9	55.7 ms
31	0.16	-344.9	7.34	24.1	55.8 ms
32	0.17	-242.5	7.81	24.1	2075 ms
33	0.15	-224.7	7.74	24.0	2093 ms
34	0.12	-347.9	8.47	24.2	2003 ms
35	0.10	-264.7	8.02	24.0	2053 ms
36	0.15	-206.3	7.91	24.1	2080 ms

Vessel #

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- Yellow-green -

> 38 ml replaced
#8 redone for Cations

• Added H_2S to #5, #6, #9
for approx. 20 seconds

Sample #	DO	ORP	pH	Temp	Cond ^{ms} / _{us}
37	0.18	-208.6	7.01	24.8	5.88 ms
38	0.15	-263.9	7.23	25.1	5.90 ms
39	0.16	-315.9	7.33	25.1	55.9 ms
40	0.15	-316.6	7.31	25.2	55.9 ms
41	0.18	-393.1	7.51	25.4	2.29 ms
42	0.17	-384.8	7.54	25.1	2.29 ms
43	0.20	-352.3	8.50	25.6	1.994 ms
44	0.12	-268.0	7.97	25.3	2.054 ms
45	0.17	-374.1	7.50	25.2	2.29 ms

Vessel #
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Sample #	DO	ORP	pH	Temp	Cond.
46	0.23	-213.9	6.9	25.0	5.84ms
47	0.13	-241.5	7.22	25.5	5.92ms
48	0.14	-312.6	7.39	25.6	55.9ms
49	0.13	-318.2	7.31	25.5	56.1ms
50	0.15	-378.0	7.66	25.4	2.22ms
51	0.13	-372.4	7.72	25.6	2.17ms
52	0.11	-342.6	8.21	26.1	2.00ms
53	0.11	-301.0	7.92	25.4	2.05ms
54	0.15	-388.8	7.74	25.5	2.22ms

* Alkalinity Samples Taken

Vessel #7 no Alkalinity
Sample accidentally skipped

* Water Change after Sampling
Change to Hi DO SW

- CPS-2 water for W-18852

- CPS-4 water for W-18778+
W-18849 (NSTS+CPS-4)

Start water change at 10:00AM

Vessel #

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Green

6

Yellow Brown

7

Light yellow Green

8

NOT Green

9

← Green Tint

Drop

Sample 4-30-9

#	DO	ORP	pH	Temp	Cond.
SW CPS-2	*11.83	*52.8	6.50	10.5	593 μ S
SW CPS-4	*10.76	763.2	7.57	9.8	765 μ S

*Alkalinity Samples Taken

*No alkalinity for Blank, #7

No vacuum

Started at 10 AM

Water Change w/ Peristaltic Pump to remove NGW

Filtered when needed w/ 1.0 μ m millipore filter. Material on filter washed back into vessel.

Vessels refilled w/ appropriate SWater CPS2-W-18852

CPS-4-W-18778 + 18849

No vacuum applied, air

bubbles appeared minimal

SW Sampled before filling vessels. Temp appears to have had huge effect on DO.

Finished filling all vessels
12:30pm

*DO value is Temp dependant.

Sample #	DO	ORP	pH	Temp	Cond.
55	6.48	+576	6.82	26.1	1236 μ S
56	6.48	+623.2	7.12	25.8	1289 μ S
57	7.15	+244.5	7.39	26.1	3.60 ms
58	6.99	+315.1	7.35	26.1	3.84 ms
59	7.88	+346.7	7.38	26.1	952 μ S
60	4.57	+326.1	7.44	26.1	908 μ S
61	7.80	+714.0	7.97	25.9	791 μ S
62	6.32	+507.2	7.93	25.9	877 μ S
63	4.48	+409.7	7.74	26.0	915 μ S

Vessel

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Sample #

5-4-09

7:30 am

	DO	ORP	pH	Temp	Cond
64	5.73	+263.2	6.45	26.0	1268 μ S
65	6.80	+260.8	6.74	26.0	1317 μ S
66	6.36	+247.8	7.17	26.1	4.89 ms
67	6.47	+249.8	7.26	26.1	5.82 ms
68	5.81	+257.5	7.31	25.9	971 μ S
69	4.30	+255.4	7.22	25.9	955 μ S
70	8.12	+684.0	7.83	26.0	792 μ S
71	5.57	+418.2	7.66	26.0	891 μ S
72	5.09	+380.2	7.49	26.0	933 μ S

Vessel #

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Sample #	DO	ORP	pH	Temp	Cond.
73	6.64	+299.6	6.44	25.7	1265
74	7.20	+297.9	6.75	25.6	1352
75	6.66	+283.5	7.19	25.7	5.63
76	7.01	+282.0	7.26	25.7	5.75
77	6.71	+285.2	7.42	25.7	961
78	5.59	+294.5	7.35	25.7	963
79	8.29	+672.8	7.93	25.6	790
80	6.92	+427.9	7.79	25.6	886
81	6.08	+391.0	7.54	25.6	920

Vessel

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sample #	DO	ORP	pH	Temp	Concl.
82	6.88	+299.8	6.40	25.8	1248 μ S
83	7.47	+302.4	6.69	25.5	1351 μ S
84	7.04	+294.7	7.22	25.7	5.99 ms
85	7.70	+294.6	7.21	25.8	5.76 ms
86	6.90	+306.5	7.30	25.9	954 μ S
87	5.56	+312.0	7.27	25.9	966 μ S
88	8.06	+469.1	7.79	25.8	790 μ S
89	7.71	429.0	7.82	25.7	859 μ S
90	6.18	417.2	7.56	25.8	931 μ S

Vessel

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Sample #

5-11-09 8:30am

DO	ORP	pH	Temp	Cond
91	7.18	+309.2	6.68	26.2
92	7.69	+309.9	6.81	26.4
93	7.11	+303.9	7.12	26.4
94	7.51	+302.3	7.17	26.4
95	7.54	+316.4	7.31	26.5
96	5.81	+321.0	7.23	26.4
97	8.12	+665.4	7.57	26.4
98	7.55	+419.3	7.64	26.3
99	7.12	+412.9	7.57	26.2

Vessel #

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Sample #	DO	ORP	pH	Temp	Cond #
100	7.82	+305.9	6.46	26.0	1214 μ S
101	6.80	+314.9	6.91	26.0	1352 μ S
102	7.07	+303.7	7.24	26.0	6.73 mS
103	6.90	+303.1	7.32	26.1	5.71 mS
104	7.72	+311.6	7.41	26.0	939 μ S
105	6.74	+315.7	7.35	26.0	971 μ S
106	8.30	+444.5	7.83	25.9	792 μ S
107	7.78	+414.5	7.91	26.0	850 μ S
108	6.31	+406.0	7.60	25.9	922 μ S

Vessel #
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Sample #

5-18-09 7:45 am

	DO	ORP	pH	Temp	Cond
109	7.94	314.7	6.59	25.9	1199 μ S
110	7.78	322.9	6.93	25.9	1339 μ S
111	7.56	315.0	7.21	25.9	6189 μ S
112	7.48	313.7	7.26	26.0	5.77 μ S
113	7.75	323.2	7.36	26.0	932 μ S
114	6.93	328.7	7.32	26.1	975 μ S
115	8.19	334.9	7.76	26.0	796 μ S
116	7.83	402.1	7.88	26.0	848 μ S
117	7.18	400.3	7.62	25.9	919 μ S

Vessel #

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sample #	DO	ORP	pH	Temp	Cond.
118	7.98	+320.9	6.57	25.3	1184 μ S
119	7.86	+327.8	6.89	25.4	1320 μ S
120	7.06	+320.2	7.29	25.4	6.94 μ S
121	7.47	+318.9	7.27	25.4	5.67 μ S
122	7.88	+319.5	7.41	25.4	921 μ S
123	7.26	+326.4	7.33	25.5	969 μ S
124	8.20	+319.0	8.01	25.4	797 μ S
125	7.94	+317.8	7.97	25.4	840 μ S
126	7.49	+323.2	7.80	25.5	910 μ S

Alkalinity Samples
taken today

12 ml.

32 ml replaced
in each
vessel

Vessel

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* ORP for 8+9

took before ORP for
7, big difference

* Redid ORP for 8 after
doing ORP for 7 - -
+403.4 - ??

Sample
#

5-26-08 7:45

	DO	ORP	pH	Temp	Cond
127	7.96	327.5	7.19	25.5	1159 μ S
128	7.96	329.5	7.18	25.6	1294 μ S
129	7.59	324.3	7.23	25.6	6.77ms
130	7.90	324.2	7.30	25.7	5.52ms
131	7.92	329.5	7.45	25.6	909 μ S
132	7.49	332.9	7.36	25.7	961 μ S
133	8.17	604.8	7.93	25.6	795 μ S
134	7.94	322.3	7.43	25.6	835 μ S
135	7.69	325.9	7.46	25.7	899 μ S

Vessel
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Sample #	DO	ORP	pH	Temp	Cond
136	8.22	324.7	6.96	22.8	1130 μ S
137	8.11	329.4	7.08	22.8	1277 μ S
138	8.18	322.5	7.24	22.9	6.62 ms
139	8.21	323.3	7.29	23.0	5.36 ms
140	8.11	328.0	7.44	23.1	897 μ S
141	7.85	332.5	7.35	23.1	955 μ S
142	8.34	612.3	8.16	23.1	793 μ S
143	8.15	326.4	7.43	23.0	828 μ S
144	8.10	327.4	7.51	23.1	890 μ S

Vessel #

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Sample #	DO	6-2-09 ORP	pt	Temp	Cond
145	8.18	331.6	6.85	24.2	1140 μ S
146	8.13	333.8	7.02	24.3	1271 μ S
147	8.03	331.1	7.22	24.2	6.57 μ S
148	8.08	331.0	7.30	24.4	5.32 μ S
149	8.07	331.7	7.46	24.4	900 μ S
150	7.95	340.2	7.36	24.4	954 μ S
151	8.29	561.3	7.68	24.4	798 μ S
152	8.11	331.0	7.43	24.3	830 μ S
153	8.02	329.4	7.40	24.3	889 μ S

Vessel #

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Sample #	DO	DRP	pH	Temp	Conid
154	8.05	314.3	6.92	23.6	1128 μ S
155	8.09	322.4	7.07	23.7	1253 μ S
156	8.06	321.8	7.30	23.4	6.47 ms
157	7.99	324.5	7.37	23.9	5.23 ms
158	7.99	328.1	7.52	23.9	894 μ S
159	7.83	334.3	7.46	24.0	946 μ S
160	8.08	546.0	7.58	24.0	798 μ S
161	7.93	329.7	7.56	24.0	826 μ S
162	7.94	325.4	7.53	23.9	881 μ S

Vessel #

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6-9-09 8 Am					
Sample #	DO	ORP	pH	Temp	Cond
1163	8.34	323.5	6.42	22.5	1115 μ S
1164	8.32	327.7	6.67	22.5	1232 μ S
1165	8.25	328.4	7.12	22.6	6.42 ms
1166	8.31	327.8	7.22	22.8	5.14 ms
1167	8.29	327.9	7.40	22.8	888 μ S
1168	8.25	334.4	7.33	22.7	940 μ S
1169	8.39	551.1	7.65	22.8	797 μ S
1170	8.18	328.2	7.40	22.7	824 μ S
1171	8.17	326.4	7.44	22.8	874 μ S

Vessel #

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Sample #	DO	ORP	pH	Temp	Conduct
172	8.29	329.1	7.05	25.8	1110 μ S
173	8.07	330.4	7.13	25.8	1124 μ S
174	8.11	322.9	7.20	25.8	6.19 mS
175	8.05	325.6	7.27	25.9	5.05 mS
176	8.06	325.6	7.41	25.9	881 μ S
177	7.79	332	7.36	25.8	929 μ S
178	8.18	509.1	7.59	25.7	797 μ S
179	7.98	322.9	7.44	25.8	819 μ S
180	7.75	322.2	7.42	25.8	868 μ S

Vessel #

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7-6-09 Sparged 3 NGW's
with H₂S 15 sec. ~ 1:00 PM

7-7-09 Sampled - all 3 NGW's
Each one Sampled for

Centrifuged
Filtered

Unfiltered

NSTS - is dark Grayish Color.

2ND PROTOCOL

LDO-LIQUICELL

10-16-09 - Sampled SW - Pre H₂S

CPS-4 & CPS-2 - Cations,
Anions + Alkalinity

W#	min	Max	Sp/WT	Vessel #
18778	840	841	264.65	NSTS 1
18778	851.5	852.5	308.32	NSTS 2
18852	837.5	838.5	270.98	CPS-2 3
18852	842.5	843	266.21	CPS-2 4
18849	830	830.75	311.82	CPS-4 5 ²
18849	830	830.75	306.88	CPS-4 6 ³
18849	832	833	300.71	CPS-4 7 ³
18849	834	835	271.66	CPS-4 8 ¹
Blank				9

SW CPS-2 - W-18852

SW CPS-4 - W-18778 + 18849

~~Started filling 8:00~~

CPS-2 water slightly gray
after adding H₂S

10-16-09 Sparge w/ H₂S
3 min. Both CPS-2, CPS-4

10-19-09 Add preserved
Core to vessels +
fill all vessels w/
sparged SW.

- Pull Vacuum on all Vessels

- Put N₂ headspace on all
Vessels

Vessel #2 had a lot of air
vacuum on longer there
than the others ~ 3-5 min
most of the other vessels
vacuum on for 2-3 min.

Sample #	DO	ORP	pH	Temp	Cond.
2-1	0.25	-353.9	7.55	23.3	667µs
2-2	0.27	-374.2	7.50	23.1	761µs
2-3	0.20	-370.0	7.75	23.0	3.01ms
2-4	0.22	-360.0	7.85	23.0	3.17ms
2-5	0.16	-364.6	7.50	23.0	692µs
2-6	0.15	-370.2	7.62	23.0	695µs
2-7	0.20	-356.8	7.58	22.9	695µs
2-8	0.17	-374.9	7.47	23.3	687µs
2-9	0.18	-363.9	7.48	23.5	554µs

Replacement Water
 CPS-2
 CPS-4
 is Cloudy

Parameters at 7am
 Sampled at 11:15am

Vessel #

1

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Sample #	DO	ORP	pH	Temp	Cond.
2-10	0.19	-365.0	7.58	25.3	613 μ S
2-11	0.21	-378.4	7.63	25.0	747 μ S
2-12	0.21	-373.7	7.75	25.1	3.14 mS
2-13	0.13	-374.1	7.73	25.1	3.28 mS
2-14	0.18	-369.2	7.63	24.7	632 μ S
2-15	0.18	-378.3	7.67	24.9	651 μ S
2-16	0.19	-364.5	7.61	24.9	649 μ S
2-17	0.16	-381.0	7.60	25.1	657 μ S
2-18	0.21	-397.0	8.06	25.0	551 μ S

Parameters at 7:00am

Sampled at 1:00pm

SW Cloudy as before

Vessel #

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→ Redish Color (Pink)

→ yellow green color

sample #	DO	ORP	pH	Temp	Cond
2-19	0.20	-360.0	7.65	25.4	639 μ S
2-20	0.17	-364.0	7.66	24.4	734 μ S
2-21	0.16	-368.3	7.82	25.2	3.10 ms
2-22	0.14	-344.3	7.70	24.9	3.36 ms
2-23	0.12	-359.8	7.69	25.4	624 μ S
2-24	0.15	-363.8	7.74	25.5	637 μ S
2-25	0.13	-347.6	7.70	25.3	630 μ S
2-26	0.17	-368.1	7.67	25.4	639 μ S
2-27	0.18	-393.3	8.36	25.5	545 μ S

Vessel #

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> Seum on top

— Reddish Color

— yellow Green

	DO	10-26-09 ORP	8:00 AM pH	Temp	Cond.
2-28	0.18	-313.3	7.75	24.5	603 μ S
2-29	0.18	-354.9	7.81	23.5	707 μ S
2-30	0.12	-350.2	7.91	24.6	3.04 mS
2-31	0.13	-290.8	7.66	24.1	3.33 mS
2-32	0.18	-350.0	7.78	23.9	612 μ S
2-33	0.10	-352.6	7.78	24.5	614 μ S
2-34	0.15	-328.4	7.73	24.5	615 μ S
2-35	0.16	-344.6	7.77	24.2	607 μ S
2-36	0.19	-384.5	8.53	24.7	529 μ S

vessel
#

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(film)
> Scum on top

— Slightly Reddish (Less than before)

— film on top

— yellow green

Sample #	DO	ORP	pH	Temp	Cond.
2-37	0.19	-305.9	7.80	24.7	600 μ S
2-38	0.18	-353.9	7.80	24.8	687 μ S
2-39	0.19	-336.5	7.86	25.0	2.99 mS
2-40	0.20	-248.9	7.79	25.0	3.27 mS
2-41	0.16	-345.2	7.81	24.6	585 μ S
2-42	0.17	-354.4	7.82	24.9	594 μ S
2-43	0.17	-335	7.75	24.7	603 μ S
2-44	0.17	-353.0	7.82	24.5	591 μ S
2-45	0.16	-374.9	8.57	24.7	518 μ S

Vessel #

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> Film

— Slightly Red or Pink Brown

— Film

— yellow Green

sample
#

10-30-09

8:00AM

DO

ORP

pH

Temp

Cond.

2-46	0.14	-266.2	7.77	24.0	599 μ S
2-47	0.15	-338.1	7.88	24.1	673 μ S
2-48	0.13	-319.1	7.94	24.4	2.95ms
2-49	0.16	-243.2	7.79	24.3	3.23ms
2-50	0.13	-333.6	7.87	24.0	581 μ S
2-51	0.13	-343.8	7.81	24.4	580 μ S
2-52	0.13	-322.2	7.84	24.3	592 μ S
2-53	0.14	-338.2	7.83	24.4	579 μ S
2-54	0.13	-375.5	8.55	24.4	509 μ S

Vessel
#

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Sample
#

11-2-09

8:00 am

DO

ORP

pH

Temp

Cond.

2-55	0.16	-251.4	7.70	24.0	598 μ S
2-56	0.18	-302.0	7.89	23.6	654 μ S
2-57	0.16	-282.6	7.94	25.0	2.9 μ S
2-58	0.19	-218.5	7.78	24.9	3.19 μ S
2-59	0.14	-313.8	7.88	24.8	570 μ S
2-60	0.14	-322.5	7.87	24.7	567 μ S
2-61	0.15	-309.4	7.84	24.8	581 μ S
2-62	0.15	-338.1	7.86	25.0	563 μ S
2-63	0.14	-366.6	8.47	24.6	496 μ S

Vessel
#

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> Film on top

— Very faint Brownish Red

— faint yellow green

Sample #	DO	11-4-09 ORP	7:15am PH	Temp	Cond.
2-64	0.20	-276.4	7.89	23.7	595 μ S
2-65	0.17	-322.9	7.93	23.7	651 μ S
2-66	0.24	-229.2	8.01	24.1	2.87 mS
2-67	0.22	-183.3	7.84	24.5	3.15 mS
2-68	0.18	-314.5	7.95	23.6	564 μ S
2-69	0.19	-319.7	7.96	24.4	558 μ S
2-70	0.12	-318.4	7.74	23.8	575 μ S
2-71	0.17	-349.1	7.95	24.8	555 μ S
2-72	0.15	-361.6	8.45	24.6	491 μ S

Vessel #

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11-5-09

Spurge w/ H_2S CPS-2
 2 min and CPS-4 for 2 min
 each. This water will
 be used for Water Change
 tomorrow 11-6-09 after
 Regular Sampling

← CPS-2 water same
 Carboy as before just
 resurge with H_2S
 shorter time

11-6-09 2 more min of
 H_2S due to very low
 input for CPS-4 because
 Carboy full & cannot
 bubble at high rate

	DO	ORP	pH	Temp	Cond
2-73	0.15	-272.8	7.90	24.2	589 μ S
2-74	0.12	-323.6	7.92	23.9	648 μ S
2-75	0.17	-244.6	8.09	24.1	2.83ms
2-76	0.20	-233.8	7.83	23.9	3.12ms
2-77	0.18	-313.1	7.94	23.8	561 μ S
2-78	0.14	-312.3	7.95	23.9	553 μ S
2-79	0.18	-314.1	7.91	23.8	569 μ S
2-80	0.16	-338.6	7.98	24.1	549 μ S
2-81	0.16	-338.8	8.47	24.2	489 μ S

After Sampling:

Remove water add "New"

CPS-4 or CPS-2 water (sparged

w/ H_2S yesterday) while

purging with N_2 .

CPS-2 + CPS-4 water

samples taken Post H_2S

with 11-6-09 date

Alkalinity
sample
taken today

	DO	ORP	pH	Temp	Cond.
2-82	0.20	-353.1	7.55	24.3	543 μ S
2-83	0.20	-325.5	7.53	24.4	554 μ S
2-84	0.19	-356.7	7.62	24.5	1580 μ S
2-85	0.17	-346.1	7.40	24.8	1582 μ S
2-86	0.19	-360.1	7.58	24.9	543 μ S
2-87	0.19	-358.5	7.58	24.8	539 μ S
2-88	0.17	-358.7	7.59	24.8	549 μ S
2-89	0.18	-359.9	7.56	24.7	536 μ S
2-90	0.16	-365.8	7.57	25.0	549 μ S

Vessel #

1

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8

9 — Slightly yellow

Most of them have
a film over the top of
the water
except #9

	DO	ORP	pH	Temp	Cond.
2-91	0.18	-300.9	7.62	23.3	530 μ S
2-92	0.18	-338.7	7.59	24.1	532 μ S
2-93	0.18	-273.3	7.53	24.2	1571 μ S
2-94	0.20	-250.4	7.49	24.5	1584 μ S
2-95	0.18	-356.0	7.64	24.5	522 μ S
2-96	0.21	-350.2	7.66	24.5	514 μ S
2-97	0.15	-351.6	7.63	24.3	524 μ S
2-98	0.16	-353.0	7.57	24.6	520 μ S
2-99	0.16	-373.3	8.02	24.3	548 μ S

Vessel
#

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	DO	ORP	pH	Temp	Cond
2-100	0.15	-235.1	7.66	22.9	533 μ S
2-101	0.20	-309.9	7.62	23.2	519 μ S
2-102	0.16	-247.0	7.64	23.8	579 μ S
2-103	0.24	-179.0	7.55	23.7	1596 μ S
2-104	0.17	-343.7	7.68	23.7	499 μ S
2-105	0.17	-329.8	7.68	24.0	490 μ S
2-106	0.18	-339.3	7.60	23.8	509 μ S
2-107	0.18	-338.2	7.66	23.9	496 μ S
2-108	0.12	-364.9	8.36	23.9	544 μ S

Vessel
#

1

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8 → vessel got bumped/shaken up

9 - slightly yellow

No film on 9, 7, 3+4

	DO	ORP	pH	Temp	Conc
2-109	.12	-251.5	7.78	23.2	519 μ S
2-110	.18	-245.1	7.62	23.3	508 μ S
2-111	.17	-166.4	7.66	24.1	1572 μ S
2-112	.18	-127.3	7.62	24.1	1590 μ S
2-113	.116	-358.6	7.67	24.0	492 μ S
2-114	.112	-303.6	7.74	24.0	471 μ S
2-115	.18	-322.7	7.78	23.9	490 μ S
2-116	.17	-323.1	7.72	24.0	479 μ S
2-117	.12	-344.5	8.39	24.1	539 μ S

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11-23-09 7:15 am

	DO	ORP	pH	Temp	Cond.
2-118	0.19	-164.1	7.80	22.8	510
2-119	0.19	-211.4	7.68	23.3	502
2-120	0.21	-123.4	7.67	23.4	1566
2-121	0.22	-146.5	7.61	23.5	1584
2-122	0.18	-325.4	7.71	23.6	482
2-123	0.17	-302.5	7.28	23.2	463
2-124	0.19	-334.2	7.72	23.6	478
2-125	0.18	-303.2	7.75	23.5	466
2-126	0.18	-321.1	8.32	23.8	535

Vessel
#

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11-25-09

7:30

	DO	ORP	pH	Temp	Cond.
2-127	0.20	-177.2	7.38	22.3	502
2-128	0.19	-234.0	7.79	22.9	496
2-129	0.34	-182.1	7.60	23.0	1567
2-130	0.18	-167.0	7.68	23.6	1576
2-131	0.19	-300.3	7.72	23.5	475
2-132	0.19	-277.4	7.81	23.6	458
2-133	0.13	-293.4	7.84	23.3	469 μ S
2-134	0.17	-294.4	7.82	23.7	458
2-135	0.19	-296.6	8.34	24.0	532

Vessel
#

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	DO	11-30-09 ORP	8:00 am pH	Temp	Cond.
2-136	0.21	-283.7	8.04	19.7	500
2-137	0.26	-185.7	7.49	21.5	490
2-138	0.23	-155.4	7.72	22.5	156 S
2-139	0.34	-130.1	7.68	22.4	1571 μ S
2-140	0.17	-342.1	7.54	22.3	469 μ S
2-141	0.18	-341.0	7.77	22.3	460 μ S
2-142	0.14	-342.8	7.86	22.2	459
2-143	0.21	-344.2	7.78	22.3	451
2-144	0.17	-316.6	8.23	22.3	527

Spurge #1-4 with H_2S
 $\approx$ 15-20 sec.

4-Dec Reactor 3 & 4 water is
 yellow - others clear

7-Dec #2, 3, 4 appear
 slightly yellow

9-Dec #2 & 3 yellow 4 almost
 clear

Vessel #	
1	ORP meter technical problems
2	(trying two different
3	probes)
4	original probe cleaned
5	in 0.1 molar solution
6	of HCl
7	2 nd probe is new
8	using HQ20
9	1 st vessel measured
	+185 old probe
	+130 New probe
	Vessel 9 measured
	-316 old probe
	-320 New probe
	So all ORP measurements
	today used old
	probe after cleaning.
	Measured Vessel 1 at
	and now vessel reads
	-283.7.

Dec 7, 2009

Hook DO probe + flow cell (No Filter) to N₂ get 0 ppb

Hook DO probe + Flow cell (No Filter) to Liqui-cell Water - Down to 120 ppb
Some fittings Leaking
Eric helped tighten.

Now DO Reads $\approx$ 120 ppb

Dec 8, 09

Sponge DDI water w/ N₂
Use N₂ Sweep w/ Vac.
Water into Beaker w/
probe.

Now DO Reads 125 ppb
No filter, No flow cell

*10

Dec 9, 09

Membrana said to try
uncreasing the N₂ to 60 cfh
w/ No vacuum -

Air bubbles coming from
stainless hose w/ water.
O₂ only went down to
 $\approx$ 280 ppb Increase N₂ No
change

Increase N₂ to 70-80 cfh
used vacuum - No air
bubbles in water O₂
down to $\approx$ 120.

Dec 11, 09

Sponge empty Vessel w/ N₂
Seal $\approx$ 1/2 hour.

Remove Stainless hose on Liqui-cell END replace w/ Teflon

run Liqui-cell O₂ reading $\approx$ 135 ppb
O₂ reading in empty Sponged Vessel $\approx$ 28 ppb

Fill Sponged Vessel w/ Liqui-cell
water while bubbling w/ N₂
O₂ reads $\approx$ 125 ppb

Seal Vessel

Dec 14, 09

Check DO + ORP in sealed
water, only Kessel
(Liquicell) ORP 194.5 O₂ 165.0

Check O₂ Value w/ N₂
thru Flow Cell Oppb
Check ORP of DDI water after
Flow Cell 173

Dec 14, 09

Get ready for water switch
to Liquicell.

3 - CPB-4 Carboys

2 CPS-2 Carboys

out of refrigerator - leave in
lab to come to room temp

Spurge w/ N₂ to remove

Cl + some O₂

UHP N₂ Tank Switched to
Liquicell line.

Spurge Tanks w/ N₂ 1 minute

	DO	ORP	pH	Temp	Cond.
12-15-09 7:30am					
2-145	0.17	-380.9	7.40	22.5	751 μ S
2-146	0.19	-380.8	7.49	23.0	697 μ S
2-147	0.19	-293.7	7.46	23.3	1700 μ S
2-148	0.21	-257.5	7.38	23.3	1716 μ S
2-149	0.19	-337.5	7.78	23.1	484 μ S
2-150	0.15	-314.5	7.76	23.1	474 μ S
2-151	0.18	-336.4	7.85	23.4	474 μ S
2-152	0.18	-309.9	7.69	23.5	476 μ S
2-153	0.13	-330.9	7.74	23.4	540 μ S

Alkalinity Samples Taken

After sampling Water Change

Remove water while maintaining a N_2 headspace (DO All Vessels)

Seal Vessels - Went to lunch

Use Liquicell - water to replace in Vessels.

use Cond. to determine when water is flushed thru Contactors
Take parameters of Liquicell

1
2
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CPS-4 Sample after Liquicell

CPS-2 Sample Raw Water No Liquicell

→ water after DO Removal.

Pre-Liquicell ← CPS-4 DO 7.03 Cond. 541 μ S
CPS-2 DO 8.0 mg/L
Cond. 1274 μ S

Liquicell - use Vac - Set N_2 at 58 CFH
use pump to push water thru
Liquicell. Reset N_2 near Zero
use Vacuum

	DO	ORP	pH	Temp	Cond.
CPS-2	400-468	233.8	7.65	23.2	1294
CPS-4	350-550	255.0	7.72	24.2	542

Finish emptying vessel 12:00
Started filling 2:00. Finish Filling 4:00

* 3+4 - line closed when filling
reopened let N_2 run longer after filling

Very hard to adjust + keep
Constant.

Center Stopcocks were regreased

ORBIT 12-16-09 7:10

	DO	ORP	pH	Temp	Cond.
2-154	123.9	-301.1	7.60	23.5	520
2-155	155.0	-295.3	7.67	22.6	515
2-156	128.1	-233.8	7.70	23.5	1328
2-157	256.0	-179.6	7.68	22.9	1343
2-158	390.6	-264.0	7.63	23.1	498
2-159	285.7	-245.5	7.70	22.9	497
2-160	169.5	-276.6	7.66	23.5	503
2-161	437.4	-257.4	7.60	24.0	490
2-162	233.6	-141.7	8.19	24.1	539

Hack

	DO
1	0.17
2	0.17
3	0.18
4	0.17
5	0.18
6	0.16
7	0.14
8	0.18
9	0.16

12-17-09

7:30am

	DO	ORP	pH	Temp	Cond
2-163	130	-274.7	7.65	22.0	506
2-164	123	-288.3	7.63	22.2	504
2-165	127.7	-219.4	7.66	22.1	1335
2-166	123.6	-134.0	7.73	21.6	1240
2-167	118.9	-238.9	7.68	21.8	479
2-168	120.1	-220.5	7.71	22.3	477
2-169	120.9	-247.1	7.75	22.1	484
2-170	114.5	-243.0	7.66	22.2	474
2-171	113.9	+147.1	8.33	22.3	533

-232.3 ← end of day
↑

ORP

#9 #147.1 when done first

Orbitsphere → today changed quickly between vessels so did not reach "air" equilibrium seemed to work faster.

Vessel O/D
DO

1	0.18
2	0.18
3	0.22
4	0.19
5	0.16
6	0.19
7	0.18
8	0.20
9	0.15

← Note different ORP reading based on when reading was taken ??
..

ppb12-18-09 7:30 AM

	DO	ORP	pH	Temp	Cond.
2-172	122	-276.9	7.71	20.6	488
2-173	122	-274.2	7.64	22.1	485
2-174	118	-173.6	7.75	22.2	1320
2-175	114	-114.8	7.48	21.5	1321
2-176	118	-254.0	7.70	21.9	459
2-177	114	-202.4	7.67	22.2	457
2-178	110	-265.7	7.79	22.1	397
2-179	111	-264.8	7.72	22.7	455
2-180	128	-3.3	8.40	22.7	520

#9 Done after all others
-184.9

Then #1 For a Second
Time after #9's second
-287.0 Time

Vessel #	Old DO
1	0.17
2	0.16
3	0.20
4	0.19
5	0.21
6	0.18
7	0.18
8	0.18
9	0.17

#9 ← ORP done First

	DO	ORP	pH	Temp	Cond.
2-181	123	-279.9	7.73		
2-182	120	-312.2	7.60	20.7	482 μ S
2-183	122	-182.0	7.75	20.9	1314 μ S
2-184	118	-147.0	7.70	20.8	1321 μ S
2-185	118	-289.8	7.74	20.9	445 μ S
2-186	116	-295.5	7.72	21.0	442 μ S
2-187	113	-296.1	7.77	20.8	446 μ S
2-188	110	-288.0	7.92	21.2	438 μ S
2-189	117	-100.2	8.32	20.9	511

pH probe malfunctioned
on #8

#9 is OK it was done first.
pH probe reading very low
on #8 between 5 & 6

Trid to use old pH probe
even though it appeared
to calibrate it is not reading
correctly.

Call Hach Clean problem
0.1N HCl recalibrate
then Read pH reading for
#8

old
Doprobe

1

2

3

4

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0.20

0.18

0.27

0.18

0.17

0.17

0.17

0.13

← First Readings
ORP Reading after all
others -285.1

	12-24-09				
	DO	ORP	pH	Temp	Cond
2-190	131	-227.7	7.79	21.4	463
2-191	123	-291.8	7.80	21.2	477
2-192	113	-128.8	7.86	21.4	1316
2-193	127	-50.8	7.78	21.6	1335
2-194	111	-289.2	7.85	21.4	432
2-195	113	-261.3	7.87	21.5	429
2-196	113	-277.6	7.87	21.6	431
2-197	111	-270.8	7.90	21.8	427
2-198	118	-238.1	8.38	21.4	503

Before Sampling
 Cleaned ORP probe
 w/ soap + wiped Pt.
 electrode w/ Q-tip
 soaked w/ soap. Also
 rinsed pH probe w
 soapy water

Vessel #	old DO
1	0.19
2	0.18
3	0.18
4	0.19
5	0.22
6	0.18
7	0.16
8	0.17
9	0.22

ORP still very
 slow

	DO	12-28-09	8:00 am		
	DO	ORP	pH	Temp	COND
2-199	122	-180.4	7.75	20.5	466
2-200	118	-203.7	7.82	20.2	473
2-201	112	-151.6	7.84	20.2	1315
2-202	120	-30.3	7.73	20.6	1337
2-203	114	-212.3	7.83	21.0	428
2-204	113	-224.1	7.86	20.2	426
2-205	116	-230.0	7.81	20.5	430
2-206	113	-234.7	7.92	20.1	425
2-207	115	-160.3	8.31	19.5	506

OLD DO	vessel #				
0.18	1				
0.17	2				
0.19	3				
0.17	4				
0.21	5				
0.18	6				
0.16	7				
0.19	8				
0.20	9				

12-31-09 7:30

	DO	ORP	pH	Temp	COND
2-208	140	-115.1	7.96	20.3	449
2-209	131	-199.4	7.84	19.8	472
2-210	140	-153.5	7.78	20.8	1315
2-211	134	-260.9	7.81	20.1	1347
2-212	130	-239.3	7.92	20.6	416
2-213	1103	-208.9	7.93	20.5	412
2-214	142	-215.0	7.94	20.4	415
2-215	141	-196.4	7.92	20.8	410
2-216	150	-199.2	8.38	20.8	497

010d
DO

1	0.24
2	0.24
3	0.22
4	0.25
5	0.22
6	0.24
7	0.20
8	0.22
9	0.20

Sample #	DO	ORP	pH	Temp	COND
2-217	155	-78	7.90	22.7	445
2-218	132	-172.4	7.84	22.2	470
2-219	123	-180.1	7.84	22.6	1341
2-220	111	-236.4	7.43	21.9	1372
2-221	113	-229.2	7.97	22.1	408
2-222	118	-211.3	8.01	22.1	404
2-223	123	-208.3	7.95	22.1	408
2-224	120	-187.9	7.98	22.4	404
2-225	118	-113.3	8.42	22.2	497
		-187.3			

Vessel #	OLD DO
1	.24
2	.22
3	.21
4	.19
5	.21
6	.18
7	.20
8	.21
9	.19

Sample #	DO	1-11-10 ORP	1:00 pm pH	Temp	Cond.
2-226	183	-196.1	8.01	20.5	440
2-227	170	-20.4?	7.88	21.1	471 mS
2-228	132	-262.6	7.71	21.3	1376
2-229	142	-213.8	7.64	21.7	1427
2-230	139	-212.2	7.98	21.2	400
2-231	121	-193.2	7.97	22.0	396
2-232	128	-197.4	7.94	21.9	399
2-233	144	-170.4	7.96	22.4	395
2-234	130	-23.7	8.28	21.5	503

Vessel #	OLD DO
1	0.28
2	0.34
3	0.14
4	0.20
5	0.24
6	0.23
7	0.26
8	0.18
9	0.22

	DO	1-15 ORP	-10 pH	Temp	COND
2-235	166	-167.9	7.87	22.7	418
2-236	151	-169.8	7.62	22.5	454
2-237	128	-233.4	7.53	22.3	1.350
2-238	136	-233.7	7.54	22.7	1.380
2-239	128	-240.2	7.91	22.4	379
2-240	114	-199.6	7.92	22.9	378
2-241	118	-223.0	7.58	22.6	378
2-242	133	-204.9	7.87	22.7	374
2-243	123	-203.2	8.29	22.7	465

Last Sample
 for Protocol 2
 Alkalinity Samples
 Taken

Vessel #	DO				
1	.21				
2	.33				
3	.21				
4	.19				
5	.28				
6	.17				
7	.22				
8	.17				
9	.20				

* Protocol 3 *

1-26-10 Start Protocol 3

H₂ DO

2 SW - CPS-4 + CPS-2
Spurge w/ 50/50 N₂/O₂
on 1-22-10 for $\approx$ 5 min.
each

Cond. is high for Both

CPS-2 = 13 ms

CPS-4 = 7 ms

1-26-10 DO $\approx$ 12 mg/L
Spurge again w/ N₂/O₂ mixture
DO $\approx$ 18.0

1/26/10 9:00 AM

	ORP	DO	pH	TEMP	COND
CPS-4	106.2	17.16	8.34	23.3	764 μ S
CPS-2	369.6	16.26	8.12	23.7	1472 μ S

Both source waters were
sampled Cations anions
+ alkalinity

filled vessels w/ 1 L water
while purging w/ N₂/O₂ mix

CPS-4 has a very
Strong Chlorine Smell

Wt#	min	max	Splwt	Vessel #
18778	840	841		CPS-4 1
18778	851.5	852.5		CPS-4 2
18852	837.5	838.5		CPS-2 3
18852	842.5	843		CPS-2 4
18849	830	830.75	313.18	CPS-4 5
18849	832	833	310.21	CPS-4 6
18849	832	833	299.54	CPS-4 7
18849	834	835	249.91	CPS-4 8
Blank				CPS-4 9

Sample #

1-27-10

7:15am

DO ORP pH Temp Cond

P3-1	19.29	+735.0	7.88	23.2	807 μ S
P3-2	19.01	+736.8	7.89	23.2	877 μ S
P3-3	16.51	+484.5	8.07	23.1	2.56mS
P3-4	16.93	+436.3	8.13	23.1	2.65mS
P3-5	18.86	+723.1	7.96	22.6	835 μ S
P3-6	18.97	+711.8	7.99	22.6	814 μ S
P3-7	18.68	+705.5	7.94	22.4	813 μ S
P3-8	17.66	+725.6	7.96	22.8	821 μ S
P3-9	18.47	+727.2	8.62	23.1	764 μ S

Vessel

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Sample #	DO	ORP	pH	Temp	Cond
P3-10	19.44	+675.7	7.65	22.8	856
P3-11	19.82	+692.2	7.67	23.4	923
P3-12	17.17	+419.19	7.84	22.4	3.37mS
P3-13	18.46	+388.4	7.89	23.3	3.05mS
P3-14	19.59	+580.3	7.71	23.1	856
P3-15	19.30	+331.1	7.71	22.9	886
P3-16	18.95	+326.1	7.72	23.0	875
P3-17	18.96	+431.2	7.70	22.6	834
P3-18	19.25	+719.2	8.48	23.4	763

Vessel #
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3pm Sample	DO	1-29-10 ORP	pH	Temp	COND
P3-19	19.66	+587.1	7.74	22.9	850
P3-20	19.57	+609.2	7.25	23.3	916
P3-21	18.82	+463.7	7.94	22.5	3.38 mS
P3-22	18.63	+463.7	7.77	21.9	3.31 mS
P3-23	19.95	+360.4	7.80	22.3	845
P3-24	19.25	+307.6	7.78	22.1	870
P3-25	19.54	+299.8	7.39	22.9	862
P3-26	19.17	+303.2	7.80	22.8	826
P3-27	19.63	+711.7	8.54	22.9	763

Vessel

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sample #	DO	2-1-10 DRP	pH	Temp	Cond
P3-28	19.99	284.3	7.78	21.2	831
P3-29	19.30	255.1	7.75	21.6	905
P3-30	19.59	246.9	7.79	21.9	3.37m
P3-31	18.91	236.7	6.85?	21.9	3.44
P3-32	19.22	238.9	7.81	21.7	884
P3-33	18.19	231.1	7.77	21.7	890
P3-34	19.71	223.2	7.53	21.8	873
P3-35	19.60	225.9	7.73	21.9	845
P3-36	19.44	205.2	8.59	21.8	771

* P3-36 skipped -
mislabelled

vessel #

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P3-37 is probably vessel #1

P3-36 skipped in book
but has a physical sample

Sample #	DO	ORP	pH	Temp	COND
P3-37	19.88	249.7	7.13	21.4	819
P3-38	20.07	234.4	7.45	21.9	887
P3-39	19.55	227.3	7.34	21.6	3.35mS
P3-40	18.55	229.4	7.27	22.1	345mS
P3-41	18.00	235.8	7.36	21.6	854
P3-42	15.24	233.1	7.33	21.7	871
P3-43	16.42	226.0	7.06	21.7	868
P3-44	17.23	233.2	7.15	21.6	822
P3-45	20.39	699.1	8.09	21.8	762

vessel #

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Sample #	DO	ORP	2-8-10 pH	3:00 pm Temp	Cond.
P3-46	19.39	272.4	7.80	22.7	821
P3-47	19.54	270.8	7.76	23.1	886
P3-48	19.07	228.4	7.84	23.0	
P3-49	18.32	275.3	7.80	22.9	3.50
P3-50	18.92	280.5	7.76	22.9	847
P3-51	18.38	275.4	7.70	22.8	869
P3-52	17.58	280.9	7.68	22.8	863
P3-53	18.93	223.2	7.73	22.9	818
P3-54	20.11	698.3	8.68	23.0	771

Vessel #

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Sample #	DO	ORP	PH	Temp	Cond.
P3-55	19.76	269.3	7.61	23.5	809
P3-56	19.65	266.5	6.78	24.2	985
P3-57	19.16	253.6	7.75	24.1	3.37 mS
P3-58	18.42	254.0	7.64	24.3	3.52 mS
P3-59	19.37	270.9	7.64	24.3	848
P3-60	19.11	277.6	7.63	23.9	868
P3-61	19.24	274.1	7.71	24.0	855
P3-62	19.47	271.6	7.67	23.9	818
P3-63	20.15	674.3	8.57	24.2	776

P3-64 sample nonexistent,
no Alkalinity sample either

Vessel #

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Sample #	DO	2-15-10 DRP	PH	3:00 Temp	COND
P3-65	19.81	263.1	7.79	22.1	792
P3-66	20.12	270.3	7.80	21.9	864
P3-67	19.65	259.1	7.81	21.8	833 mS
P3-68	18.35	258.8	7.76	22.5	845 mS
P3-69	19.99	261.7	6.25	22.8	835
P3-70	19.71	266.5	6.25	22.3	850
P3-71	19.62	266.6	8.55	21.9	846
P3-72	19.82	265.4	8.51	22.8	806
P3-73	20.20	656.3	8.48	23.0	773

Last Sample
for Phase 1
Alkalinity Samples
taken on Feb 16/10
7:30 AM

Vessel #

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pH meter slow

	2-16-10	7:30 am			
	DO	ORP	pH	Temp	Cond.
CPS4	11.70	761.0	8.16	24.5	766
CPS2	18.94	478.6	7.90	24.9	1477

Water Change

CPS-2 water slightly discolored - Kind of Tan

Vessels purged w/ N_2/O_2 mix while refilling with water.

Both waters sparged w/ O_2/N_2 Mix on 2-15-10 for 3 min.

← parameters for Source water taken in an open beaker not closed Vessel. There was no O_2/N_2 headspace will waiting for probes to stabilize

Sample #	DO	ORP	pH	Temp	Cond
P3-74	18.28	792.2	7.69	21.1	722
P3-75	18.43	785.3	7.65	21.9	732
P3-76	19.90	526.2	7.94	21.9	1603
P3-77	19.51	522.8	7.90	21.7	1675
P3-78	18.91	777.2	7.66	22.1	738
P3-79	18.64	755.6	7.70	22.1	754
P3-80	19.13	779.1	7.75	22.1	752
P3-81	18.76	782.9	7.72	22.1	739
P3-82	18.60	774.6	8.30	22.3	769

Vessel #

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Sample #	DO	ORP	pH	Temp	Cond.
P3-83	19.53	776.5	8.30	22.0	715
P3-84	19.87	764.6	8.34	21.9	728
P3-85	20.24	543.4	8.77	22.1	1610
P3-86	19.97	539.3	8.73	22.1	1672
P3-87	20.05	725.0	8.53	22.7	732
P3-88	19.93	695.5	8.53	22.1	748
P3-89	19.93	741.3	8.61	22.7	746
P3-90	19.80	742.6	8.50	22.3	731
P3-91	20.07	762.8	9.19	22.6	769

Recalibrated
 pH probe on 2-19-10
 It was way off. 1.8 for 7.0
 * Watch Probes carefully
 if large variance from
 previous days readings
 Check calibration
 + re measure

Vessel #

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sample #	DO	2-19-10 3:00pm ORP	pH	Temp	Cond
P3-92	20.44	760.0	7.79	20.5	696
P3-93	20.11	736.5	7.73	21.1	704
P3-94	20.67	515.1	7.91	21.3	1582
P3-95	20.22	512.3	7.87	21.3	1642
P3-96	20.33	652.3	7.74	21.4	712
P3-97	20.20	503.1	7.74	21.5	727
P3-98	20.36	714.2	7.78	21.5	725
P3-99	20.07	717.5	7.68	21.5	711
P3-100	20.69	753.5	8.51	21.5	757

Vessel #

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→ checked pH probe read
7.02 and 10.04

→ Rechecked pH meter, read
7.00 and 10.06, recalibrated
and still reads 10.06

pH meter acting more
normally, not taking as
long but also not calibrating
well in the pH 10.0 buffer

Sample #	DO	ORP	pH	Temp	Cond
P3-101	20.21	654.1	7.89	20.8	681
P3-102	20.34	505.6	7.74	21.4	694
P3-103	20.29	461.5	7.93	21.7	1579
P3-104	19.18	459.4	7.93	21.8	1628
P3-105	19.85	456.1	7.82	21.9	700
P3-106	19.75	448.9	7.81	21.9	716
P3-107	20.16	430.9	7.81	22.0	716
P3-108	19.89	427.8	7.80	22.1	703
P3-109	20.59	725.2	8.57	22.1	755

Vessel #

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*new pH meter

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sample #	DO	ORP	pH	Temp	COND
2-25 10				12:00pm	
P3-110	21.13	459.1	7.94	18.7	671
P3-111	20.63	395.6	7.85	19.6	681
P3-112	20.79	379.2	7.96	19.8	1567
P3-113	20.24	369.3	7.98	19.9	1628
P3-114	20.36	362.0	7.84	20.0	690
P3-115	20.74	352.5	7.85	19.9	710
P3-116	20.49	342.2	7.88	19.6	706
P3-117	20.35	332.6	7.84	19.9	694
P3-118	21.09	721.5	8.67	19.5	753

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sample #	DO	3-1-10 ORP	pH	Temp	COND
P3-119	21.06	311.6	7.34	20.5	664
P3-120	20.67	2416.2	7.21	20.6	679
P3-121	20.71	261.2	8.07	20.4	1564
P3-122	20.72	255.3	7.93	20.4	1165
P3-123	19.53	263.1	7.87	20.5	686
P3-124	20.95	279.1	7.87	20.4	699
P3-125	20.86	285.0	7.86	20.3	698
P3-126	20.50	273.6	7.84	20.5	687
P3-127	21.42	696.6	8.70	20.6	758

vessel

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sample #	DO	ORP	pH	Temp	COND
P3-128	20.51	312.3	8.00	19.7	659
P3-129	20.46	282.0	7.89	20.4	670
P3-130	20.65	253.7	8.00	20.4	1557
P3-131	20.31	262.6	7.97	20.6	1606
P3-132	19.42	275.1	7.90	20.7	675
P3-133	20.70	265.5	7.87	20.3	695
P3-134	20.79	275.6	7.89	20.4	692
P3-135	20.43	555.4	7.89	20.5	680
P3-136	20.91	673.0	8.67	20.8	756

↓
 Double-checked this entry
 Probe shut off during first reading, value was 555, took second reading then recalibrated and the reading was the same all 3 times

vessel #

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Water Change 3-8-10
 Water out of refrigerator 3-8-10
 7am Sparged w/ Na₂O₂ mix
 3 min, Water Samples
 Taken CPS-2 + CPS-4 3-8-10
 Removed water starting 8am

	DO	ORP	pH	Temp	Cond
CPS-4	16.84	676.1	8.36	10.5	694
CPS-2	overrange	501.9	8.31	9.8	1440

*Temp Cold DO will be higher

CPS2 water slightly discolored.

Sample #	3-9-10	3:00 pm			
	DO	ORP	pH	Temp.	Cond
P3-137	19.08	693.8	7.72	20.5	654
P3-138	18.94	679.9	7.72	20.9	657
P3-139	20.47	547.4	7.96	21.2	1454
P3-140	20.69	524.4	7.97	21.2	1448
P3-141	18.05	633.0	7.72	21.3	657
P3-142	18.90	621.7	7.78	21.3	668
P3-143	18.66	666.4	7.82	21.2	670
P3-144	18.36	625.6	7.75	21.4	661
P3-145	18.74	691.2	8.27	21.3	704

Vessel #

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Sample #	3-10 DO	-10 ORP	3:00 pm pH	Temp	Concl
P3-146	19.64	674.6	7.88	21.4	643
P3-147	19.45	642.6	7.65	22.0	645
P3-148	19.79	501.6	7.99	22.2	1449
P3-149	19.96	486.0	8.05	22.2	1448
P3-150	18.35	586.2	7.76	22.1	649
P3-151	19.09	569.2	7.82	22.3	660
P3-152	18.99	634.1	7.86	22.0	660
P3-153	19.05	580.1	7.78	22.3	651
P3-154	19.40	678.4	8.45	22.3	705

Vessel #

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For vessel 3 pH was reading
8.22, checked in standard
and calibration was way off
10.15 for the 10 pH.
7.11 for pH 7 buffer.
Recalibrated and it was OK

Sample #	3-11-16	2:00pm			
	DO	ORP	pH	Temp	Cond.
P3-155	19.83	673.9	7.81	21.5	634
P3-156	19.73	625.3	7.83	22.0	634
P3-157	20.01	499.6	7.98	22.3	1447
P3-158	20.17	493.3	8.05	22.3	1438
P3-159	19.13	540.4	7.79	22.1	636
P3-160	19.61	543.1	7.84	21.9	647
P3-161	19.71	592.2	7.90	21.9	656
P3-162	19.42	527.9	7.77	22.3	640
P3-163	20.06	684.4	8.47	22.4	701

Vessel #

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Sample #	DO	ORP	pH	Temp	COND
P3-164	20.18	628.6	7.63	21.9	624
P3-165	20.02	549.4	7.85	22.0	627
P3-166	20.05	430.3	7.98	22.3	1442
P3-167	19.78	419.8	8.06	22.1	1444
P3-168	19.69	405.1	7.83	22.1	631
P3-169	19.86	431.2	7.89	22.2	640
P3-170	20.04	464.0	7.93	22.2	643
P3-171	19.70	443.5	7.85	22.1	635
P3-172	20.25	652.0	8.60	22.0	703

Residual #

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Sample #	DO	ORP	pH	Temp	COND
P3-173	20.02	387.9	7.81	21.1	609
P3-174	20.05	347.1	7.80	21.1	610
P3-175	19.82	329.8	7.90	21.3	1432
P3-176	19.32	322.3	7.87	21.6	1433
P3-177	19.84	315.4	7.73	21.4	620
P3-178	19.89	313.0	7.74	21.7	630
P3-179	19.95	310.2	7.83	21.2	630
P3-180	19.72	312.9	7.79	21.5	626
P3-181	20.53	576.2	8.61	21.7	704

Vessel #

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Sample #	DO	3-19-10 3:00pm			
		ORP	PH	Temp	COND
P3-182	20.20	260.1	7.78	23.2	598
P3-183	19.98	261.9	7.78	23.2	606
P3-184	19.98	250.1	7.85	23.5	1443
P3-185	18.96	244.5	7.83	23.6	1440
P3-186	19.79	258.5	7.71	23.6	610
P3-187	19.94	258.1	7.72	23.5	621
P3-188	19.74	257.5	7.74	23.4	627
P3-189	19.81	265.1	7.72	23.3	615
P3-190	20.12	560.2	8.62	23.4	706

Vessel #

1

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Sample #	DO	DRP	pH	Temp	COND	
P3-191	20.13	269.3	7.83	21.5	590	1
P3-192	20.48	239.0	7.83	21.4	596	2
P3-193	19.74	239.1	7.93	21.5	1436	3
P3-194	20.01	236.5	7.93	21.6	1426	4
P3-195	20.12	249.0	7.79	21.6	600	5
P3-196	20.34	238.1	7.76	21.7	608	6
P3-197	20.48	238.4	7.80	21.7	615	7
P3-198	20.15	239.2	7.78	21.8	606	8
P3-199	20.49	550.4	8.62	21.6	699	9

CURVE TABLES

HOW TO USE CURVE TABLES

Table I. contains Tangents and External to a 1° curve. Tan. and Ext. to any other radius may be found nearly enough, by dividing the Tan. or Ext. opposite the given Central Angle by the given degree of curve.

To find Deg. of Curve, having the Central Angle and Tangent: Divide Tan. opposite the given Central Angle by the given Tangent.

To find Deg. of Curve, having the Central Angle and External: Divide Ext. opposite the given Central Angle by the given External.

To find Nat. Tan. and Nat. Ex. Sec. for any angle by Table I.: Tan. or Ext. of twice the given angle divided by the radius of a 1° curve will be the Nat. Tan. or Nat. Ex. Sec.

EXAMPLE

Wanted a Curve with an Ext. of about 12 ft. Angle of Intersection or I. P. = 23° 20' to the R. at Station 542 + 72.

Ext. in Tab. I opposite 23° 20' = 120.87
 $120.87 \div 12 = 10.07$. Say a 10° Curve.

Tan. in Tab. I opp. 23° 20' = 1183.1
 $1183.1 \div 10 = 118.31$.

Correction for A. 23° 20' for a 10° Cur. = 0.16
 $118.31 + 0.16 = 118.47$ = corrected Tangent.

(If corrected Ext. is required find in same way)
 Ang. 23° 20' = $23.33^\circ \div 10 = 2.3333$ = L. C.

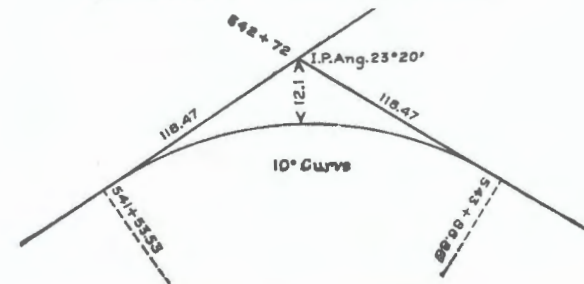
2° 19½' = def. for sta.	542	I. P. = sta.	542 + 72
4° 49½' = " " "	+ 50	Tan. =	118.47
7° 19½' = " " "	543	B. C. = sta.	541 + 53.53
9° 49½' = " " "	+ 50	L. C. =	2.33.33
11° 40' = " " "	543 +	E. C. = Sta.	543 + 86.86
	86.86		

$100 - 53.53 = 46.47 \times 3' \text{ (def. for 1 ft. of } 10^\circ \text{ Cur.)} = 139.41' =$

2° 19½' = def. for sta. 542.

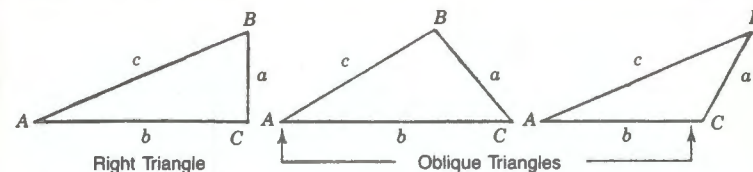
Def. for 50 ft. = 2° 30' for a 10° Curve.

Def. for 36.86 ft. = 1° 50½' for a 10° Curve.



Measure
opening of
Vessels for
Probes

TRIGONOMETRIC FORMULÆ



Solution of Right Triangles

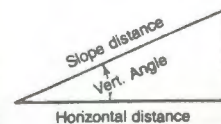
For Angle A. $\sin = \frac{a}{c}$, $\cos = \frac{b}{c}$, $\tan = \frac{a}{b}$, $\cot = \frac{b}{a}$, $\sec = \frac{c}{b}$, $\csc = \frac{c}{a}$

Given a, b	Required A, B, c	$\tan A = \frac{a}{b} = \cot B$, $c = \sqrt{a^2 + b^2} = a \sqrt{1 + \frac{b^2}{a^2}}$
a, c	A, B, b	$\sin A = \frac{a}{c} = \cos B$, $b = \sqrt{(c+a)(c-a)} = c \sqrt{1 - \frac{a^2}{c^2}}$
A, a	B, b, c	$B = 90^\circ - A$, $b = a \cot A$, $c = \frac{a}{\sin A}$
A, b	B, a, c	$B = 90^\circ - A$, $a = b \tan A$, $c = \frac{b}{\cos A}$
A, c	B, a, b	$B = 90^\circ - A$, $a = c \sin A$, $b = c \cos A$

Solution of Oblique Triangles

Given A, B, a	Required b, c, C	$b = \frac{a \sin B}{\sin A}$, $C = 180^\circ - (A + B)$, $c = \frac{a \sin C}{\sin A}$
A, a, b	B, c, C	$\sin B = \frac{b \sin A}{a}$, $C = 180^\circ - (A + B)$, $c = \frac{a \sin C}{\sin A}$
a, b, C	A, B, c	$A + B = 180^\circ - C$, $\tan \frac{1}{2}(A - B) = \frac{(a - b) \tan \frac{1}{2}(A + B)}{a + b}$ $c = \frac{a \sin C}{\sin A}$
a, b, c	A, B, C	$s = \frac{a + b + c}{2}$, $\sin \frac{1}{2} A = \sqrt{\frac{(s - b)(s - c)}{b c}}$ $\sin \frac{1}{2} B = \sqrt{\frac{(s - a)(s - c)}{a c}}$, $C = 180^\circ - (A + B)$
a, b, c	Area	$s = \frac{a + b + c}{2}$, $\text{area} = \sqrt{s(s - a)(s - b)(s - c)}$
A, b, c	Area	$\text{area} = \frac{b c \sin A}{2}$
A, B, C, a	Area	$\text{area} = \frac{a^2 \sin B \sin C}{2 \sin A}$

REDUCTION TO HORIZONTAL



Horizontal distance = Slope distance multiplied by the cosine of the vertical angle. Thus: slope distance = 319.4 ft. Vert. angle = $5^\circ 10'$. From Table, Page IX, $\cos 5^\circ 10' = .9959$. Horizontal distance = $319.4 \times .9959 = 318.09$ ft.

Horizontal distance also = Slope distance minus slope distance times $(1 - \cos \text{vertical angle})$. With the same figures as in the preceding example, the following result is obtained. $\cos 5^\circ 10' = .9959$. $1 - .9959 = .0041$. $319.4 \times .0041 = 1.31$. $319.4 - 1.31 = 318.09$ ft.

When the rise is known, the horizontal distance is approximately: - the slope distance less the square of the rise divided by twice the slope distance. Thus: rise = 14 ft., slope distance = 302.6 ft. Horizontal distance = $302.6 - \frac{14 \times 14}{2 \times 302.6} = 302.6 - 0.32 = 302.28$ ft.

