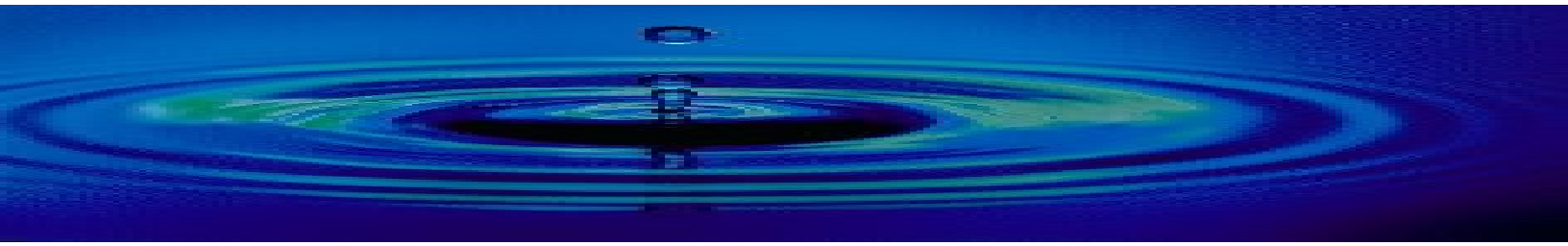
Completion Report

Well Name: USGS-149



October 23, 2019

Completion Report

Well Name: USGS-149

Project Number: WB843

Prepared for:

USGS
1955 North Fremont Ave
Idaho Falls, Idaho
83415

Prepared by:

Westbay Instruments
A Division of Nova Metrix Ground Monitoring (Canada) Limited.
8610 Glenlyon Parkway
Unit 134
Burnaby, BC
V5J 0B6

CONTENTS

TABLES

FIGURES

APPENDICES

1. Introduction

This report and the attached Appendix document the technical services carried out by Westbay Instruments (WB) under USGS Order No. 140G0319P0203 dated June 25, 2019. The Westbay System completion was installed in borehole USGS 149 at the Idaho National Laboratory (INL) site near Idaho Falls, Idaho.

Westbay technical services representative Mr. Mark Lessard was on site for installation of the Westbay System from September 23 to 26, 2019. This report documents the installation tasks and related QA checks.

2. Pre-Installation Activities

The well was drilled with PQ-size rotary core drilling method, and air/water was used as a lubricant for the section drilled in the aquifer. Surface casing was installed to 5 ft below the ground surface, and the borehole was cemented from 5 ft to 293 ft with 53 yards of grout to fill voids and fractures. The borehole total depth is 974 ft.

A steel PQ-size (4.8 inch) guide tube was placed in the borehole to a depth of 837ft. The guide tube is to protect against caving while the Westbay casing is lowered into the borehole. The bottom of the guide tube was positioned such that the bottom four Westbay System packers were in the open hole. Before the guide tube was installed acoustic televiewer, neutron, natural gamma, density, gyro deviation and video logging were performed.

The monitoring well was installed according to the procedure described below.

(Note: all depths are with respect to ground surface. Monitoring well reference elevations were not available at the time of writing).

3. Installation

Westbay Instruments technical services representative Mr. Lessard and Mr. Twining of INL were on site to install the Westbay System in USGS 149 as indicated below in Table 1.

(Note: Monitoring well reference elevation was not available at the time of writing).

Table 1: Summary of Westbay System Installation

Well Name.	Field Installation Dates	Total Depth (ft)	MP55 Tubing Length (ft)	No. Monitoring Zones
USGS 149	September 23-26, 2019	974	958.34	4

The Westbay System in USGS 149 was installed according to the procedure described below.

3.1 Preparation of Westbay System Design

Packer depths for the borehole were provided to Westbay by Mr. Twining of INL. A well design was created based on these depths. The well design was used to prepare a Westbay Completion Log, which specifies the location of the Westbay System components in the well. This log was reviewed and approved in the

field by Mr. Twining prior to installation of the Westbay System. The Westbay Completion Log as approved was used as an installation guide in the field. A field copy of the log is in the Appendix.

Measurement port couplings were included in each primary monitoring zone to provide the capability to measure fluid pressures and collect fluid samples. In selected cases, two measurement ports were installed in a single zone to provide redundant monitoring capability. Measurement port couplings were also included in QA zones to provide QA testing capabilities and to permit operation of squeeze relief venting capabilities of the Westbay Model No. 6055 vented inflation tool. Mr. Twining requested that optional synthetic (PET) filters were not to be installed over the measurement port couplings.

A summary of the installed Westbay System components is shown on Table 2 below and in the Summary Completion Log Legend in the Appendix.

Table 2: Summary of Installed Westbay System Components

Well Name	Packers (0604)	Measurement Ports (0605)
USGS 149	**11**	**15**

3.2 Layout of Westbay System Tubing Components

Prior to the installation, the Westbay System components were set out at the borehole according to the sequence indicated on the Westbay Completion Log. Each casing length was numbered beginning with the lowermost as an aid to confirming the proper sequence of components. The appropriate Westbay System couplings were attached to each casing section. Magnetic location collars were attached 2-feet below the top of the measurement port couplings in the monitoring intervals. Locations of key components are listed in Table 5 in the Appendix.

Each component was visually inspected. Serial numbers for each packer and measurement port coupling were recorded on the Westbay Completion Log. The component layout was confirmed with the log before the components were lowered into the borehole.

3.3 Lowering of Westbay System Components

A hoist rig was used to lower the Westbay System components into the guide tube placed previously. Each joint up to component number 55 was tested with a minimum internal hydraulic pressure of 250-psi for one minute to confirm hydraulic seals. Mr. Twining requested not to test the joint after component number 56 since there will be no water in that section of the borehole. A record of each successful joint test and the placement of each component are noted by check marks on the Westbay Completion Log. Clean water supplied by INL was added to the Westbay System when necessary to counter buoyancy effects while components were lowered into the borehole and was used for testing of joint seals during lowering.

3.4 Hydraulic Integrity Testing

After the Westbay System string was lowered into the borehole, the water level inside the Westbay System completion was monitored at a depth different from the open borehole water level for a minimum period of thirty minutes to confirm hydraulic integrity of the completion. The data from the hydraulic integrity test are shown in Table 3 below.

Table 3: Hydraulic Integrity Test

Well Name	September 24,2019	Fluid Levels	
	Time	Inside Tubing at depth of 937.46ft (Port 1)	Outside Tubing
USGS 149	12:50	24.36 psia	654.9 ft
	13:00	24.38 psia	654.9 ft
	13:10	24.38 psia	654.9 ft
	13:20	24.38 psia	654.9 ft
	13:30	24.38 psia	654.9 ft

3.5 Positioning of Westbay System Completion

After the Westbay System components were lowered into the well, the Westbay System was positioned as illustrated on the Westbay Completion Log. The Westbay System was supported in this position while packer inflation was carried out. The positioning of the Westbay System components is based on the "nominal" lengths of Westbay System components. The positioning calculations do not include allowances for borehole temperature or deviation effects.

The attached figure titled “MOSDAX Transducer Position” provides information to correlate the position of the MOSDAX transducer sensor to the reference position at the top of the measurement port. The attached figure titled “Dimensions of Packer Seals and Monitoring Zones” outlines the calculations used to determine the packer depths and zone length. The Summary Completion Log, which shows the final “as-built” locations of the components in the well, is included in the Appendix.

3.6 Pre-inflation Profile

A pre-inflation pressure profile was carried out at the well prior to inflating the packers to confirm the proper position and operation of measurement ports and magnetic collars. The ports operated properly and were positioned correctly in the well. A plot of the Pre-inflation Piezometric levels in all zones is shown on Figure 3 in the Appendix.

3.7 Inflation of Westbay System Packers

The packer inflation was coordinated with retrieval of the temporary guide tube. The guide tube was initially positioned to at a depth of 837 feet leaving the bottom four packers exposed in the open hole section. After the four exposed bottom packers were inflated, the guide tube was removed. During removal of the guide tube, the weight of the Westbay tubing was supported by the inflated packers.

The Westbay System packers were inflated using clean water provided by INL. The Westbay Model No. 6055 vented inflation tool was used for packer inflation. All the packers appear to have inflated normally.

The data for inflation of each packer are provided on the Westbay Packer Inflation Records included in the Appendix.

3.8 De-Stressing of Westbay Casing

Westbay's procedure for de-stressing the Westbay components were used to reduce the long-term load on the upper components. A summary of the de-stressing activities is shown on Table 4. The final positions of the Westbay components (ports and packers) are shown on the Table 5 and 6 in the Appendix. After de-stressing, the component number 110 was cut and trimmed by 2.63 ft to have the final height of 3.57 ft above the datum.

Table 4: Summary of De-stressing Activities

Well Name.	Initial Hanging Wt. (lbs)	Final Clamp-off Wt. (lbs)	Total Movement at Surface (ft)	Beginning Stick-up (ft) *	End Stick-up (ft) *	Final stick-up after wellhead completion built (ft) **
USGS 149	1200	300	0.92	2.81	1.89	3.57

*Measurements taken above datum from the temporary stick-up before wellhead completion built.

**Measurement taken above datum after wellhead completion built.

4. Fluid Pressure Measurements

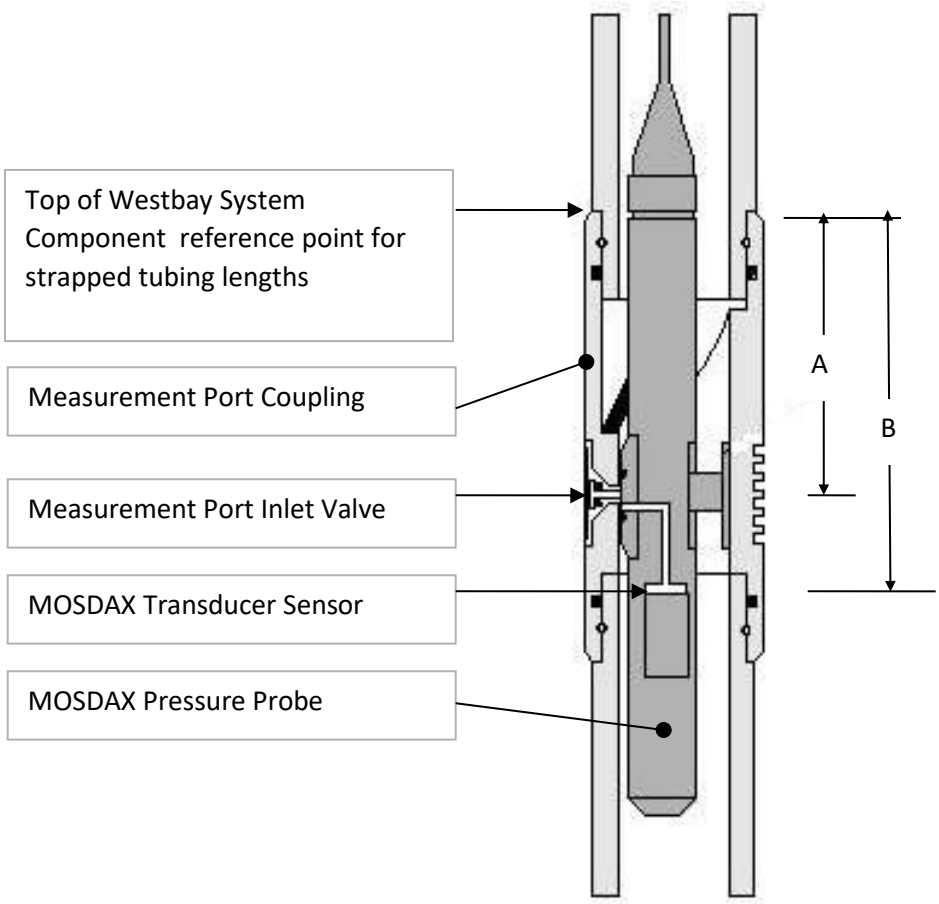
After packer inflation was completed, fluid pressures were measured at each measurement port. At that time, the in-situ formation pressures may not have recovered from the pre-installation activities and potential groundwater pressure changes in monitoring zones that may result from packer inflation. This latter effect may be more likely to occur in monitoring zones located in low-permeability geological formations. Longer term monitoring may be required to establish representative fluid pressures.

A plot of the Post-Inflation Piezometric levels in all zones in the well is shown on Figures 4 and 5 in the Appendix. The data were examined to confirm proper operation of the measurement ports and as a check on the presence of annulus seals between monitoring zones. The calculation sheets for all pressure profiles of the Westbay System are also enclosed in the Appendix.

Figure 1:

MOSDAX Transducer Position

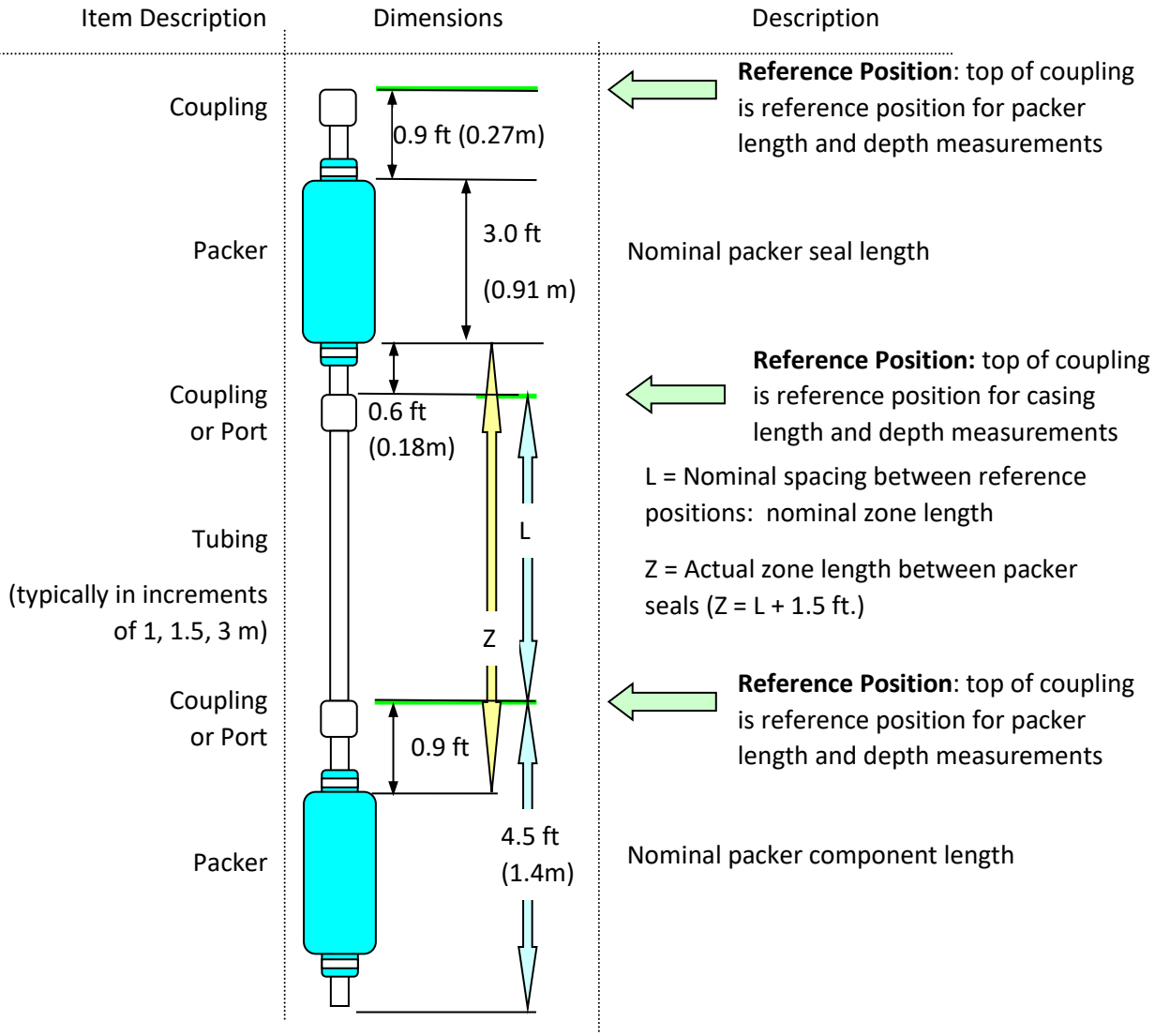
In an Westbay System Measurement Port Coupling



System	Measurement Port	A	B
Plastic MP55(2valves)	0605v4	6 in (152.4 mm)	8 in (203.2 mm)

Figure 2:

Dimensions of Packer Seals and Monitoring Zones
Westbay System – Plastic 0604 Packers



Discussion Points:

- The top of a coupling (Regular Coupling, Measurement Port or Pumping Port) is the reference point for describing nominal depths and nominal lengths. Actual positions of packer seals and zone lengths are determined with respect to the appropriate reference positions.
- Packer Position Example: A packer with a nominal depth of 50 ft (15.2m), will have a nominal packer seal position of 50.9 to 53.9 ft. (15.51 to 16.42m)
- Information on the position of Measurement Port Valve and MOSDAX Transducer sensor, used for detailed calculation of piezometric level measurements, are described separately.

APPENDIX: MONITORING WELL: USGS 149

TABLE 5
As-Built Packer and Port Summary

Port No.	Zone	Measurement Port Depth (ft)	Magnetic Collar Depth (ft)	Top of Zone (ft)	Bottom of Zone (ft)	Comments
1	Zone 1a	937.5	939.5	926.6	974.0	
2	Zone 1b	927.2		926.6	974.0	
3	QA 1	917.3		916.8	923.6	
4	Zone 2a	892.7	894.7	858.9	913.8	
5	Zone 2b	859.5		858.9	913.8	
6	QA 2	849.6		849.1	855.9	
7	Zone 3a	805.4	807.4	779.8	846.1	
8	Zone 3b	780.3		779.8	846.1	
9	QA 3	755.7		755.2	776.8	
10	QA 4	731.2		730.6	752.2	
11	Zone 4a	721.3	723.3	656.4	727.6	
12	Zone 4b	656.9		656.4	727.6	
13	QA 5	555.3		554.8	653.4	
14	QA 6	373.5		372.9	551.8	
15	QA 7	157.2		156.6	369.9	

Note 1: All depth measurements in feet below ground surface.
Note 2: All depth measurements use 'Nominal' casing lengths.
Note 3: Not corrected for borehole deviation or borehole temperature effects.
Note 4: All Westbay Port depth measurements to upper edge of coupling item.
Note 5: Depths for top and bottom of zone based on packer seal position.

As-Built Tubing Summary USGS 149

October 10, 2019

Item No.	Component P/N	Component S/N	Coupling P/N	Coupling S/N	Accessory P/N	Mag Collar (ft)	Initial Depth (ft)	Nominal Length (ft)	Final Change (ft)	Final Depth (ft)
									0.9	
111	0603		0602				-7.9	0.8	0.9	-6.9
110	060115		0602				-7.1	4.9	0.9	-6.2
109	060110		0602				-2.2	3.3	0.9	-1.3
108	060110		0602				1.1	3.3	0.9	2.0
107	060130		0602				4.4	9.8	0.9	5.3
106	060130		0602				14.2	9.8	0.9	15.1
105	060130		0602		0608	25.54	24.1	9.8	0.9	24.9
104	060130		0602				33.9	9.8	0.9	34.8
103	060130		0602				43.7	9.8	0.9	44.6
102	060130		0602				53.6	9.8	0.8	54.4
101	060130		0602				63.4	9.8	0.8	64.3
100	060130		0602				73.3	9.8	0.8	74.1
99	060130		0602				83.1	9.8	0.8	83.9
98	060130		0602				93.0	9.8	0.8	93.7
97	060130		0602				102.8	9.8	0.8	103.6
96	060130		0602				112.7	9.8	0.8	113.4
95	060130		0602				122.5	9.9	0.7	123.2
94	060130		0602				132.3	9.8	0.7	133.1
93	060130		0602				142.2	9.8	0.7	142.9
92	0604	159	0602				152.0	4.5	0.7	152.7
91	060130		0605	224			156.5	10.3	0.7	157.2
90	060115		0602				166.8	4.9	0.7	167.5
89	060130		0602				171.7	9.8	0.7	172.4
88	060130		0602				181.5	9.8	0.7	182.2
87	060130		0602				191.4	9.8	0.7	192.0
86	060130		0602				201.2	9.8	0.6	201.9
85	060130		0602				211.1	9.8	0.6	211.7
84	060130		0602				220.9	9.8	0.6	221.5
83	060130		0602				230.8	9.8	0.6	231.4
82	060130		0602				240.6	9.8	0.6	241.2
81	060130		0602				250.4	9.9	0.6	251.0
80	060130		0602				260.3	9.8	0.6	260.9
79	060130		0602				270.1	9.8	0.6	270.7
78	060130		0602				280.0	9.8	0.5	280.5
77	060130		0602				289.8	9.8	0.5	290.4
76	060130		0602				299.7	9.8	0.5	300.2
75	060130		0602				309.5	9.9	0.5	310.0
74	060130		0602				319.4	9.8	0.5	319.8
73	060130		0602				329.2	9.8	0.5	329.7
72	060130		0602				339.0	9.8	0.5	339.5
71	060130		0602				348.9	9.9	0.5	349.3
70	060130		0602				358.7	9.8	0.4	359.2
69	0604	158	0602				368.6	4.5	0.4	369.0
68	060130		0605	1222			373.0	10.3	0.4	373.5
67	060130		0602				383.3	9.8	0.4	383.7
66	060130		0602				393.2	9.8	0.4	393.6
65	060130		0602				403.0	9.8	0.4	403.4
64	060130		0602				412.9	9.8	0.4	413.2
63	060130		0602				422.7	9.9	0.4	423.1
62	060130		0602				432.5	9.8	0.4	432.9
61	060130		0602				442.4	9.8	0.3	442.7
60	060130		0602				452.2	9.8	0.3	452.6
59	060130		0602				462.1	9.9	0.3	462.4
58	060130		0602				471.9	9.8	0.3	472.2
57	060130		0602				481.8	9.8	0.3	482.0

As-Built Tubing Summary USGS 149

October 10, 2019

Item No.	Component P/N	Component S/N	Coupling P/N	Coupling S/N	Accessory P/N	Mag Collar (ft)	Initial Depth (ft)	Nominal Length (ft)	Final Change (ft)	Final Depth (ft)
56	060130		0602				491.6	9.9	0.3	491.9
55	060130		0602				501.4	9.8	0.3	501.7
54	060130		0602				511.3	9.8	0.3	511.5
53	060130		0602				521.1	9.9	0.3	521.4
52	060130		0602				531.0	9.8	0.2	531.2
51	060130		0602				540.8	9.8	0.2	541.0
50	0604	186	0602				550.7	4.5	0.2	550.9
49	060130		0605	1223			555.1	10.3	0.2	555.3
48	060110		0602				565.4	3.3	0.2	565.6
47	060115		0602				568.7	4.9	0.2	568.9
46	060130		0602				573.6	9.8	0.2	573.8
45	060130		0602				583.5	9.8	0.2	583.6
44	060130		0602				593.3	9.8	0.2	593.5
43	060130		0602				603.1	9.8	0.2	603.3
42	060130		0602				613.0	9.9	0.2	613.1
41	060130		0602				622.8	9.8	0.2	623.0
40	060130		0602				632.7	9.8	0.1	632.8
39	060130		0602				642.5	9.9	0.1	642.6
38	0604	148	0602				652.4	4.5	0.1	652.5
37	060130		0605	1218			656.8	10.3	0.1	656.9
36	060115		0602				667.1	4.9	0.1	667.2
35	060130		0602				672.0	9.9	0.1	672.1
34	060130		0602				681.9	9.8	0.1	682.0
33	060130		0602				691.7	9.8	0.1	691.8
32	060130		0602				701.6	9.9	0.1	701.6
31	060130		0602				711.4	9.8	0.1	711.5
30	060115		0605	1220	0608	723.32	721.3	5.4	0.1	721.3
29	0604	189	0602				726.6	4.5	0.1	726.7
28	060130		0605	1221			731.1	10.3	0.1	731.1
27	060130		0602				741.4	9.8	0.1	741.4
26	0604	236	0602				751.2	4.5	0.1	751.3
25	060130		0605	1217			755.7	10.3	0.1	755.7
24	060130		0602				766.0	9.8	0.0	766.0
23	0604	233	0602				775.8	4.5	0.0	775.9
22	060130		0605	1216			780.3	10.3	0.0	780.3
21	060115		0602				790.6	4.9	0.0	790.6
20	060130		0602				795.5	9.8	0.0	795.5
19	060130		0605	1215	0608	807.37	805.3	10.3	0.0	805.4
18	060130		0602				815.6	9.8	0.0	815.7
17	060130		0602				825.5	9.8	0.0	825.5
16	060130		0602				835.3	9.8	0.0	835.3
15	0604	235	0602				845.2	4.5	0.0	845.2
14	060115		0605	1256			849.6	5.4	0.0	849.6
13	0604	232	0602				855.0	4.5	0.0	855.0
12	060130		0605	1214			859.5	10.3	0.0	859.5
11	060110		0602				869.8	3.3	0.0	869.8
10	060130		0602				873.0	9.8	0.0	873.0
9	060130		0602				882.9	9.9	0.0	882.9
8	060130		0605	1213	0608	894.73	892.7	10.3	0.0	892.7
7	060130		0602				903.0	9.8	0.0	903.0
6	0604	234	0602				912.9	4.5	0.0	912.9
5	060115		0605	1211			917.3	5.4	0.0	917.3
4	0604	237	0602				922.7	4.5	0.0	922.7
3	060130		0605				927.2	10.3	0.0	927.2
2	060130		0605	1210	0608	939.46	937.5	10.3	0.0	937.5
1	060130		0602				947.8	9.8	0.0	947.8
0	0603		0602				957.6		0.0	957.6

* Component positions are refered to the top of the subject Westbay System coupling.

The position of a MOSDAX Transducer in a Measurement Port is illustrated in the attached "MOSDAX Transducer Position".

Summary Completion Log

Company: USGS
Well: USGS 149
Site: INL
Project: INL

Job No: WB843
Author: BT/ML

Well Information

Reference Datum: GL
Elevation of Datum: 0.00 ft.
MP Casing Top: 0.00 ft.
MP Casing Length: 958.34 ft.

Borehole Depth: 974.00 ft.
Borehole Inclination: Vertical
Borehole Diameter: 4.90 in.

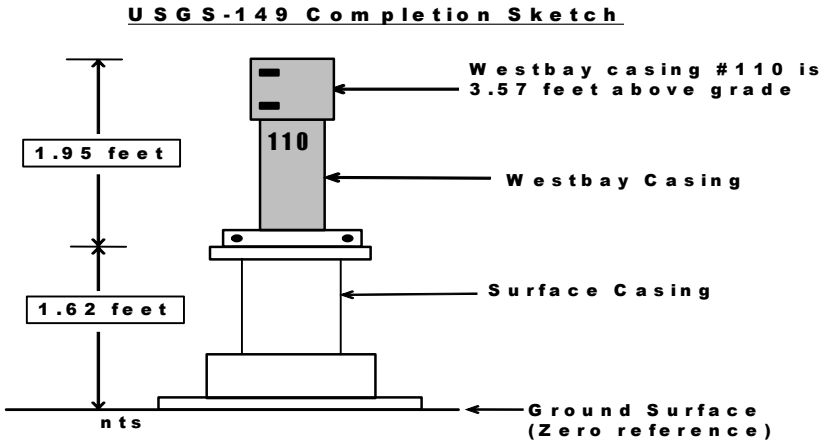
Well Description:
Plastic MP55
Other References:

File Information

File Name: USGS149.WWD
Report Date: Thu Oct 10 15:22:43 2019

File Date: Oct 10 15:19:38 2019

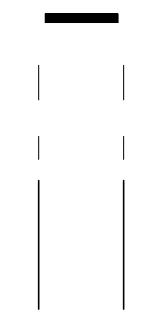
Sketch of Wellhead Completion



Legend

(Qty) MP Components

(Library - WD Library 7/27/00)



(2) 0603 - MP55 End Plug

(8) 060115 - MP55 Casing 2 (1.5M/5F)

(4) 060110 - MP55 Casing 3 (1M/3F)

(87) 060130 - MP55 Casing 1 (3M/10F)

(11) 0604 - MP55 Packer 100mm PVC(1.5M/5F)

(97) 0602 - MP55 Regular Coupling

(15) 0605 - MP55 Measurement Port

(5) 0608 - MP55 Magnetic Location Collar

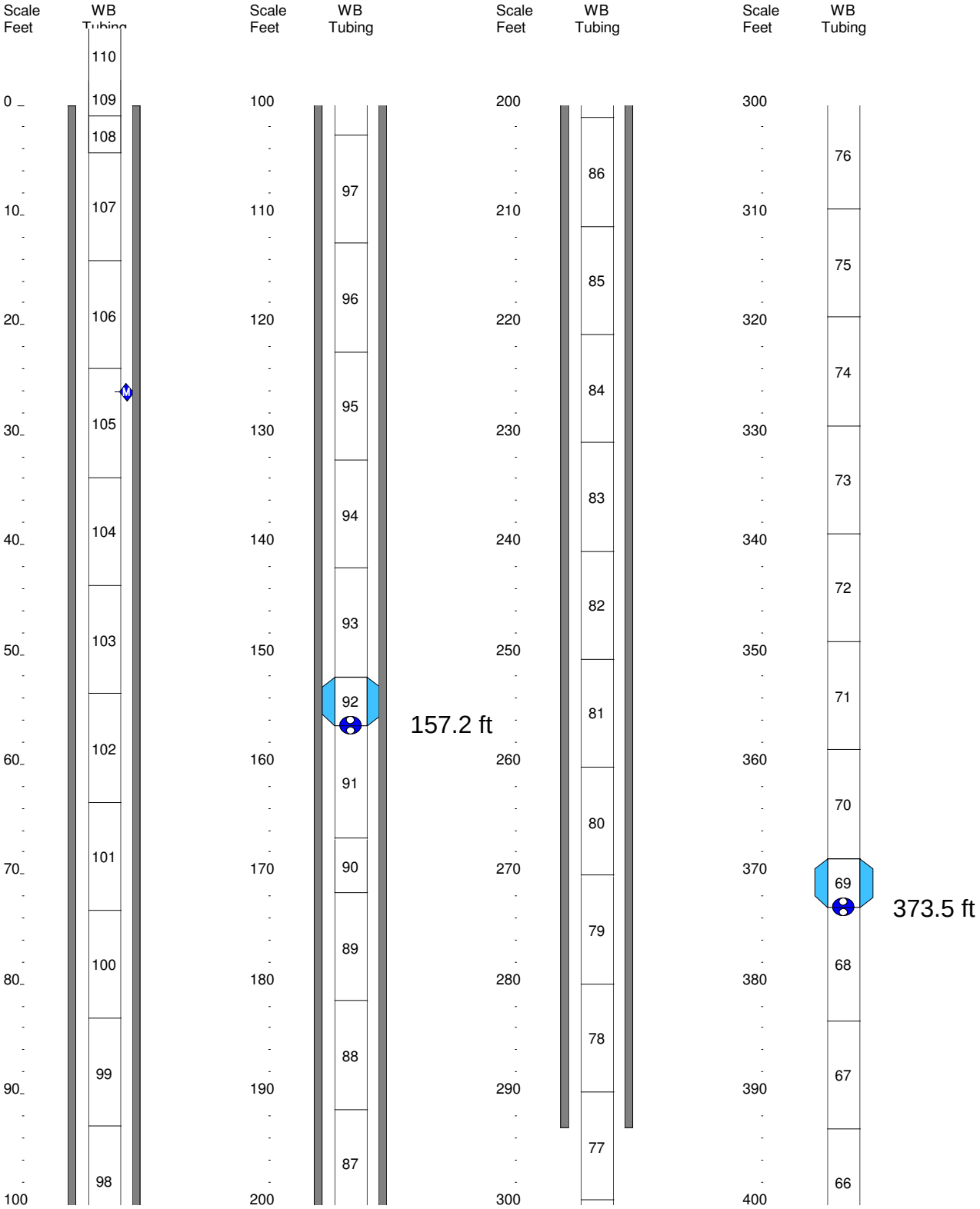
Geology

Backfill/Casing

Mild Steel

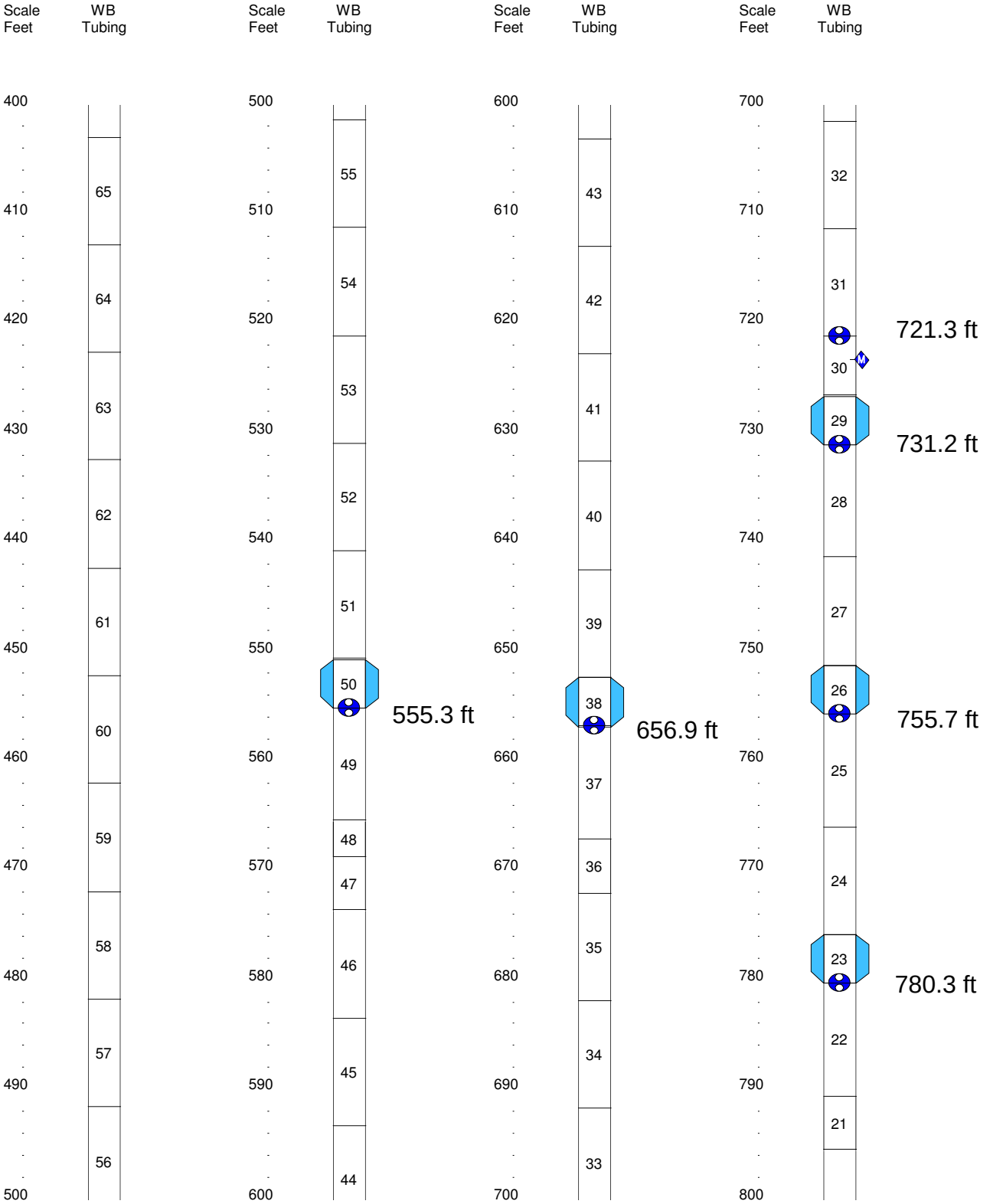
Summary Completion Log
USGS

Job No: WB843
Well: USGS 149



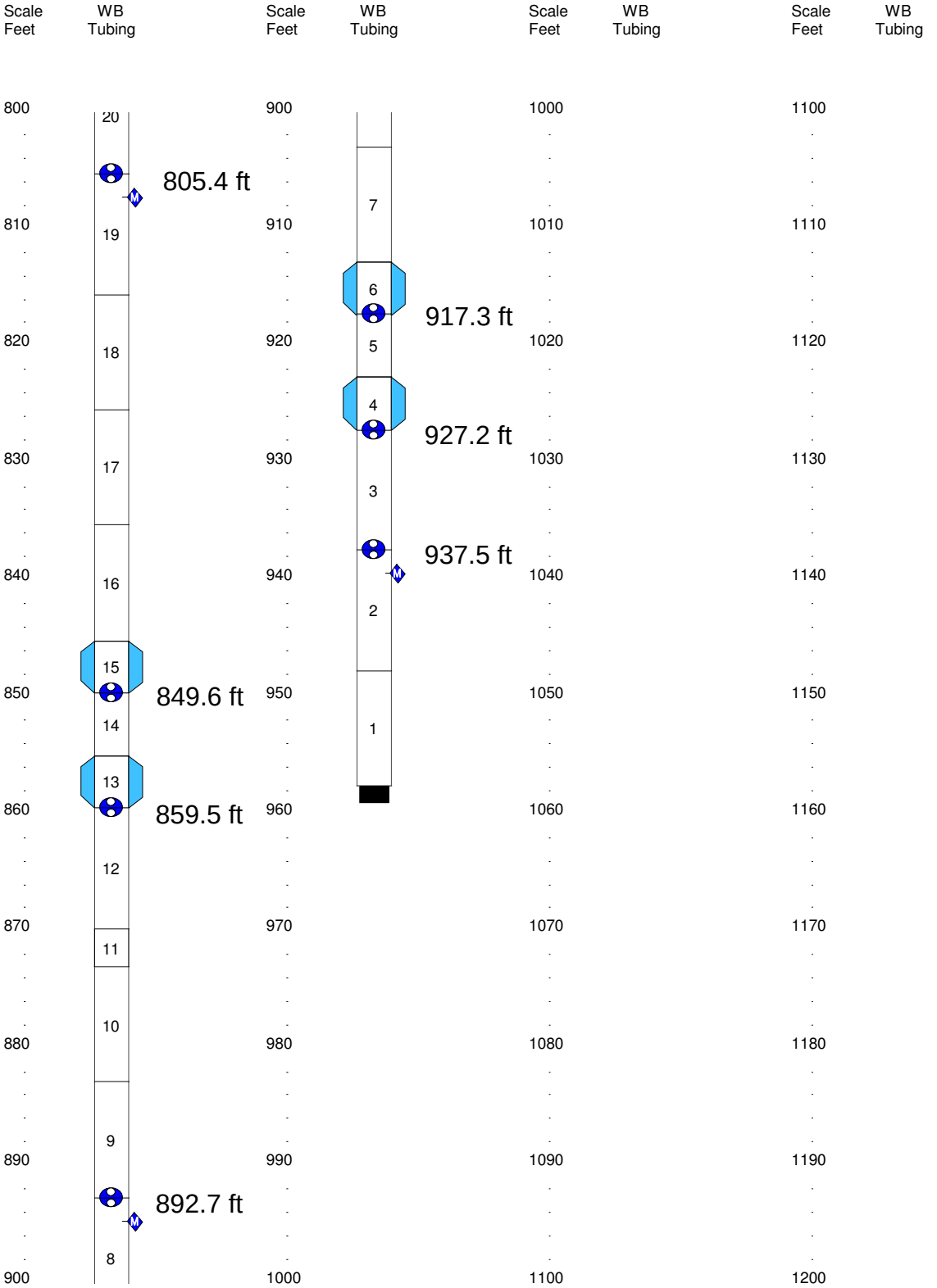
Summary Completion Log
USGS

Job No: WB843
Well: USGS 149



Summary Completion Log
USGS

Job No: WB843
Well: USGS 149



PRE-INFLATION

Westbay Piezometric Pressures/Levels

Field Data and Calculation Sheet

Westbay Instruments

Well No.: USGS 149
Datum: GS
Elev. G.S.: Ø
Height of Westbay above G.S.: 5.97 ft
Elev. top of Westbay Casing: Ø
Reference Elevation: Ø
Borehole angle: Vertical

Probe Type: Sampler
Serial No.: EMS 3552
Probe Range: 500
Westbay Casing Type: MP55
Sampler Valve Position: Closed

Date: Sept 24/19
Client: USGS
Job No.: UB843
Location: INL
Weather: Hot / clear
Operator: ML / TB

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

P_{atm} 12.22 psi

Ambient Reading (P_{atm}) (pressure, temperature, time)

	Start	Finish
Pressure	12:00	12.23
Temp	21.94 °C	14.0
Time	12:30	2:24

Port No.	Port Position From Log (ft)	Port Position From Cable (ft)	True Port Depth "Dp" (ft)	Fluid Pressure Readings: Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)	Pressure Head Outside Port (ft) H = (P2-Patm)/w	Piez. Level Outside Port (ft) Dz = Dp - H	Zones	Comments	Counter difference
1	937.46	935.3	–	107.51	135.23	1:42	13.15	107.53	283.76	653.70	Zone 1a		2.2
2	912.86	–	–										Avg
2	927.17	925.5	–	103.10	130.76	1:47	13.11	103.11	273.45	653.72	Zone 1b		1.7
3	917.33	915.2	–	98.85	126.49	1:50	13.10	98.86	263.60	653.73	QA1		2.1
4	892.73	890.9	–	88.17	115.82	1:53	13.18	88.18	238.99	653.75	Zone 2a		1.8
5	859.47	857.4	–	73.72	101.43	1:55	13.46	73.73	205.79	653.68	Zone 2b		2.1
6	849.63	847.7	–	69.46	97.15	1:58	13.70	69.46	195.92	653.71	QA2		1.9
7	805.34	803.1	–	50.22	77.95	2:03	14.24	50.22	151.63	653.71	Zone 3a		2.2
8	780.29	778.1	–	39.32	67.09	2:06	14.62	39.32	126.57	653.72	Zone 3b		2.2
9	755.69	753.8	–	28.61	56.42	2:08	14.99	28.61	101.96	653.73	QA3		1.9
10	731.09	729.4	–	17.91	45.71	2:10	15.21	17.92	77.25	653.83	QA4		1.7
11	721.25	719.4	–	13.57	41.40	2:18	15.40	13.56	67.31	653.94	Zone 4a		1.9
12	656.82	655.7	–	12.51	13.39	2:17	15.21	12.51	2.70	654.12	Zone 4b		1.1
13	555.12	554.4	–	12.47	12.49	2:20	15.11	12.44			QA5		0.7
14	373.03	371.6	–	12.38	12.37	2:28	14.79	12.38			QA6		1.4
15	156.44	155.9	–	12.31	12.31	2:27	14.31	12.31			QA7		0.6

Difference 22

Notes: w = 0.4335 psi/ft (1.42[illegible] kPa/m of H_2O) Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

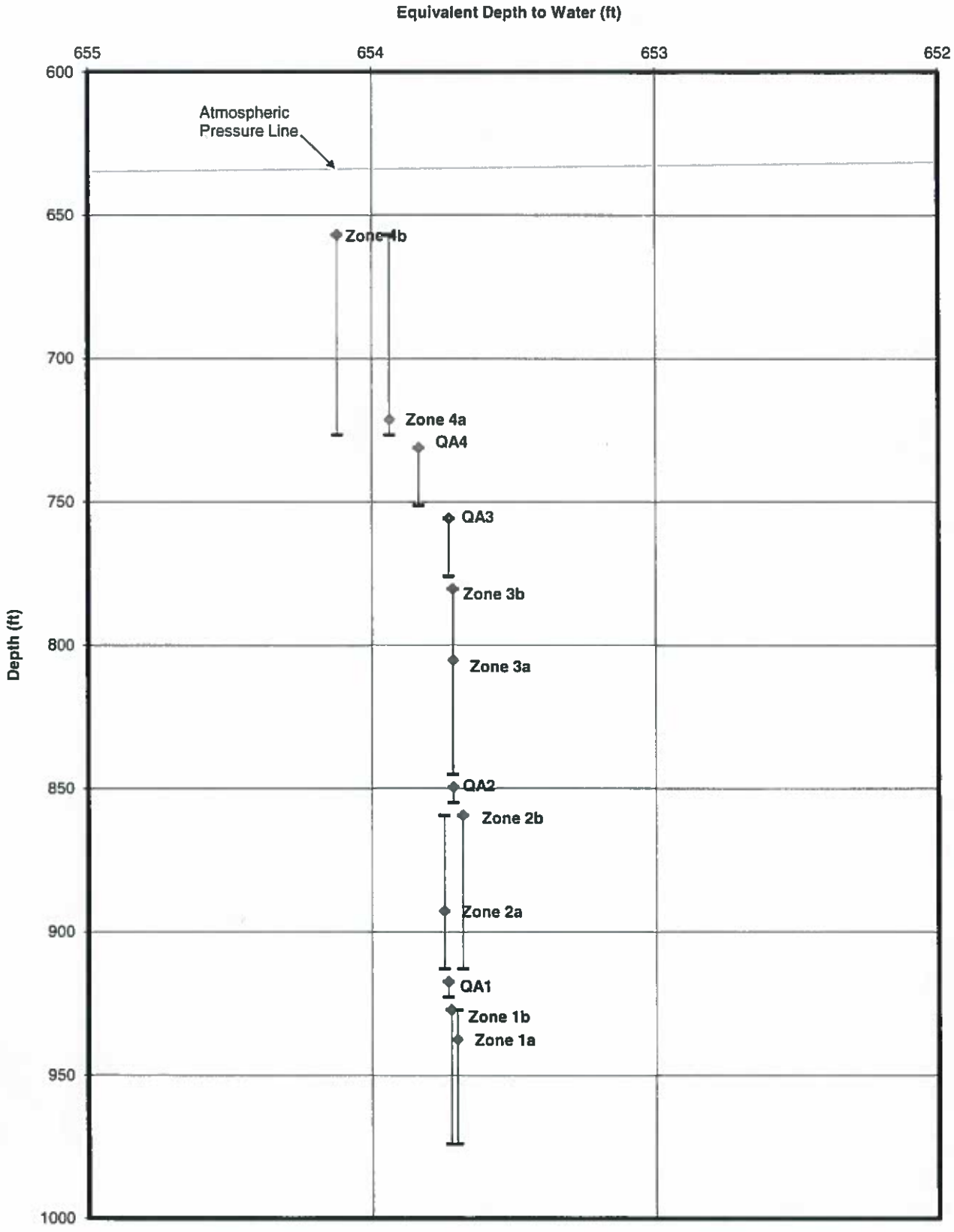
Beep 833.1 ft
by counter

Hanging weight: 1180 lbs

WBWL: 719 ft added ~ 8 gallons of water after profile

Piezometric Profile
Monitoring Well: USGS149

Profile Date: Sept 24, 2019
Comments: Pre-Inflation Profile



Client: USGS
Site: INL
Datum: Ground Level

Figure 3

Plot By: TK Date: 04-14-19
Checked By: DL Date: 04-23-2019
Westbay Project: WB843

Post-Inflation

Westbay Piezometric Pressures/Levels

Field Data and Calculation Sheet

Westbay Instruments

Well No.: USGS149
Datum: GS
Elev. G.S.: 0
Height of Westbay above G.S.: 0
Elev. top of Westbay Casing:
Reference Elevation: 0
Borehole angle: Vertical

Probe Type: Sampler
Serial No.: EMS 3552
Probe Range: 500
Westbay Casing Type: MP55
Sampler Valve Position: Closed

Date: Sept 26/19
Client: USGS
Job No.: UB843
Location: INL
Weather: Warm/clear
Operator: MC/BT

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

Ambient Reading (P_{atm}) (pressure, temperature, time)

	Start:	Finish:
Pressure	12.14	12.15
Temp	13.34	12.78
Time	11:50 am	12:77 pm

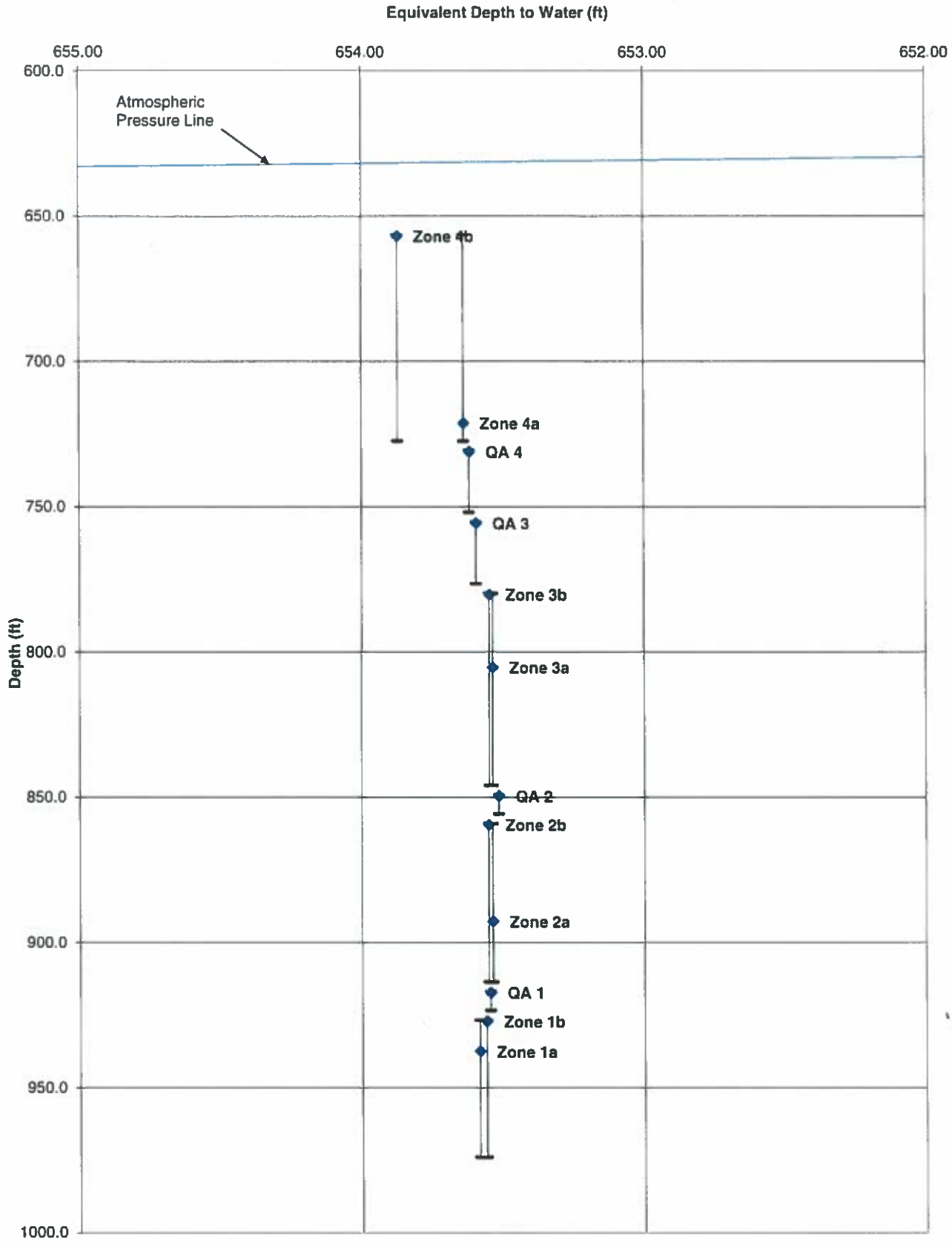
P_{atm} 12.14 psi

Port No.	Port Position From Log (ft)	Port Position From Cable (ft)	True Port Depth "Dp" (ft)	Fluid Pressure Readings: Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)	Pressure Head Outside Port (ft) H = (P2-Patm)/w	Piez. Level Outside Port (ft) Dz = Dp - H	Zones	Comments
1	937.46	935.4	–	135.98	135.20	12:04	13.28	135.98	283.88	653.58	Zone 1a	
2	927.17	925.4	–	131.49	130.75	12:06	13.26	131.51	273.61	653.56	Zone 1b	
3	917.33	915.3	–	127.25	126.49	12:08	13.25	127.24	263.78	653.55	QA1	
4	892.73	890.7	–	116.55	115.83	12:11	13.23	116.54	239.19	653.54	Zone 2a	
5	859.47	857.5	–	102.11	101.41	12:13	13.22	102.11	205.93	653.54	Zone 2b	
6	849.63	848.1	–	97.84	97.16	12:15	13.22	99.84	196.12	653.51	QA2	
7	805.34	804.0	–	78.60	77.96	12:17	13.21	78.58	151.83	653.51	Zone 3a	
8	780.29	779.0	–	67.69	67.10	12:19	13.20	67.70	126.78	653.51	Zone 3b	
9	755.69	754.6	–	57.01	56.42	12:21	13.17	57.01	102.13	653.54	QA3	
10	791.09	730.0	–	46.30	45.75	12:23	13.18	46.30	77.53	653.56	QA4	
11	721.25	720.9	–	42.07	41.48	12:25	13.18	42.07	67.68	653.57	Zone 4a	
12	656.87	656.2	–	13.93	13.47	12:29	13.18	13.93	3.07	653.75	Zone 4b	

Notes: w = 0.4335 psi/ft (1.422psi/m) of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

Piezometric Profile
Monitoring Well:USGS149

Profile Date:Sept 26,2019
Comments:Post-Inflation Profile



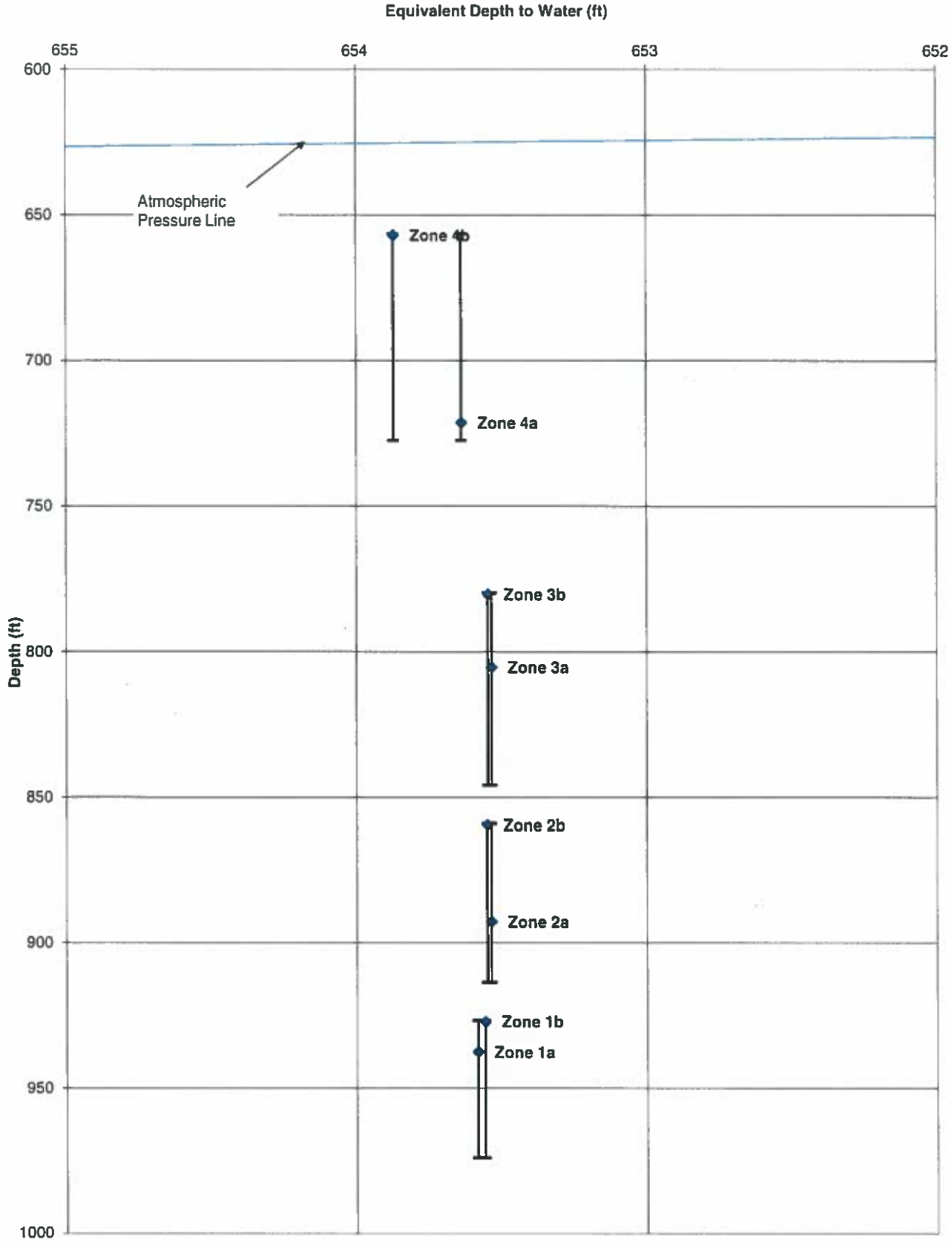
Client:USGS
Site:INL
Datum:Ground Surface

Plot By: TF Date: Oct 4/19
Checked By: DL Date: OCT 23, 2019

Figure 4

Piezometric Profile
Monitoring Well:USGS 149

Profile Date:Sept 26, 2019
Comments:Post-Inflation Profile



Client:USGS
Site:INL
Datum:Ground Level

Plot By: TK Date: Oct 11, 2019
Checked By: DL Date: 10/23, 2019

Figure 5

Westbay Completion Log

Company: USGS
Well: USGS-149
Site: INL
Project: INL

Job No: WB843
Author: BT/ML

Well Information

Reference Datum: GS
Elevation of Datum: 0.00 ft.
MP Casing Top: 0.00 ft.
MP Casing Length: 958.34 ft.

Borehole Depth: 974.00 ft.
Borehole Inclination: Vertical
Borehole Diameter: 4.90 in.

Well Description:
Plastic MP55
Other References:

File Information

File Name: USGS149.WWD
Report Date: Mon Sep 23 06:14:29 2019

File Date: Sep 20 14:15:18 2019

Comments

Zero reference is Ground Surface (0.9' below weld) BCM
(1.3' below plate) BCM

Filter socks not to be used BCM

Log Information

Borehole condition confirmed.	(method) Video	Date: Sept 23/19
MP well design & preparation.	By: ML	Date: Sept 23/19
MP well design checked.	By: BV	Date: 9/23/2019
MP well and borehole approved to install.	By: BV	Date: 9/23/2019

Legend

(Qty) MP Components

(Library - WD Library 7/27/00)

(2) 0603 - MP55 End Plug

(8) 060115 - MP55 Casing 2 (1.5M/5F)

(4) 060110 - MP55 Casing 3 (1M/3F)

(87) 060130 - MP55 Casing 1 (3M/10F)

(11) 0604 - MP55 Packer 100mm PVC(1.5M/5F)

(97) 0602 - MP55 Regular Coupling

(15) 0605 - MP55 Measurement Port

(5) 0608 - MP55 Magnetic Location Collar

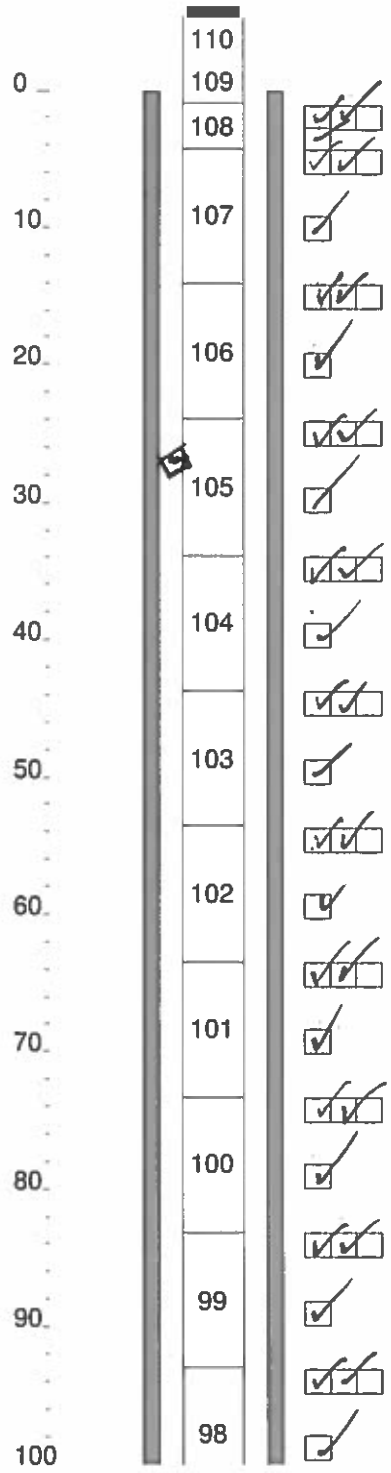
Geology

Backfill/Casing

Mild Steel

Westbay Completion Log
USGS

Job No: WB843
Well: USGS-149



WB Tubing Description

060110 - MP55 Casing 3 (1M/3F)
060130 - MP55 Casing 1 (3M/10F)
060130 - MP55 Casing 1 (3M/10F)
060130 - MP55 Casing 1 (3M/10F)
060130 - MP55 Casing 1 (3M/10F)
060130 - MP55 Casing 1 (3M/10F)
060130 - MP55 Casing 1 (3M/10F)
060130 - MP55 Casing 1 (3M/10F)
060130 - MP55 Casing 1 (3M/10F)
060130 - MP55 Casing 1 (3M/10F)

Serial Numbers

Finish lowering at 12:15pm Sept 24/19
780 lbs @ 12:00pm

840 lbs

920 lbs @ 11:42

(c) Westbay Instruments Inc. 2000

Mon Sep 23 06:15:35 2019

Westbay Completion Log
USGS

Job No: WB843
Well: USGS-149

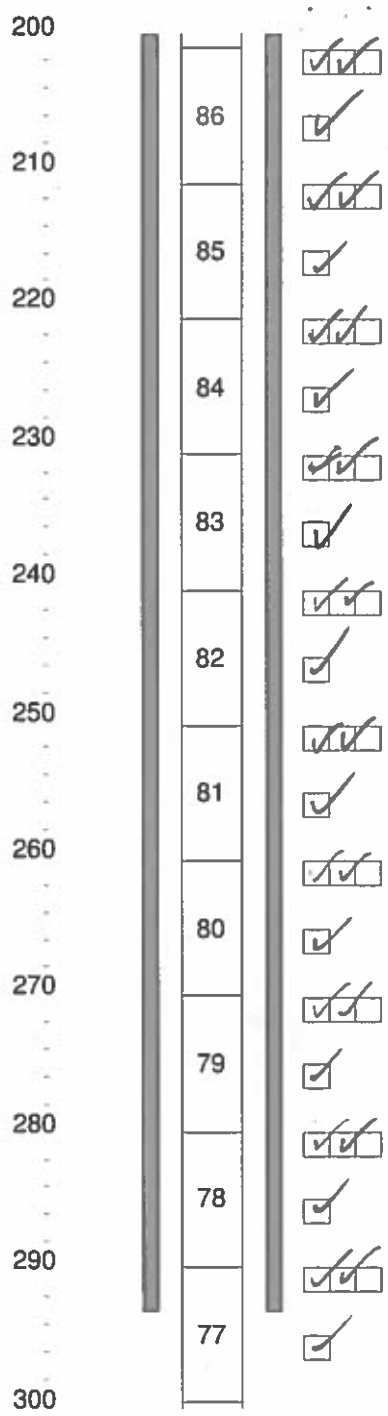
Scale Feet	WB Tubing	QA Tested OK	WB Tubing Description	Serial Numbers
100				
110	97		060130 - MP55 Casing 1 (3M/10F)	
120	96		060130 - MP55 Casing 1 (3M/10F)	9E016
130	95		060130 - MP55 Casing 1 (3M/10F)	
140	94		060130 - MP55 Casing 1 (3M/10F)	
150	93		060130 - MP55 Casing 1 (3M/10F)	
	92		0604 - MP55 Packer 100mm PVC(1.5M/5F) 0605 - MP55 Measurement Port	
160	91		060130 - MP55 Casing 1 (3M/10F)	
170	90		060115 - MP55 Casing 2 (1.5M/5F)	
180	89		060130 - MP55 Casing 1 (3M/10F)	
190	88		060130 - MP55 Casing 1 (3M/10F)	
200	87		060130 - MP55 Casing 1 (3M/10F)	

(c) Westbay Instruments Inc. 2000

Mon Sep 23 06:15:35 2019

Westbay Completion Log
USGS

Job No: WB843
Well: USGS-149



11:20am

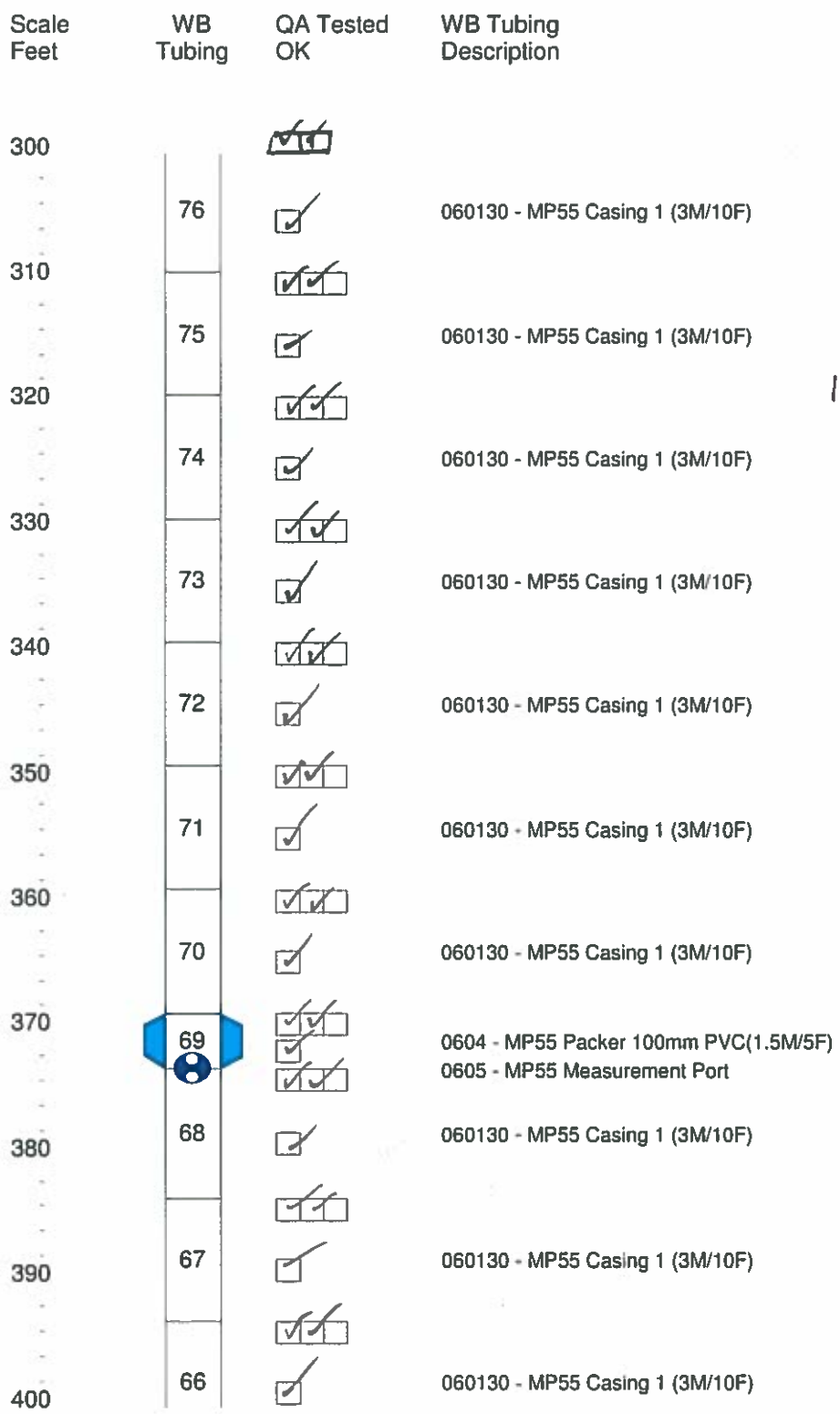
1100 lbs

1180 lbs

1200 lbs

Westbay Completion Log
USGS

Job No: WB843
Well: USGS-149



(c) Westbay Instruments Inc. 2000

Mon Sep 23 06:15:35 2019

Westbay Completion Log
USGS

Job No: WB843
Well: USGS-149

Scale Feet	WB Tubing	QA Tested OK	WB Tubing Description	Serial Numbers
400				
	65		060130 - MP55 Casing 1 (3M/10F)	
410				
	64		060130 - MP55 Casing 1 (3M/10F)	
420				
	63		060130 - MP55 Casing 1 (3M/10F)	
430				
	62		060130 - MP55 Casing 1 (3M/10F)	
440				
	61		060130 - MP55 Casing 1 (3M/10F)	
450				
	60		060130 - MP55 Casing 1 (3M/10F)	
460				
	59		060130 - MP55 Casing 1 (3M/10F)	
470				
	58		060130 - MP55 Casing 1 (3M/10F)	
480				
	57		060130 - MP55 Casing 1 (3M/10F)	
490				
	56		060130 - MP55 Casing 1 (3M/10F)	
500				

10:36 am

10:20 - continue
9:57 am - Break

No joint testing as per client request.

(c) Westbay Instruments Inc. 2000

Mon Sep 23 06:15:35 2019

Westbay Completion Log
USGS

Job No: WB843
Well: USGS-149

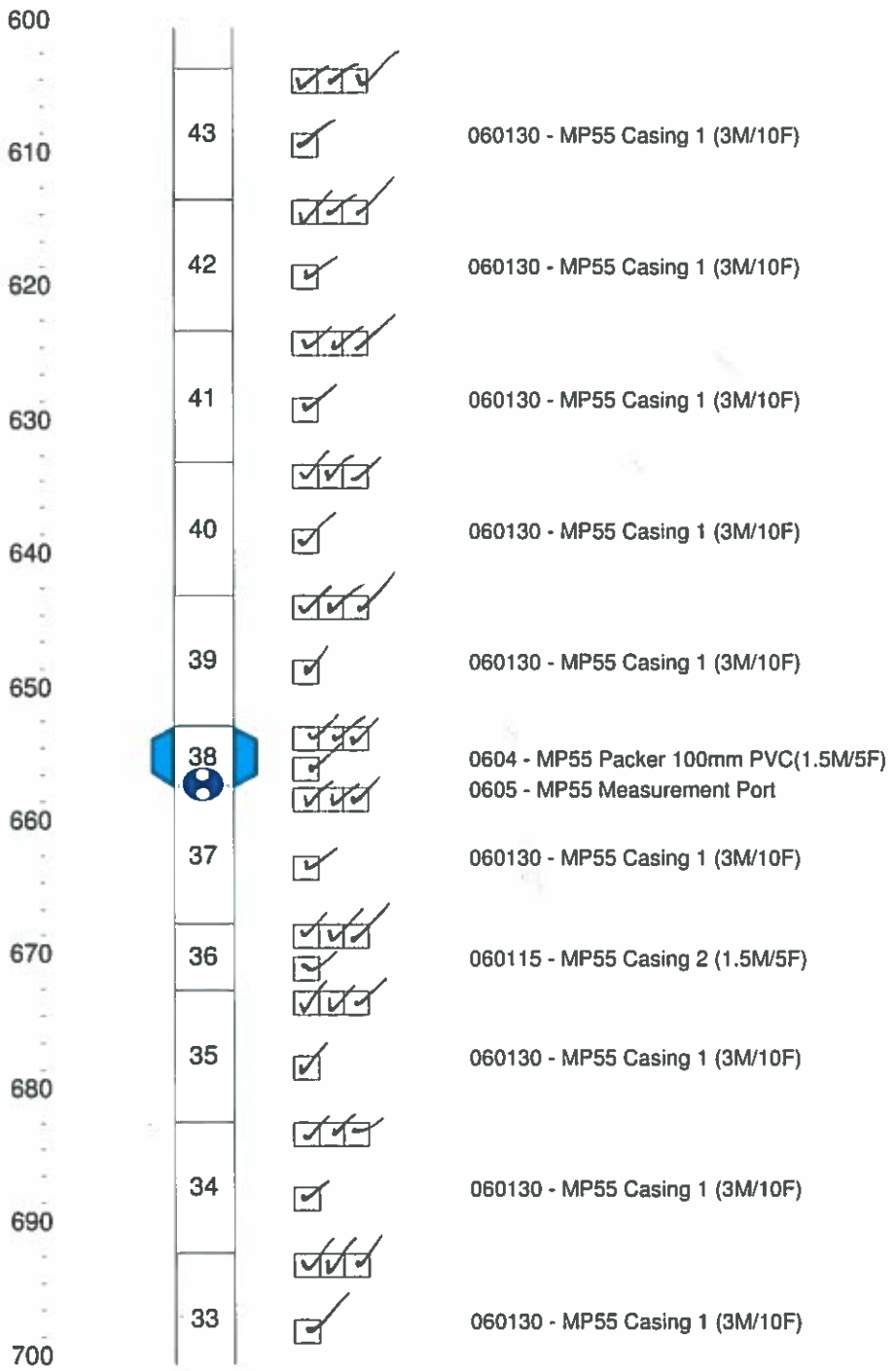
Scale Feet	WB Tubing	QA Tested OK	WB Tubing Description	Serial Numbers
500				
	55		060130 - MP55 Casing 1 (3M/10F)	
510				
	54		060130 - MP55 Casing 1 (3M/10F)	
520				
	53		060130 - MP55 Casing 1 (3M/10F)	
530				9:39 am
	52		060130 - MP55 Casing 1 (3M/10F)	
540				
	51		060130 - MP55 Casing 1 (3M/10F)	
550				
	50		0604 - MP55 Packer 100mm PVC(1.5M/5F) 0605 - MP55 Measurement Port	
560	49		060130 - MP55 Casing 1 (3M/10F)	
	48		060110 - MP55 Casing 3 (1M/3F)	
570	47		060115 - MP55 Casing 2 (1.5M/5F)	
580	46		060130 - MP55 Casing 1 (3M/10F)	
590	45		060130 - MP55 Casing 1 (3M/10F)	
600	44		060130 - MP55 Casing 1 (3M/10F)	

(c) Westbay Instruments Inc. 2000

Mon Sep 23 06:15:53 2019

Westbay Completion Log
USGS

Job No: WB843
Well: USGS-149

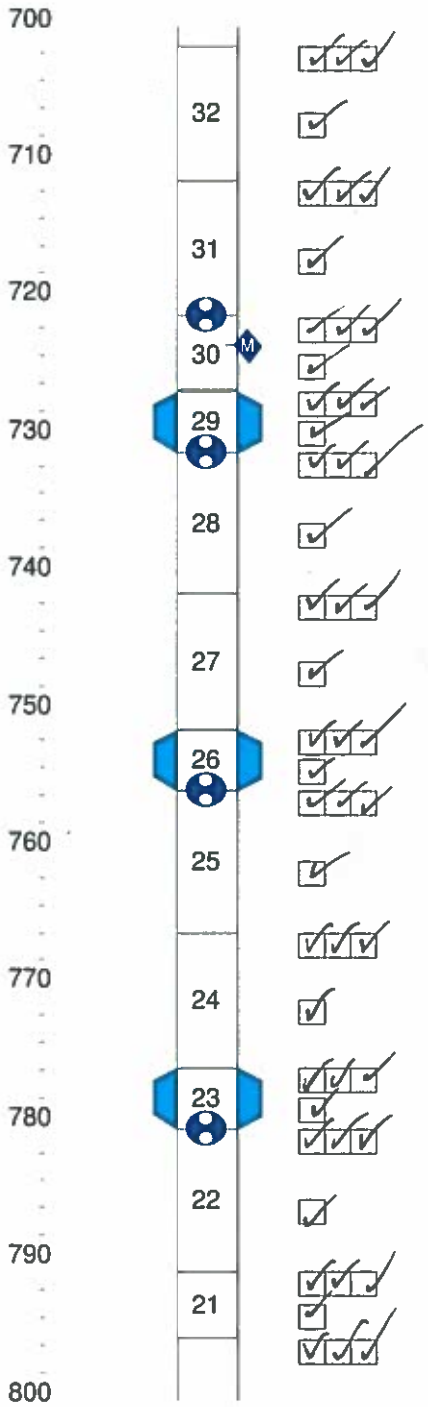


(c) Westbay Instruments Inc. 2000

Mon Sep 23 06:15:53 2019

Westbay Completion Log
USGS

Job No: WB843
Well: USGS-149



8:22 am

Start lowering for the day at 7:55 am Sept24/19

Finish lowering for the day at 4:50 pm Sept23/19

Comp#24 in borehole

Westbay Completion Log
USGS

Job No: WB843
Well: USGS-149

Scale Feet	WB Tubing	QA Tested OK	WB Tubing Description	Serial Numbers
800	20	☑	060130 - MP55 Casing 1 (3M/10F)	
		☑☑☑	0605 - MP55 Measurement Port	
810	19	☑	060130 - MP55 Casing 1 (3M/10F)	
		☑☑☑		
820	18	☑	060130 - MP55 Casing 1 (3M/10F)	
		☑☑☑		
830	17	☑	060130 - MP55 Casing 1 (3M/10F)	
		☑☑☑		
840	16	☑	060130 - MP55 Casing 1 (3M/10F)	
	15	☑☑☑	0604 - MP55 Packer 100mm PVC(1.5M/5F)	
850		☑☑☑	0605 - MP55 Measurement Port	
	14	☑	060115 - MP55 Casing 2 (1.5M/5F)	
	13	☑☑☑	0604 - MP55 Packer 100mm PVC(1.5M/5F)	
860		☑☑☑	0605 - MP55 Measurement Port	4:00 pm
	12	☑	060130 - MP55 Casing 1 (3M/10F)	
870	11	☑☑☑	060110 - MP55 Casing 3 (1M/3F)	
		☑☑☑		
	10	☑	060130 - MP55 Casing 1 (3M/10F)	
880		☑☑☑		
	9	☑	060130 - MP55 Casing 1 (3M/10F)	
890		☑☑	0605 - MP55 Measurement Port	
	8	☑	060130 - MP55 Casing 1 (3M/10F)	
900				

(c) Westbay Instruments Inc. 2000

Mon Sep 23 06:15:54 2019

Westbay Completion Log
USGS

Job No: WB843
Well: USGS-149

Scale Feet	WB Tubing	QA Tested OK	WB Tubing Description	Serial Numbers
900				3:39 pm
910	7		060130 - MP55 Casing 1 (3M/10F)	
	6		0604 - MP55 Packer 100mm PVC(1.5M/5F)	
			0605 - MP55 Measurement Port	
920	5		060115 - MP55 Casing 2 (1.5M/5F)	
	4		0604 - MP55 Packer 100mm PVC(1.5M/5F)	
			0605 - MP55 Measurement Port	
930	3		060130 - MP55 Casing 1 (3M/10F)	
			0605 - MP55 Measurement Port	
940	2		060130 - MP55 Casing 1 (3M/10F)	
950	1		060130 - MP55 Casing 1 (3M/10F)	
960			0603 - MP55 End Plug	

Start lowering. Sept 23/19 at 3:10pm
Joint test tool: 200 psi Sept 24/19
210 psi Sept 23/19

Borehole water level: 654.9 ft below GL.

970
980
990
1000

(c) Westbay Instruments Inc. 2000

Sheet 1 of 11

Westbay Packer Inflation Record

Project: USGS | Project No.: WB843 | Well No.: USGS 149

Location: INL | Completed by: Mark Lessard | Date Inflated: Sept 25/19

Packer No. 1 comp 4 SN# 237 | Depth (ft): 922.7 | Inflation Tool No.: TIW1085

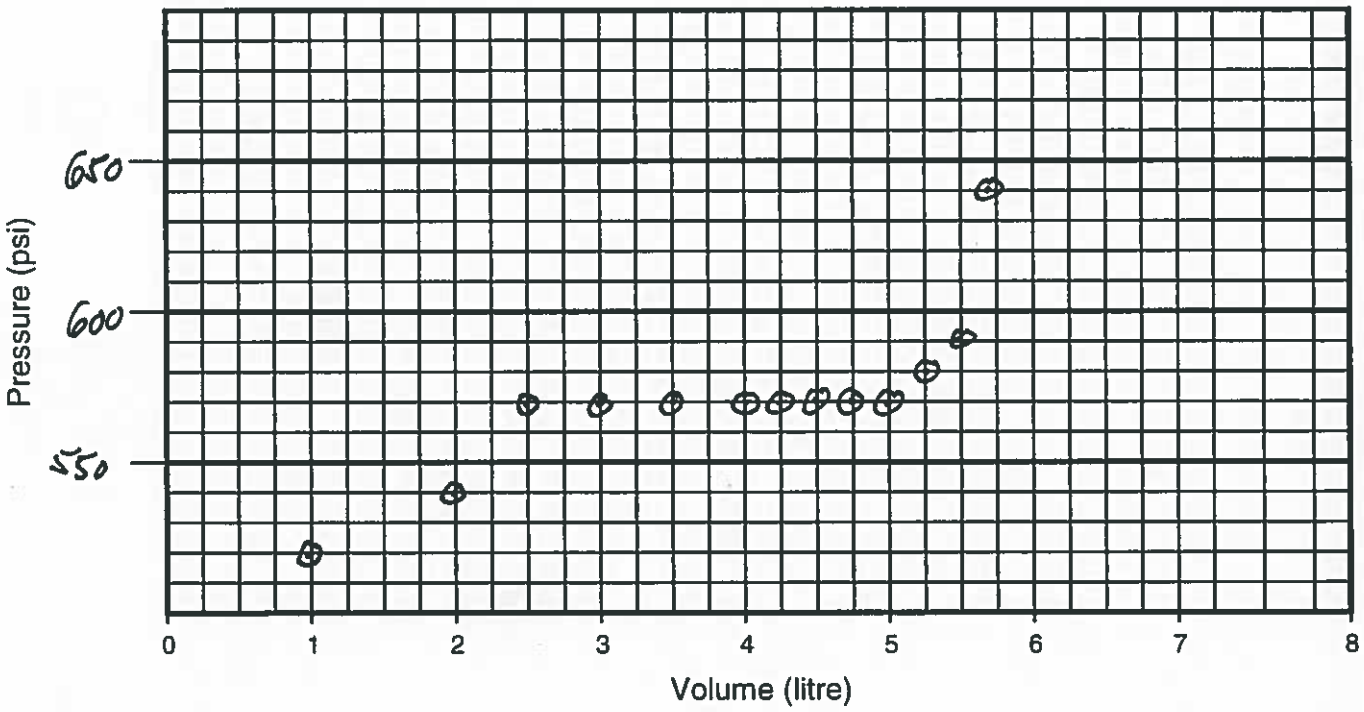
Packer Valve Pressure, P_V: 140 psi | Final Line Pressure, P_L: 640 psi | Tool Pressure, P_T: 670 psi

Borehole Water Level: 655 (ft) = 285 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 115 psi

70 sec

Volume, litres	1.0	2.0	2.5	3.0	3.5	4.0	4.25	4.5	4.75	5.0
Pressure, psi	520	540	570	570	570	570	570	570	570	570
Volume, litres	5.25	5.5	5.7	/	5.25					
Pressure, psi	580	590	640	/	∅					



Comments: Target - 625 psi 520 @ 50 sec at 1L. Time - 11:12 am

Westbay Packer Inflation Record

Project: USGS | Project No.: WB843 | Well No.: USGS 149

Location: INL | Completed by: Mark Lessard | Date Inflated: Sept 25/19

Packer No. 2, comp 6 SN# 234 | Depth (ft): 92.9 | Inflation Tool No.: TIW1085

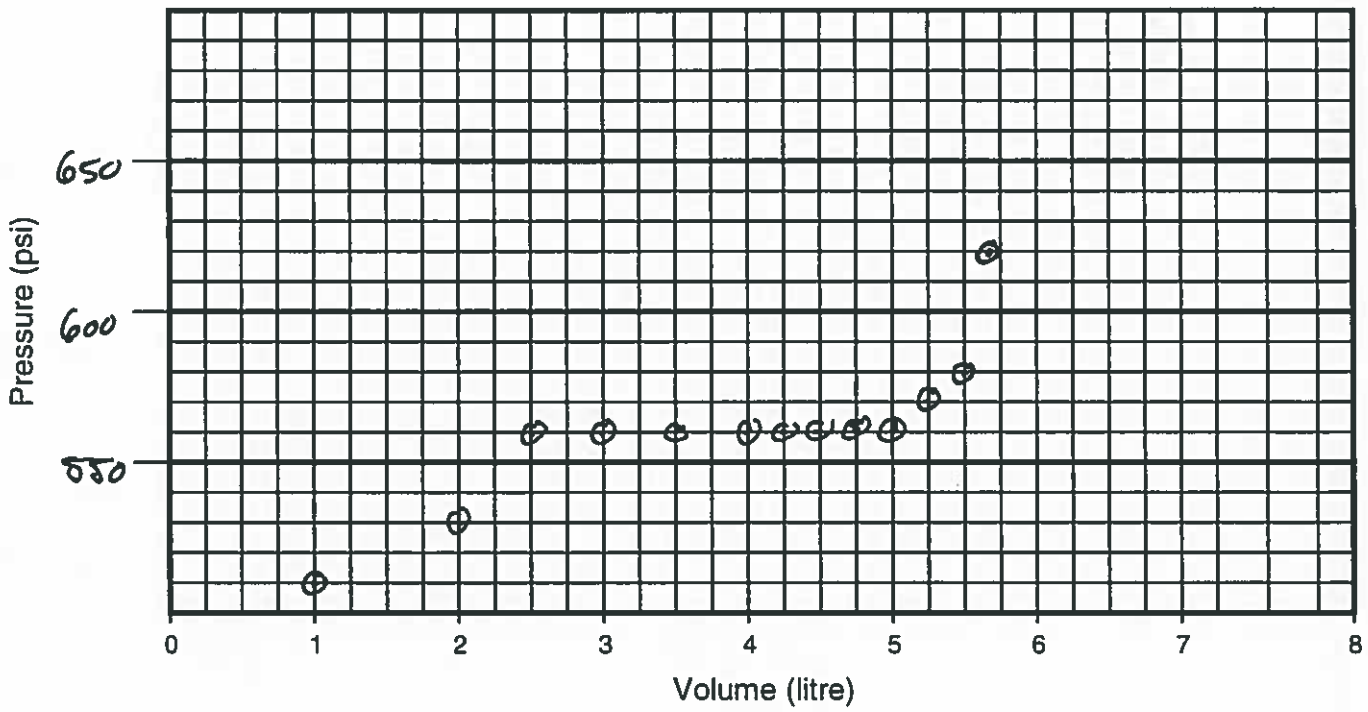
Packer Valve Pressure, P_V: 145 psi | Final Line Pressure, P_L: 620 psi | Tool Pressure, P_T: 670 psi

Borehole Water Level: 655 (ft) = 285 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 90 psi

:67

Volume, litres	1.0	2.0	2.5	3.0	3.5	4.0	4.25	4.5	4.75	5.0
Pressure, psi	510	530	560	560	560	560	560	560	560	560
Volume, litres	5.25	5.5	5.7	/	5.25					
Pressure, psi	570	580	620	/	ø					



Comments: Time - 11:47am

Westbay Packer Inflation Record

Project: USGS | Project No.: WB843 | Well No.: USGS 149

Location: INL | Completed by: Mark Lessard | Date Inflated: Sept 25/19

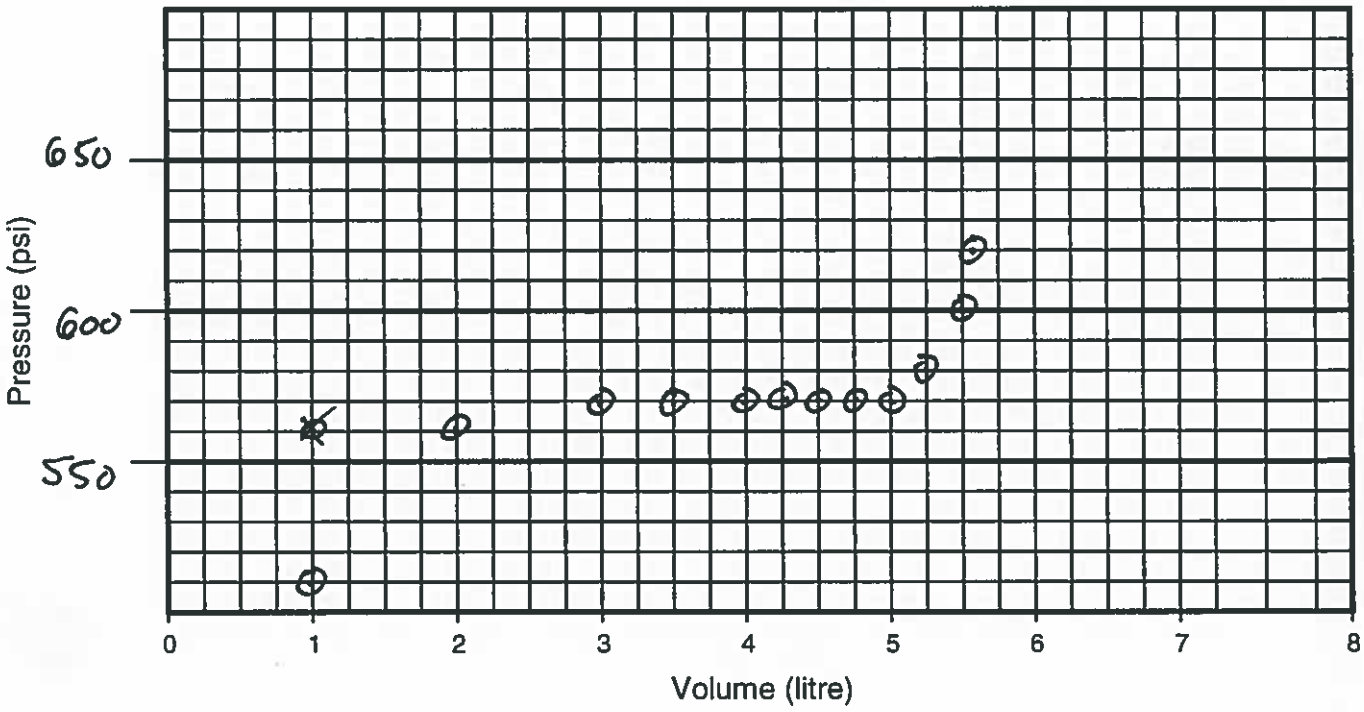
Packer No. 3 comp 13 SN# 232 | Depth (ft): 855.0 | Inflation Tool No.: TIW1085

Packer Valve Pressure, P_V: 150 psi | Final Line Pressure, P_L: 620 psi | Tool Pressure, P_T: 670 psi

Borehole Water Level: 655 (ft) = 285 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 85 psi

Volume, litres	1.0	2.0	3.0	3.5	4.0	4.25	4.5	4.75	5.0	5.25
Pressure, psi	510	560	570	570	570	570	570	570	570	580
Volume, litres	5.5	5.6	/	5.1						
Pressure, psi	600	620	/	ϕ						



Comments: Time - 12:35pm

Sheet 4 of 11

Westbay Packer Inflation Record

Project: USGS | Project No.: WB843 | Well No.: USGS 149

Location: INL | Completed by: Mark Lessard | Date Inflated: Sept 25/19

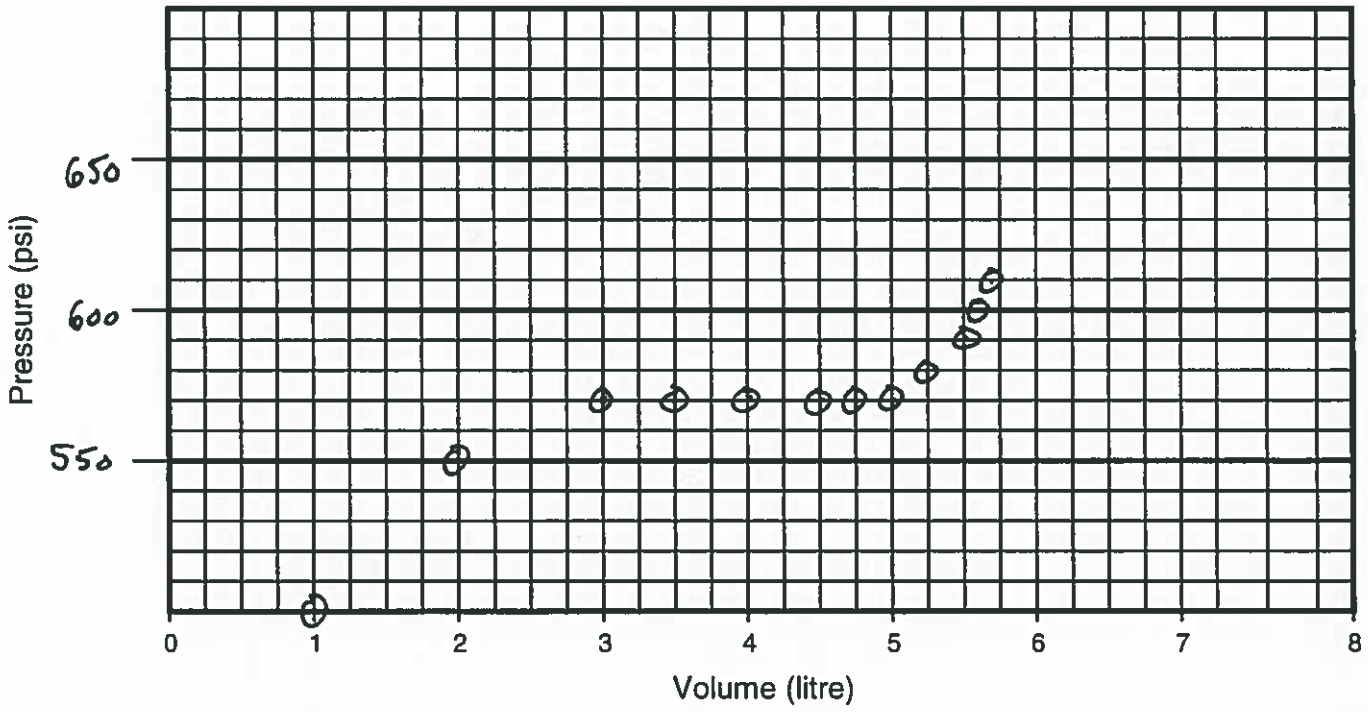
Packer No. 4, comp 15 SN# 235 | Depth (ft): 845.2 | Inflation Tool No.: TIW1085

Packer Valve Pressure, P_V: 155 psi | Final Line Pressure, P_L: 60 psi | Tool Pressure, P_T: 670 psi

Borehole Water Level: 655 (ft) = 285 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 70 psi

Volume, litres	1.0	2.0	3.0	3.5	4.0	4.5	4.75	5.0	5.25	5.5
Pressure, psi	500	550	570	570	570	570	570	570	580	590
Volume, litres	5.6	5.65	/	5.25						
Pressure, psi	600	610	/	∅						



Comments: Time - 1:02 pm

Westbay Packer Inflation Record

Project: USGS | Project No.: WB843 | Well No.: USGS 149

Location: INL | Completed by: Mark Lessard | Date Inflated: Sept 25/19

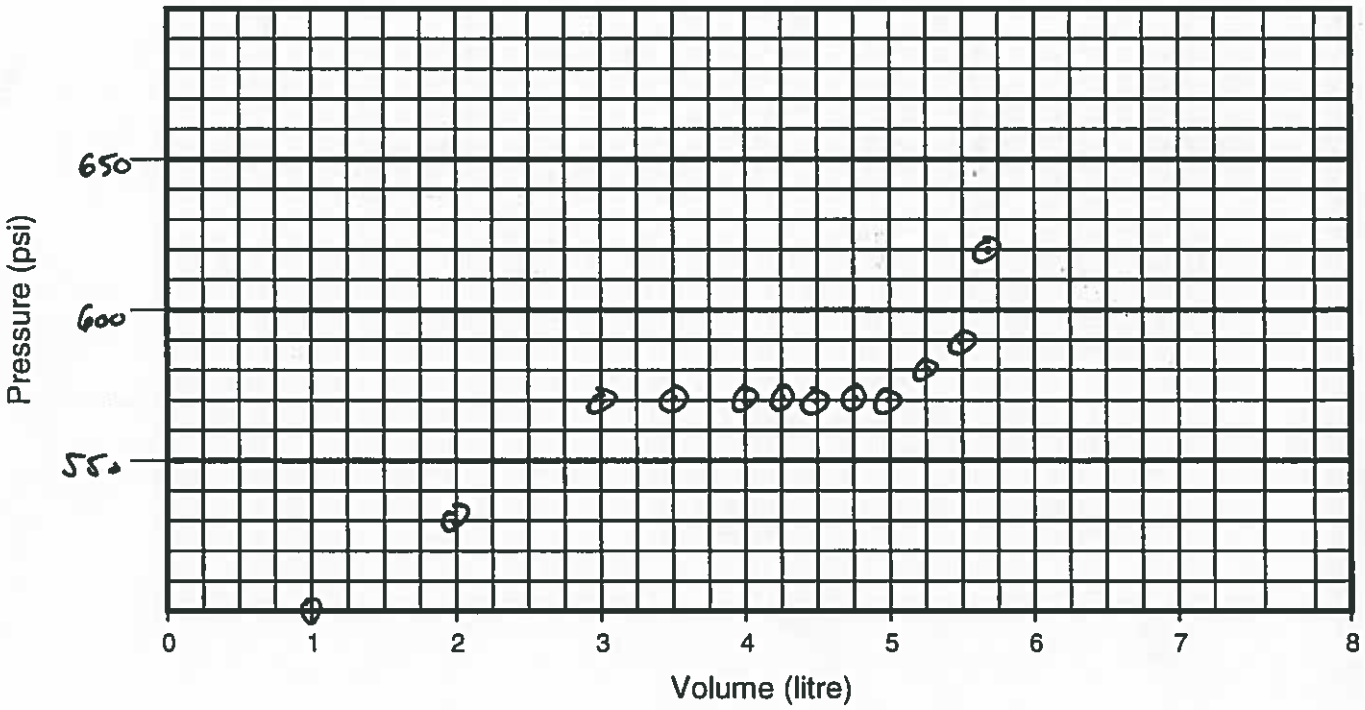
Packer No. 5, Comp 23 SN# 233 | Depth (ft): 755.8 | Inflation Tool No.: TIW1085

Packer Valve Pressure, P_V: 150 psi | Final Line Pressure, P_L: 620 psi | Tool Pressure, P_T: 650 psi

Borehole Water Level: 655 (ft) = 285 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 105 psi

Volume, litres	1.0	2.0	3.0	3.5	4.0	4.25	4.5	4.75	5.0	5.25
Pressure, psi	500	530	570	570	570	570	570	570	570	580
Volume, litres	5.5	5.7	/	5.25						
Pressure, psi	990	620	/	0						



Comments: Time - 4:42 pm

Sheet 6 of 11

Westbay Packer Inflation Record

Project: USGS | Project No.: WB843 | Well No.: USGS 149

Location: INL | Completed by: Mark Lessard | Date Inflated: Sept 25/19

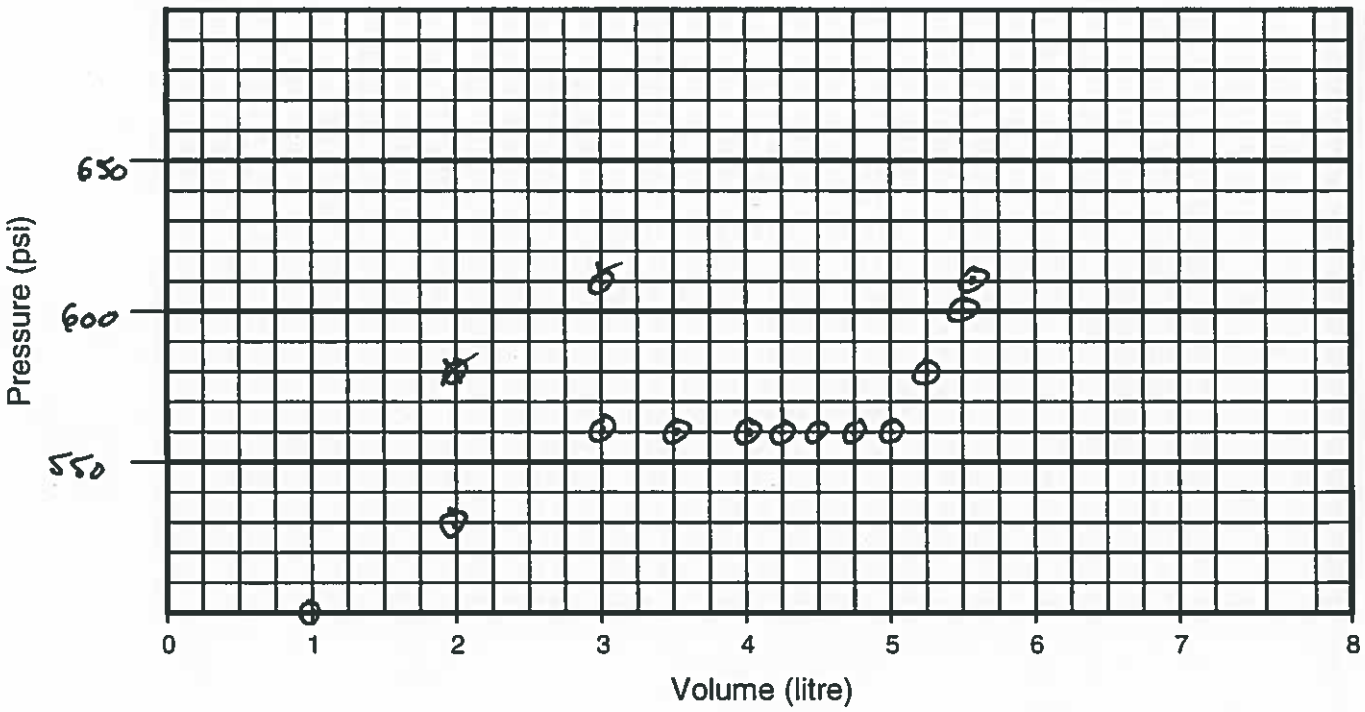
Packer No. 6, comp 26 SN# 236 | Depth (ft): 751.2 | Inflation Tool No.: TIW1085

Packer Valve Pressure, P_V: 140 psi | Final Line Pressure, P_L: 610 psi | Tool Pressure, P_T: 650 psi

Borehole Water Level: 655 (ft) = 285 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 105 psi

Volume, litres	1.0	2.0	3.0	3.5	4.0	4.25	4.5	4.75	5.0	5.25
Pressure, psi	500	530	560	560	560	560	560	560	560	580
Volume, litres	5.5	5.6	/	5.1						
Pressure, psi	600	610	/	ϕ						



Comments: Time - 5:13 pm

Sheet 7 of 11

Westbay Packer Inflation Record

Project: USGS | Project No.: WB843 | Well No.: USGS 149

Location: INL | Completed by: Mark Lessard | Date Inflated: Sept 26/19

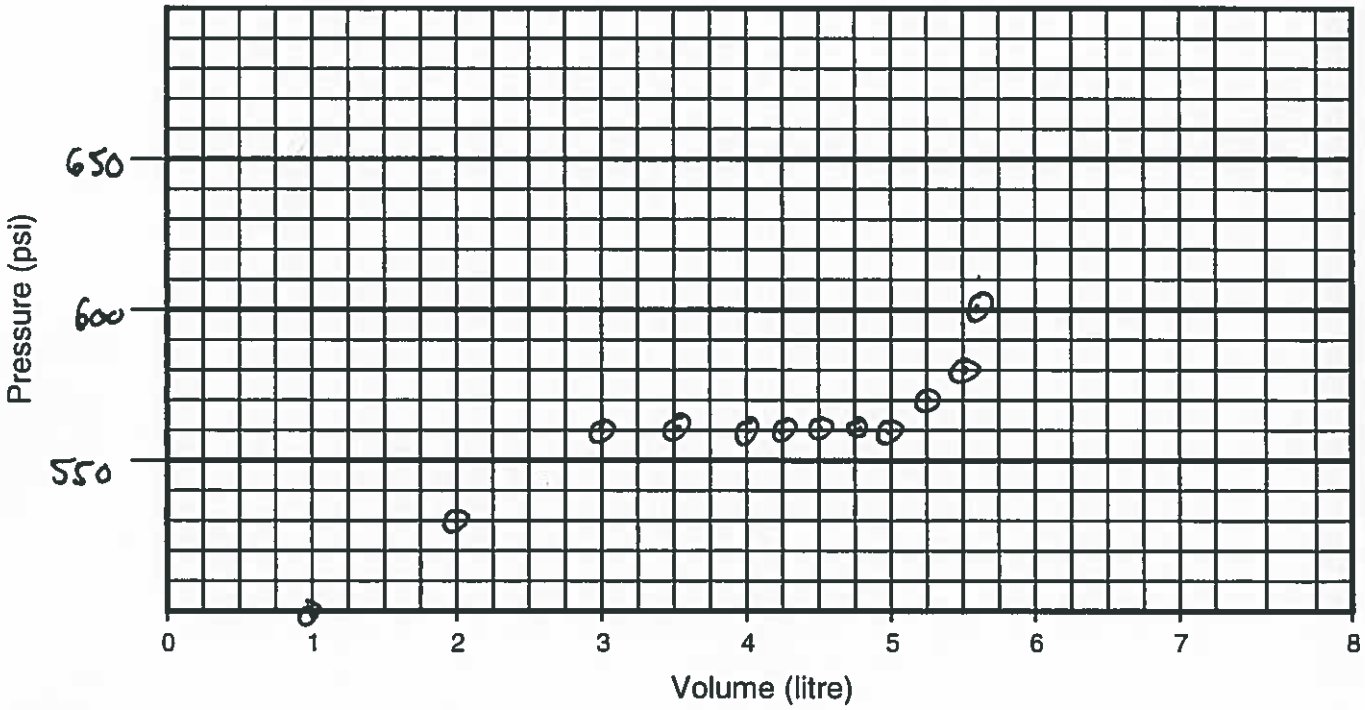
Packer No. 7, comp 29 SN# 189 | Depth (ft): 726.6 | Inflation Tool No.: TIW1085

Packer Valve Pressure, P_V: 140 psi | Final Line Pressure, P_L: 600 psi | Tool Pressure, P_T: 650 psi

Borehole Water Level: 655 (ft) = 285 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = ~~595~~ psi

Volume, litres	1.0	2.0	3.0	3.5	4.0	4.25	4.5	4.75	5.0	5.25
Pressure, psi	500	530	560	560	560	560	560	560	560	570
Volume, litres	5.5	5.6	/	5.25						
Pressure, psi	580	600	/	Ø						



Comments: Time - 9:27 am

Sheet 8 of 11

Westbay Packer Inflation Record

Project: USGS | Project No.: WB843 | Well No.: USGS 149

Location: INL | Completed by: Mark Lessard | Date Inflated: Sept 26/19

Packer No. 8, comp 38 sn# 148 | Depth (ft): 652.4 | Inflation Tool No.: TIW1085

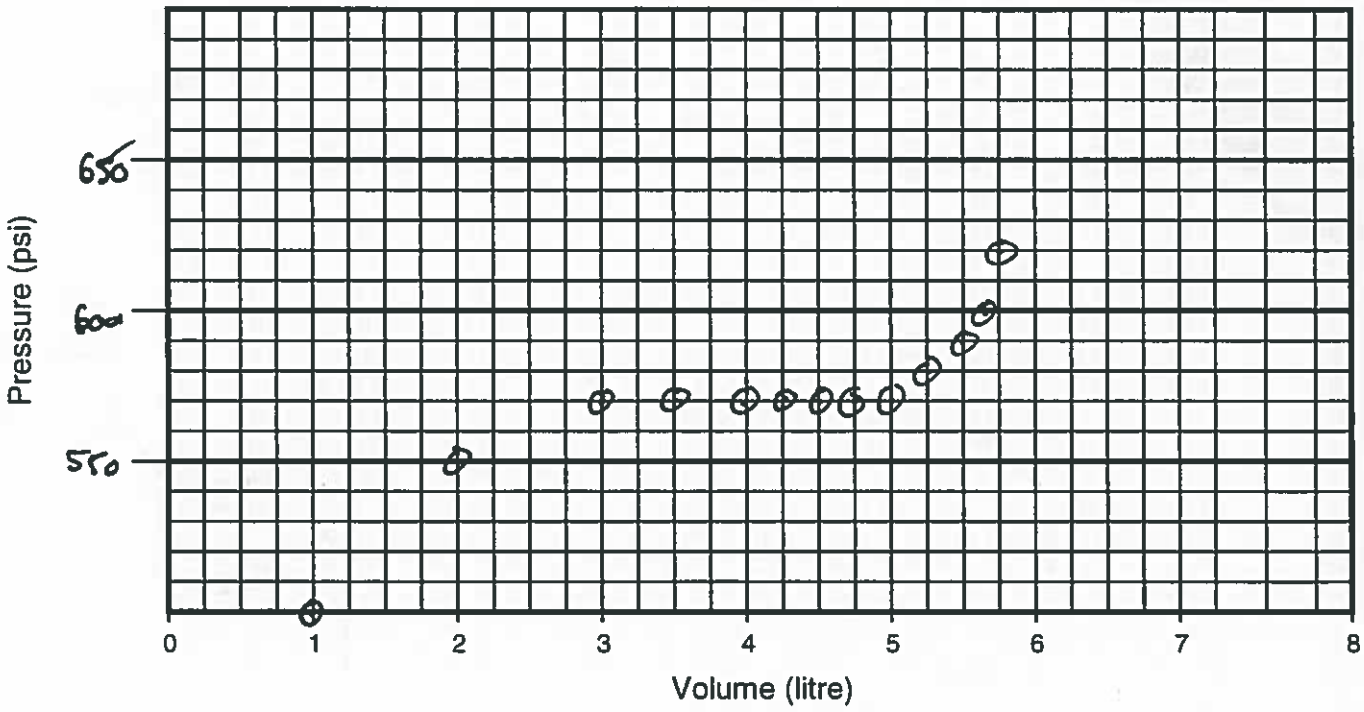
Packer Valve Pressure, P_V: 150 psi | Final Line Pressure, P_L: 620 psi | Tool Pressure, P_T: 650 psi

Borehole Water Level: 655 (ft) = 285 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 105 psi

:90

Volume, litres	1.0	2.0	3.0	3.5	3.75	4.0	4.25	4.5	4.75	5.0
Pressure, psi	500	550	570	570	570	570	570	570	570	570
Volume, litres	5.25	5.5	5.7	5.75	/	5.3				
Pressure, psi	580	590	600	620	/	∅				



Comments: Time - 9:33 am

Westbay Packer Inflation Record

Project: USGS | Project No.: WB843 | Well No.: USGS 149

Location: INL | Completed by: Mark Lessard | Date Inflated: Sept 26/19

Packer No. 9, comp 50 SN# 186 | Depth (ft): 550.6 | Inflation Tool No.: TIW1085

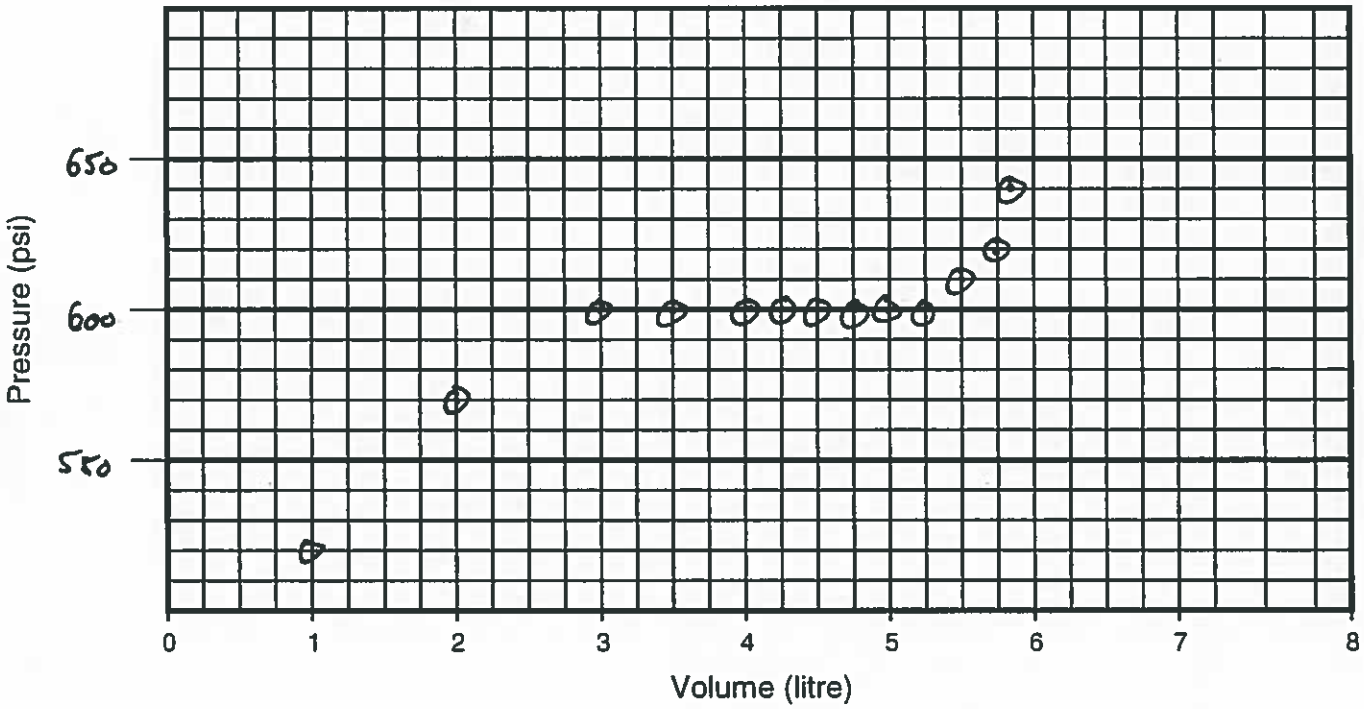
Packer Valve Pressure, P_V: 140 psi | Final Line Pressure, P_L: 640 psi | Tool Pressure, P_T: 650 psi

Borehole Water Level: 655 (ft) = 285 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 90 psi

Packer depth = 550 psi - 240 psi (pw)

Volume, litres	1.0	2.0	3.0	3.5	4.0	4.25	4.5	4.75	5.0	5.25
Pressure, psi	520	570	600	600	600	600	600	600	600	600
Volume, litres	5.5	5.75	5.85	/	5.35					
Pressure, psi	610	620	640	/	0					



Comments: Time - 10:08 am

Sheet 10 of 11

Westbay Packer Inflation Record

Project: USGS | Project No.: WB843 | Well No.: USGS 149

Location: INL | Completed by: Mark Lessard | Date Inflated: Sept-26/19

Packer No. 10, comp 69 SN# 158 | Depth (ft): 368.6 | Inflation Tool No.: TIW1085

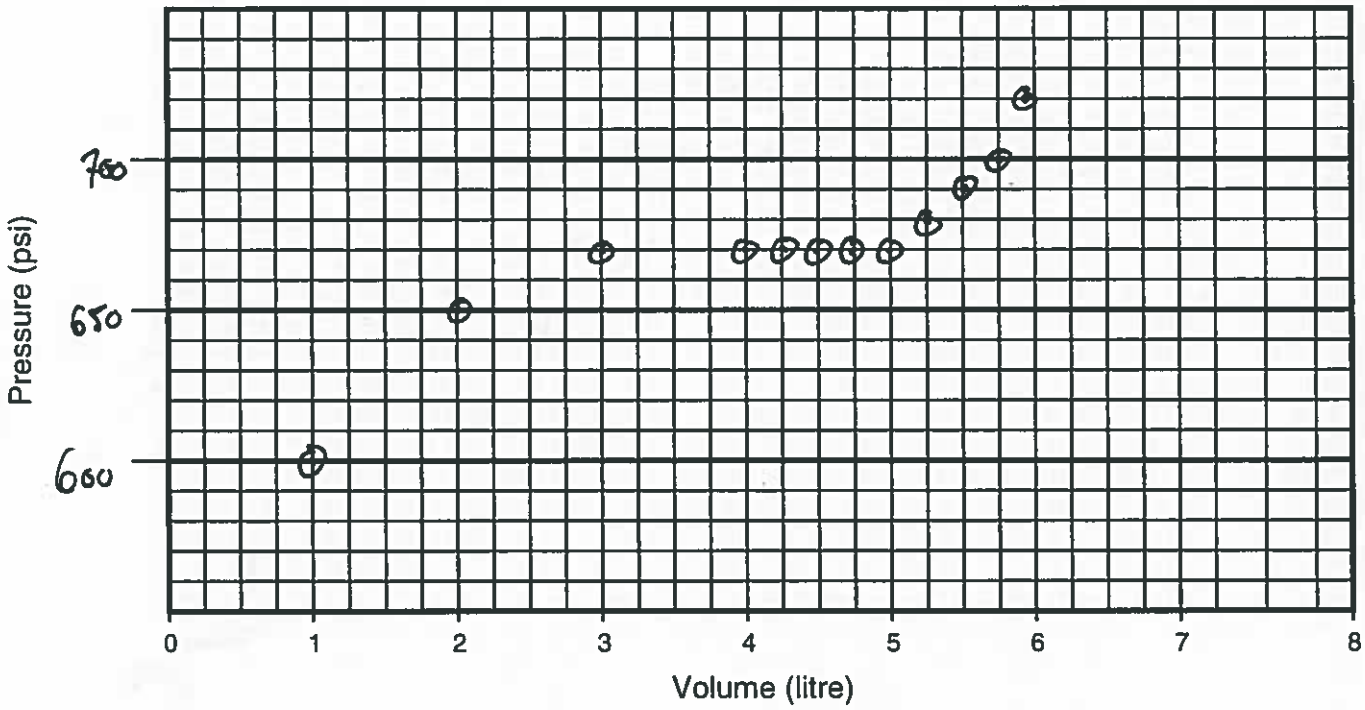
Packer Valve Pressure, P_V: 140 psi | Final Line Pressure, P_L: _____ psi | Tool Pressure, P_T: 650 psi

Borehole Water Level: 655 (ft) = 285 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 90 psi

Packer depth = 369 ft = 160 psi (P_W)

Volume, litres	1.0	2.0	3.0	4.0	4.25	4.5	4.75	5.0	5.25	5.5
Pressure, psi	600	650	670	670	670	670	670	670	680	690
Volume, litres	5.75	5.9	✓	5.3						
Pressure, psi	700	720	✓	Ø						



Comments: Target ~720 psi

Time - 10:46 am

Sheet 11 of 11

Westbay Packer Inflation Record

Project: USGS | Project No.: WB843 | Well No.: USGS 149

Location: INL | Completed by: Mark Lessard | Date Inflated: Sept 26/19

Packer No. 11, comp 92 SN# 159 | Depth (ft): 152.0 | Inflation Tool No.: TIW1085

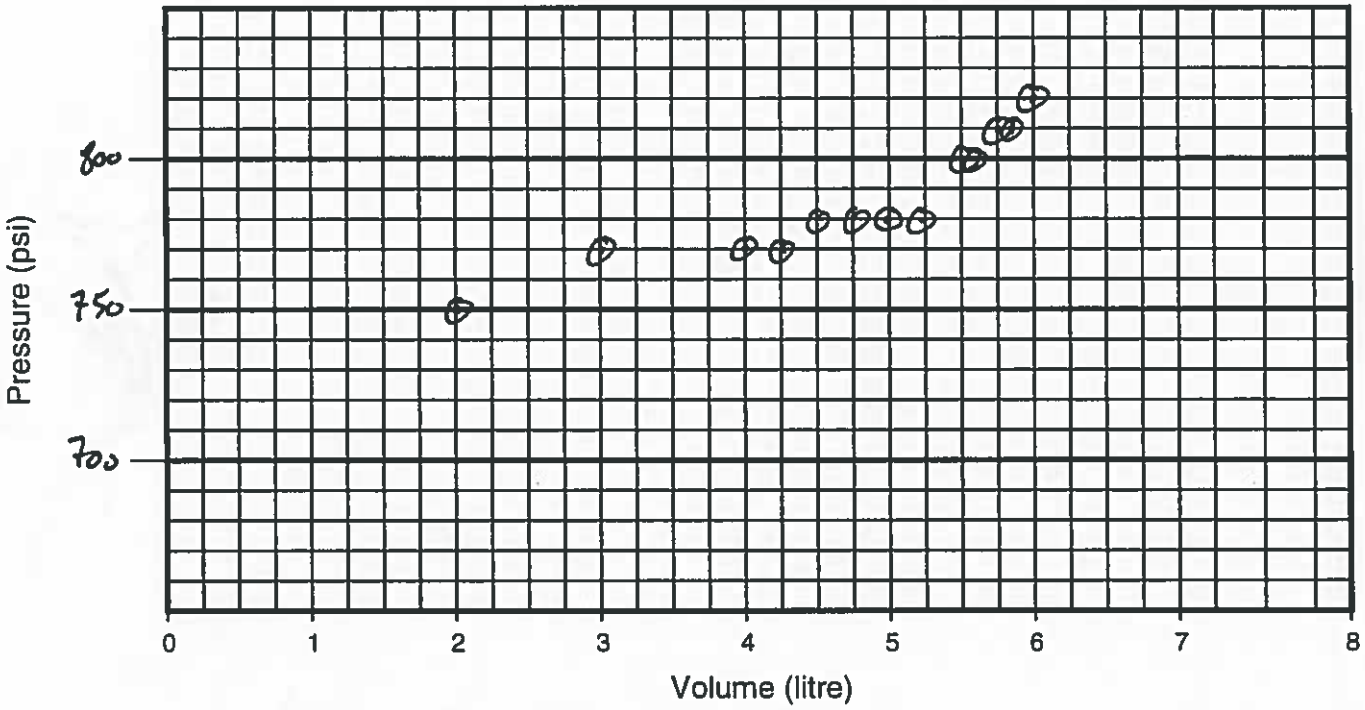
Packer Valve Pressure, P_V: 145 psi | Final Line Pressure, P_L: 820 psi | Tool Pressure, P_T: 650 psi

Borehole Water Level: 655 (ft) = 285 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 90 psi

Packer depth = 152 ft = 665 psi (P_W)

Volume, litres	1.0	2.0	3.0	4.0	4.25	4.5	4.75	5.0	5.25	5.5
Pressure, psi	610	750	770	770	770	780	780	780	780	800
Volume, litres	5.6	5.75	5.85	6.0	/	5.3				
Pressure, psi	800	810	810	820	/	∅				



Comments: In cement surface casing | Time - 11:30 am

Target 820 psi


Westbay
Instruments