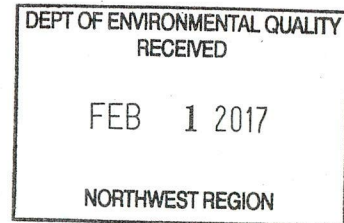


ORIGINAL



January 30, 2017

Mr. Andrew Danhof, Jr., PE
Environmental Manager
Arc Terminals
3000 Research Forest Drive, Suite 250
The Woodlands, Texas 77381

Re: Groundwater and LNAPL Gauging
Portland Terminal
5501 NW Front Avenue
Portland, Oregon 97210
2291-02

Dear Mr. Danhof:

Apex Companies, LLC (Apex) performed gauging activities on December 29, 2016 on behalf of Arc Terminals at the Portland Terminal (Terminal) to document the groundwater elevations and thickness of light non-aqueous phase liquid (LNAPL) in the area of a past naphtha release near Tank T-113. Measurements were made in five monitoring wells (A-4, W-31 to W-34) and eight sumps (S-1 to S-8) associated with the naphtha release. With the exception of upgradient well W-31 and cross-gradient sumps S-1 and S-8, all locations are downgradient of Tank T-113.

METHODOLOGY

An Apex field staff member mobilized to the Terminal on December 29, 2016; field notes are presented in Attachment A. Upon arrival at the field location, the covers were opened on wells A-4 and W-31 to W-34, as well as sumps S1 to S8, which allowed the groundwater level in each well to equilibrate in response to ambient atmospheric pressure (see Figures 1 and 2). An oil/water interface probe was used to measure the depths to LNAPL (where present) and the groundwater surface. These measurements were made to the nearest one-hundredth of a foot (i.e., 0.01 ft). Where only groundwater is present, two separate measurements were made and recorded on the Well Gauging Data Sheet (see Attachment A). If LNAPL was present, three separate measurements were made for the depth to the LNAPL and groundwater surfaces. Each set of values was averaged and the resulting mean value was recorded on Table 1, which presents the historical data from May 2013 to present. Groundwater elevations, LNAPL thickness, and groundwater surface contours are presented in Figure 3.

During the fourth quarter 2016, LNAPL purging events were performed on a regular basis by Terminal staff. LNAPL is removed from wells and sumps associated with the naphtha release. The most recent LNAPL purging was reportedly performed on December 28, 2016, which was the day before the gauging event.

FINDINGS

The groundwater measurements generally indicate a northeasterly flow direction, toward the Willamette River, at a gradient of approximately 0.013 foot per foot (ft/ft). The groundwater flow direction was generally consistent with historical measurements. The groundwater levels in the sumps were approximately 3.87 to 4.69 feet (ft) higher than in September 2016, which reflects increasing rainfall available for infiltration into the subsurface during the previous three months. With the exception of well W-31, the groundwater levels in the wells increased between 3.98 and 4.48 ft compared to the September 2016 measurements. Figure 3 presents groundwater elevations and contours in the area of the gauged wells and sumps. Where LNAPL was present, the groundwater elevation was corrected using

a specific gravity of 0.80 as a general value for petroleum LNAPL (see Table 1). The corrected groundwater elevation values are presented on Figure 3 and are used for contouring. However, LNAPL was only detected and measured in well W-31, which was not fully recovered from the purging event and, consequently, not deemed to have a stabilized gauging measurement for groundwater contouring.

The LNAPL thickness values were less than 0.10 ft as required by the Oregon Department of Environmental Quality to support site closure. LNAPL was absent from wells and sumps downgradient of the naphtha release area. Only upgradient well W-31 had measurable LNAPL (0.02 ft).

The next scheduled gauging event will be conducted in March 2017.

If there are any questions regarding the information in this report, or if I can be of further assistance, please contact me at (503) 924-4704.

Sincerely,



EXPIRES 5/31/2017

Gary Walvatne, R.G.
Senior Associate Geologist

ATTACHMENTS

Table 1 – Well Gauging

Figure 1 – Site Location Map

Figure 2 – Site Vicinity Plan

Figure 3 – Groundwater Elevations

Attachment A – Well Gauging Data Sheet

Table 1
Groundwater and LNAPL Gauging
Arc Terminals
5501 NW Front Avenue
Portland, Oregon

Sump or Monitoring Well No.	Sample Date	Casing Elevation (feet msl) ¹	Depth to Water (feet) ²	Depth to LNAPL (feet) ²	LNAPL Thickness in Well (feet)	Groundwater Elevation (feet msl)	Corrected Groundwater Elevation ³ (feet msl)
A-4	5/20/2013	37.25	8.12	--	0.01	29.13	29.13
	10/14/2013		7.48	--		29.77	29.77
	2/3/2014		8.49	--		28.76	28.76
	5/16/2014		6.31	--		30.94	30.94
	9/29/2015		10.39	--		26.86	26.86
	12/15/2015		4.80	--		32.45	32.45
	3/16/2016		3.65	--		33.60	33.60
	6/29/2016		8.24	--		29.01	29.02
	9/28/2016		10.10	--		27.15	27.15
W-31	12/29/2016	37.08	5.62	--	0.02	31.63	31.63
	12/15/2015		5.69	5.41	0.28	31.39	31.61
	3/16/2016		3.55	3.46	0.09	33.53	33.60
	6/29/2016		12.69	12.40	0.29	24.39	24.62
	9/28/2016-Note 8		12.95	12.46	0.49	24.13	NM
W-32	12/29/2016	34.56	5.26	5.24	0.02	31.82	31.84
	5/20/2013		5.34	--		29.22	29.22
	10/14/2013		5.03	--		29.53	29.53
	2/3/2014		5.78	--		28.78	28.78
	5/16/2014		3.66	--		30.90	30.90
	9/29/2015		7.81	--		26.75	26.75
	12/15/2015		3.43	--		31.13	31.13
	3/16/2016		2.32	--		32.24	32.24
	6/29/2016		5.45	--		29.11	29.11
W-33	9/28/2016	34.66	7.28	--		27.28	27.28
	12/29/2016		3.30	--		31.26	31.26
	5/20/2013		5.69	--		28.97	28.97
	10/14/2013		5.24	--		29.42	29.42
	2/3/2014		6.12	--		28.54	28.54
	5/16/2014		4.07	--		30.59	30.59
	9/29/2015		7.58	--		27.08	27.08
	12/15/2015		3.07	--		31.59	31.59
	3/16/2016		2.03	--		32.63	32.63
W-34	6/29/2016	34.13	5.82	--		28.84	28.84
	9/28/2016		7.50	--		27.16	27.16
	12/29/2016		3.49	--		31.17	31.17
	5/20/2013		4.88	--		29.25	29.25
	10/14/2013		4.32	--		29.81	29.81
	2/3/2014		5.26	--		28.87	28.87
	5/16/2014		3.32	--		30.81	30.81
	9/29/2015		7.34	--		26.79	26.79
	12/15/2015		1.56	--		32.57	32.57
S-1	3/16/2016	36.25	0.70	--		33.43	33.43
	6/29/2016		5.01	--		29.12	29.12
	9/28/2016		6.76	--		27.37	27.37
	12/29/2016		2.55	--		31.58	31.58
	5/20/2013		6.10	6.05	0.05	30.15	30.19
	10/14/2013		5.38	--	0.03	30.87	30.87
	2/3/2014		6.17	--		30.08	30.08
	5/16/2014		4.08	--		32.17	32.17
	9/29/2015		9.03	9.00	0.03	27.22	27.24
S-2	12/15/2015	35.87	4.10	4.10	0.00	32.15	32.15
	3/16/2016		2.42	--	0.08	33.83	33.83
	6/29/2016		6.00	--		30.25	30.25
	9/28/2016		8.56	8.48		27.69	27.75
	12/29/2016		3.81	--		32.44	32.44
	5/20/2013		5.88	--	0.02	29.99	29.99
	10/14/2013		5.67	--		30.20	30.20
	2/3/2014		6.23	--		29.64	29.64
	5/16/2014		4.18	--		31.69	31.69
	9/29/2015		8.23	8.21		27.64	27.66
S-2	12/15/2015		4.07	--	0.01	31.80	31.80
	3/16/2016		2.40	--		33.47	33.47
	6/29/2016		5.90	--		29.97	29.97
	9/28/2016		7.83	7.82		28.04	28.05
	12/29/2016		3.95	--		31.92	31.92

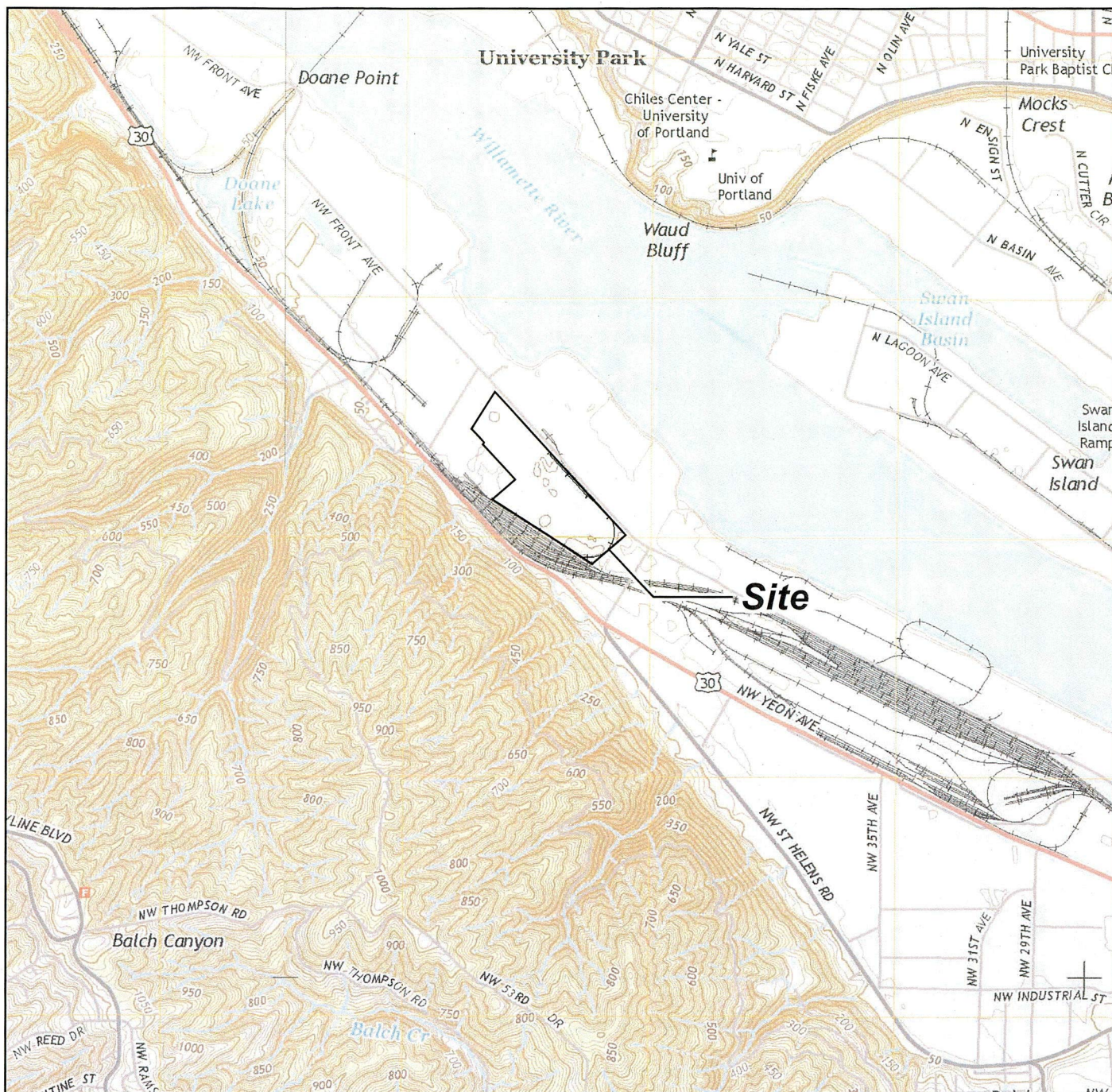
Please see notes at end of table.

Table 1
Groundwater and LNAPL Gauging
Arc Terminals
5501 NW Front Avenue
Portland, Oregon

Sump or Monitoring Well No.	Sample Date	Casing Elevation (feet msl) ¹	Depth to Water (feet) ²	Depth to LNAPL (feet) ²	LNAPL Thickness in Well (feet)	Groundwater Elevation (feet msl)	Corrected Groundwater Elevation ³ (feet msl)
S-3	5/20/2013	35.73	5.83	5.83	0.00	29.90	29.90
	10/14/2013		5.55	5.54	0.01	30.18	30.19
	2/3/2014		6.19	6.19	0.00	29.54	29.54
	5/16/2014		4.05	4.03	0.02	31.68	31.70
	9/29/2015		8.28	8.25	0.03	27.45	27.47
	12/15/2015		3.84	--		31.89	31.89
	3/16/2016		2.21			33.52	33.52
	6/29/2016		5.89	5.87	0.02	29.84	29.86
	9/28/2016		7.80	7.79	0.01	27.93	27.94
	12/29/2016		3.76	--		31.97	31.97
S-4	5/20/2013	35.80	6.45	--		29.35	29.35
	10/14/2013		5.92	--		29.88	29.88
	2/3/2014		6.81			28.99	28.99
	5/16/2014		4.53	4.53	0.00	31.27	31.27
	9/29/2015		8.43	8.42	0.01	27.37	27.38
	12/15/2015		4.00	4.00	0.00	31.80	31.80
	3/16/2016		2.37	Trace		33.43	33.43
	6/29/2016		6.51	6.48	0.03	29.29	29.31
	9/28/2016		8.40	8.39	0.01	27.40	27.41
	12/29/2016		4.12	--		31.68	31.68
S-5	5/20/2013	35.63	6.54	6.54	0.00	29.09	29.09
	10/14/2013		5.92	--		29.71	29.71
	2/3/2014		6.92			28.71	28.71
	5/16/2014		4.52	--		31.11	31.11
	9/29/2015		8.91	8.87	0.04	26.72	26.75
	12/15/2015		3.60	--		32.03	32.03
	3/16/2016		2.16	--		33.47	33.47
	6/29/2016		6.55	6.52	0.03	29.08	29.10
	9/28/2016		8.47	8.40	0.07	27.16	27.22
	12/29/2016		3.99	--		31.64	31.64
S-6	5/20/2013	35.30	6.35	6.34	0.01	28.95	28.96
	10/14/2013		5.99	5.98	0.01	29.31	29.32
	2/3/2014		6.71	6.70	0.01	28.59	28.60
	5/16/2014		4.32	--		30.98	30.98
	9/29/2015		8.76	8.73	0.03	26.54	26.56
	12/15/2015		3.09	--		32.21	32.21
	3/16/2016		1.78	--		33.52	33.52
	6/29/2016		6.35	--		28.95	28.95
	9/28/2016		8.35	8.17	0.18	26.95	27.09
	12/29/2016		3.65	--		31.65	31.65
S-7	5/20/2013	36.23	7.25	7.19	0.06	28.98	29.03
	10/14/2013		6.43	6.42	0.01	29.80	29.81
	2/3/2014		7.46	7.42	0.04	28.77	28.80
	5/16/2014		5.14	5.14	0.00	31.09	31.09
	9/29/2015		9.35	9.27	0.08	26.88	26.94
	12/15/2015		3.95	--		32.28	32.28
	3/16/2016		2.66	--		33.57	33.57
	6/29/2016		7.18	--		29.05	29.05
	9/28/2016		9.01	8.94	0.07	27.22	27.28
	12/29/2016		4.55	--		31.68	31.68
S-8	5/20/2013	36.88	6.28	6.27	0.01	30.60	30.61
	10/14/2013		6.48	6.47	0.01	30.40	30.41
	2/3/2014		6.83	6.82	0.01	30.05	30.06
	5/16/2014		4.76	4.63	0.13	32.12	32.22
	9/29/2015		9.80	9.74	0.06	27.08	27.13
	12/15/2015		6.87	--		30.01	30.01
	3/16/2016		3.00	--		33.88	33.88
	6/29/2016		6.39	6.31	0.08	30.49	30.55
	9/28/2016		9.29	9.01	0.28	27.59	27.81
	12/29/2016		4.52	--		32.36	32.36

Notes:

1. "Depth to Water" and "Depth to LNAPL" are measured from a surveyed reference elevation at the top of the sump or well casing.
2. Where LNAPL was present, a groundwater elevation correction was calculated using a specific gravity of 0.80 for the LNAPL.
3. feet bgs = feet below ground surface.
4. msl = mean sea level
5. LNAPL = light non-aqueous phase liquid
6. NM = not measured.
7. -- = Not applicable, or no measurable LNAPL present.
8. No groundwater indicated during gauging to total depth (TD) of W-31. "Depth to Groundwater" is well TD. Consequently, there is no corrected groundwater elevation.



Note: Base map prepared from USGS 7.5-minute quadrangles of Linnton and Portland, OR, dated 2014 as provided by USGS.gov.

0 2,000 4,000
Approximate Scale in Feet



Site Location Map

Groundwater and LNAPL Gauging
Arc Terminals - 5501 NW Front Avenue
Portland, Oregon



Apex Companies, LLC
3015 SW First Avenue
Portland, Oregon 97201

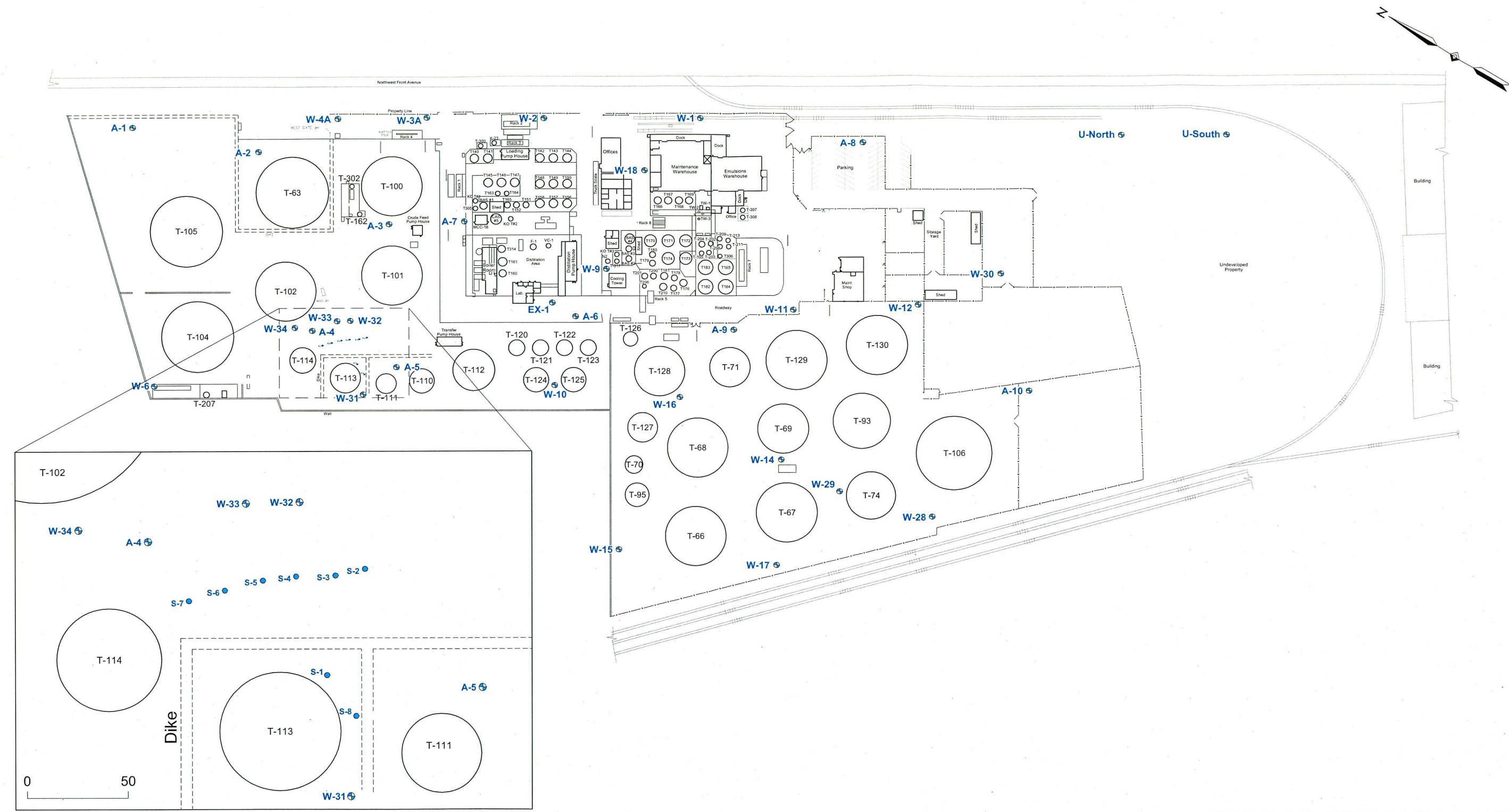
Project Number

2291-02

January 2017

Figure

I

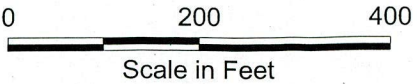


Legend:

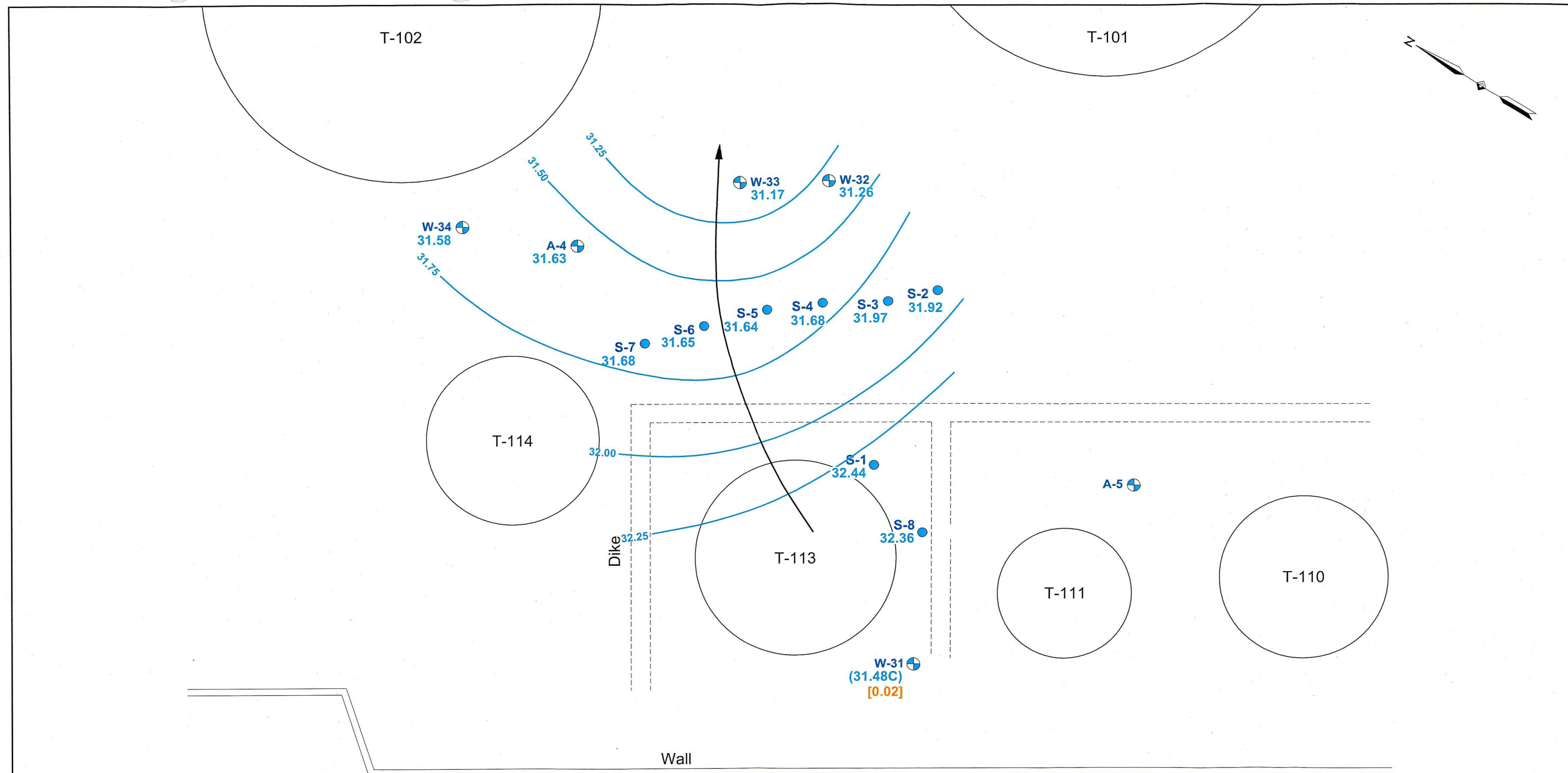
W-15 Monitoring Well Location

S-3 Sump Location

Base map prepared from a Paramount Petroleum, Inc. Site Plan L-WBA-0200 (6/5/2006).

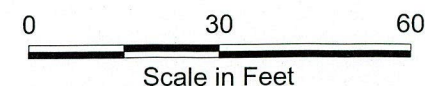


Site Vicinity Plan Groundwater and LNAPL Gauging Arc Terminals - 5501 NW Front Avenue Portland, Oregon			
 Apex Companies, LLC 3015 SW First Avenue Portland, Oregon 97201	Project Number	2291-02	Figure 2
	January 2017		



Legend:

- S-3 ● Sump Location
- W-34 ⊕ Monitoring Well Location
- 31.58 Groundwater Elevation in Feet Above Mean Sea Level (MSL)
- C Corrected Groundwater Elevation
(Groundwater Elevation at this Location
was Corrected for LNAPL Thickness)
- 31.25 — Groundwater Elevation Contour in Feet MSL
- (31.84) Elevation Not Used for Contouring
- [0.02] Light Non-Aqueous Phase Liquid (LNAPL) Thickness in Feet
- Inferred Groundwater Flow Direction



Groundwater Elevations (December 29, 2016)

Groundwater and LNAPL Gauging
Arc Terminals - 5501 NW Front Avenue
Portland, Oregon

APEX Apex Companies, LLC
3015 SW First Avenue
Portland, Oregon 97201

Project Number **2291-02**
January 2017

Figure
3

Attachment A

Well Gauging Data Sheet



3015 SW First Avenue
Portland, Oregon 97201-4707
(503) 924-4704 Phone
(503) 943-6357 Fax

PROJECT NUMBER 2291-02
FIELD REPORT NUMBER _____
PAGE 1 OF 1
DATE 12/29/16

PROJECT	<u>Storm water / LNAPL</u>	ARRIVAL TIME	<u>0930</u>
LOCATION	<u>Portland OR</u>	DEPARTURE TIME	<u>1130</u>
CLIENT	<u>Arc Terminals</u>	WEATHER	<u>Sun</u>
PURPOSE OF OBSERVATIONS	<u>Sample stormwater, gauge</u>		
APEX REPRESENTATIVE	<u>Kyle Kline</u>	APEX PROJECT MANAGER	<u>Gary Walvetne</u>
CONTRACTOR	_____	PERMIT NO.	_____
CONTRACTOR REP.	_____	H&S REVIEW	<u>yes</u>

Our firm's professionals are represented on site solely to observe operations of the contractor identified, to form opinions about the adequacy of those operations, and to report those opinions to our client. The presence and activities of our field representative do not relieve any contractor from its obligation to meet contractual requirements. The contractor retains sole responsibility for site safety and the methods, operations, and sequence of construction. Unless signed by the Ash Creek Associates Project Manager, this report is preliminary. A preliminary report is provided solely as evidence that field observation was performed. Observations and/or conclusions and/or recommendations conveyed in the final report may vary from and shall take precedence over those included in a preliminary report.

0930 - on site, sign in, wait for Ty.
0945 - start at SWV 33 pH = 7.34 sample @ 0950
1005 - move to SWV 39 pH = 7.40 sample @ 1010
1020 - move over to wells to start gauging. pop all caps first
1030 - start gauging wells
1100 - Finish gauging wells. 13 wells gauged.
1130 - sign out, off site

BY

Kyle Kline
APEX REPRESENTATIVE

REVIEWED BY

APEX PROJECT MANAGER

Client:

Are Terminals

Job Number:

2791-02

Project:

L N A P L G a u s s i n

Date:

12/29/16

Weather:

Sum

Sampler:

LK

Time In/Out:

[illegible]