Monitoring Well Installation and Data Summary Report
Lower Yakima Valley
Yakima County, Washington

March 2013

Prepared by:

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TABLE OF CONTENTS

1. Introduction 1
2. Investigation Objectives 1
3. Environmental Setting 1
4. Summary of Field Activities 2
   A. Drilling and Monitoring Well Installation 2
   B. Groundwater Elevations and Flow Direction 4
   C. Sample Collection and Analysis 4
5. Analytical Results 5
6. Quality Assurance and Quality Control 7
7. Summary and Conclusions 7
8. References 8

List of Tables

Table 1 – Monitoring Well Locations and Elevations

Table 2 - Monitoring Well Water Level Elevations

Table 3 – Analytical Methods, Sample Containers, Holding Times and Preservation

Table 4 – Analytical Results

Table 5 – Field Quality Control Sample Laboratory Analytical Results

List of Figures

Figure 1 – Vicinity Map

Figure 2 – Dairy Cluster Well Locations

Figure 3 – Haak Dairy Well Locations

Figure 4 – Dairy Cluster Groundwater Elevations, Flow Direction and Nitrate Concentrations

Figure 5 – Haak Dairy Groundwater Elevations, Flow Direction and Nitrate Concentrations

Appendices

Appendix A – Well Logs

Appendix B – Groundwater Sampling Logs

Appendix C – Sample Alteration Forms

Appendix D – Data Validation Memoranda

1. INTRODUCTION

In February and April 2010, EPA conducted a study to identify potential sources of nitrate contamination in groundwater and residential drinking water wells in the Lower Yakima Valley in central Washington State. The study was in response to community concerns about the high nitrate levels in residential drinking water wells and the potential disproportionate impacts on low income and minority rural populations in the area. U.S. Environmental Protection Agency (EPA) released a report on this study in September 2012, entitled "Relation Between Nitrate in Water Wells and Potential Sources in the Lower Yakima Valley" (EPA 2012a).

In the 2010 study, EPA collected samples from existing residential drinking water and dairy supply wells. Information on well depths and screened intervals were known for about one-third of the wells that were sampled. Designation of upgradient and downgradient wells was based on regional groundwater flow data from the United States Geological Survey (USGS 2009).

As a follow-up to the 2010 study, EPA installed and sampled ten groundwater monitoring wells in the vicinity of the Yakima Valley dairies that were included in the 2010 study. These dairies consist of a group of adjacent dairies, including the George DeRuyter & Son Dairy, D and A Dairy, Cow Palace, Liberty Dairy and Bosma Dairy, referred to collectively as the Dairy Cluster, and the Haak Dairy. The primary sources of nitrogen at these dairies include application fields, manure lagoons, manure piles, silage, and cow pens. This report presents a summary of monitoring well installation, groundwater sampling and analytical results for this most recent field investigation which was conducted in December 2012 and January 2013.

2. INVESTIGATION OBJECTIVES

The objectives of the December 2012 and January 2013 monitoring well installation and sampling were to:

- Confirm the direction of groundwater flow in the shallow drinking water aquifer in the vicinity of the dairies;
- Complement the understanding of the nitrate concentrations in the drinking water aquifer upgradient and downgradient of the dairies with monitoring wells of documented construction; and
- Determine if there is a shallow, perched aquifer above the drinking water aquifer in the vicinity of the dairies.

3. ENVIRONMENTAL SETTING

The Yakima Basin (Figure 1) is bounded by basalt ridgelines to the north and south, and the Cascade Mountains to the west. The Yakima Basin is a watershed of great diversity in climate,

vegetation, and land use. More than 30 percent of the Yakima Basin is forested, about 30 percent is shrub-steppe rangeland, and about 28 percent is in agricultural production (USGS 2009). The Yakima River flows from its headwaters near the crest of the Cascade Mountains to its mouth where it joins the Columbia River, 160 miles to the east. Precipitation is less than nine inches annually and irrigation plays a key role in the viability of agriculture. A series of high mountain reservoirs captures snowmelt, which is released through the Yakima River into a complex set of irrigation diversions and canals throughout the basin.

The hydrological setting in the vicinity of the monitoring wells consists of fine- and coarse-grained sediments overlying a sequence of three major basalt flows. The structural setting is created by bounding ridges such as the Rattlesnake Mountains, Ahtanum Ridge, Toppenish Ridge, and Horse Heaven Hills. The uppermost basalts of the Saddle Mountain Unit of the Columbia River Basalt Group are typically exposed in these upland ridges. This unit averages more than 500 feet thick. The underlying Wanapum Unit averages 600 feet thick. These units are separated by the Mabton Interbed, with an average thickness of 70 feet.

There are two main aquifer types underlying the area. They include a surficial unconfined to semi-confined alluvial aquifer and an extensive basalt aquifer of great thickness underlying the sedimentary deposits. The basalt aquifer is believed to be semi-isolated from the surficial aquifer and stream systems. Groundwater flow within the surficial aquifer generally follows topography, with natural recharge occurring within the headlands and on the sides of the valley and discharge occurring to the Yakima River. Flow within the uppermost portions of the underlying basaltic aquifer also generally follows this pattern. A detailed description of the hydrogeology of the Yakima River Basin Aquifer System is presented in the USGS publication "Hydrogeologic Framework of the Yakima River Basin Aquifer System, Washington" (USGS 2009).

4. SUMMARY OF FIELD ACTIVITIES

Monitoring well drilling, installation, surveying, sampling procedures and analytical methods are described in the Lower Yakima Valley Dairy Investigation Quality Assurance Project Plan (QAPP) (EPA 2012b) and summarized below.

A. Drilling and Monitoring Well Installation

The investigation described in the QAPP included drilling approximately thirteen boreholes and installing monitoring wells in the alluvial drinking water aquifer and in the perched aquifer if encountered at those locations. The QAPP indicated that more or fewer wells would be drilled depending on access, field conditions and drilling progress within the field investigation schedule. Of the thirteen potential well locations identified in the QAPP, EPA installed ten monitoring wells. One upgradient and six downgradient wells were installed near the Dairy Cluster and one upgradient and two downgradient wells were installed near the Haak Dairy (Figures 2 and 3). No

perched aquifer was encountered during drilling; therefore, only one well was completed at each location.

Boreholes were advanced using an air-rotary casing hammer drill rig until groundwater was encountered. Monitoring wells were constructed using 2-inch diameter schedule 40 polyvinyl chloride (PVC) casing. The majority of wells were screened with one 20-foot section of 2 inch 0.0100 continuous slot PVC screen. Wells HK-11 and HK-12 were screened with 10-foot instead of 20-foot long screens to attempt to reduce the turbidity in these wells. The monitoring wells were completed to ground surface with a schedule 40 PVC riser. Wells were developed according to the procedures identified in Appendix A of the QAPP. Drill cuttings were spread on the ground surface adjacent to each monitoring well. Well development water was discharged to the Zillah Wastewater Treatment Plant after receipt and review of development water sample results.

Soils encountered during drilling were primarily sand mixed with small amounts of gravels of different sizes, silts or clay. No low-permeability layers that would inhibit infiltration through the alluvium were encountered during drilling. In monitoring well DC-01, basalt was encountered at approximately 155 feet below ground surface. This well was completed at the alluvium/basalt interface. Boring logs are included in Appendix A.

Monitor well locations and top of casing elevations were surveyed by a Washington licensed professional land surveyor. This information is summarized in Table 1.

Table 1 - Monitoring Well Locations and Elevations

Well No.	Northing	Easting	Top of Casing Elevation (feet aMSL)
DC-01	396035.927	1731673.203	1199.56
DC-03	384172.901	1729718.927	911.09
DC-04	382789.225	1733514.588	877.82
DC-05	382770.202	1736263.732	912.51
DC-07	385390.146	1730842.184	889.91
DC-09	390744.768	1736012.372	1049.10
DC-14	390726.492	1731319.001	1037.13
HK-10	382948.949	1766885.828	1053.99
HK-11	380157.444	1766995.687	978.47
HK-12	380186.496	1768204.215	998.65

Datum
Horizontal – NAD 83 (2011) SPC WA S
Vertical – NAVD 88

Abbreviations
DC – Dairy Cluster
HK – Haak Dairy
aMSL – above mean sea level

B. Groundwater Elevations and Flow Direction

EPA measured water level elevations in the new monitoring wells prior to sampling to determine the groundwater flow direction. Water level elevations are summarized in Table 2 and the groundwater gradients near the Dairy Cluster and the Haak Dairy are illustrated in Figures 4 and 5, respectively.

Table 2 - Monitoring Well Water Level Elevations

Well No.	Well Coordinates		Top of Casing Elevation (feet aMSL)	Depth to Water (feet)	Water Level Elevation (feet aMSL)	Date of Measurement
	Northing	Easting				
DC-01	396035.927	1731673.203	1199.56	150.50	1049.06	1/4/2013
DC-03	384172.901	1729718.927	911.09	72.40	838.69	1/2/2013
DC-04	382789.225	1733514.588	877.82	32.68	845.14	1/3/2013
DC-05	382770.202	1736263.732	912.51	68.31	844.20	1/4/2013
DC-07	385390.146	1730842.184	889.91	44.11	845.80	1/3/2013
DC-09	390744.768	1736012.372	1049.10	144.13	904.97	1/3/2013
DC-14	390726.492	1731319.001	1037.13	130.61	906.52	1/3/2013
HK-10	382948.949	1766885.828	1053.99	48.66	1005.33	1/4/2013
HK-11	380157.444	1766995.687	978.47	12.55	965.92	1/4/2013
HK-12	380186.496	1768204.215	998.65	25.70	972.95	1/3/2013

Datum
Horizontal – NAD 83 (2011) SPC WA S
Vertical – NAVD 88

Abbreviations
DC – Dairy Cluster
HK – Haak Dairy
aMSL – above mean sea level

C. Sample Collection and Analysis

Monitoring well sampling was conducted from January 2 through January 4, 2013. Samples were collected from each of the new wells using the low flow sampling technique described in the standard operating procedure (SOP) included in the QAPP (EPA 2012b). Low flow sampling included monitoring water quality parameters (i.e., dissolved oxygen, turbidity, pH and temperature) prior to sample collection (Appendix B).

Samples from each well were field screened for nitrate and ammonia using Hach test strips. A sample was collected from each new well and submitted to TestAmerica Laboratories, Inc. located in Denver, Colorado for nitrate analysis using EPA Method 300.0. TestAmerica is a National Environmental Laboratory Accreditation Program certified drinking water laboratory for nitrate analysis. If the Hach test strip indicated ammonia could be present, an additional sample was collected and analyzed for ammonia by EPA's Manchester Environmental Laboratory using EPA

Method 350.1. In addition, the following field quality control (QC) samples were collected: two trip blanks, two equipment blanks, two field blanks, and two field duplicates were collected. The field QC samples were analyzed for nitrate in accordance with EPA Method 300.0 by TestAmerica Laboratories, Inc. or ammonia in accordance with EPA Method 350.1, as appropriate.

Analytical methods, sample containers, holding times and sample preservation requirements are summarized in Table 3.

Table 3
Analytical Methods, Sample Containers, Holding Times and Preservation

Analyte	Analytical Method	Reporting Limit or Range (mg/L)	Container Type	Holding time	Preservation
Nitrate	EPA 300.0	0.9	500ml polyethylene	48 hours	< 6 deg. C
Ammonia	EPA 350.1	0.5	500ml polyethylene	28 Days	H_2SO_4 to pH < 2, < 6 deg. C
Ammonia	Hach Ammonia Test Strip	0-6.0	N/A	N/A	N/A
Nitrate	Hach Nitrate Test Strip	0-50	N/A	N/A	N/A

5. ANALYTICAL RESULTS

The field test strip and analytical sample results are presented in Table 4. The Hach nitrate field test strips are a colorimetric test that measures nitrate concentrations in increments of 0, 1, 2, 5, 10, 20, and 50. The Hach ammonia field test strips indicated that ammonia could be present in three wells; however the laboratory did not detect ammonia in any of the samples. A summary of the results for the field QC samples is presented in Table 5. Groundwater nitrate concentrations for the Dairy Cluster and the Haak Dairy wells are shown on Figures 4 and 5, respectively.

Table 4
Analytical Sample Results

Well No.	EPA Sample ID	Well Location	Hach Test Strip		Laboratory Results	
			Nitrate (mg/L)	Ammonia (mg/L)	Nitrate as N (mg/L)	Ammonia (mg/L)
DC-01	12534005	Upgradient	5-10	0	9.8	Not Analyzed
DC-03	12534000	Downgradient	20-50	0.25	190	0.10 U
DC-04	12534003	Downgradient	20	0	26	Not Analyzed
DC-05	12534009	Downgradient	20	0	32	Not Analyzed
DC-07	12534002	Downgradient	<1	0	2.8	Not Analyzed
DC-09	12534004	Downgradient	5	0.25-0.5	6.0	0.10 U
DC-14	12534001	Downgradient	20	0	26	Not Analyzed
HK-10	12534006	Upgradient	0	0	0.94	Not Analyzed
HK-11	12534007	Downgradient	30	0	31	Not Analyzed
HK-12	12534008	Downgradient	20	0.25	47	0.10 U

Abbreviations

DC - Dairy Cluster

HK - Haak Dairy

mg/L - milligrams per Liter

U -The material was analyzed for but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

Table 5
Field Quality Control Sample Laboratory Analytical Results

Sample ID	EPA Sample ID	QC Type	Nitrate as N (mg/L)	Ammonia (mg/L)
TB01WT	12534012	Trip Blank	0.5 U	Not Analyzed
TB02WT	12534013	Trip Blank	0.5 U	Not Analyzed
EB01WT	12534020	Equipment Blank	0.043 J	0.10 U
EB02WT	12534021	Equipment Blank	0.5 U	Not Analyzed
FB01WT	12534024	Field Blank	0.5 U	0.10 U
FB02WT	12534025	Field Blank	0.5 U	Not Analyzed
FD01WT	12534016	Field Duplicate of Sample 12534002	2.7	Not Analyzed
FD02WT	12534017	Field Duplicate of Sample 12534004	6.0	0.10 U

Abbreviations

mg/L - milligrams per Liter

J - The associated value is an estimated quantity.

U -The material was analyzed for but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

6. QUALITY ASSURANCE AND QUALITY CONTROL

This investigation was implemented following the procedures described in the approved QAPP (EPA 2012b). There were six documented deviations from the approved QAPP based on conditions encountered in the field. An explanation of these deviations and the completed and signed sample alteration forms are included in Appendix C.

A stage 4 data validation was performed by the EPA Region 10 Quality Assurance team for all the data generated by the TestAmerica laboratory. The ammonia analyses conducted at the EPA Manchester Environmental Laboratory were reviewed and verified in accordance with the Laboratory Quality Manual and method SOPs. The quality assurance memoranda for the nitrate and ammonia analyses are included in Appendix D. All of the chemical analyses met project data quality goals and criteria and are useable for all purposes.

7. SUMMARY AND CONCLUSIONS

The groundwater flow direction in the vicinity of the dairies based on the water level measurements in the new wells is towards the Yakima River which is consistent with the regional groundwater flow direction developed by the USGS and presented in EPA's September 2012 report. No shallow, perched aquifer was encountered during drilling.

At the Dairy Cluster, the nitrate concentration in the upgradient well was 9.8 mg/L which is elevated above the range of naturally occurring nitrate concentrations (generally below 1.1 mg/L), but below EPA's drinking water standard[1] for nitrate of 10 milligrams per liter (mg/L) or parts per million (ppm). This indicates that there are potential anthropogenic sources of nitrate upgradient of this well. The nitrate concentrations in the wells downgradient of the Dairy Cluster ranged from 2.8 mg/L to 190 mg/L, with four of six downgradient monitoring wells exceeding EPA's drinking water standard.

At the Haak Dairy, the nitrate concentration in the upgradient well was 0.94 mg/L and the concentrations in the two downgradient wells were 31 mg/L and 47 mg/L.

The conclusions in the September 2012 report indicated that the dairies in the study are a likely source[2] of nitrate contamination in residential drinking water wells downgradient of the dairies. The new data demonstrate that the dairies are a source of nitrate contamination to the groundwater beneath and downgradient of these dairies, thereby reinforcing the conclusions in the September 2012 report.

[1] EPA's drinking water standard for nitrate is also referred to as the Maximum Contaminant Level (MCL).
[2] The primary sources of nitrogen at the dairies include application fields, manure lagoons, manure piles, silage and cow pens.

8. REFERENCES

EPA. 2012a. Relation Between Nitrate in Water Wells and Potential Sources in the Lower Yakima Valley, Washington. EPA-910-R-12-003. September 2012.

EPA. 2012b. Quality Assurance Project Plan. Lower Yakima Valley Dairy Investigation Yakima County, Washington. December 2012.

USGS. 2009. Hydrogeologic Framework of the Yakima River Basin Aquifer System, Washington. U.S. Geological Survey. Scientific Investigations Report 2009-5152.

Figures

Yakima
Union Gap
Moxee City
Wapato
Toppenish
Granger
Sunnyside
Grandview
Mabton
Prosser
Harrah
Parker
Donald
Sawyer
Buena
Outlook
Brownstown
White Swan
Medicine Valley
Washout Gulch
Yakima Sportsman State Park
Yakima Air Terminal/Mcallister Fld
Hanford Nuclear Reservation
The Badlands
The Island
Yakima Reservation
Ahtanum Ridge
Toppenish Ridge
Horse Heaven Hills
Rattlesnake Hills
Snipes Mountain
Sagebrush Ridge
Yakima Ridge
Ahtanum Valley
Moxee Valley
Yakima Valley
Wide Hollow
Cold Creek
Coyote Canyon
Tannawasha Pasture
Yakima
Benton
Klickitat
1277 m
1106 m
1091 m
1274 m
623
24
82
22
97

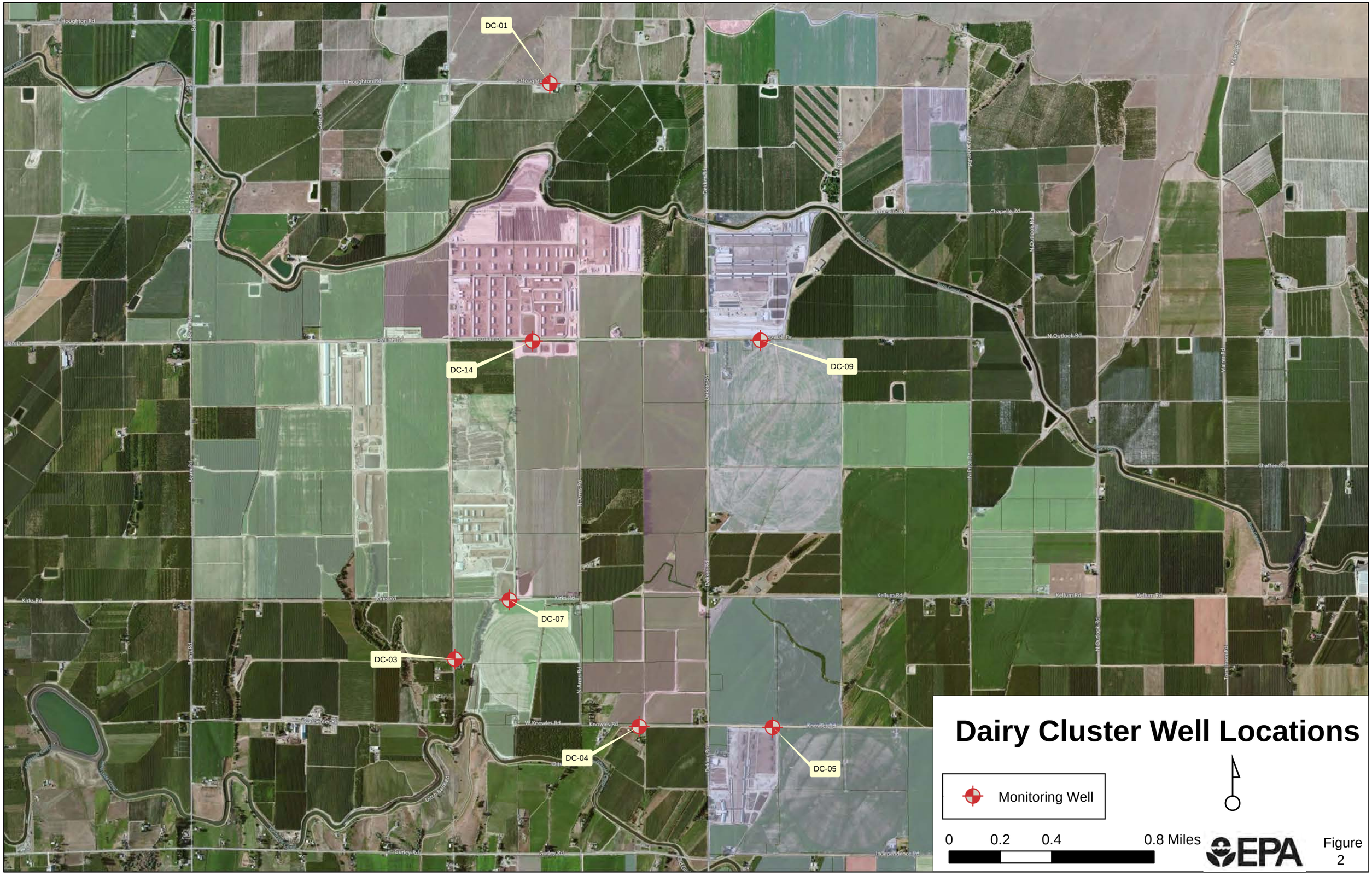
Washington

Vicinity Map

Yakama Reservation

0 1.75 3.5 7 Miles

Figure 1



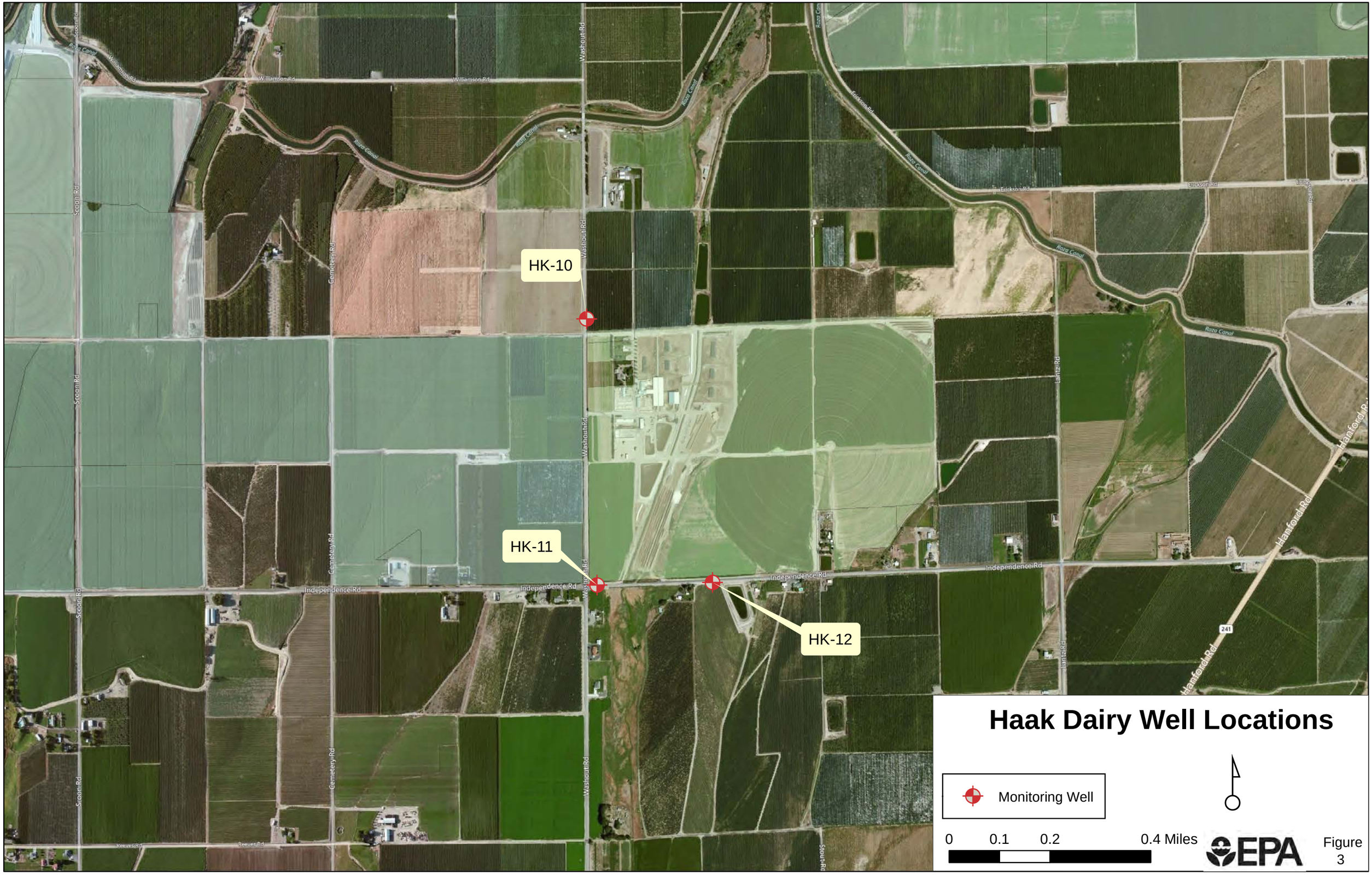
Dairy Cluster Well Locations

Monitoring Well

0 0.2 0.4 0.8 Miles

EPA

Figure 2


HK-10
HK-11
HK-12
Williamson Rd
Scoon Rd
Cemetery Rd
Washout Rd
Raza Canal
Erickson Rd
Lantz Rd
Hanford Rd
Independence Rd
Reeves Rd
241
Haak Dairy Well Locations
Monitoring Well
0
0.1
0.2
0.4 Miles
EPA
Figure 3

DC-01
Water Elevation 1049.06 ft
9.8 mg/L Nitrate as Nitrogen

1040 ft

1020 ft

1000 ft

980 ft

960 ft

940 ft

920 ft

900 ft

880 ft

860 ft

840 ft

DC-14
Water Elevation 906.52 ft
26 mg/L Nitrate as Nitrogen

DC-09
Water Elevation 904.97 ft
6.0 mg/L Nitrate as Nitrogen

DC-07
Water Elevation 845.8 ft
2.8 mg/L Nitrate as Nitrogen

DC-03
Water Elevation 838.69 ft
190 mg/L Nitrate as Nitrogen

DC-04
Water Elevation 845.14 ft
26 mg/L Nitrate as Nitrogen

DC-05
Water Elevation 844.2 ft
32 mg/L Nitrate as Nitrogen

Dairy Cluster Monitoring Well Locations, Flow Direction and Nitrate Concentrations

Water Level Elevations

Monitoring Well

0 0.2 0.4 0.8 Miles

EPA

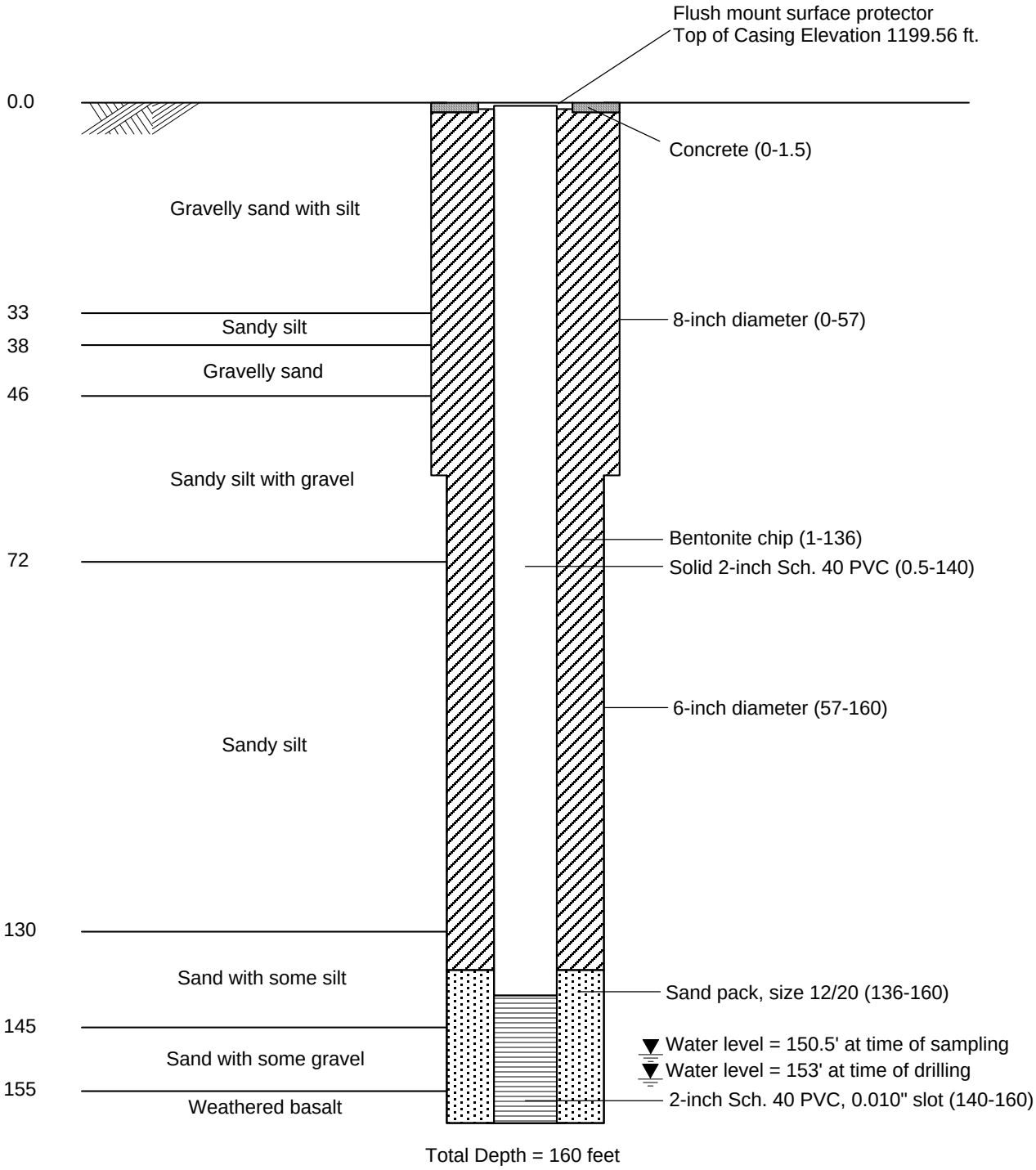
Figure 4


HK-10
Water Elevation 1005.33 ft
0.94 mg/L Nitrate as Nitrogen
HK-11
Water Elevation 965.92 ft
31 mg/L Nitrate as Nitrogen
HK-12
Water Elevation 972.95 ft
47 mg/L Nitrate as Nitrogen
1000 ft
990 ft
980 ft
970 ft
Williamson Rd
Washout Rd
Roza Canal
Erickson Rd
Scoon Rd
Cemetery Rd
Independence Rd
Reeves Rd
Stout Rd
Hanford Rd
241
Haak Dairy Groundwater Elevations,
Flow Direction and Nitrate Concentrations
Water Level Elevations?
Monitoring Well
0 0.1 0.2 0.4 Miles
EPA

Figure 5

Appendix A
Well Logs

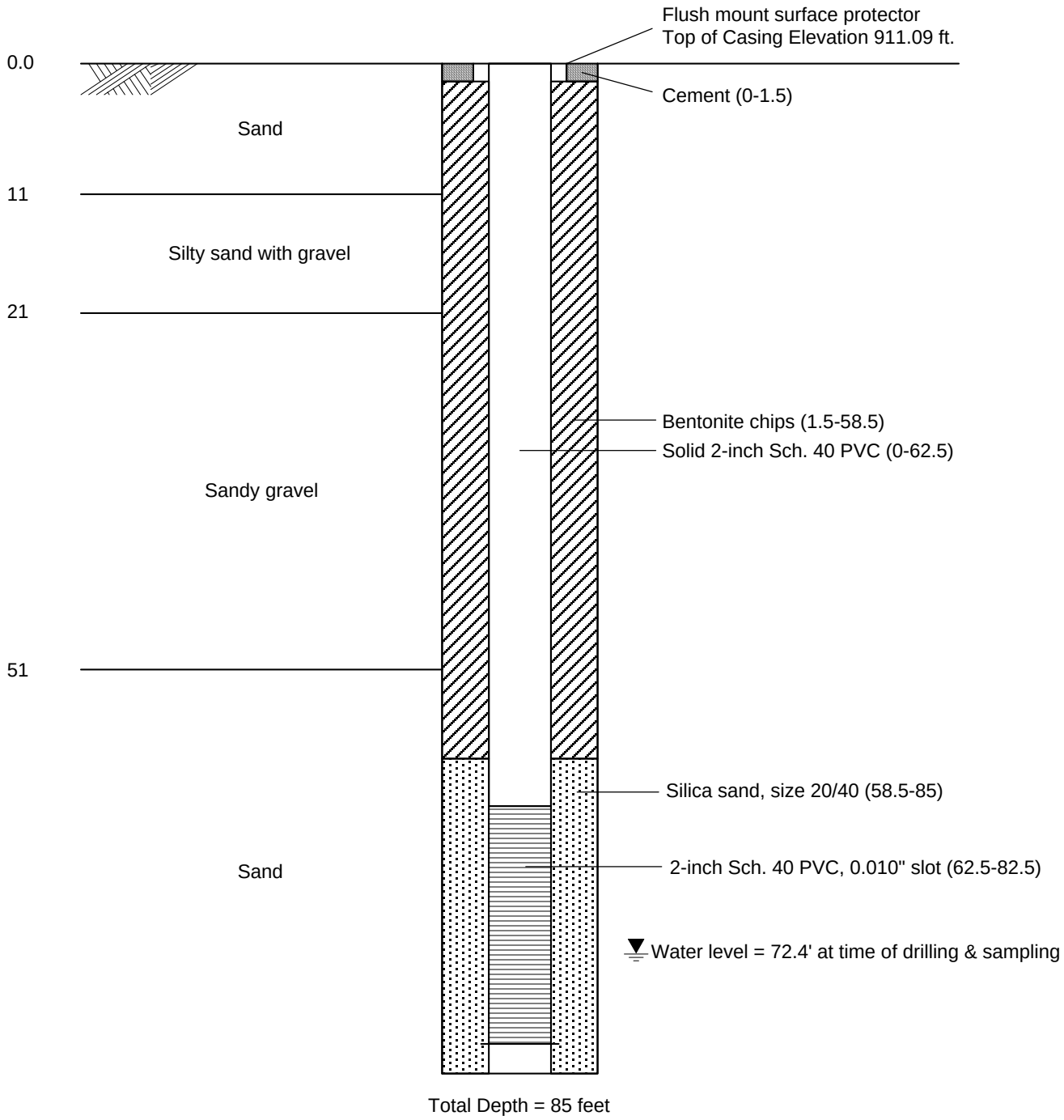
LOG & COMPLETION DIAGRAM
Well ID Tag No. BHP137 DC-1



Completed 12/18-19/12
Drilling Method = Air Rotary

All depths are in feet

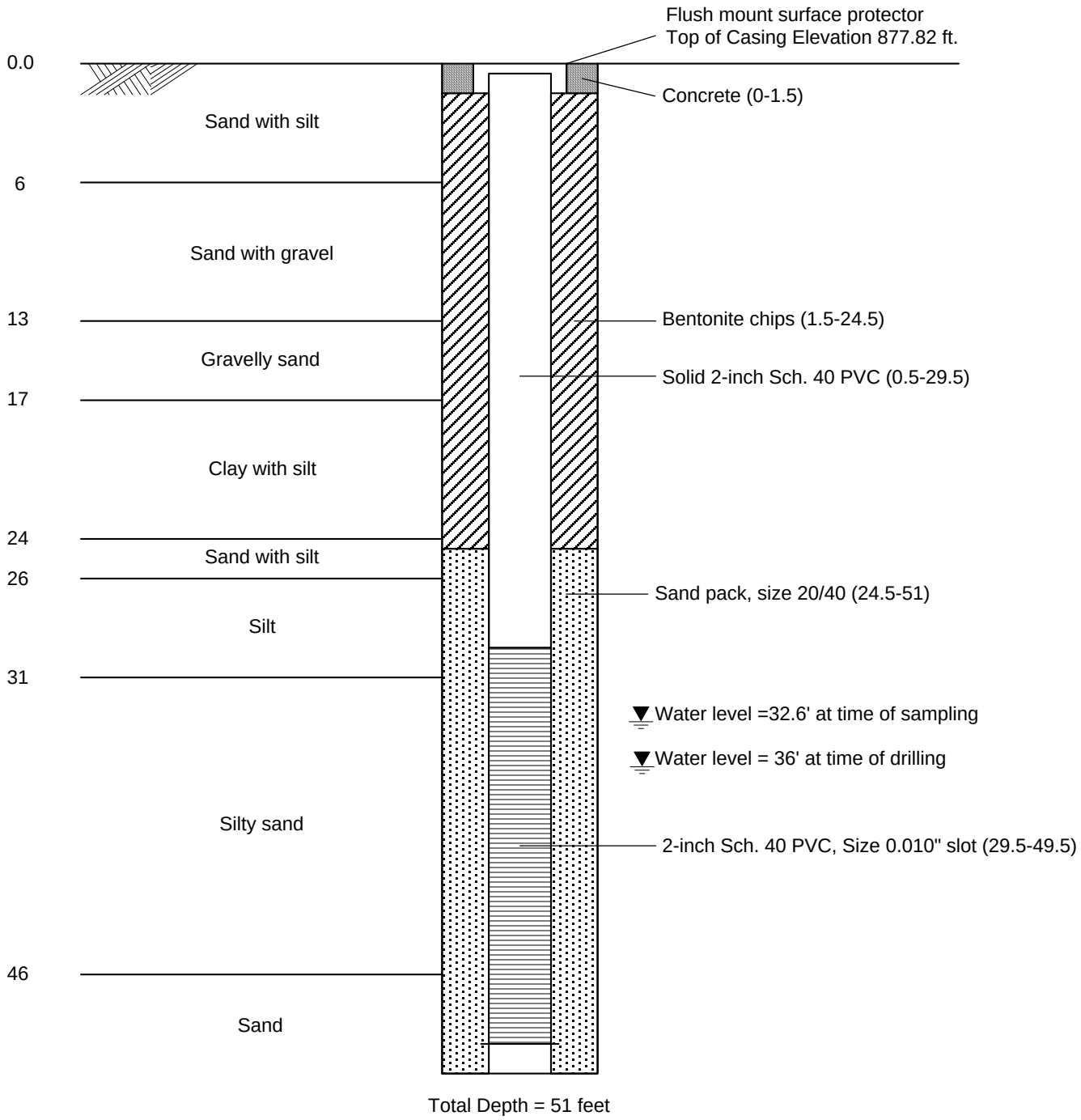
LOG & COMPLETION DIAGRAM
Well ID Tag No. BHP129 DC-3



Completed 12/10/2012
Drilling Method = Air Rotary

All depths are in feet

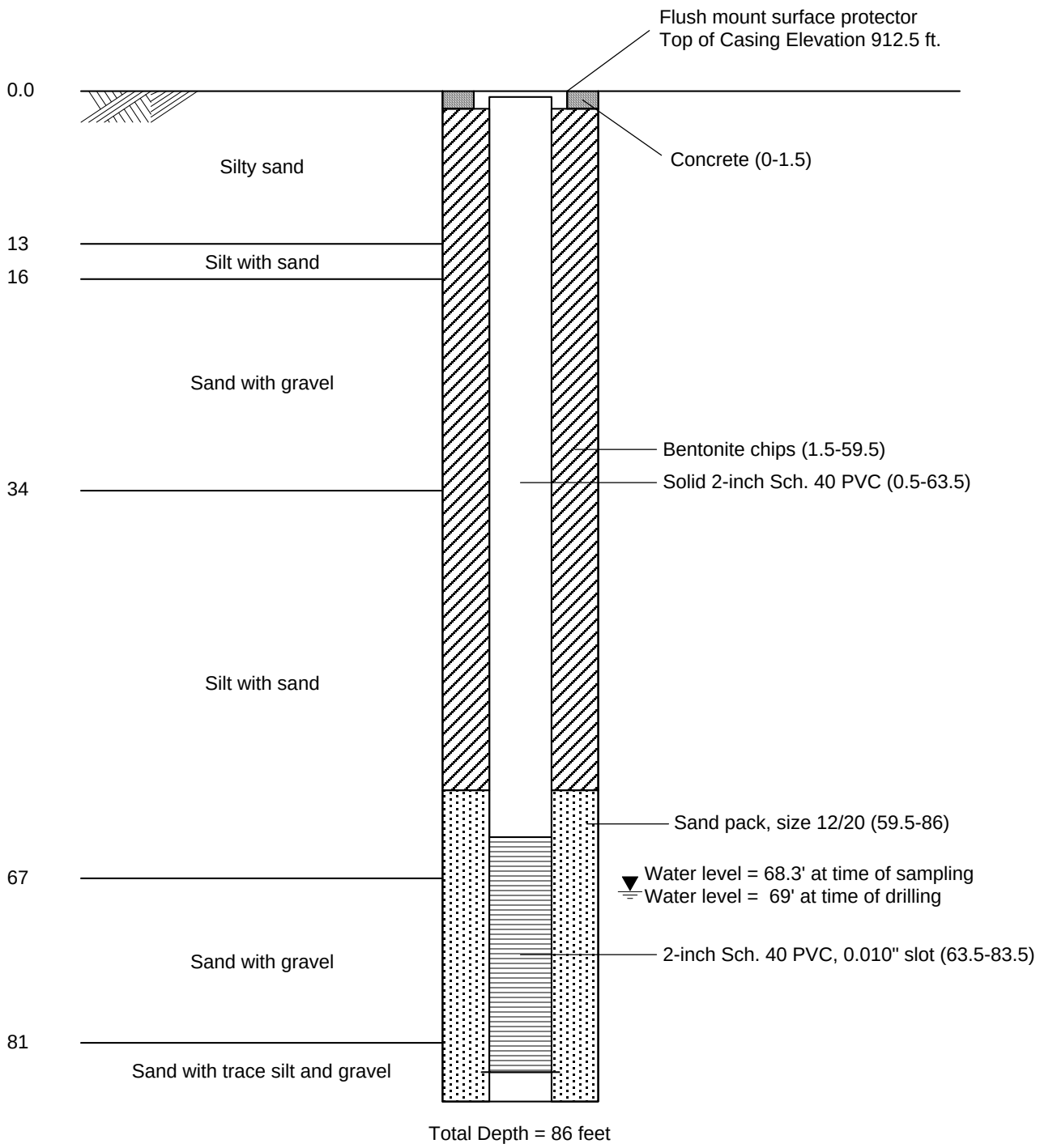
LOG & COMPLETION DIAGRAM
Well ID Tag No. BHP132 DC-4



Completed 12/13/12
Drilling Method = Air Rotary

All depths are in feet

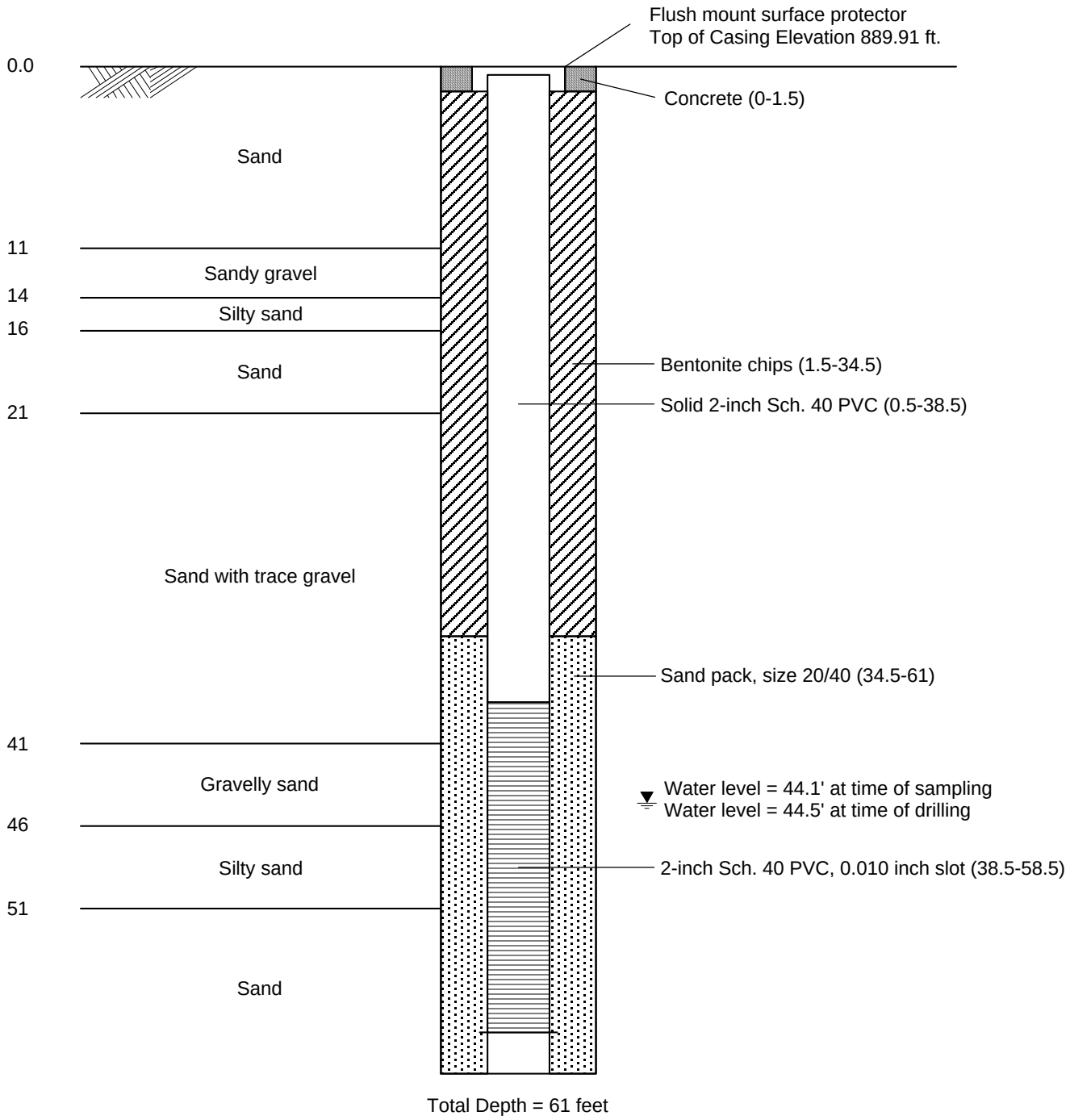
LOG & COMPLETION DIAGRAM
Well ID Tag No. BHP138 DC-5



Completed 12/20/12
Drilling Method = Air Rotary

All depths are in feet

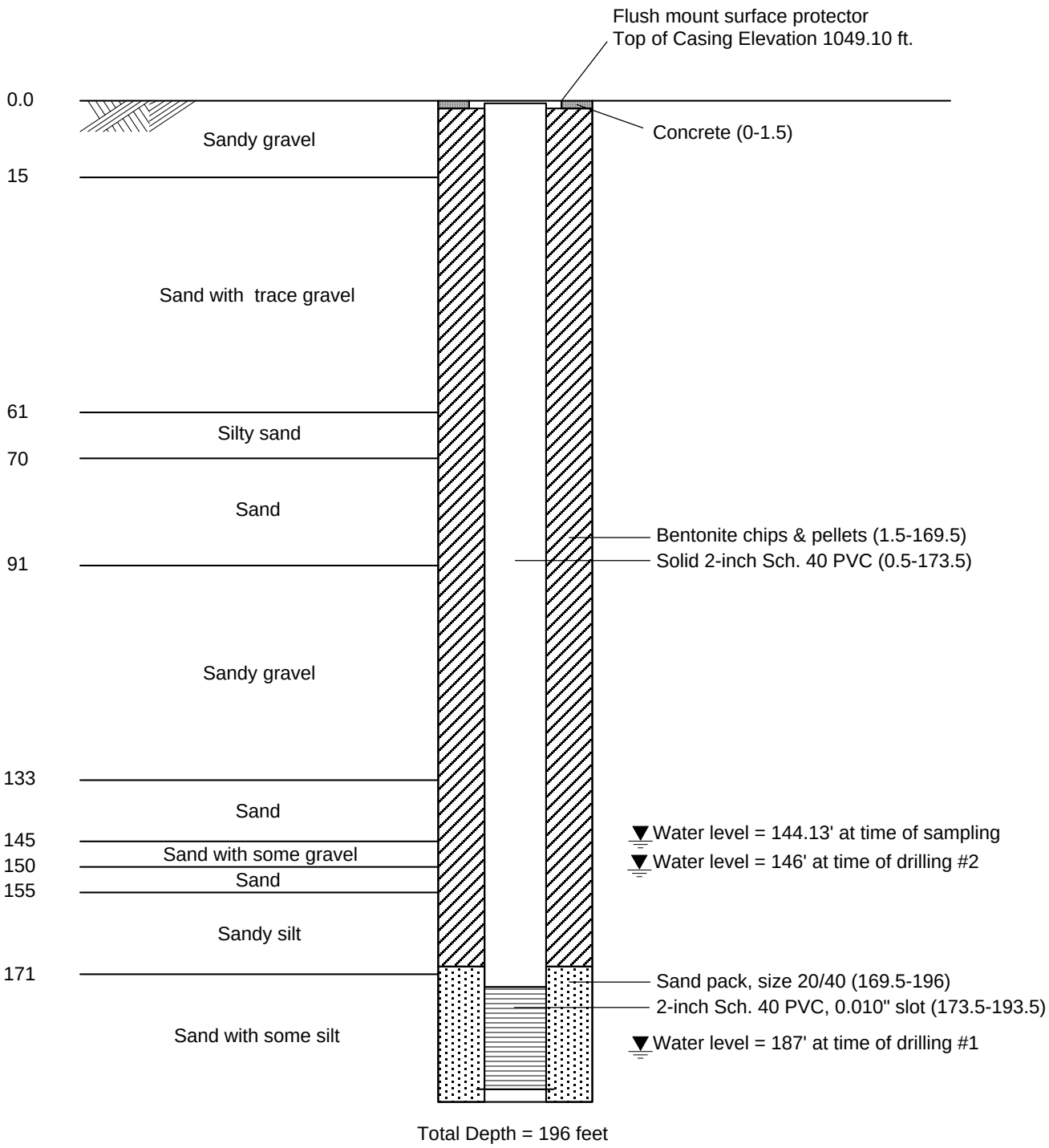
LOG & COMPLETION DIAGRAM
Well ID Tag No. BHP131 DC-7



Completed 12/13/2012
Drilling Method = Air Rotary

All depths are in feet

LOG & COMPLETION DIAGRAM
Well ID Tag No. BHP133 DC-9

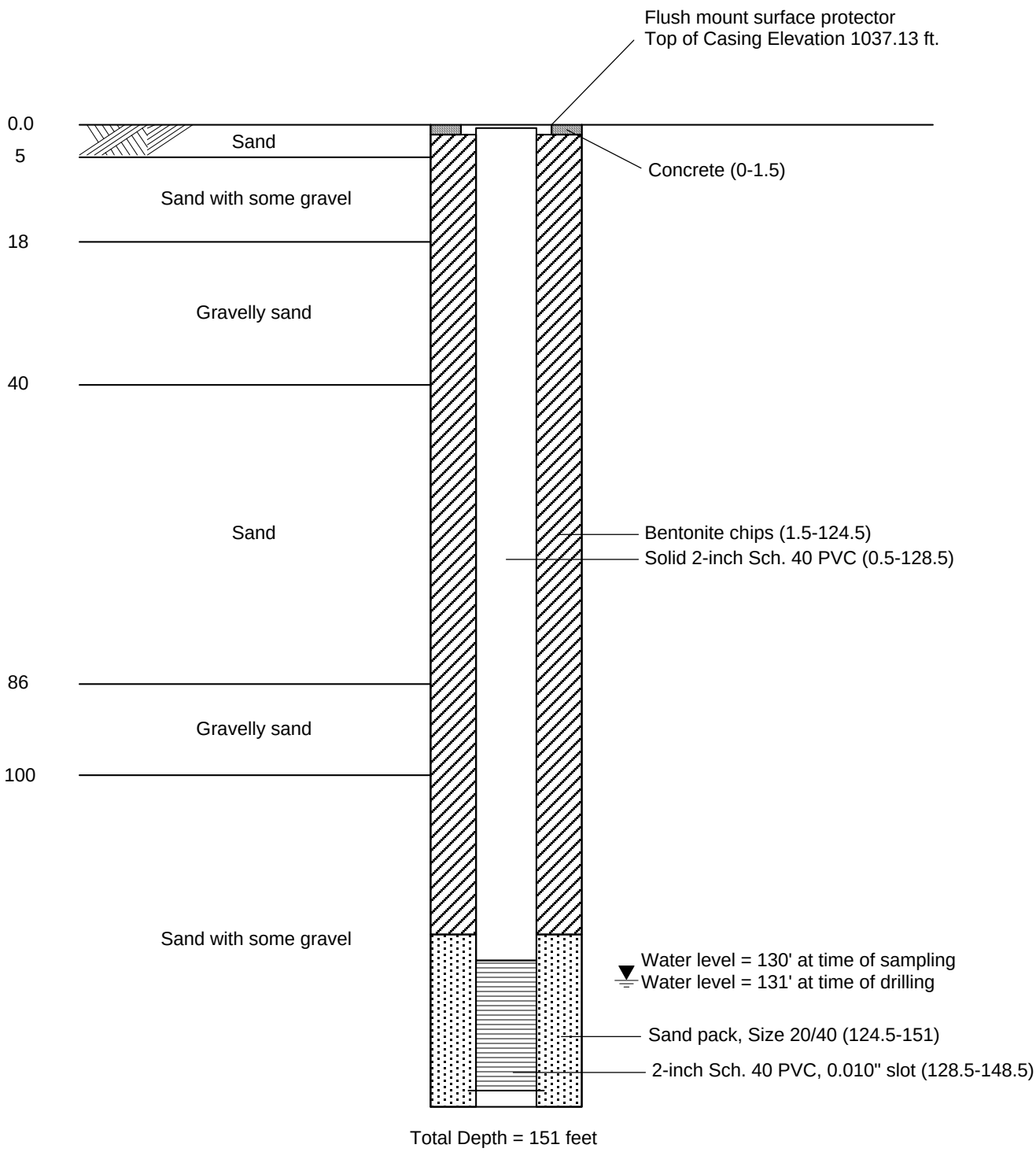


Total Depth = 196 feet

Completed 12/13-14/12
Drilling Method = Air Rotary

All depths are in feet

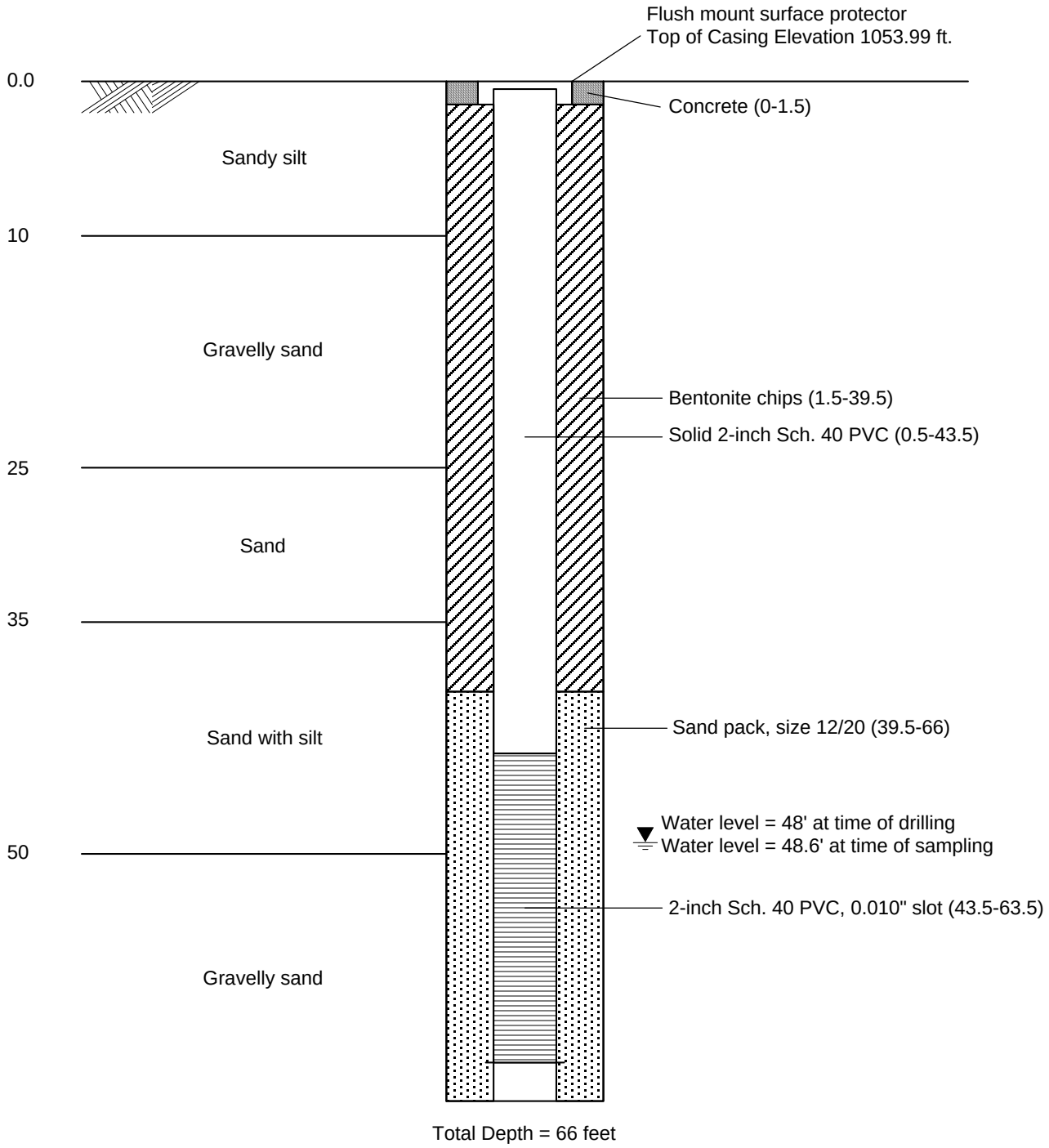
LOG & COMPLETION DIAGRAM
Well D Tag No. BHP130 DC-14



Completed 12/11-12/12
Drilling Method = Air Rotary

All depths are in feet

LOG & COMPLETION DIAGRAM
Well ID Tag No. BHP136 HK-10



Completed 12/18/12
Drilling Method = Air Rotary

All depths are in feet

LOG & COMPLETION DIAGRAM
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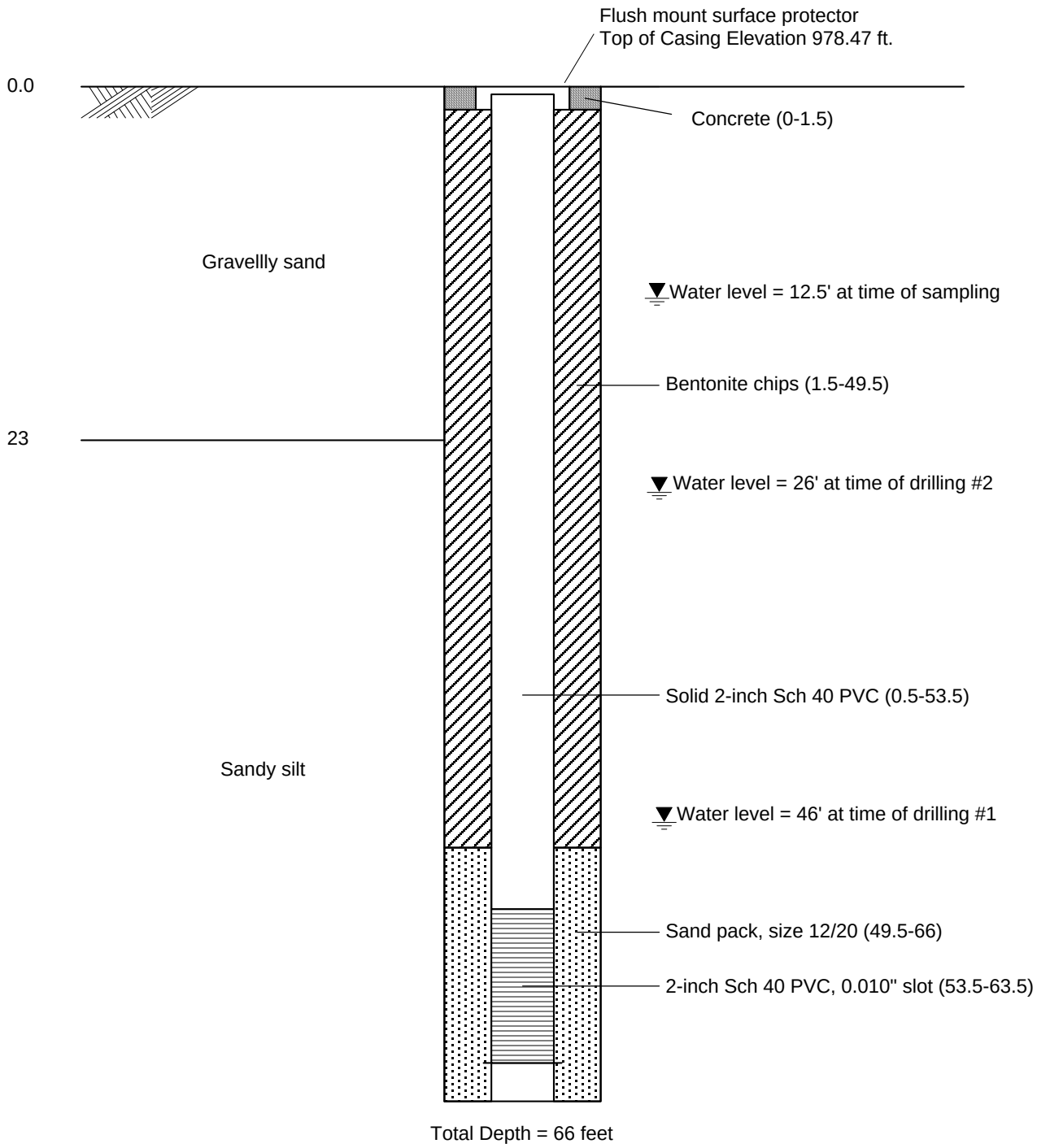
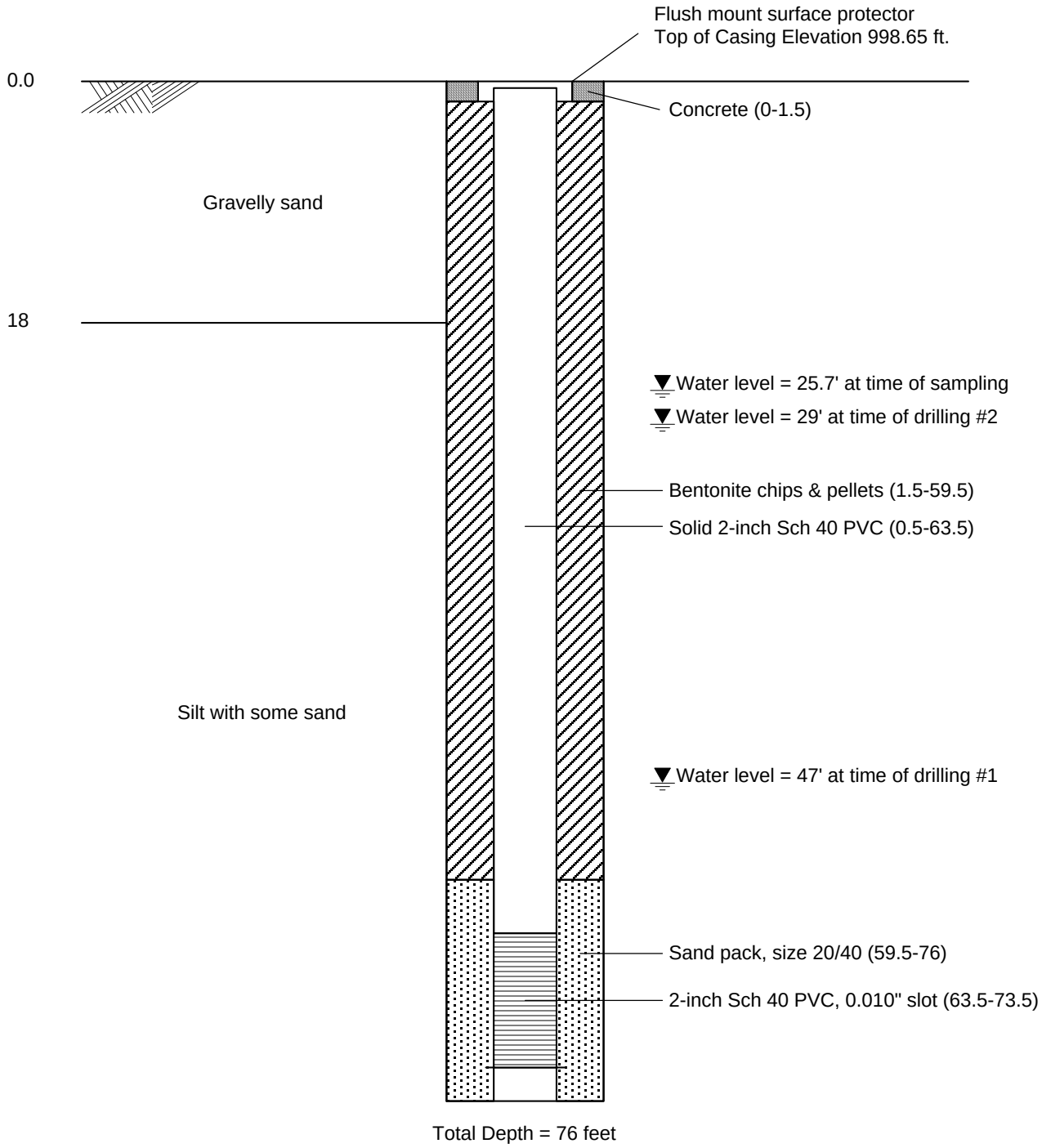


Completed 12/17/12
Drilling Method = Air Rotary

All depths are in feet

LOG & COMPLETION DIAGRAM
Well ID Tag No. BHP134 HK-12



Completed 12/16/12
Drilling Method = Air Rotary

All depths are in feet

Appendix B
Groundwater Sampling Logs

Ground Water Sampling Log

Site Name: DC-01 **Well #:** **Date:** 1/4/2013

Well Depth(Ft-BTOC[1]): 159.15 **Screen Interval**(Ft): PVC

Well Dia.: 2" **Casing Material:** PVC **Sampling Device:**

Pump placement(Ft from TOC[2]):

NO_3 test strip result = $NO_2 + NO_3$

Measuring Point: From survey mark on N. side of casing **Water level (static)**(Ft): 150.50'

Water level (pumping)(Ft): **Pump rate**(Liter/min):

Initial Field Test Strip results @ 13:25: NO_2 = ø ppm; NO_3 = ~7.5 ppm; NH_3 = ø ppm

14:08 Conf. test strip results: NO_2 = ø; NO_3 = 7.5 ppm; NH_3 = ø

*7.5 = est. between 5+10

Sampling Personnel:
J. CRAWFORD B. RICHMOND

Other info: (such as sample numbers, weather conditions and field notes)
Well security cap did not have a lock present upon arrival for sampling.
Started pumping 2 cycles/min @ ~13:00. Collecting prelim. sample after minimal tubing rinse in case water level drops.
1st 1/4/13 **Water Quality Indicator Parameters**

Time	Pumping rates (L/Min)	Water level (ft)	DO * (mg/L)	ORP (mv)	SEC[3]	Turb. (NTU)	pH	Temp. (C^0)	Volume pumped (L)
13:14	0.290	~~150~~ 151.25							
13:21	0.290	151.4							
13:32	↓	~~150.60~~ 151.6	6.43	137	0.968	109	7.78	9.50	
13:37			6.08	133	0.990	82.7	7.75	10.15	
13:42		151.74	5.64	132	0.991	51.0	7.81	11.14	
13:47		151.83	5.47	131	0.996	33.8	7.79	11.18	
13:50	0.140	151.88	5.38	134	0.999	27.9	7.73	11.53	

Type of Samples collected: 13:21 NO_3 sample collected for NO_3 (discarded) 13:31 started MEAS w/Horiba for WQ parameters
Waited to meas. WQ meas. due to minimal H_2O - unsure if it would hold.
1 casing volume was: *14:05 second sample NO_3 collected - FOR ANALYSIS*
Total volume purged prior to sample collection:
[1]BTOC-Below Top of Casing 14:15 field blank NO_3 collected
[2]TOC-Top of Casing
[3]Specific Electrical Conductance
* DO membrane has an air bubble, likely inaccurate

Stabilization Criteria

D.O.	+/- 0.3 mg/l
Turb.	+/- 10%
S.C.	+/- 3%
ORP	+/- 10 mV
pH	+/- 0.1 unit

The Other team (ENB) mentioned DC-05 did not have a security cap lock either.

Time	Pumping rates (L/Min)	Water level (ft)	DO (mg/L)	ORP (mv)	SEC³	Turb. (NTU)	pH	Temp. (C⁰)	Volume pumped (L)
13:52	0.140	151.83	4.92	135	1.01	25.8	7.77	11.52	
13:55	↓	151.78	5.44	132	1.00	27.6	7.81	11.22	13:59
13:58		151.63	4.41	132	0.991	24.2	7.80	10.71	lost flow, WQ mon. disconnected +reconnected when flow started up again (↑ pressure)
14:05	↓		Collected sample as a precaution				8z 1/4/13 13:14:05		
14:11	0.150	151.78	5.04	136	0.992	24.0	7.78	10.70	~4L
14:14	↑	151.89	5.39	133	1.01	16.2	7.79	11.03	
14:17	↓	151.91	5.90	133	1.01	8.42	7.76	11.27	

Time	Pumping rates (L/Min)	Water level (ft)	DO (mg/L)	ORP (mv)	SEC³	Turb. (NTU)	pH	Temp. (C⁰)	Volume pumped (L)
14:20	0.150	151.85	4.96	132	1.01	6.45	7.77	11.10	
	Stable. Tried to collect sample + lost flow - mechanical issue.								
			Will use 14:05		sample for analysis (same mech. issue prev)				

Time	Pumping rates (L/Min)	Water level (ft)	DO (mg/L)	ORP (mv)	SEC³	Turb. (NTU)	pH	Temp. (C⁰)	Volume pumped (L)

Pg 1 of 2

Ground Water Sampling Log

Site Name: Vulcan North **Well #:** DC-3 **Date:** 1/2/13
Well Depth(Ft-BTOC[1]): 84.36 **Screen Interval(Ft):**

Well Dia.: 2" **Casing Material:** PVC **Sampling Device:** Geo Tech Portable Sampling Device (Bladder Pump

Pump placement(Ft from TOC[2]): 80

Measuring Point: TOC-North **Water level (static)**(Ft): 72.40' BTOC-North

Water level (pumping)(Ft): **Pump rate**(Liter/min): ~.3 Lpm

Sampling Personnel: B. Cicclo, J. Fetters, M. Worden

Other info: (such as sample numbers, weather conditions and field notes) 1355 - Begin purge
1520 collect sample in 2-500 ml polys, one w/ H_2SO_4.
TD = 84.36

Water Quality Indicator Parameters

Time	Pumping rates (L/Min)	Water level (ft)	DO (mg/L)	ORP (mv)	Turb. (NTU)	SEC[3] ~~(S/cm)~~ mS/cm	pH	Temp. (C^0)	Volume pumped (L)
1401	45sec ref.l 15sec disch	72.38	11.23	132	509	2.58	6.91	10.7	0.1
1407	15sec ref.l 15sec disch	72.41	10.89	135	404	2.78	6.96	10.48	1.25
1413	"	72.41	9.64	146	90.7	2.77	7.12	9.23	2
1418	"	72.41	8.93	150	60.5	2.74	7.08	9.96	4
1423		72.40	8.25	157	50.3	2.80	7.03	10.01	6
1428	"	72.39	8.30	159	39.7	2.82	7.06	9.78	7
1434	"	72.40	8.24	162	33.9	2.85	7.11	9.39	8

Continued →

Type of Samples collected:

1 casing volume was:

Total volume purged prior to sample collection:

[1]BTOC-Below Top of Casing
[2]TOC-Top of Casing
[3]Specific Electrical Conductance

Stabilization Criteria

D.O.	+/- 0.3 mg/l
Turb.	+/- 10%
S.C.	+/- 3%
ORP	+/- 10 mV
pH	+/- 0.1 unit

Continued

Ground Water Sampling Log

Pg 2 of 2

Site Name: **Well #:** DC-3 **Date:**
Well Depth(Ft-BTOC[1]): **Screen Interval**(Ft):

Well Dia.: **Casing Material:** **Sampling Device:**

Pump placement(Ft from TOC[2]):

Measuring Point: **Water level (static)**(Ft):

Water level (pumping)(Ft): **Pump rate**(Liter/min):

Sampling Personnel:

Other info: (such as sample numbers, weather conditions and field notes)
Collect DC-03 at 1520 in 2-500ml polys (one w/ H_2SO_4) for Ammonia and Nitrate

Water Quality Indicator Parameters

Time	Pumping rates (L/Min)	Water level (ft)	DO (mg/L)	ORP (mv)	Turb. (NTU)	SEC[3] (S/cm)	pH	Temp. (C^0)	Volume pumped (L)
1445	1L/90sec	72.41	8.61	169	23.6	2.92	7.13	8.76	13
1457	"	72.40	8.76	178	12.9	3.11	7.07	8.31	17
1504	"	72.40	8.22	181	10.5	3.08	7.06	8.65	19
1508	"	72.39	8.97	179	9.78	3.12	7.12	8.05	21
1512	"	72.42	9.32	181	8.37	3.10	7.13	7.94	23
1516	"	72.42	9.01	184	7.18	3.11	7.08	7.84	24
1520	"	72.43	8.75	186	5.76	3.11	7.08	7.75	25

Type of Samples collected:

Ammonia test strip = 0.25 ppm
Nitrate test strip 20-50 ppm

1 casing volume was:

Total volume purged prior to sample collection:

[1]BTOC-Below Top of Casing
[2]TOC-Top of Casing
[3]Specific Electrical Conductance

Stabilization Criteria

D.O.	+/- 0.3 mg/l
Turb.	+/- 10%
S.C.	+/- 3%
ORP	+/- 10 mV
pH	+/- 0.1 unit

Ground Water Sampling Log

Site Name: Yakima Nitrate **Well #:** OL-4 **Date:** 1/3/13

Well Depth(Ft-BTOC[1]): 49.9' **Screen Interval(Ft):**

Well Dia.: 2" **Casing Material:** PVC **Sampling Device:** Geotech Bladder pump

Pump placement(Ft from TOC[2]): TD 49.4 BTOC-N

Measuring Point: TOC-North **Water level (static)(Ft):** 32.68 BTOC-North

Water level (pumping)(Ft): **Pump rate(Liter/min):** ~.25 LPM

Sampling Personnel: B. Cecko, M. Wilder

Other info: (such as sample numbers, weather conditions and field notes) 0923 Begin Purge
Sample collected at 1020 in 1-500ml poly unpreserved.

Water Quality Indicator Parameters

Time	Pumping rates (L/Min)	Water level (ft)	DO (mg/L)	ORP (mv)	Turb. (NTU)	SEC[3] ~~(S/cm)~~ mS/cm	pH	Temp. (C^0)	Volume pumped (L)
932	250 ml/min	32.70	12.15	169	142	1.12	7.00	10.41	
0940	"	32.80	10.38	173	49.0	1.03	6.96	10.98	2
0946	"	32.76	10.21	171	23.4	1.02	6.90	10.93	3.5
0952	"	32.80	10.28	170	16.1	1.02	6.94	10.92	5
1000	"	32.79	10.10	171	14.6	1.01	6.91	11.05	7
1010	"	32.81	9.98	173	11.2	1.01	6.94	10.96	9.5
1014	"	32.80	10.0	174	10.0	1.01	6.93	10.95	10.5
1018	"	32.81	9.85	175	9.44	1.01	6.91	10.95	11.5

Type of Samples collected:

1 casing volume was:

Total volume purged prior to sample collection:

Note: While disassembling the Water Quality meter after the sample was collected, I realized that rubber caps were left on the pH and DO sensors during the purge and these two parameters were not reading correctly.

[1]BTOC-Below Top of Casing
[2]TOC-Top of Casing
[3]Specific Electrical Conductance

Ammonia test strip: 0.0 ppm
Nitrate test strip: 20 ppm

Stabilization Criteria

D.O.	+/- 0.3 mg/l
Turb.	+/- 10%
S.C.	+/- 3%
ORP	+/- 10 mV
pH	+/- 0.1 unit

Ground Water Sampling Log

Site Name: Yakima Nitrate **Well #:** DC-5 **Date:** 1-4-13

Well Depth(Ft-BTOC[1]): 85.56 **Screen Interval(Ft):**

Well Dia.: 2" **Casing Material:** PVC **Sampling Device:** Geotech bladder pump

Pump placement(Ft from TOC[2]):

Measuring Point: TC-Mark **Water level (static)**(Ft): 68.31

Water level (pumping)(Ft): **Pump rate**(Liter/min): ~ 0.25 LPM

Sampling Personnel: B. Ciecko. M. Vorder

Other info: (such as sample numbers, weather conditions and field notes)

1255 ~~1225~~ - begin purge

Ammonia Test strip = 0 ppm

Nitrate Test strip = 20 ppm

Water Quality Indicator Parameters

Time	Pumping rates (L/Min)	Water level (ft)	DO (mg/L)	ORP (mv)	Turb. (NTU)	SEC[3] ~~(S/cm)~~ mS/cm	pH	Temp. (C°)	Volume pumped (L)
1326	.25LPM	68.31	8.32	194	773	1.30	7.48	8.97	4
1345	"	68.31	5.41	224	322	1.31	7.02	12.45	9
1353	"	"	5.61	~~227~~ ~~+63~~	163	1.31	6.94	12.81	11
1401	"	"	5.51	~~236~~ ~~51.1~~	51.1	1.30	6.92	12.70	13
1409	"	"	5.61	232	23.4	1.31	6.99	12.74	15
1413	"	"	5.47	236	7.91	1.31	6.97	12.69	16
~~1416~~	"	"							17

Type of Samples collected:

1415 collect sample in 1-500 mL poly. unpreserved.

1 casing volume was:

Total volume purged prior to sample collection:

Stabilization Criteria

D.O.	+/- 0.3 mg/l
Turb.	+/- 10%
S.C.	+/- 3%
ORP	+/- 10 mV
pH	+/- 0.1 unit

[1]BTOC-Below Top of Casing
[2]TOC-Top of Casing
[3]Specific Electrical Conductance

Ground Water Sampling Log

Site Name: DC-07 **Well #:** **Date:** 01/03/2013
Well Depth(Ft-BTOC[1]): 61.3' **Screen Interval**(Ft):

Well Dia.: 2" **Casing Material:** PVC **Sampling Device:** HORIBA A94852 (EPA BC#)

Pump placement(Ft from TOC[2]): 56.3'

Measuring Point: ~~N.~~ EAST Side of casing (DC 1/3/13) **Water level (static)**(Ft): ~~44 ft +~~ 44.11 ft (DC 1/3/13)

Water level (pumping)(Ft): 44.14 **Pump rate**(Liter/min): 0.380

Sampling Personnel: B. RICHMOND / J. CRAWFORD (EPA)

(NO3 test strip result = NO3+NO2)
Ammonia test strip: <1 ϕ (DC 1/3/13)
Other info: (such as sample numbers, weather conditions and field notes) NO3 test strip: ~~ϕ~~ <1 (DC 1/3/13) / NO2 = ϕ
9:10 began pumping, air leak. Fixed + restarted pumping @ 9:40
Sample collection time: 10:48am Field duplicate: 10:49am

Water Quality Indicator Parameters

Time	Pumping rates (L/Min)	Water level (ft)	DO (mg/L)	ORP (mv)	SEC[3]	Turb. (NTU)	pH	Temp. (C^0)	Volume pumped (L)
9:40	0.380	44.14							0.380
9:51	↓	44.14	6.72	149	0.710	639	5.65	12.45	
10.00		44.14	6.02	156	0.775	255	5.68	13.15	9.0
10:10		44.14	5.71	144	0.777	139	5.92	13.25	
10:12		44.14	5.97	137	0.767	~~137~~ 79 (DC 1/3/13)	6.08	13.13	11.0
10:20		44.14	5.73	129	0.750	47.3	6.25	13.30	13.0
10:24	↓	44.14	(DC 1/3/13) 5.53	128	0.753	27.9	6.33	13.30	

Type of Samples collected:
NO3 field sample and field duplicate
Field BL (transfer)
1 casing volume was:
Total volume purged prior to sample collection:
[1]BTOC-Below Top of Casing
[2]TOC-Top of Casing
[3]Specific Electrical Conductance

Stabilization Criteria

D.O.	+/- 0.3 mg/l
Turb.	+/- 10% (or <10 NTU)
S.C.	+/- 3%
ORP	+/- 10 mV
pH	+/- 0.1 unit

DC-07 1/3/2013 CONT.

Time	Pumping rates (L/Min)	Water level (ft)	DO (mg/L)	ORP (mv)	SEC³	Turb. (NTU)	pH	Temp. (C⁰)	Volume pumped (L)
10:27	0.380	44.14	5.59	125	0.752	20.9	6.42	13.26	
10:30	↓	44.14	5.20	125	0.748	17.1	6.42	13.36	
10:34		44.14	5.31	125	0.743	14.5	6.46	13.25	15.0
10:37		44.14	5.19	123	0.741	11.3	6.50	13.36	
10:40		44.14	5.29	124	0.739	11.1	6.50	13.37	
10:43	↓	44.14	5.25	124	0.737	9.88	6.51	13.34	17.0

Time	Pumping rates (L/Min)	Water level (ft)	DO (mg/L)	ORP (mv)	SEC³	Turb. (NTU)	pH	Temp. (C⁰)	Volume pumped (L)

Time	Pumping rates (L/Min)	Water level (ft)	DO (mg/L)	ORP (mv)	SEC³	Turb. (NTU)	pH	Temp. (C⁰)	Volume pumped (L)

Ground Water Sampling Log

Site Name: Yakima Nitrate **Well #:** DC-9 **Date:** 1/3/12

Well Depth(Ft-BTOC[1]): **Screen Interval(Ft):**

Well Dia.: 2 **Casing Material:** PVC **Sampling Device:** Geotech Bladder pump

Pump placement(Ft from TOC[2]):

Measuring Point: TC-mark **Water level (static)(Ft):** 144.13 BTOC - mark

Water level (pumping)(Ft): **Pump rate(Liter/min):** ~.25 Lpm

Sampling Personnel: B. Cuccio, M. Warden

Other info: (such as sample numbers, weather conditions and field notes) Begin purge at 1145

Nitrate test strip = 5 ppm

Ammonia test strip = .25-.50 ppm

1315 collect sample

Water Quality Indicator Parameters

Time	Pumping rates (L/Min)	Water level (ft)	DO (mg/L)	ORP (mv)	Turb. (NTU)	SEC[3] (S/cm)	pH	Temp. (C°)	Volume pumped (L)
1214	~250 mL/min	144.10	10.05	141	High	.431	6.91	9.48	2
1224	.25 L/min	144.15	~~10.0~~ 7.27	135	589	0.432	7.55	10.16	4
1232	"	144.19	6.32	135	149	0.428	7.70	10.6	6
1240	"	144.16	7.71	154	50.9	.428	7.56	10.76	8
1248	"	144.19	7.80	160	29.3	.425	7.56	11.01	10
1256	"	144.19	7.94	165	23.5	.421	7.58	10.95	12
1304	"	144.23	7.93	167	19.1	.419	7.67	10.96	14

Continued →

Type of Samples collected: 1315 collect primary, Field Dup, MS/MSD for Ammonia + Nitrate in 8-500mL polys (4 w/ H_2SO_4)

1 casing volume was:

Total volume purged prior to sample collection:

Stabilization Criteria

D.O.	+/- 0.3 mg/l
Turb.	+/- 10%
S.C.	+/- 3%
ORP	+/- 10 mV
pH	+/- 0.1 unit

[1]BTOC-Below Top of Casing
[2]TOC-Top of Casing
[3]Specific Electrical Conductance

Time	Pumping rates (L/Min)	Water level (ft)	DO (mg/L)	ORP (mv)	SEC³	Turb. (NTU)	pH	Temp. (C⁰)	Volume pumped (L)
1308	.25 LPM	144.21	7.96	171	0.419	18.3	7.60	10.90	15
1312	11	144.20	~~7.96~~ 7.97	169	.419	17.4	7.66	10.84	16

Time	Pumping rates (L/Min)	Water level (ft)	DO (mg/L)	ORP (mv)	SEC³	Turb. (NTU)	pH	Temp. (C⁰)	Volume pumped (L)

Time	Pumping rates (L/Min)	Water level (ft)	DO (mg/L)	ORP (mv)	SEC³	Turb. (NTU)	pH	Temp. (C⁰)	Volume pumped (L)

Ground Water Sampling Log

Site Name: DC-14 **Well #:** DC-14 **Date:** 01/03/2013

Well Depth(Ft-BTOC[1]): 150.4 **Screen Interval**(Ft):

Well Dia.: 2" **Casing Material:** PVC **Sampling Device:** HORIBA A-94852

Pump placement(Ft from TOC[2]):

Measuring Point: N. side of casing (filed w/ sharpie mark) **Water level (static)**(Ft): 130.61' ← 12:30 (pump issues) – controller frozen
130.65' ← 14:23 [Checked after rec'd replacement pump & before pumping well]

Water level (pumping)(Ft): 130.67' **Pump rate**(Liter/min):

Sampling Personnel: B. RICHMOND J. CRAWFORD

Other info: (such as sample numbers, weather conditions and field notes)
COLD WEATHER 27°F ISSUES W/ CONTROLLER - N - FROZEN, REPLACED BY ENE FIELD TEAM
Nitrogen tank running low (15:10)
15:37 NO_3 sample collected
Tot Shots: 20ppm NO_3 / 0ppm NH_3 / 0 NO_2 (NO_3 result = NO_2 + NO_3)

Water Quality Indicator Parameters

Time	Pumping rates (L/Min)	Water level (ft)	DO (mg/L)	ORP (mv)	SEC[3]	Turb. (NTU)	pH	Temp. (C^0)	TOTAL Volume pumped (L) @ TIME
*14:25	0.350								
14:29	↑	130.67	3.99	144	1.83	865	6.80	11.93	
14:41		130.67	2.64	125	1.85	407	6.91	12.83	
14:50	↓	130.67	2.22	121	1.84	296	6.93	12.87	
15:00	↓	130.67	1.79	118	1.84	213	6.95	12.86	LOST FLOW + REESTABLISHED PUMP RATE AFTER 15:00 SAMPLE
15:10	0.200	130.67	1.62	129	1.77	158	6.79	11.41	
1520	.200	130.62	1.61	118	1.82 1.64	164	6.96	12.14	

Type of Samples collected: *1/8/13 NO_3 field sample, EQUIP. BLANK NO_3 + NH_3

* Previous Horiba data logged was while troubleshooting a frozen control box for the pump. ENE team provided replacement. Sample pumping started @ 14:25.

1 casing volume was:

Total volume purged prior to sample collection:

[1]BTOC-Below Top of Casing
[2]TOC-Top of Casing
[3]Specific Electrical Conductance

Stabilization Criteria

D.O.	+/- 0.3 mg/l
Turb.	+/- 10%
S.C.	+/- 3%
ORP	+/- 10 mV
pH	+/- 0.1 unit

Time	Pumping rates (L/Min)	Water level (ft)	DO (mg/L)	ORP (mv)	SEC³	Turb. (NTU)	pH	Temp. (C⁰)	Volume pumped (L)
15:23	0.200	130.62	1.56	119	1.82	132	6.95	12.24	
15:26	↓	130.62	1.57	118	1.82	123	6.96	12.13	
15:29		130.61	1.44	118	1.82	121	6.96	12.14	
15:32	↓	130.62	1.41	118	1.81	115	6.96	12.08	

Time	Pumping rates (L/Min)	Water level (ft)	DO (mg/L)	ORP (mv)	SEC³	Turb. (NTU)	pH	Temp. (C⁰)	Volume pumped (L)

Time	Pumping rates (L/Min)	Water level (ft)	DO (mg/L)	ORP (mv)	SEC³	Turb. (NTU)	pH	Temp. (C⁰)	Volume pumped (L)

pg 1 of 2

Ground Water Sampling Log

Site Name: **Well #:** HK-10 **Date:** 1/4/13

Well Depth(Ft-BTOC[1]): 65.10 **Screen Interval**(Ft):

Well Dia.: 2" **Casing Material:** PVC **Sampling Device:** Geotech bladder pump

Pump placement(Ft from TOC[2]):

Measuring Point: TIC - Mark **Water level (static)**(Ft): 48.66

Water level (pumping)(Ft): **Pump rate**(Liter/min): ~.25 LPM

Sampling Personnel: B. Ciccone, M. Worden

Other info: (such as sample numbers, weather conditions and field notes) 0832 Begin purge
Ammonia test strip: 0 ppm 1135 collect sample in 1-500 ml poly, unpreserved
Nitrate test strip: 0 ppm

Water Quality Indicator Parameters

Time	Pumping rates (L/Min)	Water level (ft)	DO (mg/L)	ORP (mv)	Turb. (NTU)	SEC[3] ~~(S/cm)~~ mS/cm	pH	Temp. (C^0)	Volume pumped (L)
0900	.25 LPM	48.67	5.70	97	high	0.706	7.55	8.7	.25
0915	"	48.66	2.57	111	873	.748	7.29	10.38	4
1015	"	48.65	2.83	116	368	.757	7.0	7.30	5
1037	"	48.69	3.82	130	127	.796	7.25	10.75	10
1047	"	48.66	3.11	132	84.3	.802	7.23	11.02	12.5
1052	"	48.69	3.94	136	73.4	.799	7.28	10.95	14
1100	"	48.66	3.77	141	55.7	.804	7.30	10.98	16

Type of Samples collected:

Cont. need →

1 casing volume was:

Total volume purged prior to sample collection:

[1]BTOC-Below Top of Casing
[2]TOC-Top of Casing
[3]Specific Electrical Conductance

Stabilization Criteria

D.O.	+/- 0.3 mg/l
Turb.	+/- 10%
S.C.	+/- 3%
ORP	+/- 10 mV
pH	+/- 0.1 unit

65.10

Time	Pumping rates (L/Min)	Water level (ft)	DO (mg/L)	ORP (mv)	SEC³	Turb. (NTU)	pH	Temp. (C⁰)	Volume pumped (L)
1106	.25 1PM	48.66	4.18	150	~~.151~~ .803 B2	67.8	7.32	10.96	18
1116	11	11	2.82	153	~~.15~~ .802	37.7	7.33	10.74	20
1124	11	48.66	3.18	159	.807	24.5	7.30	10.70	22
1128	11	48.66	2.97	165	.813	21.1	7.26	10.74	23
1132	11	48.66	2.93	168	.821	18.7	7.25	10.97	24

Time	Pumping rates (L/Min)	Water level (ft)	DO (mg/L)	ORP (mv)	SEC³	Turb. (NTU)	pH	Temp. (C⁰)	Volume pumped (L)

Time	Pumping rates (L/Min)	Water level (ft)	DO (mg/L)	ORP (mv)	SEC³	Turb. (NTU)	pH	Temp. (C⁰)	Volume pumped (L)

Ground Water Sampling Log

Site Name: HK-11 **Well #:** **Date:** 01/04/2012
Well Depth(Ft-BTOC[1]): 65.28 **Screen Interval**(Ft):

Well Dia.: 2" **Casing Material:** PVC **Sampling Device:** Horiba

Pump placement(Ft from TOC[2]):

Measuring Point: From survey mark N. side of casing **Water level (static)**(Ft): 12.55'

Water level (pumping)(Ft): ~14' (see below) **Pump rate**(Liter/min): 0.200

Field Test Strip Results
- Ø ppm NH_3
- 1 ppm NO_2
- ~30 ppm NO_3

NO_3 test strip result = NO_2 + NO_3

Sampling Personnel: B. RICHMOND J. CRAWFORD

Other info: (such as sample numbers, weather conditions and field notes)
Pressure under well casing cap, released when removed. Monitored water level prior to recording to allow time to stabilize. 1st 17:01 14.0' @ 9:00am.

Water Quality Indicator Parameters

Time	Pumping rates (L/Min)	Water level (ft)	DO (mg/L)	ORP (mv)	SEC[3]	Turb. (NTU)	pH	Temp. (C^0)	Volume pumped (L)
10:00	0.200	13.45							
10:10 10:30 ~	1/4/13 ↓	13.64	1.57	90	1.99	432	7.28	11.91	
10:21		13.84	1.59	85	1.96	354	7.24	11.91	
10:32	↓	13.98	5.54*	83	1.93	310	7.31	11.74	
10:35	0.200	13.98	0.00	82	1.93	322	7.21	11.70	
10:38	0.200	14.03	0.00	82	1.91	286	7.22	11.64	
10:42	↓	14.03	0.00	81	1.91	274	7.22	11.75	

Type of Samples collected:
*Water is off gassing - bubbles present, shook flow through cell + it dropped, likely @ Ø DO prev.
NO_3 sample collected 1/4/13 @ 11:41am sc

1 casing volume was:
Total volume purged prior to sample collection:

[1]BTOC-Below Top of Casing
[2]TOC-Top of Casing
[3]Specific Electrical Conductance

Stabilization Criteria

D.O.	+/- 0.3 mg/l
Turb.	+/- 10%
S.C.	+/- 3%
ORP	+/- 10 mV
pH	+/- 0.1 unit

Time	Pumping rates (L/Min)	Water level (ft)	DO (mg/L)	ORP (mv)	SEC³	Turb. (NTU)	pH	Temp. (C⁰)	Volume pumped (L)
10:45	0.200	14.07	0.00	80	1.90	249	7.22	11.72	
10:48	↓	•	0.00	80	1.90	330	7.22	11.81	
10:50		14.08	0.00	80	1.91	208	7.21	11.85	
10:53		14.10	0.00	81	1.90	188	7.20	11.75	
10:56			0.00	81	1.89	165	7.20	11.67	
* 10:59	↓	14.12	0.00	80	1.88	246	7.21	11.73	
	* clear out fine sediment from the cell of Horiba - turbidity was bouncing around								

Time	Pumping rates (L/Min)	Water level (ft)	DO (mg/L)	ORP (mv)	SEC³	Turb. (NTU)	pH	Temp. (C⁰)	Volume pumped (L)
				Bubble in cell - removed					
11:04	0.200	14.12	1.67*	92	1.97	111	7.22 ~~11.38~~ 01/14/12	11.40	
11:07	↓	14.17	1.55	89	1.97	97.5	7.24	11.42	
11:10			0.60	86	1.97	107	7.24	11.56	
11:13			0.10	85	1.96	78.2	7.24	11.68	
11:16			0.00	84	1.96	71.6	7.25	11.73	
11:19	↓		0.00	83	1.96	68.1	7.24	11.77	
11:22	0.200	14.21	0.00	85	1.96	62.4	7.20	11.84	15.2

Time	Pumping rates (L/Min)	Water level (ft)	DO (mg/L)	ORP (mv)	SEC³	Turb. (NTU)	pH	Temp. (C⁰)	Volume pumped (L)
11:25	0.200		0.00	83	1.96	57.4	7.23	11.77	
11:28	↓		0.00	82	1.95	54.4	7.24	11.84	
11:31	↓		0.00	81	1.95	61.2	7.24	11.88	
11:34	0.200	14.25	0.00	82	1.94	57.2	7.24	11.86	
		stable.		sample collected @		11:41 am for	NO3	only	

Ground Water Sampling Log

Site Name: Yakima Nitrate **Well #:** HK-12 **Date:** 1/3/13

Well Depth(Ft-BTOC[1]): 75.5 **Screen Interval(Ft):**

Well Dia.: 2 **Casing Material:** PVC **Sampling Device:** Geotech Bladder pump

Pump placement(Ft from TOC[2]):

Measuring Point: TC - mark **Water level (static)(Ft):** 25.7

Water level (pumping)(Ft): **Pump rate(Liter/min):** ~.3 LPM

Sampling Personnel: B. Ciecko, M. Wurdeman

Other info: (such as sample numbers, weather conditions and field notes) 1537. Begin purge

Ammonia test strip: 0.25

Nitrate test strip: ~20 ppm

Water Quality Indicator Parameters

Time	Pumping rates (L/Min)	Water level (ft)	DO (mg/L)	ORP (mv)	Turb. (NTU)	SEC[3] ~~(S/cm)~~ mS/cm	pH	Temp. (C^0)	Volume pumped (L)
1546	0.3 LPM	25.9	7.55	184	116	1.31	7.24	5.95	.25
1600	"	25.89	2.04	138	86	1.28	7.05	10.50	4.25
1610	"	25.92	1.59	123	32.0	1.28	7.07	10.62	7.75
1616	"	26.01	1.55	116	18.8	1.27	7.07	10.6	9.75
1622	"	25.96	1.52	112	11.9	1.27	7.07	10.75	11.75
1625	"	25.89	1.50	110	9.82	1.27	7.05	10.9	12.75
1630	"	26.01	1.39	109	7.84	1.27	7.06	10.92	14.0

Continued →

Type of Samples collected:

1645 collect sample at HK-12 IN 2-500 mL poly's, one pres w/ H_2SO_4

1 casing volume was:

Total volume purged prior to sample collection:

[1]BTOC-Below Top of Casing
[2]TOC-Top of Casing
[3]Specific Electrical Conductance

Stabilization Criteria

D.O.	+/- 0.3 mg/l
Turb.	+/- 10%
S.C.	+/- 3%
ORP	+/- 10 mV
pH	+/- 0.1 unit

Time	Pumping rates (L/Min)	Water level (ft)	DO (mg/L)	ORP (mv)	SEC³	Turb. (NTU)	pH	Temp. (C⁰)	Volume pumped (L)
1642	0-31PM		1.40	108	1.27	5-29	7.09	10.86	

Time	Pumping rates (L/Min)	Water level (ft)	DO (mg/L)	ORP (mv)	SEC³	Turb. (NTU)	pH	Temp. (C⁰)	Volume pumped (L)

Time	Pumping rates (L/Min)	Water level (ft)	DO (mg/L)	ORP (mv)	SEC³	Turb. (NTU)	pH	Temp. (C⁰)	Volume pumped (L)

Appendix C
Sample Alteration Forms

Sample Alteration Form

Project Name and Number: _Lower Yakima Dairy Investigation, ESD-163F

Material to be Sampled: _Investigation-Derived Waste

Measurement Parameter: _See Attached Table 1.

Standard Procedure for Field Collection & Laboratory Analysis (cite reference):

_Up to three (3) composite samples from the containerized wastewater will be collected and sent to TestAmerica Tacoma for analyses. See approved project QAPP and attached Table 1 for field sampling SOPs and analytical method references.

Reason for Change in Field Procedure or Analysis Variation:

_The wastewater treatment plant (WWTP) where drilling wastewater will be discharged, which was named in Section 5 of the Work Plan, has been changed to the City of Zillah WWTP. The analyses in Table 1 were added to meet the WWTP requirements.

Variation from Field or Analytical Procedure:

_None

Special Equipment, Materials or Personnel Required:

_None

Initiators Name: _____ Date: 12/20/2012

Project Officer: _____ Date: 12/20/2012

QA Officer: _____ Date: 12/20/2012

Table 1 – Analytes, Methods, Holding Times and Preservation

Analyte	Number of Field Samples	Analytical Method	Reporting Limit	Container Type	Bias (accuracy)	Variability (precision)	Holding Time	Preservation
Laboratory Measurements								
Mercury	3	EPA 245.1	0.0002 mg/L	500ml polyethylene	80-120%	+/- 20%	28 Days	HNO_3 to pH < 2, < 6 deg. C
Metals[1]	3	EPA 200.7	See Footnote[1]	500ml polyethylene	80-120%	+/- 20%	6 Months	HNO_3 to pH < 2, < 6 deg. C

[1]Priority Pollutant Metal (Reporting Limit) – Antimony (0.06 mg/L), Arsenic (0.06 mg/L), Beryllium (0.005 mg/L), Cadmium (0.01 mg/L), Chromium (0.025 mg/L), Copper (0.02 mg/L), Lead (0.03 mg/L), Nickel (0.02 mg/L), Selenium (0.1 mg/L), Silver (0.02 mg/L), Thallium (0.1 mg/L), Zinc (0.04 mg/L)

SAMPLE PLAN ALTERATION FORM
(QAPP Addendum)

QAPP Title, Author (company), Revision, and Approval Date of standing 'parent' QAPP:

Quality Assurance Project Plan, Lower Yakima Valley Dairy Investigation, December 2012, by U.S. Environmental Protection Agency, Region 10

Project Name and assigned Regional Project Code:

Lower Yakima Valley Dairy Investigation, ESD-163F

Material to be Used:

Installation of wells with a sand pack of grade 10-20 sand outside screens was planned for all the monitoring wells.

Measurement Parameters:

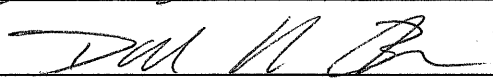
Standard Procedure for Field Collection and Laboratory Analysis (cite references):

Reason for Change in Field Procedure or Analytical Variation:

Had several wells which were deeper than anticipated and ran out of the grade 10-20 sand which the driller had available, and the only sand which they could obtain was a sand of grade 8-12 which was coarser. Given that we had a tight field schedule days I (Rene Fuentes, USEPA, Lead Project Hydrogeologist) approved the change to the coarser material.

Variation from Field or Analytical Procedure (reference specific QAPP sections):

Special Equipment, Materials, or Personnel Required:

CONTACT, Title	APPROVAL SIGNATURE	DATE
Initiator: Rene Fuentes		30 January 2013
EPA Project Coordinator: Eric Winiecki		30 January 2013
EPA QA Officer: Donald M. Brown		30 January 2013

SAMPLE PLAN ALTERATION FORM
(QAPP Addendum)

QAPP Title, Author (company), Revision, and Approval Date of standing 'parent' QAPP:

Quality Assurance Project Plan, Lower Yakima Valley Dairy Investigation, December 2012, by U.S. Environmental Protection Agency, Region 10

Project Name and assigned Regional Project Code:

Lower Yakima Valley Dairy Investigation, ESD-163F

Material to be Sampled:

Installation of monitoring wells and development based on water quality field parameter stabilization was planned for all the monitoring wells.

Measurement Parameters:

Standard Procedure for Field Collection and Laboratory Analysis (cite references):

Reason for Change in Field Procedure or Analytical Variation:

Had many post calibration problems with the field parameter equipment reliability, even after multiple calibrations over several days. Values, mostly for the turbidity which is the key parameter, seemed significantly higher than what would be expected from a visual comparison, and the values would not stabilize or change in a reasonable pattern.

Variation from Field or Analytical Procedure (reference specific QAPP sections):

The plan was to obtain water quality field parameters using a field monitor, but given that the values obtained seemed too erratic to trust, I (Rene Fuentes, USEPA, Lead Project Hydrogeologist) decided to proceed without the field parameter values as the criteria, and instead relied on visual changes of the water being discharged by the well development team as the criteria to accept well development as completed. Took photos of several of the wells development water to document the changes, and suggested that we use the field parameters during the field sampling event rather than rely on them for determining when well development was complete.

Special Equipment, Materials, or Personnel Required:

CONTACT, Title	APPROVAL SIGNATURE	DATE
Initiator: Rene Fuentes		30 January 2013
EPA Project Coordinator: Eric Winiecki		30 January 2013
EPA QA Officer: Donald M. Brown		30 January 2013

SAMPLE PLAN ALTERATION FORM
(QAPP Addendum)

QAPP Title, Author (company), Revision, and Approval Date of standing 'parent' QAPP:

Quality Assurance Project Plan, Lower Yakima Valley Dairy Investigation, December 2012, by U.S. Environmental Protection Agency, Region 10

Project Name and assigned Regional Project Code:

Lower Yakima Valley Dairy Investigation, ESD-163F

Material to be Sampled:

Installation of wells with bentonite chips used for well construction seal outside the well casing.

Measurement Parameters:

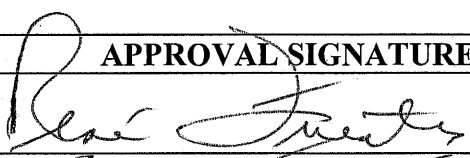
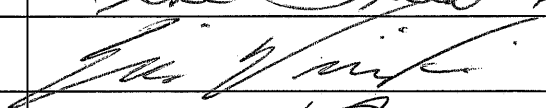
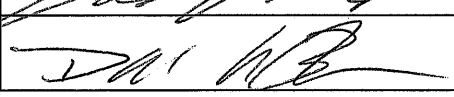
Standard Procedure for Field Collection and Laboratory Analysis (cite references):

Reason for Change in Field Procedure or Analytical Variation:

During the well installation several wells had water levels rise significantly once the air pressure was turned off from the drill rig. Driller requested that we allow the use of bentonite pellets rather than chips since these would sink through the water column outside the well casing faster than chips, and would minimize the potential for bridging with the bentonite chips. I (Rene Fuentes, USEPA, Lead Project Hydrogeologist) agreed that it seemed like a logical solution to the field problem and used the pellets in several wells where the rise in water was considered a problem for the bentonite chips.

Variation from Field or Analytical Procedure (reference specific QAPP sections):

Special Equipment, Materials, or Personnel Required:

CONTACT, Title	APPROVAL SIGNATURE	DATE
Initiator: Rene Fuentes		30 January 2013
EPA Project Coordinator: Eric Winiecki		30 January 2013
EPA QA Officer: Donald M. Brown		30 January 2013

SAMPLE PLAN ALTERATION FORM
(QAPP Addendum)

QAPP Title, Author (company), Revision, and Approval Date of standing 'parent' QAPP:

Quality Assurance Project Plan, Lower Yakima Valley Dairy Investigation, December 2012, by U.S. Environmental Protection Agency, Region 10

Project Name and assigned Regional Project Code:

Lower Yakima Valley Dairy Investigation, ESD-163F

Material to be Sampled:

Installation of wells with twenty (20) foot screens was planned for all the monitoring wells. However, in wells HK-12 and HK-11 there was a zone of finer material which, while saturated, may have caused a turbidity problem if the wells were screened in that zone. I (Rene Fuentes, USEPA, Lead Project Hydrogeologist) and Erin Lynch (E&E Hydrogeologist and Project Manager) decided to use a shorter screen to avoid that zone.

Measurement Parameters:

Standard Procedure for Field Collection and Laboratory Analysis (cite references):

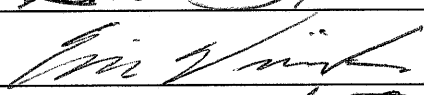
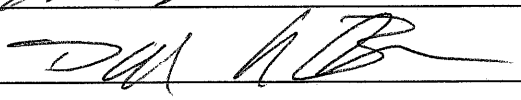
Reason for Change in Field Procedure or Analytical Variation:

Boring material from cyclone and water levels at time of drilling seemed to indicate that there was a zone above the proposed screen zone which may be finer grain material. Shorter screen located deeper to avoid getting too many of the fines in the well screen zones.

Variation from Field or Analytical Procedure (reference specific QAPP sections):

Due to the apparent formation and water depths, ten (10) foot long screens were used.

Special Equipment, Materials, or Personnel Required:

CONTACT, Title	APPROVAL SIGNATURE	DATE
Initiator: Rene Fuentes		28 January 2013
EPA Project Coordinator: Eric Winiecki		28 January 2013
EPA QA Officer: Donald M. Brown		28 January 2013

Sample Alteration Form

Project Name and Number: _Lower Yakima Dairy Investigation, ESD-163F_____

Material to be Sampled: _Groundwater from monitoring wells._____

Measurement Parameter: _Ammonia_____

Standard Procedure for Field Collection & Laboratory Analysis (cite reference):
_ See approved project QAPP for field sampling SOPs and analytical method references._____

Reason for Change in Field Procedure or Analysis Variation:
_The QAPP called for equipment blanks to be sampled at a rate of one per sampling team for each analytical parameter. Since the EPA sampling team had no positive test strip results for ammonia, the equipment blank collected by EPA (Sample ID 12534021) will be canceled for analysis. Additionally, the QAPP called for trip blanks to be sent with each sample cooler. However, since the equipment and field blanks represent the same sampling conditions (i.e., preservation and sample container) as the trip blanks, the two trip blanks (Sample IDs 12534012 and 12534013) will be canceled for the ammonia analysis. _____

Variation from Field or Analytical Procedure:
_None_____

Special Equipment, Materials or Personnel Required:
_None_____

Initiators Name: _____ Date: 01/07/2013

Project Officer: _____ Date: 1/7/2013

QA Officer: _____ Date: 1/7/2013

Appendix D
Data Validation Memoranda

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, Washington 98101

January 9, 2013

Reply to: Donald M. Brown
Attn of: OEA-095

MEMORANDUM

Subject: Data Validation Report for the Nitrate Analysis of the Water Samples Collected for the Lower Yakima Valley Dairy Investigation – Project Code ESD-163F

From: Donald M. Brown, QA Chemist DMB
USEPA Region 10, Office of Environmental Assessment, Environmental Services Unit

To: Eric Winiecki, Project Coordinator
USEPA Region 10, Office of Water and Watersheds, Drinking Water Unit

The quality assurance (QA) review of the analytical data generated from the analysis of ten (10) well water samples, two (2) trip blanks, two (2) equipment blanks, two (2) field blanks, and two (2) field duplicates collected from the above referenced project has been completed. These samples were analyzed for Nitrate in accordance with EPA Method 300.0 by TestAmerica Laboratories, Inc. located in Denver, Colorado.

This review was conducted for the following samples (station locations identified in parentheses):

12534000 (DC-3)	12534006 (HK-10)	12534016 (FD01WT)
12534001 (DC-14)	12534007 (HK-11)	12534017 (FD02WT)
12534002 (DC-07)	12534008 (HK-12)	12534020 (EB01WT)
12534003 (DC-04)	12534009 (DC-05)	12534021 (EB02WT)
12534004 (DC-09)	12534012 (TB01WT)	12534024 (FB01WT)
12534005 (DC-1)	12534013 (TB02WT)	12534025 (FB02WT)

The validation was conducted according to the Quality Control Specifications outlined in the *Quality Assurance Project Plan for the Lower Yakima Valley Dairy Investigation* (December 2012), *USEPA Method 300.0 – Determination of Inorganic Anions by Ion Chromatography* (Revision 2.1, August 1993), and the *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review* (USEPA-540-R-10-011). Some of the data quality elements may be qualified using the reviewer's professional judgment. The conclusions presented herein are based on the information provided for the review.

Holding Time

Sample holding times were evaluated from the dates of sample collection to the dates of sample analysis. All samples were analyzed within the 48 hour holding time for nitrate.

Sample Results & Reporting Limits

A comparison of the reported analyte values was conducted against the instrument data and the results were verified. All sample results that were less than the method detection limit (MDL) were considered non-detected (ND) and qualified "U". Additionally, sample results that were greater than the MDL but less than the reporting limit (RL) were qualified "J".

The following samples were reanalyzed at dilutions (listed in parentheses) to bring the concentration of nitrate within the linear range of the instrument: 12534000 (50X), 12534001 (5X), 12534003 (5X), 12534005 (2X), 12534007 (5X), 12534008 (5X), and 12534009 (5X). Results for this analyte in these samples are reported from the diluted analyses and the reporting limit is elevated.

Field Quality Control

There are two (2) field duplicate pairs in this data set and they are identified as follows: sample 12534002 is the parent sample of field duplicate 12534016 and sample 12534004 is the parent sample of field duplicate 12534017. All field QA/QC samples were evaluated according to the specifications listed in the quality control results table below.

Quality Control Results Summary

The assessment of instrument specific quality control results included instrument calibration, verification standards, and blanks. Sample quality control results were assessed for matrix spike and matrix spike duplicate (MS/MSD) recoveries as well as laboratory duplicate comparison. Field quality control results were assessed for blanks and field duplicate comparison. The following table is a list of these quality control indicators, the relevant evaluation criteria, and an indication of compliance.

Quality Control Test	Outliers?	Evaluation Criteria
Calibration, Method, Equipment, Field, & Trip Blanks	N	Non-detect or sample <10X Blank
Initial & Continuing Calibration Verification	N	90 – 110%
Method Reporting Limit Check	N	50 – 150%
Laboratory Control Sample / Laboratory Control Sample Duplicate	N	90 – 110%
LCS/LCSD Comparison	N	<10% RPD
Matrix Spike / Matrix Spike Duplicate	N	80 – 120 %
MS/MSD Comparison	N	<20% RPD
Laboratory Duplicate Comparison	N	<15% RPD
Field Duplicate Comparison	N	<20% RPD

(Note: RPD = Relative Percent Difference)

Data Qualifiers

The following is a list of validation qualifiers applied to the sample result(s) when needed to indicate associated out-of-control QA/QC results:

Data Qualifiers	
U	The material was analyzed for but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.
J	The associated value is an estimated quantity.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10 LABORATORY
7411 Beach Dr. East
Port Orchard, Washington 98366

QUALITY ASSURANCE MEMORANDUM FOR INORGANIC CHEMICAL ANALYSES

Date: January 14, 2013

To: Eric Winiecki, Project Manager
Office of Water and Watersheds, US EPA Region 10

From: Katie Adams, Chemist
Office of Environmental Assessment, US EPA Region 10 Laboratory

Subject: Quality Assurance Review of Yakima Basin Monitoring Well Sampling for Ammonia

Project Code: ESD-163F
Account Code: 20132014B10P501E44

CC: Renee Nordeen, E&E

The following is a quality assurance review of the results of the analysis of 6 water samples for ammonia. These samples were submitted for the Yakima Basin Monitoring Well Sampling Project. The analyses were performed by EPA chemists at the US EPA Region 10 Laboratory in Port Orchard, WA, following US EPA and Laboratory guidelines.

This review was conducted for the following samples:
12534000 12534004 12534008 12534017 12534020 12534024

Data Qualifications

Comments below refer to the quality control specifications outlined in the Laboratory's current Quality Assurance Manual, Standard Operating Procedures (SOPs) and the Quality Assurance Project Plan (QAPP). No excursions were required from the method Standard Operating Procedure.

All measures of quality control met Laboratory/QAPP criteria.

For those tests for which the USEPA Region 10 Laboratory has been accredited by the National Environmental Laboratory Accreditation Conference (NELAC), all requirements of the current NELAC Standard have been met.

1. Sample Transport and Receipt

Upon sample receipt, all conditions met Laboratory/QAPP requirements for this project.

2. Sample Holding Times

The concentration of an analyte in a sample or sample extract may increase or decrease over time depending on the nature of the analyte. For this reason, holding time limits are recommended for samples. The samples covered by this review met method holding time recommendations.

3. Sample Preparation

Samples were prepared according to the method outlined in the SOP for this analyte for this type of matrix. No qualification of the data was required based on sample preparation. A comparison study was performed to ensure similar

analytical results are obtained from analyzing distilled and non-distilled samples; reported results are from the non-distilled analysis.

4. Initial Calibration and Calibration Verification

The linear regression generated for the initial calibration met method criteria. The low point of the calibration curve is usually the Minimum Reporting Level (MRL) of the method. All calibration verification checks met the frequency and recovery criteria on the day of analysis. No qualification was required based on calibration or calibration verification.

5. Laboratory Control Samples

All laboratory control sample results met the recovery acceptance criteria for the method and project QAPP. No qualification was required based on laboratory control sample analysis.

6. Blank Analysis

The method blank did not contain detectable levels of analyte which would require data qualification.

7. Duplicate Analysis

Duplicate analysis was performed on sample 12534004. Sample results which were greater than five times the MRL level were within the +/- 20% RPD requirement. No qualification was required based on duplicate analysis.

8. Matrix Spike/Matrix Spike Duplicate Analysis

Matrix spike analyses were performed on sample 12534004. Sample results were within the 75-125% recovery and relative percent difference (RPD) requirements. No qualification was required based on matrix spike analyses.

9. Reporting Limits

All sample results that fall below the MRL are assigned the value of the MRL and the 'U' qualifier is attached.

10. Data Qualifiers

The (U) qualifier was attached to those results which were below the Method Reporting Limit (MRL). No other qualification was required. The definition for the data qualifier is as follows:

U - The analyte was not detected at or above the reported value.

The usefulness of qualified data should be treated according to the severity of the qualifier in light of the project's data quality objectives. Should questions arise regarding the data, contact Katie Adams at the Region 10 Laboratory, phone number (360) 871- 8748.

11. Definitions

Accuracy - the degree of conformity of a measured or calculated quantity to its actual value.

Duplicate Analysis – when a duplicate of a sample (DU), a matrix spike (MSD), or a laboratory control sample (LCSD) is analyzed, it is possible to use the comparison of the results in terms of relative percent difference (RPD) to calculate precision.

Laboratory Control Sample (LCS) - a clean matrix spiked with known quantities of analytes. The LCS is processed with samples through every step of preparation and analysis. Measuring percent recovery of each analyte in the LCS provides a measurement of accuracy for the analyte in the project samples. A

laboratory control sample is prepared and analyzed at a frequency no less than one for every 20 project samples.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) - Sample analyses performed to provide information about the effect of the sample matrix on analyte recovery and measurement within the project samples. To create the MS/MSD, a project sample is spiked with known quantities of analyte and the percent recovery of the analyte is determined.

Method Blank- An analytical control that is carried through the entire analytical procedure. The method blank is used to define the level of laboratory background and reagent contamination. A method blank is prepared and analyzed for every batch of samples at a minimum frequency of one per every 20 samples. To produce unqualified data, the result of the method blank analysis is required to be less than the MRL and less than 10 times the amount of analyte found in any project sample.

Minimum Reporting Level (MRL) - the smallest measured concentration of a substance that can be reliably measured using a given analytical method.

Precision – the degree of mutual agreement or repeatability among a series of individual results.

Relative Percent Difference – The difference between two sample results divided by their mean and expressed as a percentage.