1246627

[00679664]

SGW-58157
Revision 0

Borehole Summary Report for the Installation of Three Wells in the 100-KR-4 Operable Unit, FY2013

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

CH2MHILL
Plateau Remediation Company
P.O. Box 1600
Richland, Washington 99352

RECEIVED
OCT 26 2017
EDMC

Approved for Public Release;
Further Dissemination Unlimited

159

1246627

SGW-58157
Revision 0

Borehole Summary Report for the Installation of Three Wells in the 100-KR-4 Operable Unit, FY2013

Document Type: RPT

J. K. Carter
Freestone Environmental, Inc.

Date Published
October 2014

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

CH2MHILL
Plateau Remediation Company
P.O. Box 1600
Richland, Washington 99352

APPROVED
By Janis D. Aardal at 9:27 am, Oct 02, 2014

Release Approval Date

RECEIVED
OCT 2 6 2014
EDMC

Approved for Public Release;
Further Dissemination Unlimited

TRADEMARK DISCLAIMER

Reference herein to any specific commercial product, process, or service by tradename, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors.

This report has been reproduced from the best available copy.

Printed in the United States of America

Contents

1 Introduction 1-1

1.1 Purpose and Scope 1-1

2 Field Activities 2-1

2.1 General Information 2-1

2.1.1 Well Drilling and Borehole Logging 2-1

2.1.2 Sampling and Health and Safety Screening 2-1

2.1.3 Well Construction and Development 2-2

2.2 Site Specific Information for Groundwater Wells 2-3

2.2.1 Well 199-K-210 (C8297) 2-6

2.2.2 Well 199-K-212 (C8299) 2-8

2.2.3 Well 199-K-220 (C8795) 2-9

3 Geologic Observations 3-1

3.1 General Geology Description 3-1

3.2 Borehole Geology 3-1

3.2.1 Borehole Geology for Well 199-K-210 (C8297) 3-1

3.2.2 Borehole Geology for Well 199-K-212 (C8299) 3-2

3.2.3 Borehole Geology for Well 199-K-220 (C8795) 3-3

3.3 Hydrogeology 3-4

3.4 Contaminants 3-4

4 Waste Management 4-1

4.1 Vadose Zone Cuttings 4-1

4.2 Saturated Zone Cuttings 4-1

4.3 Purgewater 4-1

5 Civil Survey 5-1

6 Well Acceptance 6-1

7 References 7-1

Figure

Figure 1-1. Well Locations in 100-KR-4 OU 1-3
Figure 2-1. Stillwater Drilling, Inc. Bucyrus-Erie 22-W Cable-Tool Rig 2-6

Tables

Table 1-1. Identification of New Wells in 100-KR-4 OU 1-2
Table 2-1. Well Construction Information 2-4
Table 2-2. Well Development Information 2-5
Table 2-3. C8297 Split-Spoon Samples 2-7
Table 2-4. C8297 Groundwater Samples Collected During Drilling 2-7
Table 2-5. C8299 Split-Spoon Samples 2-8
Table 2-6. C8299 Groundwater Samples Collected During Drilling 2-9
Table 2-7. C8795 Split-Spoon Samples 2-10
Table 2-8. C8795 Groundwater Samples Collected During Drilling 2-10
Table 5-1. Surveyed Well Locations 5-1

Appendices

A. Well Documentation for 199-K-210 (C8297) ..... A-i
B. Well Documentation for 199-K-212 (C8299) ..... B-i
C. Well Documentation for 199-K-220 (C8795) ..... C-i

Terms

bgs	below ground surface
CHPRC	CH2M Hill Plateau Remediation Company
CrVI	hexavalent chromium
HCl	hydrochloric acid
KE	100-K East
KW	100-K West
NMLS	Neutron Moisture Logging System
OU	operable unit
ppm	parts per million
Ringold Unit E	Ringold Formation member of Wooded Island Unit E
RUM	Ringold Upper Mud unit
SGLS	Spectral Gamma Logging System
Stoller	S. M. Stoller, Inc.
TD	total depth
WAC	*Washington Administrative Code*

This page intentionally left blank.

1 Introduction

This report presents field-generated records and summarizes field activities performed during the drilling and construction of three pump and treat wells in the 100-K Area of the Hanford Site. Extraction wells are being installed to increase mass removal of hexavalent chromium (Cr[VI]) from groundwater and to provide better plume definition and capability for removal of strontium-90 from the groundwater.

The 100-KR-4 Operable Unit (OU) is located in the northwest portion of the Hanford Site along the southern shoreline of the Columbia River and is located approximately 28 miles north-northwest of Richland, Washington. The 100-KR-4 groundwater OU includes the 100-K East (KE) and 100-K West (KW) Reactor Areas and adjacent portions of the 600 Area.

The primary groundwater contaminant of concern in the 100-KR-4 OU is Cr(VI). Groundwater co-contaminants of concern are strontium-90, carbon-14, nitrate, trichloroethylene, and tritium. Cr(VI) groundwater contamination originated from planned discharges of chromium-treated cooling water in addition to planned and unplanned releases of concentrated sodium dichromate solution used to treat the reactor cooling water. Tritium, nitrate, and carbon-14 were primarily released to the ground in wastewater at the 116-KE-1 and 116-KW-1 Reactor Gas Dryer Condensate Cribs. Strontium-90 in radiologically-contaminated water from the reactor fuel storage basins was discharged to the 116-KE-3 and 116-KW-2 Cribs/Reverse Wells. Radiologically-contaminated reactor cooling water, also containing strontium-90, was released to the ground at the 116-K-2 Trench. A specific source and release point has not been identified for the trichloroethylene observed in groundwater near the 105-W Reactor; it is assumed to have originated from the use of the solvent during maintenance and repair of reactor components. The installation of the three groundwater wells supports Ecology et al., (1989), *Hanford Federal Facility Agreement and Consent Order*, and will be in compliance with requirements of the *Resource Conservation and Recovery Act of 1976* as well as the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980.*

Drilling and construction activities occurred from March 11, 2014 through June 9, 2014 by Stillwater Drilling Company, Inc. under the direction of CH2M HILL Plateau Remediation Company (CHPRC). Freestone Environmental Services, Inc. provided well site geology and well construction documentation services. S. M. Stoller, Inc. (Stoller) provided geophysical logging services.

1.1 Purpose and Scope

The purpose of this document is to compile field records and summarize observations and measurements made during the drilling and construction of the three new groundwater extraction wells. This report includes field notes and forms, well construction details, well development data, and geologic observations. Additional information provided in this report includes civil survey results and records of the management of investigation-derived waste and the well acceptance.

The primary controlling documents for the drilling and construction activities were the *Statement of Work for the Installation of Three Wells in the 100-KR-4 Operable Unit, FY 2014* and SGW-56414, *Description of Work for the Installation of Three Wells in the 100-KR-4 Operable Unit, FY 2014*. Soil and groundwater sampling activities were performed in accordance with addendums 1 and 2 of *DOE/RL-2013-36, 100-KR-4 Operable Unit Well Installation Sampling and Analysis Plan*. The locations of the three new groundwater wells are shown in Figure 1-1. Well identification and drilling date information are presented in Table 1-1. Appendices A (C8297), B (C8299), and C (C8795) contain the borehole geologic log, well summary sheet, well development and testing data, sample collection summary, photographic log, well survey report, and geophysical logs for the respective well.

All field measurements obtained during drilling or construction are reported in the units in which they were made and with the same number of significant digits as originally recorded. For convenience, all wells are referred to in the text by their well identification number (e.g., C8289).

Table 1-1. Identification of New Wells in 100-KR-4 OU

Well ID	Well Name	Well Type	Ecology ID Number	Well Activity Dates	
				Drilling Start Date	Well Completion Date
C8297	199-K-210	Extraction	BIF 359	March 11, 2014	June 3, 2014
C8299	199-K-212	Extraction	BIF 370	March 19, 2014	May 20, 2014
C8795	199-K-220	Extraction	BIF 382	March 31, 2014	June 9, 2014

Ecology = Washington State Department of Ecology

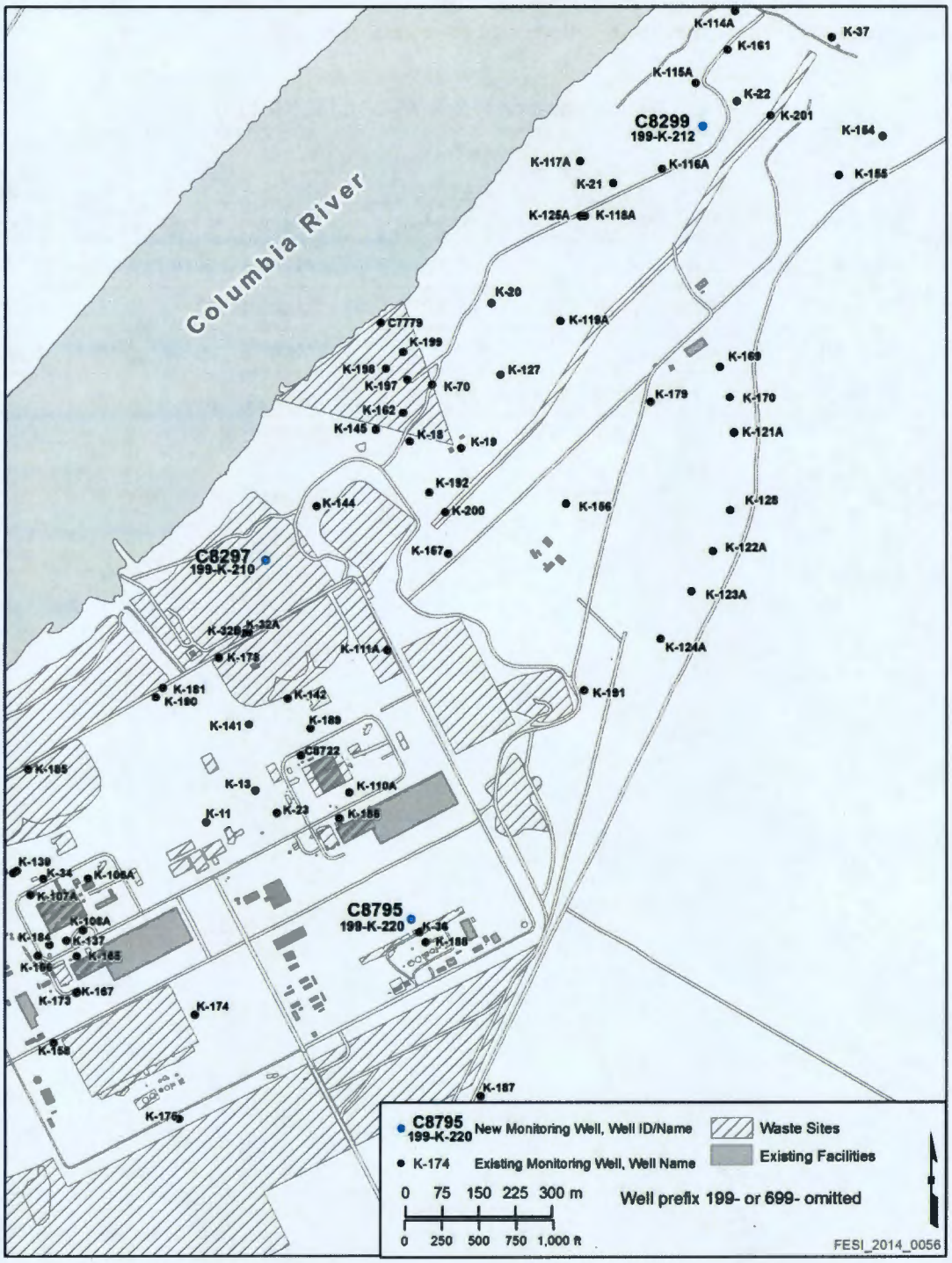


Figure 1-1. Well Locations in 100-KR-4 OU

This page intentionally left blank.

2 Field Activities

This section summarizes the field activities associated with the three groundwater wells. Drilling, sampling, and construction details common to all the wells are summarized in Section 2.1. Well-specific information is presented in Tables 2-1 and 2-2, and Section 2.2. Geologic borehole logs, well summary sheets, geophysical logs, and drill cutting photographs for each borehole are presented in Appendices A through C.

2.1 General Information

Sections 2.1.1 through 2.1.3 summarize activities common to the drilling, sampling, and installation of the three groundwater wells.

2.1.1 Well Drilling and Borehole Logging

The boreholes were drilled and the wells were constructed to Washington State standards detailed in the WAC 173-160, *Minimum Standards for Construction and Maintenance of Wells*. Well construction activities were recorded and borehole geology was logged in accordance with CHPRC procedures SGRP-PRO-EN-50030 (GRP-EE-02-14.1), *Drilling, Remediating, and Decommissioning Resource Protection Wells, and Geotechnical Soil Borings,* and SGRP-PRO-EN-50025 (GRP-EE-01-7.0), *Geologic Logging.*

2.1.1.1 Borehole Geologic Logging and Photography

Detailed descriptions of all drill cuttings were recorded according to CHPRC procedure SGRP-PRO-EN-50025. Scaled digital photographs were taken in the field to accompany the field description. Geologic logs and drill cutting photographs for each borehole are presented in Appendices A through C.

2.1.1.2 Geophysical Logging

Each borehole was logged using Stoller's Spectral Gamma Logging System (SGLS) and Neutron Moisture Logging System (NMLS) to identify natural and man-made gamma-emitting radionuclides and moisture levels in each borehole. Borehole logging was performed through the temporary casing to produce a geophysical log of the entire length of the borehole. Log Data Reports of all geophysical logging results, provided by Stoller, are presented in Appendices A through C.

2.1.2 Sampling and Health and Safety Screening

2.1.2.1 Archive Lithologic Sampling

Archive samples were collected from the drill cuttings at each borehole at 5-ft intervals. Samples were placed in labeled pint-sized glass jars and sequential chip tray compartments for archive storage.

2.1.2.2 Sieve Sampling and Analysis

Sediment samples were collected for sieve analysis every 5 ft, then composited over 10-ft intervals through the saturated zone. A sieve analysis was performed in accordance with SGRP-PRO-OP-50037 (GRP-EE-05-1.21), *Particle Size Distribution of Soil-Wet Sieve Analysis,* on each composite sample. Sieve analyses were used to determine the appropriate screen slot size for the completed well. Sieve analysis results are presented in Appendices A through C.

2.1.2.3 Split-Spoon Sampling

Split-spoon samples were collected at the top and bottom of the unconfined aquifer and at the midpoint of the planned screen interval for physical and chemical analyses of the sediment in each borehole. The samples were collected by driving a decontaminated 4-in diameter split-spoon 2.5 ft through the sampling

interval or until refusal. Split-spoon sample depths and associated *Hanford Environmental Information System* (HEIS) numbers are included in Appendices A through C.

2.1.2.4 Groundwater Sampling

Groundwater samples were collected at the top and bottom of the unconfined aquifer and at the midpoint of the planned screen interval using a temporary submersible pump. When conditions prevented sample collection at the planned depth due to insufficient yield or heaving sands, the borehole was advanced 5 to 10 ft for sample collection. Boreholes were purged for a minimum of three borehole volumes and until the dissolved oxygen level stabilized at or above 7 mg/L to ensure that groundwater samples are representative of undisturbed groundwater conditions. Drilling has been shown to create reducing conditions proximate to the borehole which may result in inaccurate Cr(VI) chemical analysis results. Groundwater samples were collected by CHPRC nuclear chemical operators once field parameters (temperature, pH, conductivity, dissolved oxygen, turbidity, and oxidation-reduction potential) were allowed to stabilize within 10 percent of variance over three consecutive measurements prior to sample collection according to CHPRC procedure GRP-FS-04-G-012, *Sample Packaging, Transporting and Shipping*. Each completed well also had one groundwater sample collected at the end of well development for laboratory analysis. All groundwater sample depths and associated HEIS numbers are included in Appendices A through C.

2.1.2.5 Radiological Field Screening

A radiological control technician performed radiological surveys of the drill cuttings, geologic samples, temporary drive casing, and driller's control station every morning and afternoon at wells C8299 and C8795 using standard field screening instruments. Continuous radiological support and a radiological buffer zone were required at C8297 due to low-level radiological contamination in the surrounding soil. No field measurements above background levels were reported during the installation of wells C8299 and C8795. Radiation readings slightly above background levels were detected in the cuttings during the first five feet of drilling at well C8297, but were not significant enough to suspend drilling.

2.1.2.6 Air Quality Monitoring

Air quality monitoring was performed by an industrial hygienist technician twice daily to check for volatile organic contamination. The drillers' breathing zone near the wellhead, the fresh drill cuttings, and geologic samples were surveyed for volatile organic compounds using a photo-ionization detector. Additional air quality monitoring was conducted in the breathing zone during both split-spoon and groundwater sampling. Elevated volatile organic compound (VOC) levels (120 ppm) from sediments in the 84.7 to 87.2 ft bgs split spoon sample at well C8297 on March 25, 2014. An odor was detected by the drillers during drilling at well C8297 on March 26, 2014. Work stopped after both occurrences until the lead industrial hygienist determined it was safe for work to continue. In both occurrences, work continued based on the recommendation of the lead industrial hygienist. No other field measurements above background levels were reported during drilling activities.

Continuous industrial hygienist support and noise dosimeters were required during drilling at C8795 due to a noise exposure level exceeding the OSHA limit of 85 decibels in an eight-hour shift. Noise levels were determined safe after two days of drilling, discontinuing noise coverage.

2.1.3 Well Construction and Development

2.1.3.1 Backfill Material

Backfill material was not necessary at the three borehole sites. Specific well construction information is listed in Table 2-1.

2.1.3.2 Well Screen and Casing

Each well was constructed using 6-in nominal diameter, schedule 10, 304/304L stainless steel casing, continuous wire wrap stainless steel well screen and a sump with end cap. Centralizers were installed above and below the screen and at 40-ft intervals to ground surface. The well summary sheets included in the appendices provide visual representations of each well design as-built.

2.1.3.3 Primary Filter Pack

The filter pack surrounding the screen at wells C8297 and C8795 consists of 10-20 mesh Colorado Silica Sand (CSS) .The filter pack at well C8299 consists of 8-12 mesh Colorado silica sand. Following placement of each 10-ft interval, the filter pack was surged using a dual surge block until measured settling met CHPRC well development specifications (i.e., less than 0.1 ft of settling in 15 minutes of surging).

2.1.3.4 Annular Seal

Directly above the primary filter pack, 3 to 5 ft of 3/8-in coated bentonite pellets were placed to form an impermeable seal. Bentonite crumbles were used for a seal at well C8297 instead of bentonite pellets in accordance with the well design. Medium bentonite chips or crumbles were placed above the pellets to approximately 10 ft bgs. The annular surface seal consists of Portland Type I/II cement grout placed from the bentonite to ground surface.

2.1.3.5 Surface Completion

The surface completion consists of a 8-in nominal diameter stainless steel protective casing, a 4-ft by 4-ft concrete pad, and a protective cap with locking hasp. Four, 3-in diameter steel posts were installed at each corner of the cement pad and extend to 3 ft above the ground surface.

2.1.3.6 Well Development

Well development occurred at each well following completion. Development was performed with a 15 horsepower submersible pump at wells C8297 and C8795, and a 3 and 15 horsepower submersible pump at well C8299 . Wells were developed at one or more intervals depending on the length of the screen. Each interval was pumped until turbidity was less than 5 nephelometric turbidity units and additional water quality parameters (conductivity, pH, and temperature) stabilized. The water level was monitored using an In-Situ Inc., Level TROLL[1] 700 pressure transducer and Rugged Reader[2] datalogger. Final development data is summarized in Table 2-2. Well development was performed in accordance with CHPRC procedure SGRP-PRO-OP-50024 (GRP-EE-01-6.3), *Well Development and Testing*.

2.1.3.7 Washington State Department of Ecology Identification

The unique well identification tags were affixed to the protective casing of each well. The identification numbers are found in Table 1-1.

2.2 Site Specific Information for Groundwater Wells

This section summarizes the borehole drilling and sampling, split-spoon and groundwater sampling, and well construction and development activities specific to each well. Well construction information for each well is summarized in Table 2-1. Well development information for each well is summarized in Table 2-2.

---

[1] Level Troll is a registered trademark of In-Situ, Inc., Fort Collins, Colorado.

[2] Rugged Reader is a registered trademark of In-Situ, Inc., Fort Collins, Colorado.

Table 2-1. Well Construction Information

Well ID	Total Depth Drilled (ft bgs)	Permanent Screen and Casing[a]					Surface Seal[b] (ft bgs)	Annular Seal[c] (ft bgs)	Bentonite Seal[d] (ft bgs)	Primary Filter Pack[e] (ft bgs)	Backfill Material[f] (ft bgs)
		Casing Size	Blank Casing (ft bgs)	Screen (ft bgs)	Screen Slot Size	Sump/End Cap (ft bgs)					
C8297	122.1	6-in	+2.0 – 16.0	16.0 – 116.07	40	116.07 – 121.08	0 – 8.0	N/A	8.0 – 13.2	13.2 – 122.1 (10-20)	N/A
C8299	85.8	6-in	+1.99 – 31.88	31.88 – 76.92	65	76.92 – 81.91	0 – 10.3	10.3 – 25.1	25.1 – 28.2	28.2 – 84.4 (8-12)	84.4 – 85.8
C8795	171.3	6-in	+2.0 – 69.1	69.1 – 164.14	40	164.14 – 169.16	0 – 9.3	9.3 – 60.3	60.3 – 65.3	65.3 – 171.3 (10-20)	N/A

All measurements in feet below ground surface unless otherwise marked.

a. Schedule 10, Type 304/304L Stainless Steel

b. Type I/II Portland cement grout

c. Cetco medium bentonite chips or crumbles

d. Cetco coated bentonite pellets (3/8-in)

e. Premier Colorado silica sand (CSS), 8-12 or 10-20 mesh

f. Borehole slough

+ = above ground surface

N/A = not applicable

Table 2-2. Well Development Information

Well ID	Static Water Level (ft bgs w/ date)	Intake Depth (ft bgs)	Duration (minutes)	Average Flow Rate (gpm)	Final Turbidity (NTU)	Final Drawdown (ft)	Total Gallons Pumped
C8297	17.04 (6/2/2014)	U: 45.5 MU: 66.5 ML: 87.5 L: 108.5	U: 40 MU: 15 & 21 ML: 11 & 30 L: 67 & 46	U: 140 MU: 200 & 140 ML: 200 & 150 L: 195 & 150	U: 1.44 MU: 3.05 ML: 4.97 L: 3.50	U: 10.68 MU: 15.64 & 11.55 ML: 14.28 & 10.89 L: 14.69 & 10.86	38,200
C8795	78.0 (6/5/2014)	U: 88.2 MU: 109.3 ML: 130.4 L: 151.5	U: 49 MU: 32 ML: 64 L: 56	U: 49 MU: 122 ML: 136 L: 161	U: 0.95 MU: 3.61 ML: 2.52 L: 4.64	U: 4.25 MU: 9.88 ML: 10.64 L: 12.5	24,000
C8299	33.38 (5/14/2014)	U: 56.75 MU: 59.18 M: 67.81 ML: 69.18 L: 74.19	U: 76 MU: 85 M: 110 & 13 ML: 90 L: 50	U: 100 MU: 30 M: 162 & 120 ML: 29 L: 27	U: 2.91 MU: 4.82 M: 7.76 & 2.88 ML: 1.17 L: 1.97	U: 12.28 MU: 1.76 M: 24.57 & 12.58 ML: 1.47 L: 1.15	33,500

gpm = gallons per minute
L = lower interval
M = middle interval
ML = middle lower interval
MU = middle upper interval
NTU = nephelometric turbidity unit
U = upper interval

2.2.1 Well 199-K-210 (C8297)

Borehole C8297 was drilled from March 11, 2014 to April 2, 2014 by Stillwater Drilling, Inc. using a Bucyrus-Erie 22-W Series 3 cable-tool rig (Figure 2-1) and temporary 10¾-inch nominal diameter threaded carbon steel casing to reach a total depth (TD) of 122.1 ft bgs. The borehole was drilled using core barrel drilling methods to advance to TD. All temporary casing was removed during well construction.

Figure 2-1. Stillwater Drilling, Inc. Bucyrus-Erie 22-W Cable-Tool Rig

Geologic archive grab samples were collected from drill cuttings at 5-ft intervals throughout the borehole and samples for sieve analysis were collected every 5 ft and composited over 10 ft intervals throughout the aquifer. Split-spoon soil samples and pumped groundwater samples were collected at the top and bottom of the unconfined aquifer and the midpoint of the planned screened interval. There was an additional split-spoon sample collected at 70 ft, the historical high water mark. Groundwater characterization samples were collected using a submersible pump. Sample information is included in Tables 2-3 and 2-4.

Table 2-3. C8297 Split-Spoon Samples

Date	Sample Depth (ft bgs)	Sample Method	Media	Recovery %	HEIS number
3/13/14	26.8 – 29.3	Split-Spoon	Soil	100	B2T034(RS), B2R2X0
3/20/14	60.3 – 62.8	Split-Spoon	Soil	100	B2T036, B2T038(RS)
3/25/14	84.7 – 87.2	Split-Spoon	Soil	100	B2TIL0(RS),B2TIL2
4/1/14	109.5 – 112	Split-Spoon	Soil	45	B2W9Y4,B2W9Y5

DUP = duplicate sample

HEIS = *Hanford Environmental Information System*

RS = rad screen

Table 2-4. C8297 Groundwater Samples Collected During Drilling

Date	Depth (ft bgs)	Sample Method	Pump Rate (gpm)	Volume Purged (gal)	Turbidity (NTU)	D.O at Sample Collection (mg/L)	HEIS number
3/13/14	30.5	Groundwater pumped	1.85	98	71.7	8.01	B2W306, B2W313
3/20/14	62.8	Groundwater pumped	7.5	848	18	7.61	B2W308, B2W314
3/25/14	87.2	Groundwater pumped	23	1,610	10.7	7.79	B2W309, B2W310, B2W315
4/1/14	109.61	Groundwater pumped	27.3	1,611	9.97	7.05	B2W9Y2, B2W9Y3
6/3/14	45.5	Groundwater pumped	139	5,560	1.44	–	B2W311, B2W312, B2W316, B2X1L5

D.O. = dissolved oxygen

gpm = gallons per minute

HEIS = *Hanford Environmental Information System*

NR = not recorded

NTU = nephelometric turbidity unit

The entire borehole was logged using a SGLS on April 7, 2014. The dry portion of the borehole to 18.25 ft was logged using a NMLS on April 8, 2014. A borehole straightness test was successfully performed on April 2, 2014. Well construction was performed from May 15, 2014 to May 29, 2014. Well development occurred from June 2, 2014 to June 3, 2014 and one groundwater sample was taken with the intake set at 45.5 ft bgs. Static water level was measured before well development at 17.04 ft bgs on June 2, 2014.

2.2.2 Well 199-K-212 (C8299)

Drilling at borehole C8299 was performed from March 19, 2014 to May 27, 2014 by Stillwater Drilling, Inc. using a Bucyrus-Erie 22-W Series 3 cable-tool rig (Figure 2-1) and temporary 10¾-inch nominal diameter threaded carbon steel casing from ground surface to a TD of 85.8 ft bgs. All temporary casing was removed during well construction.

Geologic archive grab samples were collected from drill cuttings at 5-ft intervals throughout the borehole and samples for sieve analysis were collected every 5 ft and composited over 10 ft intervals through the saturated zone. Three split-spoon samples and three groundwater samples were collected at the top and bottom of the unconfined aquifer and at the midpoint of the planned screened interval. Sample information for C8299 is summarized in Tables 2-5 and 2-6.

Table 2-5. C8299 Split-Spoon Samples

Date	Sample Depth (ft bgs)	Sample Method	Media	Recovery %	HEIS number
3/24/14	39.5 – 42	Split-Spoon	Soil	100	B2W318(RS), B2W317
3/25/14	59.8 – 62.0	Split-Spoon	Soil	100	B2W319, B2W320(RS)
3/26/14	70.1 – 72.6	Split-Spoon	Soil	100	B2W328,B2W3C4

DUP = duplicate sample

FTB = field transfer blank

HEIS = *Hanford Environmental Information System*

RS = radiation screen

Table 2-6. C8299 Groundwater Samples Collected During Drilling

Date	Depth (ft bgs)	Sample Method	Pump Rate (gpm)	Volume Purged (gal)	Turbidity (NTU)	D.O at Sample Collection (mg/L)	HEIS number
3/24/14	45	Groundwater Pumping	1.2	135	14.1	8.44	B2W323, B2W324, B2W335
3/25/14	59.6	Groundwater Pumping	5	360	290	8.6	B2W325, B2W326, B2W327, B2W3C3, B2W336
3/26/14	69.9	Groundwater Pumping	5	660	52.2	8.93	B2W328, B2W3C4, B2W337
5/20/14	156.75	Groundwater Pumping	65	6,500	0.61	8.98	B2W331, B2W332, B2W333, B2W334, B2W338

D.O. = dissolved oxygen

gpm = gallons per minute

HEIS = *Hanford Environmental Information System*

NTU = nephelometric turbidity unit

The entire borehole was logged using a SGLS on March 31, 2014 and April 1, 2014. The dry portion of the borehole to 31.25 ft was logged using a NMLS on March 31, 201. A borehole straightness test was successfully performed on April 28, 2014. Two additional successful straightness tests were performed on May 5 and 7, 2014; before and after the permanent well casing was removed, the borehole was cleaned out, and the permanent well casing was repositioned in the borehole. Well construction was performed from April 28, 2014 to May 20, 2014 using a Pulstar Pump Rig. Well development occurred May 14, 2014 to May 20, 2014 and one groundwater sample was taken with the intake set at 156.75 ft bgs. Static water level was measured before well development at 33.38 ft bgs on May 20, 2014.

2.2.3 Well 199-K-220 (C8795)

Drilling at borehole C8795 was performed from March 31, 2014 to April 21, 2014 by Stillwater Drilling, Inc. using a Bucyrus-Erie 22-W Series 3 cable-tool rig (Figure 2-1) and both 13½ -inch and 11¾ -inch nominal diameter temporary welded carbon steel casing to reach a TD of 171.3 ft bgs. The 13-in casing was used to 69.71 ft bgs and the 11½ -in casing to TD. All temporary casing was removed during well construction.

Geologic archive grab samples were collected from drill cuttings at 5-ft intervals throughout the borehole and samples for sieve analysis were collected every 5 ft and composited over 10 ft intervals through the aquifer. Split-spoon soil samples and pumped groundwater samples were collected at the top and bottom of the unconfined aquifer and at the midpoint of the planned screened interval. An additional split-spoon sample was collected at the historic high water mark. Sample information for C8795 is summarized in Tables 2-7 and 2-8.

The borehole was logged on April 2 and 3, 2014 using both the SGLS and NMLS after placement of the 13-in temporary casing to a depth of 70.4 ft bgs. The entire borehole was logged again using the SGLS on April 22, 2014. The upper 79.75 ft of the borehole was logged using the NMLS on April 22, 2014. A borehole straightness test was performed on April 21, 2014 and well construction was performed from May 28, 2014 to June 4, 2014. Well development occurred on June 5, 2014 and June 9, 2014 using a Pulstar Pump Rig and one groundwater sample was taken with the intake set at 88.2 ft bgs. Due to excessive inflow of formation and filter pack sand observed during construction, the well was developed at low pump rates, then stressed by developing at high pump rates. Static water level was measured before well development at 78.0ft bgs on June 5, 2014.

Table 2-7. C8795 Split-Spoon Samples

Date	Sample Depth (ft bgs)	Sample Method	Media	Recovery %	HEIS number
4/2/14	70.4 – 72.1	Split-Spoon	Soil	100	B2TIK5,B2TIK6,B2TIK7(RS),B2TIK8
4/7/14	85.7 – 88.2	Split-Spoon	Soil	100	B2TIK9(RS),B2WB58
4/10/14	121.1 – 122.5	Split-Spoon	Soil	100	B2WB59,B2TILI(RS)
4/17/14	157.5 – 160	Split-Spoon	Soil	100	B2WB60,B2TIL3(RS)

HEIS = *Hanford Environmental Information System*

RS = rad screen

Table 2-8. C8795 Groundwater Samples Collected During Drilling

Date	Depth (ft bgs)	Sample Method	Pump Rate (gpm)	Vol. Purged (gal)	Turbidity (NTU)	D.O at Sample Collection (Mg/L)	HEIS number
4/8/14	90.5	Groundwater pumped	1.4	196	>1,000	7.66	B2TIL5,B2TIM2
4/14/14	125.5	Groundwater pumped	8.8	1,443	41.1	8.98	B2TIL6,B2TIM3
4/17/14	160.2	Groundwater pumped	17.6	1,443	>1,000	7.00	B2TIL7,B2TIM4
6/9/14	88.2	Groundwater pumped	48.8	2,450	0.64	8.14	B2TIL8, B2TIL9, B2TIM5, B2TIM0, B2TIM1

D.O. = dissolved oxygen

DUP = duplicate

gpm = gallons per minute

HEIS = *Hanford Environmental Information System*

NTU = nephelometric turbidity unit

3 Geologic Observations

The following sections summarize the general geology in the area of the three new wells and present the stratigraphy encountered during the drilling of each well.

3.1 General Geology Description

The major stratigraphic units encountered during this project included backfill and/or Holocene eolian deposits, cataclysmic flood deposits of the Hanford formation and fluvially-derived Ringold Formation deposits. The gravel facies dominates the Hanford formation within the project area and consists of coarse-grained basaltic sands, gravels, and boulders. At the three borehole locations, the interpreted Hanford formation was thickest at C8795 (55 ft) and thinnest at C8299 (15 ft). The Hanford formation overlies the interpreted Ringold Formation within the project area.

The Ringold Formation encountered during this drilling project includes the Ringold unit E and the Ringold Upper Mud unit (RUM). The Ringold unit E is characterized as clast-supported gravels with fine to coarse-grained sand matrix and lesser silt fractions. Clasts associated with the Ringold unit E are predominately quartzite and silicic volcanics with lesser amounts of basalt. The sand matrix mineralogy is predominately quartzo-feldspathic. At the three borehole locations, the Ringold unit E was thickest at C8795 (109.7 ft) and thinnest at C8299 (62.2 ft). The Ringold unit E overlies the lacustrine silt and clay deposit of the RUM encountered at the three boreholes.

3.2 Borehole Geology

The following discussion focuses on the geologic conditions encountered at each individual borehole. Original borehole logs are presented in Appendices A through C.

Stratigraphic unit contacts included in this document are based on field drill cuttings examination (i.e., lithology, texture, color, reaction to 10 percent dilute hydrochloric acid [HCl], etc.) and drilling observations (i.e., drill rate) in the field. As such, the unit contacts included herein should not be considered final. Final stratigraphic unit contact depths will be determined during the remedial investigation data review and will incorporate the field observations, borehole geophysical logging information, and regional stratigraphic interpretations. The basis for the field stratigraphic unit contacts is included in the individual borehole summaries below.

3.2.1 Borehole Geology for Well 199-K-210 (C8297)

The sediments encountered from ground surface to 17 ft bgs consist of unconsolidated basalt-dominated silty gravels and silty sandy gravels, averaging 40 to 50 percent gravel, 10 to 25 percent sand, increasing with depth, and a silt percentage of up to 50 percent. The gravel fraction consists of very poorly sorted, subrounded, mostly basaltic clasts, with an overall size range from 0.2 to 18 cm, but dominantly fine pebble in size. The sand fraction consists of poorly sorted, very fine to very coarse, dominantly coarse, primarily basaltic grains. The color of the silt fraction was light brownish grey (2.5Y6/2) based on a Munsell soil color chart[1]. No reaction to dilute HCl was observed over these depths. At 17 ft bgs a significant decrease in basalt content, an increase in felsic lithologies, and an emergence of mica was observed and interpreted as the Hanford/Ringold Formation based on a comparison of the observed sediment and descriptions of the regional geology.

[1] Munsell Soil Color Charts is a registered trademark of X-Rite, Inc. Grand Rapids, Michigan.

Gravelly sand to silty sandy gravel was encountered from 17 to 116.4 ft bgs. In the first 27 ft, sandy gravel fines into gravelly sand, with depth. Sandy gravel interbedded with 5 to 10 ft thick gravelly sand intervals occupy the next 72.4 ft from 44 to 116.4 bgs. The gravel dominated sediments consist of 50 to 55 percent gravel and 35 to 45 percent sand. The sand dominated interbeds consist of 70 percent or greater sand, up to 25 percent gravel, and minor silt. The gravel clasts observed from 17 to 116.4 ft bgs were generally subangular to subrounded, 15 to 25 percent basalt, and small pebble to small cobble, averaging medium pebble in size. Occasional large cobbles or small boulders were observed at shallower depths. The sand fraction is comprised of fine to very coarse, moderately sorted, subrounded to rounded, quartzo-feldspathic sand in the gravelly sediments, and well rounded, well sorted, fine to medium felsic grains in the sandy layers. The color of the fine fraction ranges from grayish brown (2.5Y5/2) to olive brown (2.5Y4/3) to dark yellowish brown(10YR4/4). Calcium carbonate content was generally low throughout, identified by weak reactions to diluted HCl, however a 1 to 2-inch, white, fine grained layer around 110 ft bgs reacted vigorously with HCl. Strong calcium carbonate cementation (reacted with HCl) was also observed at 47 ft bgs. Low to moderate consolidation was noted at 65, 75, and 90 ft bgs. Strong iron staining and crumbling gravel clasts were observed from 87 to 116.4 ft bgs and clay stringers were observed in the same interval. Flowing sand heaved 2 ft into the borehole during drilling at 105 ft bgs. Groundwater was encountered at 22.35 ft bgs on March 12, 2014.

At 116.4 ft bgs, a light olive brown (2.5Y5/4) to dark grayish brown (2.5Y4/2), medium to highly plastic, undifferentiated sandy silt containing well sorted, well rounded, fine quartzitic sand was encountered, indicating the contact between the Ringold unit E and RUM. Drilling continued into the RUM until TD at 122.1 ft bgs.

3.2.2 Borehole Geology for Well 199-K-212 (C8299)

The sediments encountered at C8299 consist of unconsolidated gravelly sand and sandy gravel from ground surface to 15 ft bgs. The gravelly sand consisting of 10 percent gravel and 85 percent sand, grades with depth to form sandy gravel with 80 percent gravel and 15 percent sand. The gravel fraction of the sediments consist of very poorly sorted, fine to very coarse, subrounded to rounded, primarily basaltic grains. The sand fraction of the sediment consists of moderate to poorly sorted, very fine to coarse, angular to subrounded, primarily quartz grains. The color of the fine fraction was light brownish gray (10YR6/2) to light gray (10YR7/1). No reaction to dilute HCl was observed throughout. At 15 ft bgs, the basaltic composition of the sediment significantly decreases to form a mostly quartzo-feldspathic sediment with 30 percent basalt content. The compositional change coincides with descriptions previously made of the Hanford/Ringold contact and therefore have been interpreted here as the contact between the Hanford formation and the Ringold Formation.

Sandy gravel was encountered from 15 ft bgs to 77.2 ft bgs varying from 75 to 80 percent gravel, 12 to 15 percent sand, and 5 increasing to 13 percent silt with depth. The gravel fraction consists of poorly sorted, subrounded to rounded, 30 percent basaltic, fine to medium pebbles, with numerous cobbles in the first 30 ft. The sand fraction consists of poorly sorted, very fine to coarse, subangular to angular, 90 percent quartz grains. Weak reactions to diluted HCl were noted between 15 and 50 ft bgs. The color of the silt is grayish brown (10YR5/2). Minor iron staining was observed from 50 to 77.2 ft bgs. Groundwater was encountered at 35.92 ft bgs on March 24, 2014.

At 77.2 ft bgs, a sharp contact with a grayish brown (2.5Y5/2) undifferentiated sandy silt exhibiting moderate plasticity and no reaction to HCl was encountered and interpreted as the Ringold unit E/RUM contact. The 20 percent sand fraction was noted as very well sorted, very fine grained, and 90 percent felsic. Drilling continued into the RUM until TD at 85.8 ft bgs.

3.2.3 Borehole Geology for Well 199-K-220 (C8795)

The sediments encountered at C8795 consist of gravel to gravelly sand from ground surface to 55 ft bgs. The uppermost 10 ft of sediment is 80 percent gravel and 15 percent sand, followed by 10 ft of gravelly sand consisting of 15 to 20 percent gravel and 75 to 80 percent sand. From 20 to 55 ft bgs is sandy gravel consisting of 40 percent gravel and 55 percent sand. Silt content remained at 5 percent from ground surface to 55 ft bgs. The gravel clasts were subrounded to rounded, poorly sorted, mostly basaltic, fine to medium pebbles with occasional small cobbles throughout. The sand fraction consists of poorly sorted, subangular to subrounded, mostly basaltic, fine to very coarse grains coarsening with depth to medium to very coarse grains. The color of the silt fraction was gray (2.5Y6/1). No reactions to dilute HCl were observed. The basalt-dominated sediments observed from ground surface to 55 ft bgs coincide with descriptions that have been made of the Hanford formation. At 55 ft bgs, a color change to grayish brown (2.5Y5/2), a decrease in basalt content, and an increase in felsic content was observed and interpreted as the Hanford/Ringold Formation contact.

Sandy gravel was encountered from 55 to 164.7 ft bgs. Sediment from 55 to 100 ft bgs consists of 40 to 60 percent gravel increasing with depth, 37 to 60 percent sand decreasing with depth, and 3 to 5 percent silt. At 100 ft bgs, a 10 ft interval of 80 percent gravel and 17 percent sand was observed, followed by a decrease in gravel to 50 percent, an increase in sand to 48 percent, and a range of 2 to 10 percent silt until 125 ft bgs. A 85 to 100 percent sand lens with some fine to medium pebbles was noted from 125 to 140 ft bgs and described as quartzitic, well sorted, well rounded, and fine to medium grained. The bottom 24.7 ft consists of 32 to 45 percent gravel, 50 to 65 percent sand, and 3 to 5 percent silt. The gravel clasts from 55 to 164.7 ft bgs were generally subangular to subrounded, poorly sorted, fine to coarse pebble in size, with occasional small and large cobbles. From 80 to 120 ft bgs, gravels were moderate to well sorted. The gravel lithology ranged from 20 to 40 percent basalt, except for intervals 45 to 60 ft bgs and 100 to 140 ft bgs where the basalt content reached 80 to 90 percent. Sands from 55 to 125 ft bgs were mostly quartzo-feldspathic, subangular to angular, poorly sorted, and averaged fine to medium grained, but ranged from very fine to coarse grained. Sands from 140 to 164.7 ft bgs were 60 to 80 percent quartzo-feldspathic, well rounded, moderate to well sorted, and averaged medium to coarse grained, but ranged from very fine to very coarse grained. Sediments from 55 to 164.7 ft bgs were micaceous throughout and, in general, did not react to diluted HCl, except for strong reactions between 117 and 124 ft bgs and slight reactions between 155 to 164.7 ft bgs where consolidation was also observed. Strong iron staining and clayey rinds on gravel clasts were noted from 115 to 125 ft bgs and clay stringers were observed at 160 ft bgs. The color of the fine fraction ranged from grayish brown (2.5Y5/2) to light brownish gray (2.5Y6/2) to olive brown (2.5Y4/3). Groundwater was encountered at 79.8 ft bgs on April 7, 2014.

At 164.7 ft bgs, a highly plastic, light olive brown (2.5Y5/4) sandy silt was encountered and interpreted as the contact between Ringold unit E and the RUM. The sandy silt was described as 35 percent sand, 63 percent silt, and 2 percent gravel and reacted slightly to dilute HCl. The sand is very fine grained, well sorted, and 90 percent quartz. The silt was estimated as 75 percent silt and 25 percent clay. Drilling continued into the RUM until TD at 171.3 ft bgs.

3.3 Hydrogeology

Regional groundwater flow in the 100-K Area is primarily to the northwest toward the Columbia River, but is locally influenced by pump-and-treat operations, erosional channels in the RUM (DOE/RL-2006-75, *Supplement to the 100-HR-3 and 100-KR-4 Remedial Design Report and Remedial Action Workplan for the Expansion of the 100-KR-4 Pump-and-Treat System)*, and fluctuations in river stage.

At the three borehole locations, the vadose zone occurs within the Holocene deposits, Hanford formation, and the uppermost Ringold Formation unit E, and ranges in thickness from 22.4 ft at C8297 to 79.8 ft at C8795. The unconfined aquifer occurs entirely within the Ringold Formation unit E and ranges in thickness from 41.3 ft at C8299 to 94.1 ft at C8297. The RUM is an aquitard, and defines the bottom of the unconfined aquifer in the 100-KR-4 OU. The RUM was encountered at all three of the borehole locations and ranged in depth from 77.2 ft bgs at C8299 to 164.7 ft bgs at C8795.

Well development data are summarized in Table 2-2. Maximum drawdown levels measured during final well development varied from 12.5 ft at C8795 (161 gallons per minute pumping rate) to 24.6 ft at C8299 (162 gallons per minute pumping rate). Pumping rates during final well development were primarily influenced by pump capacity and pump depth.

3.4 Contaminants

Groundwater contamination at the 100-KR-4 OU originated from planned and unplanned discharges of contaminated waste water and chemical solutions during and after operation of the 105-KE and 105-KW plutonium production reactors. The primary contaminant of concern in the 100-KR-4 OU is Cr(VI). Other contaminants of concern are strontium-90, carbon-14, nitrate, trichloroethylene, and tritium. Groundwater samples were collected during drilling and following well development at each location. Groundwater analytical results are not included in this report.

4 Waste Management

Waste from individual wells was managed according to SGW-34903, *Data Quality Objective Summary Report to Support the Characterization of Waste Generated from the Expansion of Pump-and-Treat Network in the 100-KR-4 Operable Unit,* as well as Waste Management Specialist-approved Waste Packaging/Labeling Instruction Sheets. Waste generated during drilling activities included drill cuttings, decontamination water, and miscellaneous solid waste.

4.1 Vadose Zone Cuttings

All vadose zone drill cuttings from above the historic high water mark were contained in designated roll off boxes. Roll off boxes were periodically surveyed by Radiological Control Technicians and Industrial Hygiene personnel, and transferred to Environmental Restoration Disposal Facility for disposal. Miscellaneous solid waste associated with vadose zone cuttings, including nitrile gloves, plastic bags used to collect drill cuttings, and other waste associated with sampling activities, were contained in clear plastic bags and placed in the designated roll off box. Roll off boxes were transported to the Environmental Restoration and Disposal Facility for disposal.

4.2 Saturated Zone Cuttings

All drill cuttings collected at or below the water table were released into tip dumpsters, dewatered, and placed in designated waste roll off boxes. Dewatered fluid was treated as purgewater. Water-absorbing crystals were spread over the dewatered drill cuttings to capture free liquids that could not be dewatered, allowing the waste container to be designated as solid waste. Miscellaneous solid waste associated with saturated zone cuttings, including nitrile gloves, plastic bags, and other waste associated with sampling activities, were containerized in clear plastic bags in the roll off boxes. Roll off boxes were transported to the Environmental Restoration and Disposal Facility for disposal.

4.3 Purgewater

Purgewater was generated during well drilling, development activities, and from water decanted from the tip dumpster containing saturated drill cuttings. All purgewater was contained on site in a poly-tank or purgewater truck and later transported to the Purgewater Storage and Treatment Facility.

This page intentionally left blank.

5 Civil Survey

The well locations were surveyed in accordance with CHPRC procedure SGRP-PRO-SMP-52857 (GRP-EE-01-1.6), *Survey Requirements and Techniques*. Vertical survey data were recorded using NAVD88, *North American Vertical Datum of 1988* and the horizontal coordinates were recorded using the Washington State Plane (South Zone) NAD83, *North American Datum of 1983*, with the 1991 adjustment for horizontal coordinates. Surveyed locations of the boreholes are presented in Table 5-1.

Table 5-1. Surveyed Well Locations

Well Name	Well ID	Type	Northing[a] (m)	Easting[a] (m)	Ground Surface Elevation[b] (Brass Cap) (m)
C8297	199-K-210	Extraction	147155.25	569058.13	125.611
C8299	199-K-212	Extraction	148047.71	569954.44	129.587
C8795	199-K-220	Extraction	146417.52	569356.25	145.357

a Northing and easting coordinates are based on Washington State Plane Coordinates NAD83, *North American Datum of 1983.*

b Vertical Elevation values are based on NAVD88, *North American Vertical Datum of 1988* and are rounded to 0.01 m.

This page intentionally left blank.

6 Well Acceptance

Well acceptance is the final step in the well construction process and represents confirmation of meeting requirements of the work scope. Well acceptance also serves as the contractual completion of the finished product.

Representatives from Stillwater Drilling Inc. and CHPRC conducted an acceptance inspection of the well sites and reviewed the well drilling and completion documentation. The walk-down inspections for the three wells was conducted on July 16, 2014. Final well acceptance was documented by completion of a checklist and signatures from representatives of the drilling contractor and CHPRC. A Quality Assurance Work Site Assessment will be prepared to document well acceptance.

This page intentionally left blank.

7 References

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 USC 9601, et seq.

DOE/RL-2006-75, 2008, *Supplement to the 100-HR-3 and 100-KR-4 Remedial Design Report and Remedial Action Workplan for the Expansion of the 100-KR-4 Pump-and-Treat System*, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2013-36-ADD1, 2013, *100-KR-4 Groundwater Operable Unit Well Installation Sampling and Analysis Plan, Addendum 1: 199-K-202, 199-K-205, 199-K-206, and 199-K-220*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington. Available at: http://www.hanford.gov/?page=90&parent=91.

Groundwater Protection Program Procedures, CH2M HILL Plateau Remediation Company, Richland, Washington:

SGRP-PRO-EN-50025 (GRP-EE-01-7.0), *Geologic Logging*

SGRP-PRO-EN-50030 (GRP-EE-02-14.1), *Drilling, Remediating, and Decommissioning Resource Protection Wells and Geotechnical Borings*

SGRP-PRO-OP-50024 (GRP-EE-01-6.3), *Well Development and Testing*

SGRP-PRO-OP-50037 (GRP-EE-05-1.21), *Particle Size Distribution of Soil – Wet Sieve Analysis*

SGRP-PRO-SMP-50047 (GRP-FS-04-G-012), *Sample Packaging, Transporting and Shipping*

SGRP-PRO-SMP-52857 (GRP-EE-01-1.6), *Survey Requirements and Techniques*

NAD83, 1991, *North American Datum of 1983*, National Geodetic Survey, Federal Geodetic Control Committee, Silver Springs, Maryland, as revised.

NAVD88, 1988, *North American Vertical Datum of 1988,* National Geodetic Survey, Federal Geodetic Control Committee, Silver Springs, Maryland.

Resource Conservation and Recovery Act of 1976, 42 U.S.C 6901, et seq.

SGW-34903, 2007, *Data Quality Objective Summary Report to Support the Characterization of Waste Generated From the Expansion of Pump-and-Treat Network in the 100-KR-4 Operable Unit,* Rev. 0, Fluor Hanford, Inc., Richland, Washington.

SGW-56414, 2014, *Description of Work for the Installation of Three Wells in the 100-KR-4 Groundwater Operable Unit, FY 2014*, Rev. 1, CH2M HILL Plateau Remediation Company, Richland, Washington.

WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," *Washington Administrative Code*, as amended, Washington State Department of Ecology, Olympia, Washington.

This page intentionally left blank.

Appendix A

Well Documentation for 199-K-210 (C8297)

- Borehole log
- Well Summary Sheet,
- Well Development and Testing Data
- Sieve Analysis
- Photographic Log
- Well Survey Report
- Geophysical logs

This page intentionally left blank.

BOREHOLE LOG

Page 1 of 4

Date: 8/11/14

Well ID: C8297	Well Name: 199-K-210	Location: 450m NNW of 105-KE Reactor
Project: 3 Wells in the 100-KR-4 OU		Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
					Cable Tool: Drive Barrel
0				0-8 ; Silty Sandy GRAVEL (msG); 50% Gravel, 25% Sand, 25% Silt. Gravel is very fine pebble to small cobble, max 90mm in size; Poorly sorted; Subrounded; 95% basalt. Sand is medium to very coarse grained, dominantly coarse; Poorly sorted; 95% basalt. Silt is 2.5Y5/3 light olive brown (Dry), 100% silt. No rxn to HCl. Drill pad material for the top several inches.	Samples every 5' or at lithology changes for geologic archive.
5	G			@8' increase in silt, color becoming more gray	Samples collected from 8 5/8" diameter, 2' long drive barrel.
					@6' add 4 gallons H_2O
10	G			8-17 ; silty GRAVEL (mG); 40% Gravel, 10% Sand, 50% silt. Gravel is very fine pebble to large cobble, max 180mm, dominantly fine pebble; Very poorly sorted; subrounded; 90% basalt. Sand is very fine to coarse, dominantly coarse; Poorly sorted; 95% basalt. No rxn to HCl. Silt is 2.5Y6/2 light brownish gray. (Dry) Frequent boulders	↓↓ decrease in drill rate ↑↑ increase in drill rate
15	G				0-17' Holocene backfill or Hanford formation
	G G JC			@15' ~~increase in coarse sand 15%, silt 45%~~ JC 8/12/14 increase in gravel 50%, ↓silt 35%, ↑coarse sand 15%, increase in fines	@17' suspect Ringold E contact ~~no~~ Yes JC 7/7/14
20	G	21.0' bgs ▼ 3/26/14		17-22 ; sandy GRAVEL (sG); 50% Gravel, 40% Sand, 10% Silt. Gravel is very fine pebble to large cobble in size, max 200mm, dominantly fine pebble; Very poorly sorted; Subangular; 20% Basalt. Sand is vf-vc, dominantly fine; moderately sorted; well rounded; 90% basalt; trace mica. Silt is 10YR6/1 gray (dry).	First occurance of water @ 22.35' bgs on 8/12/14 @20' looks like ~~Hanford Fm~~ JC 8/13/14 ~~Holocene Backfill or Han. Fm.~~
25	G SS, GW JC 8/14/14	26.8		@20 gravel is 75% basalt; sand is dominantly medium grained, 80% basalt; silt is 2.5Y7/2 light gray, minimal reaction to HCl.	@22' ~~Ringold E contact~~ (?) JC 7/7 ↓↓ decrease in drill rate I-002, Groundwater sample, 29.3 bgs B2W30b, B2W313 I-001, Split spoon, 26.8'-29.3' bgs. B2T034(RS), B2R70
		100% Recovery 42 blows			JH 7/2
		29.3 GW			
30	G			22-28 ; sandy GRAVEL (sG); 50% Gravel, 40% Sand, 10% silt. Gravel is very fine pebble to large cobble in size, dominantly medium pebble; poorly sorted; subrounded; 20% basalt. Sand is vf-vc; dominantly coarse; mod sorted; 20% basalt. Trace Mica. Silt is 2.5Y4/3 olive brown	↑↑ increase in drill rate ↓↓ decrease in drill rate
35	G			28-44; gravelly SAND (gS); 15% Gravel, 80% Sand, 5% Silt. Gravel: PS, sm pebble - lg pebble, dom sm peb, 20% basalt; A-R JC 8/8/14 Sand: VWS, fine, 5% bslt. 2.5Y5/3 light olive brown. Micaceous.	@36' increase in gravels @38' decrease in gravels

Reported By: Janine Carter		Reviewed By: BA WILLIAMS	
Title: Geologist		Title: SR GEOLOGIST	
Signature: Janine Carter	Date: 8/11/14	Signature:	Date: 8/15/14

A-6003-642 (03/03)

BOREHOLE LOG

Page 2 of 4
Date: 3/18/14

Well ID: C8297	Well Name: 199-K-210	Location: 450m NNW of 105-KE Reactor
Project: 3 Wells in the 100-KR-4 OU		Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
40	G			28'-44'; gravelly SAND (gS); 15% Gravel, 80% Sand, 5% Silt. Gravel: PS; sm pebble - lg pebble, some cobbles & sm boulders; 20% basalt; A-R. Sand: very well sorted; fine-medium; mica; 5% basalt. 2.5 Y 5/3 light olive brown.	Cable Tool: Drive barrel Samples every 5' or at lithology changes for geologic archive.
45	G			@41'; small boulder; increase in gravels	@41'; Add 2 gallons H_2O
				44'-60'; sandy GRAVEL (sG); 50% Gravel, 45% Sand, 5% Silt. Gravel is poorly sorted; very small pebble to large cobble, max est. 25cm, dominantly medium pebble; 15% basalt; A-R, dominantly SA. Sand is poorly sorted; fine to coarse, dom. medium; 10% basalt; micaceous up to 5%. 2.5 Y 5/2 grayish brown.	@47'; Add 5 gallons H_2O High cementation
50	G			@51'; color orange to 10 YR 4/4 dark yellowish brown; sand is moderately sorted	slow drilling rate
55	G			@55'; gravels more rounded; Sand is moderately sorted; increase in gravel = 55%, decrease in sand = 40%	@57'; Add 2 gallons H_2O
				@58'; increase in sand = 60%, decrease in gravel = 35% Moderate iron staining	↑↑ increase in drill rate
60	G	60.3 Split Spoon 100% Recovery 203 Blows 62.8'		@60'; 2ft of fine-med, well sorted sand lens	
				60'-65'; gravelly SAND (sG) (Predominantly sand with gravel interbeds); SC 3/24/14 ~~25%~~ 20% Gravel when present; 80-100% Sand; minor silt when gravel is present. Gravel is sm pebb - sm. cob., max 16cm; A-R; 20% basalt, many lithologies; frequent iron staining. Sand is well rounded/well sorted; medium grained; moderately consolidated; moist; minor mica. 10 YR 4/4 dk yellowish brown. When more gravels are present, sands become finer & coarser (and poorly sorted), color is more 10 YR 4/2 dk grayish brown.	Interbeds are 1-2' thick ~~5003~~, split spoon, 60.8'-62.8' I-003, B2T036, B2T038(RS) I-004GW sample, 62.8 bgs. B2W308, B2W314 JH 7/2 ↑↑ increase in drill rate Moderately consolidated
65	G				↓↓ decrease in drill rate
70	G			65'-88'; sandy GRAVEL (sG); Same as above but 55% Gravel, 45% Sand	~~↑↑ increase in drill rate~~ JC 3/24/14
				@70' increase in silt, 5%; decrease in sand, 40%	Low consolidation
75	G				@74'; add 2 gallons H_2O

Reported By: Janine Carter		Reviewed By: R.A. WILLIAMS	
Title: Geologist		Title: SR. GEOLOGIST	
Signature: Janine Carter	Date:	Signature:	Date: 3/18/14

A-6003-642 (03/03)

BOREHOLE LOG

Page 3 of 4
Date: 3/24/14

Well ID: C8297 | Well Name: 199-K-210 | Location: 450m NNW of 105-KE Reactor

Project: 3 Wells in the 100-KR-4 OU | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
80	G			65'-88'; sandy GRAVEL (sG); 55% gravel, 45% sand; Gravel is sm. peb-sm. cob., max 16cm; A-R; 20% basalt, 80% felsic/other, many different clast lithologies; frequent iron staining. Sand is well R; PS; dom med. grained; vf-VC; slight to mod consolodated; minor mica. Dark grayish brown 10YR4/2 (wet)	Cable Tool: DB; Samples every 5' or at lithology changes @82'; add 2 gal. H_2O; switch to 7" OD; 3' long drive head
85	G, GW	84.7–87.2 Split Spoon 100% Recovery 491 blows		@81'; ↑ in sand, 55%; ↓ in gravel, 40%; ↑ silt, 5% @85'; ↑ in sand, 60%; ↓ in gravel, 38%; ↓ silt, 2% Sand is more coarse grained	@87.2; Split spoon sample read 120 ppm VOCs. I-006, Split spoon, 84.7-87.2 bgs
90	G			@87', ↑ in sand, 65%; ↓ in gravel, 33%; 2% silt Sand is mod. sort - well sort., med-coarse grained. 1-2" thick sandy silt layer; sand is WS, 100% Qtz; silt matrix is 2.5Y8/3 pale yellow, hard / ~~very~~ high consolodation, does not react with HCl; ~~river~~ reworked ash(?), diatomaceous earth(?). Gravel is well weathered - chemically; granite clasts crumble into regolith easily; clasts are highly iron stained; very deep red orange staining fades once exposed to atm in a matter of seconds; lighter orange iron staining once faded. Mafic clasts seem to be brighter green than normal.	BaT1L2, BaT1L0 (RS) JH 9/2 Low consolodation I-005, groundwater sample, 87.2 bgs BaW309, BaW315, BaW310 JH 7/2
95	G				@96'; Drillers notice slight creosote smell; 5' heaving sand. Clay nodules exhibit very earthy smell when crushed; faint organic smell
100	G			88-98'; gravelly SAND (gS); 25% gravel, 70% sand, 5% silt/clay. Gravel is sm. peb-sm. cob., max 20cm; A-R; 25% basalt, 75% felsic/other; high iron staining. Sand is well sorted; WS; dom. med; vf-vC; no consolodation; minor mica. Dark grayish brown, 10YR 4/2 (wet). Occ'l clay nodules: 10YR 5/6, yellowish brown, 2.5Y7/4 pale yellow, & 2.5Y 4/2 dk grayish brown	
105	G			98-105'; sandy GRAVEL (sG); 50% gravel, 40% sand, 10% silt/clay. Gravel is A, VPS, FP-NP, SPeb avg.; max 20cm; lg cob are R. Sand is vf-vC; VPS; A-R; 40% basalt 60% felsic/other. Some Fe-staining, minor mica. Silt/clay nodules are 20% clay, low plasticity, 2.5Y5/3 light olive brown (wet). [25% gravel, 65% sand, 10% silt	@105'; 2' sand heave I-008, groundwater sample, 102.6 bgs ~~BaW993~~, BaW912, BaW913 JH 7/2 I-007, Split-spoon sample 109.5-112' bgs JH 7/2
110	GW, G	109.6–112.1 Split Spoon 45% Recovery 200 blows		105-110'; gravelly SAND (gS); Gravel is SP-R, max est. 40cm; A-R; 25% basalt, 75% felsic/other; minor Fe-staining. Sand is WS; WR; dom. Med, P-C, no consolodation, minor mica. Clay nodules are iron stained. Light olive brown 2.5Y5/3, wet.	BaW914, BaW915
115	G, G			Some dark gray & white rock weathering rinds. 110-116.4'; silty sandy GRAVEL (msG); 50% gravel, 35% sand, 15% silt/clay. Gravel is A-R; PS; med. peb dom.;	@116.4' Ringold Upper Mud Contact

Reported By: Janine Carter | Reviewed By: B.A. WILLIAMS

Title: Geologist | Title: SR GEOLOGIST

Signature: Janine Carter | Date: 3/24/14 | Signature: [signature] | Date: 3/25/14

A-6003-642 (03/03)

BOREHOLE LOG

Page 4 of 4
Date: 4/2/14

Well ID: C8297	Well Name: 199-K-210	Location: 450m NNW of 105-KE Reactor
Project: 3 Wells in the 100-KR-4 OU		Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
120				(continued) Sm. peb. - Sm. cob.; 25% basalt, 75% felsic/other. Sand is med. sort.; vf-vc; dom. med; WR. 1-2" thick white layer reacts to HCl vigorously.	Cable Tool: DB; Samples every 5' or at lithology changes.
	G		122.1 TD	116.4-122.1'; sandy SILT (~~fm~~-sM); 2% gravel, 33% sand, 65% silt/clay. Gravel is A-R, PS; med. peb. Sand is vf-m, dom f; WS; 10% basalt, 90% felsic. Silt/clay is 30% clay, 70% silt, med-high plasticity. 2% gravel, 20% clay, 33% sand, 45% silt = Loam. Color varies: 2.5Y 6/3 light yellowish brown, 2.5Y 5/4 light olive brown, & 2.5Y dark grayish brown (4/2).	
125				TD = 122.1' bgs	
				Not used JC 4/10/14	

Reported By: Janine Carter		Reviewed By: BA WILLIAMS	
Title: Geologist		Title: SR. GEOLOGIST	
Signature: Janine Carter	Date: 4/2/14	Signature:	Date: 5/15/14

A-6003-642 (03/03)

WELL SUMMARY SHEET	Start Date: 3/11/2014 Finish Date: 6/3/2014	Page 1 of 2
Well ID: C8297	Well Name: 199-K-210	
Location: 450m NNW of 105-KE Reactor	Project: 3 Wells in the 100-KR-4 OU FY2014	
Prepared By: Janine Carter	Date: 6/23/14	Reviewed By: J.D. MEHRER	Date: 7/15/14
Signature: Janine Carter	Signature:	

CONSTRUCTION DATA

Description

Concrete Pad: 0.5 ft above ground surface (ags)

8-in Protective Casing: 3.0 ft ags - 2.0 ft below ground surface (bgs)

Type I/II Portland Cement Grout: 0 - 8.0 ft bgs

3/8 in Cetco Medium Bentonite Crumbles: 8.0 - 13.2 ft bgs

6-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.0 ft ags - 16.0 ft bgs

6-in I.D. Schedule 10, Type 304/304L, 40-slot (0.040 in.) Stainless Steel Screen: 16.0 - 116.07 ft bgs

10 - 20 mesh Premier Colorado Silica Filter Pack Sand: 13.2 - 122.1 ft bgs

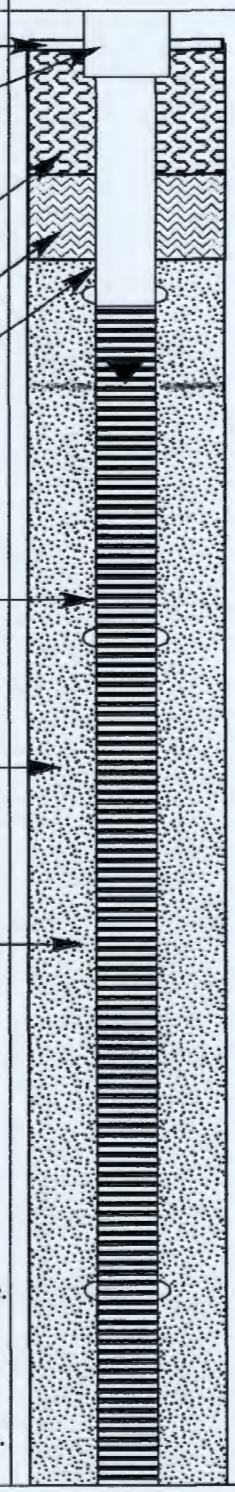
Stainless steel centralizer installed above and below screen and every 40 ft

Depths are in ft below ground surface.

Borehole drilled with 10 3/4-in O.D. casing from 0.0 - 119.1 ft bgs

All temporary drill casing was removed from the ground.

Diagram



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet: 0, 10, 20, 30, 40, 50, 60, 70, 80

Graphic Log

Lithologic Description (ft bgs)

0 - 8 Silty Sandy Gravel (msG)

8 - 17 Silty Gravel (mG)

17 - 28 Sandy Gravel (sG)

Static Water Level: 21.0 ft bgs (3/26/2014)

28 - 44 Gravelly Sand (gS)

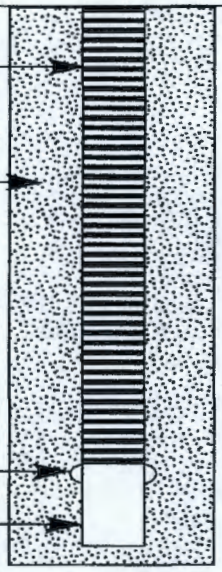
44 - 60 Sandy Gravel (sG)

60 - 65 Gravelly Sand (gS)

65 - 88 Sandy Gravel (sG)

WELL SUMMARY SHEET	Start Date: 3/11/2014 Finish Date: 6/3/2014	Page 2 of 2
Well ID: C8297	Well Name: 199-K-210	
Location: 450m NNW of 105-KE Reactor	Project: 3 Wells in the 100-KR-4 OU FY2014	
Prepared By: Janine Carter — Date: 6/23/14	Reviewed By: J.D. MEHRER — Date: 7-15-14	
Signature: Janine Carter	Signature:	

CONSTRUCTION DATA

Description	Diagram
6-in I.D. Schedule 10, Type 304/304L, 40-slot (0.040 in.) Stainless Steel Screen: 16.0 - 116.07 ft bgs 10 - 20 mesh Premier Colorado Silica Filter Pack Sand: 13.2 - 122.1 ft bgs Stainless steel centralizer installed above and below screen and every 40 ft 6-in I.D. Schedule 10, Type 304/304L, Stainless Steel Sump: 116.07 - 121.08 ft bgs	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
90		88 - 98 Gravelly Sand (gS)
100		98 - 105 Sandy Gravel (sG)
		105 - 110 Gravelly Sand (gS)
110		110 - 116.4 Silty Sandy Gravel (msG)
		116.4 - 122.1 Sandy Silty (sM)
120		Straightness Test: 4/2/2014, Pass
		Total Depth: 122.1 ft bgs
130		
140		
150		
160		
170		

Depths are in ft below ground surface.

Borehole drilled with 10 3/4-in O.D. casing from 0.0 - 119.1 ft bgs

All temporary drill casing was removed from the ground.

WELL DEVELOPMENT AND TESTING DATA

Well Name:	Well ID:	Well Location:	Date:
199-K-210	C8297	450m NNW of 105-KE Reactor	6/2/14

Reference Measuring Point (unless otherwise noted): TOP OF OUTER CASING (TOC)

Has the well been surveyed? ○ Yes ⊗ No | Does the well have a cement pad? ⊗ Yes ○ No

PART 1

STATIC WATER LEVEL:

Start of Job	19.44
End of Job	19.94

DEPTH TO BOTTOM:

Start of Job	123.4
End of Job	123.4

PART 2

WELL DEVELOPMENT DATA

Pump Model Franklin Electric 15 hp

Intake Depth (1)

Starting Turbidity 221 (max)

	Pump Start	Stop	Flow Rate	Drawdown
I-001	0941 / 1345	1048 / 1431	195 / 150	14.69 / 10.86
	0824 / 0835	0835 / 0905	200 / 150	14.12 / ~~15.53~~ 10.83 / ~~11.34~~
I-002 / I-003	1048 / 1103	1103 / 1124	200 / 140	15.53 / 11.34
I-004	1235	1315	140	10.18

Total Pumped ~38,205

Final Turbidity 1.44 (min)

XD SN/Range (PSI) 141741 / 231' [0-50 psi only noted on probe]

PART 3

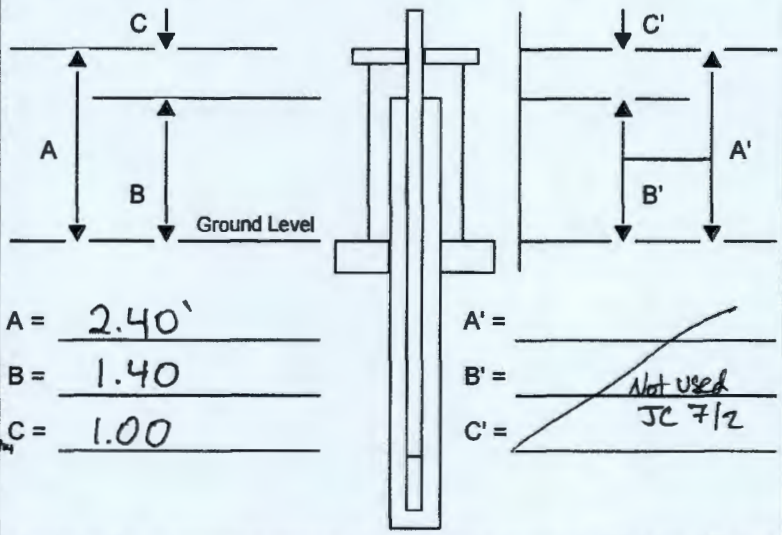
INSTANTANEOUS SLUG TEST

Static Water Level (TOC)	
Transducer Depth	
Baseline Start	
Injection Start	
Baseline Start	
Withdrawal Start	
Slug Volume	
XD SN/Range (PSI)	

PART 4

Last Recorded Measurements Date: 6/2/14

Current Measurements Date:



A = 2.40'

B = 1.40

C = 1.00

A' =

B' = Not used JC 7/2

C' =

Are there any reference marks on the casing strings? ○ Yes ○ No

PART 5

COMMENTS:

I-001 intake @ 108.5' bgs (6/2/14)
I-002 intake @ 87.5' bgs (6/3/14)
I-003 intake @ 66.5' bgs (6/3/14)
I-004 intake @ 45.5' bgs (6/3/14)
(1)

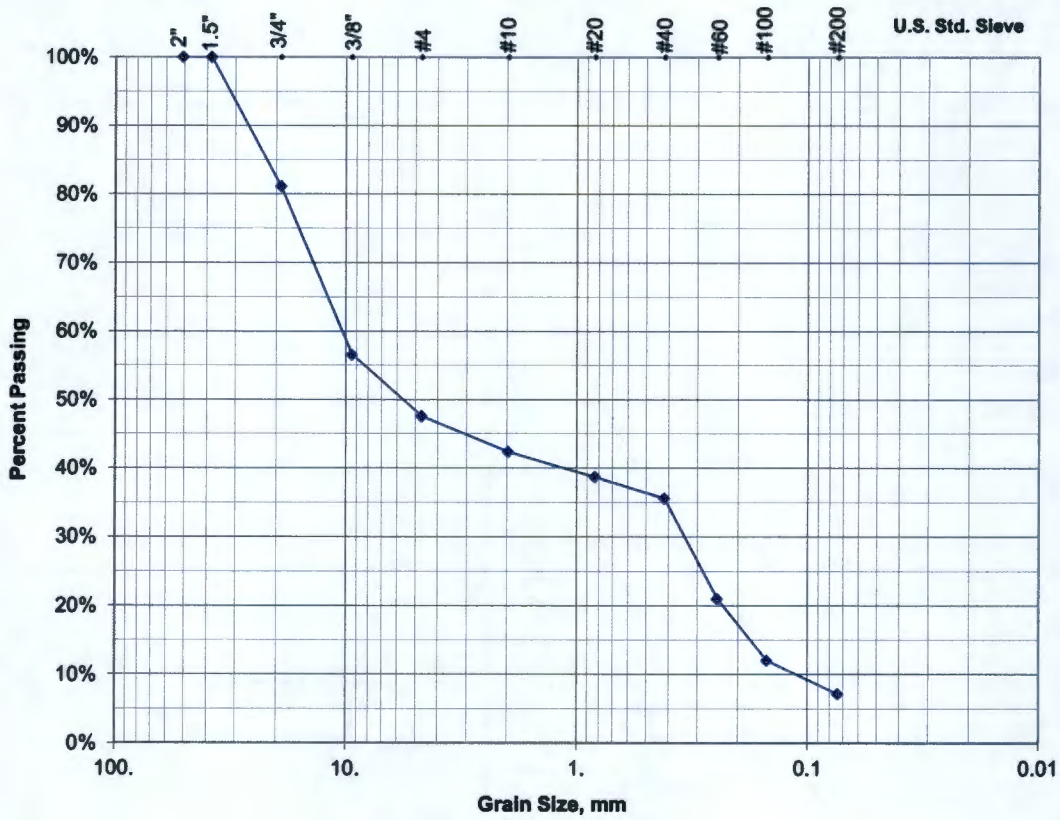
Prepared by (print name): Kim Schuyler	Signature: Kim Schuyler	Date: 6/2/14
Reviewed by (print name): J.D. MEHRER	Signature: [illegible]	Date: 7-15-14

A-6005-205 (REV 1)

SIEVE ANALYSIS

WELL NAME	199-K-210	SAMPLE DEPTH	20-30 ft bgs	SAMPLE#	1	WELL ID#	C8297
TESTED BY	Jennifer Russel	CONTACT	Freestone Env.	PHONE	943-5222	DATE	03/20/2014

SAMPLE WEIGHT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	GRAIN SIZE (mm)	COMMENTS
984.60	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	185.8	18.9	81.1	19.05	
	3/8"	428.1	43.5	56.5	9.42	
	#4	516.6	52.5	47.5	4.70	
	#10	567.7	57.7	42.3	1.98	
	#20	603.7	61.3	38.7	0.83	
	#40	634.6	64.5	35.5	0.42	
	#60	777.8	79.0	21.0	0.25	
	#100	866.5	88.0	12.0	0.150	
	#200	914.5	92.9	7.1	0.074	



Soil Description	57.7% Gravel	35.2% Sand	7.0% Silt
	18.9% Coarse-V Coarse Pebble	6.8% Coarse-V Coarse	
	24.6% Medium Pebble	14.5% Medium	
	14.2% Fine-V Fine Pebble	13.9% Fine-V Fine	

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

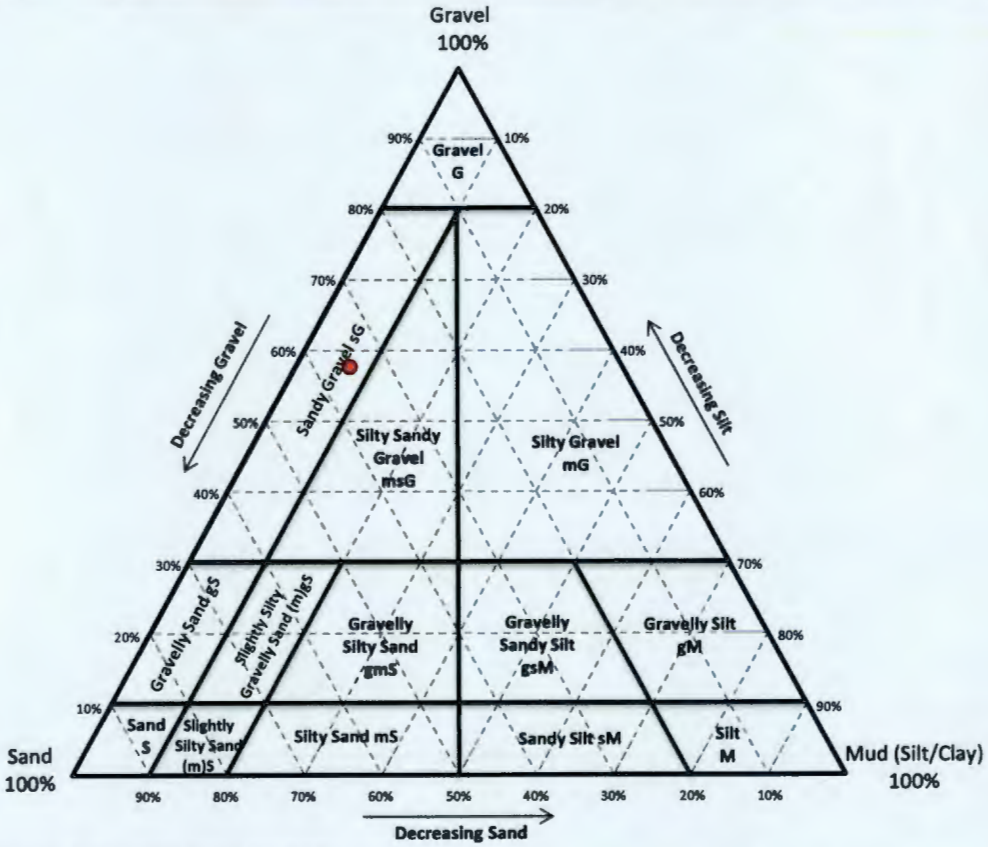
Checked By: Janine Carter Date: 7/9/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS DATA

Date:	3/20/2014	Well Name:	199-K-210
Soil Description:	Sandy Gravel	Well ID:	C8297
Sample Number:	1	Sample Depth (ft bgs):	20-30 ft bgs
Sample bowl (g):	754.9	Final Variance (grams):	0.9
Sample bowl+dry sample (g):	1739.5	Sample bowl + wash/dry sample (g):	1695.7
Dry sample weight (g):	984.6	Wash/dry sample weight (g):	940.8

Sieve No.	Sieve Opening	Sieve Weight (g)	Sieve + Soil Weight (g)	Weight of Soil Retained (g)	Percent Retained	Cumulative Weight Retained (g)	Cumulative Percent Retained	Percent Finer
--	2.0 IN	469.8	469.8	0.0	0.0%	0.0	0.0%	100.0
--	1.5 IN	491.2	491.2	0.0	0.0%	0.0	0.0%	100.0
--	0.75 IN	497.8	683.6	185.8	18.9%	185.8	18.9%	81.1
--	0.375 IN	490.2	732.5	242.3	24.6%	428.1	43.5%	56.5
4	4.75 mm	463.9	552.4	88.5	9.0%	516.6	52.5%	47.5
10	2.00 mm	489.3	540.4	51.1	5.2%	567.7	57.7%	42.3
20	0.85 mm	380.5	416.5	36.0	3.7%	603.7	61.3%	38.7
40	0.425 mm	336.1	367.0	30.9	3.1%	634.6	64.5%	35.5
60	0.25 mm	321.2	464.4	143.2	14.5%	777.8	79.0%	21.0
100	0.15 mm	308.8	397.5	88.7	9.0%	866.5	88.0%	12.0
200	0.075 mm	328.5	376.5	48.0	4.9%	914.5	92.9%	7.1
PAN	--	370.7	396.1	25.4 43.8	7.0%	983.7	99.9%	0.0



If percentages are borderline, use the coarser classification.
i.e. 90% sand, 10% silt equals sand, not slightly silty sand or 60% gravel, 30% sand, and 10% silt equals sandy gravel, not silty sandy gravel

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC

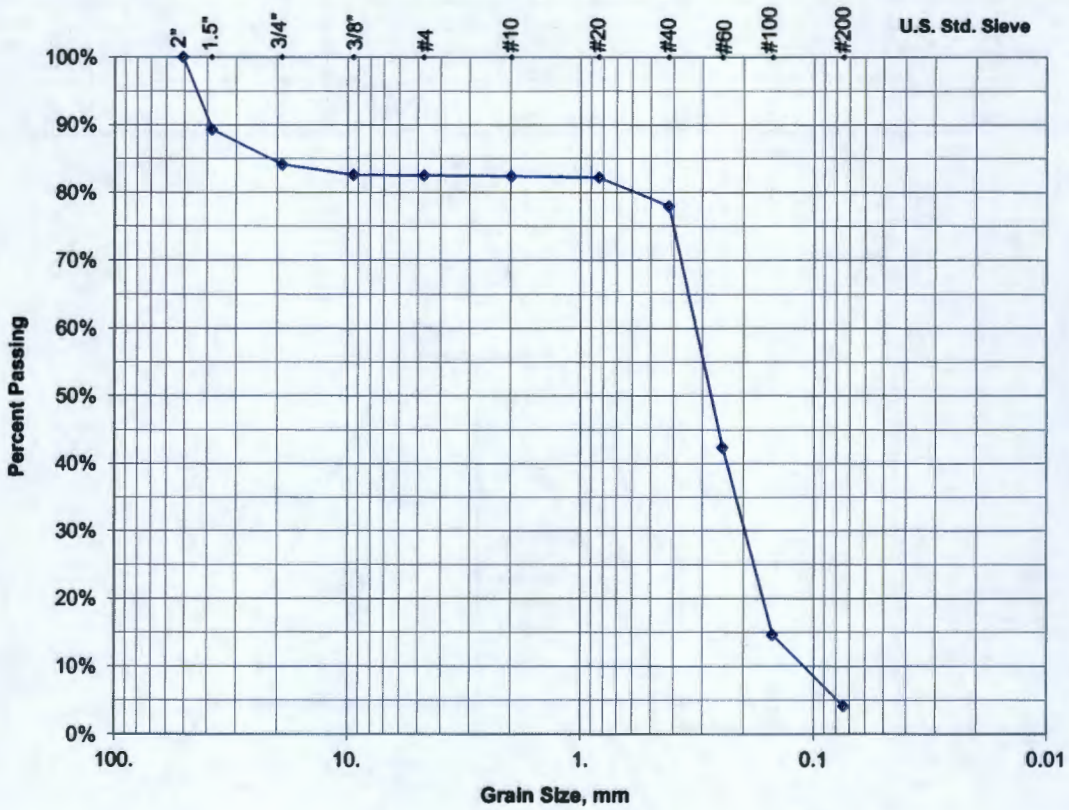
Checked By: Janine Carter Date: 7/9/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS

WELL NAME	199-K-210	SAMPLE DEPTH	20-30 ft bgs	SAMPLE#	2	WELL ID#	C8297
TESTED BY	Jennifer Russel	CONTACT	Freestone Env.	PHONE	943-5222	DATE	03/20/2014

SAMPLE WEIGHT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	GRAIN SIZE (mm)	COMMENTS
967.20	2"	0.0	0.0	100.0	50.80	
	1.5"	103.7	10.7	89.3	38.10	
	3/4"	153.8	15.9	84.1	19.05	
	3/8"	168.5	17.4	82.6	9.42	
	#4	169.2	17.5	82.5	4.70	
	#10	170.0	17.6	82.4	1.98	
	#20	172.0	17.8	82.2	0.83	
	#40	213.3	22.1	77.9	0.42	
	#60	557.7	57.7	42.3	0.25	
	#100	826.0	85.4	14.6	0.150	
	#200	928.1	96.0	4.0	0.074	



Soil Description	17.6% Gravel	78.4% Sand	3.9% Silt
	15.9% Coarse-V Coarse Pebble	4.5% Coarse-V Coarse	
	1.5% Medium Pebble	35.6% Medium	
	0.2% Fine-V Fine Pebble	38.3% Fine-V Fine	

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

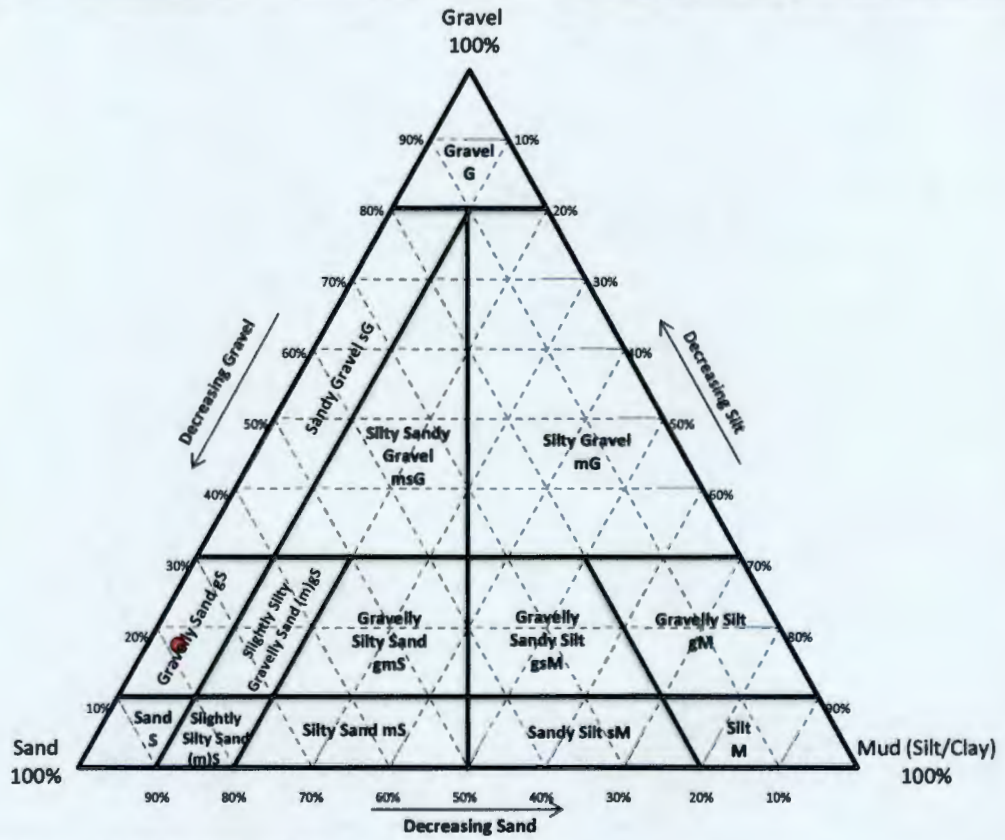
Checked By: Janine Carter Date: 7/9/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS DATA

Date:	3/20/2014	Well Name:	199-K-210
Soil Description:	Gravelly Sand	Well ID:	C8297
Sample Number:	2	Sample Depth (ft bgs):	20-30 ft bgs
Sample bowl (g):	767.6	Final Variance (grams):	1.1
Sample bowl+dry sample (g):	1734.8	Sample bowl + wash/dry sample (g):	1723.0
Dry sample weight (g):	967.2	Wash/dry sample weight (g):	955.4

Sieve No.	Sieve Opening	Sieve Weight (g)	Sieve + Soil Weight (g)	Weight of Soil Retained (g)	Percent Retained	Cumulative Weight Retained (g)	Cumulative Percent Retained	Percent Finer
--	2.0 IN	469.8	469.8	0.0	0.0%	0.0	0.0%	100.0
--	1.5 IN	491.2	594.9	103.7	10.7%	103.7	10.7%	89.3
--	0.75 IN	497.8	547.9	50.1	5.2%	153.8	15.9%	84.1
--	0.375 IN	490.2	504.9	14.7	1.5%	168.5	17.4%	82.6
4	4.75 mm	463.9	464.6	0.7	0.1%	169.2	17.5%	82.5
10	2.00 mm	489.3	490.1	0.8	0.1%	170.0	17.6%	82.4
20	0.85 mm	380.5	382.5	2.0	0.2%	172.0	17.8%	82.2
40	0.425 mm	336.1	377.4	41.3	4.3%	213.3	22.1%	77.9
60	0.25 mm	321.2	665.6	344.4	35.6%	557.7	57.7%	42.3
100	0.15 mm	308.8	577.1	268.3	27.7%	826.0	85.4%	14.6
200	0.075 mm	328.5	430.6	102.1	10.6%	928.1	96.0%	4.0
PAN	--	370.7	396.9	26.2 11.8	3.9%	966.1	99.9%	0.0



If percentages are borderline, use the coarser classification.
i.e. 90% sand, 10% silt equals sand, not slightly silty sand or 60% gravel, 30% sand, and 10% silt equals sandy gravel, not silty sandy gravel

Comments:

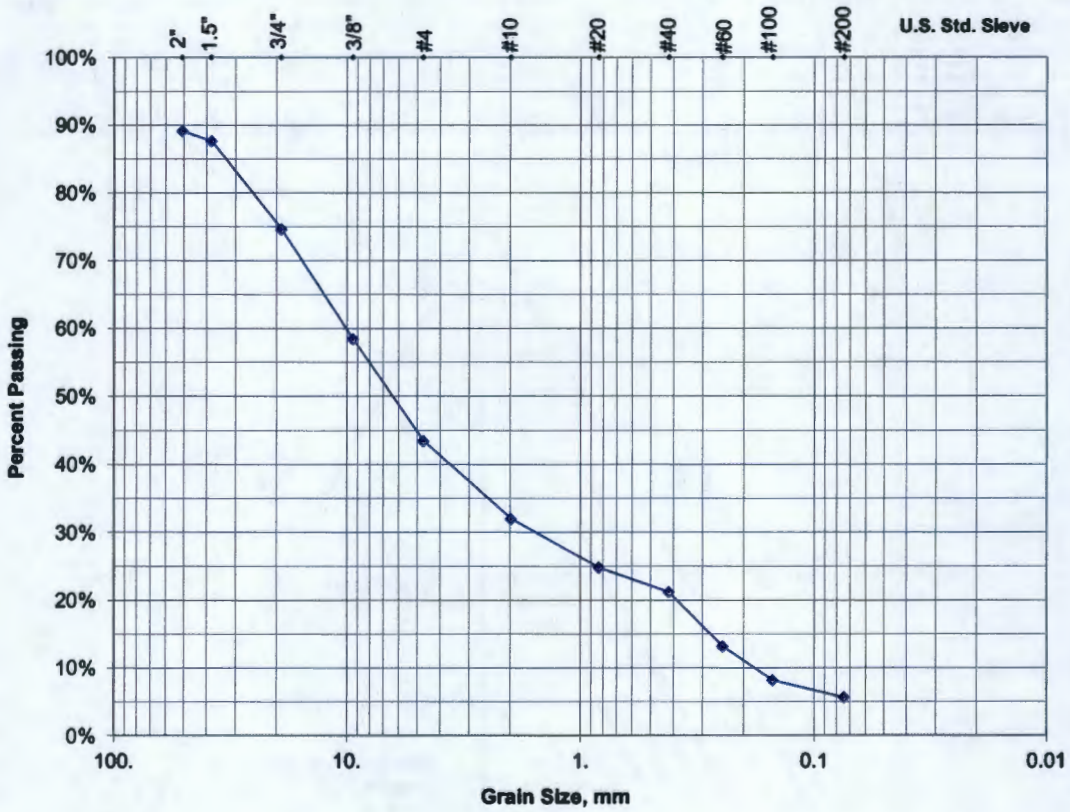
FREESTONE ENVIRONMENTAL SERVICES, INC.

Checked By: Janine Carter Date: 7/9/2014 **Office Phone:** (509) 943-5222

SIEVE ANALYSIS

WELL NAME	199-K-210	SAMPLE DEPTH	40-50	SAMPLE#	3	WELL ID#	C8297
TESTED BY	Jennifer Russel	CONTACT	Freestone Env.	PHONE	943-5222	DATE	03/20/2014

SAMPLE WEIGHT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	GRAIN SIZE (mm)	COMMENTS
1223.00	2"	133.3	10.9	89.1	50.80	
	1.5"	151.3	12.4	87.6	38.10	
	3/4"	310.9	25.4	74.6	19.05	
	3/8"	509.3	41.6	58.4	9.42	
	#4	692.6	56.6	43.4	4.70	
	#10	832.4	68.1	31.9	1.98	
	#20	919.9	75.2	24.8	0.83	
	#40	964.0	78.8	21.2	0.42	
	#60	1062.5	86.9	13.1	0.25	
	#100	1123.8	91.9	8.1	0.150	
	#200	1154.7	94.4	5.6	0.074	



Soil Description	68.1% Gravel	26.4% Sand	5.5% Silt
	25.4% Coarse-V Coarse Pebble	10.8% Coarse-V Coarse	
	16.2% Medium Pebble	8.1% Medium	
	26.4% Fine-V Fine Pebble	7.5% Fine-V Fine	

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

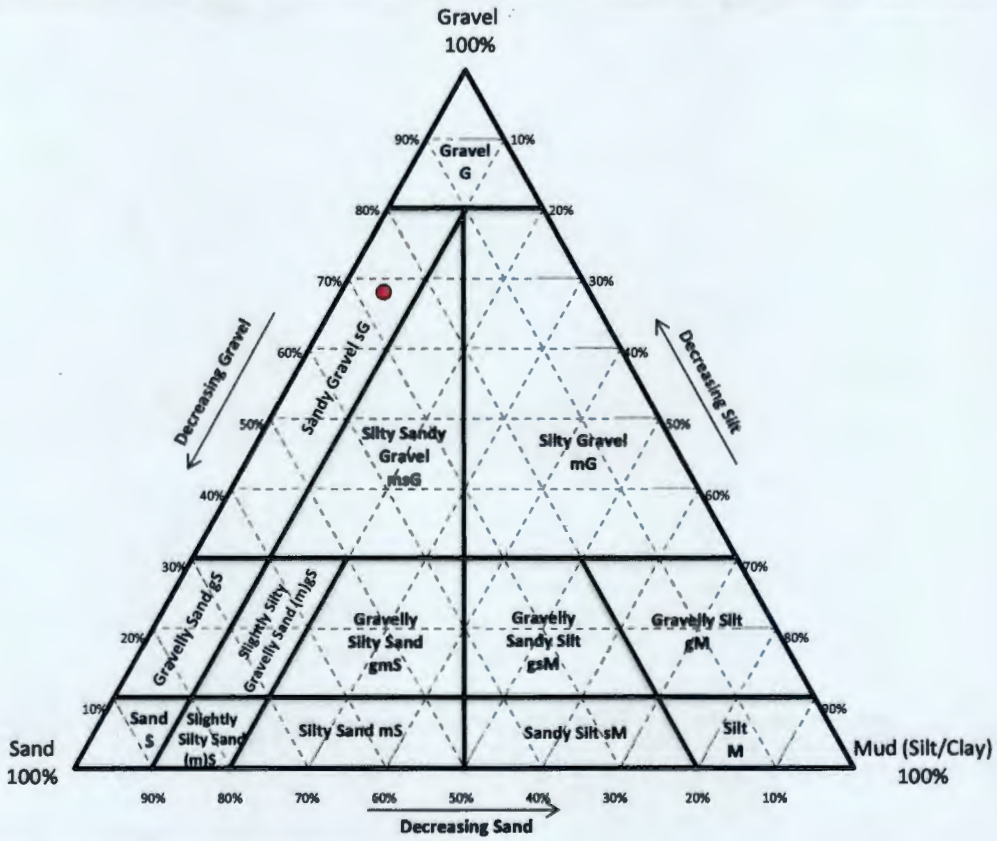
Checked By: Janine Carter Date: 7/9/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS DATA

Date:	3/20/2014	Well Name:	199-K-210
Soil Description:	Sandy Gravel	Well ID:	C8297
Sample Number:	3	Sample Depth (ft bgs):	40-50
Sample bowl (g):	767.6	Final Variance (grams):	1.4
Sample bowl+dry sample (g):	1990.6	Sample bowl + wash/dry sample (g):	1949.3
Dry sample weight (g):	1223.0	Wash/dry sample weight (g):	1181.7

Sieve No.	Sieve Opening	Sieve Weight (g)	Sieve + Soil Weight (g)	Weight of Soil Retained (g)	Percent Retained	Cumulative Weight Retained (g)	Cumulative Percent Retained	Percent Finer
–	2.0 IN	469.8	603.1	133.3	10.9%	133.3	10.9%	89.1
–	1.5 IN	491.2	509.2	18.0	1.5%	151.3	12.4%	87.6
–	0.75 IN	497.8	657.4	159.6	13.0%	310.9	25.4%	74.6
–	0.375 IN	490.2	688.6	198.4	16.2%	509.3	41.6%	58.4
4	4.75 mm	463.9	647.2	183.3	15.0%	692.6	56.6%	43.4
10	2.00 mm	489.3	629.1	139.8	11.4%	832.4	68.1%	31.9
20	0.85 mm	380.5	468.0	87.5	7.2%	919.9	75.2%	24.8
40	0.425 mm	336.1	380.2	44.1	3.6%	964.0	78.8%	21.2
60	0.25 mm	321.2	419.7	98.5	8.1%	1062.5	86.9%	13.1
100	0.15 mm	308.8	370.1	61.3	5.0%	1123.8	91.9%	8.1
200	0.075 mm	328.5	359.4	30.9	2.5%	1154.7	94.4%	5.6
PAN	–	370.7	396.3	25.6 41.3	5.5%	1221.6	99.9%	0.0



If percentages are borderline, use the coarser classification.
i.e. 90% sand, 10% silt equals sand, not slightly silty sand or 60% gravel, 30% sand, and 10% silt equals sandy gravel, not silty sandy gravel

Comments:

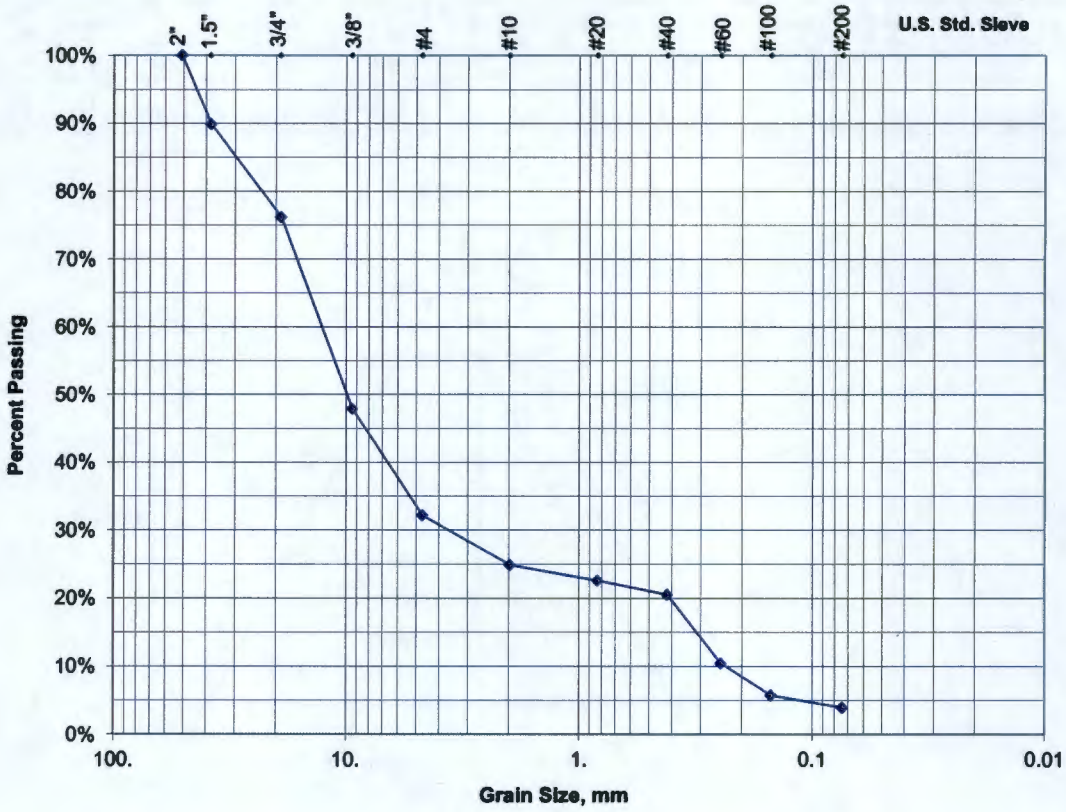
FREESTONE ENVIRONMENTAL SERVICES, INC.

Checked By: Janine Carter Date: 7/9/2014 Office Phone: (509) 943-5222

SIEVE ANALYSIS

WELL NAME	199-K-210	SAMPLE DEPTH	50-60 ft bgs	SAMPLE#	4	WELL ID#	C8297
TESTED BY	Jennifer Russel	CONTACT	Freestone Env.	PHONE	943-5222	DATE	03/20/2014

SAMPLE WEIGHT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	GRAIN SIZE (mm)	COMMENTS
1401.30	2"	0.0	0.0	100.0	50.80	
	1.5"	142.2	10.1	89.9	38.10	
	3/4"	333.8	23.8	76.2	19.05	
	3/8"	730.6	52.1	47.9	9.42	
	#4	950.7	67.8	32.2	4.70	
	#10	1053.0	75.1	24.9	1.98	
	#20	1085.0	77.4	22.6	0.83	
	#40	1114.1	79.5	20.5	0.42	
	#60	1255.7	89.6	10.4	0.25	
	#100	1321.2	94.3	5.7	0.150	
	#200	1346.8	96.1	3.9	0.074	



Soil Description	75.1% Gravel	21.0% Sand	3.6% Silt
	23.8% Coarse-V Coarse Pebble	4.4% Coarse-V Coarse	
	28.3% Medium Pebble	10.1% Medium	
	23.0% Fine-V Fine Pebble	6.5% Fine-V Fine	

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

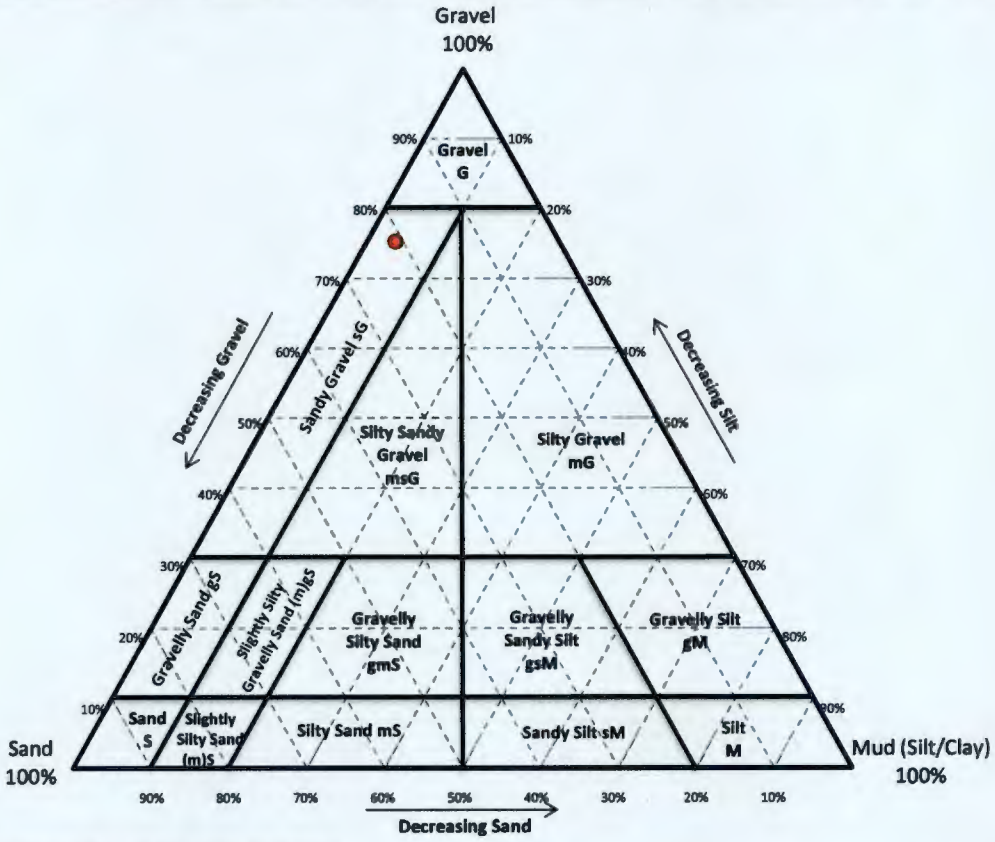
Checked By: Janine Carter Date: 7/9/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS DATA

Date:	3/20/2014	Well Name:	199-K-210
Soil Description:	Sandy Gravel	Well ID:	C8297
Sample Number:	4	Sample Depth (ft bgs):	50-60 ft bgs
Sample bowl (g):	754.9	Final Variance (grams):	3.6
Sample bowl+dry sample (g):	2156.2	Sample bowl + wash/dry sample (g):	2120.7
Dry sample weight (g):	1401.3	Wash/dry sample weight (g):	1365.8

Sieve No.	Sieve Opening	Sieve Weight (g)	Sieve + Soil Weight (g)	Weight of Soil Retained (g)	Percent Retained	Cumulative Weight Retained (g)	Cumulative Percent Retained	Percent Finer
--	2.0 IN	469.8	469.8	0.0	0.0%	0.0	0.0%	100.0
--	1.5 IN	491.2	633.4	142.2	10.1%	142.2	10.1%	89.9
--	0.75 IN	497.8	689.4	191.6	13.7%	333.8	23.8%	76.2
--	0.375 IN	490.2	887.0	396.8	28.3%	730.6	52.1%	47.9
4	4.75 mm	463.9	684.0	220.1	15.7%	950.7	67.8%	32.2
10	2.00 mm	489.3	591.6	102.3	7.3%	1053.0	75.1%	24.9
20	0.85 mm	380.5	412.5	32.0	2.3%	1085.0	77.4%	22.6
40	0.425 mm	336.1	365.2	29.1	2.1%	1114.1	79.5%	20.5
60	0.25 mm	321.2	462.8	141.6	10.1%	1255.7	89.6%	10.4
100	0.15 mm	308.8	374.3	65.5	4.7%	1321.2	94.3%	5.7
200	0.075 mm	328.5	354.1	25.6	1.8%	1346.8	96.1%	3.9
PAN	--	370.7	386.1	15.4 35.5	3.6%	1397.7	99.7%	0.0



If percentages are borderline, use the coarser classification.
i.e. 90% sand, 10% silt equals sand, not slightly silty sand or 60% gravel, 30% sand, and 10% silt equals sandy gravel, not silty sandy gravel

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

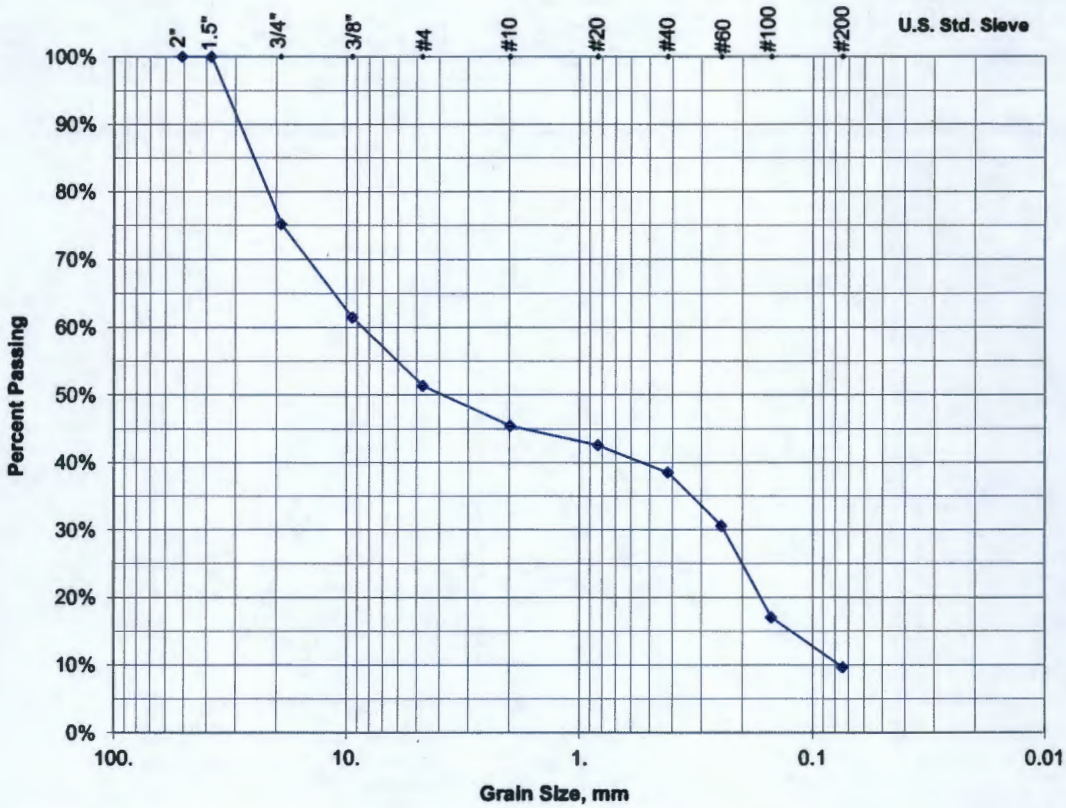
Checked By: Janine Carter Date: 7/9/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS

WELL NAME	199-K-210	SAMPLE DEPTH	60-70	SAMPLE#	5	WELL ID#	C8297
TESTED BY	Kim Schuyler	CONTACT	Freestone Env.	PHONE	943-5222	DATE	04/02/2014

SAMPLE WEIGHT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	GRAIN SIZE (mm)	COMMENTS
545.70	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	135.5	24.8	75.2	19.05	
	3/8"	210.7	38.6	61.4	9.42	
	#4	265.7	48.7	51.3	4.70	
	#10	297.9	54.6	45.4	1.98	
	#20	313.5	57.4	42.6	0.83	
	#40	335.7	61.5	38.5	0.42	
	#60	378.9	69.4	30.6	0.25	
	#100	452.9	83.0	17.0	0.150	
	#200	493.4	90.4	9.6	0.074	



Soil Description	**54.6% Gravel**	**35.8% Sand**	**9.5% Silt**
	24.8% Coarse-V Coarse Pebble	6.9% Coarse-V Coarse	
	13.8% Medium Pebble	7.9% Medium	
	16.0% Fine-V Fine Pebble	21.0% Fine-V Fine	

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

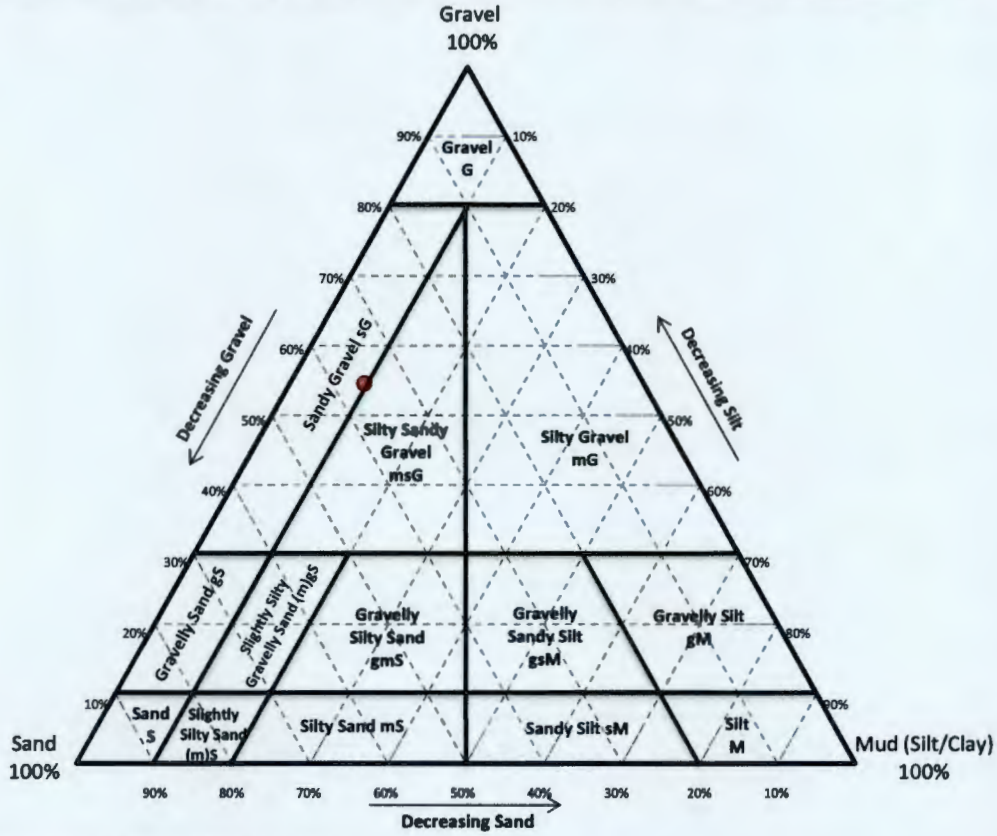
Checked By: Janine Carter Date: 7/9/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS DATA

Date:	4/2/2014	Well Name:	199-K-210
Soil Description:	Sandy Gravel	Well ID:	C8297
Sample Number:	5	Sample Depth (ft bgs):	60-70
Sample bowl (g):	767.8	Final Variance (grams):	0.4
Sample bowl+dry sample (g):	1313.5	Sample bowl + wash/dry sample (g):	1265.7
Dry sample weight (g):	545.7	Wash/dry sample weight (g):	497.9

Sieve No.	Sieve Opening	Sieve Weight (g)	Sieve + Soil Weight (g)	Weight of Soil Retained (g)	Percent Retained	Cumulative Weight Retained (g)	Cumulative Percent Retained	Percent Finer
–	2.0 IN	469.8	469.8	0.0	0.0%	0.0	0.0%	100.0
–	1.5 IN	491.5	491.5	0.0	0.0%	0.0	0.0%	100.0
–	0.75 IN	497.6	633.1	135.5	24.8%	135.5	24.8%	75.2
–	0.375 IN	490.4	565.6	75.2	13.8%	210.7	38.6%	61.4
4	4.75 mm	464.0	519.0	55.0	10.1%	265.7	48.7%	51.3
10	2.00 mm	489.6	521.8	32.2	5.9%	297.9	54.6%	45.4
20	0.85 mm	380.6	396.2	15.6	2.9%	313.5	57.4%	42.6
40	0.425 mm	336.1	358.3	22.2	4.1%	335.7	61.5%	38.5
60	0.25 mm	321.2	364.4	43.2	7.9%	378.9	69.4%	30.6
100	0.15 mm	308.9	382.9	74.0	13.6%	452.9	83.0%	17.0
200	0.075 mm	328.5	369.0	40.5	7.4%	493.4	90.4%	9.6
PAN	–	370.8	374.9	4.1 47.8	9.5%	545.3	99.9%	0.0



If percentages are borderline, use the coarser classification.
i.e. 90% sand, 10% silt equals sand, not slightly silty sand or 60% gravel, 30% sand, and 10% silt equals sandy gravel, not silty sandy gravel

Comments:

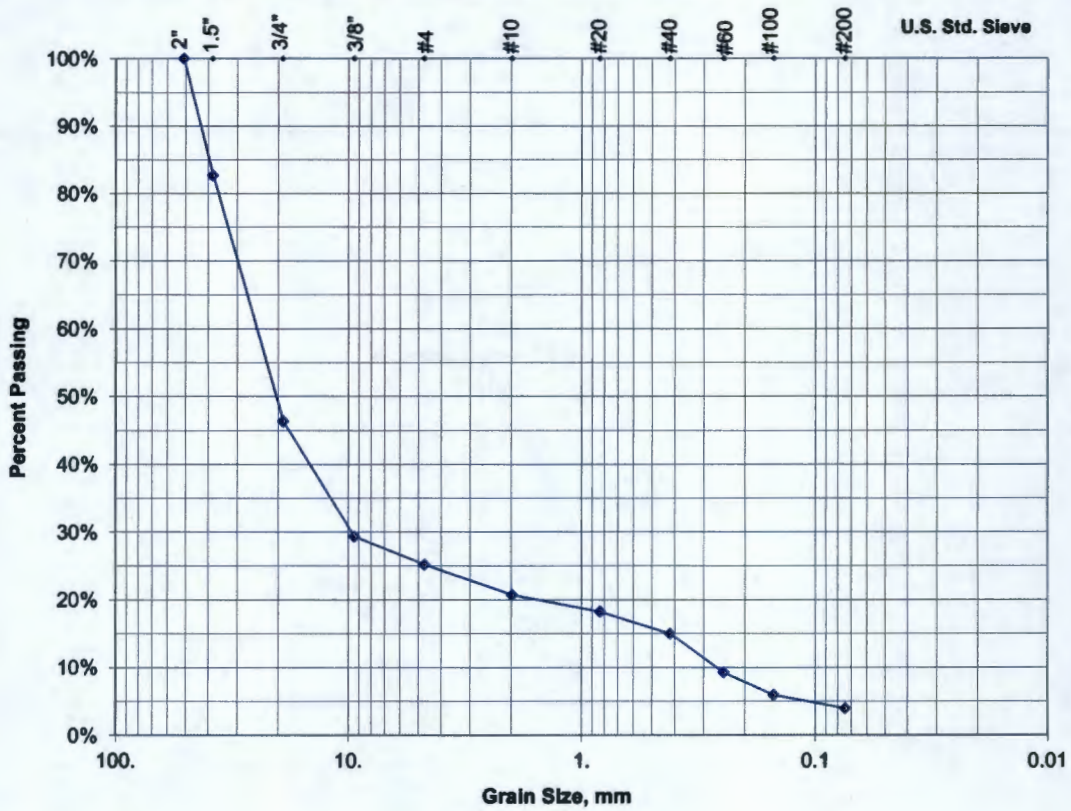
FREESTONE ENVIRONMENTAL SERVICES, INC.

Checked By: Janine Carter Date: 7/9/2014 **Office Phone:** (509) 943-5222

SIEVE ANALYSIS

WELL NAME	199-K-210	SAMPLE DEPTH	70-80	SAMPLE#	6	WELL ID#	C8297
TESTED BY	Kim Schuyler	CONTACT	Freestone Env.	PHONE	943-5222	DATE	04/02/2014

SAMPLE WEIGHT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	GRAIN SIZE (mm)	COMMENTS
652.30	2"	0.0	0.0	100.0	50.80	
	1.5"	112.9	17.3	82.7	38.10	
	3/4"	350.2	53.7	46.3	19.05	
	3/8"	461.1	70.7	29.3	9.42	
	#4	488.2	74.8	25.2	4.70	
	#10	517.3	79.3	20.7	1.98	
	#20	533.6	81.8	18.2	0.83	
	#40	554.7	85.0	15.0	0.42	
	#60	592.0	90.8	9.2	0.25	
	#100	613.7	94.1	5.9	0.150	
	#200	626.8	96.1	3.9	0.074	



Soil Description	79.3% Gravel	16.8% Sand	3.8% Silt
	53.7% Coarse-V Coarse Pebble	5.7% Coarse-V Coarse	
	17.0% Medium Pebble	5.7% Medium	
	8.6% Fine-V Fine Pebble	5.3% Fine-V Fine	

Comments:

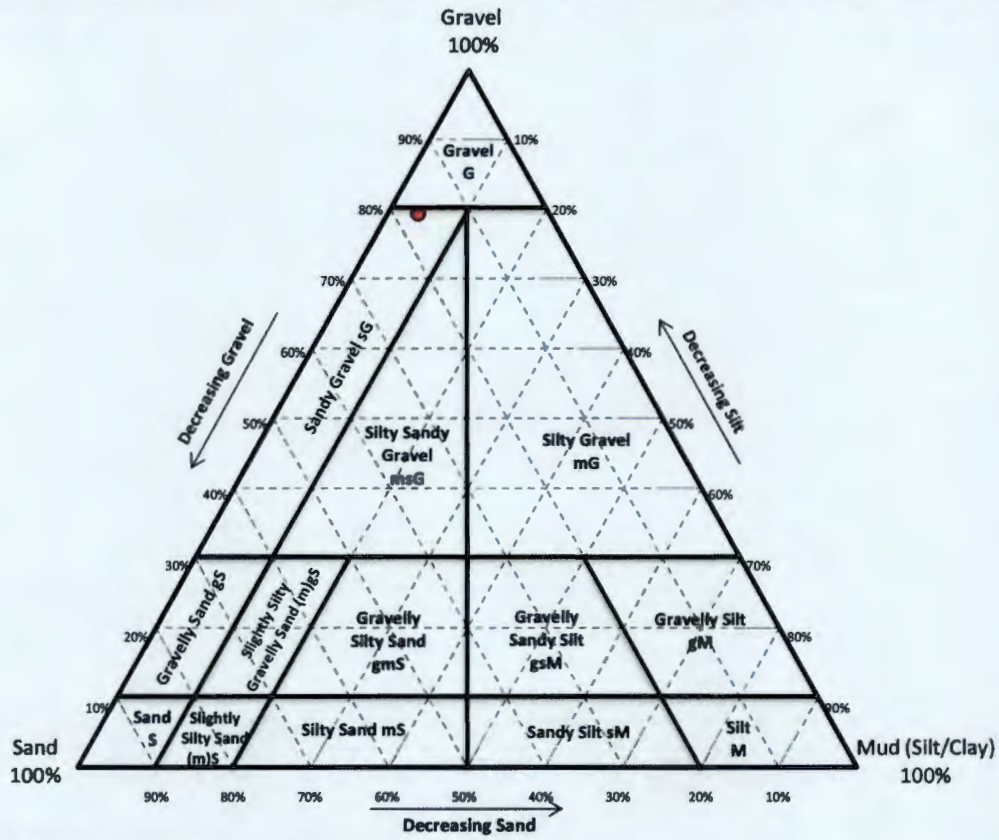
FREESTONE ENVIRONMENTAL SERVICES, INC.

Checked By: Janine Carter Date: 7/9/2014 **Office Phone:** (509) 943-5222

SIEVE ANALYSIS DATA

Date:	4/2/2014	Well Name:	199-K-210
Soil Description:	Sandy Gravel	Well ID:	C8297
Sample Number:	6	Sample Depth (ft bgs):	70-80
Sample bowl (g):	746.8	Final Variance (grams):	0.4
Sample bowl+dry sample (g):	1399.1	Sample bowl + wash/dry sample (g):	1380.0
Dry sample weight (g):	652.3	Wash/dry sample weight (g):	633.2

Sieve No.	Sieve Opening	Sieve Weight (g)	Sieve + Soil Weight (g)	Weight of Soil Retained (g)	Percent Retained	Cumulative Weight Retained (g)	Cumulative Percent Retained	Percent Finer
–	2.0 IN	469.8	469.8	0.0	0.0%	0.0	0.0%	100.0
–	1.5 IN	491.2	604.1	112.9	17.3%	112.9	17.3%	82.7
–	0.75 IN	497.8	735.1	237.3	36.4%	350.2	53.7%	46.3
–	0.375 IN	490.1	601.0	110.9	17.0%	461.1	70.7%	29.3
4	4.75 mm	463.7	490.8	27.1	4.2%	488.2	74.8%	25.2
10	2.00 mm	489.3	518.4	29.1	4.5%	517.3	79.3%	20.7
20	0.85 mm	380.5	396.8	16.3	2.5%	533.6	81.8%	18.2
40	0.425 mm	336.0	357.1	21.1	3.2%	554.7	85.0%	15.0
60	0.25 mm	321.2	358.5	37.3	5.7%	592.0	90.8%	9.2
100	0.15 mm	308.7	330.4	21.7	3.3%	613.7	94.1%	5.9
200	0.075 mm	328.6	341.7	13.1	2.0%	626.8	96.1%	3.9
PAN	–	370.3	376.3	6.0 19.1	3.8%	651.9	99.9%	0.0



If percentages are borderline, use the coarser classification.
i.e. 90% sand, 10% silt equals sand, not slightly silty sand or 60% gravel, 30% sand, and 10% silt equals sandy gravel, not silty sandy gravel

Comments:

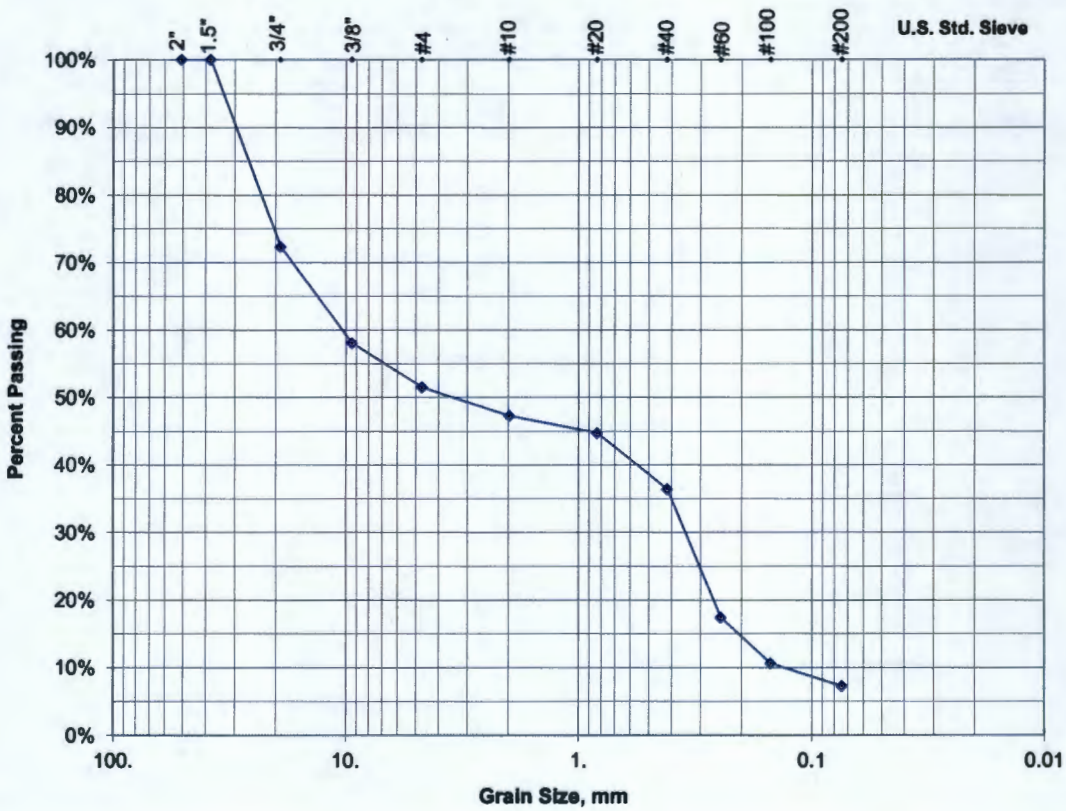
FREESTONE ENVIRONMENTAL SERVICES, INC.

Checked By: Janine Carter Date: 7/9/2014 **Office Phone:** (509) 943-5222

SIEVE ANALYSIS

WELL NAME	199-K-210	SAMPLE DEPTH	80-90	SAMPLE#	7	WELL ID#	C8297
TESTED BY	Kim Schuyler	CONTACT	Freestone Env.	PHONE	943-5222	DATE	04/02/2014

SAMPLE WEIGHT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	GRAIN SIZE (mm)	COMMENTS
602.20	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	166.8	27.7	72.3	19.05	
	3/8"	252.9	42.0	58.0	9.42	
	#4	292.3	48.5	51.5	4.70	
	#10	317.7	52.8	47.2	1.98	
	#20	333.1	55.3	44.7	0.83	
	#40	383.1	63.6	36.4	0.42	
	#60	497.6	82.6	17.4	0.25	
	#100	538.5	89.4	10.6	0.150	
	#200	558.7	92.8	7.2	0.074	



Soil Description	52.8% Gravel	40.0% Sand	7.4% Silt
	27.7% Coarse-V Coarse Pebble	10.9% Coarse-V Coarse	
	14.3% Medium Pebble	19.0% Medium	
	10.8% Fine-V Fine Pebble	10.1% Fine-V Fine	

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

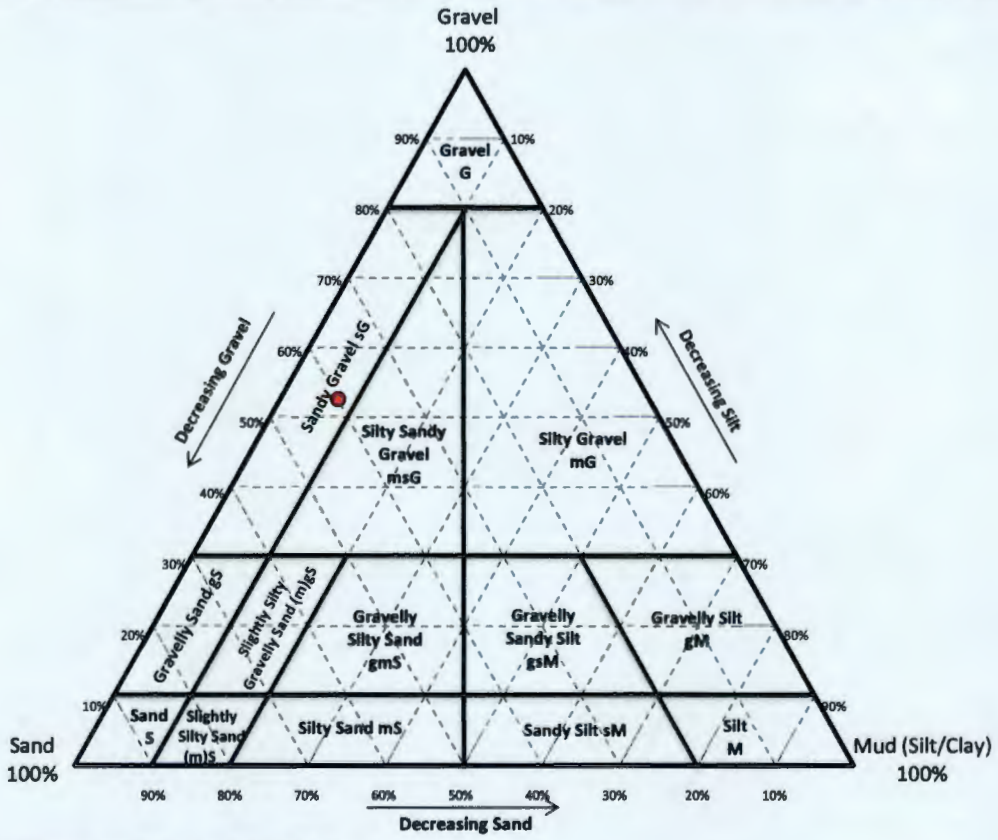
Checked By: Janine Carter Date: 7/9/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS DATA

Date:	4/2/2014	Well Name:	199-K-210
Soil Description:	Sandy Gravel	Well ID:	C8297
Sample Number:	7	Sample Depth (ft bgs):	80-90
Sample bowl (g):	747.0	Final Variance (grams):	1.2
Sample bowl+dry sample (g):	1349.2	Sample bowl + wash/dry sample (g):	1311.2
Dry sample weight (g):	602.2	Wash/dry sample weight (g):	564.2

Sieve No.	Sieve Opening	Sieve Weight (g)	Sieve + Soil Weight (g)	Weight of Soil Retained (g)	Percent Retained	Cumulative Weight Retained (g)	Cumulative Percent Retained	Percent Finer
–	2.0 IN	469.7	469.7	0.0	0.0%	0.0	0.0%	100.0
–	1.5 IN	491.1	491.1	0.0	0.0%	0.0	0.0%	100.0
–	0.75 IN	497.4	664.2	166.8	27.7%	166.8	27.7%	72.3
–	0.375 IN	490.1	576.2	86.1	14.3%	252.9	42.0%	58.0
4	4.75 mm	463.6	503.0	39.4	6.5%	292.3	48.5%	51.5
10	2.00 mm	489.2	514.6	25.4	4.2%	317.7	52.8%	47.2
20	0.85 mm	380.6	396.0	15.4	2.6%	333.1	55.3%	44.7
40	0.425 mm	336.2	386.2	50.0	8.3%	383.1	63.6%	36.4
60	0.25 mm	321.2	435.7	114.5	19.0%	497.6	82.6%	17.4
100	0.15 mm	308.9	349.8	40.9	6.8%	538.5	89.4%	10.6
200	0.075 mm	328.5	348.7	20.2	3.4%	558.7	92.8%	7.2
PAN	–	370.8	377.5	6.7 38.0	7.4%	603.4	100.2%	0.0



If percentages are borderline, use the coarser classification.
i.e. 90% sand, 10% silt equals sand, not slightly silty sand or 60% gravel, 30% sand, and 10% silt equals sandy gravel, not silty sandy gravel

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

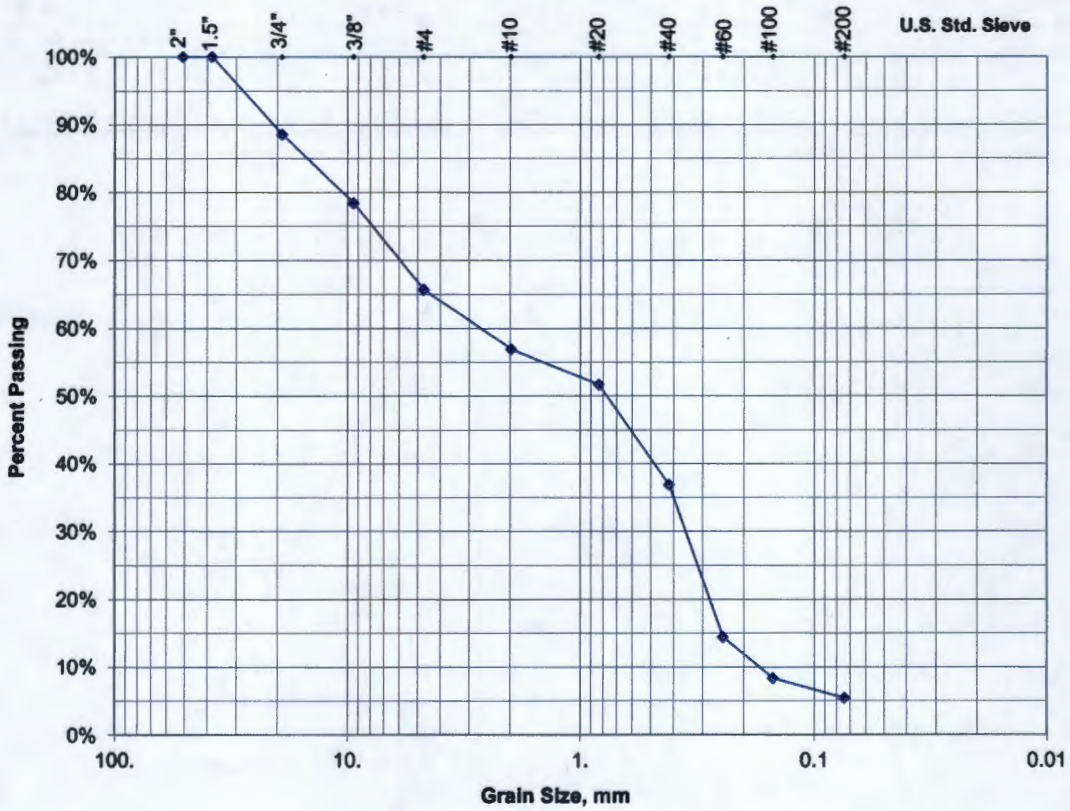
Checked By: Janine Carter Date: 7/9/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS

WELL NAME	199-K-210	SAMPLE DEPTH	90-100	SAMPLE#	8	WELL ID#	C8297
TESTED BY	Kim Schuyler	CONTACT	Freestone Env.	PHONE	943-5222	DATE	04/02/2014

SAMPLE WEIGHT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	GRAIN SIZE (mm)	COMMENTS
637.60	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	73.2	11.5	88.5	19.05	
	3/8"	137.7	21.6	78.4	9.42	
	#4	219.2	34.4	65.6	4.70	
	#10	275.1	43.1	56.9	1.98	
	#20	308.3	48.4	51.6	0.83	
	#40	402.7	63.2	36.8	0.42	
	#60	545.9	85.6	14.4	0.25	
	#100	584.7	91.7	8.3	0.150	
	#200	603.4	94.6	5.4	0.074	



Soil Description	43.1% Gravel	51.5% Sand	5.4% Silt
	11.5% Coarse-V Coarse Pebble	20.0% Coarse-V Coarse	
	10.1% Medium Pebble	22.5% Medium	
	21.5% Fine-V Fine Pebble	9.0% Fine-V Fine	

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

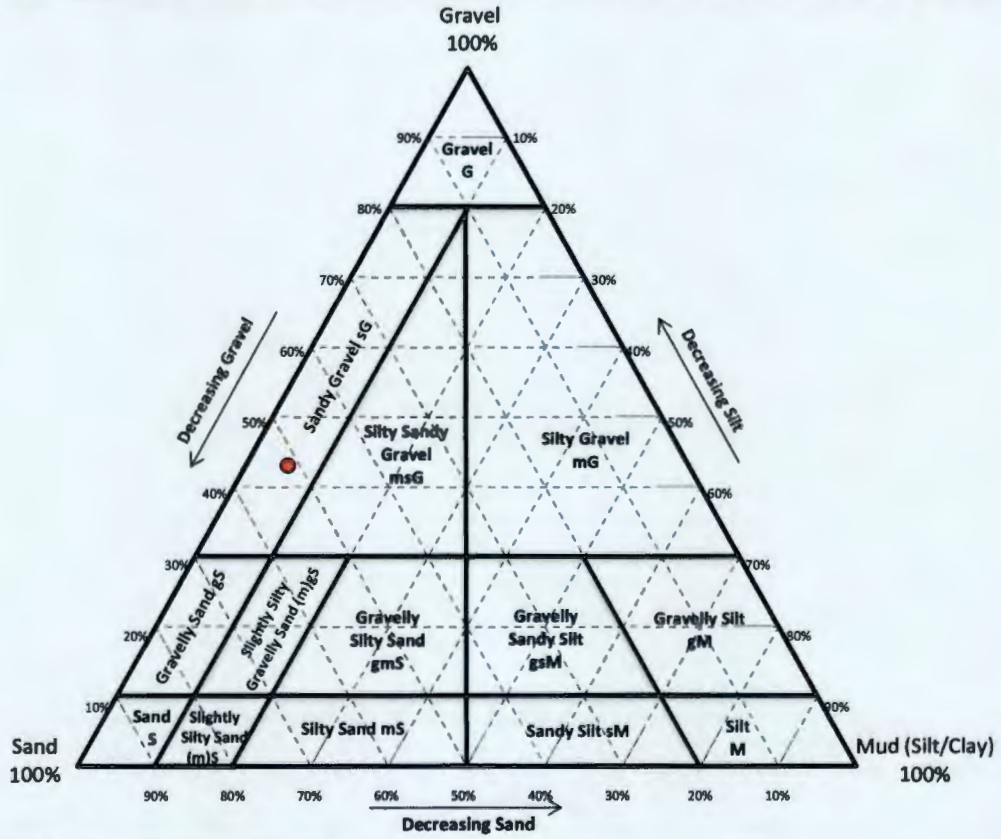
Checked By: Janine Carter Date: 7/9/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS DATA

Date:	4/2/2014	Well Name:	199-K-210
Soil Description:	Sandy Gravel	Well ID:	C8297
Sample Number:	8	Sample Depth (ft bgs):	90-100
Sample bowl (g):	767.1	Final Variance (grams):	0.4
Sample bowl+dry sample (g):	1404.7	Sample bowl + wash/dry sample (g):	1381.7
Dry sample weight (g):	637.6	Wash/dry sample weight (g):	614.6

Sieve No.	Sieve Opening	Sieve Weight (g)	Sieve + Soil Weight (g)	Weight of Soil Retained (g)	Percent Retained	Cumulative Weight Retained (g)	Cumulative Percent Retained	Percent Finer
–	2.0 IN	469.8	469.8	0.0	0.0%	0.0	0.0%	100.0
–	1.5 IN	491.2	491.2	0.0	0.0%	0.0	0.0%	100.0
–	0.75 IN	497.8	571.0	73.2	11.5%	73.2	11.5%	88.5
–	0.375 IN	490.3	554.8	64.5	10.1%	137.7	21.6%	78.4
4	4.75 mm	463.6	545.1	81.5	12.8%	219.2	34.4%	65.6
10	2.00 mm	489.4	545.3	55.9	8.8%	275.1	43.1%	56.9
20	0.85 mm	380.4	413.6	33.2	5.2%	308.3	48.4%	51.6
40	0.425 mm	336.2	430.6	94.4	14.8%	402.7	63.2%	36.8
60	0.25 mm	321.3	464.5	143.2	22.5%	545.9	85.6%	14.4
100	0.15 mm	308.7	347.5	38.8	6.1%	584.7	91.7%	8.3
200	0.075 mm	328.3	347.0	18.7	2.9%	603.4	94.6%	5.4
PAN	–	370.7	382.3	11.6 23.0	5.4%	638.0	100.1%	0.0



If percentages are borderline, use the coarser classification.
i.e. 90% sand, 10% silt equals sand, not slightly silty sand or 60% gravel, 30% sand, and 10% silt equals sandy gravel, not silty sandy gravel

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

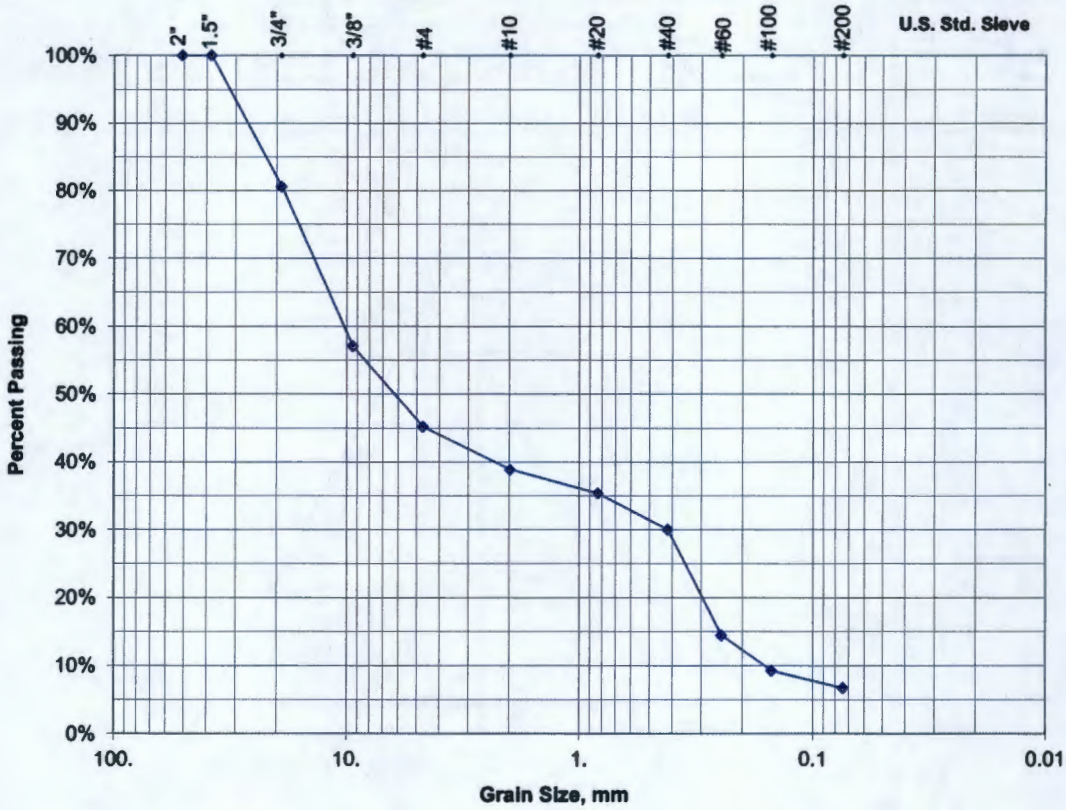
Checked By: Janine Carter Date: 7/9/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS

WELL NAME	199-K-210	SAMPLE DEPTH	100-110	SAMPLE#	9	WELL ID#	C8297
TESTED BY	Kim Schuyler	CONTACT	Freestone Env.	PHONE	943-5222	DATE	04/02/2014

SAMPLE WEIGHT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	GRAIN SIZE (mm)	COMMENTS
580.00	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	112.7	19.4	80.6	19.05	
	3/8"	249.3	43.0	57.0	9.42	
	#4	318.1	54.8	45.2	4.70	
	#10	354.9	61.2	38.8	1.98	
	#20	375.0	64.7	35.3	0.83	
	#40	406.0	70.0	30.0	0.42	
	#60	496.5	85.6	14.4	0.25	
	#100	526.6	90.8	9.2	0.150	
	#200	541.2	93.3	6.7	0.074	



Soil Description	**61.2% Gravel**	**32.1% Sand**	**6.5% Silt**
	19.4% Coarse-V Coarse Pebble	8.8% Coarse-V Coarse	
	23.6% Medium Pebble	15.6% Medium	
	18.2% Fine-V Fine Pebble	7.7% Fine-V Fine	

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

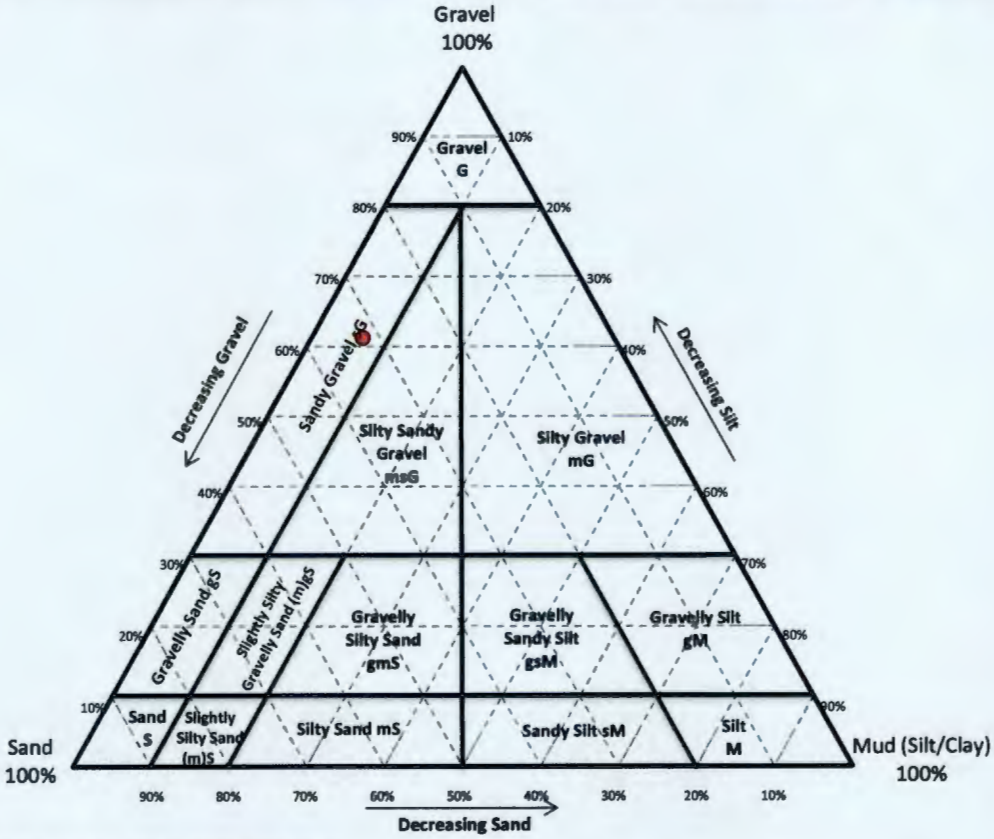
Checked By: Janine Carter Date: 7/9/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS DATA

Date:	4/2/2014	Well Name:	199-K-210
Soil Description:	Sandy Gravel	Well ID:	C8297
Sample Number:	9	Sample Depth (ft bgs):	100-110
Sample bowl (g):	754.9	Final Variance (grams):	0.9
Sample bowl+dry sample (g):	1334.9	Sample bowl + wash/dry sample (g):	1305.8
Dry sample weight (g):	580.0	Wash/dry sample weight (g):	550.9

Sieve No.	Sieve Opening	Sieve Weight (g)	Sieve + Soil Weight (g)	Weight of Soil Retained (g)	Percent Retained	Cumulative Weight Retained (g)	Cumulative Percent Retained	Percent Finer
–	2.0 IN	469.9	469.9	0.0	0.0%	0.0	0.0%	100.0
–	1.5 IN	491.2	491.2	0.0	0.0%	0.0	0.0%	100.0
–	0.75 IN	497.9	610.6	112.7	19.4%	112.7	19.4%	80.6
–	0.375 IN	490.3	626.9	136.6	23.6%	249.3	43.0%	57.0
4	4.75 mm	463.8	532.6	68.8	11.9%	318.1	54.8%	45.2
10	2.00 mm	489.6	526.4	36.8	6.3%	354.9	61.2%	38.8
20	0.85 mm	380.7	400.8	20.1	3.5%	375.0	64.7%	35.3
40	0.425 mm	336.3	367.3	31.0	5.3%	406.0	70.0%	30.0
60	0.25 mm	321.3	411.8	90.5	15.6%	496.5	85.6%	14.4
100	0.15 mm	308.6	338.7	30.1	5.2%	526.6	90.8%	9.2
200	0.075 mm	328.4	343.0	14.6	2.5%	541.2	93.3%	6.7
PAN	–	370.7	379.5	8.8 29.1	6.5%	579.1	99.8%	0.0



If percentages are borderline, use the coarser classification.
i.e. 90% sand, 10% silt equals sand, not slightly silty sand or 60% gravel, 30% sand, and 10% silt equals sandy gravel, not silty sandy gravel

Comments:

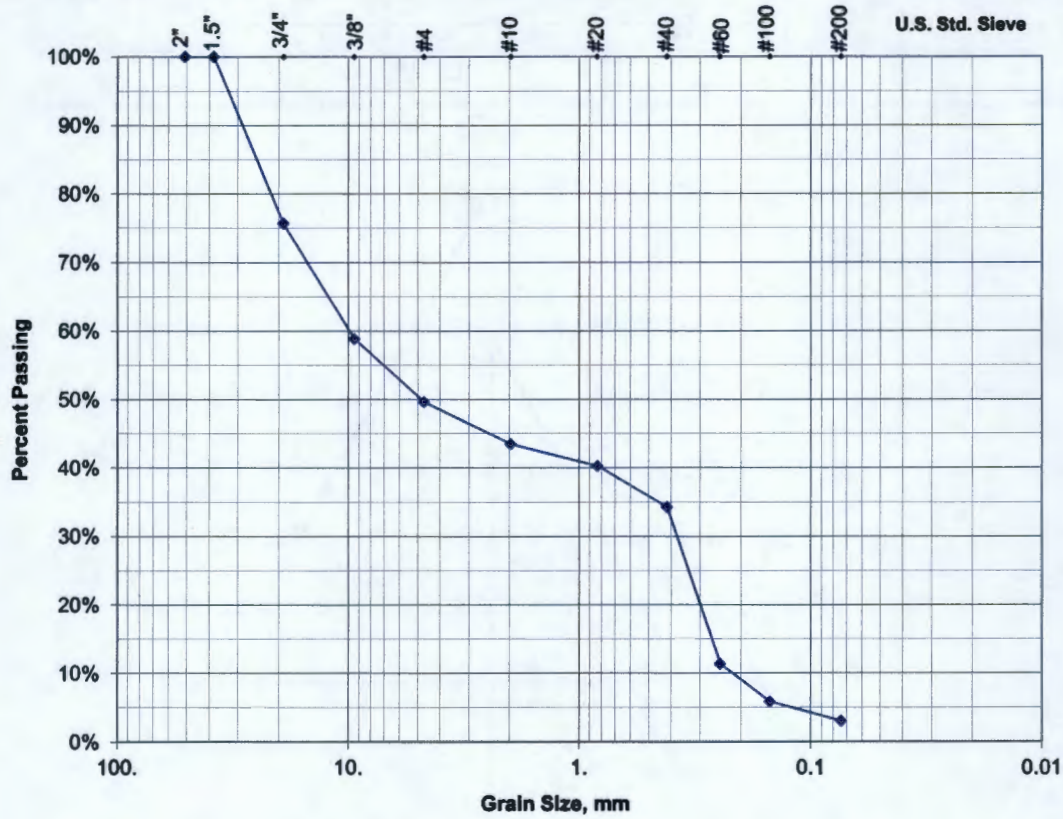
FREESTONE ENVIRONMENTAL SERVICES, INC.

Checked By: Janine Carter Date: 7/9/2014 **Office Phone:** (509) 943-5222

SIEVE ANALYSIS

WELL NAME	199-K-210	SAMPLE DEPTH	110-115	SAMPLE#	10	WELL ID#	C8297
TESTED BY	Greg Kasza	CONTACT	Freestone Env.	PHONE	943-5222	DATE	04/09/2014

SAMPLE WEIGHT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	GRAIN SIZE (mm)	COMMENTS
703.10	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	171.0	24.3	75.7	19.05	
	3/8"	289.8	41.2	58.8	9.42	
	#4	354.2	50.4	49.6	4.70	
	#10	397.4	56.5	43.5	1.98	
	#20	420.1	59.7	40.3	0.83	
	#40	462.4	65.8	34.2	0.42	
	#60	623.5	88.7	11.3	0.25	
	#100	662.2	94.2	5.8	0.150	
	#200	682.0	97.0	3.0	0.074	



Soil Description	56.5% Gravel	40.5% Sand	3.3% Silt
	24.3% Coarse-V Coarse Pebble	9.2% Coarse-V Coarse	
	16.9% Medium Pebble	22.9% Medium	
	15.3% Fine-V Fine Pebble	8.3% Fine-V Fine	

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

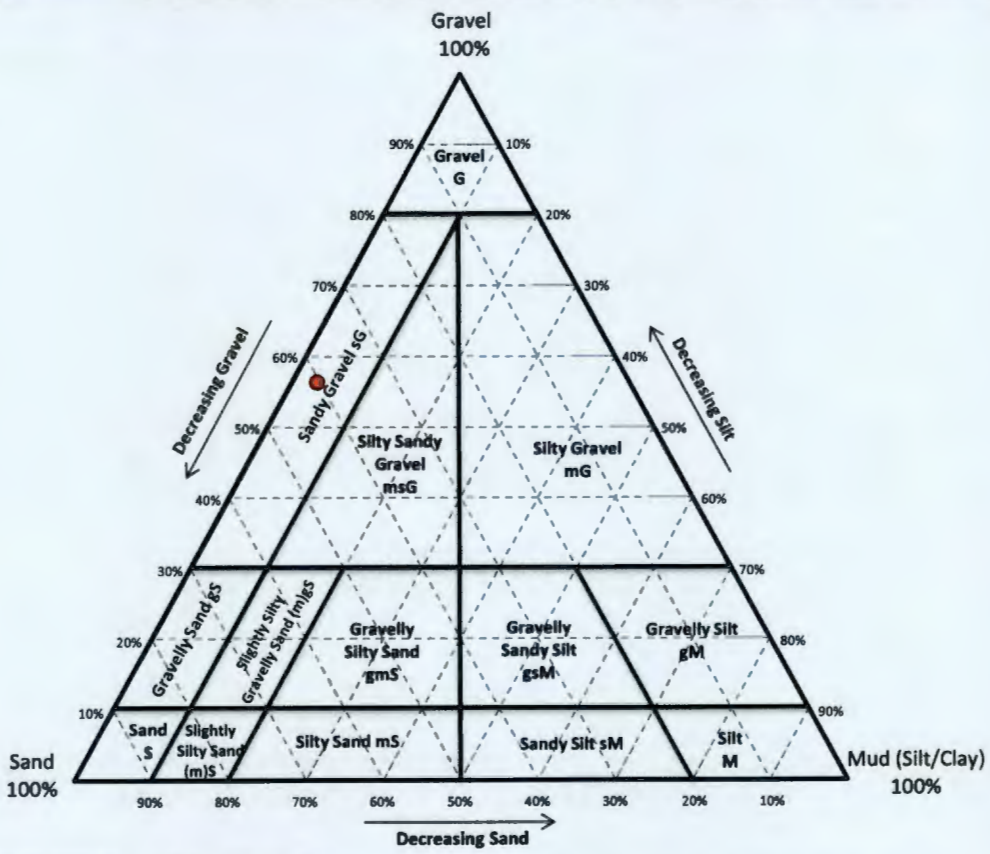
Checked By: Janine Carter Date: 7/7/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS DATA

Date:	4/9/2014	Well Name:	199-K-210
Soil Description:	Sandy Gravel	Well ID:	C8297
Sample Number:	10	Sample Depth (ft bgs):	110-115
Sample bowl (g):	754.9	Final Variance (grams):	1.8
Sample bowl+dry sample (g):	1458.0	Sample bowl + wash/dry sample (g):	1454.2
Dry sample weight (g):	703.1	Wash/dry sample weight (g):	699.3

Sieve No.	Sieve Opening	Sieve Weight (g)	Sieve + Soil Weight (g)	Weight of Soil Retained (g)	Percent Retained	Cumulative Weight Retained (g)	Cumulative Percent Retained	Percent Finer
--	2.0 IN	469.9	469.9	0.0	0.0%	0.0	0.0%	100.0
--	1.5 IN	491.2	491.2	0.0	0.0%	0.0	0.0%	100.0
--	0.75 IN	497.9	668.9	171.0	24.3%	171.0	24.3%	75.7
--	0.375 IN	490.3	609.1	118.8	16.9%	289.8	41.2%	58.8
4	4.75 mm	463.8	528.2	64.4	9.2%	354.2	50.4%	49.6
10	2.00 mm	489.6	532.8	43.2	6.1%	397.4	56.5%	43.5
20	0.85 mm	380.7	403.4	22.7	3.2%	420.1	59.7%	40.3
40	0.425 mm	336.3	378.6	42.3	6.0%	462.4	65.8%	34.2
60	0.25 mm	321.3	482.4	161.1	22.9%	623.5	88.7%	11.3
100	0.15 mm	308.6	347.3	38.7	5.5%	662.2	94.2%	5.8
200	0.075 mm	328.4	348.2	19.8	2.8%	682.0	97.0%	3.0
PAN	--	370.7	389.8	19.1 3.8	3.3%	704.9	100.3%	0.0



If percentages are borderline, use the coarser classification.
i.e. 90% sand, 10% silt equals sand, not slightly silty sand or 60% gravel, 30% sand, and 10% silt equals sandy gravel, not silty sandy gravel

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

Checked By: Janine Carter Date: 7/7/2014

Office Phone: (509) 943-5222

cm
FREESTONE
C8297 5 ft

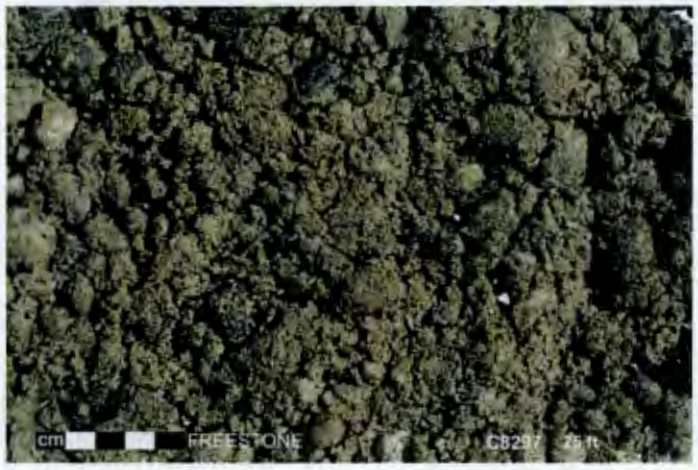
cm
FREESTONE
C8297 10 ft

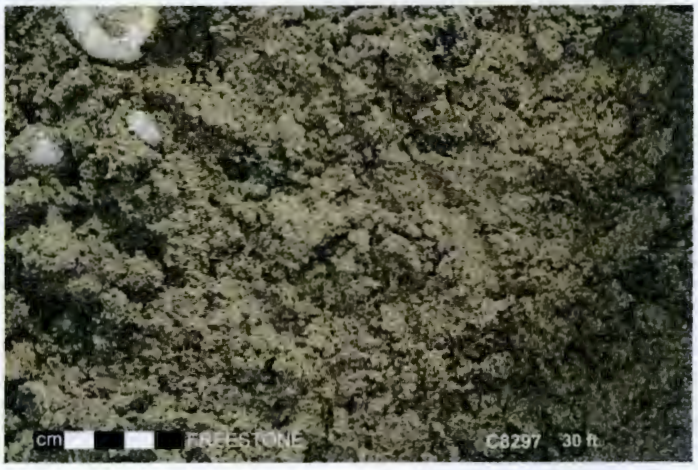
cm
FREESTONE
C8297 15 ft

cm
FREESTONE
C8297 17 ft

cm
FREESTONE
C8297 20 ft

cm
FREESTONE
C8297 22 ft


cm
FREESTONE
C8297 25 ft

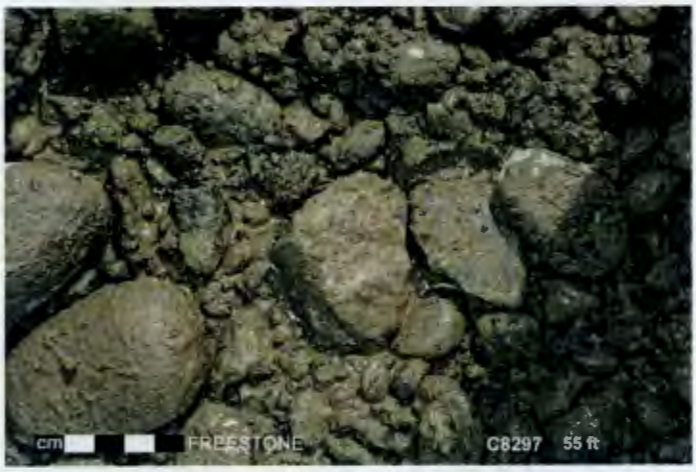

cm
FREESTONE
C8297 30 ft

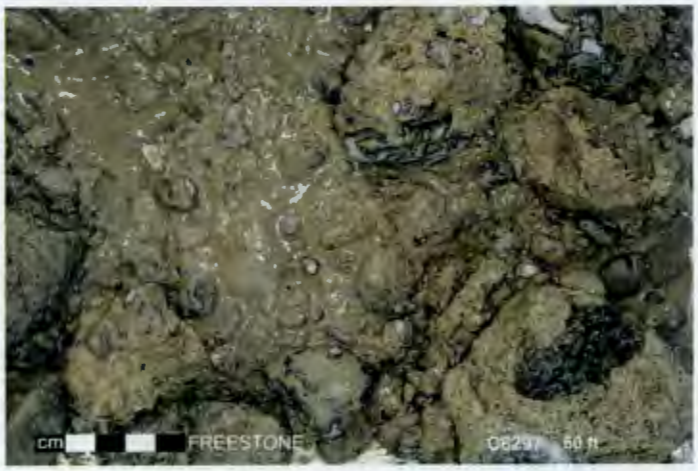
cm
FREESTONE
C8297 35 ft

cm
FREESTONE
C8297 40 ft

cm
FREESTONE
C8297 45 ft

cm
FREESTONE
C8297 50 ft


cm
FREESTONE
C8297 55 ft

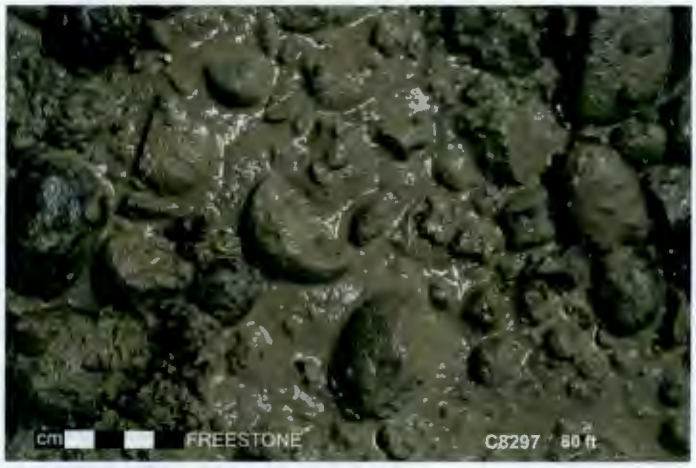

cm
FREESTONE

cm
C8297 63 ft

FREESTONE
C8297 65 ft

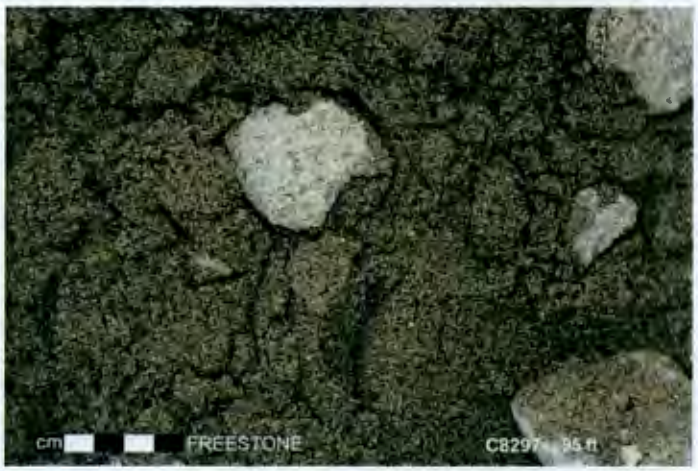
cm
FREESTONE
C8297 70 ft

cm
FREESTONE
C8297 75 ft


cm
FREESTONE
C8297 80 ft

cm
FREESTONE
C8297 85 ft

cm
FREESTONE
C8297 90 ft


cm
FREESTONE
C8297 95 ft

cm
FREESTONE
C8297 100 ft

cm
FREESTONE
C8297 105 ft

cm
FREESTONE
C8297 110 ft

cm
FREESTONE
C8297 115 ft

cm
FREESTONE
C8297 116 ft

cm
FREESTONE
C8297 122 ft

SURVEY DATA REPORT				Request No. 143-082
Project No.	Title KR-4 Wells C8297 and C8299 Final Surveys			File No. 1KT14R26
Job. No. CACN: 303067-DP20	Prepared By N.P. Fastabend	Date 6/24/14	Reviewer LBM	

DESCRIPTION OF WORK	DISTRIBUTION	SDR	PLOT	DWG
Obtained final coordinates (C/L Casings) and elevations of completed KR-4 Wells C8297 (199-K-210) and C8299 (199-K-212) located north and northeast of 100K Area.	Survey File	OR		
	S.E. Imhoff	1		
	S.J. Trent	1		
	K.M. Whitley	1		
	J.B. Geiger	1		
	B.J. Howard	1		
Horizontal Coordinate System: WCS83S/91 (Meters) Vertical Datum: NAVD88 (Meters)	A.J. Green	1		

SURVEY RESULTS AND COMMENTS

See Attached Well Survey Data Report Sheets

WELL SURVEY DATA REPORT

Project:	Prepared By: Neil P. Fastabend Company: CHPRC
Date Requested: 06/10/14	Requestor: Steve Imhoff (CHPRC)
Date of Survey: 06/19/14	Surveyor: Lawrence B. Munnell (CHPRC)
Fluor Hanford Point of Contact:	Survey Co. Point of Contact: Neil P. Fastabend
Description of Work: Obtain final survey coordinates (C/L Casing) and elevations of Well C8297 (199-K-210).	Horizontal Datum: NAD83(91) Vertical Datum: NAVD88 Units: Meters Hanford Area Designation: 100K

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
Washington State Reference Network

Vertical Control Monuments:
M49 (COE) and T324 (COE)

Well ID	Well Name	Easting	Northing	Elevation	
C8297	199-K-210	569058.13	147155.25		Center of Casing
				126.350	"X" on Rim
				125.611	Brass Survey Marker

Notes:

126.048' Top Inner Casing, North Edge

Elevation on Brass Survey Marker was measured to Top Domed Brass Cap in concrete.

Equipment Used: Trimble R8 RTK GPS
Trimble DiNi 12 Level

Surveyor Statement:

I, Lawrence B. Munnell, a Professional Land Surveyor registered in the State of Washington (Registration No. 16216), hereby certify this report is based on a field survey performed by me, or under my direct supervision.

LAWRENCE B. MUNNELL
STATE OF WASHINGTON
16216
REGISTERED
PROFESSIONAL LAND SURVEYOR

6-25-14

A-6003-659 (04/03)

199-K-210 (C8297)
Log Data Report

Borehole Information:

Log Date:	2014-04-08	Filename:	C8297_HG-NM_2014-04-08	Site:	100-K
Coordinates (WA St Plane)		DTW[1] (ft):	20.8	DTW Date:	04/02/14
North (m)	East (m)	Drill Date	TOC[2]Elevation	Total Depth (ft)	Type
N/A	N/A	04/02/14	N/A	122.1	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.) Outer	Diameter (in.) Inside	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	1.5	103/4	91/2	0.625	1.5	119

Borehole Notes:

The total depth, casing depth, and DTW are provided by the onsite geologist. The logging engineer measured casing stick-up and casing diameter (rounded to the nearest 1/16-in.). Depth to water was reported at 20.8 ft on April 2. At the time of logging, April7, depth to water inside the casing was 18 ft according to gamma and moisture logs. The maximum logging depth achieved was 117 ft, approximately 2 ft above the casing depth. The logging engineer reported possible sediment (mud) in the bottom of the borehole that precluded logging to the bottom of the casing.

Zero reference is ground surface.

Logging Equipment Information:

Logging System:	Gamma 1L	Type:	60% HPGe SGLS[3]
Effective Calibration Date:	11/11/13	Serial No.:	45-TP32211A
Calibration Reference:	HGLP-CC-096, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

Logging System:	Gamma 1H	Type:	NMLS[4]
Effective Calibration Date:	11/11/13	Serial No.:	H310700352
Calibration Reference:	HGLP-CC-097, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

SGLS Log Run Information:

Log Run	3	4Repeat			
HEIS Number	1018360	1018361			
Date	04/07/14	04/07/14			
Logging Engineer	McClellan	McClellan			
Start Depth (ft)	0.0	116.0			
Finish Depth (ft)	117.0	106.99			
Count Time (sec)	100	100			
Live/Real	R	R			

[1]depth to water inside casing
[2] top of casing
[3] Spectral Gamma Logging System
[4]Neutron Moisture Logging System

Log Run	3	4Repeat			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	AL189CAB	AL189CAB			
Start File	AL189000	AL189118			
Finish File	AL189117	AL189127			
Post-Verification	AL189CAA	AL189CAA			
Depth Return Error (in.)	N/A	0.5 Low			
Comments	Fine gain adjustment made before file -049	No fine gain adjustments made			

NMLS Log Run Information:

Log Run	1	2 Repeat			
HEIS Number	1018362	1018363			
Date	04/08/14	04/08/14			
Logging Engineer	McClellan	McClellan			
Start Depth (ft)	0.0	18.0			
Finish Depth (ft)	18.25	16.24			
Count Time (sec)	15	15			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	AH154CAB	AH154CAB			
Start File	AH154000	AH154074			
Finish File	AH154073	AH154081			
Post-Verification	AH154CAA	AH154CAA			
Depth Return Error (in.)	N/A	0			
Comments	None	None			

Logging Operation Notes:

A centralizer was installed on the sondes.

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

Analysis Notes:

Analyst:	P.D. Henwood	Date:	04/18/14	Reference:	HGLP-MAN-003, Rev. 0

A casing correction for a 5/8-in. thick casing was applied to the log data.

A correction for water inside the casing was applied below 17 ft in depth.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in EXCEL template identified as 1L20131111, using an efficiency function and corrections for casing and dead time as determined by annual calibration.

NMLS data are represented in counts per second because no calibration data exist for a 9 1/2-in. inner diameter casing.

The HGU[5] is an empirical unit of gamma activity proposed as a means to standardize gamma log response across multiple logging systems with different response characteristics. The HGU is defined in terms of measurements in the Hanford Borehole Calibration Facility, and the magnitude is selected such that 1 HGU is approximately equivalent to typical Hanford background activity, based on data from background samples as reported in *Hanford Site Background: Part 2, Soil Background for Radionuclides* (DOE/RL-96-12).

Results and Interpretations:

Cs-137 was detected at 0.7 pCi/g at 1 ft in depth. The MDLs for Cs-137 and Pu-239 are plotted on the Manmade Radionuclide plot.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content.

The KUT and moisture repeat plots indicate that the respective systems were working properly.

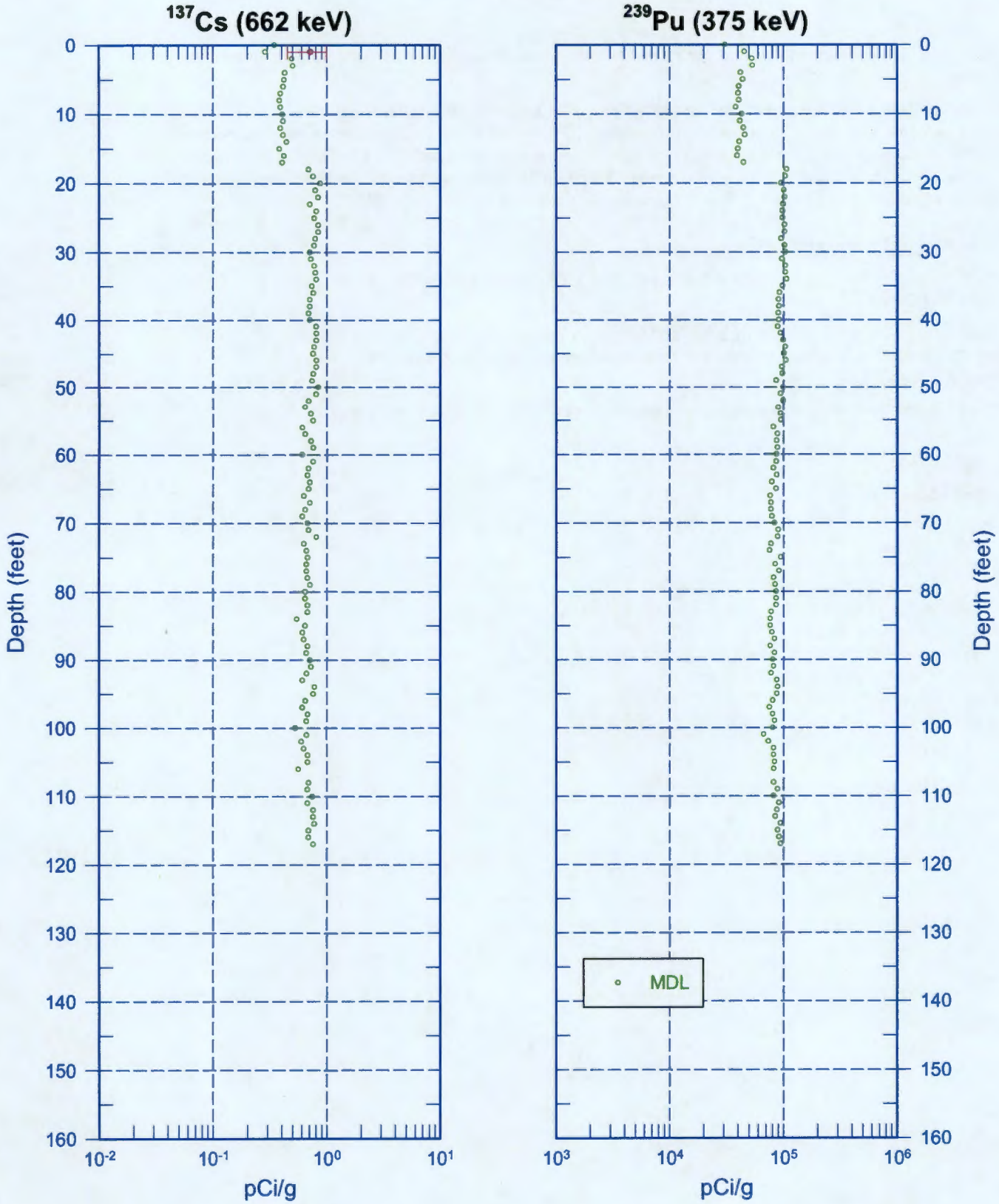
List of Log Plots:

Depth Reference is ground surface.

Manmade Radionuclides (0-160)
Natural Gamma Logs (0-160)
Combination Plot (0-120 ft)
Total Gamma & Moisture (0-160)
Total Gamma & Hanford Gamma Unit (0-160)
Repeat Section of Natural Gamma Logs (107 to 116 ft)
Moisture Repeat Section (16 to 18 ft)

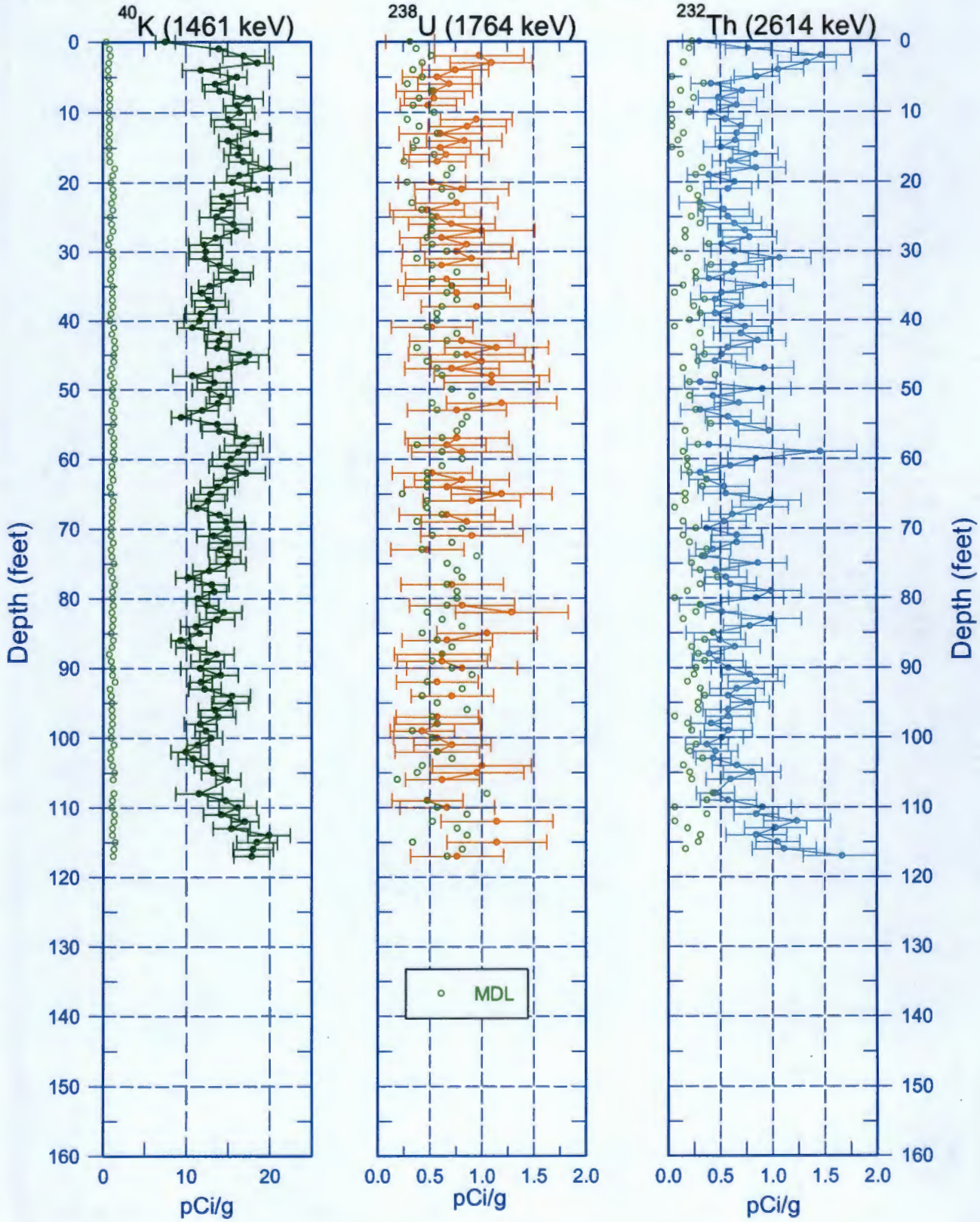
[5] Hanford Gamma Unit

199-K-210 (C8297)
Manmade Radionuclides



Zero Reference - Ground Surface

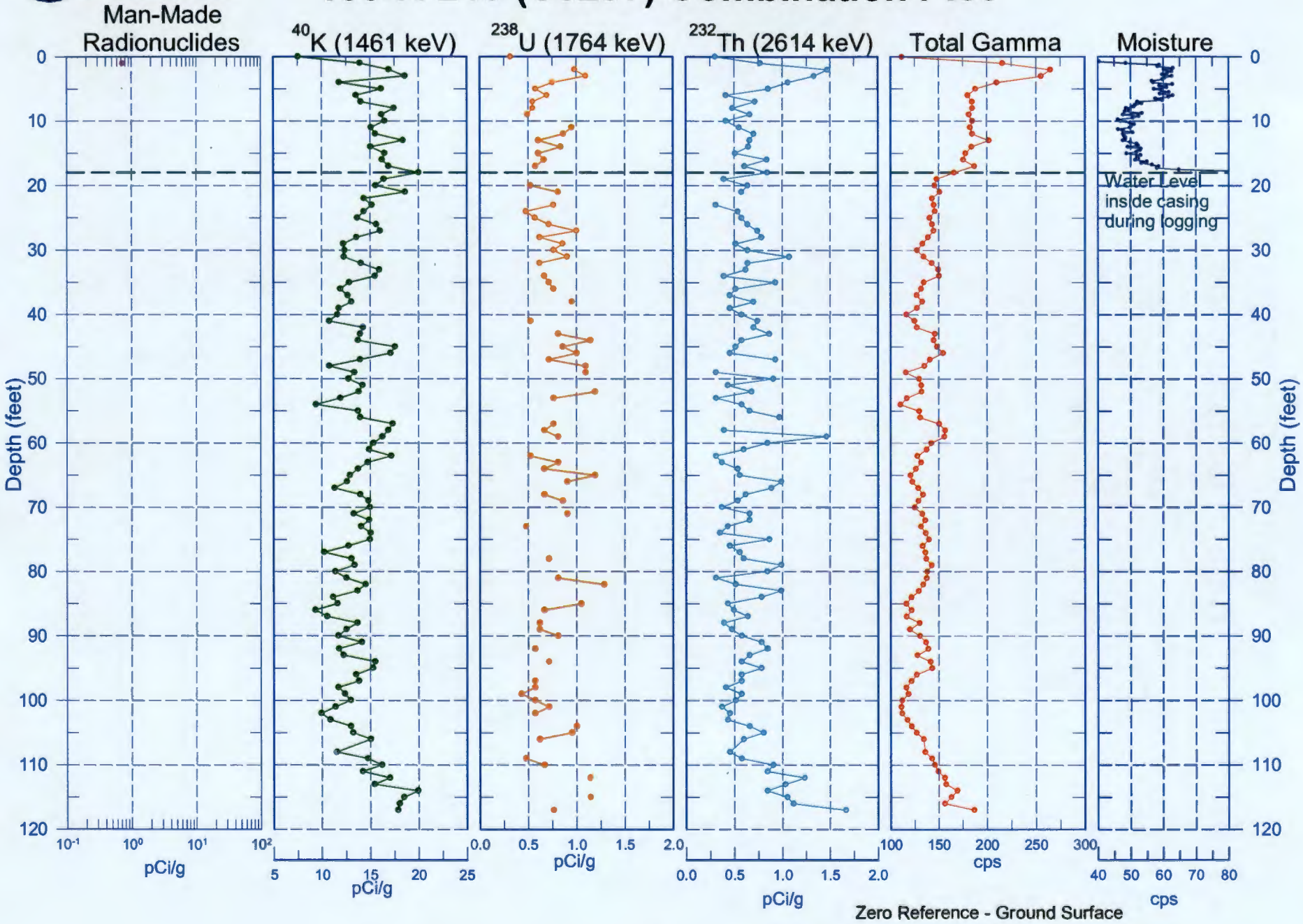
199-K-210 (C8297)
Natural Gamma Logs



Zero Reference - Ground Surface

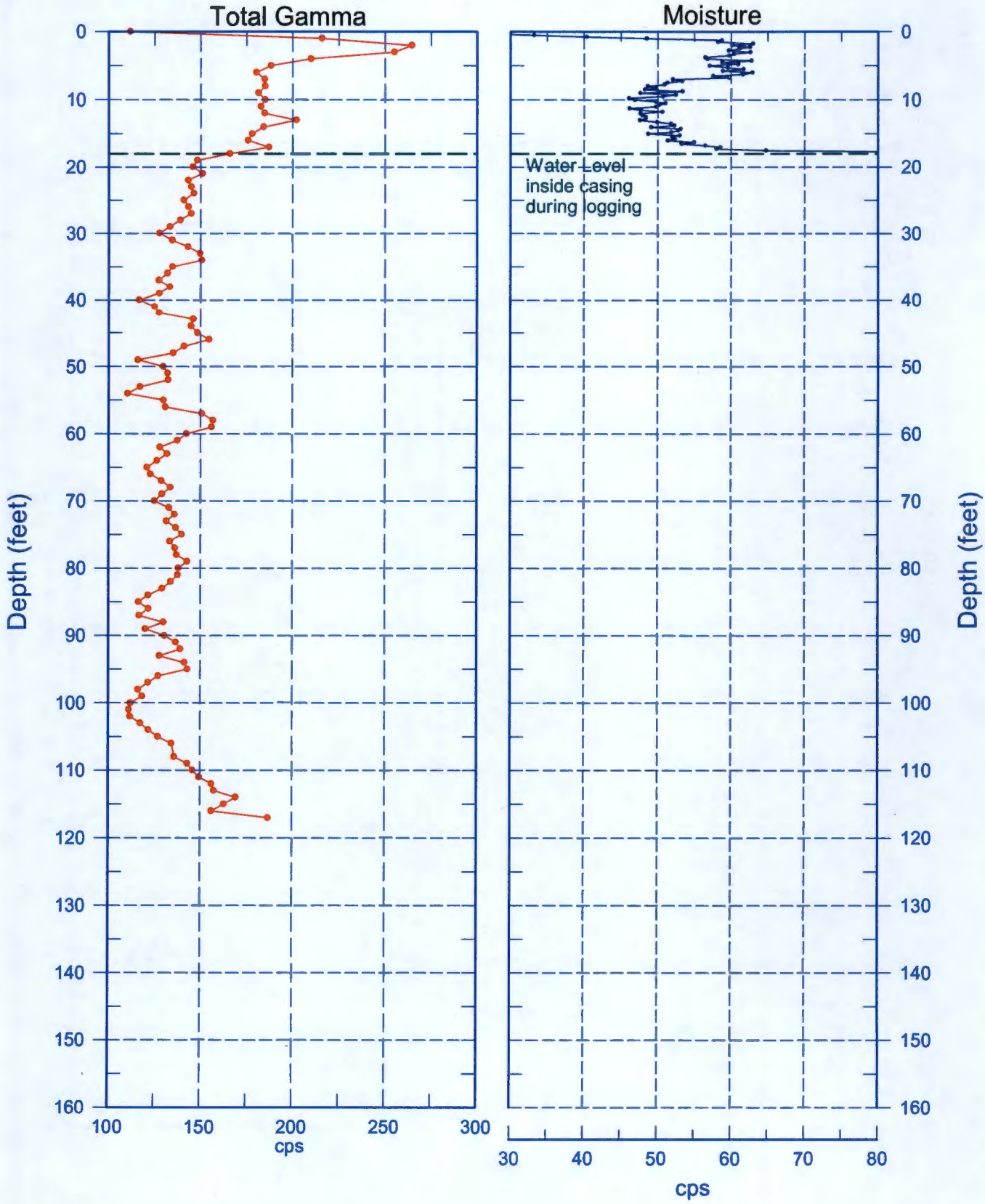
Stoller
A Subsidiary of Huntington Ingalls Industries

199-K-210 (C8297) Combination Plot



Stoller
A Subsidiary of Huntington Ingalls Industries

199-K-210 (C8297)
Total Gamma & Moisture

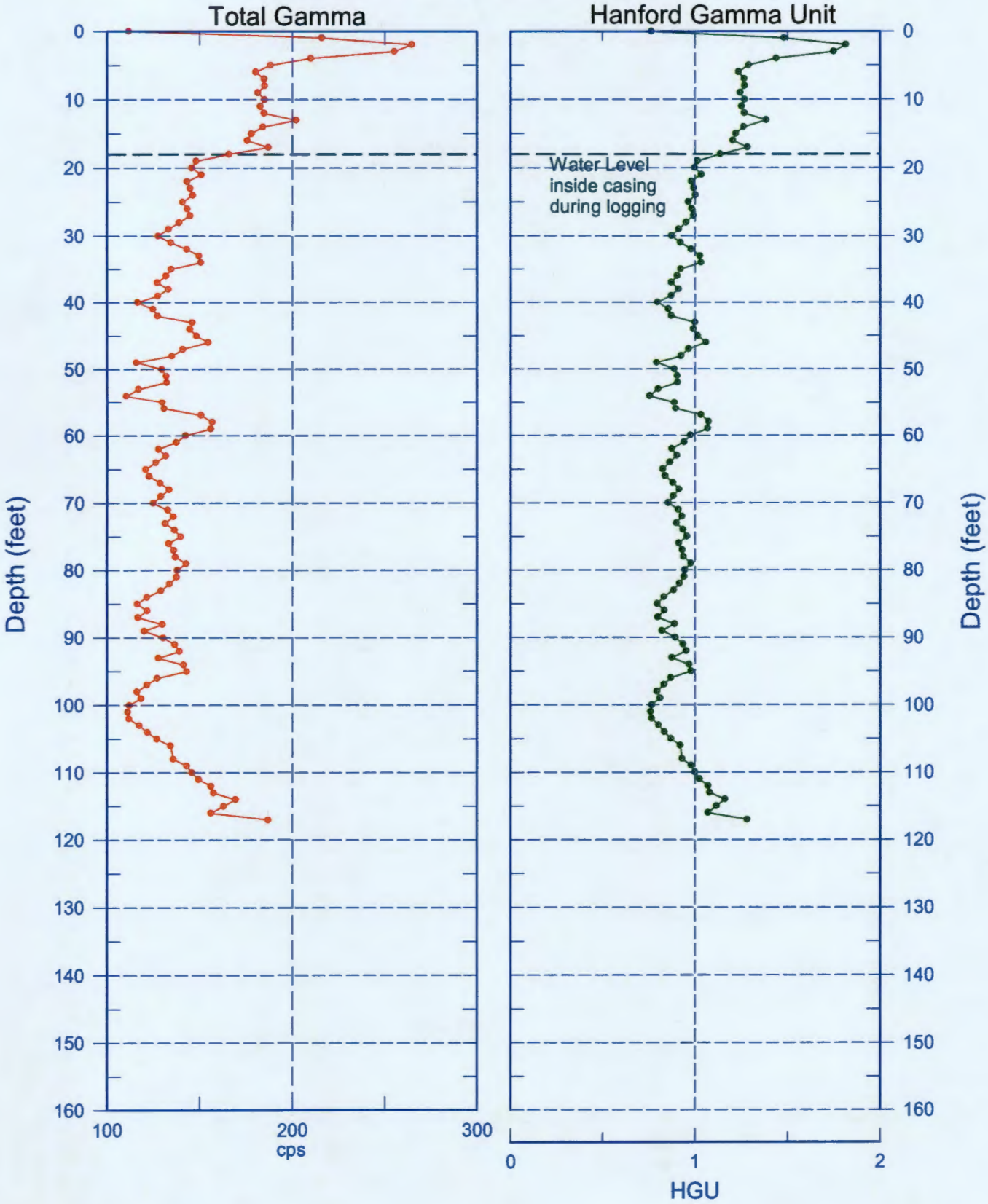


Reference - Ground Surface

Stoller
A Subsidiary of Huntington Ingalls Industries

199-K-210 (C8297)

Total Gamma & Hanford Gamma Unit

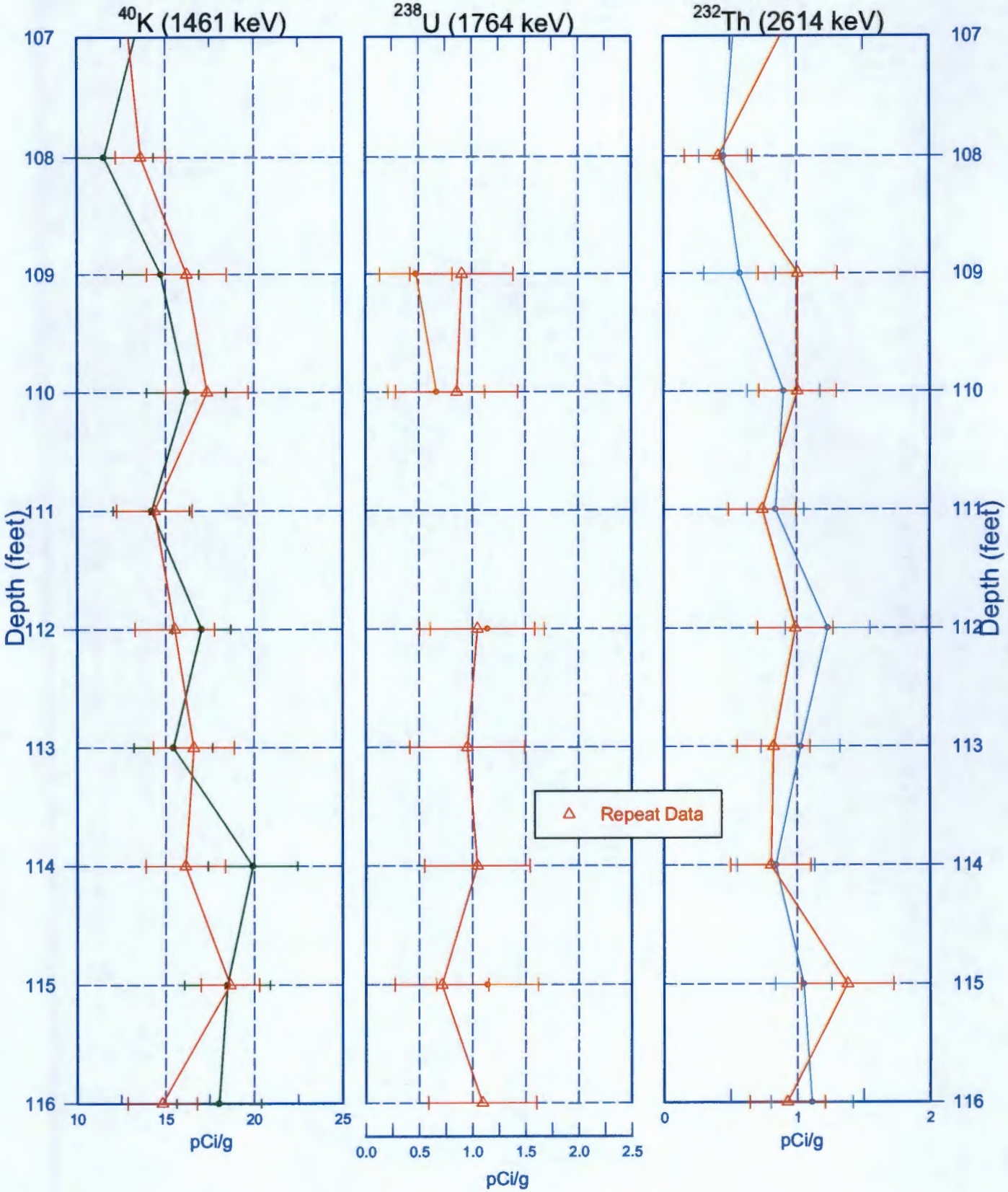


Reference - Ground Surface

Stoller
A Subsidiary of Huntington Ingalls Industries

199-K-210 (C8297)

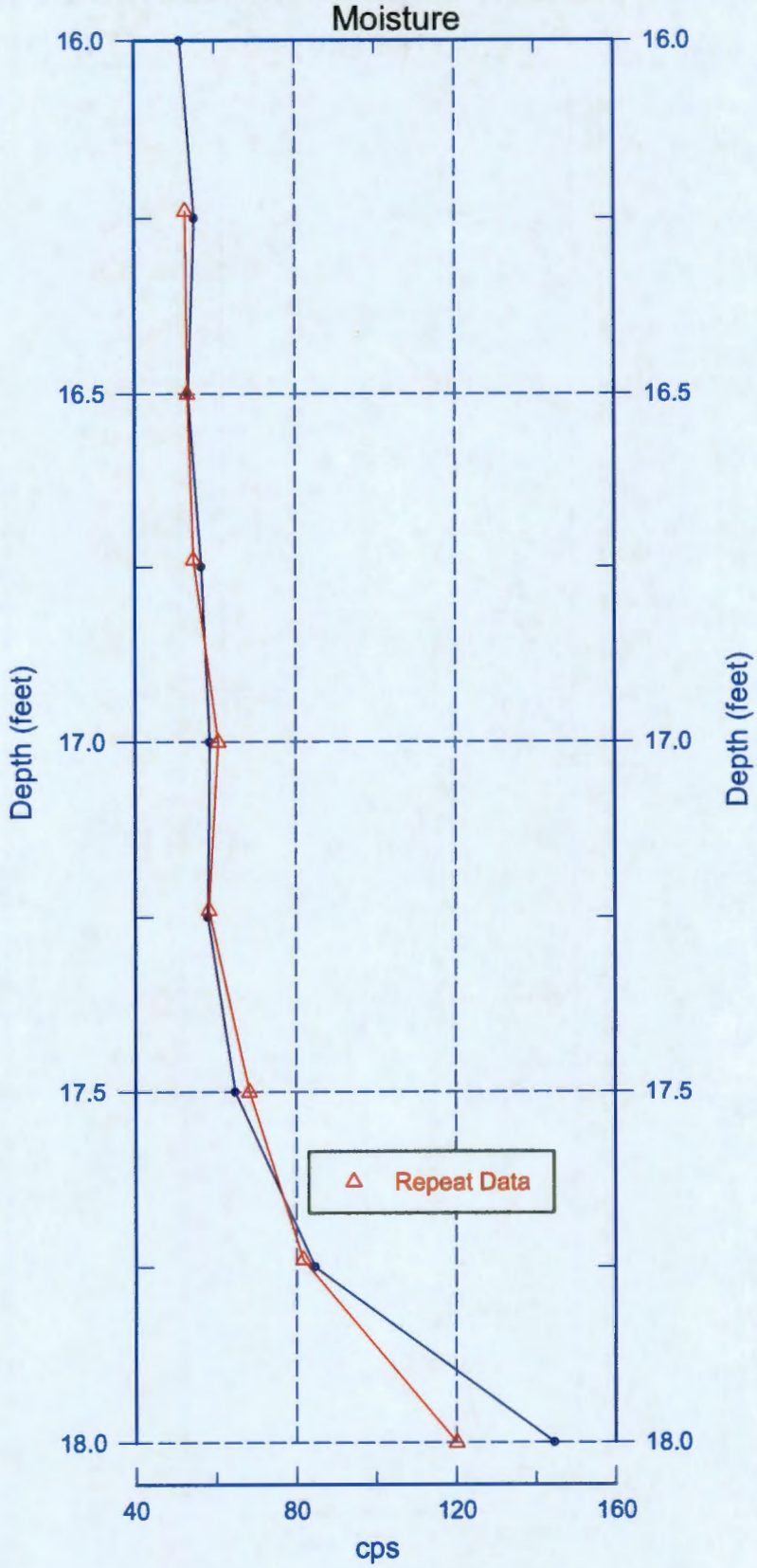
Repeat Section of Natural Gamma Logs



Zero Reference - Ground Surface

Stoller
A Subsidiary of Huntington Ingalls Industries

199-K-210 (C8297)
Moisture Repeat Section



Reference - Ground Surface

This page intentionally left blank.

Appendix B

Well Documentation for 199-K-212 (C8299)

- Borehole log
- Well Summary Sheet,
- Well Development and Testing Data
- Sieve Analysis
- Photographic Log
- Well Survey Report
- Geophysical logs

This page intentionally left blank.

BOREHOLE LOG

Page 1 of 3

Date: 3/19 TO 3/20

Well ID: C8299 | Well Name: 199-K-212 | Location: 85 m SSE OF 199-K-115A

Project: INSTALL 3 WELLS @ 100-KR-4 OU IN FY 2014 | Reference Measuring Point: GROUND SURFACE

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
0				0-2 PIT RUN GRAVEL FOR PAD	CABLE TOOL W/ DRIVE
				85% GR	BARREL
				2'-8 GRAVELLY SAND & S 90% SAND	
				10% GRAVEL 5% SILT 10YR 6/2	
				H BROWNISH GRAY, DRY, V POORLY SORTED	
5	G			GRAVEL - V COARSE TO FINE, MAX 210 MM	
				100% BASALT, ROUND; SAND - M-VF,	
				95% QTZ 5% MAFIC, SA-A, NO HCl RXN,	
8	G			8-15' G ~~SANDY~~ GRAVEL 80% G	
				15% SAND 5% SILT 10YR 7/1	
10	G			LIGHT GRAY DRY POORLY SORTED	
				GRAVEL - 75% BASALT 25% OTHER	
				SR-R MAX 80 MM VC-VF	
				SAND SA-SR ~~M-VC~~ C-VF 90% QTZ, SA	
				10% MAFIC NO HCl RXN	
15	G			15'-50' LARGER COBBLES & MORE NUMEROUS	NO TEXTURAL CHANGE
				COMPOSITION NOW 60-70% ~~MAFIC~~ FELSIC REST	BUT > ~~MAFIC~~ FELSIC INDICATE
				BASALTS FINES - NO CHANGE (COLOR, SIZE	HANFORD - RINGOLD E
				SORTING) V. WEAK HCl RXN	CONTACT @ 15' BGS
20	G			20' SAME AS ABOVE; STILL	REVIEWED PHOTO LOG
				WEAK HCl RXN.	7/8/14 - APPARENTLY
					HAD MIXED FELSIC VS.
					MAFIC DESCRIPTIONS
					GASZA 7/8/14 - HAVE
25	G			25' SAME AS ABOVE	LINED OUT & CORRECTED
				CUTTINGS DRY	ALL ERRORS.
30	G			30' SAME AS ABOVE	
				CUTTINGS DRY	
		35.92 BGS 3/24/14 7AM			
35	G			36' AS ABOVE 85% G ~~SANDY~~ GRAVEL	WL = 35.92' BGS
				80% G 15% SAND 5% SILT 10YR 7/1	W.L. TAGGED NEXT
				LT. GRAY DRY POORLY SORTED G - 70% MAFIC	MORNING AFTER
				30% BASALT SR-R MAX 60 MM SAND SA-A	CONTACT 3/24/14
				C-VF 90% QTZ 10% DARK SLT HCl RXN	FELSIC 7/8/14

Reported By: GREG L. KASZA | Reviewed By: BA WILLIAMS

Title: GEOLOGIST | Title: SR. GEOLOGIST

Signature: [signature] Date: 3/24/14 | Signature: [signature] Date: 3/13/14

A-6003-642 (03/03)

BOREHOLE LOG

Page 2 of 3
Date: 3/19 TO 3/26

Well ID: C8299	Well Name: 199-K-212	Location: 85 m SSE OF 199-K-115A	
Project: INSTALL 3 WELLS @ 100-KRX OU IN FY 2014		Reference Measuring Point: G.S.	

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
40	G. SPLIT SPOON	SS 39.5 TO 42.0		40 SG AS ABOVE WET SAMPLE 10YR 5/2 GRAYISH BROWN AS RECEIVED	CABLE TOOL W/DRIVE BARREL SAMPLE TRAVELER 14-061 40 & 45' GRAB SAMPLES COMPOSITED FOR SIEVE SAMPLE #1
45	G, WATER @ 45'			45' SAME AS ABOVE	I-001, Splitspoon 39.5'-42' B2W318(RS), B2W317 I-002, GW. 45' B2W323, 324, 335 7/3 JH
50	G			50-77.2 SG SANDY GRAVEL G-75% VF-M PEBBLE, MAX 60 mm SR-R 70% FELSIC 30% BASALT S-12% VF-C GRAIN SA-A 90% QTZ 10% MAFIC, 12-15% SILT MINOR FeOX STAIN, 10 YR 5/2 GRAYISH BRN POOR SORTING NO HCl RXN	50' & 55' GRAB SAMPLES COMPOSITED FOR SIEVE SAMPLE #2
56	G			55' SAME AS ABOVE	
60	SPLIT SPOON	SS G 58.8' TO 62.2' WATER @ 52.6		60 DESCRIPTION AS ABOVE	60 & 65' GRAB SAMPLES COMPOSITED FOR SIEVE SAMPLE # 3 I-003, Splitspoon, 58.8-62' B2W320(RS), B2W319 JH 7/2
65	G.			65 DESCRIPTION AS ABOVE: SG CONSTITUENT PROPORTIONS SAME, PHYSICAL DESCRIPTION SAME COLOR SAME.	I-004 GW, 52.6. B2W325, 326, 336 B2W327, 303 JH 7/2
70	GW G 70.1 SS 72.6			70' SG SANDY GRAVEL 75% VF-M PEBBLE MAX 40 mm SR-R 70% FELSIC 30% BASALT SAND 12 VF, C GRAIN SA-A 90% QTZ 10% MAFIC MINOR FeOX STAIN MUD 12-13% NO HCL RXN	70' & 75' GRAB SAMPLES COMPOSITED FOR SIEVE SAMPLE #4 I-005, GW Sample @ 69.9', HEIS# B2W328, B2W324, B2W337 I-006, SS Sample @ 70.1-72.6, HEIS# B2W322(RS), B2W321
75	G.			75 SG GRAVELS ARE FINING MAX 25 mm	JC 7/22/14
	G			77.2 SHARP CONTACT W/ RUM 77.2 - 85.8 SANDY SILT SM	77.2 RUM CONTACT

Reported By: GREG L. KASZA		Reviewed By: RA WILLIAMS	
Title: GEOLOGIST		Title: SR. GEOLOGIST	
Signature: [signature]	Date: 3/28/14	Signature: [signature]	Date: 8/18/14

A-6003-642 (03/03)

BOREHOLE LOG

Page 3 of 3

Date: 3/27/14

Well ID: C8299 | Well Name: 199-K-212 | Location: 85 m SSE of 199-K-115A.

Project: Swells @ 100-KR4 OU in FY 2014 | Reference Measuring Point: GS

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
80	G.			20% SAND ; 80% SILT	CABLE TOOL W/
				SAND 100% VFS, VERY WELL SORTED	DRIVE BARREL
				90% QTZ 10% MAFICS 2.5Y 5/2	
				GRAYISH BROWN MODERATE	
				PLASTICITY NO HCl RXN.	
85				80' BGS SAME AS ABOVE	
85.8	G			85.8 TD SAME AS ABOVE	85.8' BGS
					TAGGED T.D.
				NOT USED	

Reported By: Greg Kasza | Reviewed By: BA Williams

Title: Geologist | Title: SA Geologist

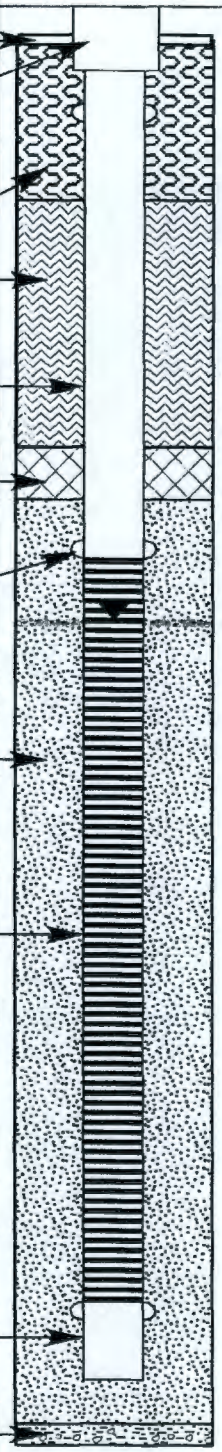
Signature: [signature] | Date: 3/28/14 | Signature: [signature] | Date: 6/18/14

A-6003-642 (03/03)

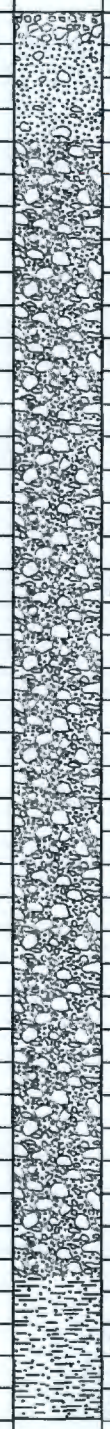
WELL SUMMARY SHEET	Start Date: 3/19/2014 Finish Date: 5/20/2014	Page 1 of 1

Well ID: C8299		Well Name: 199-K-212	
Location: 85m SSE of 199-K-115A		Project: 3 Wells in the 100-KR-4 OU FY2014	
Prepared By: Janine Carter	Date: 6/19/14	Reviewed By: J.D. MEHRER	Date: 7-15-14
Signature: Janine Carter		Signature:	

CONSTRUCTION DATA

Description	Diagram
Concrete Pad: 0.5 ft above ground surface (ags) 8-in Protective Casing: 2.89 ft ags - 2.11 ft below ground surface (bgs) Type I/II Portland Cement Grout: 0 - 10.3 ft bgs 3/8 in Cetco Medium Bentonite Chips: 10.3 - 25.1 ft bgs 6-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 1.99 ft ags - 31.88 ft bgs 3/8 in Cetco Coated Bentonite Pellet Seal: 25.1 - 28.2 ft bgs Stainless steel centralizer installed above and below screen and every 40 ft 8-12 mesh Premier Colorado Silica Filter Pack Sand: 28.2 - 84.4 ft bgs 6-in I.D. Schedule 10, Type 304/304L, 65-slot (0.065 in.) Stainless Steel Screen: 31.88 - 76.92 ft bgs Depths are in ft below ground surface. Borehole drilled with 10 3/4-in O.D. casing from 0.0 - 83.0 ft bgs All temporary drill casing was removed from the ground. 6-in I.D. Schedule 10, Type 304/304L, Stainless Steel Sump: 76.92 - 81.91 ft bgs Borehole slough: 84.4 - 85.8 ft bgs	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
0		0 - 2 Crushed Gravel Drill Pad
		2 - 8 Gravelly Sand (gS)
10		8 - 77.2 Sandy Gravel (sG)
20		
30		Static Water Level: 35.92 ft bgs (3/24/2014)
40		
50		
60		
70		
80		77.2 - 85.8 Sandy Silt (sM)
		Straightness Test: 4/28/2014, Pass
		Total Depth: 85.8 ft bgs

WELL DEVELOPMENT AND TESTING DATA

Well Name:	Well ID:	Well Location:	Date:
199-K-212	C8299	85m SSW of 199-K-115A	5/14/14

Reference Measuring Point (unless otherwise noted): TOP OF OUTER CASING (TOC)

Has the well been surveyed? ○ Yes ⊗ No

Does the well have a cement pad? ~~⊗~~ Yes ⊗ No

PART 1

STATIC WATER LEVEL:

Start of Job 33.38' bgs

End of Job 33.26' bgs

DEPTH TO BOTTOM:

Start of Job 79.75' bgs

End of Job 75.9 on 5/14, >1000 on 5/19

PART 2

WELL DEVELOPMENT DATA

Pump Model Grundfos, MS4000, 3HP & Franklin Elec 15HP

Intake Depth 59.18/69.18/74.19/67.81/56.75 (ft bgs)

Starting Turbidity 75.9/104/123/>1000/19.4

	* Pump Start	* Stop	Flow Rate	Drawdown
I-001	0947	1112	30.6gpm	1.76'
I-002	1131	1301	29gpm	1.47'
I-003	1314	1404	27gpm	1.15'
I-004	1040/0735	1457/~~0944~~ 0748	162/120gpm	24.57'/12.58'
I-005	0826	0942	100gpm	12.28'

Total Pumped ~33,540 gallons total

Final Turbidity 0.61 NTU

XD SN/Range (PSI) 50 PSI

PART 3

INSTANTANEOUS SLUG TEST

Static Water Level (TOC)

Transducer Depth

Baseline Start

Injection Start

Baseline Start

Withdrawal Start

Slug Volume

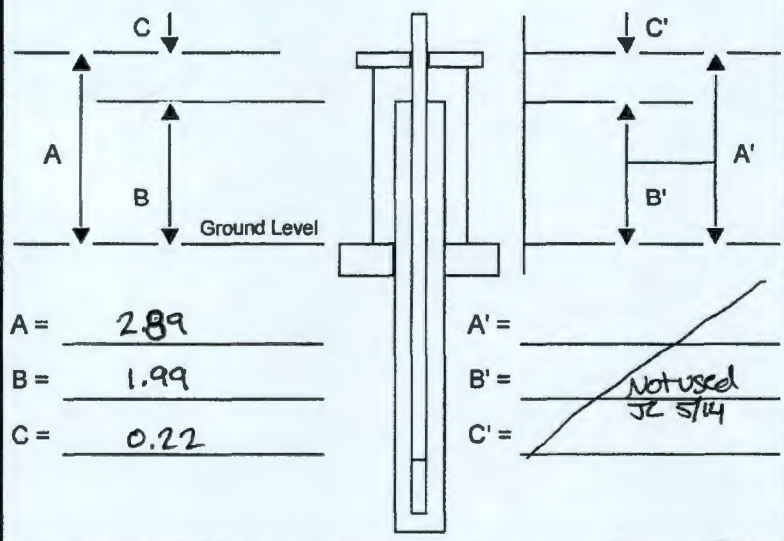
XD SN/Range (PSI)

Not used JC 7/3

PART 4

Last Recorded Measurements Date:

Current Measurements Date:



A = 2.89

B = 1.99

C = 0.22

A' =

B' =

C' =

Not used JC 5/14

Are there any reference marks on the casing strings? ○ Yes ⊗ No

PART 5

COMMENTS:

Field Kit #7

Data: C8299_develop_interval_051414

3 intervals developed at low flow rate

2 intervals developed/stressed at high flow rate

*Pump Start & stop times vary; consequently, initial start & stop times for the day or interval were used.

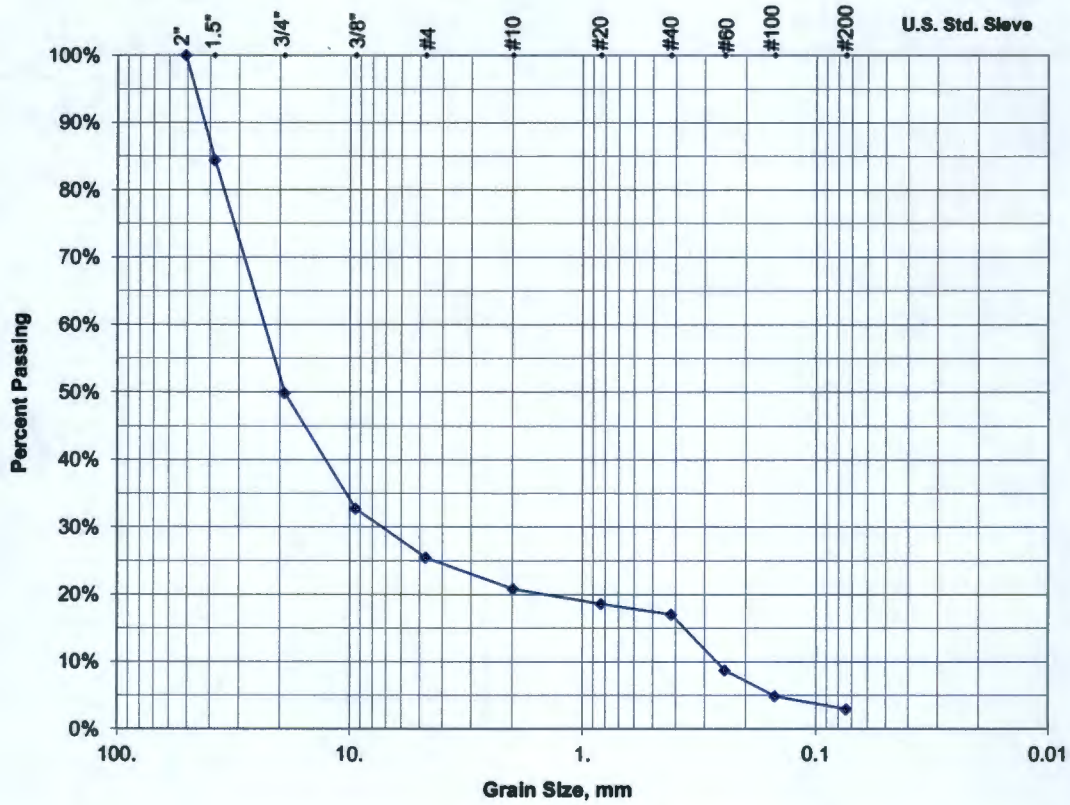
Prepared by (print name):	Signature:	Date:
Janine Carter	Janine Carter	5/14/14
Reviewed by (print name): J.D. MEHRER	Signature:	Date: 5/15/14

A-6005-205 (REV 1)

SIEVE ANALYSIS

WELL NAME	C8299	SAMPLE DEPTH	40 - 45	SAMPLE#	1	WELL ID#	199-K-212
TESTED BY	Greg Kasza	CONTACT	Freestone Env.	PHONE	943-5222	DATE	03/28/2014

SAMPLE WEIGHT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	GRAIN SIZE (mm)	COMMENTS
894.60	2"	0.0	0.0	100.0	50.80	
	1.5"	139.4	15.6	84.4	38.10	
	3/4"	448.9	50.2	49.8	19.05	
	3/8"	602.1	67.3	32.7	9.42	
	#4	667.2	74.6	25.4	4.70	
	#10	708.5	79.2	20.8	1.98	
	#20	728.5	81.4	18.6	0.83	
	#40	742.8	83.0	17.0	0.42	
	#60	817.2	91.3	8.7	0.25	
	#100	851.6	95.2	4.8	0.150	
	#200	868.9	97.1	2.9	0.074	



Soil Description	79.2% Gravel	17.9% Sand	2.8% Silt
	50.2% Coarse-V Coarse Pebble	3.8% Coarse-V Coarse	
	17.1% Medium Pebble	8.3% Medium	
	11.9% Fine-V Fine Pebble	5.8% Fine-V Fine	

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

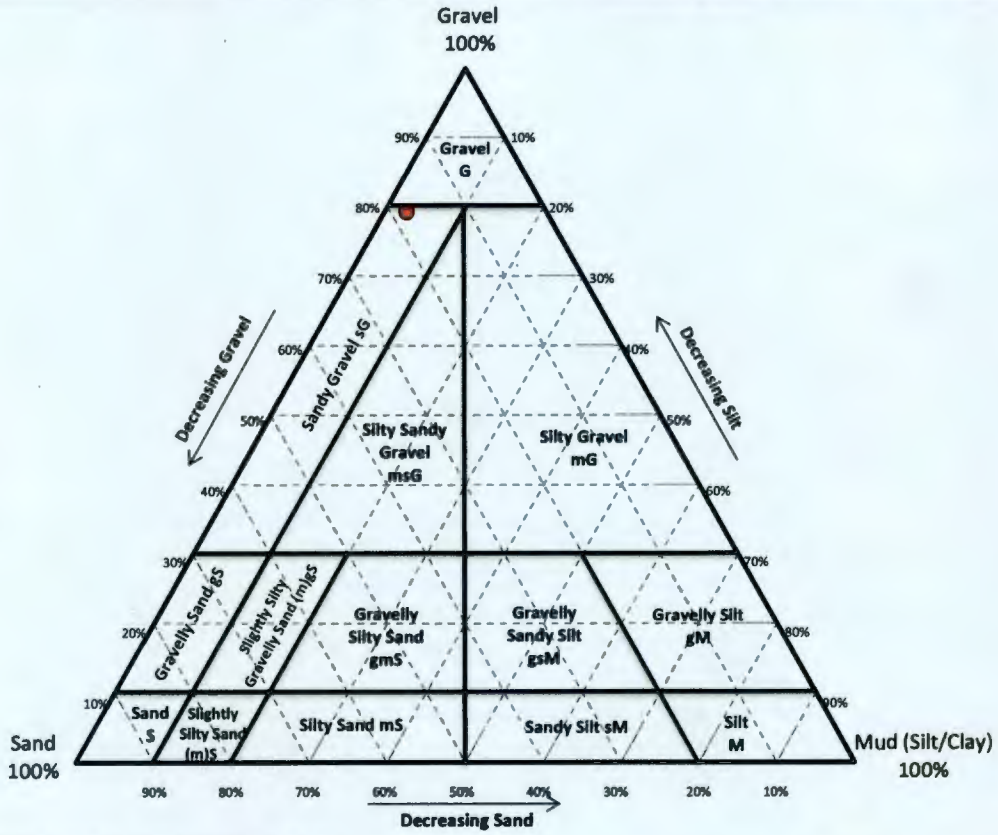
Checked By: Janine Carter Date: 7/9/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS DATA

Date:	3/28/2014	Well Name:	C8299
Soil Description:	Sandy Gravel	Well ID:	199-K-212
Sample Number:	1	Sample Depth (ft bgs):	40 - 45
Sample bowl (g):	754.8	Final Variance (grams):	0.4
Sample bowl+dry sample (g):	1649.4	Sample bowl + wash/dry sample (g):	1640.7
Dry sample weight (g):	894.6	Wash/dry sample weight (g):	885.9

Sieve No.	Sieve Opening	Sieve Weight (g)	Sieve + Soil Weight (g)	Weight of Soil Retained (g)	Percent Retained	Cumulative Weight Retained (g)	Cumulative Percent Retained	Percent Finer
--	2.0 IN	469.8	469.8	0.0	0.0%	0.0	0.0%	100.0
--	1.5 IN	491.2	630.6	139.4	15.6%	139.4	15.6%	84.4
--	0.75 IN	497.7	807.2	309.5	34.6%	448.9	50.2%	49.8
--	0.375 IN	490.3	643.5	153.2	17.1%	602.1	67.3%	32.7
4	4.75 mm	463.7	528.8	65.1	7.3%	667.2	74.6%	25.4
10	2.00 mm	489.3	530.6	41.3	4.6%	708.5	79.2%	20.8
20	0.85 mm	380.6	400.6	20.0	2.2%	728.5	81.4%	18.6
40	0.425 mm	336.1	350.4	14.3	1.6%	742.8	83.0%	17.0
60	0.25 mm	321.3	395.7	74.4	8.3%	817.2	91.3%	8.7
100	0.15 mm	308.9	343.3	34.4	3.8%	851.6	95.2%	4.8
200	0.075 mm	328.4	345.7	17.3	1.9%	868.9	97.1%	2.9
PAN	--	370.7	387.3	16.6 8.7	2.8%	894.2	100.0%	0.0



If percentages are borderline, use the coarser classification.
i.e. 90% sand, 10% silt equals sand, not slightly silty sand or 60% gravel, 30% sand, and 10% silt equals sandy gravel, not silty sandy gravel

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

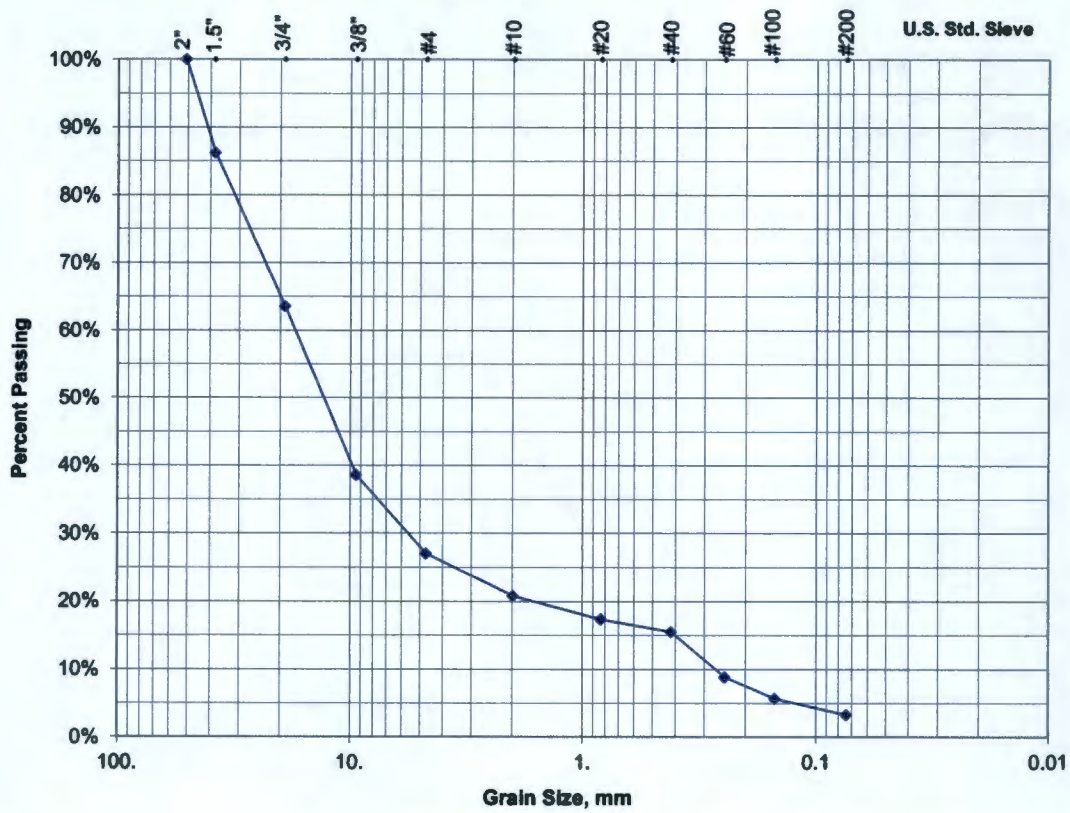
Checked By: Janine Carter Date: 7/9/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS

WELL NAME	C8299	SAMPLE DEPTH	50 - 55	SAMPLE#	2	WELL ID#	199-K-212
TESTED BY	Greg Kasza	CONTACT	Freestone Env.	PHONE	943-5222	DATE	03/28/2014

SAMPLE WEIGHT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	GRAIN SIZE (mm)	COMMENTS
1046.40	2"	0.0	0.0	100.0	50.80	
	1.5"	144.5	13.8	86.2	38.10	
	3/4"	382.0	36.5	63.5	19.05	
	3/8"	642.9	61.4	38.6	9.42	
	#4	763.9	73.0	27.0	4.70	
	#10	829.0	79.2	20.8	1.98	
	#20	864.9	82.7	17.3	0.83	
	#40	884.7	84.5	15.5	0.42	
	#60	954.2	91.2	8.8	0.25	
	#100	987.2	94.3	5.7	0.150	
	#200	1012.4	96.8	3.2	0.074	



Soil Description	**79.2% Gravel**	**17.5% Sand**	**3.2% Silt**
	36.5% Coarse-V Coarse Pebble	5.3% Coarse-V Coarse	
	24.9% Medium Pebble	6.6% Medium	
	17.8% Fine-V Fine Pebble	5.6% Fine-V Fine	

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

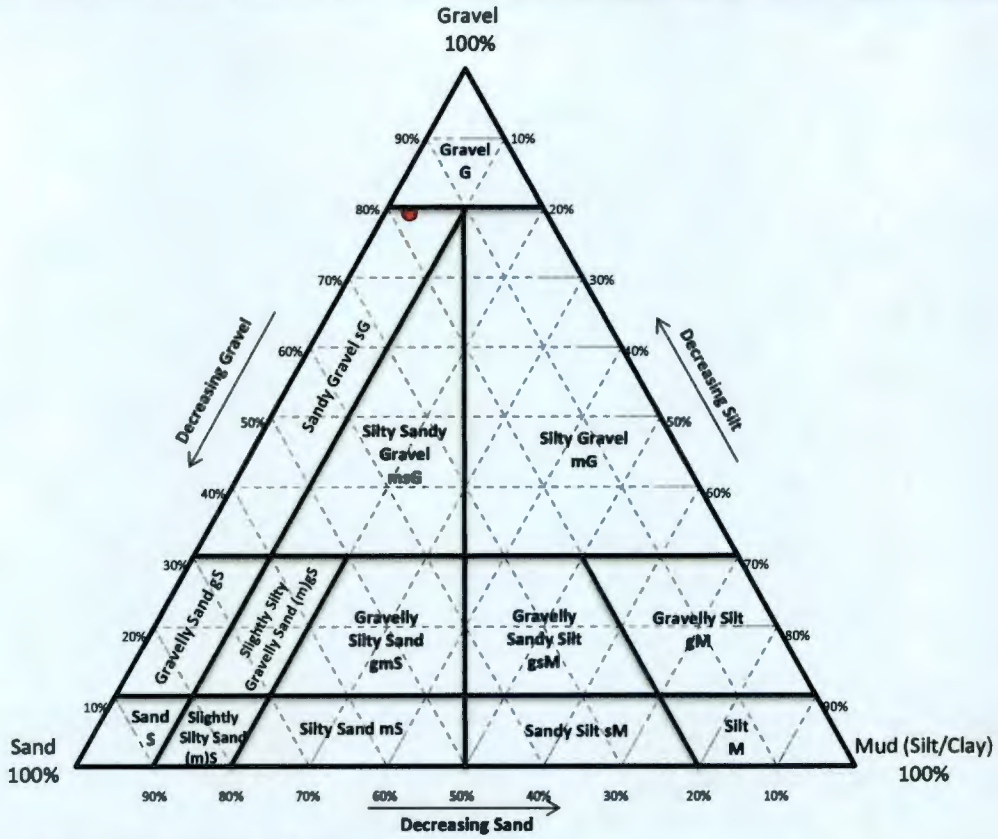
Checked By: Janine Carter Date: 7/9/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS DATA

Date:	3/28/2014	Well Name:	C8299
Soil Description:	Sandy Gravel	Well ID:	199-K-212
Sample Number:	2	Sample Depth (ft bgs):	50 - 55
Sample bowl (g):	754.8	Final Variance (grams):	0.9
Sample bowl+dry sample (g):	1801.2	Sample bowl + wash/dry sample (g):	1790.7
Dry sample weight (g):	1046.4	Wash/dry sample weight (g):	1035.9

Sieve No.	Sieve Opening	Sieve Weight (g)	Sieve + Soil Weight (g)	Weight of Soil Retained (g)	Percent Retained	Cumulative Weight Retained (g)	Cumulative Percent Retained	Percent Finer
--	2.0 IN	469.8	469.8	0.0	0.0%	0.0	0.0%	100.0
--	1.5 IN	491.2	635.7	144.5	13.8%	144.5	13.8%	86.2
--	0.75 IN	497.7	735.2	237.5	22.7%	382.0	36.5%	63.5
--	0.375 IN	490.3	751.2	260.9	24.9%	642.9	61.4%	38.6
4	4.75 mm	463.7	584.7	121.0	11.6%	763.9	73.0%	27.0
10	2.00 mm	489.3	554.4	65.1	6.2%	829.0	79.2%	20.8
20	0.85 mm	380.6	416.5	35.9	3.4%	864.9	82.7%	17.3
40	0.425 mm	336.1	355.9	19.8	1.9%	884.7	84.5%	15.5
60	0.25 mm	321.3	390.8	69.5	6.6%	954.2	91.2%	8.8
100	0.15 mm	308.9	341.9	33.0	3.2%	987.2	94.3%	5.7
200	0.075 mm	328.4	353.6	25.2	2.4%	1012.4	96.8%	3.2
PAN	--	370.7	393.3	22.6 10.5	3.2%	1045.5	99.9%	0.0



If percentages are borderline, use the coarser classification.
i.e. 90% sand, 10% silt equals sand, not slightly silty sand or 60% gravel, 30% sand, and 10% silt equals sandy gravel, not silty sandy gravel

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

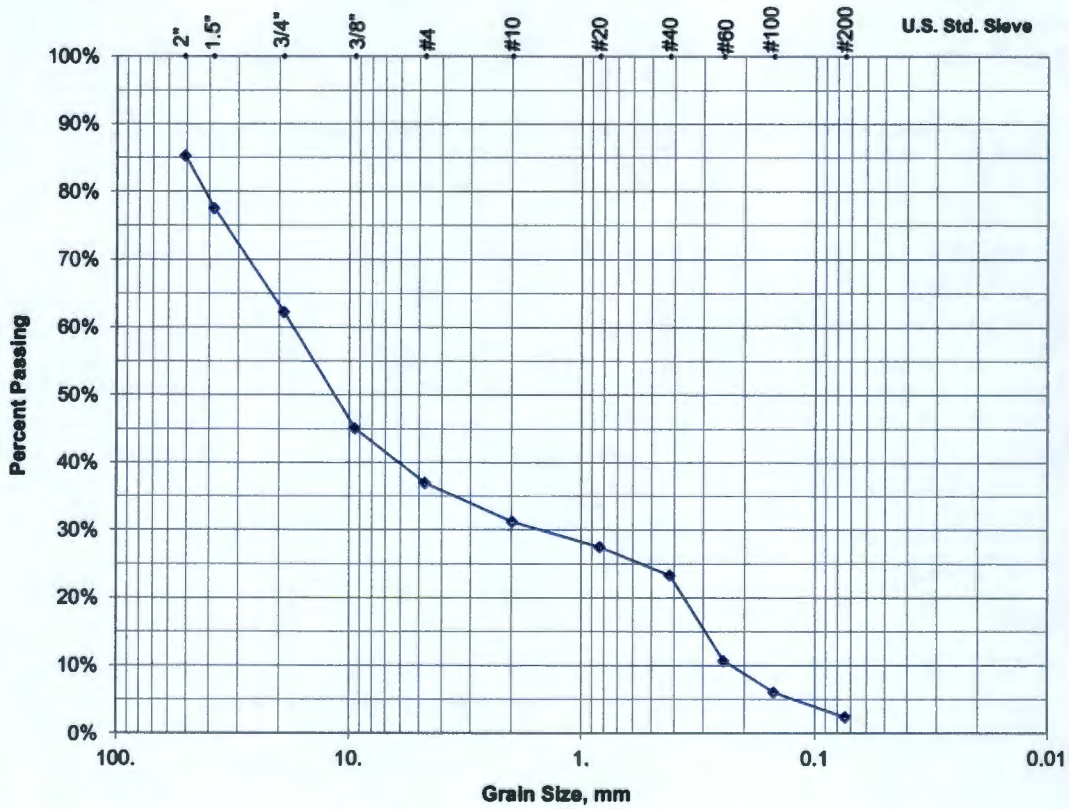
Checked By: Janine Carter Date: 7/9/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS

WELL NAME	C8299	SAMPLE DEPTH	60 - 65	SAMPLE#	3	WELL ID#	199-K-212
TESTED BY	Greg Kasza	CONTACT	Freestone Env.	PHONE	943-5222	DATE	03/28/2014

SAMPLE WEIGHT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	GRAIN SIZE (mm)	COMMENTS
1158.50	2"	171.2	14.8	85.2	50.80	
	1.5"	260.8	22.5	77.5	38.10	
	3/4"	438.3	37.8	62.2	19.05	
	3/8"	637.2	55.0	45.0	9.42	
	#4	730.8	63.1	36.9	4.70	
	#10	797.2	68.8	31.2	1.98	
	#20	840.5	72.6	27.4	0.83	
	#40	888.7	76.7	23.3	0.42	
	#60	1035.2	89.4	10.6	0.25	
	#100	1089.2	94.0	6.0	0.150	
	#200	1131.6	97.7	2.3	0.074	



Soil Description	68.8% Gravel	28.9% Sand	2.1% Silt
	37.8% Coarse-V Coarse Pebble	7.9% Coarse-V Coarse	
	17.2% Medium Pebble	12.6% Medium	
	13.8% Fine-V Fine Pebble	8.3% Fine-V Fine	

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

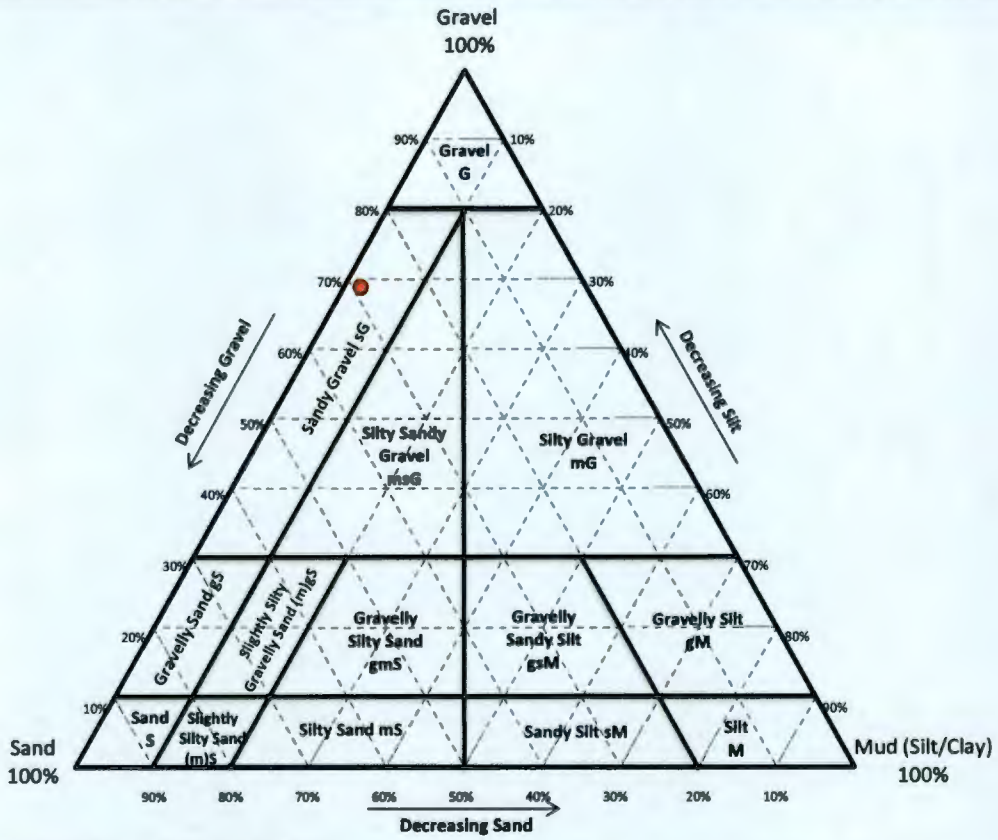
Checked By: Janine Carter Date: 7/9/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS DATA

Date:	3/28/2014	Well Name:	C8299
Soil Description:	Sandy Gravel	Well ID:	199-K-212
Sample Number:	3	Sample Depth (ft bgs):	60 - 65
Sample bowl (g):	746.7	Final Variance (grams):	2.1
Sample bowl+dry sample (g):	1905.2	Sample bowl + wash/dry sample (g):	1890.2
Dry sample weight (g):	1158.5	Wash/dry sample weight (g):	1143.5

Sieve No.	Sieve Opening	Sieve Weight (g)	Sieve + Soil Weight (g)	Weight of Soil Retained (g)	Percent Retained	Cumulative Weight Retained (g)	Cumulative Percent Retained	Percent Finer
–	2.0 IN	469.8	641.0	171.2	14.8%	171.2	14.8%	85.2
–	1.5 IN	491.2	580.8	89.6	7.7%	260.8	22.5%	77.5
–	0.75 IN	497.7	675.2	177.5	15.3%	438.3	37.8%	62.2
–	0.375 IN	490.3	689.2	198.9	17.2%	637.2	55.0%	45.0
4	4.75 mm	463.7	557.3	93.6	8.1%	730.8	63.1%	36.9
10	2.00 mm	489.3	555.7	66.4	5.7%	797.2	68.8%	31.2
20	0.85 mm	380.6	423.9	43.3	3.7%	840.5	72.6%	27.4
40	0.425 mm	336.1	384.3	48.2	4.2%	888.7	76.7%	23.3
60	0.25 mm	321.3	467.8	146.5	12.6%	1035.2	89.4%	10.6
100	0.15 mm	308.9	362.9	54.0	4.7%	1089.2	94.0%	6.0
200	0.075 mm	328.4	370.8	42.4	3.7%	1131.6	97.7%	2.3
PAN	–	370.7	380.5	9.8 15.0	2.1%	1156.4	99.8%	0.0



If percentages are borderline, use the coarser classification.
i.e. 90% sand, 10% silt equals sand, not slightly silty sand or 60% gravel, 30% sand, and 10% silt equals sandy gravel, not silty sandy gravel

Comments:

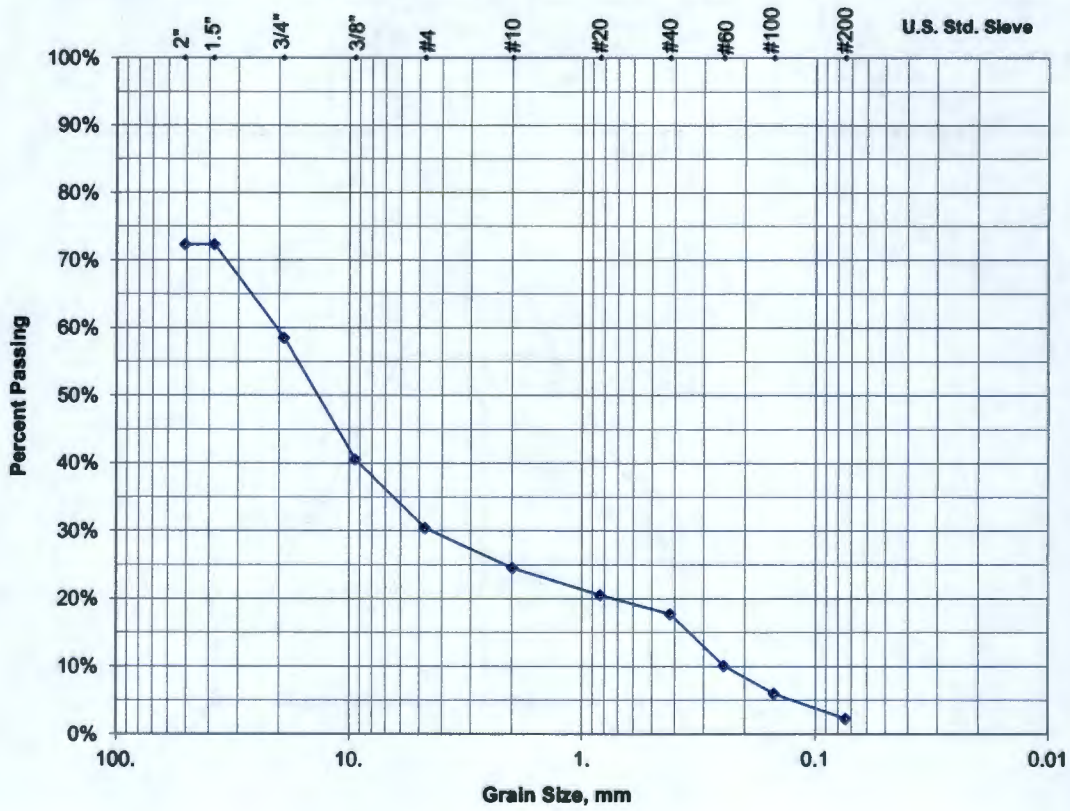
FREESTONE ENVIRONMENTAL SERVICES, INC.

Checked By: Janine Carter Date: 7/9/2014 **Office Phone:** (509) 943-5222

SIEVE ANALYSIS

WELL NAME	C8299	SAMPLE DEPTH	70 - 75	SAMPLE#	4	WELL ID#	199-K-212
TESTED BY	Greg Kasza	CONTACT	Freestone Env.	PHONE	943-5222	DATE	03/28/2014

SAMPLE WEIGHT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	GRAIN SIZE (mm)	COMMENTS
1113.20	2"	308.9	27.7	72.3	50.80	
	1.5"	308.9	27.7	72.3	38.10	
	3/4"	462.6	41.6	58.4	19.05	
	3/8"	662.2	59.5	40.5	9.42	
	#4	775.0	69.6	30.4	4.70	
	#10	840.4	75.5	24.5	1.98	
	#20	885.2	79.5	20.5	0.83	
	#40	916.3	82.3	17.7	0.42	
	#60	1001.8	90.0	10.0	0.25	
	#100	1047.3	94.1	5.9	0.150	
	#200	1088.6	97.8	2.2	0.074	



Soil Description	**75.5% Gravel**	**22.3% Sand**	**2.7% Silt**
	41.6% Coarse-V Coarse Pebble	6.8% Coarse-V Coarse	
	17.9% Medium Pebble	7.7% Medium	
	16.0% Fine-V Fine Pebble	7.8% Fine-V Fine	

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

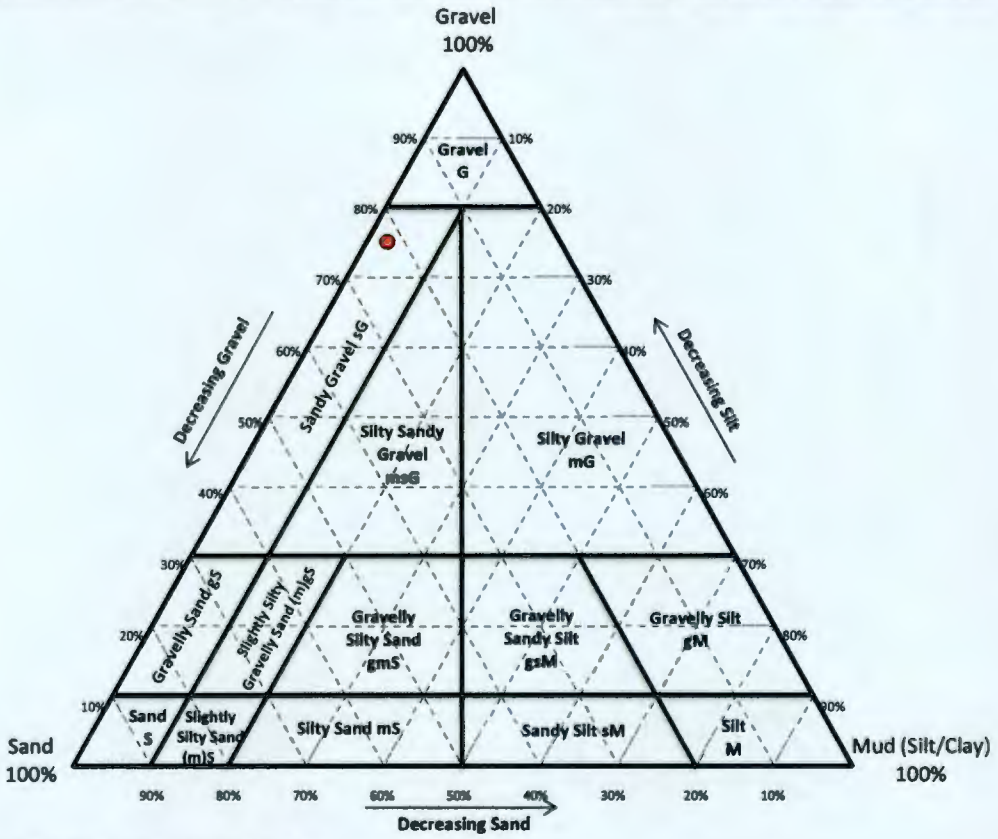
Checked By: Janine Carter Date: 7/9/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS DATA

Date:	3/28/2014	Well Name:	C8299
Soil Description:	Sandy Gravel	Well ID:	199-K-212
Sample Number:	4	Sample Depth (ft bgs):	70 - 75
Sample bowl (g):	767.6	Final Variance (grams):	4.9
Sample bowl+dry sample (g):	1880.8	Sample bowl + wash/dry sample (g):	1874.4
Dry sample weight (g):	1113.2	Wash/dry sample weight (g):	1106.8

Sieve No.	Sieve Opening	Sieve Weight (g)	Sieve + Soil Weight (g)	Weight of Soil Retained (g)	Percent Retained	Cumulative Weight Retained (g)	Cumulative Percent Retained	Percent Finer
--	2.0 IN	469.8	778.7	308.9	27.7%	308.9	27.7%	72.3
--	1.5 IN	491.2	491.2	0.0	0.0%	308.9	27.7%	72.3
--	0.75 IN	497.7	651.4	153.7	13.8%	462.6	41.6%	58.4
--	0.375 IN	490.3	689.9	199.6	17.9%	662.2	59.5%	40.5
4	4.75 mm	463.7	576.5	112.8	10.1%	775.0	69.6%	30.4
10	2.00 mm	489.3	554.7	65.4	5.9%	840.4	75.5%	24.5
20	0.85 mm	380.6	425.4	44.8	4.0%	885.2	79.5%	20.5
40	0.425 mm	336.1	367.2	31.1	2.8%	916.3	82.3%	17.7
60	0.25 mm	321.3	406.8	85.5	7.7%	1001.8	90.0%	10.0
100	0.15 mm	308.9	354.4	45.5	4.1%	1047.3	94.1%	5.9
200	0.075 mm	328.4	369.7	41.3	3.7%	1088.6	97.8%	2.2
PAN	--	370.7	393.8	23.1 6.4	2.7%	1118.1	100.4%	0.0



If percentages are borderline, use the coarser classification.
i.e. 90% sand, 10% silt equals sand, not slightly silty sand or 60% gravel, 30% sand, and 10% silt equals sandy gravel, not silty sandy gravel

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

Checked By: Janine Carter Date: 7/9/2014

Office Phone: (509) 943-5222

cm
FREESTONE
C8299 5 ft

cm
FREESTONE
C8299 10 ft

cm
FREESTONE
C8299 15 ft

cm
FREESTONE
C8299 20 ft

cm
FREESTONE
C8299 25 ft

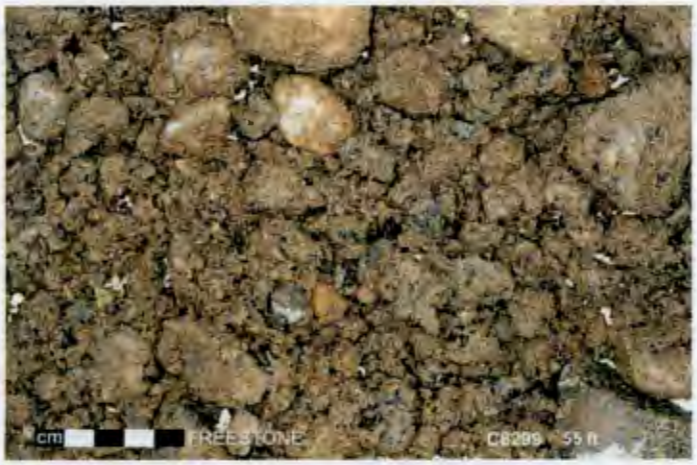
cm
FREESTONE
C8299 30 ft

cm
FREESTONE
C8299 35 ft

cm
FREESTONE
C8299 40 ft

cm
FREESTONE
C8299 45 ft

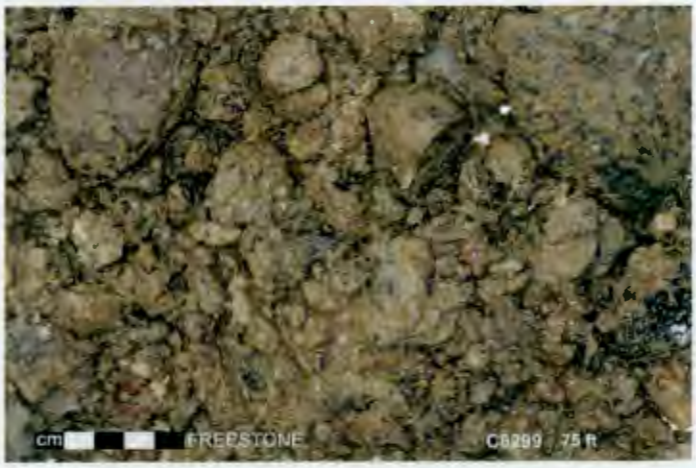
cm
FREESTONE
C8299 50 ft


cm
FREESTONE
C8299 55 ft

cm
FREESTONE
C8299 60 ft

cm
FREESTONE
C8299 65 ft

cm
FREESTONE
C8299 70 ft


cm
FREESTONE
C8299 75 ft

cm
FREESTONE
C8299 77 ft

cm
FREESTONE
C8299 80 ft

cm
FREESTONE

SURVEY DATA REPORT				Request No. 143-082
Project No.	Title KR-4 Wells C8297 and C8299 Final Surveys			File No. 1KT14R26
Job. No. CACN: 303067-DP20	Prepared By N.P. Fastabend	Date 6/24/14	Reviewer LBM	

DESCRIPTION OF WORK	DISTRIBUTION	SDR	PLOT	DWG
Obtained final coordinates (C/L Casings) and elevations of completed KR-4 Wells C8297 (199-K-210) and C8299 (199-K-212) located north and northeast of 100K Area.	Survey File	OR		
	S.E. Imhoff	1		
	S.J. Trent	1		
	K.M. Whitley	1		
	J.B. Geiger	1		
	B.J. Howard	1		
Horizontal Coordinate System: WCS83S/91 (Meters) Vertical Datum: NAVD88 (Meters)	A.J. Green	1		

SURVEY RESULTS AND COMMENTS

See Attached Well Survey Data Report Sheets

WELL SURVEY DATA REPORT

Project:	Prepared By: Neil P. Fastabend Company: CHPRC
Date Requested: 06/10/14	Requestor: Steve Imhoff (CHPRC)
Date of Survey: 06/19/14	Surveyor: Lawrence B. Munnell (CHPRC)
Fluor Hanford Point of Contact:	Survey Co. Point of Contact: Neil P. Fastabend
Description of Work: Obtain final survey coordinates (C/L Casing) and elevations of Well C8299 (199-K-212).	Horizontal Datum: NAD83(91) Vertical Datum: NAVD88 Units: Meters Hanford Area Designation: 100K

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
Washington State Reference Network

Vertical Control Monuments:
T324 (COE) and FLINE (COE)

Well ID	Well Name	Easting	Northing	Elevation	
C8299	199-K-212	569954.44'	148047.71'		Center of Casing
				130.321'	"X" on Rim
				129.587'	Brass Survey Marker

Notes:

130.022' Top Inner Casing, North Edge

Elevation on Brass Survey Marker was measured to Top Domed Brass Cap in concrete.

Equipment Used: Trimble R8 RTK GPS
Trimble DiNi 12 Level

Surveyor Statement:

I, Lawrence B. Munnell, a Professional Land Surveyor registered in the State of Washington (Registration No. 16216), hereby certify this report is based on a field survey performed by me, or under my direct supervision.

LAWRENCE B. MUNNELL
STATE OF WASHINGTON
16216
REGISTERED
PROFESSIONAL LAND SURVEYOR

6-25-14

A-6003-659 (04/03)

Stoller
A Subsidiary of Huntington Ingalls Industries

HGLP-LDR-753, Rev. 0

199-K-212 (C8299)
Log Data Report

Borehole Information:

Log Date:	2014-04-01	Filename:	C8299_HG-NM_2014-04-01	Site:	100-K
Coordinates (WA St Plane)		DTW[1] (ft) :	31.25	DTW Date:	03/31/14
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	03/27/14	N/A	85.8	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.) Outer	Diameter (in.) Inside	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	3.0	10 3/4	9 1/2	0.625	3.0	83

Borehole Notes:

The buyer's technical representative provided the total depth and casing depth. The logging engineer measured casing stick-up and casing diameter (rounded to the nearest 1/16-in.). Depth to water was reported at 35.92 ft on March 24. At the time of logging March 31, depth to water inside the casing was 31.25 ft according to gamma and moisture logs. The maximum logging depth achieved was 83 ft.

Zero reference is ground surface.

Logging Equipment Information:

Logging System:	Gamma 1L	Type:	60% HPGe SGLS[3]
Effective Calibration Date:	11/11/13	Serial No.:	45-TP32211A
Calibration Reference:	HGLP-CC-096, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

Logging System:	Gamma 1H	Type:	NMLS[4]
Effective Calibration Date:	11/11/13	Serial No.:	H310700352
Calibration Reference:	HGLP-CC-097, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

SGLS Log Run Information:

Log Run	3	4	5 Repeat		
HEIS Number	1018355	1018356	1018357		
Date	03/31/14	04/01/14	04/01/14		
Logging Engineer	Meisner	Meisner	Meisner		
Start Depth (ft)	0.0	43.0	83.0		
Finish Depth (ft)	45.0	83.0	74.0		
Count Time (sec)	100	100	100		
Live/Real	R	R	R		
Shield (Y/N)	N	N	N		

[1] depth to water inside casing
[2] top of casing
[3] Spectral Gamma Logging System
[4] Neutron Moisture Logging System

Stoller
A Subsidiary of Huntington Ingalls Industries

Log Run	3	4	5 Repeat		
MSA Interval (ft)	1.0	1.0	1.0		
Log Speed (ft/min)	N/A	N/A	N/A		
Pre-Verification	AL186CAB	AL187CAB	AL187CAB		
Start File	AL186000	AL187000	AL187041		
Finish File	AL186045	AL187040	AL187050		
Post-Verification	AL186CAA	AL187CAA	AL187CAA		
Depth Return Error (in.)	0	N/A	0.5 low		
Comments	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made		

NMLS Log Run Information:

Log Run	1	2 Repeat			
HEIS Number	1018358	1018359			
Date	03/31/14	03/31/14			
Logging Engineer	Meisner	Meisner			
Start Depth (ft)	0.0	31.0			
Finish Depth (ft)	31.25	28.0			
Count Time (sec)	15	15			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	AH151CAB	AH151CAB			
Start File	AH151000	AH151126			
Finish File	AH151125	AH151139			
Post-Verification	AH151CAA	AH151CAA			
Depth Return Error (in.)	N/A	1.0 low			
Comments	None	None			

Logging Operation Notes:

A centralizer was installed on the sondes.

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

Analysis Notes:

Analyst:	P.D. Henwood	Date:	04/02/14	Reference:	HGLP-MAN-003, Rev. 0

A casing correction for a 5/8-in. thick casing was applied to the log data.

A correction for water inside the casing was applied below 31 ft in depth.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in EXCEL template identified as 1L20131111, using an efficiency function and corrections for casing and dead time as determined by annual calibration.

NMLS data are represented in counts per second because no calibration data exist for a 9 1/2-in. inner diameter casing.

The HGU[5] is an empirical unit of gamma activity proposed as a means to standardize gamma log response across multiple logging systems with different response characteristics. The HGU is defined in terms of measurements in the Hanford Borehole Calibration Facility, and the magnitude is selected such that 1 HGU is approximately equivalent to typical Hanford background activity, based on data from background samples as reported in *Hanford Site Background: Part 2, Soil Background for Radionuclides* (DOE/RL-96-12).

Results and Interpretations:

No manmade radionuclides were detected. Although not detected, the MDLs for Cs-137 and Pu-239 are plotted on the Manmade Radionuclide plot.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content.

The KUT and moisture repeat plots indicate that the respective systems were working properly.

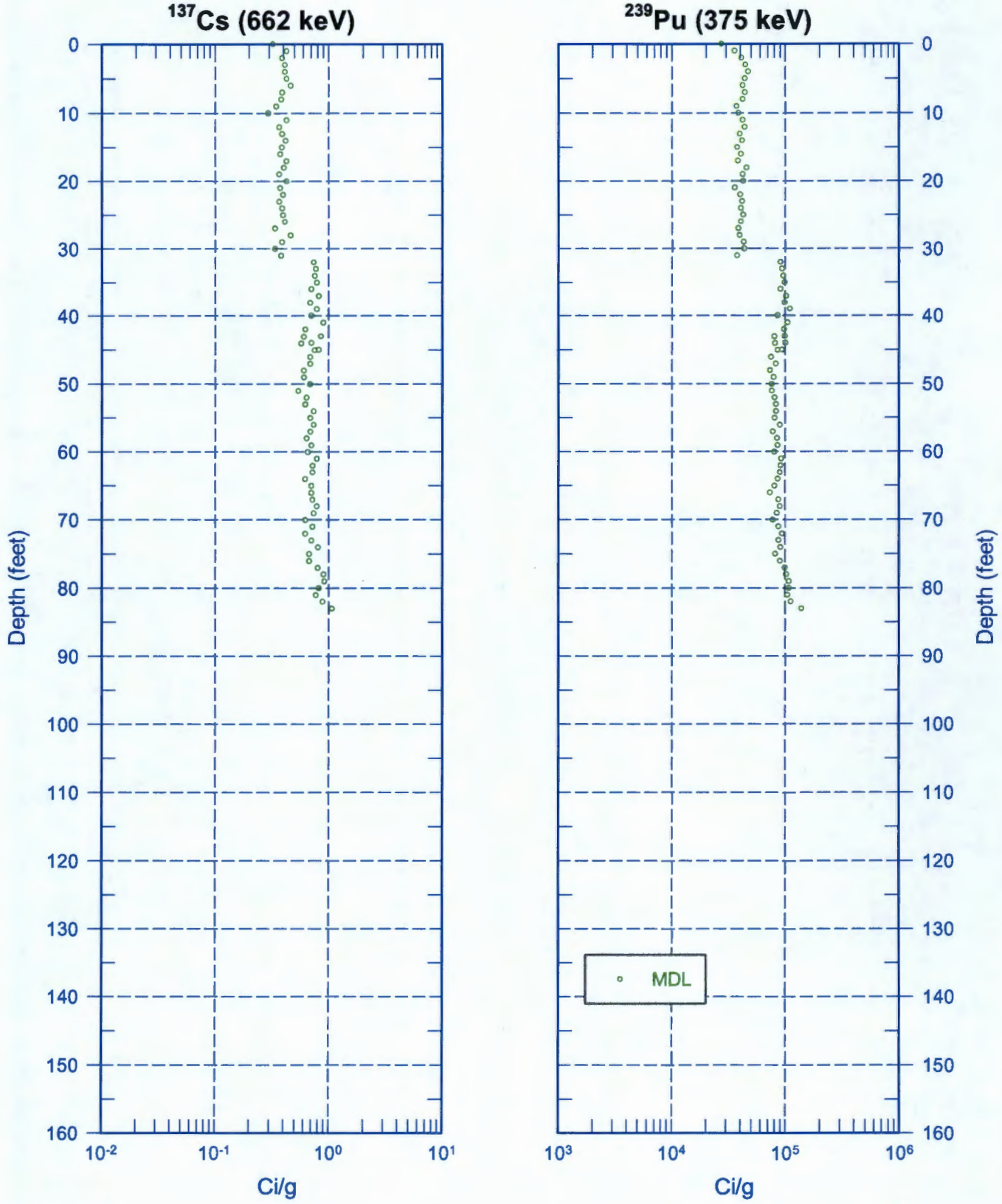
List of Log Plots:

Depth Reference is ground surface.

Manmade Radionuclides (0-160)
Natural Gamma Logs (0-160)
Combination Plot (0-120 ft)
Total Gamma & Moisture (0-160)
Total Gamma & Hanford Gamma Unit (0-160)
Repeat Section of Natural Gamma Logs (74 to 83 ft)
Moisture Repeat Section (28 to 31 ft)

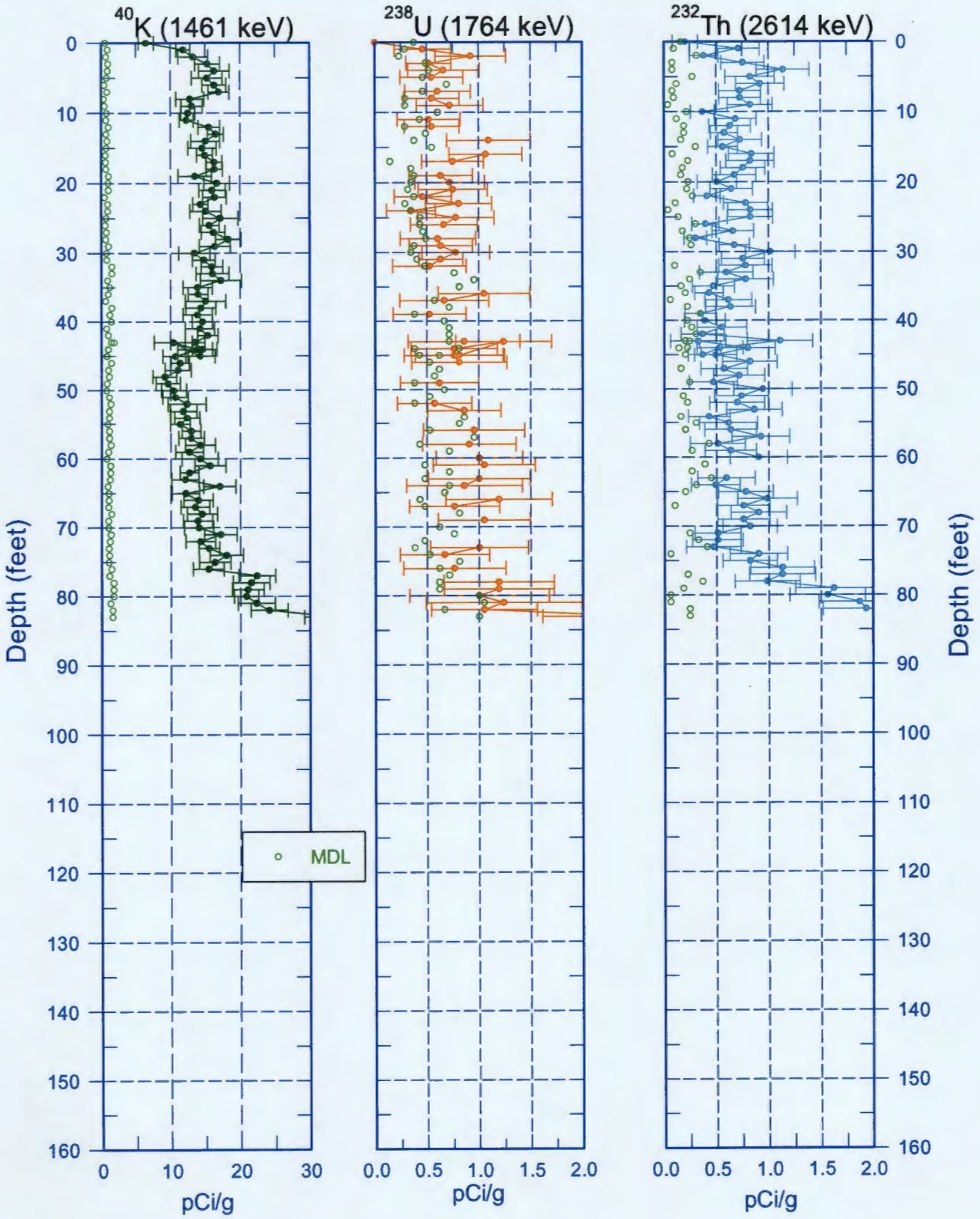
[5] Hanford Gamma Unit

199-K-212 (C8299)
Manmade Radionuclides



Zero Reference - Ground Surface

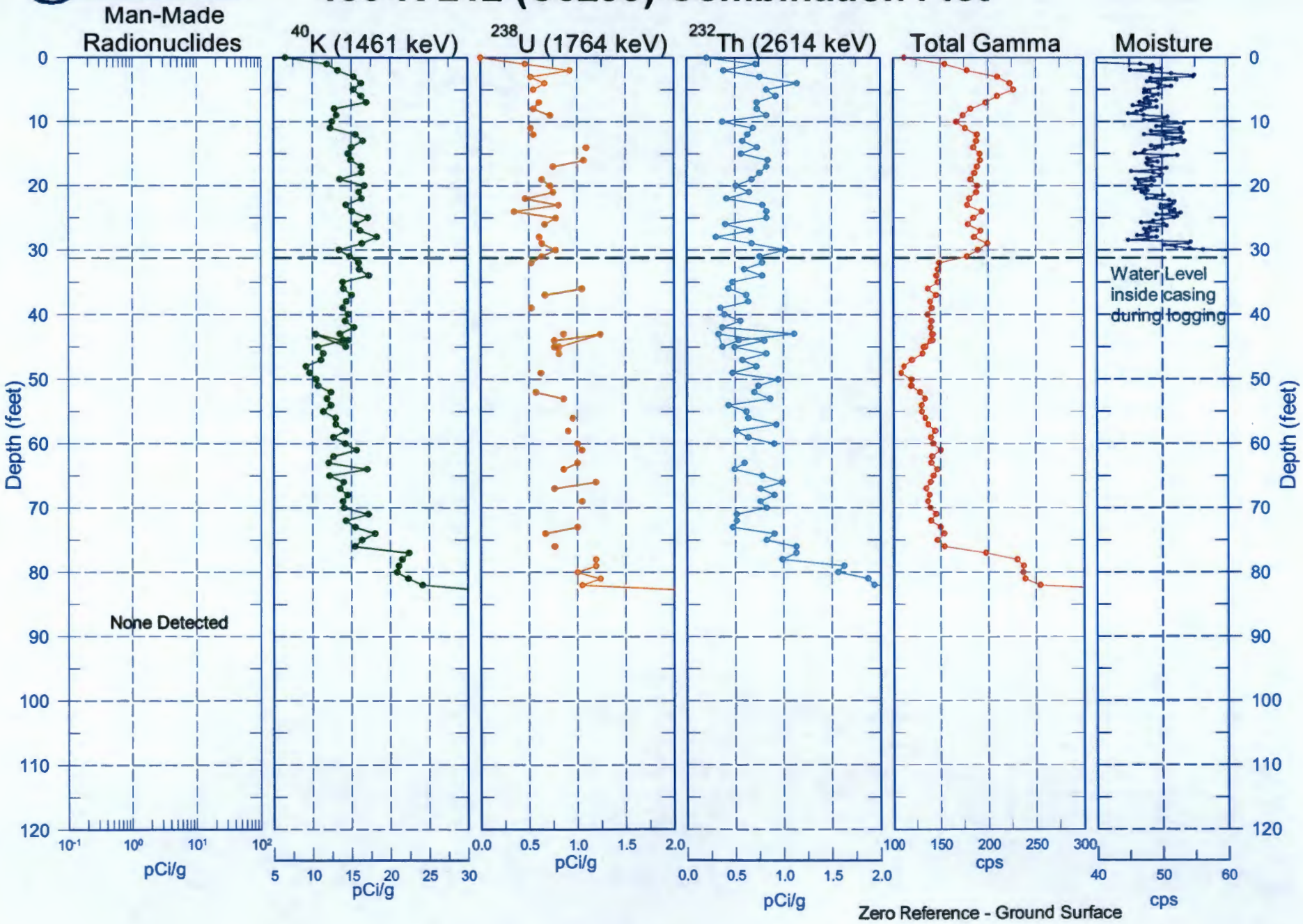
199-K-212 (C8299)
Natural Gamma Logs



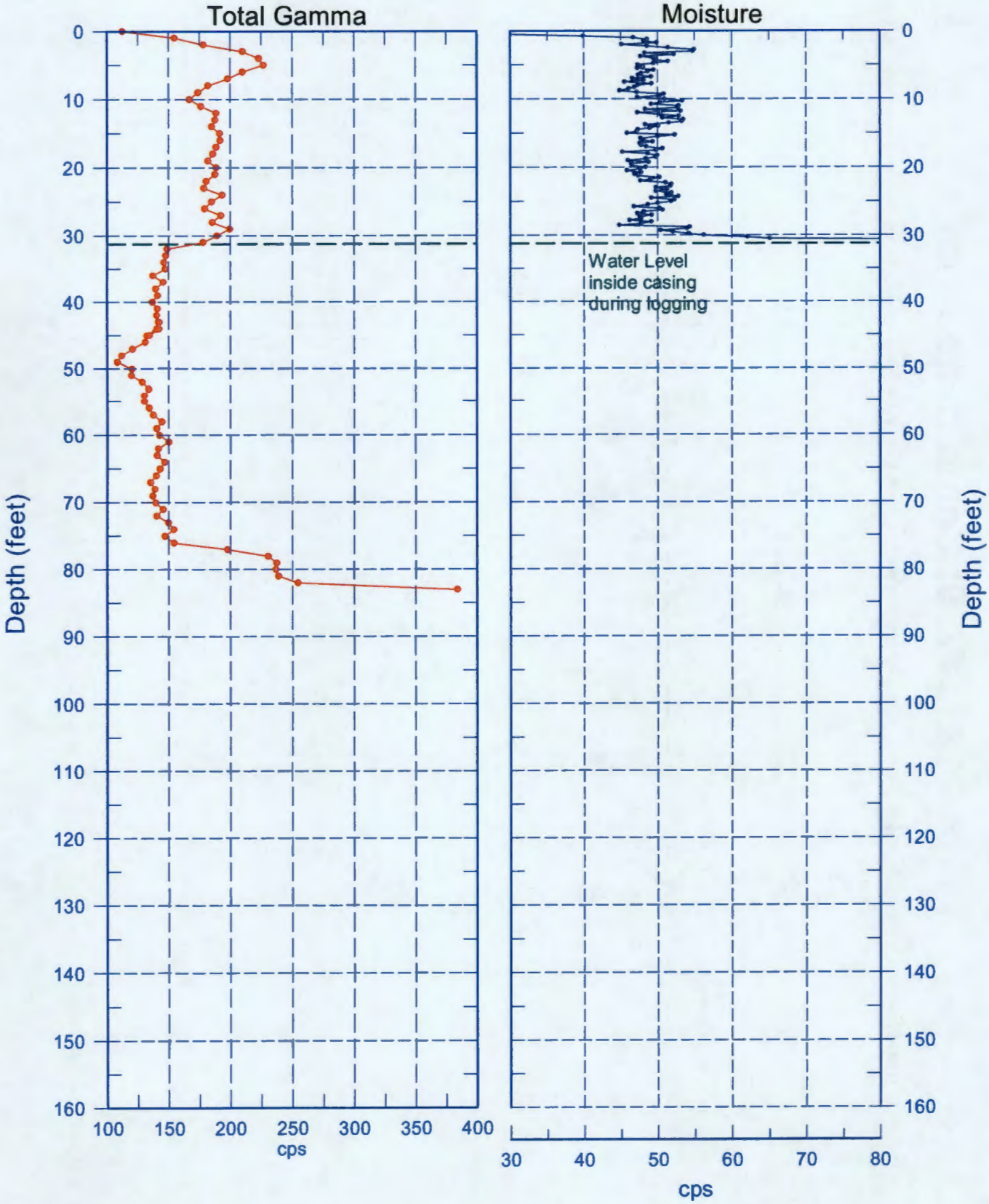
Zero Reference - Ground Surface

Stoller
A Subsidiary of Huntington Ingalls Industries

199-K-212 (C8299) Combination Plot



199-K-212 (C8299)
Total Gamma & Moisture

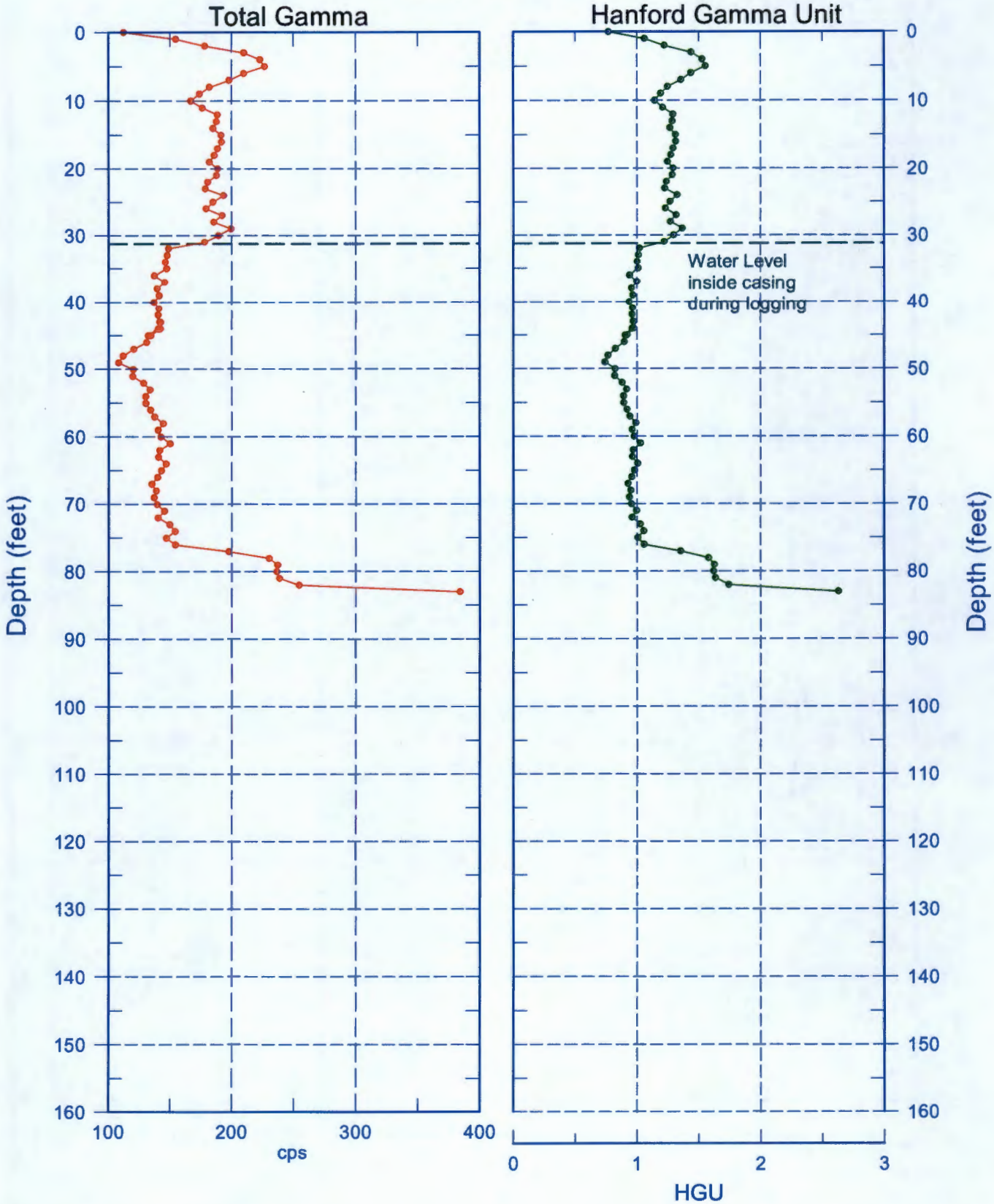


Reference - Ground Surface

Stoller
A Subsidiary of Huntington Ingalls Industries

199-K-212 (C8299)

Total Gamma & Hanford Gamma Unit

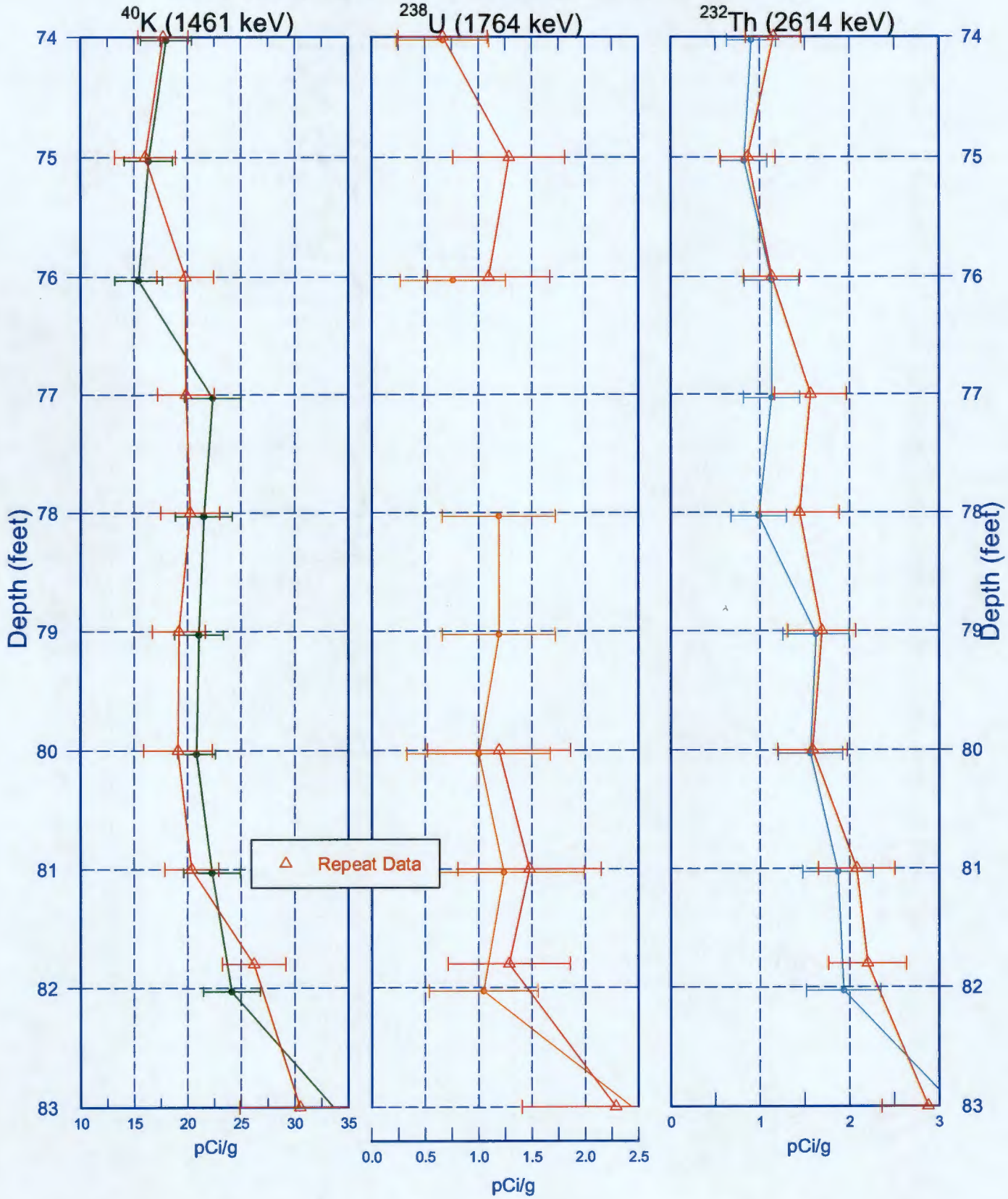


Reference - Ground Surface

Stoller
A Subsidiary of Huntington Ingalls Industries

199-K-212 (C8299)

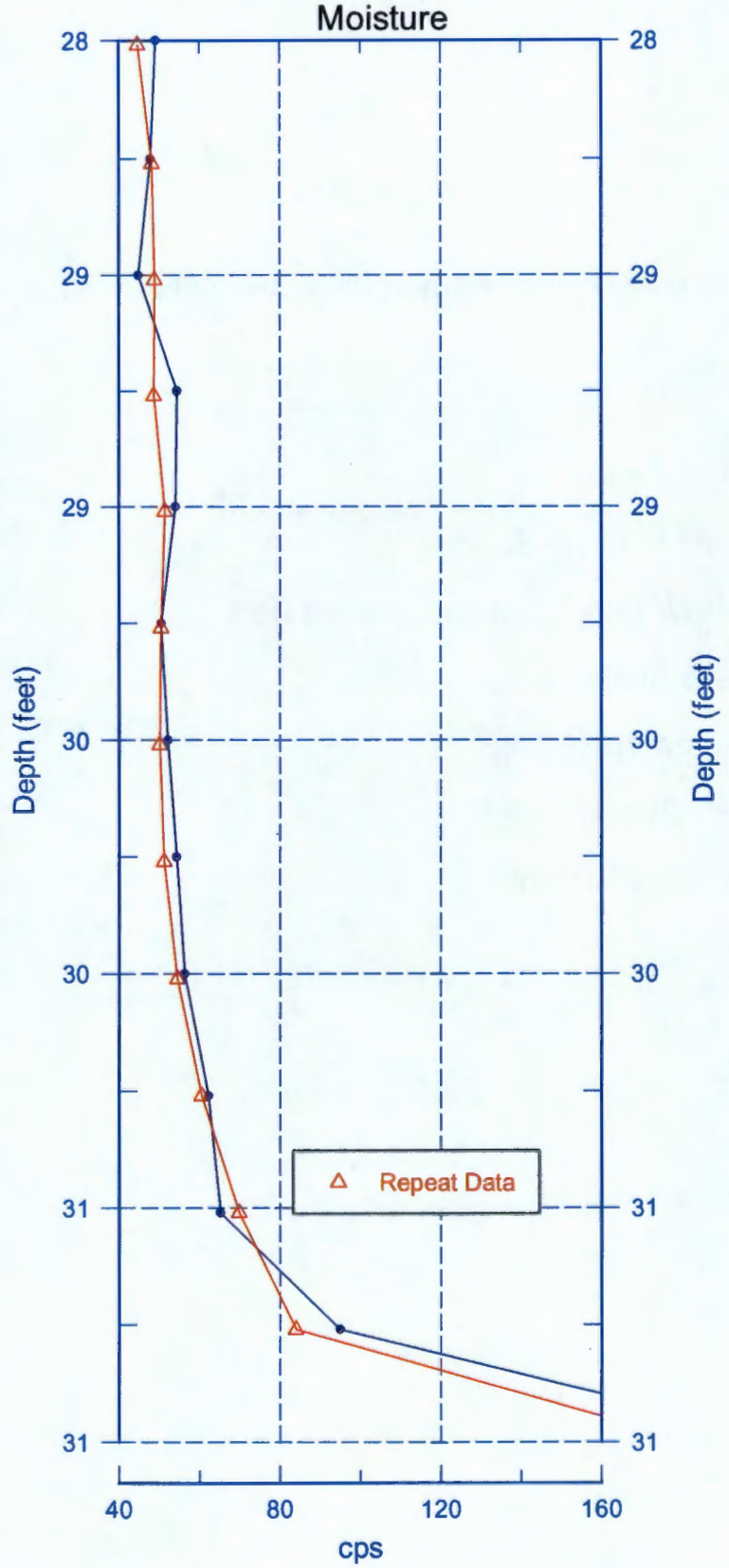
Repeat Section of Natural Gamma Logs



Zero Reference - Ground Surface

Stoller
A Subsidiary of Huntington Ingalls Industries

199-K-212 (C8299)
Moisture Repeat Section



Reference - Ground Surface

Appendix C

Well Documentation for 199-K-220 (C8795)

- Borehole log
- Well Summary Sheet,
- Well Development and Testing Data
- Sieve Analysis
- Photographic Log
- Well Survey Report
- Geophysical logs

This page intentionally left blank.

BOREHOLE LOG

Page 1 of 5

Date: 4/1/14

Well ID: C8795 | Well Name: 199-K-220 | Location: 350m SE of 105-KE Reactor

Project: Three extraction wells in 100-K Ou | Reference Measuring Point: Ground surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
0	G			0-0.5' - Crushed Gravel drill pad	Cable Tool: Drive Barrel
				0.5-10' Gravel(G) 80% G 15% Sand 5% Silt	Grab samples every 5' or lithology
				Gravel: 1-20mm avg. ocnl. Cobble, Sub R, 90% mafic 10% F	Likely backfill to 15' changes
				Sand: F→VC, avg. M, A→Sub R, 95% mafic 5% felsic	
				P. Sorted ~~7.5GY 4/1~~ ex Gray, no rxn. w/HCL, Sli. moist	
				2.5Y 6/1	
5	G				
				↑ Sand % to 60% @ 7'	
10	G			10-20' Gravelly Sand(gS) 20% G 75% Sand 5% Silt	
				Gravel: 1-3mm avg., ocnl. Cobble max 300mm, Sub R→R,	
				95% mafic 5% felsic Sand: F→VC, A→Sub R,	
				90% mafic 10% felsic (Qtz), P. sorted, no rxn w/HCL	
				6/1 Gray(2.5Y), moist	
15	G				
				Gravelly Sand(gS) 15% G 80% Sand 5% Silt	
20	G			20-1~~6~~7 Sandy Gravel(sG) 40% G 55% Sand 5% Silt	
				Gravel: 2-10mm with ocnl Cobble, Sand: F→VC,	
				Sub A, slight rxn. w/HCL, 6/1 Gray(2.5Y)	
25	G			↑ moisture, clay lens at 22-23'	↑ moisture
30	G			Sandy Gravel (sG) - same as above, 2.5Y	
				5/1 Gray, slight rxn. w/HCL, moist	
					↓ Drill rate, large cobbles
35	G			Sandy Gravel (sG) 40% G 55% Sand 5% Silt	
				6/1 Gray, moist, no rxn w/HCL	
				Gravel: 1-10mm, 100mm max, 90% mafic 10% felsic, P. sorted	
				Sand: 85% mafic 15% felsic, sub A→Sub R	

Reported By: Chad Koepfle | Reviewed By: BA WILLIAMS

Title: Geologist | Title: SR. GEOLOGIST

Signature: Chad Koepfle | Date: 4/1/14 | Signature: [signature] | Date: 8/18/14

A-6003-642 (03/03)

BOREHOLE LOG

Page 2 of 5
Date: 4/1/14

Well ID: C8795	Well Name: 199-K-220	Location: 350m SE of 105-KE Reactor
Project: Three extraction wells in 100-K-220		Reference Measuring Point: Ground surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
40	G			20-164.7 Sandy Gravel (sG) - 40% G 55% Sand 5% silt	Cable Tool: Drive Barrel
				Gravel: 4-10mm avg., 100mm max, Sub R., 90% B 10% F	Grab samples every 5' & at
				Sand: m→VC, sub A→sub R, 85% B, 10% Felsic	lithology changes
				6/1 Gray, slight rxn. w/HCL, moist	
					Hanford
45	G			↑ Felsic content 20-30% (Quartzite)	~~Hanford~~ Ringold Contact
				in Sand @ 45'	suspected at 45'
50	G			Sandy Gravel (sG) - 40% G 55% Sand 5% silt	
				Gravel: 2-10mm avg., ocnl. 50mm pebble, Sub A.,	
				80% B 20% Felsic (Quartzite + granite) Sand: F→VC	
				pred. C→VC, sub A, 55% B 45% Felsic, ocnl.	
				mica, Poorly sorted, 5/2 Grayish brown (2.5Y),	
55	G			no rxn. w/HCL, moist	
					Slow drilling rate
				↑ Large cobble and boulders @ 53' bgs	
				↑ Felsic content - Gravel: 50% B 50% F, Sand: 60% F	
				40% basalt	
60	G				
				Sandy Gravel (sG) 35% Gravel 60% Sand 5% silt	
				Gravel: 2-50mm pebbles, ocnl LL Cobble, 70% felsic 30% B	
				Sub A→R, Sand: VF→C, pred. F, 90% Felsic	
				10% mafic, sub A→sub R, mod. sorted,	
65	G			6/2 light grayish brown, no rxn w/HCL,	
				slightly moist	
70	G	70.4 SS 72.1	218 blows 100% Recovery	Sandy Gravel (sG) 45% G 50% Sand 5% silt	
				Gravel: 2-20mm avg., ocnl 50mm Pebble, 60% felsic	I-601 Split-spoon sample
				40% mafic, Sub A.→Sub R. Sand: F→C, avg. F,	From 70.4-72.1 bgs
				90% felsic 10% mafic, A.→Sub R., ocnl. mica	HEIS: B2TIK5, B2TIK6,
				6/2 light brownish gray, no rxn. w/HCL, slightly	B2TIK7(RS), B2TIK8
75	G			moist 10YR 6/2	SC 7/2
				76' SAME AS ABOVE	

Reported By: Chad Koepfle G L Koser 4/7/14		Reviewed By: RA WILLIAMS	
Title: Geologist		Title: Sr. Geologist	
Signature: Chad Koepfle	Date: 4/1/14	Signature:	Date: 8/18/14

A-6003-642 (03/03)

BOREHOLE LOG

Page 3 of 5

Date: 4/7 - 4/9/14

Well ID: C8795 | Well Name: 199-K-220 | Location: 350 m SE of KE (105-KE) Reactor

Project: THREE EXTRACTION WELLS @ 100-KR-4 | Reference Measuring Point: GROUND SURFACE

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
80	G	▼79.8'		80' SANDY GRAVEL SG 50% G 47%	CABLE TOOL DRIVE
				SAND 3% SILT GRAVEL = VF-C	BARREL
				PEBBLE MAX 60 MM WELL SORTED SR-R	WL = 79.8 @ 4/7/14
				70% FELSIC 30% MAFICS SAND = VF-C	
				AVG. MED, A-SA 90% QTZ 10% BASALT	
85	G 85.7			TR MICA, WET POORLY SORTED	
		SS. 100%		10YR 4/2 DK GRAY BROWN NO HCl	COLOR IS WET, AS
				RXN	RECEIVED SAMPLE
				85' SAME AS ABOVE	HEIS#(SS): B2T1K9(RS),
	88.2 GW				B2WB58, I-002
90	G			90' SAME AS ABOVE	90.5 WATER SAMPLE
					HEIS#(GW): B2T1L5,
					B2T1M2, I-003
				BECOMING MORE COARSE ↓	JC 7/2
95	G			95' SANDY GRAVEL SG 60% G 37%	
				SAND, 3% SILT. GRAVEL = VF-C, MAX	
				50 MM, WELL SORTED SR-R. 70% FELSIC	
				30% MAFIC. SAND = ~~VF-C~~ AVG MED, SA-A	M-VC
				80% QTZ 20% BASALT, TR MICA, WET	
100	G			10YR 4/2 DK GRAY BRN - NO HCl RXN	
				100 [illegible] G 80% G - 17% SAND 3%	
				SILT GRAVEL = 40% SM COBBLE	
				40% C-M PEBBLE 20% F-VF PEBBLE	
				MAX 80 MM (70% MAFIC) 30% BASALT	FELSIC ?
105	G			MOD SORTED SR-R SAND ~~[illegible]~~	
				F-C SA-A 80% QTZ, OTHER, 20%	
				FELSIC TR MICA NO HCl RXN	
				10YR 5/1 GRAY AS RECEIVED WET	
				105 - SAME AS ABOVE	
110	G			@110' - 65% Gravel, 30% sand, 5% silt/clay;	
				some Fe-staining, no cementation or HCl rxn	
				@115' - 60% Gravel, 30% Sand, 10% silt/clay;	
				Gravel is mod.sort.; fine peb.-coarse cob., dom. med	
				peb.; sub-a - sub-r; 80% basalt, 20% felsic &	
115	G			others; weathered dark gray rinds. Sand is very poorly	
				sort.; very fine - v.coarse, dom. med.; 50% basalt,	@115 drill rate ↓↓
				50% felsic & others, v.little mica. 2.5Y5/3 lt. olive	
				brown. No HCl rxn. Rinds are 2.5Y7/2 light gray,	@117; some rxn to HCl
				10YR 5/6 yellowish brown, & 10YR 3/1 very dark gray	drill rate ↓↓

Reported By: GREG L. HASZN (4-7-98) | Reviewed By: BA WILLIAMS

Title: GEOLOGIST | Title: SR GEOLOGIST

Signature: [signature] | Date: 4/8/14 | Signature: [signature] | Date: 8/15/14

A-6003-642 (03/03)

BOREHOLE LOG

Page 4 of 5

Date: 4/10/14

Well ID: C8795	Well Name: 199-K-220	Location: 350m SE of KE-105 Reactor
Project: Three Wells at 100-KR-4 OU		Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
120	G			20'-114.7'; sandy Gravel (sG); 55% gravel, 40% sand, 5% M (silt/clay). Gravel is sub.A-sub.R; poor sort.; sm. peb.-coarse cob., max 15cm. Sand is v.fine-coarse, ~~mod~~ JE average is fine; 30% basalt, 70% other or felsic; mod. sort. Gravel is 80% basalt, 20% felsic. V. minor mica, well cemented; high rxn to HCl; 2.5 Y 6/2 light brownish gray.	Cable Tool: Drive Barrel Grab samples every 5' and at lithology changes @120; drill rate ↓↓ @120'; very low water production, measured 1.4gpm ~~at max~~ JE 4/10
	121.1 Split Spoon 122.5	100% recovery at refusal 333 blows			
125	G, GW			@125; Gravel is well rounded to subrounded, mod. sort.; sm peb. to med. cob., max is 7cm. Sand is well sort; well rounded; f-c, dom. med. Heavy Fe-staining	115-124'; High consolidation @125'; ↑↑↑ drill rate
130	G			@130; ↓ gravel, 50%; ↑ sand, 48%; ↓ silt/clay, 2%. Gravel is fine peb.-sm. cob, dom. fine peb; mod. sort., sub. angular. Sand is WS, f-M, 20% basalt, 80% felsic or other. Some mica. 2.5 Y 4/3 olive brown, wet.	SS HEIS#: I-004, B2WB59, B2T1E1 (RS) GW HEIS#: I-005, B2T1L6, B2T1M3
135	G			@132; ↓ gravel, 15%; ↑ sand, 85% @133; 100% Sand @134; ↑ gravel, 15%; ↓ sand, 85% @135; ↑ gravel, 50%; ↓ sand, 50% @137; 100% sand	↓↓ drill rate @131' 2' sand heave @134' 2' sand heave @138'
140	G			@140; ↑ gravel, 37%; ↓ sand, 60%; 3% silt. Gravel is sm. peb-sm cob., dom. sm-med peb; PS; sub rounded; 30% basalt, 70% felsic/other. Sand is vf-vc, dom. f-m; PS; 30% basalt, 70% felsic/other; minor mica. 2.5 Y 4/3 olive brown, wet. No rxn HCl.	@140; ↑↑ drill rate
145	G			@145; ↓ gravel, 32%; ↑ sand, 65%; 3% silt. Gravel is sm. peb.-lg. cob, PS, R, dom. lg. cob. Sand is vf-vc, dom. med.; Mod.-well sorted; minor mica, no rxn to HCl. Gravel is 20% basalt, 80% felsic/other, Sand is 30% basalt, 70% felsic/other.	
150	G			@150; ↑ gravel, 45%; ↓ sand, 50%; 5% silt. Gravel is sm. peb.-sm. cob., dom. sm peb, max 18cm; sub. angular; 40% basalt, 60% felsic/other. Sand is vf-vc, dom. med-c; PS, 40% basalt, 60% felsic/other.	@150; slight compaction PS;
155	G			@155'; Sand is moderately sorted, dom. med-coarse; well rounded; 20% basalt, 80% felsic/other. Minor mica, slight rxn to HCl.	@155'; Slight cementation
	157.5 Split Spoon	160.0' 121 Blows 100% Recovery			Split-Spoon HEIS # B2WB60, B2T1L3 (RS), I-006

Reported By: Janine Carter		Reviewed By: BA WILLIAMS	
Title: Geologist		Title: SR. GEOLOGIST	
Signature: Janine Carter	Date: 4/14/14	Signature: [signature]	Date: 8/18/14

A-6003-642 (03/03)

BOREHOLE LOG

Page 5 of 5

Date: 4/17/14

Well ID: C8795 | Well Name: 199-K-220 | Location: 350m SE of KE-105 Reactor

Project: Three Wells at 100-KR-4 OU | Reference Measuring Point:

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
160	Split Spoon 157.5-160.0' GW; G	121 Blows 100% Recovery		20'-164.7; sandy Gravel (sG); Gravel, 45%, sand, 50%; 5% silt. Gravel is sm.peb.-sm.cob., dom. sm. peb., max 18cm; PS; subangular; 40% basalt, 60% other/felsic. Sand is vf-vc, dom. med-coarse, mod. sort., well rounded; 80% felsic/other, 20% basalt. Minor mica, slight rxn to HCl. Slight cementation.	Cable Tool: Drive Barrel Grab samples every 5' and at lithology changes. 160' Water sample HEIS# ~~B2T1L3, B2W8L0~~ JC 4/30 B2T1L7, B2T1M4, I-007
165	G			@160'; Slight rxn to HCl; slight cementation; slight compaction. 2.5 Y 5/3 light olive brown. Some clay stringers.	
				@164.7 RUM contact	
170	G			164.7'-171.3'; sandy Silt (sM); ~~50%~~ 2% JC 4/24/14 gravel, 35% sand, 63% silt/clay. Gravel is R; PS; med peb-sm cob. Sand is vf-m, dom vf; WS; 10% basalt, 90% felsic/other. Silt/clay is 2.5 Y 5/4 light olive brown, 25% clay, 75% silt, high plasticity. Slight rxn to HCl.	
			171.3' TD	TD = 171.3' bgs	

NOT USED JC 4/24/14

Reported By: Janine Carter | Reviewed By: B.A. WILLIAMS

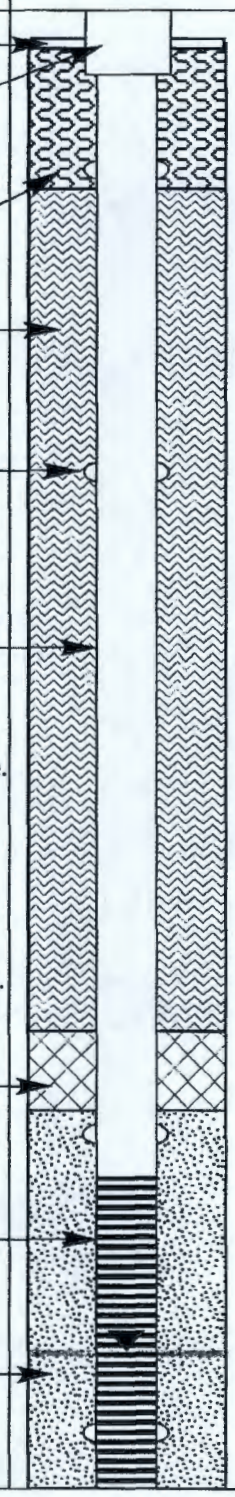
Title: Geologist | Title: CR GEOLOGIST

Signature: Janine Carter | Date: 4/24/14 | Signature: [illegible] | Date: 8/18/14

A-6003-642 (03/03)

WELL SUMMARY SHEET	Start Date: 3/31/2014 Finish Date: 6/9/2014	Page 1 of 2
Well ID: C8795	Well Name: 199-K-220	
Location: 350m SE of 105-KE Reactor	Project: 3 Wells in the 100-KR-4 OU FY2014	
Prepared By: Janine Carter — Date: 6/23/14	Reviewed By: J.D. MEHRER — Date: 7-15-14	
Signature: Janine Carter	Signature:	

CONSTRUCTION DATA

Description	Diagram
Concrete Pad: 0.5 ft above ground surface (ags) 8-in Protective Casing: 3.0 ft ags - 2.0 ft below ground surface (bgs) Type I/II Portland Cement Grout: 0 - 9.3 ft bgs 3/8 in Cetco Medium Bentonite Crumbles: 9.3 - 60.3 ft bgs Stainless steel centralizer installed above and below screen and every 40 ft 6-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.0 ft ags - 69.1 ft bgs Depths are in ft below ground surface. Borehole drilled with 13 1/2-in O.D. casing from 0.0 - 69.71 ft bgs and 11 3/4-in O.D. casing from 0.0 - 170.24 ft bgs All temporary drill casing was removed from the ground. 3/8 in Cetco Coated Bentonite Pellet Seal: 60.3 - 65.3 ft bgs 6-in I.D. Schedule 10, Type 304/304L, 40-slot (0.040 in.) Stainless Steel Screen: 69.1 - 164.14 ft bgs 10 - 20 mesh Premier Colorado Silica Filter Pack Sand: 65.3 - 171.3 ft bgs	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
0		0 - 0.5 Crushed Gravel Drill Pad 0.5 - 10 Gravel (G)
10		10 - 20 Gravelly Sand (gS)
20		20 - 164.7 Sandy Gravel (sG)
30		
40		
50		
60		
70		
80		Static Water Level: 79.8 ft bgs (4/7/2014)

WELL SUMMARY SHEET	Start Date: 3/31/2014 Finish Date: 6/9/2014	Page 2 of 2
Well ID: C8795	Well Name: 199-K-220	
Location: 350m SE of 105-KE Reactor	Project: 3 Wells in the 100-KR-4 OU FY2014	
Prepared By: Janine Carter — Date: 6/23/14	Reviewed By: J.D. MEHRER	Date: 7/15/14
Signature: Janine Carter	Signature:	

CONSTRUCTION DATA

Depths are in ft below ground surface.

Borehole drilled with 13 1/2-in O.D. casing from 0.0 - 69.71 ft bgs and 11 3/4-in O.D. casing from 0.0 - 170.24 ft bgs

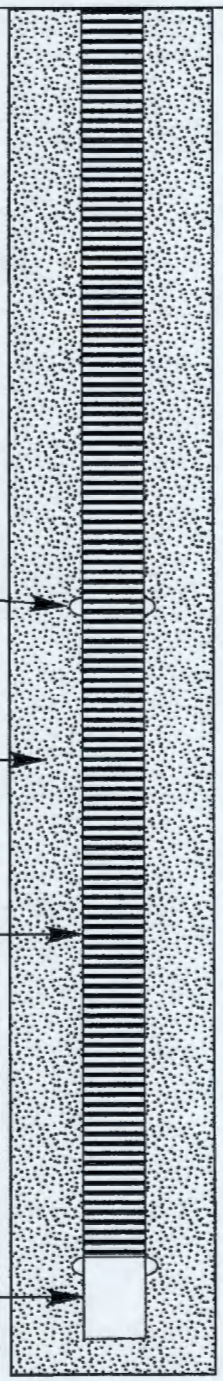
All temporary drill casing was removed from the ground.

Stainless steel centralizer installed above and below screen and every 40 ft

10 - 20 mesh Premier Colorado Silica Filter Pack Sand: 65.3 - 171.3 ft bgs

6-in I.D. Schedule 10, Type 304/304L, 40-slot (0.040 in.) Stainless Steel Screen: 69.1 - 164.14 ft bgs

6-in I.D. Schedule 10, Type 304/304L, Stainless Steel Sump: 164.14 - 169.16 ft bgs



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Lithologic Description (ft bgs)
90	20 - 164.7 Sandy Gravel (sG)
100	
110	
120	
130	
140	
150	
160	
	164.7 - 171.3 Sandy Silty (sM)
170	Straightness Test: 4/21/2014, Pass Total Depth: 171.3 ft bgs

WELL DEVELOPMENT AND TESTING DATA

Well Name:	Well ID:	Well Location:	Date:
199-K-220	C8795	350 M SSE of 105 KE	6/5/14

Reference Measuring Point (unless otherwise noted): TOP OF OUTER CASING (TOC)

Has the well been surveyed? ○ Yes ⊗ No

Does the well have a cement pad? ~~⊗ Yes~~ ⊗ No

PART 1

STATIC WATER LEVEL:

Start of Job 78.0' bgs

End of Job 78.08' bgs

DEPTH TO BOTTOM:

Start of Job 166.0' bgs

End of Job ~~167.4~~ JC 167.4' bgs

PART 2

WELL DEVELOPMENT DATA

Pump Model Franklin Electric 15HP

Intake Depth 151.5/130.4/109.3/88.2' bgs

Starting Turbidity 34.3/13.6/2.6/7.02 NTU

Pump Start	Stop	Flow Rate	Drawdown
10:14	1110	161 gpm	12.5
1159	1303	136 gpm	10.64
1342	1414	122 gpm	9.88
0755	0844	48.8	4.25
-	-	-	-

Total Pumped 24,015 gallons total

Final Turbidity 4.64/2.52/3.61/0.95 NTU

XD SN/Range (PSI) Level Troll 700, 50 PSI

PART 3

INSTANTANEOUS SLUG TEST

Static Water Level (TOC)

Transducer Depth

Baseline Start

Injection Start

Baseline Start

Withdrawal Start

Slug Volume

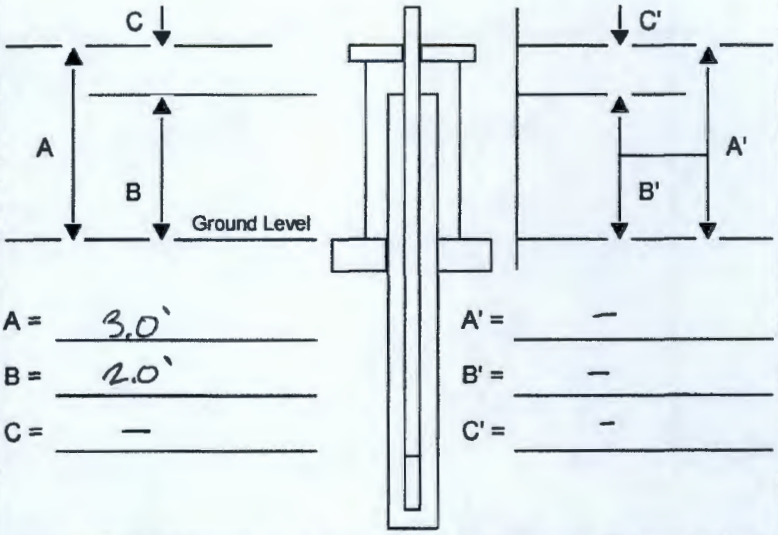
XD SN/Range (PSI)

Not used JC 6/30

PART 4

Last Recorded Measurements Date:

Current Measurements Date:



A = 3.0'

B = 2.0'

C = —

A' = —

B' = —

C' = —

Are there any reference marks on the casing strings? ○ Yes ⊗ No

PART 5

COMMENTS:

Four intervals developed.

Rugged Reader File: C8795_004_6_9_14_Development

NCOs collect HEIS#s B2T1L8, B2T1L9, B2X1L6, B2T1M0, B2T1M1, B2X1L7 I-008

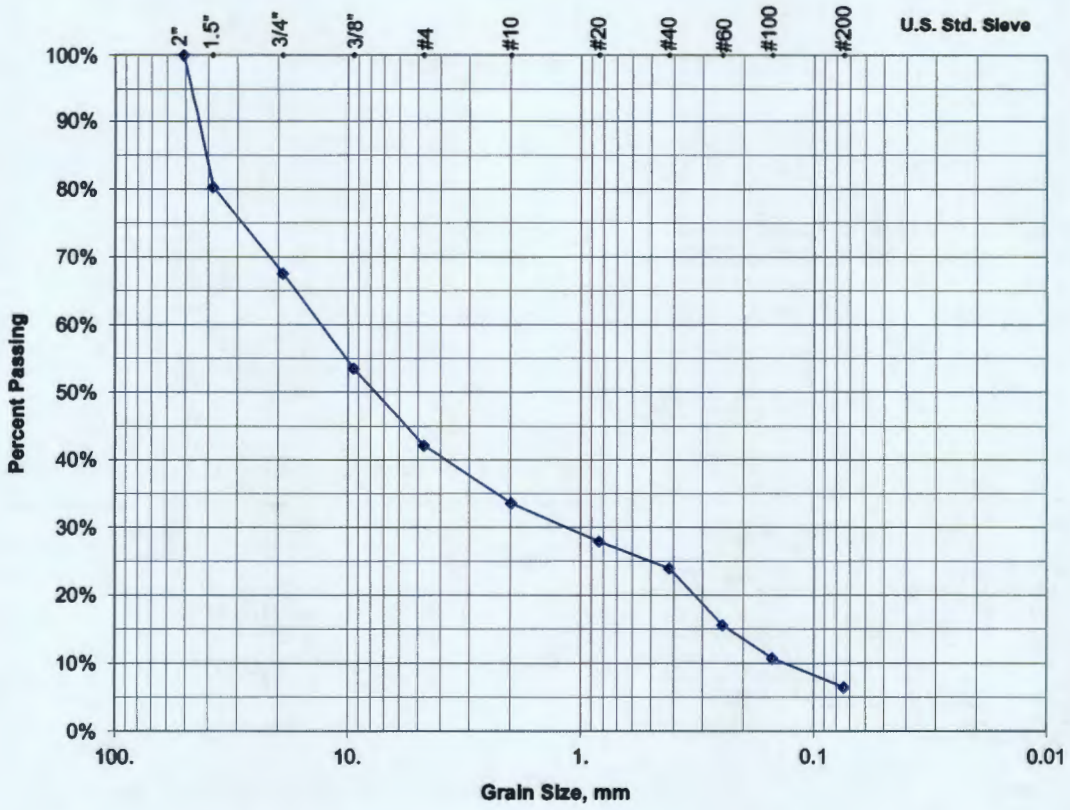
Prepared by (print name):	Signature:	Date:
Janine Carter	Janine Carter	6/5/14
Reviewed by (print name): J.D. MEHRER	Signature:	Date: 7/15/14

A-6005-205 (REV 1)

SIEVE ANALYSIS

WELL NAME	199-K-220	SAMPLE DEPTH	80 - 89	SAMPLE#	1	WELL ID#	C8795
TESTED BY	Greg Kasza	CONTACT	Freestone Env.	PHONE	943-5222	DATE	04/09/2014

SAMPLE WEIGHT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	GRAIN SIZE (mm)	COMMENTS
1059.80	2"	0.0	0.0	100.0	50.80	
	1.5"	209.4	19.8	80.2	38.10	
	3/4"	344.0	32.5	67.5	19.05	
	3/8"	493.1	46.5	53.5	9.42	
	#4	614.2	58.0	42.0	4.70	
	#10	704.2	66.4	33.6	1.98	
	#20	764.2	72.1	27.9	0.83	
	#40	806.4	76.1	23.9	0.42	
	#60	895.2	84.5	15.5	0.25	
	#100	946.8	89.3	10.7	0.150	
	#200	992.1	93.6	6.4	0.074	



Soil Description	66.4% Gravel	27.2% Sand	6.0% Silt
	32.5% Coarse-V Coarse Pebble	9.6% Coarse-V Coarse	
	14.1% Medium Pebble	8.4% Medium	
	19.9% Fine-V Fine Pebble	9.1% Fine-V Fine	

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

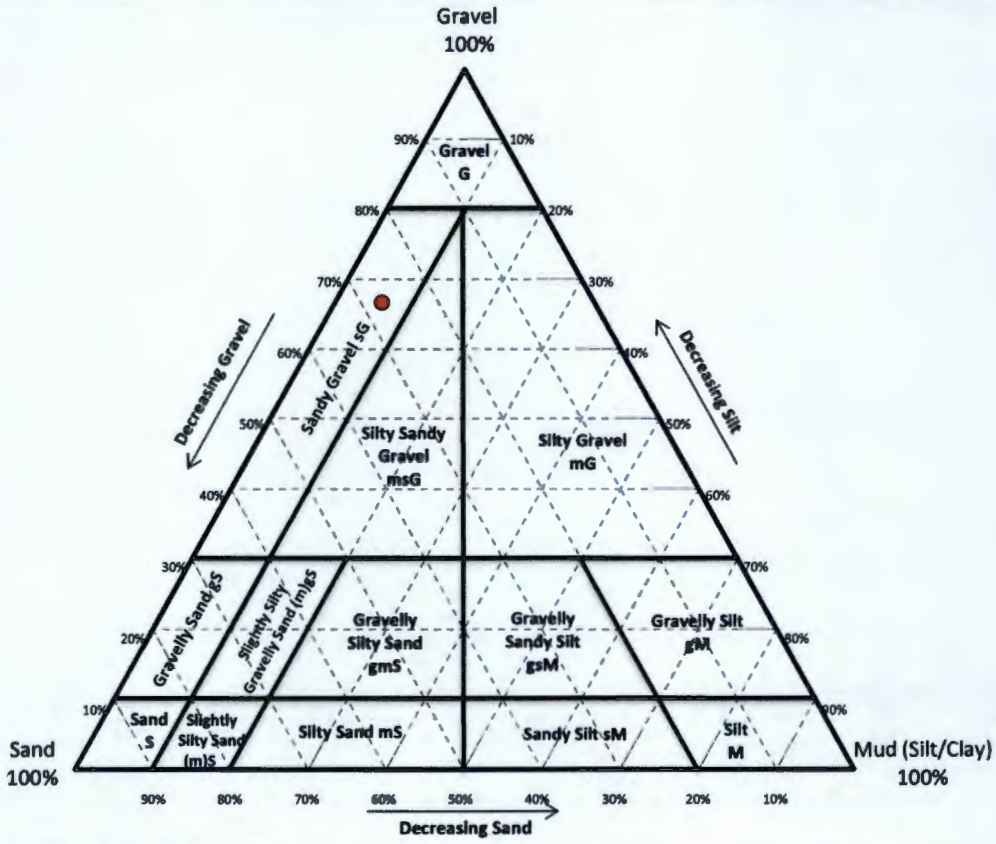
Checked By: Janine Carter Date: 7/9/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS DATA

Date:	4/9/2014	Well Name:	199-K-220
Soil Description:	Sandy Gravel	Well ID:	C8795
Sample Number:	1	Sample Depth (ft bgs):	80 - 89
Sample bowl (g):	754.9	Final Variance (grams):	4.3
Sample bowl+dry sample (g):	1814.7	Sample bowl + wash/dry sample (g):	1811.1
Dry sample weight (g):	1059.8	Wash/dry sample weight (g):	1056.2

Sieve No.	Sieve Opening	Sieve Weight (g)	Sieve + Soil Weight (g)	Weight of Soil Retained (g)	Percent Retained	Cumulative Weight Retained (g)	Cumulative Percent Retained	Percent Finer
–	2.0 IN	469.9	469.9	0.0	0.0%	0.0	0.0%	100.0
–	1.5 IN	491.2	700.6	209.4	19.8%	209.4	19.8%	80.2
–	0.75 IN	497.9	632.5	134.6	12.7%	344.0	32.5%	67.5
–	0.375 IN	490.3	639.4	149.1	14.1%	493.1	46.5%	53.5
4	4.75 mm	463.8	584.9	121.1	11.4%	614.2	58.0%	42.0
10	2.00 mm	489.6	579.6	90.0	8.5%	704.2	66.4%	33.6
20	0.85 mm	380.7	440.7	60.0	5.7%	764.2	72.1%	27.9
40	0.425 mm	336.3	378.5	42.2	4.0%	806.4	76.1%	23.9
60	0.25 mm	321.3	410.1	88.8	8.4%	895.2	84.5%	15.5
100	0.15 mm	308.6	360.2	51.6	4.9%	946.8	89.3%	10.7
200	0.075 mm	328.4	373.7	45.3	4.3%	992.1	93.6%	6.4
PAN	–	370.7	430.5	59.8 3.6	6.0%	1055.5	99.6%	0.0



If percentages are borderline, use the coarser classification.
i.e. 90% sand, 10% silt equals sand, not slightly silty sand or 60% gravel, 30% sand, and 10% silt equals sandy gravel, not silty sandy gravel

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

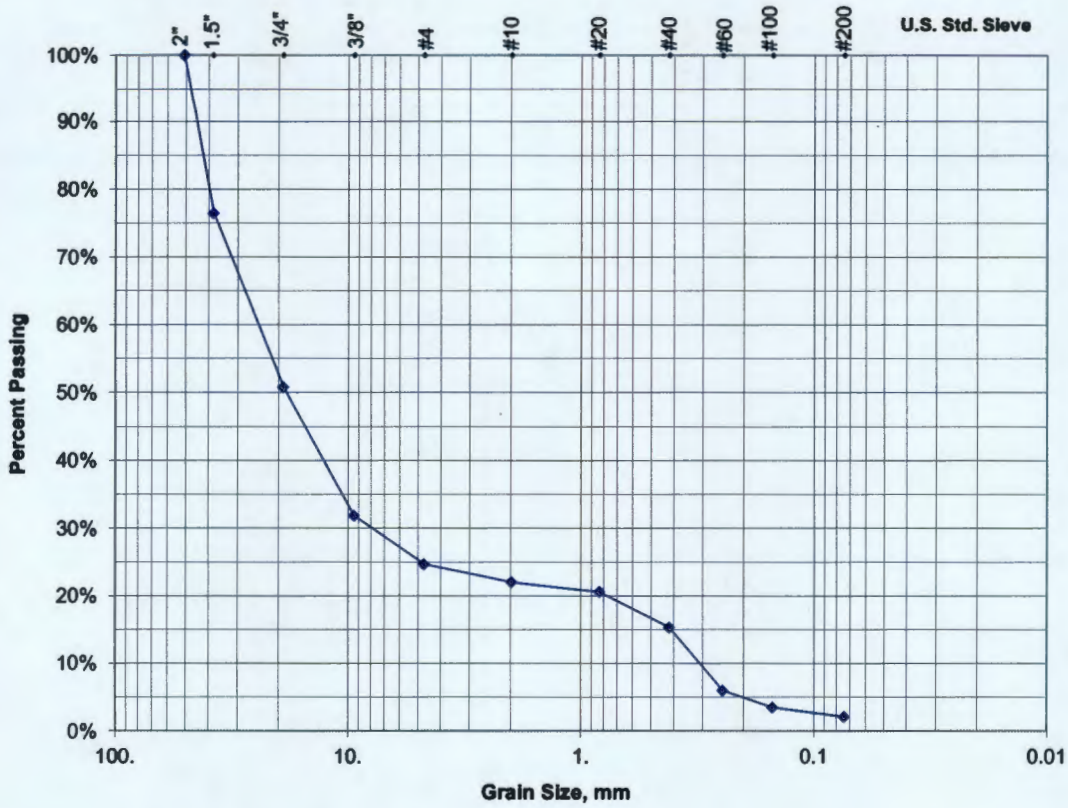
Checked By: Janine Carter Date: 7/9/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS

WELL NAME	199-K-220	SAMPLE DEPTH	90 - 99	SAMPLE#	2	WELL ID#	C8795
TESTED BY	Greg Kasza	CONTACT	Freestone Env.	PHONE	943-5222	DATE	04/09/2014

SAMPLE WEIGHT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	GRAIN SIZE (mm)	COMMENTS
1054.10	2"	0.0	0.0	100.0	50.80	
	1.5"	248.3	23.6	76.4	38.10	
	3/4"	519.0	49.2	50.8	19.05	
	3/8"	718.5	68.2	31.8	9.42	
	#4	794.3	75.4	24.6	4.70	
	#10	822.2	78.0	22.0	1.98	
	#20	837.3	79.4	20.6	0.83	
	#40	892.9	84.7	15.3	0.42	
	#60	991.6	94.1	5.9	0.25	
	#100	1017.9	96.6	3.4	0.150	
	#200	1032.3	97.9	2.1	0.074	



Soil Description	**78.0% Gravel**	**19.9% Sand**	**2.0% Silt**
	49.2% Coarse-V Coarse Pebble	6.7% Coarse-V Coarse	
	18.9% Medium Pebble	9.4% Medium	
	9.8% Fine-V Fine Pebble	3.9% Fine-V Fine	

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

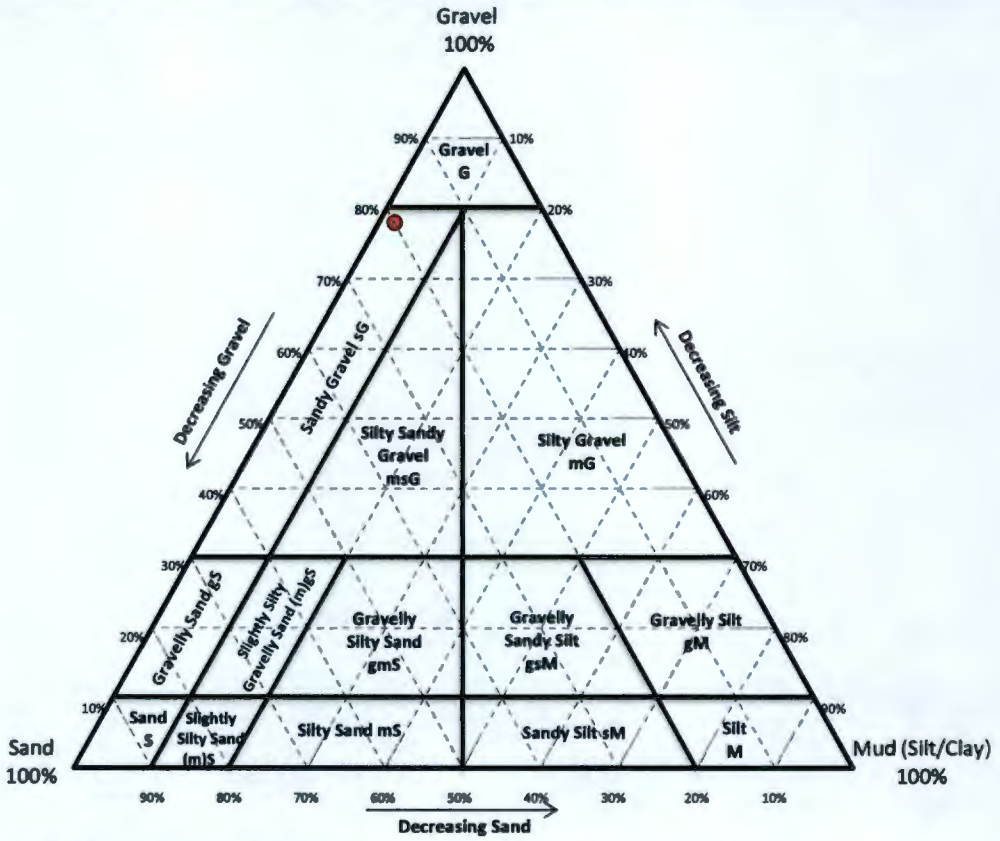
Checked By: Janine Carter Date: 7/9/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS DATA

Date:	4/9/2014	Well Name:	199-K-220
Soil Description:	Sandy Gravel	Well ID:	C8795
Sample Number:	2	Sample Depth (ft bgs):	90 - 99
Sample bowl (g):	746.7	Final Variance (grams):	0.5
Sample bowl+dry sample (g):	1800.8	Sample bowl + wash/dry sample (g):	1798.0
Dry sample weight (g):	1054.1	Wash/dry sample weight (g):	1051.3

Sieve No.	Sieve Opening	Sieve Weight (g)	Sieve + Soil Weight (g)	Weight of Soil Retained (g)	Percent Retained	Cumulative Weight Retained (g)	Cumulative Percent Retained	Percent Finer
–	2.0 IN	469.9	469.9	0.0	0.0%	0.0	0.0%	100.0
–	1.5 IN	491.2	739.5	248.3	23.6%	248.3	23.6%	76.4
–	0.75 IN	497.9	768.6	270.7	25.7%	519.0	49.2%	50.8
–	0.375 IN	490.3	689.8	199.5	18.9%	718.5	68.2%	31.8
4	4.75 mm	463.8	539.6	75.8	7.2%	794.3	75.4%	24.6
10	2.00 mm	489.6	517.5	27.9	2.6%	822.2	78.0%	22.0
20	0.85 mm	380.7	395.8	15.1	1.4%	837.3	79.4%	20.6
40	0.425 mm	336.3	391.9	55.6	5.3%	892.9	84.7%	15.3
60	0.25 mm	321.3	420.0	98.7	9.4%	991.6	94.1%	5.9
100	0.15 mm	308.6	334.9	26.3	2.5%	1017.9	96.6%	3.4
200	0.075 mm	328.4	342.8	14.4	1.4%	1032.3	97.9%	2.1
PAN	–	370.7	389.2	18.5 2.8	2.0%	1053.6	100.0%	0.0



If percentages are borderline, use the coarser classification.
i.e. 90% sand, 10% silt equals sand, not slightly silty sand or 60% gravel, 30% sand, and 10% silt equals sandy gravel, not silty sandy gravel

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

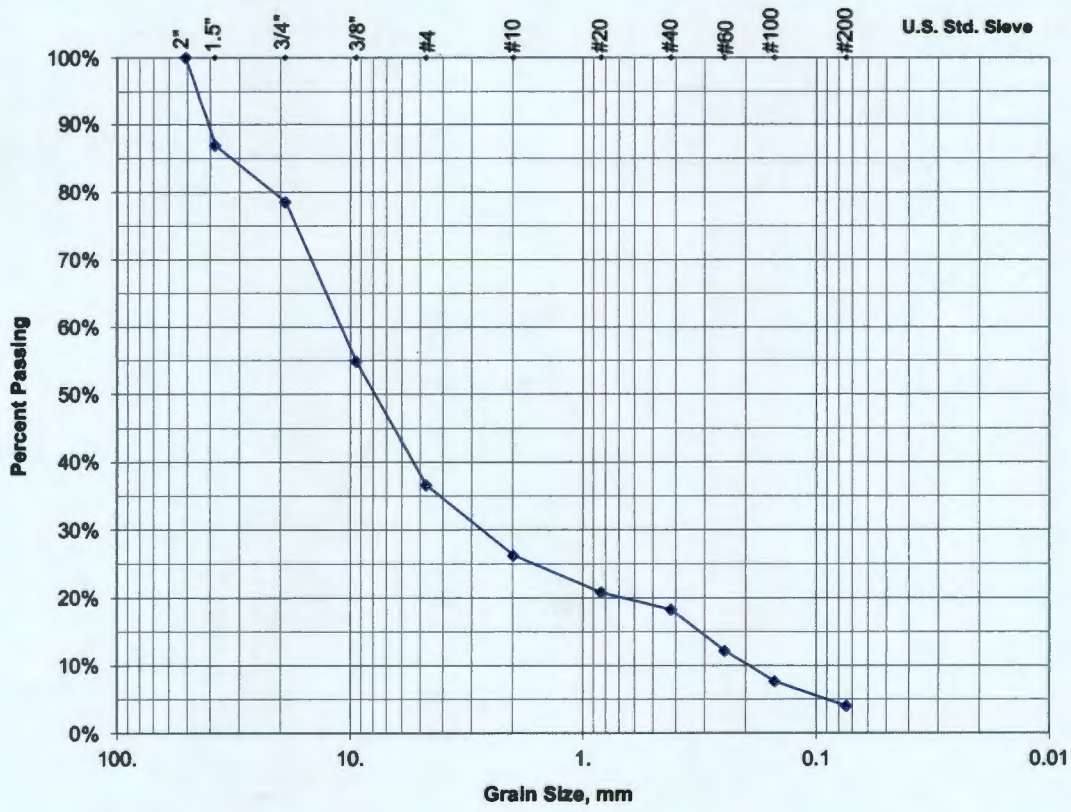
Checked By: Janine Carter Date: 7/9/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS

WELL NAME	199-K-220	SAMPLE DEPTH	100 - 109	SAMPLE#	3	WELL ID#	C8795
TESTED BY	Greg Kasza	CONTACT	Freestone Env.	PHONE	943-5222	DATE	04/09/2014

SAMPLE WEIGHT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	GRAIN SIZE (mm)	COMMENTS
1109.80	2"	0.0	0.0	100.0	50.80	
	1.5"	145.5	13.1	86.9	38.10	
	3/4"	238.7	21.5	78.5	19.05	
	3/8"	501.5	45.2	54.8	9.42	
	#4	704.2	63.5	36.5	4.70	
	#10	819.0	73.8	26.2	1.98	
	#20	879.2	79.2	20.8	0.83	
	#40	907.5	81.8	18.2	0.42	
	#60	975.3	87.9	12.1	0.25	
	#100	1025.5	92.4	7.6	0.150	
	#200	1065.8	96.0	4.0	0.074	



Soil Description	73.8% Gravel	22.2% Sand	4.1% Silt
	21.5% Coarse-V Coarse Pebble	8.0% Coarse-V Coarse	
	23.7% Medium Pebble	6.1% Medium	
	28.6% Fine-V Fine Pebble	8.2% Fine-V Fine	

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

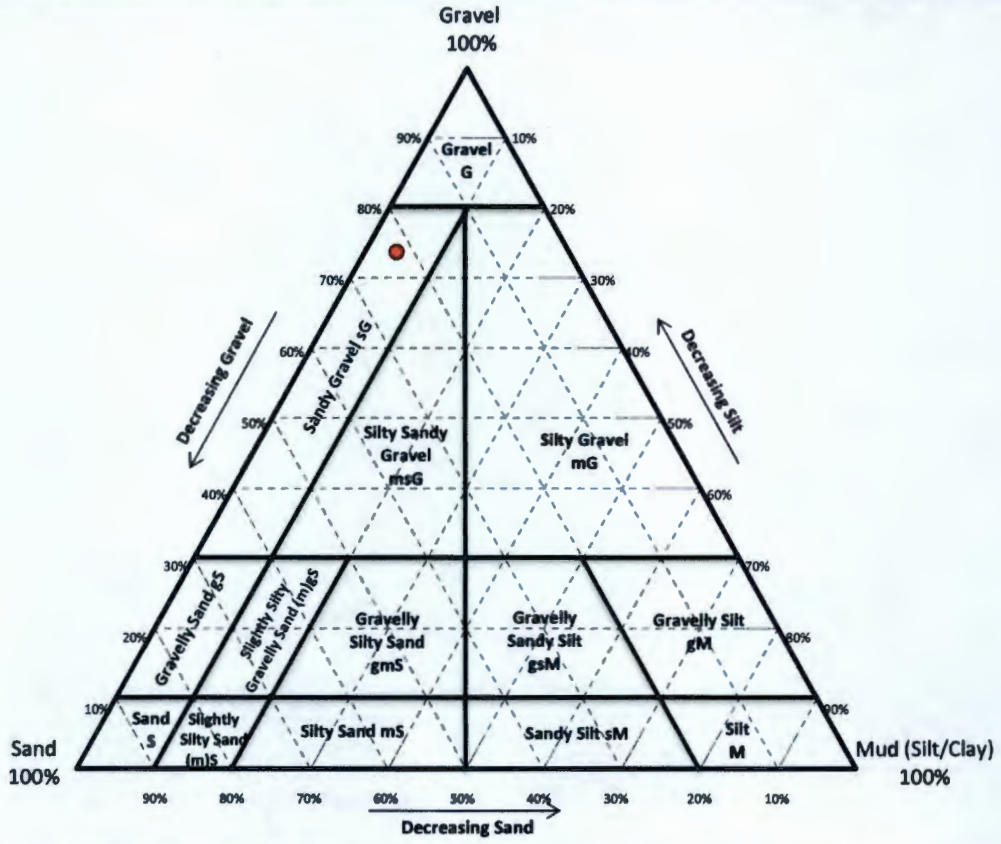
Checked By: Janine Carter Date: 5/2/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS DATA

Date:	4/9/2014	Well Name:	199-K-220
Soil Description:	Sandy Gravel	Well ID:	C8795
Sample Number:	3	Sample Depth (ft bgs):	100 - 109
Sample bowl (g):	767.6	Final Variance (grams):	1.2
Sample bowl+dry sample (g):	1877.4	Sample bowl + wash/dry sample (g):	1871.2
Dry sample weight (g):	1109.8	Wash/dry sample weight (g):	1103.6

Sieve No.	Sieve Opening	Sieve Weight (g)	Sieve + Soil Weight (g)	Weight of Soil Retained (g)	Percent Retained	Cumulative Weight Retained (g)	Cumulative Percent Retained	Percent Finer
–	2.0 IN	469.9	469.9	0.0	0.0%	0.0	0.0%	100.0
–	1.5 IN	491.2	636.7	145.5	13.1%	145.5	13.1%	86.9
–	0.75 IN	497.9	591.1	93.2	8.4%	238.7	21.5%	78.5
–	0.375 IN	490.3	753.1	262.8	23.7%	501.5	45.2%	54.8
4	4.75 mm	463.8	666.5	202.7	18.3%	704.2	63.5%	36.5
10	2.00 mm	489.6	604.4	114.8	10.3%	819.0	73.8%	26.2
20	0.85 mm	380.7	440.9	60.2	5.4%	879.2	79.2%	20.8
40	0.425 mm	336.3	364.6	28.3	2.6%	907.5	81.8%	18.2
60	0.25 mm	321.3	389.1	67.8	6.1%	975.3	87.9%	12.1
100	0.15 mm	308.6	358.8	50.2	4.5%	1025.5	92.4%	7.6
200	0.075 mm	328.4	368.7	40.3	3.6%	1065.8	96.0%	4.0
PAN	–	370.7	409.7	39.0 6.2	4.1%	1111.0	100.1%	0.0



If percentages are borderline, use the coarser classification.
i.e. 90% sand, 10% silt equals sand, not slightly silty sand or 60% gravel, 30% sand, and 10% silt equals sandy gravel, not silty sandy gravel

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

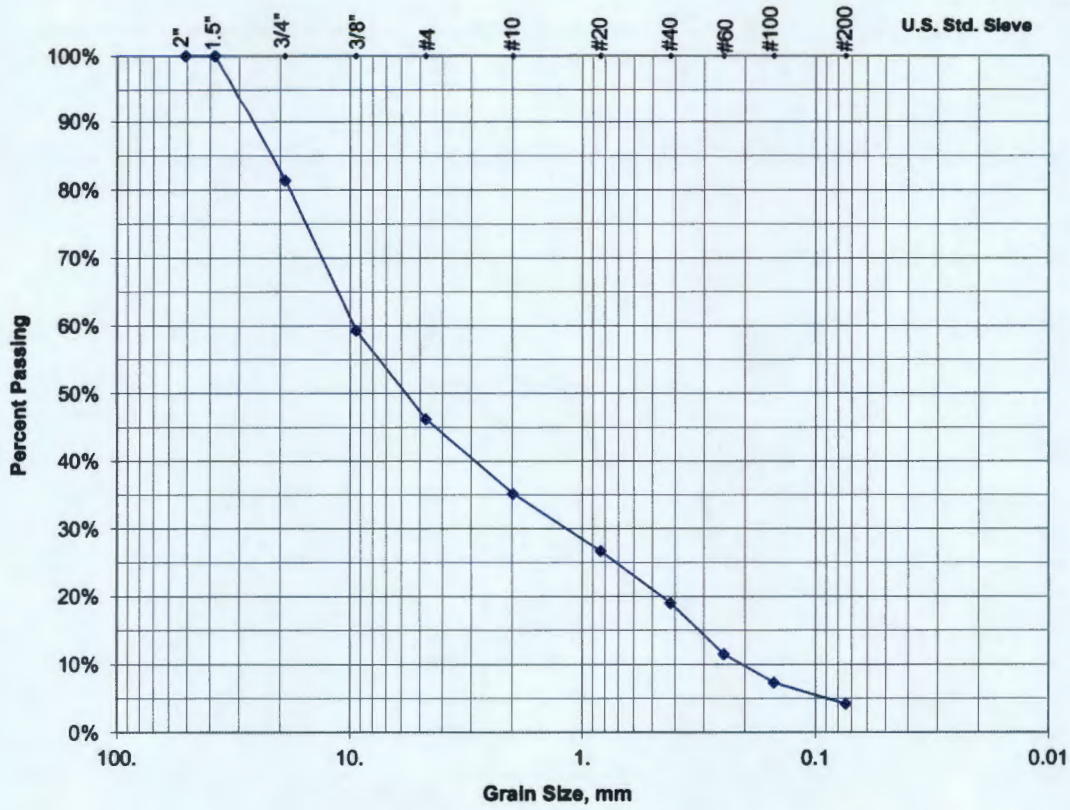
Checked By: Janine Carter Date: 5/2/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS

WELL NAME	199-K-220	SAMPLE DEPTH	110-119	SAMPLE#	4	WELL ID#	C8795
TESTED BY	Janine Carter	CONTACT	Freestone Env.	PHONE	943-5222	DATE	04/22/2014

SAMPLE WEIGHT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	GRAIN SIZE (mm)	COMMENTS
1097.50	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	204.4	18.6	81.4	19.05	
	3/8"	446.9	40.7	59.3	9.42	
	#4	590.8	53.8	46.2	4.70	
	#10	711.9	64.9	35.1	1.98	
	#20	804.9	73.3	26.7	0.83	
	#40	889.2	81.0	19.0	0.42	
	#60	971.7	88.5	11.5	0.25	
	#100	1017.6	92.7	7.3	0.150	
	#200	1052.0	95.9	4.1	0.074	



Soil Description	**64.9% Gravel**	**31.0% Sand**	**3.7% Silt**
	18.6% Coarse-V Coarse Pebble	16.2% Coarse-V Coarse	
	22.1% Medium Pebble	7.5% Medium	
	24.1% Fine-V Fine Pebble	7.3% Fine-V Fine	

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

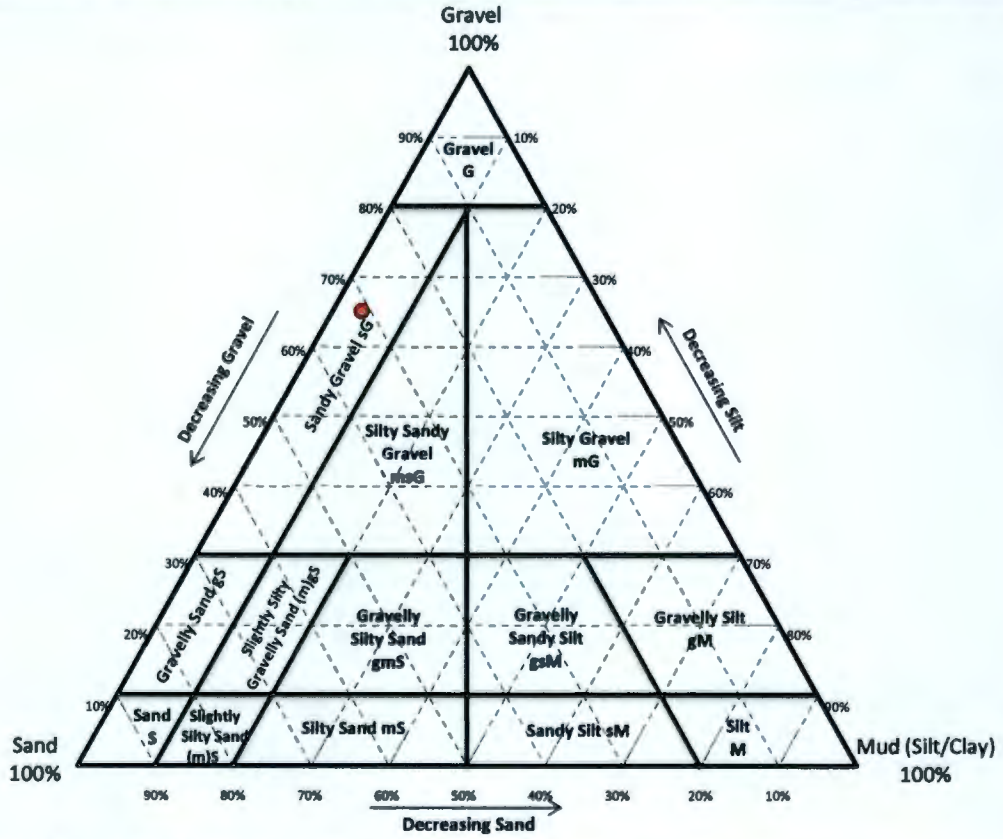
Checked By: Greg Kasza Date: 7/9/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS DATA

Date:	4/22/2014	Well Name:	199-K-220
Soil Description:	Sandy Gravel	Well ID:	C8795
Sample Number:	4	Sample Depth (ft bgs):	110-119
Sample bowl (g):	767.6	Final Variance (grams):	5.2
Sample bowl+dry sample (g):	1865.1	Sample bowl + wash/dry sample (g):	1833.5
Dry sample weight (g):	1097.5	Wash/dry sample weight (g):	1065.9

Sieve No.	Sieve Opening	Sieve Weight (g)	Sieve + Soil Weight (g)	Weight of Soil Retained (g)	Percent Retained	Cumulative Weight Retained (g)	Cumulative Percent Retained	Percent Finer
--	2.0 IN	470.0	470.0	0.0	0.0%	0.0	0.0%	100.0
--	1.5 IN	491.3	491.3	0.0	0.0%	0.0	0.0%	100.0
--	0.75 IN	497.8	702.2	204.4	18.6%	204.4	18.6%	81.4
--	0.375 IN	490.3	732.8	242.5	22.1%	446.9	40.7%	59.3
4	4.75 mm	463.7	607.6	143.9	13.1%	590.8	53.8%	46.2
10	2.00 mm	489.2	610.3	121.1	11.0%	711.9	64.9%	35.1
20	0.85 mm	380.5	473.5	93.0	8.5%	804.9	73.3%	26.7
40	0.425 mm	336.0	420.3	84.3	7.7%	889.2	81.0%	19.0
60	0.25 mm	321.1	403.6	82.5	7.5%	971.7	88.5%	11.5
100	0.15 mm	308.7	354.6	45.9	4.2%	1017.6	92.7%	7.3
200	0.075 mm	328.4	362.8	34.4	3.1%	1052.0	95.9%	4.1
PAN	--	370.7	379.4	8.7 31.6	3.7%	1092.3	99.5%	0.0



If percentages are borderline, use the coarser classification.
i.e. 90% sand, 10% silt equals sand, not slightly silty sand or 60% gravel, 30% sand, and 10% silt equals sandy gravel, not silty sandy gravel

Comments:

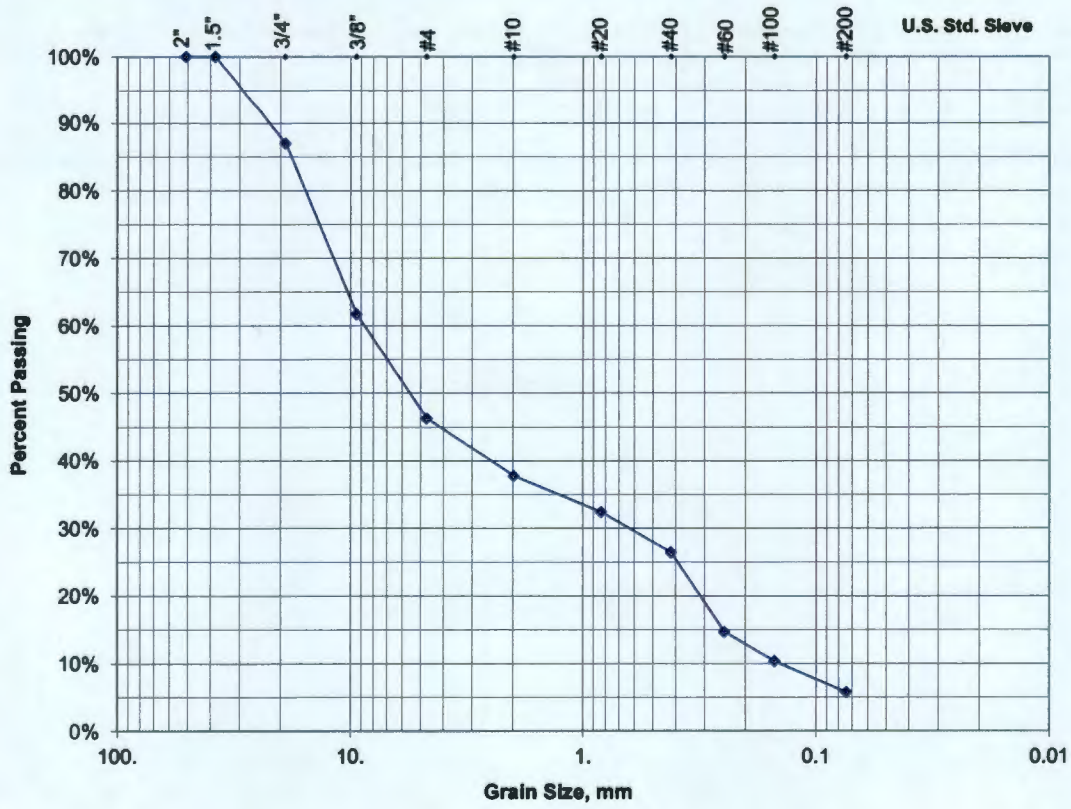
FREESTONE ENVIRONMENTAL SERVICES, INC.

Checked By: Greg Kasza Date: 7/9/2014 Office Phone: (509) 943-5222

SIEVE ANALYSIS

WELL NAME	199-K-220	SAMPLE DEPTH	120-129	SAMPLE#	5	WELL ID#	C8795
TESTED BY	Janine Carter	CONTACT	Freestone Env.	PHONE	943-5222	DATE	04/22/2014

SAMPLE WEIGHT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	GRAIN SIZE (mm)	COMMENTS
1173.40	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	152.8	13.0	87.0	19.05	
	3/8"	449.3	38.3	61.7	9.42	
	#4	630.8	53.8	46.2	4.70	
	#10	730.6	62.3	37.7	1.98	
	#20	793.2	67.6	32.4	0.83	
	#40	863.6	73.6	26.4	0.42	
	#60	1001.8	85.4	14.6	0.25	
	#100	1052.3	89.7	10.3	0.150	
	#200	1106.4	94.3	5.7	0.074	



Soil Description	**62.3% Gravel**	**32.0% Sand**	**5.8% Silt**
	13.0% Coarse-V Coarse Pebble	11.3% Coarse-V Coarse	
	25.3% Medium Pebble	11.8% Medium	
	24.0% Fine-V Fine Pebble	8.9% Fine-V Fine	

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

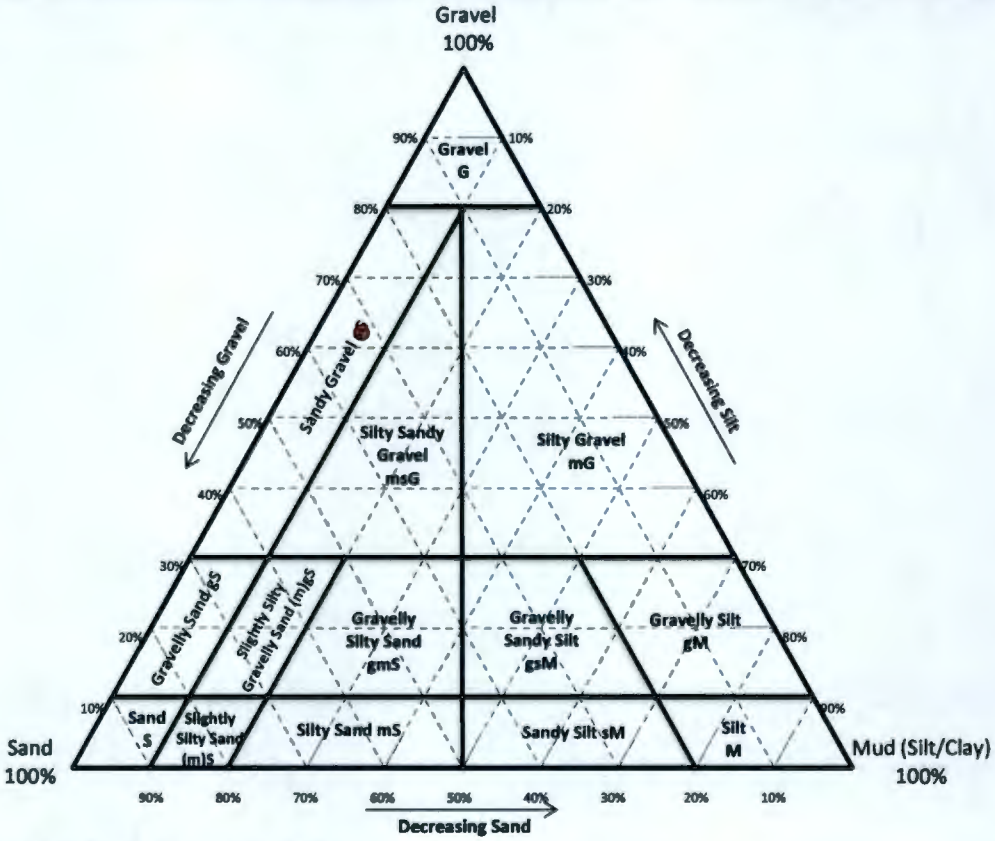
Checked By: Greg Kasza Date: 7/9/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS DATA

Date:	4/22/2014	Well Name:	199-K-220
Soil Description:	Sandy Gravel	Well ID:	C8795
Sample Number:	5	Sample Depth (ft bgs):	120-129
Sample bowl (g):	746.8	Final Variance (grams):	1.6
Sample bowl+dry sample (g):	1920.2	Sample bowl + wash/dry sample (g):	1876.9
Dry sample weight (g):	1173.4	Wash/dry sample weight (g):	1130.1

Sieve No.	Sieve Opening	Sieve Weight (g)	Sieve + Soil Weight (g)	Weight of Soil Retained (g)	Percent Retained	Cumulative Weight Retained (g)	Cumulative Percent Retained	Percent Finer
--	2.0 IN	470.0	470.0	0.0	0.0%	0.0	0.0%	100.0
--	1.5 IN	491.3	491.3	0.0	0.0%	0.0	0.0%	100.0
--	0.75 IN	497.5	650.3	152.8	13.0%	152.8	13.0%	87.0
--	0.375 IN	489.9	786.4	296.5	25.3%	449.3	38.3%	61.7
4	4.75 mm	463.4	644.9	181.5	15.5%	630.8	53.8%	46.2
10	2.00 mm	489.1	588.9	99.8	8.5%	730.6	62.3%	37.7
20	0.85 mm	380.2	442.8	62.6	5.3%	793.2	67.6%	32.4
40	0.425 mm	335.8	406.2	70.4	6.0%	863.6	73.6%	26.4
60	0.25 mm	320.8	459.0	138.2	11.8%	1001.8	85.4%	14.6
100	0.15 mm	308.4	358.9	50.5	4.3%	1052.3	89.7%	10.3
200	0.075 mm	328.3	382.4	54.1	4.6%	1106.4	94.3%	5.7
PAN	--	370.4	395.7	25.3 43.3	5.8%	1175.0	100.1%	0.0



If percentages are borderline, use the coarser classification.
i.e. 90% sand, 10% silt equals sand, not slightly silty sand or 60% gravel, 30% sand, and 10% silt equals sandy gravel, not silty sandy gravel

Comments:

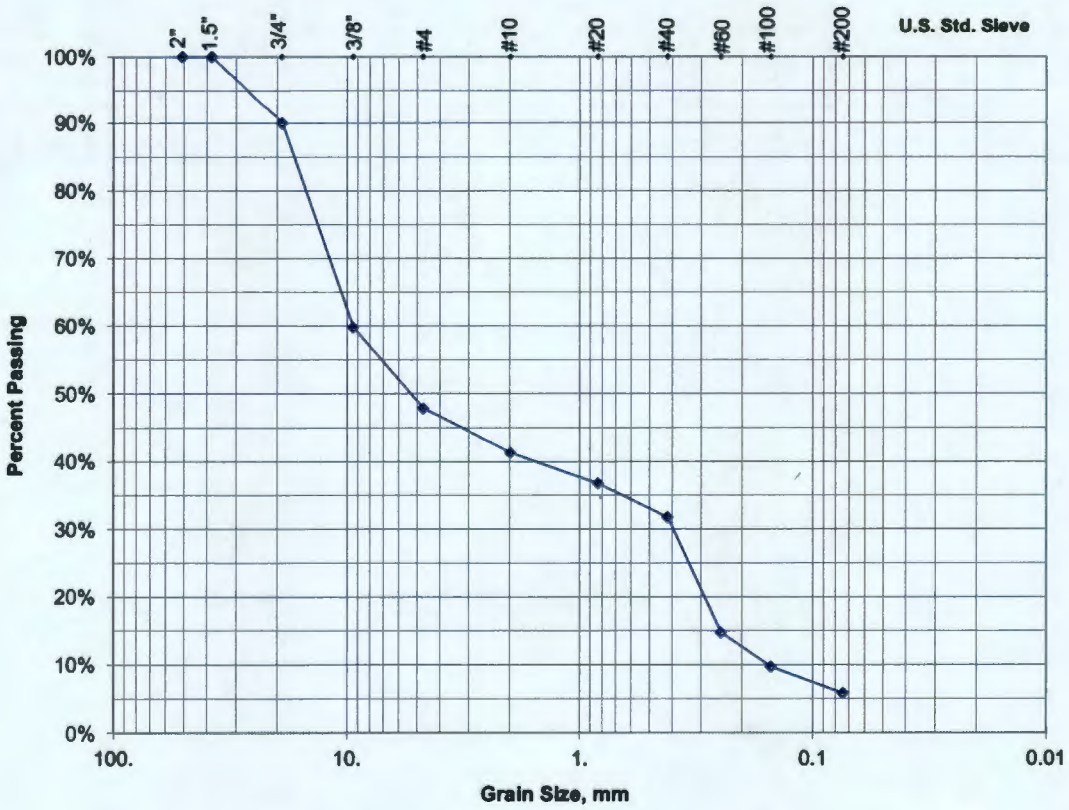
FREESTONE ENVIRONMENTAL SERVICES, INC.

Checked By: Greg Kasza Date: 7/9/2014 **Office Phone:** (509) 943-5222

SIEVE ANALYSIS

WELL NAME	199-K-220	SAMPLE DEPTH	130-139	SAMPLE#	6	WELL ID#	C8795
TESTED BY	Janine Carter	CONTACT	Freestone Env.	PHONE	943-5222	DATE	04/22/2014

SAMPLE WEIGHT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	GRAIN SIZE (mm)	COMMENTS
940.20	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	94.3	10.0	90.0	19.05	
	3/8"	378.3	40.2	59.8	9.42	
	#4	490.6	52.2	47.8	4.70	
	#10	552.3	58.7	41.3	1.98	
	#20	594.5	63.2	36.8	0.83	
	#40	642.0	68.3	31.7	0.42	
	#60	802.3	85.3	14.7	0.25	
	#100	849.4	90.3	9.7	0.150	
	#200	886.0	94.2	5.8	0.074	



Soil Description	**58.7% Gravel**	**35.5% Sand**	**5.8% Silt**
	10.0% Coarse-V Coarse Pebble	9.5% Coarse-V Coarse	
	30.2% Medium Pebble	17.0% Medium	
	18.5% Fine-V Fine Pebble	8.9% Fine-V Fine	

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

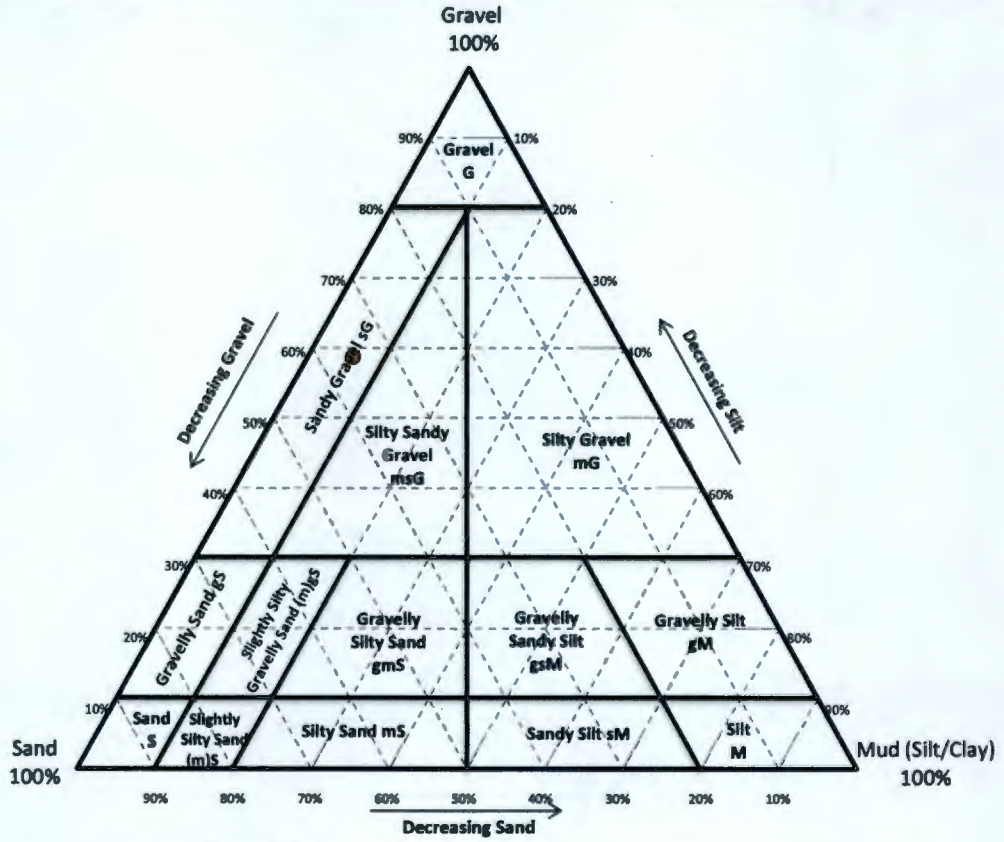
Checked By: Greg Kasza Date: 7/9/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS DATA

Date:	4/22/2014	Well Name:	199-K-220
Soil Description:	Sandy Gravel	Well ID:	C8795
Sample Number:	6	Sample Depth (ft bgs):	130-139
Sample bowl (g):	754.9	Final Variance (grams):	0.0
Sample bowl+dry sample (g):	1695.1	Sample bowl + wash/dry sample (g):	1673.0
Dry sample weight (g):	940.2	Wash/dry sample weight (g):	918.1

Sieve No.	Sieve Opening	Sieve Weight (g)	Sieve + Soil Weight (g)	Weight of Soil Retained (g)	Percent Retained	Cumulative Weight Retained (g)	Cumulative Percent Retained	Percent Finer
–	2.0 IN	470.0	470.0	0.0	0.0%	0.0	0.0%	100.0
–	1.5 IN	491.3	491.3	0.0	0.0%	0.0	0.0%	100.0
–	0.75 IN	497.6	591.9	94.3	10.0%	94.3	10.0%	90.0
–	0.375 IN	490.1	774.1	284.0	30.2%	378.3	40.2%	59.8
4	4.75 mm	463.6	575.9	112.3	11.9%	490.6	52.2%	47.8
10	2.00 mm	489.3	551.0	61.7	6.6%	552.3	58.7%	41.3
20	0.85 mm	380.5	422.7	42.2	4.5%	594.5	63.2%	36.8
40	0.425 mm	336.1	383.6	47.5	5.1%	642.0	68.3%	31.7
60	0.25 mm	321.1	481.4	160.3	17.0%	802.3	85.3%	14.7
100	0.15 mm	308.8	355.9	47.1	5.0%	849.4	90.3%	9.7
200	0.075 mm	328.5	365.1	36.6	3.9%	886.0	94.2%	5.8
PAN	–	370.6	402.7	32.1 22.1	5.8%	940.2	100.0%	0.0



If percentages are borderline, use the coarser classification.
i.e. 90% sand, 10% silt equals sand, not slightly silty sand or 60% gravel, 30% sand, and 10% silt equals sandy gravel, not silty sandy gravel

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

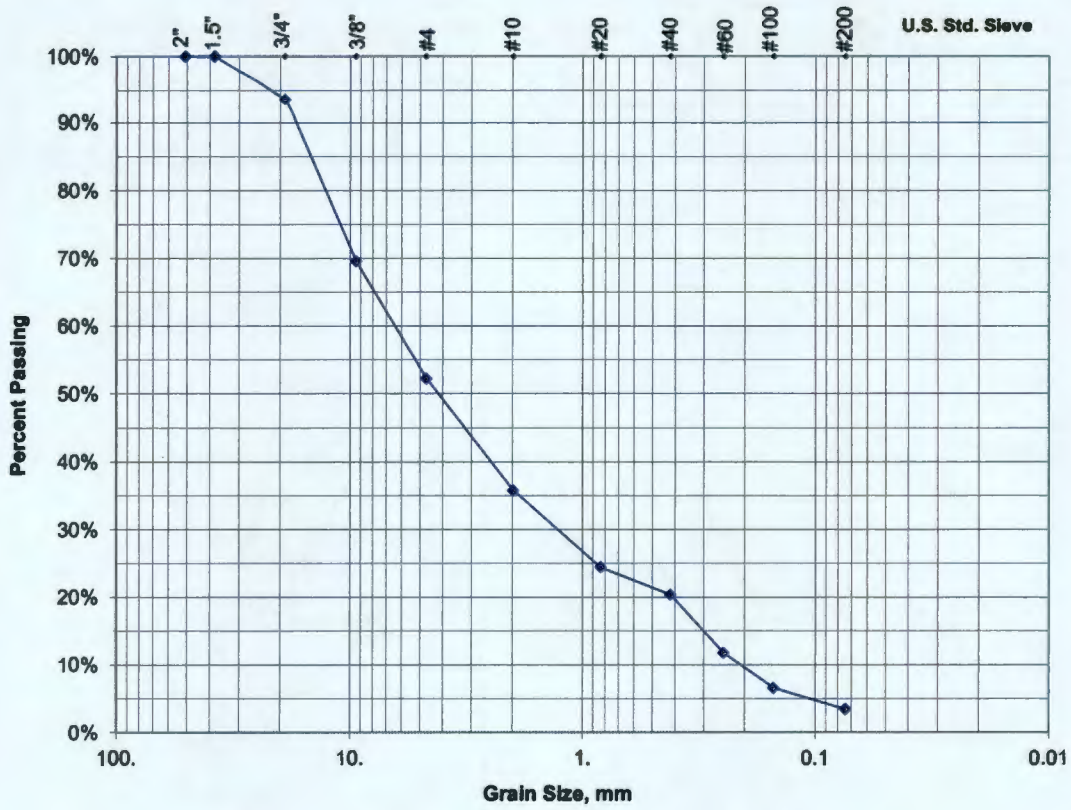
Checked By: Greg Kasza Date: 7/9/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS

WELL NAME	199-K-220	SAMPLE DEPTH	140-149	SAMPLE#	7	WELL ID#	C8795
TESTED BY	Janine Carter	CONTACT	Freestone Env.	PHONE	943-5222	DATE	04/22/2014

SAMPLE WEIGHT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	GRAIN SIZE (mm)	COMMENTS
815.10	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	51.6	6.3	93.7	19.05	
	3/8"	248.2	30.5	69.5	9.42	
	#4	389.4	47.8	52.2	4.70	
	#10	523.8	64.3	35.7	1.98	
	#20	616.1	75.6	24.4	0.83	
	#40	649.3	79.7	20.3	0.42	
	#60	719.5	88.3	11.7	0.25	
	#100	761.7	93.4	6.6	0.150	
	#200	787.3	96.6	3.4	0.074	



Soil Description	64.3% Gravel	32.3% Sand	3.5% Silt
	6.3% Coarse-V Coarse Pebble	15.4% Coarse-V Coarse	
	24.1% Medium Pebble	8.6% Medium	
	33.8% Fine-V Fine Pebble	8.3% Fine-V Fine	

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

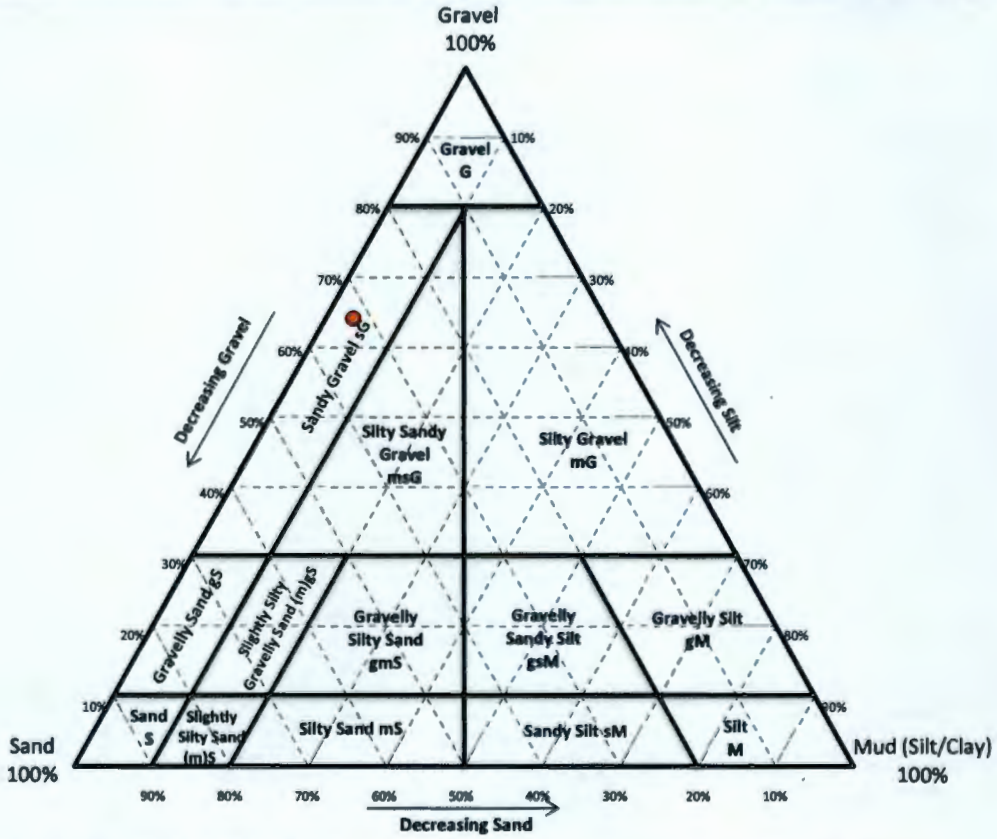
Checked By: Greg Kasza Date: 7/9/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS DATA

Date:	4/22/2014	Well Name:	199-K-220
Soil Description:	Sandy Gravel	Well ID:	C8795
Sample Number:	7	Sample Depth (ft bgs):	140-149
Sample bowl (g):	767.6	Final Variance (grams):	0.9
Sample bowl+dry sample (g):	1582.7	Sample bowl + wash/dry sample (g):	1579.7
Dry sample weight (g):	815.1	Wash/dry sample weight (g):	812.1

Sieve No.	Sieve Opening	Sieve Weight (g)	Sieve + Soil Weight (g)	Weight of Soil Retained (g)	Percent Retained	Cumulative Weight Retained (g)	Cumulative Percent Retained	Percent Finer
–	2.0 IN	470.0	470.0	0.0	0.0%	0.0	0.0%	100.0
–	1.5 IN	491.3	491.3	0.0	0.0%	0.0	0.0%	100.0
–	0.75 IN	497.6	549.2	51.6	6.3%	51.6	6.3%	93.7
–	0.375 IN	490.1	686.7	196.6	24.1%	248.2	30.5%	69.5
4	4.75 mm	463.6	604.8	141.2	17.3%	389.4	47.8%	52.2
10	2.00 mm	489.3	623.7	134.4	16.5%	523.8	64.3%	35.7
20	0.85 mm	380.5	472.8	92.3	11.3%	616.1	75.6%	24.4
40	0.425 mm	336.2	369.4	33.2	4.1%	649.3	79.7%	20.3
60	0.25 mm	321.1	391.3	70.2	8.6%	719.5	88.3%	11.7
100	0.15 mm	308.8	351.0	42.2	5.2%	761.7	93.4%	6.6
200	0.075 mm	328.5	354.1	25.6	3.1%	787.3	96.6%	3.4
PAN	–	370.6	396.3	25.7 3.0	3.5%	816.0	100.1%	0.0



If percentages are borderline, use the coarser classification.
i.e. 90% sand, 10% silt equals sand, not slightly silty sand or 60% gravel, 30% sand, and 10% silt equals sandy gravel, not silty sandy gravel

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

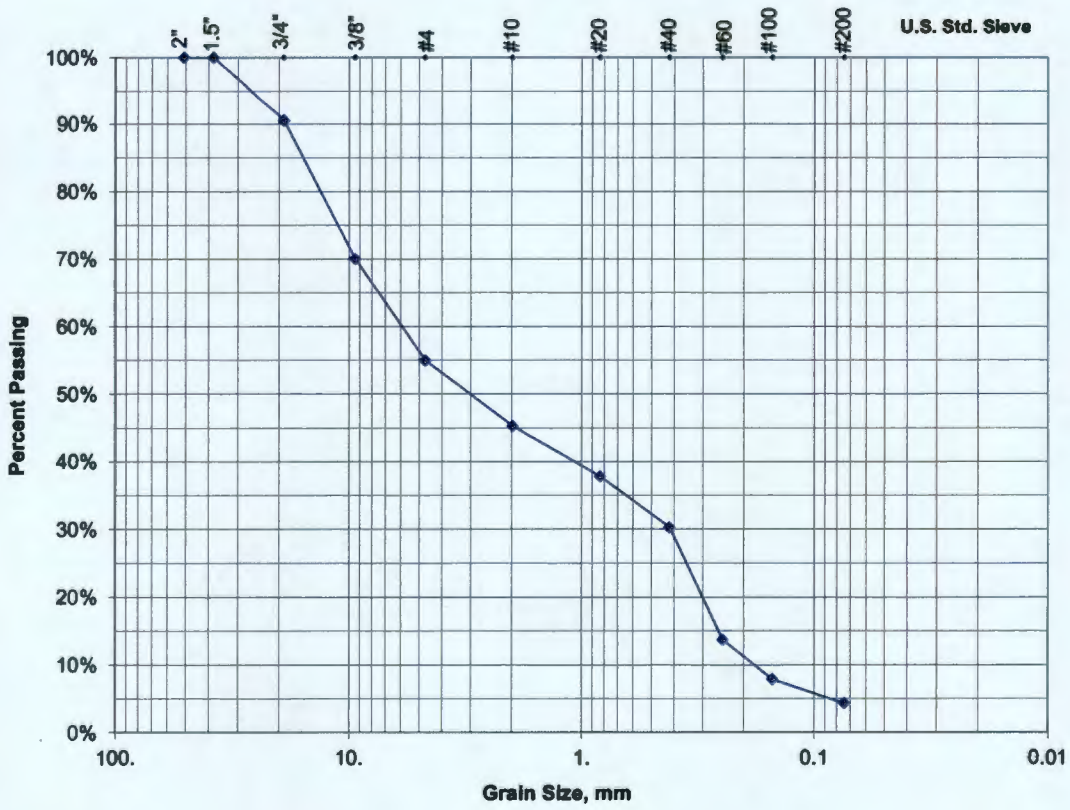
Checked By: Greg Kasza Date: 7/9/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS

WELL NAME	199-K-220	SAMPLE DEPTH	150-159	SAMPLE#	8	WELL ID#	C8795
TESTED BY	Janine Carter	CONTACT	Freestone Env.	PHONE	943-5222	DATE	04/22/2014

SAMPLE WEIGHT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	GRAIN SIZE (mm)	COMMENTS
997.60	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	94.8	9.5	90.5	19.05	
	3/8"	299.4	30.0	70.0	9.42	
	#4	449.6	45.1	54.9	4.70	
	#10	546.4	54.8	45.2	1.98	
	#20	620.6	62.2	37.8	0.83	
	#40	695.8	69.7	30.3	0.42	
	#60	861.3	86.3	13.7	0.25	
	#100	919.5	92.2	7.8	0.150	
	#200	954.9	95.7	4.3	0.074	



Soil Description	**54.8% Gravel**	**40.9% Sand**	**4.3% Silt**
	9.5% Coarse-V Coarse Pebble	15.0% Coarse-V Coarse	
	20.5% Medium Pebble	16.6% Medium	
	24.8% Fine-V Fine Pebble	9.4% Fine-V Fine	

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

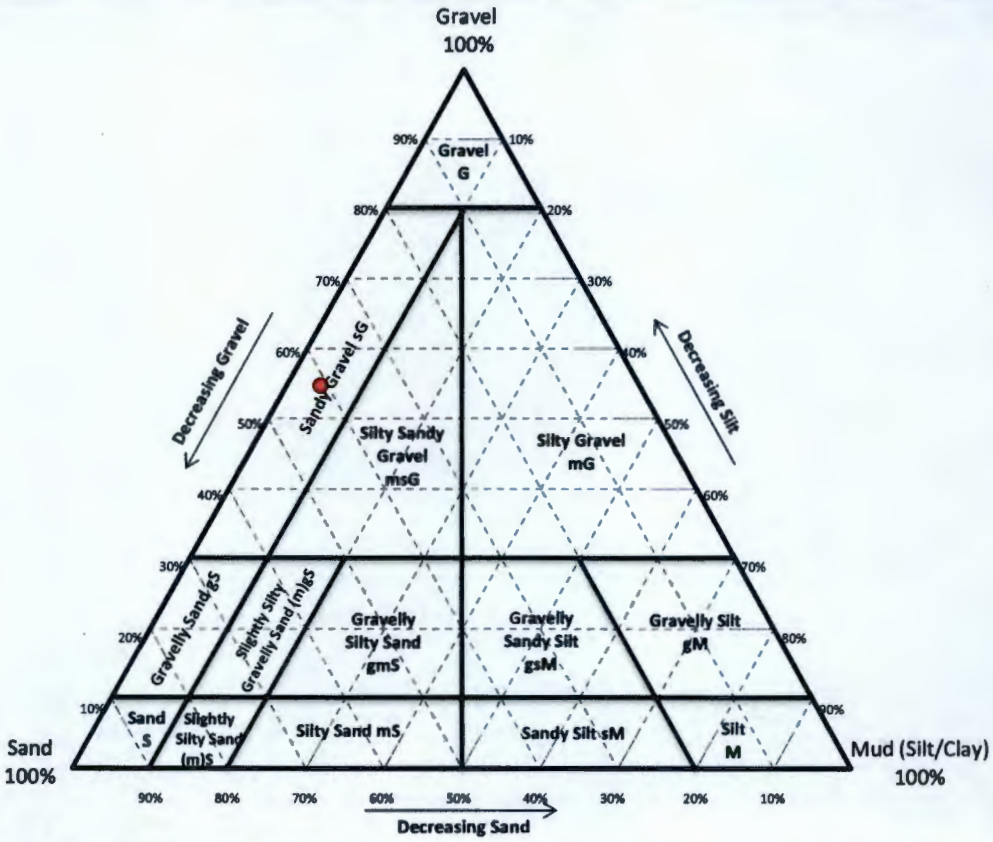
Checked By: Greg Kasza Date: 7/9/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS DATA

Date:	4/22/2014	Well Name:	199-K-220
Soil Description:	Sandy Gravel	Well ID:	C8795
Sample Number:	8	Sample Depth (ft bgs):	150-159
Sample bowl (g):	746.7	Final Variance (grams):	0.1
Sample bowl+dry sample (g):	1744.3	Sample bowl + wash/dry sample (g):	1722.7
Dry sample weight (g):	997.6	Wash/dry sample weight (g):	976.0

Sieve No.	Sieve Opening	Sieve Weight (g)	Sieve + Soil Weight (g)	Weight of Soil Retained (g)	Percent Retained	Cumulative Weight Retained (g)	Cumulative Percent Retained	Percent Finer
–	2.0 IN	470.0	470.0	0.0	0.0%	0.0	0.0%	100.0
–	1.5 IN	491.3	491.3	0.0	0.0%	0.0	0.0%	100.0
–	0.75 IN	497.7	592.5	94.8	9.5%	94.8	9.5%	90.5
–	0.375 IN	490.1	694.7	204.6	20.5%	299.4	30.0%	70.0
4	4.75 mm	463.5	613.7	150.2	15.1%	449.6	45.1%	54.9
10	2.00 mm	489.2	586.0	96.8	9.7%	546.4	54.8%	45.2
20	0.85 mm	380.5	454.7	74.2	7.4%	620.6	62.2%	37.8
40	0.425 mm	336.2	411.4	75.2	7.5%	695.8	69.7%	30.3
60	0.25 mm	321.1	486.6	165.5	16.6%	861.3	86.3%	13.7
100	0.15 mm	308.7	366.9	58.2	5.8%	919.5	92.2%	7.8
200	0.075 mm	328.5	363.9	35.4	3.5%	954.9	95.7%	4.3
				21.2				
PAN	–	370.6	391.8	21.6	4.3%	997.7	100.0%	0.0



If percentages are borderline, use the coarser classification.
i.e. 90% sand, 10% silt equals sand, not slightly silty sand or 60% gravel, 30% sand, and 10% silt equals sandy gravel, not silty sandy gravel

Comments:

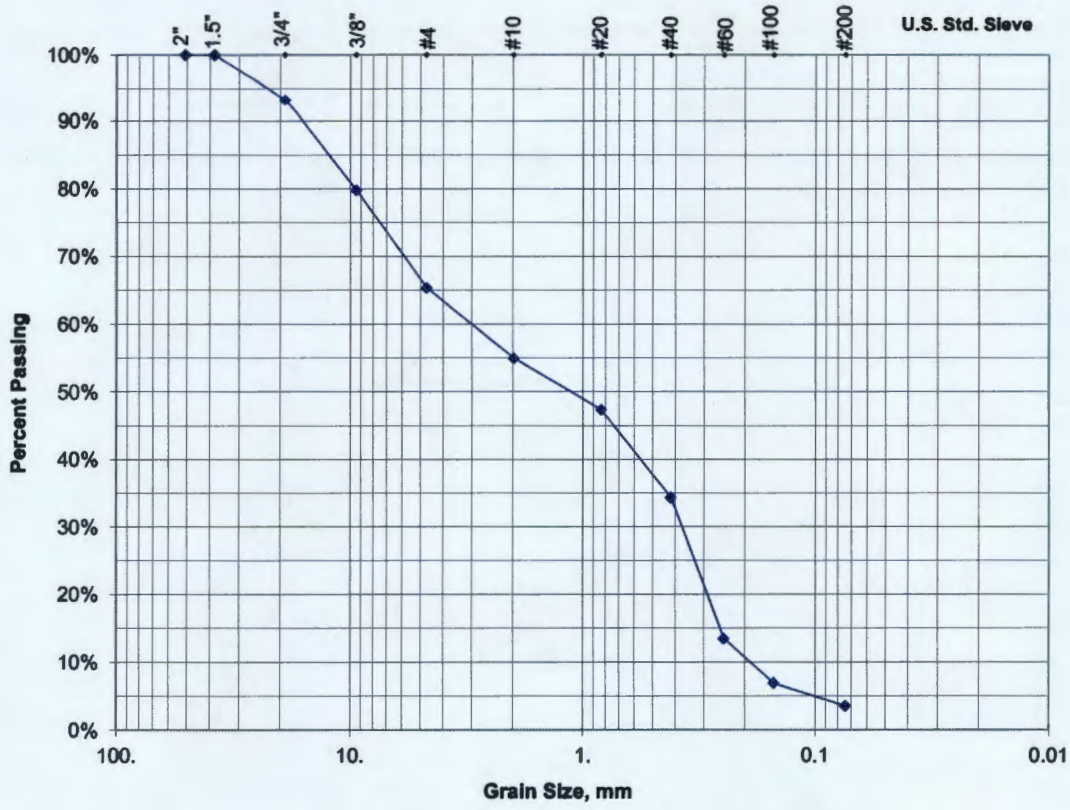
FREESTONE ENVIRONMENTAL SERVICES, INC.

Checked By: Greg Kasza Date: 7/9/2014 **Office Phone:** (509) 943-5222

SIEVE ANALYSIS

WELL NAME	199-K-220	SAMPLE DEPTH	160-165	SAMPLE#	9	WELL ID#	C8795
TESTED BY	Janine Carter	CONTACT	Freestone Env.	PHONE	943-5222	DATE	04/22/2014

SAMPLE WEIGHT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	GRAIN SIZE (mm)	COMMENTS
645.30	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	43.5	6.7	93.3	19.05	
	3/8"	130.6	20.2	79.8	9.42	
	#4	223.9	34.7	65.3	4.70	
	#10	290.9	45.1	54.9	1.98	
	#20	339.9	52.7	47.3	0.83	
	#40	423.9	65.7	34.3	0.42	
	#60	558.8	86.6	13.4	0.25	
	#100	600.9	93.1	6.9	0.150	
	#200	622.9	96.5	3.5	0.074	



Soil Description	45.1% Gravel	51.4% Sand	3.6% Silt
	6.7% Coarse-V Coarse Pebble	20.6% Coarse-V Coarse	
	13.5% Medium Pebble	20.9% Medium	
	24.8% Fine-V Fine Pebble	9.9% Fine-V Fine	

Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

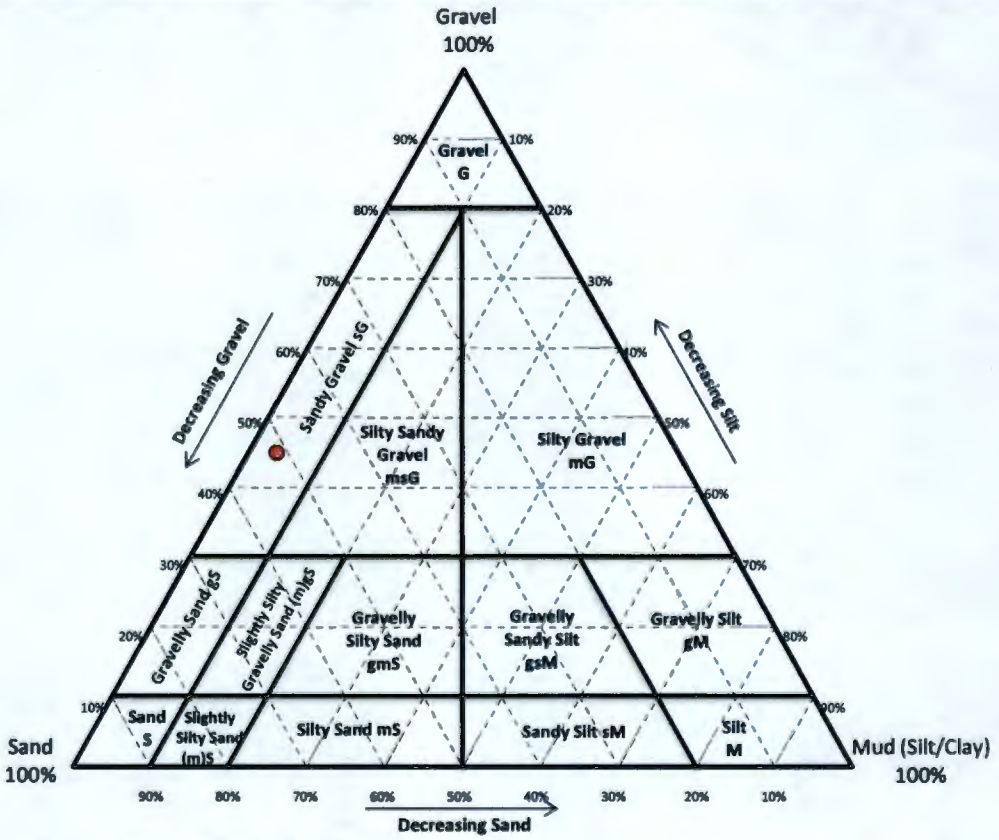
Checked By: Greg Kasza Date: 7/9/2014

Office Phone: (509) 943-5222

SIEVE ANALYSIS DATA

Date:	4/22/2014	Well Name:	199-K-220
Soil Description:	Sandy Gravel	Well ID:	C8795
Sample Number:	9	Sample Depth (ft bgs):	160-165
Sample bowl (g):	754.8	Final Variance (grams):	0.8
Sample bowl+dry sample (g):	1400.1	Sample bowl + wash/dry sample (g):	1389.6
Dry sample weight (g):	645.3	Wash/dry sample weight (g):	634.8

Sieve No.	Sieve Opening	Sieve Weight (g)	Sieve + Soil Weight (g)	Weight of Soil Retained (g)	Percent Retained	Cumulative Weight Retained (g)	Cumulative Percent Retained	Percent Finer
--	2.0 IN	470.0	470.0	0.0	0.0%	0.0	0.0%	100.0
--	1.5 IN	491.3	491.3	0.0	0.0%	0.0	0.0%	100.0
--	0.75 IN	497.7	541.2	43.5	6.7%	43.5	6.7%	93.3
--	0.375 IN	490.1	577.2	87.1	13.5%	130.6	20.2%	79.8
4	4.75 mm	463.6	556.9	93.3	14.5%	223.9	34.7%	65.3
10	2.00 mm	489.2	556.2	67.0	10.4%	290.9	45.1%	54.9
20	0.85 mm	380.5	429.5	49.0	7.6%	339.9	52.7%	47.3
40	0.425 mm	336.1	420.1	84.0	13.0%	423.9	65.7%	34.3
60	0.25 mm	321.0	455.9	134.9	20.9%	558.8	86.6%	13.4
100	0.15 mm	308.7	350.8	42.1	6.5%	600.9	93.1%	6.9
200	0.075 mm	328.4	350.4	22.0	3.4%	622.9	96.5%	3.5
PAN	--	370.5	383.2	12.7 10.5	3.6%	646.1	100.1%	0.0



If percentages are borderline, use the coarser classification.
i.e. 90% sand, 10% silt equals sand, not slightly silty sand or 60% gravel, 30% sand, and 10% silt equals sandy gravel, not silty sandy gravel

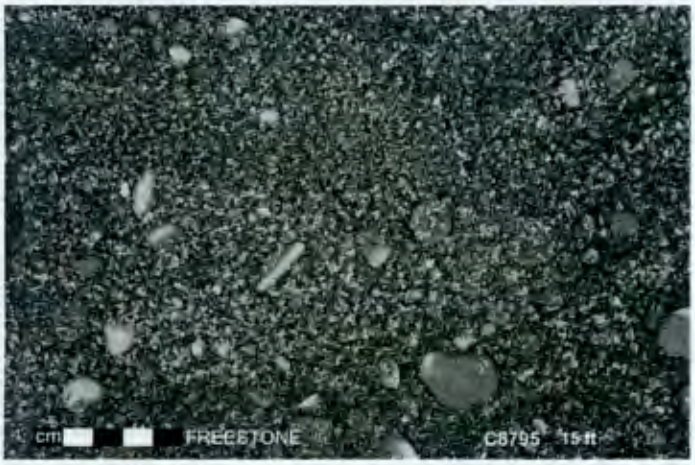
Comments:

FREESTONE ENVIRONMENTAL SERVICES, INC.

Checked By: Greg Kasza Date: 7/9/2014 **Office Phone:** (509) 943-5222

cm
FREESTONE
C8795 5 ft

cm
FREESTONE
C8795 10 ft


cm
FREESTONE
C8795 15 ft

cm
FREESTONE
C8795 20 ft

cm
C8795 25 ft

cm
FREESTONE
C8795 30 ft

cm
FREESTONE
C8795 35 ft

cm
FREESTONE
C8795 40 ft

cm
FREESTONE
C8795 45 ft

cm
FREESTONE
C8795 50 ft

cm
FREESTONE
C8795 55 ft

cm
FREESTONE
C8795 60 ft

cm
FREESTONE
C8795 65 ft

cm
FREESTONE
C8795 70 ft

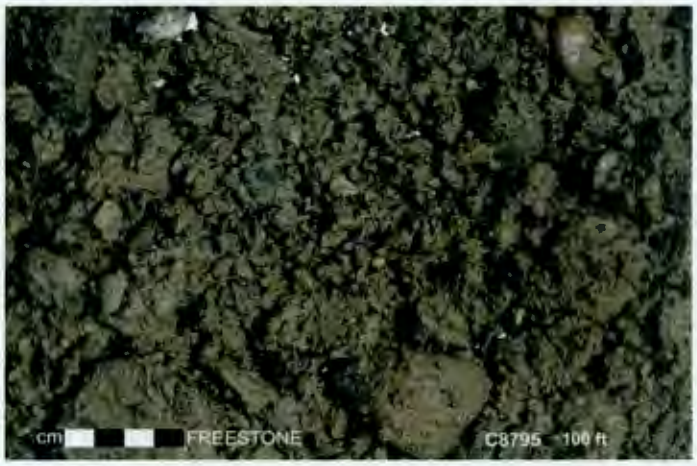
cm
FREESTONE
C8795 75 ft

cm
FREESTONE
C8795 80 ft

cm
FREESTONE
C8795 85 ft

cm
FREESTONE
C8795 90 ft

cm
FREESTONE
C8795 95 ft


cm
FREESTONE
C8795 100 ft

cm
FREESTONE
C8795 105 ft

cm
FREESTONE
C8795 110 ft

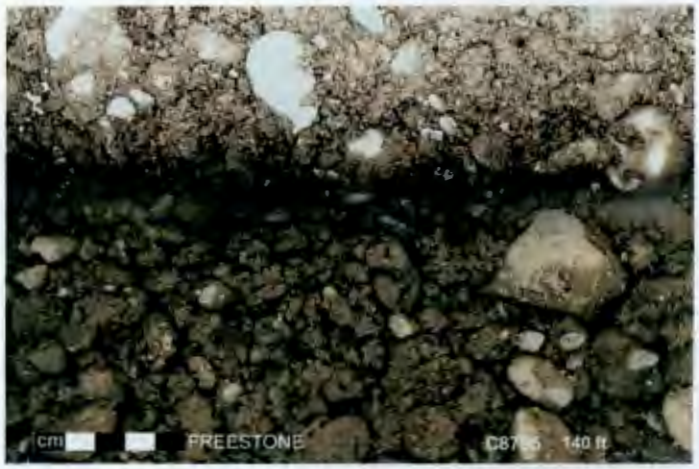
cm
FREESTONE
C8795 115 ft

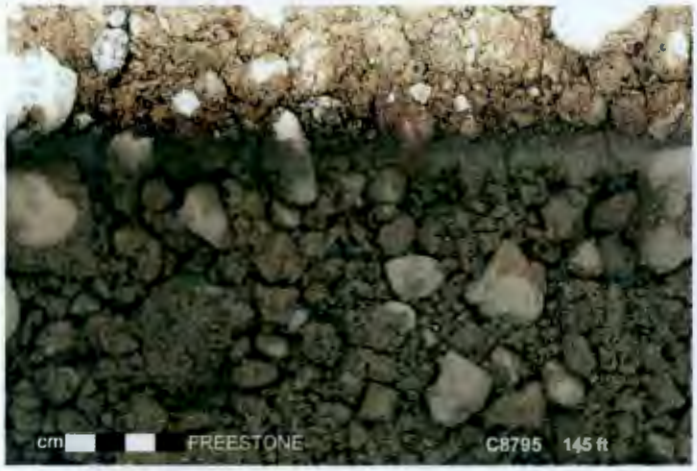
cm
FREESTONE
C8795 120 ft

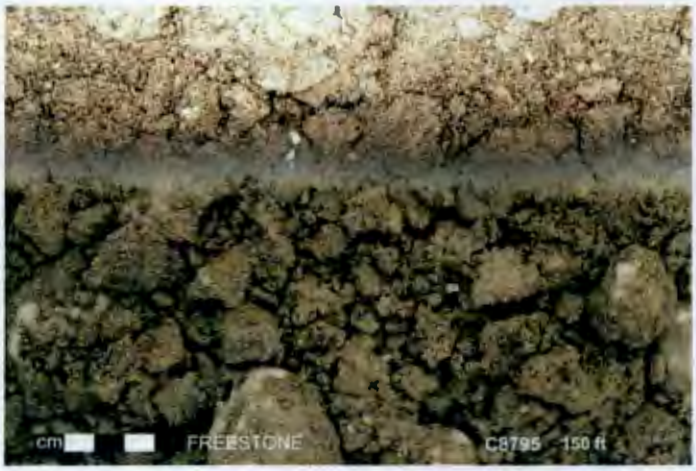
cm
FREESTONE
C8795 125 ft

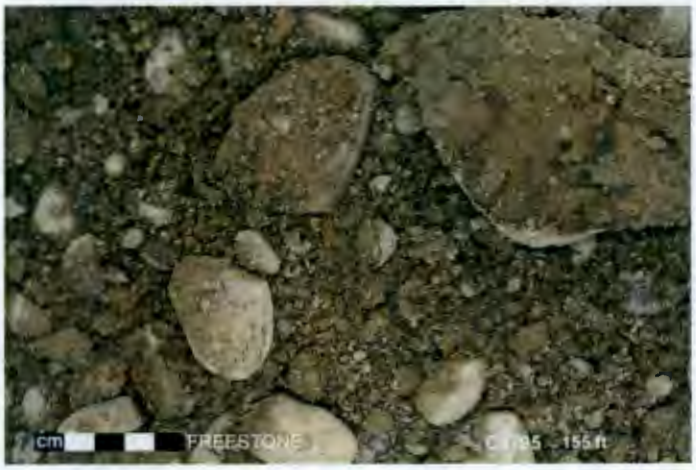
cm
FREESTONE
C8795 130 ft

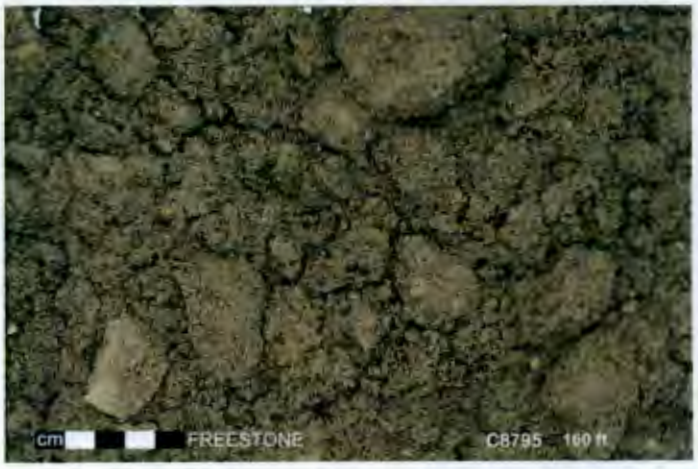
cm
FREESTONE
C8795 135 ft


cm
FREESTONE
140 ft


cm
FREESTONE
C8795 145 ft


cm
FREESTONE
C8795 150 ft


cm
FREESTONE


cm
FREESTONE
C8795 160 ft

cm
FREESTONE
C8795 165 ft

cm
FREESTONE
C8795 170 ft

SURVEY DATA REPORT				Request No. 143-083
Project No.	Title KR-4 Well C8795 (199-K-220) Final Survey			File No. 1KT13R26
Job. No. CACN: 303067-DP20	Prepared By N.P. Fastabend	Date 6/24/14	Reviewer CBM	

DESCRIPTION OF WORK	DISTRIBUTION	SDR	PLOT	DWG
Obtained final coordinates (C/L Casing) and elevations of completed KR-4 Well C8795 (199-K-220) inside 100K Area.	Survey File	OR		
	S.E. Imhoff	1		
	S.J. Trent	1		
	K.M. Whitley	1		
	J.B. Geiger	1		
	B.J. Howard	1		
Horizontal Coordinate System: WCS83S/91 (Meters) Vertical Datum: NAVD88 (Meters)	A.J. Green	1		

SURVEY RESULTS AND COMMENTS

See Attached Well Survey Data Report Sheet

WELL SURVEY DATA REPORT

Project:	Prepared By: Neil P. Fastabend Company: CHPRC
Date Requested: 06/10/14	Requestor: Steve Imhoff (CHPRC)
Date of Survey: 06/19/14	Surveyor: Lawrence B. Munnell (CHPRC)
Fluor Hanford Point of Contact:	Survey Co. Point of Contact: Neil P. Fastabend
Description of Work: Obtain final survey coordinates (C/L Casing) and elevations of Well C8795 (199-K-220) in 100K Area.	Horizontal Datum: NAD83(91) Vertical Datum: NAVD88 Units: Meters Hanford Area Designation: 100K

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
Washington State Reference Network

Vertical Control Monuments:
100K-1 (CHPRC) and HSWB-045 (COE)

Well ID	Well Name	Easting	Northing	Elevation	
C8795	199-K-220	569356.25	146417.52		Center of Casing
				146.077·	"X" on Rim
				145.357·	Brass Survey Marker

Notes:

145.795· Top Inner Casing, North Edge

Elevation on Brass Survey Marker was measured to Top Domed Brass Cap in concrete.

Equipment Used: Trimble R8 RTK GPS
Trimble DiNi 12 Level

Surveyor Statement:

I, Lawrence B. Munnell, a Professional Land Surveyor registered in the State of Washington (Registration No. 16216), hereby certify this report is based on a field survey performed by me, or under my direct supervision.

LAWRENCE B. MUNNELL
STATE OF WASHINGTON
16216
REGISTERED
PROFESSIONAL LAND SURVEYOR

6-25-14

A-6003-659 (04/03)

199-K-220 (C8795)
Log Data Report

Borehole Information:

Log Date:	2014-04-22	Filename:	C8795_HG-NM_2014-04-22	Site:	100-K
Coordinates (WA St Plane)		DTW[1] (ft):	79.7	DTW Date:	04/21/14
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	04/21/14	N/A	171.3	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.) Outer	Diameter (in.) Inside	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	1.0	13 1/2	12 1/2	0.5	1.0	69.7
Threaded Steel	0.6	11 3/4	10 5/8	0.5625	0.6	165.3

Borehole Notes:

The buyer's technical representative provided the total depth and casing depth. The logging engineer measured casing stick-up and casing diameter (rounded to the nearest 1/16-in.). The maximum logging depth achieved was 168 ft, approximately 3 ft below maximum casing depth.

Zero reference is ground surface.

Logging Equipment Information:

Logging System:	Gamma 1L	Type:	60% HPGe SGLS[3]
Effective Calibration Date:	11/11/13	Serial No.:	45-TP32211A
Calibration Reference:	HGLP-CC-096, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

Logging System:	Gamma 1H	Type:	NMLS[4]
Effective Calibration Date:	11/11/13	Serial No.:	H310700352
Calibration Reference:	HGLP-CC-097, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

SGLS Log Run Information:

Log Run	3	4 Repeat	7	8 Repeat	
HEIS Number	1015999	1018368	1018369	1018370	
Date	04/03/14	04/03/14	04/22/14	04/22/14	
Logging Engineer	Pope	Pope	Pope	Pope	
Start Depth (ft)	0.0	60.0	68.0	168.0	
Finish Depth (ft)	70.0	53.0	168.0	158.0	
Count Time (sec)	100	100	100	100	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	

[1] depth to water inside casing
[2] top of casing
[3] Spectral Gamma Logging System
[4] Neutron Moisture Logging System

Log Run	3	4 Repeat	7	8 Repeat	
MSA Interval (ft)	1.0	1.0	1.0	1.0	
Log Speed (ft/min)	N/A	N/A	N/A	N/A	
Pre-Verification	AL188CAB	AL188CAB	AL190CAB	AL190CAB	
Start File	AL188000	AL188071	AL190000	AL190101	
Finish File	AL188070	AL188078	AL190100	AL190109	
Post-Verification	AL188CAA	AL188CAA	AL190CAA	AL190CAA	
Depth Return Error (in.)	N/A	1.0 high	N/A	1.5 low	
Comments	Fine gain adjustment prior to file -060	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	

NMLS Log Run Information:

Log Run	1	2 Repeat	5	6 Repeat	
HEIS Number	1018371	1018372	1018373	1018374	
Date	04/02/14	04/02/14	04/22/14	04/22/14	
Logging Engineer	Pope	Pope	Pope	Pope	
Start Depth (ft)	0.0	20.0	68.0	79.0	
Finish Depth (ft)	70.0	27.0	79.75	77.0	
Count Time (sec)	15	15	15	15	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	0.25	0.25	0.25	0.25	
Log Speed (ft/min)	N/A	N/A	N/A	N/A	
Pre-Verification	AH153CAB	AH153CAB	AH155CAB	AH155CAB	
Start File	AH153000	AH153281	AH155000	AH155048	
Finish File	AH153280	AH153309	AH155047	AH155056	
Post-Verification	AH153CAA	AH153CAA	AH155CAA	AH155CAA	
Depth Return Error (in.)	N/A	1.0 high	N/A	0.5 low	
Comments	None	None	None	None	

Logging Operation Notes:

A centralizer was installed on the sondes.

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

Analysis Notes:

Analyst:	P.D. Henwood	Date:	05/19/14	Reference:	HGLP-MAN-003, Rev. 0

Casing corrections for a 0.5-in. thick casing from 0 to 70 ft and for a 0.5625-in. thick casing from 71 to 168 ft were applied to the log data. For the depth overlap from 68 to 69 ft (log run 2) a correction for a 1.0625-in. thick casing was applied. No correction was applied from 166 to 168 ft where no casing existed.

A correction for water inside the casing was applied below 79 ft in depth.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in EXCEL template identified as 1L20131111, using an efficiency function and corrections for casing and dead time as determined by annual calibration.

NMLS data are represented in counts per second because no calibration data exist for 10 5/8 or 12 1/2-in. inner diameter casings.

The HGU[5] is an empirical unit of gamma activity proposed as a means to standardize gamma log response across multiple logging systems with different response characteristics. The HGU is defined in terms of measurements in the Hanford Borehole Calibration Facility, and the magnitude is selected such that 1 HGU is approximately equivalent to typical Hanford background activity, based on data from background samples as reported in *Hanford Site Background: Part 2, Soil Background for Radionuclides* (DOE/RL-96-12).

Results and Interpretations:

No manmade radionuclides were detected. Although not detected, the MDLs for Cs-137 and Pu-239 are plotted on the Manmade Radionuclide plot.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content. The count rate increase below 70 ft is the result of a casing change and is not the result of a general increase in moisture content.

The KUT and moisture repeat plots indicate that the respective systems were working properly.

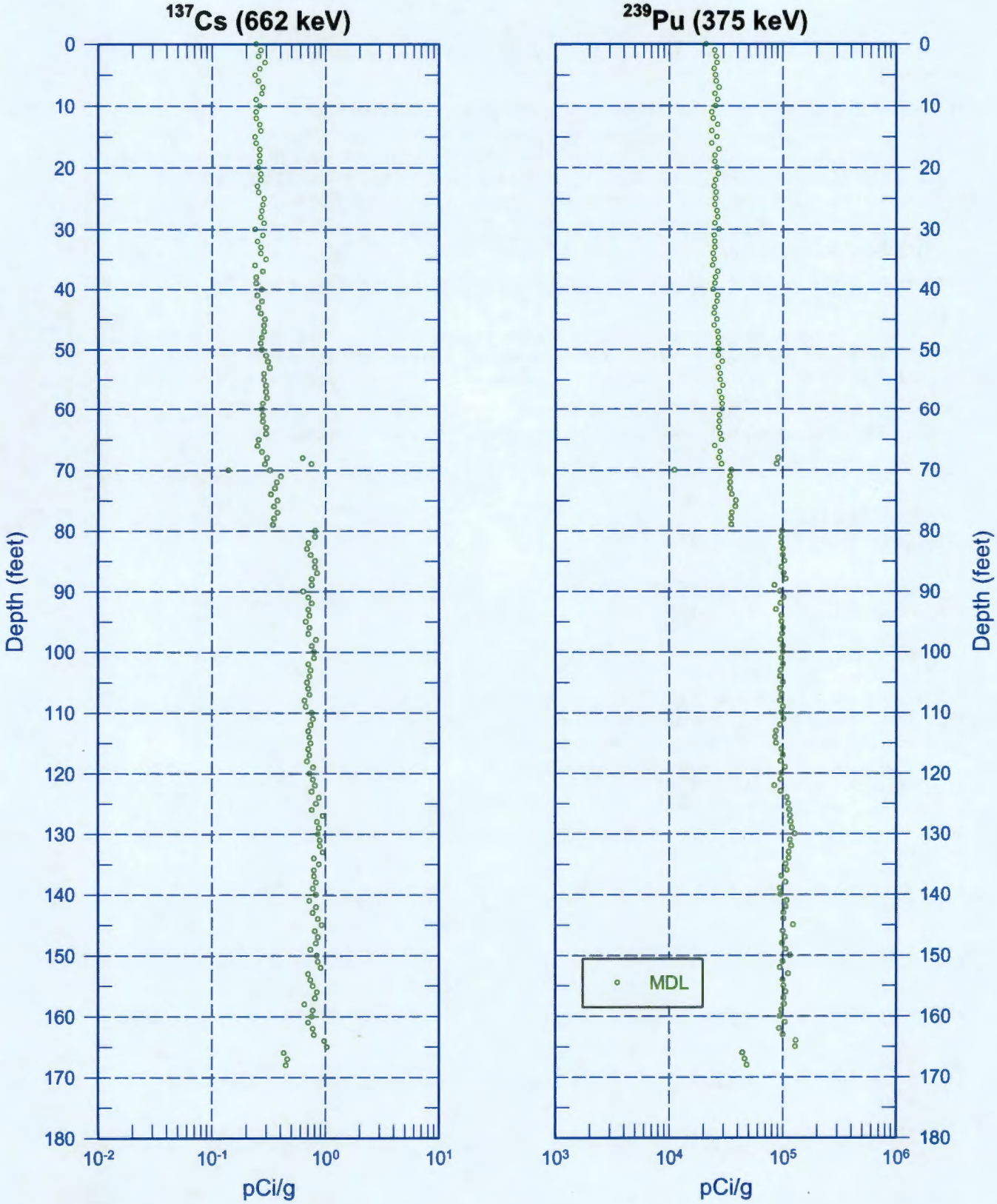
List of Log Plots:

Depth Reference is ground surface.

Manmade Radionuclides (0 - 180 ft)
Natural Gamma Logs (0 - 180 ft)
Combination Plot (0 - 120 ft)
Combination Plot (110 - 230 ft)
Combination Plot (0 - 180 ft)
Total Gamma & Moisture (0 - 180 ft)
Total Gamma & Hanford Gamma Unit (0 - 180 ft)
Repeat Section of Natural Gamma Logs (53 - 60 ft)
Repeat Section of Natural Gamma Logs (158 - 168 ft)
Moisture Repeat Section (20 - 27 ft)
Moisture Repeat Section (77 - 79 ft)

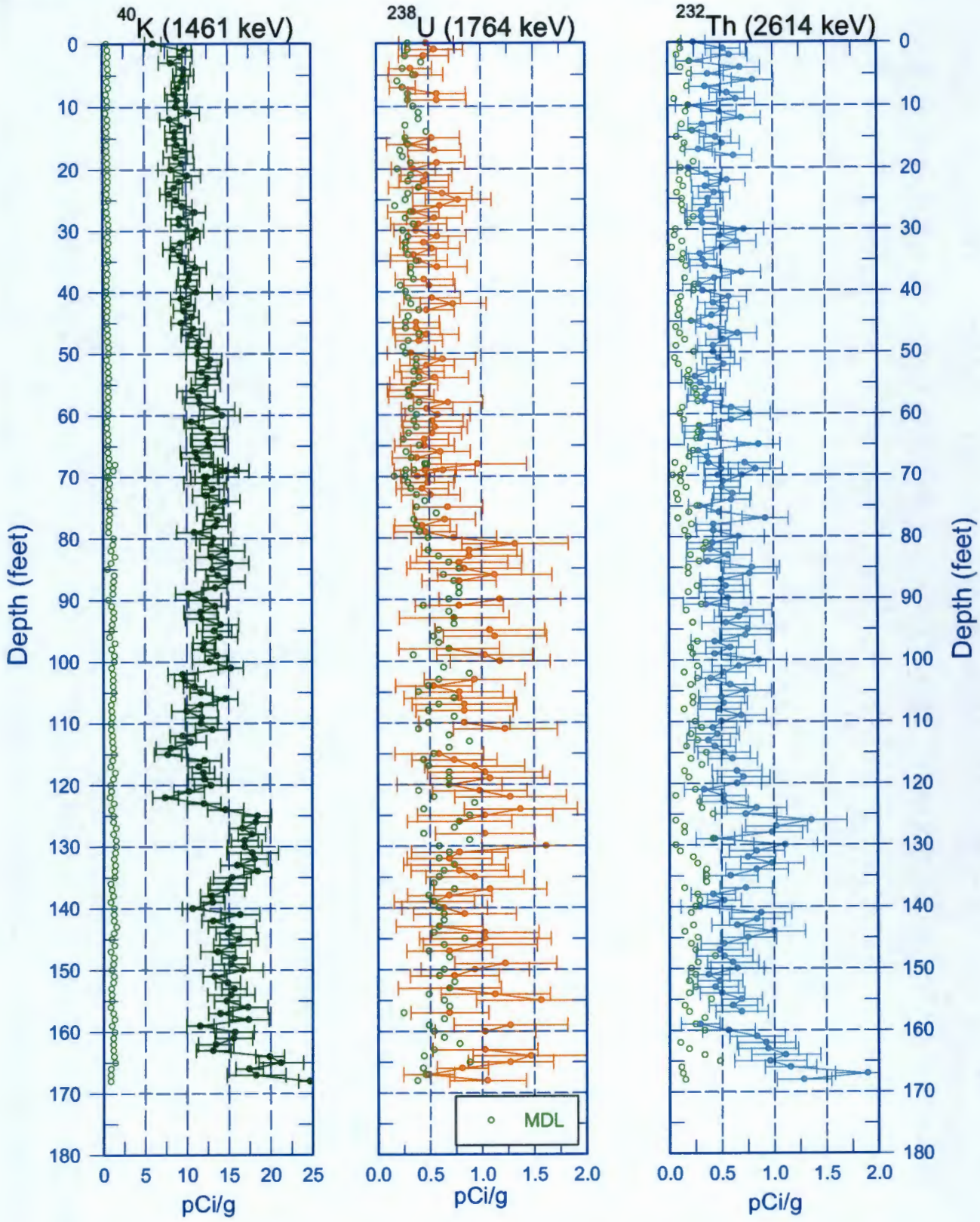
[5] Hanford Gamma Unit

199-K-220 (C8795)
Manmade Radionuclides



Zero Reference - Ground Surface

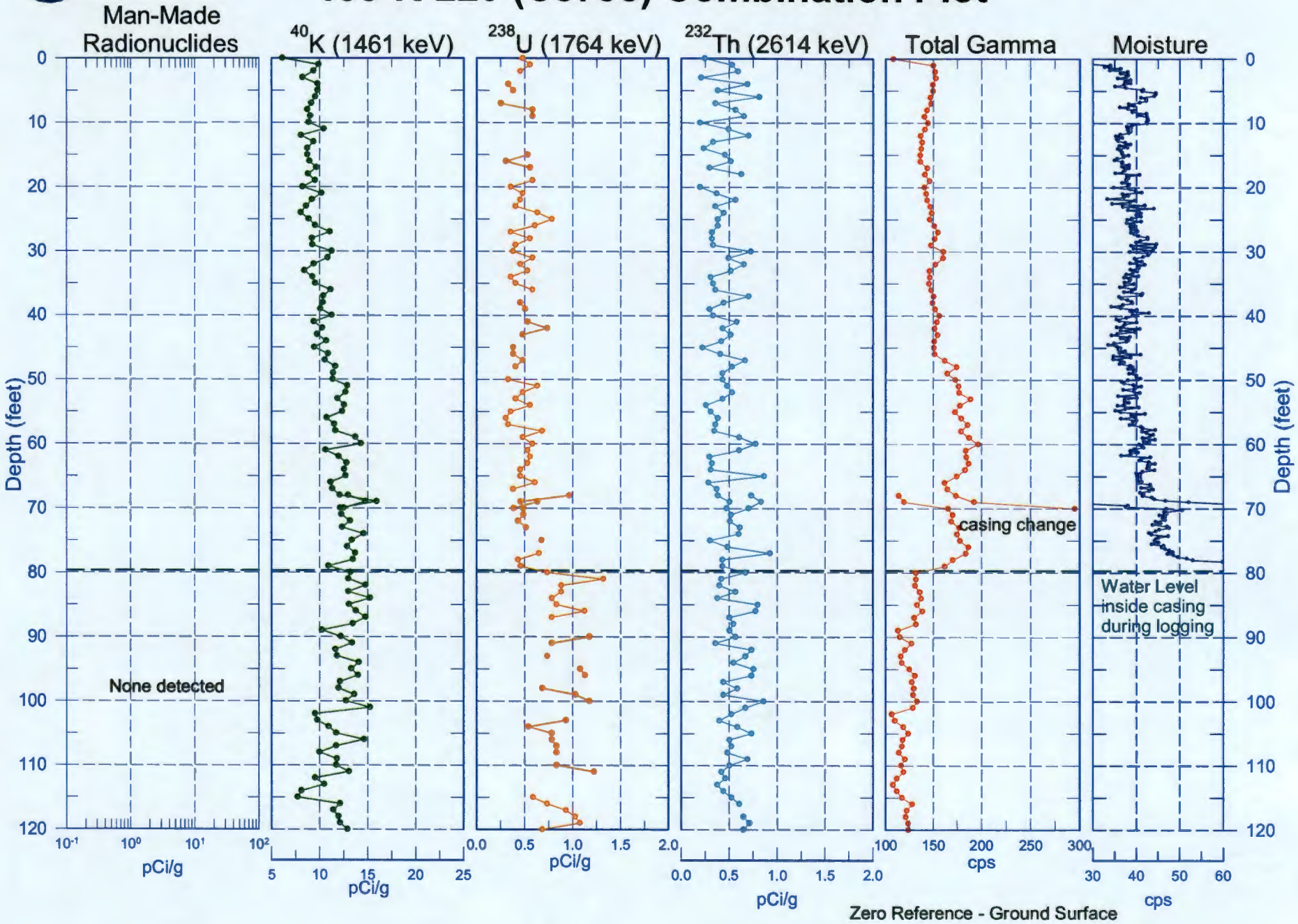
199-K-220 (C8795)
Natural Gamma Logs



Zero Reference - Ground Surface

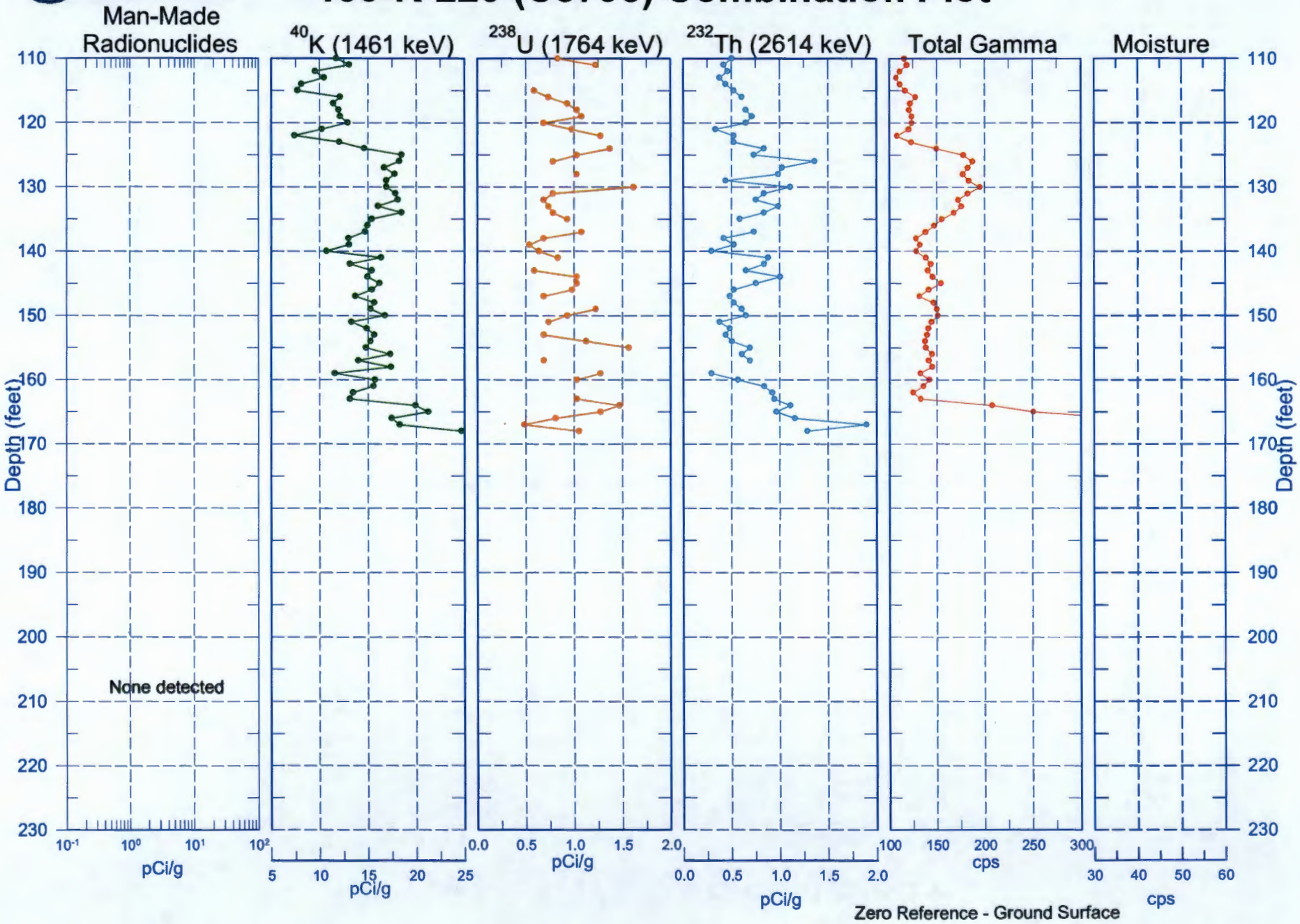
Stoller
A Subsidiary of Huntington Ingalls Industries

199-K-220 (C8795) Combination Plot



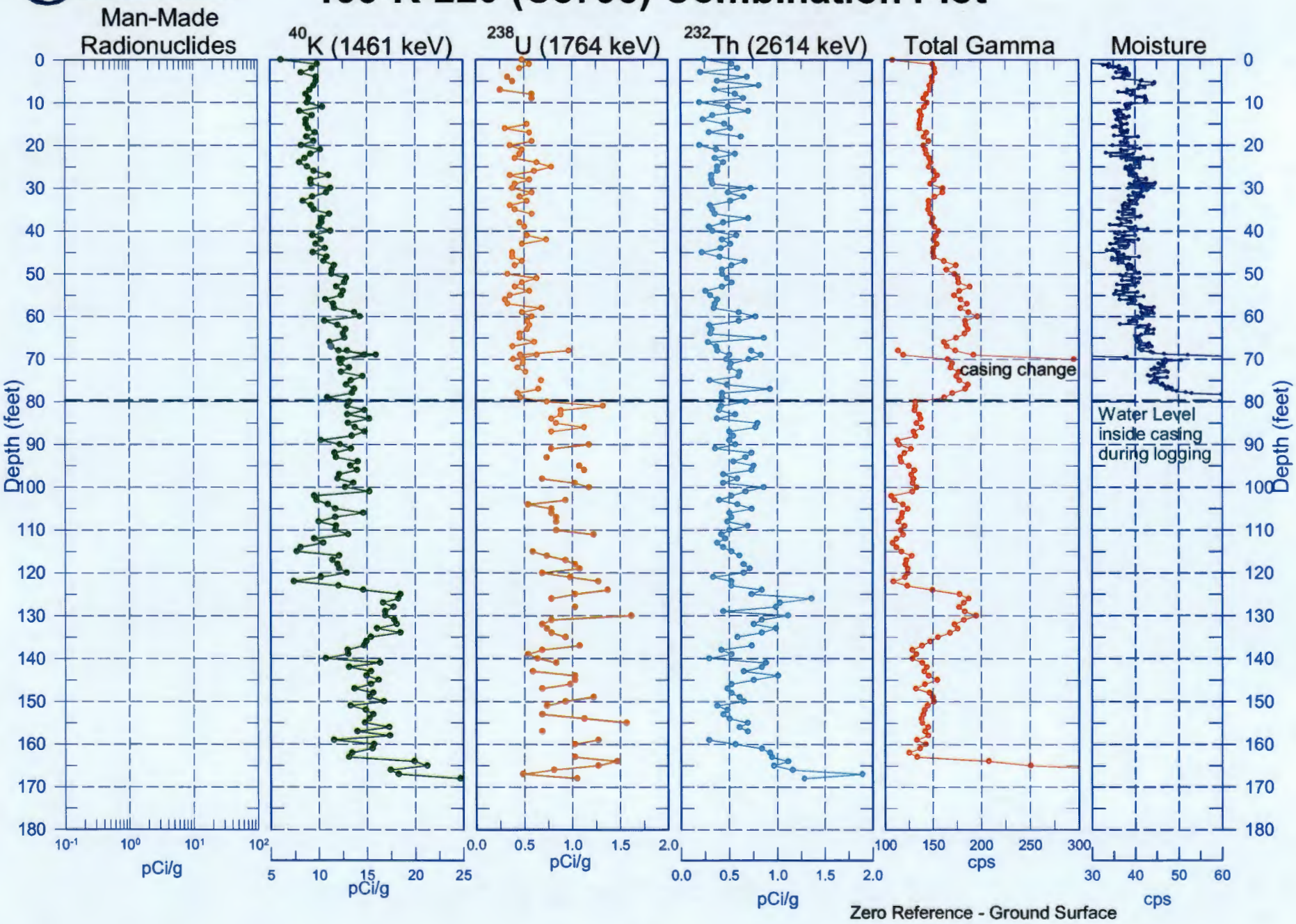
Stoller
A Subsidiary of Huntington Ingalls Industries

199-K-220 (C8795) Combination Plot



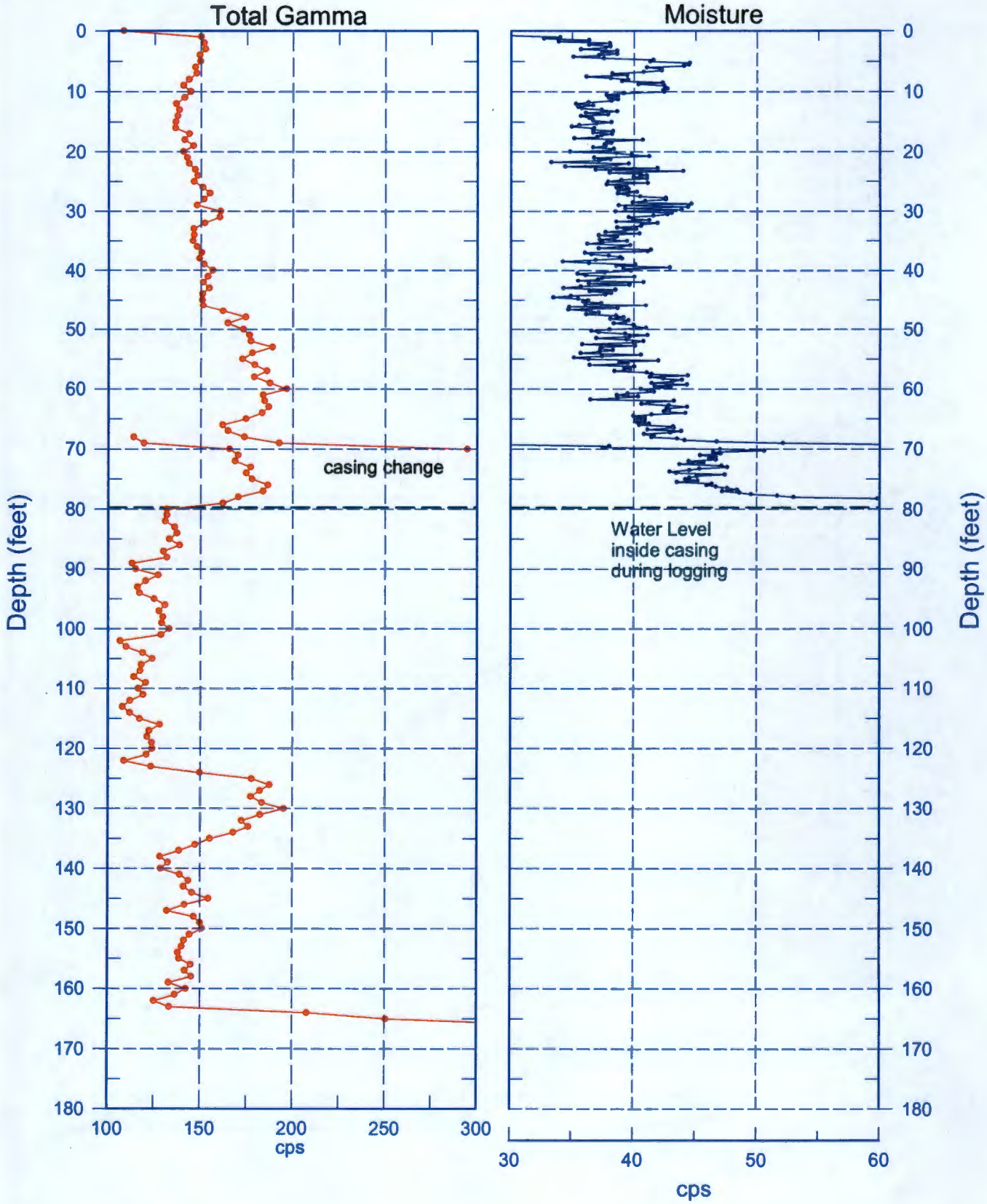
Stoller
A Subsidiary of Huntington Ingalls Industries

199-K-220 (C8795) Combination Plot



Stoller
A Subsidiary of Huntington Ingalls Industries

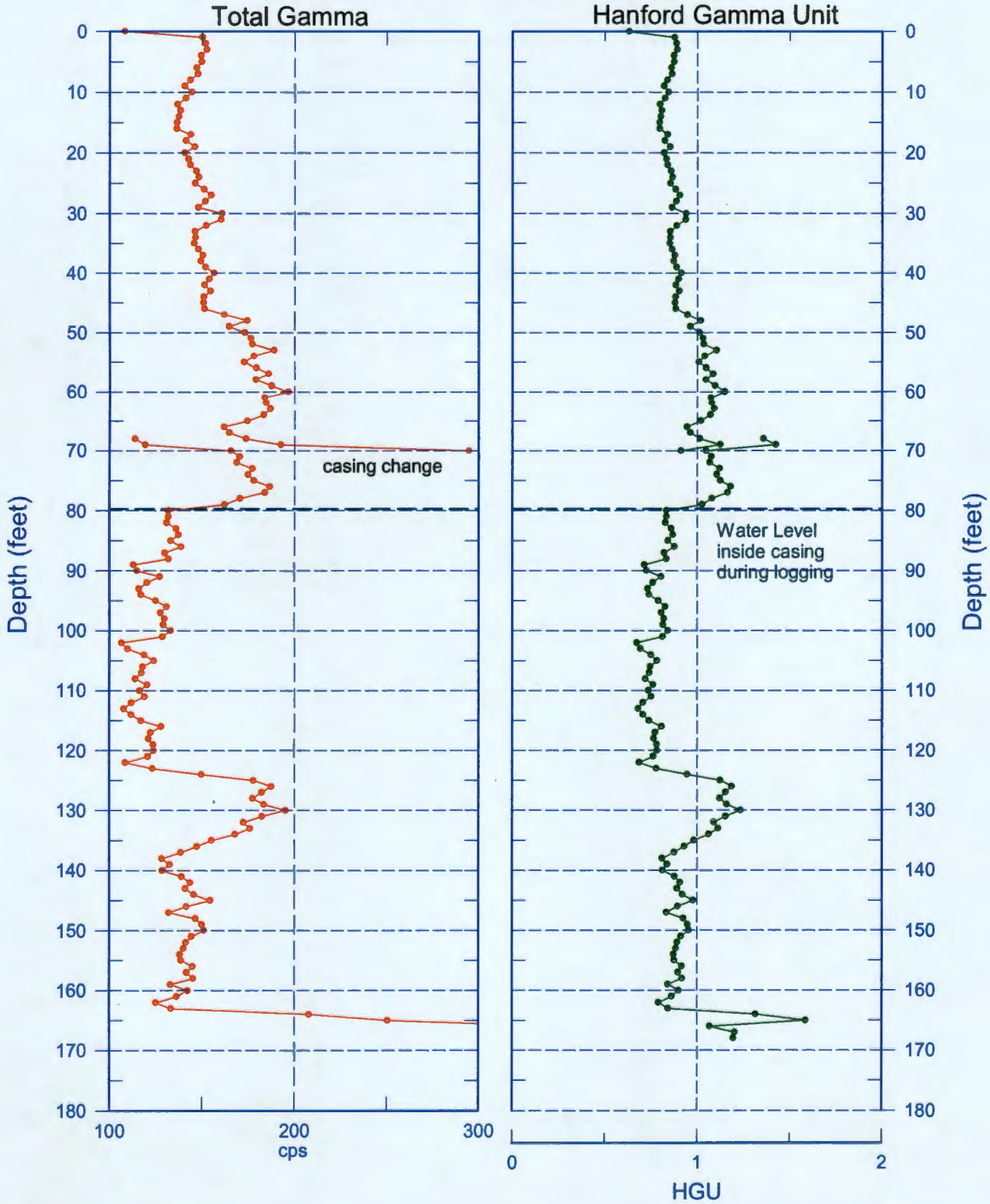
199-K-220 (C8795)
Total Gamma & Moisture



Reference - Ground Surface

199-K-220 (C8795)

Total Gamma & Hanford Gamma Unit

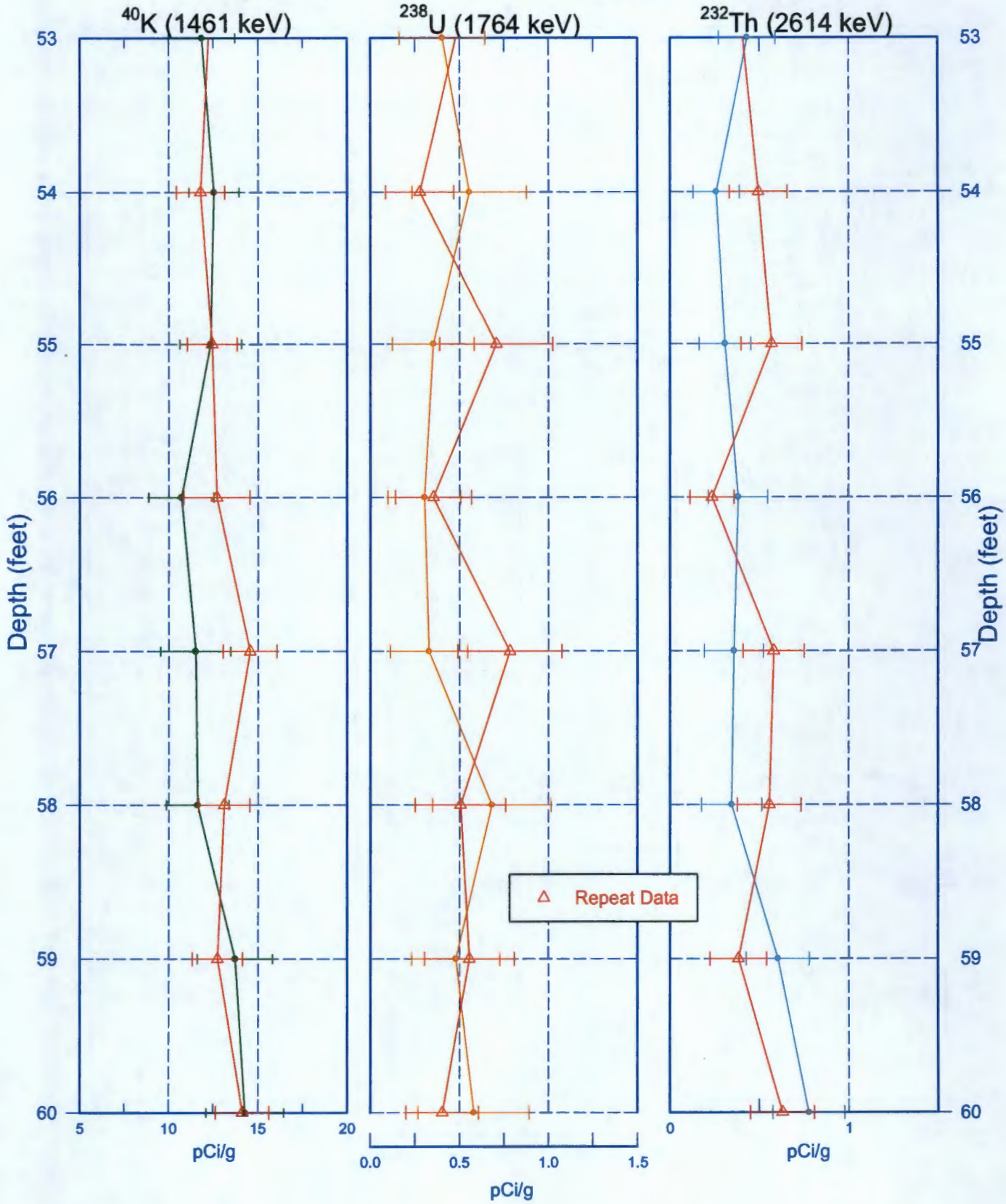


Reference - Ground Surface

Stoller
A Subsidiary of Huntington Ingalls Industries

199-K-220 (C8795)

Repeat Section of Natural Gamma Logs

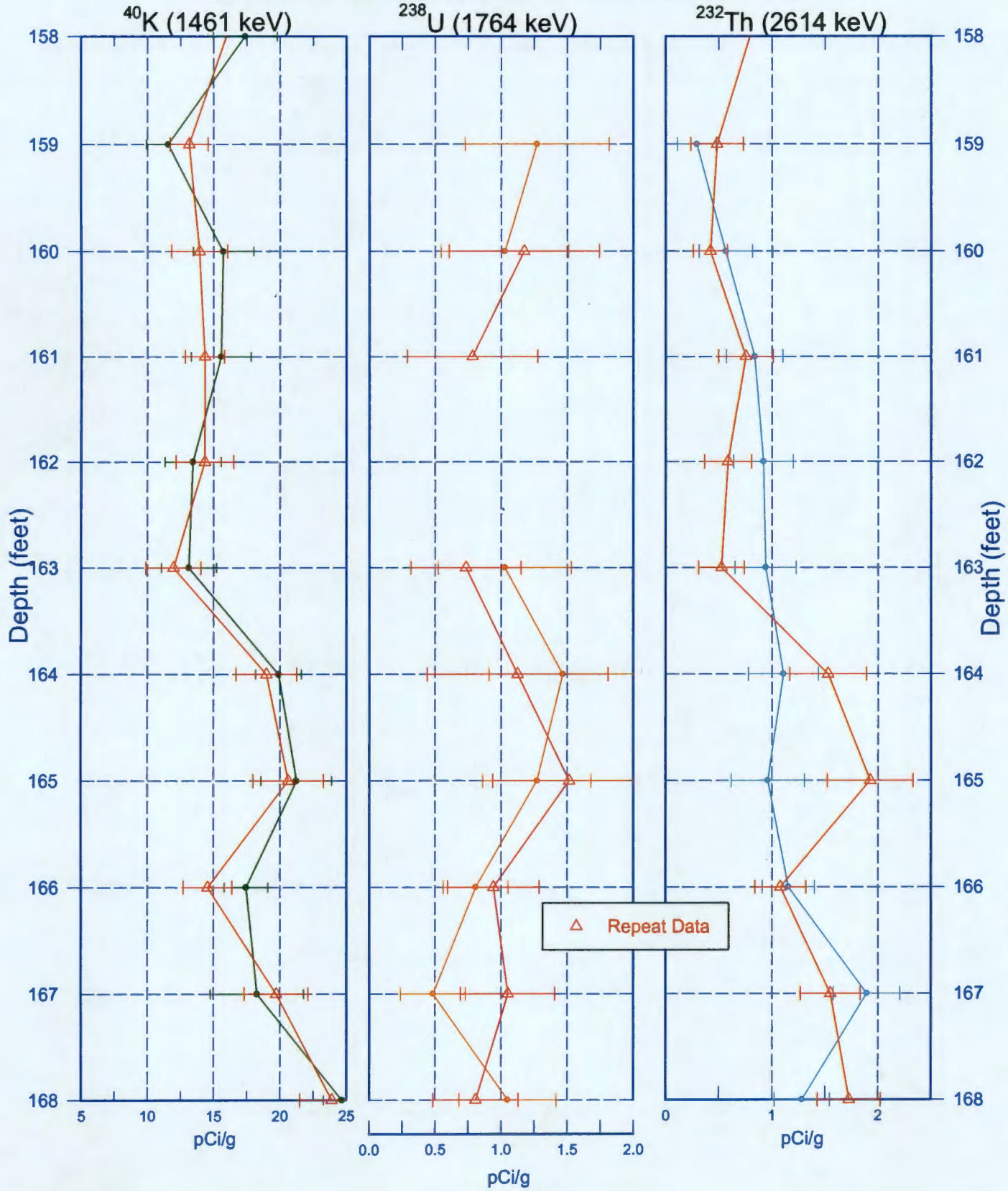


Zero Reference - Ground Surface

Stoller
A Subsidiary of Huntington Ingalls Industries

199-K-220 (C8795)

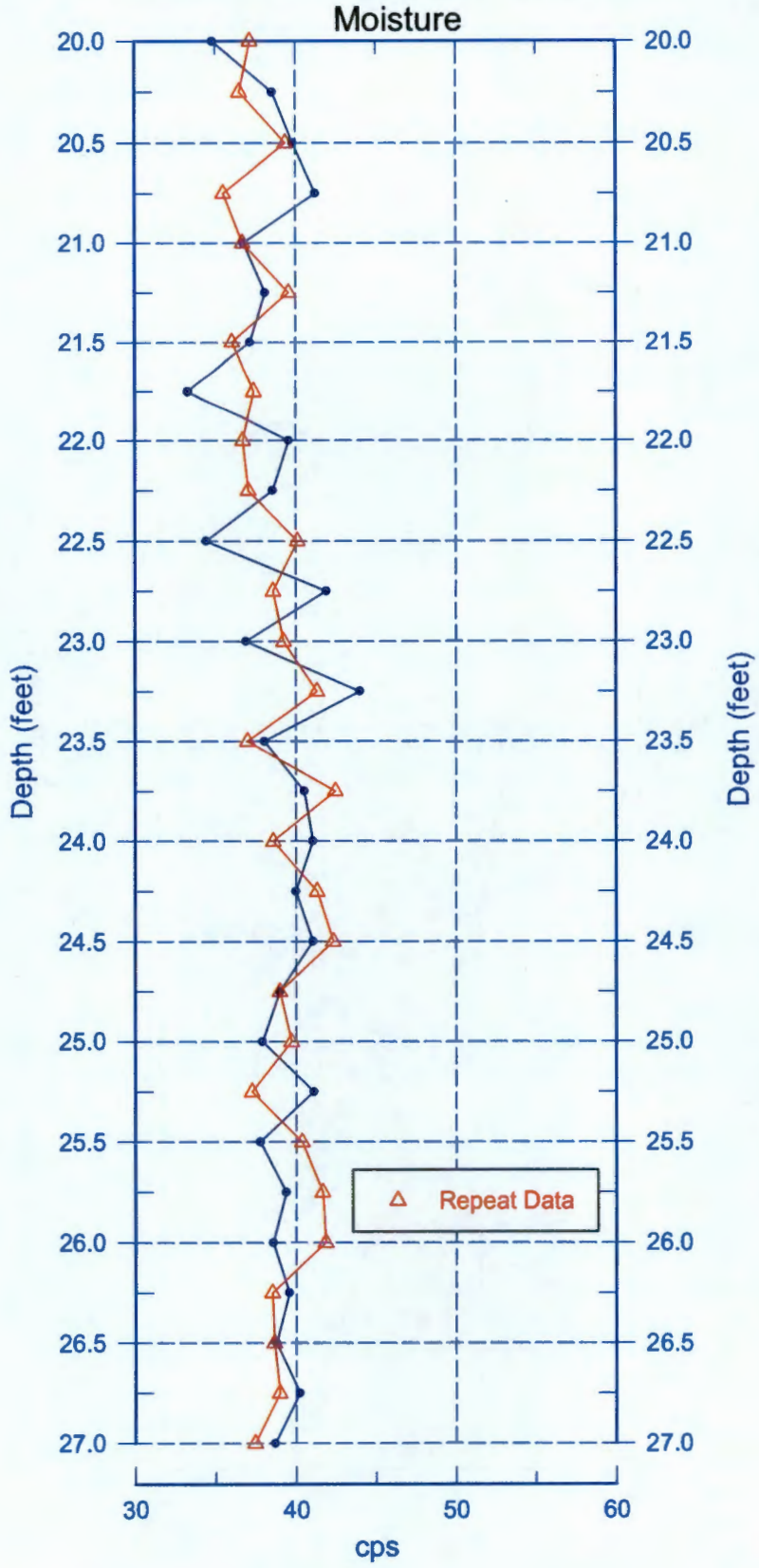
Repeat Section of Natural Gamma Logs



Zero Reference - Ground Surface

Stoller
A Subsidiary of Huntington Ingalls Industries

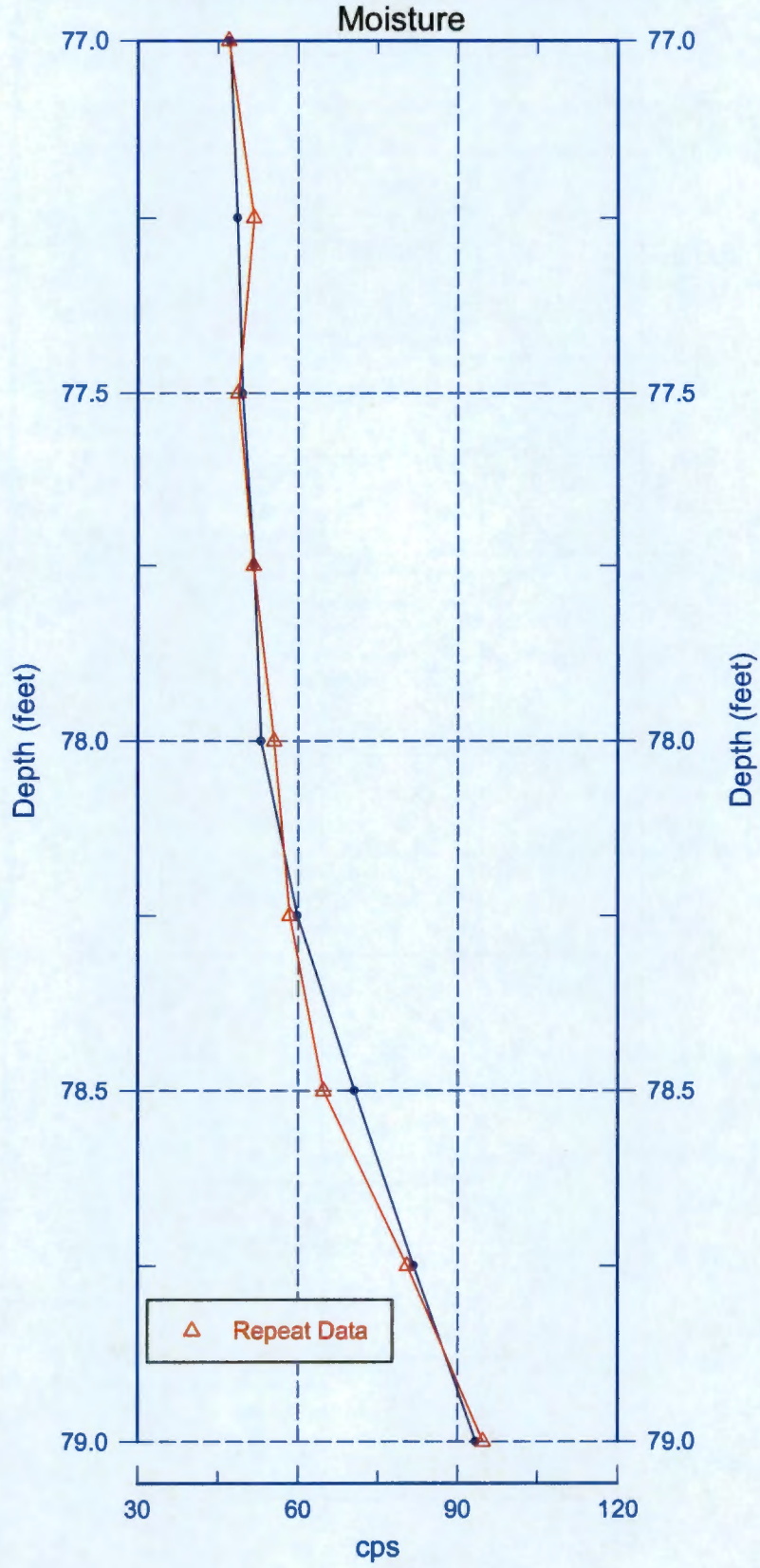
199-K-220 (C8795)
Moisture Repeat Section



Reference - Ground Surface

Stoller
A Subsidiary of Huntington Ingalls Industries

199-K-220 (C8795)
Moisture Repeat Section



Reference - Ground Surface

This page intentionally left blank.