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Revision 0

Borehole Summary Report for the Installation of Two RCRA Groundwater Monitoring Wells in the 200 Areas, FY2011

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 for Public Release;
Further Dissemination Unlimited

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Terms

bgs	below ground surface
CHPRC	CH2M Hill Plateau Remediation Company
CRBG	Columbia River Basalt Group
ID	inner diameter
IH	Industrial Hygiene
HEIS	*Hanford Environmental Information System*
NMLS	Neutron-Moisture Logging System
NTU	nephelometric turbidity unit
OD	outer diameter
PID	photoionization detector
RCRA	*Resource Conservation and Recovery Act of 1976*
RCT	radiological control technician
SGLS	Spectral Gamma Logging System
TD	total depth
VOC	volatile organic compound
WAC	*Washington Administrative Code*
WP/LIS	Waste Packaging/Labeling Instruction Sheet

1 Introduction

This report presents field-generated records and summarizes field activities performed during the drilling and construction of two groundwater wells at the Hanford Site. The well installation project was conducted to fulfill commitments contained in M-24 Milestone of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989). The work activities were conducted as a *Resource Conservation and Recovery Act of 1976* (RCRA) activity and the data obtained from the wells will be used for RCRA as well as *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* groundwater monitoring activities. The document supporting the drilling and construction of these wells is SGW-48819, Rev 1, *Description of Work for the Installation of Five Groundwater Monitoring Wells to Support M-24 RCRA Work in FY11*.

The new wells are located adjacent to two RCRA monitored facilities within the 200 Areas of the Hanford Site. Well 299-W9-2 (C8201) is located in the northwest 200 West Area, near Mixed Waste Trenches 31 and 34, north of the Waste Receiving and Processing Facility. Well 299-E26-14 (C8204) was drilled near the Liquid Effluent Retention Facility in the northeast corner of the 200 East Area. The new wells will provide further groundwater monitoring of contaminant transport and spread.

The monitoring wells C8201 and C8204 were drilled and completed during the period of July 26, 2011 through September 28, 2011 by StillWater LLC, under the direction of CH2M HILL Plateau Remediation Company (CHPRC). Freestone Environmental Services, Inc. provided well-site geology and well construction documentation services.

1.1 Purpose and Scope

The purpose of this document is to compile and archive records, observations, and measurements associated with the drilling and construction of the two wells. This borehole summary report includes the field notes and forms prepared during the drilling and construction of the wells. Additional information contained in this report includes descriptions of the subsurface geology encountered, an account of the management of drilling-derived waste, civil survey results and well acceptance documentation.

All drilling data are recorded in the units in which they were measured. Well identifiers and drilling dates are listed in Table 1-1. The locations of the wells are shown in Figure 1-1. Appendices A and B contain the well summary sheets, well survey reports, geologic borehole logs, and photographic logs for each well. Henceforth, in this document, all wells are referred to by their C-series well identification numbers (e.g., C8201).

Table 1-1. Project Well Identification and Drilling Date Summary

Well ID	Well Name	Drilling Date		Washington State Department of Ecology Well Tag
		Start	Finish	
C8201	299-W9-2	July 26, 2011	September 22, 2011	APS 596
C8204	299-E26-14	September 8, 2011	September 27, 2011	APS 594

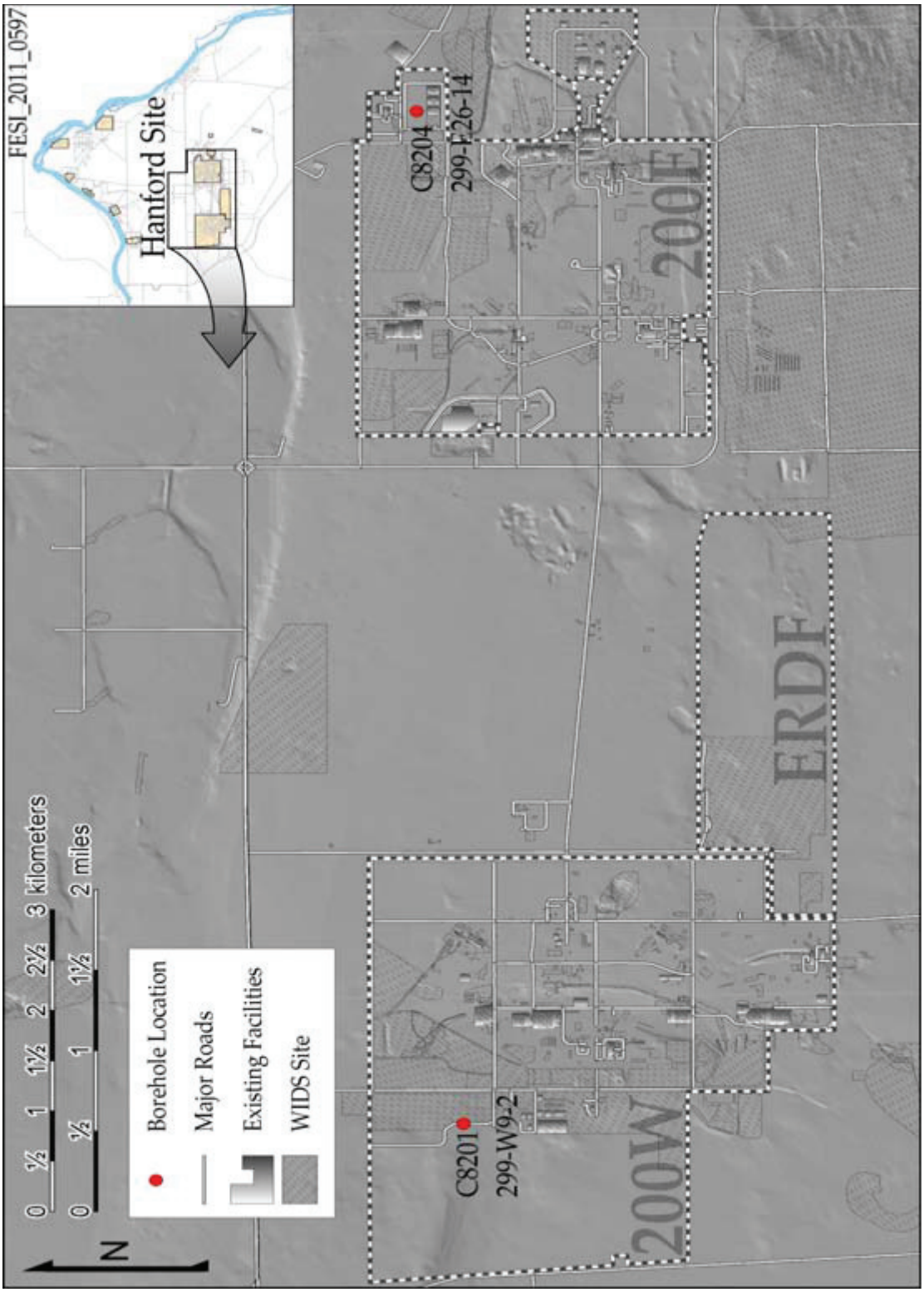

Figure 1-1. Location of Wells C8201 and C8204

2 Drilling, Sampling, and Well Construction Activites

This section summarizes the drilling, sampling, and well construction activities associated with wells C8201 and C8204.

2.1 General Information

The new wells were constructed in conformance with standards detailed in WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," and the CHPRC construction specifications summarized in SGW-48819. Well construction activities were recorded and borehole geology was logged in accordance with CHPRC procedures GRP-EE-02-14.1, *Drilling, Remediating, and Decommissioning Resource Protection Wells, and Geotechnical Soil Borings* and GRP-EE-01-7.0, *Geologic Logging*.

- **Drilling** – Both boreholes were drilled with a Bucyrus Erie 22-W Series III cable-tool drill rig. Most of the drilling was performed using drive barrels, but hard-tooling methods were utilized when the formation was especially hard. Both boreholes were drilled using two, telescoped strings of temporary, threaded carbon steel casing. The first string, with an outer diameter (OD) of 10.75-in and an inner diameter (ID) of 9.75-in, was advanced to approximately 100 to 120 ft below ground surface (bgs). The second string, (8.625-in OD/7.625-in ID casing) was telescoped inside the first string to reach an additional 120 to 225 ft. While the second casing string was drilled to total depth (TD) at C8201, at C8204, the borehole was extended to TD using open-hole drilling. Open-hole drilling was utilized because the bedrock was strong enough to support an open borehole. All temporary casing was removed during well construction.

- **Sampling** – Sampling activities for this project are outlined in DOE/RL-2008-41, *Sampling and Analysis Plan for the Liquid Effluent Retention Facility (LERF) Replacement RCRA Wells*. Sediment grab samples were collected during drilling at 5-ft intervals and recognizable changes in lithology; groundwater and split-spoon samples were collected at depth-discreet intervals during drilling.

  The grab samples were collected for geologic description and archive requirements. A portion of each, was stored in a labeled pint jar and a chip tray that was delivered to the Hanford Geotechnical Sample Library, a storage building managed by CHPRC. A digital photograph of each archive sample was taken in the field and used to construct a photographic log of each well. The geologic and photographic logs of the borehole cuttings are presented in the appendices. Grab samples for sieve analysis were collected from the intervals proposed for screen installation at both boreholes. Sieve analyses were performed in accordance with CHPRC procedure GRP-EE-05-1.21, *Particle Size Distribution of Soil- Wet Sieve Analysis*.

  The split-spoon sample was collected for stratigraphic information using a 4-in-diameter, 2.5 ft-long (including shoe) split-spoon sampler. The split-spoon was driven until refusal. Split-spoon sampling intervals are presented in and in the borehole logs.

  The groundwater samples were collected for chemical analyses discussed in the sampling and analysis plan with a submersible pump or a bottle sampler, depending on aquifer conditions. Wherever possible, the borehole was purged until field parameters (i.e., pH, temperature, conductivity, turbidity, dissolved oxygen, and oxidation reduction potential) stabilized. Sample depths and corresponding *Hanford Environmental Information System* (HEIS) database sample identification numbers for each sample are noted in the well-specific information section.

- **Geophysical Logging** – S. M. Stoller Corporation logged each borehole using a Spectral Gamma Logging System (SGLS) to identify natural and man-made gamma-emitting radionuclides and a

Neutron-Moisture Logging System (NMLS) to identify the occurrence of high moisture zones present in the vicinity of the boreholes.

- **Radiological Field Screening** – The drilling of each borehole was classified as a low radiological risk activity. Based on this classification, continuous radiological coverage was provided only for the first 20 ft of drilling. Thereafter, radiological surveys were conducted twice daily in the morning and afternoon. A radiological control technician (RCT) performed radiological surveys of the drill cuttings, geologic samples, temporary drive casing and driller's control station using standard radiological field screening instruments.
  - On August 26, 2011, elevated levels of radiation (alpha: 10,660 dpm/100cm², beta/gamma: 60,000 dpm/100cm²) were detected in the last drive barrel of material removed from the borehole that day. The tools were lowered back into the borehole and the RCT declared the borehole a "Contaminated Area." The measured radiation levels decreased greatly over night and it was suspected that the contamination may be from a pocket of radon. Radiological coverage increased from AM/PM checks to continuous radiological coverage until, on August 30, 2011, the radiation levels returned to background levels and drilling activities were cleared to continue as planned.
- **Air Monitoring for Volatile Chemicals** – Air quality monitoring was performed twice daily during drilling to check for mercury vapors and volatile organic compounds (VOCs). The drillers' breathing zone near the wellhead, the fresh drill cuttings, and geologic samples were screened for VOCs using a photoionization detector (PID). The air near the wellhead was screened for mercury vapor using a Lumex mercury monitor.
  - On September 16, 2011, PID measurements made by the industrial hygiene (IH) technician indicated concentrations of VOCs above background levels but below the action limit for the project (0.5 ppm VOC). The next IH survey detected no VOCs and drilling continued as planned. No mercury vapor measurements above background levels were reported at any time during the project at either of the boreholes.
- **Well Construction Materials** – All wells were constructed using 4-in nominal diameter, schedule 10, Type 304 stainless steel blank casing and 4-in nominal diameter, schedule 10, Type 304, 20-slot (0.020-in slot opening), continuous wire-wrap, stainless steel screen. All blank and screen sections were connected with flush-threads. A sump consisting of 4-in diameter stainless steel casing with end-cap was installed below the screen for each well.
- **Well Completion Materials** – Backfill material, consisting of coated 0.375-in bentonite pellets, was used to adjust the borehole depth of C8204 to the desired screen depth specified in the well design. The filter pack surrounding the well screens consists of 10-20 mesh Colorado silica sand. Following the exposure of each 10-ft interval of screen, the wells were surged using a dual surge block and the filter pack level was monitored until measured settling met CHPRC well development specifications (i.e., less than one tenth of a foot of settling in 15 minutes of surging). The annular seal consists of 5 gallons of uncoated 0.375-in bentonite pellets, placed directly above the primary filter pack, and of 8-20 mesh #8 granular bentonite (crumbles) placed above the pellets to approximately 10 ft bgs. The annular surface seal consists of Type I-II Portland cement grout placed directly above the bentonite crumbles to ground surface.
- **Surface Completion** – The above-ground stickup of the permanent casing is protected by 6-in nominal diameter stainless steel casing embedded into a 6-in thick, 4-ft by 4-ft concrete pad placed around the well. The top of the 8-in protective casing was fitted with a 1-ft-long cap with locking

hasp. The wellhead is protected by 3-in diameter, 3-ft tall steel protective posts at each corner of the cement pad as rerequired in the CHPRC well design specifications..

- **Final Well Development** – Following construction of each well, final well development was performed with an electric submersible pump. The pumping was performed following CHPRC procedure GRP-EE-01-6.3, *Well Development and Testing*. Drawdown and recovery tests were monitored using an In-Situ Inc. LevelTROLL 700 pressure transducer/data logger. A summary of the final field water quality data is summarized in Table 2-1.

- **Washington State Department of Ecology Well Identification** – A well identification tag embossed with the assigned unique state well identification number was permanently affixed to the outer protective casing of each well. A list of the identification numbers is found in Table 1-1.

Table 2-1. Well Construction, Completion, and Development Summary

Well ID	C8201	C8204
Top of Protective Casing (ft ags)	3.33	2.88
Top of 4” Schedule 10, Type 304, Stainless Steel Permanent Well Casing (ft ags)	2.35	1.79
Top of 4” Schedule 10, Type 304, Stainless Steel, 20-slot Screen (ft bgs)	284.69	195.90
Bottom of Schedule 10, Type 304, Stainless Steel, 20slot Screen (ft bgs)	319.65	215.90
Bottom of Schedule 10, Type 304, Stainless Steel Sump (ft bgs)	324.57	218.90
Type I-II Portland Cement Grout Surface Seal (ft bgs)	0.0 – 10.2	0.0 – 9.2
8-20 mesh #8 Granular Bentonite Crumbles (ft bgs)	10.2 – 277.1	9.2 – 187.3
⅜-inch Bentonite Pellet Seal (ft bgs)	277.1 – 278.4	187.3 – 190.0
Primary Filter Pack: 10-20 mesh Colorado Silica Sand (ft bgs)	278.4 – 325.0	190.0 – 219.6
Backfill (⅜-inch Bentonite Pellets) (ft bgs)	-	219.6 – 240.6
Total Depth Drilled (ft bgs)	325.0	240.6
Static water level (ft bgs)	292.09	201.28
Date of development and static water level measurement	September 20/21, 2011[a]	September 27, 2011
Development Pump Intake depth (ft bgs)	318.0 / 308.0	212.7
Pumping duration (minutes)	602 / 325	75
Final turbidity (NTU)	4.90 / 6.40	0.58
Final conductivity (µS/cm)	375 / 384	721
Final pH	8.15 / 8.07	7.89
Final temp (°C)	23.7 / 22.5	20.4
Average discharge rate (gpm)	1.8 / 1.5	27
Final drawdown (ft)	10.26 / 8.26	0.14
Total gallons pumped	1080 / 480	2,040

a C8201 was developed in two intervals. The first interval was developed over two days and the second was developed over one afternoon and evening.

ags = above ground surface

bgs = below ground surface

gpm = gallons per minute

µS/cm = microsiemens per centimeter

NTU = nephelometric turbidity units

2.2 Well-Specific Information

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

2.2.1 Borehole C8201 (299-W9-2)

Drilling at location C8201 was initiated on July 26, 2011 and the total drill depth of 325.0 ft bgs was reached on September 7, 2011. Static water level was measured at 292.09 ft bgs on September 22, 2011.

- **Drilling** – The borehole was drilled using a cable tool drill rig and drive barrel methods to advance the first string of temporary 10.75-in OD/9.75-in ID carbon steel threaded casing to119.4 ft bgs. Hard tooling methods were employed during the advancement of the 8.625-in OD/7.625-in ID carbon steel threaded casing to TD (325.0 ft bgs). All temporary casing was removed during well construction.

- **Sampling** – Grab archive samples were collected during drilling at 5-ft intervals and recognizable changes in lithology. One grab sample was collected for sieve analysis at 309 ft bgs.

- **Geophysical Logging** – NMLS geophysical logging was conducted inside the 10.75-in OD casing from ground surface to 119 ft bgs on August 4, 2011. SGLS logging was conducted on August 5 from ground surface to 118 ft bgs. After the well reached TD, Stoller performed SGLS geophysical logging through the 8.625-in OD casing from 118 to 325 ft bgs on September 9, 2011 and NMLS logging was conducted from 118 to 289.75 ft bgs on September 10, 2011. Results of these geophysical surveys can be found in HGLP-LDR-661, *299-W9-2 (C8201) Log Data Report*.

- **Permanent Casing** – On September 12, 2011, after passing a borehole straightness test, the permanent 4-inch casing was placed from 2.35 ft above ground to 284.69 ft bgs. The screened interval is located from 284.69 to 319.65 ft bgs and the sump is located from 319.65 to 324.57 ft bgs. The 6-in diameter stainless steel protective casing was placed to 3.33 ft above ground surface. See Table 2-1 and Appendix A for well construction details.

- **Filter Pack and Annular Seal** – The filter pack surrounding the screen consists of 10-20 mesh Colorado silica sand from 278.4 to 325.0 ft bgs. The annular seal consists of a seal of 0.375-in uncoated bentonite pellets placed from 277.1 to 278.4 ft bgs, a layer of bentonite crumbles placed from 10.2 to 277.1 ft bgs, and a surface seal of cement grout from ground surface to 10.2 ft bgs.

- **Development** – C8201 was developed in two 15-ft intervals. The first interval was pumped over the course of two days until turbidity values declined to less than 5 nephelometric turbidity units (NTUs) and additional water quality parameters (conductivity, pH, and temperature) stabilized. The second interval was pumped during one afternoon and evening. Though turbidity and other water quality parameters values had stabilized, turbidity values had not declined to less than 5 NTUs. After three hours of stable parameters and with darkness less than half an hour away, the development was declared complete. C8201 had a much lower specific capacity of ~0.2 gpm/ft of drawdown, which is consistent with the low-permeability sediments encountered in the 200 West Area.

- **Permanent Pump Installation** – A permanent 1-HP submersible electric sampling pump (Grundfos) was installed on September 22, 2011 and tested by pumping 5 gallons of water at a rate of 7 gpm. The pump intake depth was set at 313.3 ft bgs.

2.2.2 Borehole C8204 (299-E26-14)

Drilling at location C8204 was initiated on September 8, 2011 and the total drill depth of 240.6 ft bgs was reached on September 21, 2011. Static water level was measured at 198.40 ft bgs on September 27, 2011.

- **Drilling** – The borehole was drilled using a cable tool drill rig and drive barrel method to advance the first string of temporary 10.75-in OD/9.75-in ID carbon steel threaded casing to100.6 ft bgs. Hard-tooling was also employed to advance the second string of temporary 8.75-in OD/7.75-in ID carbon steel threaded casing to 220.7ft bgs. The remainder of the borehole, from 220.7 to 240.6 ft bgs, was drilled open-hole into basalt using hard-tooling methods. All temporary casing was removed during well construction.

- **Sampling** – Grab samples of drill cuttings were collected during drilling at 5-ft intervals and recognizable changes in lithology for archive specimens. One split-spoon sample was collected at 219.8 ft bgs for stratigraphic characterization of the top of the basalt. Three grab samples were collected for sieve analysis at depths of 200, 205, and 210 ft bgs. Groundwater samples were collected for chemical analyses from 203.0 ft bgs on September 19, 2011 using a bottle sampler (*HEIS#s: B2FPH3, B2FPH4*) and from 218.4 ft bgs on September 22, 2011 using a submersible pump (*HEIS#: B2FPH9*).

- **Geophysical Logging** – SGLS and NMLS geophysical logging was conducted inside the 10.75-in OD casing on September 13, 2011. SGLS logging occurred from ground surface to 101 ft bgs and NMLS logging was conducted from ground surface to 100.5 ft bgs. After the borehole reached TD, Stoller performed NMLS geophysical logging inside the 8.75-in OD casing from 99 to 198.75 ft bgs on September 21, 2011. After the final water sample was collected, SGLS logging was performed between 99 and 225 ft bgs on September 22, 2011. Results of these geophysical surveys can be found in HGLP-LDR-667, *299-W9-2 (C8201) Log Data Report*.

- **Permanent Casing** – The permanent 4-inch casing, screen, and sump were installed after adding backfill to adjust the depth of the borehole and passing a straightness test on September 23, 2011. The permanent casing is located from 1.79 ft above ground to 195.90 ft bgs, the screened interval is from 195.90 to 215.90 ft bgs, and the sump extends from 215.90 to 218.90 ft bgs. The 6-in diameter stainless steel protective casing was placed to 2.88 ft above ground surface. See Table 2-1 and Appendix B for well construction details.

- **Backfill, Filter Pack, and Annular Seal** – The depth of borehole C8204 was adjusted by adding backfill material, consisting of coated 0.375-in bentonite pellets, to a depth of 219.6 ft bgs. The filter pack surrounding the screen consists of 10-20 mesh Colorado silica sand from 190.0 to 219.6 ft bgs. The annular seal consists of a seal of 0.375-in uncoated bentonite pellets placed from 187.3 to 190.0 ft bgs, a layer of bentonite crumbles placed from 9.2 to 187.3 ft bgs, and a surface seal of cement grout from ground surface to 9.2 ft bgs.

- **Development** – C8204 was developed in one 17.5-ft interval. The well was pumped until turbidity values declined to less than 5 NTUs and additional water quality parameters (conductivity, pH, and temperature) stabilized. The pumping was performed as a short duration constant rate pumping test. The tests resulted in very little drawdown, with calculated specific capacities of ~200 gpm/ft of drawdown.

- **Permanent Pump Installation** – A permanent 1-HP submersible electric sampling pump (Grundfos) was installed on September 28, 2011 and tested by pumping five gallons of water at a rate of 11 gpm. The pump intake depth was set at 209.1 ft bgs.

3 Geologic Observations

The following section summarizes the general geology of the Hanford Site 200 East and West Areas and also includes borehole-specific observations at both locations.

3.1 General Geology of the 200 Areas

Detailed descriptions of geologic stratigraphy, lithology, and hydrology in the vicinity of the boreholes (written prior to the drilling project) can be found in the following documents:

- DOE/RL-2002-39, *Standardized Stratigraphic Nomenclature for the Post-Ringold-Formation Sediments Within the Central Pasco Basin*
- PNNL-12261, *Revised Hydrology for the Suprabasalt Aquifer System, 200-East Area and Vicinity, Hanford Site*
- PNNL-14202, *Mineralogical and Bulk-Rock Geochemical Signatures of Ringold and Hanford Formation Sediments*
- PNNL-15837, *Data Package for Past and Current Groundwater Flow and Contamination Beneath Single-Shell Tank Waste Management Areas*
- PNNL-17913, *Hydrogeology of the Hanford Site Central Plateau – A Status Report for the 200 West Area*
- PNNL-19277, *Conceptual Models for Migration of Key Groundwater Contaminants Through the Vadose Zone and Into the Upper Unconfined Aquifer Below the B-Complex*

The geologic stratigraphy in the 200 Areas of the Hanford Site consists of unconsolidated late Miocene to Holocene sedimentary deposits that overlie the Miocene Columbia River Basalt Group (CRBG) flood basalts and associated sedimentary interbeds. Significant variation in the presence and thickness of the particular suprabasalt sedimentary units due to the different structural, depositional and erosional histories at each site were observed at the two locations.

The principal units, from youngest to oldest, identified at the new boreholes include the following:

- Holocene surface deposits and/or backfill material
- Hanford formation (Hf) sediments
- Cold Creek Unit (CCU)
- Ringold Formation (Taylor Flat member and unit E)
- Elephant Mountain Member Basalt (Saddle Mountains Formation, CRBG)

Holocene surface deposits were present at both boreholes. The top foot of these deposits consisted of crushed gravel used for construction of the drill pad. Older deposits, consisting of aeolian sand, were observed near the near the Mixed Waste Trenches, but recent excavation removed any backfill material or windblown deposits that might have accumulated near the Liquid Effluent Retention Facility and left a large area of Hanford formation exposed at the site.

The Hanford formation, which consists of Pleistocene cataclysmic flood, and inter-flood deposits, was present at both borehole locations. The Hanford formation consists of mostly unconsolidated sediments that

cover a wide range in grain size from pebble- to boulder-gravel, fine- to coarse-grained sand, silty sand, and silt. The lithologic features of the Hanford formation vary greatly over the project area but the unit can be readily identified by the presence of angular sand to cobble-sized fragments of basalt. The formation can be subdivided into sequences: an upper gravel-dominated sequence (Hf1), and a lower sand-dominated sequence (Hf2). The gravel sequence consists of gravels, sandy gravels, silty sandy gravels, gravelly sands, and sands. In the 200 West Area, this sequence also included considerable sand and silt facies. The sand sequence is predominantly medium- to coarse-grained sand with localized silt layers and can be described as "salt and pepper sand," due to the presence of both dark-colored basalt and lighter quartz and feldspar. This sequence was not visible in the 200 West Area and the drilling results confirmed the direct contact of Hf1 sequence with the underlying basalt.

The CCU includes the sedimentary sequence that disconformably overlies the Ringold Formation and underlies cataclysmic flood deposits of the Hanford formation. These deposits, formerly referred to as the Plio-Pleistocene unit, pre-Missoula Gravels, early Palouse soil, or caliche, represent mainstream alluvial, calcic paleosol, sidestream alluvial, colluvial, and overbank-aeolian environments marginal to the ancestral Columbia River (DOE/RL-2002-39). The CCU is not continuous over the entire project area and were only observed at C8201.

The Ringold Formation was deposited by the ancient Columbia and Snake Rivers as they migrated eastward across the Site from the late Miocene to early Pliocene. The older, coarse-grained sediments of the Ringold Formation unit E were deposited in a fluvial environment associated with a through-flowing river system. Later, the Columbia River sediments became more sand-dominated, and interbedded fluvial sand and overbank deposits, collectively called the Taylor Flat member of the Ringold Formation, accumulated at the Hanford Site (PNNL-17913). The Ringold Formation was encountered beneath the 200 West Area but was not present in the northeast of the 200 East Area.

The Elephant Mountain Member of the Saddle Mountain Formation of the CRBG is a 10.5-million-year old fine-grained tholeiitic basalt which occurs beneath the 200 Areas, however, C8201 was not drilled deep enough to reach the basalt. This formation has a variable elevation throughout the project area due to folding and erosion. Surface geophysical exploration, including seismic profiles by Golder suggested evidence of a possible erosional depression in the basalt at the location of C8204. The Elephant Mountain Member basalt consists of two separate basalt flows and is expected to be over 100 ft thick in the project area.

3.2 Borehole-Specific Geologic Observations

This section describes the general geologic characteristics and stratigraphic units (when evident) observed during drilling of each of the six boreholes. Geologic logs were prepared in accordance with CHPRC procedure GRP-EE-01-7.0, *Geologic Logging* and are included in Appendices A and B.

3.2.1 Borehole C8201 (299-W9-2)

This borehole was drilled in the 200 West Area of the Hanford Site; stratigraphic units encountered during drilling of C8201 included backfill, Hanford formation, CCU, and Ringold Formation. Holocene deposits including 1 ft of gravel from the drill pad at the surface and about 8 ft of well-sorted, find-to-medium-grained, aeolian sand were present at the borehole. The Hf1 sequence in the 200 West Area extended from 9 to 85 ft bgs and contained significantly more fine-grained material; the contact between the Hf1 and Hf2 was placed at the bottom of the last significant appearance of gravel. The Hf2 sequence was observed between 85 and 120 ft bgs and was composed of medium grained sand with a basalt content of approximately 25 percent. A layer of pale yellow, clayey, strongly cemented caliche between 152 and 164 ft bgs was representative of the carbonate facies of the CCU. A sharp lithologic contact is visible at

164 ft bgs, where the CCU gives way to the Taylor Flat Member of the Ringold Formation. The Taylor Flat member was visible from 164 to 183 ft bgs and was characterized by a loose, poorly-sorted, light yellowish brown sand which lacked the calcareous cementation of the CCU. The sandy gravel, silty sandy gravel, and gravel of the Ringold Formation unit E were encountered from 183 ft to the TD of 325.0 ft bgs. A layer of silty sand was noted at approximately 280 to 287 ft bgs but this was during an episode of drilling with hard tooling methods and therefore is not likely to be representative of the natural sediment. The borehole and photographic logs for C8201 are presented in Appendix A.

3.2.2 Borehole C8204 (299-E26-14)

Stratigraphic units encountered during drilling of C8204 included backfill, Hanford formation, and Elephant Mountain Basalt. Gravel from the drill pad was present from ground surface to roughly 1 ft bgs; any backfill or surficial deposit that may have once been present at the site had recently been cleared away leaving exposed Hanford formation. The Hf1 sequence at C8204 extended from 1 to 221 ft bgs and consisted mainly of silty sandy gravel, sandy gravel, and gravelly sand with some sand and gravel. Though the Hf2 sequence was not encountered at this well, two sand interbeds were encountered at 36 to 45 ft bgs and 103 to 106 ft bgs and a layer of silty sediments were found just above the basalt. The Elephant Mountain Basalt was encountered at 221 ft bgs and continued to the TD of 240.6 ft bgs. The basalt bedrock is weathered and fracture with a vesicular texture. The borehole and photographic logs for C7571 are presented in Appendix B.

4 Waste Management

Investigation-derived waste includes drill cuttings, purge water, and miscellaneous solid waste. Investigation-derived waste generated during drilling and construction of well C8201 was managed according to DOE/RL-2000-40, *Waste Management Plan for the Expedited Response Action for the 200 West Area Carbon Tetrachloride Plume and 200-ZP-1 and 200-PW-1 Operable Units.* C8204 investigative-derived waste was managed using the strategy documented in DOE/RL-2003-30, *Waste Control Plan for the 200-BP-5 Operable Unit*. Waste characterization for the investigative-derived waste was performed in accordance with SGW-50269, *Data Quality Objectives Summary Report for the Installation of Five M-24 RCRA Wells in Fiscal Year 2011*, as well as the Waste Management Specialist-approved Waste Packaging/Labeling Instruction Sheets (WP/LIS).

A WP/LIS was prepared to provide site-specific guidance on waste packaging and labeling. Investigation-derived waste was surveyed by the IH and RCTs in accordance with the site-specific Health and Safety Plan and Radiological Work Permit.

4.1 Vadose Zone Cuttings

All drill cuttings collected from above the highest historical water table were contained at the drill pad and sampled and analyzed for waste designation and determination of the appropriate disposal method. These soils were disposed at the drill pad when return-to-environment requirements were met.

4.2 Saturated Zone Cuttings

All drill cuttings from below the historical high water mark were contained in drums and periodically surveyed using the appropriate radiological and volatile organic field screening instruments at the point of generation. Drummed soil slurries were de-watered as necessary before disposal and decanted water was managed as purge water. The saturated soils were sampled and analyzed prior to disposition in accordance with the site-specific WP/LIS. Decontamination waste and associated miscellaneous solid waste were stored and managed as stated in the WP/LIS. At the time this report was written, drums of

saturated zone cuttings from boreholes C8201 and C8204 remained at the point of generation (well location) in roped-off zones. Drummed cuttings will be transported to and disposed of at the Environmental Restoration Disposal Facility.

4.3 Purge Water

Purge water was generated during well drilling, development activities, and from water decanted from the saturated soil drums. All purge water was pumped to purge water trucks and transported to the Purge Water Storage and Treatment Facility for disposal (Izatt 1990, *Strategy* for *Handling and Disposing of Purgewater at the Hanford Site, Washington*).

5 Civil Survey

The well locations were surveyed in accordance with CHPRC procedure GRP-EE-01-1.6, "Survey Requirements and Techniques," on October 31, 2011.Vertical survey data were recorded using *North American Vertical Datum of 1988* (NAVD88) and the horizontal coordinates were recorded using the Washington State Plane (South Zone) *North American Datum of 1983* (NAD83), with the 1991 adjustment for horizontal coordinates. Surveyed locations of the boreholes are presented in Table 5-1 and the reports are located in Appendices A and B.

Table 5-1. Civil Survey Summary.

Well Name	Well ID	Northing[a] (m)	Easting[a] (m)	Brass Survey Marker Elevation[b] (m)	Top of Casing[b,c] Elevation (m)
299-W9-2	C8201	136872.84	565742.21	223.765	224.635
299-E26-14	C8204	137264.50	575786.45	182.494	183.228

6 Well Acceptance

Well acceptance is the final step in the well construction process and represents confirmation of meeting the requirements of the work scope. The well acceptance walk-down involved a detailed inspection of the well and well site and a review of the well drilling and completion documentation. The well acceptance walk-down for C8201 and C8204 took place on September 28, 2011. Representatives from CHPRC and StillWater LLC participated in the inspection of both wells.

Worksite Assessment SGRP-2012-WSA-11679 was issued to document the acceptance of the two wells.

7 References

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