Appendix C

RI Field Sampling Information

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Environmental Calculation and Report

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Terms

amsl	above mean sea level
bgs	below ground surface
COC	contaminant of concern
COPC	contaminant of potential concern
CVP	cleanup verification package
D	decommissioned
DO	dissolved oxygen
DUP	duplicate
EB	equipment blank
EBL	equipment blank
FTB	field trip blank
FXR	field transfer blank
GEA	gamma energy analysis
HEIS	Hanford Environmental Information System
ID	identification
LFI	limited field investigation
MTCA	*Model Toxics Control Act*
N/A	not applicable
N/I	not identifiable from log
N/P	not present
N/R	did not reach unit
NE	not encountered
NM	not measured
NTU	nephelometric turbidity unit
ORP	oxidation-reduction potential
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
QC	quality control

RAG	remedial action goal
RI	remedial investigation
RTD	removal, treatment, and disposal
RUM	Ringold upper mud
SAP	sampling and analysis plan
TCN	Tri-Party Agreement change notice
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
VOC	volatile organic carbon

C1 Introduction

Appendix C provides the details of the remedial investigation (RI) field effort sampling. Details include locations, depths of drilling or excavation work, sample numbers and location, and other information, as outlined below:

- Table C-1 contains the aquifer tube analytical sample numbers and water quality parameters that were collected in the field, including conductivity, pH, and turbidity. Comments made by the sampling team are also provided.
- Table C-2 provides a summary of the number and type (soil chemistry or physical properties) of soil samples collected at each of the RI wells, in addition to what was planned in the sampling and analysis plan (SAP). Deviations from the SAP are noted; however, deviations in sample numbers are expected with variations in field conditions and sample recovery.
- Table C-3 provides the number of groundwater samples collected, the depth the samples were collected from, and deviations from the SAP.
- Table C-4 identifies the wells and boreholes associated with specific data gaps.
- Table C-5 contains well/ borehole geologic and construction details. The information includes the well or borehole location, the elevation of each drilling location, the depth that each geologic unit was interpreted to be present, the water level measured during drilling, the screened interval for the well, and total well depth.
- Table C-6 provides a breakdown of samples collected. This table includes information such as the number of samples collected for geochemical analysis, and the number of filtered and unfiltered groundwater samples collected. The table also identifies the wells that were completed and screened for specific geologic units, as well as the boreholes that were converted into temporary wells.
- Table C-7 includes the test pit location, depth of excavation, and number of samples collected.
- Table C-8 provides the waste sites that were characterized per the work plan, and the justification for selecting each waste site for additional investigation following closeout.
- Table C-9 provides the location of the Cr(VI) pilot study samples, including depth. Also included are the depths to the water table during the pilot study.
- Table C-10 provides the depths, number of samples collected, and construction details for the RI aquifer tubes.
- Table C-11 provides details for wells used in the evaluation of groundwater spatial and temporal distribution. Well name, location, geologic unit depths, and screen depth information are included. The dates of sample collection and summary of quality control sample information are also provided.

Also included are ECF-100HR3-12-0011, *Analysis of Slug Test Data at the 100-HR-3 Operable Unit*, which provides the data used to determine the hydraulic conductivities for the various geologic units, and PNNL-20486, *Report for Batch Leach Analyses on Sediments at 100-HR-3 Operable Unit, Boreholes C7620, C7621, C7622, C7623, C7626, C7627, C7628, C7629, C7630, and C7866*. PNNL-20486 provides analysis of samples from the saturated zone, only one sample of the 117 samples analyzed had a value above the detection limit. The result was only slightly above the detection limit.

C2 Batch Leach Testing Data Evaluation

The batch leach test results were further evaluated to provide a basis for estimating a K_d value to use in the vadose zone transport estimates used to prepare the SSLs and PRGs for Cr(VI). This data analysis includes evaluation of uncertainty and a focused statistical analysis to recommend an area-wide conservative estimate for residual Cr(VI) K_d. The basis for the K_d value for Cr(VI) used in vadose zone numerical modeling is documented in ECF-HANFORD-11-0165, *Evaluation of Hexavalent Chromium Leach Test Data Conducted on Vadose Zone Sediment Samples from the 100 Area*.

The relative vertical distribution of soil batch leach results for chromium and Cr(VI) are presented on Figures C-1 through C-31. In calculating K_d, it was assumed that each soil sample was 100 g, and the volumes of water used in the ratios were 100, 250, and 500 mL. Exact quantities of soil and water were not available from the laboratory, but the K_d value is not very sensitive to slight variances from these assumed values. Given these uncertainties, along with laboratory analytical uncertainty, the reported K_d values are considered accurate within approximately 30 percent.

Because of the nature of the procedure, these K_d values are to be viewed as *desorption* partition coefficients, as opposed to adsorption coefficients. It is common to observe differences in K_d between adsorption and desorption reactions, termed hysteresis ("Nonreversible Adsorption of Divalent Metal Ions [Mn^{II}, Co^{II}, Ni^{II}, Cu^{II}, and Pb^{II}] onto Goethite: Effects of Acidification, Fe^{II} Addition, and Picolinic Acid Addition" [Coughlin and Stone, 1995]), with the desorption K_d usually greater than the adsorption value.

There does not appear to be a consistent relationship between the soil:water ratio and the calculated K_d. This is likely due to the inherent uncertainty in analytical methods. Trace metal analysis with ICP typically carries a ±20 percent uncertainty, and this can be magnified when total soil concentrations are calculated. If a total porosity of 35 percent is assumed, along with a soil particle density of 2.65 kg/L, a saturated soil will have a soil:water mass ratio of about 5:1, whereas in these batch leach tests, the ratios were 1:1, 1:2.5, and 1:5. The low ratios used in the batch tests are designed to estimate the maximum mass of metals that may be leached over multiple flushes of the vadose and saturated soil. Because the K_d values do not consistently decrease with decreasing soil:water ratios, the results suggest that partition coefficients represent an approximate maximum leaching, or equilibrium, condition.

Among the consistently detected metals in vadose zone soil, barium was the only one that was detected in the majority of leaching solutions. The calculated K_d values ranged between 179 to 20,000 L/kg. The arsenic K_d ranged from >9 to 268 L/kg. Cadmium was not detected in any of the leachate solutions, so no reliable partition coefficient could be calculated. The data suggest that K_d is greater than 0 L/kg, based on the largest value calculated using analytical reporting limits for the water analysis. Cadmium was not reported in groundwater. Lead was not detected in any batch leach extract; these data and the reporting limit calculations suggest a K_d greater than 10 L/kg for lead.

Cr(VI) was only detected in a relatively few vadose soil samples (65 of 251 samples), whereas acid-extractable total chromium was detected in all 251 samples. This indicates that the majority of chromium in the soil is in trivalent form. This form of chromium is known to be far less soluble and a much stronger adsorbing ion than Cr(VI). The calculated K_d values for total chromium reflect the properties of Cr(III), suggesting a K_d in the hundreds to thousands. By contrast, 97 soil samples could be quantified for Cr(VI), but only 19 batch leach extract samples contained detectable Cr(VI), because of most soil samples being below the detection limit.

The range of calculated K_d for Cr(VI) based on batch leaching results for samples collected at 100-D/H was from 0.03 to 55 L/kg. Because Cr(VI) is a weak adsorber and stays soluble in solution, the resulting low concentrations in soil make quantification of K_d highly uncertain, but the low measured values in these samples and in other literature sources suggest a K_d of less than 1. It is important to note that the Cr(VI) sample alkaline extraction method used to prepare the solid soil samples for analysis for Cr(VI) is intended to extract low-water-solubility Cr(VI) compounds for measurement. Although mineralogical analysis to identify specific mineral species in soil samples was not performed, some of these compounds (for example, potassium dichromate and lead chromate) likely can be found in soil from 100-D/H as a result of simple ionic reactions between the sodium dichromate in reactor cooling water and other naturally occurring metal ions. The batch leach solution used in this test is intended to approximate acid precipitation and may not be as aggressive at dissolving low solubility Cr(VI) compounds.

Leachate results from the 116-H-4 Pluto Crib (Figure C-23) and 100-D-56 Sodium Dichromate Pipeline (Figure C-26) appear to be outliers that require further explanation.

- The 116-H-4 results were not included in the analysis in ECF-HANFORD-11-0165 because three of the four soil samples had no detectable level of Cr(VI). The fourth sample had an estimated value of 0.3 mg/kg Cr(VI). The method required all four soil samples to have at least an estimated level of Cr(VI) in order to calculate a K_d value. However, using the one estimated value to calculate K_d values would result in an estimated K_d for this location of 0.5, 2.5, 7.5, and 14 mL/g. Again, the majority of these values are above the 0.6 mL/g value recommended in ECF-HANFORD-11-0165. The estimated K_d values from these samples were either used in selecting a recommended K_d value for Cr(VI) or produce similar results to those used in the analysis.
- The 100-D-6 results from well C7866 were included in the analysis in ECF-HANFORD-11-0165. Note these data were collected at a well that was drilled 70 m east of intended location, immediately adjacent to the 108-D Chemical Pump House (where solid sodium dichromate was received and mixed for deliver to the 185-D, 190-D, and 105-D buildings). A replacement well, C8375, was drilled in the location where C7866 should have been placed. The K_d values resulting from leachate results from well C7866 for Cr(VI) ranged from 0.03 to 3.69 mL/g. However, only one value (0.03) is lower than the recommended K_d value (0.8 mL/g) in ECF-HANFORD-11-0165. Some actual leachable total chromium and Cr(VI) was found in intervals I-011 and I-014. Interval I-011 was collected between 16 to 16.8 m (52.5 and 55 ft) bgs and I-014 at 18.5 to 19.1 m (60.7 to 62.7 ft) bgs. Based on the geologist's logbook, the Hanford-Ringold contact was encountered at 14.6 m (48 ft) bgs. It was noted that between 14.6 and 15.2 m(48 and 50 ft), the vadose zone soils consisted of very fine to slightly silty sand, a difference from the surrounding soils. It appears that there may be a lens of material right there that may impact the leachability of total chromium and Cr(VI) differently than those around it.

Thus, while data for the 116-H-4 and 100-D-56 sites may appear be outliers, these data were addressed in the analysis that resulted in the recommended K_d value for Cr(VI).

C3 References

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Table C-1. Aquifer Tube Water Quality Field Data

Tube Data				Sample Water Quality Parameters							Post-Sampling Water Quality Parameters					
Aquifer Tube ID	Sample Date	HEIS Sample No.	Number of Sample Containers	Start Time	Conductivity µS/cm	Temperature °C	pH	ORP (mV)	DO (mg/L)	Turbidity (NTU)	Time	Conductivity µS/cm	Temp °C	pH	Conductivity Percent Change	Comments
C7645	7/23/2010	B25X89, B25X95, B25XC3, B25XC7, B25XD0, B25XD8	6	11:14	167	17.0	7.86	141	4.66	>1000	11:58	162	17.8	7.86	-3%	Filtered chromium sample bottle broken during transport to vehicle. Clean sample bottle brought to location from vehicle. Tube C7646 purged until conductivity was stable (176 µS/cm) and sample was collected using new filter at 12:49. Conductivity after sample (500 mL) collection was 174 µS/cm.
	8/29/2010	B26N43, B26N44, B26N46, B26PV4, B26PV5, B26PX7	6	8:53	189	15.6	7.24	201	6.69	4.57	9:37	169	16.4	7.29	-11%	
	12/14/2010	B27V07, B27V08, B27V10, B28FV5, B28HH1, B28HH2	6	10:53	171	9.8	8.77	192	8.41	4.01	11:21	170	10.2	7.69	-1%	
C7646	7/23/2010	B25X90, B25X96, B25XC4, B25XC6, B25XD1, B25XD9	6	12:04	227	14.9	7.83	177	7.24	7.69	12:46	231	16.8	8.00	2%	
	8/29/2010	B26N47, B26N48, B26N50, B26PV6, B26PV7, B26R24	6	9:41	231	14.9	7.50	135	7.57	3.14	10:18	227	15.7	7.83	-2%	
	12/14/2010	B27V11, B27V12, B27V13, B28FV6, B28HH5, B28HH6	6	11:25	224	10.5	7.83	254	7.94	0.9	11:54	219	11.8	7.87	-2%	
C7647	7/23/2010	B25X91, B25X97, B25XB6, B25XC5, B25XD2, B25XF0	6	10:10	221	15.7	8.14	114	5.99	2.65	11:00	212	21.7	8.26	-4%	
	8/29/2010	B26N51, B26N52, B26N54, B26PV8, B26PV9, B26R25	6	10:27	240	14.6	7.74	150	7.32	0.87	11:04	240	15.0	8.08	0%	
	12/14/2010	B27V18, B27V19, B27V21, B28FV8, B28HH7, B28HH8	6	11:58	234	11	8.06	232	7.62	0.92	12:24	230	11.4	8.11	-2%	
C7648	7/23/2010	B25X92, B25X98, B25XB7, B25XB8, B25XD3, B25XF1	6	8:22	220	17.9	8.20	121	8.27	67	10:07	231	21.3	8.15	5%	Lowest flow rate of the four tubes.
	8/29/2010	B26N55, B26N56, B26N58, B26R26	4	11:09	243	16.5	8.17	126	5.09	24.3	12:31	245	16.5	8.21	1%	
	12/14/2010	B27V22, B27V23, B27V25, B28FV9	4	12:28	240	10.6	8.19	220	6.03	144	13:27	244	11.8	8.20	2%	Slower flow rate than other tubes.

Table C-1. Aquifer Tube Water Quality Field Data

Tube Data				Sample Water Quality Parameters							Post-Sampling Water Quality Parameters				Conductivity Percent Change	Comments
Aquifer Tube ID	Sample Date	HEIS Sample No.	Number of Sample Containers	Start Time	Conductivity µS/cm	Temperature °C	pH	ORP (mV)	DO (mg/L)	Turbidity (NTU)	Time	Conductivity µS/cm	Temp °C	pH		
C7649	8/10/2010	B25X93, B25X99, B25XB9, B25XC0, B25XD4, B25XF2	6	8:34	185	20.9	7.17	93	3.94	2.17	9:16	177	21.3	7.26	-4%	
	9/15/2010	B26N59, B26N60, B26PW0, B26PW1, B26R93, B26N62	6	11:29	173	25.7	7.29	109	6.98	2.53	11:57	175	20.9	7.36	1%	
	12/16/2010	B27V26 B27V27, B27V29, B28FW0, B28HH9, B28HJ0	6	9:50	136	4.1	7.69	209	10.58	3.8	10:36	137	7.3	7.2	1%	
C7650	8/10/2010	B25XC2, B25X94, B25XB0, B25XC1, B25XD5, B25XF3	6	8/10/2010	196	19.1	7.44	71	4.92	2.66	9:57	190	21.0	7.49	-3%	
	9/15/2010	B26N63, B26N64, B26N66,B26PW2, B26PW3,B26R27	6	9/15/2010	186	21.1	7.48	150	6.5	3.49	12:31	181	20.7	7.50	-3%	
	12/16/2010	B27V30, B27V31, B27V33, B28FW1, B28KH1, B28KH2	6	12/16/2010	177	5.8	8.15	229	8.62	39.9	11:28	169	9.6	7.66	-5%	

DO = dissolved oxygen
ID = identification
ORP = oxygen-reduction potential
HEIS = Hanford Environmental Information System
NTU = nephelometric turbidity unit

Table C-2. Summary of Soil Samples Collected for 100-D/H RI Wells

Well Name	Borehole ID	SAP ID	Soil Chemistry		Physical Properties		Deviations from 100-D/H SAP (DOE/RL-2009-40)	
			Number Planned[a]	Number Collected	Number Planned[a]	Number Collected	Soil Chemistry	Physical Properties
199-D3-5	C7620	2	7	10	4	4	• Groundwater was encountered deeper than estimated. Two additional soil chemistry samples were collected. • Four samples with insufficient recovery for all analyses. VOCs and batch leach not collected for four samples. GEA not collected for one sample.	• One sample with insufficient recovery for all determinations. Moisture content only for the sample.
199-D5-133	C7621	3	7	9	4	4	• One sample not collected due to lack of recovery. • Groundwater encountered shallower than estimated. One less soil chemistry sample was collected. • Three samples with insufficient recovery for all analyses. VOCs and batch leach not collected for these three samples.	• One sample not collected due to lack of recovery. • Two samples with insufficient recovery for all determinations. Moisture content only for these samples.
199-D5-132	C7622	4	20	19	4	5	• One soil chemistry sample not collected due to lack of recovery. • Groundwater encountered deeper than estimated. One additional sample was collected.	• Two samples with insufficient recovery for all determinations. Moisture content only for these samples.
199-D6-3	C7623	5	7	12	4	3	• Groundwater encountered deeper than estimated; therefore, two additional samples were collected. • Five samples with insufficient recovery to fill all containers. VOCs not collected for five samples. GEA not collected for two samples. Batch leach not collected for five samples. Total uranium, strontium-90, and technetium-99 not collected for one sample.	• Two samples not collected due to lack of recovery. • Two samples with insufficient recovery for all determinations. Moisture content only for these samples.
199-D5-134	C7624	R4	10	15	4	6	• Groundwater encountered deeper than estimated. One additional sample was collected.	• None.
199-D5-141	C7625	R5	20	19	4	5	• Groundwater encountered deeper than estimated. One contingency sample was collected. Two scheduled vadose zone samples not collected. • Six samples with insufficient recovery to fill all containers. VOCs not collected for six samples. Batch leach and GEA not collected for one sample.	• Two samples with insufficient recovery for all determinations. Moisture content only for these samples.
199-H3-6	C7626	6	7	7	2	1	• Five samples with insufficient recovery to fill all containers. VOCs and batch leach not collected for three samples. Technetium-99 not collected for one sample.	• Sample characterizing the Hanford formation was not collected.
199-H3-7	C7627	7	7	8	2	2	• Groundwater encountered deeper than estimated. One additional sample was collected.	• None
199-H6-3	C7628	10	7	7	2	1	• Four samples with insufficient recovery to fill all containers. VOCs not collected for three samples. Batch leach not collected for four samples. GEA not collected for one sample.	• Sample characterizing the Hanford formation was not collected.
199-H6-4	C7629	11	7	7	2	1	• Two samples with insufficient recovery to fill all containers. VOCs not collected for one sample. Batch leach was not collected for two samples.	• Sample characterizing the Hanford formation was not collected.

Table C-2. Summary of Soil Samples Collected for 100-D/H RI Wells

Well Name	Borehole ID	SAP ID	Soil Chemistry		Physical Properties		Deviations from 100-D/H SAP (DOE/RL-2009-40)	
			Number Planned[a]	Number Collected	Number Planned[a]	Number Collected	Soil Chemistry	Physical Properties
199-H1-7	C7630	12	7	8	2	2	• One additional sample collected. The RUM was encountered at 9.6 m (31.5 ft) bgs with a damp layer overlying it. Water level could not be measured. • Two samples with insufficient recovery to fill all containers. VOCs not collected for two samples.	• None.
199-H2-1	C7631	R3	10	8	2	3	• One sample with insufficient recovery to fill all containers. Tritium, total uranium, GEA, strontium-90, technetium-99, and VOCs not collected for one sample.	• None.
199-H3-9	C7639	R1	10	10	2	4	• Three samples with insufficient recovery to fill all containers. Batch leach samples not collected for two samples. Tritium, total uranium, strontium-90, and GEA not collected for one sample.	• Two additional RUM samples were collected. • Ringold unit B sample was not collected due to heaving sands.
199-H3-10	C7640	R2	10	11	2	3	• None.	• None.
199-D5-140	C7866	9	19	21	4	4	• Groundwater encountered deeper than estimate; therefore, one additional sample was collected. • Nine samples with insufficient recovery to fill all containers. VOCs not collected for nine samples. Batch leach not collected for two samples. Anions not collected for five samples.	• One samples with insufficient recovery for all determinations. Moisture content only for the samples.
199-D5-143	C8375	9 (redrill)	19	25	5	7	• Six samples with insufficient recovery to fill all containers. VOCs not collected for six samples. Batch leach not collected for three samples.	• Two additional samples were collected.
199-D5-144	C8668[b]	R5 (redrill)	24	21	5	5	• No requirements were missed since some samples filled more than one sample protocol.	• None.

a. Actual number of samples may vary depending on geology. Samples were collected at changes in lithology at the geologist's discretion during drilling.

b. Drilling depth and sampling conducted under *Tri-Party Agreement Change Notice Form: DOE/RL-2009-40 Sampling and Analysis Plan for the 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units Remedial Investigation Feasibility Study, Rev. 0* (TPA CN-460).

bgs = below ground surface

GEA = gamma energy analysis

RUM = Ringold upper mud

VOC = volatile organic compound

Table C-3. Summary of Groundwater Samples Collected for 100-D/H RI Wells

Well Name	Borehole ID	SAP ID	SAP Requirement	Depth Sampled (ft bgs)	Depth Sampled (m bgs)	No. of Intervals	Deviations from SAP
199-D3-5	C7620	2	Collect sample every 1.5 m (5 ft) through unconfined aquifer.	92.3, 97.4, 101.2, 103	28.1, 29.7, 30.8, 31.4	4	
199-D5-133	C7621	3	Collect sample every 1.5 m (5 ft) through unconfined aquifer.	88.2, 92.7, 97.8, 103	26.9, 28.3, 29.8, 31.4	4	
199-D5-132	C7622	4	Collect sample every 1.5 m (5 ft) through unconfined aquifer.	88.7, 92.3, 96.4, 102, 105	27, 28.1, 29.4, 31.1, 32	5	
199-D6-3	C7623	5	Collect sample every 1.5 m (5 ft) through unconfined aquifer.	94, 99, 101.5	28.7, 30.2, 30.9	3	
199-D5-134	C7624	R4	Collect sample every 1.5 m (5 ft) through unconfined aquifer, from water-bearing intervals of the RUM, and Ringold unit B if sufficient water present.	92, 97, 102, 107.3, 135.5, 158, 268.9	28, 29.6, 31.1, 32.7, 41.3, 46.9, 82	7	
199-D5-141	C7625	R5	Collect sample every 1.5 m (5 ft) through unconfined aquifer and from water-bearing intervals of the RUM, and Ringold unit B if sufficient water is present.	90.3, 95.5, 100.5, 106.5, 112, 162.5, 308.8	27.5, 29.1, 30.6, 32.5, 34.1, 49.5, 94.1	7	Well was mislocated, but was used to fill the data gap since sampling was conducted as per Well R5. Under TPA-CN-460, Well R5 redrill was placed in the planned location but completed in the unconfined aquifer.
199-H3-6	C7626	6	Collect sample every 1.5 m (5 ft) through unconfined aquifer.	49.8, 51.8, 53.9	15.2, 15.8, 16.4	3	
199-H3-7	C7627	7	Collect sample every 1.5 m (5 ft) through unconfined aquifer.	49.5, 51.6	15.1, 15.7	2	
199-H6-3	C7628	10	Collect sample every 1.5 m (5 ft) through unconfined aquifer.	48.5, 53.1, 64	14.8, 16.2, 19.5	3	
199-H6-4	C7629	11	Collect sample every 1.5 m (5 ft) through unconfined aquifer.	45.7, 48, 53, 60.5	13.9, 14.6, 16.2, 18.4	4	
199-H1-7	C7630	12	Collect sample every 1.5 m (5 ft) through unconfined aquifer.	N/A	N/A	0	Insufficient water for sample collection. The RUM was encountered at 9.6 m (31.5 ft) bgs with a damp layer overlying it. Water level could not be measured.
199-H2-1	C7631	R3	Collect sample every 1.5 m (5 ft) through unconfined aquifer and from water-bearing intervals of the RUM, and Ringold unit B if sufficient water is present.	30.1, 34.9, 62.9, 158.3, 179.6	9.2, 10.6, 19.2, 48.2, 54.7	5	
199-H3-9	C7639	R1	Collect sample every 1.5 m (5 ft) through unconfined aquifer and from water-bearing intervals of the RUM, and Ringold unit B if sufficient water is present.	40.4, 45.2, 46.5, 68.4, 134, 177	12.3, 13.8, 14.2, 20.8, 40.8, 53.9	6	
199-H3-10	C7640	R2	Collect sample every 1.5 m (5 ft) through unconfined aquifer and from water-bearing intervals of the RUM, and Ringold unit B if sufficient water is present.	45.5, 49.9, 52.8, 198, 223.6	13.9, 15.2, 16.1, 60.4, 68.2	5	
199-D5-140	C7866	9	Collect sample every 1.5 m (5 ft) through unconfined aquifer.	90.2, 94.2, 99, 103.3	27.5, 28.7, 30.2, 31.5	4	Well was mislocated. Well 9 redrill was placed in the planned location. Samples from this location were not required in the SAP.
199-D5-143	C8375	9 (redrill)	Collect sample every 1.5 m (5 ft) through unconfined aquifer.	91, 95, 102.5, 104	27.7, 29, 31.2, 31.7	4	
199-D5-144	C8668*	R5 (redrill)	Collect sample every 1.2 m (4 ft) through unconfined aquifer.	91.9, 95.5, 99.3, 103.8, 107.0	28.0, 29.1, 30.3, 31.6, 32.6	5	Per TPA-CN-460, the well was changed from a RUM well to an unconfined aquifer well.

* Drilling depth and sampling conducted under *Tri-Party Agreement Change Notice Form: DOE/RL-2009-40 Sampling and Analysis Plan for the 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units Remedial Investigation Feasibility Study, Rev. 0* (TPA CN-460).

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Table C-4. Boreholes and Wells Installed to Address the Associated Data Gap

Data Gap	Waste Site/Boreholes	Waste Site/Well (Borehole ID, SAP ID)
2	116-D-1B Trench (C7855) 116-D-7 Retention Basin (C7851) 116-DR-1&2 Trench (C7852) 116-DR-9 Retention Basin (C7850) 116-H-1 Trench (C7864) 116-H-4 Pluto Crib (C7862) 116-H-6 Solar Evaporation Basin (C7860) 116-H-7 Retention Basin (C7861) 118-D-6:3 Reactor Fuel Storage Basin (C7857) 118-H-6:2, 118-H-6:3, and 118-H-6:6 Reactor Fuel Storage Basin (C7863)	100-D-12 French Drain (Well 199-D5-144; C8668, Well R5 redrill) 116-D-1A Trench (Well 199-D5-132; C7622, Well 4)
3	118-D-6:3 Reactor Fuel Storage Basin (C7857) 118-H-6:3 Reactor Fuel Storage Basin (C7863)	None
5	None	199-D3-5 (C7620; Well 2) 199-D5-133 (C7621; Well 3) 199-D5-132 (C7622; Well 4) 199-D6-3 (C7623; Well 5) 199-D5-143 (C8375; Well 9 redrill) 199-D5-140 (C7866; Well 9 mislocated) 199-D5-144 (C8668, Well R5 redrill) 199-H3-6 (C7626; Well 6) 199-H3-7 (C7627; Well 7) 199-H6-3 (C7628; Well 10) 199-H6-4 (C7629; Well 11) 199-H1-7 (C7630; Well 12)
7	None	199-D5-134 (C7624; Well R4) 199-D5-141 (C7625; Well R5 mislocated) 199-H3-9 (C7639; Well R1) 199-H3-10 (C7640, Well R2) 199-H2-1 (C7631; Well R3)

SAP = sampling analysis plan

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Table C-5. RI Well and Borehole Summary

Well Name	Borehole ID	SAP Location ID	Northing (m)	Easting (m)	Elevation at Grade m (ft) amsl	Ringold Unit E Upper Contact m (ft) bgs	Depth to RUM m (ft) bgs	Total Borehole Depth m (ft) bgs	Depth to Static Water Level m (ft) bgs	Screened Interval m (ft) bgs	Total Well Depth m (ft) bgs
100-D											
Unconfined Shallow Aquifer Wells											
199-D3-5	C7620	2	150994.54	572787.66	144.053 (472.609)	26.5 (87.0) [d]	31.7 (104.0)	34.21 (112.20)	27.07 (88.80)	22.50–31.64 (73.80–103.80)	33.17 (108.80)
199-D5-133	C7621	3	151497.37	573731.55	143.439 (470.595)	16.2 (53.0)	31.7 (104)	34.14 (112.00)	25.3(83.0)	22.86–31.99 (74.99–104.97)	33.52 (109.96)
199-D5-132	C7622	4	151586.87	573875.35	144.363 (473.626)	15.5 (51.0)	32.3 (106.0)	34.14 (112.00)	26.03 (85.40)	24.64–32.27 (80.84–105.84)	33.78 (110.84)
199-D6-3	C7623	5	151643.85	574159.09	143.927 (472.196)	18.3 (60.0)	31.0 (101.6)	33.69 (110.50)	25.61 (84.00)	23.20–30.82 (76.10–101.10)	32.35 (106.10)
199-D5-140[a]	C7866	9	151778.82	573750.68	143.946 (472.258)	14.6 (48.0)	32.9 (108.0)	34.42 (112.90)	25.79 (84.60)	24.78–32.41 (81.29–106.31)	33.93 (111.31)
199-D5-143[b]	C8375	9–redrill	151784.26	573701.53	143.709 (471.480)	17.4 (57.0)	32.0 (105.0)	35.97 (118.00)	25.15 (82.5)	24.35–31.97 (79.9–104.9)	33.50 (109.9)
199-D5-144[c]	C8668	R5–redrill	151404.96	573352.05	143.64 (471.3)	24.1 (79.0)	33.1 (108.5)	34.96 (114.70)	25.9 (81.5)	22.4 – 33.1 (73.5 – 108.5)	34.59 (113.50)
RUM Wells											
199-D5-134	C7624	R4	151862.46	573675.32	143.676 (471.372)	16.2 (53.0)	33.1 (108.5)	82.32 (270.00)	25.30 (83.00)	40.21–43.29 (131.90–142.00)	44.21 (145.00)
199-D5-141[a]	C7625	R5	151424.51	573243.43	144.213 (473.134)	18.0 (59.0)	34.1 (112.0)	96.53 (316.7)	31.85 (104.5)	49.07–52.12 (161.01–171)	53.04 (174.00)
Boreholes Converted to Temporary Wells											
199-D8-101	C7852	116-DR-1&2 Trench	152262.43	574069.46	136.38 (447.42)	Undefined	NE	21.95 (72.0)	19.57 (64.20)	18.21–21.25 (59.73–69.73)	21.95 (72.00)
199-D5-142	C7857	118-D-6:3 Reactor Fuel Storage Basin	151563.26	573791.87	143.16 (469.68)	13.7 (45.0)	NE	27.38 (89.80)	25.06 (82.20)	23.46–26.52 (76.97–87.00)	26.61 (87.30)
Boreholes											
N/A	C7850	116-DR-9 Retention Basin	152315.27	573888.94	136.39 (447.47)	Not present	NE	22.04 (72.30)	19.57 (64.20)	D (1/13/2011)	
N/A	C7851	116-D-7 Retention Basin	152307.29	573701.48	135.88 (445.80)	Not defined	NE	21.03 (69.00)	18.99 (62.30)	D (1/5/2011)	
N/A	C7855	116-D-1B Trench	151608.16	573841.65	144.13 (472.862)	15.2 (50)	NE	27.80 (91.20)	26.34 (86.40)	D (12/30/2010)	
100-H											
Unconfined Shallow Aquifer Wells											
199-H3-6	C7626	6	152425.33	578266.47	128.533(421.691)	Not present	16.6 (54.5)	18.78 (61.60)	13.84 (45.40)	10.52–16.61 (34.50–54.50)	18.14 (59.50)
199-H3-7	C7627	7	152279.97	577931.74	129.071 (423.456)	Not present	16.0 (52.5)	17.99 (59.00)	14.46 (47.43)	11.37–15.94 (37.30–52.30)	17.47 (57.30)
199-H6-3	C7628	10	151929.35	578340.40	128.401 (421.258)	Not present	18.3 (60.0)	20.55 (67.40)	13.84 (45.40)	11.28–18.90 (37.00–62.00)	20.42 (67.00)
199-H6-4	C7629	11	151737.10	577771.59	127.456 (418.158)	Not defined	16.9 (55.5)	19.39 (63.60)	11.64 (38.20)	9.72–17.35 (31.90–56.90)	18.84 (61.80)
199-H1-7	C7630	12	153172.10	577629.60	124.804 (409.457)	Not present	9.6 (31.5)	11.28 (37.00)	11.03 (36.20)	6.55–9.60 (21.50–31.50)	11.13 (36.50)

Table C-5. RI Well and Borehole Summary

Well Name	Borehole ID	SAP Location ID	Northing (m)	Easting (m)	Elevation at Grade m (ft) amsl	Ringold Unit E Upper Contact m (ft) bgs	Depth to RUM m (ft) bgs	Total Borehole Depth m (ft) bgs	Depth to Static Water Level m (ft) bgs	Screened Interval m (ft) bgs	Total Well Depth m (ft) bgs
RUM Wells											
199-H2-1	C7631	R3	153239.89	577752.31	123.347 (404.677)	Not present	11.3 (37.0)	57.61 (189)	7.16 (23.5)	19.50–22.54 (63.96–73.96)	23.46 (76.96)
199-H3-9	C7639	R1	152913.60	578039.12	126.364 (414.575)	Not present	15.2 (50.0)	66.49 (218.1)	10.67 (35.00)	23.82–26.87 (78.14–88.14)	27.78 (91.14)
199-H3-10	C7640	R2	152723.52	577545.14	128.249 (420.759)	Not present	16.8 (55.0)	70.35 (230.8)	12.65 (41.5)	31.35–34.40 (102.86–112.86)	35.31 (115.86)
Boreholes Converted to Temporary Wells											
199-H4-84	C7860	116-H-6 Solar Evaporation Basin	152848.73	577902.58	128.66 (422.09)	Not present	NE	14.63 (48.00)	12.65 (41.50)	11.48–14.52 (37.65–47.65)	14.63 (48.00)
199-H4-83	C7861	116-H-7 Retention Basin	152634.01	578135.04	126.48 (414.96)	Not present	NE	12.89 (42.30)	10.67 (35.00)	9.71–12.76 (31.85–41.85)	12.86 (42.2)
199-H3-11	C7863	118-H-6 Reactor Fuel Storage Basin	152490.41	577786.74	130.21 (427.18)	Not present	NE	17.01 (55.8)	14.51 (47.60)	12.82–15.88 (42.05–52.10)	15.97 (52.40)
Boreholes											
N/A	C7862	116-H-4 Pluto Crib	152479.39	577708.85	129.61 (425.22}	Not present	NE	15.97 (52.40)	13.81 (45.30)	D (9/1/2010)	D (9/1/2010)
N/A	C7864	116-H-1 Trench	152428.01	578090.07	128.74 (422.37)	Not present	NE	15.48 (50.8)	10.67 (35.00)	D (2/9/2011)	D (2/9/2011)
	Intermixed zone/transitional gravels										

Note: Depth to static water was obtained post well development.

a. Well installed in the wrong location.

b. Replacement well for the well on the line above.

c. Replacement well for Well 199-D5-141. Drilled and sampled in accordance with *Tri-Party Agreement Change Notice Form: DOE/RL-2009-40 Sampling and Analysis Plan for the 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units Remedial Investigation Feasibility Study, Rev. 0* (TPA-CN-460).

d. Transition gravels were noted starting at 14 m (46 ft).

N/A = not applicable

NE = not encountered

D = decommissioned (date performed)

SAP = sampling analysis plan

Table C-6. Samples Collected for the RI Wells and Boreholes

Well Name	Borehole ID	SAP Reference	Samples Planned in SAP and Associated Tri-Party Agreement Change Notices[a]				Samples Collected			
			Geochemical Soil Samples	Physical Soil Samples	Groundwater Samples–Unfiltered	Groundwater Samples–Filtered	Geochemical Soil Samples	Physical Soil Samples	Groundwater Samples–Unfiltered	Groundwater Samples–Filtered
100-D										
Unconfined Shallow Aquifer Wells										
199-D3-5	C7620	2	7	4	5	2	11	5	4[b]	1
199-D5-133	C7621	3	7	4	5	1	9	3[b]	5	2
199-D5-132	C7622	4	20	4	5	1	20	7	4[b]	1
199-D6-3	C7623	5	7	4	5	1	13	3[b]	3[b]	1
199-D5-140[c]	C7866	9	19	4	5	1	24	4	4[b]	1
199-D5-143[d]	C8375	9–redrill	19	4	5	1	25	7	4[b]	1
199-D5-144[e]	C8668	R5–redrill	21	4	4	2	20	4	4	3
RUM Wells										
199-D5-134	C7624	R4	10	4	8	1	18	6	7[b]	1
199-D5-141[c]	C7625	R5	17	4	11	2	20	4	7[b]	1
Boreholes Converted to Temporary Wells										
199-D8-101	C7852	116-DR-1&2 Trench	13	2	0	1	13	0[b]	0	1
199-D5-142	C7857	118-D-6:3 Reactor Fuel Storage Basin	17	2	0	1	17	1[b]	1	1
Boreholes										
N/A	C7850	116-DR-9 Retention Basin	14	2	0	1	15	0[b]	0	1
N/A	C7851	116-D-7 Retention Basin	12	2	0	1	15	1[b]	0	1
N/A	C7855	116-D-1B Trench	17	2	0	1	19	1[b]	0	1
100-H										
Unconfined Shallow Aquifer Wells										
199-H3-6	C7626	6	7	2	5	1	7	2	2[f]	1
199-H3-7	C7627	7	7	2	5	1	8	2	2[f]	1
199-H6-3	C7628	10	7	2	5	1	7	2	3[f]	1
199-H6-4	C7629	11	7	2	5	1	7	1[b]	4[f]	1
199-H1-7	C7630	12	7	2	5	1	8	3	0[g]	0

Table C-6. Samples Collected for the RI Wells and Boreholes

Well Name	Borehole ID	SAP Reference	Samples Planned in SAP and Associated Tri-Party Agreement Change Notices[a]				Samples Collected			
			Geochemical Soil Samples	Physical Soil Samples	Groundwater Samples–Unfiltered	Groundwater Samples–Filtered	Geochemical Soil Samples	Physical Soil Samples	Groundwater Samples–Unfiltered	Groundwater Samples–Filtered
RUM Wells										
199-H2-1	C7631	R3	10	2	8	1	10	3	5[b]	1
199-H3-9	C7639	R1	10	2	8	1	12	5	6[b]	1
199-H3-10	C7640	R2	10	2	8	1	11	3	5[b,f]	1
Boreholes Converted to Temporary Wells										
199-H4-84	C7860	116-H-6 Solar Evaporation Basin	11	2	0	1	10[h]	0[b]	1	1
199-H4-83	C7861	116-H-7 Retention Basin	8	2	0	1	8	0[b]	1	1
199-H3-11	C7863	118-H-6 Reactor Fuel Storage Basin	9	2	0	1	9	2	1	1
Boreholes										
N/A	C7862	116-H-4 Pluto Crib	12	2	0	1	12	0[b]	0	1
N/A	C7864	116-H-1 Trench	8	2	0	1	9	1[b]	0	1

Note: This table will be updated once all data have been assembled.

a. Quality control requirements per *Sampling and Analysis Plan for the 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units Remedial Investigation/Feasibility Study* (DOE/RL-2009-40), and *Tri-Party Agreement Change Notice Form: DOE/RL-2009-40 Sampling and Analysis Plan for the 10-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units Remedial Investigation Feasibility Study, Rev. 0* (TPA-CN-460).

b. Poor sample recovery. Obtained samples were prioritized in accordance with Section 3.6 of the *Sampling and Analysis Plan for the 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units Remedial Investigation/Feasibility Study* (DOE/RL-2009-40).

c. Well installed in the wrong location.

d. Replacement well for the well on the line above.

e. Replacement well for Well 199-D5-141. Drilled and sampled in accordance with *Tri-Party Agreement Change Notice Form: DOE/RL-2009-40 Sampling and Analysis Plan for the 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units Remedial Investigation Feasibility Study, Rev. 0* (TPA-CN-460).

f. Water table was deeper than expected in the *Sampling and Analysis Plan for the 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units Remedial Investigation/Feasibility Study* (DOE/RL-2009-40).

g. RUM contact was encountered sooner than expected.

h. One sample missed due to elevated water table.

N/A = not applicable

RUM = Ringold upper mud

TCN = Tri-Party Agreement change notice

Table C-7. RI Test Pit Locations, Depths, Samples Collected

Test Pit Location ID	Northing (m)	Easting (m)	Elevation at Grade m (ft) amsl	Sample Depths According to Table 3-1 SAP m (ft) bgs	Actual Sample Depths m (ft) bgs	Samples Planned (SAP)	QC Samples Planned (SAP)	Sample Date	Samples Collected	QC Samples Taken
100-D										
100-D-4 Trench	152171.03	573969.04	136.03 (446.17)	2.7-3.3 (9–11)	2.7-3.3 (9–11)	1		1/31/2011	1	
100-D-4 Trench	152171.03	573969.04	136.03 (446.17)	3.3-3.9 (11–13)	3.3-3.9 (11–13)	1		1/31/2011	1	
100-D-4 Trench	152171.03	573969.04	136.03 (446.17)	3.9-4.6 (13–15)	3.9-4.6 (13–15)	1		1/31/2011	1	
100-D-4 Trench	152171.03	573969.04	136.03 (446.17)	4.6-5.2 (15–17)	4.6-5.2 (15–17)	1		1/31/2011	1	
100-D-4 Trench	152171.03	573969.04	136.03 (446.17)	5.2-5.8 (17–19)	5.2-5.8 (17–19)	1		1/31/2011	1	
100-D-4 Trench	152171.03	573969.04	136.03 (446.17)			5	FXB, DUP, EB	1/31/2011	5	FXB, DUP, EB
116-D-4 Crib	151757.67	573833.64	144.45 (473.79)	2.7-3.3 (9–11)	2.7-3.3 (9–11)	1		2/1/2011	1	
116-D-4 Crib	151757.67	573833.64	144.45 (473.79)	3.3-3.9 (11–13)	3.3-3.9 (11–13)	1		2/1/2011	1	
116-D-4 Crib	151757.67	573833.64	144.45 (473.79)	3.9-4.6 (13–15)	3.9-4.6 (13–15)	1		2/1/2011	1	
116-D-4 Crib	151757.67	573833.64	144.45 (473.79)	4.6-5.2 (15–17)	4.6-5.2 (15–17)	1		2/1/2011	1	
116-D-4 Crib	151757.67	573833.64	144.45 (473.79)	5.2-5.8 (17–19)	5.2-5.8 (17–19)	1		2/1/2011	1	
116-D-4 Crib	151757.67	573833.64	144.45 (473.79)			5	FXB	2/1/2011	5	FXB
100-D-12 French Drain	151404.96	573352.05	143.88 (471.93)	2.4-3.0 (8–10)	2.4-3.0 (8–10)	1		4/6/2011	1	
100-D-12 French Drain	151404.96	573352.05	143.88 (471.93)	3.0-3.6 (10–12)	3.0-3.6 (10–12)	1		4/6/2011	1	
100-D-12 French Drain	151404.96	573352.05	143.88 (471.93)	3.9-4.6 (13–15)	3.9-4.6 (13–15)	1		4/6/2011	1	
100-D-12 French Drain	151404.96	573352.05	143.88 (471.93)	4.6-5.2 (15–17)	4.6-5.2 (15–17)	1		4/6/2011	1	
100-D-12 French Drain	151404.96	573352.05	143.88 (471.93)	5.2-5.8 (17–19)	5.2-5.8 (17–19)	1		4/6/2011	1	
100-D-12 French Drain	151404.96	573352.05	143.88 (471.93)	5.8-6.4 (19–21)	5.8-6.4 (19–21)	1		4/6/2011	1	
100-D-12 French Drain	151404.96	573352.05	143.88 (471.93)	6.4-7.0 (21–23)	6.4-7.0 (21–23)	1		4/6/2011	1	
100-D-12 French Drain	151404.96	573352.05	143.88 (471.93)	7.0-7.6 (23–25)	7.0-7.6 (23–25)	1		4/6/2011	1	
100-D-12 French Drain	151404.96	573352.05	143.88 (471.93)			8	FXB, DUP	4/6/2011	8	FXB, DUP, FTB
100-H										
1607-H4 Septic System	153424.54	577557.99	125.21 (410.69)	3.3-3.9 (11–13)	3.3-3.9 (11–13)	1		11/19/2010	1	
1607-H4 Septic System	153424.54	577557.99	125.21 (410.69)	3.9-4.6 (13–15)	3.9-4.6 (13–15)	1		11/19/2010	1	

Table C-7. RI Test Pit Locations, Depths, Samples Collected

Test Pit Location ID	Northing (m)	Easting (m)	Elevation at Grade m (ft) amsl	Sample Depths According to Table 3-1 SAP m (ft) bgs	Actual Sample Depths m (ft) bgs	Samples Planned (SAP)	QC Samples Planned (SAP)	Sample Date	Samples Collected	QC Samples Taken
1607-H4 Septic System	153424.54	577557.99	125.21 (410.69)	4.6-5.2 (15–17)	4.6-5.2 (15–17)	1		11/19/2010	1	
1607-H4 Septic System	153424.54	577557.99	125.21 (410.69)	5.2-5.8 (17–19)	5.2-5.8 (17–19)	1		11/19/2010	1	
1607-H4 Septic System	153424.54	577557.99	125.21 (410.69)			4	FXB, DUP	11/19/2010	4	FXB, DUP
116-H-2 Trench	152408.50	577732.79	128.96 (422.98)	2.7-3.3 (9–11)	2.7-3.3 (9–11)	1		11/20/2010	1	
116-H-2 Trench	152408.50	577732.79	128.96 (422.98)	3.3-3.9 (11–13)	3.3-3.9 (11–13)	1		11/20/2010	1	
116-H-2 Trench	152408.50	577732.79	128.96 (422.98)	3.9-4.6 (13–15)	3.9-4.6 (13–15)	1		11/20/2010	1	
116-H-2 Trench	152408.50	577732.79	128.96 (422.98)	4.6-5.2 (15–17)	4.6-5.2 (15–17)	1		11/20/2010	1	
116-H-2 Trench	152408.50	577732.79	128.96 (422.98)	5.2-5.8 (17–19)	5.2-5.8 (17–19)	1		11/20/2010	1	
116-H-2 Trench	152408.50	577732.79	128.96 (422.98)			5	EB, FXB, FTB	11/20/2010	5	EB, FXB, FTB, DUP

amsl = above mean sea level
EB = equipment blank
DUP = duplicate
FTB = full trip blank
FXB = transfer blank
QC = quality control
SAP = sampling analysis plan

Table C-8. Justification for Selecting Waste Sites for Characterization

Waste Site	Site Type	Characterization Conducted to Fill Data Gap	Justification for Inclusion
100-D-4	Trench	Test pit was excavated and sampled for all COPCs. Sample intervals are presented in Table C-7.	• RTD less than reported site design depth. • Soil concentrations (PCB) exceeded MTCA (WAC 173-340) Method B cleanup levels. • Sludge represents highest radioactive inventory for retention basins. Received sludge from 116-D-7 and 116-DR-7 Retention Basins; not all COCs from these retention basins were analyzed at this site. • Represents "sludge trench" site type.
100-D-56:1	Sodium Dichromate Pipeline	Groundwater monitoring well 199-D5-143 (C8375, Well 9 redrill) was installed at the selected location. Soil was sampled through the vadose zone. Groundwater samples were collected (Tables C-2, C-3, and C-6).	• Hole in the pipeline noted during remediation activities.
100-D-12	French Drain	Test pit was excavated and sampled for all COPCs. Sample intervals are presented in Table C-7. Groundwater monitoring well 199-D5-144 (C8668, Well R5 redrill) was installed at the selected location. Soil was sampled through the vadose zone. Groundwater samples were collected (Tables C-2, C-3, and C-6).	• Liquid quantity received unknown; 70 percent solutions of sodium dichromate discharged. • RTD less than reported site design depth. • LFI soil concentrations (technetium-99) exceeded RAG value. • LFI contaminants omitted from CVP sampling. • Site located proximal to high concentration portion of the southern chromium plume.
116-D-1A	Trench	Groundwater monitoring well 199-D5-132 (C7622, Well 4) was installed at the selected location. Soil was sampled through the vadose zone. Groundwater samples were collected (Tables C-2, C-3, and C-6).	• RTD less than reported site design depth. • Soil concentrations exceed MTCA (WAC 173-340), Method B cleanup levels. • Low volume liquid waste site. • Effluent did not impact groundwater during operation. Therefore, a continuing source of chromium may remain in the soil column. • In samples collected during the LFI (DOE/RL-93-29), additional contaminants were detected below the depth of remediation in the borehole drilled into this waste site. The highest concentrations of heavy metals were found at depths of approximately 9 m (30 ft). Chromium, lead, and nickel exhibited this behavior, with chromium and lead also showing a smaller but distinct high at 4.5 m (15 ft) bgs. The highest concentration of strontium-90 was found in the upper 3 m (10 ft). Highest concentrations of radionuclides (cobalt-60, europium-152, europium-154, plutonium-239, and strontium-90) are found above 9 m (30 ft) bgs, decreasing to near zero by 15 m (50 ft) bgs.
116-D-1B	Trench	Borehole C7855 was installed at the selected location. Soil was sampled through the vadose zone. Groundwater samples were collected (Tables C-3 and C-6).	• RTD less than reported site design depth. • Soil concentrations exceed MTCA (WAC 173-340), Method B cleanup levels. • LFI contaminants omitted from CVP sampling. • High-volume liquid site. • Effluent reached groundwater during operations.
116-D-4	Crib	Test pit was excavated and sampled for all COPCs. Sample intervals are presented in Table C-7.	• RTD less than reported site design depth. • LFI contaminants omitted from CVP sampling. • CVP included only Cr(VI) and uranium-238. • Associated with effluent from 108-D Building high-priority Cr(VI) site.
116-D-7	Retention Basin	Borehole C7851 was installed at the selected location. Soil was sampled through the vadose zone. Groundwater samples were collected (Tables C-3 and C-6).	• Contamination increases with depth. • Soil concentrations exceeds MTCA (WAC 173-340), Method B cleanup levels. • LFI contaminants omitted from CVP sampling. • Effluent reached groundwater during operations.

Table C-8. Justification for Selecting Waste Sites for Characterization

Waste Site	Site Type	Characterization Conducted to Fill Data Gap	Justification for Inclusion
118-D-6:3	105-D Reactor Fuel Storage Basin	Borehole C7857 was installed at the selected location. The borehole was converted to temporary Well 199-D5-142. Soil was sampled through the vadose zone. Groundwater samples were collected (Tables C-3 and C-6).	• Fuel storage basin walls and floor left in place. • High concentrations of radionuclides and chemicals on concrete samples. • RTD less than reported site design depth. • Reported to have leaked during operations. • Contamination detected exceeds MTCA (WAC 173-340), Method B cleanup levels. • No soil sampling beneath basin floor.
116-DR-1&2	Liquid Waste Trench/Crib	Borehole C7852 was installed at the selected location. The borehole was converted to temporary Well 199-D8-101. Soil was sampled through the vadose zone. Groundwater samples were collected (TablesC-3 and C-6).	• RTD less than reported site design depth. • Soil concentration exceeds MTCA (WAC 173-340), Method B cleanup levels. • LFI contaminants omitted from CVP sampling. • Effluent reached groundwater during operations.
116-DR-9	Retention Basin	Borehole C7850 was installed at the selected location. Soil was sampled through the vadose zone. Groundwater samples were collected (Tables C-3 and C-6).	• Identified as the worst-case waste site based on contaminant soil data in the LFI report. • RTD less than reported site design depth. • Exceeds MTCA (WAC 173-340), Method B cleanup levels, concentrations. • Contamination increases with depth. • LFI contaminants omitted from CVP sampling. • Effluent reached groundwater during operations.
116-H-1	Trench	Borehole C7864 was installed at the selected location. Soil was sampled through the vadose zone. Groundwater samples were collected (Table C-3 and C-6).	• RTD less than reported site design depth. • LFI contaminants omitted from CVP sampling. • Effluent reached groundwater during operations. • Site is located proximal to strontium-90 plume.
116-H-2	Trench	Test pit was excavated and sampled for all COPCs. Sample intervals are presented in Table C-7.	• LFI contaminants omitted from CVP sampling. • High-volume liquid waste site (6 million L [1.6 million gal]).
116-H-4	Crib	Borehole C7862 was installed at the selected location. Soil was sampled through the vadose zone. Groundwater samples were collected (Tables C-3 and C-6).	• This site was exhumed during the construction of the 117-H Building in 1960. • The depth of soil removal is not well documented. • It is unknown whether the contamination in the soil column beneath this site was removed. • Data do not exist to determine the nature and extent of contamination. • This site was a significant source of chromium and sodium dichromate.
116-H-6 (100-H-33)	Solar Evaporation Basin	Borehole C7860 was installed at the selected location. Soil was sampled through the vadose zone. Groundwater samples were collected (Tables C-3 and C-6).	• This facility is not “clean closed” due to nitrate, fluoride, and radiological contaminants remaining in the soil column. • Site may be a Cr(VI) source to groundwater.
116-H-7	Retention Basin	Borehole C7861 was installed at the selected location. The borehole was converted to temporary Well 199-H4-83. Soil was sampled through the vadose zone. Groundwater samples were collected (Tables C-3 and C-6).	• RTD less than reported site design depth. • LFI contaminants omitted from CVP sampling. • Soil concentrations exceed MTCA (WAC 173-340), Method B cleanup levels. • High-volume liquid site reported to have leaked. • Lateral contamination was reported during other investigations; therefore, this borehole will be placed to address uncertainty regarding the lateral extent of remediation.

Table C-8. Justification for Selecting Waste Sites for Characterization

Waste Site	Site Type	Characterization Conducted to Fill Data Gap	Justification for Inclusion
118-H-6:3	105-H Reactor Fuel Storage Basin	Borehole C7863 was installed at the selected location. The borehole was converted to temporary Well 199-H3-11. Soil was sampled through the vadose zone. Groundwater samples were collected (Tables C-3 and C-6).	• Known location of a fuel storage basin leak. • Identified data need in systematic planning. • RTD less than reported site design depth.
1607-H4	Septic System	Test pit was excavated and sampled for all COPCs. Sample intervals are presented in Table C-7.	• Elevated PAH and metals in tank sludge. • Elevated PAH in CVP samples. • Shallow depth to groundwater 3.6 m (11.8 ft). • Represents “septic system” site type.

Source: *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan, Addendum 1: 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units* (DOE/RL-2008-46-ADD1).

COC = contaminant of concern

COPC = contaminant of potential concern

CVP = cleanup verification package

LFI = limited field investigation (*Limited Field Investigation Report for the 100-DR-1 Operable Unit* [DOE/RL-93-29])

MTCA = *Model Toxics Control Act* (WAC 173-340, “Model Toxics Control Act—Cleanup”)

PAH = polycyclic aromatic hydrocarbon

PCB = polychlorinated biphenyl

RAG = remedial action goal

RTD = removal, treatment, and disposal

Table C-9. Cr(VI) Pilot Study Samples

Well Name	Borehole ID	Interval Number	Northing (m)	Easting (m)	Elevation at Grade m (ft) amsl	Date Deployed	Samples Planned in SAP m (ft) bgs	Initial Static Water Level m (ft) bgs	Sample Depth m (ft) bgs	Final Static Water Level m (ft) bgs	Sample Collection Date
199-D5-99	C5392	1001	151402.01	573349.61	144.67 (474.63)	12/29/2010	Water table dependent	25.77 (84.54)	26.46 (86.8)	25.69 (84.28)	1/17/2011
199-D5-99	C5392	1002	151402.01	573349.61	144.67 (474.63)	12/29/2010	29.5 (97.0)	25.77 (84.54)	28.80 (94.5)	25.69 (84.28)	1/17/2011
199-D5-99	C5392	1003	151402.01	573349.61	144.67 (474.63)	12/29/2010	33.2 (109.0)	25.77 (84.54)	32.46 (106.5)	25.69 (84.28)	1/17/2011
199-D5-99	C5392	1004	151402.01	573349.61	144.67 (474.63)	12/29/2010	34.1 (112.0)	25.77 (84.54)	33.38 (109.5)	25.69 (84.28)	1/17/2011
199-D5-122	C5936	1001	151349.29	573300.25	144.45 (473.91)	12/17/2010	Water table dependent	25.76 (84.5)	26.44 (86.75)	25.67 (84.21)	1/17/2011
199-D5-122	C5936	1002	151349.29	573300.25	144.45 (473.91)	12/17/2010	29.5 (97.0)	25.76 (84.5)	28.96 (95)	25.67 (84.21)	1/17/2011
199-D5-122	C5936	1003	151349.29	573300.25	144.45 (473.91)	12/17/2010	32.4 (106.5)	25.76 (84.5)	31.85 (104.5)	25.67 (84.21)	1/17/2011
199-D5-122	C5936	1004	151349.29	573300.25	144.45 (473.91)	12/17/2010	33.4 (109.5)	25.76 (84.5)	32.77 (107.5)	25.67 (84.21)	1/17/2011
199-D5-126	C6390	1001	151843.28	573705.71	144.40 (473.76)	12/29/2010	Water table dependent	25.73 (84.43)	27.13 (89)	NM	1/31/2011
199-D5-126	C6390	1002	151843.28	573705.71	144.40 (473.76)	12/29/2010	29.5 (97.0)	25.73 (84.43)	29.57 (97)	NM	1/31/2011
199-D5-126	C6390	1003	151843.28	573705.71	144.40 (473.76)	12/29/2010	33.4 (109.5)	25.73 (84.43)	33.22 (109)	NM	1/31/2011
199-D5-126	C6390	1004	151843.28	573705.71	144.40 (473.76)	12/29/2010	34.3 (112.5)	25.73 (84.43)	34.14 (112)	NM	1/31/2011
699-97-45	C5659	1001	152978.95	576051.7	126.03 (413.49)	12/29/2010	Water table dependent	9.11 (29.89)	9.75 (32)	NM	1/31/2011
699-97-45	C5659	1002	152978.95	576051.7	126.03 (413.49)	12/29/2010	9.9 (32.5)	9.11 (29.89)	9.91 (32.5)	NM	1/31/2011
699-97-45	C5659	1003	152978.95	576051.7	126.03 (413.49)	12/29/2010	11.1 (36.4)	9.11 (29.89)	11.09 (36.4)	NM	1/31/2011
699-97-45	C5659	1004	152978.95	576051.7	126.03 (413.49)	12/29/2010	12.0 (39.4)	9.11 (29.89)	12.01 (39.4)	NM	1/31/2011

Notes: All of the wells are located in 100-D, with the exception of 699-97-45, which is located in the horn area.

Sampling authorization form number F11-046.

NM = not measured

Table C-10. RI Aquifer Tube Information

Aquifer Tube ID	Hanford River Mile	Northing (m)	Easting (m)	Elevation at Grade m (ft) amsl	Depth to Top of Screen m (ft)	Elevation of Top of Screen m (ft) amsl	Number of Water Samples Collected for Field Screening and COPC Analysis	Sample Dates		
								High River Stage	Low River Stage	Transitional River Stage
100-D										
C7645	9.706	151003.06	572077.01	117.54 (385.63)	2.43 (7.98)	115.11 (377.65)	3	7/23/2010	8/29/2010	12/14/2010
C7646	9.708	151003.82	572077.51	117.57 (385.73)	3.73 (12.25)	113.84 (373.48)	3	7/23/2010	8/29/2010	12/14/2010
C7647	9.705	151002.47	572076.62	117.56 (385.70)	5.63 (18.48)	111.93 (367.22)	3	7/23/2010	8/29/2010	12/14/2010
C7648	9.707	151003.55	572077.26	117.49 (385.47)	6.43 (21.08)	111.06 (364.39)	3	7/23/2010	8/29/2010	12/14/2010
100-H										
C7649	15.356	152659.93	578271.2	114.22 (374.74)	1.69 (5.54)	112.53 (369.20)	3	8/10/2010*	9/15/2010	12/16/2010
C7650	15.355	152659.02	578271.58	114.13 (374.44)	2.37 (7.76)	111.76 (366.68)	3	8/10/2010*	9/15/2010	12/16/2010

Notes: Hanford river mile marker is measured from the Vernita Bridge.

* This was the earliest the aquifer tube could be sampled as it was under water until then.

Field QC samples in the SAP:

1 EB/round
1 field blank/round
1 DUP/round
Total: 9 QC samples for three rounds

Number of field QC samples taken:

6 field blank QC samples

Table C-11. Spatial and Temporal Uncertainty Well Information and Dates Samples Were Collected

Well Name	Northing (m)	Easting (m)	Elevation at Grade m (ft) amsl	Ringold Unit E Upper Contact m (ft) bgs	Depth to RUM Unit m (ft) bgs	Depth to Static Water Level m (ft) bgs	Screened Interval m (ft) bgs	Total Well Depth m (ft) bgs	Samples Planned (SAP)	Samples Collected			QC Samples Collected		
										1	2	3	Oct. 2011	Mar. 2010	May to June 2010
100-D															
199-D2-11	151120.7	573328.2	143.45 (470.52)	27.50 (90.10)	33.53 (110.00)	25.89 (84.91)	24.41-33.57 (80.07-110.10)	33.57 (110.10)	3	08-Oct-09	30-Mar-10	11-May-10	FTB	EBL	
199-D2-6	151119.9	573000.2	143.36 (470.20)	22.90 (75.00)	31.35 (102.90)	25.30 (82.98)	23.53-29.96 (77.20-98.30)	29.96 (98.30)	3	08-Oct-09	30-Mar-10	12-May-10			
199-D4-23	151592.9	572672.5	140.39 (460.48)	13.70 (45.00)	25.30 (83.00)	23.97 (78.63)	19.60-25.70 (64.30-84.30)	25.82 (84.70)	3	07-Oct-09	31-Mar-10	12-May-10		FTB	
199-D4-84	151433.5	572568.0	143.63 (471.11)	17.70 (58.00)	30.93 (101.50)	27.12 (88.96)	23.15-30.77 (75.94-100.92)	31.69 (103.94)	3	08-Oct-09	24-Mar-10	03-Jun-10			DUP
199-D5-13	151955.1	573535.5	144.71 (474.65)	15.54 (51.0)	27.74 (91.0)	27.19 (89.18)	23.26-29.57 (76.30-97.00)	29.57 (97.00)	3	08-Oct-09	22-Mar-10	13-May-10			
199-D5-14	151787.9	573789.6	144.75 (474.78)	N/A	N/A	27.13 (89.00)	23.51-29.85 (77.10-97.90)	29.94 (98.20)	3	07-Oct-09	22-Mar-10	13-May-10			
199-D5-15	151673.8	573738.6	143.90 (471.99)	14.00 (46.00)	30.78 (101.00)	26.81 (87.95)	23.51-29.93(77.10-98.20)	29.93 (98.20)	3	07-Oct-09	22-Mar-10	12-May-10	FTB	DUP	
199-D5-16	151652.5	573917.4	145.19 (476.22)	N/A	N/A	27.35 (89.71)	23.59-29.84 (77.4-97.9)	29.94 (98.2)	3	07-Oct-09	22-Mar-10	12-May-10			
199-D5-17	151322.8	573730.5	143.26 (469.89)	N/I	31.55 (103.50)	25.37 (83.21)	22.92-29.28(75.20-96.05)	29.37 (96.35)	3	07-Oct-09	23-Mar-10	13-May-10			
199-D5-18	151325.2	573861.7	142.58 (467.66)	N/A	30.18 (99.00)	25.24 (82.81)	20.76-28.50(68.10-93.50)	28.50 (93.50)	3	21-Oct-09	30-Mar-10	12-May-10			
199-D5-19	151243.2	573849.1	141.99 (465.75)	15.20 (50.00)	28.80 (94.50)	23.93 (78.50)	22.80-29.02(74.80-95.20)	29.02 (95.20)	3	08-Oct-09	24-Mar-10	12-May-10			
199-D5-37	151916.4	573092.2	143.07 (469.27)	140.0 (46.00)	28.80 (94.50)	25.62 (84.04)	23.71-28.29 (77.78-92.79)	29.20 (95.79)	3	07-Oct-09	23-Mar-10	12-May-10			
199-D5-38	151545.6	572996.8	143.96 (472.19)	16.50 (54.00)	32.00 (105.00)	26.42 (86.65)	24.96-31.06 (81.87-101.88)	31.96 (104.84)	3	07-Oct-09	23-Mar-10	12-May-10	DUP		
199-D5-41	151792.2	573358.2	142.43 (467.17)	15.20 (50.00)	31.85 (104.50)	26.43 (86.70)	24.85-30.95 (81.50-101.50)	31.86 (104.50)	3	09-Oct-09	N/A	N/A			
199-D5-43	151269.4	573180.0	143.84 (471.80)	20.10 (66.00)	32.61 (107.00)	26.43 (86.68)	23.99-31.63 (78.70-103.73)	32.54 (106.74)	3	07-Oct-09	23-Mar-10	12-May-10			
199-D5-99	151402.0	573349.6	144.67 (474.63)	N/I	33.37 (109.50)	26.53 (87.02)	24.17-33.36 (79.29-109.42)	33.36 (109.42)	3	08-Oct-09	23-Mar-10	12-May-10	EBL	FTB	
199-D8-5	152243.5	573537.1	138.17 (453.20)	13.50 (44.40)	25.29 (83.00)	20.87 (68.45)	19.21-25.30 (63.00-83.00)	25.30 (83.00)	3	08-Oct-09	24-Mar-10	12-May-10			DUP
199-D8-55	152364.3	573621.0	135.60 (444.77)	10.70 (35.00)	21.03 (69.00)	17.71 (58.10)	16.95-72.82 (55.60-76.10)	23.29 (76.40)	3	08-Oct-09	24-Mar-10	12-May-10			FTB
199-D8-70	152508.7	573942.1	131.95 (432.80)	N/P	21.64 (71.00)	14.65 (48.06)	12.50-21.65 (41.00-71.00)	22.50 (73.80)	3	07-Oct-09	22-Mar-10	12-May-10	FTB		FTB
199-D8-71	152429.4	573837.1	133.72 (438.60)	N/P	23.47 (77.00)	17.52 (57.45)	14.02-24.09 (46.00-76.00)	24.09(79.00)	3	07-Oct-09	22-Mar-10	13-May-10			SPLIT
199-D8-88	152141.3	573292.3	141.10 (462.81)	15.80 (52.00)	29.26 (96.00)	23.50 (77.09)	22.69-29.11 (74.43-95.48)	29.56 (96.98)	3	08-Oct-09	24-Mar-10	03-Jun-10		DUP	
100-H															
199-H3-2A	152750.1	577624.6	128.05 (420.00)	N/I	16.50 (54.00)	12.36 (40.54)	10.98-15.55 (36.00-51.00)	15.55 (51.00)	3	11-Oct-09	21-Mar-10	13-May-10	DUP		DUP
199-H3-4	152293.2	577544.3	126.46 (414.79)	N/P	13.70 (45.00)	10.79 (35.39)	6.40-14.02(21.00-46.00)	14.94 (49.00)	3	11-Oct-09	21-Mar-10	13-May-10			
199-H3-5	152287.5	577454.7	126.29 (414.23)	N/P	13.70 (45.00)	10.57 (34.67)	7.93-14.02 (26.00-46.00)	14.94 (49.00)	3	11-Oct-09	21-Mar-10	16-May-10			

Table C-11. Spatial and Temporal Uncertainty Well Information and Dates Samples Were Collected

Well Name	Northing (m)	Easting (m)	Elevation at Grade m (ft) amsl	Ringold Unit E Upper Contact m (ft) bgs	Depth to RUM Unit m (ft) bgs	Depth to Static Water Level m (ft) bgs	Screened Interval m (ft) bgs	Total Well Depth m (ft) bgs	Samples Planned (SAP)	Samples Collected			QC Samples Collected		
										1	2	3	Oct. 2011	Mar. 2010	May to June 2010
199-H4-10	153155.8	577827.2	123.70 (405.74)	N/I	11.60 (38.00)	9.40 (30.85)	7.01-11.59 (23.00-38.00)	11.59 (38.00)	3	11-Oct-09	01-Apr-10	16-May-10	--	--	--
199-H4-11	152728.4	578141.9	127.68 (418.79)	N/I	18.00 (59.00)	12.73 (41.77)	11.59-16.16 (38.00-53.00)	16.16 (53.00)	3	21-Oct-09	21-Mar-10	18-May-10	--	--	--
199-H4-13	152595.3	578219.3	127.86 (419.38)	N/I	18.00 (59.00)	14.39 (47.20)	11.28-15.85 (37.00-52.00)	15.85 (52.00)	3	11-Oct-09	21-Mar-10	13-May-10	--	--	--
199-H4-16	152591.6	577981.9	129.82 (425.81)	18.00 (59.00)	N/R	14.45 (47.41)	12.96-17.84 (42.50-58.50)	17.84 (58.50)	3	11-Oct-09	21-Mar-10	11-Jun-10	--	--	--
199-H4-3	152858.5	577940.5	128.48 (421.41)	15.20 (50.00)	N/R	13.29 (43.58)	10.36-16.77 (34.00-55.00)	16.77 (55.00)	3	05-Nov-09	22-Apr-10	20-May-10	--	--	--
199-H4-45	152433.3	578156.3	128.01 (419.87)	N/R	N/R	12.21 (40.04)	9.75-16.09 (32.00-52.80)	16.09 (52.80)	3	11-Oct-09	21-Mar-10	13-May-10	--	--	--
199-H4-46	152439.9	577883.9	129.38 (424.37)	N/I	18.60 (61.00)	14.64 (48.02)	11.79-18.14 (38.70-59.50)	18.14 (59.50)	3	11-Oct-09	21-Mar-10	13-May-10	--	DUP	--
199-H4-48	152620.2	577792.7	129.97 (426.30)	12.20 (40.00)	18.90 (62.00)	14.63 (47.97)	11.89-18.23 (39.00-59.80)	18.23 (59.80)	3	11-Oct-09	21-Mar-10	13-May-10	DUP	--	--
199-H4-5	152939.8	577944.9	127.33 (417.64)	N/I	14.60 (48.00)	12.41 (40.70)	9.75-12.95 (32.20-42.50)	17.83 (58.50)	3	11-Oct-09	24-Mar-10	18-May-10	--	--	--
199-H4-6	152888.4	577585.3	129.07 (423.35)	N/P	N/R	13.40 (43.95)	11.89-14.94 (39.00-49.00)	14.94 (49.00)	3	11-Oct-09	21-Mar-10	16-May-10	FTB	--	--
199-H4-9	152893.9	577923.2	128.28 (420.76)	N/I	14.20 (46.50)	12.99 (42.63)	10.98-14.02 (36.00-46.00)	14.02 (46.00)	3	11-Oct-09	01-Apr-10	16-May-10	--	--	--
199-H5-1A	152257.7	577650.1	128.17 (420.40)	N/I	15.80 (52.00)	12.40 (40.66)	10.61-15.52 (34.80-50.90)	15.52 (50.90)	3	11-Oct-09	21-Mar-10	13-May-10	--	--	--
199-H6-1	152247.6	578236.5	128.45 (421.31)	N/P	16.76 (55.0)	12.55 (41.15)	10.33-16.67 (33.9-54.70)	16.67 (54.70)	3	11-Oct-09	21-Mar-10	13-May-10	--	--	FTB
Outer Areas															
699-101-45	154124.2	576032.4	121.81 (399.54)	N/P	7.80 (25.50)	6.25 (20.49)	4.79-7.84 (15.70-25.72)	8.76 (28.74)	3	09-Oct-09	22-Mar-10	18-May-10	--	EBL	FTB
699-87-55	149903.9	572969.7	141.12 (462.87)	N/A	N/A	22.56 (74.01)	17.98-28.04 (59-92)	28.65 (94)	3	09-Oct-09	21-Mar-10	18-May-10	--	FTB	--
699-90-45	151024.5	576169.2	129.51 (424.79)	N/A	N/A	11.80 (38.70)	9.75-12.80 (32.00-42.00)	12.80 (42.00)	3	09-Oct-09	21-Mar-10	17-May-10	--	--	DUP
699-93-48A	151795.3	575094.1	133.54 (438.01)	N/I	22.30 (73.00)	16.43 (53.90)	12.56-18.90 (41.20-62.00)	18.90 (62.00)	3	09-Oct-09	21-Mar-10	18-May-10	--	--	--
699-94-41	152111.7	577223.1	124.96 (409.87)	9.90 (32.05)	10.80 (35.50)	10.35 (33.95)	7.90-10.95 (25.90-35.90)	11.86 (38.90)	3	09-Oct-09	18-Mar-10	18-May-10	DUP	--	--
699-94-43	152087.9	576625.6	129.81 (425.78)	N/I	16.90 (55.50)	12.86 (42.17)	12.22-16.80 (40.09-55.09)	17.71 (58.09)	3	09-Oct-09	18-Mar-10	17-May-10	--	--	--
699-95-45	152556.3	576257.0	128.54 (421.61)	N/I	13.70 (45.00)	11.45 (37.54)	11.01-14.05 (36.10-46.10)	14.97 (49.10)	3	09-Oct-09	18-Mar-10	17-May-10	EBL	DUP	--
699-95-48	152323.1	575253.4	130.69 (428.66)	N/I	18.00 (59.00)	13.29 (43.59)	12.12-18.22 (39.76-59.76)	19.13 (62.76)	3	09-Oct-09	21-Mar-10	17-May-10	--	--	--
699-95-51	152528.6	574439.5	132.29 (433.91)	N/I	20.10 (66.00)	15.08 (49.45)	14.02-20.12 (46.00-66.00)	21.04 (69.00)	3	09-Oct-09	21-Mar-10	17-May-10	--	--	--
699-96-52B	152656.2	573910.2	123.56 (405.28)	N/P	12.00 (40.00)	6.70 (21.96)	6.09-12.23 (19.98-40.10)	13.14 (43.10)	3	09-Oct-09	21-Mar-10	18-May-10	DUP	--	--
699-97-41	153090.4	577217.5	127.59 (418.50)	14.90 (49.00)	16.50 (54.00)	11.78 (38.65)	10.30-16.40 (33.80-53.80)	17.32 (56.80)	3	09-Oct-09	21-Mar-10	17-May-10	--	--	--
699-97-45	152979.0	576051.7	126.03 (413.38)	N/I	12.20 (39.90)	9.04 (29.64)	7.53-12.10 (24.70-39.70)	12.99 (42.60)	3	09-Oct-09	18-Mar-10	17-May-10	--	--	FTB

Table C-11. Spatial and Temporal Uncertainty Well Information and Dates Samples Were Collected

Well Name	Northing (m)	Easting (m)	Elevation at Grade m (ft) amsl	Ringold Unit E Upper Contact m (ft) bgs	Depth to RUM Unit m (ft) bgs	Depth to Static Water Level m (ft) bgs	Screened Interval m (ft) bgs	Total Well Depth m (ft) bgs	Samples Planned (SAP)	Samples Collected			QC Samples Collected		
										1	2	3	Oct. 2011	Mar. 2010	May to June 2010
699-97-48B	152979.4	576049.3	125.99 (413.25)	N/P	12.10 (39.60)	9.33 (30.61)	16.92-18.60 (55.50-61.00)	19.51 (64.00)	3	09-Oct-09	18-Mar-10	18-May-10	--	FTB	--
699-98-43	153369.9	576862.1	122.44 (401.60)	N/P	10.40 (34.00)	6.61 (21.69)	5.93-10.52 (19.44-34.50)	11.43 (37.50)	3	09-Oct-09	18-Mar-10	18-May-10	--	--	--
699-98-49A	153310.1	574823.3	123.48 (405.01)	N/A	N/A	6.46 (21.18)	Not screened/perforated	7.92 (26)	3	09-Oct-09	29-Apr-10	17-May-10	--	--	--
699-98-51	153302.7	574339.3	120.40 (394.91)	N/P	7.60 (25.00)	3.51 (11.50)	3.17-7.74 (10.40-25.40)	8.66 (28.40)	3	09-Oct-09	30-Mar-10	18-May-10	--	--	--

Note: 199-D5-41 removed via *Tri-Party Agreement Change Notice Form: DOE/RL-2009-40, Sampling and Analysis Plan for the 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units Remedial Investigation/Feasibility Study, Rev. 0* (TPA-CN-368) (156 samples were taken versus the 159 mentioned in *Sampling and Analysis Plan for the 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units Remedial Investigation/Feasibility Study* [DOE/RL-2009-40]).

EBL = equipment blank

N/I = not identifiable from log

N/P = not present

N/R = well did not reach unit

The SAP specifies:	**QC collected data:**
3 EB rounds	4 EBs
3 field blank rounds	13 field blanks
3 DUP rounds	13 DUP
1 split/round	1 split
Total: 30 QC samples required	31 QC samples were taken

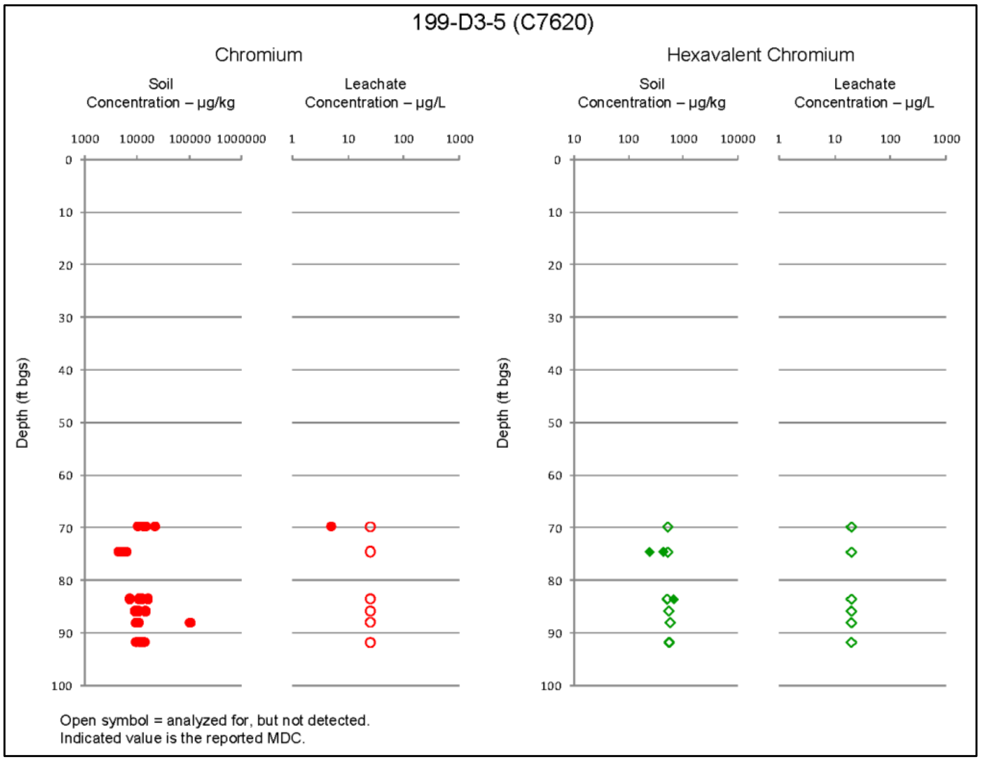


Figure C-1. Vertical Distribution of Chromium Batch Leaching Results for Well 199-D3-5 Drilled to Define the Extent of Cr(VI) in Groundwater West of the 118-D-2 Waste Site

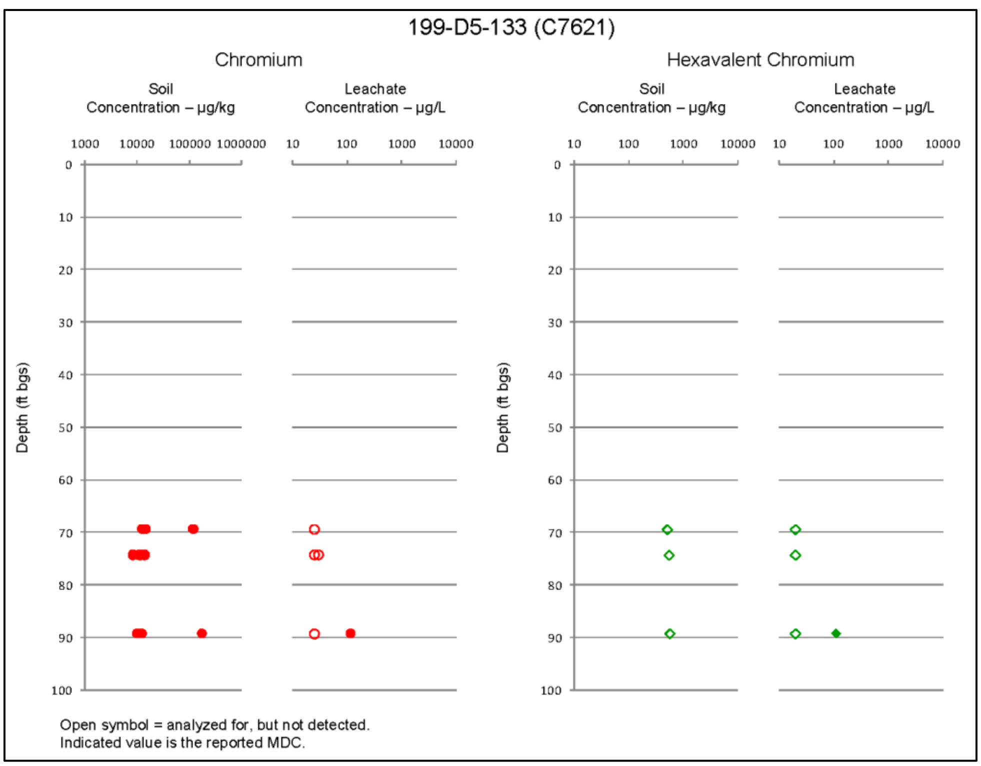


Figure C-2. Vertical Distribution of Chromium Batch Leaching Results for Well 199-D5-133 Drilled to Define the Extent of Cr(VI) and Strontium-90 in Groundwater Southwest of 105-DR

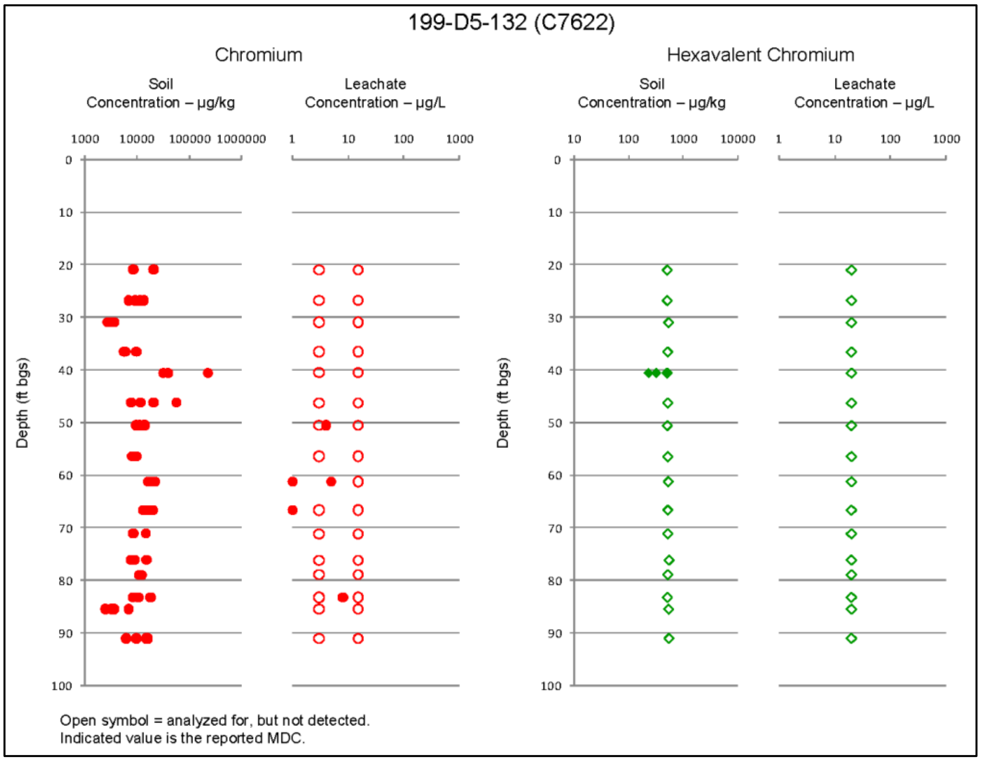


Figure C-3. Vertical Distribution of Chromium Batch Leaching Results for Well 199-D5-132 Drilled to Assess Vadose Zone Contamination Beneath Remediated Waste Site 116-D1-A and Define the Extent of Cr(VI) and Strontium-90 in Groundwater

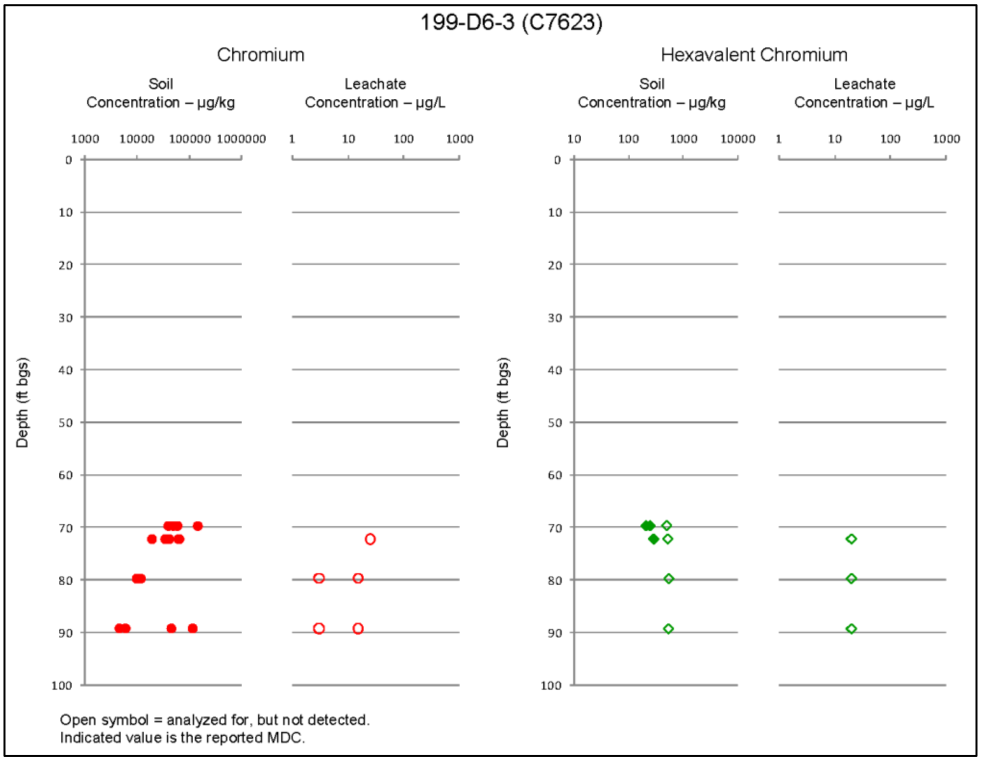


Figure C-4. Vertical Distribution of Chromium Batch Leaching Results for Well 199-D6-3 Drilled to Define the Extent of Cr(VI) and Strontium-90 in Groundwater East of D Reactor

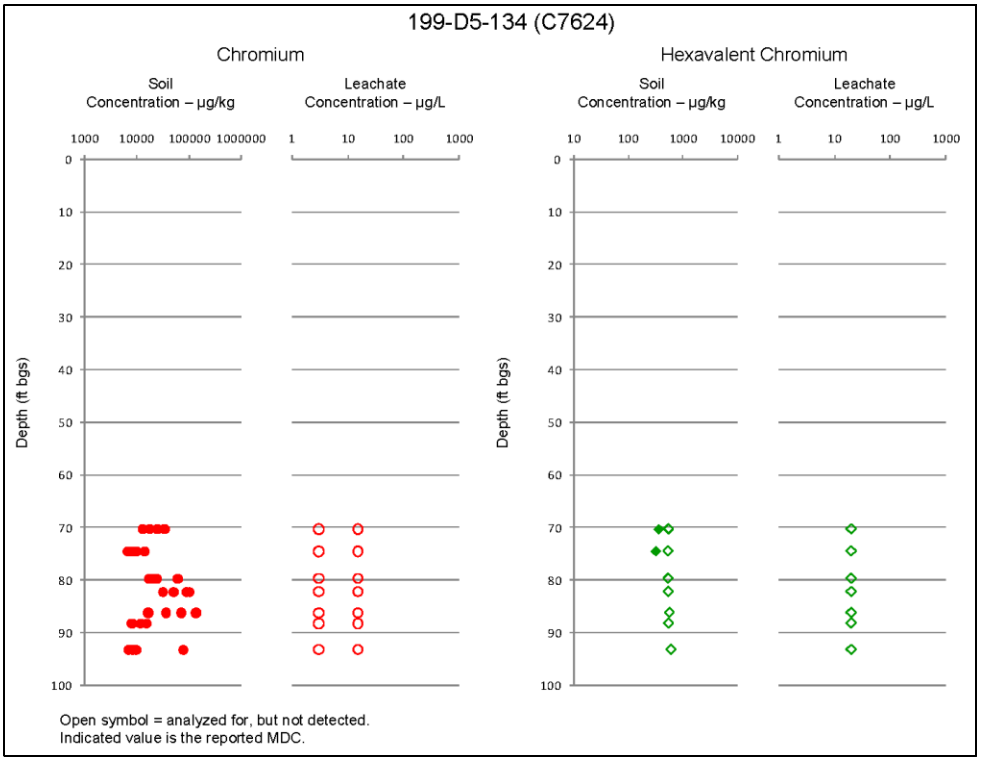
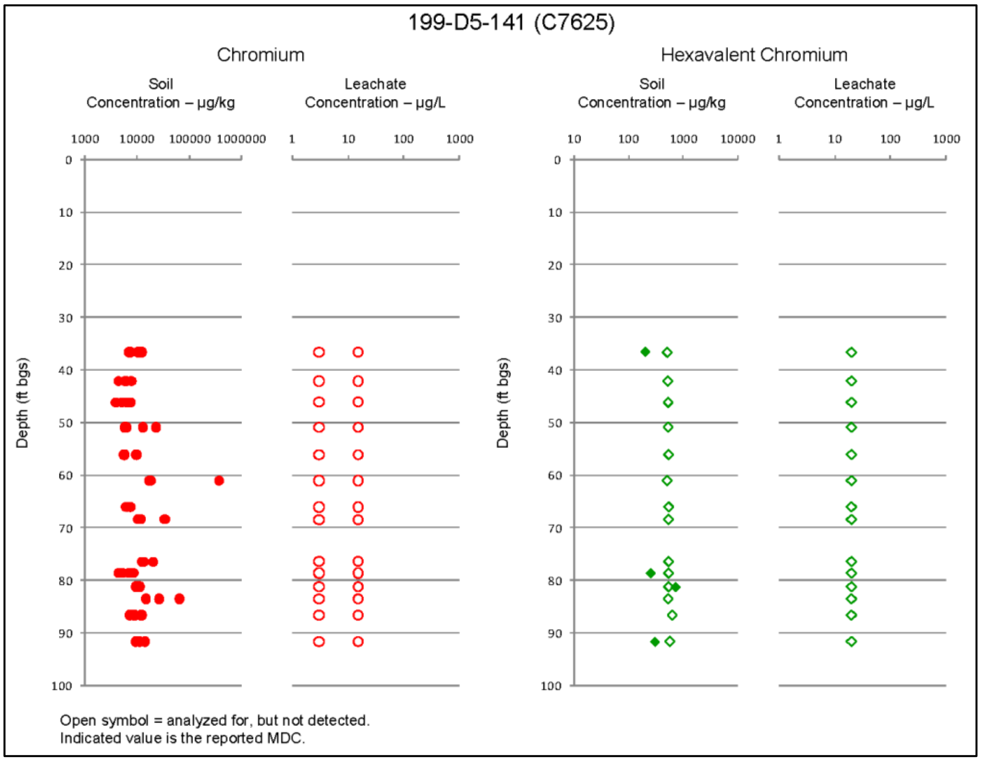
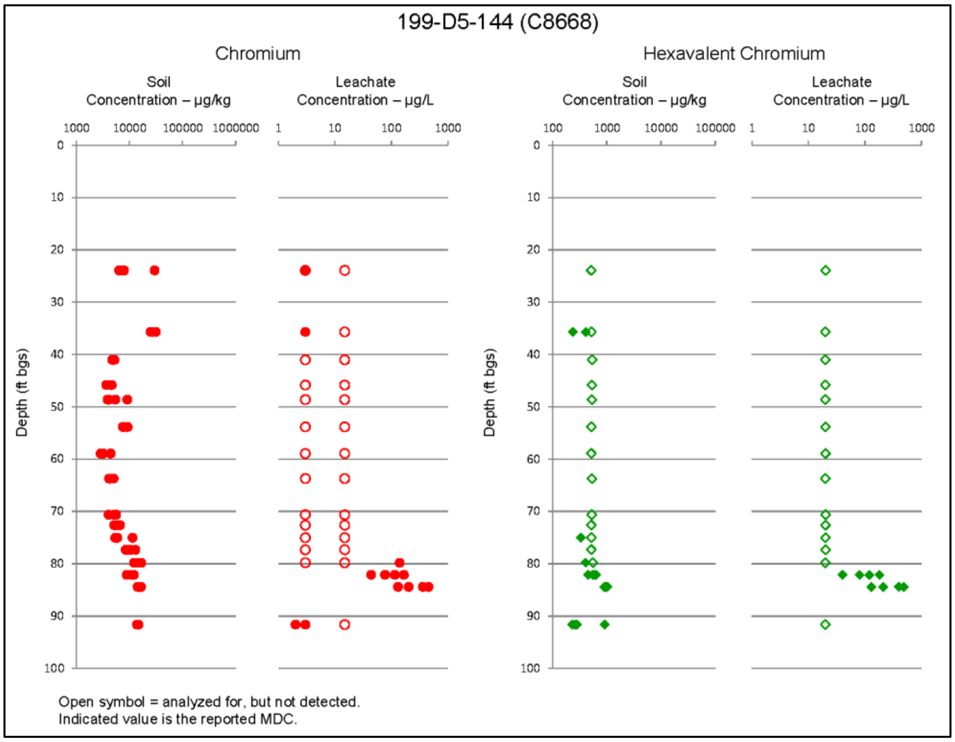


Figure C-5. Vertical Distribution of Chromium Batch Leaching Results for Well 199-D5-134 Drilled to Characterize the Deep RUM in the 100-D North Plume



Note: Well was drilled east of the intended 100-D-12 location.

Figure C-6. Vertical Distribution of Chromium Batch Leaching Results for Well 199-D5-141 Drilled to Characterize the Deep RUM in the 100-D South Plume



Note: Well was drilled at the intended 100-D-12 location.

Figure C-7. Vertical Distribution of Chromium Batch Leaching Results for Well 199-D5-144 Drilled to Characterize the Vadose Zone and Replace Misplaced Well 199-D5-141 in the 100-D South Plume

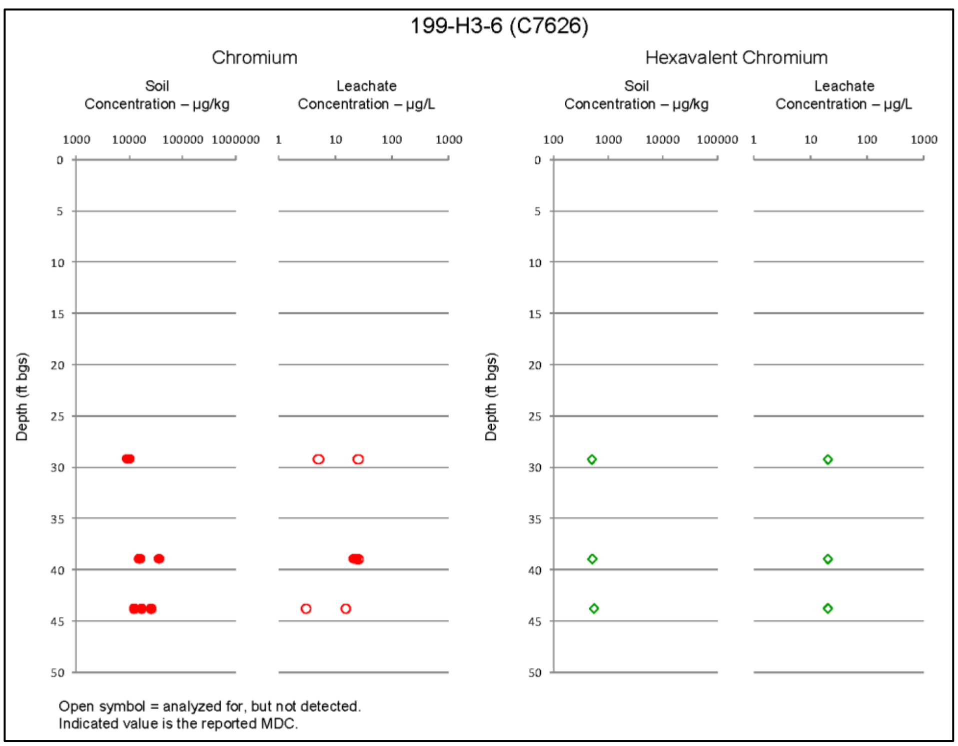


Figure C-8. Vertical Distribution of Chromium Batch Leaching Results for Well 199-H3-6 Drilled in the Unconfined Aquifer in 100-H East of the 116-H-1 Waste Site to Define the Extent of Strontium-90 in Groundwater

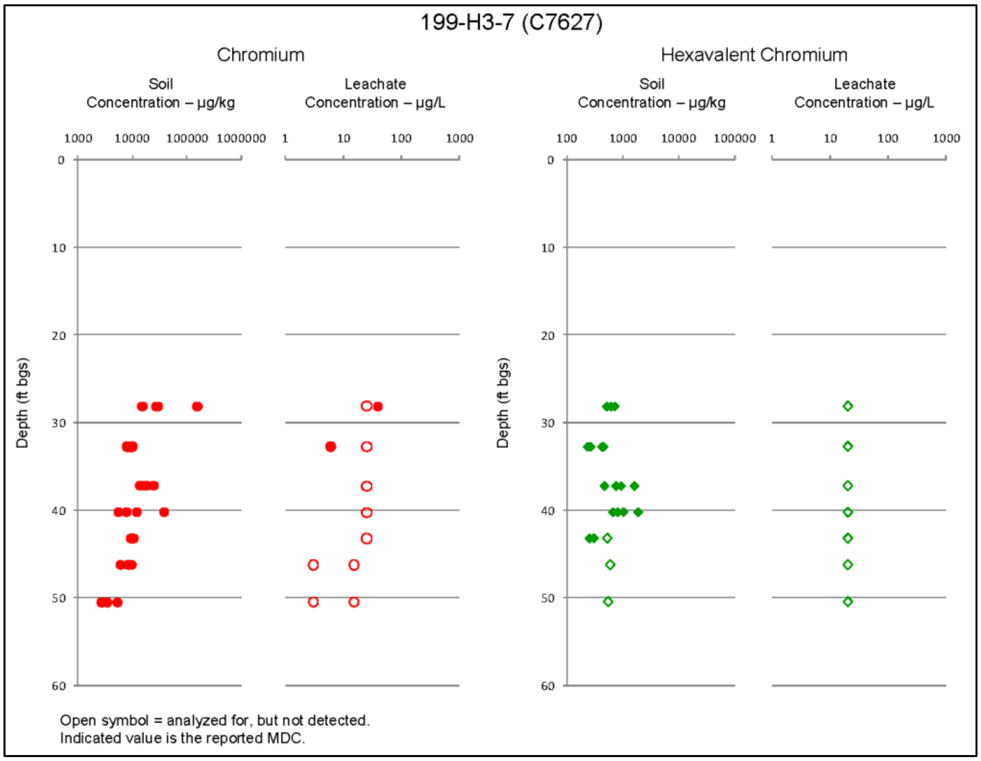


Figure C-9. Vertical Distribution of Chromium Batch Leaching Results for Well 199-H3-7 Drilled in the Unconfined Aquifer in 100-H West of the 116-H-1 Waste Site to Define the Extent of Strontium-90 in Groundwater

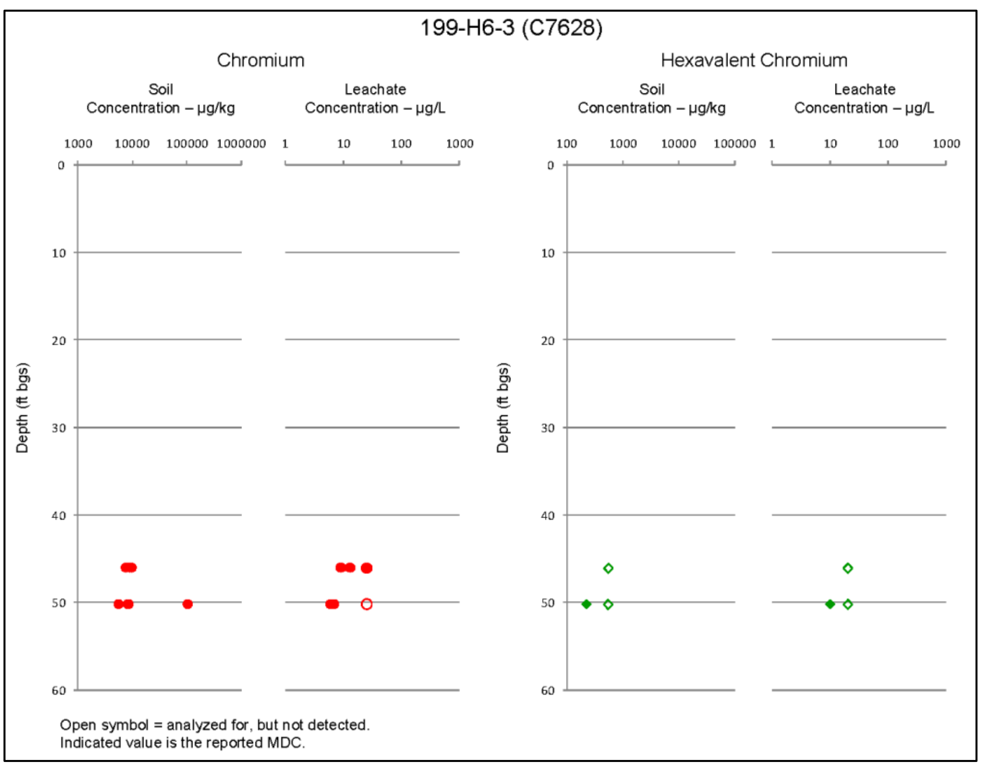


Figure C-10. Vertical Distribution of Chromium Batch Leaching Results for Well 199-H6-3 Drilled in the Southeast Side of 100-H to Define the Extent of Strontium-90 and Nitrate in Groundwater

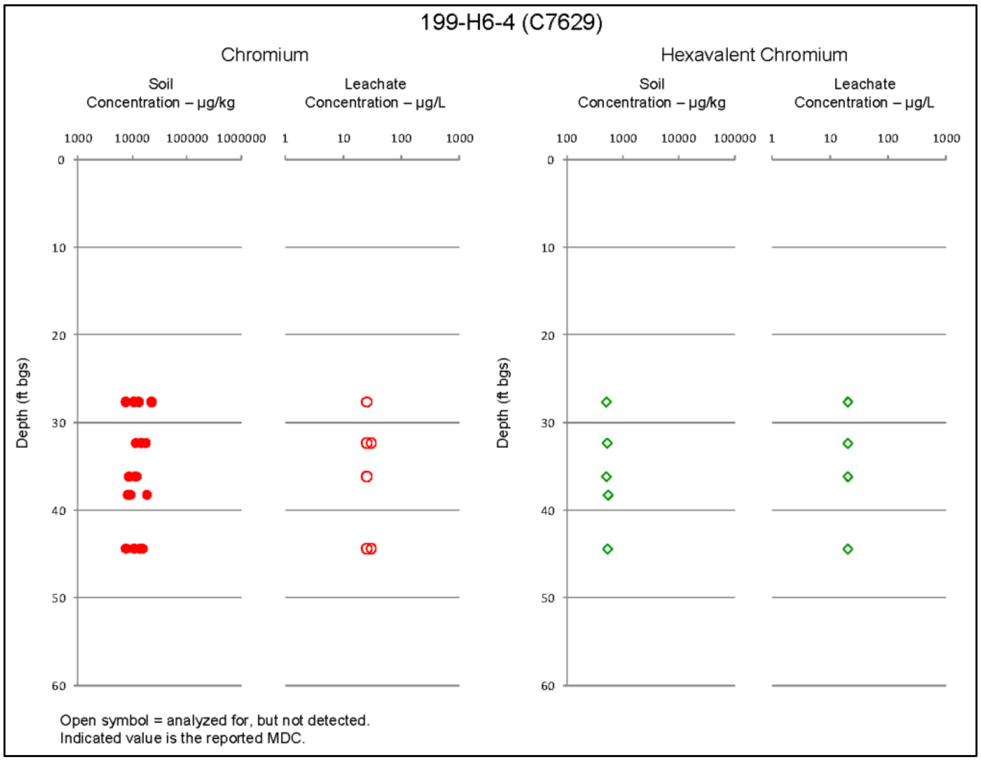


Figure C-11. Vertical Distribution of Chromium Batch Leaching Results for Well 199-H6-4 Drilled in the South Side of 100-H to Determine the Extent of Nitrate in Groundwater

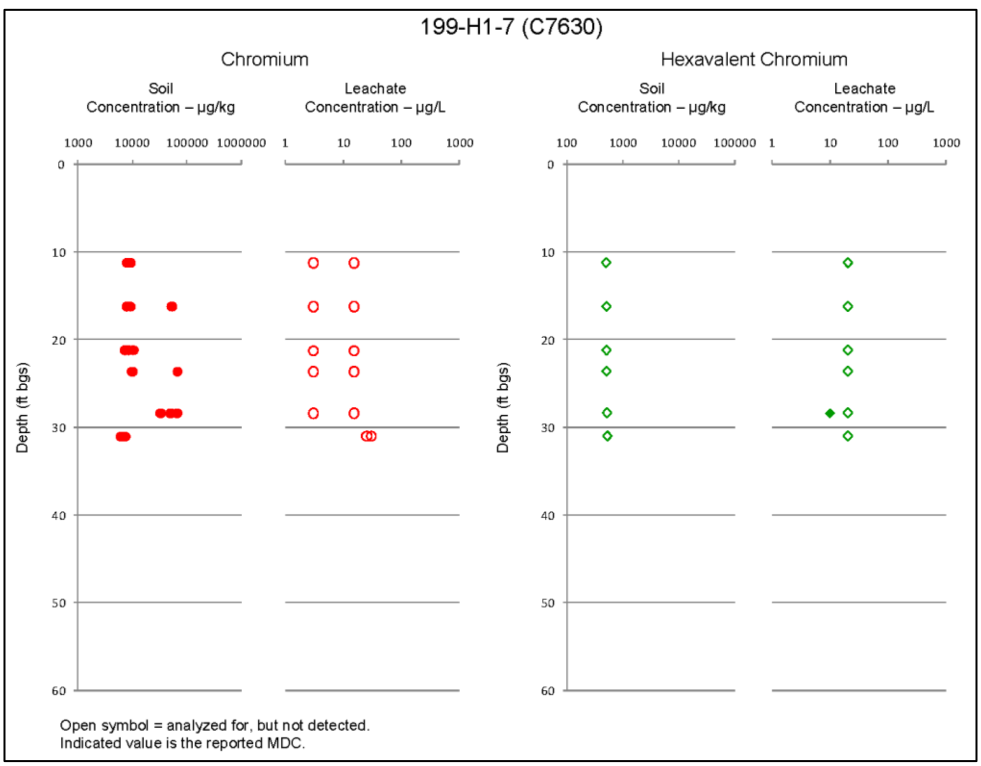
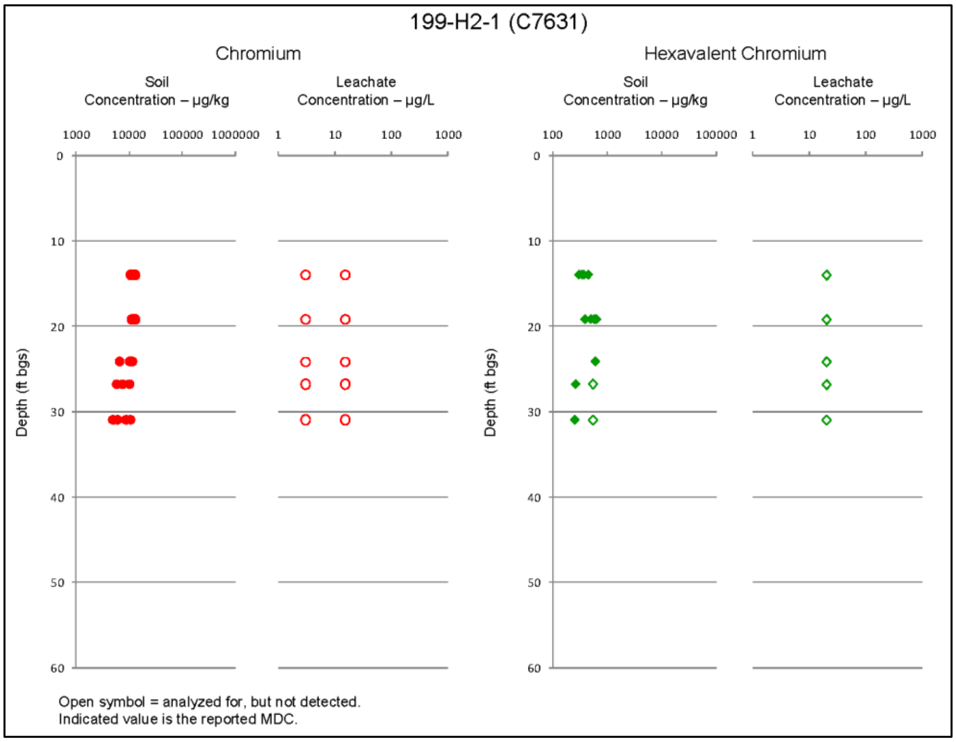


Figure C-12. Vertical Distribution of Chromium Batch Leaching Results for Well 199-H1-7 Drilled Downgradient of the 1607-H3 Septic Tank and Drain Field



FigureC-13. Vertical Distribution of Chromium Batch Leaching Results for Well 199-H2-1 Drilled in the Deep RUM Downgradient of the 1607-H3 Septic Tank and Drain Field to Define the Extent of Deep Contamination of Cr(VI)

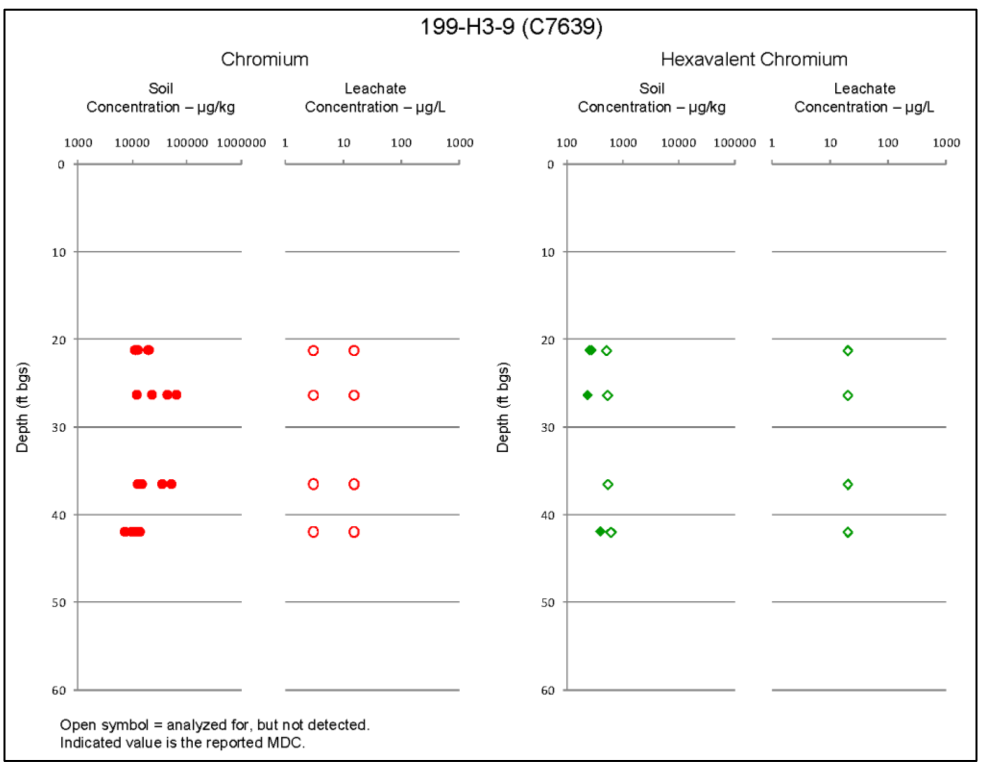


Figure C-14. Vertical Distribution of Chromium Batch Leaching Results for Well 199-H3-9 Drilled in the Deep RUM North of the 116-H-7 Waste Site to Define the Extent of Deep Contamination of Cr(VI)

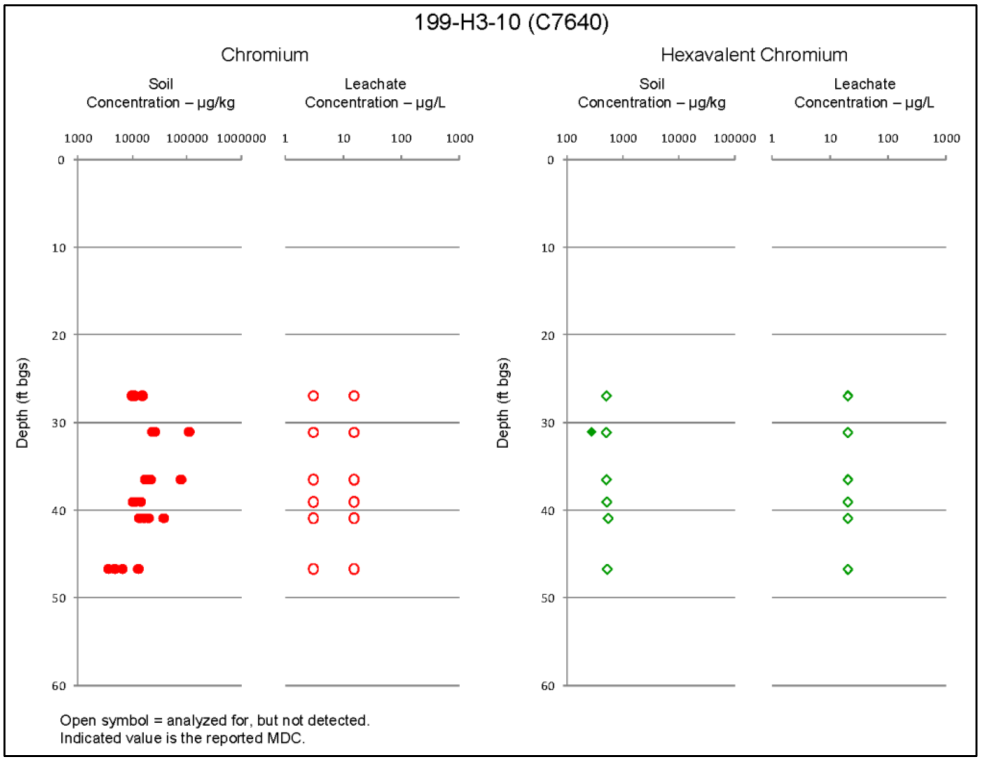


Figure C-15. Vertical Distribution of Chromium Batch Leaching Results for Well 199-H3-10 Drilled in the Deep RUM Northwest of H Reactor to Define the Extent of Deep Contamination of Cr(VI)

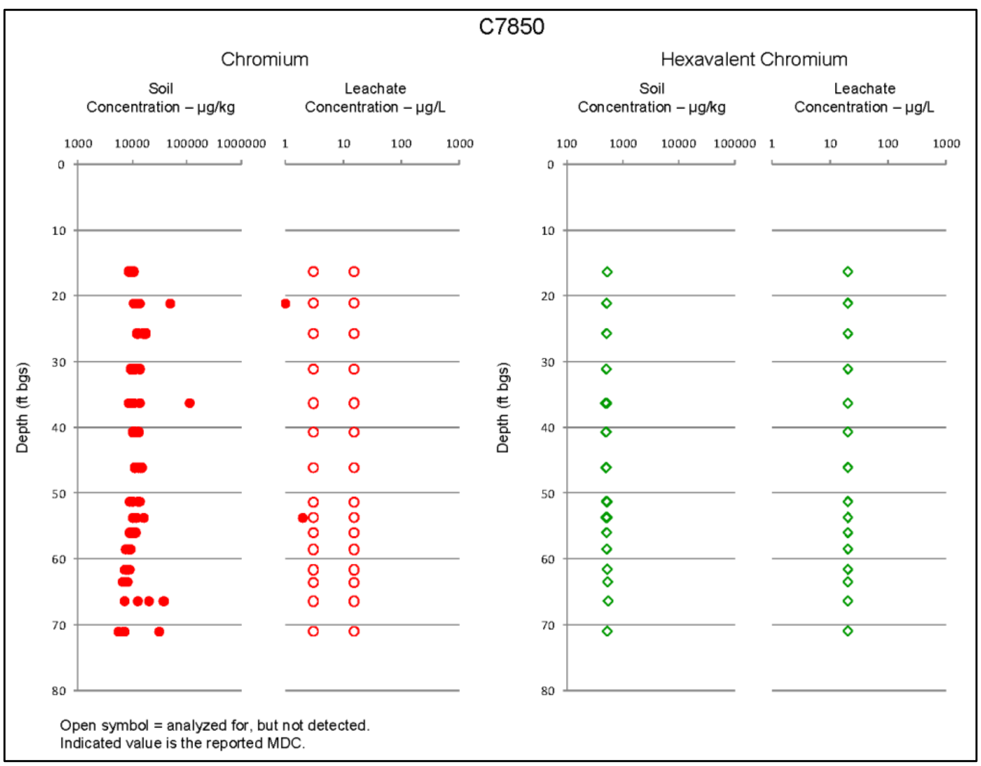


Figure C-16. Vertical Distribution of Chromium Batch Leaching Results for Boring C7850 Drilled to Characterize Residual Vadose Zone Contamination below the Depth of the Interim Action at the 116-DR-9 Retention Basin

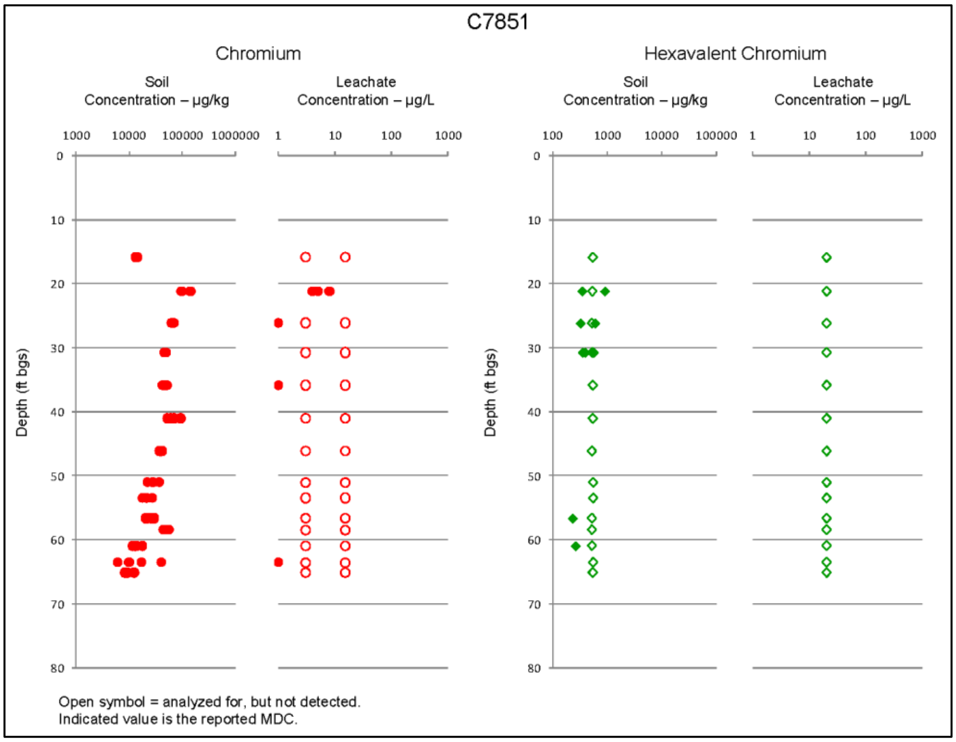


Figure C-17. Vertical Distribution of Chromium Batch Leaching Results for Boring C7851 Drilled to Characterize Residual Vadose Zone Contamination below the Depth of the Interim Action at the 116-D-7 Retention Basin

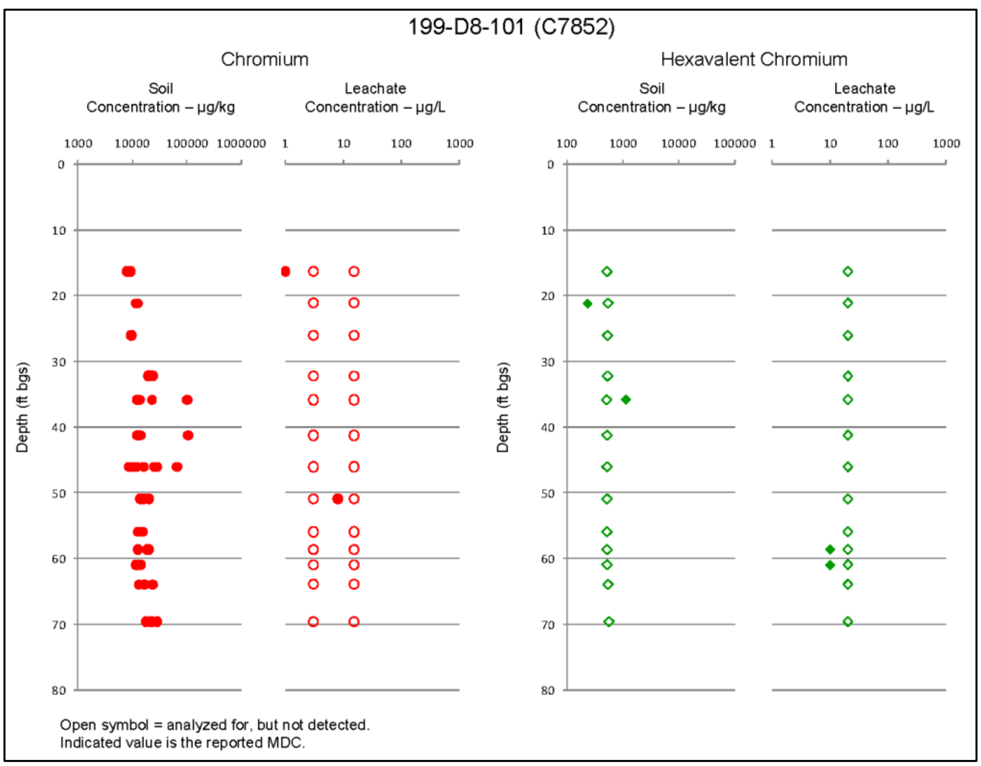


Figure C-18. Vertical Distribution of Chromium Batch Leaching Results for Boring C7852 Drilled to Characterize Residual Vadose Zone Contamination below the Depth of the Interim Action at the 116-DR-1&2 Trench

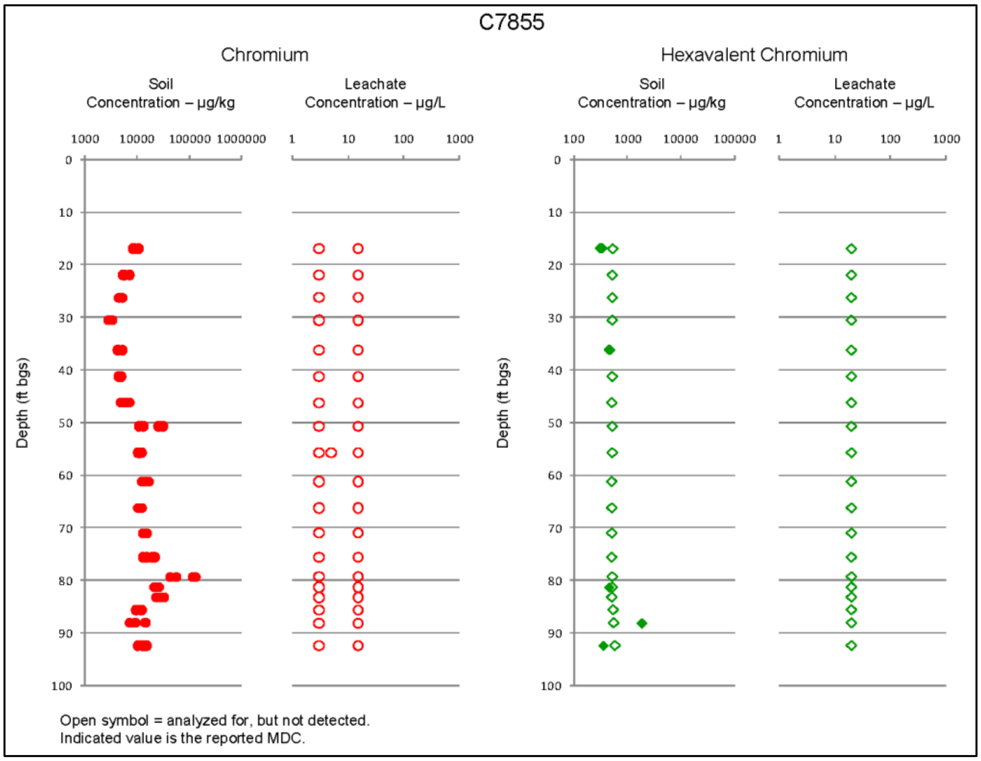


Figure C-19. Vertical Distribution of Chromium Batch Leaching Results for Boring C7855 Drilled to Characterize Residual Vadose Zone Contamination to Follow Up on the LFI at the 116-D-1B Trench

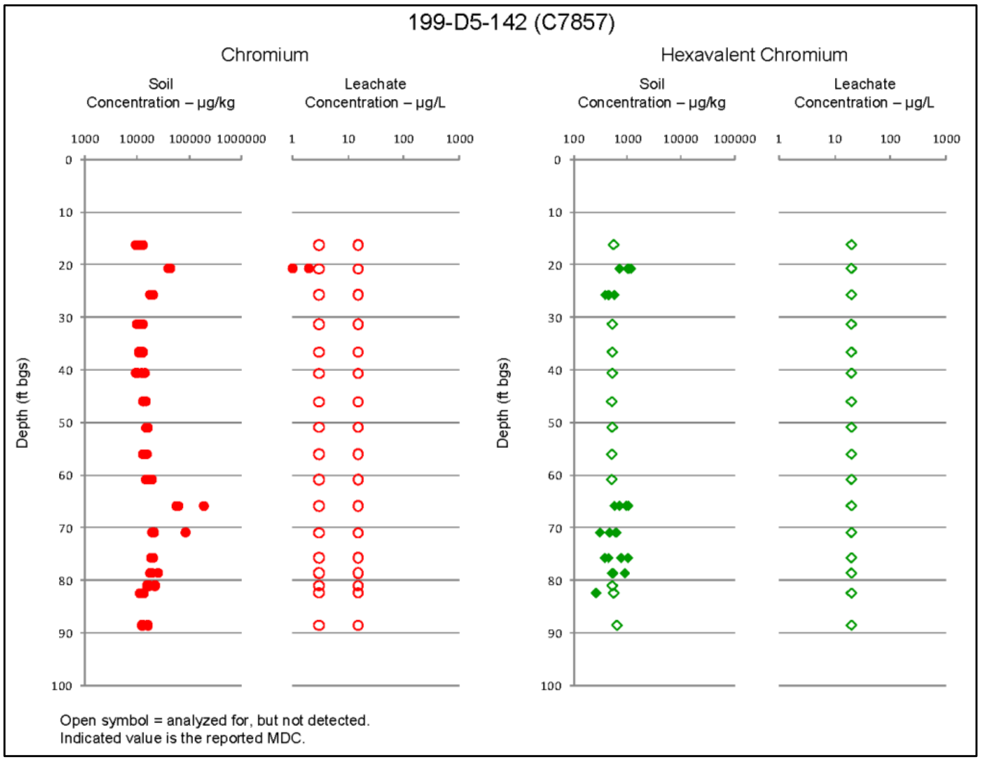


Figure C-20. Vertical Distribution of Chromium Batch Leaching Results for Boring C7857 Drilled to Characterize Vadose Zone Contamination at the 118-D-6 Reactor Fuel Storage Basin

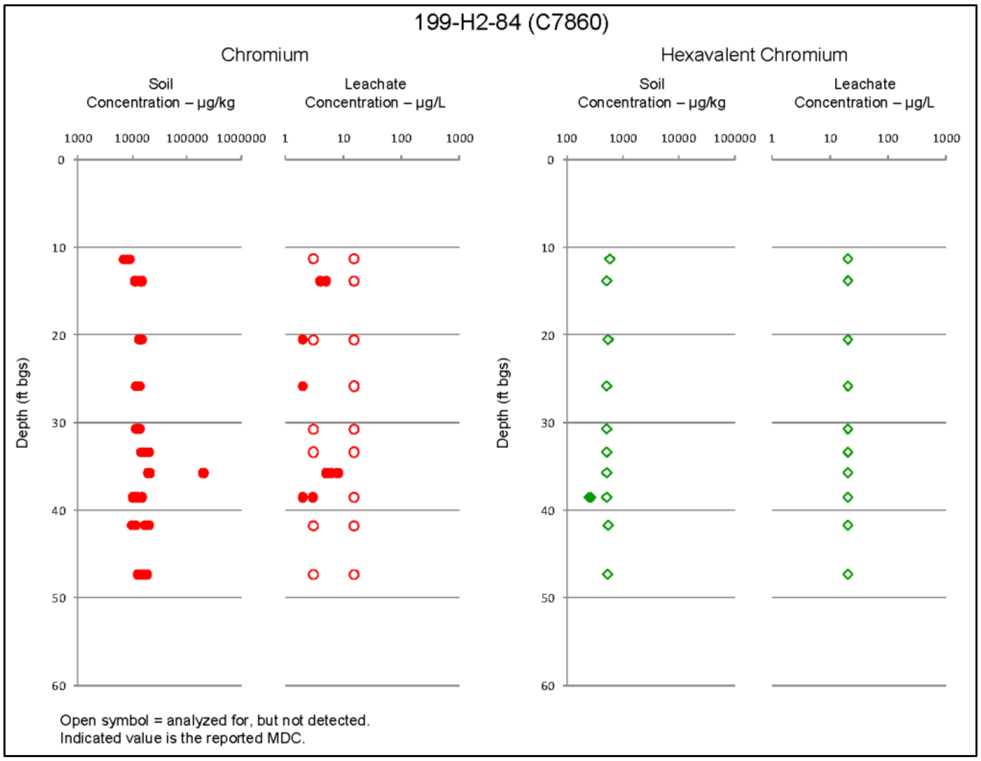


Figure C-21. Vertical Distribution of Chromium Batch Leaching Results for Boring C7860 Drilled to Characterize Vadose Zone Contamination at the 116-H-6 Solar Evaporation Basin

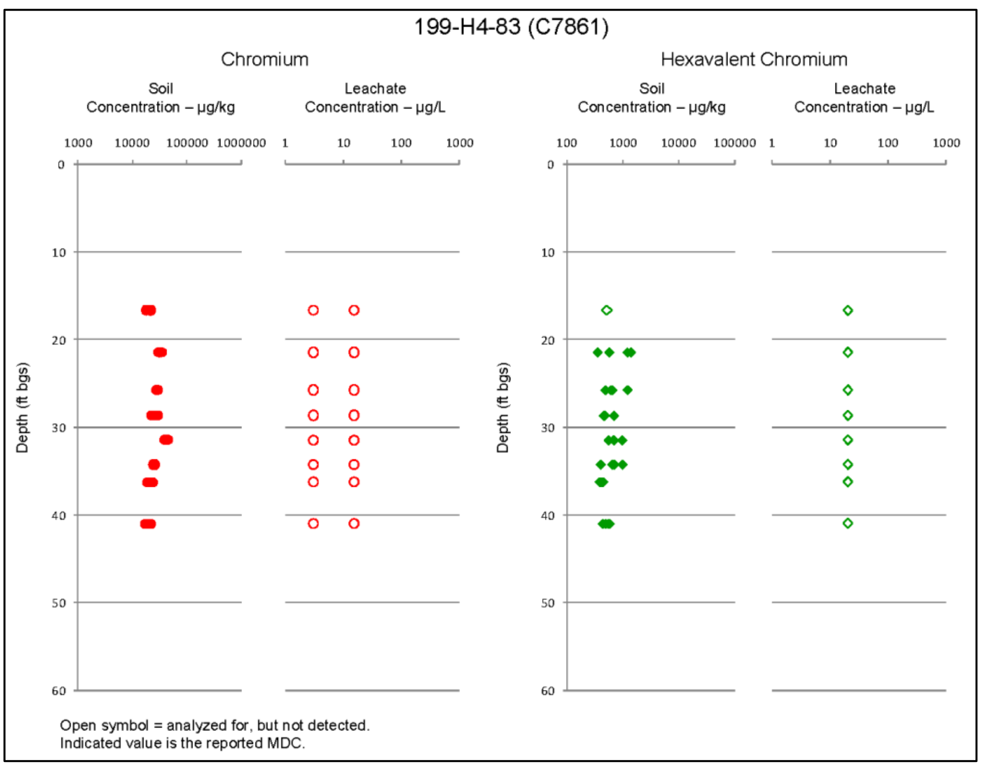


Figure C-22. Vertical Distribution of Chromium Batch Leaching Results for Boring C7861 Drilled to Characterize Vadose Zone Contamination below the Depth of Remedial Action at the 116-H-7 Retention Basin

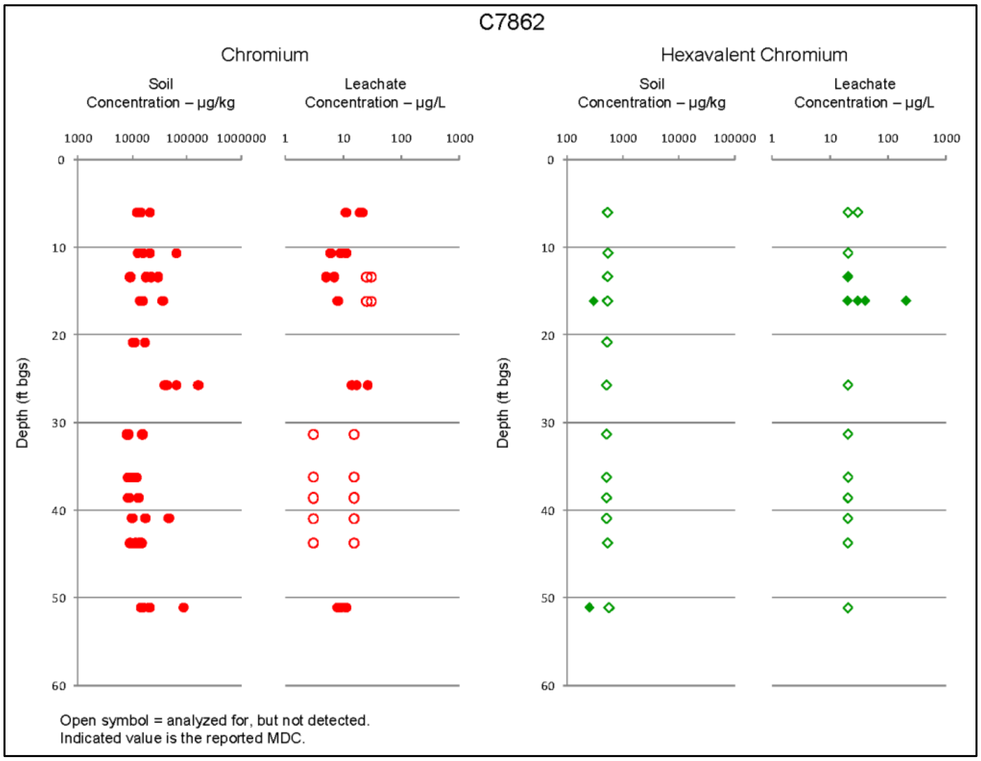


Figure C-23. Vertical Distribution of Chromium Batch Leaching Results for Boring C7862 Drilled to Characterize the Vadose Zone at the 116-H-4 Pluto Crib

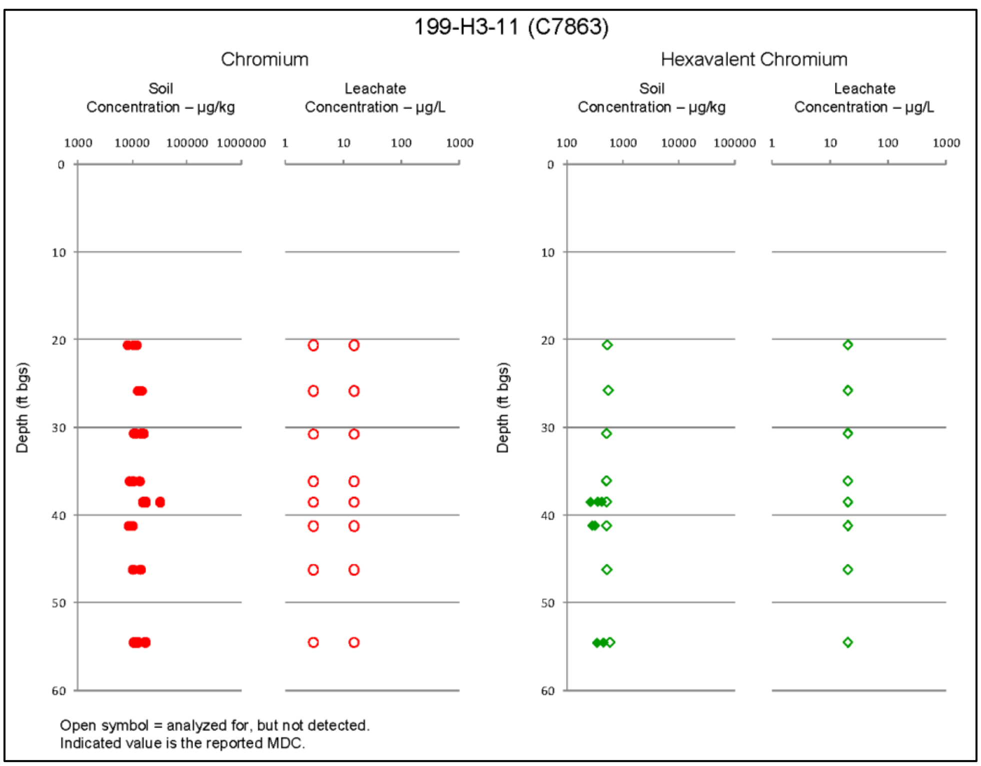


Figure C-24. Vertical Distribution of Chromium Batch Leaching Results for Boring C7863 Drilled to Characterize Vadose Zone Contamination at the 118-H-6 Reactor Fuel Storage Basin

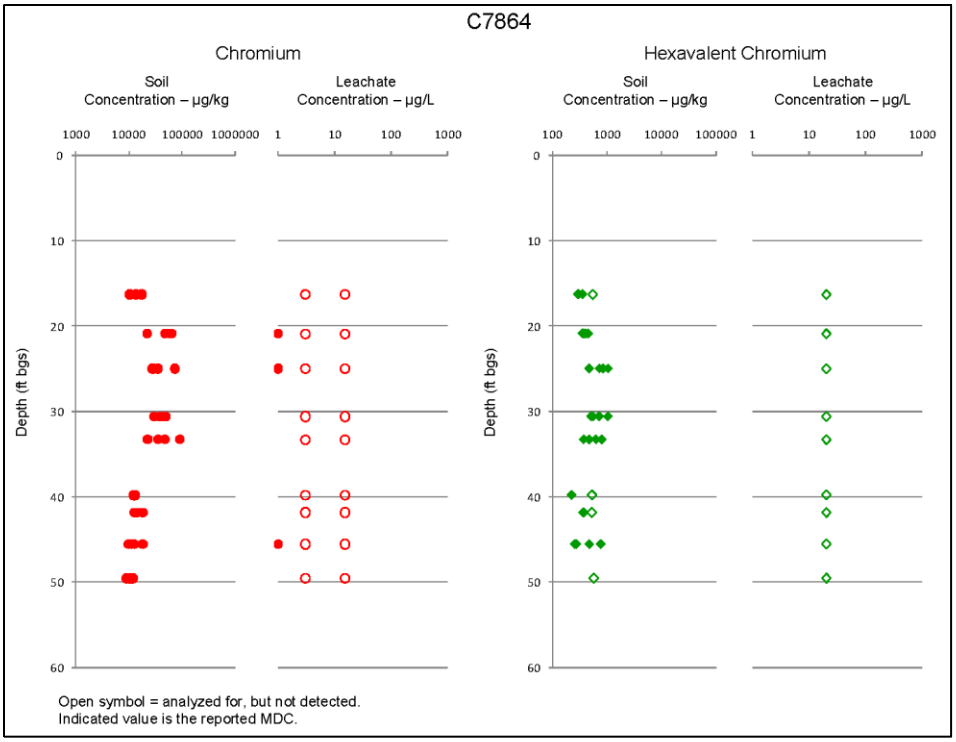
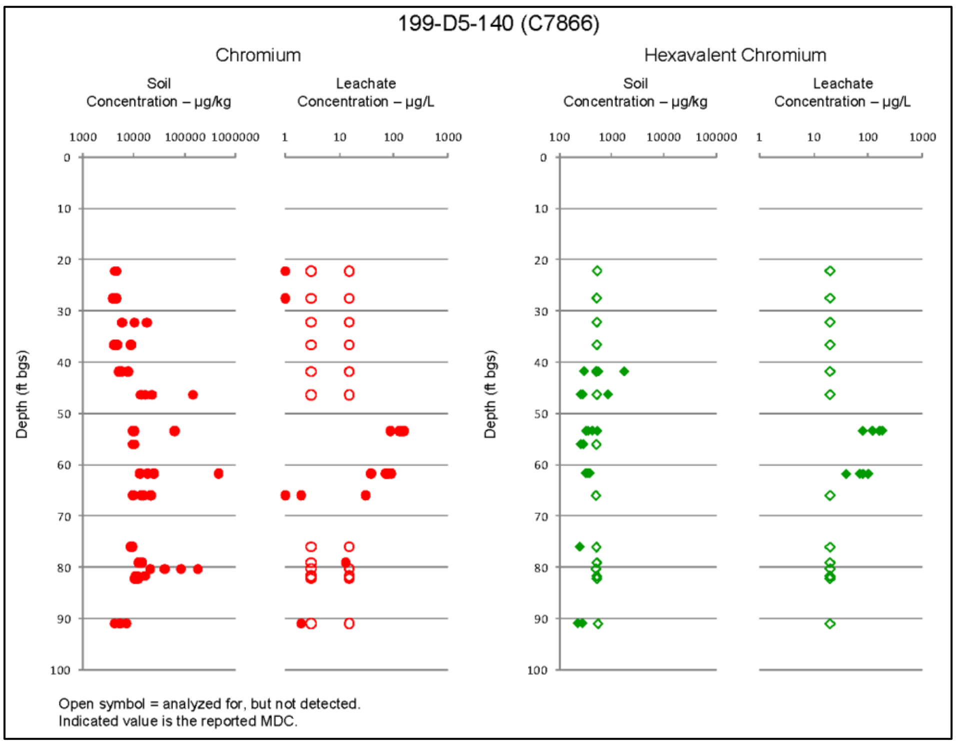


Figure C-25. Vertical Distribution of Chromium Batch Leaching Results for Boring C7864 Drilled to Characterize Residual Contamination below the Depth of Remediation at the 116-H-1 Trench



Note: Well was drilled 70 m east of intended location, immediately adjacent to the 108-D Chemical Pump House (where solid sodium dichromate was received and mixed for deliver to the 185-D, 190-D, and 105-D buildings).

Figure C-26. Vertical Distribution of Chromium Batch Leaching Results for Well C7866 Drilled with Intent to Define the Extent of Cr(VI) in Soil and Groundwater Near the 100-D-56 Sodium Dichromate Pipeline

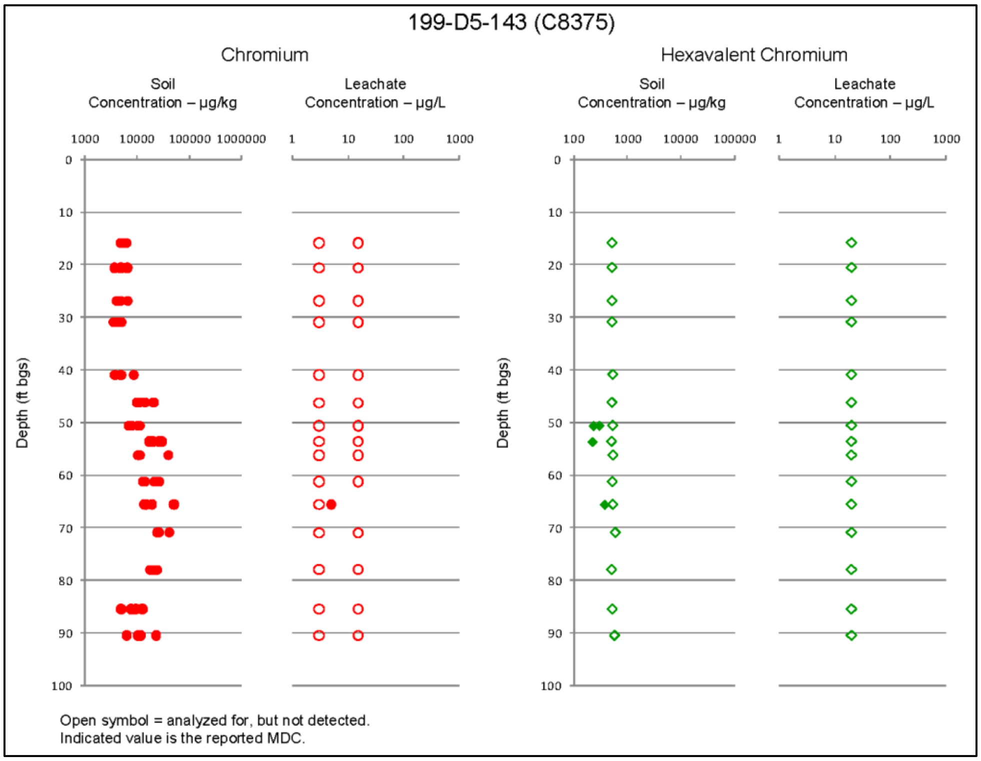


Figure C-27. Vertical Distribution of Chromium Batch Leaching Results for Well 199-D5-143 (C8375; Well 9 Redrill) Drilled to Define the Extent of Cr(VI) in Soil and Groundwater Near the 100-D-56 Sodium Dichromate Pipeline

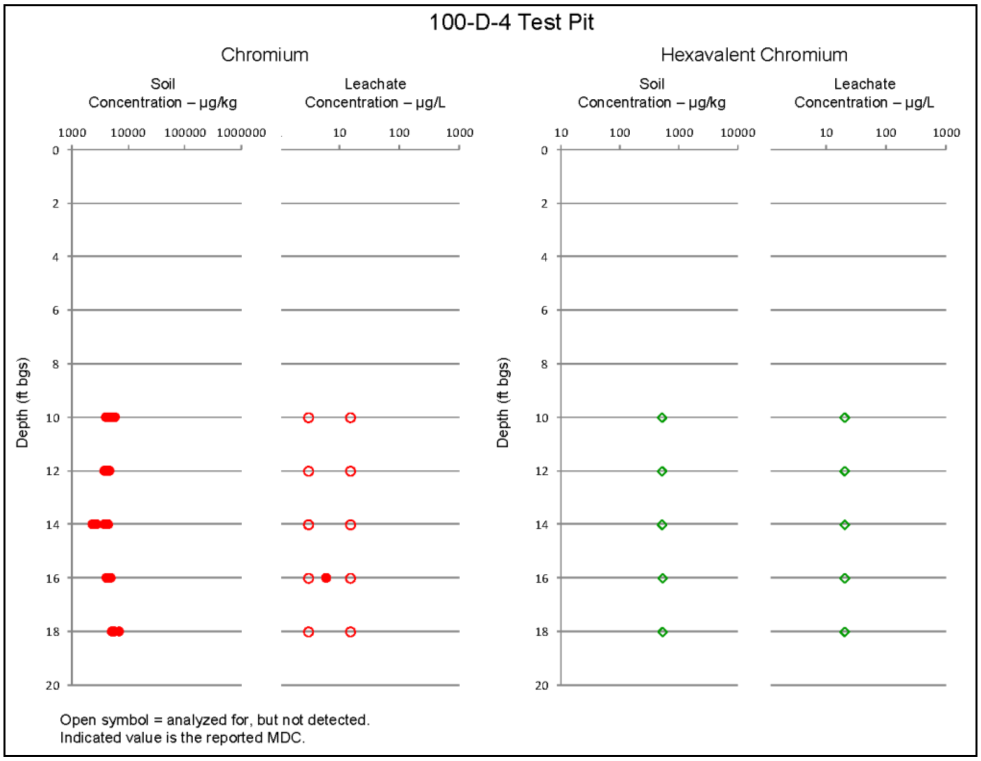


Figure C-28. Vertical Distribution of Chromium Batch Leaching Results for Test Pit at 100-D-4

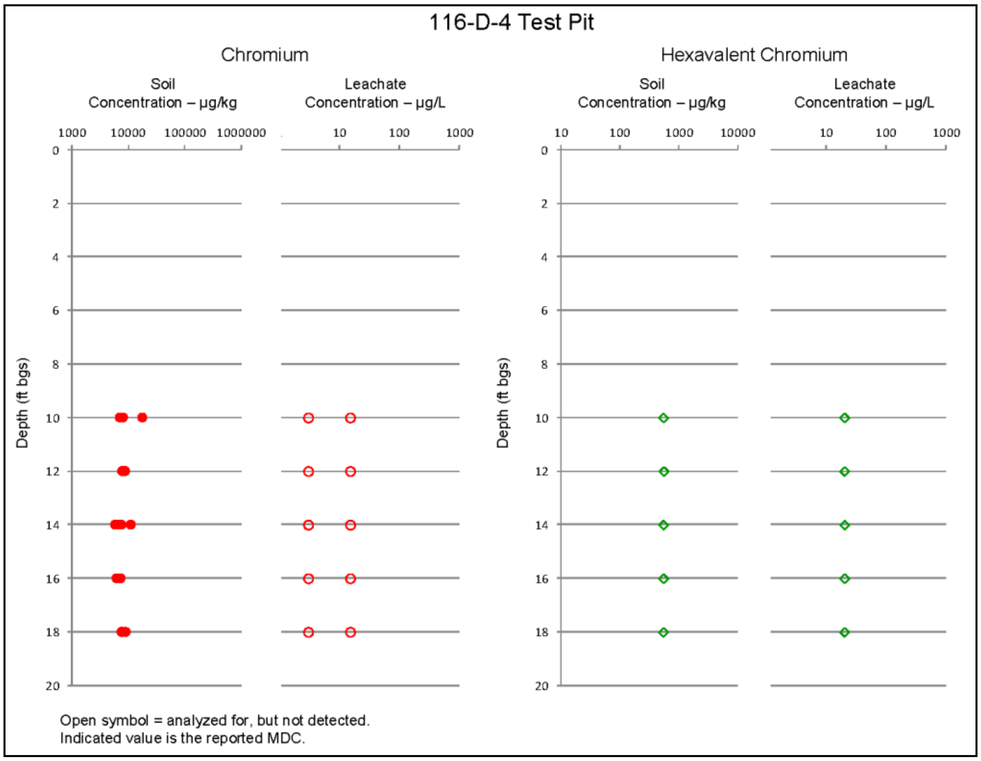


Figure C-29. Vertical Distribution of Chromium Batch Leaching Results for Test Pit at 116-D-4

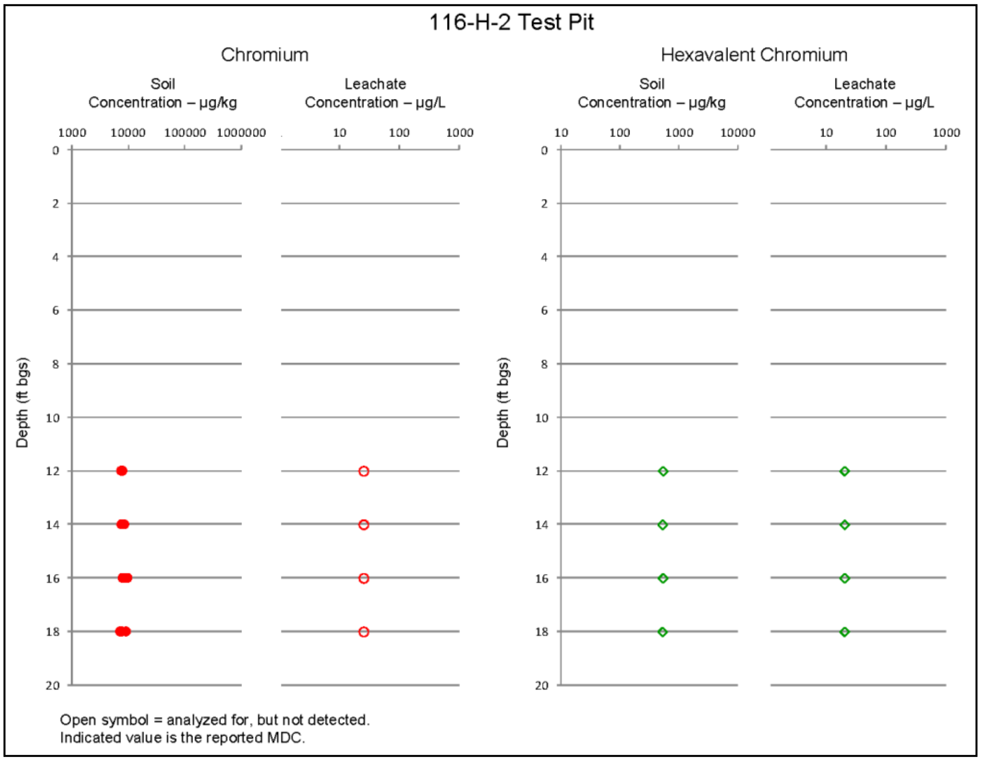


Figure C-30. Vertical Distribution of Chromium Batch Leaching Results for Test Pit at 116-H-2

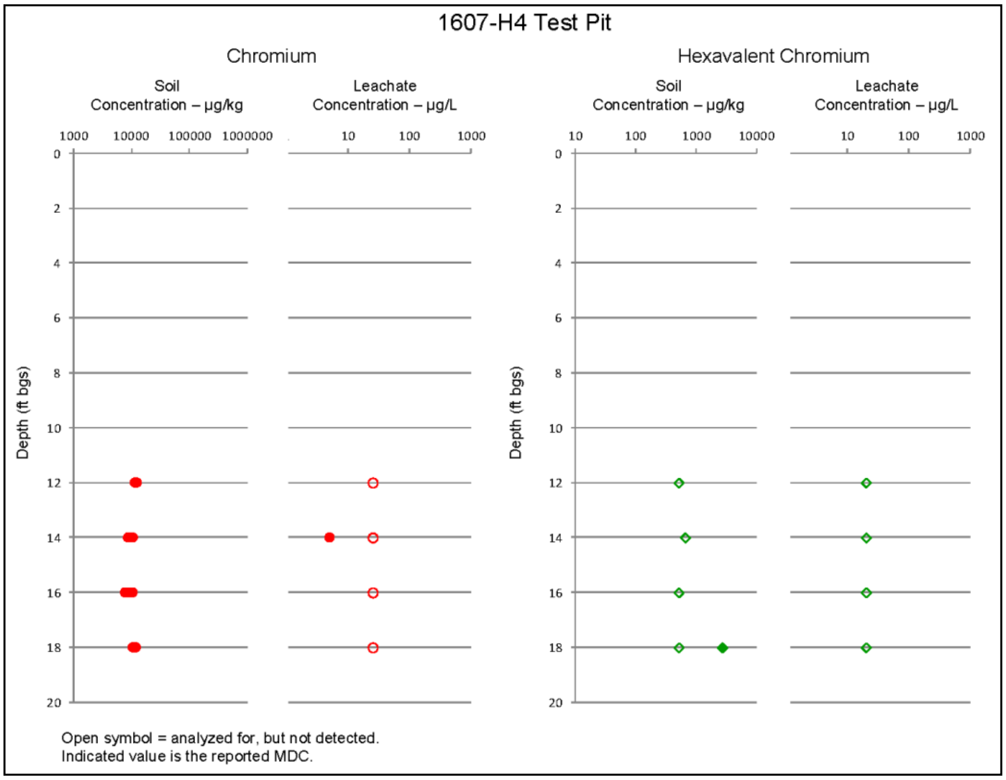


Figure C-31. Vertical Distribution of Chromium Batch Leaching Results for Test Pit at 1607-H4

ECF-100HR3-12-0011
Revision 0

Analysis of Slug Test Data at the 100-HR-3 OU

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

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ECF-100HR3-12-0011
Revision 0

Analysis of Slug Test Data at the 100-HR-3 OU

Document Type: TR Program/Project: SGRP

P. Khambhammettu
SSP&A

Date Published
May 2012

Prepared for the U.S. Department of Energy
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APPROVED
By D. M. Pinkal at 8:43 am, May 10, 2012

Release Approval Date

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Total Pages: 134

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Environmental Calculation Cover Page

Part 1: Completed by the Responsible Manager

Project: Soil and Groundwater Remediation **Date: 09-March-2012**

Calculation Title & Description: Analysis of Slug Test Data at the 100-HR-3 OU

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Part 2: Completed by Preparer

Calculation No.: ECF-100HR3-12-0011 **Revision No.: 0**

Revision History:

Revision No.	Description	Date	Affected Pages
0	Initial Issue	09-Mar-2012	All

Part 3: Document Review & Approval:

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1. Purpose

The purpose of this environmental calculation brief is to present the analysis of slug test data at wells in the 100-HR-3 Operating Unit. Withdrawal slug test data at sixteen wells are analyzed with AQTESOLV software. First-cut and refined estimates of hydraulic conductivity are provided.

2. Methodology

An effective initial displacement is estimated for each withdrawal test by back-fitting the measured displacement values to zero time. This effective initial displacement is compared with the theoretical initial displacement value for verification. The displacements are normalized by the effective initial displacement and analyzed using AQTESOLV aquifer test software which has computerized implementations of several analytical methods. A first-cut estimate of the hydraulic conductivity is estimated with the Cooper, Bredehoeft and Papadopulos [CBP] model (Cooper et al., 1967). A refined estimate is made with the Kansas Geological Survey [KGS] model for partial penetration (Hyder et al., 1994). Details regarding the two models are presented subsequently.

2.1 CBP Model

The CBP model considers a well that fully penetrates a 'Theissian aquifer' (infinite in areal extent, uniform and perfectly confined) (Cooper et al., 1967). The model has two important advantages over approximate methods such as those of Hvorslev (1951) and Bouwer and Rice (1976):

1. The model incorporates storage in the formation; and
2. The model incorporates a rigorous representation of the geometry of the tests.

The CBP model assumes purely radial flow which is strictly valid for a well penetrating the full thickness of an aquifer. For partially penetrating wells the assumption of purely radial flow is invalidated to some degree. In general, the error introduced by ignoring partial penetration is typically not very significant. If the length of the screen is greater than about 20 times the radius, then flow will be essentially radial. The errors introduced by neglecting vertical components of flow are further limited in vertically anisotropic aquifers in which the vertical hydraulic conductivity is lower than the horizontal, if it is assumed that the effective thickness of the aquifer is equal to the length of the well screen.

The solution can be plotted as a set of type curves which show the variation of normalized displacement over time; each curve corresponding to a combination of transmissivity, storage coefficient, casing and screen radii. The aquifer parameters can be estimated by matching the type curve from the observed data with the library of analytical type curves. AQTESOLV provides the option of matching the curves visually or using automatic parameter-estimation methods.

2.2 KGS Models

The KGS models were developed for analyzing slug tests in wells that penetrate a portion of a perfectly confined or unconfined aquifer that is uniform, anisotropic and infinite in areal extent (Hyder et al., 1994). As with the CBP model, these models incorporate storage in the formation and are based on a correct fluid balance for the well screen; while also accommodating a well of any radius and extending over any length of the aquifer. They also consider two alternative boundary conditions for the top of the formation: no-flow (as with the CBP model) and constant-head.

The KGS models represent state-of-the-art in slug test interpretation. They are free of restrictive geometries and also free of questionable conceptions of hydraulic processes. AQTESOLV can estimate the aquifer parameters with the KGS models with the aid of automatic parameter-estimation methods.

Approximate methods of analysis, such as the Bouwer and Rice method, are not applied in this investigation. The CBP and KGS analyses are more rigorous, and have the advantage of being able to match the entire responses, instead of restricting attention to that portion of the data which appears to approximate a straight line.

3. Software Applications, Descriptions, Installation & Checkout, and Statements of Validity

3.1 Description

AQTESOLV (Calculation Software)

- Software Title: AQTESOLV by HydroSolve Inc. (www.aqtesolv.com); software for the design and analysis of aquifer tests in confined, unconfined, leaky and fractured aquifers.
- Software Version: Version 4.5 for Windows.
- The software identified above was used consistent with its intended use for, and is a valid use of this software for, the problem addressed in this application.
- The software was used within its limitations.

4. Calculation

The well locations for the D-Area Wells and the H-Area wells are shown in Figures 4-1 and Figure 4-2 respectively. The locations of the D and H areas and other Hanford groundwater interest areas are visually shown in Figure 5-1 of section 5. The well/screen information for the D Area Wells and the H Area Wells is tabulated respectively on Tables 4-1 and Table 4-2.

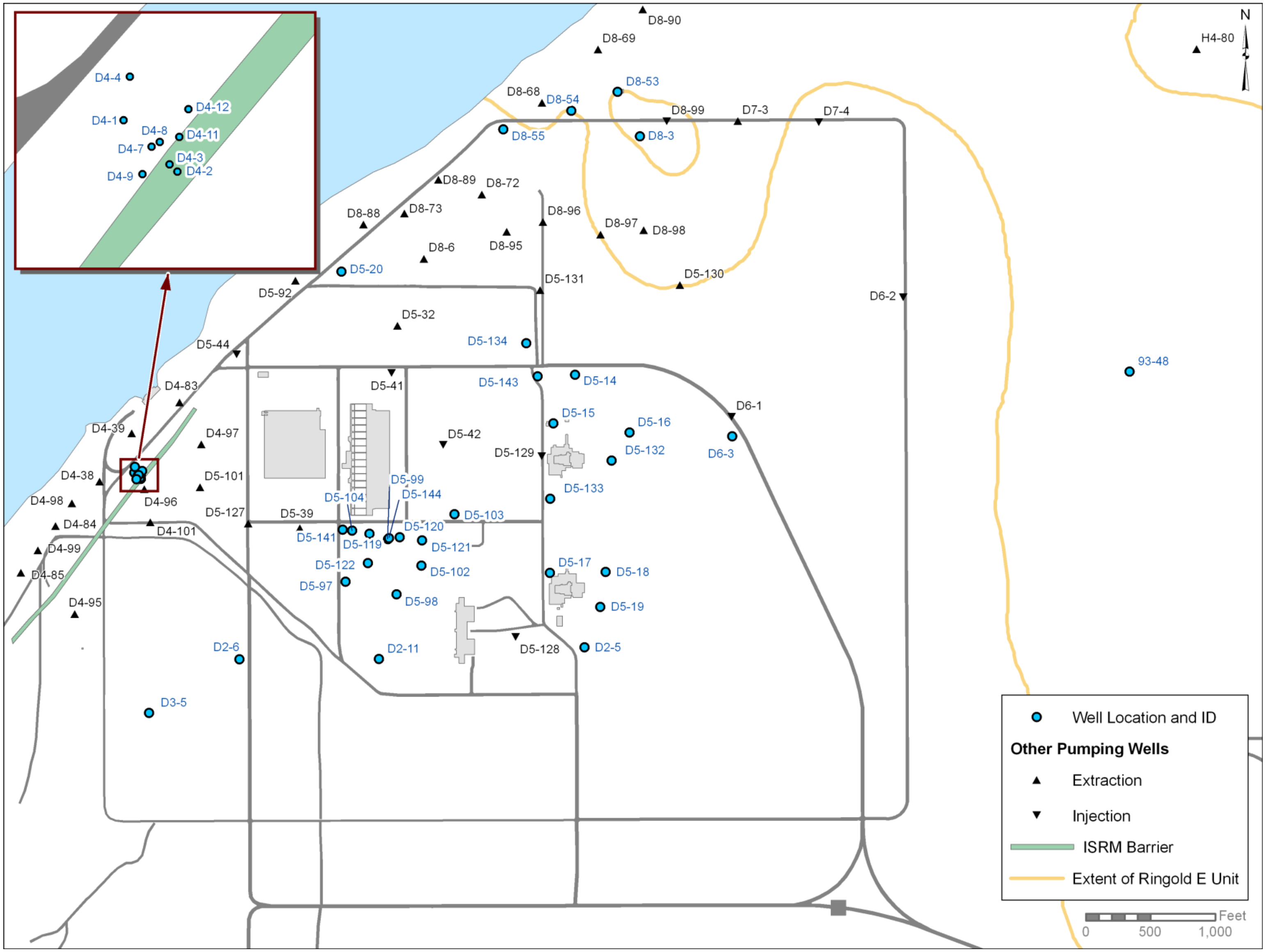

Figure 4-1. Well locations for D-Area Wells

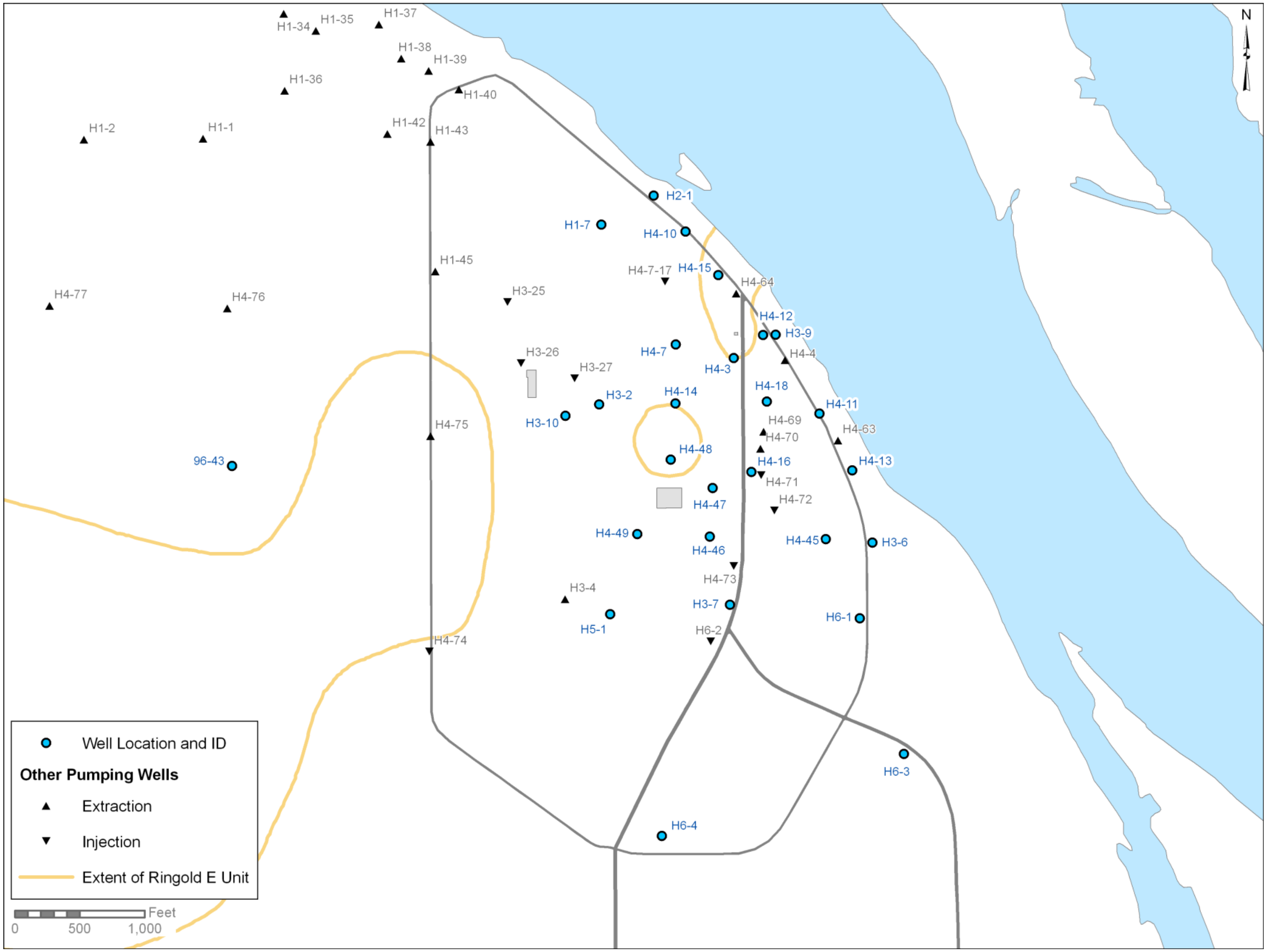

Figure 4-2. Well locations for H-Area Wells

Table 4-1. Well / screen information for D-Area Wells.

	199-D3-5	199-D5-132	199-D5-133	199-D5-134	199-D5-141	199-D5-143	199-D5-144	199-D6-3
Easting (m)	572787.66	573875.35	573731.55	573675.32	573243.43	573701.53	573352.03	574159.09
Northing (m)	150994.54	151586.87	151497.37	151862.46	151424.51	151784.26	151404.83	151643.85
Land Surface Elevation (m)	144.78	145.07	144.12	144.33	144.94	144.43	144.94	143.93
Hanford-Ringold unit E Contact Elevation (m)	117.14	128.85	126.98	127.48	126.21	126.31	126.62	125.17
Top of RUM (m)	111.94	112.76	111.48	110.58	110.11	111.71	111.17	112.47
Water Table Elevation (m)	118.78	119.77	120.13	118.56	118.77	119.60	119.83	118.93
Screen Top Elevation (m)	123.03	121.14	121.93	104.92	96.61	121.05	123.48	121.43
Screen Bottom Elevation (m)	113.89	113.52	112.80	101.84	93.56	113.43	112.82	113.81
Casing Diameter (inches)	6	6	6	6	6	6	4	6
Borehole diameter (inches)	10.75	10.75	10.75	10.75	10.75	10.75	8.75	10.75
Well log description	Mixture of Sand, Gravel, and Silt	Mixture of Sand, Gravel, and Silt	Mixture of Sand, Gravel, and Silt	Gravelly Sandy Silt	Gravelly Silt	Silty Sandy Gravel	Mixture of Sand, Gravel, and Silt	Silty Sandy Gravel
Geologic Unit in 100 Area Model	Hanford and Ringold E	Ringold E	Ringold E	RUM	RUM	Ringold E	Ringold E	Ringold E

Table 4-2. Well / screen information for H-Area Wells.

	199-H2-1	199-H3-6	199-H3-7	199-H3-9	199-H3-10	199-H6-3	199-H6-4	199-H1-7
Easting (m)	577752.31	578266.47	577931.74	578039.12	577545.14	578340.40	577771.59	577629.60
Northing (m)	153239.89	152425.33	152279.97	152913.60	152723.52	151929.35	151737.10	153172.10
Land Surface Elevation (m)	124.10	128.53	129.07	127.02	129.01	128.40	127.46	125.53
Hanford-Ringold unit E Contact Elevation (m)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Top of RUM (m)	112.65	111.45	112.79	110.84	111.45	109.66	110.09	114.15
Water Table Elevation (m)	116.21	115.56	116.21	115.17	116.80	115.45	116.21	116.37
Screen Top Elevation (m)	105.49	118.93	118.68	104.05	98.54	117.98	118.62	119.77
Screen Bottom Elevation (m)	102.44	112.84	114.11	101.00	95.49	110.36	111.00	116.72
Casing Diameter (inches)	6	6	6	6	6	6	6	6
Borehole diameter (inches)	10.625	10.75	10.75	10.625	10.625	10.75	10.75	10.75
Well log description	Slightly Silty Sand	Sandy Gravel	Sandy Gravel	Sand	Sand and Sandy Silt	Mixture of Sand, Gravel, and Silt	Sandy Gravel	Mixture of Sand, Gravel, and Silt
Geologic Unit in 100 Area Model	RUM	Hanford	Hanford	RUM	RUM	Hanford	Hanford	Hanford

4.1 Analysis of Slug Test Data at well 199-D3-5

Three withdrawal tests were conducted at 199-D3-5 and all of them are analyzed here.

4.1.1 Raw displacement data for withdrawal tests

The three withdrawal tests were conducted with slugs of volume 0.688 ft^3, 0.328 ft^3 and 0.472 ft^3 respectively. The displacements are plotted in Figure 4.3. The normalized displacements in section 4.1.4 will tell us if these responses are consistent. Inspection of the displacements suggests that the tests are not instantaneous but that there is an effective start time for each test. These effective start times are estimated in section 4.1.2.

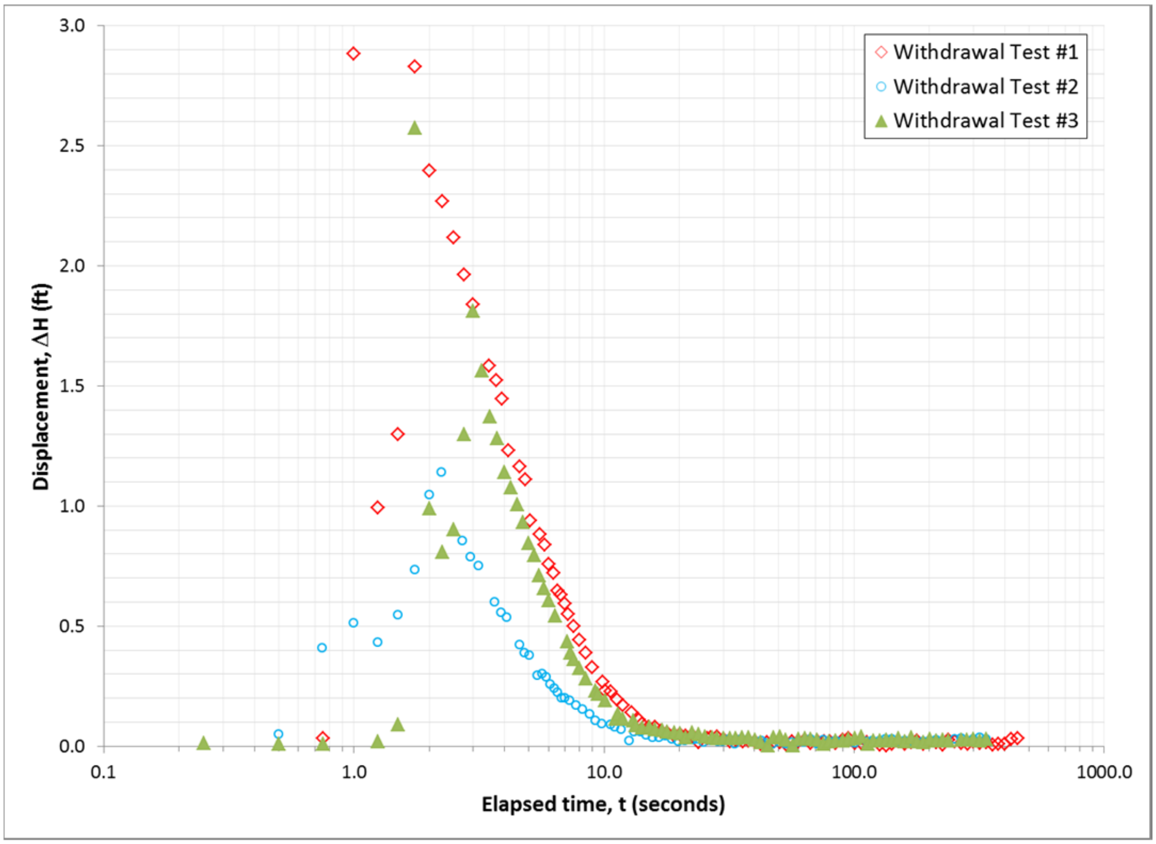

Figure 4-3. Displacements from three withdrawal tests at 199-D3-5

4.1.2 Estimation of effective start time

Effective start times of 1.75 seconds, 2.25 seconds and 1.75 seconds are estimated for the three withdrawal tests respectively.

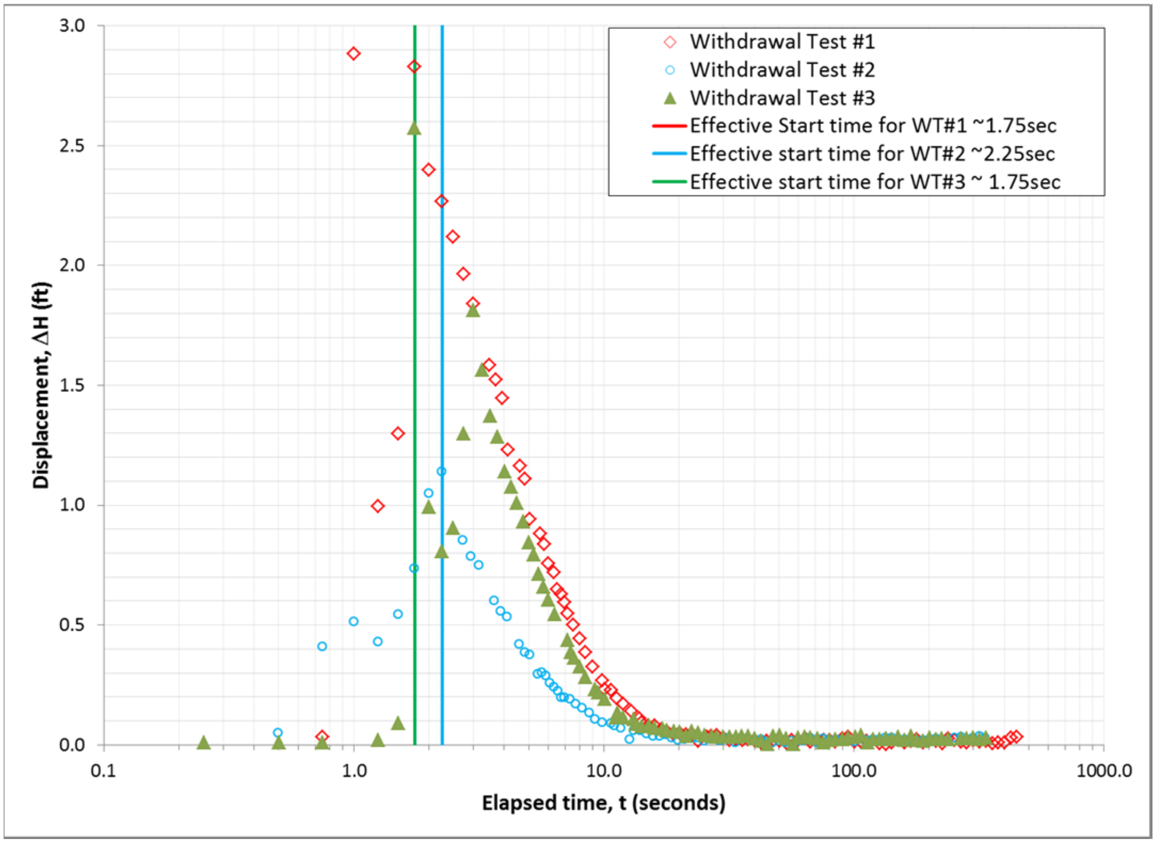

Figure 4-4. Effective start time for withdrawal tests at 199-D3-5

4.1.3 Estimation of effective initial displacement

Adjusted elapsed times are calculated by subtracting the effective start time from the reported elapsed times. The displacements are plotted against the adjusted elapsed times. The estimation of the initial displacements is shown in Figure 4-5. Effective initial displacements of 2.6 ft., 0.9 ft., and 1.75 ft. are estimated for the three withdrawal tests by back-fitting the observations to 0.0 elapsed time. For a slug volume (V) of 0.688 ft^3 and a casing radius (r_c) of 3 inches, a theoretical initial displacement (H_0) of 3.5 ft. is calculated ($H_0 = V/\pi r_c^2$). Similarly, theoretical initial displacements of 1.67 ft. and 2.4 ft. are estimated for the slug volumes of 0.328 ft^3 and 0.472 ft^3. The visually estimated initial displacements are less than the theoretical estimates probably because of the non-instantaneous nature of the tests.

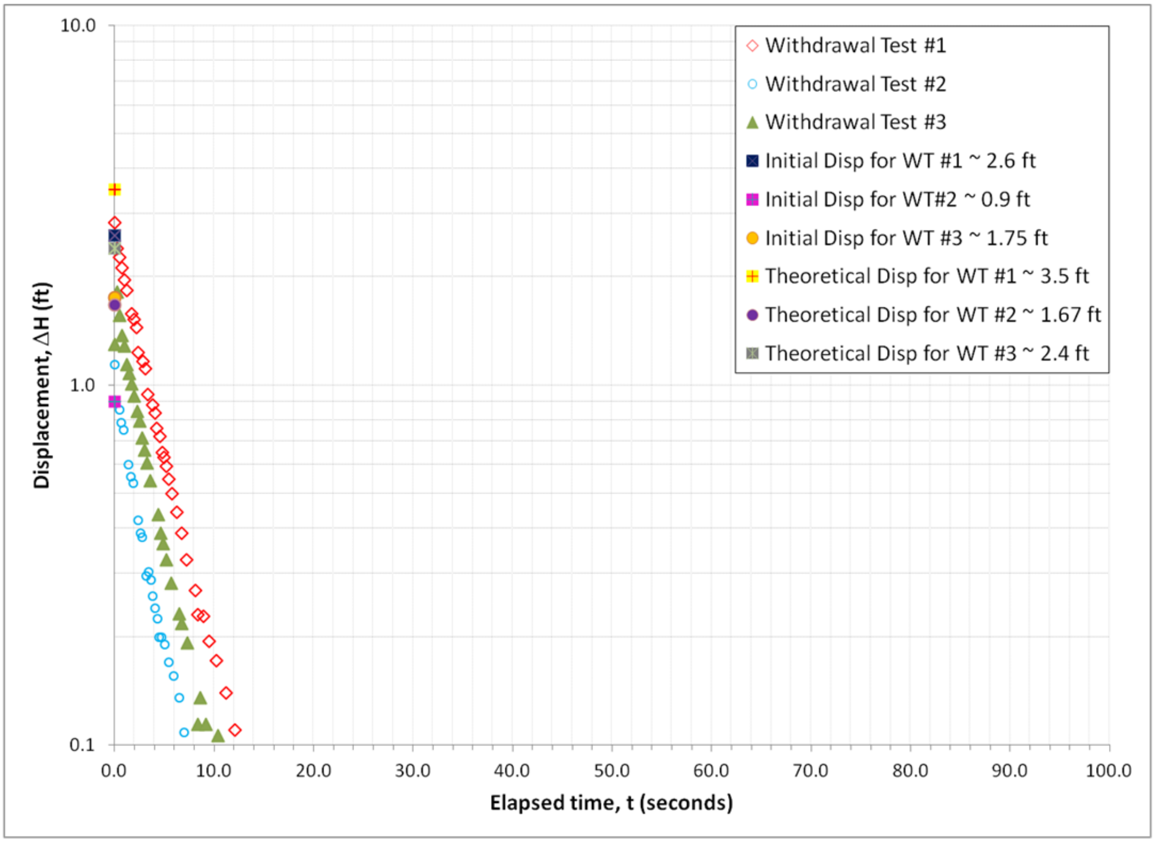

Figure 4-5. Estimation of effective initial displacement at 199-D3-5

4.1.4 Normalized displacements

The normalized displacements are calculated by dividing the observed displacements for the withdrawal tests by their respective effective initial displacement. The normalized responses plotted in Figure 4-6 confirm that the results for all the withdrawal tests are internally consistent. The close correspondence of the normalized displacement curves suggests that it is sufficient to analyze the data from only one of the withdrawal tests. The first withdrawal test is chosen for analysis because its record is the most complete.

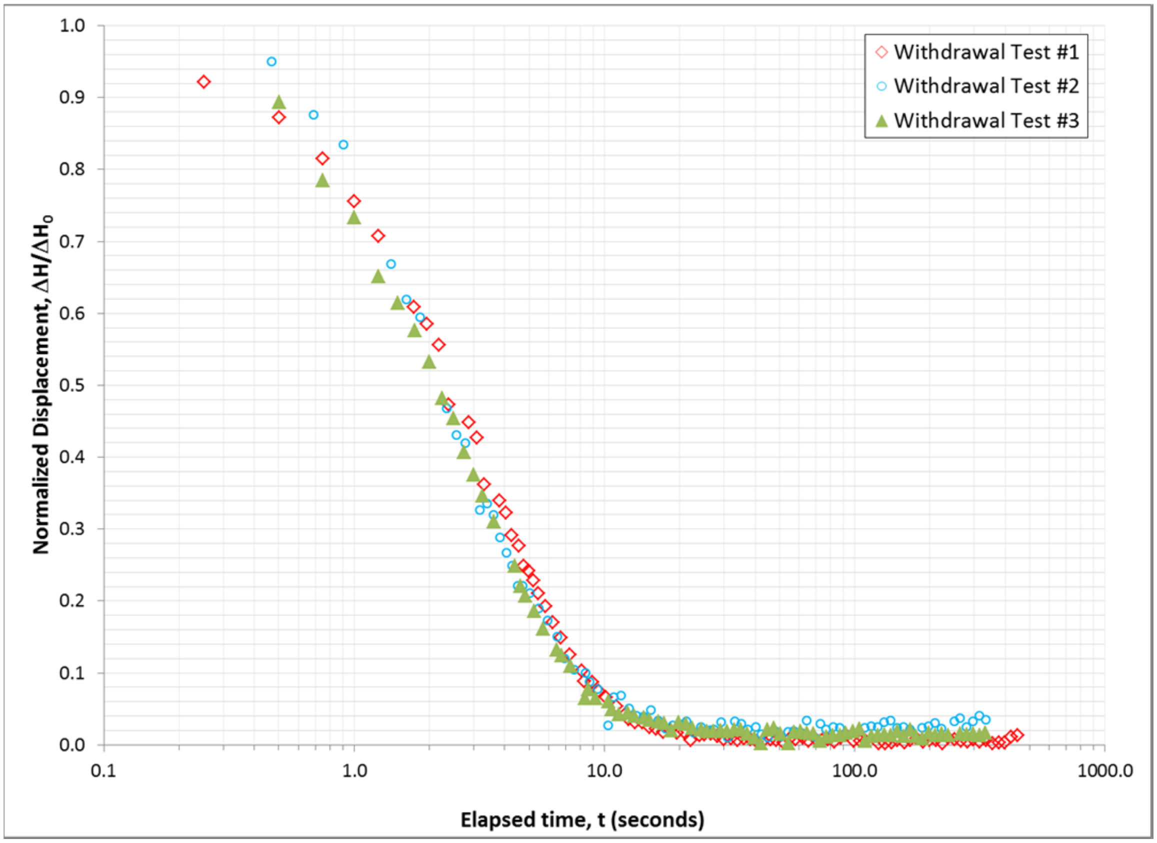

Figure 4-6. Normalized displacement at 199-D3-5

4.1.5 Preliminary analysis

For a first-cut analysis, the normalized displacements for the first withdrawal test are fit with the CBP model. The CBP model fit is shown in Figure 4-7. A good match to the observations is achieved with a storage coefficient, *S*, of 10^{-5}, and a fitted transmissivity, *T*, of 440 m^2/d. This analysis assumes that the well penetrates the full thickness of the aquifer. Referring to Table 4-1, we see that for well 199-D3-5, this is not the case. The aquifer (Hanford and Ringold unit E) is about 6.94 m (118.78 m – 111.94 m) thick at this location, and the length of the well screen is about 4.9 m. Cooper et al. (1967) suggested that in the case of a well that penetrates only a portion of the thickness of the aquifer, the effective thickness of the aquifer can be specified as the effective length of the well screen. Since the length of the submerged well screen length is 16.05 ft. (4.9 m), the estimated transmissivity corresponds to a horizontal hydraulic conductivity, K_H, of **90 m/d** **or** **1.0×10^{-3} m/s.**

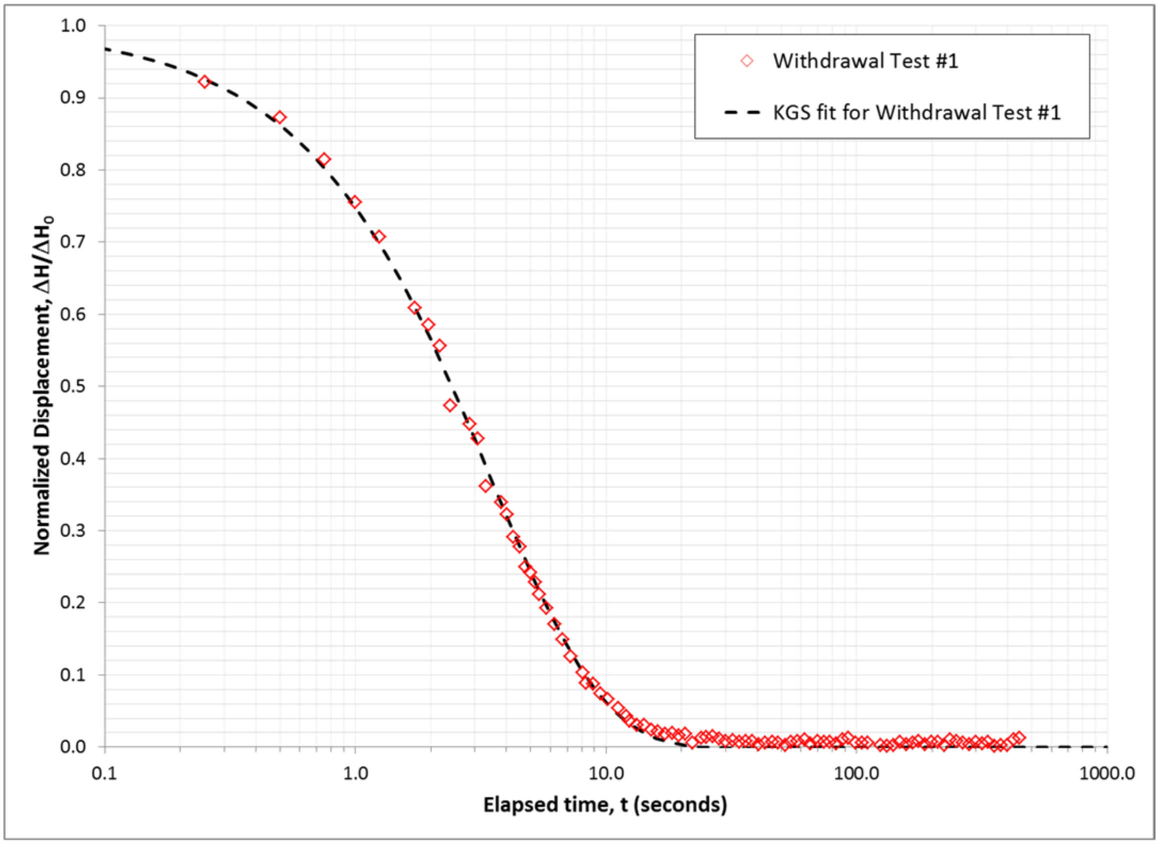

Figure 4-7 CBP Model fit at 199-D3-5

4.1.6 Refined analysis

For a more refined analysis, the normalized displacements for the first withdrawal test are fit with the KGS model for an unconfined aquifer. The KGS model fit is shown in Figure 4-8. A good match to the observations is achieved with a specific storage, S_s, of 2.0×10^{-6} m^{-1}, an anisotropy ratio K_V/K_H of 0.1, and a fitted horizontal hydraulic conductivity, K_H, of **55 m/d** or **6.4×10^{-4} m/s**. The specific storage value is not iteratively estimated but instead calculated by dividing an assumed storage coefficient of 10^{-5} by the well screen length (16.05 ft. or 4.9 m).

The fitted value of the specific storage value falls in the range suggested by Younger (1993) as representative of aquifer materials that consist of coarse sand and gravel. This is consistent with the well log which describes the screened interval as a mixture of Sand, Gravel and Silt.

The estimated hydraulic conductivity is in the middle of the range for clean sand and at the higher end of the range for silty sand reported in the literature (see for example, Freeze and Cherry, 1979; Table 2.2). This is consistent with the well log which describes the screened interval as a mixture of Sand, Gravel and Silt.

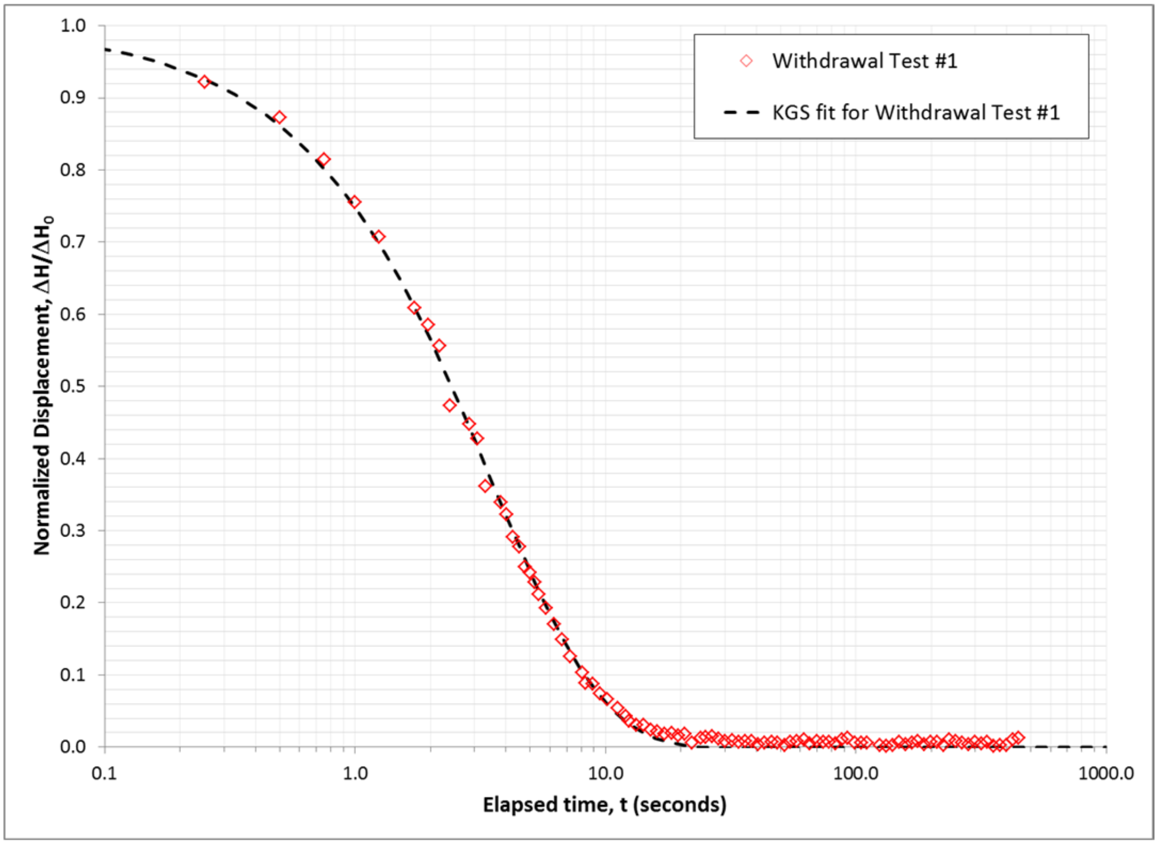

Figure 4-8. KGS Model fit at 199-D3-5

4.2 Analysis of Slug Test Data at well 199-D5-132

Three withdrawal tests were conducted at 199-D5-132 and all of them are analyzed here.

4.2.1 Raw displacement data for withdrawal tests

The three withdrawal tests were conducted with slugs of volume 0.688 ft^3, 0.328 ft^3 and 0.472 ft^3 respectively. The displacements are plotted in Figure 4-9. The normalized displacements in section 4.2.4 will tell us if these responses are consistent. Inspection of the displacements suggests that the tests are not instantaneous but that there is an effective start time for each test. These effective start times are estimated in section 4.2.2.

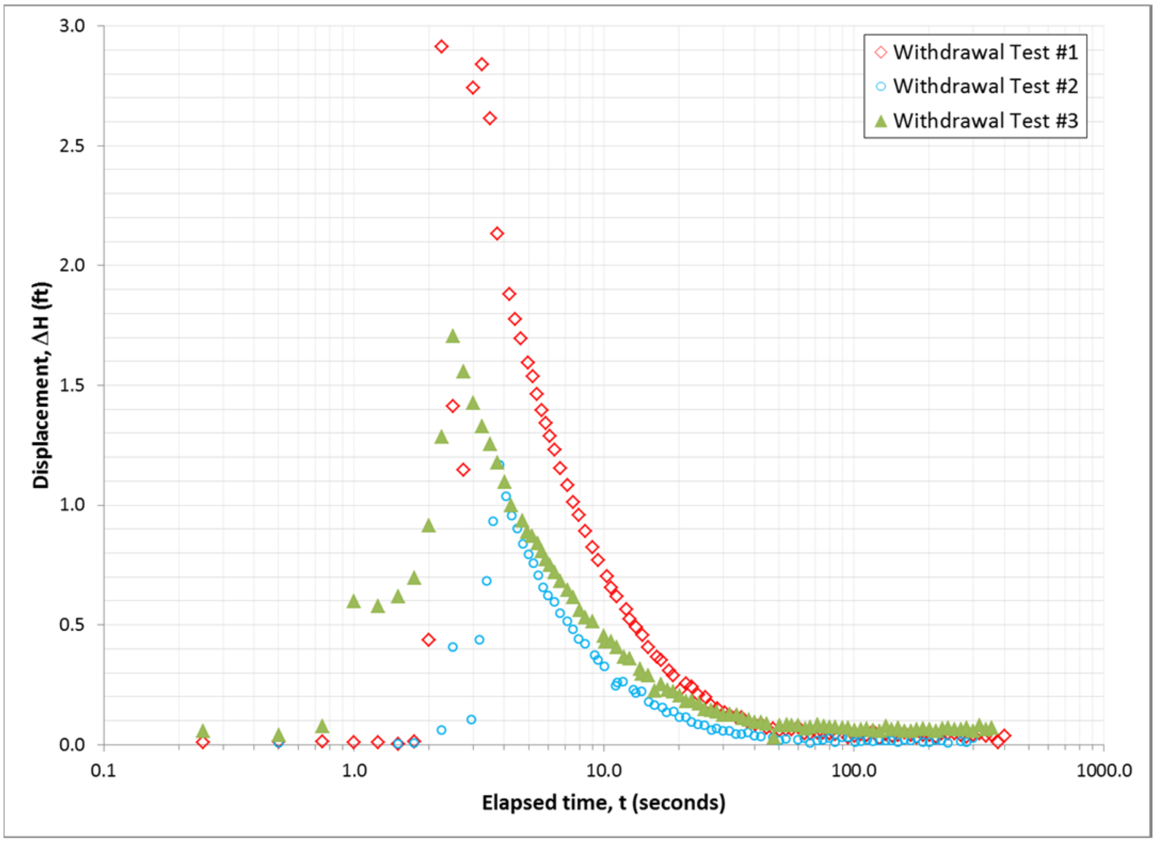

Figure 4-9. Displacements from three withdrawal tests at 199-D5-132

4.2.2 Estimation of effective start time

Effective start times of 3.25 seconds, 3.8 seconds and 2.5 seconds are estimated for the three withdrawal tests respectively as shown in Figure 4-10.

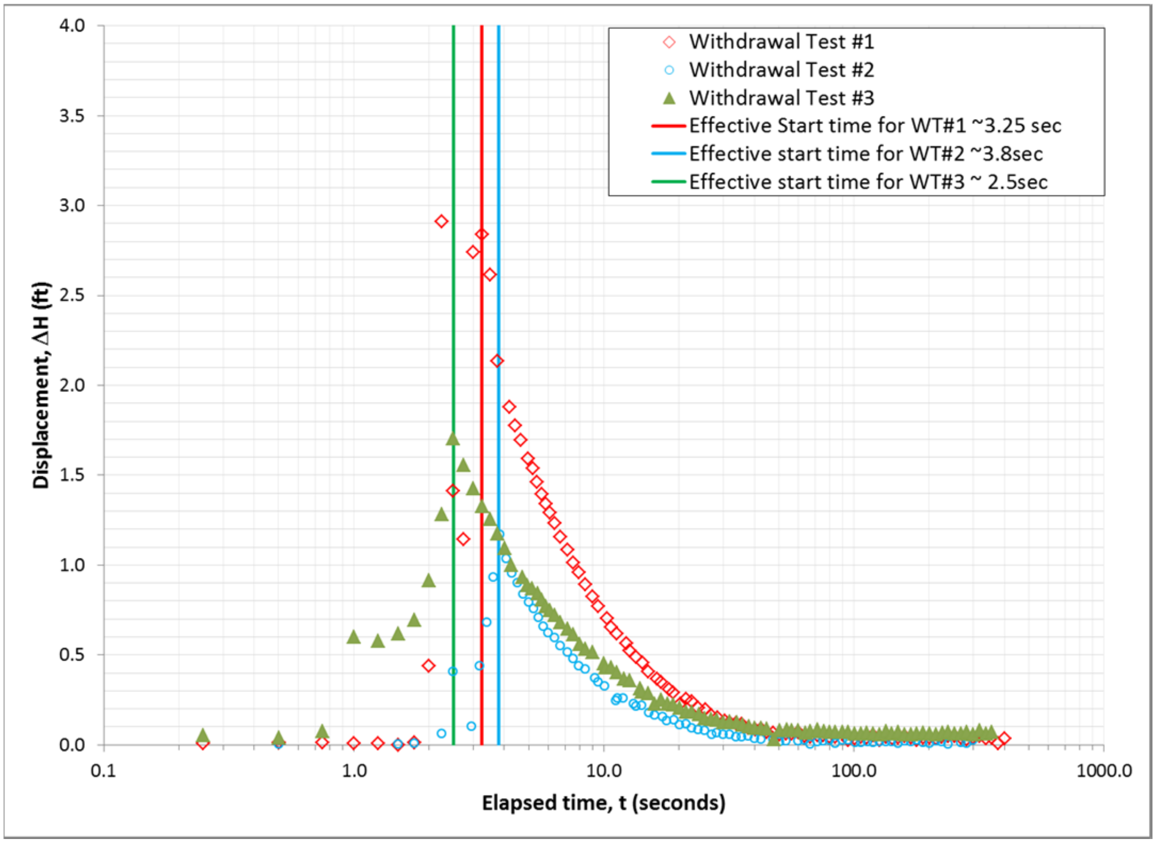

Figure 4-10. Effective start time for withdrawal tests at 199-D5-132

4.2.3 Estimation of effective initial displacement

Adjusted elapsed times are calculated by subtracting the effective start time from the reported elapsed times. The displacements are plotted against the adjusted elapsed times. The estimation of the initial displacements is shown in Figure 4-11. Effective initial displacements of 2.45 ft., 1.1 ft., and 1.65 ft. are estimated for the three withdrawal tests by back-fitting the observations to 0.0 elapsed time. For a slug volume (V) of 0.688 ft^3 and a casing radius (r_c) of 3 inches, a theoretical initial displacement (H_0) of 3.5 ft. is calculated ($H_0 = V/\pi r_c^2$). Similarly, theoretical initial displacements of 1.67 ft. and 2.4 ft. are estimated for the slug volumes of 0.328 ft^3 and 0.472 ft^3. The visually estimated initial displacements are lesser than the theoretical estimates probably because of the non-instantaneous nature of the tests.

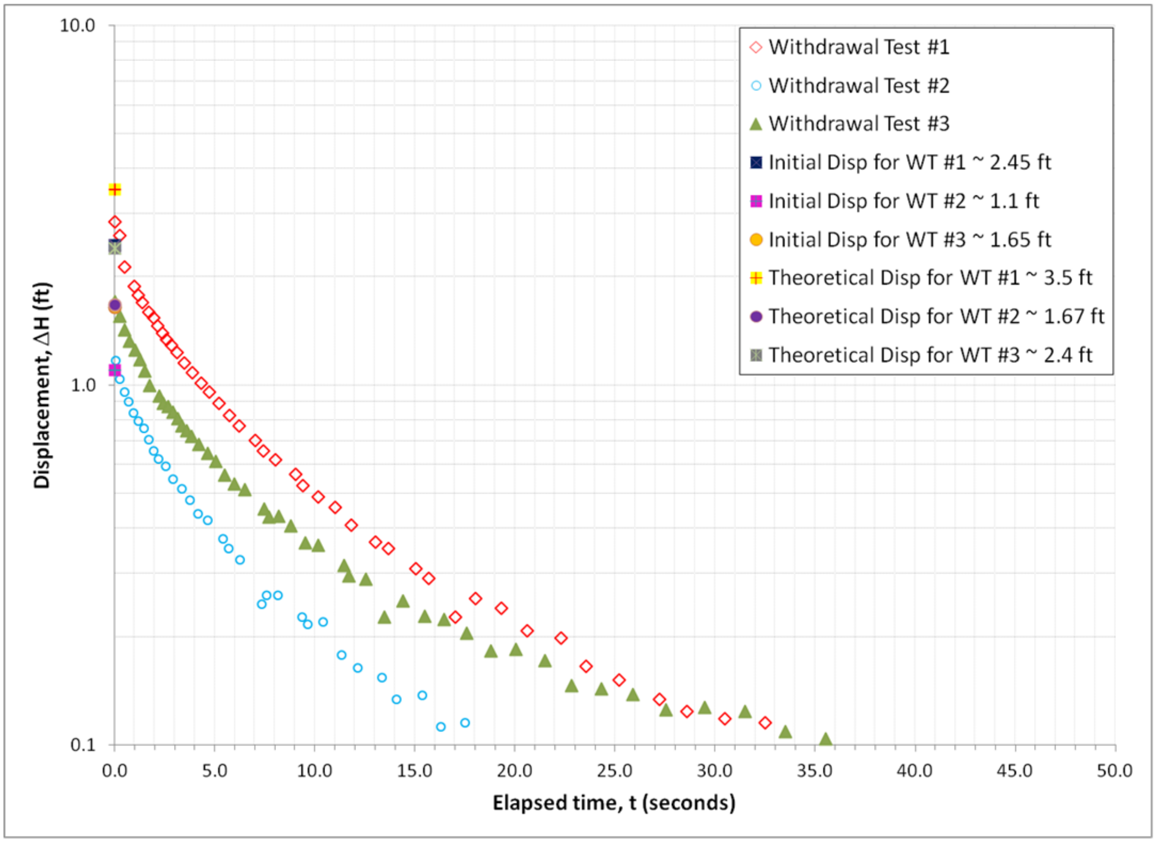

Figure 4-11. Estimation of effective initial displacement at 199-D5-132

4.2.4 Normalized displacements

The normalized displacements are calculated by dividing the observed displacements for the withdrawal tests by their respective effective initial displacement. The normalized responses are plotted in Figure 4-12. The responses of the three tests are consistent for the first 10 seconds. After 10 seconds, the first two tests are consistent but the displacements in the third test do not dissipate quickly. The third test is therefore not considered for further analysis. The close correspondence of the normalized displacement curves of the first two tests suggests that it is sufficient to analyze the data from only one of the withdrawal tests. The first withdrawal test is chosen for analysis because its record is the most complete.

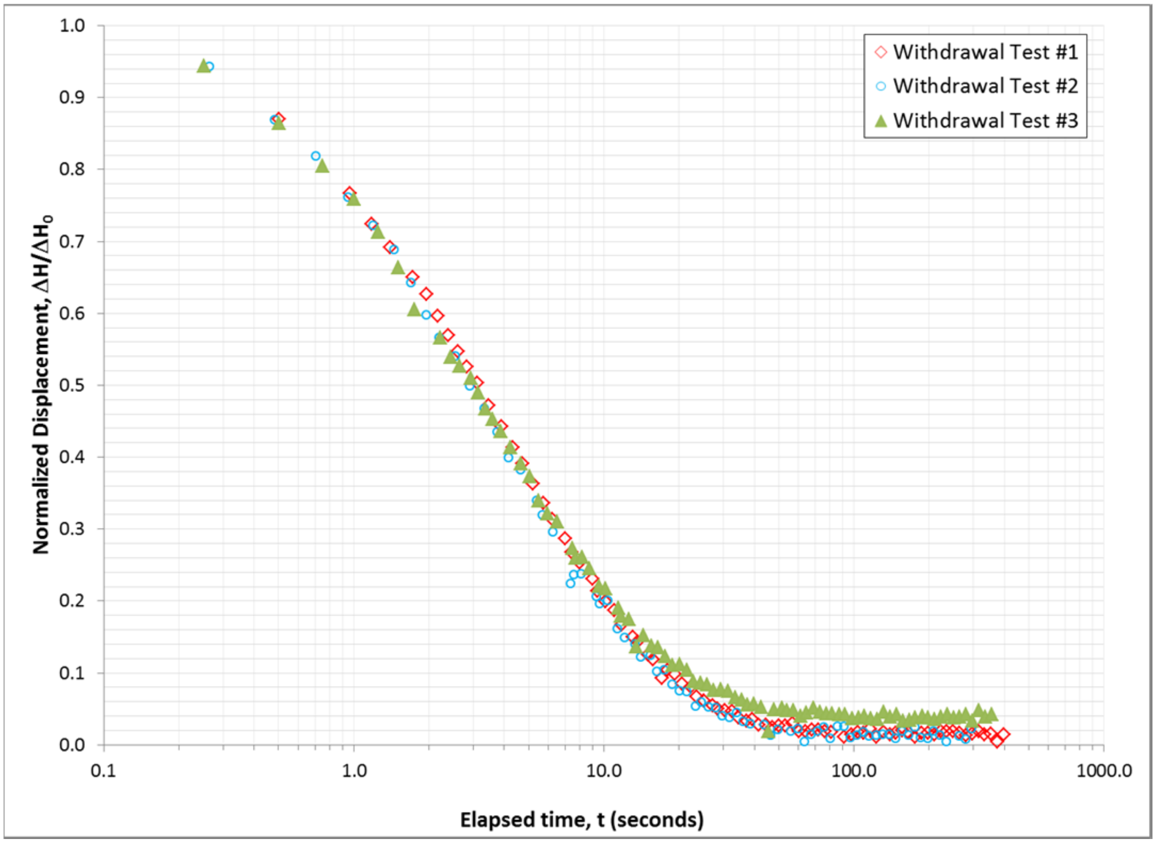

Figure 4-12. Normalized displacement at 199-D5-132

4.2.5 Preliminary analysis

For a first-cut analysis, the normalized displacements for the first withdrawal test are fit with the CBP model. The CBP model fit is shown in Figure 4-13. A good match to the observations is achieved with a storage coefficient, *S*, of 4×10^{-3}, and a fitted transmissivity, *T*, of 129 m^2/d. This analysis assumes that the well penetrates the full thickness of the aquifer. Referring to Table 4-1, we see that for well 199-D5-132, this is not the case. The aquifer (Ringold unit E) is about 7.01 m (119.77 m – 112.76 m) thick at this location, and the length of the submerged well screen is about 6.25 m. Cooper et al. (1967) suggested that in the case of a well that penetrates only a portion of the thickness of the aquifer, the effective thickness of the aquifer can be specified as the effective length of the well screen. Since the length of the submerged well screen length is 20.515 ft. (6.25 m), the estimated transmissivity corresponds to a horizontal hydraulic conductivity, K_H, of **21 m/d or 2.4×10^{-4} m/s.**

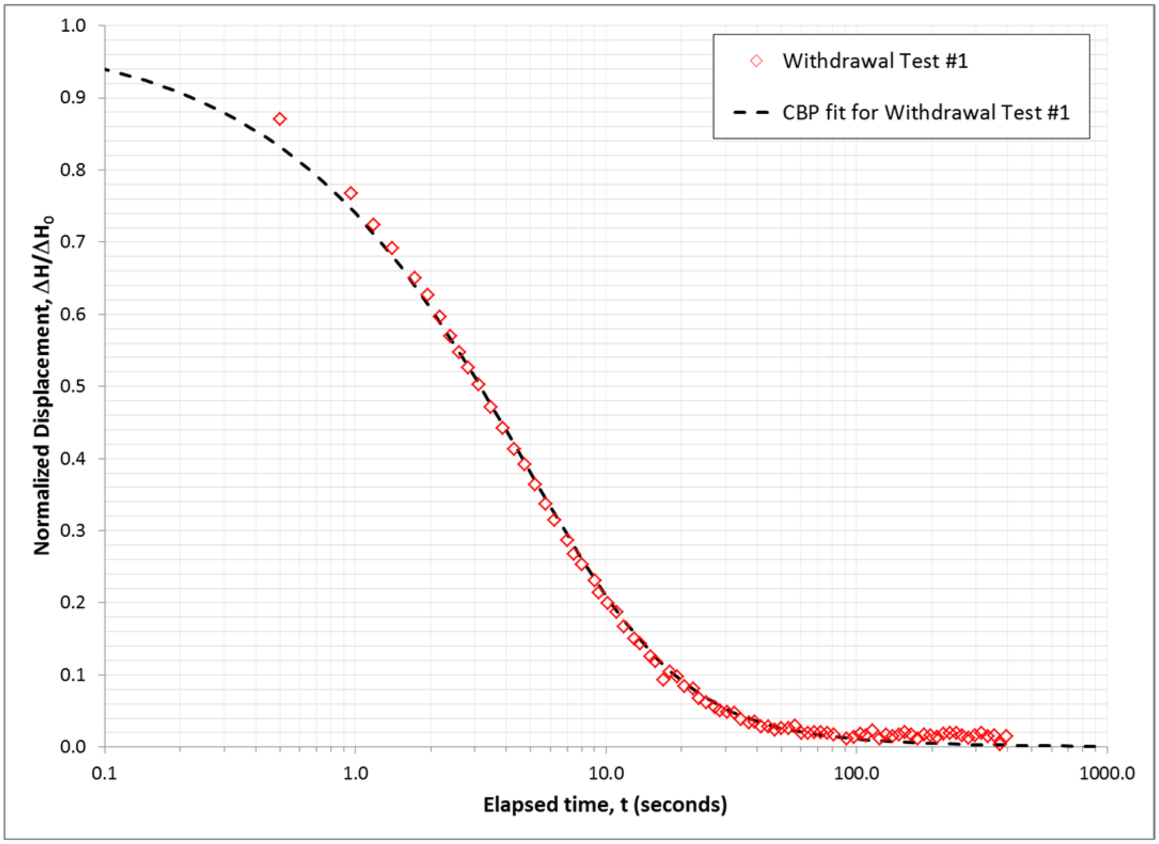

Figure 4-13 CBP Model fit at 199-D5-132

4.2.6 Refined analysis

For a more refined analysis, the normalized displacements for the first withdrawal test are fit with the KGS model for an unconfined aquifer. The KGS model fit is shown in Figure 4-14. A good match to the observations is achieved with a specific storage, S_s, of 6.4×10^{-4} m^{-1}, an anisotropy ratio K_V/K_H of 0.1, and a fitted horizontal hydraulic conductivity, K_H, of **19 m/d** or **2.2×10^{-4} m/s**. The specific storage value is not iteratively estimated but instead calculated by dividing an assumed storage coefficient of 4×10^{-3} by the well screen length (20.615 ft. or 6.25 m).

The fitted value of the specific storage value falls in the range suggested by Younger (1993) as representative of aquifer materials that consist of silt, fine sand and medium sand. This is consistent with the well log which describes the screened interval as a mixture of Sand, Gravel and Silt.

The estimated hydraulic conductivity is in the middle of the range for clean sand and at the higher end of the range for silty sand reported in the literature (see for example, Freeze and Cherry, 1979; Table 2.2). This is consistent with the well log which describes the screened interval as a mixture of Sand, Gravel and Silt.

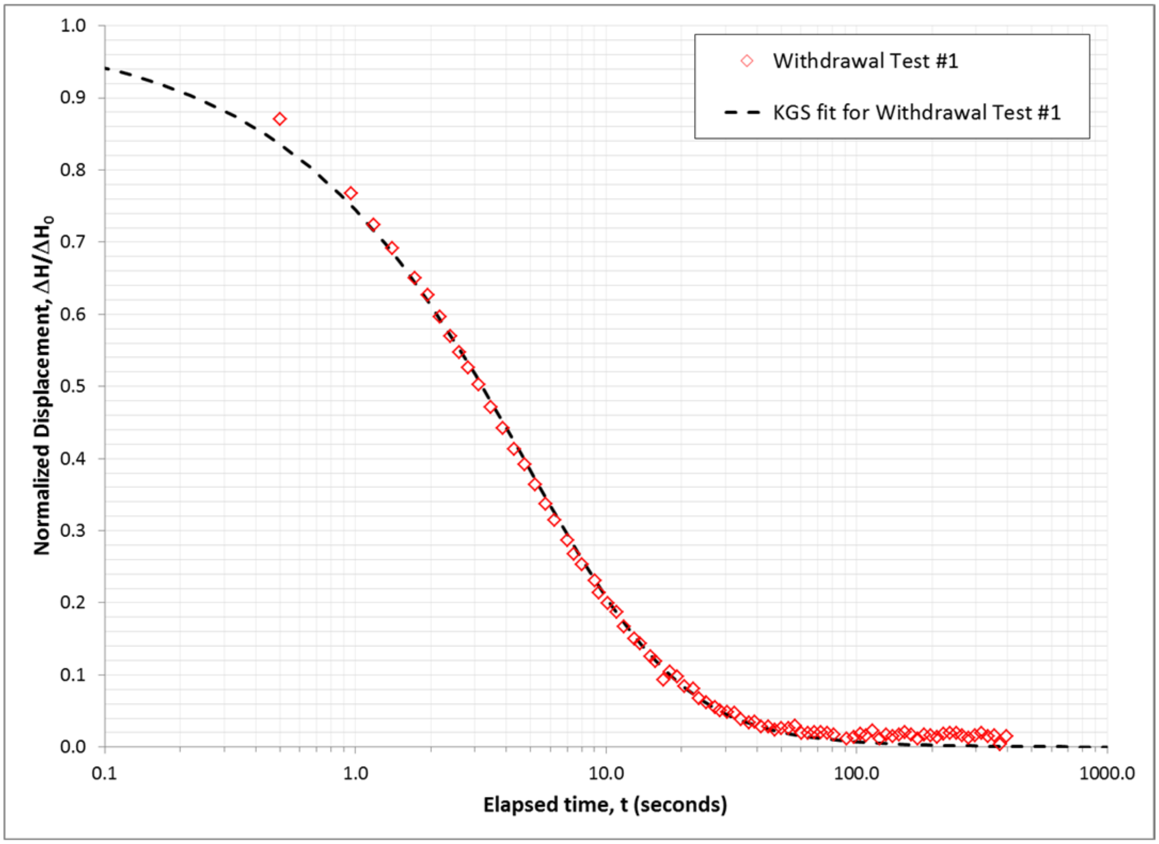

Figure 4-14. KGS Model fit at 199-D5-132

4.3 Analysis of Slug Test Data at well 199-D5-133

Three withdrawal tests were conducted at 199-D5-133 and all of them are analyzed here.

4.3.1 Raw displacement data for withdrawal tests

The three withdrawal tests were conducted with slugs of volume 0.688 ft^3, 0.328 ft^3 and 0.472 ft^3 respectively. The displacements are plotted in Figure 4.15. The normalized displacements in section 4.3.4 will tell us if these responses are consistent. Inspection of the displacements suggests that the tests are not instantaneous but that there is an effective start time for each test. These effective start times are estimated in section 4.3.2.

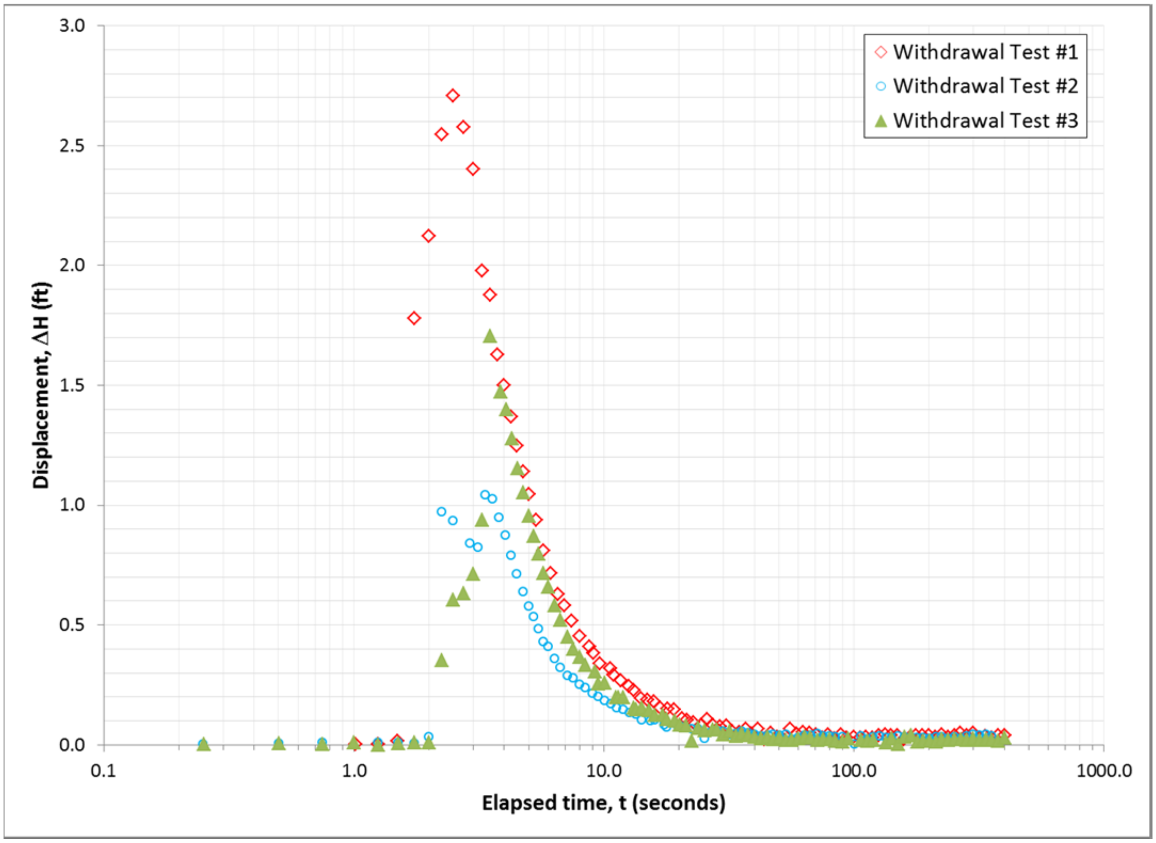

Figure 4-15. Displacements from three withdrawal tests at 199-D5-133

4.3.2 Estimation of effective start time

Effective start times of 2.75 seconds, 3.3 seconds and 3.5 seconds are estimated for the three withdrawal tests respectively.

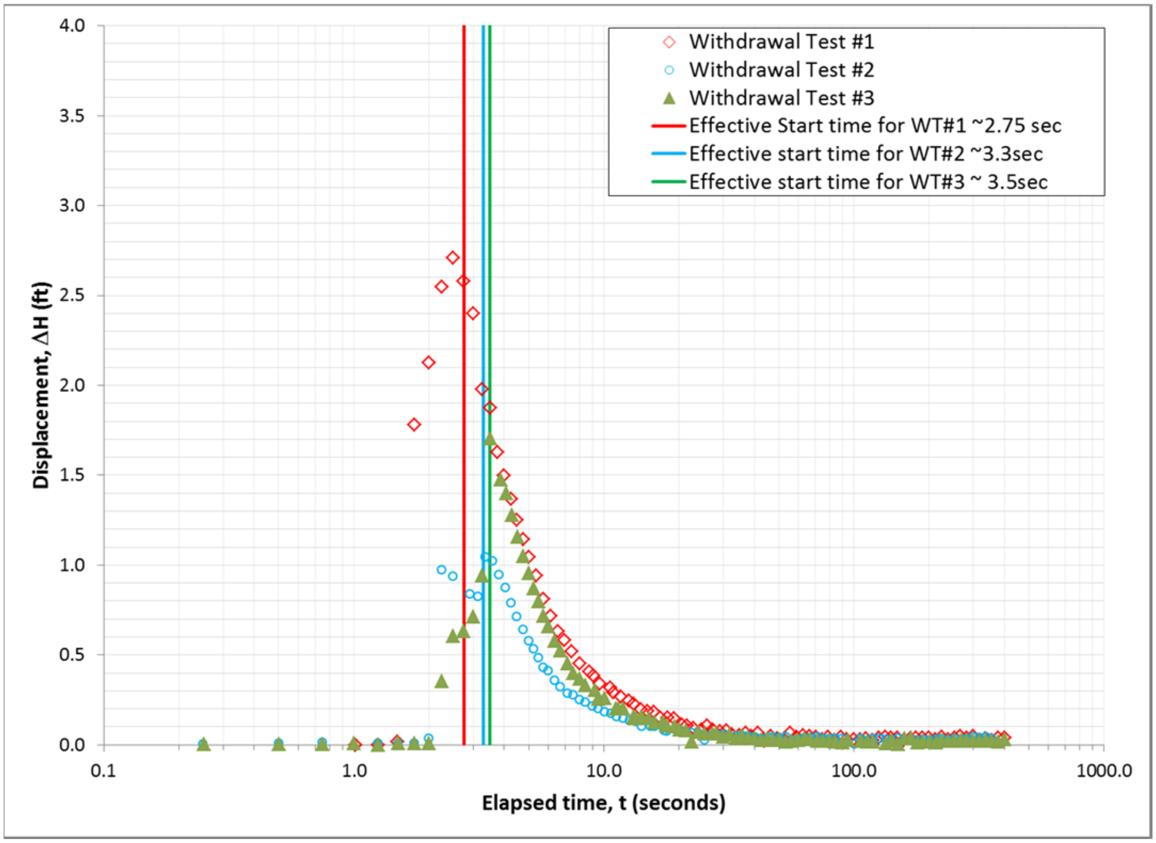

Figure 4-16. Effective start time for withdrawal tests at 199-D5-133

4.3.3 Estimation of effective initial displacement

Adjusted elapsed times are calculated by subtracting the effective start time from the reported elapsed times. The displacements are plotted against the adjusted elapsed times. The estimation of the initial displacements is shown in Figure 4-17. Effective initial displacements of 2.4 ft., 1.1 ft., and 1.7 ft. are estimated for the three withdrawal tests by back-fitting the observations to 0.0 elapsed time. For a slug volume (V) of 0.688 ft^3 and a casing radius (r_c) of 3 inches, a theoretical initial displacement (H_0) of 3.5 ft. is calculated ($H_0 = V/\pi r_c^2$). Similarly, theoretical initial displacements of 1.67 ft. and 2.4 ft. are estimated for the slug volumes of 0.328 ft^3 and 0.472 ft^3. The visually estimated initial displacements are lesser than the theoretical estimates probably because of the non-instantaneous nature of the tests.

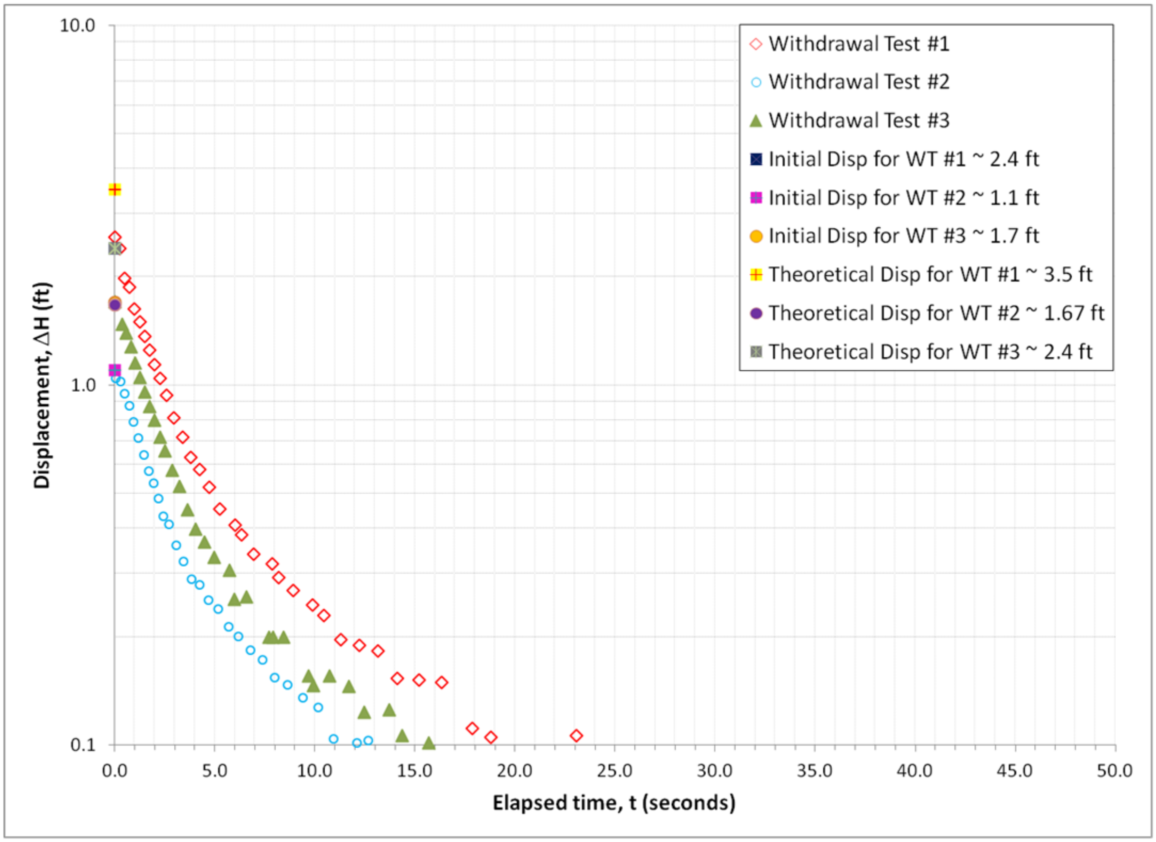

Figure 4-17. Estimation of effective initial displacement at 199-D5-133

4.3.4 Normalized displacements

The normalized displacements are calculated by dividing the observed displacements for the withdrawal tests by their respective effective initial displacement. The normalized responses plotted in Figure 4-18 confirm that the results for all the withdrawal tests are internally consistent. The close correspondence of the normalized displacement curves suggests that it is sufficient to analyze the data from only one of the withdrawal tests. The third withdrawal test is chosen for analysis because its record is the most complete.

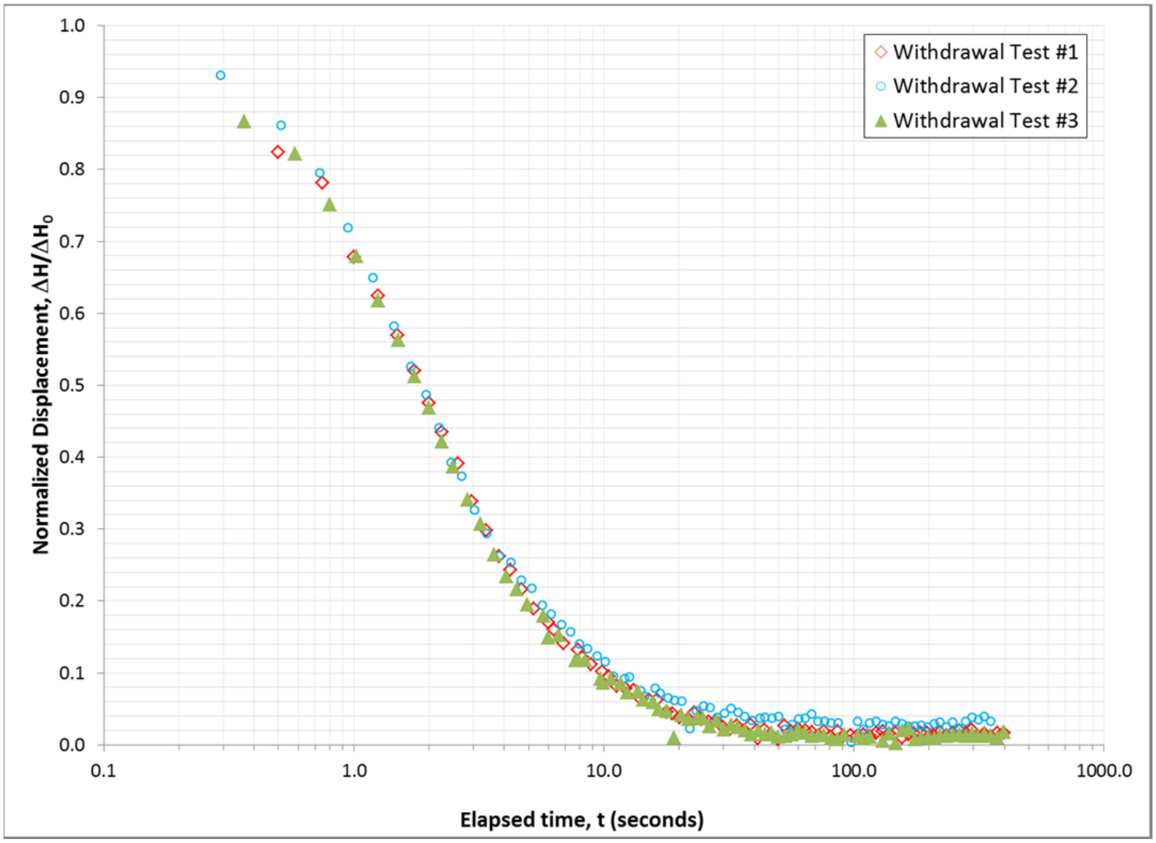

Figure 4-18. Normalized displacement at 199-D5-133

4.3.5 Preliminary analysis

For a first-cut analysis, the normalized displacements for the third withdrawal test are fit with the CBP model. The CBP model fit is shown in Figure 4-19. A good match to the observations is achieved with a storage coefficient, *S*, of 1.5×10^{-3}, and a fitted transmissivity, *T*, of 288 m^2/d. This analysis assumes that the well penetrates the full thickness of the aquifer. Referring to Table 4-1, we see that for well 199-D5-133, this is not the case. The aquifer (Ringold unit E) is about 8.65 m (120.13 m – 111.48 m) thick at this location, and the length of the well screen is about 7.34 m. Cooper et al. (1967) suggested that in the case of a well that penetrates only a portion of the thickness of the aquifer, the effective thickness of the aquifer can be specified as the effective length of the well screen. Since the length of the submerged well screen length is 24.07 ft. (7.34 m), the estimated transmissivity corresponds to a horizontal hydraulic conductivity, K_H, of **39 m/d** **or** **4.5×10^{-4} m/s**.

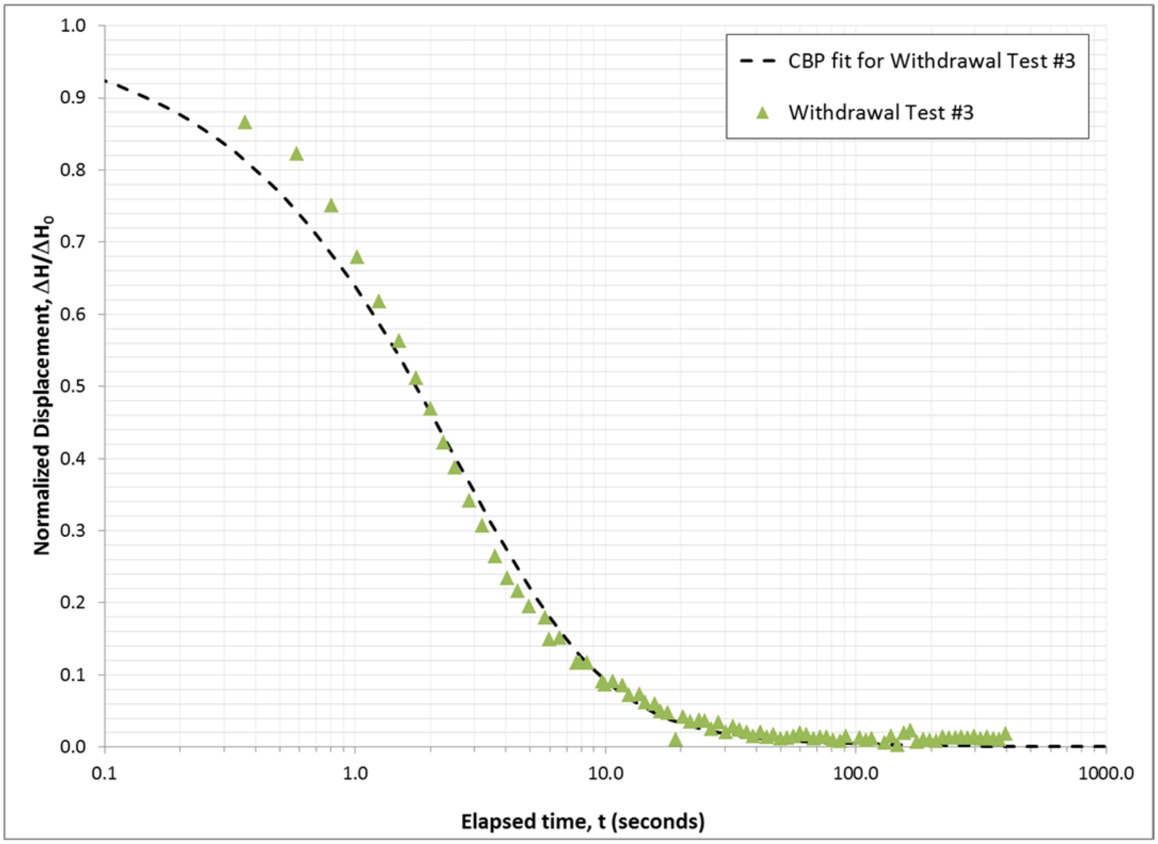

Figure 4-19. CBP Model fit at 199-D5-133

4.3.6 Refined analysis

For a more refined analysis, the normalized displacements for the third withdrawal test are fit with the KGS model for an unconfined aquifer. The KGS model fit is shown in Figure 4-20. A good match to the observations is achieved with a specific storage, S_s, of 2.0×10^{-4} m^{-1}, an anisotropy ratio K_V/K_H of 0.1, and a fitted horizontal hydraulic conductivity, K_H, of **38 m/d** or **4.4×10^{-4} m/s**. The specific storage value is not iteratively estimated but instead calculated by dividing an assumed storage coefficient of 1.5×10^{-3} by the well screen length (24.07 ft. or 7.34 m).

The fitted value of the specific storage value falls in the range suggested by Younger (1993) as representative of aquifer materials that consist of silt, fine sand and medium sand. This is consistent with the description of the screened interval as a mixture of sand, silt and gravel.

The estimated hydraulic conductivity is in the middle of the range for clean sand and at the higher end of the range for silty sand reported in the literature (see for example, Freeze and Cherry, 1979; Table 2.2). This is consistent with the description of the screened interval as a mixture of sand, silt and gravel.

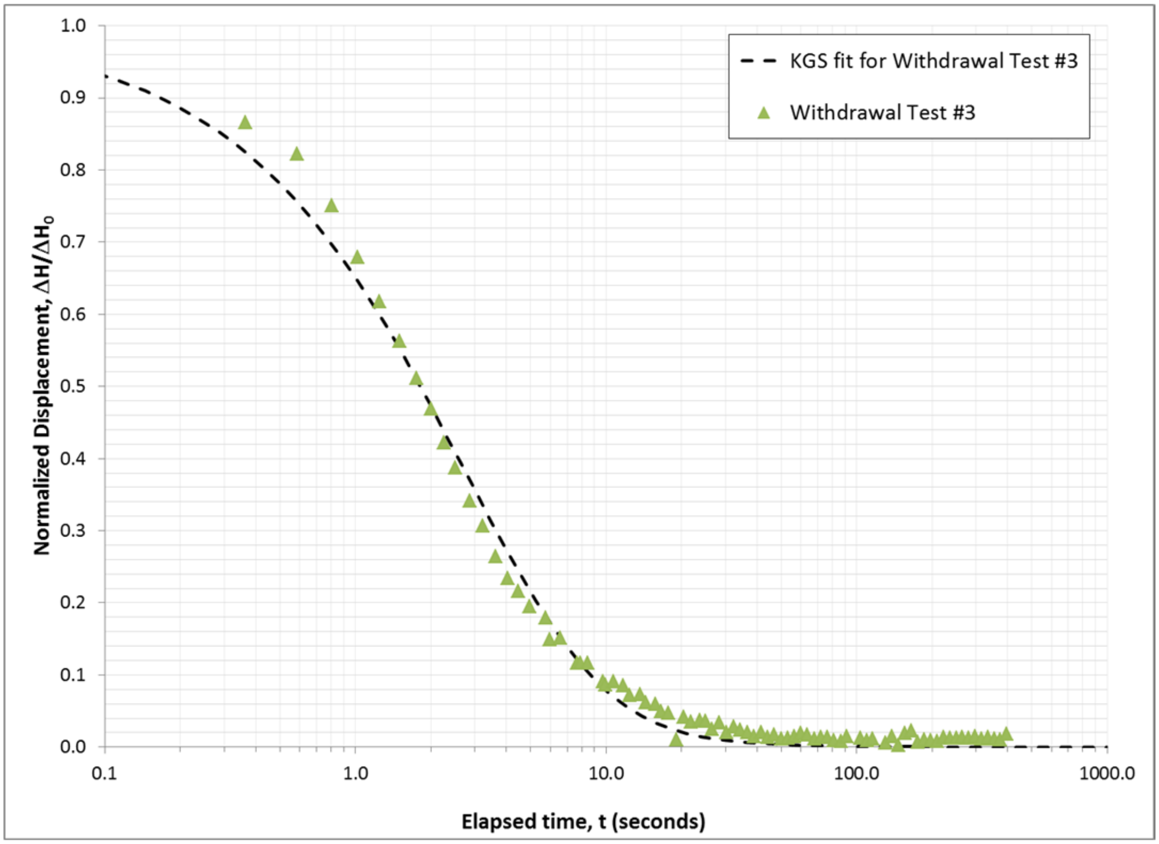

Figure 4-20. KGS Model fit at 199-D5-133

4.4 Analysis of Slug Test Data at well 199-D5-134

Three withdrawal tests were conducted at 199-D5-134 and all of them are analyzed here.

4.4.1 Raw displacement data for withdrawal tests

The three withdrawal tests were conducted with slugs of volume 0.688 ft^3, 0.328 ft^3 and 0.472 ft^3 respectively. The displacements are plotted in Figure 4.21. The normalized displacements in section 4.4.4 will tell us if these responses are consistent. Inspection of the displacements suggests that the tests are not instantaneous but that there is an effective start time for each test. These effective start times are estimated in section 4.4.2.

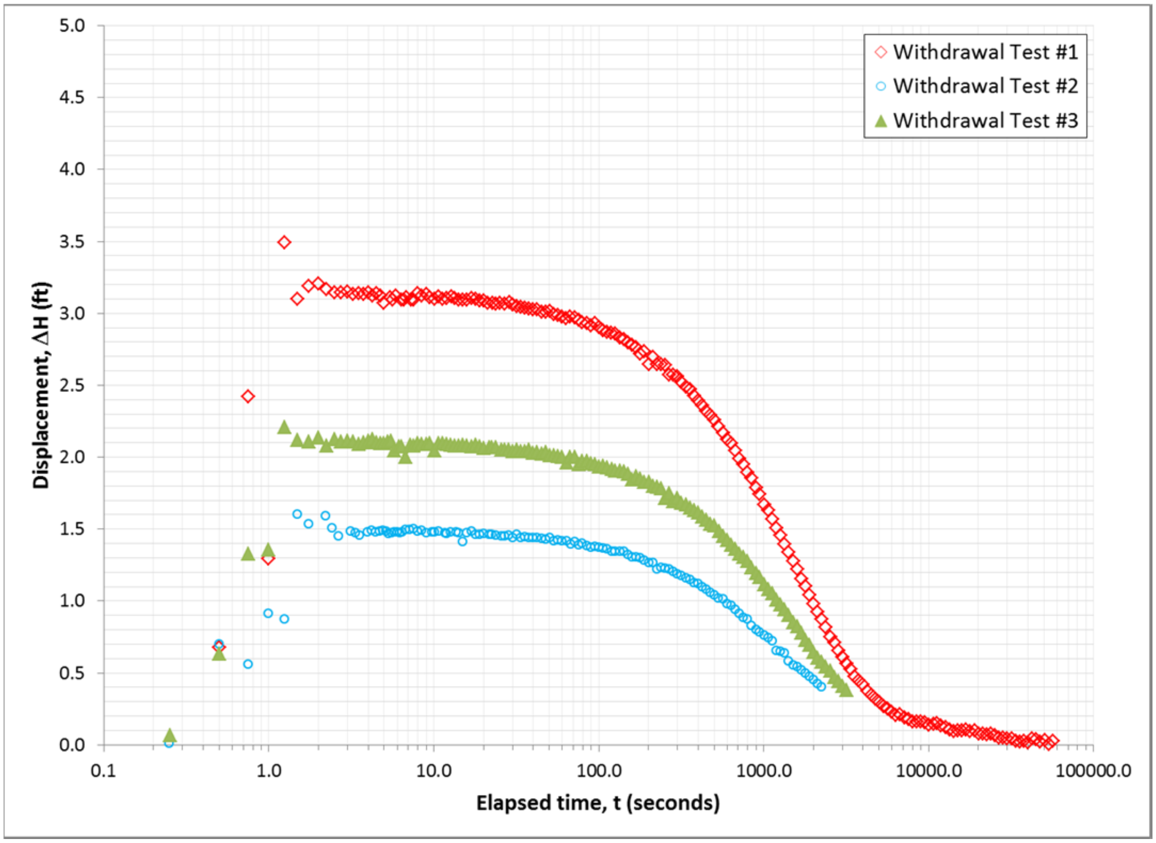

Figure 4-21. Displacements from three withdrawal tests at 199-D5-134

4.4.2 Estimation of effective start time

Effective start times of 1.75 seconds, 1.5 seconds and 1.25 seconds are estimated for the three withdrawal tests respectively.

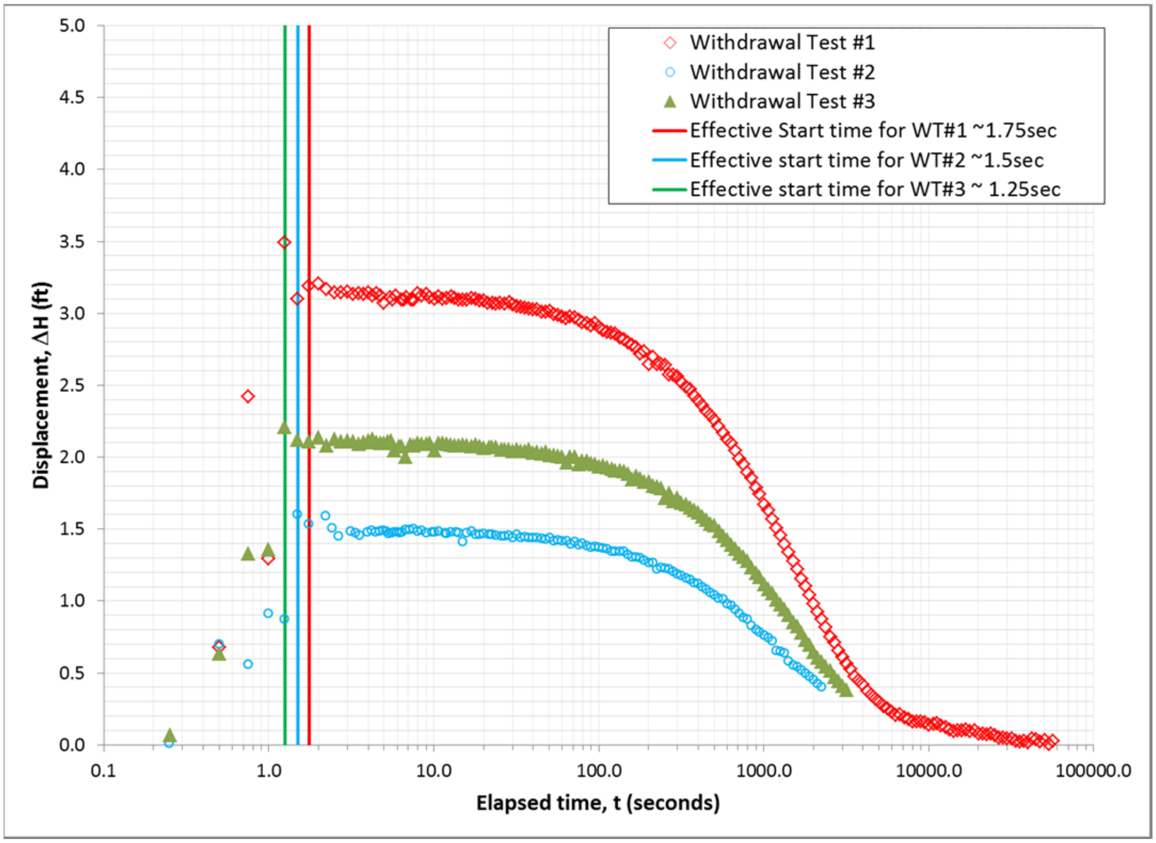

Figure 4-22. Effective start time for withdrawal tests at 199-D5-134

4.4.3 Estimation of effective initial displacement

Adjusted elapsed times are calculated by subtracting the effective start time from the reported elapsed times. The displacements are plotted against the adjusted elapsed times. The estimation of the initial displacements is shown in Figure 4-23. Effective initial displacements of 3.2 ft., 1.5 ft., and 2.1 ft. are estimated for the three withdrawal tests by back-fitting the observations to 0.0 elapsed time. For a slug volume (V) of 0.688 ft^3 and a casing radius (r_c) of 3 inches, a theoretical initial displacement (H_0) of 3.5 ft. is calculated ($H_0 = V/\pi r_c^2$). Similarly, theoretical initial displacements of 1.67 ft. and 2.4 ft. are estimated for the slug volumes of 0.328 ft^3 and 0.472 ft^3. The visually estimated initial displacements are comparable to the theoretical estimates suggesting that the test data are reliable.

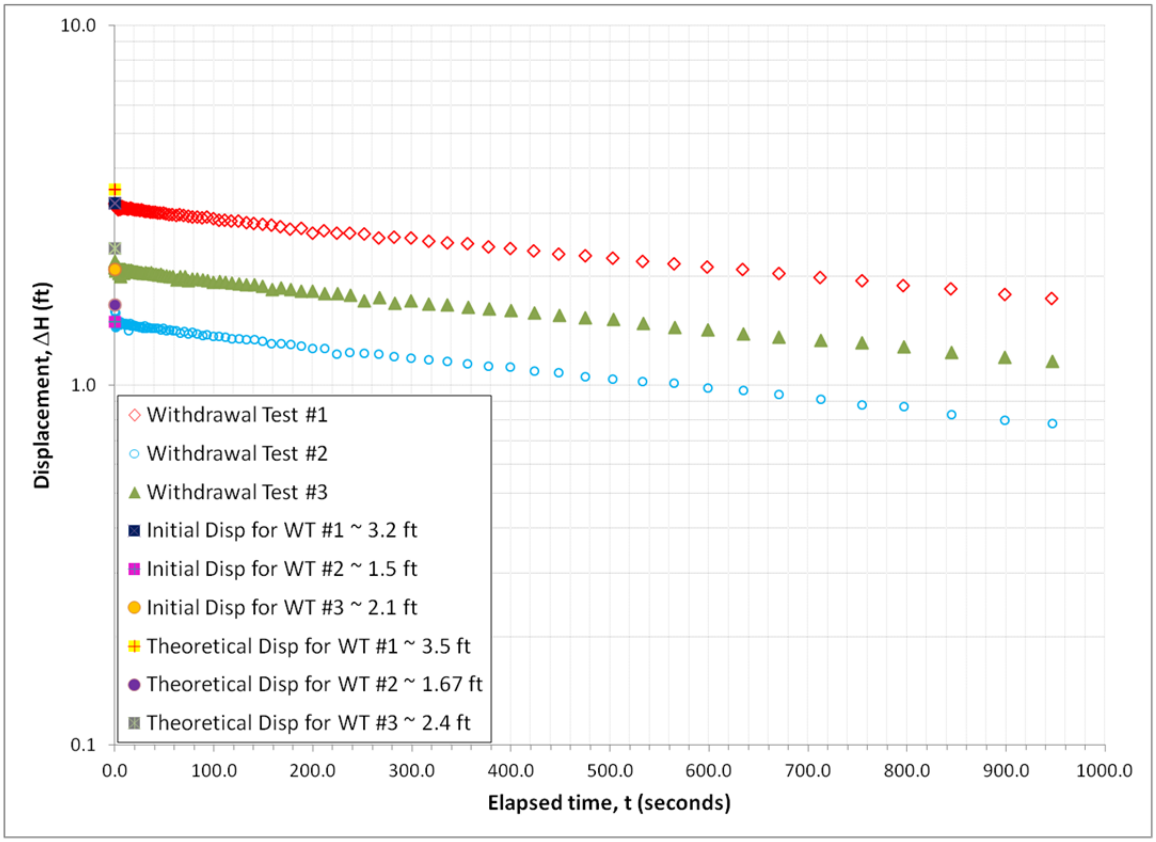

Figure 4-23. Estimation of effective initial displacement at 199-D5-134

4.4.4 Normalized displacements

The normalized displacements are calculated by dividing the observed displacements for the withdrawal tests by their respective effective initial displacement. The normalized responses plotted in Figure 4-24 confirm that the results for all the withdrawal tests are internally consistent. The close correspondence of the normalized displacement curves suggests that it is sufficient to analyze the data from only one of the withdrawal tests. The first withdrawal test is chosen for analysis because its record is the most complete.

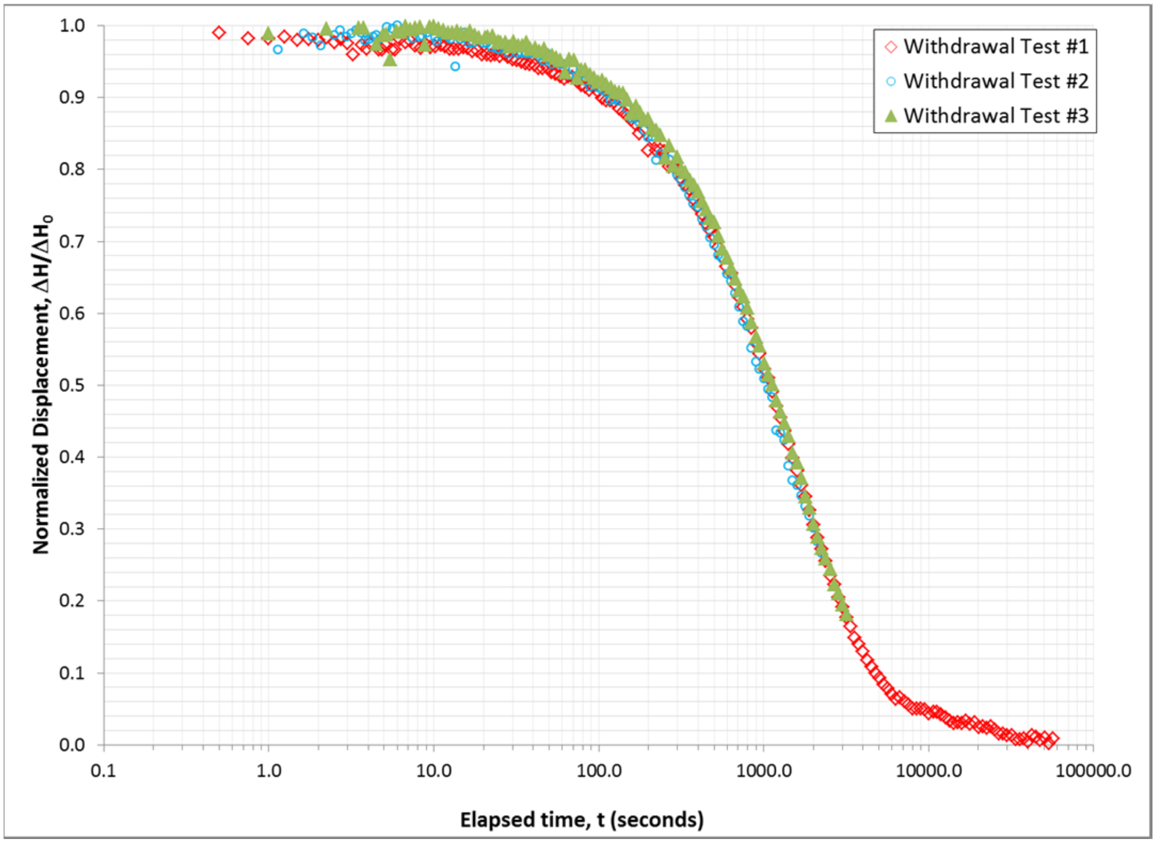

Figure 4-24. Normalized displacement at 199-D5-134

4.4.5 Preliminary analysis

For a first-cut analysis, the normalized displacements for the first withdrawal test are fit with the CBP model. The CBP model fit is shown in Figure 4-25. A good match to the observations is achieved with a storage coefficient, *S*, of 4×10^{-3}, and a fitted transmissivity, *T*, of 0.4 m^2/d. This analysis assumes that the well penetrates the full thickness of the aquifer. Referring to Table 4-1, we see that for well 199-D5-134, this is not the case. The aquifer (RUM) is at least 8.74 m (110.58 m – 101.84 m) thick at this location, and the length of the well screen is about 3.08 m. Cooper et al. (1967) suggested that in the case of a well that penetrates only a portion of the thickness of the aquifer, the effective thickness of the aquifer can be specified as the effective length of the well screen. Since the length of the submerged well screen length is 10.1 ft. (3.08 m), the estimated transmissivity corresponds to a horizontal hydraulic conductivity, K_H, of **0.1 m/d or 1.2×10^{-6} m/s.**

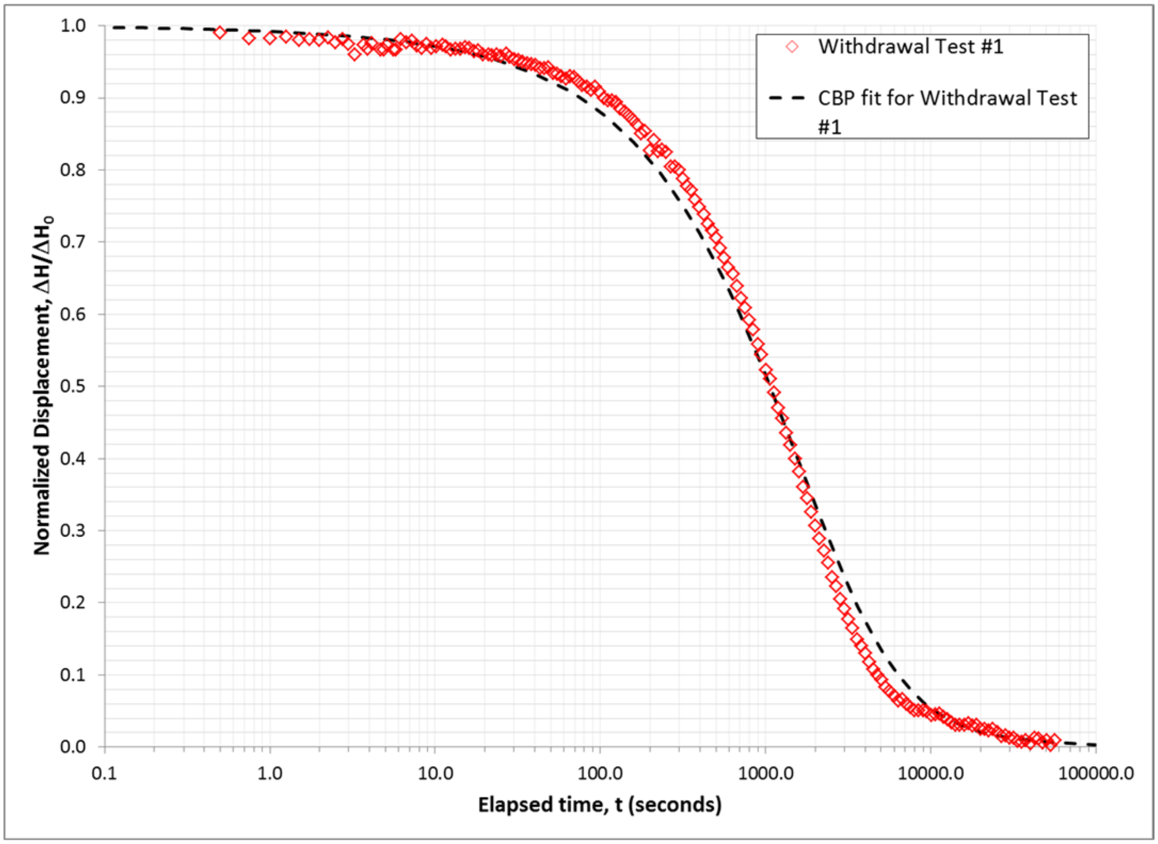

Figure 4-25. CBP Model fit at 199-D5-134

4.4.6 Refined analysis

For a more refined analysis, the normalized displacements for the first withdrawal test are fit with the KGS model for an unconfined aquifer. The KGS model fit is shown in Figure 4-26. A good match to the observations is achieved with a specific storage, S_s, of 1.3×10^{-3} m^{-1}, an anisotropy ratio K_V/K_H of 0.1, and a fitted horizontal hydraulic conductivity, K_H, of **0.1 m/d** or **1.2×10^{-6} m/s**. The specific storage value is not iteratively estimated but instead calculated by dividing an assumed storage coefficient of 4.0×10^{-3} by the well screen length (10.1 ft. or 3.08 m).

The fitted value of the specific storage value falls in the range suggested by Younger (1993) as representative of aquifer materials that consist of clay, silt and fine sand. This is consistent with the description of the material across which the well is screened as ‘Gravelly Sandy Silt’.

The estimated hydraulic conductivity is in the middle of the range for ‘silt, loess’ and at the lower end of the range for silty sand reported in the literature (see for example, Freeze and Cherry, 1979; Table 2.2). This corresponds well with the description of the screened interval.

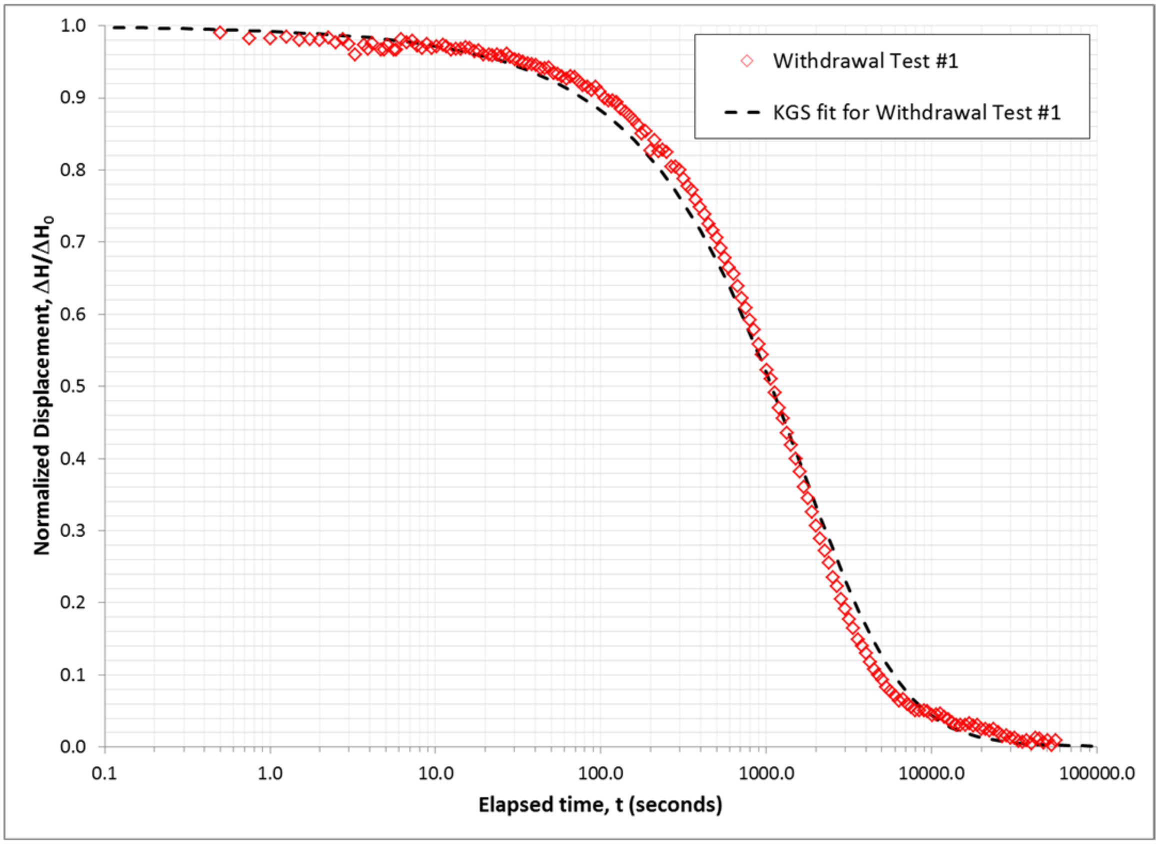

Figure 4-26. KGS Model fit at 199-D5-134

4.5 Analysis of Slug Test Data at well 199-D5-141

Three withdrawal tests were conducted at 199-D5-141 and all of them are analyzed here.

4.5.1 Raw displacement data for withdrawal tests

The three withdrawal tests were conducted with slugs of volume 0.688 ft^3, 0.328 ft^3 and 0.472 ft^3 respectively. The displacements are plotted in Figure 4.27. The normalized displacements in section 4.5.4 will tell us if these responses are consistent. Inspection of the displacements suggests that the tests are not instantaneous but that there is an effective start time for each test. These effective start times are estimated in section 4.5.2.

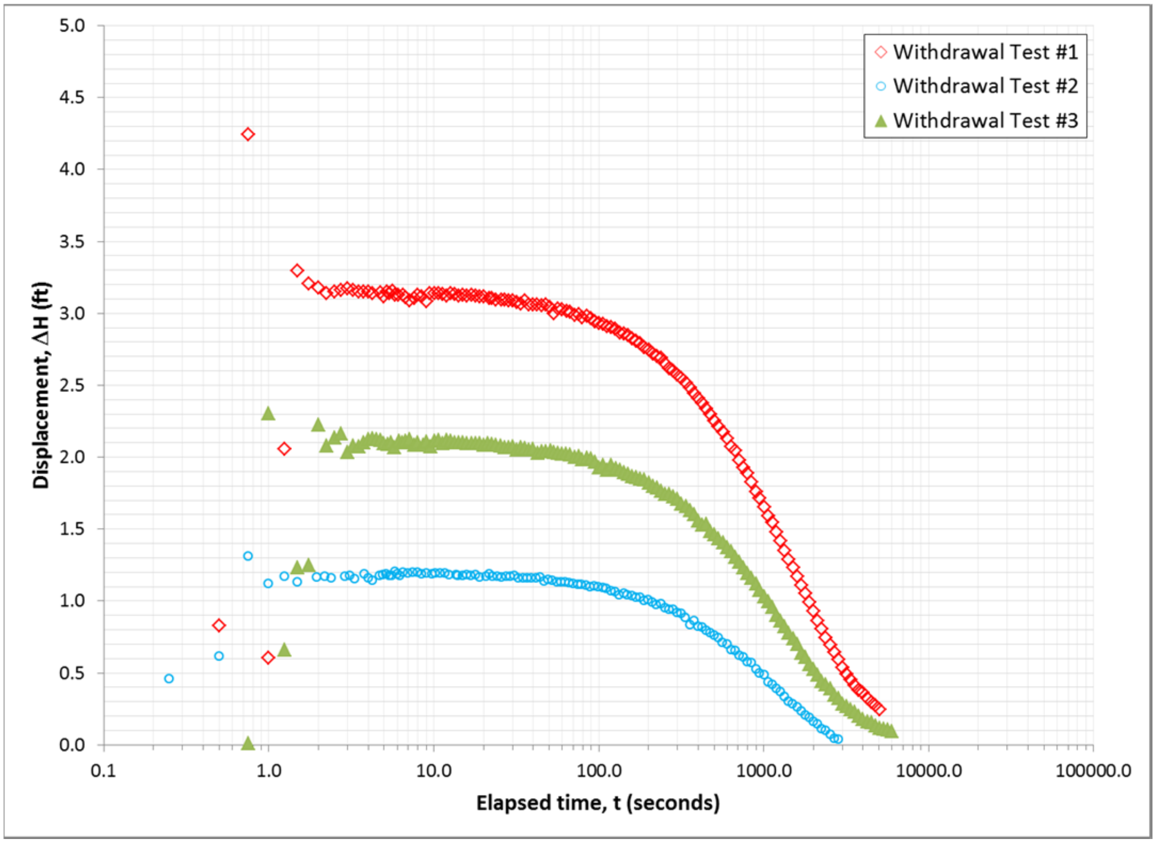

Figure 4-27. Displacements from three withdrawal tests at 199-D5-141

4.5.2 Estimation of effective start time

Effective start times of 1.75 seconds, 1.0 seconds and 2.0 seconds are estimated for the three withdrawal tests respectively.

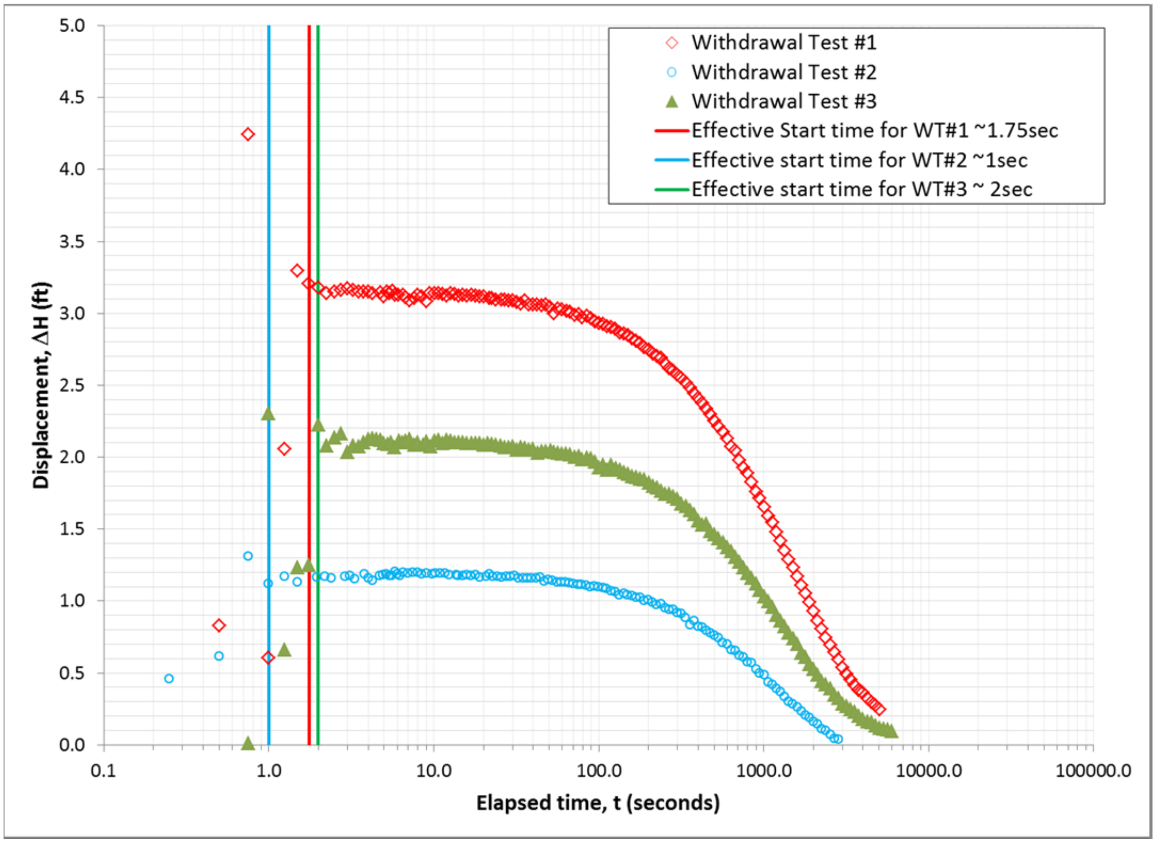

Figure 4-28. Effective start time for withdrawal tests at 199-D5-141

4.5.3 Estimation of effective initial displacement

Adjusted elapsed times are calculated by subtracting the effective start time from the reported elapsed times. The displacements are plotted against the adjusted elapsed times. The estimation of the initial displacements is shown in Figure 4-29. Effective initial displacements of 3.2 ft., 1.5 ft., and 2.15 ft. are estimated for the three withdrawal tests by back-fitting the observations to 0.0 elapsed time. For a slug volume (V) of 0.688 ft^3 and a casing radius (r_c) of 3 inches, a theoretical initial displacement (H_0) of 3.5 ft. is calculated ($H_0 = V/\pi r_c^2$). Similarly, theoretical initial displacements of 1.67 ft. and 2.4 ft. are estimated for the slug volumes of 0.328 ft^3 and 0.472 ft^3. The visually estimated initial displacements are comparable to the theoretical estimates suggesting that the test data are reliable.

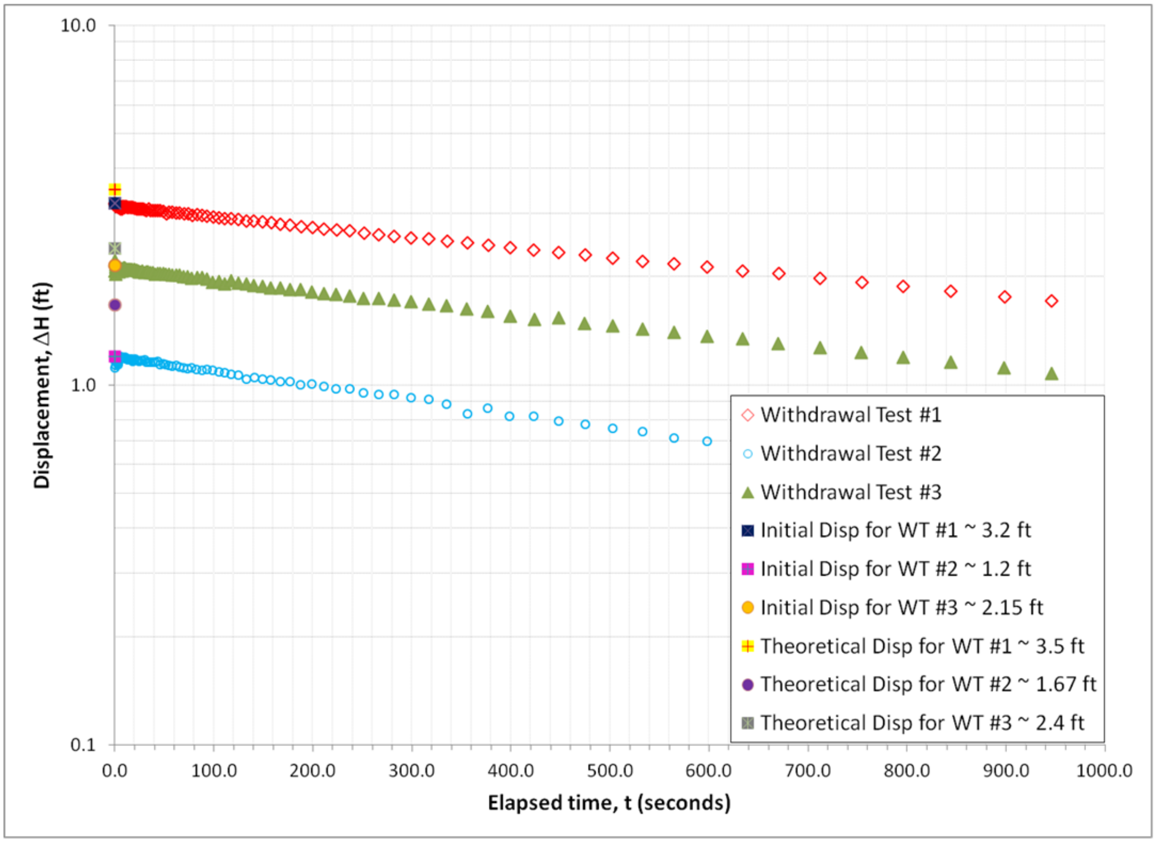

Figure 4-29. Estimation of effective initial displacement at 199-D5-141

4.5.4 Normalized displacements

The normalized displacements are calculated by dividing the observed displacements for the withdrawal tests by their respective effective initial displacement and plotted in Figure 4-30. The responses of the first and third tests are internally consistent but the second test's response deviates from the others after 300 seconds. An inspection of the field log indicates that the second slug test was abandoned midway because the recovery was too long. Therefore, it was excluded from further analysis. The close correspondence of the other normalized displacement curves suggests that it is sufficient to analyze the data from only one of the withdrawal tests. The third withdrawal test is chosen for analysis because its record is the most complete.

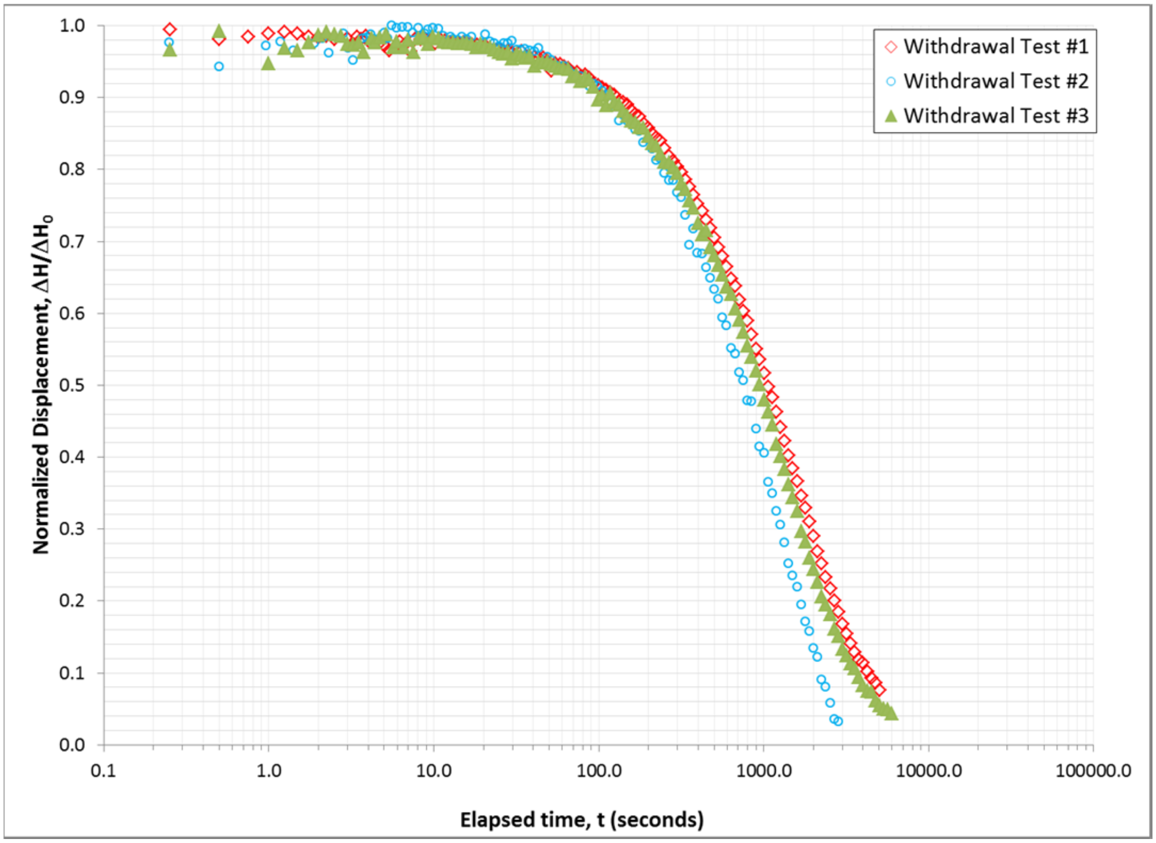

Figure 4-30. Normalized displacement at 199-D5-141

4.5.5 Preliminary analysis

For a first-cut analysis, the normalized displacements for the third withdrawal test are fit with the CBP model. The CBP model fit is shown in Figure 4-31. A good match to the observations is achieved with a storage coefficient, *S*, of 1×10^{-3}, and a fitted transmissivity, *T*, of 0.59 m^2/d. This analysis assumes that the well penetrates the full thickness of the aquifer. Referring to Table 4-1, we see that for well 199-D5-141, this is not the case. The aquifer (RUM) is at least 16.55 m (110.11 m – 93.56 m) thick at this location, and the length of the well screen is about 3.05 m. Cooper et al. (1967) suggested that in the case of a well that penetrates only a portion of the thickness of the aquifer, the effective thickness of the aquifer can be specified as the effective length of the well screen. Since the length of the submerged well screen length is 10 ft. (3.05 m), the estimated transmissivity corresponds to a horizontal hydraulic conductivity, K_H, of **0.2 m/d** or **2.3×10^{-6} m/s.**

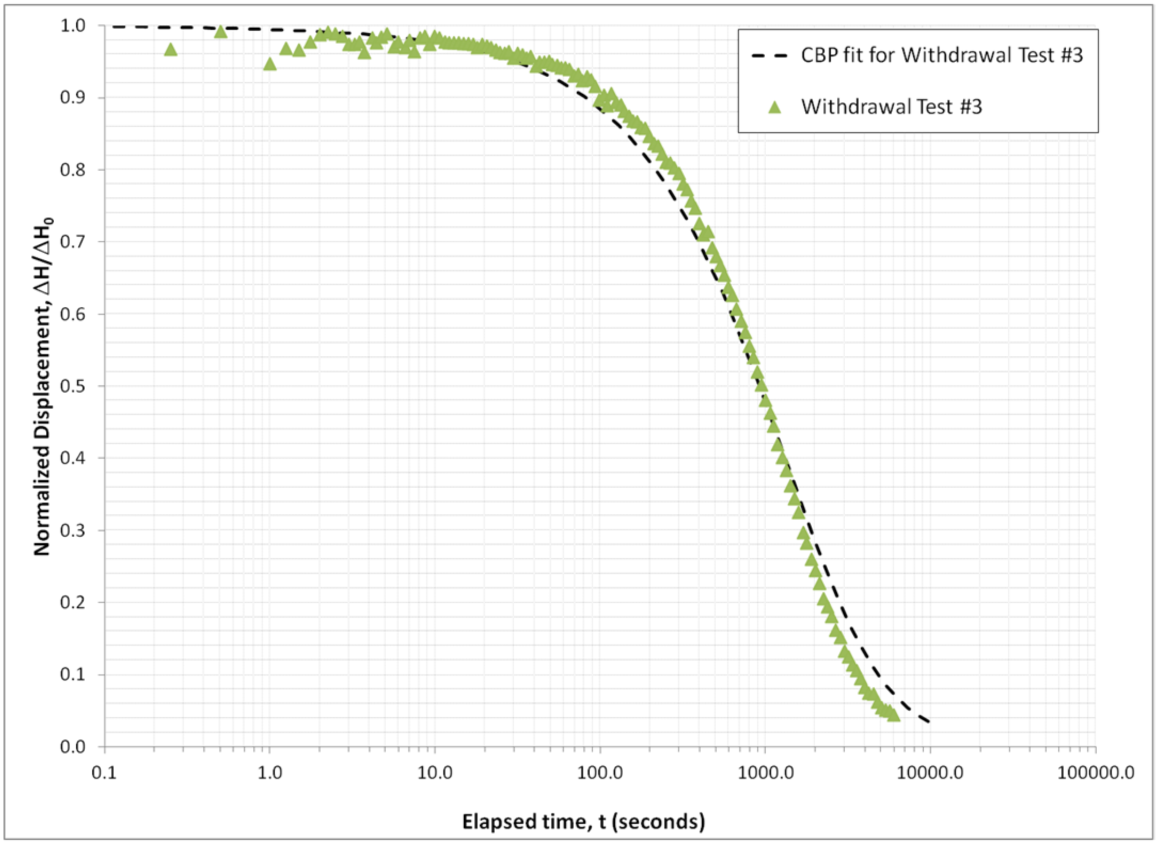

Figure 4-31. CBP Model fit at 199-D5-141

4.5.6 Refined analysis

For a more refined analysis, the normalized displacements for the third withdrawal test are fit with the KGS model for an unconfined aquifer. The KGS model fit is shown in Figure 4-32. A good match to the observations is achieved with a specific storage, S_s, of 3.3×10^{-4} m^{-1}, an anisotropy ratio K_V/K_H of 0.1, and a fitted horizontal hydraulic conductivity, K_H, of **0.2 m/d** or **2.3×10^{-6} m/s**. The specific storage value is not iteratively estimated but instead calculated by dividing an assumed storage coefficient of 1.0×10^{-3} by the well screen length (10 ft. or 3.05 m).

The fitted value of the specific storage value falls in the range suggested by Younger (1993) as representative of aquifer materials that consist of clay, silt and fine sand. This is consistent with the description of the material across which the well is screened as 'Gravelly Silt'.

The estimated hydraulic conductivity is at the higher end of the range for 'silt, loess' and at the lower end of the range for silty sand reported in the literature (see for example, Freeze and Cherry, 1979; Table 2.2). This corresponds well with the description of the screened interval.

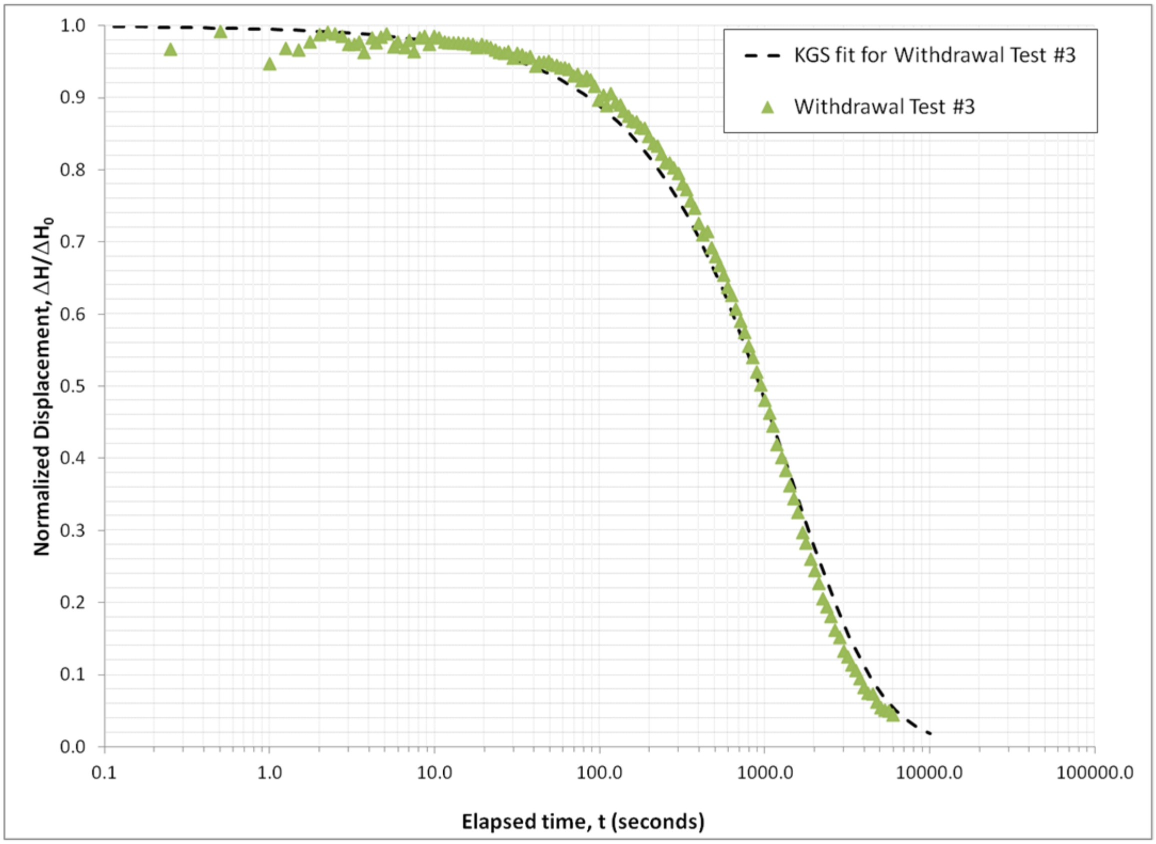

Figure 4-32. KGS Model fit at 199-D5-141

4.6 Analysis of Slug Test Data at well 199-D5-143

Three withdrawal tests were conducted at 199-D5-143 and all of them are analyzed here.

4.6.1 Raw displacement data for withdrawal tests

The three withdrawal tests were conducted with slugs of volume 0.688 ft^3, 0.328 ft^3 and 0.472 ft^3 respectively. The displacements are plotted in Figure 4.33. The normalized displacements in section 4.6.4 will tell us if these responses are consistent. Inspection of the displacements suggests that the tests are not instantaneous but that there is an effective start time for each test. These effective start times are estimated in section 4.6.2.

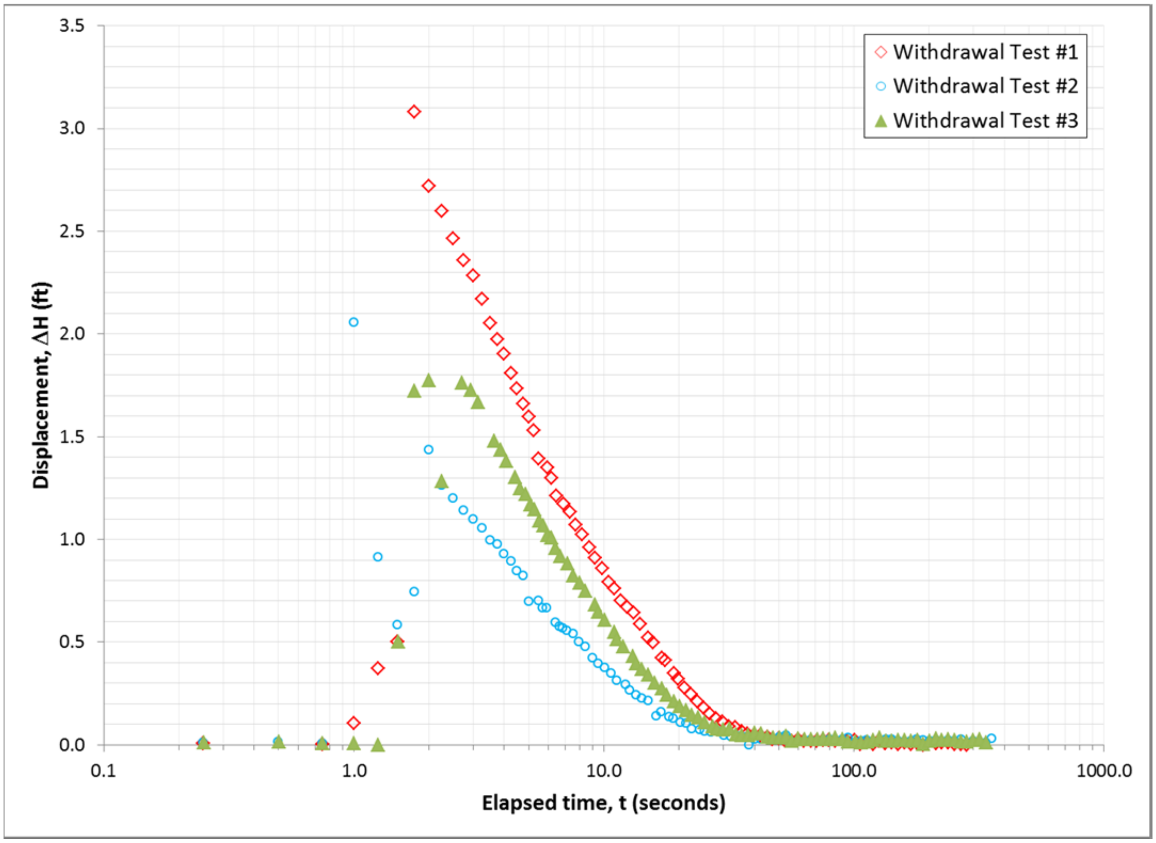

Figure 4-33. Displacements from three withdrawal tests at 199-D5-143

4.6.2 Estimation of effective start time

Effective start times of 1.75 seconds, 2 seconds and 2.7 seconds are estimated for the three withdrawal tests respectively.

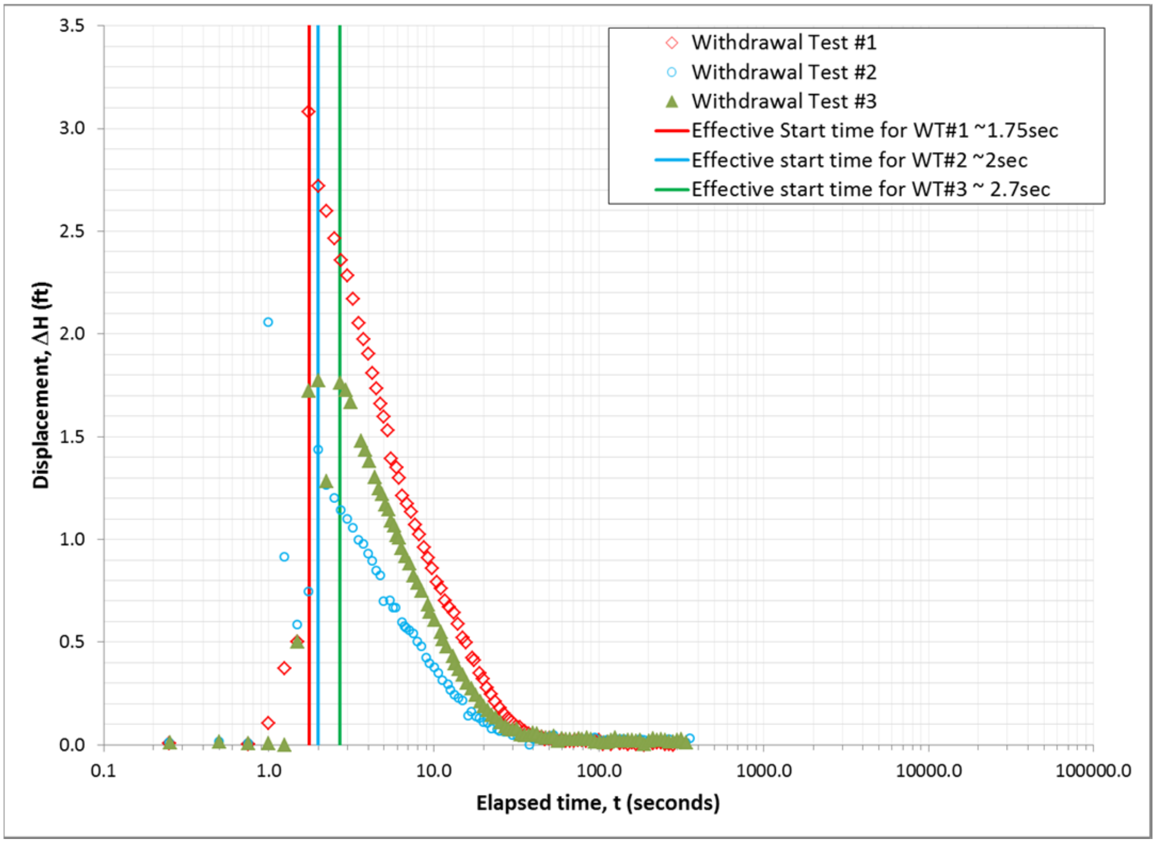

Figure 4-34. Effective start time for withdrawal tests at 199-D5-143

4.6.3 Estimation of effective initial displacement

Adjusted elapsed times are calculated by subtracting the effective start time from the reported elapsed times. The displacements are plotted against the adjusted elapsed times. The estimation of the initial displacements is shown in Figure 4-35. Effective initial displacements of 2.9 ft., 1.35 ft., and 1.8 ft. are estimated for the three withdrawal tests by back-fitting the observations to 0.0 elapsed time. For a slug volume (V) of 0.688 ft^3 and a casing radius (r_c) of 3 inches, a theoretical initial displacement (H_0) of 3.5 ft. is calculated ($H_0 = V/\pi r_c^2$). Similarly, theoretical initial displacements of 1.67 ft. and 2.4 ft. are estimated for the slug volumes of 0.328 ft^3 and 0.472 ft^3. The visually estimated initial displacements are lesser than the theoretical estimates probably because of the non-instantaneous nature of the tests.

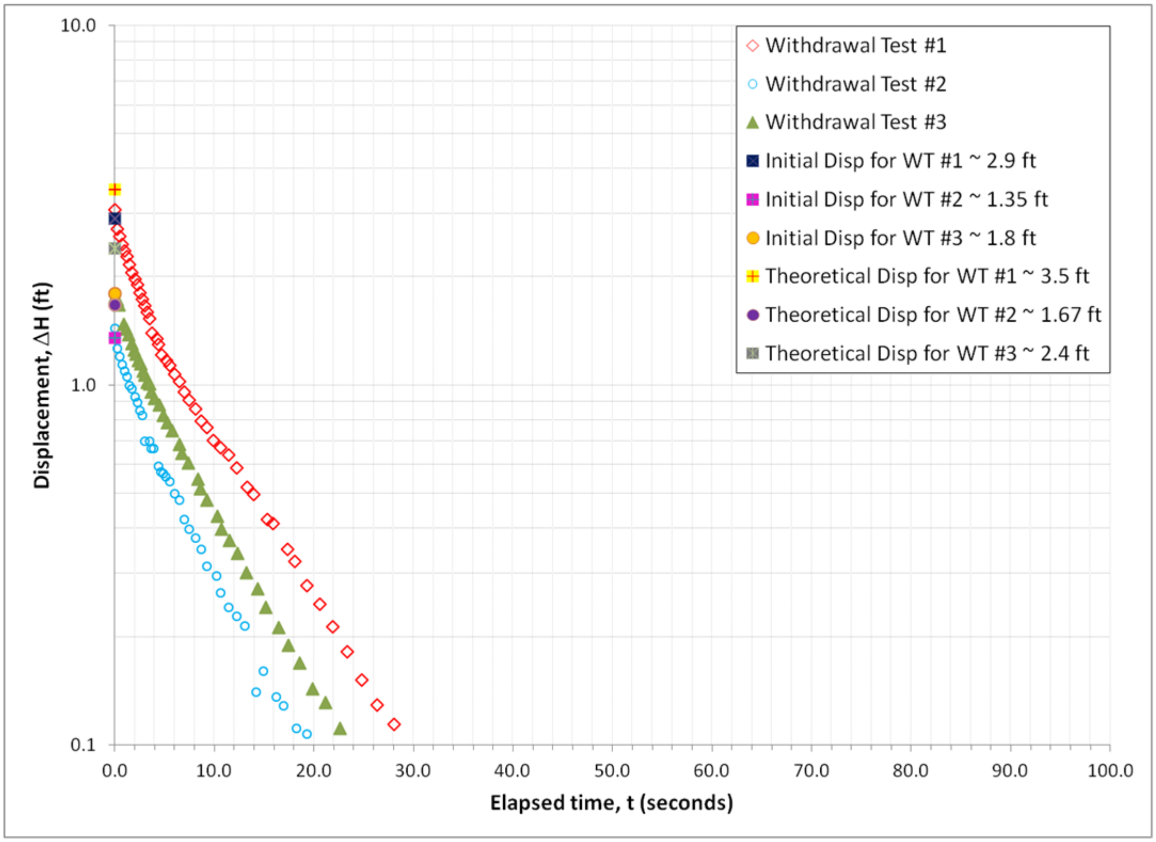

Figure 4-35. Estimation of effective initial displacement at 199-D5-143

4.6.4 Normalized displacements

The normalized displacements are calculated by dividing the observed displacements for the withdrawal tests by their respective effective initial displacement. The normalized responses plotted in Figure 4-36 confirm that the results for all the withdrawal tests are internally consistent. The close correspondence of the normalized displacement curves suggests that it is sufficient to analyze the data from only one of the withdrawal tests. The first withdrawal test is chosen for analysis.

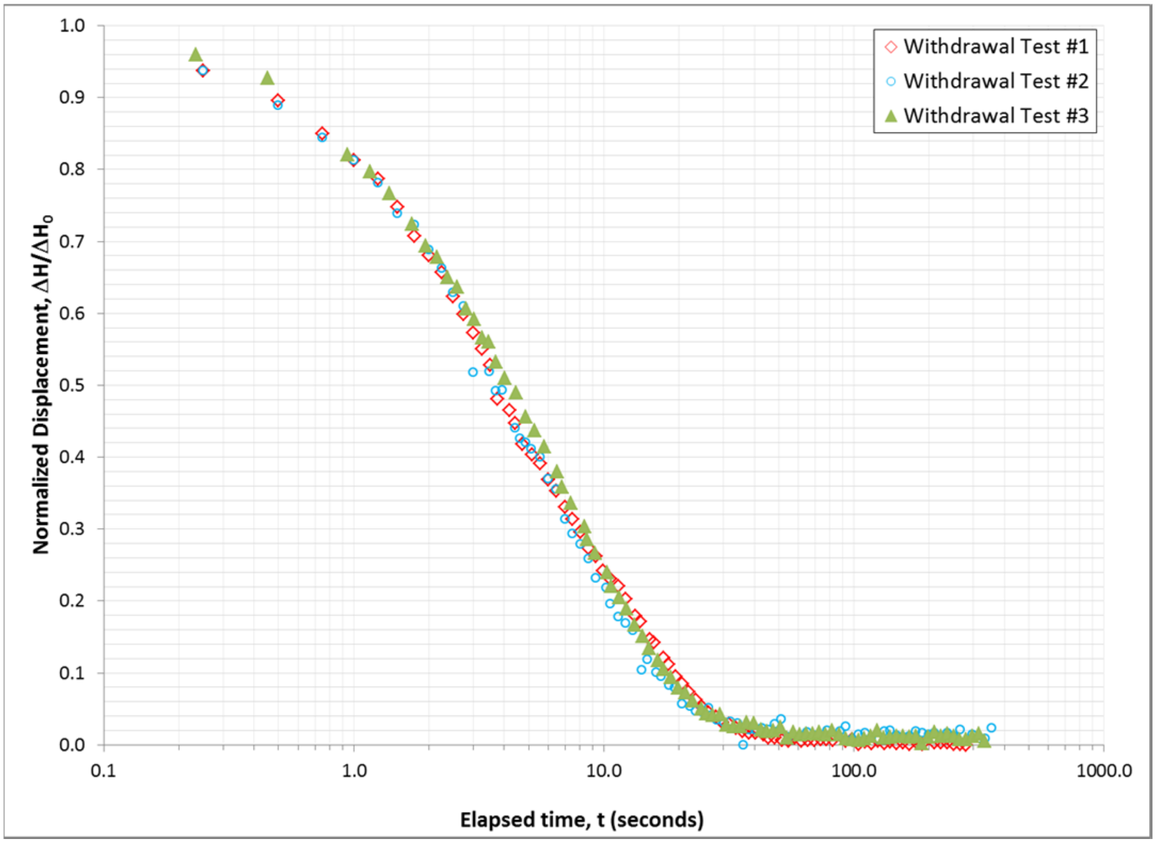

Figure 4-36. Normalized displacement at 199-D5-143

4.6.5 Preliminary analysis

For a first-cut analysis, the normalized displacements for the first withdrawal test are fit with the CBP model. The CBP model fit is shown in Figure 4-37. A good match to the observations is achieved with a storage coefficient, *S*, of 1.2×10^{-3}, and a fitted transmissivity, *T*, of 137 m^2/d. This analysis assumes that the well penetrates the full thickness of the aquifer. Referring to Table 4-1, we see that for well 199-D5-143, this is not the case. The aquifer (Ringold unit E) is about 7.89 m (119.60 m – 111.71 m) thick at this location, and the length of the well screen is about 6.16 m. Cooper et al. (1967) suggested that in the case of a well that penetrates only a portion of the thickness of the aquifer, the effective thickness of the aquifer can be specified as the effective length of the well screen. Since the length of the submerged well screen length is 20.225 ft. (6.16 m), the estimated transmissivity corresponds to a horizontal hydraulic conductivity, K_H, of **22 m/d** **or** **2.5×10^{-4} m/s**.

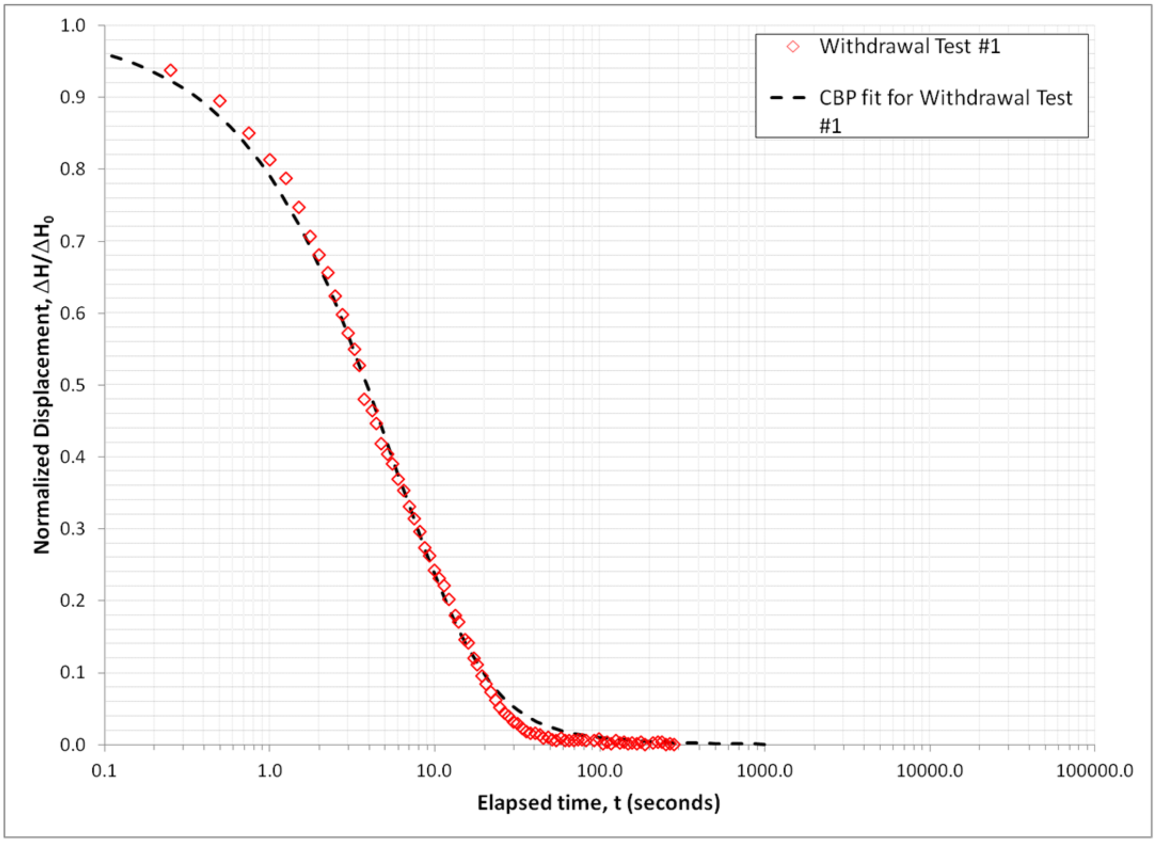

Figure 4-37. CBP Model fit at 199-D5-143

4.6.6 Refined analysis

For a more refined analysis, the normalized displacements for the first withdrawal test are fit with the KGS model for an unconfined aquifer. The KGS model fit is shown in Figure 4-38. A good match to the observations is achieved with a specific storage, S_s, of 2.0×10^{-4} m^{-1}, an anisotropy ratio K_V/K_H of 0.1, and a fitted horizontal hydraulic conductivity, K_H, of **20 m/d** or **2.3×10^{-4} m/s**. The specific storage value is not iteratively estimated but instead calculated by dividing an assumed storage coefficient of 1.2×10^{-3} by the well screen length (20.225 ft. or 6.16 m).

The fitted value of the specific storage value falls in the range suggested by Younger (1993) as representative of aquifer materials that consist of medium sand, fine sand and silt. This does not correspond well with the 'Silty Sandy Gravel' description of the screened interval. It is possible that there could be some fines in the screened interval accounting for the higher specific storage.

The estimated hydraulic conductivity is in the middle of the range for clean sand and at the higher end of the range for silty sand reported in the literature (see for example, Freeze and Cherry, 1979; Table 2.2). This does not correspond well with the 'Silty Sandy Gravel' description of the screened interval. It is possible that there could be some unreported fines in the aquifer across from the screened interval accounting for the lower hydraulic conductivity.

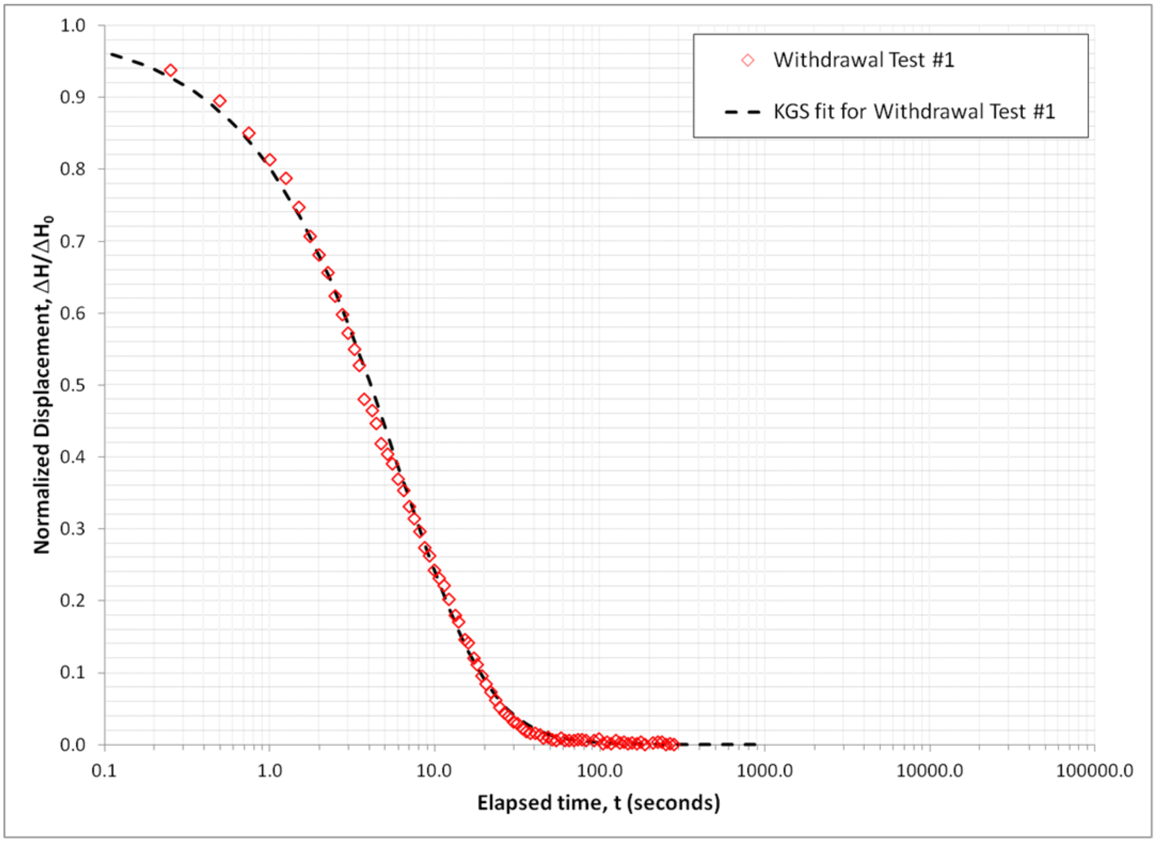

Figure 4-38. KGS Model fit at 199-D5-143

4.7 Analysis of Slug Test Data at well 199-D5-144

Two withdrawal tests were conducted at 199-D5-144 and both are analyzed here.

4.7.1 Raw displacement data for withdrawal tests

The two withdrawal tests were conducted with a slug of volume 0.328 ft^3. The displacements are plotted in Figure 4.39. The agreement in the responses between the two tests suggests that the test data are reliable. Inspection of the displacements suggests that the tests are not instantaneous but that there is an effective start time for each test. These effective start times are estimated in section 4.7.2.

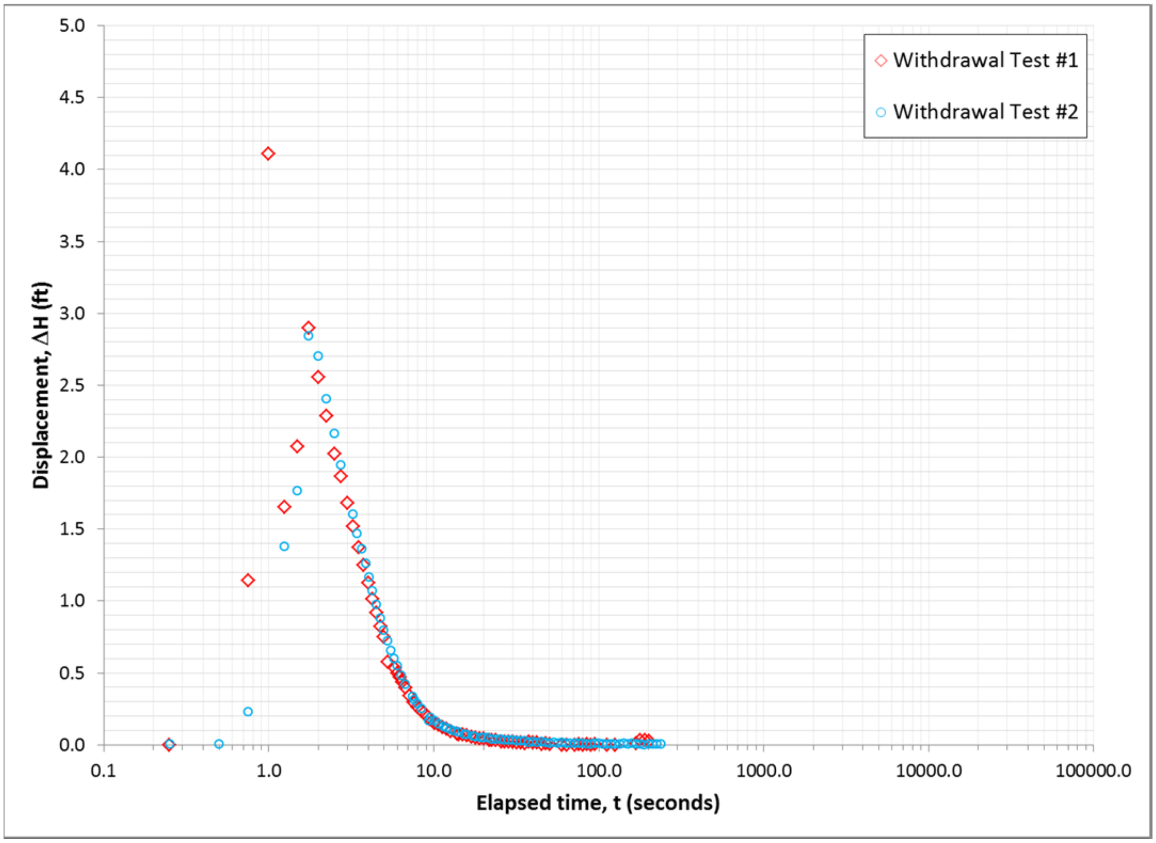

Figure 4-39. Displacements from two withdrawal tests at 199-D5-144

4.7.2 Estimation of effective start time

An effective start time of 1.75 seconds was estimated for the two withdrawal tests as shown in Figure 4-40.

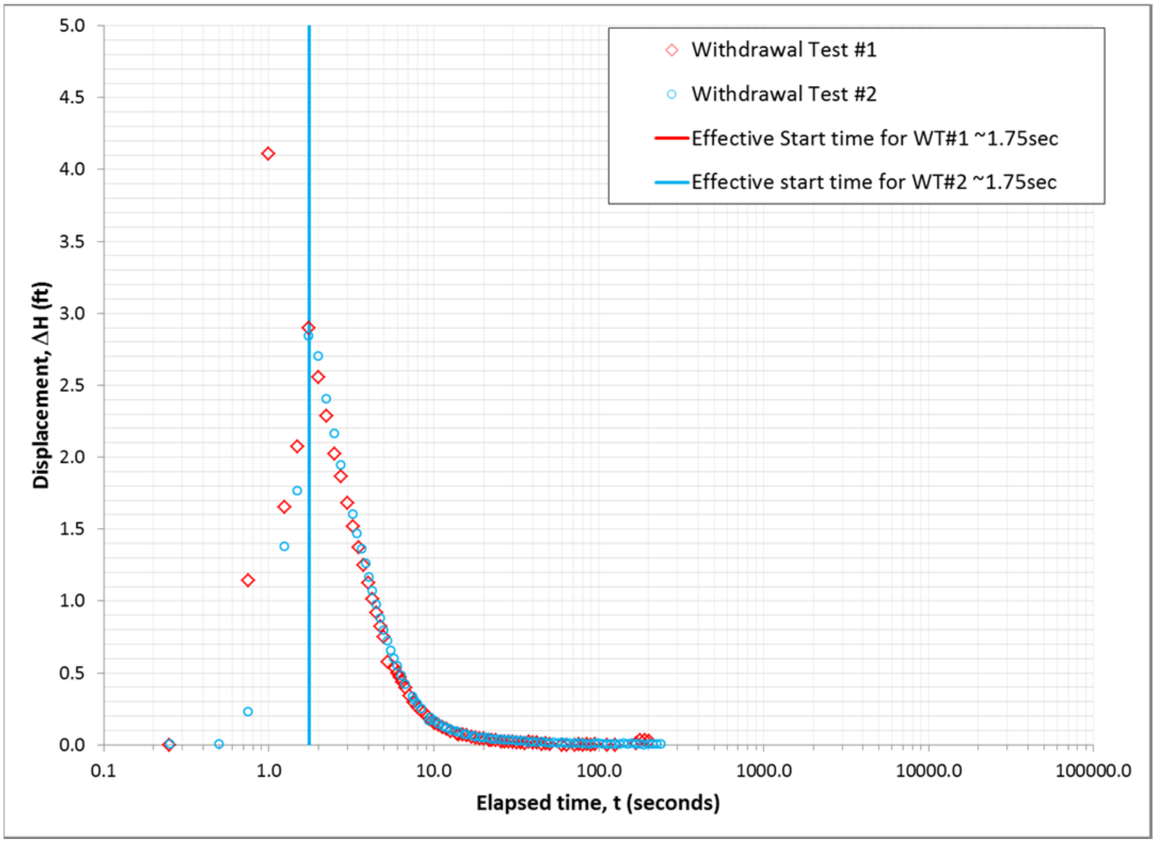

Figure 4-40. Effective start time for withdrawal tests at 199-D5-144

4.7.3 Estimation of effective initial displacement

Adjusted elapsed times are calculated by subtracting the effective start time from the reported elapsed times. The displacements are plotted against the adjusted elapsed times. The estimation of the initial displacements is shown in Figure 4-41. Effective initial displacements of 2.78 ft., and 2.88 ft. are estimated for the two withdrawal tests by back-fitting the observations to 0.0 elapsed time. For a slug volume (V) of 0.328 ft^3 and a casing radius (r_c) of 2 inches, a theoretical initial displacement (H_0) of 3.75 ft. is calculated ($H_0 = V/\pi r_c^2$). The visually estimated initial displacements are close to the theoretical estimates suggesting that the test data are reliable.

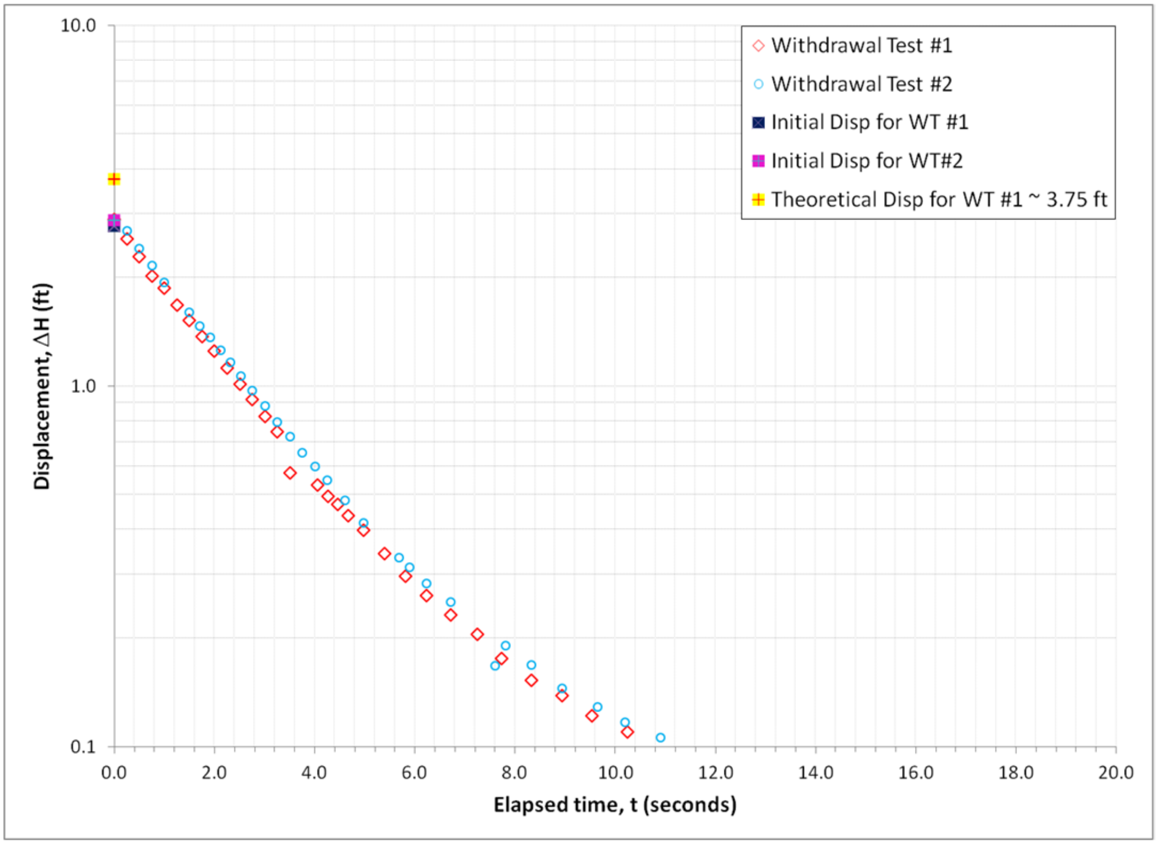

Figure 4-41. Estimation of effective initial displacement at 199-D5-144

4.7.4 Normalized displacements

The normalized displacements are calculated by dividing the observed displacements for the withdrawal tests by their respective effective initial displacement. The normalized responses plotted in Figure 4-42 confirm that the results for all the withdrawal tests are internally consistent. The close correspondence of the normalized displacement curves suggests that it is sufficient to analyze the data from only one of the withdrawal tests. The first withdrawal test is chosen for analysis.

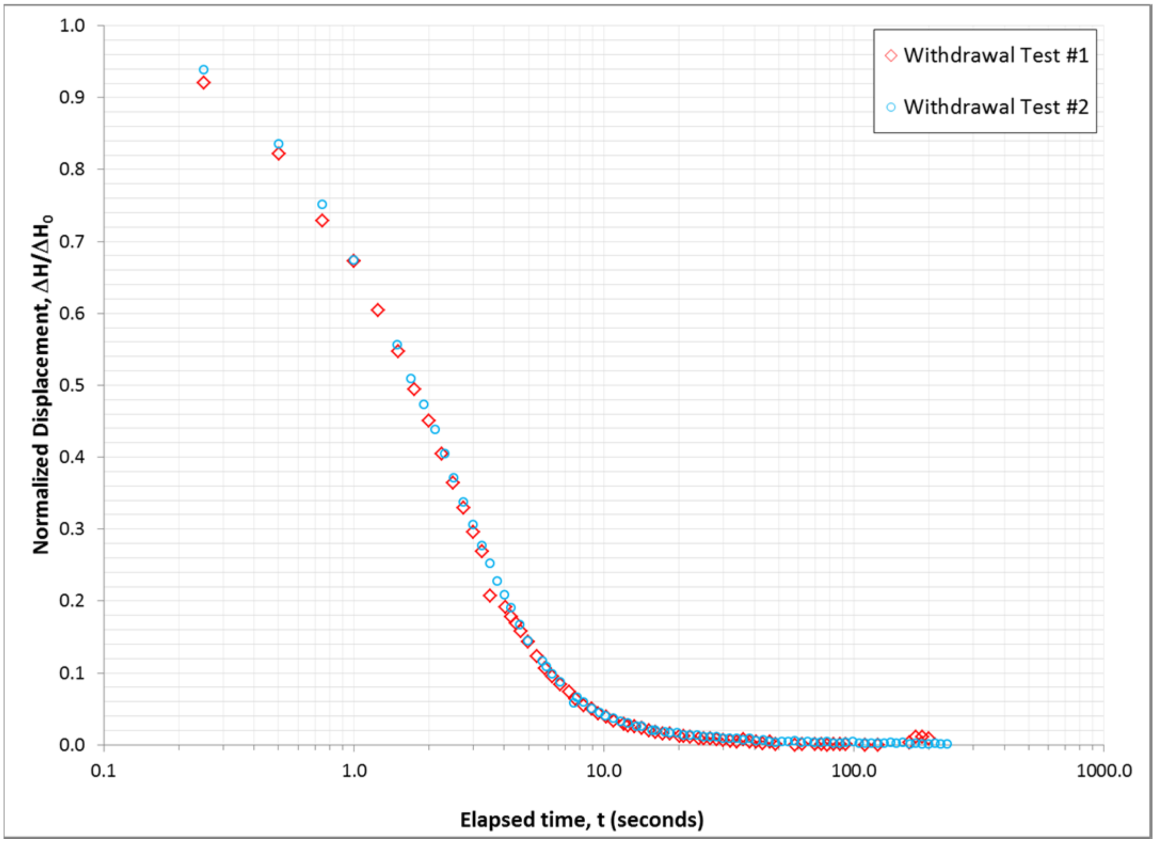

Figure 4-42. Normalized displacement at 199-D5-144

4.7.5 Preliminary analysis

For a first-cut analysis, the normalized displacements for the first withdrawal test are fit with the CBP model. The CBP model fit is shown in Figure 4-43. A good match to the observations is achieved with a storage coefficient, *S*, of 4.6×10^{-4}, and a fitted transmissivity, *T*, of 173 m^2/d. This analysis assumes that the well penetrates the full thickness of the aquifer. Referring to Table 4-1, we see that for well 199-D5-144, this is not the case. The aquifer (Ringold unit E) is about 8.66 m (119.83 m – 111.17 m) thick at this location, and the length of the well screen is about 7 m. Cooper et al. (1967) suggested that in the case of a well that penetrates only a portion of the thickness of the aquifer, the effective thickness of the aquifer can be specified as the effective length of the well screen. Since the length of the submerged well screen length is 23 ft. (7 m), the estimated transmissivity corresponds to a horizontal hydraulic conductivity, K_H, of **25 m/d** **or** **2.9×10^{-4} m/s.**

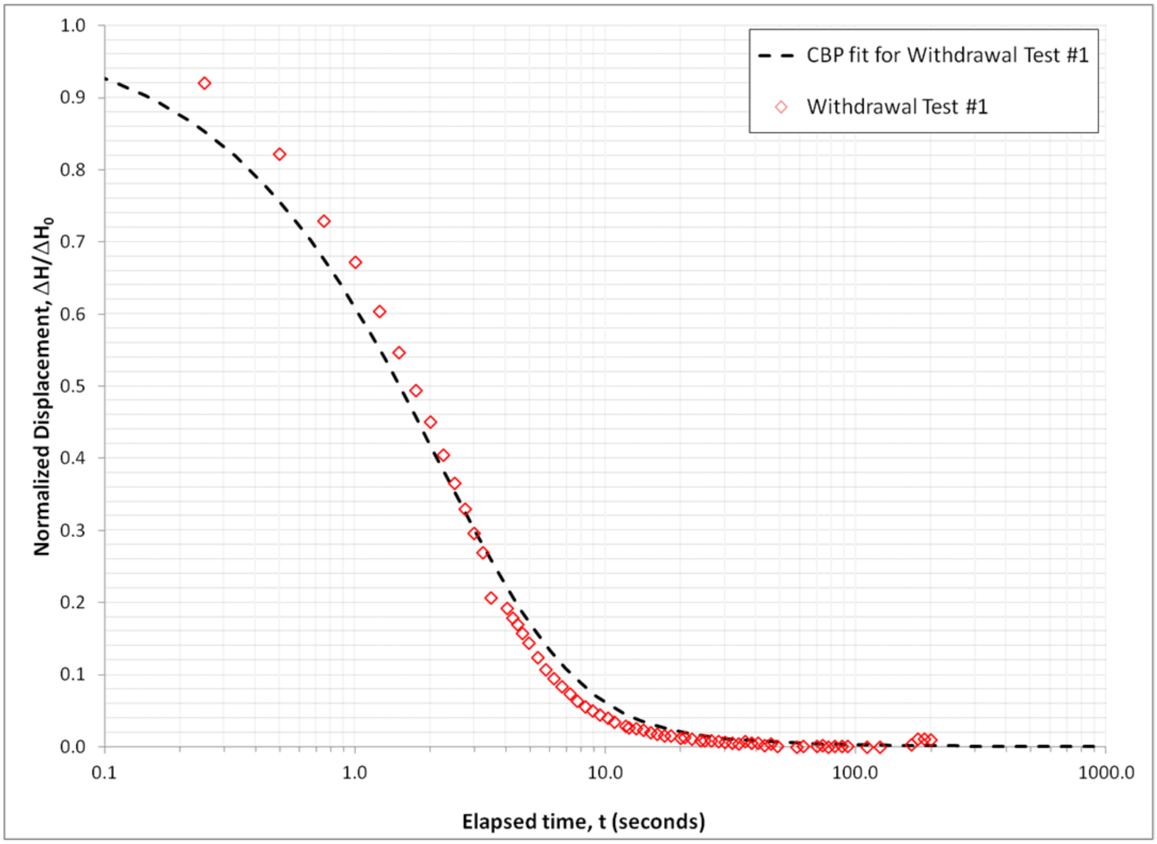

Figure 4-43. CBP Model fit at 199-D5-144

4.7.6 Refined analysis

For a more refined analysis, the normalized displacements for the first withdrawal test are fit with the KGS model for an unconfined aquifer. The KGS model fit is shown in Figure 4-44. A good match to the observations is achieved with a specific storage, S_s, of 6.6×10^{-5} m^{-1}, an anisotropy ratio K_V/K_H of 0.1, and a fitted horizontal hydraulic conductivity, K_H, of **23 m/d** or **2.7×10^{-4} m/s**. The specific storage value is not iteratively estimated but instead calculated by dividing an assumed storage coefficient of 4.6×10^{-4} by the well screen length (23 ft. or 7 m).

The fitted value of the specific storage value falls in the range suggested by Younger (1993) as representative of aquifer materials that consist of medium sand and coarse sand. This corresponds well with the well log which describes the screened interval as a mixture of sand, gravel and silt.

The estimated hydraulic conductivity is in the middle of the range for clean sand and at the higher end of the range for silty sand reported in the literature (see for example, Freeze and Cherry, 1979; Table 2.2). This corresponds well with the well log which describes the screened interval as a mixture of sand, gravel and silt.

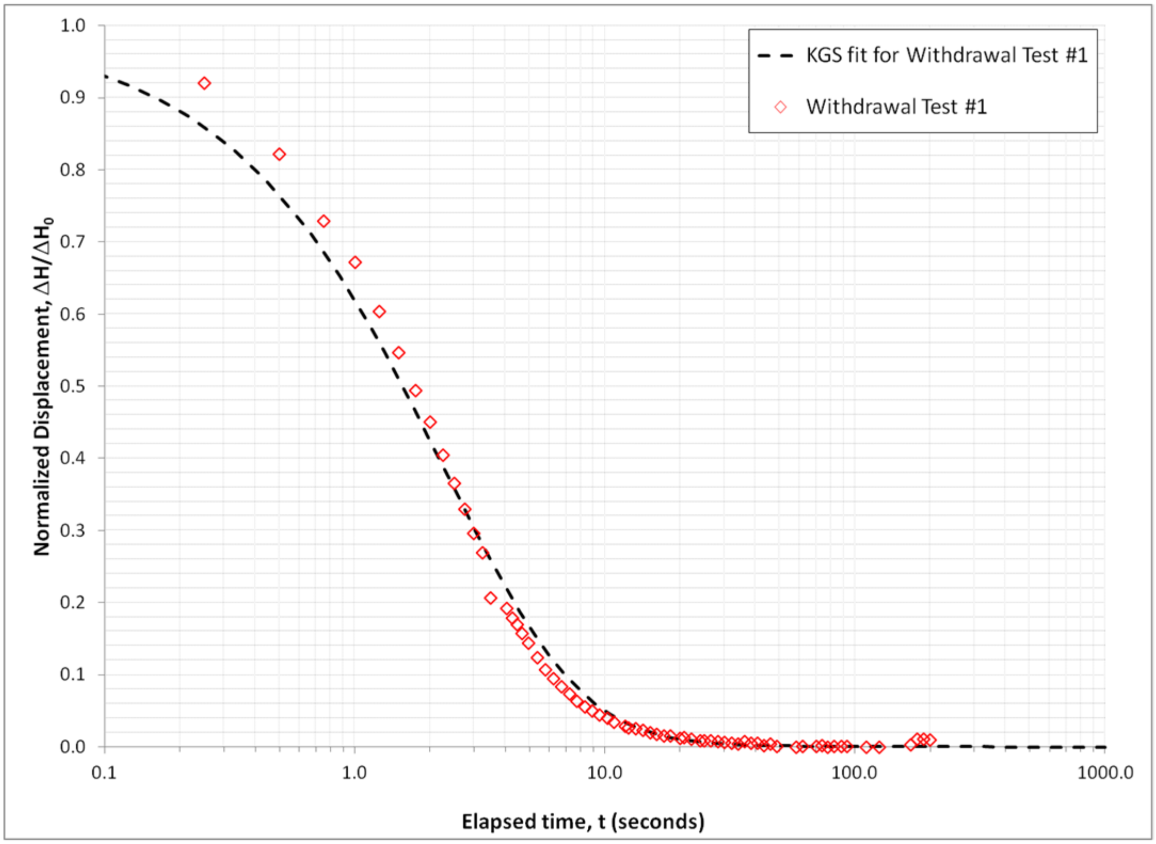

Figure 4-44. KGS Model fit at 199-D5-144

4.8 Analysis of Slug Test Data at well 199-D6-3

Three withdrawal tests were conducted at 199-D6-3 and all of them are analyzed here.

4.8.1 Raw displacement data for withdrawal tests

The three withdrawal tests were conducted with slugs of volume 0.688 ft^3, 0.328 ft^3 and 0.472 ft^3 respectively. The displacements are plotted in Figure 4.45. The normalized displacements in section 4.8.4 will tell us if these responses are consistent. Inspection of the displacements suggests that the tests are not instantaneous but that there is an effective start time for each test. These effective start times are estimated in section 4.8.2.

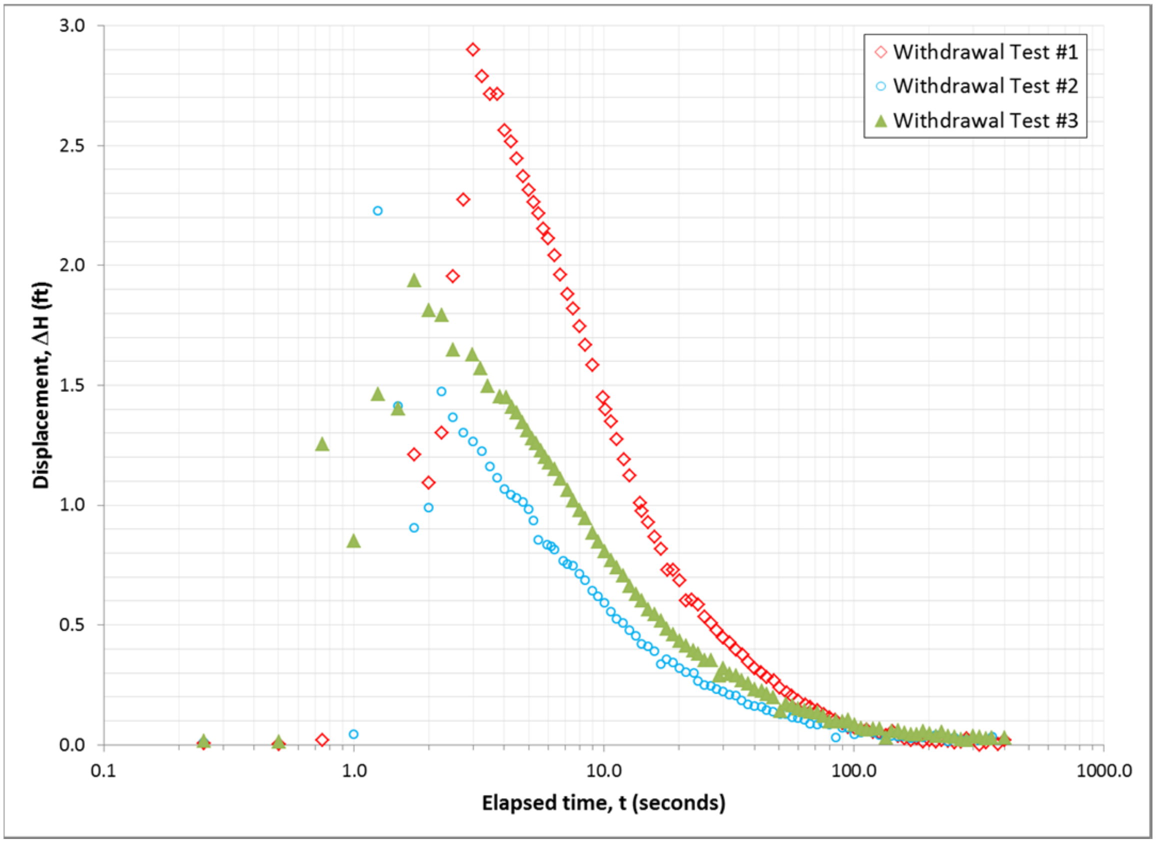

Figure 4-45. Displacements from three withdrawal tests at 199-D6-3

4.8.2 Estimation of effective start time

Effective start times of 3 seconds, 2.25 seconds and 1.75 seconds are estimated for the three withdrawal tests respectively.

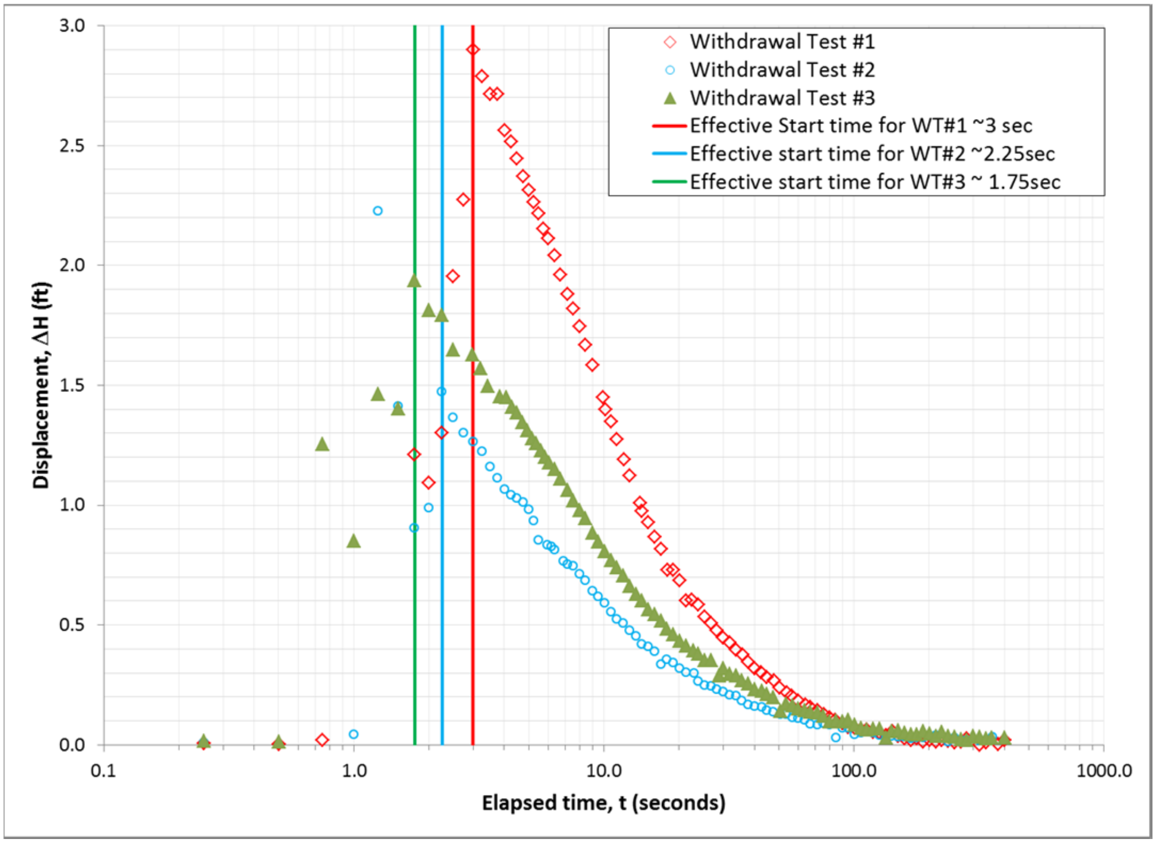

Figure 4-46. Effective start time for withdrawal tests at 199-D6-3

4.8.3 Estimation of effective initial displacement

Adjusted elapsed times are calculated by subtracting the effective start time from the reported elapsed times. The displacements are plotted against the adjusted elapsed times. The estimation of the initial displacements is shown in Figure 4-47. Effective initial displacements of 2.95 ft., 1.4 ft., and 1.9 ft. are estimated for the three withdrawal tests by back-fitting the observations to 0.0 elapsed time. For a slug volume (V) of 0.688 ft^3 and a casing radius (r_c) of 3 inches, a theoretical initial displacement (H_0) of 3.5 ft. is calculated ($H_0 = V/\pi r_c^2$). Similarly, theoretical initial displacements of 1.67 ft. and 2.4 ft. are estimated for the slug volumes of 0.328 ft^3 and 0.472 ft^3. The visually estimated initial displacements are lesser than the theoretical estimates probably because of the non-instantaneous nature of the tests.

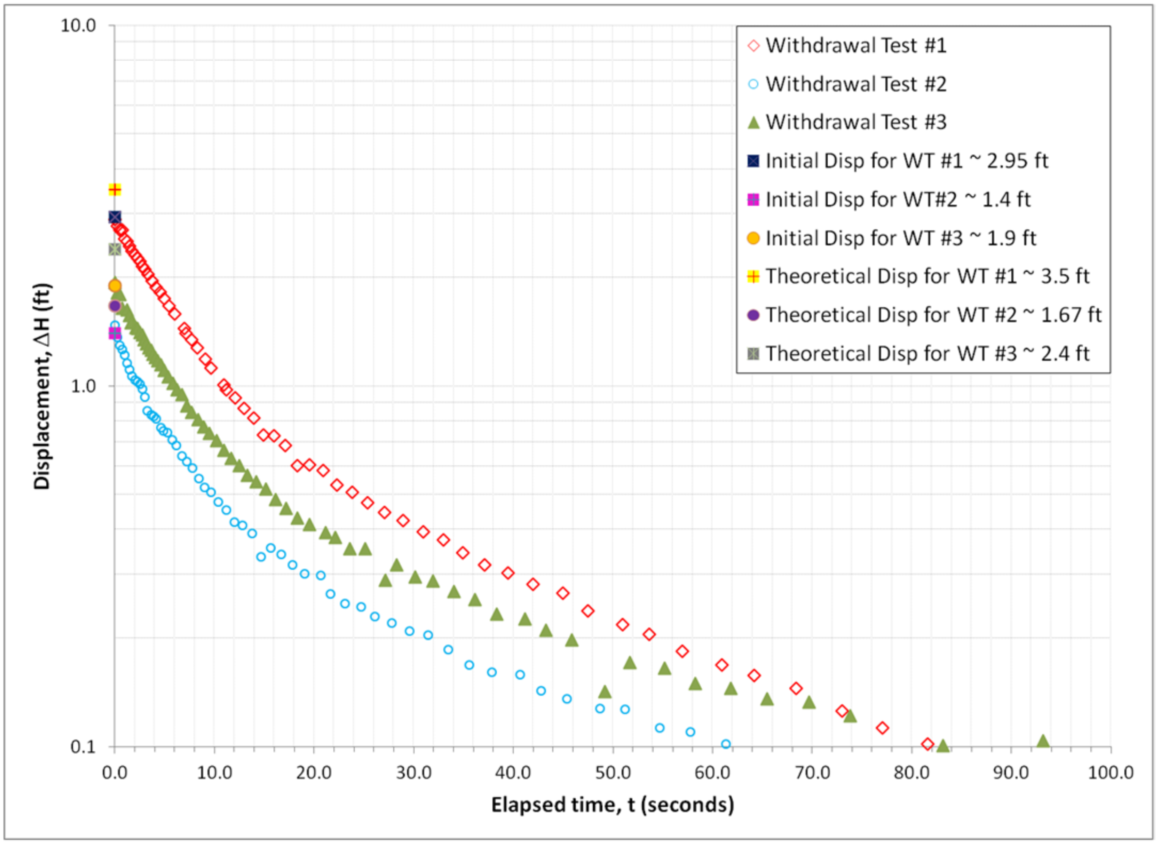

Figure 4-47. Estimation of effective initial displacement at 199-D6-3

4.8.4 Normalized displacements

The normalized displacements are calculated by dividing the observed displacements for the withdrawal tests by their respective effective initial displacement. The normalized responses plotted in Figure 4-48 confirm that the results for all the withdrawal tests are internally consistent. The close correspondence of the normalized displacement curves suggests that it is sufficient to analyze the data from only one of the withdrawal tests. The first withdrawal test is chosen for analysis.

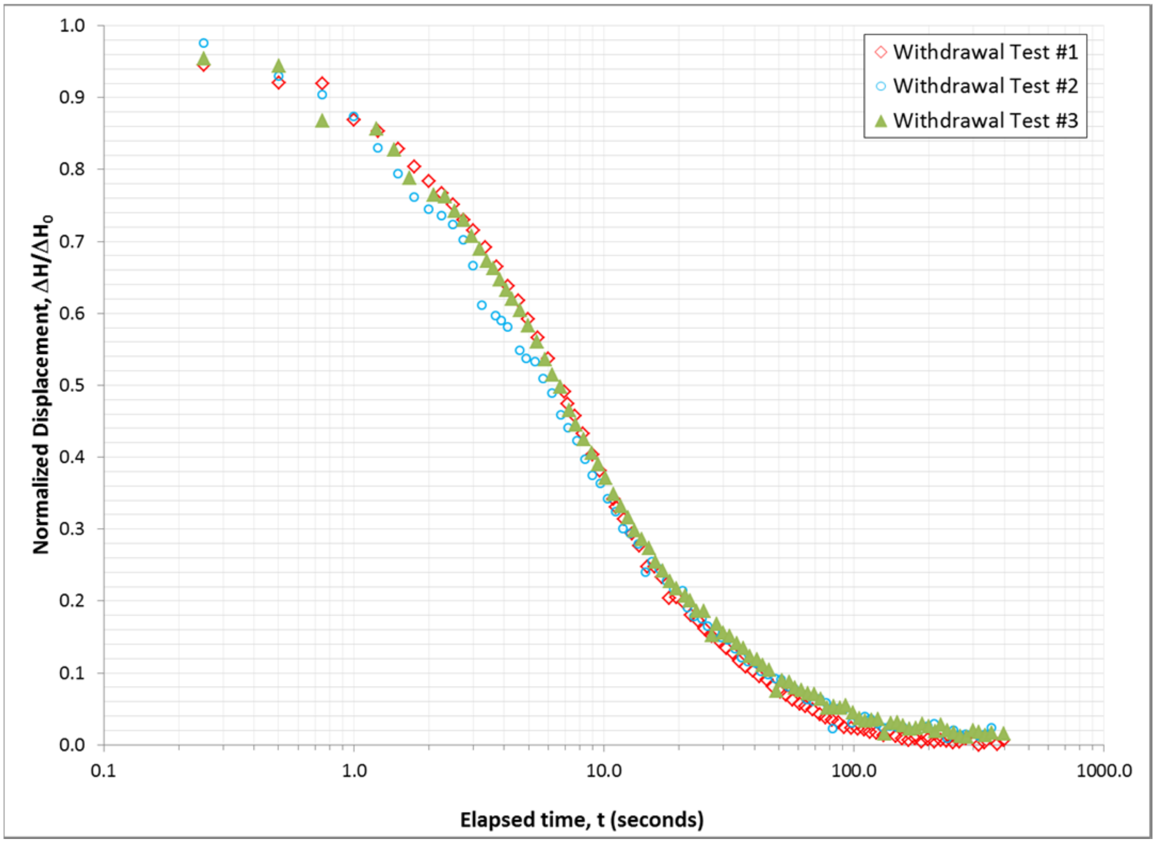

Figure 4-48. Normalized displacement at 199-D6-3

4.8.5 Preliminary analysis

For a first-cut analysis, the normalized displacements for the first withdrawal test are fit with the CBP model. The CBP model fit is shown in Figure 4-49. A good match to the observations is achieved with a storage coefficient, *S*, of 3×10^{-3}, and a fitted transmissivity, *T*, of 65 m^2/d. This analysis assumes that the well penetrates the full thickness of the aquifer. Referring to Table 4-1, we see that for well 199-D6-3, this is not the case. The aquifer (Ringold unit E) is about 6.46 m (118.93 m – 112.47 m) thick at this location, and the length of the well screen is about 5.11 m. Cooper et al. (1967) suggested that in the case of a well that penetrates only a portion of the thickness of the aquifer, the effective thickness of the aquifer can be specified as the effective length of the well screen. Since the length of the submerged well screen length is 16.78 ft. (5.11 m), the estimated transmissivity corresponds to a horizontal hydraulic conductivity, K_H, of **13 m/d** or **1.5×10^{-4} m/s**.

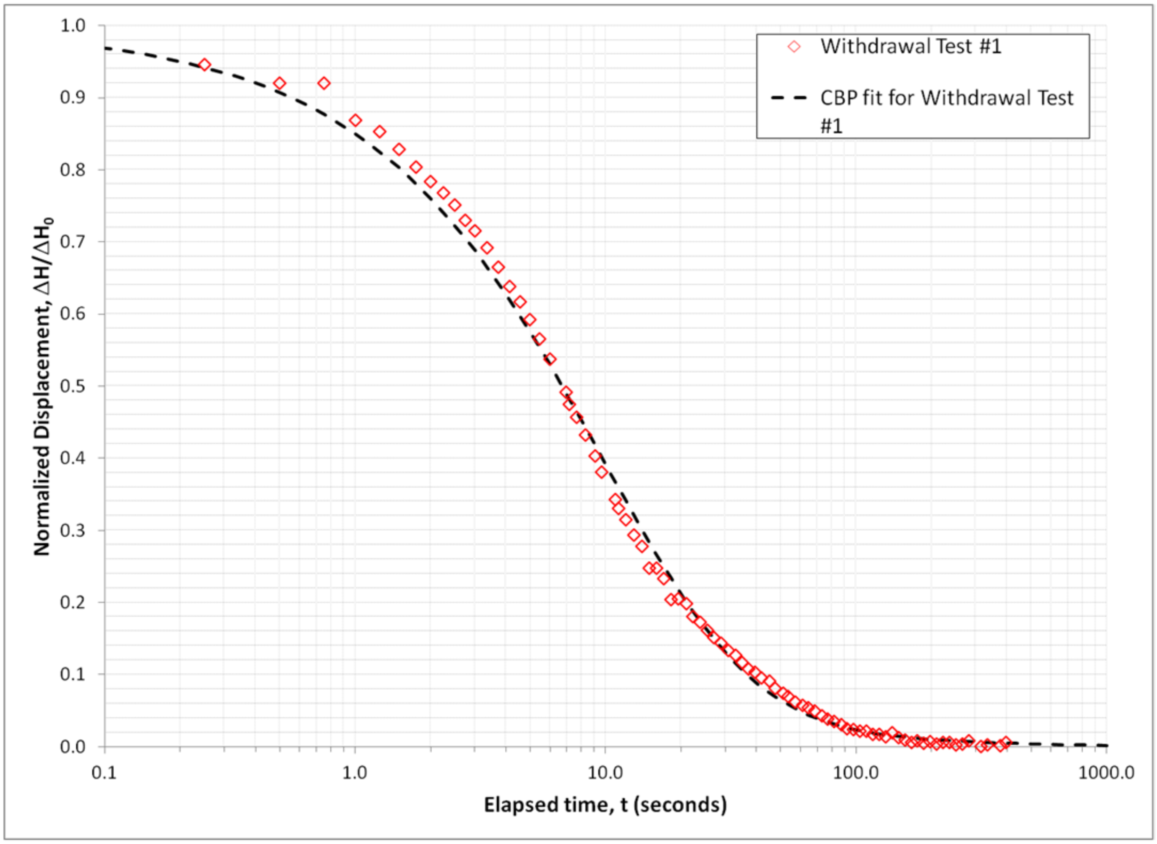

Figure 4-49. CBP Model fit at 199-D6-3

4.8.6 Refined analysis

For a more refined analysis, the normalized displacements for the first withdrawal test are fit with the KGS model for an unconfined aquifer. The KGS model fit is shown in Figure 4-50. A good match to the observations is achieved with a specific storage, S_s, of 5.9×10^{-4} m^{-1}, an anisotropy ratio K_V/K_H of 0.1, and a fitted horizontal hydraulic conductivity, K_H, of **12 m/d** or **1.4×10^{-4} m/s**. The specific storage value is not iteratively estimated but instead calculated by dividing an assumed storage coefficient of 3×10^{-3} by the well screen length (16.78 ft. or 5.11 m).

The fitted value of the specific storage value falls in the range suggested by Younger (1993) as representative of aquifer materials that consist of medium sand, fine sand and silt. This does not correspond well with the 'Silty Sandy Gravel' description of the screened interval. It is possible that there could be some fines in the aquifer across the screened interval accounting for the higher specific storage. Further discussion with personnel who had knowledge of drilling activities at this well revealed that the geologist could have missed the fines because of the well was drilled with a very fast dual percussion method using air.

The estimated hydraulic conductivity is in the middle of the range for clean sand and at the higher end of the range for silty sand reported in the literature (see for example, Freeze and Cherry, 1979; Table 2.2). This does not correspond well with the 'Silty Sandy Gravel' description of the screened interval. It is possible that there could be some fines in the aquifer across from the screened interval accounting for the lower hydraulic conductivity.

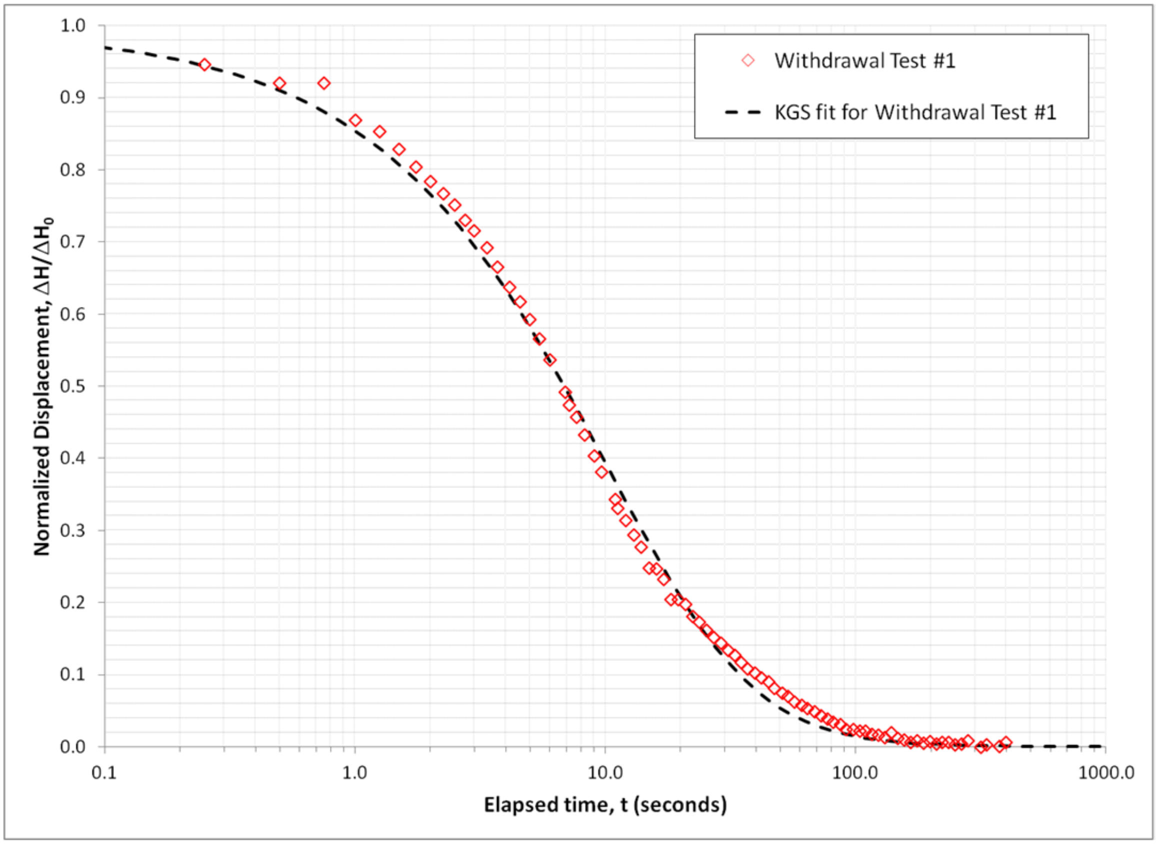

Figure 4-50. KGS Model fit at 199-D6-3

4.9 Analysis of Slug Test Data at well 199-H2-1

Three withdrawal tests were conducted at 199-H2-1 and all of them are analyzed here.

4.9.1 Raw displacement data for withdrawal tests

The three withdrawal tests were conducted with slugs of volume 0.688 ft^3, 0.328 ft^3 and 0.472 ft^3 respectively. The displacements are plotted in Figure 4-51. The normalized displacements in section 4.9.3 will tell us if these responses are consistent.

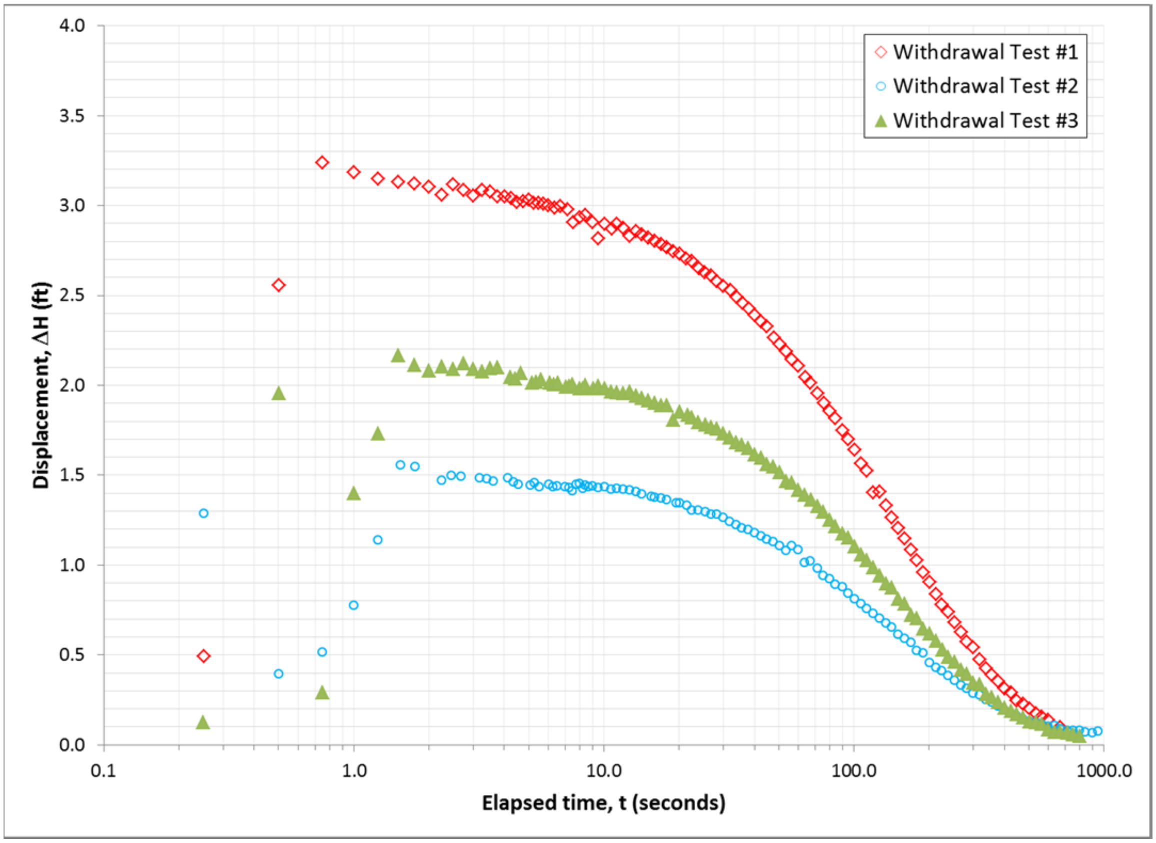

Figure 4-51. Displacements from three withdrawal tests at 199-H2-1

4.9.2 Estimation of effective initial displacement

Adjusted elapsed times are calculated by subtracting the effective start time from the reported elapsed times. The displacements are plotted against the adjusted elapsed times. The estimation of the initial displacements is shown in Figure 4-52. Effective initial displacements of 3.2 ft., 1.54 ft., and 2.14 ft. are estimated for the three withdrawal tests by back-fitting the observations to 0.0 elapsed time. For a slug volume (V) of 0.688 ft^3 and a casing radius (r_c) of 3 inches, a theoretical initial displacement (H_0) of 3.5 ft. is calculated ($H_0 = V/\pi r_c^2$). Similarly, theoretical initial displacements of 1.67 ft. and 2.4 ft. are estimated for the slug volumes of 0.328 ft^3 and 0.472 ft^3. The visually estimated initial displacements are relatively close to the theoretical estimates suggesting that the test data are reliable.

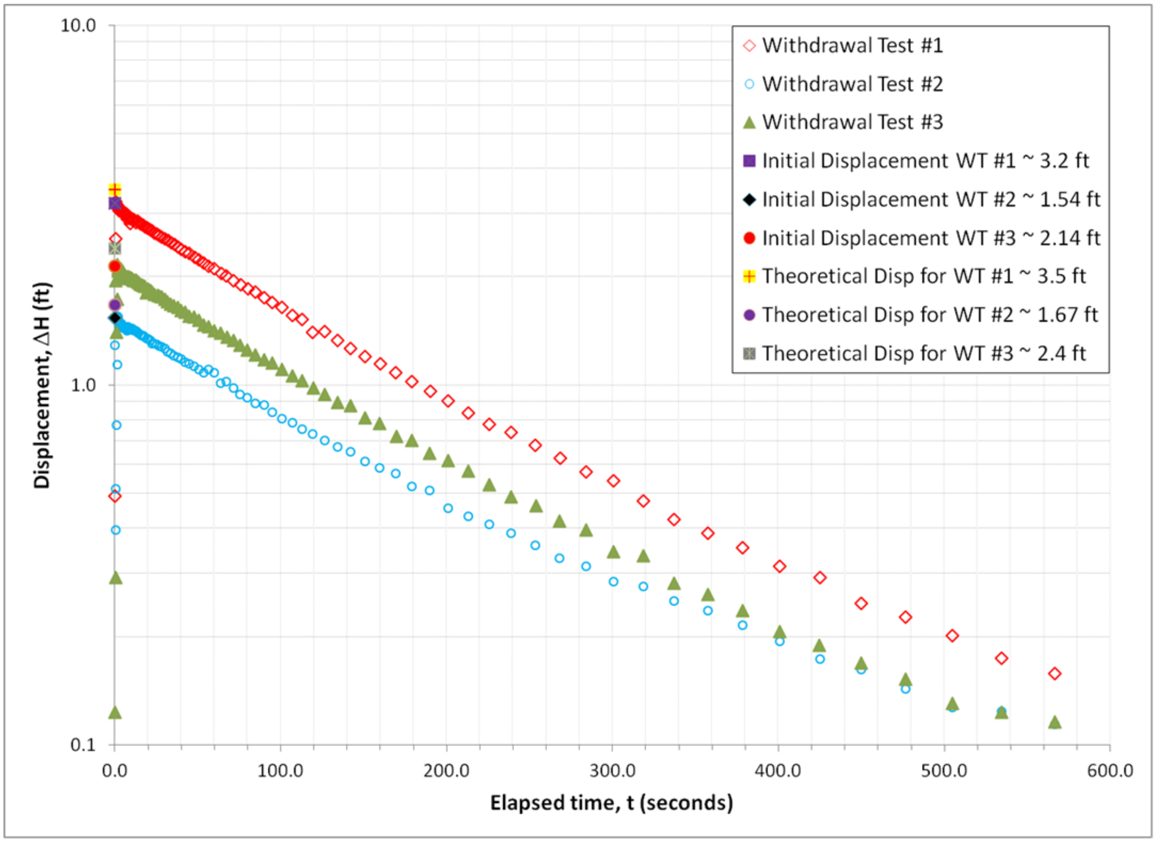

Figure 4-52. Estimation of effective initial displacement at 199-H2-1

4.9.3 Normalized displacements

The normalized displacements are calculated by dividing the observed displacements for the withdrawal tests by their respective effective initial displacement. The normalized responses plotted in Figure 4-53 confirm that the results for all the withdrawal tests are internally consistent. The close correspondence of the normalized displacement curves suggests that it is sufficient to analyze the data from only one of the withdrawal tests. The first withdrawal test is chosen for analysis.

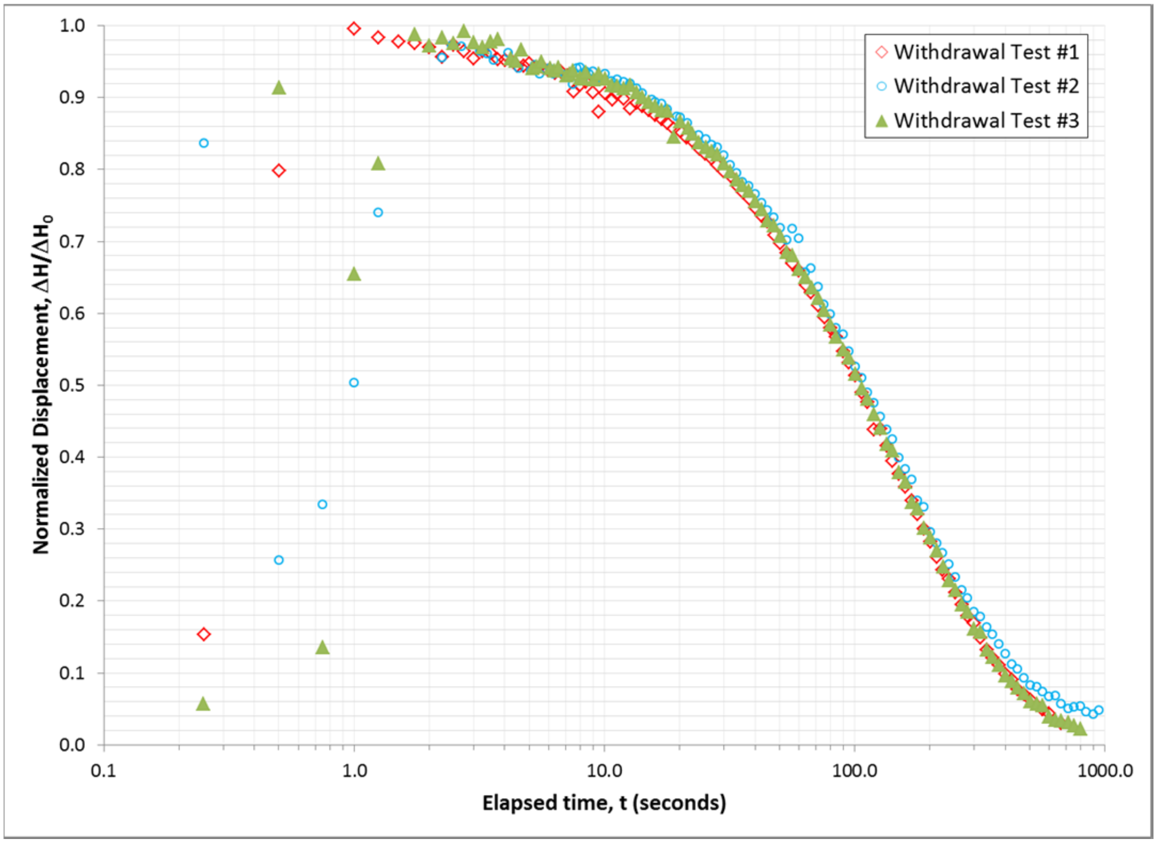

Figure 4-53. Normalized displacement at 199-H2-1

4.9.4 Preliminary analysis

For a first-cut analysis, the normalized displacements for the first withdrawal test are fit with the CBP model. The CBP model fit is shown in Figure 4-54. A good match to the observations is achieved with a storage coefficient, *S*, of 4×10^{-4}, and a fitted transmissivity, *T*, of 6.8 m^2/d. This analysis assumes that the well penetrates the full thickness of the aquifer. Referring to Table 4-2, we see that for well 199-H2-1, this is not the case. The aquifer (RUM) is at least 10.21 m (112.65 m – 102.44 m) thick at this location, and the length of the well screen is about 3.05 m. Cooper et al. (1967) suggested that in the case of a well that penetrates only a portion of the thickness of the aquifer, the effective thickness of the aquifer can be specified as the effective length of the well screen. Since the length of the submerged well screen length is 10 ft. (3.05 m), the estimated transmissivity corresponds to a horizontal hydraulic conductivity, K_H, of **2.2 m/d or 2.5 $\times 10^{-5}$ m/s.**

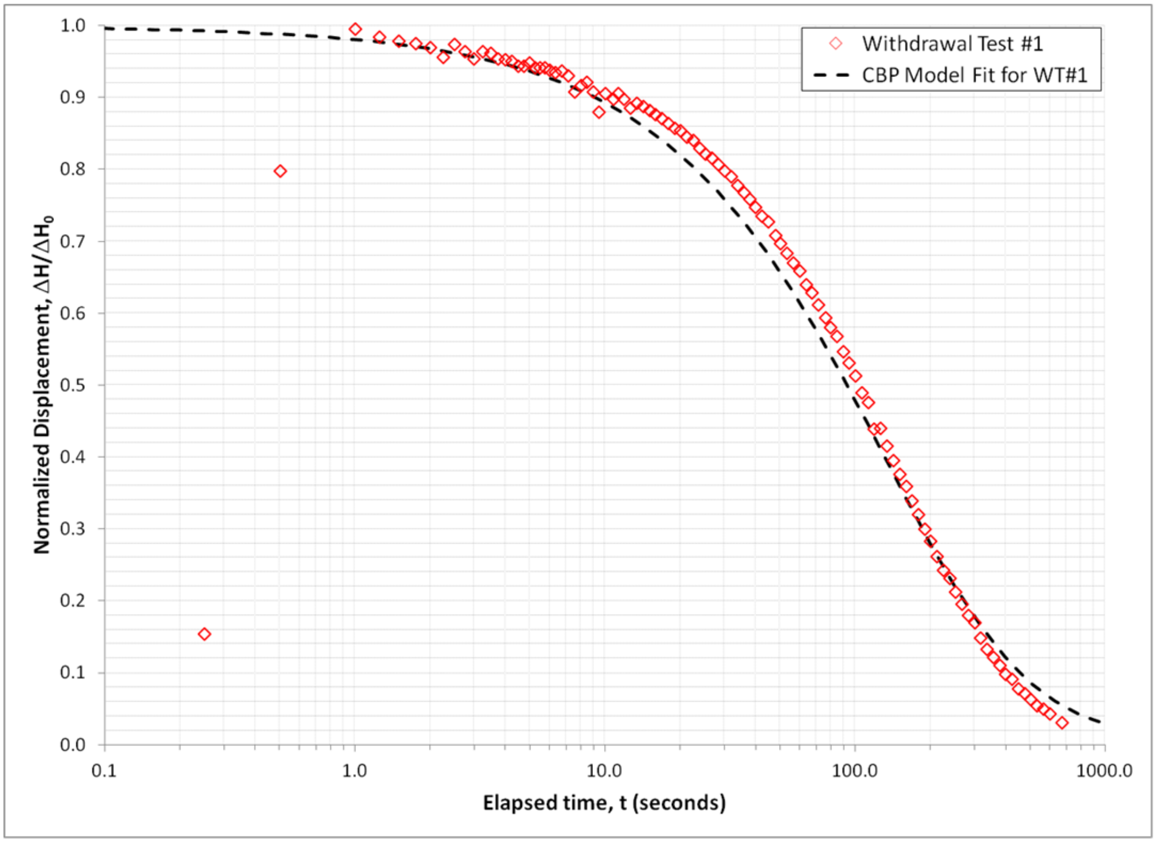

Figure 4-54. CBP Model fit at 199-H2-1

4.9.5 Refined analysis

For a more refined analysis, the normalized displacements for the first withdrawal test are fit with the KGS model for an unconfined aquifer. The KGS model fit is shown in Figure 4-55. A good match to the observations is achieved with a specific storage, S_s, of 1.3×10^{-4} m^{-1}, an anisotropy ratio K_V/K_H of 0.1, and a fitted horizontal hydraulic conductivity, K_H, of **2 m/d** or **2.3×10^{-5} m/s**. The specific storage value is not iteratively estimated but instead calculated by dividing an assumed storage coefficient of 4×10^{-4} by the well screen length (10 ft. or 3.05 m).

The fitted value of the specific storage value falls in the range suggested by Younger (1993) as representative of aquifer materials that consist of medium sand, fine sand and silt. This corresponds well with the 'Slightly Silty Sand' description of the screened interval.

The estimated hydraulic conductivity is in the middle of the range for silty sand and at the lower end of the range for clean sand reported in the literature (see for example, Freeze and Cherry, 1979; Table 2.2). This corresponds well with the 'Slightly Silty Sand' description of the screened interval.

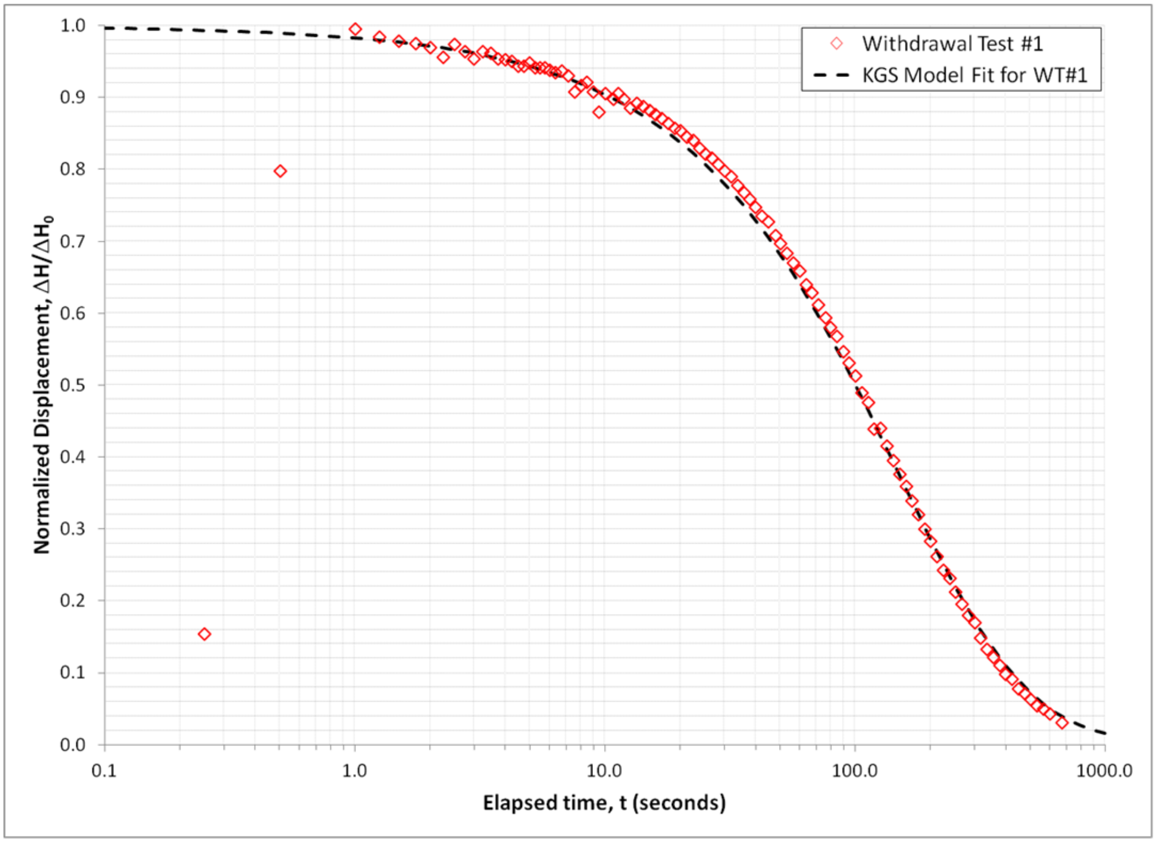

Figure 4-55. KGS Model fit at 199-H2-1

4.10 Analysis of Slug Test Data at well 199-H3-6

Three withdrawal tests were conducted at 199-H3-6 and all of them are analyzed here.

4.10.1 Raw displacement data for withdrawal tests

The three withdrawal tests were conducted with slugs of volume 0.688 ft^3, 0.328 ft^3 and 0.472 ft^3 respectively. The displacements are plotted in Figure 4.56. The first two tests show dissipation after a few hundred seconds whereas the third test dissipates in less than ten seconds. Inspection of the field log reveals that the transducer slipped during the third test. Therefore, the third test's response is not considered for further analysis. The normalized displacements in section 4.10.4 will tell us if the responses from the first two tests are consistent. Inspection of the displacements suggests that the tests are not instantaneous but that there is an effective start time for each test. These effective start times are estimated in section 4.10.2.

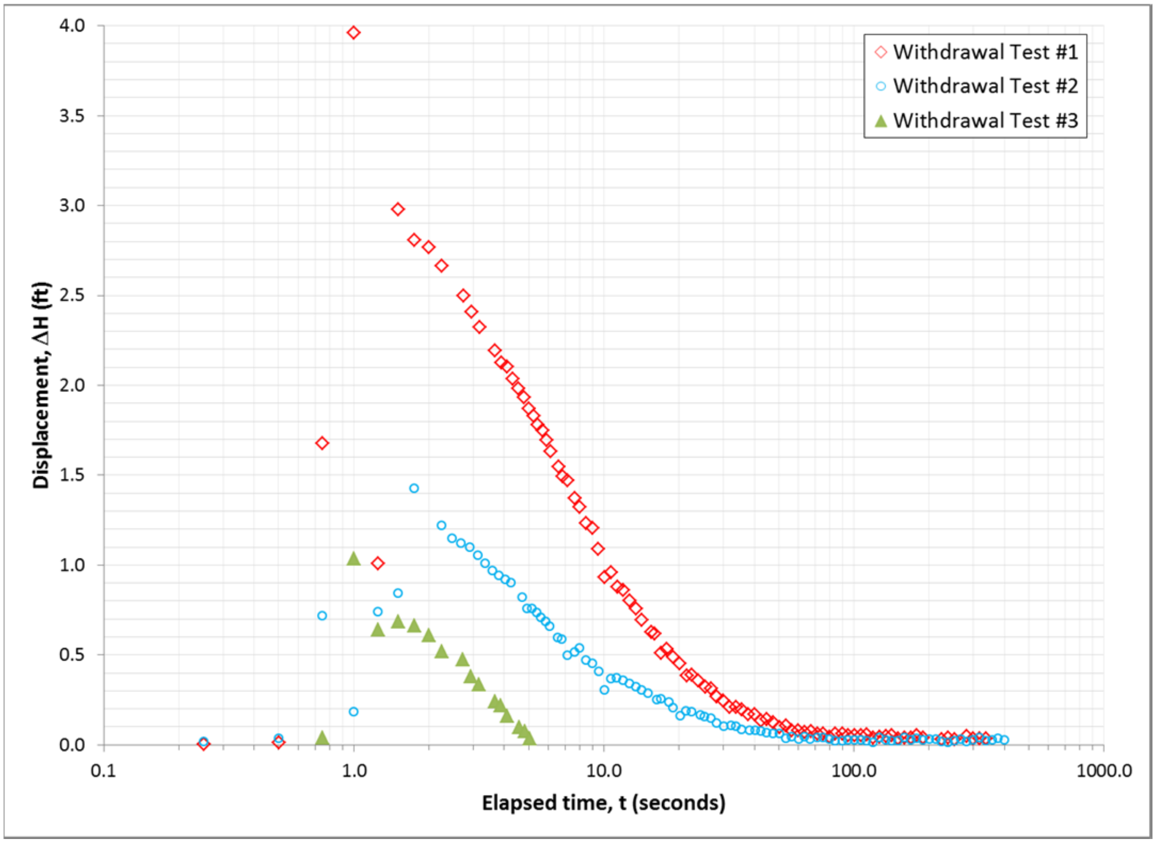

Figure 4-56. Displacements from three withdrawal tests at 199-H3-6

4.10.2 Estimation of effective start time

Effective start times of 1.5 seconds and 1.75 seconds are estimated for the first and second withdrawal tests respectively.

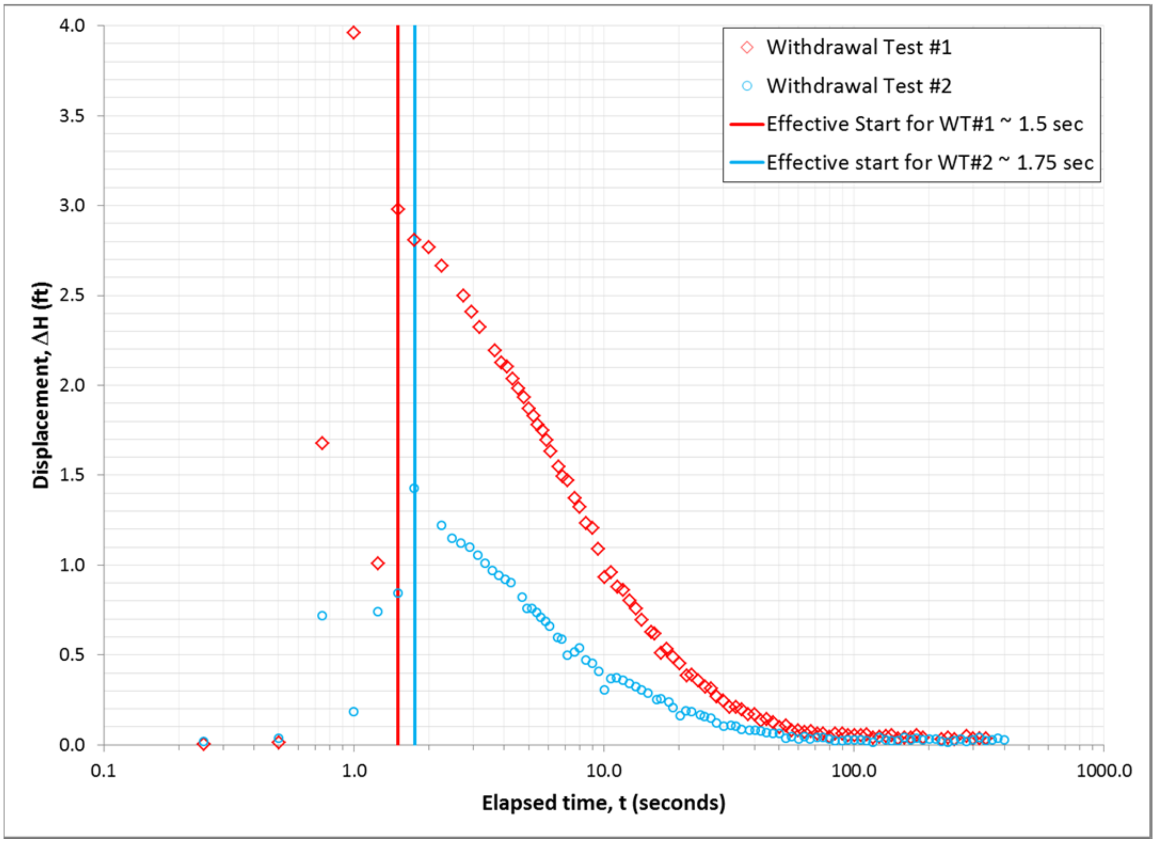

Figure 4-57. Effective start time for withdrawal tests at 199-H3-6

4.10.3 Estimation of effective initial displacement

Adjusted elapsed times are calculated by subtracting the effective start time from the reported elapsed times. The displacements are plotted against the adjusted elapsed times. The estimation of the initial displacements is shown in Figure 4-58. Effective initial displacements of 3.0 ft. and 1.3 ft. are estimated for the withdrawal tests by back-fitting the observations to 0.0 elapsed time. For a slug volume (V) of 0.688 ft^3 and a casing radius (r_c) of 3 inches, a theoretical initial displacement (H_0) of 3.5 ft. is calculated ($H_0 = V/\pi r_c^2$). Similarly, a theoretical initial displacement of 1.67 ft. is estimated for the slug volume of 0.328 ft^3. The visually estimated initial displacements are less than the theoretical estimates probably because of the non-instantaneous nature of the tests.

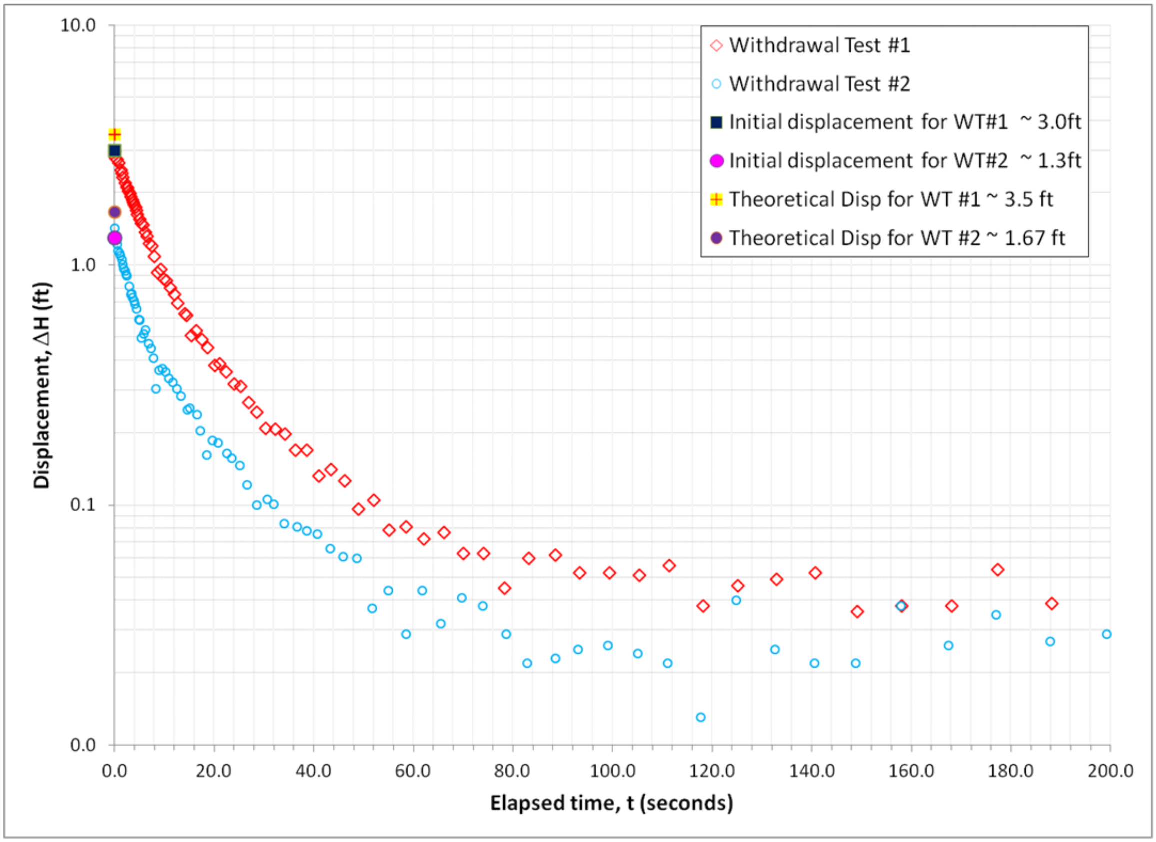

Figure 4-58. Estimation of effective initial displacement at 199-H3-6

4.10.4 Normalized displacements

The normalized displacements are calculated by dividing the observed displacements for the withdrawal tests by their respective effective initial displacement. The normalized responses plotted in Figure 4-59 confirm that the results for all the withdrawal tests are internally consistent. The close correspondence of the normalized displacement curves suggests that it is sufficient to analyze the data from only one of the withdrawal tests. The first withdrawal test is chosen for analysis.

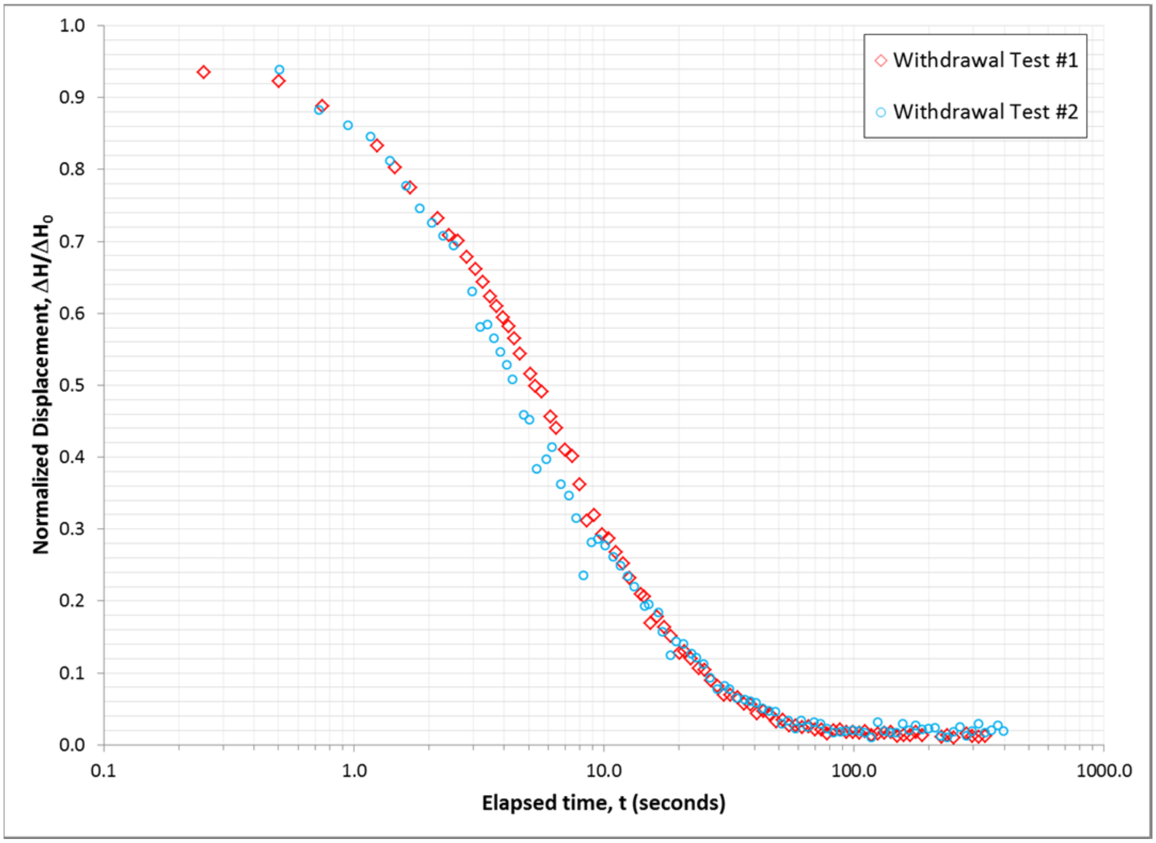

Figure 4-59. Normalized displacement at 199-H3-6

4.10.5 Preliminary analysis

For a first-cut analysis, the normalized displacements for the first withdrawal test are fit with the CBP model. The CBP model fit is shown in Figure 4-60. A good match to the observations is achieved with a storage coefficient, S, of 6×10^{-4}, and a fitted transmissivity, T, of 113 m^2/d. This analysis assumes that the well penetrates the full thickness of the aquifer. Referring to Table 4-2, we see that for well 199-H3-6, this is not the case. The aquifer (Hanford) is about 4.11 m (115.56 m – 111.45 m) thick at this location, and the length of the well screen is about 2.73 m. Cooper et al. (1967) suggested that in the case of a well that penetrates only a portion of the thickness of the aquifer, the effective thickness of the aquifer can be specified as the effective length of the well screen. Since the length of the submerged well screen length is 8.95 ft. (2.73 m), the estimated transmissivity corresponds to a horizontal hydraulic conductivity, K_H, of **41 m/d** **or** **4.7×10^{-4} m/s.**

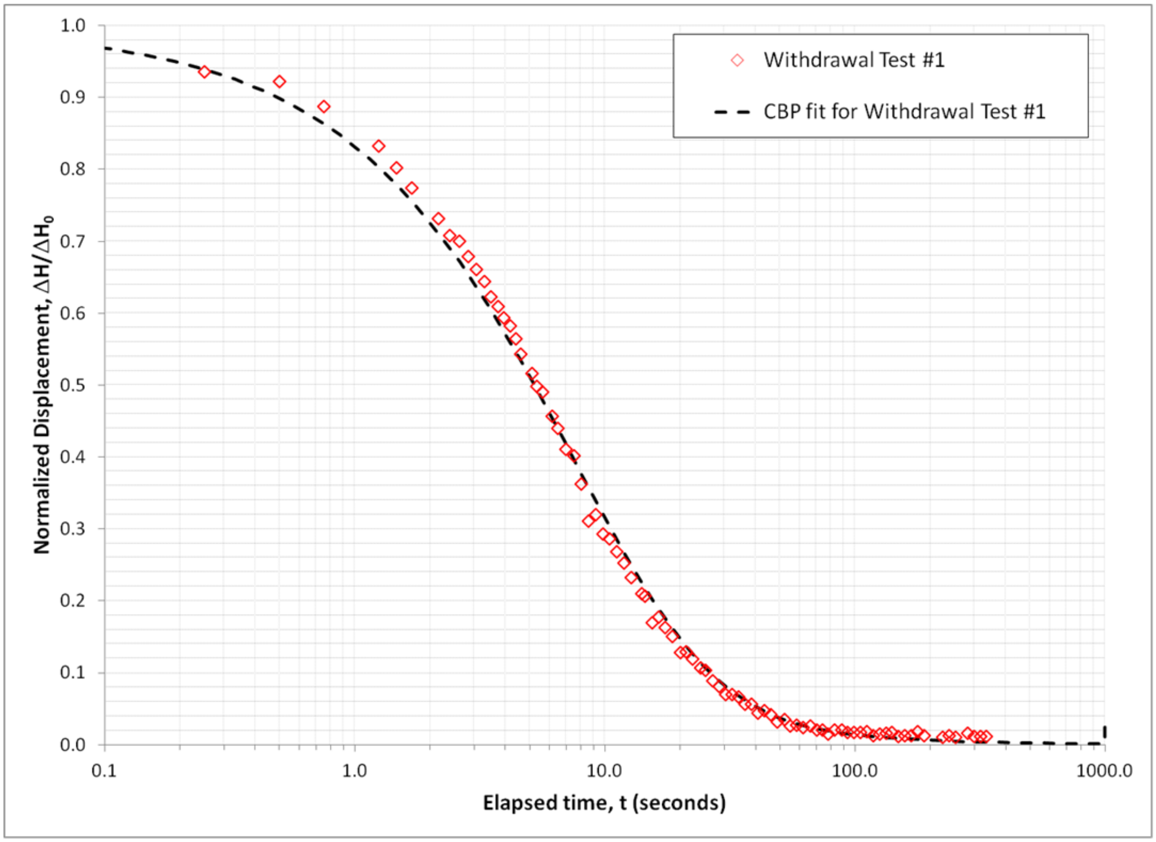

Figure 4-60. CBP Model fit at 199-H3-6

4.10.6 Refined analysis

For a more refined analysis, the normalized displacements for the first withdrawal test are fit with the KGS model for an unconfined aquifer. The KGS model fit is shown in Figure 4-61. A good match to the observations is achieved with a specific storage, S_s, of 2.2×10^{-4} m^{-1}, an anisotropy ratio K_V/K_H of 0.01, and a fitted horizontal hydraulic conductivity, K_H, of **38 m/d** or **4.4×10^{-4} m/s**. The specific storage value is not iteratively estimated but instead calculated by dividing an assumed storage coefficient of 6×10^{-4} by the well screen length (8.95 ft. or 2.73 m).

The fitted value of the specific storage value falls in the range suggested by Younger (1993) as representative of aquifer materials that consist of medium sand and coarse sand. This partly corresponds with the 'Sandy Gravel' description of the screened interval. It is possible that there could be some fines in the screened interval accounting for the higher specific storage.

The estimated hydraulic conductivity is in the middle of the range for clean sand and at the higher end of the range for silty sand reported in the literature (see for example, Freeze and Cherry, 1979; Table 2.2). This partly corresponds with the 'Sandy Gravel' description of the screened interval. It is possible that there could be some fines in the screened interval accounting for the lower hydraulic conductivity.

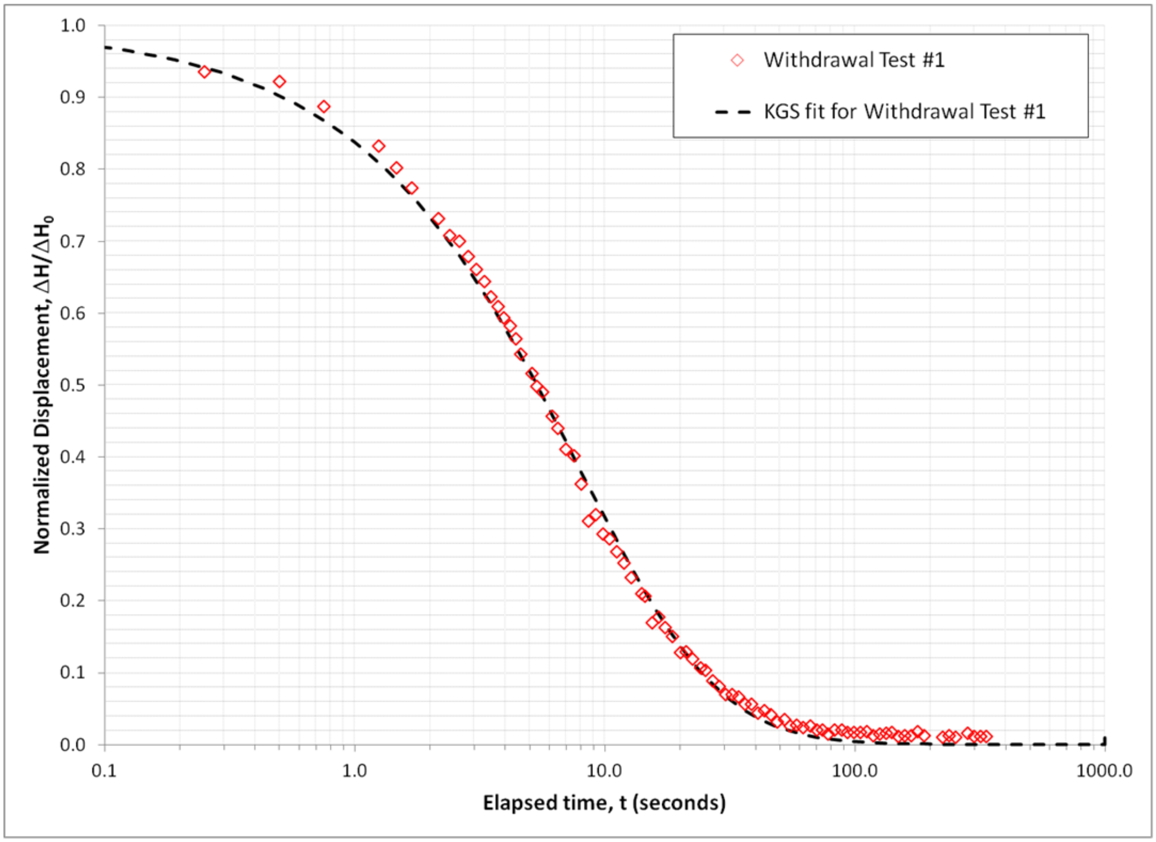

Figure 4-61. KGS Model fit at 199-H3-6

4.11 Analysis of Slug Test Data at well 199-H3-7

Three withdrawal tests were conducted at 199-H3-7 and all of them are analyzed here.

4.11.1 Raw displacement data for withdrawal tests

The three withdrawal tests were conducted with slugs of volume 0.688 ft^3, 0.328 ft^3 and 0.472 ft^3 respectively. The displacements are plotted in Figure 4.62. The normalized displacements in section 4.11.4 will tell us if these responses are consistent. Inspection of the displacements suggests that the tests are not instantaneous but that there is an effective start time for each test. These effective start times are estimated in section 4.11.2.

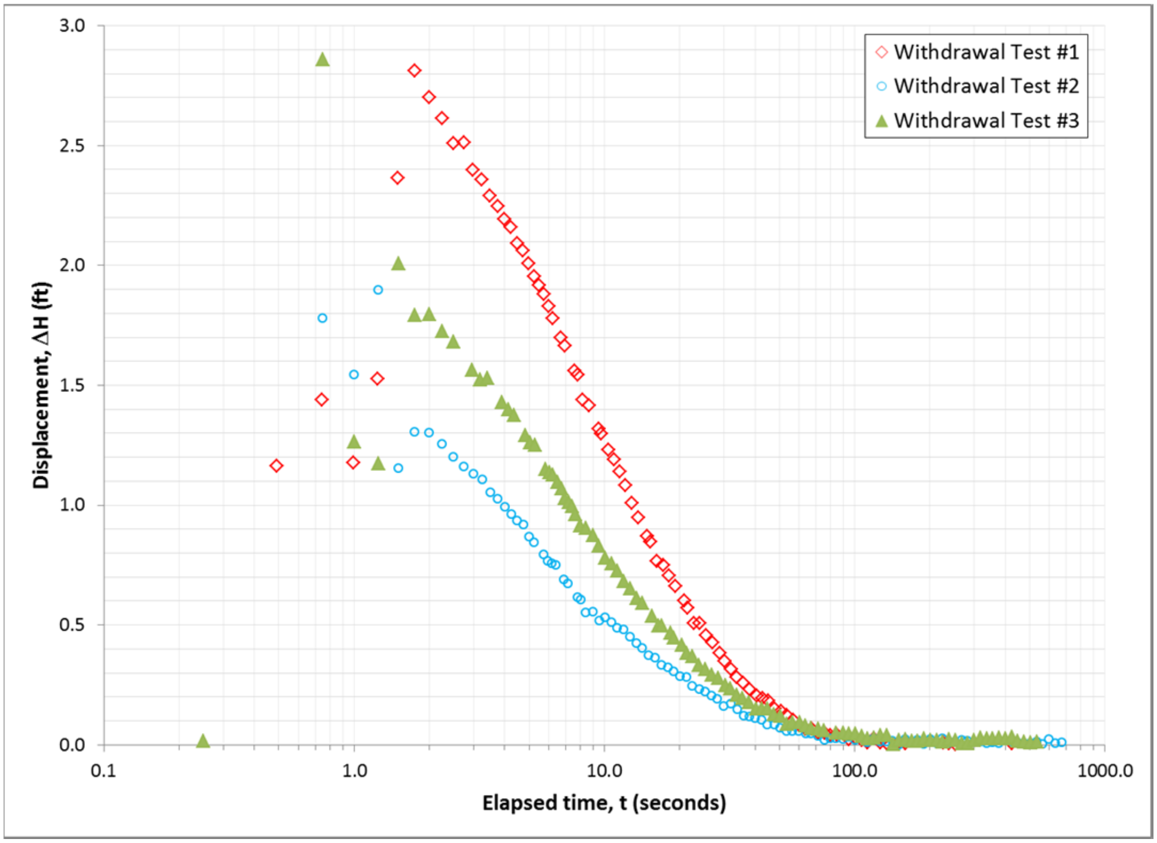

Figure 4-62. Displacements from three withdrawal tests at 199-H3-7

4.11.2 Estimation of effective start time

Effective start times of 1.7 seconds, 1.75 seconds and 1.5 seconds are estimated for the three withdrawal tests respectively.

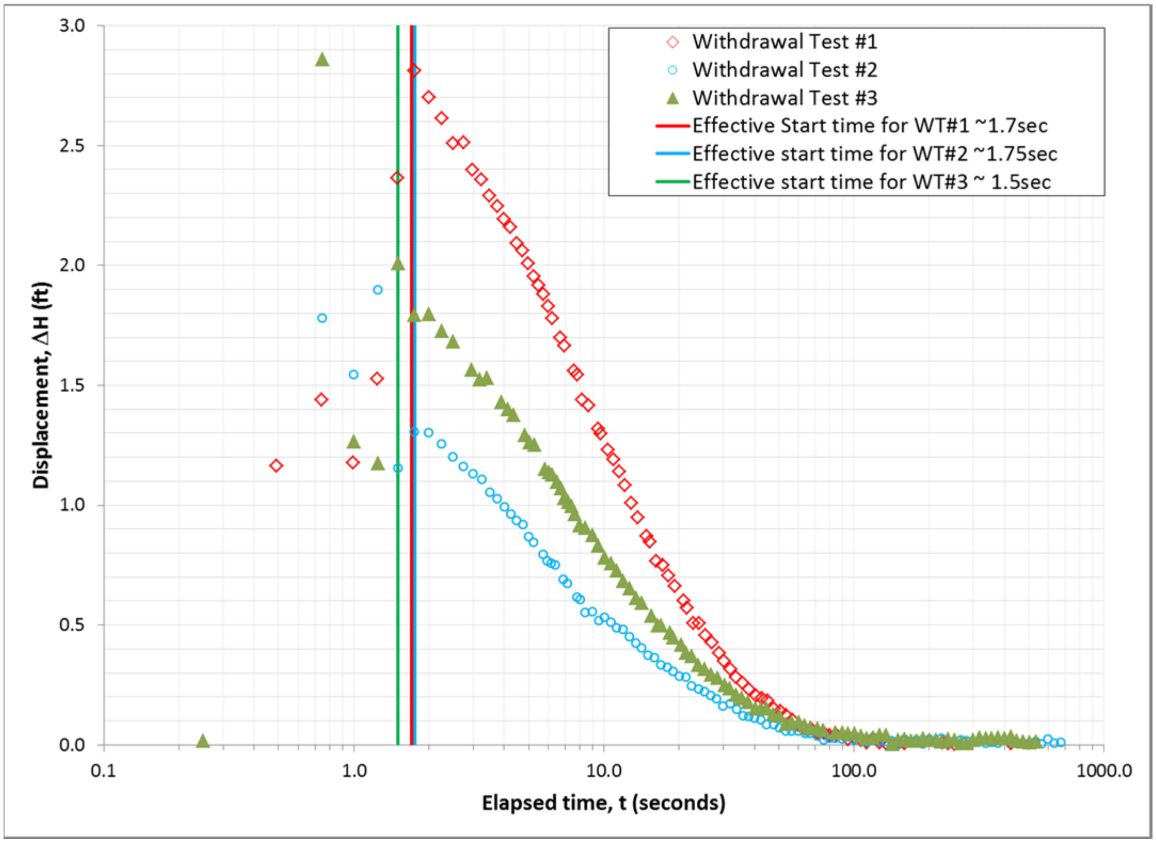

Figure 4-63. Effective start time for withdrawal tests at 199-H3-7

4.11.3 Estimation of effective initial displacement

Adjusted elapsed times are calculated by subtracting the effective start time from the reported elapsed times. The displacements are plotted against the adjusted elapsed times. The estimation of the initial displacements is shown in Figure 4-64. Effective initial displacements of 2.8 ft., 1.3 ft., and 1.85 ft. are estimated for the three withdrawal tests by back-fitting the observations to 0.0 elapsed time. For a slug volume (V) of 0.688 ft^3 and a casing radius (r_c) of 3 inches, a theoretical initial displacement (H_0) of 3.5 ft. is calculated ($H_0 = V/\pi r_c^2$). Similarly, theoretical initial displacements of 1.67 ft. and 2.4 ft. are estimated for the slug volumes of 0.328 ft^3 and 0.472 ft^3. The visually estimated initial displacements are lesser than the theoretical estimates probably because of the non-instantaneous nature of the tests.

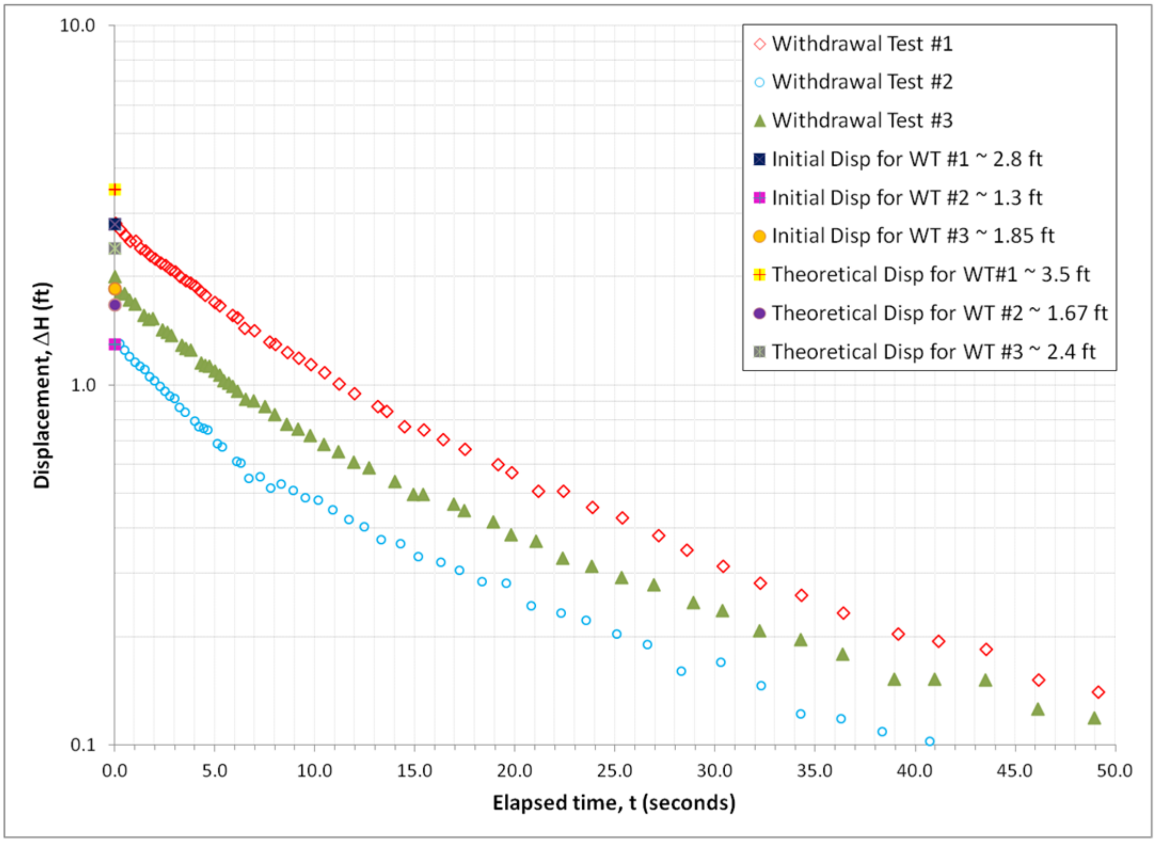

Figure 4-64. Estimation of effective initial displacement at 199-H3-7

4.11.4 Normalized displacements

The normalized displacements are calculated by dividing the observed displacements for the withdrawal tests by their respective effective initial displacement. The normalized responses plotted in Figure 4-65 confirm that the results for all the withdrawal tests are internally consistent. The close correspondence of the normalized displacement curves suggests that it is sufficient to analyze the data from only one of the withdrawal tests. The first withdrawal test is chosen for analysis.

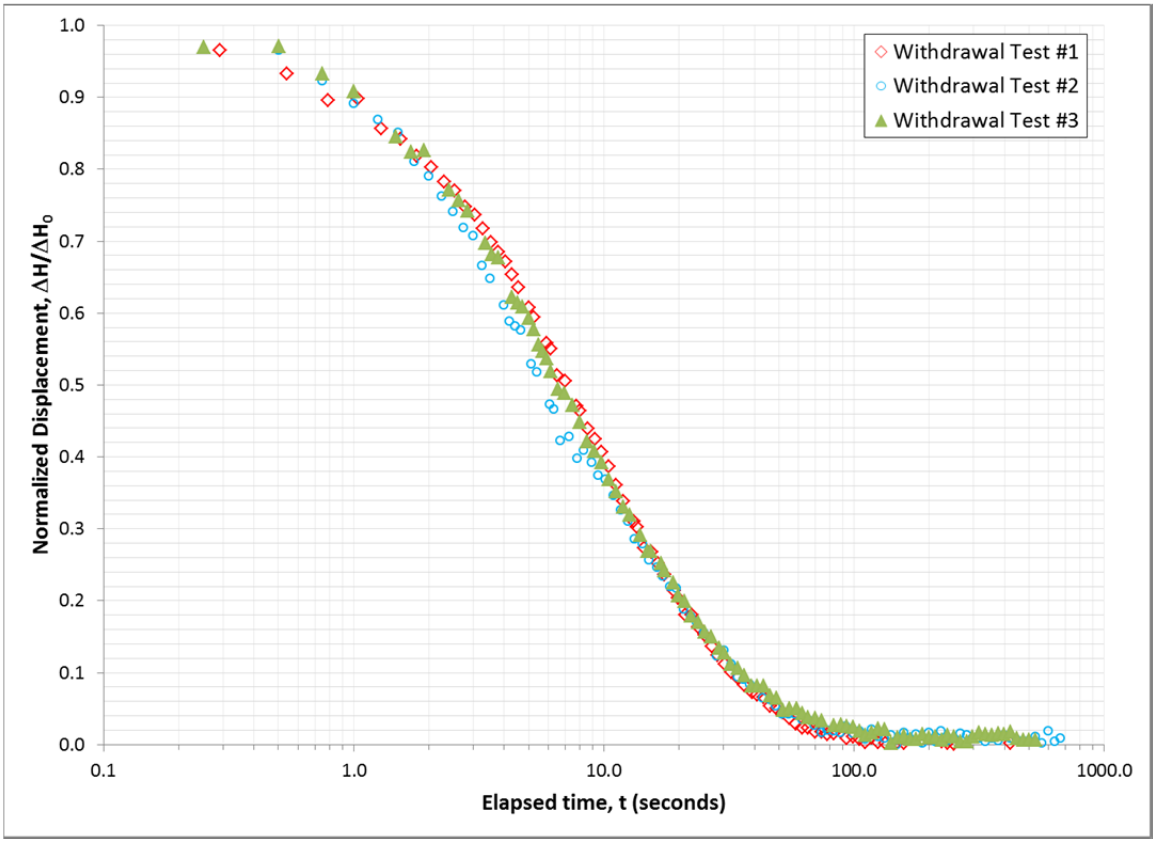

Figure 4-65. Normalized displacement at 199-H3-7

4.11.5 Preliminary analysis

For a first-cut analysis, the normalized displacements for the first withdrawal test are fit with the CBP model. The CBP model fit is shown in Figure 4-66. A good match to the observations is achieved with a storage coefficient, *S*, of 1.5×10^{-3}, and a fitted transmissivity, *T*, of 71 m^2/d. This analysis assumes that the well penetrates the full thickness of the aquifer. Referring to Table 4-2, we see that for well 199-H3-7, this is not the case. The aquifer (Hanford) is about 3.42 m (116.21 m – 112.79 m) thick at this location, and the length of the well screen is about 2.1 m. Cooper et al. (1967) suggested that in the case of a well that penetrates only a portion of the thickness of the aquifer, the effective thickness of the aquifer can be specified as the effective length of the well screen. Since the length of the submerged well screen length is 6.88 ft. (2.1 m), the estimated transmissivity corresponds to a horizontal hydraulic conductivity, K_H, of **34 m/d** **or** **3.9×10^{-4} m/s**.

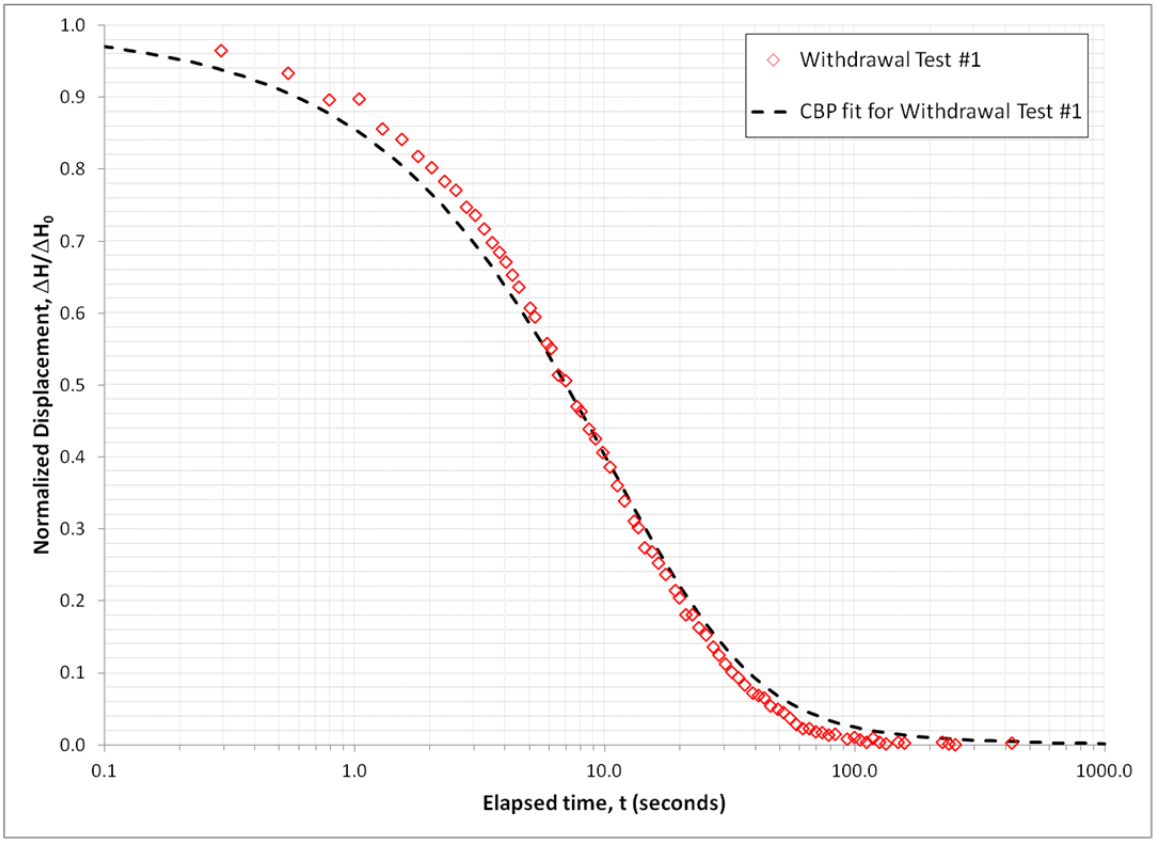

Figure 4-66. CBP Model fit at 199-H3-7

4.11.6 Refined analysis

For a more refined analysis, the normalized displacements for the first withdrawal test are fit with the KGS model for an unconfined aquifer. The KGS model fit is shown in Figure 4-67. A good match to the observations is achieved with a specific storage, S_s, of 7.2×10^{-4} m^{-1}, an anisotropy ratio K_V/K_H of 0.1, and a fitted horizontal hydraulic conductivity, K_H, of **27 m/d** or **3.1×10^{-4} m/s**. The specific storage value is not iteratively estimated but instead calculated by dividing an assumed storage coefficient of 1.5×10^{-3} by the well screen length (6.88 ft. or 2.1 m).

The fitted value of the specific storage value falls in the range suggested by Younger (1993) as representative of aquifer materials that consist of medium sand, fine sand and silt. This does not correspond well with the ‘Sandy Gravel’ description of the screened interval. It is possible that there could be some fines in the screened interval accounting for the higher specific storage.

The estimated hydraulic conductivity is in the middle of the range for clean sand and at the higher end of the range for silty sand reported in the literature (see for example, Freeze and Cherry, 1979; Table 2.2). This does not correspond well with the ‘Sandy Gravel’ description of the screened interval. It is possible that there could be some fines in the screened interval accounting for the lower hydraulic conductivity.

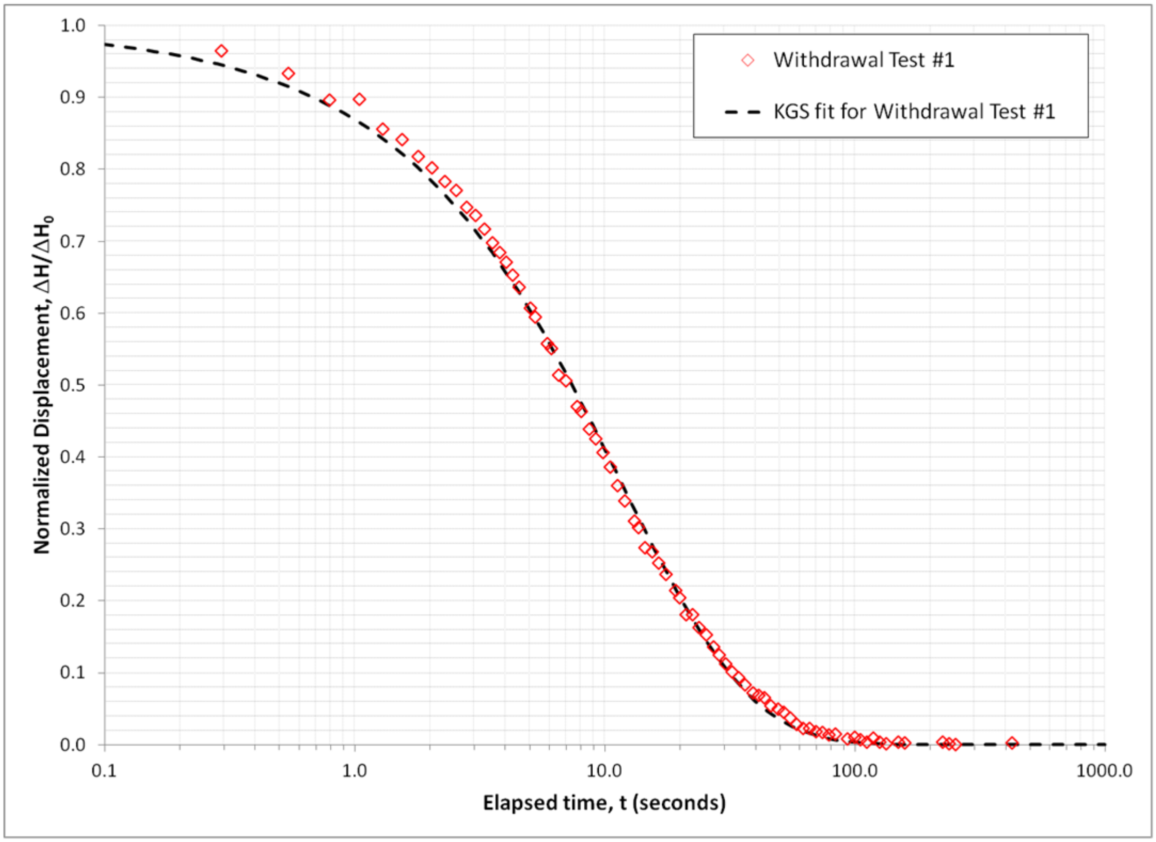

Figure 4-67. KGS Model fit at 199-H3-7

4.12 Analysis of Slug Test Data at well 199-H3-9

Three withdrawal tests were conducted at 199-H3-9 and all of them are analyzed here.

4.12.1 Raw displacement data for withdrawal tests

The three withdrawal tests were conducted with slugs of volume 0.688 ft^3, 0.328 ft^3 and 0.472 ft^3 respectively. The displacements are plotted in Figure 4.68. The normalized displacements in section 4.12.4 will tell us if these responses are consistent. Inspection of the displacements suggests that the tests are not instantaneous but that there is an effective start time for each test. These effective start times are estimated in section 4.12.2.

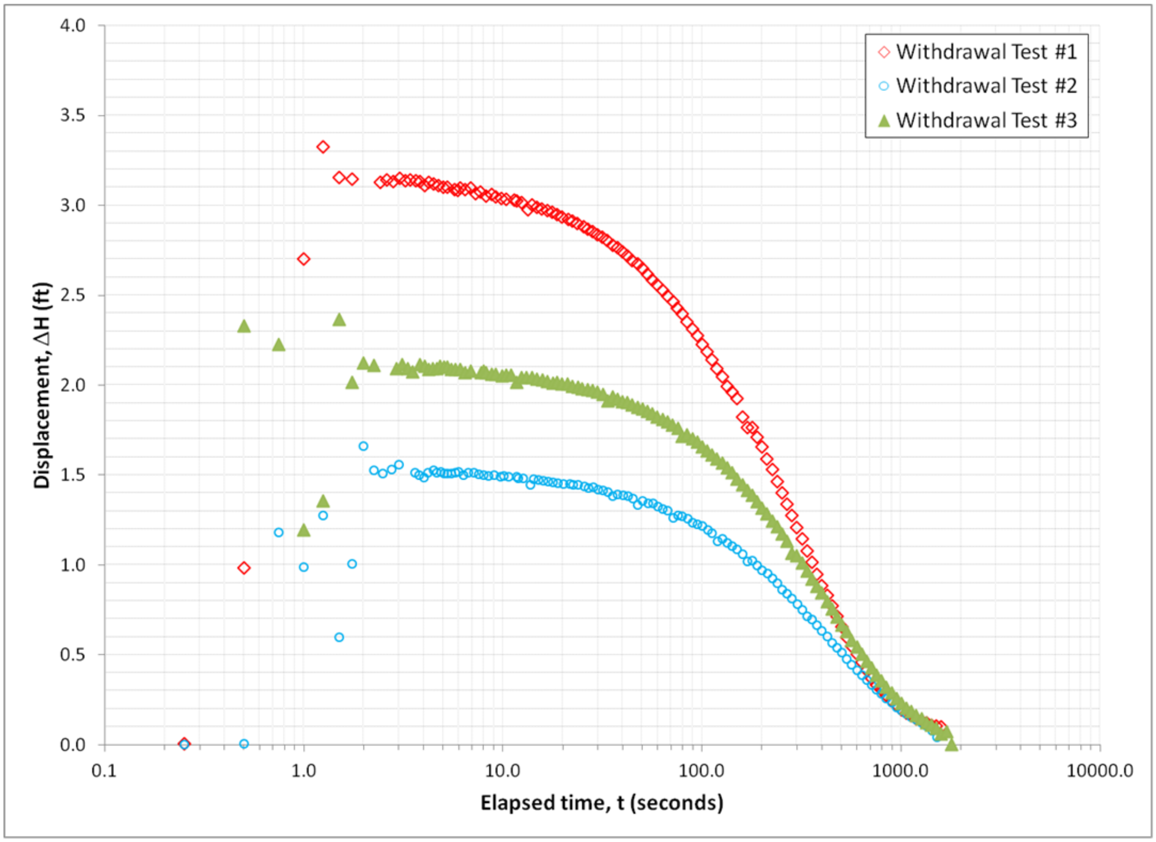

Figure 4-68. Displacements from three withdrawal tests at 199-H3-9

4.12.2 Estimation of effective start time

Effective start times of 2.75 seconds, 3.6 seconds and 3 seconds are estimated for the three withdrawal tests respectively.

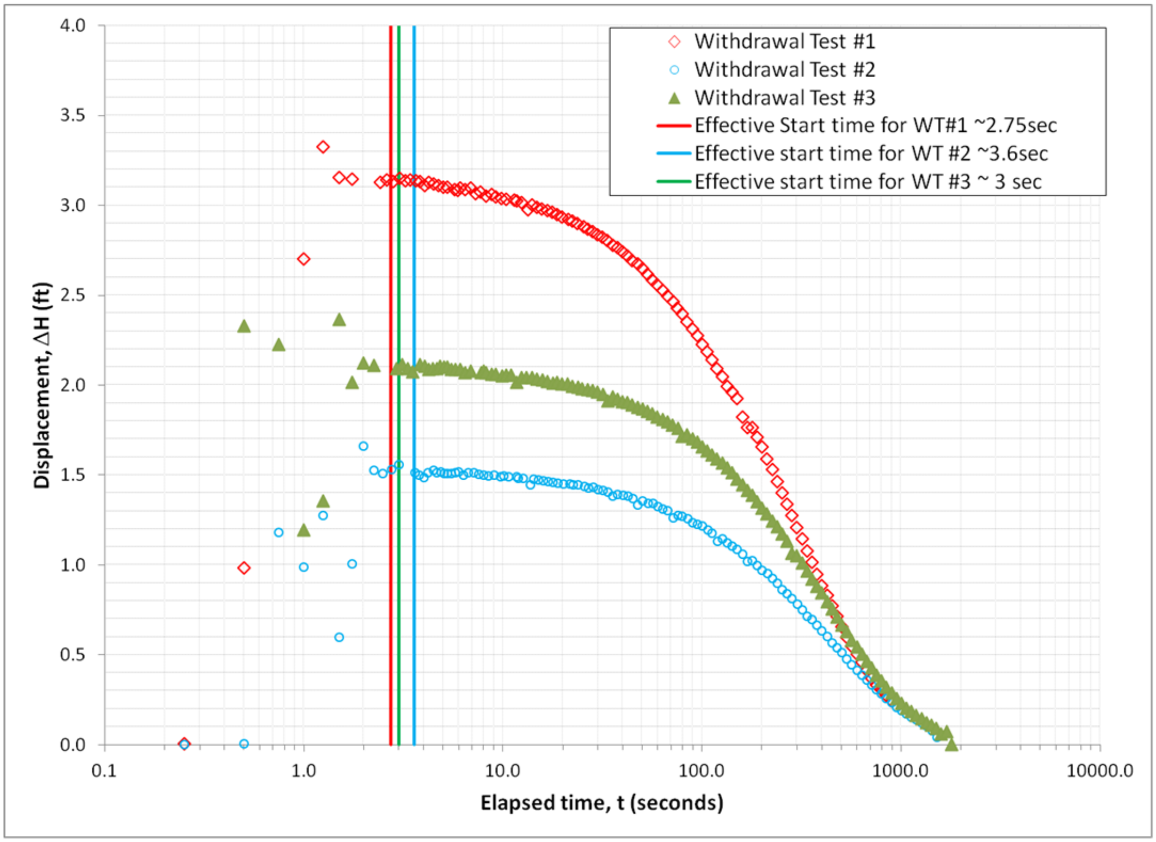

Figure 4-69. Effective start time for withdrawal tests at 199-H3-9

4.12.3 Estimation of effective initial displacement

Adjusted elapsed times are calculated by subtracting the effective start time from the reported elapsed times. The displacements are plotted against the adjusted elapsed times. The estimation of the initial displacements is shown in Figure 4-70. Effective initial displacements of 3.15 ft., 1.55 ft., and 2.12 ft. are estimated for the three withdrawal tests by back-fitting the observations to 0.0 elapsed time. For a slug volume (V) of 0.688 ft^3 and a casing radius (r_c) of 3 inches, a theoretical initial displacement (H_0) of 3.5 ft. is calculated ($H_0 = V/\pi r_c^2$). Similarly, theoretical initial displacements of 1.67 ft. and 2.4 ft. are estimated for the slug volumes of 0.328 ft^3 and 0.472 ft^3. The visually estimated initial displacements are lesser than the theoretical estimates probably because of the non-instantaneous nature of the tests.

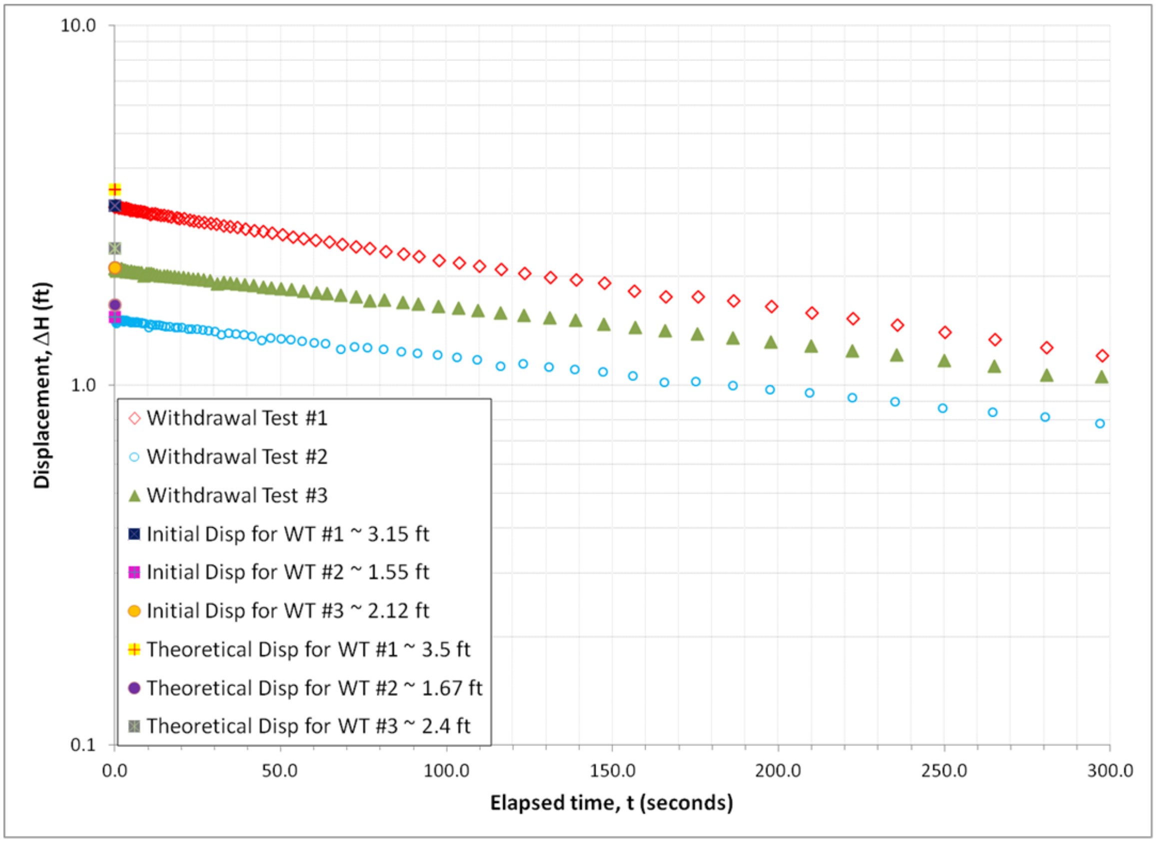

Figure 4-70. Estimation of effective initial displacement at 199-H3-9

4.12.4 Normalized displacements

The normalized displacements are calculated by dividing the observed displacements for the withdrawal tests by their respective effective initial displacement. The normalized responses are plotted in Figure 4-71. The displacements for the second and third withdrawal tests are internally consistent. However, the first test exhibits a different response. The field log did not yield any clues for the cause of this discrepancy. The close correspondence of the second and third normalized displacement curves suggests that it is sufficient to analyze the data from only one of the withdrawal tests. The third withdrawal test is chosen for analysis. In the refined analysis section, the first withdrawal test is also considered to check if the resulting hydraulic conductivity values would differ between the first and third tests.

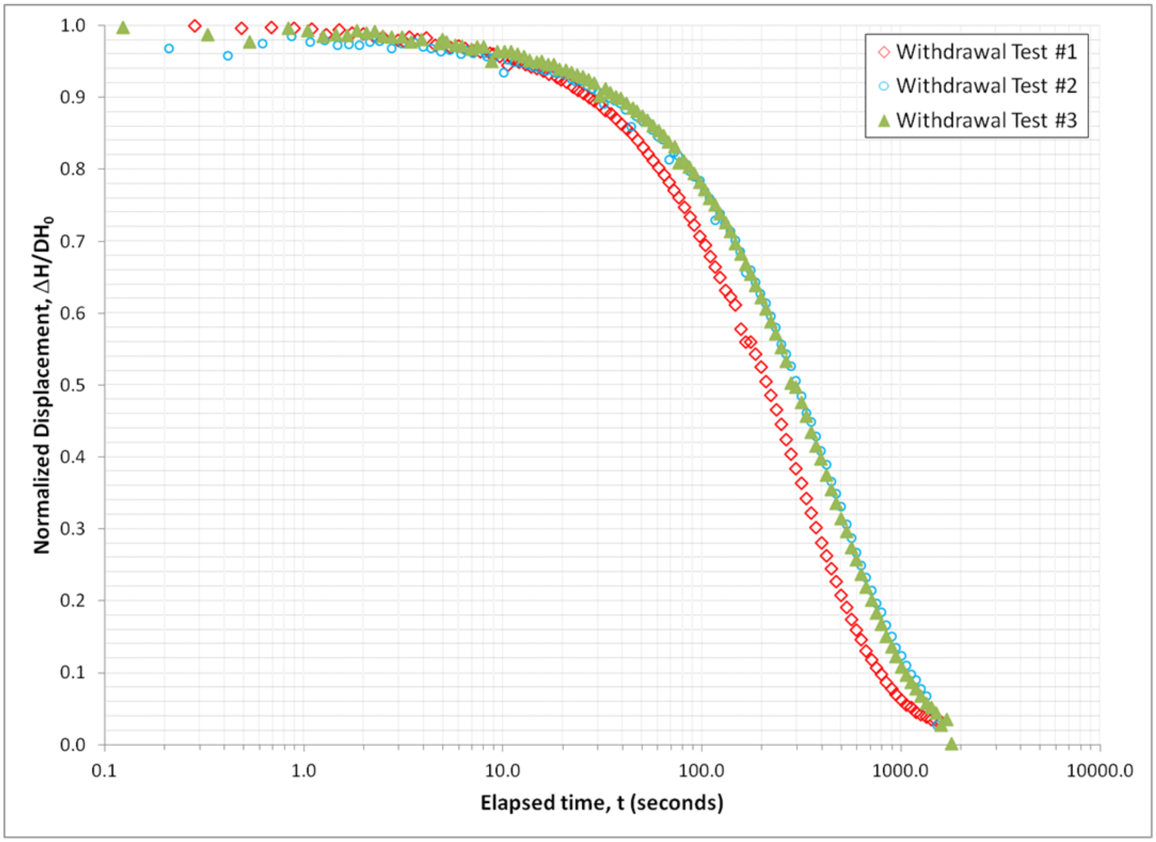

Figure 4-71. Normalized displacement at 199-H3-9

4.12.5 Preliminary analysis

For a first-cut analysis, the normalized displacements for the third withdrawal test are fit with the CBP model. The CBP model fit is shown in Figure 4-72. A good match to the observations is achieved with a storage coefficient, *S*, of 4×10^{-4}, and a fitted transmissivity, *T*, of 2.2 m^2/d. This analysis assumes that the well penetrates the full thickness of the aquifer. Referring to Table 4-2, we see that for well 199-H3-9, this is not the case. The aquifer (RUM) is at least 14.17 m (115.17 m – 101.00 m) thick at this location, and the length of the well screen is about 3.05 m. Cooper et al. (1967) suggested that in the case of a well that penetrates only a portion of the thickness of the aquifer, the effective thickness of the aquifer can be specified as the effective length of the well screen. Since the length of the submerged well screen length is 10 ft. (3.05 m), the estimated transmissivity corresponds to a horizontal hydraulic conductivity, K_H, of **0.7 m/d** or **8.1×10^{-6} m/s**.

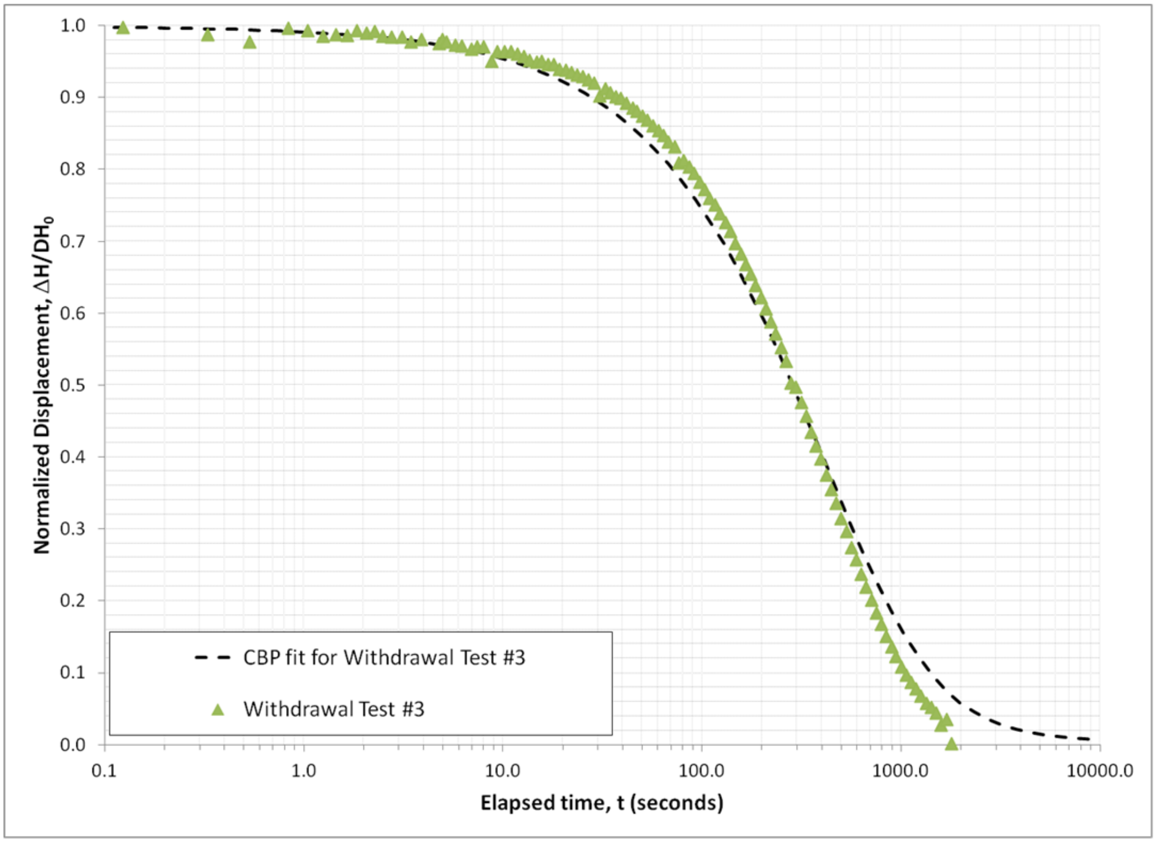

Figure 4-72. CBP Model fit at 199-H3-9

4.12.6 Refined analysis

For a more refined analysis, the normalized displacements for the first and third withdrawal tests are fit with the KGS model for an unconfined aquifer.

The KGS model fit for the third withdrawal test is shown in Figure 4-73. A good match to the observations is achieved with a specific storage, S_s, of 1.3×10^{-4} m^{-1}, an anisotropy ratio K_V/K_H of 1.0, and a fitted horizontal hydraulic conductivity, K_H, of **0.5 m/d** or **5.8×10^{-6} m/s**. The specific storage value is not iteratively estimated but instead calculated by dividing an assumed storage coefficient of 4×10^{-4} by the well screen length (10 ft. or 3.05 m). The KGS model fit for the first withdrawal test is shown in Figure 4-74. Using the specific storage and anisotropy from the third test, a good match to the observations is achieved with a fitted horizontal hydraulic conductivity, K_H, of **0.7 m/d** or **8.1×10^{-6} m/s**. Since there is negligible difference between the two estimates, it is sufficient to report only one of them. The relatively conservative estimate from the third test, K_H, of **0.5 m/d** or **5.8×10^{-6} m/s** is reported.

The fitted value of the specific storage value falls in the range suggested by Younger (1993) as representative of aquifer materials that consist of medium sand. This corresponds well with the well log which describes the screened interval as 'Sand'.

The estimated hydraulic conductivity values are in the middle of the range for silty sand and at the lower end of the range for clean sand reported in the literature (see for example, Freeze and Cherry, 1979; Table 2.2). This corresponds well with the well log which describes the screened interval as 'Sand'.

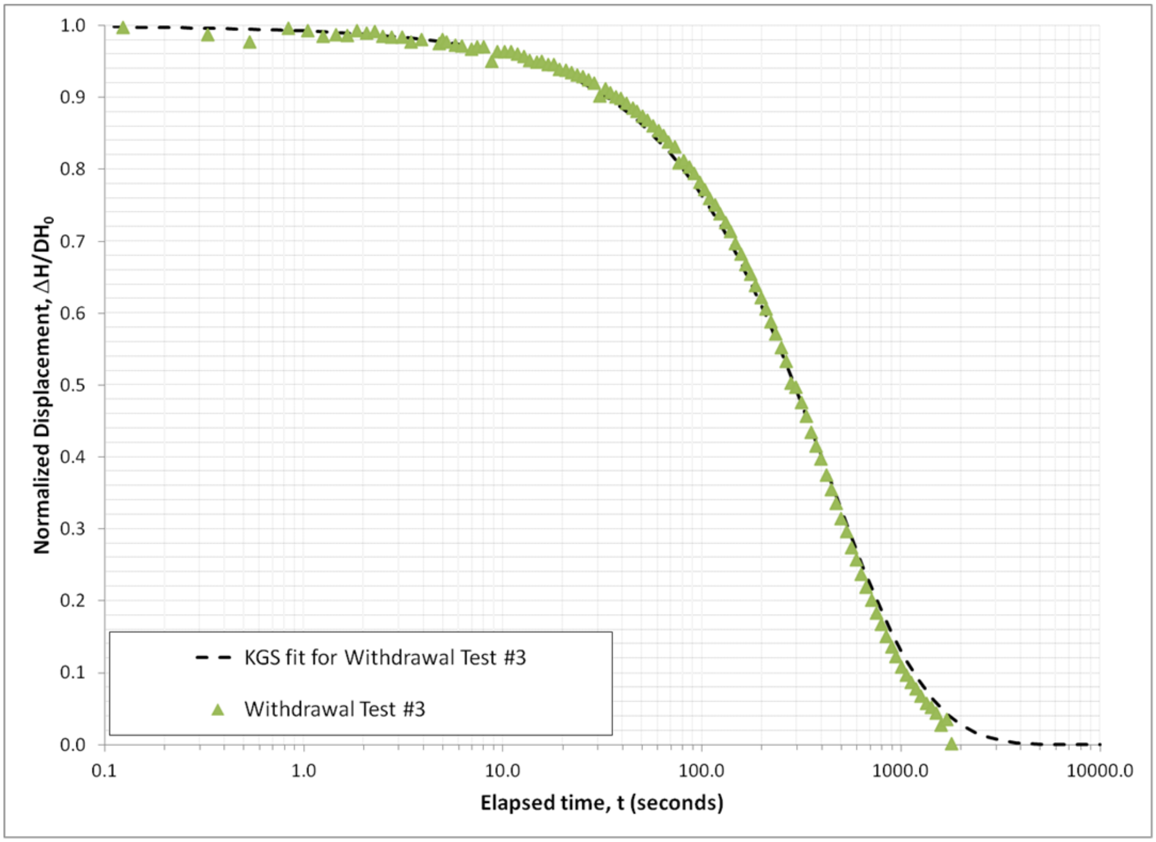

Figure 4-73. KGS Model fit for WT#3 at 199-H3-9

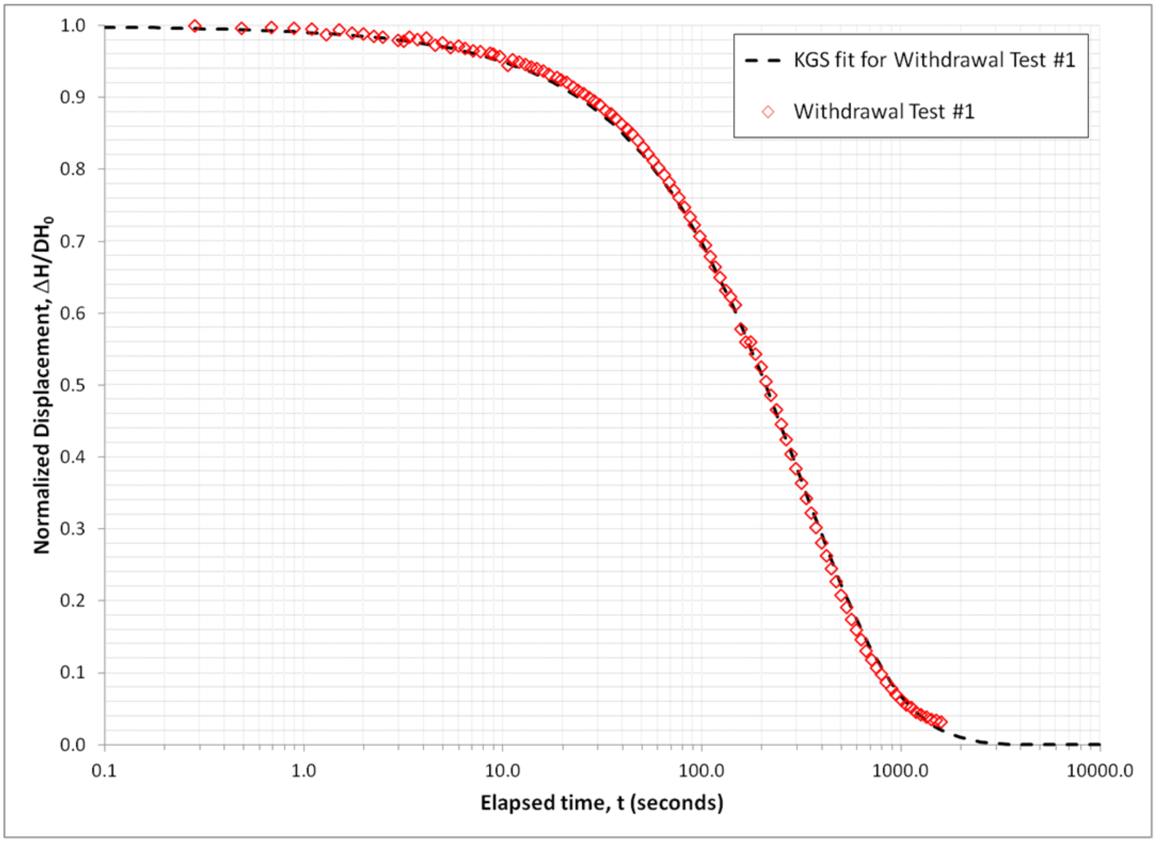

Figure 4-74. KGS Model fit for WT #1 at 199-H3-9

4.13 Analysis of Slug Test Data at well 199-H3-10

Three withdrawal tests were conducted at 199-H3-10 and all of them are analyzed here.

4.13.1 Raw displacement data for withdrawal tests

The three withdrawal tests were conducted with slugs of volume 0.688 ft^3, 0.328 ft^3 and 0.472 ft^3 respectively. The displacements are plotted in Figure 4.75. The normalized displacements in section 4.13.4 will tell us if these responses are consistent. Inspection of the displacements suggests that the tests are not instantaneous but that there is an effective start time for each test. These effective start times are estimated in section 4.13.2.

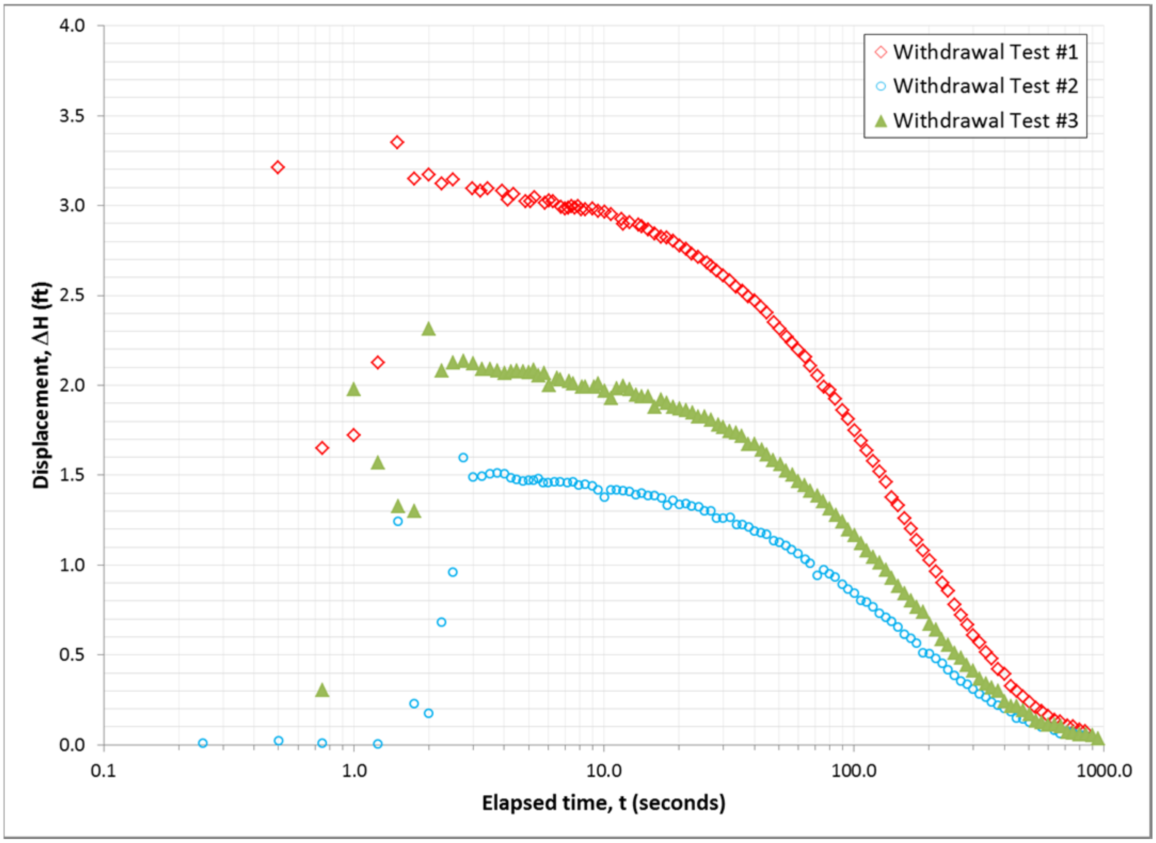

Figure 4-75. Displacements from three withdrawal tests at 199-H3-10

4.13.2 Estimation of effective start time

Effective start times of 1.75 seconds, 3 seconds and 2 seconds are estimated for the three withdrawal tests respectively.

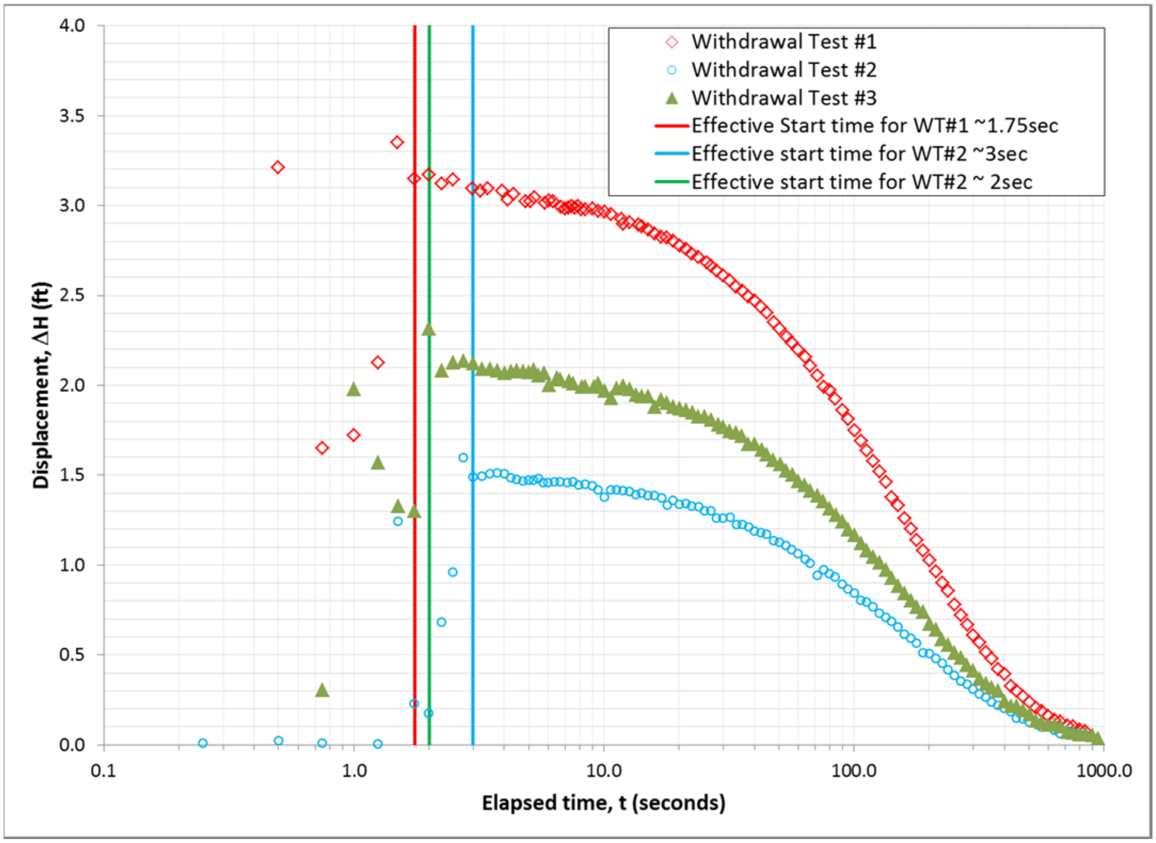

Figure 4-76. Effective start time for withdrawal tests at 199-H3-10

4.13.3 Estimation of effective initial displacement

Adjusted elapsed times are calculated by subtracting the effective start time from the reported elapsed times. The displacements are plotted against the adjusted elapsed times. The estimation of the initial displacements is shown in Figure 4-77. Effective initial displacements of 3.15 ft., 1.5 ft., and 2.1 ft. are estimated for the three withdrawal tests by back-fitting the observations to 0.0 elapsed time. For a slug volume (V) of 0.688 ft^3 and a casing radius (r_c) of 3 inches, a theoretical initial displacement (H_0) of 3.5 ft. is calculated ($H_0 = V/\pi r_c^2$). Similarly, theoretical initial displacements of 1.67 ft. and 2.4 ft. are estimated for the slug volumes of 0.328 ft^3 and 0.472 ft^3. The visually estimated initial displacements are lesser than the theoretical estimates probably because of the non-instantaneous nature of the tests.

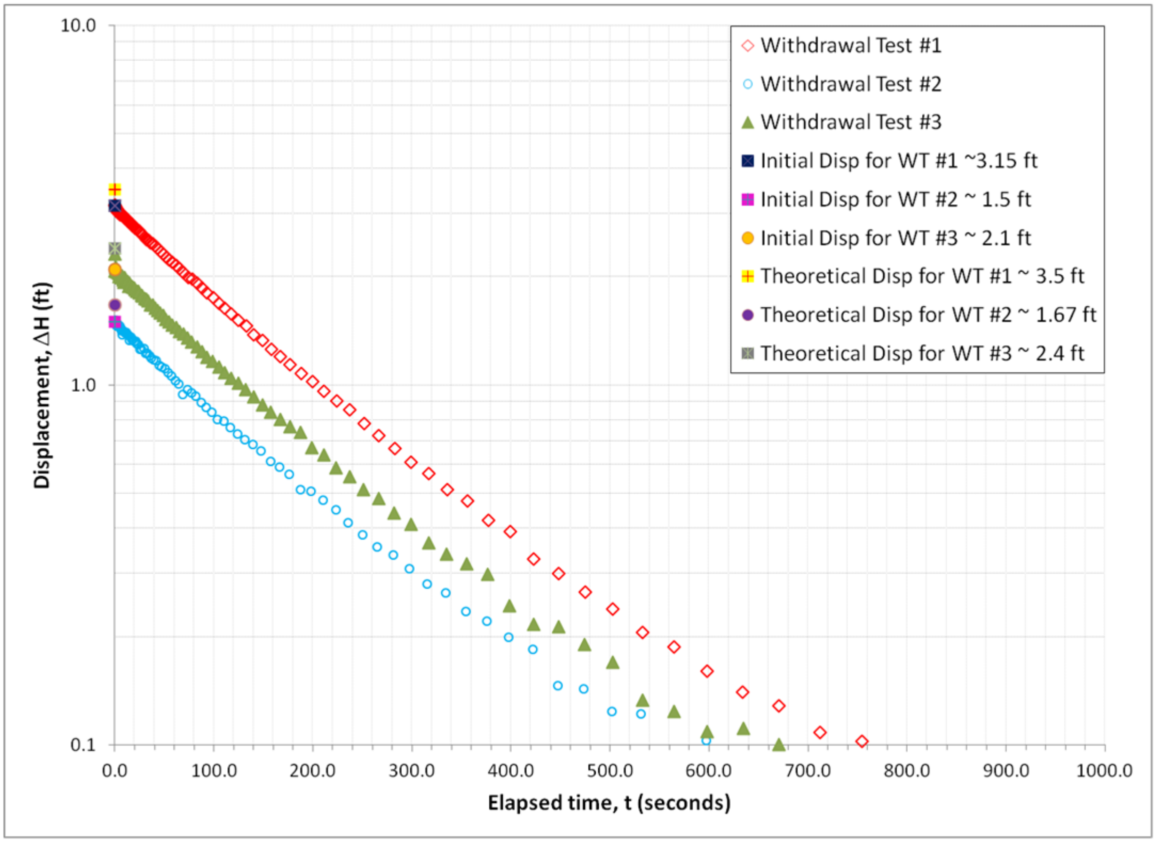

Figure 4-77. Estimation of effective initial displacement at 199-H3-10

4.13.4 Normalized displacements

The normalized displacements are calculated by dividing the observed displacements for the withdrawal tests by their respective effective initial displacement. The normalized responses plotted in Figure 4-78 confirm that the results for all the withdrawal tests are internally consistent. The close correspondence of the normalized displacement curves suggests that it is sufficient to analyze the data from only one of the withdrawal tests. The first withdrawal test is chosen for analysis.

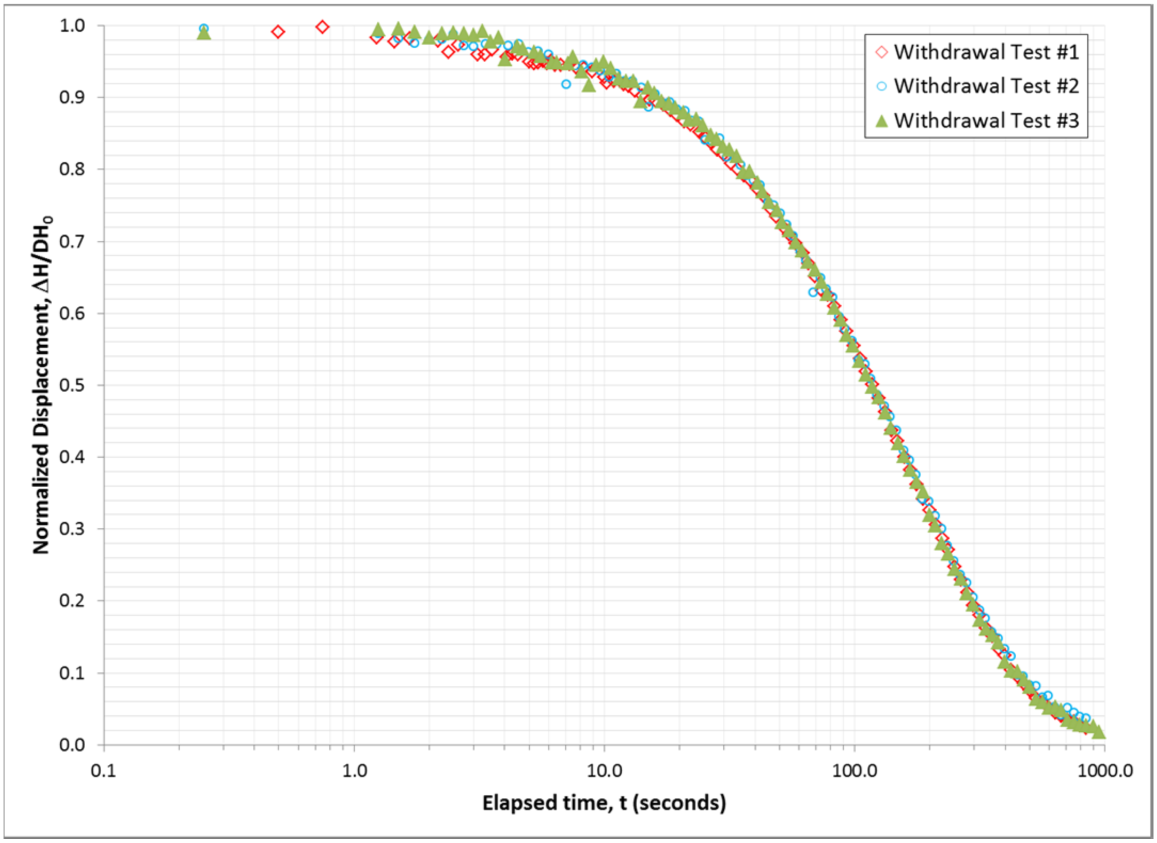

Figure 4-78. Normalized displacement at 199-H3-10

4.13.5 Preliminary analysis

For a first-cut analysis, the normalized displacements for the first withdrawal test are fit with the CBP model. The CBP model fit is shown in Figure 4-79. A good match to the observations is achieved with a storage coefficient, *S*, of 5×10^{-4}, and a fitted transmissivity, *T*, of 5.3 m^2/d. This analysis assumes that the well penetrates the full thickness of the aquifer. Referring to Table 4-2, we see that for well 199-H3-10, this is not the case. The aquifer (RUM) is at least 15.96 m (111.45 m – 95.49 m) thick at this location, and the length of the well screen is about 3.05 m. Cooper et al. (1967) suggested that in the case of a well that penetrates only a portion of the thickness of the aquifer, the effective thickness of the aquifer can be specified as the effective length of the well screen. Since the length of the submerged well screen length is 10 ft. (3.05 m), the estimated transmissivity corresponds to a horizontal hydraulic conductivity, K_H, of **1.7 m/d or 2.0×10^{-5} m/s.**

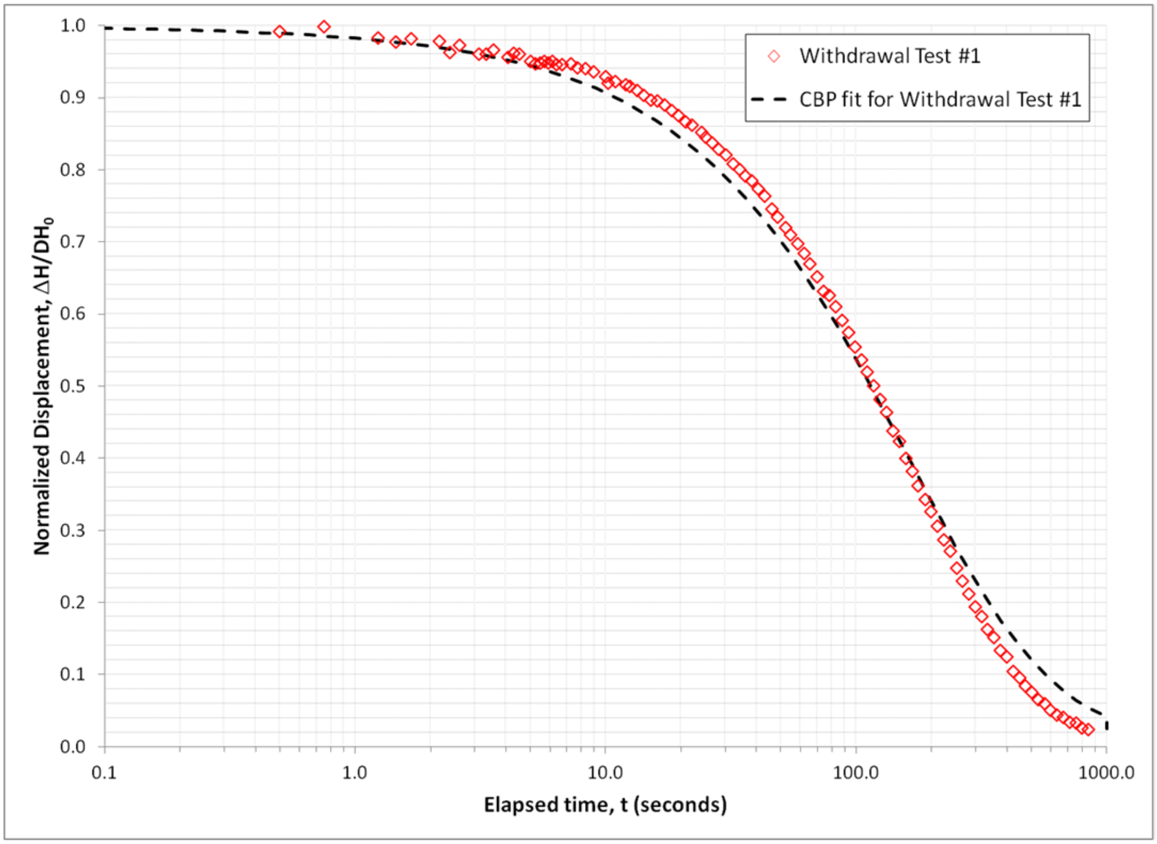

Figure 4-79. CBP Model fit at 199-H3-10

4.13.6 Refined analysis

For a more refined analysis, the normalized displacements for the first withdrawal test are fit with the KGS model for an unconfined aquifer. The KGS model fit is shown in Figure 4-80. A good match to the observations is achieved with a specific storage, S_s, of 1.6×10^{-4} m^{-1}, an anisotropy ratio K_V/K_H of 0.1, and a fitted horizontal hydraulic conductivity, K_H, of **1.6 m/d** or **1.9×10^{-5} m/s**. The specific storage value is not iteratively estimated but instead calculated by dividing an assumed storage coefficient of 5×10^{-4} by the well screen length (10 ft. or 3.05 m).

The fitted value of the specific storage value falls in the range suggested by Younger (1993) as representative of aquifer materials that consist of medium sand, fine sand and silt. This corresponds well with the 'Sand and Sandy Silt' description of the screened interval.

The estimated hydraulic conductivity is in the middle of the range for silty sand and at the lower end of the range for clean sand reported in the literature (see for example, Freeze and Cherry, 1979; Table 2.2). This corresponds well with the 'Sand and Sandy Silt' description of the screened interval.

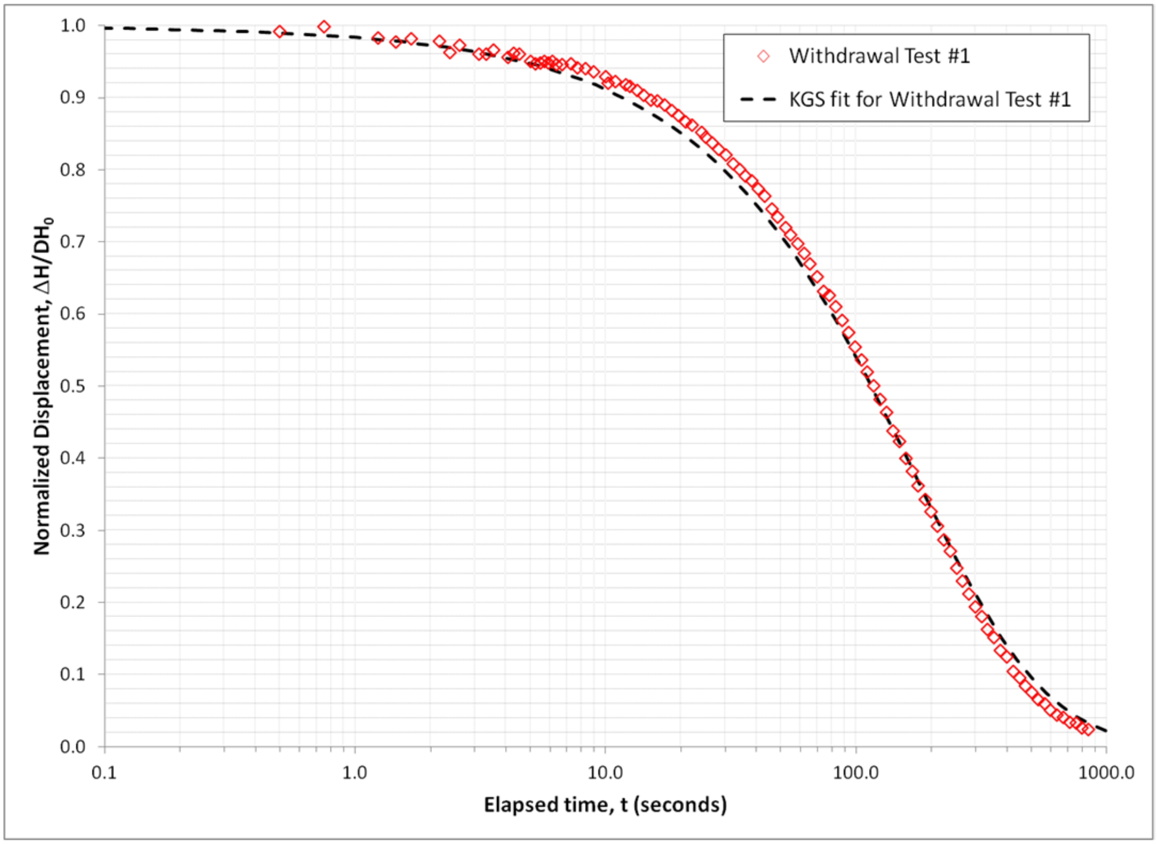

Figure 4-80. KGS Model fit at 199-H3-10

4.14 Analysis of Slug Test Data at well 199-H6-3

Three withdrawal tests were conducted at 199-H6-3 and all of them are analyzed here.

4.14.1 Raw displacement data for withdrawal tests

The three withdrawal tests were conducted with slugs of volume 0.688 ft^3, 0.328 ft^3 and 0.472 ft^3 respectively. The displacements are plotted in Figure 4.81. The normalized displacements in section 4.14.4 will tell us if these responses are consistent. Inspection of the displacements suggests that the tests are not instantaneous but that there is an effective start time for each test. These effective start times are estimated in section 4.14.2.

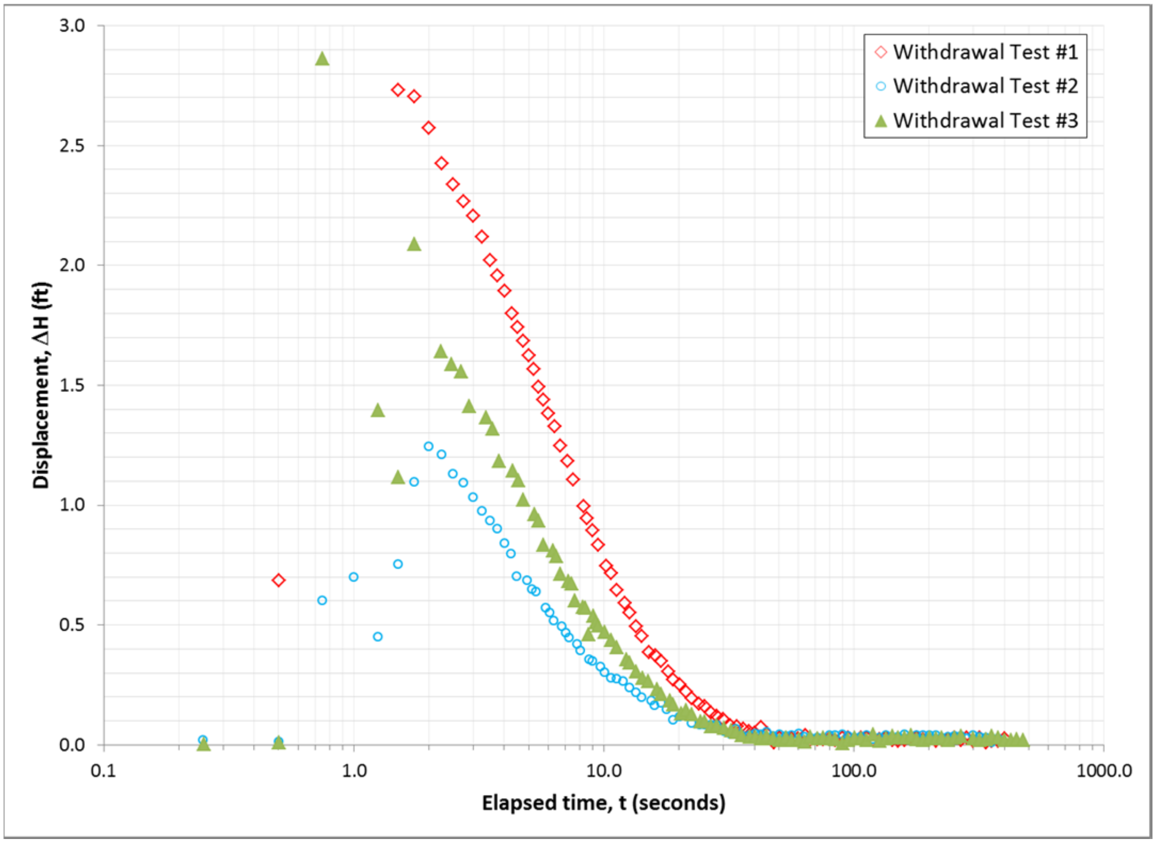

Figure 4-81. Displacements from three withdrawal tests at 199-H6-3

4.14.2 Estimation of effective start time

Effective start times of 1.5 seconds, 2 seconds and 2.25 seconds are estimated for the three withdrawal tests respectively.

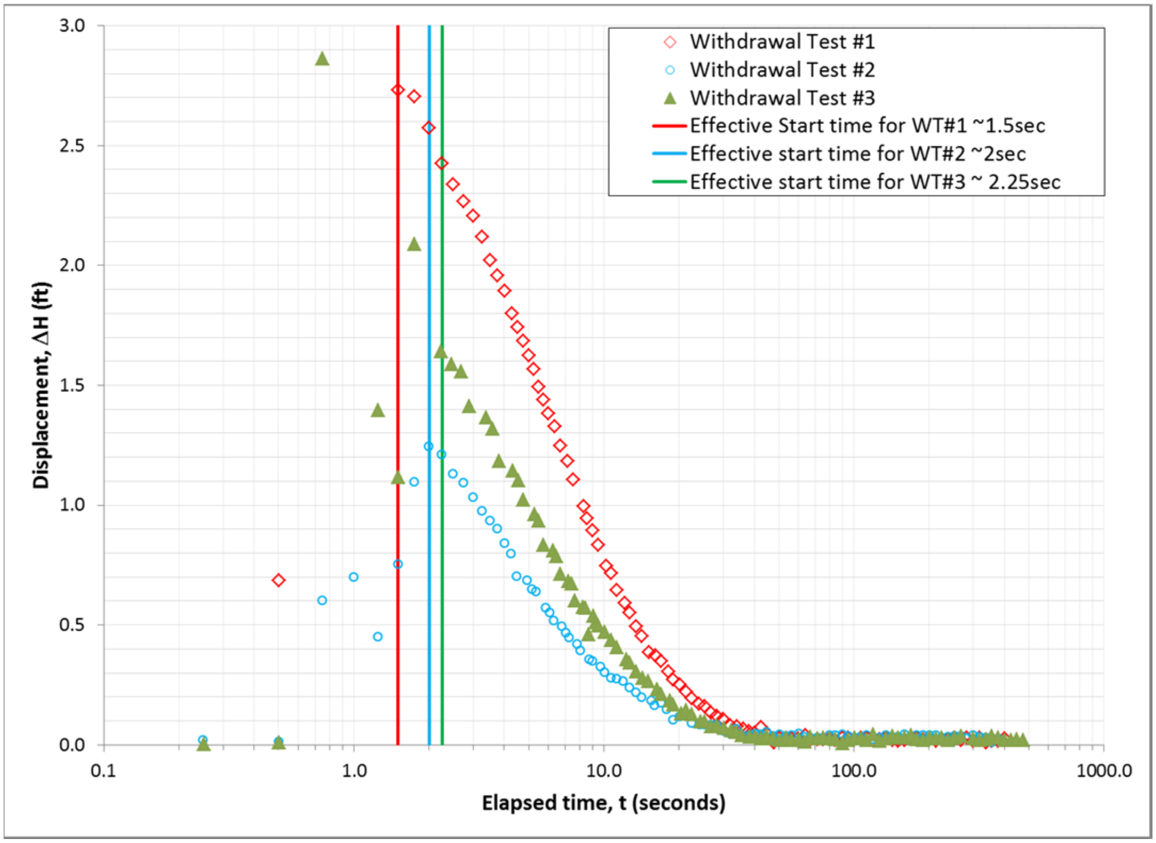

Figure 4-82. Effective start time for withdrawal tests at 199-H6-3

4.14.3 Estimation of effective initial displacement

Adjusted elapsed times are calculated by subtracting the effective start time from the reported elapsed times. The displacements are plotted against the adjusted elapsed times. The estimation of the initial displacements is shown in Figure 4-83. Effective initial displacements of 2.8 ft., 1.2 ft., and 1.6 ft. are estimated for the three withdrawal tests by back-fitting the observations to 0.0 elapsed time. For a slug volume (V) of 0.688 ft^3 and a casing radius (r_c) of 3 inches, a theoretical initial displacement (H_0) of 3.5 ft. is calculated ($H_0 = V/\pi r_c^2$). Similarly, theoretical initial displacements of 1.67 ft. and 2.4 ft. are estimated for the slug volumes of 0.328 ft^3 and 0.472 ft^3. The visually estimated initial displacements are lesser than the theoretical estimates probably because of the non-instantaneous nature of the tests.

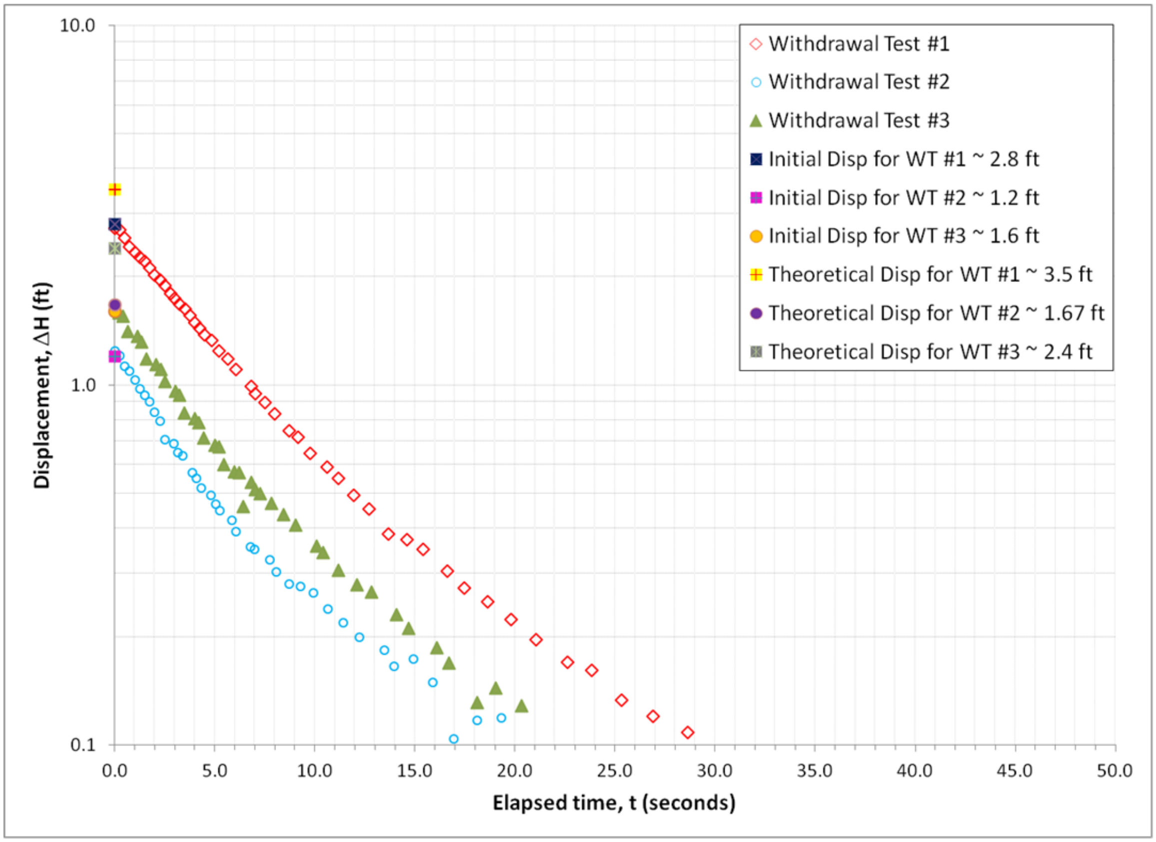

Figure 4-83. Estimation of effective initial displacement at 199-H6-3

4.14.4 Normalized displacements

The normalized displacements are calculated by dividing the observed displacements for the withdrawal tests by their respective effective initial displacement. The normalized responses plotted in Figure 4-84 confirm that the results for all the withdrawal tests are internally consistent. The close correspondence of the normalized displacement curves suggests that it is sufficient to analyze the data from only one of the withdrawal tests. The first withdrawal test is chosen for analysis.

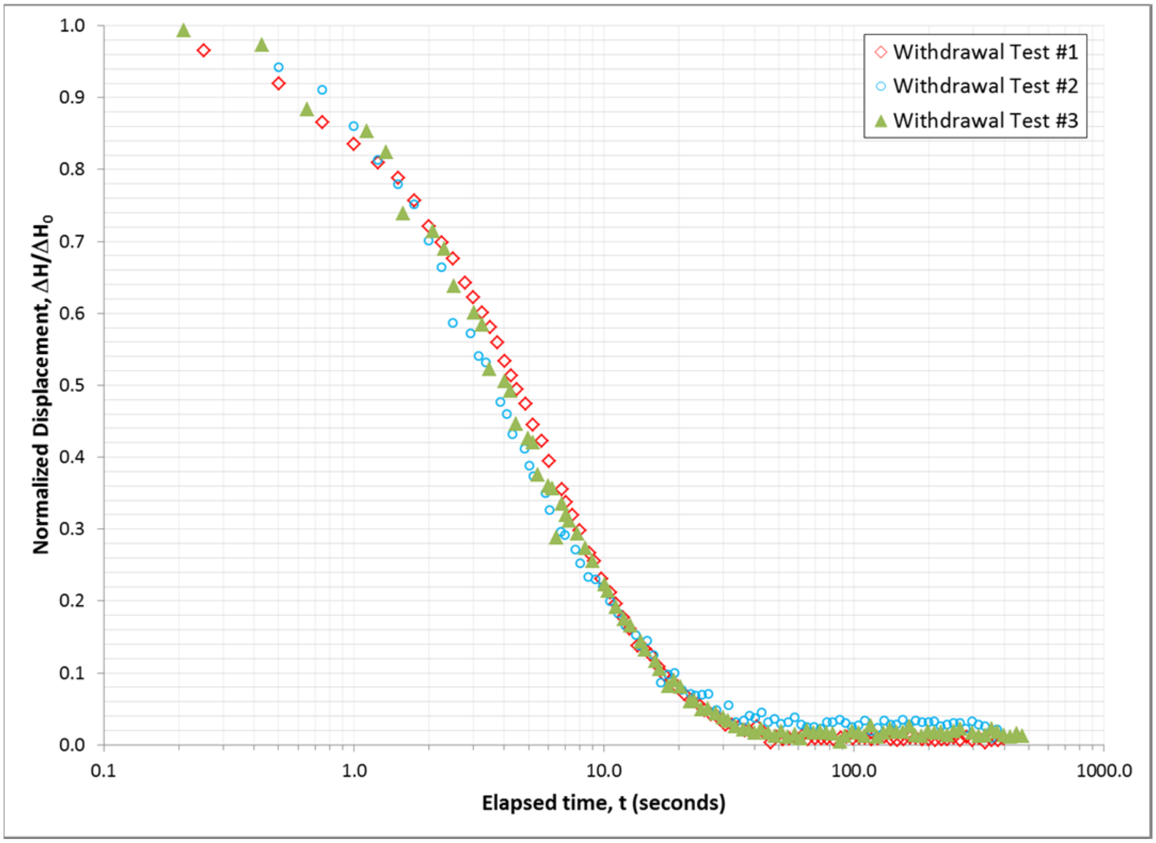

Figure 4-84. Normalized displacement at 199-H6-3

4.14.5 Preliminary analysis

For a first-cut analysis, the normalized displacements for the first withdrawal test are fit with the CBP model. The CBP model fit is shown in Figure 4-85. A good match to the observations is achieved with a storage coefficient, *S*, of 1×10^{-4}, and a fitted transmissivity, *T*, of 180 m^2/d. This analysis assumes that the well penetrates the full thickness of the aquifer. Referring to Table 4-2, we see that for well 199-H6-3, this is not the case. The aquifer (Hanford) is about 5.79 m (115.45 m – 109.66 m) thick at this location, and the length of the well screen is about 5.09 m. Cooper et al. (1967) suggested that in the case of a well that penetrates only a portion of the thickness of the aquifer, the effective thickness of the aquifer can be specified as the effective length of the well screen. Since the length of the submerged well screen length is 16.7 ft. (5.09 m), the estimated transmissivity corresponds to a horizontal hydraulic conductivity, K_H, of **35 m/d** or **4.1×10^{-4} m/s.**

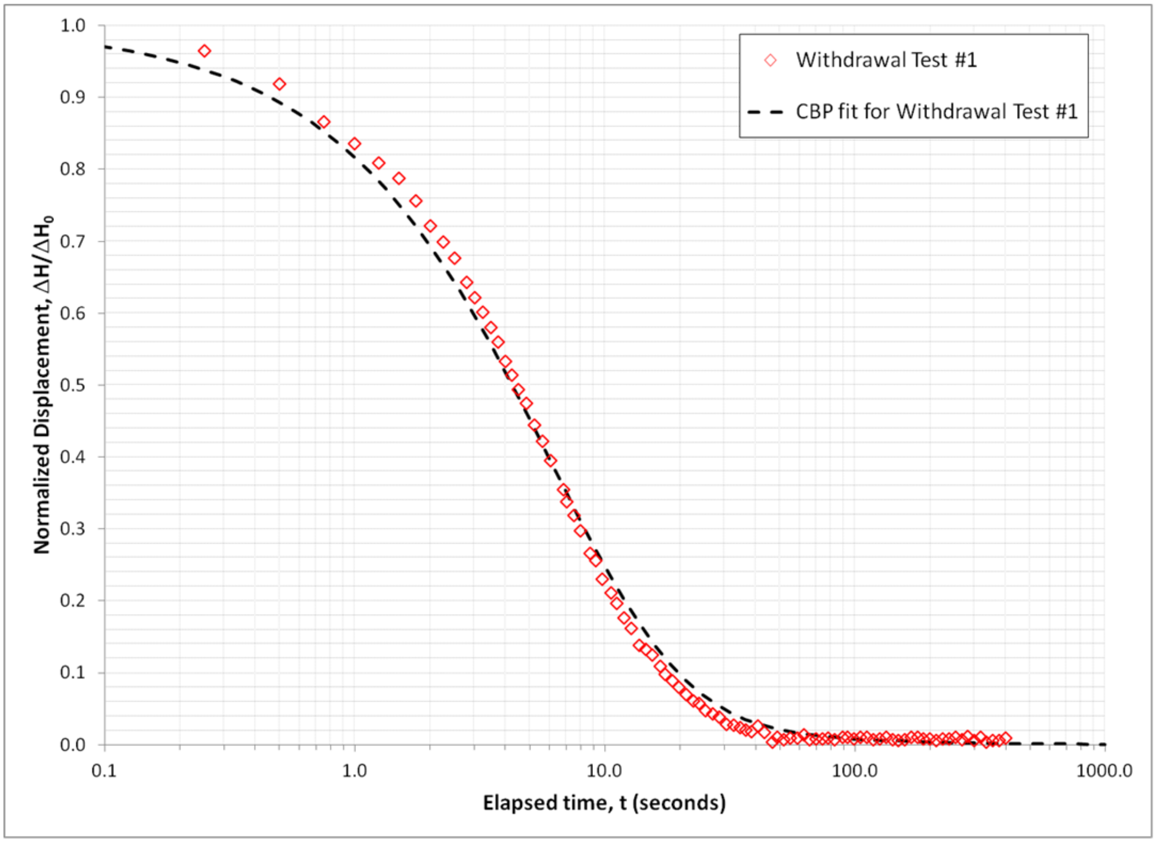

Figure 4-85. CBP Model fit at 199-H6-3

4.14.6 Refined analysis

For a more refined analysis, the normalized displacements for the first withdrawal test are fit with the KGS model for an unconfined aquifer. The KGS model fit is shown in Figure 4-86. A good match to the observations is achieved with a specific storage, S_s, of 2.0×10^{-5} m^{-1}, an anisotropy ratio K_V/K_H of 0.1, and a fitted horizontal hydraulic conductivity, K_H, of **27 m/d** or **3.1×10^{-4} m/s**. The specific storage value is not iteratively estimated but instead calculated by dividing an assumed storage coefficient of 1×10^{-4} by the well screen length (16.7 ft. or 5.09 m).

The fitted value of the specific storage value falls in the range suggested by Younger (1993) as representative of aquifer materials that consist of medium sand and coarse sand. This corresponds reasonably well with the description of the screened interval as a mixture of sand, gravel, and silt.

The estimated hydraulic conductivity is in the middle of the range for clean sand and at the higher end of the range for silty sand reported in the literature (see for example, Freeze and Cherry, 1979; Table 2.2). This corresponds reasonably well with the description of the screened interval as a mixture of sand, gravel, and silt.

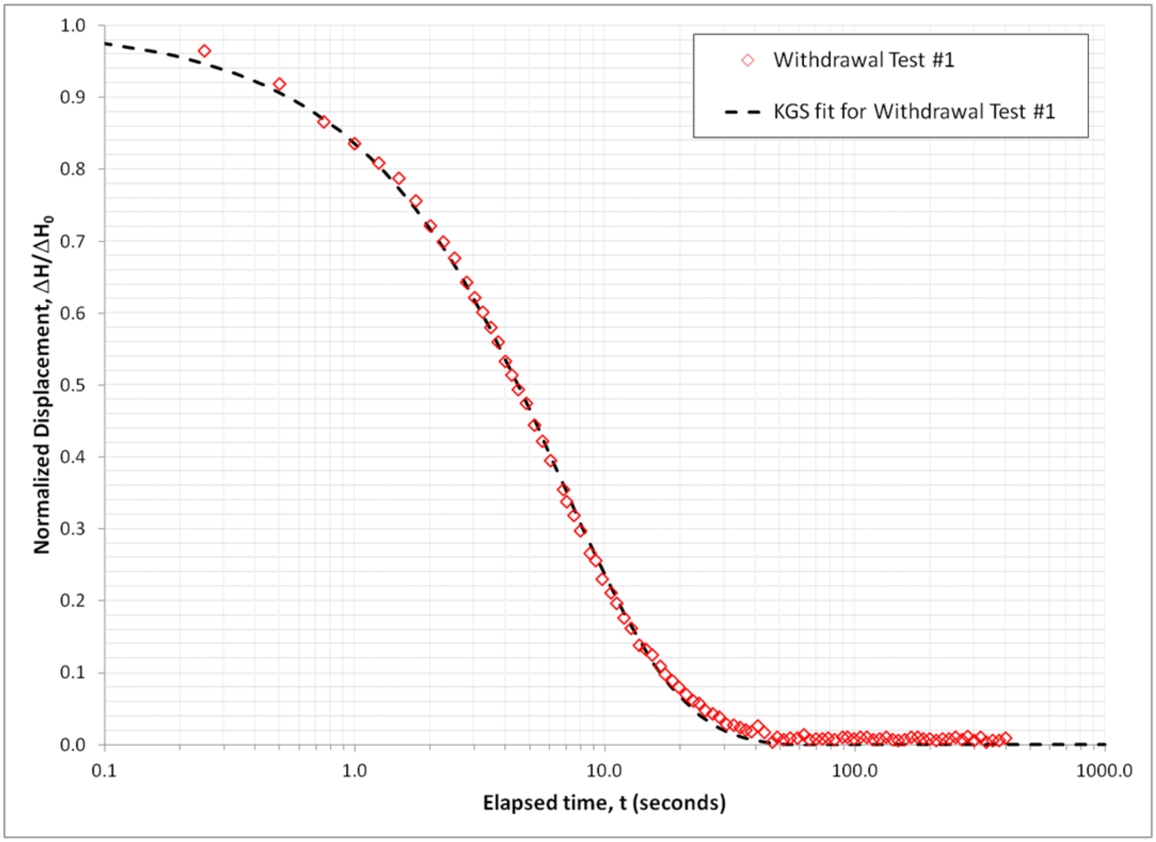

Figure 4-86. KGS Model fit at 199-H6-3

4.15 Analysis of Slug Test Data at well 199-H6-4

Three withdrawal tests were conducted at 199-H6-4 and all of them are analyzed here.

4.15.1 Raw displacement data for withdrawal tests

The three withdrawal tests were conducted with slugs of volume 0.688 ft^3, 0.328 ft^3 and 0.472 ft^3 respectively. The displacements are plotted in Figure 4.87. The normalized displacements in section 4.15.4 will tell us if these responses are consistent. Inspection of the displacements suggests that the tests are not instantaneous but that there is an effective start time for each test. These effective start times are estimated in section 4.15.2.

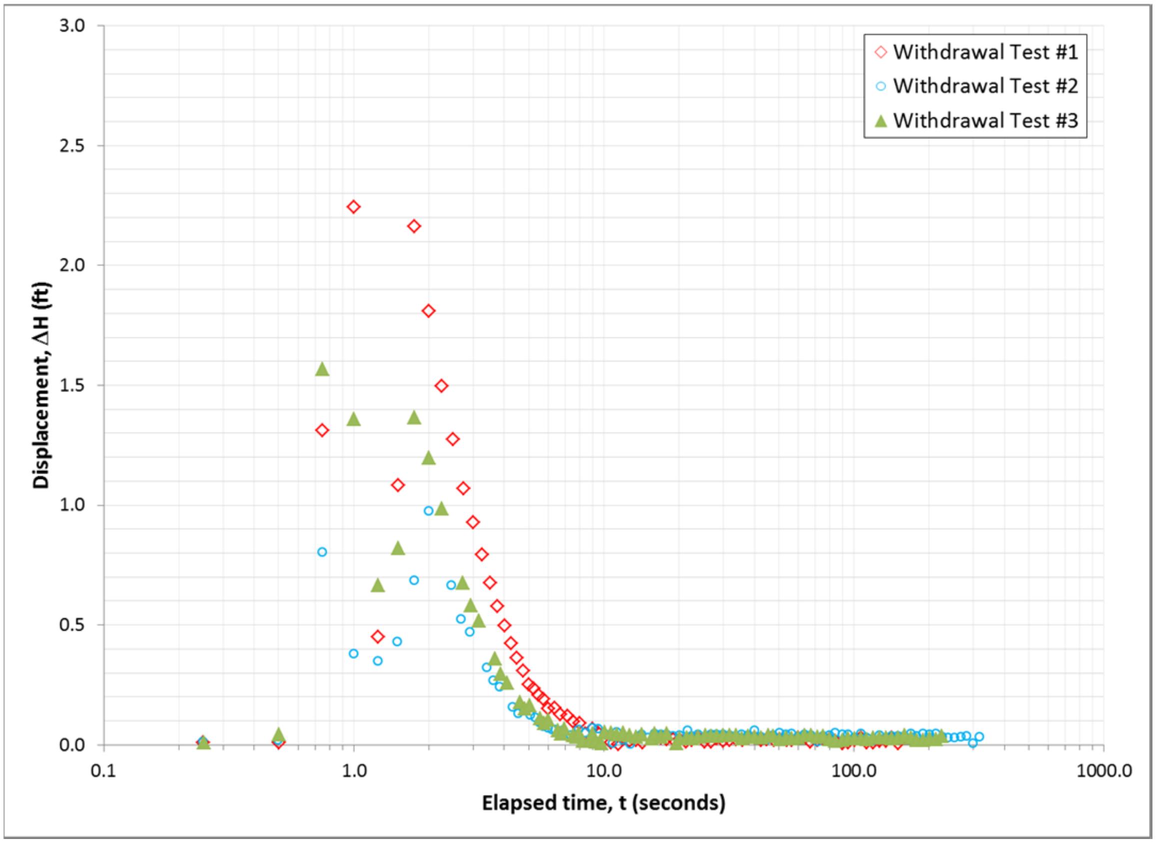

Figure 4-87. Displacements from three withdrawal tests at 199-H6-4

4.15.2 Estimation of effective start time

Effective start times of 1.75 seconds, 2 seconds and 1.75 seconds are estimated for the three withdrawal tests respectively.

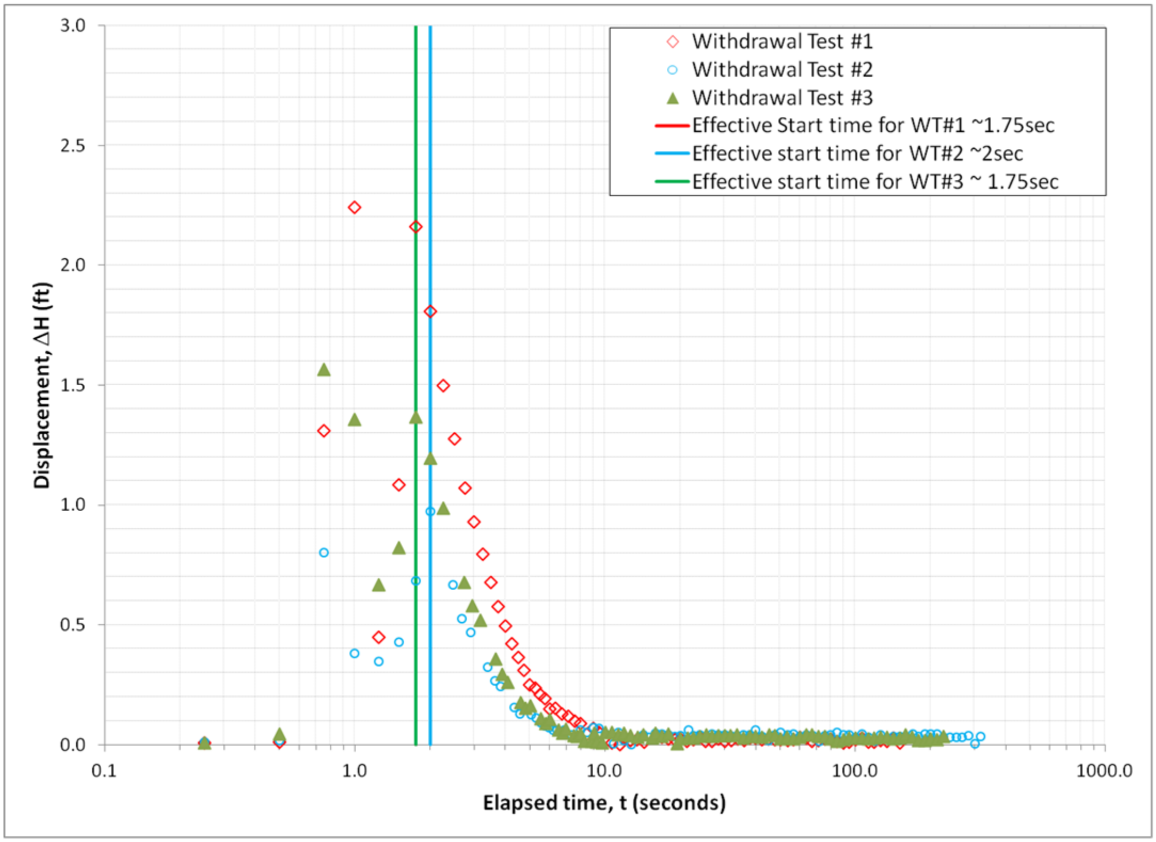

Figure 4-88. Effective start time for withdrawal tests at 199-H6-4

4.15.3 Estimation of effective initial displacement

Adjusted elapsed times are calculated by subtracting the effective start time from the reported elapsed times. The displacements are plotted against the adjusted elapsed times. The estimation of the initial displacements is shown in Figure 4-89. Effective initial displacements of 2.1 ft., 1.0 ft., and 1.4 ft. are estimated for the three withdrawal tests by back-fitting the observations to 0.0 elapsed time. For a slug volume (V) of 0.688 ft^3 and a casing radius (r_c) of 3 inches, a theoretical initial displacement (H_0) of 3.5 ft. is calculated ($H_0 = V/\pi r_c^2$). Similarly, theoretical initial displacements of 1.67 ft. and 2.4 ft. are estimated for the slug volumes of 0.328 ft^3 and 0.472 ft^3. The visually estimated initial displacements are lesser than the theoretical estimates probably because of the non-instantaneous nature of the tests.

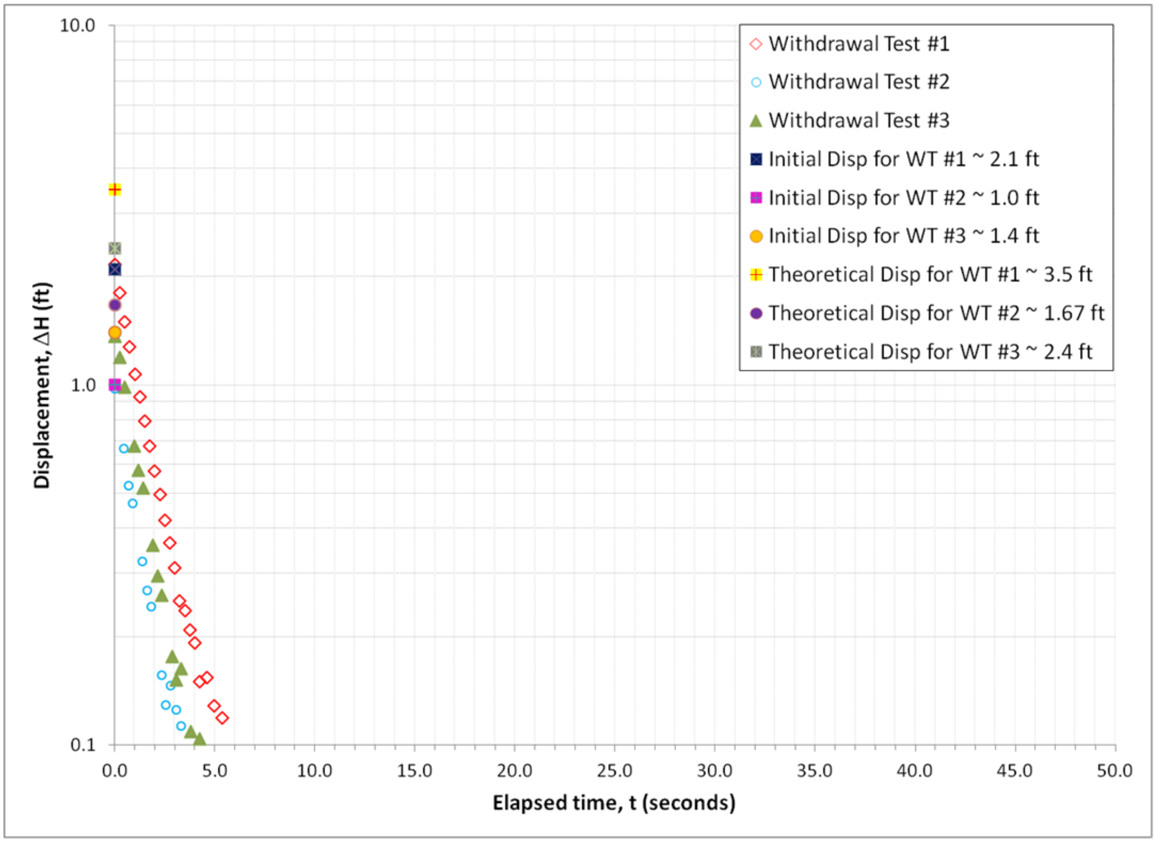

Figure 4-89. Estimation of effective initial displacement at 199-H6-4

4.15.4 Normalized displacements

The normalized displacements are calculated by dividing the observed displacements for the withdrawal tests by their respective effective initial displacement. The normalized responses plotted in Figure 4-90 confirm that the results for all the withdrawal tests are internally consistent. The close correspondence of the normalized displacement curves suggests that it is sufficient to analyze the data from only one of the withdrawal tests. The first withdrawal test is chosen for analysis.

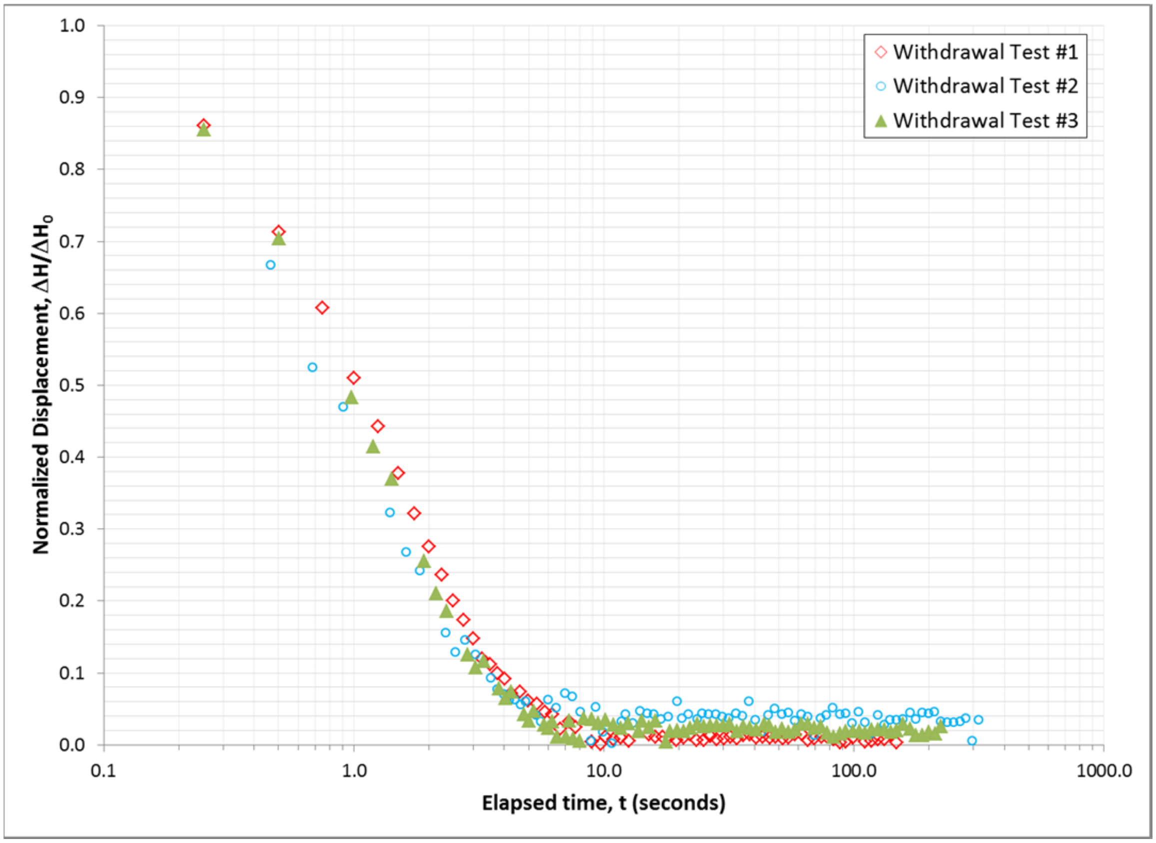

Figure 4-90. Normalized displacement at 199-H6-4

4.15.5 Preliminary analysis

For a first-cut analysis, the normalized displacements for the first withdrawal test are fit with the CBP model. The CBP model fit is shown in Figure 4-91. A good match to the observations is achieved with a storage coefficient, *S*, of 5×10^{-5}, and a fitted transmissivity, *T*, of 876 m^2/d. This analysis assumes that the well penetrates the full thickness of the aquifer. Referring to Table 4-2, we see that for well 199-H6-4, this is not the case. The aquifer (Hanford) is about 16.12 m (116.21 m – 110.09 m) thick at this location, and the length of the well screen is about 5.21 m. Cooper et al. (1967) suggested that in the case of a well that penetrates only a portion of the thickness of the aquifer, the effective thickness of the aquifer can be specified as the effective length of the well screen. Since the length of the submerged well screen length is 17.1 ft. (5.21 m), the estimated transmissivity corresponds to a horizontal hydraulic conductivity, K_H, of **168 m/d** **or** **1.9×10^{-3} m/s**.

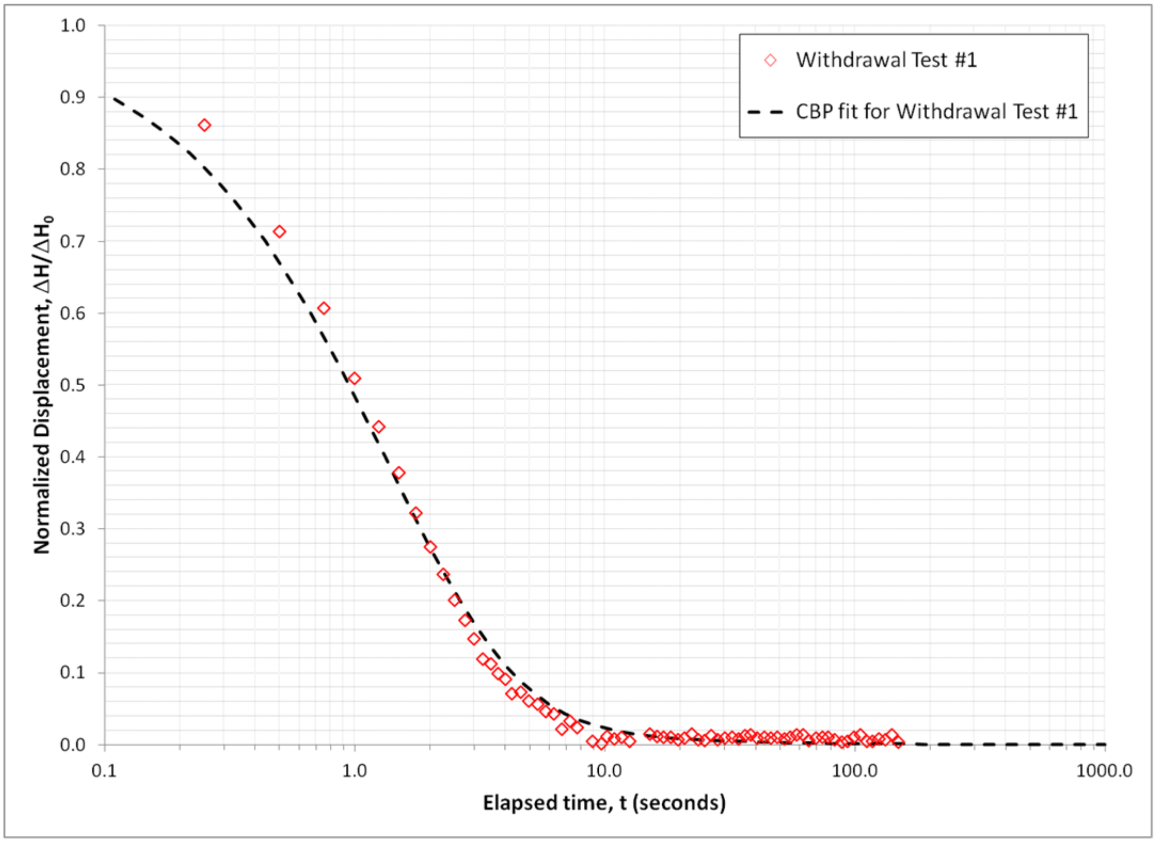

Figure 4-91. CBP Model fit at 199-H6-4

4.15.6 Refined analysis

For a more refined analysis, the normalized displacements for the first withdrawal test are fit with the KGS model for an unconfined aquifer. The KGS model fit is shown in Figure 4-92. A good match to the observations is achieved with a specific storage, S_s, of 9.6×10^{-6} m^{-1}, an anisotropy ratio K_V/K_H of 0.1, and a fitted horizontal hydraulic conductivity, K_H, of **118 m/d** or **1.4×10^{-3} m/s**. The specific storage value is not iteratively estimated but instead calculated by dividing an assumed storage coefficient of 5×10^{-5} by the submerged well screen length (17.1 ft. or 5.21 m).

The fitted value of the specific storage value falls in the range suggested by Younger (1993) as representative of aquifer materials that consist of coarse sand and gravel. This corresponds well with the 'Sandy Gravel' description of the screened interval.

The estimated hydraulic conductivity at the lower end of the range for gravel and at the higher end of the range for clean sand reported in the literature (see for example, Freeze and Cherry, 1979; Table 2.2). This corresponds well with the 'Sandy Gravel' description of the screened interval.

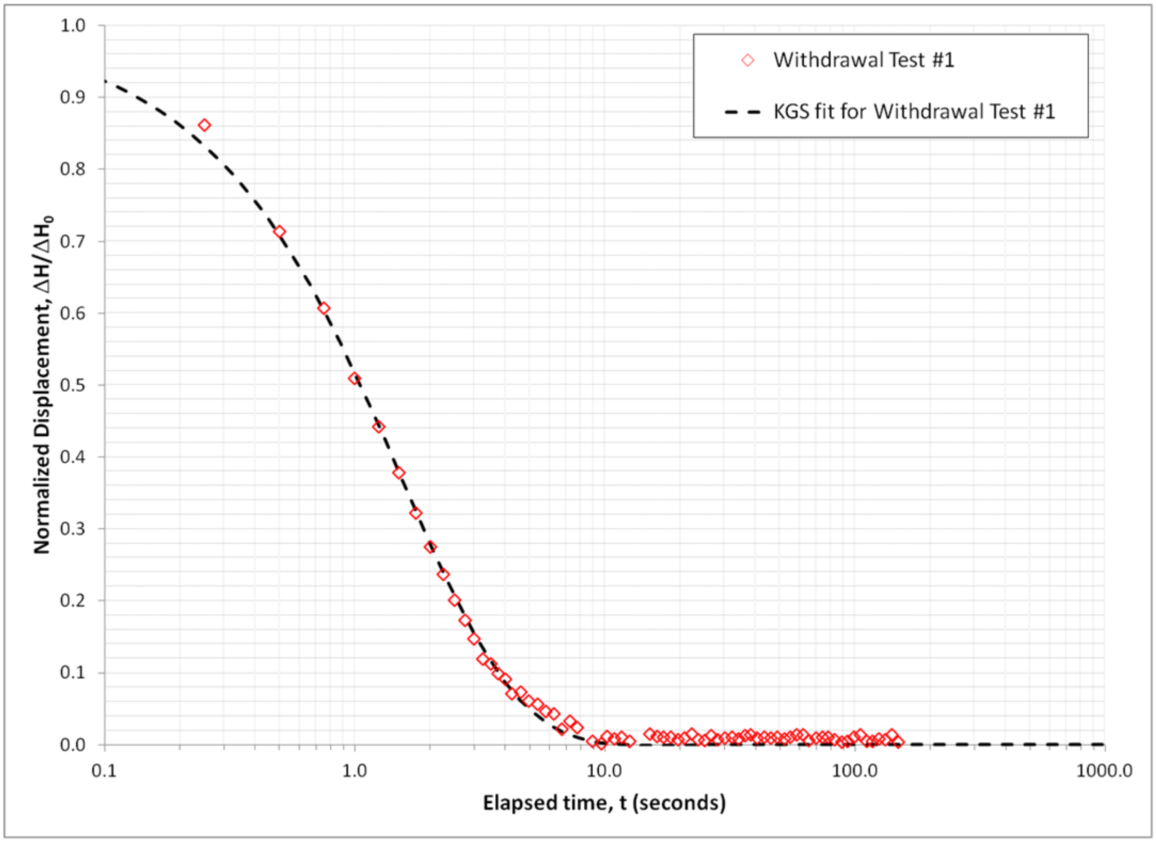

Figure 4-92. KGS Model fit at 199-H6-4

4.16 Analysis of Slug Test Data at well 199-H1-7

One withdrawal test was conducted at 199-H1-7 and it is analyzed here.

4.16.1 Raw displacement data for withdrawal tests

The withdrawal test was conducted with a slug of volume 0.688 ft^3. The displacements are plotted in Figure 4-93. Unlike the tests at other wells in the vicinity, the response at this well remains nearly static for about 230 seconds before dissipation commences. Additionally, the measured response did not document the recovery completely. According to the field log, the slug could not be fully inserted into the well screen and hit the bottom of the well during the test. An inspection of Table 4-1 reveals that the water table is below the screen elevation. Because of the above mentioned reasons, this test was not considered reliable. We recommend testing of this well with a smaller slug when the water level is within the well screen.

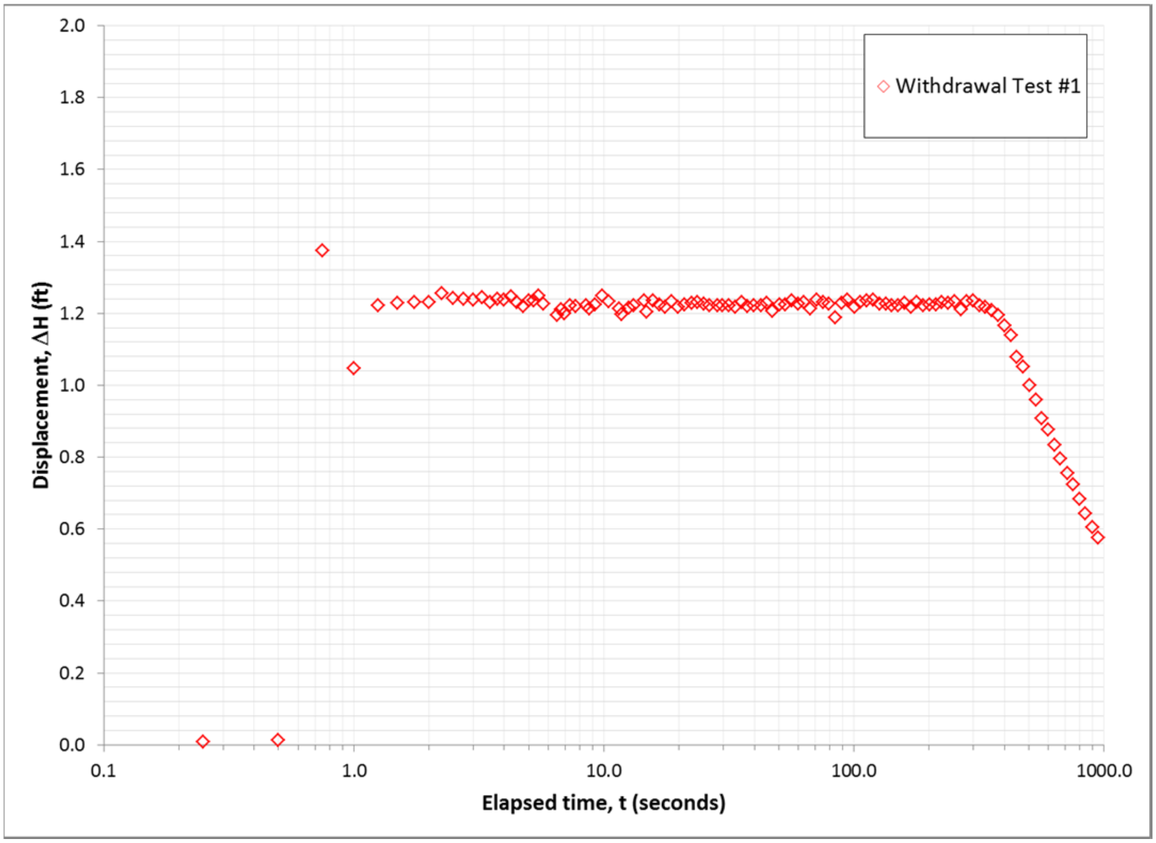

Figure 4-93. Displacements from one withdrawal test at 199-H1-7

5. Summary of interpretations

5.1 Summary of Slug Test Data

Slug test data at sixteen wells in the 100-D-Area and 100-H-Area has been analyzed with the CBP and KGS methods. The locations of the D and H areas and other Hanford groundwater interest areas are shown in Figure 5-1. The slug tests were conducted in materials of the Hanford formation, Ringold E Formation and the underlying RUM unit. The estimated specific storage and hydraulic conductivities for the D-Area and H-Area are tabulated on Table 5-1 and Table 5-2 respectively. The new estimates of hydraulic conductivity are compared with historical estimates from slug tests and pumping tests. Maps of all well locations (historical and new) are provided in Figures 5-2 and 5-6. In Figures 5-3 and 5-7, the estimates are classified according to the test type: historical slug test, historical pumping test or new slug test. In Figures 5-4 and 5-8, the estimates are classified by magnitude with the new test estimates displayed in red and the historical estimates displayed in green. In Figures 5-5 and 5-9, the estimates are classified by formation. The well screen elevations along with the elevation of the water table and the top of the RUM are shown in Figures 5-10 and 5-11.

The reported hydraulic conductivity values on Tables 5-1 and Table 5-2 are from the refined KGS analysis. While the KGS model is more refined, the CBP model has provided a useful first-cut estimate of the storage coefficient and hydraulic conductivity. Since the CBP model neglects vertical flow, it yields an upper bound estimate of the hydraulic conductivity. It is to be noted that the reported storages are the specific storage and not the specific yield. In an unconfined aquifer, the drainage of the pores of the formation at the water table is quantified with the specific yield, also referred to as the drainable porosity. The effects of the slug tests are not sufficient to cause drainage of pores; therefore, the specific yield does not enter into the analysis. Rather, the changes in storage reflect an elastic response, and are more appropriately quantified with the specific storage or confined storage coefficient, also referred to as the storativity.

In the D-Area, the RUM wells 199-D5-134 and 199-D5-141 yield the lowest hydraulic conductivity values of 0.1 m/d and 0.2 m/d, respectively. Out of the remaining six wells, five were screened in the Ringold E Formation. Among these wells, the hydraulic conductivity ranged from 13 m/d to 40 m/d. The remaining well 199-D3-5 which was screened in both the Hanford and Ringold E units had a higher hydraulic conductivity of 59 m/d. The comparison with the historical data shows that there is generally good agreement between the two datasets. The vertical anisotropy ratio was assumed to be 0.1 for all the D-wells. Changing the anisotropy ratio did not lead to a very different value of the horizontal hydraulic conductivity. For instance, at 199-D5-132, the hydraulic conductivity for an anisotropy ratio of 0.01 was estimated to be 23 m/d. This estimate is very close to that of 22 m/d for an anisotropy ratio of 0.1.

In the H-Area, three wells were screened in the RUM with hydraulic conductivities ranging from 0.6 m/d to 2 m/d. All the remaining wells were screened in the Hanford formation. The hydraulic conductivities at these wells ranged from 30 m/d to 127 m/d. The dataset for 199-H1-7 was not analyzed because the water table was below the well screen. The comparison with the historical data shows that there is generally good agreement between the two datasets. With the exception of 199-H3-6 (0.01) and 199-H3-9 (1.0), an assumed anisotropy ratio of 0.1 lead to good fits.

With the exception of 199-H1-7, the tests show 'near-textbook' responses suggesting that excellent field practices were in use during the tests. For several wells, the estimated hydraulic conductivity was not quite consistent with the value that would be inferred by matching the geologic description with typical ranges of values reported in Freeze and Cherry (1979). It was hypothesized that this likely reflects the effects of fine-grained materials. As shown in Figure 5- 12, the hydraulic conductivity decreases by orders of magnitude for even relatively small amounts of fines.

In addition to the slug test data, well development data were also analyzed in the H-area to help in the delineation of Ringold E in the Horn area. This analysis is summarized in the next section.

Table 5-1. Estimated Aquifer Properties for D-Area Wells.

Well name	Geologic Unit	KGS method				
		Specific Storage (m^{-1})	Horizontal Hydraulic Conductivity K_H (m/d)	Horizontal Hydraulic Conductivity K_H (m/s)	Horizontal Hydraulic Conductivity K_H (cm/s)	Vertical Anisotropy Ratio (K_V/K_H)
199-D3-5	Hanford and Ringold E	$2.0{\times}10^{-6}$	55	$6.4{\times}10^{-4}$	$6.4{\times}10^{-2}$	0.1
199-D5-132	Ringold E	$6.4{\times}10^{-4}$	19	$2.2{\times}10^{-4}$	$2.2{\times}10^{-2}$	0.1
199-D5-133	Ringold E	$2.0{\times}10^{-4}$	38	$4.4{\times}10^{-4}$	$4.4{\times}10^{-2}$	0.1
199-D5-134	RUM	$1.3{\times}10^{-3}$	0.1	$1.2{\times}10^{-6}$	$1.2{\times}10^{-4}$	0.1
199-D5-141	RUM	$3.3{\times}10^{-4}$	0.2	$2.3{\times}10^{-6}$	$2.3{\times}10^{-4}$	0.1
199-D5-143	Ringold E	$2.0{\times}10^{-4}$	20	$2.3{\times}10^{-4}$	$2.3{\times}10^{-2}$	0.1
199-D5-144	Ringold E	$6.6{\times}10^{-5}$	23	$2.7{\times}10^{-4}$	$2.7{\times}10^{-2}$	0.1
199-D6-3	Ringold E	$5.9{\times}10^{-4}$	12	$1.4{\times}10^{-4}$	$1.4{\times}10^{-2}$	0.1

Table 5-2. Estimated Aquifer Properties for H-Area Wells.

Well name	Geologic Unit	KGS method				
		Specific Storage (m^{-1})	Horizontal Hydraulic Conductivity K_H (m/d)	Horizontal Hydraulic Conductivity K_H (m/s)	Horizontal Hydraulic Conductivity K_H (cm/s)	Vertical Anisotropy Ratio (K_V/K_H)
199-H2-1	RUM	$1.3{\times}10^{-4}$	2	$2.3{\times}10^{-5}$	$2.3{\times}10^{-3}$	0.1
199-H3-6	Hanford	$2.2{\times}10^{-4}$	38	$4.4{\times}10^{-4}$	$4.4{\times}10^{-2}$	0.01
199-H3-7	Hanford	$7.2{\times}10^{-4}$	27	$3.1{\times}10^{-4}$	$3.1{\times}10^{-2}$	0.1
199-H3-9	RUM	$1.3{\times}10^{-4}$	0.5	$5.8{\times}10^{-6}$	$6.9{\times}10^{-4}$	1.0
199-H3-10	RUM	$1.6{\times}10^{-4}$	1.6	$1.9{\times}10^{-5}$	$1.9{\times}10^{-3}$	0.1
199-H6-3	Hanford	$2.0{\times}10^{-5}$	27	$3.1{\times}10^{-4}$	$3.1{\times}10^{-2}$	0.1
199-H6-4	Hanford	$9.6{\times}10^{-6}$	118	$1.4{\times}10^{-3}$	$1.4{\times}10^{-1}$	0.1
199-H1-7	Hanford	Dataset unreliable. Recommend re-testing with smaller slug during high water level.				

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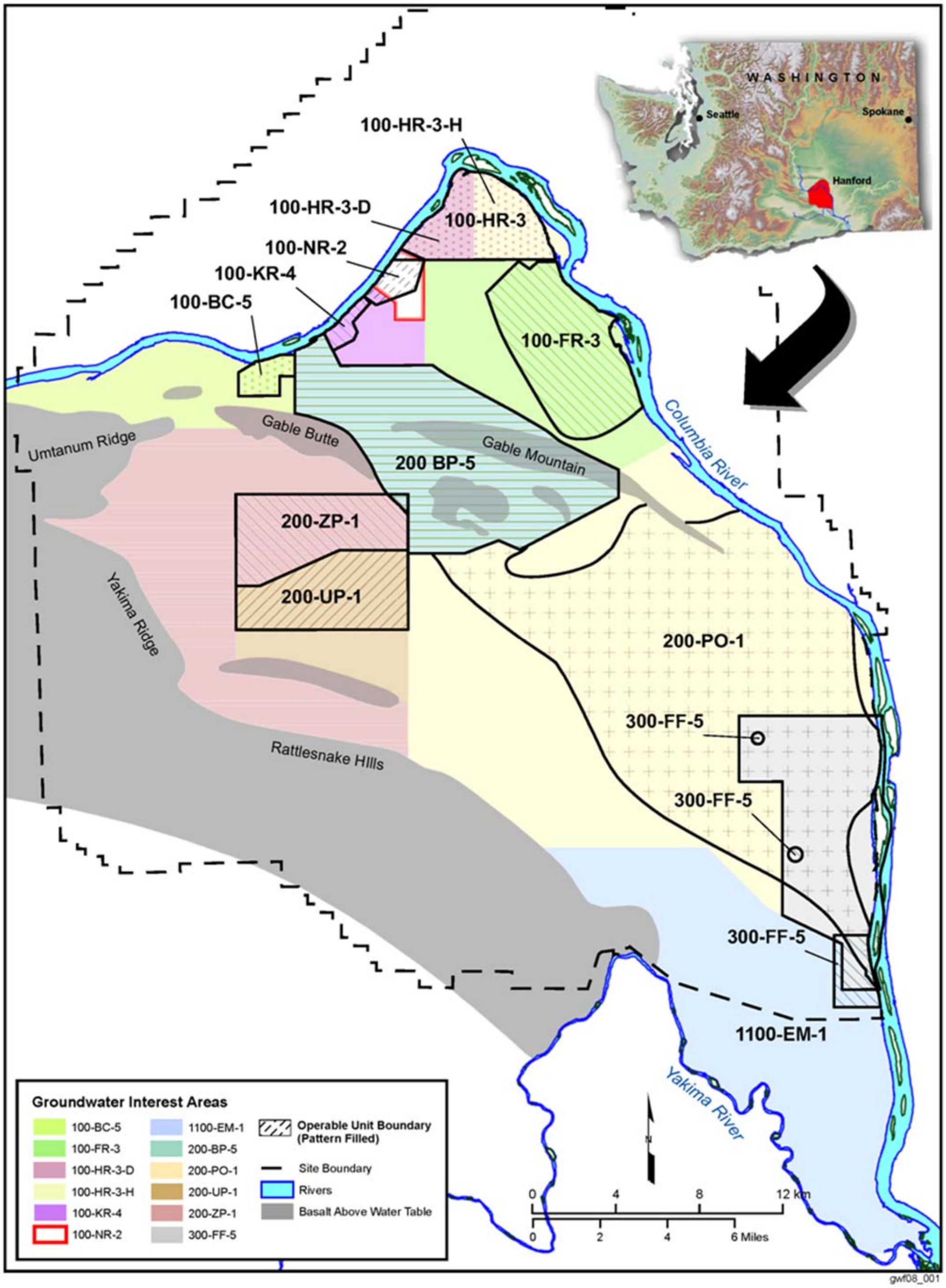

Source: DOE/RL-2008-66, *Hanford Site Groundwater Monitoring for Fiscal Year 2008.*

Figure 5-1. Location of 100 Area Groundwater Operable Units in Relation to Other Hanford Site Groundwater Operable Units

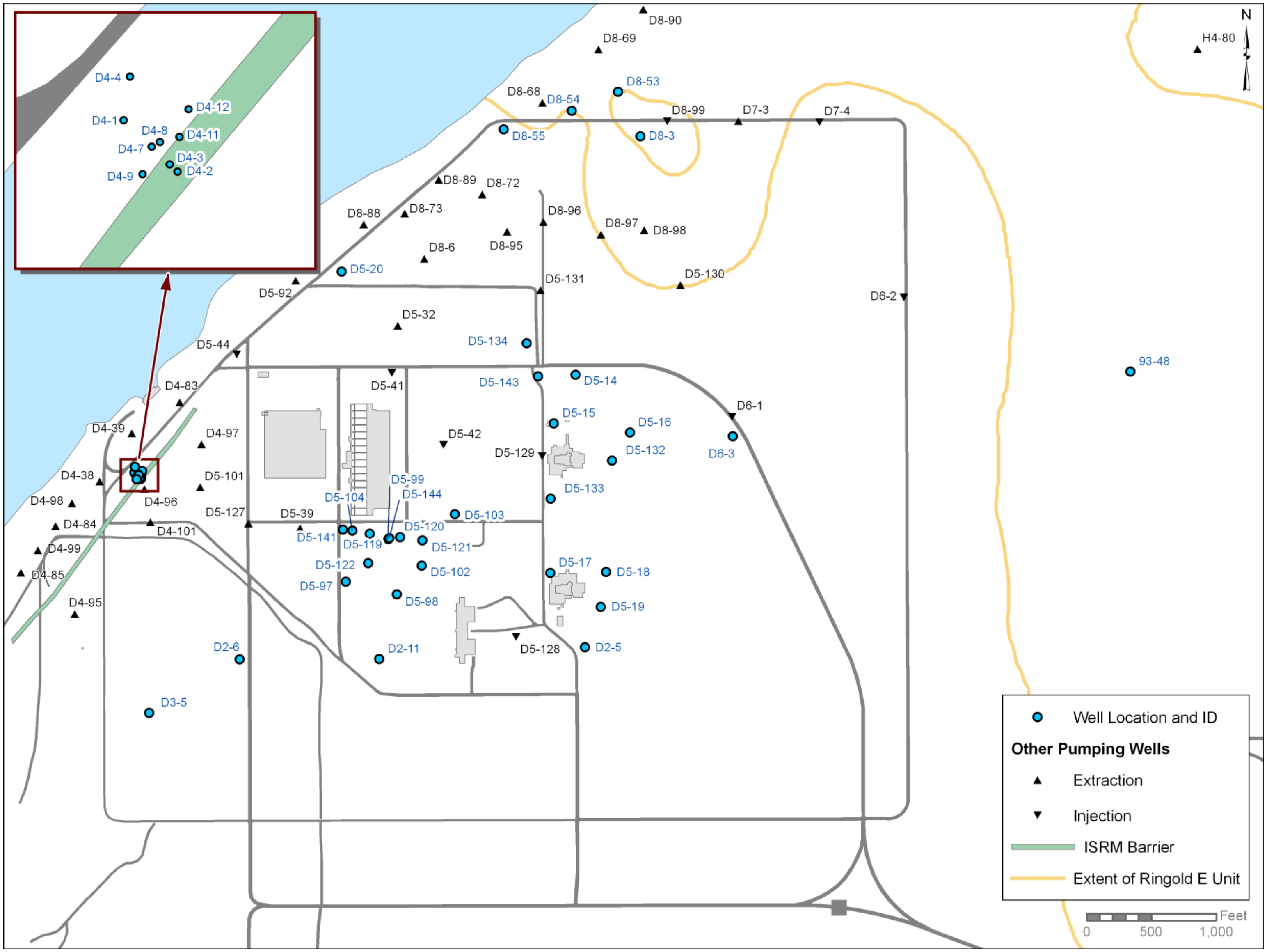

Figure 5-2. Wells: D-Area

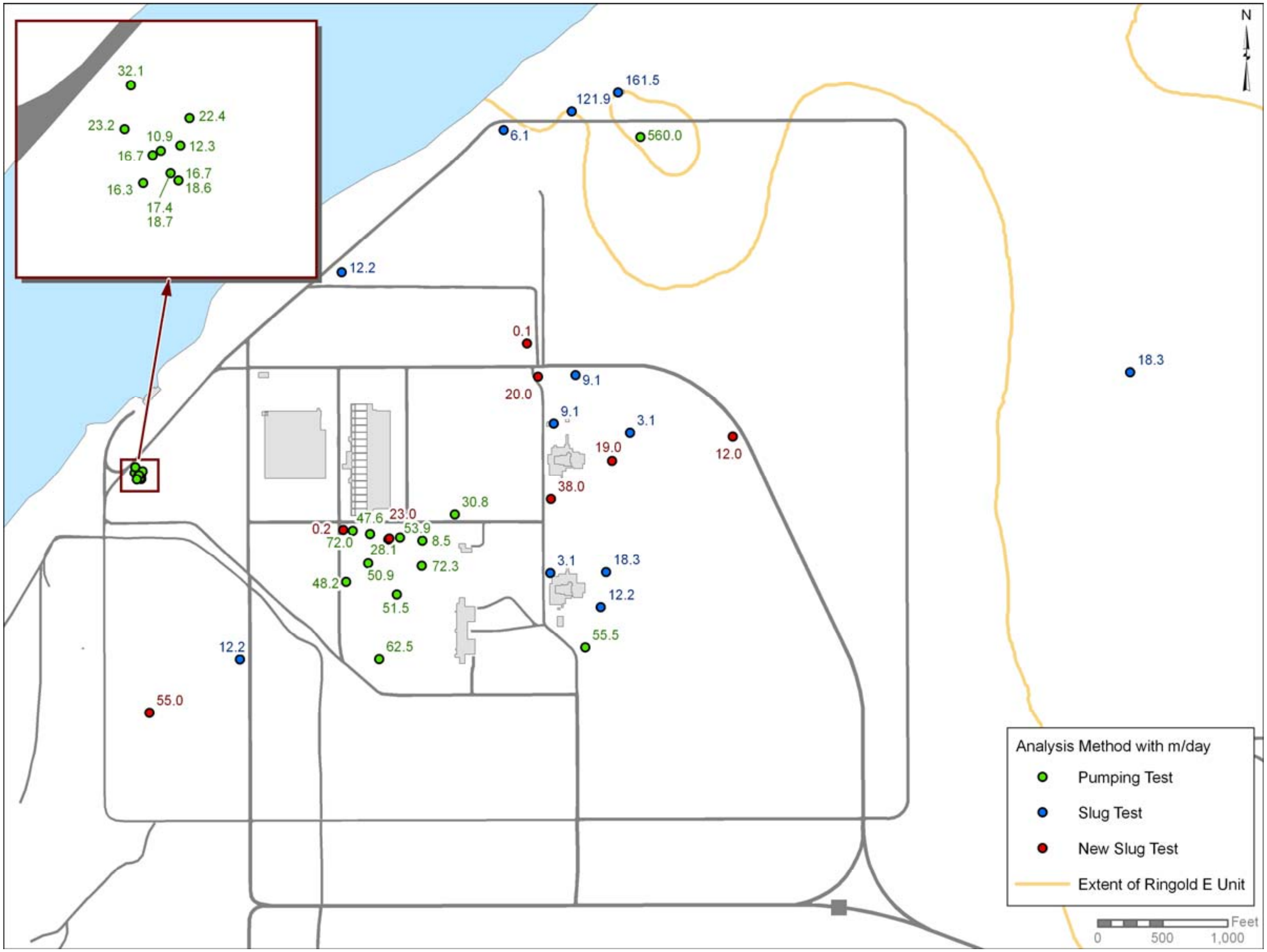

Figure 5-3. Hydraulic Conductivity (m/d) Estimates by Test Type: D-Area

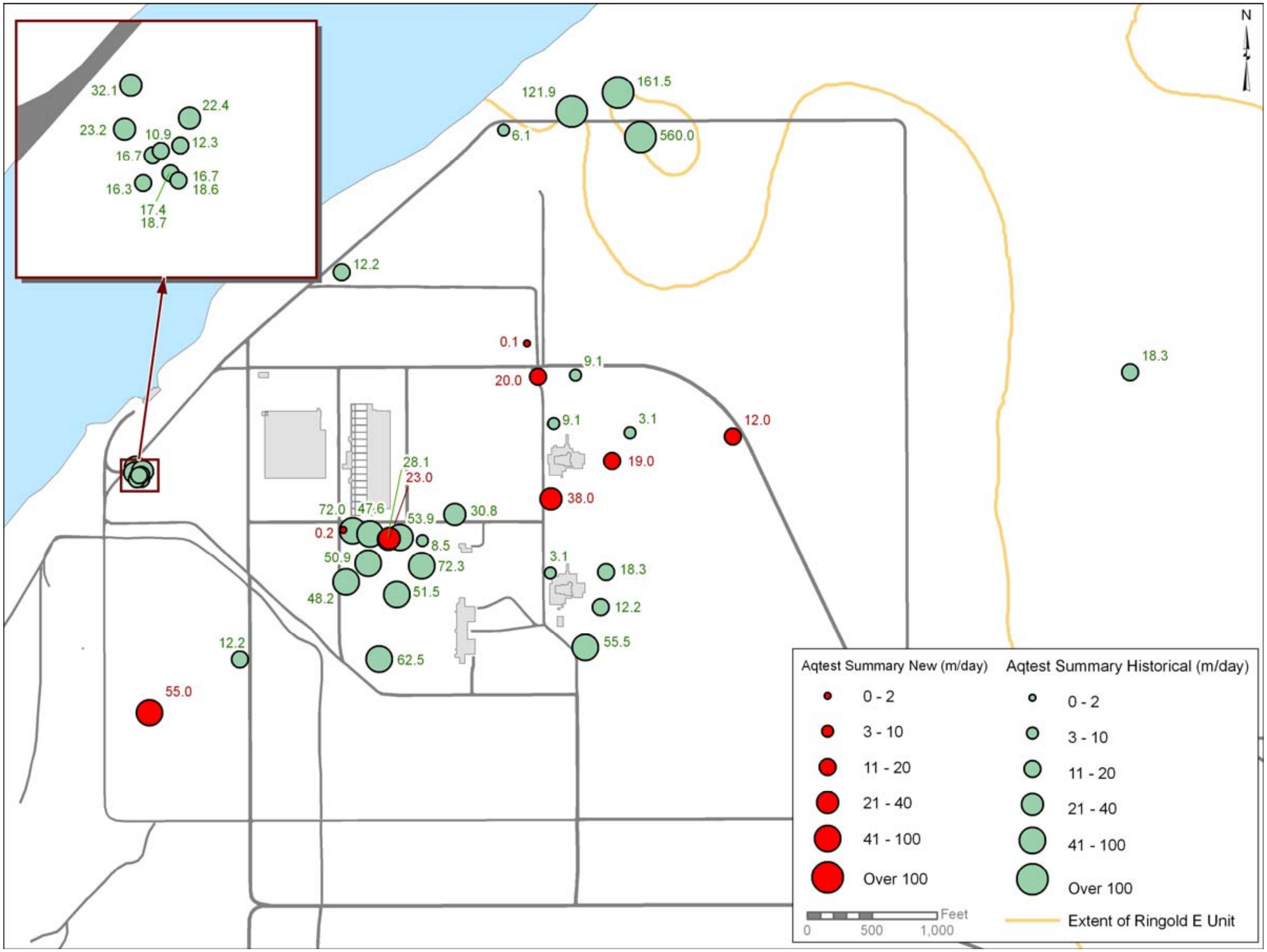

Figure 5-4. Hydraulic Conductivity (m/d) Estimates by Magnitude: D-Area

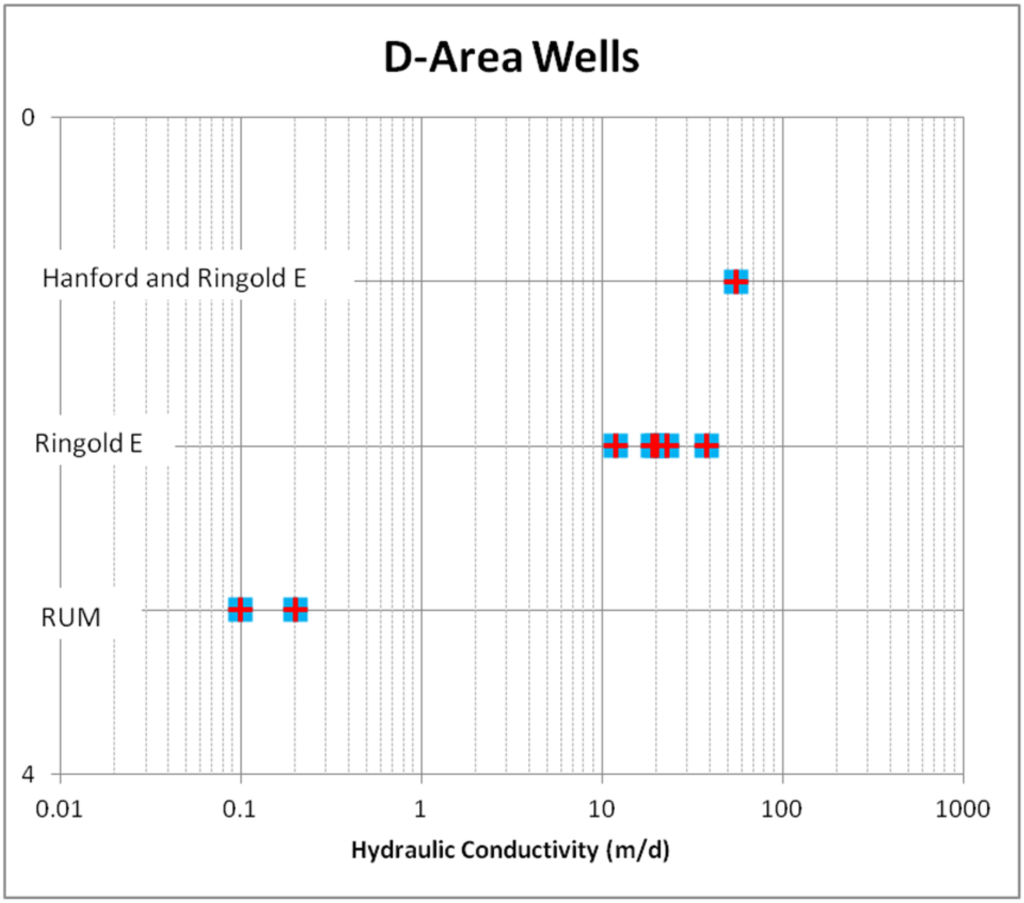

Figure 5-5. Hydraulic Conductivity (m/d) Estimates by Formation Type: D-Area

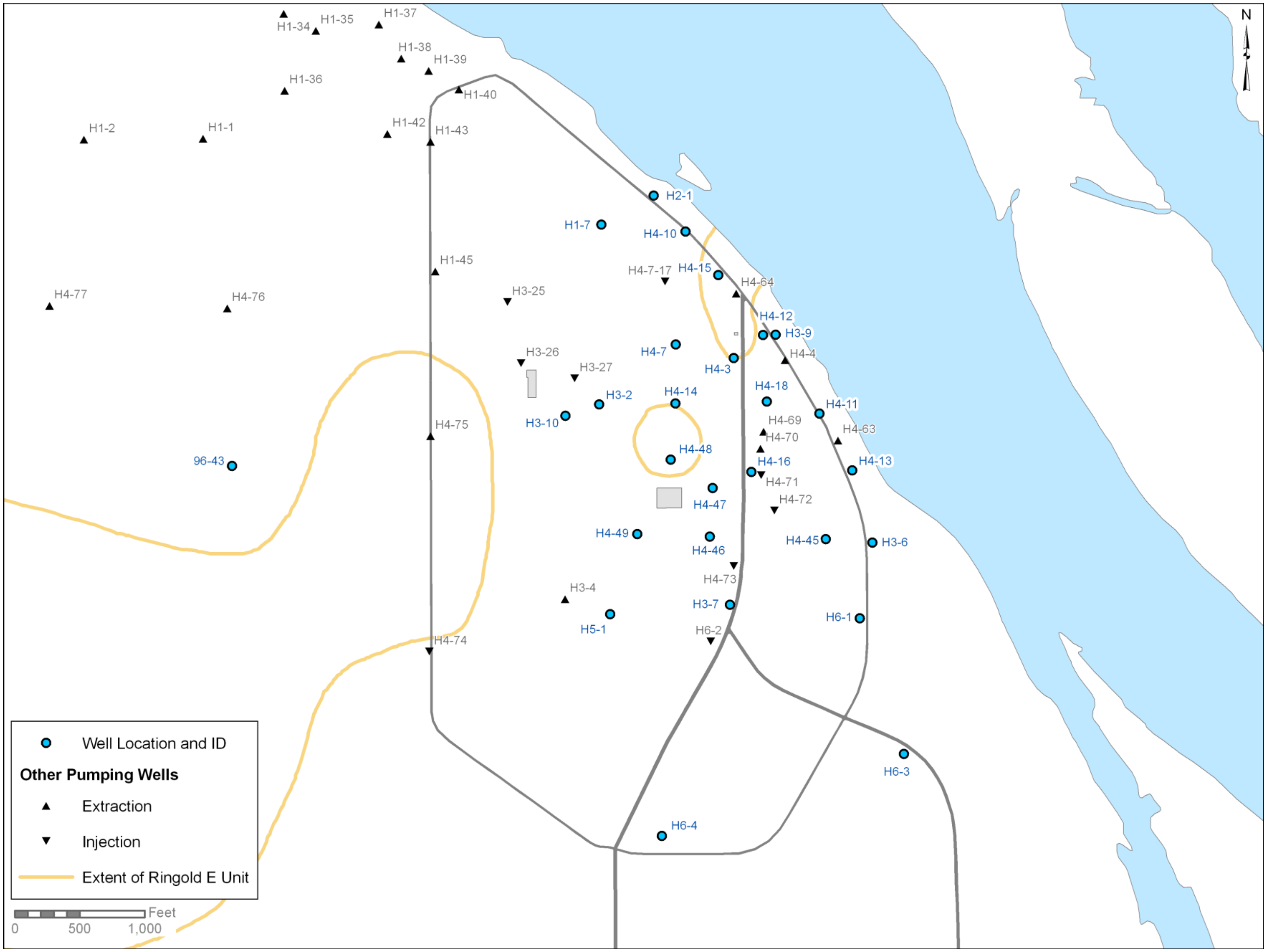

Figure 5-6. Wells: H-Area

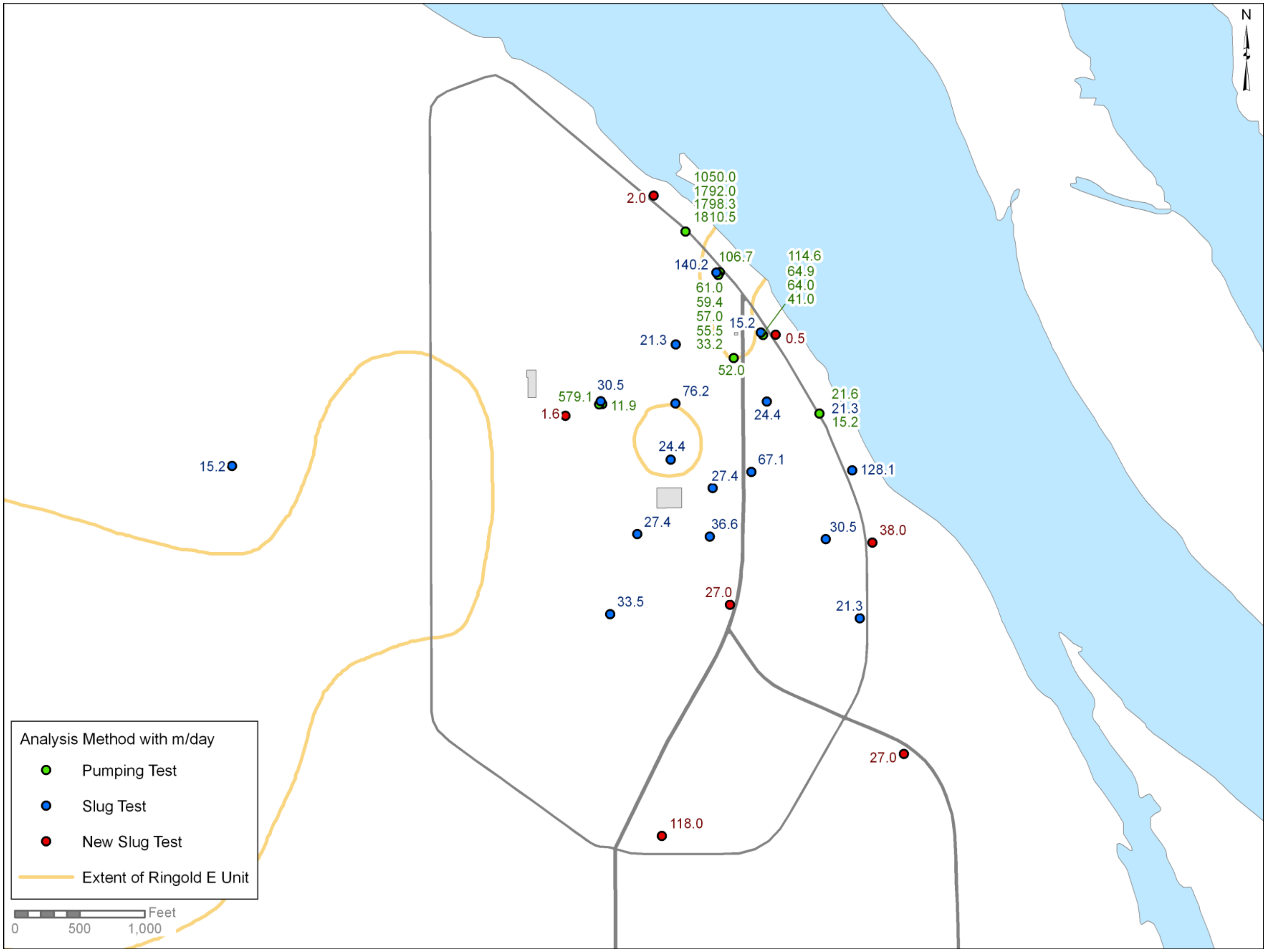

Figure 5-7. Hydraulic Conductivity (m/d) Estimates by Test Type: H-Area

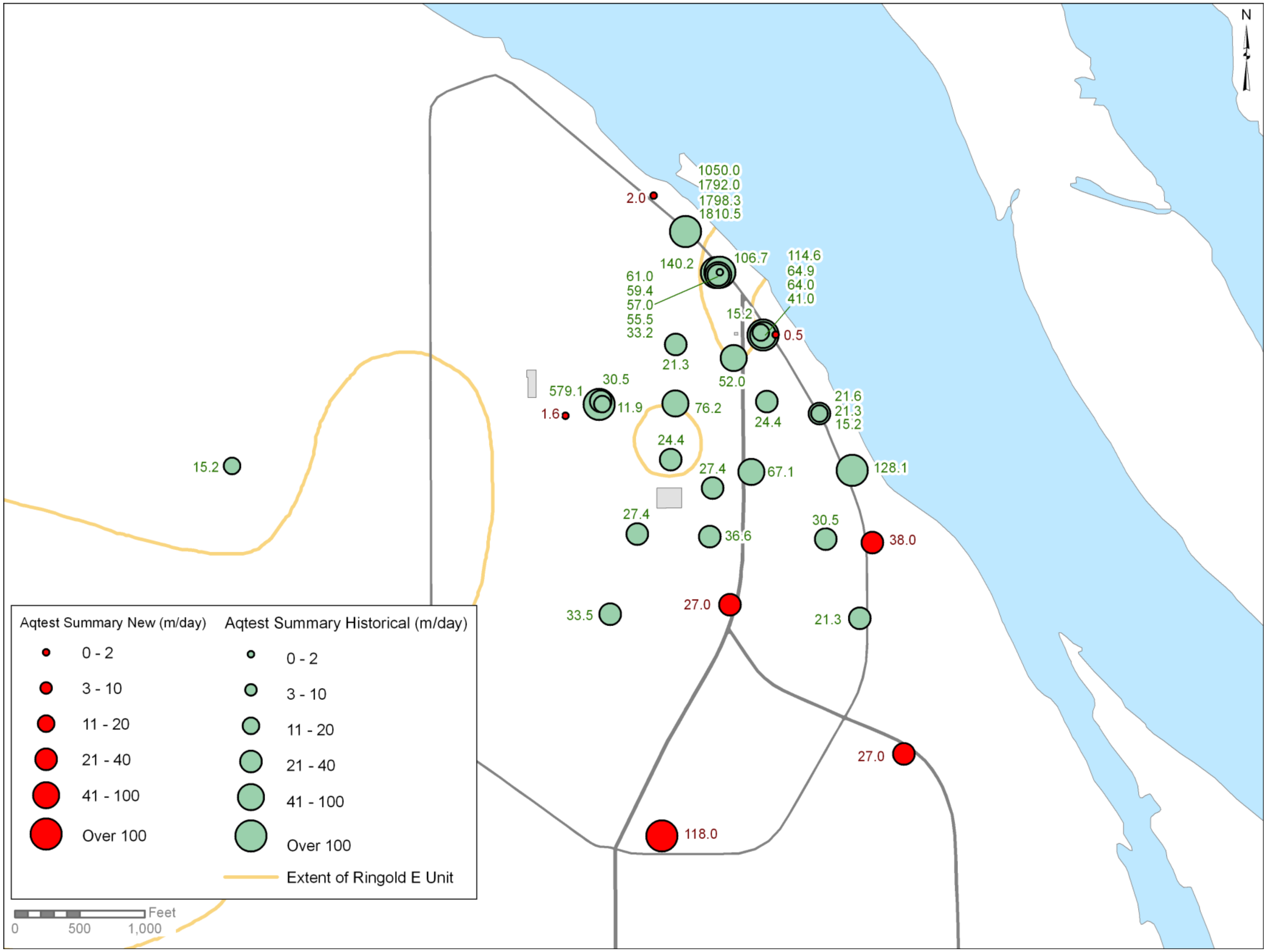

Figure 5-8. Hydraulic Conductivity (m/d) Estimates by Magnitude: H-Area

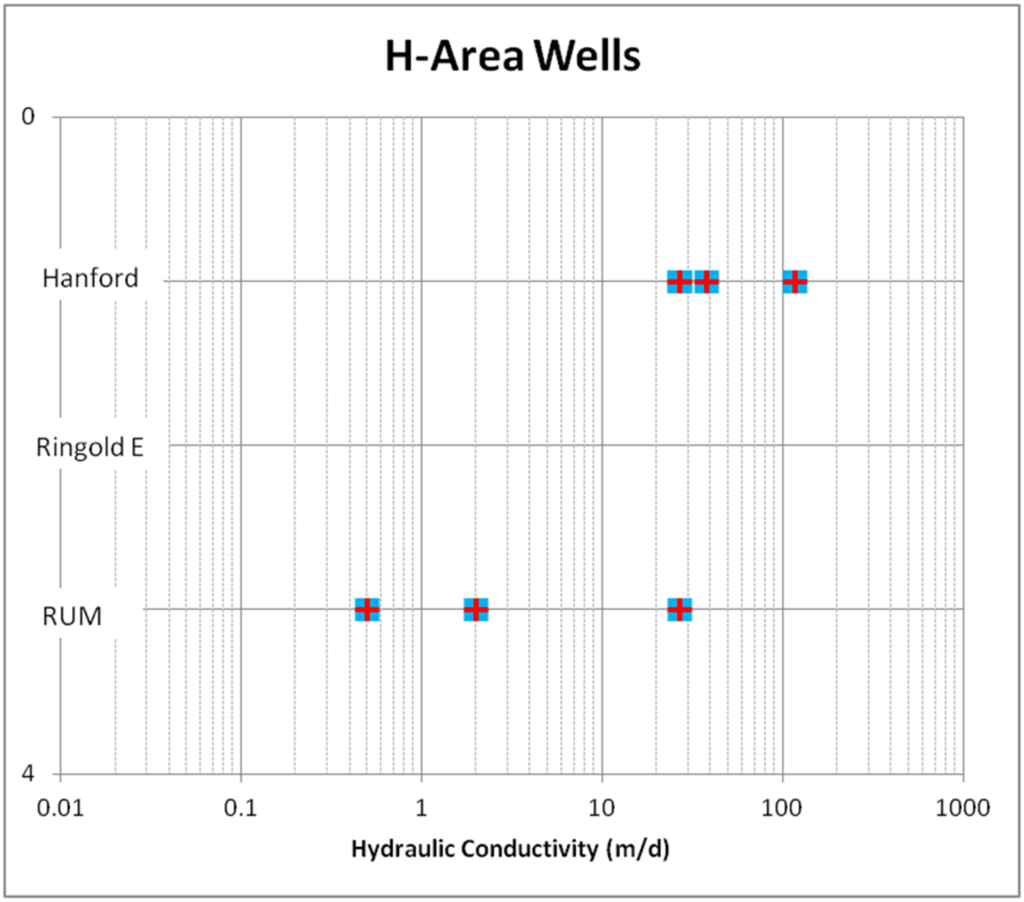

Figure 5-9. Hydraulic Conductivity (m/d) Estimates by Formation Type: H-Area

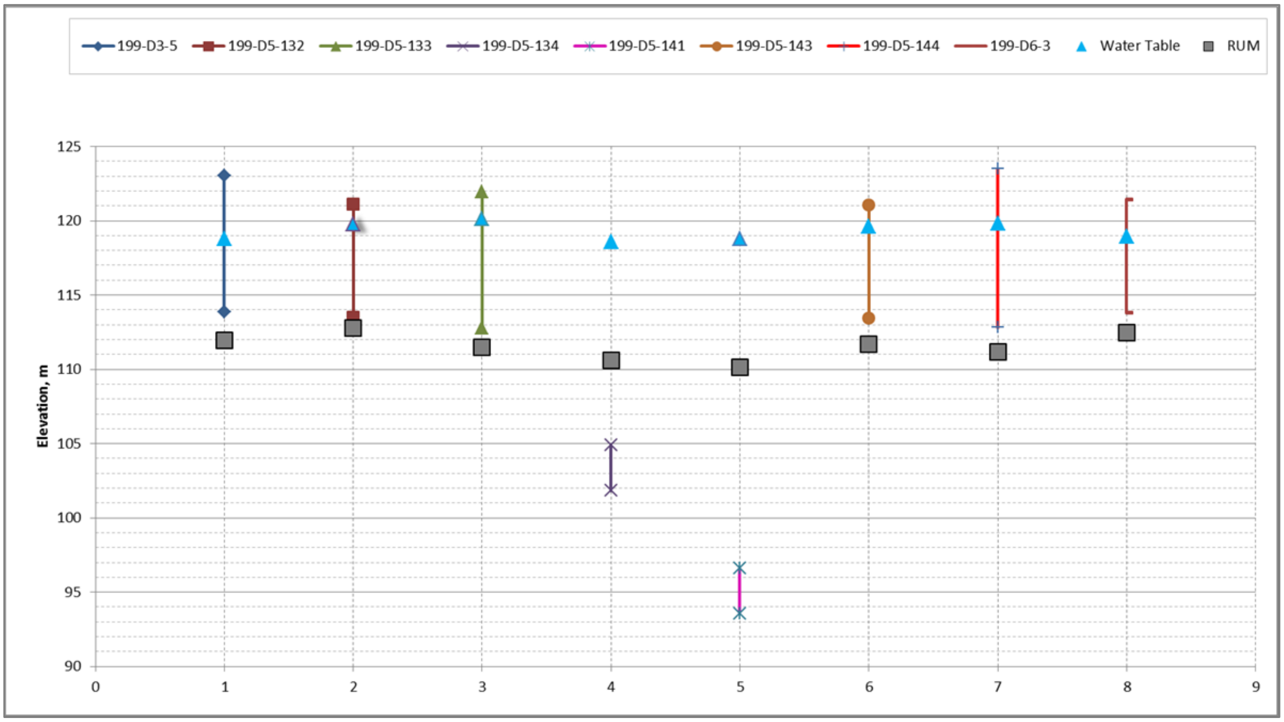

Figure 5-10. Well Screen Elevations in D-Area

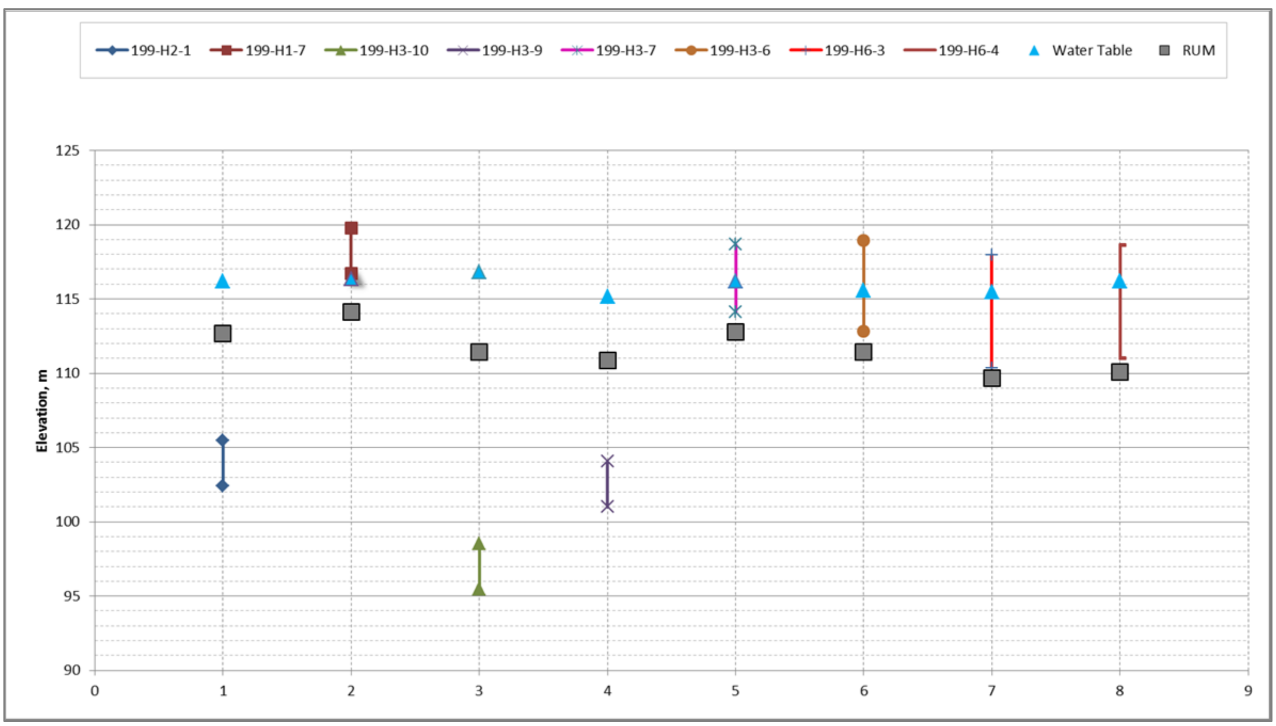

Figure 5-11. Well Screen Elevations in H-Area

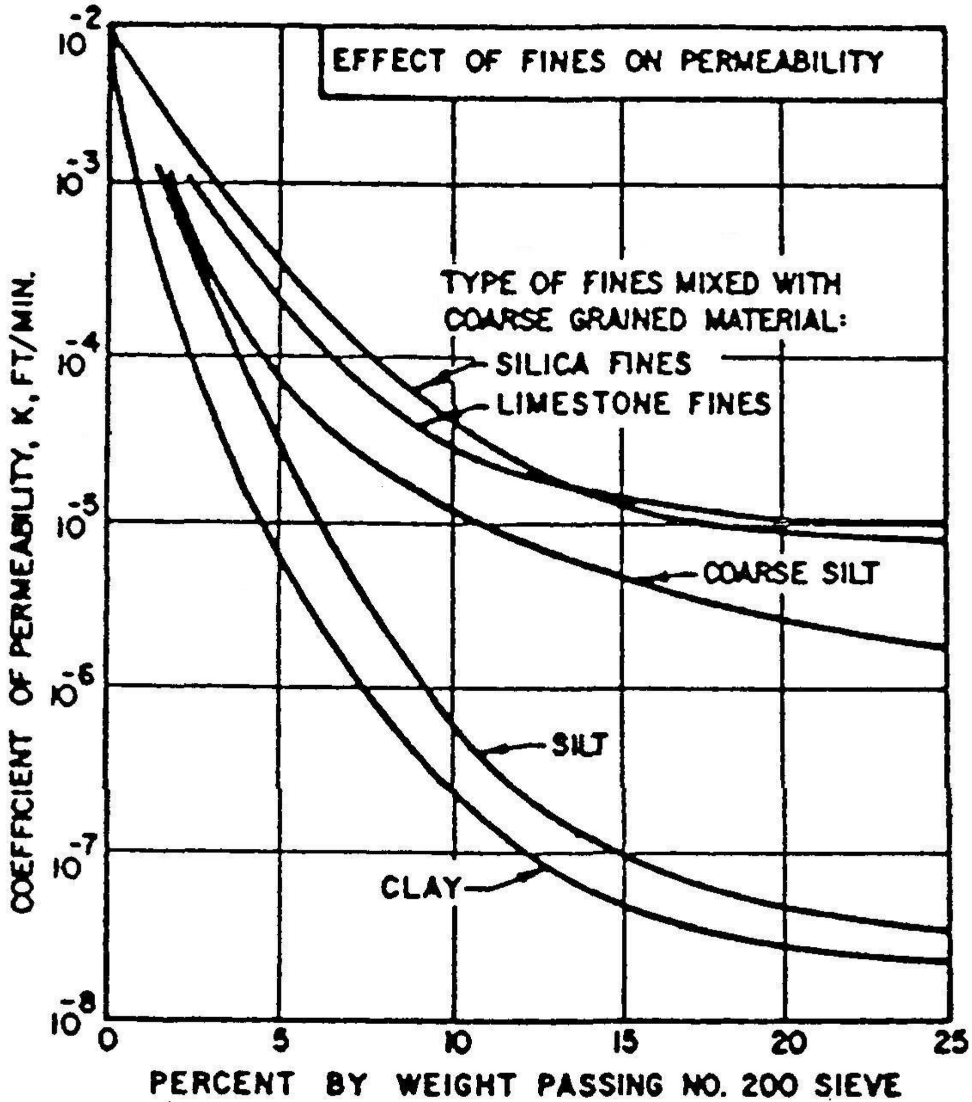

Figure 5-12. Effect of fines on the hydraulic conductivity of gravel

Source: From United States NAVFAC SM Design Manual 7.01, Figure 6 (1986)

5.2 Summary of Well Development Data

Well development was analyzed at 19 wells in HR-3 and the specific capacity calculated when data were available. When the pumping rate was known, the specific capacity was estimated to be the pumping rate divided by the maximum drawdown. The calculated specific capacities are tabulated on Table 5-3 and shown visually in Figure 5-14. When both the hydraulic conductivity and the specific capacity data were available, the two datasets were plotted against each other. As we can see in Figure 5-13, there appears to be a clear correlation between the specific capacity and hydraulic conductivity. This serves as an additional qualitative assessment of the reliability of the hydraulic conductivity estimates.

Table 5-3. Specific Capacities for H-Area Wells.

	Initial Submergence (ft.)	Maximum Drawdown (ft.)	Pumping Rate (gpm.)	Specific Capacity (gpm/ft)	Specific Capacity (m^2/d)
699-95-48	12.096	11.97	20	1.67	29.9
699-94-43	10.375	10.34	3.25	0.31	5.6
699-93-48	51.62	0.85	12.82	15.08	269.7
199-H6-4	13.658	0.727	38.9	53.51	956.7
199-H6-4	13.658	0.339	17.9	52.8	944.1
199-H6-3	7.78	3.8	29	7.63	136.5
199-H4-80	5.93	1.26	68.8	54.6	976.3
199-H4-80	19.86	1.233	68.8	55.8	997.7
199-H4-78	14.95	11.58	unknown		
199-H4-74	4.45	2.38	21	8.82	157.8
199-H3-9	44.7	44.67	6.7	0.15	2.7
199-H3-7	2.496	2.45	7.9	3.22	57.7
199-H3-6	6.25	4.01	18	4.49	80.3
199-H3-10	65.125	56.37	24	0.43	7.6
199-H3-10	65.125	56.1	20	0.36	6.4
199-H2-1	41.25	40.18	unknown		
199-H2-1	41.25	41.168	unknown		
199-H1-5	8.18	6.525	65.8	10.08	180.3
199-H1-5	14.56	9.6	71.8	7.48	133.7

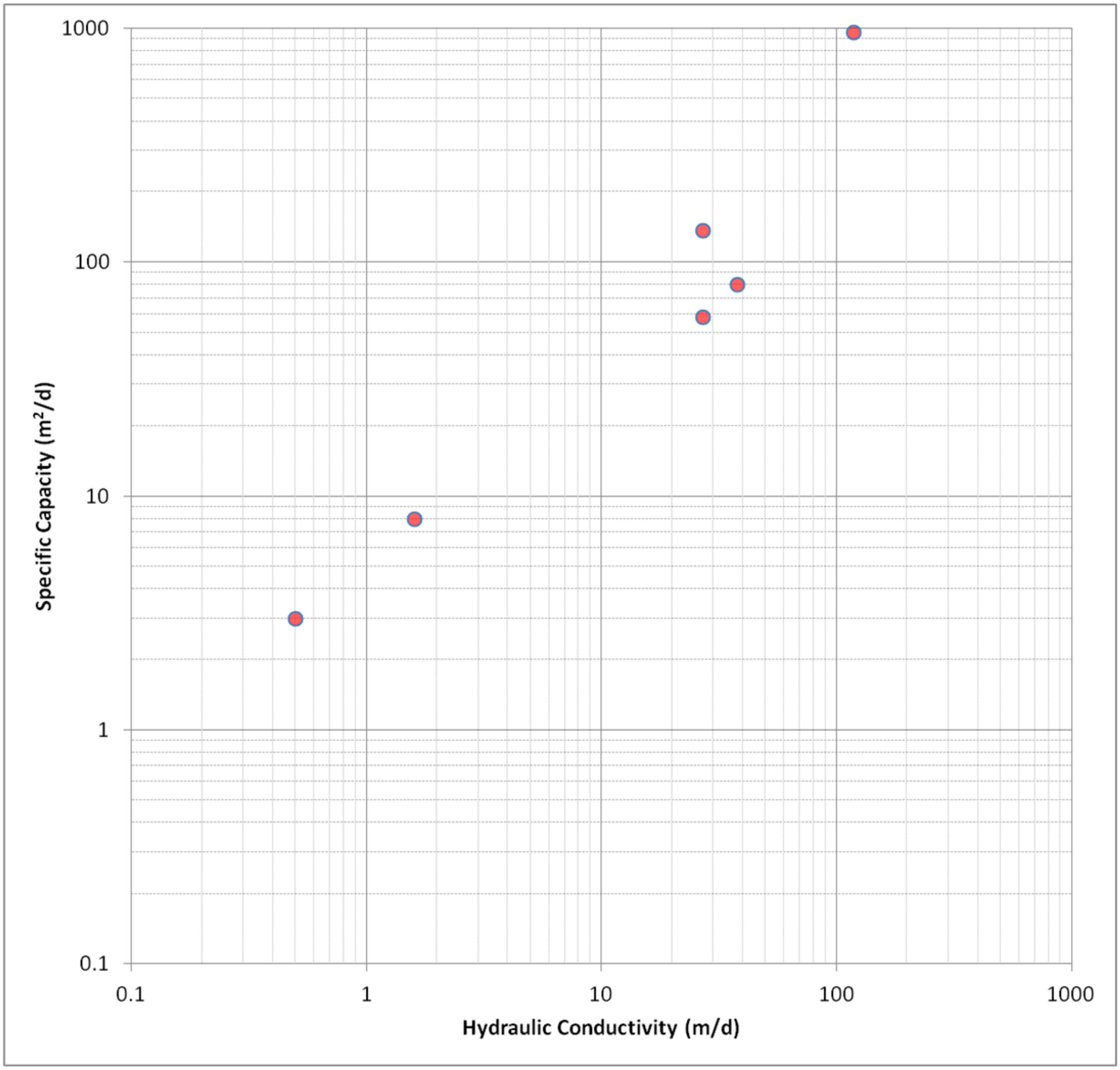

Figure 5-13. Specific Capacity vs. Hydraulic Conductivity: H-Area

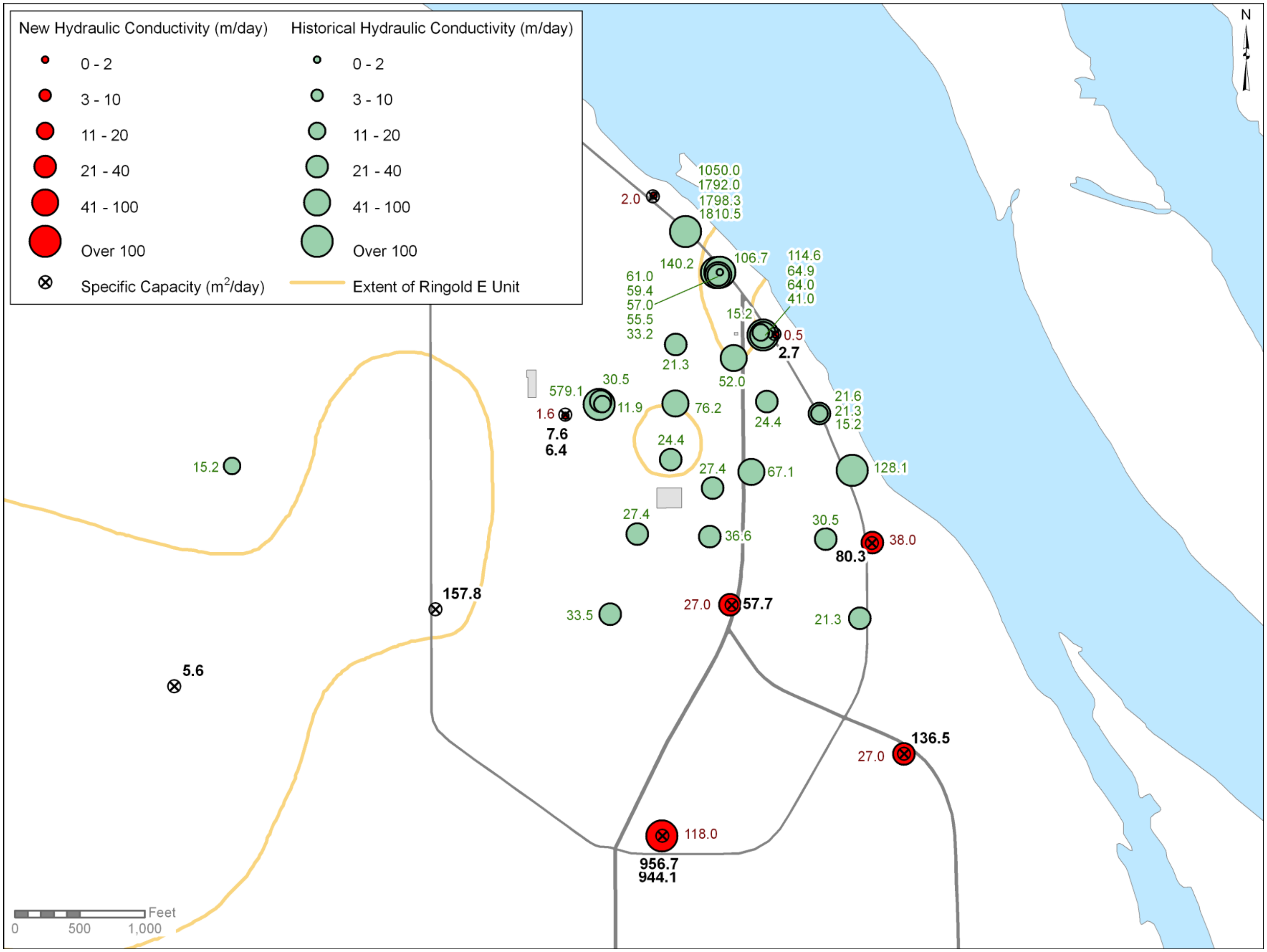

Figure 5-14. Spatial plot of Specific Capacity and Hydraulic Conductivity: H-Area

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U.S. DEPARTMENT OF ENERGY

PNNL- 20486

Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

Report for Batch Leach Analyses on Sediments at 100-HR-3 Operable Unit, Boreholes C7620, C7621, C7622, C7623, C7626, C7627, C7628, C7629, C7630, and C7866.

Michael Lindberg

June 2011

Pacific Northwest
NATIONAL LABORATORY

06/16/11 10:33

To: Anna Radloff

From: Michael J. Lindberg

Environmental Sciences Laboratory
Energy and Environment Directorate, Pacific Northwest National Laboratory

Subject: Analytical Data Report for Sediment Samples Collected From 100-HR-3 Operable Unit, Sample Delivery Group ESL090020, SAF Number F10-214

This letter contains the following information for sample delivery group ESL090020

- Cover Sheet
- Narrative
- Analytical Results
- Quality Control
- Chain of Custodies

Introduction

Between November 4, 2010 and April 25, 2011 sediment samples were received from 100-HR-3 Operable Unit for geochemical studies.

Analytical Results/Methodology

The analyses for this project were performed at the 331 building located in the 300 Area of the Hanford Site. The analyses were performed according to Pacific Northwest National Laboratory (PNNL) approved procedures and/or nationally recognized test procedures. The data sets include the sample identification numbers, analytical results, estimated quantification limits (EQL), and quality control data.

Quality Control

The preparatory and analytical quality control requirements, calibration requirements, acceptance criteria, and failure actions are defined in the on-line QA plan “Conducting Analytical Work in Support of Regulatory Programs” (CAW). This QA plan implements the Hanford Analytical Services Quality Assurance Requirements Documents (HASQARD) for PNNL.

Definitions

Dup	Duplicate
RPD	Relative Percent Difference
NR	No Recovery (percent recovery less than zero)
ND	Non-Detectable
%REC	Percent Recovery

Sample Receipt

Samples were received with a chain of custody (COC) and were analyzed according to the sample identification numbers supplied by the client. All Samples were refrigerated upon receipt until prepared for analysis.

All samples were received with custody seals intact unless noted in the Case Narrative.

Holding Times

Holding time is defined as the time from sample preparation to the time of analyses. The prescribed holding times were met for all analytes unless noted in the Case Narrative.

Analytical Results

All reported analytical results meet the requirements of the CAW or client specified SOW unless noted in the case narrative.

Case Narrative Report

Hold Time:

Preparation Blank (PB):

No Discrepancies Noted

Duplicate (DUP):

Duplicate RPD for Uranium 238 (38.9%) was above the acceptance limit (35) in 1E05003-DUP1 for ICPMS-Tc_U-WE
The sample result is less than 10 times the detection limits. Duplicate recoveries are not applicable to this analyte.

Laboratory Control Samples (LCS):

No Discrepancies Noted

Post Spike (PS):

No Discrepancies Noted

Matrix Spike (MS):

Matrix Spike Recovery for Chromium, Hexavalent (48.8%) was outside acceptance limits (75-125) in 1E23001-MS1 for Hexavalent Chromium/Soil
Potential Matrix interference. Sample results associated with this batch are below the EQL. There should be no impact to the data as reported.

Other QC Criteria:

No Discrepancies Noted

I certify that this data package is in compliance with the SOW, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hard copy data package has been authorized by the Laboratory Analytical Manager as verified by this signature.

Michael Lindberg

DISCLAIMER

SAMPLES INCLUDED IN THIS REPORT

100-HR-3 Remedial Optimization Wells

HEIS No.	Laboratory ID	Matrix	Date Collected	Date Received
B28JK2	1011025-01	SOIL	11/3/10 10:20	11/4/10 14:30
B27C24	1011025-02	SOIL	11/9/10 09:25	11/11/10 13:30
B28KF6	1011025-03	SOIL	11/5/10 14:54	11/11/10 13:30
B28KW9	1011025-04	SOIL	11/12/10 12:15	11/16/10 08:40
B28N30	1011025-05	SOIL	11/11/10 11:30	11/16/10 08:40
B273M1	1011025-07	SOIL	11/19/10 10:15	12/2/10 09:05
B27C13	1011025-08	SOIL	12/1/10 11:03	12/2/10 09:05
B29M71	1011025-09	SOIL	12/1/10 11:03	12/2/10 09:05
B28YW2	1011025-10	SOIL	12/3/10 08:35	12/6/10 13:20
B28CP2	1011025-11	SOIL	1/14/11 08:50	1/19/11 13:40
B29C20	1011025-13	SOIL	1/22/11 08:18	1/24/11 13:30
B29P71	1011025-17	SOIL	1/25/11 09:35	1/26/11 13:15
B29HN7	1011025-21	SOIL	2/16/11 14:35	2/17/11 13:30
B2B4H0	1011025-29	SOIL	3/16/11 13:05	3/21/11 13:30
B2C647	1011025-33	SOIL	4/14/11 14:40	4/25/11 13:00

The following analyses were performed on the following samples included in this report:

Metals 1:1 DI Water Extract by ICPMS

Metals Acid Extract by ICPMS

Hexavalent Chromium by Colorimetric Determination

Metals 1:1 Water Extract by ICPOES

Metals Acid Extract by ICPOES

Moisture Content

Tc_U Acid Extract by ICPMS

Tc_U 1:1 DI Water Extract by ICPMS

Wet Chemistry

Moisture Content (% by Weight) by AGG-WC-001

Lab ID	HEIS No.	Results	EQL	Analyzed	Batch
1011025-01	B28JK2	3.13E1	N/A	5/02/11	1D29007
1011025-02	B27C24	3.04E1	N/A	5/02/11	1D29007
1011025-03	B28KF6	2.66E1	N/A	5/02/11	1D29007
1011025-04	B28KW9	2.22E1	N/A	5/02/11	1D29007
1011025-05	B28N30	3.42E1	N/A	5/02/11	1D29007
1011025-07	B273M1	1.32E1	N/A	5/02/11	1D29007
1011025-08	B27C13	1.67E1	N/A	5/02/11	1D29007
1011025-09	B29M71	1.88E1	N/A	5/02/11	1D29007
1011025-10	B28YW2	2.82E1	N/A	5/02/11	1D29007
1011025-11	B28CP2	1.20E1	N/A	5/02/11	1D29007
1011025-13	B29C20	2.39E1	N/A	5/02/11	1D29007
1011025-17	B29P71	2.18E1	N/A	5/02/11	1D29007
1011025-21	B29HN7	1.72E1	N/A	5/02/11	1D29007
1011025-29	B2B4H0	1.51E1	N/A	5/02/11	1D29007
1011025-33	B2C647	2.10E1	N/A	5/02/11	1D29007

Hexavalent Chromium/Soil

Chromium, Hexavalent (ug/g dry) by Colorimetric Determination

Lab ID	HEIS No.	Results	EQL	Analyzed	Batch
1011025-01	B28JK2	<6.62E-1	6.62E-1	5/20/11	1E23001
1011025-02	B27C24	<6.52E-1	6.52E-1	5/20/11	1E23001
1011025-03	B28KF6	<6.33E-1	6.33E-1	5/20/11	1E23001
1011025-04	B28KW9	<6.10E-1	6.10E-1	5/20/11	1E23001
1011025-05	B28N30	<6.72E-1	6.72E-1	5/20/11	1E23001
1011025-07	B273M1	<5.71E-1	5.71E-1	5/20/11	1E23001
1011025-08	B27C13	<5.85E-1	5.85E-1	5/20/11	1E23001
1011025-09	B29M71	<5.94E-1	5.94E-1	5/20/11	1E23001
1011025-10	B28YW2	<6.37E-1	6.37E-1	5/20/11	1E23001
1011025-11	B28CP2	<5.59E-1	5.59E-1	5/20/11	1E23001
1011025-13	B29C20	<6.19E-1	6.19E-1	5/20/11	1E23001
1011025-17	B29P71	<6.09E-1	6.09E-1	5/20/11	1E23001
1011025-21	B29HN7	<5.87E-1	5.87E-1	5/20/11	1E23001
1011025-29	B2B4H0	<5.75E-1	5.75E-1	5/20/11	1E23001
1011025-33	B2C647	<6.05E-1	6.05E-1	5/20/11	1E23001

Hexavalent Chromium/1:1 Water Extract

Chromium, Hexavalent (ug/g dry) by Colorimetric Determination

Lab ID	HEIS No.	Results	EQL	Analyzed	Batch
1011025-01	B28JK2	<3.43E-2	3.43E-2	5/05/11	1E05001
1011025-02	B27C24	<3.48E-2	3.48E-2	5/05/11	1E05001
1011025-03	B28KF6	<3.67E-2	3.67E-2	5/05/11	1E05001
1011025-04	B28KW9	<3.89E-2	3.89E-2	5/05/11	1E05001
1011025-05	B28N30	<3.29E-2	3.29E-2	5/05/11	1E05001
1011025-07	B273M1	<4.44E-2	4.44E-2	5/05/11	1E05001
1011025-08	B27C13	<6.26E-2	6.26E-2	5/05/11	1E05001
1011025-09	B29M71	<4.05E-2	4.05E-2	5/05/11	1E05001
1011025-10	B28YW2	<3.58E-2	3.58E-2	5/05/11	1E05001
1011025-11	B28CP2	<4.40E-2	4.40E-2	5/05/11	1E05001
1011025-13	B29C20	<3.79E-2	3.79E-2	5/05/11	1E05001
1011025-17	B29P71	4.62E-2	3.91E-2	5/05/11	1E05001
1011025-21	B29HN7	<4.14E-2	4.14E-2	5/05/11	1E05001
1011025-29	B2B4H0	<4.23E-2	4.23E-2	5/05/11	1E05001
1011025-33	B2C647	<4.42E-2	4.42E-2	5/05/11	1E05001

Total Metals by PNNL-AGG-ICP-AES/1:1 Water Extract

CAS #	Analyte	Results	Units	EQL	Analyzed	Batch	Method
HEIS No.	**B28JK2**		**Lab ID:**	**1011025-01**			
7440-39-3	Barium	<1.24E-1	ug/g dry	1.24E-1	5/09/11	1E09001	PNNL-AGG-ICP-AES
HEIS No.	**B27C24**		**Lab ID:**	**1011025-02**			
7440-39-3	Barium	<1.24E-1	ug/g dry	1.24E-1	5/09/11	1E09001	PNNL-AGG-ICP-AES
HEIS No.	**B28KF6**		**Lab ID:**	**1011025-03**			
7440-39-3	Barium	<1.24E-1	ug/g dry	1.24E-1	5/09/11	1E09001	PNNL-AGG-ICP-AES
HEIS No.	**B28KW9**		**Lab ID:**	**1011025-04**			
7440-39-3	Barium	<1.24E-1	ug/g dry	1.24E-1	5/09/11	1E09001	PNNL-AGG-ICP-AES
HEIS No.	**B28N30**		**Lab ID:**	**1011025-05**			
7440-39-3	Barium	<1.24E-1	ug/g dry	1.24E-1	5/09/11	1E09001	PNNL-AGG-ICP-AES
HEIS No.	**B273M1**		**Lab ID:**	**1011025-07**			
7440-39-3	Barium	<1.26E-1	ug/g dry	1.26E-1	5/09/11	1E09001	PNNL-AGG-ICP-AES
HEIS No.	**B27C13**		**Lab ID:**	**1011025-08**			
7440-39-3	Barium	<1.76E-1	ug/g dry	1.76E-1	5/09/11	1E09001	PNNL-AGG-ICP-AES
HEIS No.	**B29M71**		**Lab ID:**	**1011025-09**			
7440-39-3	Barium	<1.24E-1	ug/g dry	1.24E-1	5/09/11	1E09001	PNNL-AGG-ICP-AES
HEIS No.	**B28YW2**		**Lab ID:**	**1011025-10**			
7440-39-3	Barium	<1.24E-1	ug/g dry	1.24E-1	5/09/11	1E09001	PNNL-AGG-ICP-AES
HEIS No.	**B28CP2**		**Lab ID:**	**1011025-11**			
7440-39-3	Barium	<1.24E-1	ug/g dry	1.24E-1	5/09/11	1E09001	PNNL-AGG-ICP-AES
HEIS No.	**B29C20**		**Lab ID:**	**1011025-13**			
7440-39-3	Barium	<1.23E-1	ug/g dry	1.23E-1	5/09/11	1E09001	PNNL-AGG-ICP-AES
HEIS No.	**B29P71**		**Lab ID:**	**1011025-17**			
7440-39-3	Barium	<1.24E-1	ug/g dry	1.24E-1	5/09/11	1E09001	PNNL-AGG-ICP-AES
HEIS No.	**B29HN7**		**Lab ID:**	**1011025-21**			
7440-39-3	Barium	<1.24E-1	ug/g dry	1.24E-1	5/09/11	1E09001	PNNL-AGG-ICP-AES
HEIS No.	**B2B4H0**		**Lab ID:**	**1011025-29**			
7440-39-3	Barium	<1.24E-1	ug/g dry	1.24E-1	5/09/11	1E09001	PNNL-AGG-ICP-AES
HEIS No.	**B2C647**		**Lab ID:**	**1011025-33**			
7440-39-3	Barium	<1.36E-1	ug/g dry	1.36E-1	5/09/11	1E09001	PNNL-AGG-ICP-AES

Radionuclides by ICP-MS/Acid Extract

CAS #	Analyte	Results	Units	EQL	Analyzed	Batch	Method
HEIS No.	**B28JK2**		**Lab ID:**	**1011025-01**			
U-238	Uranium 238	5.64E-1	ug/g dry	4.59E-2	5/05/11	1E05004	PNNL-AGG-415
HEIS No.	**B27C24**		**Lab ID:**	**1011025-02**			
U-238	Uranium 238	3.16E-1	ug/g dry	4.58E-2	5/05/11	1E05004	PNNL-AGG-415
HEIS No.	**B28KF6**		**Lab ID:**	**1011025-03**			
U-238	Uranium 238	4.30E-1	ug/g dry	4.45E-2	5/05/11	1E05004	PNNL-AGG-415
HEIS No.	**B28KW9**		**Lab ID:**	**1011025-04**			
U-238	Uranium 238	7.17E-1	ug/g dry	4.27E-2	5/05/11	1E05004	PNNL-AGG-415
HEIS No.	**B28N30**		**Lab ID:**	**1011025-05**			
U-238	Uranium 238	1.00E0	ug/g dry	4.68E-2	5/05/11	1E05004	PNNL-AGG-415
HEIS No.	**B273M1**		**Lab ID:**	**1011025-07**			
U-238	Uranium 238	1.84E-1	ug/g dry	3.96E-2	5/05/11	1E05004	PNNL-AGG-415
HEIS No.	**B27C13**		**Lab ID:**	**1011025-08**			
U-238	Uranium 238	1.61E0	ug/g dry	4.03E-2	5/05/11	1E05004	PNNL-AGG-415
HEIS No.	**B29M71**		**Lab ID:**	**1011025-09**			
U-238	Uranium 238	7.89E-1	ug/g dry	4.13E-2	5/05/11	1E05004	PNNL-AGG-415
HEIS No.	**B28YW2**		**Lab ID:**	**1011025-10**			
U-238	Uranium 238	8.41E-1	ug/g dry	4.52E-2	5/05/11	1E05004	PNNL-AGG-415
HEIS No.	**B28CP2**		**Lab ID:**	**1011025-11**			
U-238	Uranium 238	1.75E-1	ug/g dry	3.93E-2	5/05/11	1E05004	PNNL-AGG-415
HEIS No.	**B29C20**		**Lab ID:**	**1011025-13**			
U-238	Uranium 238	2.03E-1	ug/g dry	4.33E-2	5/05/11	1E05004	PNNL-AGG-415
HEIS No.	**B29P71**		**Lab ID:**	**1011025-17**			
U-238	Uranium 238	7.03E-1	ug/g dry	4.28E-2	5/05/11	1E05004	PNNL-AGG-415
HEIS No.	**B29HN7**		**Lab ID:**	**1011025-21**			
U-238	Uranium 238	3.85E-1	ug/g dry	4.05E-2	5/05/11	1E05004	PNNL-AGG-415
HEIS No.	**B2B4H0**		**Lab ID:**	**1011025-29**			
U-238	Uranium 238	2.17E-1	ug/g dry	4.04E-2	5/05/11	1E05004	PNNL-AGG-415
HEIS No.	**B2C647**		**Lab ID:**	**1011025-33**			
U-238	Uranium 238	4.37E-1	ug/g dry	4.20E-2	5/05/11	1E05004	PNNL-AGG-415

Radionuclides by ICP-MS/1:1 Water Extract

CAS #	Analyte	Results	Units	EQL	Analyzed	Batch	Method
HEIS No.	**B28JK2**		**Lab ID:**	**1011025-01**			
U-238	Uranium 238	1.68E-3	ug/g dry	7.98E-5	5/06/11	1E05003	PNNL-AGG-415
HEIS No.	**B27C24**		**Lab ID:**	**1011025-02**			
U-238	Uranium 238	4.30E-4	ug/g dry	8.00E-5	5/06/11	1E05003	PNNL-AGG-415
HEIS No.	**B28KF6**		**Lab ID:**	**1011025-03**			
U-238	Uranium 238	1.81E-3	ug/g dry	7.99E-5	5/06/11	1E05003	PNNL-AGG-415
HEIS No.	**B28KW9**		**Lab ID:**	**1011025-04**			
U-238	Uranium 238	9.00E-5	ug/g dry	8.00E-5	5/06/11	1E05003	PNNL-AGG-415
HEIS No.	**B28N30**		**Lab ID:**	**1011025-05**			
U-238	Uranium 238	<7.99E-5	ug/g dry	7.99E-5	5/06/11	1E05003	PNNL-AGG-415
HEIS No.	**B273M1**		**Lab ID:**	**1011025-07**			
U-238	Uranium 238	3.30E-4	ug/g dry	8.16E-5	5/06/11	1E05003	PNNL-AGG-415
HEIS No.	**B27C13**		**Lab ID:**	**1011025-08**			
U-238	Uranium 238	4.92E-3	ug/g dry	1.14E-4	5/06/11	1E05003	PNNL-AGG-415
HEIS No.	**B29M71**		**Lab ID:**	**1011025-09**			
U-238	Uranium 238	3.28E-3	ug/g dry	7.99E-5	5/06/11	1E05003	PNNL-AGG-415
HEIS No.	**B28YW2**		**Lab ID:**	**1011025-10**			
U-238	Uranium 238	<7.99E-5	ug/g dry	7.99E-5	5/06/11	1E05003	PNNL-AGG-415
HEIS No.	**B28CP2**		**Lab ID:**	**1011025-11**			
U-238	Uranium 238	2.31E-4	ug/g dry	8.00E-5	5/06/11	1E05003	PNNL-AGG-415
HEIS No.	**B29C20**		**Lab ID:**	**1011025-13**			
U-238	Uranium 238	4.02E-4	ug/g dry	7.98E-5	5/06/11	1E05003	PNNL-AGG-415
HEIS No.	**B29P71**		**Lab ID:**	**1011025-17**			
U-238	Uranium 238	1.26E-3	ug/g dry	8.00E-5	5/06/11	1E05003	PNNL-AGG-415
HEIS No.	**B29HN7**		**Lab ID:**	**1011025-21**			
U-238	Uranium 238	1.59E-3	ug/g dry	8.00E-5	5/06/11	1E05003	PNNL-AGG-415
HEIS No.	**B2B4H0**		**Lab ID:**	**1011025-29**			
U-238	Uranium 238	2.71E-4	ug/g dry	7.98E-5	5/06/11	1E05003	PNNL-AGG-415
HEIS No.	**B2C647**		**Lab ID:**	**1011025-33**			
U-238	Uranium 238	1.03E-3	ug/g dry	8.76E-5	5/06/11	1E05003	PNNL-AGG-415

RCRA Metals By PNNL-AGG-415/1:1 Water Extract

CAS #	Analyte	Results	Units	EQL	Analyzed	Batch	Method
HEIS No.	**B28JK2**	**Lab ID:**		**1011025-01**			
14092-98-9	Chromium	<3.44E-3	ug/g dry	3.44E-3	5/31/11	1E06003	PNNL-AGG-415
7440-38-2	Arsenic	<2.83E-3	ug/g dry	2.83E-3	6/13/11	1E06003	PNNL-AGG-415
14687-58-2	Selenium	<7.90E-3	ug/g dry	7.90E-3	5/31/11	1E06003	PNNL-AGG-415
14378-37-1	Silver	<3.12E-3	ug/g dry	3.12E-3	5/31/11	1E06003	PNNL-AGG-415
14336-64-2	Cadmium	<5.72E-4	ug/g dry	5.72E-4	5/31/11	1E06003	PNNL-AGG-415
13966-28-4	Lead	<1.16E-3	ug/g dry	1.16E-3	5/31/11	1E06003	PNNL-AGG-415
HEIS No.	**B27C24**	**Lab ID:**		**1011025-02**			
14092-98-9	Chromium	<3.44E-3	ug/g dry	3.44E-3	5/31/11	1E06003	PNNL-AGG-415
7440-38-2	Arsenic	8.12E-3	ug/g dry	2.83E-3	6/13/11	1E06003	PNNL-AGG-415
14687-58-2	Selenium	<7.91E-3	ug/g dry	7.91E-3	5/31/11	1E06003	PNNL-AGG-415
14378-37-1	Silver	<3.13E-3	ug/g dry	3.13E-3	5/31/11	1E06003	PNNL-AGG-415
14336-64-2	Cadmium	<5.73E-4	ug/g dry	5.73E-4	5/31/11	1E06003	PNNL-AGG-415
13966-28-4	Lead	<1.16E-3	ug/g dry	1.16E-3	5/31/11	1E06003	PNNL-AGG-415
HEIS No.	**B28KF6**	**Lab ID:**		**1011025-03**			
14092-98-9	Chromium	1.25E-2	ug/g dry	3.44E-3	5/31/11	1E06003	PNNL-AGG-415
7440-38-2	Arsenic	5.87E-3	ug/g dry	2.83E-3	6/13/11	1E06003	PNNL-AGG-415
14687-58-2	Selenium	<7.91E-3	ug/g dry	7.91E-3	5/31/11	1E06003	PNNL-AGG-415
14378-37-1	Silver	<3.13E-3	ug/g dry	3.13E-3	5/31/11	1E06003	PNNL-AGG-415
14336-64-2	Cadmium	<5.73E-4	ug/g dry	5.73E-4	5/31/11	1E06003	PNNL-AGG-415
13966-28-4	Lead	<1.16E-3	ug/g dry	1.16E-3	5/31/11	1E06003	PNNL-AGG-415
HEIS No.	**B28KW9**	**Lab ID:**		**1011025-04**			
14092-98-9	Chromium	<3.44E-3	ug/g dry	3.44E-3	5/31/11	1E06003	PNNL-AGG-415
7440-38-2	Arsenic	<2.84E-3	ug/g dry	2.84E-3	6/13/11	1E06003	PNNL-AGG-415
14687-58-2	Selenium	<7.92E-3	ug/g dry	7.92E-3	5/31/11	1E06003	PNNL-AGG-415
14378-37-1	Silver	<3.13E-3	ug/g dry	3.13E-3	5/31/11	1E06003	PNNL-AGG-415
14336-64-2	Cadmium	<5.73E-4	ug/g dry	5.73E-4	5/31/11	1E06003	PNNL-AGG-415
13966-28-4	Lead	<1.16E-3	ug/g dry	1.16E-3	5/31/11	1E06003	PNNL-AGG-415
HEIS No.	**B28N30**	**Lab ID:**		**1011025-05**			
14092-98-9	Chromium	<3.44E-3	ug/g dry	3.44E-3	5/31/11	1E06003	PNNL-AGG-415
7440-38-2	Arsenic	5.98E-3	ug/g dry	2.83E-3	6/13/11	1E06003	PNNL-AGG-415
14687-58-2	Selenium	<7.91E-3	ug/g dry	7.91E-3	5/31/11	1E06003	PNNL-AGG-415
14378-37-1	Silver	<3.13E-3	ug/g dry	3.13E-3	5/31/11	1E06003	PNNL-AGG-415
14336-64-2	Cadmium	<5.73E-4	ug/g dry	5.73E-4	5/31/11	1E06003	PNNL-AGG-415
13966-28-4	Lead	<1.16E-3	ug/g dry	1.16E-3	5/31/11	1E06003	PNNL-AGG-415
HEIS No.	**B273M1**	**Lab ID:**		**1011025-07**			
14092-98-9	Chromium	<3.50E-3	ug/g dry	3.50E-3	5/31/11	1E06003	PNNL-AGG-415
7440-38-2	Arsenic	<2.88E-3	ug/g dry	2.88E-3	6/13/11	1E06003	PNNL-AGG-415
14687-58-2	Selenium	<8.05E-3	ug/g dry	8.05E-3	5/31/11	1E06003	PNNL-AGG-415
14378-37-1	Silver	<3.18E-3	ug/g dry	3.18E-3	5/31/11	1E06003	PNNL-AGG-415
14336-64-2	Cadmium	<5.83E-4	ug/g dry	5.83E-4	5/31/11	1E06003	PNNL-AGG-415
13966-28-4	Lead	<1.18E-3	ug/g dry	1.18E-3	5/31/11	1E06003	PNNL-AGG-415
HEIS No.	**B27C13**	**Lab ID:**		**1011025-08**			
14092-98-9	Chromium	<4.89E-3	ug/g dry	4.89E-3	5/31/11	1E06003	PNNL-AGG-415
7440-38-2	Arsenic	7.65E-3	ug/g dry	4.03E-3	6/13/11	1E06003	PNNL-AGG-415
14687-58-2	Selenium	<1.12E-2	ug/g dry	1.12E-2	5/31/11	1E06003	PNNL-AGG-415
14378-37-1	Silver	<4.44E-3	ug/g dry	4.44E-3	5/31/11	1E06003	PNNL-AGG-415
14336-64-2	Cadmium	<8.13E-4	ug/g dry	8.13E-4	5/31/11	1E06003	PNNL-AGG-415
13966-28-4	Lead	<1.65E-3	ug/g dry	1.65E-3	5/31/11	1E06003	PNNL-AGG-415

RCRA Metals By PNNL-AGG-415/1:1 Water Extract

CAS #	Analyte	Results	Units	EQL	Analyzed	Batch	Method
HEIS No.	**B29M71**	**Lab ID:**	**1011025-09**				
14092-98-9	Chromium	<3.44E-3	ug/g dry	3.44E-3	5/31/11	1E06003	PNNL-AGG-415
7440-38-2	Arsenic	6.69E-3	ug/g dry	2.83E-3	6/13/11	1E06003	PNNL-AGG-415
14687-58-2	Selenium	<7.91E-3	ug/g dry	7.91E-3	5/31/11	1E06003	PNNL-AGG-415
14378-37-1	Silver	<3.12E-3	ug/g dry	3.12E-3	5/31/11	1E06003	PNNL-AGG-415
14336-64-2	Cadmium	<5.73E-4	ug/g dry	5.73E-4	5/31/11	1E06003	PNNL-AGG-415
13966-28-4	Lead	<1.16E-3	ug/g dry	1.16E-3	5/31/11	1E06003	PNNL-AGG-415
HEIS No.	**B28YW2**	**Lab ID:**	**1011025-10**				
14092-98-9	Chromium	<3.44E-3	ug/g dry	3.44E-3	5/31/11	1E06003	PNNL-AGG-415
7440-38-2	Arsenic	1.18E-2	ug/g dry	2.83E-3	6/13/11	1E06003	PNNL-AGG-415
14687-58-2	Selenium	<7.91E-3	ug/g dry	7.91E-3	5/31/11	1E06003	PNNL-AGG-415
14378-37-1	Silver	<3.13E-3	ug/g dry	3.13E-3	5/31/11	1E06003	PNNL-AGG-415
14336-64-2	Cadmium	<5.73E-4	ug/g dry	5.73E-4	5/31/11	1E06003	PNNL-AGG-415
13966-28-4	Lead	<1.16E-3	ug/g dry	1.16E-3	5/31/11	1E06003	PNNL-AGG-415
HEIS No.	**B28CP2**	**Lab ID:**	**1011025-11**				
14092-98-9	Chromium	<3.44E-3	ug/g dry	3.44E-3	5/31/11	1E06003	PNNL-AGG-415
7440-38-2	Arsenic	<2.84E-3	ug/g dry	2.84E-3	6/13/11	1E06003	PNNL-AGG-415
14687-58-2	Selenium	<7.92E-3	ug/g dry	7.92E-3	5/31/11	1E06003	PNNL-AGG-415
14378-37-1	Silver	<3.13E-3	ug/g dry	3.13E-3	5/31/11	1E06003	PNNL-AGG-415
14336-64-2	Cadmium	<5.73E-4	ug/g dry	5.73E-4	5/31/11	1E06003	PNNL-AGG-415
13966-28-4	Lead	<1.16E-3	ug/g dry	1.16E-3	5/31/11	1E06003	PNNL-AGG-415
HEIS No.	**B29C20**	**Lab ID:**	**1011025-13**				
14092-98-9	Chromium	<3.44E-3	ug/g dry	3.44E-3	5/31/11	1E06003	PNNL-AGG-415
7440-38-2	Arsenic	<2.83E-3	ug/g dry	2.83E-3	6/13/11	1E06003	PNNL-AGG-415
14687-58-2	Selenium	<7.90E-3	ug/g dry	7.90E-3	5/31/11	1E06003	PNNL-AGG-415
14378-37-1	Silver	<3.12E-3	ug/g dry	3.12E-3	5/31/11	1E06003	PNNL-AGG-415
14336-64-2	Cadmium	<5.72E-4	ug/g dry	5.72E-4	5/31/11	1E06003	PNNL-AGG-415
13966-28-4	Lead	<1.16E-3	ug/g dry	1.16E-3	5/31/11	1E06003	PNNL-AGG-415
HEIS No.	**B29P71**	**Lab ID:**	**1011025-17**				
14092-98-9	Chromium	3.73E-2	ug/g dry	3.45E-3	5/31/11	1E06003	PNNL-AGG-415
7440-38-2	Arsenic	8.84E-3	ug/g dry	2.84E-3	6/13/11	1E06003	PNNL-AGG-415
14687-58-2	Selenium	<7.92E-3	ug/g dry	7.92E-3	5/31/11	1E06003	PNNL-AGG-415
14378-37-1	Silver	<3.13E-3	ug/g dry	3.13E-3	5/31/11	1E06003	PNNL-AGG-415
14336-64-2	Cadmium	<5.73E-4	ug/g dry	5.73E-4	5/31/11	1E06003	PNNL-AGG-415
13966-28-4	Lead	<1.16E-3	ug/g dry	1.16E-3	5/31/11	1E06003	PNNL-AGG-415
HEIS No.	**B29HN7**	**Lab ID:**	**1011025-21**				
14092-98-9	Chromium	5.44E-3	ug/g dry	3.44E-3	5/31/11	1E06003	PNNL-AGG-415
7440-38-2	Arsenic	<2.83E-3	ug/g dry	2.83E-3	6/13/11	1E06003	PNNL-AGG-415
14687-58-2	Selenium	<7.91E-3	ug/g dry	7.91E-3	5/31/11	1E06003	PNNL-AGG-415
14378-37-1	Silver	<3.13E-3	ug/g dry	3.13E-3	5/31/11	1E06003	PNNL-AGG-415
14336-64-2	Cadmium	<5.73E-4	ug/g dry	5.73E-4	5/31/11	1E06003	PNNL-AGG-415
13966-28-4	Lead	<1.16E-3	ug/g dry	1.16E-3	5/31/11	1E06003	PNNL-AGG-415
HEIS No.	**B2B4H0**	**Lab ID:**	**1011025-29**				
14092-98-9	Chromium	<3.44E-3	ug/g dry	3.44E-3	5/31/11	1E06003	PNNL-AGG-415
7440-38-2	Arsenic	<2.83E-3	ug/g dry	2.83E-3	6/13/11	1E06003	PNNL-AGG-415
14687-58-2	Selenium	<7.90E-3	ug/g dry	7.90E-3	5/31/11	1E06003	PNNL-AGG-415
14378-37-1	Silver	<3.12E-3	ug/g dry	3.12E-3	5/31/11	1E06003	PNNL-AGG-415
14336-64-2	Cadmium	<5.72E-4	ug/g dry	5.72E-4	5/31/11	1E06003	PNNL-AGG-415
13966-28-4	Lead	<1.16E-3	ug/g dry	1.16E-3	5/31/11	1E06003	PNNL-AGG-415

RCRA Metals By PNNL-AGG-415/1:1 Water Extract

CAS #	Analyte	Results	Units	EQL	Analyzed	Batch	Method
HEIS No.	**B2C647**	**Lab ID:**		**1011025-33**			
14092-98-9	Chromium	<3.77E-3	ug/g dry	3.77E-3	5/31/11	1E06003	PNNL-AGG-415
7440-38-2	Arsenic	5.75E-3	ug/g dry	3.11E-3	6/13/11	1E06003	PNNL-AGG-415
14687-58-2	Selenium	<8.67E-3	ug/g dry	8.67E-3	5/31/11	1E06003	PNNL-AGG-415
14378-37-1	Silver	<3.42E-3	ug/g dry	3.42E-3	5/31/11	1E06003	PNNL-AGG-415
14336-64-2	Cadmium	<6.27E-4	ug/g dry	6.27E-4	5/31/11	1E06003	PNNL-AGG-415
13966-28-4	Lead	<1.27E-3	ug/g dry	1.27E-3	5/31/11	1E06003	PNNL-AGG-415

RCRA Metals By PNNL-AGG-415/Special Extract

CAS #	Analyte	Results	Units	EQL	Analyzed	Batch	Method
HEIS No.	**B28JK2**		**Lab ID:**	**1011025-01**			
7440-39-3	Barium	8.65E1	ug/g dry	1.89E0	5/09/11	1E09002	PNNL-AGG-ICP-AES
HEIS No.	**B27C24**		**Lab ID:**	**1011025-02**			
7440-39-3	Barium	5.00E1	ug/g dry	1.88E0	5/09/11	1E09002	PNNL-AGG-ICP-AES
HEIS No.	**B28KF6**		**Lab ID:**	**1011025-03**			
7440-39-3	Barium	5.20E1	ug/g dry	1.83E0	5/09/11	1E09002	PNNL-AGG-ICP-AES
HEIS No.	**B28KW9**		**Lab ID:**	**1011025-04**			
7440-39-3	Barium	4.95E1	ug/g dry	1.76E0	5/09/11	1E09002	PNNL-AGG-ICP-AES
HEIS No.	**B28N30**		**Lab ID:**	**1011025-05**			
7440-39-3	Barium	5.79E1	ug/g dry	1.93E0	5/09/11	1E09002	PNNL-AGG-ICP-AES
HEIS No.	**B273M1**		**Lab ID:**	**1011025-07**			
7440-39-3	Barium	7.12E1	ug/g dry	1.63E0	5/09/11	1E09002	PNNL-AGG-ICP-AES
HEIS No.	**B27C13**		**Lab ID:**	**1011025-08**			
7440-39-3	Barium	1.12E2	ug/g dry	1.66E0	5/09/11	1E09002	PNNL-AGG-ICP-AES
HEIS No.	**B29M71**		**Lab ID:**	**1011025-09**			
7440-39-3	Barium	9.13E1	ug/g dry	1.70E0	5/09/11	1E09002	PNNL-AGG-ICP-AES
HEIS No.	**B28YW2**		**Lab ID:**	**1011025-10**			
7440-39-3	Barium	8.13E1	ug/g dry	1.86E0	5/09/11	1E09002	PNNL-AGG-ICP-AES
HEIS No.	**B28CP2**		**Lab ID:**	**1011025-11**			
7440-39-3	Barium	4.50E1	ug/g dry	1.62E0	5/09/11	1E09002	PNNL-AGG-ICP-AES
HEIS No.	**B29C20**		**Lab ID:**	**1011025-13**			
7440-39-3	Barium	2.82E1	ug/g dry	1.78E0	5/09/11	1E09002	PNNL-AGG-ICP-AES
HEIS No.	**B29P71**		**Lab ID:**	**1011025-17**			
7440-39-3	Barium	7.01E1	ug/g dry	1.76E0	5/09/11	1E09002	PNNL-AGG-ICP-AES
HEIS No.	**B29HN7**		**Lab ID:**	**1011025-21**			
7440-39-3	Barium	1.17E2	ug/g dry	1.66E0	5/09/11	1E09002	PNNL-AGG-ICP-AES
HEIS No.	**B2B4H0**		**Lab ID:**	**1011025-29**			
7440-39-3	Barium	3.27E1	ug/g dry	1.66E0	5/09/11	1E09002	PNNL-AGG-ICP-AES
HEIS No.	**B2C647**		**Lab ID:**	**1011025-33**			
7440-39-3	Barium	6.39E1	ug/g dry	1.73E0	5/09/11	1E09002	PNNL-AGG-ICP-AES

RCRA Metals By PNNL-AGG-415/Acid Extract

CAS #	Analyte	Results	Units	EQL	Analyzed	Batch	Method
HEIS No.	**B28JK2**	**Lab ID:**	**1011025-01**				
14092-98-9	Chromium	1.64E1	ug/g dry	6.48E-1	5/31/11	1E06004	PNNL-AGG-415
7440-38-2	Arsenic	1.68E0	ug/g dry	3.76E-1	6/15/11	1E06004	PNNL-AGG-415
14687-58-2	Selenium	<7.27E-1	ug/g dry	7.27E-1	6/14/11	1E06004	PNNL-AGG-415
14378-37-1	Silver	<1.18E-3	ug/g dry	1.18E-3	5/31/11	1E06004	PNNL-AGG-415
14336-64-2	Cadmium	<3.10E-3	ug/g dry	3.10E-3	5/31/11	1E06004	PNNL-AGG-415
13966-28-4	Lead	4.19E0	ug/g dry	1.77E-1	5/31/11	1E06004	PNNL-AGG-415
HEIS No.	**B27C24**	**Lab ID:**	**1011025-02**				
14092-98-9	Chromium	1.17E1	ug/g dry	6.46E-1	5/31/11	1E06004	PNNL-AGG-415
7440-38-2	Arsenic	1.50E0	ug/g dry	3.75E-1	6/15/11	1E06004	PNNL-AGG-415
14687-58-2	Selenium	<7.25E-1	ug/g dry	7.25E-1	6/14/11	1E06004	PNNL-AGG-415
14378-37-1	Silver	<1.17E-3	ug/g dry	1.17E-3	5/31/11	1E06004	PNNL-AGG-415
14336-64-2	Cadmium	<3.09E-3	ug/g dry	3.09E-3	5/31/11	1E06004	PNNL-AGG-415
13966-28-4	Lead	4.23E0	ug/g dry	1.76E-1	5/31/11	1E06004	PNNL-AGG-415
HEIS No.	**B28KF6**	**Lab ID:**	**1011025-03**				
14092-98-9	Chromium	1.17E1	ug/g dry	6.28E-1	5/31/11	1E06004	PNNL-AGG-415
7440-38-2	Arsenic	1.14E0	ug/g dry	3.64E-1	6/15/11	1E06004	PNNL-AGG-415
14687-58-2	Selenium	<7.05E-1	ug/g dry	7.05E-1	6/14/11	1E06004	PNNL-AGG-415
14378-37-1	Silver	<1.14E-3	ug/g dry	1.14E-3	5/31/11	1E06004	PNNL-AGG-415
14336-64-2	Cadmium	<3.01E-3	ug/g dry	3.01E-3	5/31/11	1E06004	PNNL-AGG-415
13966-28-4	Lead	3.74E0	ug/g dry	1.71E-1	5/31/11	1E06004	PNNL-AGG-415
HEIS No.	**B28KW9**	**Lab ID:**	**1011025-04**				
14092-98-9	Chromium	1.18E1	ug/g dry	6.02E-1	5/31/11	1E06004	PNNL-AGG-415
7440-38-2	Arsenic	1.06E0	ug/g dry	3.50E-1	6/15/11	1E06004	PNNL-AGG-415
14687-58-2	Selenium	<6.76E-1	ug/g dry	6.76E-1	6/14/11	1E06004	PNNL-AGG-415
14378-37-1	Silver	<1.09E-3	ug/g dry	1.09E-3	5/31/11	1E06004	PNNL-AGG-415
14336-64-2	Cadmium	<2.89E-3	ug/g dry	2.89E-3	5/31/11	1E06004	PNNL-AGG-415
13966-28-4	Lead	4.22E0	ug/g dry	1.64E-1	5/31/11	1E06004	PNNL-AGG-415
HEIS No.	**B28N30**	**Lab ID:**	**1011025-05**				
14092-98-9	Chromium	2.10E1	ug/g dry	6.60E-1	5/31/11	1E06004	PNNL-AGG-415
7440-38-2	Arsenic	5.78E-1	ug/g dry	3.83E-1	6/15/11	1E06004	PNNL-AGG-415
14687-58-2	Selenium	<7.41E-1	ug/g dry	7.41E-1	6/14/11	1E06004	PNNL-AGG-415
14378-37-1	Silver	<1.20E-3	ug/g dry	1.20E-3	5/31/11	1E06004	PNNL-AGG-415
14336-64-2	Cadmium	<3.16E-3	ug/g dry	3.16E-3	5/31/11	1E06004	PNNL-AGG-415
13966-28-4	Lead	5.60E0	ug/g dry	1.80E-1	5/31/11	1E06004	PNNL-AGG-415
HEIS No.	**B273M1**	**Lab ID:**	**1011025-07**				
14092-98-9	Chromium	5.44E0	ug/g dry	5.59E-1	5/31/11	1E06004	PNNL-AGG-415
7440-38-2	Arsenic	5.34E-1	ug/g dry	3.25E-1	6/15/11	1E06004	PNNL-AGG-415
14687-58-2	Selenium	<6.27E-1	ug/g dry	6.27E-1	6/14/11	1E06004	PNNL-AGG-415
14378-37-1	Silver	<1.02E-3	ug/g dry	1.02E-3	5/31/11	1E06004	PNNL-AGG-415
14336-64-2	Cadmium	<2.68E-3	ug/g dry	2.68E-3	5/31/11	1E06004	PNNL-AGG-415
13966-28-4	Lead	1.33E0	ug/g dry	1.52E-1	5/31/11	1E06004	PNNL-AGG-415
HEIS No.	**B27C13**	**Lab ID:**	**1011025-08**				
14092-98-9	Chromium	1.35E1	ug/g dry	5.69E-1	5/31/11	1E06004	PNNL-AGG-415
7440-38-2	Arsenic	1.49E1	ug/g dry	3.30E-1	6/15/11	1E06004	PNNL-AGG-415
14687-58-2	Selenium	<6.38E-1	ug/g dry	6.38E-1	6/14/11	1E06004	PNNL-AGG-415
14378-37-1	Silver	<1.03E-3	ug/g dry	1.03E-3	5/31/11	1E06004	PNNL-AGG-415
14336-64-2	Cadmium	<2.73E-3	ug/g dry	2.73E-3	5/31/11	1E06004	PNNL-AGG-415
13966-28-4	Lead	4.40E0	ug/g dry	1.55E-1	5/31/11	1E06004	PNNL-AGG-415

RCRA Metals By PNNL-AGG-415/Acid Extract

CAS #	Analyte	Results	Units	EQL	Analyzed	Batch	Method
HEIS No.	**B29M71**	**Lab ID:**	**1011025-09**				
14092-98-9	Chromium	8.77E0	ug/g dry	5.82E-1	5/31/11	1E06004	PNNL-AGG-415
7440-38-2	Arsenic	3.51E0	ug/g dry	3.38E-1	6/15/11	1E06004	PNNL-AGG-415
14687-58-2	Selenium	<4.90E-1	ug/g dry	4.90E-1	5/31/11	1E06004	PNNL-AGG-415
14378-37-1	Silver	<1.06E-3	ug/g dry	1.06E-3	5/31/11	1E06004	PNNL-AGG-415
14336-64-2	Cadmium	<2.79E-3	ug/g dry	2.79E-3	5/31/11	1E06004	PNNL-AGG-415
13966-28-4	Lead	2.32E0	ug/g dry	1.59E-1	5/31/11	1E06004	PNNL-AGG-415
HEIS No.	**B28YW2**	**Lab ID:**	**1011025-10**				
14092-98-9	Chromium	1.01E1	ug/g dry	6.37E-1	5/31/11	1E06004	PNNL-AGG-415
7440-38-2	Arsenic	1.13E0	ug/g dry	3.70E-1	6/15/11	1E06004	PNNL-AGG-415
14687-58-2	Selenium	<5.36E-1	ug/g dry	5.36E-1	5/31/11	1E06004	PNNL-AGG-415
14378-37-1	Silver	<1.16E-3	ug/g dry	1.16E-3	5/31/11	1E06004	PNNL-AGG-415
14336-64-2	Cadmium	<3.05E-3	ug/g dry	3.05E-3	5/31/11	1E06004	PNNL-AGG-415
13966-28-4	Lead	5.36E0	ug/g dry	1.74E-1	5/31/11	1E06004	PNNL-AGG-415
HEIS No.	**B28CP2**	**Lab ID:**	**1011025-11**				
14092-98-9	Chromium	2.10E1	ug/g dry	5.55E-1	5/31/11	1E06004	PNNL-AGG-415
7440-38-2	Arsenic	8.18E-1	ug/g dry	3.22E-1	6/15/11	1E06004	PNNL-AGG-415
14687-58-2	Selenium	<4.67E-1	ug/g dry	4.67E-1	5/31/11	1E06004	PNNL-AGG-415
14378-37-1	Silver	<1.01E-3	ug/g dry	1.01E-3	5/31/11	1E06004	PNNL-AGG-415
14336-64-2	Cadmium	<2.66E-3	ug/g dry	2.66E-3	5/31/11	1E06004	PNNL-AGG-415
13966-28-4	Lead	1.42E0	ug/g dry	1.51E-1	5/31/11	1E06004	PNNL-AGG-415
HEIS No.	**B29C20**	**Lab ID:**	**1011025-13**				
14092-98-9	Chromium	5.57E0	ug/g dry	6.11E-1	5/31/11	1E06004	PNNL-AGG-415
7440-38-2	Arsenic	9.68E-1	ug/g dry	3.55E-1	6/15/11	1E06004	PNNL-AGG-415
14687-58-2	Selenium	<5.14E-1	ug/g dry	5.14E-1	5/31/11	1E06004	PNNL-AGG-415
14378-37-1	Silver	<1.11E-3	ug/g dry	1.11E-3	5/31/11	1E06004	PNNL-AGG-415
14336-64-2	Cadmium	<2.93E-3	ug/g dry	2.93E-3	5/31/11	1E06004	PNNL-AGG-415
13966-28-4	Lead	1.38E0	ug/g dry	1.67E-1	5/31/11	1E06004	PNNL-AGG-415
HEIS No.	**B29P71**	**Lab ID:**	**1011025-17**				
14092-98-9	Chromium	1.74E1	ug/g dry	6.04E-1	5/31/11	1E06004	PNNL-AGG-415
7440-38-2	Arsenic	1.07E0	ug/g dry	3.51E-1	6/15/11	1E06004	PNNL-AGG-415
14687-58-2	Selenium	<5.09E-1	ug/g dry	5.09E-1	5/31/11	1E06004	PNNL-AGG-415
14378-37-1	Silver	<1.10E-3	ug/g dry	1.10E-3	5/31/11	1E06004	PNNL-AGG-415
14336-64-2	Cadmium	<2.90E-3	ug/g dry	2.90E-3	5/31/11	1E06004	PNNL-AGG-415
13966-28-4	Lead	4.77E0	ug/g dry	1.65E-1	5/31/11	1E06004	PNNL-AGG-415
HEIS No.	**B29HN7**	**Lab ID:**	**1011025-21**				
14092-98-9	Chromium	8.20E0	ug/g dry	5.71E-1	5/31/11	1E06004	PNNL-AGG-415
7440-38-2	Arsenic	7.11E-1	ug/g dry	3.31E-1	6/15/11	1E06004	PNNL-AGG-415
14687-58-2	Selenium	<4.80E-1	ug/g dry	4.80E-1	5/31/11	1E06004	PNNL-AGG-415
14378-37-1	Silver	<1.04E-3	ug/g dry	1.04E-3	5/31/11	1E06004	PNNL-AGG-415
14336-64-2	Cadmium	<2.74E-3	ug/g dry	2.74E-3	5/31/11	1E06004	PNNL-AGG-415
13966-28-4	Lead	1.99E0	ug/g dry	1.56E-1	5/31/11	1E06004	PNNL-AGG-415
HEIS No.	**B2B4H0**	**Lab ID:**	**1011025-29**				
14092-98-9	Chromium	5.75E0	ug/g dry	5.70E-1	5/31/11	1E06004	PNNL-AGG-415
7440-38-2	Arsenic	8.45E-1	ug/g dry	3.31E-1	6/15/11	1E06004	PNNL-AGG-415
14687-58-2	Selenium	<4.80E-1	ug/g dry	4.80E-1	5/31/11	1E06004	PNNL-AGG-415
14378-37-1	Silver	<1.04E-3	ug/g dry	1.04E-3	5/31/11	1E06004	PNNL-AGG-415
14336-64-2	Cadmium	<2.73E-3	ug/g dry	2.73E-3	5/31/11	1E06004	PNNL-AGG-415
13966-28-4	Lead	1.36E0	ug/g dry	1.55E-1	5/31/11	1E06004	PNNL-AGG-415

RCRA Metals By PNNL-AGG-415/Acid Extract

CAS #	Analyte	Results	Units	EQL	Analyzed	Batch	Method
HEIS No.	**B2C647**	**Lab ID:**		**1011025-33**			
14092-98-9	Chromium	1.15E1	ug/g dry	5.93E-1	5/31/11	1E06004	PNNL-AGG-415
7440-38-2	Arsenic	8.73E-1	ug/g dry	3.44E-1	6/15/11	1E06004	PNNL-AGG-415
14687-58-2	Selenium	<4.99E-1	ug/g dry	4.99E-1	5/31/11	1E06004	PNNL-AGG-415
14378-37-1	Silver	<1.08E-3	ug/g dry	1.08E-3	5/31/11	1E06004	PNNL-AGG-415
14336-64-2	Cadmium	<2.84E-3	ug/g dry	2.84E-3	5/31/11	1E06004	PNNL-AGG-415
13966-28-4	Lead	2.87E0	ug/g dry	1.62E-1	5/31/11	1E06004	PNNL-AGG-415

Equilibrium Kd 1:1 Calculations

1011025-01 **B28JK2**

Analyte	Kd (L/g)
Arsenic	ND
Barium	ND
Cadmium	ND
Chromium	ND
Chromium, Hexavalent	ND
Lead	ND
Selenium	ND
Silver	ND
Uranium 238	0.334714

1011025-02 **B27C24**

Analyte	Kd (L/g)
Arsenic	0.183729
Barium	ND
Cadmium	ND
Chromium	ND
Chromium, Hexavalent	ND
Lead	ND
Selenium	ND
Silver	ND
Uranium 238	0.733884

1011025-03 **B28KF6**

Analyte	Kd (L/g)
Arsenic	0.193208
Barium	ND
Cadmium	ND
Chromium	0.935
Chromium, Hexavalent	ND
Lead	ND
Selenium	ND
Silver	ND
Uranium 238	0.236569

1011025-04 **B28KW9**

Analyte	Kd (L/g)
Arsenic	ND
Barium	ND
Cadmium	ND
Chromium	ND
Chromium, Hexavalent	ND
Lead	ND
Selenium	ND
Silver	ND
Uranium 238	7.965667

1011025-05 **B28N30**

Analyte	Kd (L/g)
Arsenic	0.095656
Barium	ND
Cadmium	ND
Chromium	ND
Chromium, Hexavalent	ND
Lead	ND
Selenium	ND
Silver	ND
Uranium 238	ND

1011025-07 **B273M1**

Analyte	Kd (L/g)
Arsenic	ND
Barium	ND
Cadmium	ND
Chromium	ND
Chromium, Hexavalent	ND
Lead	ND
Selenium	ND
Silver	ND
Uranium 238	0.556576

1011025-08 **B27C13**

Analyte	Kd (L/g)
Arsenic	1.946712
Barium	ND
Cadmium	ND
Chromium	ND
Chromium, Hexavalent	ND
Lead	ND
Selenium	ND
Silver	ND
Uranium 238	0.326236

1011025-09 **B29M71**

Analyte	Kd (L/g)
Arsenic	0.523664
Barium	ND
Cadmium	ND
Chromium	ND
Chromium, Hexavalent	ND
Lead	ND
Selenium	ND
Silver	ND
Uranium 238	0.239549

1011025-10 **B28YW2**

Analyte	Kd (L/g)
Arsenic	0.094763
Barium	ND
Cadmium	ND
Chromium	ND
Chromium, Hexavalent	ND
Lead	ND
Selenium	ND
Silver	ND
Uranium 238	ND

1011025-11 **B28CP2**

Analyte	Kd (L/g)
Arsenic	ND
Barium	ND
Cadmium	ND
Chromium	ND
Chromium, Hexavalent	ND
Lead	ND
Selenium	ND
Silver	ND
Uranium 238	0.756576

1011025-13 **B29C20**

Analyte	Kd (L/g)
Arsenic	ND
Barium	ND
Cadmium	ND
Chromium	ND
Chromium, Hexavalent	ND
Lead	ND
Selenium	ND
Silver	ND
Uranium 238	0.503975

1011025-17 **B29P71**

Analyte	Kd (L/g)
Arsenic	0.120041
Barium	ND
Cadmium	ND
Chromium	0.465488
Chromium, Hexavalent	ND
Lead	ND
Selenium	ND
Silver	ND
Uranium 238	0.556937

1011025-21 **B29HN7**

Analyte	Kd (L/g)
Arsenic	ND
Barium	ND
Cadmium	ND
Chromium	1.506353
Chromium, Hexavalent	ND
Lead	ND
Selenium	ND
Silver	ND
Uranium 238	0.241138

1011025-29 **B2B4H0**

Analyte	Kd (L/g)
Arsenic	ND
Barium	ND
Cadmium	ND
Chromium	ND
Chromium, Hexavalent	ND
Lead	ND
Selenium	ND
Silver	ND
Uranium 238	0.799738

1011025-33 **B2C647**

Analyte	Kd (L/g)
Arsenic	0.150826
Barium	ND
Cadmium	ND
Chromium	ND
Chromium, Hexavalent	ND
Lead	ND
Selenium	ND
Silver	ND
Uranium 238	0.423272

Hexavalent Chromium/Soil - Quality Control
Environmental Science Laboratory

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1E23001 - Hexavalent Chromium Digest										
Blank (1E23001-BLK1)				Prepared & Analyzed: 05/20/11						
Chromium, Hexavalent	<5.00E-2	5.00E-2	ug/g wet							
LCS (1E23001-BS1)				Prepared & Analyzed: 05/20/11						
Chromium, Hexavalent	4.10E-1	5.00E-2	ug/g wet	5.01E-1		81.9	80-120			
Duplicate (1E23001-DUP1)		**Source: 1011025-04**		Prepared & Analyzed: 05/20/11						
Chromium, Hexavalent	<6.09E-1	6.09E-1	ug/g dry		ND				20	
Matrix Spike (1E23001-MS1)		**Source: 1011025-04**		Prepared & Analyzed: 05/20/11						
Chromium, Hexavalent	2.44E-1	6.14E-1	ug/g dry	5.00E-1	3.00E-3	48.2	75-125			

Hexavalent Chromium/1:1 Water Extract - Quality Control
Environmental Science Laboratory

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1E05001 - 1:1 Water Extract (Cr6)										
Blank (1E05001-BLK1)				Prepared & Analyzed: 05/05/11						
Chromium, Hexavalent	<5.00E-2	5.00E-2	ug/g wet							
LCS (1E05001-BS1)				Prepared & Analyzed: 05/05/11						
Chromium, Hexavalent	5.05E-1	5.00E-2	ug/g wet	5.01E-1		101	70-130			
Duplicate (1E05001-DUP1)		**Source: 1011025-04**		Prepared & Analyzed: 05/05/11						
Chromium, Hexavalent	<3.89E-2	3.89E-2	ug/g dry		ND				20	
Post Spike (1E05001-PS1)		**Source: 1011025-04**		Prepared & Analyzed: 05/05/11						
Chromium, Hexavalent	5.25E-1	N/A	ug/mL	5.00E-1	2.00E-2	101	75-125			

Total Metals by PNNL-AGG-ICP-AES/1:1 Water Extract - Quality Control
Environmental Science Laboratory

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1E09001 - 1:1 Water Extract (ICP/ICPMS)										
Blank (1E09001-BLK1)				Prepared: 05/04/11	Analyzed: 05/09/11					
Barium	<1.24E-1	1.24E-1	ug/g wet							
LCS (1E09001-BS1)				Prepared: 05/04/11	Analyzed: 05/09/11					
Barium	4.94E0	1.24E-1	ug/g wet	4.99E0		98.9	80-120			
Duplicate (1E09001-DUP1)	**Source: 1011025-04**			Prepared: 05/04/11	Analyzed: 05/09/11					
Barium	<1.24E-1	1.24E-1	ug/g dry		ND				35	
Post Spike (1E09001-PS1)	**Source: 1011025-04**			Prepared & Analyzed: 05/09/11						
Barium	2.51E2	N/A	ug/L	2.50E2	3.20E0	99.1	75-125			

Radionuclides by ICP-MS/Acid Extract - Quality Control
Environmental Science Laboratory

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1E05004 - ASTM D 5198 (ICP/ICPMS)										
Blank (1E05004-BLK1)				Prepared & Analyzed: 05/05/11						
Uranium 238	<1.00E-2	1.00E-2	ug/g wet							
Duplicate (1E05004-DUP1)		**Source: 1011025-04**		Prepared & Analyzed: 05/05/11						
Uranium 238	6.99E-1	4.24E-2	ug/g dry		7.17E-1			2.45	35	
Post Spike (1E05004-PS1)		**Source: 1011025-33**		Prepared & Analyzed: 05/05/11						
Uranium 238	1.98E0	N/A	ug/L	1.00E0	1.04E0	93.8	75-125			

Radionuclides by ICP-MS/1:1 Water Extract - Quality Control
Environmental Science Laboratory

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1E05003 - 1:1 Water Extract (ICP/ICPMS)										
Blank (1E05003-BLK1)				Prepared: 05/05/11		Analyzed: 05/06/11				
Uranium 238	<8.00E-5	8.00E-5	ug/g wet							
Duplicate (1E05003-DUP1)		**Source: 1011025-04**		Prepared: 05/05/11		Analyzed: 05/06/11				
Uranium 238	1.33E-4	8.00E-5	ug/g dry		9.00E-5			38.9	35	
Post Spike (1E05003-PS1)		**Source: 1011025-33**		Prepared: 05/05/11		Analyzed: 05/06/11				
Uranium 238	1.21E0	N/A	ug/L	1.00E0	1.89E-1	102	75-125			

RCRA Metals By PNNL-AGG-415/1:1 Water Extract - Quality Control
Environmental Science Laboratory

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1E06003 - 1:1 Water Extract (ICP/ICPMS)										
Blank (1E06003-BLK1)				Prepared: 05/06/11		Analyzed: 05/31/11				
Chromium	<3.44E-3	3.44E-3	ug/g wet							
Arsenic	<2.84E-3	2.84E-3	"							
Selenium	<7.92E-3	7.92E-3	"							
Silver	<3.13E-3	3.13E-3	"							
Cadmium	<5.73E-4	5.73E-4	"							
Lead	<1.16E-3	1.16E-3	"							
LCS (1E06003-BS1)				Prepared: 05/06/11		Analyzed: 05/31/11				
Chromium	4.97E0	3.44E-1	ug/g wet	4.99E0		99.6	80-120			
Arsenic	4.79E0	2.84E-1	"	4.99E0		95.9	80-120			
Selenium	4.98E0	7.92E-1	"	4.99E0		99.7	80-120			
Silver	4.66E0	3.13E-1	"	4.99E0		93.3	80-120			
Cadmium	4.63E0	5.73E-2	"	4.99E0		92.7	80-120			
Lead	4.71E0	1.16E-1	"	4.99E0		94.3	80-120			
Duplicate (1E06003-DUP1)		**Source: 1011025-04**		Prepared: 05/06/11		Analyzed: 05/31/11				
Chromium	<3.44E-3	3.44E-3	ug/g dry		ND				35	
Arsenic	<2.83E-3	2.83E-3	"		ND				35	
Selenium	<7.91E-3	7.91E-3	"		ND				35	
Silver	<3.13E-3	3.13E-3	"		ND				35	
Cadmium	<5.73E-4	5.73E-4	"		ND				35	
Lead	<1.16E-3	1.16E-3	"		ND				35	
Post Spike (1E06003-PS1)		**Source: 1011025-33**		Prepared: 05/06/11		Analyzed: 05/31/11				
Chromium	5.14E0	N/A	ug/L	5.00E0	1.40E-1	99.9	75-125			
Arsenic	6.36E0	N/A	"	5.00E0	1.05E0	106	75-125			
Selenium	5.30E0	N/A	"	5.00E0	2.82E-1	100	75-125			
Silver	4.77E0	N/A	"	5.00E0	1.18E-3	95.4	75-125			
Cadmium	5.11E0	N/A	"	5.00E0	1.18E-2	102	75-125			
Lead	5.01E0	N/A	"	5.00E0	1.62E-2	99.8	75-125			

RCRA Metals By PNNL-AGG-415/Special Extract - Quality Control
Environmental Science Laboratory

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1E09002 - ASTM D 5198 (ICP/ICPMS)										
Blank (1E09002-BLK1)				Prepared: 05/04/11	Analyzed: 05/09/11					
Barium	<4.12E-1	4.12E-1	ug/g wet							
LCS (1E09002-BS1)				Prepared: 05/04/11	Analyzed: 05/09/11					
Barium	5.68E0	4.12E-2	ug/g wet	5.80E0		97.8	80-120			
Duplicate (1E09002-DUP1)	**Source: 1011025-04**			Prepared: 05/04/11	Analyzed: 05/09/11					
Barium	4.73E1	1.75E0	ug/g dry		4.95E1			4.53	35	
Post Spike (1E09002-PS1)	**Source: 1011025-04**			Prepared & Analyzed: 05/09/11						
Barium	4.88E2	N/A	ug/L	2.50E2	2.32E2	103	75-125			

RCRA Metals By PNNL-AGG-415/Acid Extract - Quality Control
Environmental Science Laboratory

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1E06004 - ASTM D 5198 (ICP/ICPMS)										
Blank (1E06004-BLK1)				Prepared: 05/06/11		Analyzed: 05/31/11				
Chromium	<1.41E-1	1.41E-1	ug/g wet							
Arsenic	<8.20E-2	8.20E-2	"							
Selenium	<1.19E-1	1.19E-1	"							
Silver	<3.85E-3	3.85E-3	"							
Cadmium	<1.02E-2	1.02E-2	"							
Lead	<3.85E-2	3.85E-2	"							
LCS (1E06004-BS1)				Prepared: 05/06/11		Analyzed: 05/31/11				
Chromium	6.04E0	9.42E-1	ug/g wet	5.80E0		104	80-120			
Arsenic	5.60E0	4.10E-1	"	5.80E0		96.4	80-120			
Selenium	5.43E0	7.93E-1	"	5.80E0		93.5	80-120			
Silver	5.66E0	2.56E-2	"	5.80E0		97.5	80-120			
Cadmium	5.72E0	6.77E-2	"	5.80E0		98.6	80-120			
Lead	5.81E0	2.57E-1	"	5.80E0		100	80-120			
Duplicate (1E06004-DUP1)		**Source: 1011025-04**		Prepared: 05/06/11		Analyzed: 05/31/11				
Chromium	1.13E1	5.98E-1	ug/g dry		1.18E1			4.60	35	
Arsenic	9.82E-1	3.47E-1	"		1.06E0			8.02	35	
Selenium	<6.71E-1	6.71E-1	"		ND				35	
Silver	6.13E-2	1.63E-2	"		ND				35	
Cadmium	6.10E-2	4.30E-2	"		ND				35	
Lead	3.93E0	1.63E-1	"		4.22E0			7.05	35	
Post Spike (1E06004-PS1)		**Source: 1011025-33**		Prepared: 05/06/11		Analyzed: 05/31/11				
Chromium	4.15E1	N/A	ug/L	5.00E0	3.65E1	101	75-125			
Arsenic	6.88E0	N/A	"	5.00E0	2.08E0	96.0	75-125			
Selenium	5.44E0	N/A	"	5.00E0	7.72E-2	107	75-125			
Silver	4.66E0	N/A	"	5.00E0	1.18E-3	93.1	75-125			
Cadmium	4.98E0	N/A	"	5.00E0	1.18E-2	99.4	75-125			
Lead	1.36E1	N/A	"	5.00E0	9.13E0	89.4	75-125			

CH2MHill Plateau Remediation Company	CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST			F10-214-016	PAGE 1 OF 1
COLLECTOR Garcia, Chamberlain	COMPANY CONTACT DYEKMAN, DL	TELEPHONE NO. 373-2530	PROJECT COORDINATOR DYEKMAN, DL	PRICE CODE 8N AIR QUALITY ☐	DATA TURNAROUND 45 Days / 45 Days
SAMPLING LOCATION C7620 (199-D3-5); I-020	PROJECT DESIGNATION 100 Area Remedial Investigation/Feasibility Analysis - 100-HR-3 - Sediment		SAF NO. F10-214		
ICE CHEST NO.	FIELD LOGBOOK NO. HNF-N-491 8 Pg 147	ACTUAL SAMPLE DEPTH 103.0 - 105.1 ft	COA 300110ES10	METHOD OF SHIPMENT FEDERAL EXPRESS	
SHIPPED TO Environmental Sciences Laboratory	OFFSITE PROPERTY NO. SEE PTR		BILL OF LADING/AIR BILL NO. SEE PTR		

MATRIX*	POSSIBLE SAMPLE HAZARDS/ REMARKS	PRESERVATION	None
A=Air DL=Drum Liquids DS=Drum Solids L=Liquid O=Oil S=Soil SE=Sediment T=Tissue V=Vegetation W=Water WI=Wipe X=Other	Contains Radioactive Material at concentrations that may or may not be regulated for transportation per 49 CFR / IATA Dangerous Goods Regulations but are not releasable per DOE Order 5400.5 (1990/1993)	HOLDING TIME	6 Months
		TYPE OF CONTAINER	G/P
		NO. OF CONTAINER(S)	1
		VOLUME	1000mL
	SPECIAL HANDLING AND/OR STORAGE	SAMPLE ANALYSIS	KD - Batch {No CAS};

SAMPLE NO.	MATRIX*	SAMPLE DATE	SAMPLE TIME	
B273M1	SOIL	11-19-10	1015	✓

CHAIN OF POSSESSION		SIGN/ PRINT NAMES	
RELINQUISHED BY/REMOVED FROM	DATE/TIME	RECEIVED BY/STORED IN	DATE/TIME
J. Garcia [signature]	11/19/10 / 1215	SSU-R1	NOV 19 2010 1215
SSU-R1	DEC 02 2010 0730	M. A. White [signature]	DEC 02 2010 0730
M. A. White [signature]	DEC 02 2010 0905	Igor Kuchynka [signature]	DEC 02 2010 0905

SPECIAL INSTRUCTIONS

** The 100 Area S&GRP Characterization and Monitoring Sampling and Analysis GKI applies to this SAF.☐ The CACN for all analytical work at WSCF laboratory is 401642ES20.

BRM # 13564

ORIGINAL

LABORATORY SECTION	RECEIVED BY	TITLE	DATE/TIME
FINAL SAMPLE DISPOSITION	DISPOSAL METHOD	DISPOSED BY	DATE/TIME

SDG # ESL090020

A-6003-618(01/06)

CH2MHill Plateau Remediation Company	CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST		F10-214-019	PAGE 1 OF 1
COLLECTOR ROMO, KAUER, ZUNKER	COMPANY CONTACT DYEKMAN, DL	TELEPHONE NO. 373-2530	PROJECT COORDINATOR DYEKMAN, DL	PRICE CODE 8N / DATA TURNAROUND
SAMPLING LOCATION C7621 (199-D5-133); I-022	PROJECT DESIGNATION 100 Area Remedial Investigation/Feasibility Analysis - 100-HR-3 - Sediment		SAF NO. F10-214	AIR QUALITY ☐ / 45 Days / 45 Days
ICE CHEST NO.	FIELD LOGBOOK NO. HNF-N-585-12 PG 36	ACTUAL SAMPLE DEPTH 102.5 - 105.0 FT	COA 300110ES10	METHOD OF SHIPMENT GOVERNMENT VEHICLE
SHIPPED TO Environmental Sciences Laboratory	OFFSITE PROPERTY NO. N/A		BILL OF LADING/AIR BILL NO. N/A	

MATRIX*
A=Air
DL=Drum Liquids
DS=Drum Solids
L=Liquid
O=Oil
S=Soil
SE=Sediment
T=Tissue
V=Vegetation
W=Water
WI=Wipe
X=Other

POSSIBLE SAMPLE HAZARDS/ REMARKS
Contains Radioactive Material at concentrations that may or may not be regulated for transportation per 49 CFR / IATA Dangerous Goods Regulations but are not releasable per DOE Order 5400.5 (1990/1993)

SPECIAL HANDLING AND/OR STORAGE

PRESERVATION	None
HOLDING TIME	6 Months
TYPE OF CONTAINER	G/P
NO. OF CONTAINER(S)	1
VOLUME	1000mL
SAMPLE ANALYSIS	KD - Batch {No CAS};

SAMPLE NO.	MATRIX*	SAMPLE DATE	SAMPLE TIME	
B27C13	SOIL	12-1-10	1103	✓

CHAIN OF POSSESSION	DATE/TIME	SIGN/ PRINT NAMES	DATE/TIME
RELINQUISHED BY/REMOVED FROM Ed Kauer [signature]	12-1-10 1205	RECEIVED BY/STORED IN SSU-R1	12-1-10 1205
RELINQUISHED BY/REMOVED FROM SSU-R1	DEC 0 2 2010 0730	RECEIVED BY/STORED IN M. A. White [signature]	DEC 0 2 2010 0730
RELINQUISHED BY/REMOVED FROM M. A. White [signature]	DEC 0 2 2010 9:05	RECEIVED BY/STORED IN Igor Kutnyakov / [signature]	DEC 0 2 2010 9:05
RELINQUISHED BY/REMOVED FROM		RECEIVED BY/STORED IN	
RELINQUISHED BY/REMOVED FROM		RECEIVED BY/STORED IN	
RELINQUISHED BY/REMOVED FROM		RECEIVED BY/STORED IN	
RELINQUISHED BY/REMOVED FROM		RECEIVED BY/STORED IN	

SPECIAL INSTRUCTIONS
** The 100 Area S&GRP Characterization and Monitoring Sampling and Analysis GKI applies to this SAF.

BRM # 13564

LABORATORY SECTION	RECEIVED BY	TITLE	DATE/TIME
FINAL SAMPLE DISPOSITION	DISPOSAL METHOD	DISPOSED BY	DATE/TIME

A-6003-618(01/06)

CH2MHill Plateau Remediation Company	CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST			F10-214-100	PAGE 1 OF 1
COLLECTOR Romo, Kauer, Zunker	**COMPANY CONTACT** RADLOFF, AW	**TELEPHONE NO.** 376-4554	**PROJECT COORDINATOR** RADLOFF, AW	**PRICE CODE** 8N **AIR QUALITY** ☐	**DATA TURNAROUND** 45 Days / 45 Days
SAMPLING LOCATION C7621 (199-D5-133); I-022 DUP	**PROJECT DESIGNATION** 100 Area Remedial Investigation/Feasibility Analysis - 100-HR-3 - Sediment		**SAF NO.** F10-214		
ICE CHEST NO.	**FIELD LOGBOOK NO.** HNF-~~N-~~585-12 PG 36	**ACTUAL SAMPLE DEPTH** 102.5' - 105.0' FT	**COA** 300110ES10	**METHOD OF SHIPMENT** GOVERNMENT VEHICLE	
SHIPPED TO Environmental Sciences Laboratory	**OFFSITE PROPERTY NO.** N/A		**BILL OF LADING/AIR BILL NO.** N/A		

MATRIX*	POSSIBLE SAMPLE HAZARDS/ REMARKS		
A=Air DL=Drum Liquids DS=Drum Solids L=Liquid O=Oil S=Soil SE=Sediment T=Tissue V=Vegetation W=Water WI=Wipe X=Other	Contains Radioactive Material at concentrations that may or may not be regulated for transportation per 49 CFR / IATA Dangerous Goods Regulations but are not releasable per DOE Order 5400.5 (1990/1993)	**PRESERVATION**	None
		HOLDING TIME	6 Months
		TYPE OF CONTAINER	G/P
		NO. OF CONTAINER(S)	1
		VOLUME	1000mL
	SPECIAL HANDLING AND/OR STORAGE	**SAMPLE ANALYSIS**	KD - Batch {No CAS};

SAMPLE NO.	MATRIX*	SAMPLE DATE	SAMPLE TIME	
B29M71	SOIL	12-1-10	1103	✓

CHAIN OF POSSESSION		SIGN/ PRINT NAMES	
RELINQUISHED BY/REMOVED FROM	**DATE/TIME**	**RECEIVED BY/STORED IN**	**DATE/TIME**
Ed Kauer [signature] 12-1-10	1205	SSU-R1 12-1-10	1205
SSU-R1 12-2-10	0730	[signature] 12-2-10	0730
[signature] 12-2-10	9:05	Igor Kutnyakov / [signature] 12-2-10	9:05

SPECIAL INSTRUCTIONS

** The 100 Area S&GRP Characterization and Monitoring Sampling and Analysis GKI applies to this SAF.

BRM # 13564

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LABORATORY SECTION	RECEIVED BY	TITLE	DATE/TIME
FINAL SAMPLE DISPOSITION	**DISPOSAL METHOD**	**DISPOSED BY**	**DATE/TIME**

A-6003-618 (REV 2)

CH2MHill Plateau Remediation Company	CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST			F10-214-021	PAGE 1 OF 1
COLLECTOR Mokler	COMPANY CONTACT DYEKMAN, DL	TELEPHONE NO. 373-2530	PROJECT COORDINATOR RADLOFF, AW	PRICE CODE 8N AIR QUALITY ☐	DATA TURNAROUND 45 Days / 45 Days
SAMPLING LOCATION C7629 (199-D6-3);Bottom unconfined aquifer; I-018	PROJECT DESIGNATION 100 Area Remedial Investigation/Feasibility Analysis - 100-HR-3 - Sediment		SAF NO. F10-214		
ICE CHEST NO. N/A	FIELD LOGBOOK NO. HNF-N-585-1 (pg 24)	ACTUAL SAMPLE DEPTH 58.84	COA 300110ES10	METHOD OF SHIPMENT GOVERNMENT VEHICLE	
SHIPPED TO Environmental Sciences Laboratory	OFFSITE PROPERTY NO. N/A		BILL OF LADING/AIR BILL NO. N/A		

MATRIX*	POSSIBLE SAMPLE HAZARDS/ REMARKS	PRESERVATION	None
A=Air DL=Drum Liquids DS=Drum Solids L=Liquid O=Oil S=Soil SE=Sediment T=Tissue V=Vegetation W=Water WI=Wipe X=Other	Contains Radioactive Material at concentrations that may or may not be regulated for transportation per 49 CFR / IATA Dangerous Goods Regulations but are not releasable per DOE Order 5400.5 (1990/1993)	HOLDING TIME	6 Months
		TYPE OF CONTAINER	G/P
		NO. OF CONTAINER(S)	1
		VOLUME	1000mL 500g
	SPECIAL HANDLING AND/OR STORAGE	SAMPLE ANALYSIS	KD - Batch {No CAS};

SAMPLE NO.	MATRIX*	SAMPLE DATE	SAMPLE TIME	
B27C24	SOIL	11/9/10	0925	✓

CHAIN OF POSSESSION		SIGN/ PRINT NAMES	
RELINQUISHED BY/REMOVED FROM	DATE/TIME	RECEIVED BY/STORED IN	DATE/TIME
D. Mokler	11/9/10-1130	MO413 SSUR 1	11/9/10-1130
SSU-R1	NOV 1 1 2010 0710	DW Brotherton / cm Aguilar	NOV 1 1 2010 0710
cm Aguilar	NOV 1 1 2010 1330	D. Smith	NOV 1 1 2010 1330

SPECIAL INSTRUCTIONS

** The 100 Area S&GRP Characterization and Monitoring Sampling and Analysis GKI applies to this SAF.

BRM# 13564

ORIGINAL

LABORATORY SECTION	RECEIVED BY	TITLE	DATE/TIME
FINAL SAMPLE DISPOSITION	DISPOSAL METHOD	DISPOSED BY	DATE/TIME

SDG# ESL090020

A-6003-618(01/06)

CH2MHill Plateau Remediation Company	CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST			F10-214-032	PAGE 1 OF 1
COLLECTOR Romo, Kayer, Billingsley	**COMPANY CONTACT** DYEKMAN, DL	**TELEPHONE NO.** 373-2530	**PROJECT COORDINATOR** DYEKMAN, DL	**PRICE CODE** 8N	**DATA TURNAROUND** 45 Days / 45 Days
SAMPLING LOCATION C7626 (199-D6-3); I-018	**PROJECT DESIGNATION** 100 Area Remedial Investigation/Feasibility Analysis - 100-HR-3 - Sediment		**SAF NO.** F10-214	**AIR QUALITY** ☐	
ICE CHEST NO.	**FIELD LOGBOOK NO.** HNF-N- 536-3 PG 124	**ACTUAL SAMPLE DEPTH** 54.9 - 56.9 FT	**COA** 300110ES10	**METHOD OF SHIPMENT** FEDERAL EXPRESS	
SHIPPED TO Environmental Sciences Laboratory	**OFFSITE PROPERTY NO.** SEE PTR		**BILL OF LADING/AIR BILL NO.** SEE PTR		

MATRIX*	POSSIBLE SAMPLE HAZARDS/ REMARKS		
A=Air DL=Drum Liquids DS=Drum Solids L=Liquid O=Oil S=Soil SE=Sediment T=Tissue V=Vegetation W=Water WI=Wipe X=Other	Contains Radioactive Material at concentrations that may or may not be regulated for transportation per 49 CFR / IATA Dangerous Goods Regulations but are not releasable per DOE Order 5400.5 (1990/1993)	**PRESERVATION**	None
		HOLDING TIME	6 Months
		TYPE OF CONTAINER	~~G/P~~ SPLIT SPOON LINER 2
		NO. OF CONTAINER(S)	1
		VOLUME	1000mL
	SPECIAL HANDLING AND/OR STORAGE	**SAMPLE ANALYSIS**	KD - Batch {No CAS};

SAMPLE NO.	MATRIX*	SAMPLE DATE	SAMPLE TIME	
B28JK2	SOIL	11-3-10	1020	✓

CHAIN OF POSSESSION		SIGN/ PRINT NAMES	
RELINQUISHED BY/REMOVED FROM	**DATE/TIME**	**RECEIVED BY/STORED IN**	**DATE/TIME**
Rob Romo, Robert Romo 11-3-10	1330	SSU-R2	NOV 03 2010 1330
SSU-R2	NOV 04 2010 1030	M Whitney M Whitney	NOV 04 2010 1030
M Whitney M Whitney	NOV 04 2010 14:30	Ben Williams Ben Williams	NOV 04 2010 14:30

SPECIAL INSTRUCTIONS

** The 100 Area S&GRP Characterization and Monitoring Sampling and Analysis GKI applies to this SAF.☐ The CACN for all analytical work at WSCF laboratory is 401642ES20.

BRM #13564

ORIGINAL

LABORATORY SECTION	RECEIVED BY	TITLE	DATE/TIME
FINAL SAMPLE DISPOSITION	**DISPOSAL METHOD**	**DISPOSED BY**	**DATE/TIME**

SDG# ESL090020

A-6003-618(01/06)

CH2MHill Plateau Remediation Company	CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST			F10-214-036	PAGE 1 OF 1
COLLECTOR Garcia, Aguilar, Ramirez	COMPANY CONTACT RADLOFF, A	TELEPHONE NO. 376-4554	PROJECT COORDINATOR RADLOFF, AW	PRICE CODE 8N AIR QUALITY ☐	DATA TURNAROUND 45 Days / 45 Days
SAMPLING LOCATION C7628 (199-D6-3); I-018	PROJECT DESIGNATION 100 Area Remedial Investigation/Feasibility Analysis - 100-HR-3 - Sediment		SAF NO. F10-214		
ICE CHEST NO. N/A	FIELD LOGBOOK NO. HNF-N-585-12 Pg 22	ACTUAL SAMPLE DEPTH ~~58.0-60~~ 60.5'-63.0'	COA 300110ES10	METHOD OF SHIPMENT GOVERNMENT VEHICLE	
SHIPPED TO Environmental Sciences Laboratory	OFFSITE PROPERTY NO. N/A		BILL OF LADING/AIR BILL NO. N/A		

MATRIX*	POSSIBLE SAMPLE HAZARDS/ REMARKS		
A=Air DL=Drum Liquids DS=Drum Solids L=Liquid O=Oil S=Soil SE=Sediment T=Tissue V=Vegetation W=Water WI=Wipe X=Other	Contains Radioactive Material at concentrations that may or may not be regulated for transportation per 49 CFR / IATA Dangerous Goods Regulations but are not releasable per DOE Order 5400.5 (1990/1993)	PRESERVATION	None
		HOLDING TIME	6 Months
		TYPE OF CONTAINER	G/P
		NO. OF CONTAINER(S)	1
		VOLUME	1000mL
	SPECIAL HANDLING AND/OR STORAGE ~~RADSCREEN TIE TO:~~ MVM 9/24/10	SAMPLE ANALYSIS	KD - Batch {No CAS};

SAMPLE NO.	MATRIX*	SAMPLE DATE	SAMPLE TIME	
B28KF6	SOIL	11/5/10	1454	✓

CHAIN OF POSSESSION		SIGN/ PRINT NAMES	
RELINQUISHED BY/REMOVED FROM	DATE/TIME	RECEIVED BY/STORED IN	DATE/TIME
J. Garcia [signature]	11/5/10 / 1600	MO-413 SSU-R1	11/5/10 / 1600
SSU-R1	NOV 1 1 2010 0710	Om Aguilar [signature]	NOV 1 1 2010 0710
Om Aguilar [signature]	NOV 1 1 2010 1330	D Smith [signature]	NOV 1 1 2010 1330

SPECIAL INSTRUCTIONS

** The laboratory is to achieve a detection limit of 10 pCi/g for Tritium.☐☐** The laboratory is to achieve a detection limit of 0.25 pCi/g for Technetium.☐

BRM# 13564

ORIGINAL

LABORATORY SECTION	RECEIVED BY	TITLE	DATE/TIME
FINAL SAMPLE DISPOSITION	DISPOSAL METHOD	DISPOSED BY	DATE/TIME

A-6003-618(01/06)

CH2MHill Plateau Remediation Company	CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST			F10-214-038	PAGE 1 OF 1
COLLECTOR GARCIA, YOUNG	**COMPANY CONTACT** RADLOFF, AW	**TELEPHONE NO.** 376-4554	**PROJECT COORDINATOR** RADLOFF, AW	**PRICE CODE** 8N	**DATA TURNAROUND** 45 Days / 45 Days
SAMPLING LOCATION C7630 (199-H1-7); I-016	**PROJECT DESIGNATION** 100 Area Remedial Investigation/Feasibility Analysis - 100-HR-3 - Sediment		**SAF NO.** F10-214	**AIR QUALITY** ☐	
ICE CHEST NO. N/A	**FIELD LOGBOOK NO.** HNF-N-5763 Pg 127	**ACTUAL SAMPLE DEPTH** 32.0-34.5 ft	**COA** 300110ES10	**METHOD OF SHIPMENT** GOVERNMENT VEHICLE	
SHIPPED TO Environmental Sciences Laboratory	**OFFSITE PROPERTY NO.** N/A		**BILL OF LADING/AIR BILL NO.** N/A		

MATRIX*
A=Air
DL=Drum Liquids
DS=Drum Solids
L=Liquid
O=Oil
S=Soil
SE=Sediment
T=Tissue
V=Vegetation
W=Water
WI=Wipe
X=Other

POSSIBLE SAMPLE HAZARDS/ REMARKS
Contains Radioactive Material at concentrations that may or may not be regulated for transportation per 49 CFR / IATA Dangerous Goods Regulations but are not releasable per DOE Order 5400.5 (1990/1993)

SPECIAL HANDLING AND/OR STORAGE

PRESERVATION	None
HOLDING TIME	6 Months
TYPE OF CONTAINER	G/P
NO. OF CONTAINER(S)	1
VOLUME	1000mL
SAMPLE ANALYSIS	KD - Batch {No CAS};

SAMPLE NO.	MATRIX*	SAMPLE DATE	SAMPLE TIME	
B28KW9	SOIL	11/12/10	1215	✓

CHAIN OF POSSESSION — **SIGN/ PRINT NAMES**

RELINQUISHED BY/REMOVED FROM	DATE/TIME	RECEIVED BY/STORED IN	DATE/TIME
J. Garcia [signature]	11/12/10 1330	SSU-R4	11/12/10 1330
SSU-R4	11-16-10 0700	cm Aguilar cmlagh	11-16-10 0700
cm Aguilar cmlagh	11-16-10 8:40	[signature]	11-16-10 8:40
		Igor Kutnyakov	

SPECIAL INSTRUCTIONS
** The 100 Area S&GRP Characterization and Monitoring Sampling and Analysis GKI applies to this SAF.☐ The CACN for all analytical work at WSCF laboratory is 401642ES20.

BRM # B564

LABORATORY SECTION	**RECEIVED BY**	**TITLE**	**DATE/TIME**
FINAL SAMPLE DISPOSITION	**DISPOSAL METHOD**	**DISPOSED BY**	**DATE/TIME**

SDG # ESL090020

A-6003-618(01/06)

CH2MHill Plateau Remediation Company	CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST			F10-214-049	PAGE 1 OF 1
COLLECTOR Morley	COMPANY CONTACT RADLOFF, AW	TELEPHONE NO. 376-4554	PROJECT COORDINATOR RADLOFF, AW	PRICE CODE 8N	DATA TURNAROUND 45 Days / 45 Days
SAMPLING LOCATION C7627 (199-H3-7); I-017	PROJECT DESIGNATION 100 Area Remedial Investigation/Feasibility Analysis - 100-HR-3 - Sediment		SAF NO. F10-214	AIR QUALITY ☐	
ICE CHEST NO. N/A	FIELD LOGBOOK NO. HNF-N-585 12 (Pg 27)	ACTUAL SAMPLE DEPTH 53.6'	COA 300110ES10	METHOD OF SHIPMENT GOVERNMENT VEHICLE	
SHIPPED TO Environmental Sciences Laboratory	OFFSITE PROPERTY NO. N/A		BILL OF LADING/AIR BILL NO. N/A		

MATRIX*	POSSIBLE SAMPLE HAZARDS/ REMARKS		
A=Air DL=Drum Liquids DS=Drum Solids L=Liquid O=Oil S=Soil SE=Sediment T=Tissue V=Vegetation W=Water WI=Wipe X=Other	Contains Radioactive Material at concentrations that may or may not be regulated for transportation per 49 CFR / IATA Dangerous Goods Regulations but are not releasable per DOE Order 5400.5 (1990/1993)	PRESERVATION	None
		HOLDING TIME	6 Months
		TYPE OF CONTAINER	G/P
		NO. OF CONTAINER(S)	1
		VOLUME	1000mL
	SPECIAL HANDLING AND/OR STORAGE	SAMPLE ANALYSIS	KD - Batch {No CAS};

SAMPLE NO.	MATRIX*	SAMPLE DATE	SAMPLE TIME	
B28N30	SOIL	11/11/10	1130	\

CHAIN OF POSSESSION	DATE/TIME	SIGN/ PRINT NAMES	DATE/TIME
RELINQUISHED BY/REMOVED FROM J Morley J Morley	11/11/10 1418	RECEIVED BY/STORED IN MO413 SSU-R4	11/11/10 ~~1418~~ 1418 DA. 11-11-10
RELINQUISHED BY/REMOVED FROM SSU-R4 11-16-10	0700	RECEIVED BY/STORED IN CmAguilar CmAguilar	11-16-10 0700
RELINQUISHED BY/REMOVED FROM CmAguilar CmAguilar 11-16-10	8:40	RECEIVED BY/STORED IN Igor Kutnyakov	11-16-10 8:40
RELINQUISHED BY/REMOVED FROM	DATE/TIME	RECEIVED BY/STORED IN Igor Kutnyakov	DATE/TIME
RELINQUISHED BY/REMOVED FROM	DATE/TIME	RECEIVED BY/STORED IN	DATE/TIME
RELINQUISHED BY/REMOVED FROM	DATE/TIME	RECEIVED BY/STORED IN	DATE/TIME
RELINQUISHED BY/REMOVED FROM	DATE/TIME	RECEIVED BY/STORED IN	DATE/TIME

SPECIAL INSTRUCTIONS

** The 100 Area S&GRP Characterization and Monitoring Sampling and Analysis GKI applies to this SAF.

BRM#13564

ORIGINAL

LABORATORY SECTION	RECEIVED BY	TITLE	DATE/TIME
FINAL SAMPLE DISPOSITION	DISPOSAL METHOD	DISPOSED BY	DATE/TIME

A-6003-618(01/06)

CH2MHill Plateau Remediation Company	CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST			F10-214-056	PAGE 1 OF 1
COLLECTOR GARCIA, ANDERSON	COMPANY CONTACT RADLOFF, AW	TELEPHONE NO. 376-4554	PROJECT COORDINATOR RADLOFF, AW	PRICE CODE 8N AIR QUALITY ☐	DATA TURNAROUND 45 Days / 45 Days
SAMPLING LOCATION C7623 (199-D6-3); I-021	PROJECT DESIGNATION 100 Area Remedial Investigation/Feasibility Analysis - 100-HR-3 - Sediment		SAF NO. F10-214		
ICE CHEST NO. N/A	FIELD LOGBOOK NO. HNF-N-491-8 Pg 152	ACTUAL SAMPLE DEPTH ~~105~~ 104 DA 12·3·10	COA 300110ES10	METHOD OF SHIPMENT GOVERNMENT VEHICLE	
SHIPPED TO Environmental Sciences Laboratory	OFFSITE PROPERTY NO. N/A		BILL OF LADING/AIR BILL NO. N/A		

MATRIX*
A=Air
DL=Drum Liquids
DS=Drum Solids
L=Liquid
O=Oil
S=Soil
SE=Sediment
T=Tissue
V=Vegetation
W=Water
WI=Wipe
X=Other

POSSIBLE SAMPLE HAZARDS/ REMARKS
Contains Radioactive Material at concentrations that may or may not be regulated for transportation per 49 CFR / IATA Dangerous Goods Regulations but are not releasable per DOE Order 5400.5 (1990/1993)

SPECIAL HANDLING AND/OR STORAGE

PRESERVATION	None
HOLDING TIME	6 Months
TYPE OF CONTAINER	G/P
NO. OF CONTAINER(S)	1
VOLUME	1000mL
SAMPLE ANALYSIS	KD - Batch {No CAS};

SAMPLE NO.	MATRIX*	SAMPLE DATE	SAMPLE TIME	
B28YW2	SOIL	12·3·10	0835	✓

CHAIN OF POSSESSION	DATE/TIME	SIGN/ PRINT NAMES	DATE/TIME
RELINQUISHED BY/REMOVED FROM Doug Anderson / [signature]	12·3·10 / 1115	RECEIVED BY/STORED IN SSU-R1	DEC 0 3 2010 / 1115
RELINQUISHED BY/REMOVED FROM SSU-R1	DEC 0 6 2010 / 1200	RECEIVED BY/STORED IN SSU-R1 M. A. White [signature]	DEC 0 6 2010 / 1200
RELINQUISHED BY/REMOVED FROM M. A. White [signature]	DEC 0 6 2010 / 13:20	RECEIVED BY/STORED IN Igor Kutnyakov [signature]	DEC 0 6 2010 / 13:20
RELINQUISHED BY/REMOVED FROM	DATE/TIME	RECEIVED BY/STORED IN	DATE/TIME
RELINQUISHED BY/REMOVED FROM	DATE/TIME	RECEIVED BY/STORED IN	DATE/TIME
RELINQUISHED BY/REMOVED FROM	DATE/TIME	RECEIVED BY/STORED IN	DATE/TIME
RELINQUISHED BY/REMOVED FROM	DATE/TIME	RECEIVED BY/STORED IN	DATE/TIME

SPECIAL INSTRUCTIONS
** The 100 Area S&GRP Characterization and Monitoring Sampling and Analysis GKI applies to this SAF.

BRM#13564

ORIGINAL

LABORATORY SECTION	RECEIVED BY	TITLE	DATE/TIME
FINAL SAMPLE DISPOSITION	DISPOSAL METHOD	DISPOSED BY	DATE/TIME

SDG # ESL090020

A-6003-618 (REV 2)

CH2MHill Plateau Remediation Company	CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST		F10-214-029	PAGE 1 OF 1
COLLECTOR Romo, Kauch, Billingsley	COMPANY CONTACT ANNA RADLOFF	TELEPHONE NO. 376-4554	PROJECT COORDINATOR RADLOFF, AW	PRICE CODE 8N AIR QUALITY ☐ DATA TURNAROUND 45 Days / 45 Days
SAMPLING LOCATION C7622 (199-D5-133); I-027	PROJECT DESIGNATION 100 Area Remedial Investigation/Feasibility Analysis - 100-HR-3 - Sediment		SAF NO. F10-214	
ICE CHEST NO. N/A	FIELD LOGBOOK NO. ~~HNF-N-~~ 585-12 PG 51	ACTUAL SAMPLE DEPTH 103.2 - 105.0	COA 300110ES10	METHOD OF SHIPMENT GOVERNMENT VEHICLE **ORIGINAL**
SHIPPED TO Environmental Sciences Laboratory	OFFSITE PROPERTY NO. N/A		BILL OF LADING/AIR BILL NO. N/A	

MATRIX*	POSSIBLE SAMPLE HAZARDS/ REMARKS		
A=Air DL=Drum Liquids DS=Drum Solids L=Liquid O=Oil S=Soil SE=Sediment T=Tissue V=Vegetation W=Water WI=Wipe X=Other	Contains Radioactive Material at concentrations that may or may not be regulated for transportation per 49 CFR / IATA Dangerous Goods Regulations but are not releasable per DOE Order 5400.5 (1990/1993)	PRESERVATION	None
		HOLDING TIME	6 Months
		TYPE OF CONTAINER	G/P
		NO. OF CONTAINER(S)	1
		VOLUME	~~1000mL~~ 500 KS 1/19/11
	SPECIAL HANDLING AND/OR STORAGE ~~RADSCREEN TIE TO: B28BP0~~ KS 1/14/11	SAMPLE ANALYSIS	KD - Batch {No CAS};

SAMPLE NO.	MATRIX*	SAMPLE DATE	SAMPLE TIME	
B28CP2	SOIL	1-14-11	0850	✓

CHAIN OF POSSESSION		SIGN/ PRINT NAMES	
RELINQUISHED BY/REMOVED FROM	DATE/TIME	RECEIVED BY/STORED IN	DATE/TIME
Rob Romo, Rob Romo	1-14-11 1300	MO-413 SSU-R1	1-14-11 1300
SSU-R1	JAN 19 2011 0940	J.R. Aguilar	JAN 19 2011 0940
J.R. Aguilar	JAN 19 2011 ~~0940~~ 13:40	Bea Williams	1/19/11 13:40
	1-19-11		

SPECIAL INSTRUCTIONS

** The 100 Area S&GRP Characterization and Monitoring Sampling and Analysis GKI applies to this SAF.☐ The CACN for all analytical work at WSCF laboratory is 401642ES20.

BRM # 13564

LABORATORY SECTION	RECEIVED BY	TITLE	DATE/TIME
FINAL SAMPLE DISPOSITION	DISPOSAL METHOD	DISPOSED BY	DATE/TIME

PRINTED ON 1/14/2011 SDG# ESL090020 A-6003-618 (REV 2)

CH2MHill Plateau Remediation Company	CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST		F10-214-059	PAGE 1 OF 1
COLLECTOR Christensen, Garcia	COMPANY CONTACT RADLOFF, AW	TELEPHONE NO. 376-4554	PROJECT COORDINATOR RADLOFF, AW	PRICE CODE 8N; Data Turnaround 30 Days/30 Days
SAMPLING LOCATION C7639 (199-H3-9); I-017	PROJECT DESIGNATION 100 Area Remedial Investigation/Feasibility Analysis - 100-HR-3 - Sediment		SAF NO. F10-214	AIR QUALITY ☐
ICE CHEST NO. N/A	FIELD LOGBOOK NO. ~~HNF-N-~~ 491-14 PG 9	ACTUAL SAMPLE DEPTH 46.0 - 48.5 FT	COA 300110ES10	METHOD OF SHIPMENT GOVERNMENT VEHICLE
SHIPPED TO Environmental Sciences Laboratory	OFFSITE PROPERTY NO. N/A		BILL OF LADING/AIR BILL NO. N/A	

MATRIX*	POSSIBLE SAMPLE HAZARDS/ REMARKS		
A=Air DL=Drum Liquids DS=Drum Solids L=Liquid O=Oil S=Soil SE=Sediment T=Tissue V=Vegetation W=Water WI=Wipe X=Other	Contains Radioactive Material at concentrations that may or may not be regulated for transportation per 49 CFR / IATA Dangerous Goods Regulations but are not releasable per DOE Order 5400.5 (1990/1993)	PRESERVATION	None
		HOLDING TIME	6 Months
		TYPE OF CONTAINER	G/P
		NO. OF CONTAINER(S)	1
		VOLUME	1000mL
	SPECIAL HANDLING AND/OR STORAGE	SAMPLE ANALYSIS	KD - Batch {No CAS};

SAMPLE NO.	MATRIX*	SAMPLE DATE	SAMPLE TIME	
B29C20	SOIL	1/22/11	0818	✓

CHAIN OF POSSESSION		SIGN/ PRINT NAMES	
RELINQUISHED BY/REMOVED FROM	DATE/TIME	RECEIVED BY/STORED IN	DATE/TIME
E. Christensen E. Christensen	1/22/11 1315	SSU R1	1/22/11 1315
SSU-R1	JAN 24 2011 1100	T.A. Wallace CHPRC	JAN 24 2011 1100
T.A. Wallace CHPRC	13:30 JAN 24 2011	Igor Katnyakov	13:30 JAN 24 2011

SPECIAL INSTRUCTIONS

** The 100 Area S&GRP Characterization and Monitoring Sampling and Analysis GKI applies to this SAF.☐ The CACN for all analytical work at WSCF laboratory is 401642ES20.

BRM# 13564

ORIGINAL

LABORATORY SECTION	RECEIVED BY	TITLE	DATE/TIME
FINAL SAMPLE DISPOSITION	DISPOSAL METHOD	DISPOSED BY	DATE/TIME

SDG# ESL090020

A-6003-618 (REV 2)

CH2MHill Plateau Remediation Company	CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST			F10-214-115	PAGE 1 OF 1
COLLECTOR Billingsley, Garcia, Christian	COMPANY CONTACT RADLOFF, AW	TELEPHONE NO. 376-4554	PROJECT COORDINATOR RADLOFF, AW	PRICE CODE 8N	DATA TURNAROUND
SAMPLING LOCATION C7624 (199-D5-134); I-024	PROJECT DESIGNATION 100 Area Remedial Investigation/Feasibility Analysis - 100-HR-3 - Sediment		SAF NO. F10-214	AIR QUALITY ☐	PRICE CODE 7 H DATA TURANAROUND 30 DAYS/30 DAYS
ICE CHEST NO. N/A	FIELD LOGBOOK NO. HNF-N-491-13 P613	ACTUAL SAMPLE DEPTH 107.3'-109.8'	COA 300110ES10	METHOD OF SHIPMENT GOVERNMENT VEHICLE	
SHIPPED TO Environmental Sciences Laboratory	OFFSITE PROPERTY NO. N/A		BILL OF LADING/AIR BILL NO. N/A		

MATRIX*	POSSIBLE SAMPLE HAZARDS/ REMARKS		
A=Air DL=Drum Liquids DS=Drum Solids L=Liquid O=Oil S=Soil SE=Sediment T=Tissue V=Vegetation W=Water WI=Wipe X=Other	Contains Radioactive Material at concentrations that may or may not be regulated for transportation per 49 CFR / IATA Dangerous Goods Regulations but are not releasable per DOE Order 5400.5 (1990/1993)	PRESERVATION	None
		HOLDING TIME	6 Months
		TYPE OF CONTAINER	G/P
		NO. OF CONTAINER(S)	1
		VOLUME	1000mL
	SPECIAL HANDLING AND/OR STORAGE	SAMPLE ANALYSIS	KD - Batch {No CAS};

SAMPLE NO.	MATRIX*	SAMPLE DATE	SAMPLE TIME	
B29P71	SOIL	1-25-11	0935	✓

CHAIN OF POSSESSION		SIGN/ PRINT NAMES	
RELINQUISHED BY/REMOVED FROM	DATE/TIME	RECEIVED BY/STORED IN	DATE/TIME
J Billingsley	1-25-11 1355	MO-413 SSU-R1	1-25-11 1355
MO 413 SSU-R1	1/26/11 0800	Thomas Wallace	1/26/11 0800
Thomas Wallace	1/26/11 13:15	Igor Kutnyakov	1/26/11 1315

SPECIAL INSTRUCTIONS

** The 100 Area S&GRP Characterization and Monitoring Sampling and Analysis GKI applies to this SAF.☐** The CACN for all analytical work at WSCF laboratory is 401642ES20.

BRM # 13564

ORIGINAL

LABORATORY SECTION	RECEIVED BY	TITLE	DATE/TIME
FINAL SAMPLE DISPOSITION	DISPOSAL METHOD	DISPOSED BY	DATE/TIME

A-6003-618 (REV 2)

CH2MHill Plateau Remediation Company	CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST			F10-214-089	PAGE 1 OF 1
COLLECTOR Morlock / Anderson	COMPANY CONTACT RADLOFF, AW	TELEPHONE NO. 376-4554	PROJECT COORDINATOR RADLOFF, AW	PRICE CODE 8N	DATA Data Turnaround 30 Days/30 Days
SAMPLING LOCATION C7631 (199-H2-1); I-014	PROJECT DESIGNATION 100 Area Remedial Investigation/Feasibility Analysis - 100-HR-3 - Sediment		SAF NO. F10-214	AIR QUALITY ☐	
ICE CHEST NO. N/A	FIELD LOGBOOK NO. HNF-N-491-14 (Pg 13)	ACTUAL SAMPLE DEPTH 38.1'	COA 300110ES10	METHOD OF SHIPMENT GOVERNMENT VEHICLE	
SHIPPED TO Environmental Sciences Laboratory	OFFSITE PROPERTY NO. N/A		BILL OF LADING/AIR BILL NO. N/A		

MATRIX*	POSSIBLE SAMPLE HAZARDS/ REMARKS	PRESERVATION	None
A=Air DL=Drum Liquids DS=Drum Solids L=Liquid O=Oil S=Soil SE=Sediment T=Tissue V=Vegetation W=Water WI=Wipe X=Other	Contains Radioactive Material at concentrations that may or may not be regulated for transportation per 49 CFR / IATA Dangerous Goods Regulations but are not releasable per DOE Order 5400.5 (1990/1993)	HOLDING TIME	6 Months
		TYPE OF CONTAINER	G/P
		NO. OF CONTAINER(S)	1
		VOLUME	1000mL
	SPECIAL HANDLING AND/OR STORAGE	SAMPLE ANALYSIS	KD - Batch {No CAS};

SAMPLE NO.	MATRIX*	SAMPLE DATE	SAMPLE TIME	
B29HN7	SOIL	2/16/11	1435	\

CHAIN OF POSSESSION		SIGN/ PRINT NAMES	
RELINQUISHED BY/REMOVED FROM	DATE/TIME	RECEIVED BY/STORED IN	DATE/TIME
J. Morlock	2/16/11 1525	MO 413 SSU-R1	2/16/11 1525
SSU-R1	2-17-11 0700	cm Aguilar	2-17-11 0700
cm Aguilar	2-17-11 1330	I. Kartnyakov	2/17/11 1330

SPECIAL INSTRUCTIONS

** The 100 Area S&GRP Characterization and Monitoring Sampling and Analysis GKI applies to this SAF.☐

BRM # 13564

ORIGINAL

LABORATORY SECTION	RECEIVED BY	TITLE	DATE/TIME
FINAL SAMPLE DISPOSITION	DISPOSAL METHOD	DISPOSED BY	DATE/TIME

SDG # ESL 090020

A-6003-618 (REV 2)

CH2MHill Plateau Remediation Company	CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST			F10-214-143	PAGE 1 OF 1
COLLECTOR BAILEY	COMPANY CONTACT RADLOFF, AW	TELEPHONE NO. 376-4554	PROJECT COORDINATOR RADLOFF, AW	PRICE CODE 8N AIR QUALITY ☐	Data Turnaround 30 Days/30 Days
SAMPLING LOCATION C7640 (199-H3-10); I-015	PROJECT DESIGNATION 100 Area Remedial Investigation/Feasibility Analysis - 100-HR-3 - Sediment		SAF NO. F10-214		
ICE CHEST NO. N/A	FIELD LOGBOOK NO. HNF-N-491-14/21	ACTUAL SAMPLE DEPTH 53.1'-55.4'	COA 300110ES10	METHOD OF SHIPMENT FEDERAL EXPRESS	
SHIPPED TO Environmental Sciences Laboratory	OFFSITE PROPERTY NO. SEE PTR		BILL OF LADING/AIR BILL NO. SEE PTR		

MATRIX*	POSSIBLE SAMPLE HAZARDS/ REMARKS		
A=Air DL=Drum Liquids DS=Drum Solids L=Liquid O=Oil S=Soil SE=Sediment T=Tissue V=Vegetation W=Water WI=Wipe X=Other	Contains Radioactive Material at concentrations that may or may not be regulated for transportation per 49 CFR / IATA Dangerous Goods Regulations but are not releasable per DOE Order 5400.5 (1990/1993)	PRESERVATION	None
		HOLDING TIME	6 Months
		TYPE OF CONTAINER	G/P
		NO. OF CONTAINER(S)	1
		VOLUME	1000mL
	SPECIAL HANDLING AND/OR STORAGE	SAMPLE ANALYSIS	KD - Batch {No CAS};

SAMPLE NO.	MATRIX*	SAMPLE DATE	SAMPLE TIME	
B2B4H0	SOIL	3-16-11	1305	✓

CHAIN OF POSSESSION	DATE/TIME	SIGN/ PRINT NAMES	DATE/TIME
RELINQUISHED BY/REMOVED FROM JEBAILEY / JEB	3-16-11/1500	RECEIVED BY/STORED IN MOU13 SSU R1	3-16-11/1500
RELINQUISHED BY/REMOVED FROM	MAR 2 1 2011 0814	RECEIVED BY/STORED IN J.R. Aguilar	MAR 2 1 2011 0814
RELINQUISHED BY/REMOVED FROM SSU R1 J.R. Aguilar	MAR 2 1 2011 1330	RECEIVED BY/STORED IN J. Kutnyaka	MAR 2 1 2011 1330
RELINQUISHED BY/REMOVED FROM	DATE/TIME	RECEIVED BY/STORED IN	DATE/TIME
RELINQUISHED BY/REMOVED FROM	DATE/TIME	RECEIVED BY/STORED IN	DATE/TIME
RELINQUISHED BY/REMOVED FROM	DATE/TIME	RECEIVED BY/STORED IN	DATE/TIME
RELINQUISHED BY/REMOVED FROM	DATE/TIME	RECEIVED BY/STORED IN	DATE/TIME

SPECIAL INSTRUCTIONS

** The 100 Area S&GRP Characterization and Monitoring Sampling and Analysis GKI applies to this SAF.

BRM # 13564

ORIGINAL

LABORATORY SECTION	RECEIVED BY	TITLE	DATE/TIME
FINAL SAMPLE DISPOSITION	DISPOSAL METHOD	DISPOSED BY	DATE/TIME

A-6003-618 (REV 2)

CH2MHill Plateau Remediation Company	CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST			F10-214-158	PAGE 1 OF 1
COLLECTOR Kauck, Romo, Kauck	COMPANY CONTACT RADLOFF, AW	TELEPHONE NO. 376-4554	PROJECT COORDINATOR RADLOFF, AW	PRICE CODE	PRICE CODE 5C DATA TURNAROUND 15 Days/15 Days
SAMPLING LOCATION C8375 (199-D5-143); I-034	PROJECT DESIGNATION 100 Area Remedial Investigation/Feasibility Analysis - 100-HR-3 - Sediment		SAF NO. F10-214	AIR QUALITY ☐	
ICE CHEST NO. N/A	FIELD LOGBOOK NO. HNF-N-491-13 Pg 28	ACTUAL SAMPLE DEPTH 105.2 - 107.7 FT	COA 300110ES10	METHOD OF SHIPMENT GOVERNMENT VEHICLE	ORIGINAL
SHIPPED TO Environmental Sciences Laboratory	OFFSITE PROPERTY NO. N/A		BILL OF LADING/AIR BILL NO. N/A		

MATRIX*	POSSIBLE SAMPLE HAZARDS/ REMARKS			
A=Air DL=Drum Liquids DS=Drum Solids L=Liquid O=Oil S=Soil SE=Sediment T=Tissue V=Vegetation W=Water WI=Wipe X=Other	Contains Radioactive Material at concentrations that may or may not be regulated for transportation per 49 CFR / IATA Dangerous Goods Regulations but are not releasable per DOE Order 5400.5 (1990/1993)		PRESERVATION	None
			HOLDING TIME	6 Months
			TYPE OF CONTAINER	G/P
			NO. OF CONTAINER(S)	1
			VOLUME	1000mL
	SPECIAL HANDLING AND/OR STORAGE		SAMPLE ANALYSIS	KD - Batch {No CAS};

SAMPLE NO.	MATRIX*	SAMPLE DATE	SAMPLE TIME	
B2C647	SOIL	4-14-11	1440	✓

CHAIN OF POSSESSION		SIGN/ PRINT NAMES	
RELINQUISHED BY/REMOVED FROM	DATE/TIME	RECEIVED BY/STORED IN	DATE/TIME
Rob Romo, Rob Romo	4-14-11 1530	MO-413 SSU R1	4-14-11 1530
MO-413 SSU-R1	4-25-11 1220	M A White, M A White	4-25-11 1220
M A White, M A White	4-25-11 13:00	I. Kutnyakov, Igor Kutnyakov	4-25-11 13:00

SPECIAL INSTRUCTIONS

** The 100 Area S&GRP Characterization and Monitoring Sampling and Analysis GKI applies to this SAF.

BRM # 13564

LABORATORY SECTION	RECEIVED BY	TITLE	DATE/TIME
FINAL SAMPLE DISPOSITION	DISPOSAL METHOD	DISPOSED BY	DATE/TIME

PRINTED ON 2/23/2011

SDG# ESL090020

A-6003-618 (REV 2)