Comanche Station, Pueblo County, Colorado

Monitoring Well Installation Report

Comanche Station

Xcel Energy

August 1, 2016

Rev. 1 June 14, 2018

Rev 2 June 28, 2021

Table of Contents

List of Tables

List of Figures

List of Appendices

Table of Abbreviations and Acronyms

AMSL	above mean sea level
bgs	below ground surface
BTOC	below top of casing
CCR	Coal Combustion Residuals
cm/sec	centimeter per second
HP Geotech	Hepworth-Pawlak Geotechnical, Inc.
µS/cm	microsiemens per centimeter
NTU	nephelometric turbidity unit
PSCo	Public Service Company of Colorado
SSD	Site Services Drilling, LLC
TOC	top of casing
USCS	Unified Soil Classification System

1.0 Introduction

The purpose of this Monitoring Well Installation Report is to document details pertaining to the drilling, construction, and development of three monitoring wells installed in 2015, two monitoring wells installed in 2017, and 15 groundwater monitoring wells installed in 2020 at the Xcel Energy Comanche Generating Station (Comanche Station) in Pueblo, Colorado (**Figure 1**). The groundwater monitoring system is intended to support compliance with the U.S. Environmental Protection Agency's final Coal Combustion Residuals (CCR) Rule (40 CFR Parts 257 and 261). Comanche Station has two CCR units[1], an impoundment and a landfill, subject to the CCR Rule. The drilling and well installations were performed in accordance with the State of Colorado Water Well Construction Rules (2 Code of Colorado Regulations 402-2).

HDR was contracted to locate, permit, and oversee the installation of the groundwater monitoring wells (installed 2015 and later) at Comanche Station. HDR retained Hepworth-Pawlak Geotechnical, Inc. (HP Geotech) in 2015, Site Services Drilling, LLC (SSD) in 2017, and Dakota Drilling, LLC in 2020 to provide on-site drilling services, while HDR provided field monitoring of the drilling, well installation, and development. All on-site personnel completed the site-specific safety training. Additionally, daily safety briefs were conducted by the on-site project team prior to commencing work. The training and safety briefs were documented in accordance with the *PSCo CCR Rule Compliance Health & Safety Plan.*

2.0 Background Information

Prior hydrogeologic and geotechnical investigations conducted at Comanche Station are identified and summarized in the Comanche Station Monitoring Well Installation Plan (HDR, 2015a). Comanche Station is underlain by unconsolidated colluvium consisting of stiff clays and silts, with interbedded sand and gravel west and south of the CCR landfill. Typical colluvium thickness is approximately 20 feet but ranges between 5 and 75 feet (Woodward-Clyde, 1987; URS, 2005). The Pierre Shale bedrock is below the colluvium and is approximately 1,450 feet thick. The southern and western portions of the substation have thin alluvial sands and gravels above the shale bedrock.

The uppermost known aquifer in literature beneath the Site is the Dakota Sandstone at a depth of over 1,450 feet (GeoTrans, Inc., 2009). Approximately 1,450 feet of low-permeability shale deposits separate the CCR units from this known aquifer. Tetra Tech (2015) estimated the groundwater velocity through the Pierre Shale and estimated that it will take 14,500 years to migrate through the bedrock shale deposits before leachate from the Comanche CCR units would reach the Dakota Sandstone Aquifer.

The monitoring well network prior to the 2020 drilling was established to monitor the colluvium, with screened intervals in the colluvium and well bottoms at the colluvium/shale contact. The wells were placed around the CCR units to capture any groundwater flow around the units, and to determine if a groundwater flow direction could be monitored and observed. Consistent with prior studies, the shallow unconsolidated colluvium deposits beneath the site were observed by HDR between 2015

[1] Comanche Station includes three coal-fired generation units. All CCR generated at Comanche Station is stored in two active CCR units subject to compliance with the CCR Rule: a CCR impoundment and a CCR landfill (Figure 2). The CCR impoundment is located southeast of the coal storage area, and the CCR landfill is west of the raw water storage pond.

and 2020 to be predominantly dry, with some isolated areas of perched water[2] (GeoTrans, Inc., 2009). Areas of perched water may be controlled by the bedrock topography where water becomes trapped by topographic lows in the shale bedrock surface (GeoTrans, Inc., 2009). A potential south-southeasterly flow gradient was assumed based on the ground surface topography, which slopes to the south-southeast towards the St. Charles River. The alluvial aquifers associated with the Arkansas River (north), the St. Charles River (south), and Salt Creek (west) do not fully extend beneath the site; however boreholes at the south and west edges of the property appear to have alluvial units interbedded with the colluvium, above the shale bedrock.

Three monitoring wells installed in 2015 (W-4, W-5, and W-6) were sited around the Bottom Ash Pond based on monitoring requirements in the CCR Rule, facility design, and existing hydrogeologic data for the vicinity, as described in the Groundwater Monitoring System Certification (HDR, 2020). Well locations are shown on **Figure 2**. These wells were screened in the colluvium to be consistent with the CCR Rule to monitor the uppermost groundwater. The uppermost groundwater known at the site in 2015 was that observed as perched water in the colluvium at W-3 adjacent to the Bottom Ash Pond and MW-3 adjacent to the landfill.

Wells MW-5 and MW-6 were installed in 2017 to provide coverage for the lateral expansion of the landfill. These wells were screened in the colluvium to be consistent with the existing wells surrounding the landfill, and to be consistent with the CCR Rule to monitor the uppermost groundwater (the uppermost groundwater known at the site in 2015-2017 was that observed as perched water in the colluvium at W-3 and MW-3).

As part of additional site hydrogeologic characterization work implemented in 2020 to support an alternate liner demonstration under the EPA CCR Part B Final Rule (November 12, 2020) (40 CFR 257.71(d)), additional drilling was performed into the bedrock that resulted in fifteen (15) new (deeper) monitoring wells at the site in August 2020 and December 2020. Eight of the new monitoring wells (MW-1B, MW-2B, MW-4B, W-2A, W-2B, W-7, W-8A, W-8B) were installed in August. In December, seven more monitoring wells were installed (W-5B, W-9, W-10A, W-10B, W-11, W-12, and W-13). Five of the wells were screened deeper in the saturated weathered shale bedrock as the uppermost saturated unit to monitor locations where existing colluvial wells have historically been dry (MW-1B, MW-2B, MW-4B, W-2A, W-5B). Ten of the wells were sited to further characterize the complex groundwater system, confirm dry colluvium, and evaluate groundwater at the property boundary (W-2B, W-7, W-8A, W-8B, W-9, W-10A, W-10B, W-11, W-12, and W-13), seven of which (W-7, W-8A, W-9, W-10B, W-11, W-12, and W-13) were screened in the saturated weathered shale as the uppermost saturated unit. One well was screened in the dry colluvium (W-10A), and two wells (W-2B and W-8B) were screened deep in the unfractured, consolidated shale bedrock. Well locations are shown on **Figure 2**.

[2] Only two of the seven previously installed wells at the site, MW-3 and W-3, have contained measurable water, and most borings previously drilled at the site, including boreholes that penetrate the Pierre Shale, have been dry.

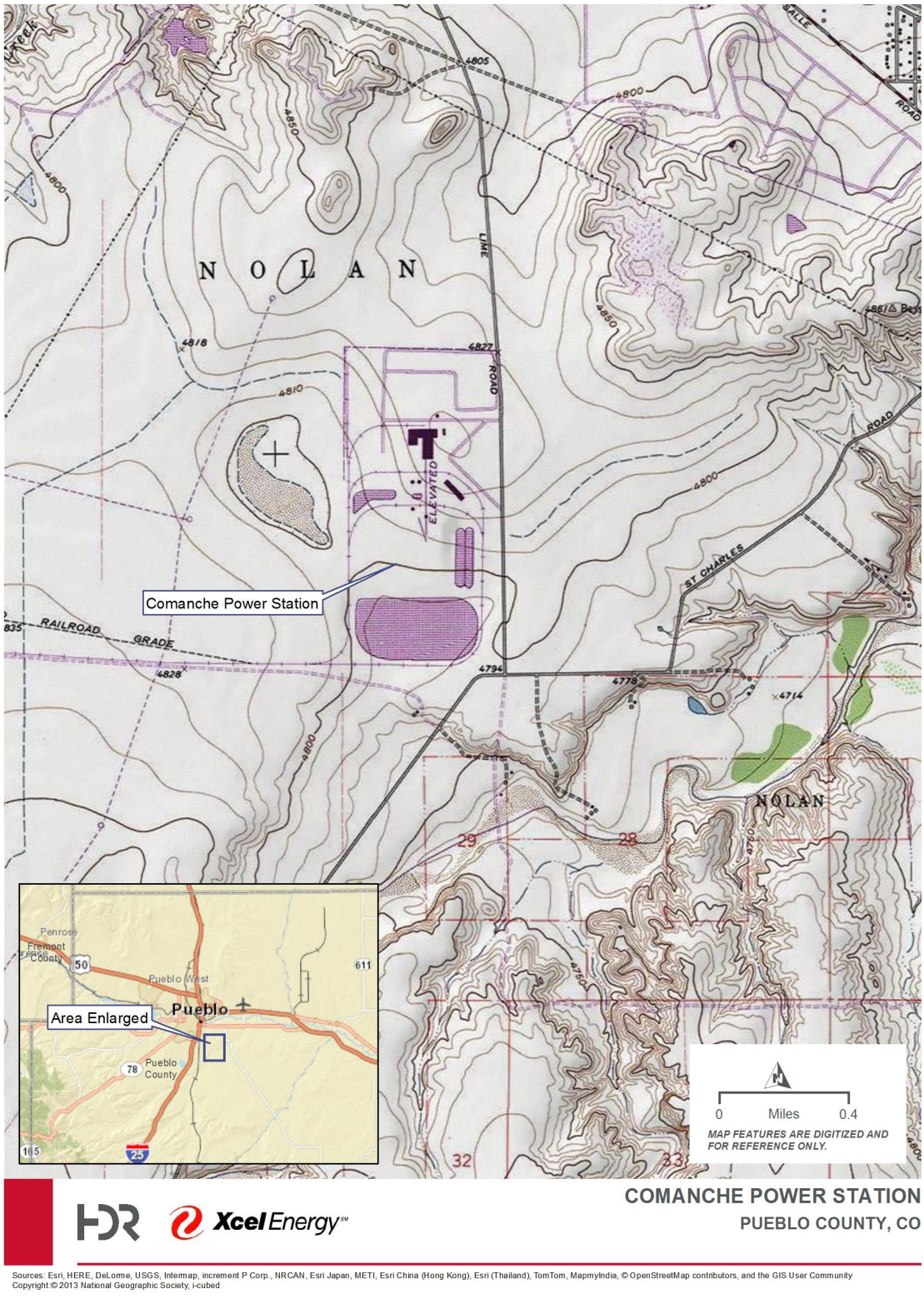


Figure 1. Vicinity Map for Comanche Station

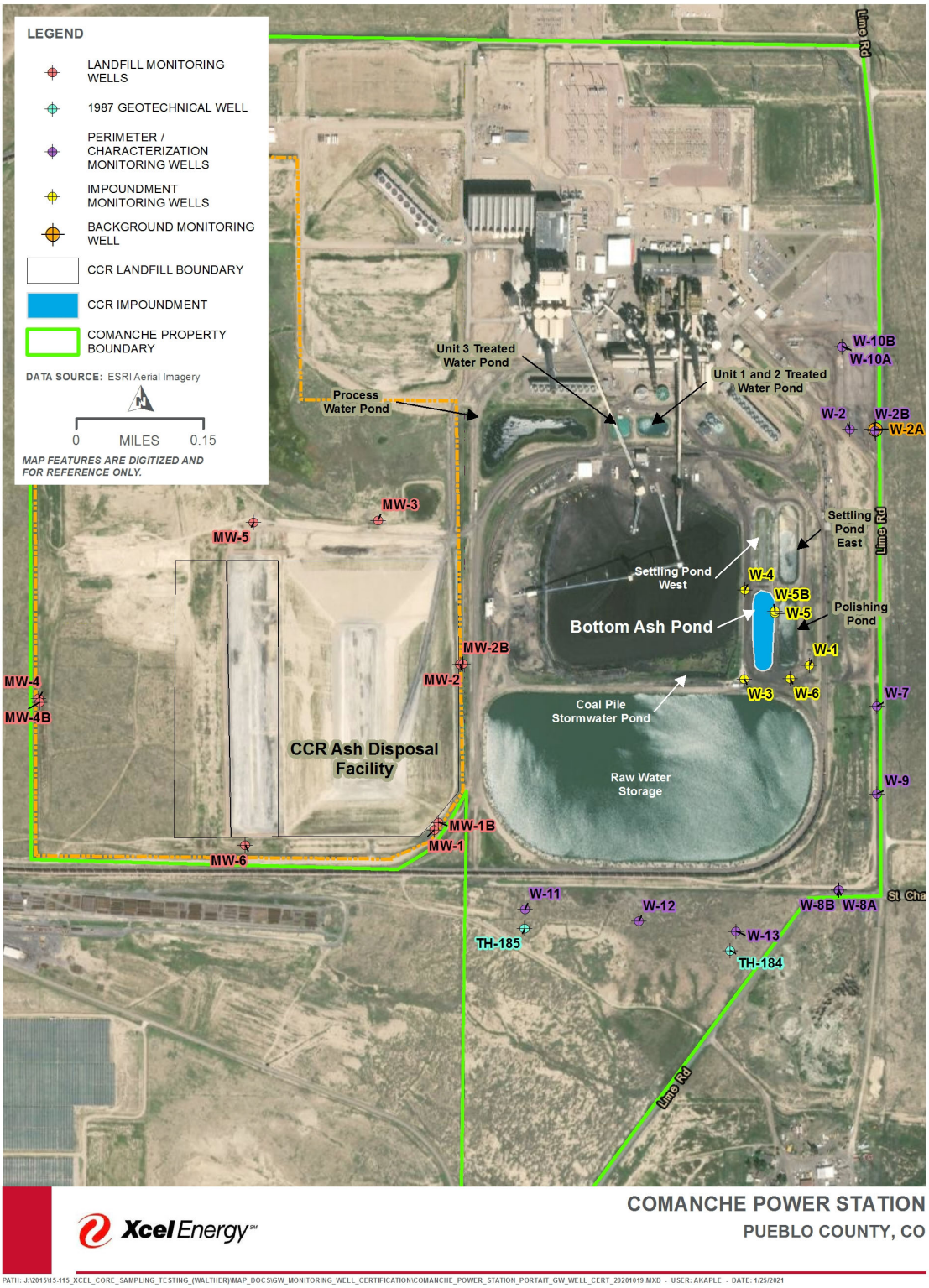


Figure 2. Well Location Map, Comanche Station

3.0 Field and Laboratory Methods

3.1 Borehole Drilling

The boreholes for wells W-4, W-5, and W-6 were drilled by HP Geotech using a hollow stem auger drilling method from November 9 through 11, 2015. The boreholes for MW-5 and MW-6 were drilled by Site Services Drilling (SSD) using the same method from August 7 through 8, 2017. The boreholes for wells MW-1B, MW-2B, MW-4B, W-2A, W-2B, W-7, W-8A, and W-8B in August 2020, and wells W-5B, W-9, W-10A, W-10B, W-11, W-12, and W-13 in December 2020 were drilled by Dakota Drilling using hollow stem auger through colluvium, then coring through bedrock. Once the well depth was determined, the borehole was reamed utilizing air rotary before installation of the monitoring well. Utility locations were identified prior to beginning drilling operations.

Screens for wells installed in 2015 and 2017 were targeted for the uppermost water-bearing zone, if encountered, or above the colluvium-bedrock contact where the hollow stem auger hit refusal. This resulted in total borehole depths that ranged from 25 feet to 75 feet, as further described in **Section 4.3**.

Screens for most wells installed in 2020 were targeting the uppermost groundwater, regardless of lithology, and were installed specifically to evaluate whether groundwater was present in the deeper weathered shale. In addition, wells W-2B and W-8B were screened in the consolidated, unfractured shale, and W-10A was screened above the colluvium-bedrock contact. An HDR geologist was present during core drilling operations to collect samples and log the subsurface material, in addition to overseeing site safety and proper well construction. Soil samples from boreholes were collected in plastic bags and logged every 5 feet by the field geologist during drilling to document lithologic soil characteristics. The geologist visually classified soil type, consistency/relative density, color, and water content in accordance with the Unified Soil Classification System (USCS) as well as grain size, mineralogy, sorting, rounding, hardness, and matrix/clast support, among other textural properties. Where coring was completed, fracture density was also noted. Samples were placed in sample bags labeled with the borehole identification and depth interval. One undisturbed soil sample from each well was collected within the well screen depth interval and submitted to a lab for hydraulic properties analysis, as described in **Section 3.2**. Soil samples were not collected in 2017. Boring logs for each borehole are provided in **Appendix A**.

Soil cuttings, fluids, and potholing slurry generated during drilling were transported to and disposed of at the existing onsite ash landfill. Drilling equipment was decontaminated with potable water before moving to the next borehole.

3.2 Soil Samples - Geotechnical Analysis

Soils were logged from the cutting returns during drilling wells W-4, W-5, and W-6 in 2015 and MW-1B, MW-2B, MW-4B, W-2B, W-7, and W-8A in August 2020 and classified based on the USCS. During drilling, one undisturbed soil sample was obtained from each borehole at a depth coinciding with the well screen depth. An 18-inch long California Modified Style Split-Spoon Sampler was used to collect the undisturbed core of sediment. The undisturbed soil samples (one from each well) were submitted to HP Geotech for analysis of the following parameters in 2015:

- Grain-size: Sieve and Hydrometer (ASTM D421/422)

- Total Porosity (SW9100)
- Bulk Density (ASTM D2937)
- Moisture Content (ASTM D2216)
- Specific Gravity (ASTM D854)

Analysis was completed in accordance with the method for grain-size analysis using sieve and hydrometer described in ASTM D421/422 (ASTM D421-85, 1998 and ASTM D422-63, 2007).

Undisturbed samples collected during drilling in August 2020 were submitted to Advanced Terra Testing (ATT) for the following analyses:

- Moisture Content (ASTM D2216)
- Permeability (ASTM D5084)

Chain of custody documentation and laboratory results are provided in **Appendix B**. Samples were not submitted to the laboratory from MW-5, MW-6, W-2A, or W-8B boreholes due to similarity of materials.

3.3 Well Construction

Once the target drilling depth was reached at each location, the 2-inch diameter, Schedule 40 PVC casing and well screen (0.010-inch slots) were assembled and lowered into the borehole. Approximately 10 feet of screen was installed in each well screened in the colluvium. To capture infiltrating perched water, a 10-foot long sump consisting of blank casing was placed beneath the screen for colluvial wells[3], as requested by CDPHE in a meeting with Xcel Energy on April 24, 2014 (Tetra Tech, 2014). However, a 5-foot long sump was placed beneath the well screen of MW-6 due to drilling refusal.

Wells installed in August 2020 have either 10, 15 or 20 feet of screen depending on the thickness of the weathered shale or to capture a longer section of bedrock for fracture flow. Wells installed in December 2020 have either 5 or 10 feet of screen depending on the thickness of the weathered shale. The well screens are completed just above the consolidated bedrock in weathered shale. None of the wells drilled and completed in December 2020 have sumps.

After PVC screen and casing placement in the borehole, sand filter pack and the bentonite seal were placed via gravity feed from the surface into the annular space. When applicable the sump was sealed in with bentonite to 2-feet below the bottom of the screen. The filter pack consisted of 10-20 (sieve size) washed silica sand emplaced from approximately 2 feet below the bottom of the screen to approximately 0.5 to 2 feet above the well screen. The annular seal of medium bentonite chips was placed above the top of the filter pack and hydrated in lifts throughout placement, while the remaining drill casing was removed from the borehole using the hydraulic jacks.

[3] Previously constructed wells W-1, W-2, W-3, and W-4 incorporated a 2-foot sump to capture infiltrating perched water. Due to the lack of a laterally extensive shallow groundwater system in the colluvium deposits beneath the site and the depth of the uppermost aquifer (Dakota Sandstone), a wet/dry monitoring well system is an effective way to detect changes in perched groundwater conditions and/or potential contaminants from the ash landfill and CCR impoundment.

An annular surface seal consisting of neat cement was installed from the top of the bentonite to the surface. All wells were finished with a 2-foot-by-2-foot concrete pad using Quickrete fast setting concrete, extending to a depth of approximately 0.5 to 2 feet below grade (to the top of the bentonite grout). Each well included a PVC stick-up. Each well was secured with a protective steel casing and lock. Well construction is further described in **Section 4.3.**

3.4 Well Development

Wells are typically developed over several days to improve hydraulic connectivity in the area immediately surrounding the well and remove any fluids introduced during drilling. Well development involves removing as much of the introduced drilling fluids, cuttings, and particulates from within and adjacent to the well as possible. Development did not begin until at least 12 hours after the wells had been grouted to ensure grout had sufficiently set.

Wells were to be developed by surge blocking and pumping. This method involves moving a surge block up and down the well screen and casing, which alternately forces water in and out of the screen, loosens sediment, and draws fine-grained materials into the well, then removing the purge water and fine sediment from the well using a pump. Wells MW-5, W-8A, W-10A, and W-13 were found to be dry after installation; therefore, well development was not attempted. Well development at other wells is further discussed in **Section 4.4**.

3.5 Well Survey

Surveying of the monitoring wells was performed by professional surveyor Edward-James Surveying, Inc. after well completion. The surveyor recorded elevations of the top of PVC casing (point at notch on the north side of the casing top) and ground surface using a level loop. The northing and easting coordinates of the wells were initially surveyed using a local coordinate system and converted to NAD 1983 UTM Zone 13 South.

3.6 Groundwater Level Measurement and Aquifer (Slug) Testing

HDR performed slug tests on monitoring wells MW-1B, MW-2B, MW-4B, MW-6, W-2A, W-2B, W-5, W-6, and W-7, to estimate hydraulic conductivity of screened units. Wells that were dry or had water levels that were very slow to equilibrate due to low permeability could not be tested using slug testing methods. All slug tested wells were constructed with 2-in diameter PVC. A 1.5-inch diameter by 2.75-foot long watertight (solid) slug, having an expected initial displacement of 1.53 feet in the wells, was used in all tests. A pressure transducer with integrated datalogger was suspended on a direct-read communications cable near the bottom of each well prior to testing, and water level measurements were recorded at 0.25-second intervals for MW-1B, MW-2B, MW-4B, MW-6, W-2A, W-5, W-6, and W-7, and increasing interval lengths from about 0.4 seconds up to a maximum of about 60 seconds for MW-2B. Both falling head (slug-in, identified as FH) and rising head (slug-out, identified as RH) tests were performed at each well. Slug-in tests were completed by emplacement of the slug into the water column as quickly as possible and measuring the falling water level that followed. Slug-out tests were completed after each slug-in test by removing the slug from the water column as quickly as possible and measuring the rising water level that followed. All non-dedicated down-well equipment used during slug testing was decontaminated after use at each location. Well-specific testing details are summarized below:

MW-1B: Two slug-in and two slug-out tests were performed on October 13, 2020. The static depth to water in the well was 31.20 feet below top of casing (btoc), and the screen was partially submerged with the water table 4.02 feet below the top of the screen interval. The screen length is 15 feet, and the bottom of the screen interval is at a depth of 42.18 feet btoc.

MW-2B: Two slug-in and two slug-out tests were performed on October 12, 2020. The depth to water in the well was 18.30 feet btoc, and the well screen was fully submerged with the top of the screen 4.09 feet below the water table. Screen length is 10 feet, and the bottom of the screen interval is at a depth of 32.39 feet btoc.

MW-4B: One slug-in and one slug-out test was performed on October 13, 2020. The depth to water in the well was 38.42 feet btoc, and the screen was partially submerged with the water table 0.42 feet below the top of the screen interval. Screen length is 20 feet, and the bottom of the screen interval is at a depth of 58.00 feet btoc.

MW-6: One slug-in and one slug-out test was performed on October 13, 2020. The depth to water in the well was 12.95 feet btoc, and the well screen was fully submerged with the top of the screen 16.28 feet below the water table. Screen length is 10 feet, and the bottom of the screen interval is at a depth of 39.23 feet btoc.

W-2A: One slug-in and one slug-out test was performed on October 15, 2020. The depth to water in the well was 27.15 feet btoc, and the screen was partially submerged with the water table 1.94 feet below the top of the screen interval. Screen length is 10 feet, and the bottom of the screen interval is at a depth of 35.21 feet btoc.

W-2B: Two slug-in and three slug-out tests were performed on October 15, 2020. The depth to water in the well was 51.56 feet btoc, and the well screen was fully submerged with the top of the screen 3.64 feet below the water table. Screen length is 20 feet, and the bottom of the screen interval is at a depth of 75.20 feet btoc.

W-5: Two slug-in and two slug-out tests were performed on October 14, 2020. The depth to water in the well was 10.33 feet btoc, and the screen was partially submerged with the water table 2.93 feet below the top of the screen interval. Screen length is 10 feet, and the bottom of the screen interval is at a depth of 17.40 feet btoc.

W-6: One slug-in and one slug-out test was performed on October 14, 2020. The depth to water in the well was 9.65 feet btoc, and the screen was partially submerged with the water table 0.82 feet below the top of the screen interval. Screen length is 10 feet, and the bottom of the screen interval is at a depth of 18.83 feet btoc.

W-7: One slug-in and one slug-out test was performed on October 14, 2020. The depth to water in the well was 6.80 feet btoc, and the well screen was fully submerged with the top of the screen 1.53 feet below the water table. Screen length is 15 feet, and the bottom of the screen interval is at a depth of 23.33 feet btoc.

Slug test data were reviewed real-time during testing and downloaded during and at the end of each working day and saved locally to a laptop computer.

3.7 Decontamination of Field Equipment

Field instrumentation (such as interface probes or water quality meters) was decontaminated between sample locations by rinsing with an Alconox/distilled water solution followed by a potable water rinse and a final rinse with deionized water.

4.0 Field and Laboratory Results

4.1 Borehole Drilling

Boring logs for each borehole are provided in **Appendix A**. Shale was encountered at approximately 14 feet bgs in all three 2015 borings; silt with shale deposits was logged at W-6 while clay with shale was recorded at wells W-4 and W-5 at this depth. This was presumed to be the top of the Pierre Shale formation. A perched, water bearing zone was encountered at 2015 wells W-4 and W-6; W-5 was dry. Approximately 24 hours after drilling, depth to perched water was measured at 14.11 feet bgs at W-4 and 11.10 feet bgs at W-6.

Shale, presumed to be the top of the Pierre Shale formation, was encountered at approximately 24 feet below ground surface at MW-5 and approximately 35 feet at MW-6 during 2017 drilling; therefore drilling was ceased and well screens were placed above the shale. Coarse gravel with sand and a 4-inch layer of brown clay was encountered at this depth at MW-6. Soil cuttings were dry in MW-5. Soil cuttings were dry in MW-6 until moisture was encountered beginning at 20 feet below the surface.

Borings drilled in 2020 consisted primarily of clay, silt, and sand. Shale was encountered at varying depths during both the August and December drilling. In August, shale was encountered at MW-1B at 15 feet below ground, MW-2B at 20 feet, and MW-4B at 56.5 feet. W-2A and W-2B encountered shale at 20 feet below ground, W-7 at 10 feet, and W-8A and W-8B at 22 feet. In December, shale was encountered at W-5B at 29 feet below ground, W-9 at 27 feet, and W-10A and W-10B at 18 feet. To the south of the Comanche Station, shale was encountered at W-11 at 5 feet below ground, W-12 at 18 feet, and W-13 at 23 feet. Most wells transitioned from colluvial silty clay to weathered shale, and then to consolidated shale. Wells MW-4B, W-8A and W-8B, W-9 and W-13 had alluvial sands and gravel interbedded with the colluvium above the shale. Depth to water in January of 2021 was measured at approximately 31 feet below ground surface (bgs) in MW-1B, 16 feet in MW-2B, 8 feet in MW-3, 36 feet in W-4B, 25 feet in MW-5, 30 feet in MW-6, 8 feet in W-1, 26 feet in W-10B, 22 feet in W-11, 20 feet in W-12, 25 feet in W-2A, 10 feet in W-3, 6 feet in W-5, 9 feet in W-5B, 8 feet in W-6, and 6 feet in W-7. Well W-4 collects small quantities of water in the sump below the screen, but the level is not in the screened interval. Dry wells include MW-1, MW-2, MW-4, W-10A, W-13, and W-8A. W-8B was measured at approximately 53 feet bgs, which is accumulation of almost two feet in the well since installation in August 2020 and continues to rise by an inch or two a month but has never stabilized at a static elevation. The well appears to be slowly weeping and therefore is considered functionally dry.

4.2 Soil Samples – Geotechnical Analysis

The undisturbed soil samples collected from the well screen depth intervals of W-4, W-5, and W-6 analyzed for grain size and porosity by HP Geotech are summarized in **Table 1**. The soils laboratory results are presented in **Appendix B**.

Table 1. Summary of Geotechnical Testing Results at Comanche Station, 2015

Well I.D.	Sample Depth (feet bgs)	Gradation			Porosity (%)	Moisture Content (%)
		Gravel (%)	Sand (%)	Silt and Clay (%)		
W-4	9	0	14	86	36.2	17.2
W-5	9	0	7	93	39.2	18.9
W-6	9	0	8	92	35.4	17.4

Note:
BGS = below ground surface

Laboratory results show the wells are screened in silt and clay with some sand, with porosities between 35 and 40 percent, which is consistent with the silt and clay colluvial material noted in the drilling logs. A general range of hydraulic conductivity for such sediments is 10^{-9} to 10^{-4} centimeter per second (cm/s) (Fetter, 1994).

Samples were taken from all 2020 installed wells except W-2A and W-8B. The geotechnical laboratory results are summarized in **Table 2**. Advanced Terra Testing results are included in **Appendix B**.

Table 2. Summary of Geotechnical Testing Results at Comanche Station, 2020

Well I.D.	Sample Depth (feet bgs)	Lithology	Permeability (cm/s)	Moisture Content (%)
MW-1B	8-8.5	Clay	8.51E-09	19.0
	28-30	Highly weathered shale	6.62E-08	20.0
MW-2B	4-5	Clay	5.25E-08	25.3
	20-21	Highly weathered shale and fractured	1.03E-08	17.0
	68-78	Shale, unweathered unfractured	5.28E-10	5.6
MW-4B	14-15	Sand with gravel (alluvial)	No cohesion	2.1
	37-39	Clay	3.68E-09	24
	89-90	Shale, unweathered unfractured	1.14E-08	5.0
W-2B	6-7	Silty clay	2.09E-05	24.4
	10-11	Clay	5.93E-09	13.7
	28-29	Slightly weathered shale, iron oxide staining	1.90E-09	10.5
	64-65	Shale, unweathered unfractured	1.36E-08	5.7
W-7	11-12	Highly weathered shale and fractured	5.04E-09	18.5
W-8A	4-5	Silty clay with sand and gravel	2.57E-07	19.2
	9-10	Silt with fine sand	6.66E-05	28.1
	17-18	Well graded sand with gravel (alluvial)	5.10E-03	12.6
	43-44	Shale, unweathered unfractured	1.54E-09	6.1

Note:
BGS = below ground surface

4.3 Well Construction

Approximately 10 feet of screen was installed in each well in 2015 and 2017. The screen was placed above the Pierre Shale formation from approximately 3.4 to 13.4 feet bgs at W-4, 3.5 to 13.5 feet bgs at W-5, 5 to 15 feet bgs at W-6, 16 to 26 feet bgs at MW-5, and 27 to 37 feet bgs at MW-6. The 10-foot blank casing sumps were placed below each well screen in 2015 and 2017; except at MW-6 a 5-foot blank casing sump was placed below the well screen. Total well depths (including the sumps) ranged from 23.4 to 42 feet bgs. A diagram for wells drilled in 2015 and 2017 that documents well construction is provided in **Appendix C**.

Wells installed in August 2020 were installed with well screens of 10 to 20 feet. The screen was placed from 25 to 40 feet bgs at MW-1B, 20 to 30 feet bgs at MW-2B, 38-58 feet bgs at MW-4B, 24 to 34 feet bgs at W-2A, 53 to 73 feet bgs at W-2B, 6 to 21 feet bgs at W-7, 15 to 30 feet bgs at W-8A, and 35 to 55 feet bgs at W-8B. Wells installed in August 2020 do not include blank sumps; the screens extend to the bottom of the wells. Total well depths ranged from 21 to 73 feet bgs.

Wells installed in December 2020 were installed with well screens of 5 or 10 feet and no blank casing sumps. The screen was placed in weathered shale above the consolidated bedrock from approximately 30.5 to 35.5 feet at W-5B, 27.35 to 37.35 feet at W-9, 7 to 17 feet at W-10A, 20 to 30 feet at W-10B, 23 to 33 feet at W-11, 14 to 24 feet at W-12, and 245 to 29 feet at W-13. Total well depths ranged from 18 to 40 feet bgs A diagram for wells drilled in 2020 that documents well construction is included on the boring logs in **Appendix A**.

Well construction details for all 20 wells are summarized in **Table 3**. State-issued well construction permits are included in **Appendix D,** where available.

Table 3. Well Construction Details for Installed Groundwater Monitoring Wells

Well ID	Easting (State Plane, NAD 1983 UTM Zone 13 S meters)	Northing (State Plane, NAD 1983 UTM Zone 13 S meters)	Elevation TOC (feet AMSL)	Well Total Depth (feet bgs)	Depth of Screen Interval (feet bgs)	Well Stickup (feet)	Casing Type	Depth to Water (feet BTOC) Jan. 6 2021	Static Water Level (feet AMSL) Jan. 6 2021
W-4	537310.48	4228491.35	4812.47	23.4	3.4-13.4	3.63	2-inch PVC	26.59	4785.88*
W-5	537396.38	4228323.54	4807.46	23.5	3.5-13.5	3.83	2-inch PVC	8.07	4799.39
W-6	537367.35	4228447.92	4811.89	24.54	5-15	3.90	2-inch PVC	9.67	4802.22
MW-5	536379.92	4228619.73	4806.97	36.0	16-26	2.43	2-inch PVC	27.19	4779.78
MW-6	536363.95	4228008.02	4823.08	42.0	27-37	2.23	2-inch PVC	31.60	4791.48
MW-1B	536729.52	4228051.34	4807.72	40.0	25-40	2.18	2-inch PVC	31.23	4776.49
MW-2B	536776.74	4228351.21	4801.72	30.0	20-30	2.39	2-inch PVC	18.32	4783.40
MW-4B	535974.97	4228278.78	4826.41	58.0	38-58	2.31	2-inch PVC	38.35	4788.06
W-2A	537556.62	4228795.47	4827.86	33.0	23-33	2.21	2-inch PVC	27.07	4800.73
W-2B	537556.64	4228794.12	4827.80	73.0	53-73	2.20	2-inch PVC	52.26	4775.60
W-7	537560.80	4228271.43	4797.80	21.0	6-21	2.33	2-inch PVC	7.74	4790.06
W-8A	537487.53	4227922.80	4804.26	30.0	15-30	2.16	2-inch PVC	Dry	Dry
W-8B	537488.42	4227922.79	4804.46	55.0	35-55	2.33	2-inch PVC	55.36	4749.10*
W-5B	536380	4228325	4810.62	36.0	30.5-35.5	2.50	2-inch PVC	11.31	4810.14
W-9	537562	4228088	4801.78	40.0	27.35-37.35	2.31	2-inch PVC	36.50	4765.28
W-10A	537490	4228951	4835.21	18.0	7-17	2.22	2-inch PVC	Dry	Dry
W-10B	537490	4228953	4835.22	31.0	20-30	2.21	2-inch PVC	28.03	4807.19

W-11	536898	4227888	4895.99	34.0	23-33	2.38	2-inch PVC	23.61	4772.38
W-12	537107	4227869	4791.65	25.0	14-24	2.22	2-inch PVC	21.93	4769.72
W-13	537292	4227853	4801.96	29.0	24-29	2.30	2-inch PVC	Dry	Dry

Notes:
TOC = top of casing
BTOC = below top of casing
BGS = below ground surface
*Water level measured Jan 6, 2021 but not static water level. Water building up in the sump in W-4, and water slowly seeping into the screen in W-8B rather than a static level. W-8B assumed to be functionally dry.

4.4 Well Development

On November 11, 2015, the depth to water was measured in each 2015 installed well in preparation to begin well development. Well W-5 was found to be dry; therefore, well development was not attempted in this monitoring well. Well development was not attempted at well W-4 due to the lack of water in the screened interval. Well development was attempted at well W-6 but was ultimately unsuccessful due to extremely slow recharge in the well, combined with a water level of only 3 feet within the wetted screened interval (above the sump).

On August 8, 2017, the depth to water was measured at MW-6 in preparation to begin well development on MW-6. Well development continued on August 9 and 10; approximately 315 total gallons of water was purged during the development of MW-6. Well development was not attempted at MW-5 due to the lack of water in the screened interval.

On August 19, 2020, the depth to water was measured at W-2A, W-2B, and W-7 prior to beginning well development on 2020 installed wells. Well development continued through August 21 for W-7; approximately 500 liters of water was purged. Well development of W-2A and W-2B continued through August 25; approximately 94 liters was purged from W-2A and 48.5 liters from W-2B. On August 20, 2020, depth to water was measured at MW-1B, MW-2B, MW-4B, and W-8B prior to development. Development of MW-1B continued through August 21 with a total of 311 liters purged. Development of MW-2B continued through August 24 with a total of 697.5 liters purged. Development of MW-4B continued through August 25 with a total of 313 liters purged. Development of W-8B continued through August 27 with a total of 11 liters purged. Well W-8A was dry.

On December 16, 2020, the depth to water was measured at W-9 prior to beginning well development. Well development continued December 17, 18, 22, 23, 28, 29, January 4, 5 and 6; approximately 230 liters of water was purged. Development of wells W-10B, W-11 and W-12 began on December 17, 2020, after preliminary static water level measurements. Approximately 67.5 liters of water was purged from W-10B through January 6, 2021. Well development of W-11 and W-12 continued through December 21, 2020; approximately 420 liters of water was purged from W-11 and 136 liters from W-12. On December 22, 2020, depth to water was measured at W-5B before approximately 481 liters of water was purged and development was completed.

4.5 Well Survey

Survey coordinates and elevations are provided in **Table 3**.

4.6 Groundwater Level Measurement and Aquifer (Slug) Testing

All slug-in and slug-out tests were analyzed using AQTESOLV® v4.5 (http://www.aqtesolv.com), with the Bouwer and Rice (1976) or KGS Model (Hyder et al. 1994) solutions for wells with the water table in the screened interval, and the Hvorslev (1951) or KGS Model solutions for wells with the screen intervals fully submerged. Solutions for unconfined and confined conditions were applied based on the water level position, and logged lithology at and above the screened interval. Unconfined conditions solutions were applied consistently to wells with the water table across the screen. Confined conditions were assumed for wells MW-2B and W-5.

Nominal casing diameter was assumed to be 2 inches for all wells. Well bore diameter was set equal to either 5 inches or 8 inches depending on the drill bit size used to drill the entirety or majority of the

screened intervals. No well skin beyond the radius of the well bore was assumed. For wells with screens below the water table (i.e. fully submerged) during the slug testing, no effective casing radius correction was applied. For wells screened across the water table during slug testing, the Bouwer-Rice method (Bouwer and Rice 1976) of correcting the casing radius for the effective porosity of the filter pack was applied to account for drainage to and from the filter pack. The effective porosity of the filter pack was assumed equal to 30%, considering that it should approximately equal the specific yield of the material (10-20 silica sand), and specific yield for sand varies between 30% and 33% based on Morris and Johnson (1967). The saturated aquifer thickness at each location was represented using the saturated screen length and included portions of aquifer above the well screen where submerged and the logged lithology indicated presence of aquifer materials. An anisotropy ratio for hydraulic conductivity (ratio of horizontal to vertical hydraulic conductivity) of 1 (unitless) was assigned to the aquifer at each well location; routine sensitivity checks on this parameter indicated little to no sensitivity.

Data identified as “noisy” due to non-instantaneous response at the initiation of the tests, were plotted and reviewed but not fitted during the analyses, following the translation method recommended by Butler (2020). Comparison of normalized displacement data and resulting hydraulic conductivity values for some tests were judged to be of low reliability and non-representative, therefore these tests were excluded from further consideration and other test results were retained. The tests excluded in this way include W-5 test FH2, and W-2B tests except for test RH3.

4.6.1 Results

Initial displacement caused by emplacement or removal of the solid slug in the wells and hydraulic conductivity results for the slug testing are shown in **Table 4**. In some tests the initial displacement did not reasonably match the expected displacement of 1.53 feet. For some tests the KGS Model solution results are presented in addition to the straight-line solutions (W-2A and W-7 slug out or Rising Head) in **Table 4**. Plots of slug test analyses are included in **Appendix E**. The range of the hydraulic conductivity calculated values were from a low of 1.9×10^{-7} centimeters per second (cm/sec) to a high of 8.3×10^{-3} cm/sec, generally corresponds with the textbook ranges (Freeze and Cherry 1979) for the shale bedrock, fat clay and lean clay on the low end, and weathered and fractured shale bedrock, silt and silty sand to sand on the high end, as described on the field boring logs. **Table 5** provides the geometric mean hydraulic conductivity values for wells that were pooled together based on the primary lithology of the well screen interval.

Table 4. Slug Testing Results

Well	Screened Interval Lithology	Test Name	Analytical Solution	Initial Displacement (feet)	Hydraulic Conductivity (cm/sec)	Hydraulic Conductivity Geometric Mean (cm/sec)
MW-1B	Highly weathered and slightly weathered shale	Falling Head (Slug In) 1	Bouwer-Rice	0.905	2.8E-05	2.0E-05
		Falling Head (Slug In) 2	Bouwer-Rice	0.837	1.3E-05	
		Rising Head (Slug Out) 1	Bouwer-Rice	0.584	4.2E-05	
		Rising Head (Slug Out) 2	Bouwer-Rice	0.687	1.1E-05	
MW-2B	Highly weathered and unweathered, fractured shale	Falling Head (Slug In) 1	KGS Model	0.106	7.1E-03	4.6E-03
		Falling Head (Slug In) 2	KGS Model	0.131	1.1E-03	
		Rising Head (Slug Out) 1	KGS Model	0.626	8.3E-03	
		Rising Head (Slug Out) 2	KGS Model	0.509	6.7E-03	
MW-4B	18.5' Colluvium (clay), 1.5' highly weathered shale	Falling Head (Slug In) 1	KGS Model	1.156	1.1E-05	1.2E-05
		Rising Head (Slug Out) 1	KGS Model	1.119	1.4E-05	
MW-6	8' Colluvium (clay and silt and gravel), 2' highly weathered shale	Falling Head (Slug In) 1	Hvorslev	1.356	7.0E-04	1.1E-03
		Rising Head (Slug Out) 1	Hvorslev	1.401	1.8E-03	
W-2A	Highly weathered and slightly weathered shale	Falling Head (Slug In) 1	Bouwer-Rice	1.113	9.7E-05	1.0E-04
		Rising Head (Slug Out) 1	Bouwer-Rice	1.561	1.8E-04	
		Rising Head (Slug Out) 1	KGS Model	1.561	5.9E-05	
W-2B	Unfractured, unweathered shale	Rising Head (Slug Out)	KGS Model	1.481	1.9E-07	--
W-5	Colluvium (clay with sand and gravel)	Falling Head (Slug In) 1	Bouwer-Rice	1.111	2.1E-06	2.4E-06
		Rising Head (Slug Out) 1	Bouwer-Rice	1.314	2.1E-06	
		Rising Head (Slug Out) 2	Bouwer-Rice	1.388	3.3E-06	
W-6	Colluvium (clay and silt with sand)	Falling Head (Slug In) 1	Bouwer-Rice	0.423	8.0E-05	8.0E-05
		Rising Head (Slug Out) 1	Bouwer-Rice	0.623	8.1E-05	
W-7	4' Clay, 11' highly weathered shale	Falling Head (Slug In) 1	Hvorslev	0.523	3.0E-04	4.3E-04
		Rising Head (Slug Out) 1	Hvorslev	0.802	8.3E-04	
		Rising Head (Slug Out) 1	KGS Model	0.802	3.3E-04	

Table 5. Hydraulic conductivity by lithologic unit

Wells with Similar Screen Lithology	Screened Interval Lithology	Hydraulic Conductivity Geometric Mean (cm/sec)
W-1B, MW-2B, W-2A, W-7	Weathered shale	2.52E-04
MW-2B	Unfractured, unweathered shale	1.90E-07
MW-4B, MW-6, W-5, W-6	Colluvium	4.07E-05

5.0 References

Bouwer, H. and R.C. Rice, 1976. A slug test method for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells, Water Resources Research, vol. 12, no. 3, pp. 423-428.

Dagan, G., 1978. A note on packer, slug, and recovery tests in unconfined aquifers, Water Resources Research, vol. 14, no. 5. pp. 929-934.

Freeze, R.A. and J.A. Cherry, 1979. Groundwater, Prentice-Hall, Inc., Englewood Cliffs, NJ.

GeoTrans, Inc. (2009). Surface Water Impoundment Infiltration Characterization Analysis, Public Service Company of Colorado, Comanche Station, Pueblo, Colorado, December 1, 2009.

HDR, 2015a. Monitoring Well Installation Plan for Compliance with the Coal Combustion Residuals (CCR) Rule, Comanche Station. Xcel Energy.

HDR, 2015b. Groundwater Monitoring System Certification for Compliance with the Coal Combustion Residuals (CCR) Rule, Comanche Station. Xcel Energy.

Tetra Tech, 2012. Inventory and Preliminary Classification Report, Waste Impoundments, Comanche Station, Pueblo, Colorado, November 1, 2012.

Tetra Tech, 2014. Sitewide Monitoring Plan, Ash Disposal Facility, Comanche Station, Pueblo, Colorado, August 29, 2014.

Tetra Tech, 2015. Engineering Design and Operations Plan, Ash Disposal Facility, Comanche Station, Pueblo, Colorado, January 13, 2015.

URS, 2005. Geotechnical Investigation, Unit 3, Comanche Station, Pueblo, Colorado, March 2, 2005.

Woodward-Clyde Consultants, 1987. Feasibility Investigation, Two Ash Disposal Areas for Comanche Power Station, Pueblo, Colorado. March 1987.

Xcel Energy, 2005. Comanche Station Coal Ash Disposal Facility Design and Operations Plan. August 24, 2005.

Appendix A

Borehole Logs

Appendix A

Borehole Logs

Boring Log

Project Name	Project No.	Drilling Company
Xcel CCR	266180	HP Geotech

Boring No.	Location	Drilling Rig Type and Drilling Method
W-4	Comanche Power	CME-55 Hollow Stem Auger (8-inch borehole)

Sample No.	Blow Count	Depth (feet)	Description (USCS)	Remarks
1' below groung surface (bgs)	N/A		7.5YR 3/2; Sandy Silt (ML), some gravel; nonplastic; noncohesive; dry	Potholed to 8' on 11/9/2015
5' bgs	N/A	5	10YR 5/3; Lean Clay (CL); stiff, med-high plasticity; cohesive; moist	
W-4: 9' bgs 10' bgs	6-8 (Cal) 5-7-8 (SS)	10	10YR 4/3; Lean Clay (CL); stiff, low plasticity; cohesive; some lamination; moist	Fe staining. Cal sample at 9'bgs submitted for geotech analysis
			10YR 4/3; Lean Clay (CL); very stiff, low plasticity; cohesive; laminated; moist	Fe staining
14' bgs	6-7-12 (SS)	15	Alluvium/bedrock contact at 14'bgs	
			Dark gray Gley 1 4/N; Lean Clay (CL) Black Shale, weathered; laminated	Fe staining
19' bgs	11-15-21(SS)	20	As above	Fe staining; hard, very micaceous
24' bgs	10-18-28(SS)	25	Very dark gray Gley 1 3/N; Silt (ML); hard, non-plastic; non-cohesive; laminted; dry to moist	Fe staining; micaceous

Total Depth (feet)	Water Level (feet)		Logged By:	Drilled/Sampled By:
	After Drilling:	Hours After:	Date Started:	Date Completed:
25.5	14.11	24	11/10/2015	11/10/2015

Nick Hanrahan

Brent McDaniel

Boring Log

Project Name	Project No.	Drilling Company
Xcel CCR	266180	HP Geotech

Boring No.	Location	Drilling Rig Type and Drilling Method
W-5	Comanche Power	CME-55 Hollow Stem Auger (8-inch borehole)

Sample No.	Blow Count	Depth (feet)	Description (USCS)	Remarks
				Potholed to 8' on 11/9/2015
2' bgs	N/A		10YR 4/3; Fat Clay (CH) with Sand and some Gravel; high plasticity; cohesive; moist to wet (likely due to potholing)	
5' bgs	N/A	5	As above	
W-5: 9' bgs 10' bgs	5-7 (Cal) 5-7-8 (SS)	10	Brown 10YR 4/3; Lean Clay (CL), some gravel; stiff; medium plasticity; cohesive; dry to moist	Cal sample at 9' bgs submitted for geotech analysis
14' bgs 15' bgs	14-21 (Cal) 10-13-21(SS)	15	As above. Hit a layer of shale bedrock with quartz vein, became laminated to thinly bedded; hard	Fe staining; quartz vein visible
19' bgs	10-12-22(SS)	20	As above; laminated	Fe staining; gravel-size mic grains
24' bgs	9-11-13 (SS)	25	Brown 7.5YR 4/4; fine-medium Sandy Silt (ML); some coarse; very stiff; non-plastic; non-cohesive; moist	

Total Depth (feet)	Water Level (feet)		Logged By:	Drilled/Sampled By:
	After Drilling:	Hours After:	Nick Hanrahan	Brent McDaniel
25	Dry	24	Date Started: 11/9/2015	Date Completed: 11/9/2015

Boring Log

Project Name	Project No.	Drilling Company
Xcel CCR	266180	HP Geotech

Boring No.	Location	Drilling Rig Type and Drilling Method
W-6	Comanche Power	CME-55 Hollow Stem Auger (8-inch borehole diameter)

Sample No.	Blow Count	Depth (feet)	Description (USCS)	Remarks
1' below ground surface (bgs)	N/A		10YR 3/2; Silty Sand (SM) with Gravel; nonplastic; non-cohesive (Fill); moist	Potholed to 8' on 11/9/2015
5' bgs	N/A	5	10YR 3/2; Silt w/ Sand (ML); nonplastic, noncohesive; wet	
W-6: 9' bgs 10.5' bgs	8-11 (Cal) 5-8-10 (SS)	10	Olive brown 2.5Y 4/3; Lean Clay (CL); very stiff; medium to high plasticity; cohesive; moist to wet	Fe staining. Cal sample at 9' bgs submitted for geotech analysis
14' bgs	4-7-8 (SS)	15	Top 14": As above; stiff Bottom 6": Gray Gley 1 5/N; Silt (ML) with Shale; stiff; nonplastic; cohesive; moist	Fe staining. Alluvium; top of refusal
19' bgs	6-7-8 (SS)	20	Olive brown 2.5Y 4/3; Lean Clay (CL); stiff; medium plasticity, cohesive; moist	Fe staining; micaceous
24' bgs	15-20 (Cal)	25	Dark grayish brown 10YR 4/2; Silt (ML); nonplastic; slightly cohesive, laminated (shale); moist	Very micaceous
29' bgs	50/5" (SS)	30	As above; noncohesive	Very micaceous

Total Depth (feet)	Water Level (feet)		Logged By:	Drilled/Sampled By:
	After Drilling:	Hours After:	Nick Hanrahan	Brent McDaniel
30	11.10	24	Date Started: 11/10/2015	Date Completed: 11/10/2015

Boring Log

Project Name	Project No.	Drilling Company
Xcel CCR	10063857	Site Services Drilling, LLC

Boring No.	Location	Drilling Rig Type and Drilling Method
MW-5	Comanche Station	CME-55 Hollow Stem Auger (6-inch diameter)

Sample No.	Blow Count	Depth (feet)	Description (USCS)	Elevation (feet)	Remarks
			(0 - 8') Dry SILT 2.5Y 5/2		Potholed to 8 ft
		5			
			(8 - 9') Poorly graded fine SAND, very dry 5 YR 4/2		
			(9 - 14') Compacted SILT with white calcite laminates, very dry, stiff 7.5YR 6/3		4' of recovery from 8 - 14' core
		10			
			(14 - 22') Compacted SILT with trace white calcite laminates, very dry, stiff 7.5YR 5/4		
		15			
		20			
			(22 - 24') Compacted SILT with increased calcite content and trace dark gray SILT laminae 7.5 YR 3/2		
			(24 - 29') Highly weathered SHALE bedrock 2.5Y 3/2		
		25			
			(29 - 36') Weathered SHALE bedrock		
		30			Well Construction: Screen 16 - 26' Sump 26 - 36'
		35			

Total Depth (feet)	Water Level (feet)		Logged/Sampled By:	Drilled By:
	After Drilling:	Hours After:	M. Violette	Site Services Drilling, LLC
36	-		Date Started: 8/8/2017	Date Completed: 8/8/2017

Boring Log

Project Name	Project No.	Drilling Company
Xcel CCR	10063857	Site Services Drilling, LLC

Boring No.	Location	Drilling Rig Type and Drilling Method
MW-6	Comanche Station	CME-55 Hollow Stem Auger (6-inch diameter)

Sample No.	Blow Count	Depth (feet)	Description (USCS)	Elevation (feet)	Remarks
			(0 - 8') Dry SILT 2.5Y 5/2		Potholed to 8 ft
		5			
			(8 - 9') SAND with brittle SILT with white CLAY pieces 2.5Y 6/4		
			(9 - 12') SILT with SAND, brittle, very dry 7.5YR 5/4		
		10			
			(12 - 14') Well graded coarse SAND with GRAVEL, very dry, hematite and quartz present 5YR 5/6		
			(14 - 19') Coarse SAND with GRAVEL, large cobbles up to 3-inches in length, hematite and quartz present, very dry 5YR 5/6		2' of recovery from 14 - 19' core
		15			
			(19 - 23') Coarse SAND with GRAVEL, large cobbles up to 2-inches in length, moist 2.5YR 5/4		2.5' of recovery from 19 - 24' core
		20			
			(23 - 24') Same as above, 7.5YR 7/1		
			(24 - 29') Coarse GRAVEL with SAND. A 4-inch layer of brown CLAY at 27', some black SHALE pieces and cobbles up to 1-inch in length, micaceous 7.5R 5/4		2.5' of recovery from 24 - 29' core
		25			
			(29 - 30.5') SILT with GRAVEL, medium to coarse SAND present, moist 7.5YR 6/4		
		30			Well Construction:
			(30.5 - 31.5') Medium SAND with SILT 7.5YR 5/6		Screen 27 - 37'
			(31.5 - 33') CLAY with SILT 7.5YR 5/4		Sump 37 - 42'
			(33 - 34') Medium to coarse SAND, moist to wet 7.5YR 5/4		
			(34 - 35') CLAY with some SILT, firm, dry 7.5YR 5/3		
		35	(35 - 42') Highly weathered SHALE bedrock, trace SILT 10YR 4/2		

Total Depth (feet)	Water Level (feet)		Logged/Sampled By:	Drilled By:
	After Drilling:	Hours After:	M. Violette	Site Services Drilling, LLC
42	28'	21	Date Started: 8/7/2017	Date Completed: 8/7/2017

MW-1B

CLIENT Xcel Energy
PROJECT NAME Comanche Station
PROJECT NUMBER 10217175
PROJECT LOCATION Pueblo, CO
DATE STARTED 08/07/20 11:09 **COMPLETED** 08/11/20 09:14
WELL LOCATION 559477.98 N 2264365.76 E
DRILLING CONTRACTOR Dakota Drilling
GROUND ELEVATION 4805.54 ft **HOLE DIAMETER** 8
DRILLING METHOD HSA/NX/AR
GROUND WATER LEVELS:
LOGGED BY E. Munoz **CHECKED BY**
AFTER DRILLING 28.99 ft / Elev 4776.55 ft
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0							Casing Top Elev: 4807.72 (ft) Casing Type: 2-in PVC
	SS 1	83	18-12-15-23 (27)	CL		LEAN CLAY, SILTY, (CL) brown (10YR 4/3), dry, soft to stiff, non plastic, stiffness and plasticity increase gradually with depth, some gravel in top 6in	
	SS 2	100	23-27-28-23 (55)				
5	MC 3	100	4-5			5.0	
	SS 4	92	12-31-40-50 (71)			FAT CLAY, (CH) yellowish brown to brownish yellow (10YR 5/4), dry to moist, stiff, laminated, medium plasticity, trace sand, iron oxide staining, relict shale structure, iron staining and gypsum recrystallization along fractures and bedding planes, some high-angle to vertical fractures	
	SS 5	100	50			8.5 Sample collected for moisture & permeability	
10	SS 6	100	20-33-50 (83)	CH			Bentonite Chips, Hydrated in Lifts
	SS 7	100	22-50				
15	SS 8	100	50			15.0	
	RC NX 9	40				SHALE, highly weathered, laminated, gray with yellowish brown (10YR 5/1), dry, iron oxide staining, clayey and weak along fractures and bedding planes, high angle to vertical fractures with iron staining and gypsum recrystallization	
20							
	RC NX 10	80					
25							
	RC NX 11	60				Sample collected for moisture & permeability	
30						30.0	
	RC NX 12	40					10-20 Silica Sand 0.010-in Slotted Screen
35						33.0	

(Continued Next Page)

CLIENT Xcel Energy **PROJECT NAME** Comanche Station

PROJECT NUMBER 10217175 **PROJECT LOCATION** Pueblo, CO

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35							
40	RC NX	80				SHALE, slightly weathered, laminated, black (N1), wet, iron oxide staining, weathered and iron-stained along bedding planes and fractures, some high angle to vertical fractures, light gray bentonitic clay zone at 38.5ft *(continued)*	
						40.0	
45	RC NX	100				SHALE, unweathered, laminated, black (N1), damp, bentonitic clayey zones and some mid-angle fractures	
						43.0	
50	RC NX	100				SHALE, unweathered, laminated, black (N1), dry, strong, two dry mid-angle fractures at 47.5ft and 51.5ft (slickensided), moist bentonitic clay zone at 55ft	
55	RC NX	100					Coated Bentonite Pellets
60	RC NX	90					
	RC NX	83					
65	RC NX	100					
						65.0	

Bottom of borehole at 65.0 feet.

MW-2B

CLIENT Xcel Energy
PROJECT NAME Comanche Station
PROJECT NUMBER 10217175
PROJECT LOCATION Pueblo, CO
DATE STARTED 08/11/20 12:35 **COMPLETED** 08/12/20 11:10
WELL LOCATION 560463.2 N 2264515.56 E
DRILLING CONTRACTOR Dakota Drilling
GROUND ELEVATION 4799.33 ft **HOLE DIAMETER** 8
DRILLING METHOD HSA/NX/AR
GROUND WATER LEVELS:
LOGGED BY E. Munoz **CHECKED BY**
AFTER DRILLING 16.06 ft / Elev 4783.27 ft
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0						
	SS	75	5-5-5-5 (10)	CL		0.7 LEAN CLAY, SILTY, (CL) gray (10YR 5/1), dry, soft, non plastic, trace gravel, trace roots
	SS	75	5-7-12-15 (19)			LEAN CLAY, (CL) light yellowish brown to brown (10YR 6/4), dry to moist, stiff, low plasticity, relict shale structure, gypsum recrystallization on bedding planes and fractures
5	MC	83	17-33			Sample collected for moisture & permeability 5.0
	SS	100	9-10-50 (60)			
	SS	100	20-15-19-21 (34)	CL		
10	SS	100	3-9-14-15 (23)			
	SS	100	13-16-18-18 (34)			
15	SS	100	13-21-22-18 (43)			16.0
	SS	100	11-15-20-24 (35)	CL		LEAN CLAY, (CL) brown (10YR 5/3), moist, stiff, low plasticity, increasing shale fragments
20	SS	100	23-27-36-33 (63)			20.0
	MC	100	19-31			21.0 SHALE, highly weathered, laminated, very dark grayish brown (10YR 3/2), dripping to damp, iron oxide staining, heavily fractured, clayey with iron staining and gypsum recrystallization along bedding planes and fractures
	SS	100	21-27-25-29 (52)			Sample collected for moisture & permeability
25	SS	100	24-50			
	RC NX	45				
30						
	RC NX	100				
35						35.0

WELL DIAGRAM

Casing Top Elev: 4801.72 (ft)
Casing Type: 2-in PVC

Bentonite Chips, Hydrated in Lifts

10-20 Silica Sand

0.010-in Slotted Screen

(Continued Next Page)

CLIENT Xcel Energy **PROJECT NAME** Comanche Station

PROJECT NUMBER 10217175 **PROJECT LOCATION** Pueblo, CO

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35	RC NX	100				SHALE, unweathered, laminated, black (N1), damp, iron oxide staining, fractured strong shale with iron staining on fractures, clayey zone at 37ft	
40	RC NX	100				40.0 SHALE, unweathered, laminated, black (N1), damp, fractured strong shale, wet along fractures but moist on fresh breaks	
45	RC NX	100					
50	RC NX	100				49.0 SHALE, unweathered, laminated, black (N1), dry, unfractured strong shale	
55	RC NX	93					Coated Bentonite Pellets
60	RC NX	96					
65	RC NX	93					
70	RC NX	140				Sample collected for moisture & permeability 70.0	

Bottom of borehole at 70.0 feet.

CLIENT Xcel Energy
PROJECT NAME Comanche Station
PROJECT NUMBER 10217175
PROJECT LOCATION Pueblo, CO
DATE STARTED 08/12/20 14:00 **COMPLETED** 08/13/20 14:46
WELL LOCATION 560238.51 N 2261884.78 E
DRILLING CONTRACTOR Dakota Drilling
GROUND ELEVATION 4826.41 ft **HOLE DIAMETER** 8
DRILLING METHOD HSA/NX/AR
GROUND WATER LEVELS:
LOGGED BY E. Munoz **CHECKED BY**
▼ **AFTER DRILLING** 36.54 ft / Elev 4789.87 ft
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0							Casing Top Elev: 4826.41 (ft) Casing Type: 2-in PVC
	SS 1	67	1-3-3-5 (6)	CL		0.3 LEAN CLAY, SILTY, (CL) brown (7.5YR 5/2), dry, soft, non plastic, with roots LEAN CLAY, SILTY, (CL) light gray (10YR 7/2), dry, soft, non plastic, loess	
	SS 2	100	8-8-9-10 (17)	CL			
5	MC 3	63	11-23	CL			
	SS 4	100	10-16-21-22 (37)	CL		7.5 LEAN CLAY, SILTY, (CL) light yellowish brown (10YR 6/4), dry to moist, medium stiff, low plasticity, trace fine to coarse sand, sand component increases with depth, gypsum crystals present	
10	SS 5	100	8-7-12-14 (19)	CL			
	SS 6	100	10-16-12-11 (28)	CL		12.0	
	SS 7	100	16-19-27-39 (46)	SW		WELL GRADED SAND, SILTY, (SW) reddish brown (5YR 5/3), well graded, rounded, fine to coarse grained, dry to moist, dense, with gravel	
15	MC 8	100	50	SW		Sample collected for moisture & permeability 15.0	
						16.0	
	SS 9	0		GP		POORLY GRADED GRAVEL, SANDY, (GP) reddish brown (5YR 5/3), poorly graded, rounded, medium grained, moist, dense, with silt, logged from auger cuttings, sampler refusal due to gravel and cobbles 18.0	
	SS 10	100	38-28-50/3"	SW		WELL GRADED SAND, SILTY, (SW) reddish brown (5YR 5/3), well graded, rounded, fine to coarse grained, moist, dense, with fine to coarse gravel, lens of SP fine light yellowish brown (10YR 6/4) sand at 22.5ft	Bentonite Chips, Hydrated in Lifts
20	SS 11	75	35-50	SW			
	SS 12	50	8	SW			
25						25.5	
	SS 13	100	9-7-15-21 (22)	CL		LEAN CLAY, (CL) yellowish brown (10YR 5/6), moist, medium stiff, medium plasticity, lens of wet fine sand at 36.5	
	SS 14	100	7-10-13-20 (23)	CL			
30	SS 15	100	8-12-15-19 (27)	CL			
	SS 16	100	7-11-19-23 (30)	CL			
	SS 17	100	8-14-17-17 (31)	CL			
35							

(Continued Next Page)

CLIENT Xcel Energy **PROJECT NAME** Comanche Station

PROJECT NUMBER 10217175 **PROJECT LOCATION** Pueblo, CO

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35	SS	100	7-8-16-16 (24)	CL		LEAN CLAY, (CL) yellowish brown (10YR 5/6), moist, medium stiff, medium plasticity, lens of wet fine sand at 36.5 *(continued)*	
	MC	75	10-20			Sample collected for moisture & permeability	
						38.0	
						FAT CLAY, (CH) yellowish brown (10YR 5/6), wet, medium stiff, high plasticity, lenses of wet sandy clay, gypsum present, some subrounded coarse sand in clay at 54-56.6ft	
						39.0	
40	SS	100	5-8-11-15 (19)				
	SS	100	5-7-9-12 (16)				
	SS	100	5-9-9-11 (18)				
45	SS	100	3-6-9-12 (15)				
	SS	100	4-5-8-9 (13)	CH			10-20 Silica Sand
50	SS	100	6-7-11-16 (18)				0.010-in Slotted Screen
55	RC NX	88					
	RC NX	90				56.5	
						SHALE, highly weathered, laminated, very dark grayish brown (10YR 3/2), damp, iron oxide staining, weak, clayey, fractured (including vertical fractures) with iron staining on fractures and bedding planes	
						57.5	
60						SHALE, slightly weathered, laminated, very dark greenish gray (10GY 3/1), damp, iron oxide staining, weak, no mid- to high-angle fractures, iron staining and pyrite on bedding planes	
						60.0	
	RC NX	100				SHALE, unweathered, laminated, black (7.5YR 2.5/1), damp, medium-strong, no mid- or high-angle fractures (bedding plane only)	
65							
	RC NX	100					
70						69.5	
	RC NX	100				SHALE, unweathered, laminated, black (7.5YR 2.5/1), dry, strong, unfractured	Coated
75							

(Continued Next Page)

CLIENT Xcel Energy **PROJECT NAME** Comanche Station

PROJECT NUMBER 10217175 **PROJECT LOCATION** Pueblo, CO

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
75							
80	RC NX	100				SHALE, unweathered, laminated, black (7.5YR 2.5/1), dry, strong, unfractured *(continued)*	Bentonite Pellets
85	RC NX	100					
90	RC NX	100				Sample collected for moisture & permeability	
					90.0	Bottom of borehole at 90.0 feet.	

W-2A

CLIENT Xcel Energy
PROJECT NAME Comanche Station
PROJECT NUMBER 10217175
PROJECT LOCATION Pueblo, CO
DATE STARTED 08/03/20 10:36 **COMPLETED** 08/04/20 08:01
WELL LOCATION 561935.18 N 2267068.03 E
DRILLING CONTRACTOR Dakota Drilling
GROUND ELEVATION 4825.65 ft **HOLE DIAMETER** 8
DRILLING METHOD HSA/NX/AR
GROUND WATER LEVELS:
LOGGED BY E. Munoz **CHECKED BY**
▼ **AFTER DRILLING** 24.81 ft / Elev 4800.84 ft
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				ML		0.8 SILT, (ML) very dark brown (10YR 2/2), dry, soft, non plastic, some fine to medium sand
				CL		LEAN CLAY, SILTY, (CL) light yellowish brown (10YR 6/4), dry, soft to medium stiff, low plasticity, trace fine sand
5						5.5
				CL		6.0 LEAN CLAY, SILTY, (CL) very light brown (10YR 7/4), dry, medium stiff, low plasticity, with fine to coarse sand
				CL		LEAN CLAY, (CL) yellowish brown (10YR 5/4), moist to dry, soft to stiff, laminated, medium plasticity, iron oxide staining, stiffness increases with depth; shale-derived clay
10						11.0
	Not Sampled			CL		LEAN CLAY, (CL) yellowish brown to yellow (10YR 5/4), moist, stiff, laminated, medium plasticity, iron oxide staining, shale-derived clay
15						
20						20.0
						SHALE, highly weathered, laminated, gray (N5), gypsiferous, damp, iron oxide staining, highly fractured, weak
						23.0
25						SHALE, highly weathered, laminated, gray (N5), gypsiferous, damp to wet, iron oxide staining, increasing fractures, iron staining, gypsum recrystalization with depth
						25.0 ▼
						SHALE, slightly weathered, laminated, black (N1), damp to wet, iron oxide staining, medium-strong
30						
						33.5

WELL DIAGRAM

Casing Top Elev: 4827.86 (ft)
Casing Type: 2-in PVC

- Bentonite Chips, Hydrated in Lifts
- 10-20 Silica Sand
- 0.010-in Slotted Screen

Bottom of borehole at 33.5 feet.

CLIENT Xcel Energy
PROJECT NAME Comanche Station
PROJECT NUMBER 10217175
PROJECT LOCATION Pueblo, CO
DATE STARTED 07/30/20 12:35 **COMPLETED** 08/06/20 17:12
WELL LOCATION 561930.73 N 2267068.12 E
DRILLING CONTRACTOR Dakota Drilling
GROUND ELEVATION 4825.6 ft **HOLE DIAMETER** 8
DRILLING METHOD HSA/NX/AR
GROUND WATER LEVELS:
LOGGED BY E. Munoz **CHECKED BY**
▼ **AFTER DRILLING** 37.15 ft / Elev 4788.45 ft Rising; Not Static
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0							Casing Top Elev: 4827.8 (ft) Casing Type: 2-in PVC
	SS 1	100	7-7-8-9 (15)	ML		0.8 SILT, (ML) very dark brown (10YR 2/2), dry, soft, non plastic, some fine to medium sand	
	SS 2	100	6-6-7-7 (13)	CL		LEAN CLAY, SILTY, (CL) light yellowish brown (10YR 6/4), dry, soft to medium stiff, low plasticity, trace fine sand	
5	SS 3	100	6-10-12-10 (22)			5.5	
	MC 4	75	3-5	CL		6.0 LEAN CLAY, SILTY, (CL) very light brown (10YR 7/4), dry, medium stiff, low plasticity, with fine to coarse sand 7.0 LEAN CLAY, (CL) yellowish brown (10YR 5/4), moist to dry, soft to stiff, laminated, medium plasticity, iron oxide staining, stiffness increases with depth; shale-derived clay Sample collected for moisture & permeability	
10	SS 5	100	12-13-15-27 (28)	CL			
	MC 6	75				Sample collected for moisture & permeability	
	RC NX 7	25				11.0 LEAN CLAY, (CL) yellowish brown to yellow (10YR 5/4), moist, stiff, laminated, medium plasticity, iron oxide staining, shale-derived clay	
15							
	RC NX 8	70		CL			
20						20.0	
	RC NX 9	100				SHALE, highly weathered, laminated, gray (N5), gypsiferous, damp, iron oxide staining, highly fractured, weak	
						23.0 SHALE, highly weathered, laminated, gray (N5), gypsiferous, damp to wet, iron oxide staining, increasing fractures, iron staining, gypsum recrystalization with depth	
25						25.0	
	RC NX 10	53				SHALE, slightly weathered, laminated, black (N1), damp to wet, iron oxide staining, medium-strong	← Bentonite Chips, Hydrated in Lifts
30						Sample collected for moisture & permeability 29.0	
	RC NX 11	90					
35						34.0	

(Continued Next Page)

CLIENT Xcel Energy **PROJECT NAME** Comanche Station

PROJECT NUMBER 10217175 **PROJECT LOCATION** Pueblo, CO

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
35						
40	RC NX	100				SHALE, unweathered, laminated, very dark greenish gray (5GY 3/1), gypsum seams, bentonitic clay at 38 & 39', damp, unfractured *(continued)*
45	RC NX	70				40.0 SHALE, unweathered, laminated, gray (N5), gypsum seams, bentonitic clay at 51', damp, unfractured
50	RC NX	100				45.0 SHALE, unweathered, laminated, gray to black (N1), dry, unfractured
55	RC NX	100				
60	RC NX	100				
65	RC NX	100				
70	RC NX	100				65.0 Sample collected for moisture & permeability
75						75.0

WELL DIAGRAM: 10-20 Silica Sand; 0.010-in Slotted Screen

Bottom of borehole at 75.0 feet.

CLIENT Xcel Energy
PROJECT NAME Comanche Station
PROJECT NUMBER 10217175
PROJECT LOCATION Pueblo, CO
DATE STARTED 08/04/20 10:01 **COMPLETED** 08/05/20 11:17
WELL LOCATION 560214.93 N 2267090.86 E
DRILLING CONTRACTOR Dakota Drilling
GROUND ELEVATION 4795.21 ft **HOLE DIAMETER** 8
DRILLING METHOD HSA/NX/AR
GROUND WATER LEVELS:
LOGGED BY E. Munoz **CHECKED BY**
▼ **AFTER DRILLING** 4.86 ft / Elev 4790.35 ft
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0						
	SS	75	2-2-4-3 (6)	CL		1.0 LEAN CLAY, SILTY, (CL) very dark brown (10YR 2/2), dry to moist, soft, non plastic
				CL		2.0 LEAN CLAY, SILTY, (CL) dark yellowish brown (10YR 4/6), moist, soft, low plasticity
	SS	79	3-4-7-9 (11)	CL		LEAN CLAY, SILTY, (CL) light yellowish brown (10YR 6/4), moist, soft, medium plasticity
						4.0
5	MC	63	4-8	CL		▼ 5.0 LEAN CLAY, SILTY, (CL) yellowish brown (10YR 5/4), moist, medium stiff, medium plasticity
	SS	92	6-13-21-26 (34)	CL		LEAN CLAY, (CL) yellowish brown with very dark grayish brown (10YR 5/6), moist, stiff, mottled, medium plasticity, recrystallized gypsum and relict shale lamination (shale-derived)
						7.0
	SS	100	16-24-50 (74)	CL		LEAN CLAY, (CL) grayish brown (10YR 5/2), moist to dry, very stiff, laminated, medium plasticity, iron oxide staining, healed fractures, relict shale structure (shale-derived)
10						10.0
	RC NX	90				SHALE, highly weathered, laminated, dark gray with brownish yellow (10YR 4/1), damp, iron oxide staining, weak with clays along fractures and bedding planes, some vertical to near-vertical fractures present with iron-staining and gypsum recrystallization
						12.0 Sample collected for moisture & permeability
15						15.0
	RC NX	83				SHALE, highly weathered, laminated, brown with brownish yellow (10YR 6/6), damp to wet, iron oxide staining, matrix strong, weak along bedding planes and fractures, some near-vertical fractures with iron staining and gypsum recrystallization
20						20.0
	RC NX	100				21.0 SHALE, slightly weathered, laminated, dark grayish brown to black (10YR 4/2), damp to wet, iron oxide staining, strong with iron-stained fractures
						SHALE, unweathered, laminated, black (N1), damp, strong, unfractured, gypsum seams, weak clayey zones 25-27 ft
25						
	RC NX	100				27.0 SHALE, unweathered, laminated, black (N1), dry, unfractured, gypsum seams
30						
	RC NX	21				
35	RC NX	67				

WELL DIAGRAM
Casing Top Elev: 4797.54 (ft)
Casing Type: 2-in PVC
Bentonite Chips, Hydrated in Lifts
10-20 Silica Sand
0.010-in Slotted Screen

(Continued Next Page)

CLIENT Xcel Energy **PROJECT NAME** Comanche Station

PROJECT NUMBER 10217175 **PROJECT LOCATION** Pueblo, CO

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35						SHALE, unweathered, laminated, black (N1), dry, unfractured, gypsum seams *(continued)*	Coated Bentonite Pellets
40	RC NX	100					
45	RC NX	100					
50	RC NX	100				50.0	

Bottom of borehole at 50.0 feet.

CLIENT Xcel Energy
PROJECT NAME Comanche Station
PROJECT NUMBER 10217175
PROJECT LOCATION Pueblo, CO
DATE STARTED 08/05/20 14:25 **COMPLETED** 08/06/20 11:24
WELL LOCATION 559069.18 N 2266856.4 E
DRILLING CONTRACTOR Dakota Drilling
GROUND ELEVATION 4802.1 ft **HOLE DIAMETER** 8
DRILLING METHOD HSA/NX/AR
GROUND WATER LEVELS:
LOGGED BY E. Munoz **CHECKED BY**
AFTER DRILLING --- Dry
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0	SS	100	13-15-19-20 (34)	CL		LEAN CLAY, SILTY, (CL) pale brown (10YR 6/3), dry, soft to stiff, blocky, non plastic, with fine sand, and gravel
	SS	75	15-14-14-20 (28)			
5	MC	56	17-14			Sample collected for moisture & permeability
	SS	100	6-6-7-12 (13)			5.0
	SS	100	8-13-10-12 (23)	ML		6.5 SILT, (ML) pale brown (10YR 7/3), dry to moist, soft, with fine sand, loess
10	MC	75	10-6			Sample collected for moisture & permeability
	SS	75	11-18-20-18 (38)			10.0 WELL GRADED SAND, (SW) light brown to pinkish gray (7.5YR 6/3), well graded, subrounded, fine to coarse grained, moist, loose to medium dense, with gravel
	SS	75	23-24-26-30 (50)			
15	SS	75	16-14-10-7 (24)	SW		
	MC	75				Sample collected for moisture & permeability
	SS	67	8-15-17-20 (32)			18.0
20	SS	100	19-50			20.0 WELL GRADED SAND, CLAYEY, (SW) brown (10YR 5/3), well graded, subangular, fine to coarse grained, moist, medium dense, with gravel, clay component increasing with depth, shale-derived clay in shoe
	SS	33	30-50	SW		
	SS	133	18-50			22.0 SHALE, highly weathered, laminated, black with light olive (N1), damp to dry, iron oxide staining, very weak with iron stained zones along bedding planes, no vertical or high-angle fractures
25						
30						30.0
	RC NX	100				SHALE, unweathered, laminated, black (N1), dry, strong
35						

WELL DIAGRAM
Casing Top Elev: 4804.26 (ft)
Casing Type: 2-in PVC
Bentonite Chips, Hydrated in Lifts
10-20 Silica Sand
0.010-in Slotted Screen

(Continued Next Page)

CLIENT Xcel Energy **PROJECT NAME** Comanche Station

PROJECT NUMBER 10217175 **PROJECT LOCATION** Pueblo, CO

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35						SHALE, unweathered, laminated, black (N1), dry, strong *(continued)*	
40	RC NX	90					Coated Bentonite Pellets
45	RC NX	100				Sample collected for moisture & permeability	
50	RC NX	90					
						44.0	
						50.0	

Bottom of borehole at 50.0 feet.

CLIENT Xcel Energy
PROJECT NAME Comanche Station
PROJECT NUMBER 10217175
PROJECT LOCATION Pueblo, CO
DATE STARTED 08/19/20 10:30 **COMPLETED** 08/19/20 16:00
WELL LOCATION 559069.16 N 2266859.31 E
DRILLING CONTRACTOR Dakota Drilling
GROUND ELEVATION 4802.13 ft **HOLE DIAMETER** 8
DRILLING METHOD HSA/NX/AR
GROUND WATER LEVELS:
LOGGED BY G. Kelly **CHECKED BY**
▼ **AFTER DRILLING** 54.58 ft / Elev 4747.55 ft Rising; Not Static
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0							Casing Top Elev: 4804.46 (ft) Casing Type: 2-in PVC
	SS 1		12-12-14-18 (26)	CL		LEAN CLAY, (CL) light brown (7.5YR 6/4), dry, stiff, with sand, and gravel	
	SS 2		17-11-12-17 (23)				
5	SS 3		18-12-9-8 (21)				
						6.0	
	SS 4		5-5-7-9 (12)	ML		SILT, (ML) light brown (7.5YR 6/4), dry, loess	
	SS 5		10-14-8-8 (22)				
10						9.5	
	SS 6		13-20-17-14 (37)	SW		WELL GRADED SAND, (SW) brown to dark yellowish brown (10YR 5/3), well graded, fine to coarse grained, moist, loose, with gravel	
	SS 7		11-12-22-32 (34)				
15	SS 8		11-15-12-11 (27)				
	SS 9		22-17-16-12 (33)				← Bentonite Chips, Hydrated in Lifts
	SS 10		11-14-22-13 (36)				
20						19.0	
	SS 11		28-30-50 (80)	SW		CLAYEY SAND, (SW) yellowish brown (10YR 5/4), moist, dense, with gravel	
						22.0	
	SS 12		50			SHALE, moderately weathered, dark yellowish brown (10YR 2/2), damp, weak, blocky	
	SS 13		50				
25							
	SS 14		50				
	SS 15		50				
30						30.0	
	RC NX					SHALE, unweathered, brownish black (5YR 2/1), dry, strong, unfractued, weak zones at 42'7" to 42'10" and 43' 9" to 43' 10"	
35							

(Continued Next Page)

CLIENT Xcel Energy **PROJECT NAME** Comanche Station

PROJECT NUMBER 10217175 **PROJECT LOCATION** Pueblo, CO

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35	RC NX					SHALE, unweathered, brownish black (5YR 2/1), dry, strong, unfractued, weak zones at 42'7" to 42'10" and 43' 9" to 43' 10" *(continued)*	
40	RC NX						
45	RC NX						10-20 Silica Sand 0.010-in Slotted Screen
50	RC NX						
55						55.0 ▼	

Bottom of borehole at 55.0 feet.

HDR, Inc.
9781 S Meridian Blvd, Suite 400
Englewood, CO 80112

W-5B

CLIENT Xcel Energy
PROJECT NAME Comanche Station
PROJECT NUMBER 10217175
PROJECT LOCATION Pueblo, CO
DATE STARTED 12/11/20 11:15 **COMPLETED** 12/14/20 13:00
WELL LOCATION 560800.98 N 2266452.74 E
DRILLING CONTRACTOR Dakota Drilling
GROUND ELEVATION 4807.99 ft **HOLE DIAMETER** 8
DRILLING METHOD HSA/NX/AR
GROUND WATER LEVELS:
LOGGED BY E. Munoz **CHECKED BY**
AFTER DRILLING 8.82 ft / Elev 4799.17 ft
NOTES New, XYZ estimated pending survey

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				GC		0.2 CLAYEY GRAVEL (GC), yellowish brown (10YR 5/4), dense, moist, (Fill)
						1.0 FAT CLAY (CH), brown (10YR 4/3) to yellowish brown (10YR 5/4), medium stiff, medium plasticity, moist, lenses of lean clay, trace sand and fine gravel, trace evaporites, iron staining (Colluvium) (W-5B-3-4)
5	AU					
	CC	100		CH		
10						
	CC	90				
15						13.5 LEAN CLAY (CL), yellowish brown (10YR 5/6) interbedded with dark grayish brown (10YR 4/2) and very dark gray (10YR 3/1), stiff to very stiff, low to medium plasticity, moist to wet at 15ft, relict shale structure, some gypsum in bedding planes (Colluvium) (W-5B-14-15)
	CC	100				
20						
	CC	100		CL		
25						
	NX	48				
30						29.0 SHALE, black (Gley 1 2.5/N) with brown (10YR 4/3) clay, highly weathered, weak, clayey, moist to wet, high-angle fractures with iron-staining and gypsum (Weathered Shale)
	NX	37				
35						34.0
	NX	100				35.5 SHALE, black (Gley 1 2.5/N) to very dark gray (2.5Y 3/1), slightly to moderately weathered, weak, clayey, moist to wet, some gypsum in bedding planes, no high angle fractures or iron staining (Weathered Shale)
						39.0 SHALE, black (Gley 1 2.5/N), unweathered, medium strong, moist to low moist, no fractures (except coring induced), no iron staining, some to trace gypsum deposits and mollusc fossils (Unweathered Shale)

Bottom of borehole at 39.0 feet.

WELL DIAGRAM

Casing Type: 2-in PVC

Bentonite Chips

0.010-in Slot

Bentonite Pellets

HDR, Inc.
9781 S Meridian Blvd, Suite 400
Englewood, CO 80112

CLIENT Xcel Energy **PROJECT NAME** Comanche Station

PROJECT NUMBER 10217175 **PROJECT LOCATION** Pueblo, CO

DATE STARTED 12/03/20 11:53 **COMPLETED** 12/04/20 15:00 **WELL LOCATION** 559642.055 N 2267090.86 E

DRILLING CONTRACTOR Dakota Drilling **GROUND ELEVATION** 4800 ft **HOLE DIAMETER** 8

DRILLING METHOD HSA/AR **GROUND WATER LEVELS:**

LOGGED BY E. Munoz **CHECKED BY** ▼ **AFTER DRILLING** 33.31 ft / Elev 4766.69 ft

NOTES New, XYZ estimated pending survey

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0							Casing Type: 2-in PVC
	AU			OL		SILT (OL), dark grayish brown (10YR 3/2), soft, non plastic, dry, rootlets in upper 0.5ft (Topsoil)	
						2.0	
5				CL		SILTY LEAN CLAY (CL), yellowish brown (10YR 5/4), medium stiff, low plasticity, dry, evaporites present (calcite, gypsum) (Colluvium)	
	CC	67				6.0	
				SM		CLAYEY SAND SILTY SAND (SM), yellowish brown (10YR 5/4), dense, dry, evaporites present (calcite, gypsum) (Alluvium) (samples W-9-5-6 & W-9-7-8)	
10						8.5	
	CC	33		SW		WELL GRADED SAND (SW), yellowish brown (10YR 5/6), loose, moist, fine to coarse grained with fine to coarse gravel (up to 2"), sub-rounded to rounded (Alluvium) (W-9-11-12)	Bentonite Chips
15						15.0	
	CC	60		ML		CLAYEY SILT (ML), yellowish brown (10YR 5/4), soft, low plasticity, moist, (W-9-15-16)	
						17.0	
20				SW		WELL GRADED SAND (SW), yellowish brown (10YR 5/6), loose, moist to wet, fine to coarse grained with fine to coarse gravel (up to 2"), sub-rounded to rounded (Alluvium) (W-9-21-22) (water added to drill clay, below)	
	CC	67				22.0	
				CL		LEAN CLAY (CL), brownish yellow (10YR 6/6), stiff, low plasticity, moist, blocky with some relict shale structure (Colluvium) (W-9-22-23)	
25						25.0	
	CC	100		CL		LEAN CLAY (CL), yellowish brown with dark grayish brown (10YR 5/6), medium stiff, low plasticity, moist to wet, shale fragments & gypsum present (water added to drill) (Colluvium) (W-9-26-27)	
						27.0	
30						SHALE, highly weathered, laminated, very dark grayish brown (10YR 3/2), dry to low moist, weak, clayey, gypsum and iron-staining along fractures and bedding planes (water added to drill) (Weathered Shale)	
						30.0	
	CC	100				SHALE, moderately weathered, laminated, black (Gley 1 2.5/N), weak to medium-strong, fissile/friable, iron staining and gypsum along bedding planes and fractures, high angle fracture 32-33ft, moist to wet (water added to drill) (Weathered Shale) (W-9-33-34)	0.010-in Slot
35						35.0	

(Continued Next Page)

HDR, Inc.
9781 S Meridian Blvd, Suite 400
Englewood, CO 80112

CLIENT Xcel Energy **PROJECT NAME** Comanche Station

PROJECT NUMBER 10217175 **PROJECT LOCATION** Pueblo, CO

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35							
	CC	100				SHALE, moderately weathered to slightly weathered, laminated, black (Gley 1 2.5/N), weak, clayey, moist, no fractures or iron staining (Weathered Shale)	
38.0						SHALE, slightly weathered to unweathered, laminated, dark gray (Gley 1 4/N), moderately strong to strong, dry, no fractures or staining (Unweathered Shale) (W-9-44-45)	
40	CC	100					
45					45.0		

Bottom of borehole at 45.0 feet.

HDR, Inc.
9781 S Meridian Blvd, Suite 400
Englewood, CO 80112

W-10A

CLIENT Xcel Energy
PROJECT NAME Comanche Station
PROJECT NUMBER 10217175
PROJECT LOCATION Pueblo, CO
DATE STARTED 12/08/20 09:25 **COMPLETED** 12/08/20 11:00
WELL LOCATION 562453.84 N 2266883.73 E
DRILLING CONTRACTOR Dakota Drilling
GROUND ELEVATION 4834 ft **HOLE DIAMETER** 8
DRILLING METHOD HSA/NX/AR
GROUND WATER LEVELS:
LOGGED BY E. Munoz **CHECKED BY**
AFTER DRILLING ---
NOTES New, XYZ estimated pending survey

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0							Casing Type: 2-in PVC
				SM		SILTY SAND (SM), very dark grayish brown (10YR 3/2), loose, dry, fine grained, some coarse sand (Fill)	
1.0							
				ML		SILT (ML), yellowish brown (10YR 5/4), soft, low plasticity, dry, with fine sand (Colluvium) (W-10-2.5)	Bentonite Chips
5							
5.0							
				SC		CLAYEY SAND (SC), light yellowish brown (10YR 6/4), medium dense, dry, fine grained, grades into silty clay with fine sand, mottled with evaporites (Colluvium) (W-10-5)	
7.5							
				CH		FAT CLAY (CH), light yellowish brown (10YR 6/4), stiff to very stiff, medium plasticity, dry, with very dark gray (10YR 3/1) shale fragments, recrystallized evaporites on high-angle fractures, rig grinding/auger sticking in clay (Colluvium) (W-10-7.5, W-10-10, W-10-12.5)	10/20 Silica Sand 0.010-in Slot
10							
15							
15.5							
				CL		LEAN CLAY (CL), light yellowish brown (10YR 6/4), stiff, low plasticity, dry, with fine sand and very dark gray (10YR 3/1) shale fragments, recrystallized evaporites on high-angle fractures (Colluvium) (W-10-15)	
17.5							

Bottom of borehole at 18.0 feet.

HDR, Inc.
9781 S Meridian Blvd, Suite 400
Englewood, CO 80112

W-10B

CLIENT Xcel Energy
PROJECT NAME Comanche Station
PROJECT NUMBER 10217175
PROJECT LOCATION Pueblo, CO
DATE STARTED 12/07/20 10:05 **COMPLETED** 12/08/20 09:25
WELL LOCATION 562456.84 N 2266963.73 E
DRILLING CONTRACTOR Dakota Drilling
GROUND ELEVATION 4837 ft **HOLE DIAMETER** 8
DRILLING METHOD HSA/NX/AR
GROUND WATER LEVELS:
LOGGED BY E. Munoz **CHECKED BY**
AFTER DRILLING 25.47 ft / Elev 4811.53 ft
NOTES New, XYZ estimated pending survey

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				SM		SILTY SAND (SM), very dark grayish brown (10YR 3/2), loose, dry, fine grained, some coarse sand (Fill)
1.0						SILT (ML), yellowish brown (10YR 5/4), soft, low plasticity, dry, with fine sand (Colluvium) (W-10-2.5)
	MC	83	4-5	ML		
5						
5.0	MC	83	11-15	SC		CLAYEY SAND (SC), light yellowish brown (10YR 6/4), medium dense, dry, fine grained, grades into silty clay with fine sand, mottled with evaporites (Colluvium) (W-10-5)
7.5	MC	91	22-28/5"			FAT CLAY (CH), light yellowish brown (10YR 6/4), stiff to very stiff, medium plasticity, dry, with very dark gray (10YR 3/1) shale fragments, recrystallized evaporites on high-angle fractures, rig grinding/auger sticking in clay (Colluvium) (W-10-7.5, W-10-10, W-10-12.5)
10	MC	89	21-29/3"	CH		
	MC	100	30-20/3"			
15						
15.5	MC	91	23-27/5"	CL		LEAN CLAY (CL), light yellowish brown (10YR 6/4), stiff, low plasticity, dry, with fine sand and very dark gray (10YR 3/1) shale fragments, recrystallized evaporites on high-angle fractures (Colluvium) (W-10-15)
17.5	MC	100	38-12/1"			SHALE, highly weathered, very dark gray (10YR 3/1), weak, friable, clayey, fractured with evaporites and iron staining (Weathered Shale) (W-10-17.5)
20						
20.0	MC	100	50			SHALE, moderately weathered, very dark gray (10YR 3/1), medium strong, dry, iron stained with trace evaporites (Weathered Shale) (W-10-20)
20.5	NX	100				SHALE, moderately weathered, dark grayish brown (10YR 4/2), medium strong, dry, fractured with iron staining and evaporite depositis (Weathered Shale) (W-10-20-25 [SPLP])
25						
25.0	NX	75				SHALE, moderately weathered to highly weathered, very dark gray (10YR 3/1), weak, clayey, moist to wet, highly fractured, iron stained (Weathered Shale)
29.0						
30						SHALE, slightly weathered, dark gray (Gley 1 4/N), weak, clayey, moist, unfractured (Weathered Shale)
31.0	NX	100				SHALE, unweathered, dark gray (Gley 1 4/N), strong, unfractured (Unweathered Shale) (W-10-32-34 [SPLP])
34.0						

Bottom of borehole at 34.0 feet.

WELL DIAGRAM

Casing Type: 2-in PVC

HDR, Inc.
9781 S Meridian Blvd, Suite 400
Englewood, CO 80112

W-11

CLIENT Xcel Energy
PROJECT NAME Comanche Station
PROJECT NUMBER 10217175
PROJECT LOCATION Pueblo, CO
DATE STARTED 12/08/20 12:15 **COMPLETED** 12/09/20 11:00
WELL LOCATION 558644.6073 N 2264830.955 E
DRILLING CONTRACTOR Dakota Drilling
GROUND ELEVATION 4775 ft **HOLE DIAMETER** 8
DRILLING METHOD HSA/NX/AR
GROUND WATER LEVELS:
LOGGED BY E. Munoz **CHECKED BY**
▼ **AFTER DRILLING** 20.95 ft / Elev 4754.05 ft
NOTES New, XYZ estimated pending survey

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				ML		SILT (ML), yellowish brown (10YR 5/4), soft, non plastic, dry, with fine sand, trace coarse sand and subrounded fine gravel, rootlets (Topsoil) 1.0
5	AU			ML		CLAYEY SILT (ML), yellowish brown (10YR 6/4), soft, low plasticity, dry, (Colluvium) 5.0
10	CC	100				SHALE, moderately weathered to highly weathered, dark gray (Gley 1 4/N) with yellowish brown (10YR 5/6) iron-staining, weak, clayey, dry to low moist, moist after 24 ft, high-angle to vertical fractures, evaporites (particularly gypsum) (Weathered Shale) (W-11-9-10)
15	CC	100				
	NX	79				
20	NX	0				
25	NX	25				
	NX	0				
	NX	75				
30	NX	50				
35	NX	100				SHALE, unweathered, very dark gray (10YR 3/1) to black (Gley 1 2.5/N), strong, unfractured (except coring-induced), dry to low moist (Unweathered Shale) (W-11-38-39) 33.5 39.0

WELL DIAGRAM

Casing Type: 2-in PVC

Bentonite Chips

10/20 Silica Sand
0.010-in Slot

Bentonite Pellets

Bottom of borehole at 39.0 feet.

HDR, Inc.
9781 S Meridian Blvd, Suite 400
Englewood, CO 80112

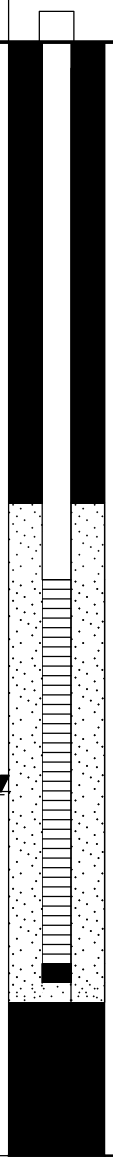
W-12

CLIENT Xcel Energy
PROJECT NAME Comanche Station
PROJECT NUMBER 10217175
PROJECT LOCATION Pueblo, CO
DATE STARTED 12/09/20 11:20 **COMPLETED** 12/09/20 14:45
WELL LOCATION 558582.6073 N 2265536.955 E
DRILLING CONTRACTOR Dakota Drilling
GROUND ELEVATION 4777 ft **HOLE DIAMETER** 8
DRILLING METHOD HSA/NX/AR
GROUND WATER LEVELS:
LOGGED BY E. Munoz **CHECKED BY**
AFTER DRILLING 19.52 ft / Elev 4757.48 ft
NOTES New, XYZ estimated pending survey

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				ML		0.5 SILT (ML), yellowish brown (10YR 5/4), soft, non plastic, dry, with fine sand, trace coarse sand and subrounded fine gravel, rootlets (Topsoil)
	AU			ML		CLAYEY SILT (ML), yellowish brown (10YR 6/4), soft, low plasticity, dry, (Colluvium)
						4.0
5				CH		FAT CLAY (CH), brownish yellow (10YR 6/8), very stiff, medium plasticity, dry, trace coarse sand in upper 2ft, evaporites throughout (Colluvium) (W-12-5-6)
	CC	100				
10						10.5
				CL		LEAN CLAY (CL), pale brown (10YR 6/3), stiff, low plasticity, dry, relict shale structure, evaporites (gypsum) (Colluvium) (W-12-11-12)
	CC	90				12.0
15						SHALE, dark gray (10YR 4/1) and yellowish brown (10YR 5/4), moderately to highly weathered, weak, clayey, many high-angle fractures with iron staining and gypsum deposits, some pyrolusite, dry to moist/wet at 19ft (Weathered Shale) (W-12-13-14)
	NX	13				
20						
	NX	80				
						23.0
25						SHALE, black (2.5Y 2.5/1 to Gley 1 2.5/N), slightly weathered, strong, moist to low moist, some clayey zones, some high angle fractures, iron staining, gypsum (Weathered Shale)
						26.0
	NX	100				SHALE, black (Gley 1 2.5/N), unweathered, strong, unfractured (except coring-induced), no staining or clayey zones present, low moist to dry (Unweathered Shale)
						29.0

Bottom of borehole at 29.0 feet.

WELL DIAGRAM



HDR, Inc.
9781 S Meridian Blvd, Suite 400
Englewood, CO 80112

W-13

CLIENT Xcel Energy
PROJECT NAME Comanche Station
PROJECT NUMBER 10217175
PROJECT LOCATION Pueblo, CO
DATE STARTED 12/10/20 08:15 **COMPLETED** 12/10/20 12:00
WELL LOCATION 558722.5789 N 2266105.628 E
DRILLING CONTRACTOR Dakota Drilling
GROUND ELEVATION 4801 ft **HOLE DIAMETER** 8
DRILLING METHOD HSA/NX/AR
GROUND WATER LEVELS:
LOGGED BY E. Munoz **CHECKED BY** ---
AFTER DRILLING ---
NOTES New, XYZ estimated pending survey

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				ML		1.0 SILT (ML), yellowish brown (10YR 5/4), soft, non plastic, dry, with fine sand, trace coarse sand and subrounded fine gravel, rootlets (Topsoil)
5	AU			ML		SILT (ML), light yellowish brown (10YR 6/4), soft, non plastic, dry, some fine sand 7-8.5ft (Loess) (W-13-4-5)
10	CC	30				8.5
15	CC	20		SW		WELL GRADED SAND WITH GRAVEL (SW), reddish brown (5YR 5/4), loose, moist, fine to coarse grained, subrounded to rounded, gravel up to 2in, 1in lens of caliche-cemented alluvium at 17ft (Alluvium) (W-13-10-11)
20	CC	33		CL		17.0 SILTY LEAN CLAY (CL), yellowish brown (10YR 5/6) to dark yellowish brown (10YR 4/4), stiff to very stiff, low plasticity, moist, relict shale structure, shaly component increases with depth, lenses of fat clay 21.5-22ft (Colluvium)
25	CC	80				23.0 SHALE, black (10YR 2/1) with yellowish brown (10YR 5/4) clays and brownish yellow (10YR 6/8) iron staining, highly weathered, weak, clayey, moist to wet at 25ft, fractured, gypsum present (Weathered Shale) (W-13-23-25)
30	NX	63				27.5 SHALE, black (7.5YR 2.5/1), slightly weathered, strong, moist, some clays and inron staining along bedding planes, no high angle fractures, gypsum present (Weathered Shale) 29.0
35	NX	100				SHALE, black (10YR 2.5/1), unweathered, strong, moist, unfractured (except coring-induced) (Unweathered Shale) 34.0

WELL DIAGRAM

Casing Type: 2-in PVC

Bentonite Chips

10/20 Silica Sand
0.010-in Slot

Bentonite Pellets

Bottom of borehole at 39.0 feet.

Appendix B

Geotechnical Soil Testing Results

Appendix B

Geotechnical Soil Testing Results

Hepworth-Pawlak Geotechnical, Inc.
10302 South Progress Way
Parker, Colorado 80134
Phone: 303-841-7119
Fax: 303-841-7556
www.hpgeotech.com

December 14, 2015

Anna Lundin
HDR
1670 Broadway, Suite 3400
Denver, CO 80202

215333B
Anna.Lundin@HDRinc.com

Subject: Laboratory Tests Results – Xcel Coal Combustion Residuals Rule Compliance Project, Comanche Power Station.

Dear Ms. Lundin:

This letter presents the results of laboratory tests performed on samples submitted for the subject project. The test results are presented on the attached Figures 1-3 and Table 1.

If there are any questions, please feel free to contact us.

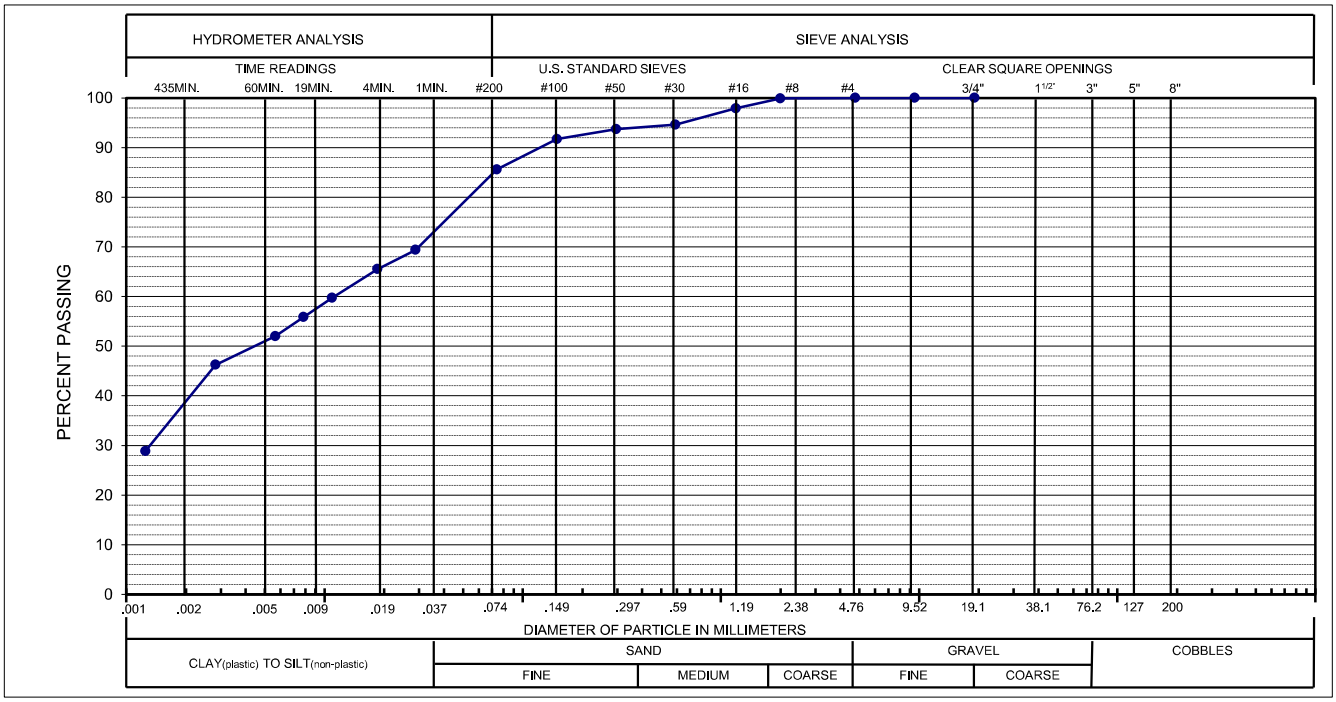
Sincerely,

HEPWORTH-PAWLAK GEOTECHNICAL, Inc.

Cuong Vu, Ph.D., P.E.

Reviewed by: Arben Kalaveshi, P.E.

215333B (Comanche) xmittal.doc



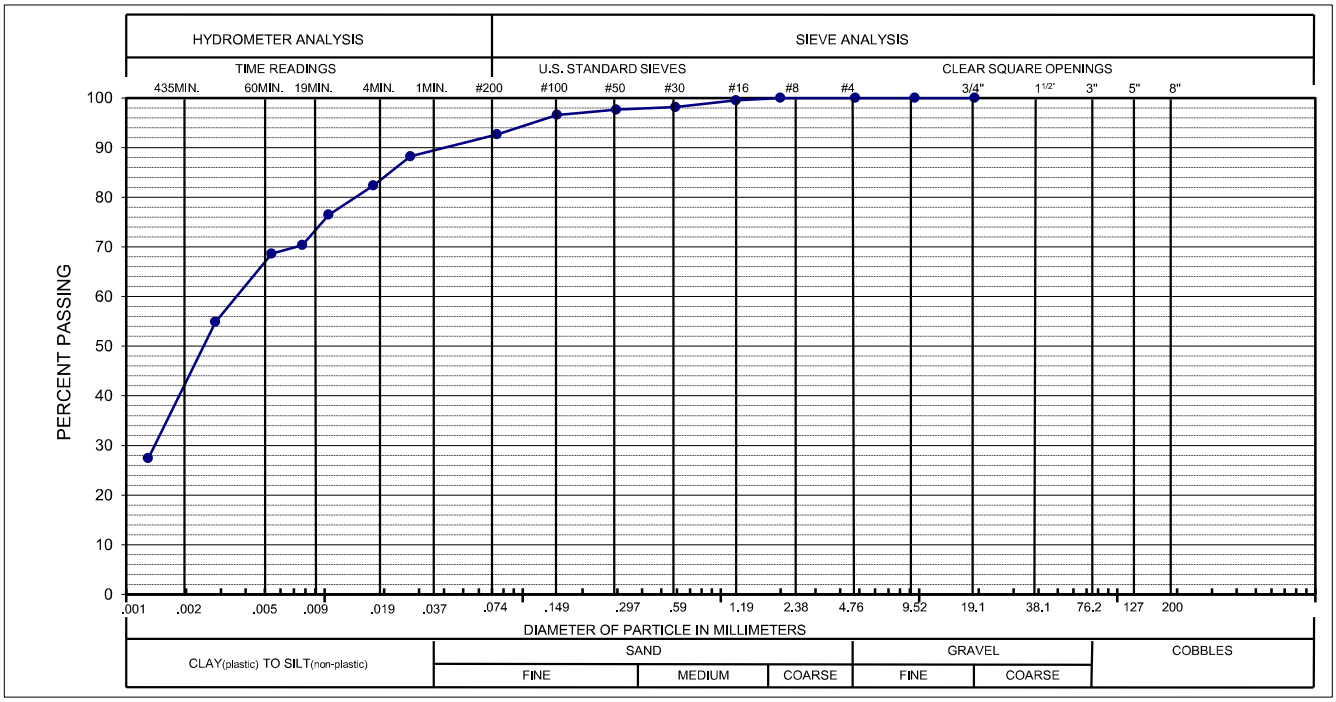
GRAVEL: 0% SAND: 14% SILT / CLAY: 86%

BORING : MW4 Specific Gravity: 2.87

DEPTH : 9 feet Porosity : 36.2%

Sieve Size / Particle Diameter	Percent Passing
(1")	100
(3/4")	100
(1/2")	100
(3/8")	100
(#4)	100
(#10)	100
(#16)	98
(#30)	95
(#50)	94
(#100)	92
(#200)	86
0.0288	69
0.0185	66
0.0109	60
0.0078	56
0.0057	52
0.0028	46
0.0012	29

215333B	HEPWORTH-PAWLAK GEOTECHNICAL, INC.	HDR COMANCHE HYDROMETER AND SIEVE ANALYSIS	FIG. 1



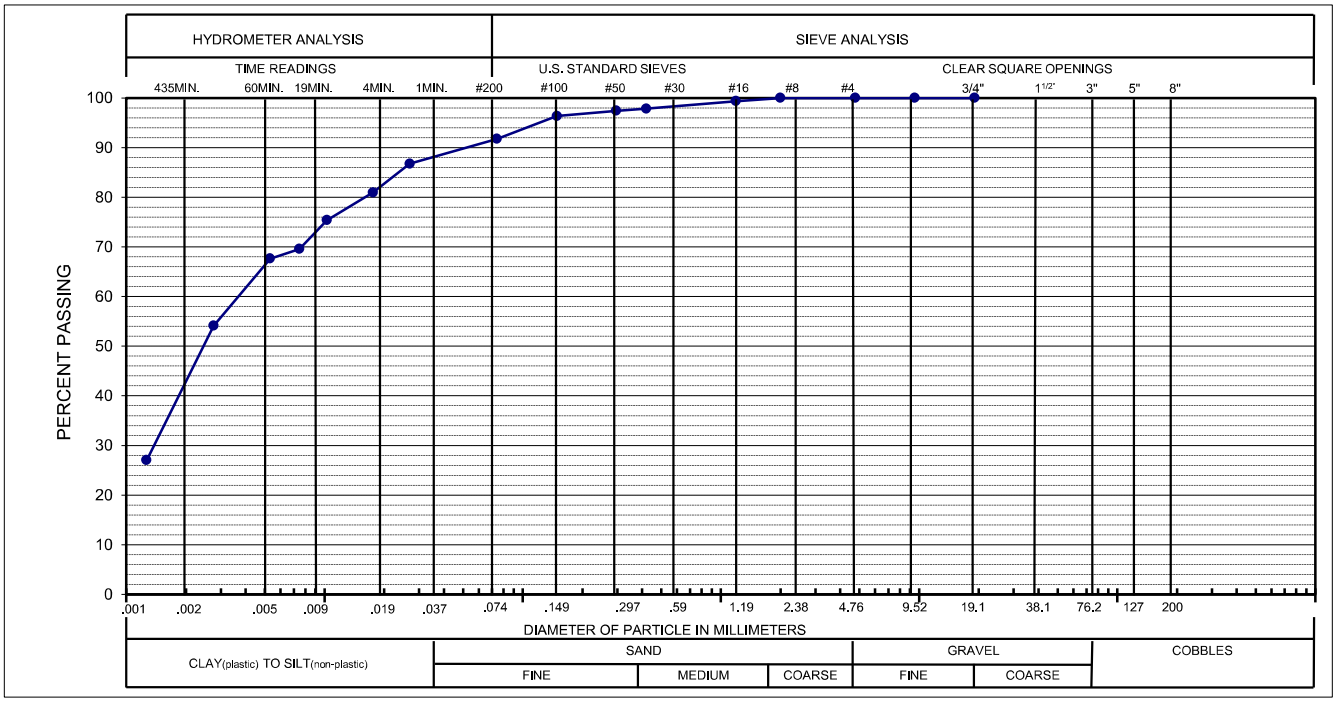
GRAVEL: 0% SAND: 7% SILT / CLAY: 93%

BORING : MW5 Specific Gravity: 2.78

DEPTH : 9 feet Porosity : 39.2%

Sieve Size / Particle Diameter	Percent Passing
(1")	100
(3/4")	100
(1/2")	100
(3/8")	100
(#4)	100
(#10)	100
(#16)	100
(#30)	98
(#50)	98
(#100)	97
(#200)	93
0.027	88
0.018	82
0.010	76
0.008	70
0.005	69
0.003	55
0.001	27

215333B	HEPWORTH-PAWLAK GEOTECHNICAL, INC.	HDR COMANCHE HYDROMETER AND SIEVE ANALYSIS	FIG. 2



GRAVEL: 0% SAND: 8% SILT / CLAY: 92%

BORING : MW6 Specific Gravity: 2.85

DEPTH : 9 feet Porosity : 35.4%

Sieve Size / Particle Diameter	Percent Passing
(1")	100
(3/4")	100
(1/2")	100
(3/8")	100
(#4)	100
(#10)	100
(#16)	99
(#30)	98
(#50)	97
(#100)	96
(#200)	92
0.027	87
0.018	81
0.010	75
0.007	70
0.005	68
0.003	54
0.001	27

215333B	HEPWORTH-PAWLAK GEOTECHNICAL, INC.	HDR COMANCHE HYDROMETER AND SIEVE ANALYSIS	FIG. 3

HEPWORTH-PAWLAK GEOTECHNICAL, INC.

JOB NO. 215333B

PROJECT: COMANCHE

TABLE 1

SUMMARY OF LABORATORY TEST RESULTS

SAMPLE LOCATION		NATURAL MOISTURE CONTENT (%)	NATURAL DRY UNIT WEIGHT (PCF)	GRADATION			SPECIFIC GRAVITY	POROSITY (%)
BORING	DEPTH (feet)			GRAVEL (%)	SAND (%)	SILT & CLAY (%)		
MW4	9	17.2	114	0	14	86	2.87	36.2
MW5	9	18.9	109	0	7	93	2.78	39.2
MW6	9	17.4	115	0	8	92	2.85	35.4

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-2B
JOB NO.	3102-001	DEPTH	28-29'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	7/31/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/02/20	DESCRIPTION	SOIL
TECHNICIAN	CAL		

Sample Conditions

Before Test Mass of Wet Soil (g):	266.7	Initial Wet Density (pcf):	140.3
After Test Mass of Wet Soil (g):	266.6	Initial Dry Density (pcf):	126.9
Mass of Dry Soil and Pan (g):	247.9	Initial Wet Density (kg/m³):	2247
Mass of Pan (g):	6.7	Initial Dry Density (kg/m³):	2032
Diameter (in):	1.87	Initial Moisture (%):	10.6
Initial Sample Height (in):	2.64	Final Wet Density (pcf):	143.9
Assumed Specific Gravity:	2.650	Final Dry Density (pcf):	130.3
		Final Wet Density (kg/m³):	2306
Back Pressure (psi):	38.0	Final Dry Density (kg/m³):	2087
Cell Pressure (psi):	61.0	Final Moisture (%):	10.5

Final density calculated using volume change method from ASTM D4767.

Permeability Data

Pump Setting		Rate of Flow (cc/s)	Pump Pressure (psi)	Head Loss (cm)	Gradient - i	Effective Stress (psi) - σ_3	Effective Stress (kPa) - σ_3	Temperature (°C)	Temperature Correction	Corrected Hydraulic Conductivity (cm/s) - k
5	--	1.12E-06	1.746	122.93	18.52	22.13	152.6	21.5	0.965	3.34E-09
5	--	1.12E-06	2.030	142.93	21.53	21.99	151.6	21.5	0.965	2.88E-09
5	--	1.12E-06	2.310	162.64	24.50	21.85	150.6	21.5	0.965	2.53E-09
5	--	1.12E-06	2.530	178.13	26.83	21.74	149.9	21.5	0.965	2.31E-09
5	--	1.12E-06	2.710	190.81	28.74	21.65	149.2	21.5	0.965	2.15E-09
5	--	1.12E-06	2.830	199.26	30.01	21.59	148.8	21.5	0.965	2.06E-09
5	--	1.12E-06	2.940	207.00	31.18	21.53	148.4	21.6	0.962	1.98E-09
5	--	1.12E-06	3.010	211.93	31.92	21.50	148.2	21.6	0.962	1.94E-09
5	--	1.12E-06	3.090	217.56	32.77	21.46	147.9	21.6	0.962	1.89E-09
5	--	1.12E-06	3.100	218.27	32.87	21.45	147.9	21.6	0.962	1.88E-09
5	--	1.12E-06	3.080	216.86	32.66	21.46	148.0	21.6	0.962	1.89E-09

Test Results

Average Corrected Hydraulic Conductivity (cm/s): 1.90E-09

NOTES:

Data entry by:	CAL	Date:	09/08/20
Checked by:	DPM	Date:	09/14/20
File name:	3102001__Permeability Method D ASTM D5084_0.xlsm		Page 1 of 2

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

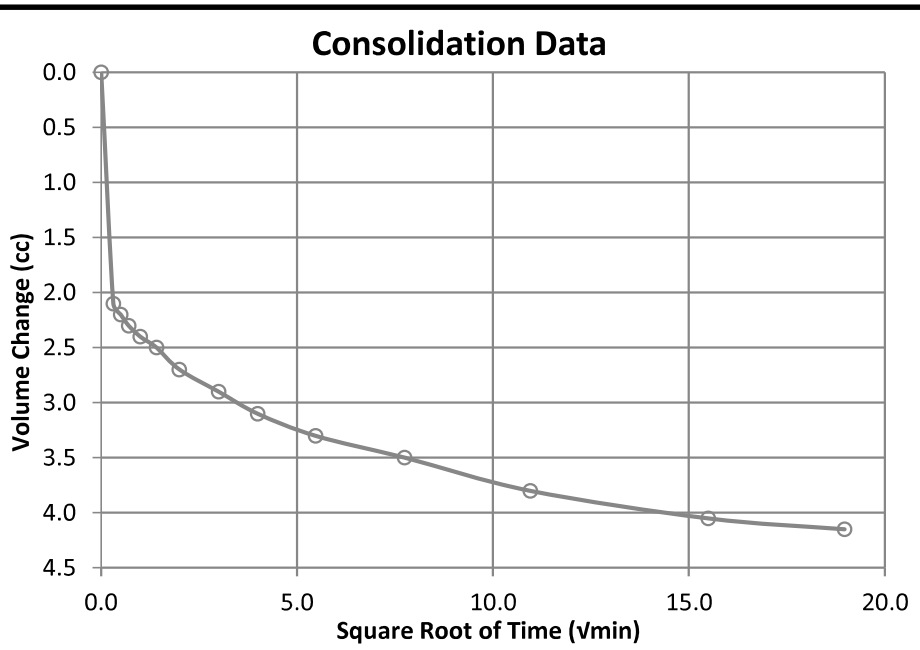
ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-2B
JOB NO.	3102-001	DEPTH	28-29'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	7/31/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/02/20	DESCRIPTION	SOIL
TECHNICIAN	CAL		

Consolidation

Initial Saturation (%):	92.0	Initial Volume of Sample (cc):	118.7
Final Saturation (%):	100.0	Final Volume of Sample (cc):	115.6
Cell Pressure (psi):	61.0	Volume Change After Consolidation (cc):	13.8
Back Pressure (psi):	38.0	Initial Dial Reading (in):	0.200
Effective Stress (psi):	23.0	Final Dial Reading (in):	0.221
Effective Stress (kPa):	158.6	Height Change (in):	0.021
Cell Expansion Correction (cc):	10.72	Initial Area (cm²):	17.74
Cell ID:	19S	Final Area (cm²):	17.42

Elapsed Time (min)	Square Root of Time (√min)	Burette Reading (cc)	Volume Change (cc)
0	0.00	0.90	0.00
0.1	0.32	3.00	2.10
0.25	0.50	3.10	2.20
0.5	0.71	3.20	2.30
1	1.00	3.30	2.40
2	1.41	3.40	2.50
4	2.00	3.60	2.70
9	3.00	3.80	2.90
16	4.00	4.00	3.10
30	5.48	4.20	3.30
60	7.75	4.40	3.50
120	10.95	4.70	3.80
240	15.49	4.95	4.05
360	18.97	5.05	4.15



Saturation

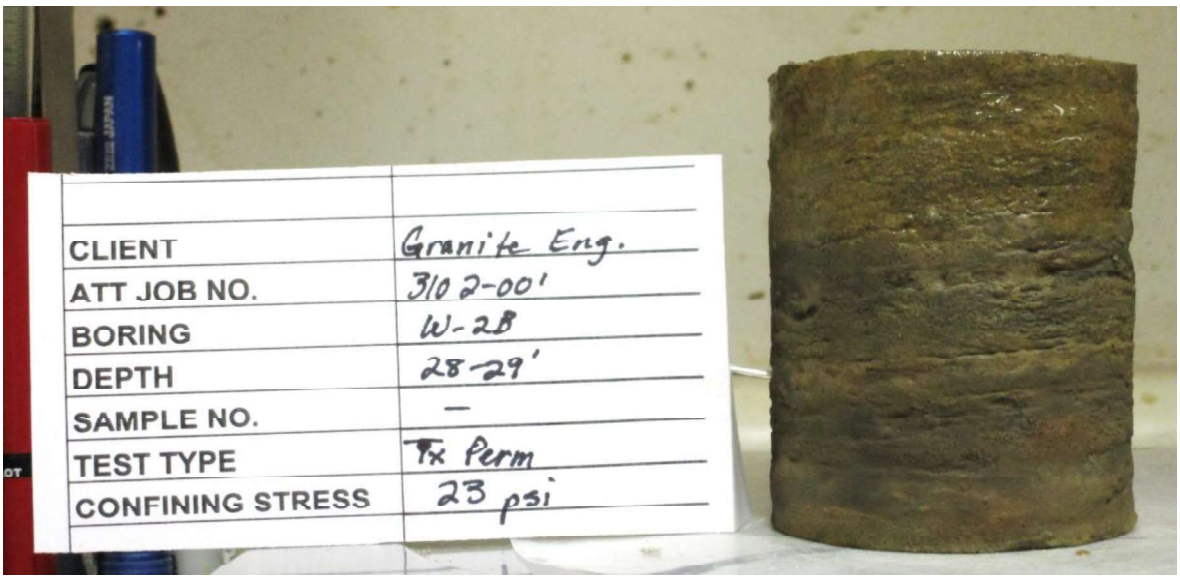
Cell Pressure (psi)		Pore Pressure (psi)		Burette Reading (cc)		Back Pressure (psi)	Volume Change (cc)	Effective Stress (psi)	Δu (psi)	B
Initial	Final	Initial	Final	Initial	Final					
40.0	50.0	39.0	48.6	11.20	11.30	38.0	0.10	2.0	9.6	0.96

File name: 3102001__Permeability Method D ASTM D5084_0.xlsm

Image Attachment

ADVANCED TERRA TESTING

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-2B
JOB NO.	3102-001	DEPTH	28-29'
PROJECT	Xcel Comanche	SAMPLE NO.	
PROJECT NO.	220-020	DATE SAMPLED	7/31/20
LOCATION	--	DESCRIPTION	soil



NOTES

File name: 3102001_PERM_W-2B_28-29.pdf

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-8
JOB NO.	3102-001	DEPTH	17-18'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	--
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/01/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Sample Conditions

Before Test Mass of Wet Soil (g):	283.3	Initial Wet Density (pcf):	123.7
After Test Mass of Wet Soil (g):	309.3	Initial Dry Density (pcf):	120.0
Mass of Dry Soil and Pan (g):	538.2	Initial Wet Density (kg/m³):	1982
Mass of Pan (g):	263.4	Initial Dry Density (kg/m³):	1922
Diameter (in):	1.93	Initial Moisture (%):	3.1
Initial Sample Height (in):	2.98	Final Wet Density (pcf):	137.7
Assumed Specific Gravity:	2.650	Final Dry Density (pcf):	122.4
		Final Wet Density (kg/m³):	2206
Back Pressure (psi):	68.0	Final Dry Density (kg/m³):	1960
Cell Pressure (psi):	83.0	Final Moisture (%):	12.6

Final density calculated using volume change method from ASTM D4767.

Permeability Data

		Rate of Flow (cc/s)	Pump Pressure (psi)	Head Loss (cm)	Gradient - i	Effective Stress (psi) - σ_3	Effective Stress (kPa) - σ_3	Temperature (°C)	Temperature Correction	Corrected Hydraulic Conductivity (cm/s) - k
--	--	5.33E-02	0.058	4.08	0.54	14.97	103.2	21.0	0.976	5.15E-03
--	--	5.33E-02	0.059	4.15	0.55	14.97	103.2	21.0	0.976	5.06E-03
--	--	5.33E-02	0.058	4.08	0.54	14.97	103.2	21.0	0.976	5.15E-03
--	--	5.33E-02	0.059	4.15	0.55	14.97	103.2	21.0	0.976	5.06E-03

Test Results

Average Corrected Hydraulic Conductivity (cm/s): 5.10E-03

NOTES:

Data entry by:	CAL	Date:	09/09/20
Checked by:	DPM	Date:	09/14/20
File name:	3102001__Permeability Method D ASTM D5084_1.xlsm		Page 1 of 2

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

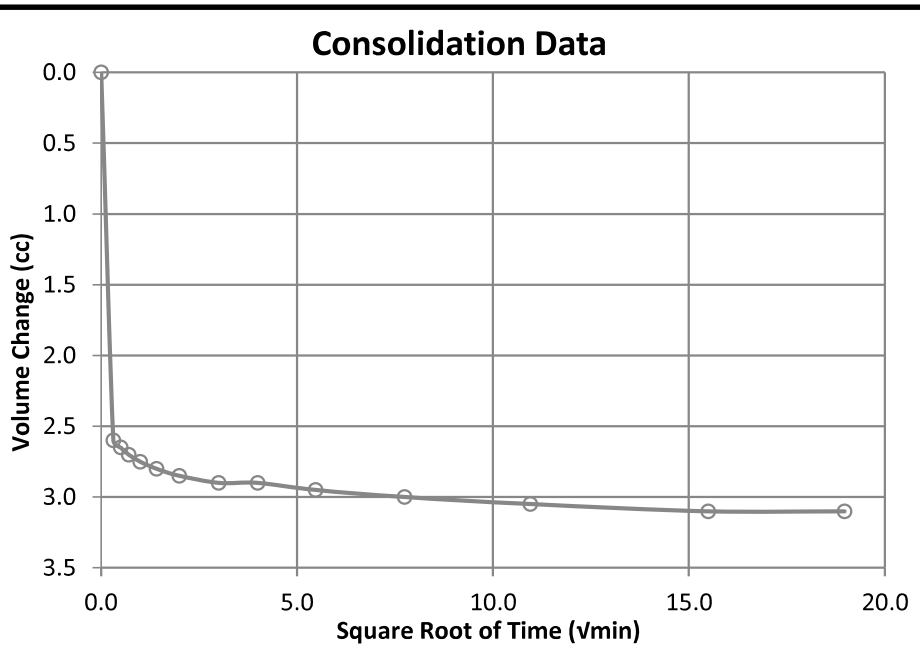
ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-8
JOB NO.	3102-001	DEPTH	17-18'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	--
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/01/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Consolidation

Initial Saturation (%):	21.8	Initial Volume of Sample (cc):	143.0
Final Saturation (%):	94.5	Final Volume of Sample (cc):	140.2
Cell Pressure (psi):	83.0	Volume Change After Consolidation (cc):	17.65
Back Pressure (psi):	68.0	Initial Dial Reading (in):	0.200
Effective Stress (psi):	15.0	Final Dial Reading (in):	0.214
Effective Stress (kPa):	103.4	Height Change (in):	0.014
Cell Expansion Correction (cc):	14.89	Initial Area (cm²):	18.91
Cell ID:	6P	Final Area (cm²):	18.64

Elapsed Time (min)	Square Root of Time (√min)	Burette Reading (cc)	Volume Change (cc)
0	0.00	17.20	0.00
0.1	0.32	19.80	2.60
0.25	0.50	19.85	2.65
0.5	0.71	19.90	2.70
1	1.00	19.95	2.75
2	1.41	20.00	2.80
4	2.00	20.05	2.85
9	3.00	20.10	2.90
16	4.00	20.10	2.90
30	5.48	20.15	2.95
60	7.75	20.20	3.00
120	10.95	20.25	3.05
240	15.49	20.30	3.10
360	18.97	20.30	3.10



Saturation

Cell Pressure (psi)		Pore Pressure (psi)		Burette Reading (cc)		Back Pressure (psi)	Volume Change (cc)	Effective Stress (psi)	Δu (psi)	B
Initial	Final	Initial	Final	Initial	Final					
40.0	50.0	39.2	47.3	12.30	13.40	38.0	1.10	2.0	8.1	0.81
50.0	60.0	49.2	58.2	14.40	15.20	48.0	0.80	2.0	9.0	0.90
60.0	70.0	59.1	68.5	15.90	16.70	58.0	0.80	2.0	9.4	0.94
70.0	80.0	69.3	79.0	17.30	17.20	68.0	-0.10	2.0	9.7	0.97

File name: 3102001__Permeability Method D ASTM D5084_1.xlsm

Image Attachment

ADVANCED TERRA TESTING

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-8
JOB NO.	3102-001	DEPTH	17-18'
PROJECT	Xcel Comanche	SAMPLE NO.	
PROJECT NO.	220-020	DATE SAMPLED	
LOCATION	--	DESCRIPTION	SOIL

NOTES

File name: 3102001_perm_w-8_17-18.pdf

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-2B
JOB NO.	3102-001	DEPTH	6'-7'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	7/30/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	08/31/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Sample Conditions

Before Test Mass of Wet Soil (g):	276.8	Initial Wet Density (pcf):	118.6
After Test Mass of Wet Soil (g):	297.4	Initial Dry Density (pcf):	102.5
Mass of Dry Soil and Pan (g):	505.1	Initial Wet Density (kg/m³):	1900
Mass of Pan (g):	266.1	Initial Dry Density (kg/m³):	1641
Diameter (in):	1.93	Initial Moisture (%):	15.8
Initial Sample Height (in):	3.05	Final Wet Density (pcf):	135.1
Assumed Specific Gravity:	2.650	Final Dry Density (pcf):	108.6
		Final Wet Density (kg/m³):	2164
Back Pressure (psi):	68.0	Final Dry Density (kg/m³):	1739
Cell Pressure (psi):	74.0	Final Moisture (%):	24.4

Final density calculated using volume change method from ASTM D4767.

Permeability Data

		Rate of Flow (cc/s)	Pump Pressure (psi)	Head Loss (cm)	Gradient - i	Effective Stress (psi) - σ_3	Effective Stress (kPa) - σ_3	Temperature (°C)	Temperature Correction	Corrected Hydraulic Conductivity (cm/s) - k
--	--	3.33E-04	0.094	6.62	0.86	5.95	41.0	21.2	0.972	2.11E-05
--	--	3.33E-04	0.094	6.62	0.86	5.95	41.0	21.2	0.972	2.11E-05
--	--	3.33E-04	0.094	6.62	0.86	5.95	41.0	21.2	0.972	2.11E-05
--	--	3.33E-04	0.095	6.69	0.87	5.95	41.0	21.2	0.972	2.09E-05
--	--	3.33E-04	0.095	6.69	0.87	5.95	41.0	21.2	0.972	2.09E-05
--	--	3.33E-04	0.095	6.69	0.87	5.95	41.0	21.2	0.972	2.09E-05

Test Results

Average Corrected Hydraulic Conductivity (cm/s): 2.09E-05

NOTES:

Data entry by:	CAL	Date:	09/09/20
Checked by:	KR	Date:	09/18/20
File name:	3102001__Permeability Method D ASTM D5084_2.xlsm		Page 1 of 2

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

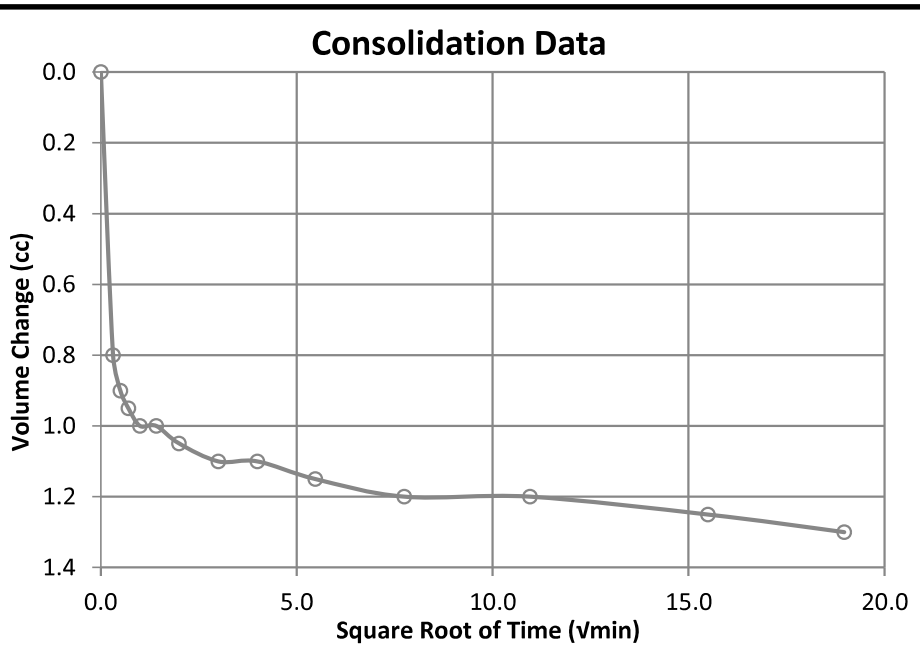
ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-2B
JOB NO.	3102-001	DEPTH	6'-7'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	7/30/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	08/31/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Consolidation

Initial Saturation (%):	68.0	Initial Volume of Sample (cc):	145.7
Final Saturation (%):	100.0	Final Volume of Sample (cc):	137.4
Cell Pressure (psi):	74.0	Volume Change After Consolidation (cc):	18.7
Back Pressure (psi):	68.0	Initial Dial Reading (in):	0.200
Effective Stress (psi):	6.0	Final Dial Reading (in):	0.222
Effective Stress (kPa):	41.4	Height Change (in):	0.022
Cell Expansion Correction (cc):	10.49	Initial Area (cm²):	18.78
Cell ID:	5P	Final Area (cm²):	17.85

Elapsed Time (min)	Square Root of Time (√min)	Burette Reading (cc)	Volume Change (cc)
0	0.00	19.40	0.00
0.1	0.32	20.20	0.80
0.25	0.50	20.30	0.90
0.5	0.71	20.35	0.95
1	1.00	20.40	1.00
2	1.41	20.40	1.00
4	2.00	20.45	1.05
9	3.00	20.50	1.10
16	4.00	20.50	1.10
30	5.48	20.55	1.15
60	7.75	20.60	1.20
120	10.95	20.60	1.20
240	15.49	20.65	1.25
360	18.97	20.70	1.30



Saturation

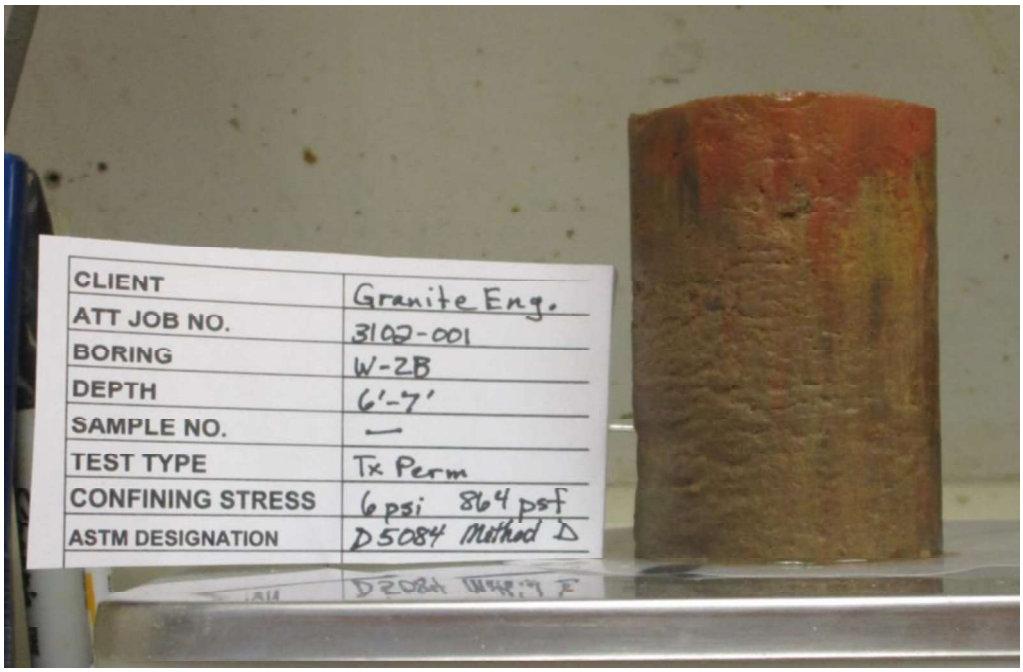
Cell Pressure (psi)		Pore Pressure (psi)		Burette Reading (cc)		Back Pressure (psi)	Volume Change (cc)	Effective Stress (psi)	Δu (psi)	B
Initial	Final	Initial	Final	Initial	Final					
40.0	50.0	38.9	46.6	14.40	15.30	38.0	0.90	2.0	7.7	0.77
50.0	60.0	49.0	57.6	16.30	17.10	48.0	0.80	2.0	8.6	0.86
60.0	70.0	59.1	68.4	17.60	18.30	58.0	0.70	2.0	9.3	0.93
70.0	80.0	69.1	78.9	19.30	19.40	68.0	0.10	2.0	9.8	0.98

File name: 3102001__Permeability Method D ASTM D5084_2.xlsm

Image Attachment

ADVANCED TERRA TESTING

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-2B
JOB NO.	3102-001	DEPTH	6-7'
PROJECT	Xcel Comanche	SAMPLE NO.	
PROJECT NO.	220-020	DATE SAMPLED	7/30/20
LOCATION	--	DESCRIPTION	SOIL



NOTES

File name: 3102001_perm_w-2b_6-7.pdf

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	MW-4
JOB NO.	3102-001	DEPTH	89-90'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	--
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/02/20	DESCRIPTION	rock
TECHNICIAN	CAL		

Sample Conditions

Before Test Mass of Wet Soil (g):	432.8	Initial Wet Density (pcf):	152.4
After Test Mass of Wet Soil (g):	434.2	Initial Dry Density (pcf):	145.6
Mass of Dry Soil and Pan (g):	420.0	Initial Wet Density (kg/m³):	2441
Mass of Pan (g):	6.7	Initial Dry Density (kg/m³):	2332
Diameter (in):	1.86	Initial Moisture (%):	4.7
Initial Sample Height (in):	4.00	Final Wet Density (pcf):	154.5
Assumed Specific Gravity:	2.650	Final Dry Density (pcf):	147.1
		Final Wet Density (kg/m³):	2476
Back Pressure (psi):	58.0	Final Dry Density (kg/m³):	2357
Cell Pressure (psi):	113.0	Final Moisture (%):	5.0

Final density calculated using volume change method from ASTM D4767.

Permeability Data

		Rate of Flow (cc/s)	Pump Pressure (psi)	Head Loss (cm)	Gradient - i	Effective Stress (psi) - σ_3	Effective Stress (kPa) - σ_3	Temperature (°C)	Temperature Correction	Corrected Hydraulic Conductivity (cm/s) - k
--	--	1.39E-06	0.352	24.78	2.44	54.82	378.0	21.0	0.976	3.21E-08
--	--	1.39E-06	0.626	44.08	4.35	54.69	377.1	21.1	0.974	1.80E-08
--	--	1.39E-06	0.833	58.65	5.79	54.58	376.3	21.1	0.974	1.35E-08
--	--	1.39E-06	0.970	68.30	6.74	54.52	375.9	21.1	0.974	1.16E-08
--	--	1.39E-06	0.975	68.65	6.77	54.51	375.9	21.1	0.974	1.15E-08
--	--	1.39E-06	0.994	69.99	6.90	54.50	375.8	21.1	0.974	1.13E-08
--	--	1.39E-06	1.002	70.55	6.96	54.50	375.8	21.1	0.974	1.12E-08
--	--	1.39E-06	0.996	70.13	6.92	54.50	375.8	21.1	0.974	1.13E-08

Test Results

Average Corrected Hydraulic Conductivity (cm/s): 1.14E-08

NOTES:

Data entry by:	CAL	Date:	09/09/20
Checked by:	DPM	Date:	09/15/20
File name:	3102001__Permeability Method D ASTM D5084_3.xlsm		Page 1 of 2

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

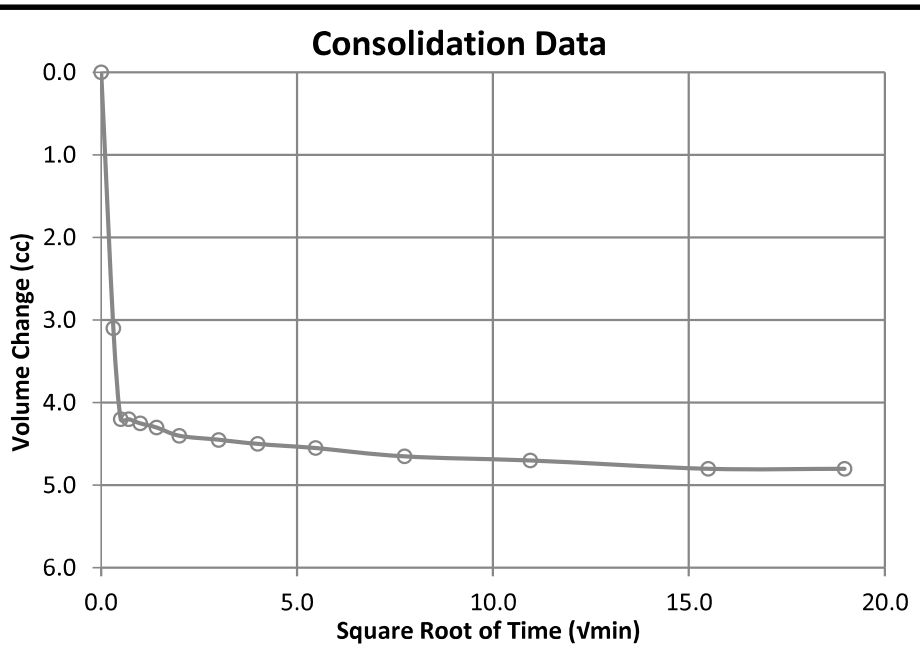
ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	MW-4
JOB NO.	3102-001	DEPTH	89-90'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	--
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/02/20	DESCRIPTION	rock
TECHNICIAN	CAL		

Consolidation

Initial Saturation (%):	91.0	Initial Volume of Sample (cc):	177.3
Final Saturation (%):	100.0	Final Volume of Sample (cc):	175.4
Cell Pressure (psi):	113.0	Volume Change After Consolidation (cc):	18.1
Back Pressure (psi):	58.0	Initial Dial Reading (in):	0.200
Effective Stress (psi):	55.0	Final Dial Reading (in):	0.208
Effective Stress (kPa):	379.2	Height Change (in):	0.008
Cell Expansion Correction (cc):	16.19	Initial Area (cm²):	17.45
Cell ID:	24S	Final Area (cm²):	17.30

Elapsed Time (min)	Square Root of Time (√min)	Burette Reading (cc)	Volume Change (cc)
0	0.00	0.90	0.00
0.1	0.32	4.00	3.10
0.25	0.50	5.10	4.20
0.5	0.71	5.10	4.20
1	1.00	5.15	4.25
2	1.41	5.20	4.30
4	2.00	5.30	4.40
9	3.00	5.35	4.45
16	4.00	5.40	4.50
30	5.48	5.45	4.55
60	7.75	5.55	4.65
120	10.95	5.60	4.70
240	15.49	5.70	4.80
360	18.97	5.70	4.80



Saturation

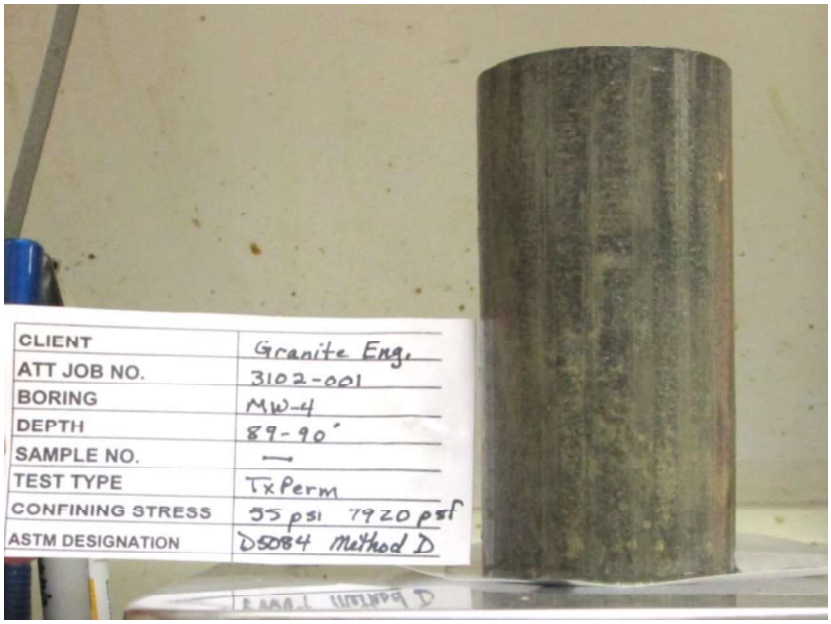
Cell Pressure (psi)		Pore Pressure (psi)		Burette Reading (cc)		Back Pressure (psi)	Volume Change (cc)	Effective Stress (psi)	Δu (psi)	B
Initial	Final	Initial	Final	Initial	Final					
40.0	50.0	38.6	46.2	12.90	13.90	38.0	1.00	2.0	7.6	0.76
50.0	60.0	48.7	58.0	14.30	15.10	48.0	0.80	2.0	9.3	0.93
60.0	70.0	58.6	68.3	15.30	15.40	58.0	0.10	2.0	9.7	0.97

File name: 3102001__Permeability Method D ASTM D5084_3.xlsm

Image Attachment

ADVANCED TERRA TESTING

CLIENT	Granite Engineering Group, Inc.	BORING NO.	MW-4
JOB NO.	3102-001	DEPTH	89-90'
PROJECT	Xcel Comanche	SAMPLE NO.	
PROJECT NO.	220-020	DATE SAMPLED	
LOCATION	--	DESCRIPTION	rock



NOTES

File name: 3102001_perm_mw-4_89-90.pdf

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	MW-2
JOB NO.	3102-001	DEPTH	68-78'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	8/12/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/02/20	DESCRIPTION	rock
TECHNICIAN	CAL		

Sample Conditions

Before Test Mass of Wet Soil (g):	228.9	Initial Wet Density (pcf):	150.7
After Test Mass of Wet Soil (g):	230.5	Initial Dry Density (pcf):	143.7
Mass of Dry Soil and Pan (g):	225.0	Initial Wet Density (kg/m³):	2414
Mass of Pan (g):	6.7	Initial Dry Density (kg/m³):	2302
Diameter (in):	1.85	Initial Moisture (%):	4.9
Initial Sample Height (in):	2.15	Final Wet Density (pcf):	154.6
Assumed Specific Gravity:	2.650	Final Dry Density (pcf):	146.4
		Final Wet Density (kg/m³):	2476
Back Pressure (psi):	58.0	Final Dry Density (kg/m³):	2345
Cell Pressure (psi):	98.0	Final Moisture (%):	5.6

Final density calculated using volume change method from ASTM D4767.

Permeability Data

Pump Setting		Rate of Flow (cc/s)	Pump Pressure (psi)	Head Loss (cm)	Gradient - i	Effective Stress (psi) - σ_3	Effective Stress (kPa) - σ_3	Temperature (°C)	Temperature Correction	Corrected Hydraulic Conductivity (cm/s) - k
5	--	1.12E-06	4.230	297.83	54.59	37.89	261.2	21.1	0.974	1.17E-09
5	--	1.12E-06	4.950	348.52	63.88	37.53	258.7	21.1	0.974	9.99E-10
5	--	1.12E-06	5.620	395.70	72.53	37.19	256.4	21.1	0.974	8.80E-10
5	--	1.12E-06	6.340	446.39	81.82	36.83	253.9	21.1	0.974	7.80E-10
5	--	1.12E-06	7.000	492.86	90.34	36.50	251.7	21.1	0.974	7.06E-10
5	--	1.12E-06	7.630	537.22	98.47	36.19	249.5	21.1	0.974	6.48E-10
5	--	1.12E-06	8.200	577.35	105.82	35.90	247.5	21.1	0.974	6.03E-10
5	--	1.12E-06	8.720	613.96	112.53	35.64	245.7	21.1	0.974	5.67E-10
5	--	1.12E-06	9.210	648.47	118.86	35.40	244.0	21.1	0.974	5.37E-10
5	--	1.12E-06	9.630	678.04	124.28	35.19	242.6	21.1	0.974	5.13E-10
5	--	1.12E-06	10.010	704.79	129.18	35.00	241.3	21.1	0.974	4.94E-10

Test Results

Average Corrected Hydraulic Conductivity (cm/s): 5.28E-10

NOTES:	Reached maximum flow pump transducer pressure prior to meeting permeability termination criteria. The actual permeability value is probably slower.

Data entry by:	CAL	Date:	09/09/20
Checked by:	DPM	Date:	09/17/20
File name:	3102001__Permeability Method D ASTM D5084_4.xlsm		Page 1 of 2

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

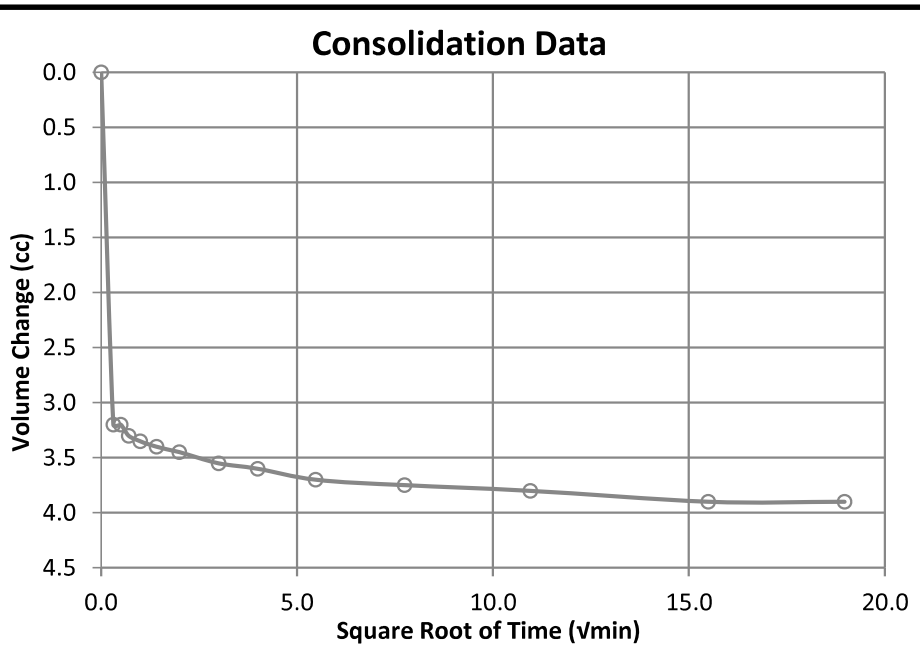
ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	MW-2
JOB NO.	3102-001	DEPTH	68-78'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	8/12/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/02/20	DESCRIPTION	rock
TECHNICIAN	CAL		

Consolidation

Initial Saturation (%):	85.2	Initial Volume of Sample (cc):	94.9
Final Saturation (%):	100.0	Final Volume of Sample (cc):	93.1
Cell Pressure (psi):	98.0	Volume Change After Consolidation (cc):	14.1
Back Pressure (psi):	58.0	Initial Dial Reading (in):	0.200
Effective Stress (psi):	40.0	Final Dial Reading (in):	0.203
Effective Stress (kPa):	275.8	Height Change (in):	0.003
Cell Expansion Correction (cc):	12.35	Initial Area (cm²):	17.36
Cell ID:	8S	Final Area (cm²):	17.06

Elapsed Time (min)	Square Root of Time (√min)	Burette Reading (cc)	Volume Change (cc)
0	0.00	1.00	0.00
0.1	0.32	4.20	3.20
0.25	0.50	4.20	3.20
0.5	0.71	4.30	3.30
1	1.00	4.35	3.35
2	1.41	4.40	3.40
4	2.00	4.45	3.45
9	3.00	4.55	3.55
16	4.00	4.60	3.60
30	5.48	4.70	3.70
60	7.75	4.75	3.75
120	10.95	4.80	3.80
240	15.49	4.90	3.90
360	18.97	4.90	3.90



Saturation

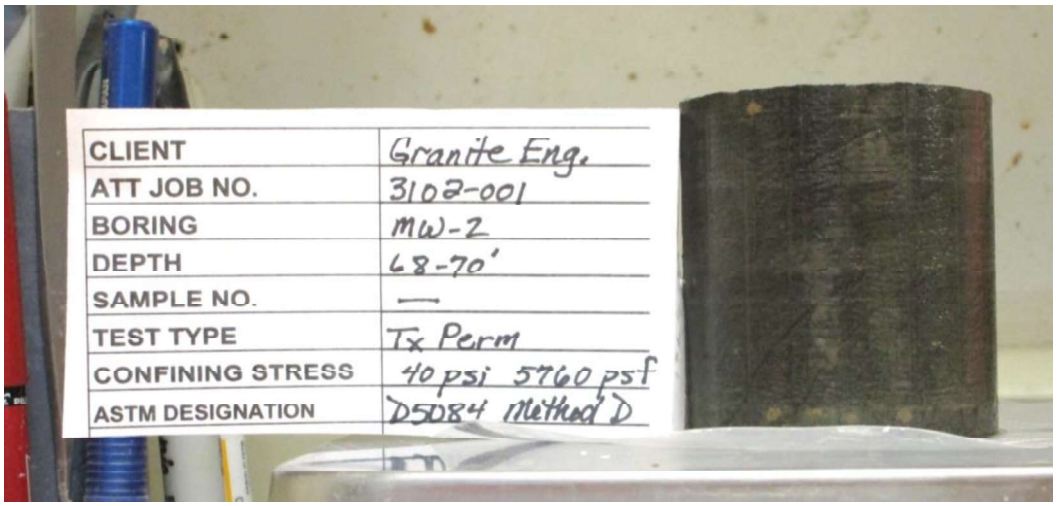
Cell Pressure (psi)		Pore Pressure (psi)		Burette Reading (cc)		Back Pressure (psi)	Volume Change (cc)	Effective Stress (psi)	Δu (psi)	B
Initial	Final	Initial	Final	Initial	Final					
40.0	50.0	39.0	48.1	9.50	10.50	38.0	1.00	2.0	9.1	0.91
50.0	60.0	49.0	58.4	10.70	11.60	48.0	0.90	2.0	9.4	0.94
60.0	70.0	59.0	68.5	12.10	12.20	58.0	0.10	2.0	9.5	0.95

File name: 3102001__Permeability Method D ASTM D5084_4.xlsm

Image Attachment

ADVANCED TERRA TESTING

CLIENT	Granite Engineering Group, Inc.	BORING NO.	MW-2
JOB NO.	3102-001	DEPTH	68-70'
PROJECT	Xcel Comanche	SAMPLE NO.	
PROJECT NO.	220-020	DATE SAMPLED	8/12/20
LOCATION	--	DESCRIPTION	rock



NOTES

File name: 3102001_perm_mw-2_68-70.pdf

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-8
JOB NO.	3102-001	DEPTH	9-10'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	8/5/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	08/31/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Sample Conditions

Before Test Mass of Wet Soil (g):	238.3	Initial Wet Density (pcf):	104.4
After Test Mass of Wet Soil (g):	274.0	Initial Dry Density (pcf):	93.7
Mass of Dry Soil and Pan (g):	397.1	Initial Wet Density (kg/m³):	1673
Mass of Pan (g):	183.2	Initial Dry Density (kg/m³):	1502
Diameter (in):	1.92	Initial Moisture (%):	11.4
Initial Sample Height (in):	3.02	Final Wet Density (pcf):	128.7
Assumed Specific Gravity:	2.650	Final Dry Density (pcf):	100.4
		Final Wet Density (kg/m³):	2061
Back Pressure (psi):	78.0	Final Dry Density (kg/m³):	1609
Cell Pressure (psi):	86.0	Final Moisture (%):	28.1

Final density calculated using volume change method from ASTM D4767.

Permeability Data

Pump Setting	Percentage of Pump Setting	Rate of Flow (cc/s)	Pump Pressure (psi)	Head Loss (cm)	Gradient - i	Effective Stress (psi) - σ_3	Effective Stress (kPa) - σ_3	Temperature (°C)	Temperature Correction	Corrected Hydraulic Conductivity (cm/s) - k
--	--	1.11E-03	0.101	7.11	0.93	7.95	54.8	20.9	0.979	6.66E-05
--	--	1.11E-03	0.101	7.11	0.93	7.95	54.8	20.9	0.979	6.66E-05
--	--	1.11E-03	0.102	7.18	0.94	7.95	54.8	20.9	0.979	6.59E-05
--	--	1.11E-03	0.100	7.04	0.93	7.95	54.8	20.9	0.979	6.72E-05
--	--	1.11E-03	0.101	7.11	0.93	7.95	54.8	20.9	0.979	6.66E-05

Test Results

Average Corrected Hydraulic Conductivity (cm/s): 6.66E-05

NOTES:

Data entry by:	CAL	Date:	09/10/20
Checked by:	KR	Date:	09/18/20
File name:	3102001__Permeability Method D ASTM D5084_5.xlsm		Page 1 of 2

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

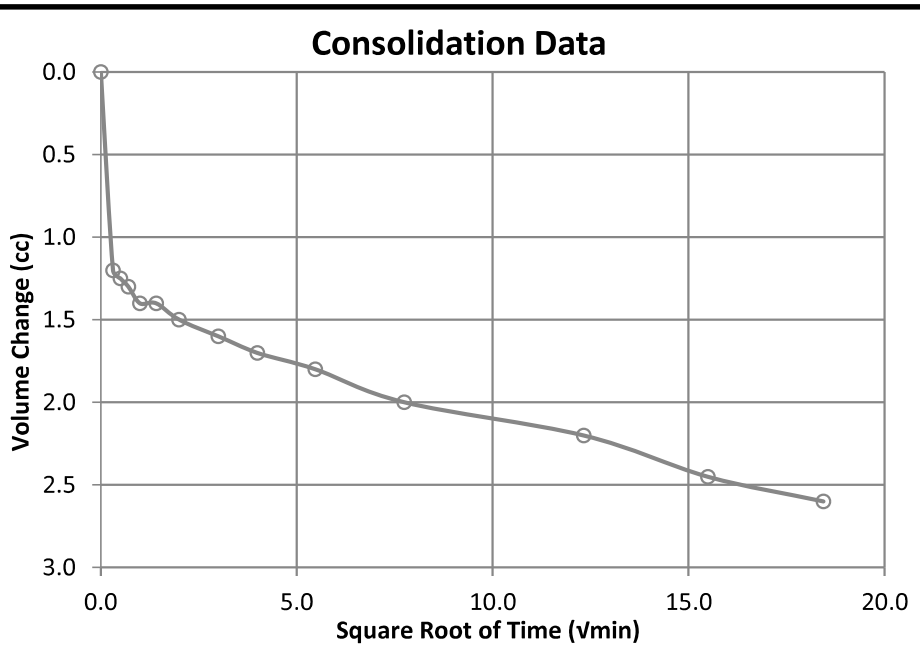
ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-8
JOB NO.	3102-001	DEPTH	9-10'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	8/5/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	08/31/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Consolidation

Initial Saturation (%):	39.4	Initial Volume of Sample (cc):	142.5
Final Saturation (%):	100.0	Final Volume of Sample (cc):	132.9
Cell Pressure (psi):	86.0	Volume Change After Consolidation (cc):	23.9
Back Pressure (psi):	78.0	Initial Dial Reading (in):	0.200
Effective Stress (psi):	8.0	Final Dial Reading (in):	0.220
Effective Stress (kPa):	55.2	Height Change (in):	0.02
Cell Expansion Correction (cc):	14.39	Initial Area (cm²):	18.60
Cell ID:	4P	Final Area (cm²):	17.48

Elapsed Time (min)	Square Root of Time (√min)	Burette Reading (cc)	Volume Change (cc)
0	0.00	1.20	0.00
0.1	0.32	2.40	1.20
0.25	0.50	2.45	1.25
0.5	0.71	2.50	1.30
1	1.00	2.60	1.40
2	1.41	2.60	1.40
4	2.00	2.70	1.50
9	3.00	2.80	1.60
16	4.00	2.90	1.70
30	5.48	3.00	1.80
60	7.75	3.20	2.00
152	12.33	3.40	2.20
240	15.49	3.65	2.45
340	18.44	3.80	2.60



Saturation

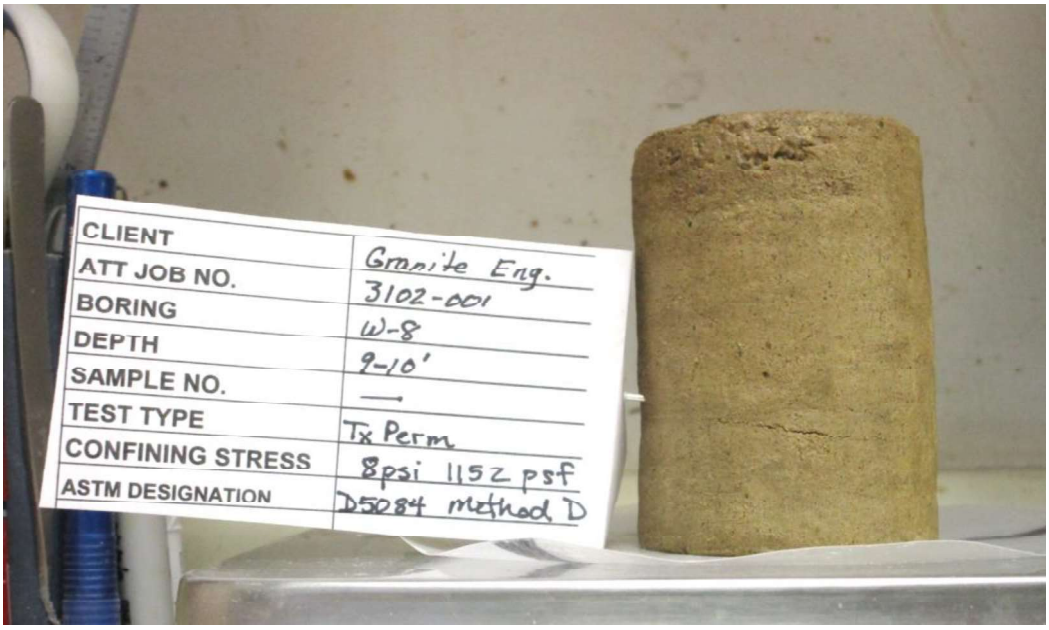
Cell Pressure (psi)		Pore Pressure (psi)		Burette Reading (cc)		Back Pressure (psi)	Volume Change (cc)	Effective Stress (psi)	Δu (psi)	B
Initial	Final	Initial	Final	Initial	Final					
40.0	50.0	38.9	46.0	17.70	19.00	38.0	1.30	2.0	7.1	0.71
50.0	60.0	49.0	56.5	19.40	20.30	48.0	0.90	2.0	7.5	0.75
60.0	70.0	58.9	67.5	20.60	21.30	58.0	0.70	2.0	8.6	0.86
70.0	80.0	69.1	78.4	21.90	22.50	68.0	0.60	2.0	9.3	0.93
80.0	90.0	79.1	88.6	22.80	22.90	78.0	0.10	2.0	9.5	0.95

File name: 3102001__Permeability Method D ASTM D5084_5.xlsm

Image Attachment

ADVANCED TERRA TESTING

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-8
JOB NO.	3102-001	DEPTH	9-10'
PROJECT	Xcel Comanche	SAMPLE NO.	
PROJECT NO.	220-020	DATE SAMPLED	8/5/20
LOCATION	--	DESCRIPTION	soil



NOTES

File name: 3102001_perm_W-8_9-10.pdf

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-8
JOB NO.	3102-001	DEPTH	4-5'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	8/5/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	08/31/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Sample Conditions

Before Test Mass of Wet Soil (g):	309.5	Initial Wet Density (pcf):	132.1
After Test Mass of Wet Soil (g):	329.8	Initial Dry Density (pcf):	118.1
Mass of Dry Soil and Pan (g):	400.4	Initial Wet Density (kg/m³):	2116
Mass of Pan (g):	123.6	Initial Dry Density (kg/m³):	1892
Diameter (in):	1.93	Initial Moisture (%):	11.8
Initial Sample Height (in):	3.04	Final Wet Density (pcf):	144.6
Assumed Specific Gravity:	2.650	Final Dry Density (pcf):	121.3
		Final Wet Density (kg/m³):	2316
Back Pressure (psi):	88.0	Final Dry Density (kg/m³):	1943
Cell Pressure (psi):	92.0	Final Moisture (%):	19.2

Final density calculated using volume change method from ASTM D4767.

Permeability Data

		Rate of Flow (cc/s)	Pump Pressure (psi)	Head Loss (cm)	Gradient - i	Effective Stress (psi) - σ_3	Effective Stress (kPa) - σ_3	Temperature (°C)	Temperature Correction	Corrected Hydraulic Conductivity (cm/s) - k
--	--	1.39E-05	0.248	17.46	2.27	3.88	26.7	21.1	0.974	3.22E-07
--	--	1.39E-05	0.273	19.22	2.50	3.86	26.6	21.2	0.972	2.92E-07
--	--	1.39E-05	0.285	20.07	2.61	3.86	26.6	21.2	0.972	2.80E-07
--	--	1.39E-05	0.293	20.63	2.68	3.85	26.6	21.3	0.969	2.71E-07
--	--	1.39E-05	0.299	21.05	2.74	3.85	26.5	21.4	0.967	2.65E-07
--	--	1.39E-05	0.300	21.12	2.74	3.85	26.5	21.5	0.965	2.64E-07
--	--	1.39E-05	0.304	21.40	2.78	3.85	26.5	21.6	0.962	2.60E-07
--	--	1.39E-05	0.306	21.55	2.80	3.85	26.5	21.6	0.962	2.58E-07
--	--	1.39E-05	0.307	21.62	2.81	3.85	26.5	21.6	0.962	2.57E-07
--	--	1.39E-05	0.310	21.83	2.84	3.85	26.5	21.7	0.960	2.54E-07

Test Results

Average Corrected Hydraulic Conductivity (cm/s): 2.57E-07

NOTES:

Data entry by:	CAL	Date:	09/11/20
Checked by:	KR	Date:	09/18/20
File name:	3102001__Permeability Method D ASTM D5084_6.xlsm		Page 1 of 2

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

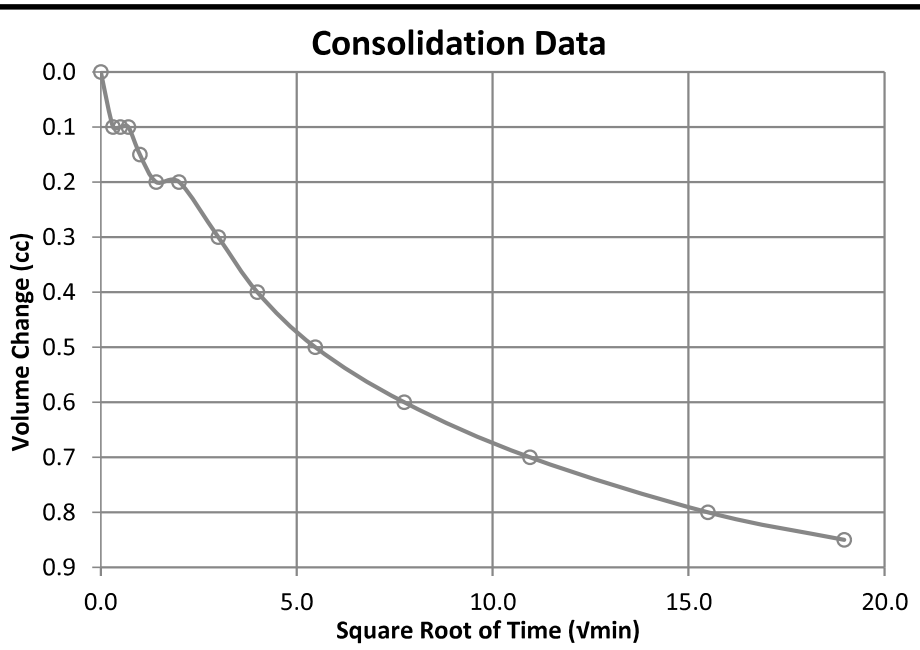
ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-8
JOB NO.	3102-001	DEPTH	4-5'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	8/5/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	08/31/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Consolidation

Initial Saturation (%):	78.3	Initial Volume of Sample (cc):	146.2
Final Saturation (%):	100.0	Final Volume of Sample (cc):	142.4
Cell Pressure (psi):	92.0	Volume Change After Consolidation (cc):	17.4
Back Pressure (psi):	88.0	Initial Dial Reading (in):	0.200
Effective Stress (psi):	4.0	Final Dial Reading (in):	0.208
Effective Stress (kPa):	27.6	Height Change (in):	0.008
Cell Expansion Correction (cc):	13.57	Initial Area (cm²):	18.95
Cell ID:	12P	Final Area (cm²):	18.51

Elapsed Time (min)	Square Root of Time (√min)	Burette Reading (cc)	Volume Change (cc)
0	0.00	18.10	0.00
0.1	0.32	18.20	0.10
0.25	0.50	18.20	0.10
0.5	0.71	18.20	0.10
1	1.00	18.25	0.15
2	1.41	18.30	0.20
4	2.00	18.30	0.20
9	3.00	18.40	0.30
16	4.00	18.50	0.40
30	5.48	18.60	0.50
60	7.75	18.70	0.60
120	10.95	18.80	0.70
240	15.49	18.90	0.80
360	18.97	18.95	0.85



Saturation

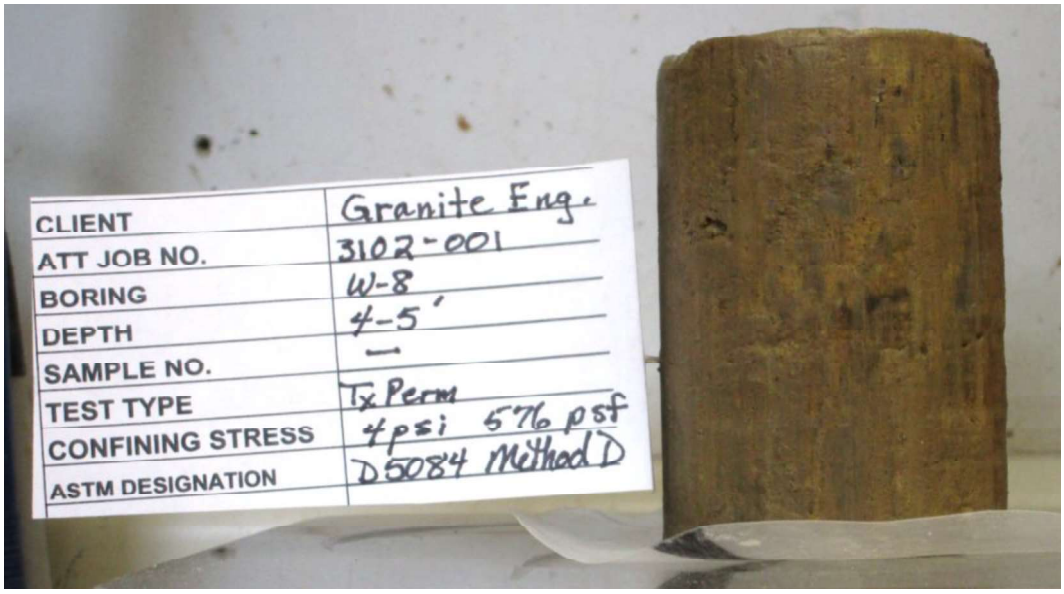
Cell Pressure (psi)		Pore Pressure (psi)		Burette Reading (cc)		Back Pressure (psi)	Volume Change (cc)	Effective Stress (psi)	Δu (psi)	B
Initial	Final	Initial	Final	Initial	Final					
50.0	60.0	49.2	58.1	13.00	14.00	38.0	1.00	12.0	8.9	0.89
60.0	70.0	59.1	68.3	4.10	15.00	48.0	10.90	12.0	9.2	0.92
70.0	80.0	69.0	78.4	16.00	16.70	58.0	0.70	12.0	9.4	0.94
80.0	90.0	79.2	88.4	17.10	17.80	68.0	0.70	12.0	9.2	0.92
90.0	100.0	88.9	98.5	17.85	17.90	78.0	0.05	12.0	9.6	0.96

File name: 3102001__Permeability Method D ASTM D5084_6.xlsm

Image Attachment

ADVANCED TERRA TESTING

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-8
JOB NO.	3102-001	DEPTH	4-5'
PROJECT	Xcel Comanche	SAMPLE NO.	
PROJECT NO.	220-020	DATE SAMPLED	8/5/20
LOCATION	--	DESCRIPTION	soil



NOTES

File name: 3102001_perm_w-8_4-5.pdf

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	MW-2
JOB NO.	3102-001	DEPTH	4-5'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	8/11/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	08/31/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Sample Conditions

Before Test Mass of Wet Soil (g):	305.3	Initial Wet Density (pcf):	130.4
After Test Mass of Wet Soil (g):	314.4	Initial Dry Density (pcf):	107.1
Mass of Dry Soil and Pan (g):	388.7	Initial Wet Density (kg/m³):	2089
Mass of Pan (g):	137.9	Initial Dry Density (kg/m³):	1716
Diameter (in):	1.93	Initial Moisture (%):	21.7
Initial Sample Height (in):	3.06	Final Wet Density (pcf):	141.9
Assumed Specific Gravity:	2.650	Final Dry Density (pcf):	113.2
		Final Wet Density (kg/m³):	2274
Back Pressure (psi):	98.0	Final Dry Density (kg/m³):	1814
Cell Pressure (psi):	102.0	Final Moisture (%):	25.3

Final density calculated using volume change method from ASTM D4767.

Permeability Data

Pump Setting	Percentage of Pump Setting	Rate of Flow (cc/s)	Pump Pressure (psi)	Head Loss (cm)	Gradient - i	Effective Stress (psi) - σ_3	Effective Stress (kPa) - σ_3	Temperature (°C)	Temperature Correction	Corrected Hydraulic Conductivity (cm/s) - k
--	--	6.94E-06	0.630	44.36	5.71	3.69	25.4	21.2	0.972	6.63E-08
--	--	6.94E-06	0.660	46.47	5.99	3.67	25.3	21.2	0.972	6.33E-08
--	--	6.94E-06	0.690	48.58	6.26	3.66	25.2	21.2	0.972	6.05E-08
--	--	6.94E-06	0.730	51.40	6.62	3.64	25.1	20.9	0.979	5.76E-08
--	--	6.94E-06	0.740	52.10	6.71	3.63	25.0	21.2	0.972	5.64E-08
--	--	6.94E-06	0.772	54.36	7.00	3.61	24.9	21.1	0.974	5.42E-08
--	--	6.94E-06	0.793	55.83	7.19	3.60	24.8	20.9	0.979	5.30E-08
--	--	6.94E-06	0.815	57.38	7.39	3.59	24.8	21.1	0.974	5.14E-08
--	--	6.94E-06	0.820	57.74	7.44	3.59	24.8	20.9	0.979	5.13E-08

Test Results

Average Corrected Hydraulic Conductivity (cm/s): 5.25E-08

NOTES:

Data entry by:	CAL	Date:	09/15/20
Checked by:	KR	Date:	09/18/20
File name:	3102001__Permeability Method D ASTM D5084_9.xlsm		Page 1 of 2

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

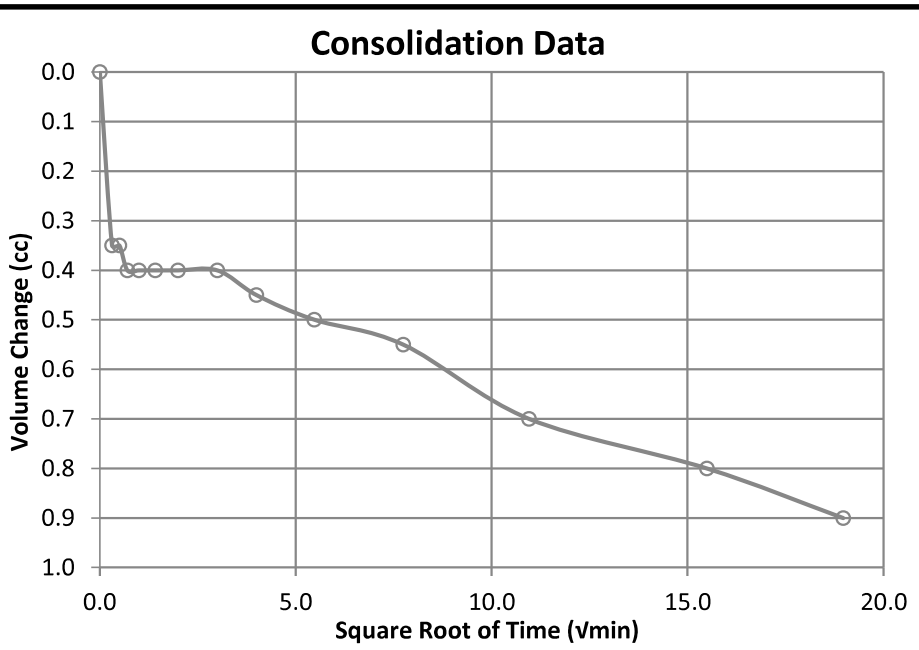
ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	MW-2
JOB NO.	3102-001	DEPTH	4-5'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	8/11/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	08/31/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Consolidation

Initial Saturation (%):	100.0	Initial Volume of Sample (cc):	146.1
Final Saturation (%):	100.0	Final Volume of Sample (cc):	138.3
Cell Pressure (psi):	102.0	Volume Change After Consolidation (cc):	22.9
Back Pressure (psi):	98.0	Initial Dial Reading (in):	0.200
Effective Stress (psi):	4.0	Final Dial Reading (in):	0.202
Effective Stress (kPa):	27.6	Height Change (in):	0.002
Cell Expansion Correction (cc):	15.04	Initial Area (cm²):	18.82
Cell ID:	3P	Final Area (cm²):	17.82

Elapsed Time (min)	Square Root of Time (√min)	Burette Reading (cc)	Volume Change (cc)
0	0.00	0.30	0.00
0.1	0.32	0.65	0.35
0.25	0.50	0.65	0.35
0.5	0.71	0.70	0.40
1	1.00	0.70	0.40
2	1.41	0.70	0.40
4	2.00	0.70	0.40
9	3.00	0.70	0.40
16	4.00	0.75	0.45
30	5.48	0.80	0.50
60	7.75	0.85	0.55
120	10.95	1.00	0.70
240	15.49	1.10	0.80
360	18.97	1.20	0.90



Saturation

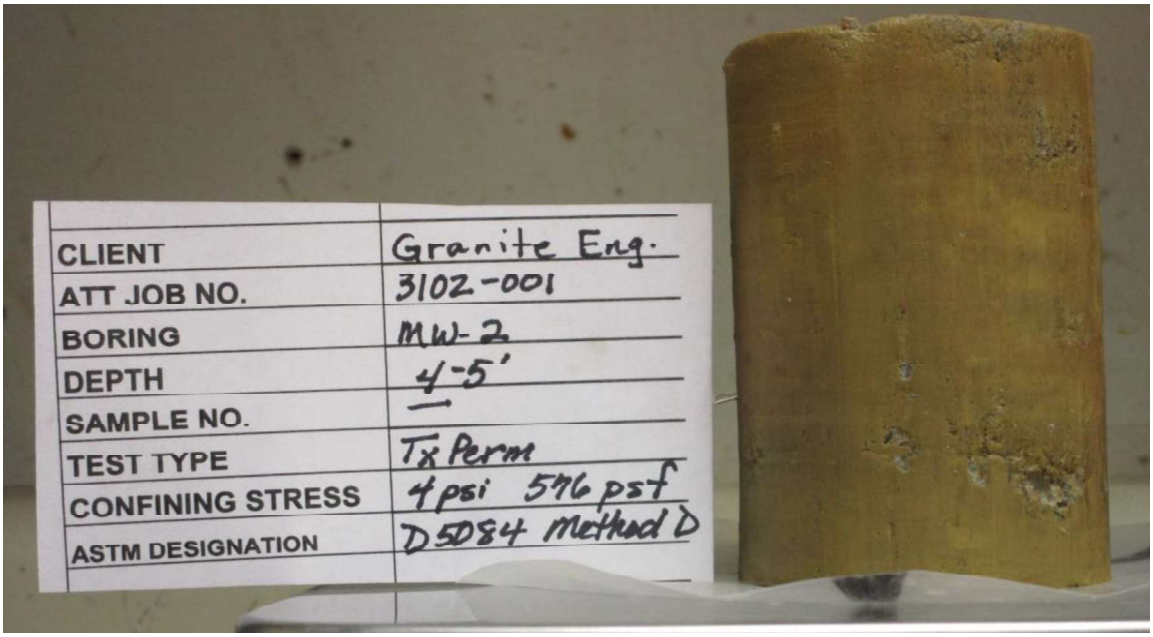
Cell Pressure (psi)		Pore Pressure (psi)		Burette Reading (cc)		Back Pressure (psi)	Volume Change (cc)	Effective Stress (psi)	Δu (psi)	B
Initial	Final	Initial	Final	Initial	Final					
60.0	70.0	59.0	67.2	15.70	16.90	58.0	1.20	2.0	8.2	0.82
70.0	80.0	69.3	78.1	17.70	18.90	68.0	1.20	2.0	8.8	0.88
80.0	90.0	79.4	88.5	19.40	20.30	78.0	0.90	2.0	9.1	0.91
90.0	100.0	89.2	98.6	20.60	21.70	88.0	1.10	2.0	9.4	0.94
100.0	110.0	99.1	108.6	22.00	22.20	98.0	0.20	2.0	9.5	0.95

File name: 3102001__Permeability Method D ASTM D5084_9.xlsm

Image Attachment

ADVANCED TERRA TESTING

CLIENT	Granite Engineering Group, Inc.	BORING NO.	MW-2
JOB NO.	3102-001	DEPTH	4-5'
PROJECT	Xcel Comanche	SAMPLE NO.	
PROJECT NO.	220-020	DATE SAMPLED	8/11/20
LOCATION	--	DESCRIPTION	soil



NOTES

File name: 3102001_PERM_MW-2_4-5.pdf

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-7
JOB NO.	3102-001	DEPTH	11-12'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	8/4/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/03/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Sample Conditions

Before Test Mass of Wet Soil (g):	215.5	Initial Wet Density (pcf):	130.7
After Test Mass of Wet Soil (g):	214.8	Initial Dry Density (pcf):	109.9
Mass of Dry Soil and Pan (g):	298.3	Initial Wet Density (kg/m³):	2093
Mass of Pan (g):	117.0	Initial Dry Density (kg/m³):	1761
Diameter (in):	1.91	Initial Moisture (%):	18.9
Initial Sample Height (in):	2.19	Final Wet Density (pcf):	135.4
Assumed Specific Gravity:	2.650	Final Dry Density (pcf):	114.3
		Final Wet Density (kg/m³):	2169
Back Pressure (psi):	88.0	Final Dry Density (kg/m³):	1830
Cell Pressure (psi):	97.0	Final Moisture (%):	18.5

Final density calculated using volume change method from ASTM D4767.

Permeability Data

Pump Setting	Percentage of Pump Setting	Rate of Flow (cc/s)	Pump Pressure (psi)	Head Loss (cm)	Gradient - i	Effective Stress (psi) - σ_3	Effective Stress (kPa) - σ_3	Temperature (°C)	Temperature Correction	Corrected Hydraulic Conductivity (cm/s) - k
5	--	1.12E-06	0.530	37.32	6.79	8.74	60.2	21.0	0.976	8.91E-09
5	--	1.12E-06	0.614	43.23	7.87	8.69	59.9	21.1	0.974	7.68E-09
5	--	1.12E-06	0.671	47.24	8.60	8.66	59.7	21.1	0.974	7.02E-09
5	--	1.12E-06	0.786	55.34	10.07	8.61	59.3	20.8	0.981	6.04E-09
5	--	1.12E-06	0.820	57.74	10.51	8.59	59.2	20.9	0.979	5.78E-09
5	--	1.12E-06	0.876	61.68	11.23	8.56	59.0	21.1	0.974	5.38E-09
5	--	1.12E-06	0.923	64.99	11.83	8.54	58.9	21.2	0.972	5.09E-09
5	--	1.12E-06	0.976	68.72	12.51	8.51	58.7	20.9	0.979	4.85E-09
5	--	1.12E-06	0.980	69.00	12.56	8.51	58.7	20.8	0.981	4.84E-09

Test Results

Average Corrected Hydraulic Conductivity (cm/s): 5.04E-09

NOTES:

Data entry by:	CAL	Date:	09/15/20
Checked by:	KR	Date:	09/18/20
File name:	3102001__Permeability Method D ASTM D5084_10.xlsm		Page 1 of 2

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

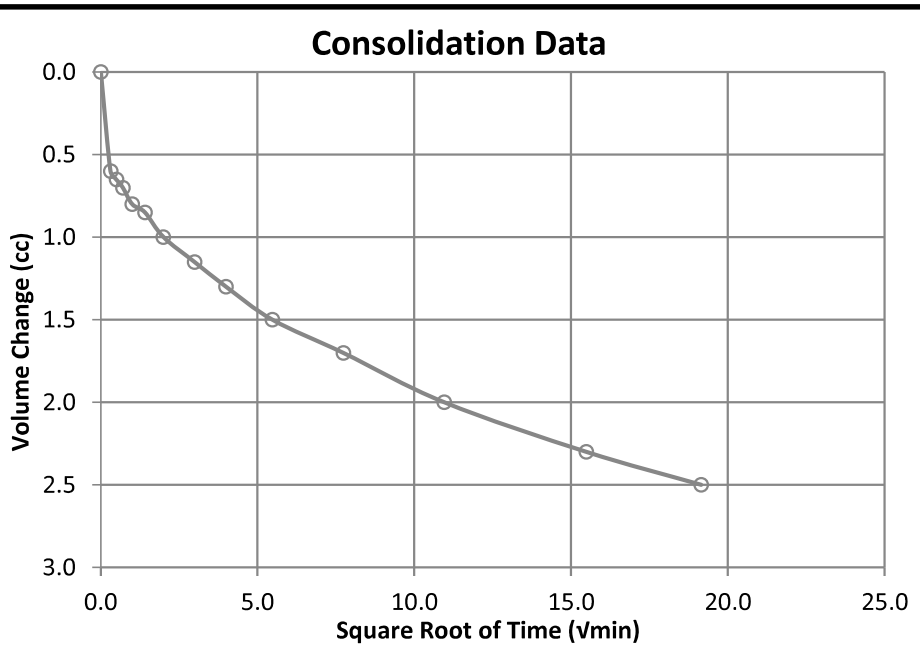
ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-7
JOB NO.	3102-001	DEPTH	11-12'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	8/4/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/03/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Consolidation

Initial Saturation (%):	99.1	Initial Volume of Sample (cc):	102.9
Final Saturation (%):	100.0	Final Volume of Sample (cc):	99.0
Cell Pressure (psi):	97.0	Volume Change After Consolidation (cc):	14.9
Back Pressure (psi):	88.0	Initial Dial Reading (in):	0.200
Effective Stress (psi):	9.0	Final Dial Reading (in):	0.227
Effective Stress (kPa):	62.1	Height Change (in):	0.027
Cell Expansion Correction (cc):	11.00	Initial Area (cm²):	18.50
Cell ID:	15S	Final Area (cm²):	18.03

Elapsed Time (min)	Square Root of Time (√min)	Burette Reading (cc)	Volume Change (cc)
0	0.00	14.20	0.00
0.1	0.32	14.80	0.60
0.25	0.50	14.85	0.65
0.5	0.71	14.90	0.70
1	1.00	15.00	0.80
2	1.41	15.05	0.85
4	2.00	15.20	1.00
9	3.00	15.35	1.15
16	4.00	15.50	1.30
30	5.48	15.70	1.50
60	7.75	15.90	1.70
120	10.95	16.20	2.00
240	15.49	16.50	2.30
367	19.16	16.70	2.50



Saturation

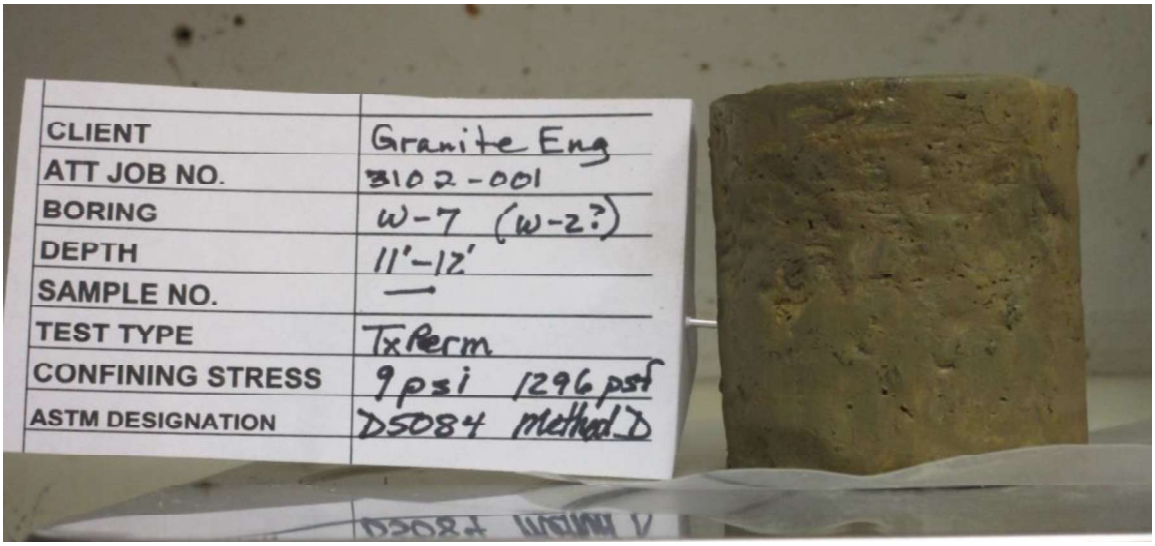
Cell Pressure (psi)		Pore Pressure (psi)		Burette Reading (cc)		Back Pressure (psi)	Volume Change (cc)	Effective Stress (psi)	Δu (psi)	B
Initial	Final	Initial	Final	Initial	Final					
50.0	60.0	49.2	58.1	10.50	11.20	48.0	0.70	2.0	8.9	0.89
60.0	70.0	59.1	68.1	11.20	11.90	58.0	0.70	2.0	9.0	0.90
70.0	80.0	69.1	78.3	12.20	13.00	68.0	0.80	2.0	9.2	0.92
80.0	90.0	79.0	88.3	13.20	14.00	78.0	0.80	2.0	9.3	0.93
90.0	100.0	89.0	98.5	14.20	14.20	88.0	0.00	2.0	9.5	0.95

File name: 3102001__Permeability Method D ASTM D5084_10.xlsm

Image Attachment

ADVANCED TERRA TESTING

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-7
JOB NO.	3102-001	DEPTH	11-12'
PROJECT	Xcel Comanche	SAMPLE NO.	
PROJECT NO.	220-020	DATE SAMPLED	8/4/200
LOCATION	--	DESCRIPTION	soil



NOTES	Bag appeared to be labled W-2

File name: 3102001_PERM_W-7_11-12.pdf

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-2B
JOB NO.	3102-001	DEPTH	10-11'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	7/30/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	08/31/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Sample Conditions

Before Test Mass of Wet Soil (g):	312.4	Initial Wet Density (pcf):	139.8
After Test Mass of Wet Soil (g):	320.6	Initial Dry Density (pcf):	126.1
Mass of Dry Soil and Pan (g):	421.1	Initial Wet Density (kg/m³):	2239
Mass of Pan (g):	139.3	Initial Dry Density (kg/m³):	2020
Diameter (in):	1.94	Initial Moisture (%):	10.8
Initial Sample Height (in):	2.90	Final Wet Density (pcf):	139.5
Assumed Specific Gravity:	2.650	Final Dry Density (pcf):	122.6
		Final Wet Density (kg/m³):	2234
Back Pressure (psi):	108.0	Final Dry Density (kg/m³):	1965
Cell Pressure (psi):	117.0	Final Moisture (%):	13.7

Final density calculated using volume change method from ASTM D4767.

Permeability Data

Pump Setting	Percentage of Pump Setting	Rate of Flow (cc/s)	Pump Pressure (psi)	Head Loss (cm)	Gradient - i	Effective Stress (psi) - σ_3	Effective Stress (kPa) - σ_3	Temperature (°C)	Temperature Correction	Corrected Hydraulic Conductivity (cm/s) - k
15	--	3.21E-06	0.695	48.93	6.70	8.65	59.7	21.5	0.965	2.35E-08
15	--	3.21E-06	0.881	62.03	8.50	8.56	59.0	21.4	0.967	1.86E-08
5	--	1.12E-06	0.771	54.29	7.44	8.61	59.4	21.4	0.967	7.40E-09
5	--	1.12E-06	0.826	58.16	7.97	8.59	59.2	21.5	0.965	6.89E-09
5	--	1.12E-06	0.896	63.09	8.64	8.55	59.0	21.7	0.960	6.32E-09
5	--	1.12E-06	0.963	67.80	9.29	8.52	58.7	21.7	0.960	5.88E-09
5	--	1.12E-06	1.006	70.83	9.70	8.50	58.6	21.7	0.960	5.63E-09
5	--	1.12E-06	0.975	68.65	9.40	8.51	58.7	21.2	0.972	5.88E-09

Test Results

Average Corrected Hydraulic Conductivity (cm/s): 5.93E-09

NOTES:

Data entry by:	CAL	Date:	09/16/20
Checked by:	KR	Date:	09/18/20
File name:	3102001__Permeability Method D ASTM D5084_11.xlsm		Page 1 of 2

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

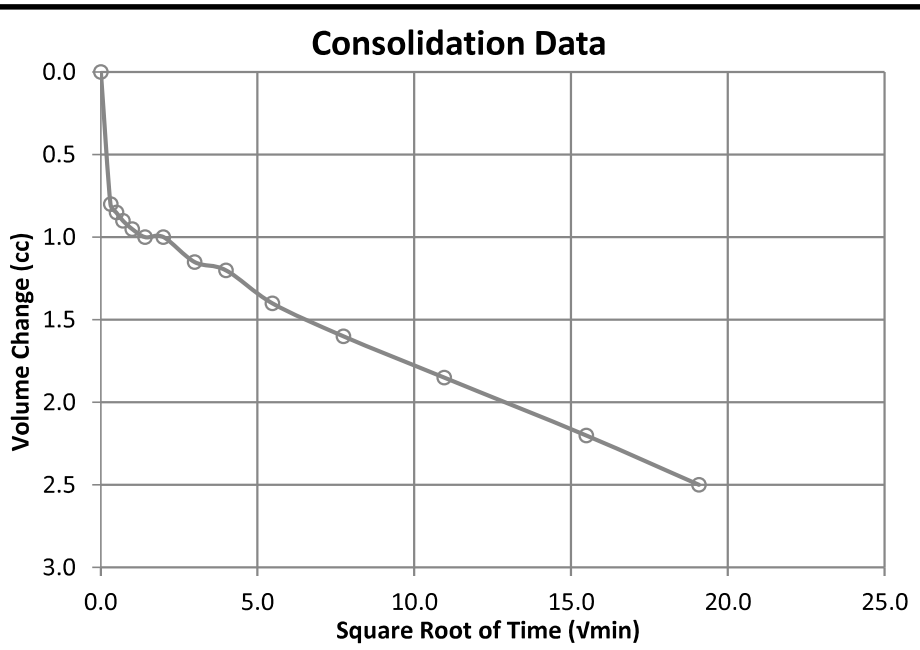
ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-2B
JOB NO.	3102-001	DEPTH	10-11'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	7/30/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	08/31/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Consolidation

Initial Saturation (%):	92.2	Initial Volume of Sample (cc):	139.5
Final Saturation (%):	100.0	Final Volume of Sample (cc):	143.5
Cell Pressure (psi):	117.0	Volume Change After Consolidation (cc):	20.3
Back Pressure (psi):	108.0	Initial Dial Reading (in):	0.400
Effective Stress (psi):	9.0	Final Dial Reading (in):	0.421
Effective Stress (kPa):	62.1	Height Change (in):	0.021
Cell Expansion Correction (cc):	24.26	Initial Area (cm²):	18.97
Cell ID:	2P	Final Area (cm²):	19.65

Elapsed Time (min)	Square Root of Time (√min)	Burette Reading (cc)	Volume Change (cc)
0	0.00	18.50	0.00
0.1	0.32	19.30	0.80
0.25	0.50	19.35	0.85
0.5	0.71	19.40	0.90
1	1.00	19.45	0.95
2	1.41	19.50	1.00
4	2.00	19.50	1.00
9	3.00	19.65	1.15
16	4.00	19.70	1.20
30	5.48	19.90	1.40
60	7.75	20.10	1.60
120	10.95	20.35	1.85
240	15.49	20.70	2.20
364	19.08	21.00	2.50



Saturation

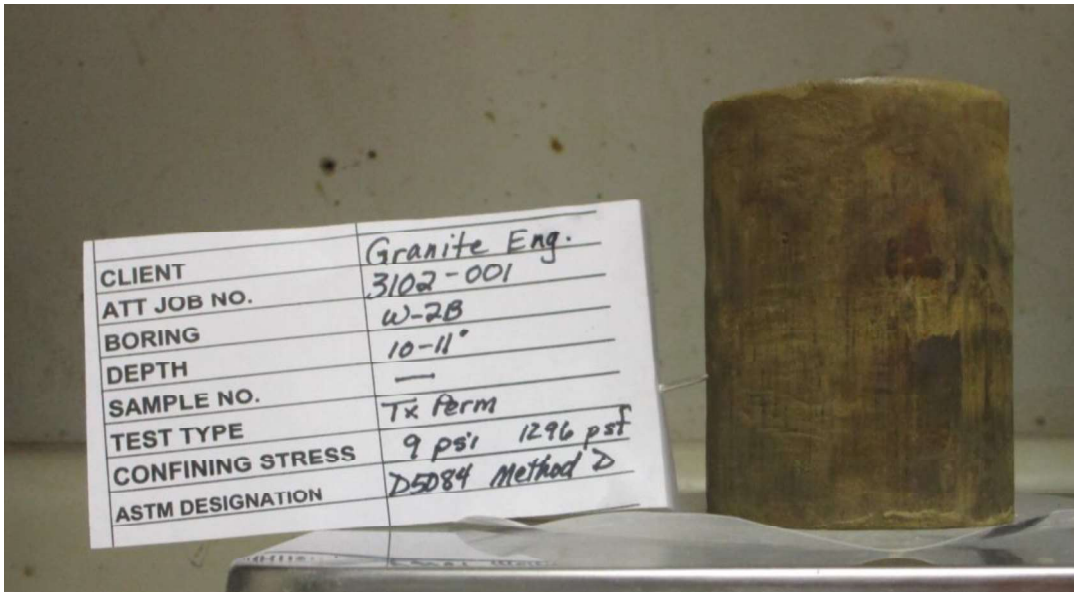
Cell Pressure (psi)		Pore Pressure (psi)		Burette Reading (cc)		Back Pressure (psi)	Volume Change (cc)	Effective Stress (psi)	Δu (psi)	B
Initial	Final	Initial	Final	Initial	Final					
70.0	80.0	68.6	77.3	12.70	13.80	68.0	1.10	2.0	8.7	0.87
80.0	90.0	79.0	87.7	14.50	15.50	78.0	1.00	2.0	8.7	0.87
90.0	100.0	89.0	97.6	15.80	16.90	88.0	1.10	2.0	8.6	0.86
100.0	110.0	99.0	108.2	16.95	18.10	98.0	1.15	2.0	9.2	0.92
110.0	120.0	108.8	118.6	18.40	18.50	108.0	0.10	2.0	9.8	0.98

File name: 3102001__Permeability Method D ASTM D5084_11.xlsm

Image Attachment

ADVANCED TERRA TESTING

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-2B
JOB NO.	3102-001	DEPTH	10-11'
PROJECT	Xcel Comanche	SAMPLE NO.	
PROJECT NO.	220-020	DATE SAMPLED	7/30/20
LOCATION	--	DESCRIPTION	soil



NOTES

File name: 3102001_PERM_W-2B_10-11.pdf

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	MW-2
JOB NO.	3102-001	DEPTH	20-21'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	8/11/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/02/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Sample Conditions

Before Test Mass of Wet Soil (g):	311.7	Initial Wet Density (pcf):	135.4
After Test Mass of Wet Soil (g):	316.4	Initial Dry Density (pcf):	117.4
Mass of Dry Soil and Pan (g):	390.1	Initial Wet Density (kg/m³):	2168
Mass of Pan (g):	119.7	Initial Dry Density (kg/m³):	1881
Diameter (in):	1.94	Initial Moisture (%):	15.3
Initial Sample Height (in):	2.98	Final Wet Density (pcf):	135.4
Assumed Specific Gravity:	2.650	Final Dry Density (pcf):	115.7
		Final Wet Density (kg/m³):	2168
Back Pressure (psi):	108.0	Final Dry Density (kg/m³):	1853
Cell Pressure (psi):	125.0	Final Moisture (%):	17.0

Final density calculated using volume change method from ASTM D4767.

Permeability Data

Pump Setting	Percentage of Pump Setting	Rate of Flow (cc/s)	Pump Pressure (psi)	Head Loss (cm)	Gradient - i	Effective Stress (psi) - σ_3	Effective Stress (kPa) - σ_3	Temperature (°C)	Temperature Correction	Corrected Hydraulic Conductivity (cm/s) - k
5	--	1.12E-06	0.556	39.15	5.20	16.72	115.3	21.1	0.974	1.08E-08
5	--	1.12E-06	0.562	39.57	5.25	16.72	115.3	20.8	0.981	1.08E-08
5	--	1.12E-06	0.574	40.41	5.36	16.71	115.2	20.8	0.981	1.06E-08
5	--	1.12E-06	0.594	41.82	5.55	16.70	115.2	20.7	0.983	1.02E-08
5	--	1.12E-06	0.599	42.17	5.60	16.70	115.1	20.7	0.983	1.01E-08
5	--	1.12E-06	0.584	41.12	5.46	16.71	115.2	20.6	0.986	1.04E-08

Test Results

Average Corrected Hydraulic Conductivity (cm/s): 1.03E-08

NOTES:

Data entry by:	CAL	Date:	09/16/20
Checked by:	KR	Date:	09/18/20
File name:	3102001__Permeability Method D ASTM D5084_12.xlsm		Page 1 of 2

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

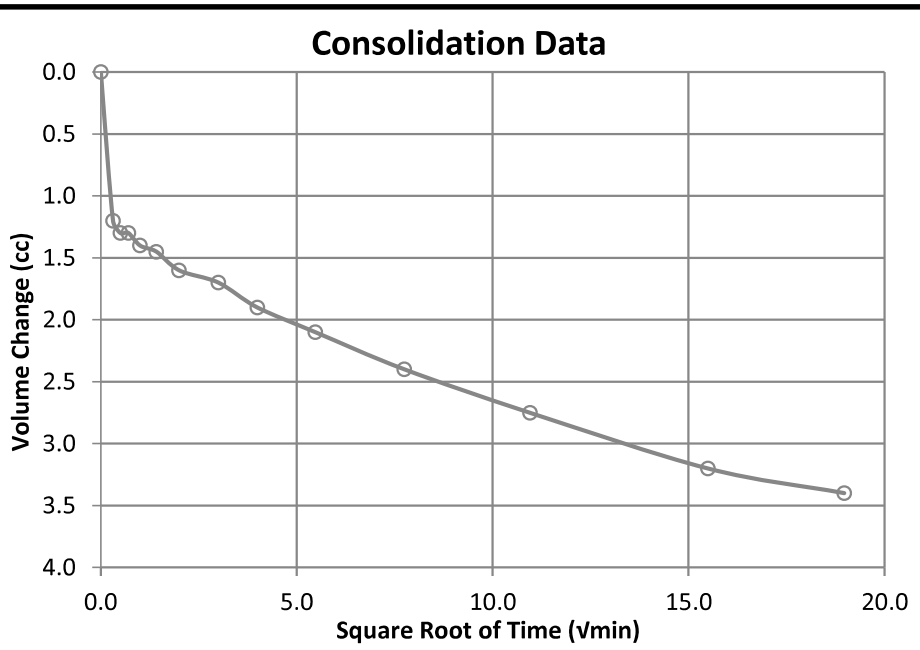
ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	MW-2
JOB NO.	3102-001	DEPTH	20-21'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	8/11/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/02/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Consolidation

Initial Saturation (%):	99.0	Initial Volume of Sample (cc):	143.7
Final Saturation (%):	100.0	Final Volume of Sample (cc):	145.9
Cell Pressure (psi):	128.0	Volume Change After Consolidation (cc):	23.1
Back Pressure (psi):	108.0	Initial Dial Reading (in):	0.200
Effective Stress (psi):	20.0	Final Dial Reading (in):	0.217
Effective Stress (kPa):	137.9	Height Change (in):	0.017
Cell Expansion Correction (cc):	25.28	Initial Area (cm²):	18.97
Cell ID:	8P	Final Area (cm²):	19.37

Elapsed Time (min)	Square Root of Time (√min)	Burette Reading (cc)	Volume Change (cc)
0	0.00	0.40	0.00
0.1	0.32	1.60	1.20
0.25	0.50	1.70	1.30
0.5	0.71	1.70	1.30
1	1.00	1.80	1.40
2	1.41	1.85	1.45
4	2.00	2.00	1.60
9	3.00	2.10	1.70
16	4.00	2.30	1.90
30	5.48	2.50	2.10
60	7.75	2.80	2.40
120	10.95	3.15	2.75
240	15.49	3.60	3.20
360	18.97	3.80	3.40



Saturation

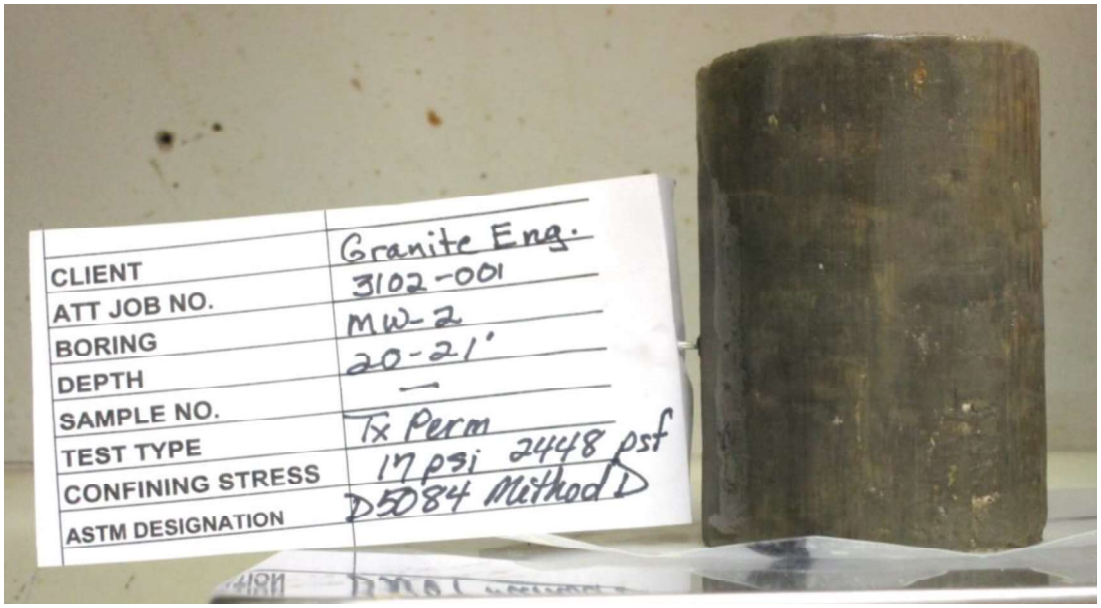
Cell Pressure (psi)		Pore Pressure (psi)		Burette Reading (cc)		Back Pressure (psi)	Volume Change (cc)	Effective Stress (psi)	Δu (psi)	B
Initial	Final	Initial	Final	Initial	Final					
70.0	80.0	68.6	76.9	15.40	16.20	68.0	0.80	2.0	8.3	0.83
80.0	90.0	78.6	87.8	16.40	17.30	78.0	0.90	2.0	9.2	0.92
90.0	100.0	88.5	97.8	17.50	18.20	88.0	0.70	2.0	9.3	0.93
100.0	110.0	98.5	107.7	18.50	19.20	98.0	0.70	2.0	9.2	0.92
110.0	120.0	108.6	118.2	20.80	20.90	108.0	0.10	2.0	9.6	0.96

File name: 3102001__Permeability Method D ASTM D5084_12.xlsm

Image Attachment

ADVANCED TERRA TESTING

CLIENT	Granite Engineering Group, Inc.	BORING NO.	MW-2
JOB NO.	3102-001	DEPTH	20-21'
PROJECT	Xcel Comanche	SAMPLE NO.	
PROJECT NO.	220-020	DATE SAMPLED	8/11/20
LOCATION	--	DESCRIPTION	soil



NOTES

File name: 3102001_PERM_MW-2_20-21.pdf

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-8
JOB NO.	3102-001	DEPTH	43-44'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	8/6/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/03/20	DESCRIPTION	rock
TECHNICIAN	CAL		

Sample Conditions

Before Test Mass of Wet Soil (g):	261.8	Initial Wet Density (pcf):	150.0
After Test Mass of Wet Soil (g):	264.2	Initial Dry Density (pcf):	142.6
Mass of Dry Soil and Pan (g):	388.6	Initial Wet Density (kg/m³):	2402
Mass of Pan (g):	139.6	Initial Dry Density (kg/m³):	2285
Diameter (in):	1.84	Initial Moisture (%):	5.1
Initial Sample Height (in):	2.51	Final Wet Density (pcf):	147.1
Assumed Specific Gravity:	2.650	Final Dry Density (pcf):	138.6
		Final Wet Density (kg/m³):	2356
Back Pressure (psi):	108.0	Final Dry Density (kg/m³):	2220
Cell Pressure (psi):	146.0	Final Moisture (%):	6.1

Final density calculated using volume change method from ASTM D4767.

Permeability Data

Pump Setting		Rate of Flow (cc/s)	Pump Pressure (psi)	Head Loss (cm)	Gradient - i	Effective Stress (psi) - σ_3	Effective Stress (kPa) - σ_3	Temperature (°C)	Temperature Correction	Corrected Hydraulic Conductivity (cm/s) - k
5	--	1.12E-06	0.709	49.92	7.81	37.65	259.6	21.6	0.962	7.84E-09
5	--	1.12E-06	1.324	93.22	14.59	37.34	257.4	21.6	0.962	4.20E-09
5	--	1.12E-06	1.982	139.55	21.85	37.01	255.2	21.6	0.962	2.80E-09
5	--	1.12E-06	2.590	182.36	28.55	36.71	253.1	21.6	0.962	2.15E-09
5	--	1.12E-06	3.070	216.16	33.84	36.47	251.4	21.6	0.962	1.81E-09
5	--	1.12E-06	3.360	236.57	37.03	36.32	250.4	21.7	0.960	1.65E-09
5	--	1.12E-06	3.560	250.66	39.24	36.22	249.7	21.8	0.958	1.55E-09
5	--	1.12E-06	3.650	256.99	40.23	36.18	249.4	21.8	0.958	1.52E-09
5	--	1.12E-06	3.800	267.55	41.88	36.10	248.9	21.2	0.972	1.48E-09
5	--	1.12E-06	3.480	245.02	38.36	36.26	250.0	21.1	0.974	1.62E-09

Test Results

Average Corrected Hydraulic Conductivity (cm/s): 1.54E-09

NOTES:

Data entry by:	CAL	Date:	09/17/20
Checked by:	KR	Date:	09/18/20
File name:	3102001__Permeability Method D ASTM D5084_13.xlsm		Page 1 of 2

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

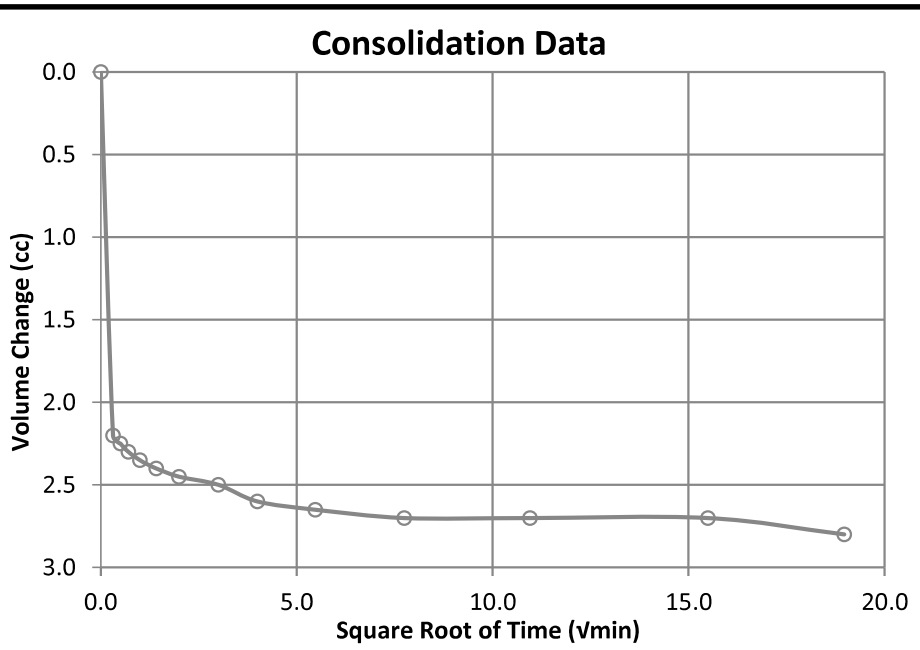
ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-8
JOB NO.	3102-001	DEPTH	43-44'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	8/6/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/03/20	DESCRIPTION	rock
TECHNICIAN	CAL		

Consolidation

Initial Saturation (%):	85.1	Initial Volume of Sample (cc):	109.0
Final Saturation (%):	83.6	Final Volume of Sample (cc):	112.2
Cell Pressure (psi):	146.0	Volume Change After Consolidation (cc):	14.2
Back Pressure (psi):	108.0	Initial Dial Reading (in):	0.300
Effective Stress (psi):	38.0	Final Dial Reading (in):	0.297
Effective Stress (kPa):	262.0	Height Change (in):	-0.003
Cell Expansion Correction (cc):	17.38	Initial Area (cm²):	17.08
Cell ID:	14S	Final Area (cm²):	17.56

Elapsed Time (min)	Square Root of Time (√min)	Burette Reading (cc)	Volume Change (cc)
0	0.00	5.50	0.00
0.1	0.32	7.70	2.20
0.25	0.50	7.75	2.25
0.5	0.71	7.80	2.30
1	1.00	7.85	2.35
2	1.41	7.90	2.40
4	2.00	7.95	2.45
9	3.00	8.00	2.50
16	4.00	8.10	2.60
30	5.48	8.15	2.65
60	7.75	8.20	2.70
120	10.95	8.20	2.70
240	15.49	8.20	2.70
360	18.97	8.30	2.80



Saturation

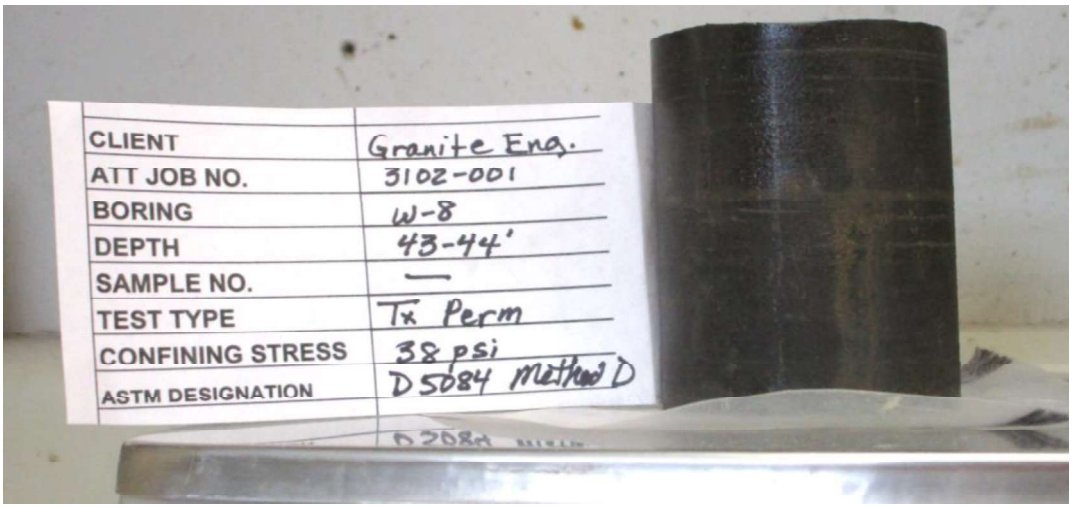
Cell Pressure (psi)		Pore Pressure (psi)		Burette Reading (cc)		Back Pressure (psi)	Volume Change (cc)	Effective Stress (psi)	Δu (psi)	B
Initial	Final	Initial	Final	Initial	Final					
70.0	80.0	69.1	78.2	10.20	10.80	68.0	0.60	2.0	9.1	0.91
80.0	90.0	78.9	88.0	10.90	11.50	78.0	0.60	2.0	9.1	0.91
90.0	100.0	88.4	97.7	11.50	12.00	88.0	0.50	2.0	9.3	0.93
100.0	110.0	98.7	108.1	12.00	12.60	98.0	0.60	2.0	9.4	0.94
110.0	120.0	108.6	118.1	12.60	12.70	108.0	0.10	2.0	9.5	0.95

File name: 3102001__Permeability Method D ASTM D5084_13.xlsm

Image Attachment

ADVANCED TERRA TESTING

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-8
JOB NO.	3102-001	DEPTH	43-44'
PROJECT	Xcel Comanche	SAMPLE NO.	
PROJECT NO.	220-020	DATE SAMPLED	8/6/20
LOCATION	--	DESCRIPTION	rock



NOTES

File name: 3102001_PERM_W-8_43-44.pdf

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-2B
JOB NO.	3102-001	DEPTH	64-65'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	--
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/02/20	DESCRIPTION	--
TECHNICIAN	CAL		

Sample Conditions

Before Test Mass of Wet Soil (g):	355.0	Initial Wet Density (pcf):	155.9
After Test Mass of Wet Soil (g):	357.3	Initial Dry Density (pcf):	148.4
Mass of Dry Soil and Pan (g):	521.3	Initial Wet Density (kg/m³):	2497
Mass of Pan (g):	183.3	Initial Dry Density (kg/m³):	2378
Diameter (in):	1.85	Initial Moisture (%):	5.0
Initial Sample Height (in):	3.25	Final Wet Density (pcf):	157.8
Assumed Specific Gravity:	2.650	Final Dry Density (pcf):	149.3
		Final Wet Density (kg/m³):	2528
Back Pressure (psi):	128.0	Final Dry Density (kg/m³):	2391
Cell Pressure (psi):	167.0	Final Moisture (%):	5.7

Final density calculated using volume change method from ASTM D4767.

Permeability Data

Pump Setting	Percentage of Pump Setting	Rate of Flow (cc/s)	Pump Pressure (psi)	Head Loss (cm)	Gradient - i	Effective Stress (psi) - σ_3	Effective Stress (kPa) - σ_3	Temperature (°C)	Temperature Correction	Corrected Hydraulic Conductivity (cm/s) - k
--	--	1.39E-06	0.040	2.82	0.34	38.98	268.8	21.8	0.958	2.26E-07
--	--	1.39E-06	0.150	10.56	1.28	38.93	268.4	21.8	0.958	6.02E-08
--	--	1.39E-06	0.375	26.40	3.21	38.81	267.6	21.9	0.956	2.40E-08
--	--	1.39E-06	0.473	33.30	4.05	38.76	267.3	21.9	0.956	1.90E-08
--	--	1.39E-06	0.631	44.43	5.41	38.68	266.7	21.9	0.956	1.43E-08
--	--	1.39E-06	0.628	44.22	5.38	38.69	266.7	21.9	0.956	1.43E-08
--	--	1.39E-06	0.740	52.10	6.34	38.63	266.3	21.8	0.958	1.22E-08
--	--	1.39E-06	0.659	46.40	5.65	38.67	266.6	21.8	0.958	1.37E-08

Test Results

Average Corrected Hydraulic Conductivity (cm/s): 1.36E-08

NOTES:	Unable to achieve skempton's B parameter greater than .84 using normal operating back pressure capability.

Data entry by:	CAL	Date:	09/18/20
Checked by:	KR	Date:	09/23/20
File name:	3102001__Permeability Method D ASTM D5084_14.xlsm		Page 1 of 2

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

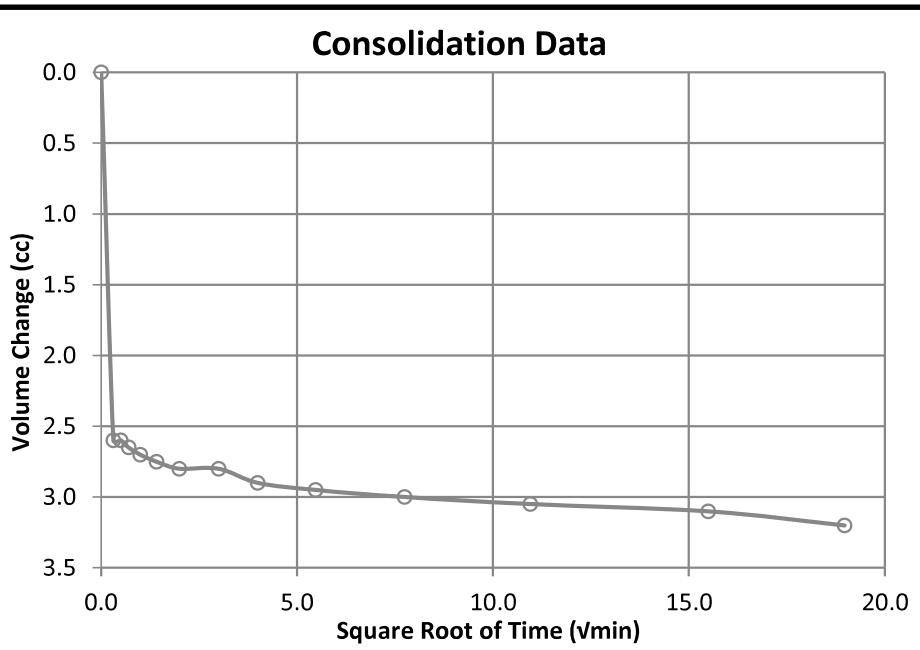
ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	W-2B
JOB NO.	3102-001	DEPTH	64-65'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	--
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/02/20	DESCRIPTION	--
TECHNICIAN	CAL		

Consolidation

Initial Saturation (%):	100.0	Initial Volume of Sample (cc):	142.2
Final Saturation (%):	100.0	Final Volume of Sample (cc):	141.3
Cell Pressure (psi):	167.0	Volume Change After Consolidation (cc):	18
Back Pressure (psi):	138.0	Initial Dial Reading (in):	0.200
Effective Stress (psi):	29.0	Final Dial Reading (in):	0.209
Effective Stress (kPa):	199.9	Height Change (in):	0.009
Cell Expansion Correction (cc):	17.17	Initial Area (cm²):	17.25
Cell ID:	13S	Final Area (cm²):	17.20

Elapsed Time (min)	Square Root of Time (√min)	Burette Reading (cc)	Volume Change (cc)
0	0.00	1.30	0.00
0.1	0.32	3.90	2.60
0.25	0.50	3.90	2.60
0.5	0.71	3.95	2.65
1	1.00	4.00	2.70
2	1.41	4.05	2.75
4	2.00	4.10	2.80
9	3.00	4.10	2.80
16	4.00	4.20	2.90
30	5.48	4.25	2.95
60	7.75	4.30	3.00
120	10.95	4.35	3.05
240	15.49	4.40	3.10
360	18.97	4.50	3.20



Saturation

Cell Pressure (psi)		Pore Pressure (psi)		Burette Reading (cc)		Back Pressure (psi)	Volume Change (cc)	Effective Stress (psi)	Δu (psi)	B
Initial	Final	Initial	Final	Initial	Final					
90.0	100.0	88.9	96.6	14.10	14.70	88.0	0.60	2.0	7.7	0.77
100.0	110.0	98.7	106.6	14.80	15.50	98.0	0.70	2.0	7.9	0.79
110.0	120.0	108.6	116.8	15.60	16.20	108.0	0.60	2.0	8.2	0.82
120.0	130.0	118.4	126.6	16.40	17.00	118.0	0.60	2.0	8.2	0.82
130.0	140.0	128.3	136.7	17.20	17.20	128.0	0.00	2.0	8.4	0.84

File name: 3102001__Permeability Method D ASTM D5084_14.xlsm

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	MW-4
JOB NO.	3102-001	DEPTH	37-39'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	8/13/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/02/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Sample Conditions

Before Test Mass of Wet Soil (g):	294.3	Initial Wet Density (pcf):	127.3
After Test Mass of Wet Soil (g):	294.9	Initial Dry Density (pcf):	102.9
Mass of Dry Soil and Pan (g):	357.5	Initial Wet Density (kg/m³):	2039
Mass of Pan (g):	119.7	Initial Dry Density (kg/m³):	1648
Diameter (in):	1.94	Initial Moisture (%):	23.8
Initial Sample Height (in):	2.98	Final Wet Density (pcf):	130.9
Assumed Specific Gravity:	2.650	Final Dry Density (pcf):	105.6
		Final Wet Density (kg/m³):	2097
Back Pressure (psi):	128.0	Final Dry Density (kg/m³):	1691
Cell Pressure (psi):	161.0	Final Moisture (%):	24.0

Final density calculated using volume change method from ASTM D4767.

Permeability Data

Pump Setting	Percentage of Pump Setting	Rate of Flow (cc/s)	Pump Pressure (psi)	Head Loss (cm)	Gradient - i	Effective Stress (psi) - σ_3	Effective Stress (kPa) - σ_3	Temperature (°C)	Temperature Correction	Corrected Hydraulic Conductivity (cm/s) - k
--	--	1.39E-06	1.499	105.54	14.21	32.25	222.4	21.5	0.965	4.98E-09
--	--	1.39E-06	1.583	111.46	15.00	32.21	222.1	21.8	0.958	4.69E-09
--	--	1.39E-06	1.784	125.61	16.91	32.11	221.4	21.6	0.962	4.18E-09
--	--	1.39E-06	1.790	126.03	16.96	32.11	221.4	21.4	0.967	4.18E-09
--	--	1.39E-06	1.814	127.72	17.19	32.09	221.3	21.4	0.967	4.13E-09
--	--	1.39E-06	1.909	134.41	18.09	32.05	220.9	21.4	0.967	3.92E-09
--	--	1.39E-06	2.001	140.89	18.96	32.00	220.6	21.2	0.972	3.76E-09
--	--	1.39E-06	2.048	144.20	19.41	31.98	220.5	21.2	0.972	3.67E-09
--	--	1.39E-06	2.053	144.55	19.46	31.97	220.4	21.3	0.969	3.66E-09
--	--	1.39E-06	2.063	145.25	19.55	31.97	220.4	21.2	0.972	3.65E-09

Test Results

Average Corrected Hydraulic Conductivity (cm/s): 3.68E-09

NOTES:	Unable to achieve Skempton's B parameter greater than .88 using normal operating back pressure.

Data entry by:	CAL	Date:	09/23/20
Checked by:	KR	Date:	09/23/20
File name:	3102001__Permeability Method D ASTM D5084_15.xlsm		Page 1 of 2

ADVANCED TERRA TESTING

Constant Rate of Flow
Flexible Wall Hydraulic Conductivity

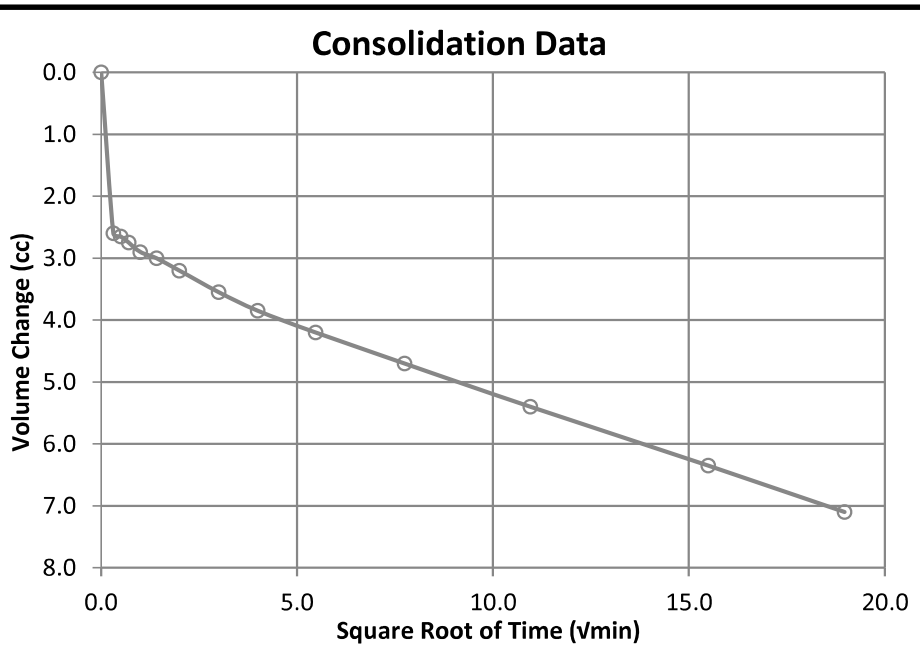
ASTM D 5084 Method D

CLIENT	Granite Engineering Group, Inc.	BORING NO.	MW-4
JOB NO.	3102-001	DEPTH	37-39'
PROJECT	Xcel Comanche	SAMPLE NO.	--
PROJECT NO.	220-020	DATE SAMPLED	8/13/2020
LOCATION	--	SAMPLED BY	--
DATE TESTED	09/02/20	DESCRIPTION	soil
TECHNICIAN	CAL		

Consolidation

Initial Saturation (%):	100.0	Initial Volume of Sample (cc):	144.3
Final Saturation (%):	100.0	Final Volume of Sample (cc):	140.6
Cell Pressure (psi):	161.0	Volume Change After Consolidation (cc):	29
Back Pressure (psi):	128.0	Initial Dial Reading (in):	0.200
Effective Stress (psi):	33.0	Final Dial Reading (in):	0.257
Effective Stress (kPa):	227.5	Height Change (in):	0.057
Cell Expansion Correction (cc):	25.33	Initial Area (cm²):	19.05
Cell ID:	9P	Final Area (cm²):	18.93

Elapsed Time (min)	Square Root of Time (√min)	Burette Reading (cc)	Volume Change (cc)
0	0.00	9.20	0.00
0.1	0.32	11.80	2.60
0.25	0.50	11.85	2.65
0.5	0.71	11.95	2.75
1	1.00	12.10	2.90
2	1.41	12.20	3.00
4	2.00	12.40	3.20
9	3.00	12.75	3.55
16	4.00	13.05	3.85
30	5.48	13.40	4.20
60	7.75	13.90	4.70
120	10.95	14.60	5.40
240	15.49	15.55	6.35
360	18.97	16.30	7.10



Saturation

Cell Pressure (psi)		Pore Pressure (psi)		Burette Reading (cc)		Back Pressure (psi)	Volume Change (cc)	Effective Stress (psi)	Δu (psi)	B
Initial	Final	Initial	Final	Initial	Final					
90.0	100.0	89.0	96.9	18.00	18.80	88.0	0.80	2.0	7.9	0.79
100.0	110.0	99.0	106.9	18.90	19.70	98.0	0.80	2.0	7.9	0.79
110.0	120.0	108.9	117.2	19.80	20.50	108.0	0.70	2.0	8.3	0.83
120.0	130.0	119.0	127.2	20.70	21.40	118.0	0.70	2.0	8.2	0.82
130.0	140.0	129.1	137.9	21.70	21.70	128.0	0.00	2.0	8.8	0.88

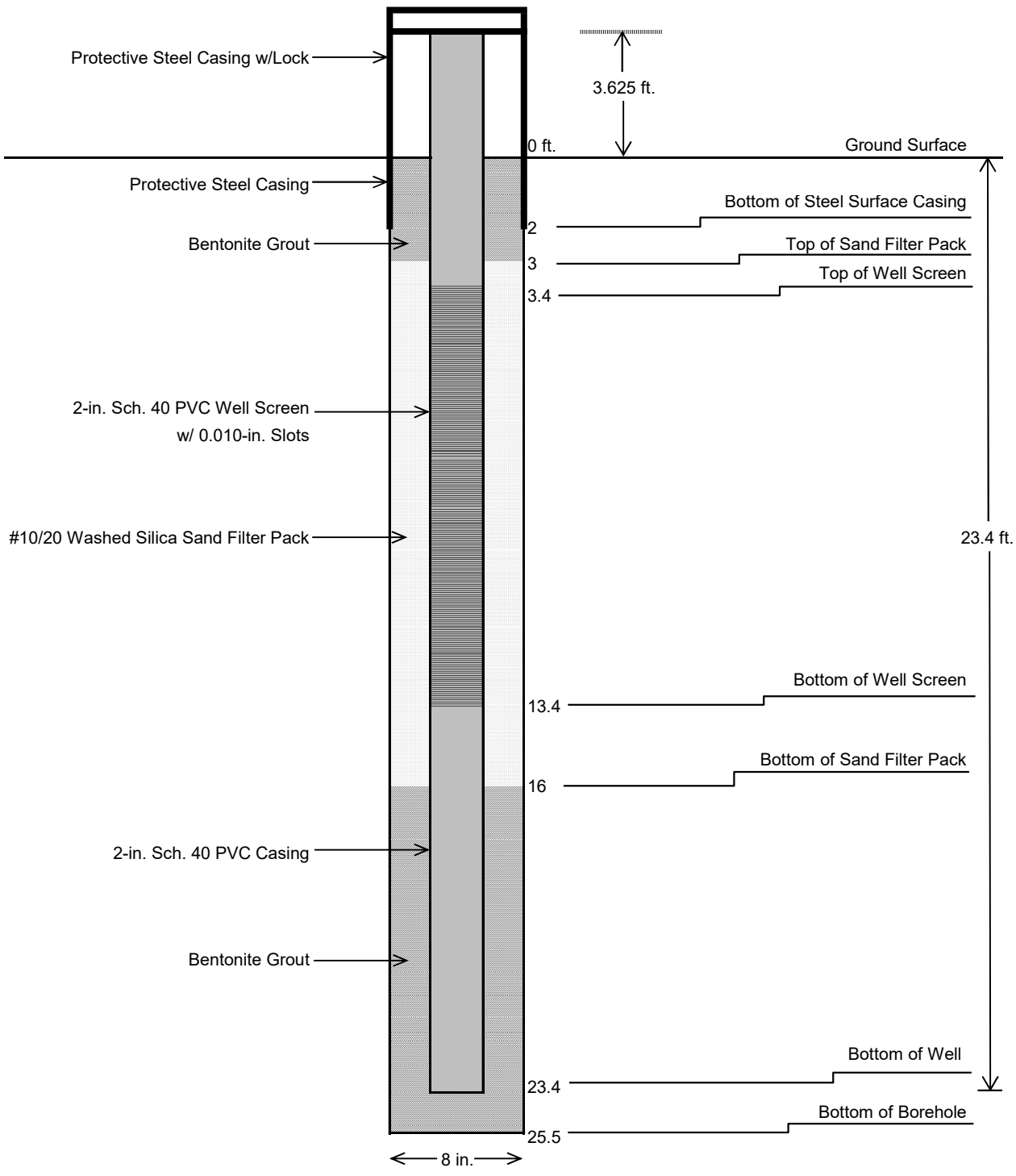
File name: 3102001__Permeability Method D ASTM D5084_15.xlsm

Appendix C

Well Construction Diagrams

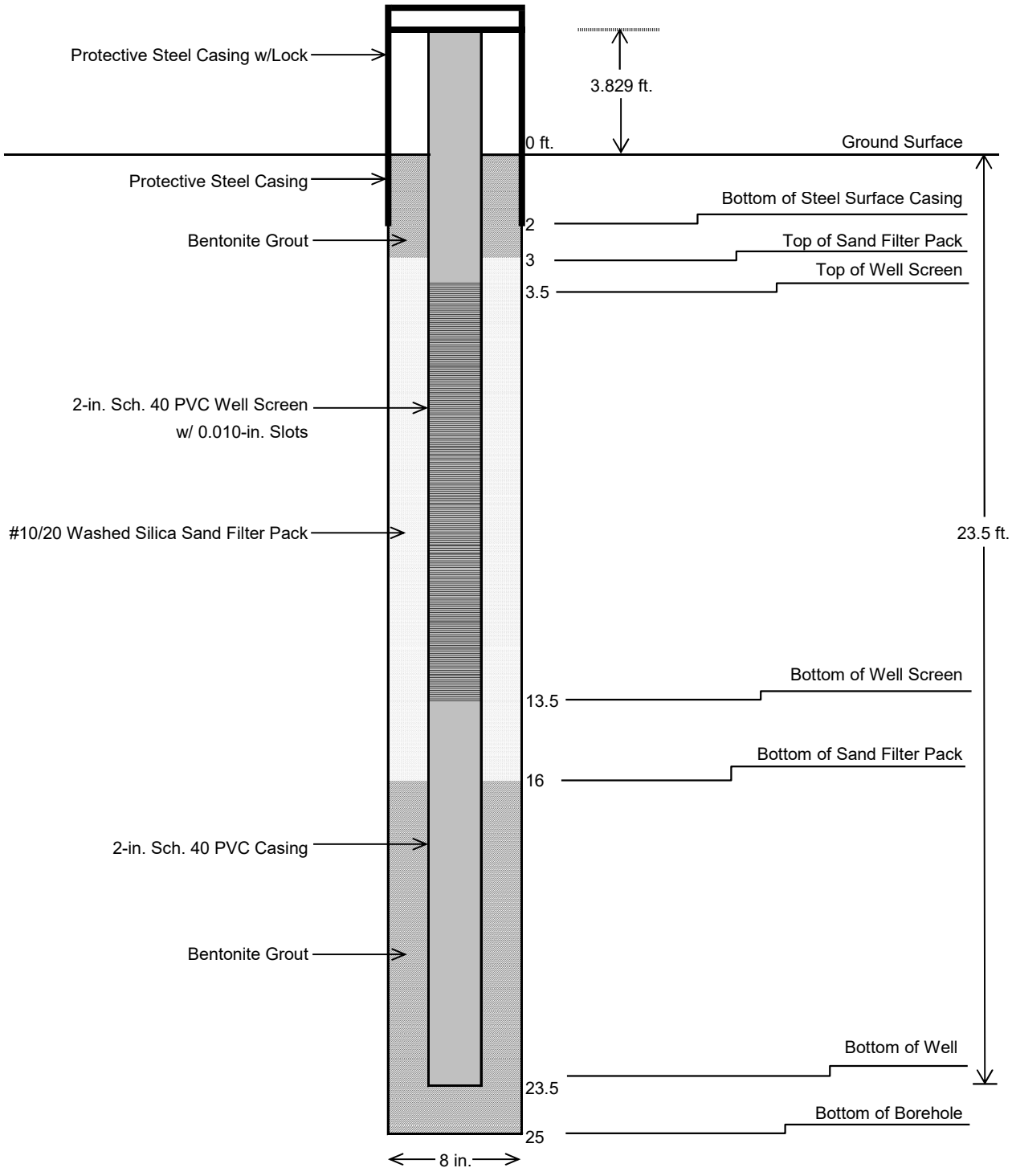
Appendix C

Well Construction Diagrams



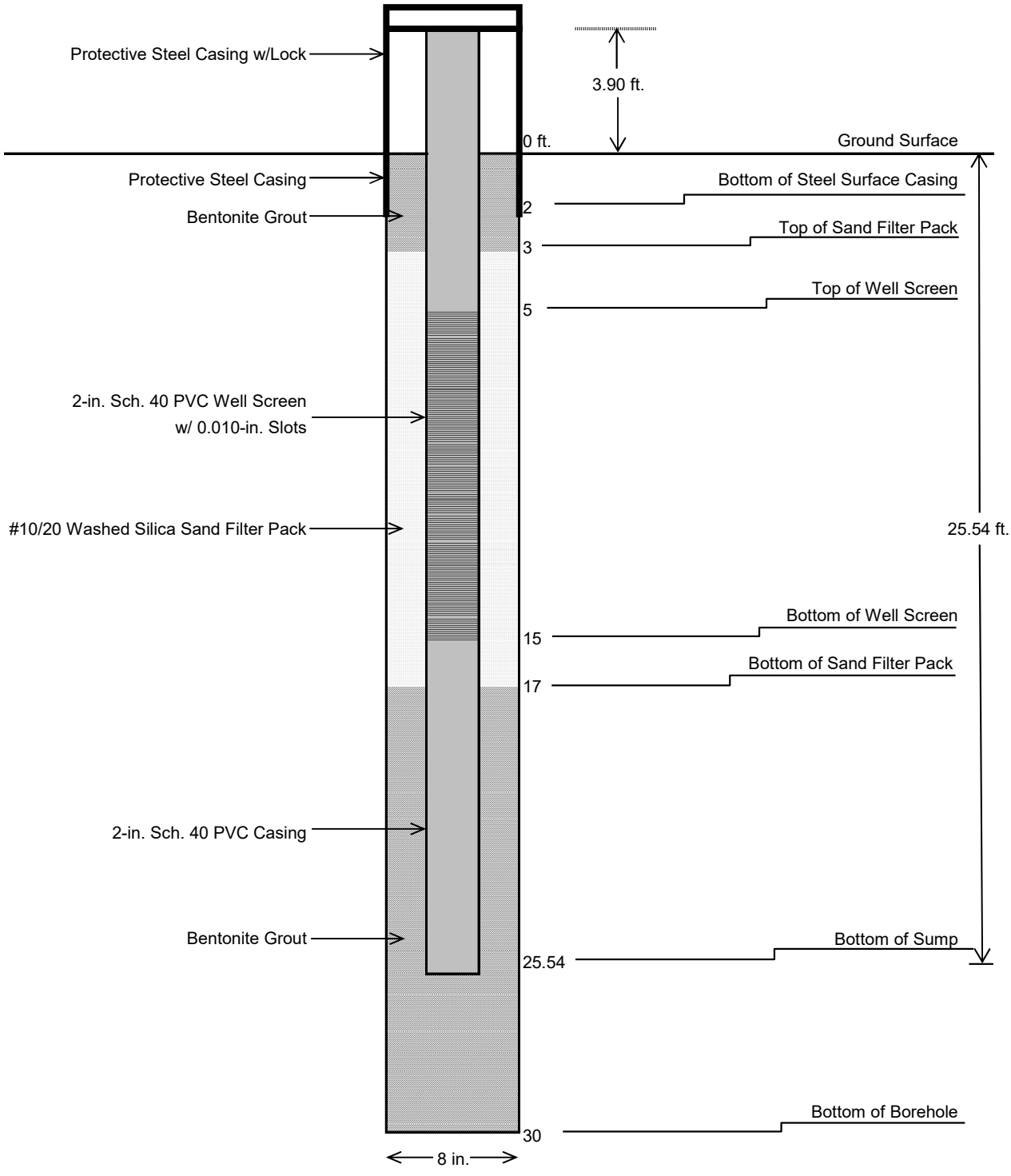
Constructed: 11/10/2015
Drilled By: HP Geotech
PVC Casing EL: 4812.47 ft amsl
Water EL: 4789.67 ft amsl (December 2015)

Monitoring Well Construction Diagram
W-4
Comanche Station
Xcel Energy



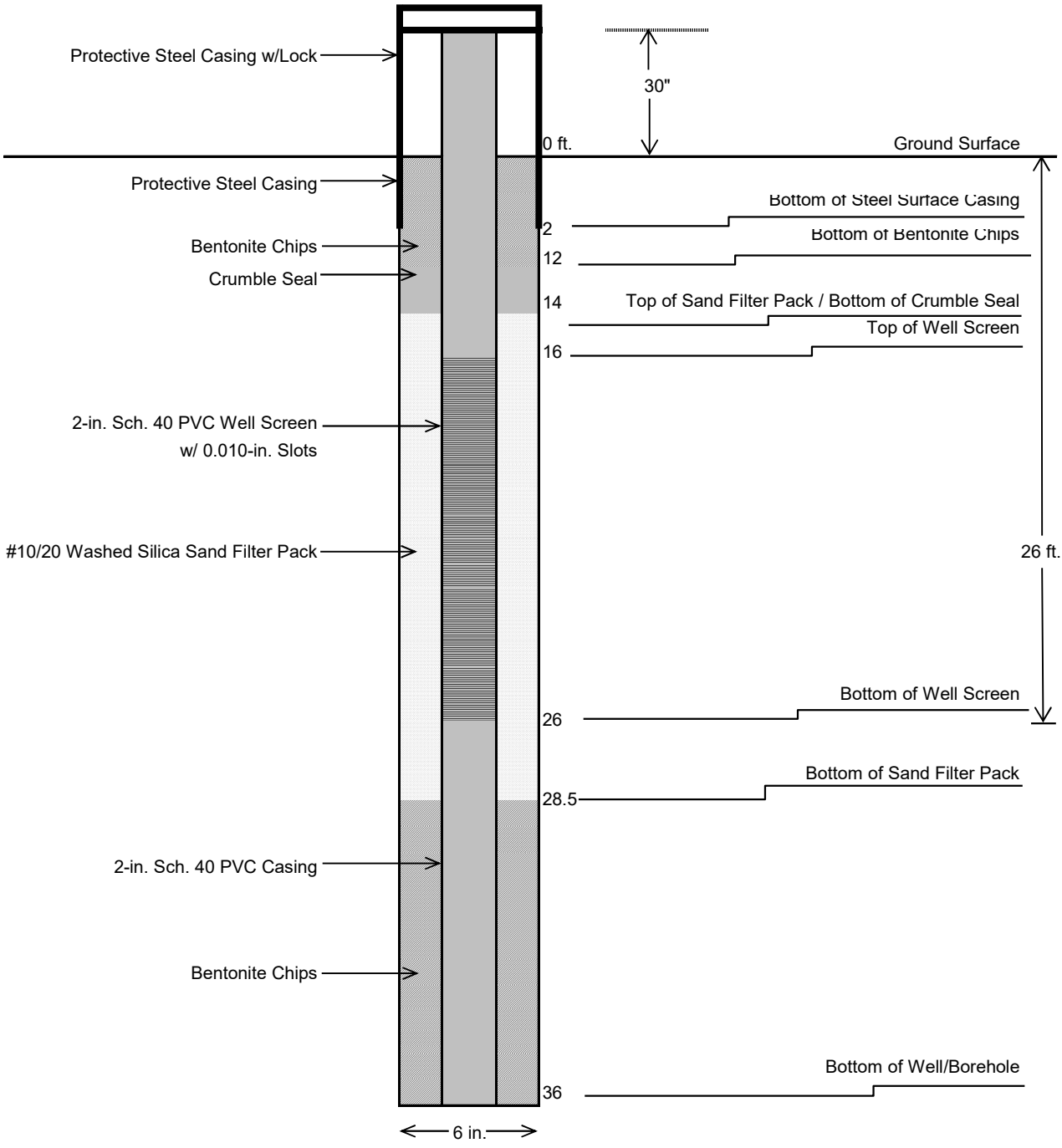
Constructed: 11/9/2015
Drilled By: HP Geotech
PVC Casing EL: 4807.46 ft amsl
Water EL: 4795.13 ft amsl (December 2015)

Monitoring Well Construction Diagram
W-5
Comanche Station
Xcel Energy



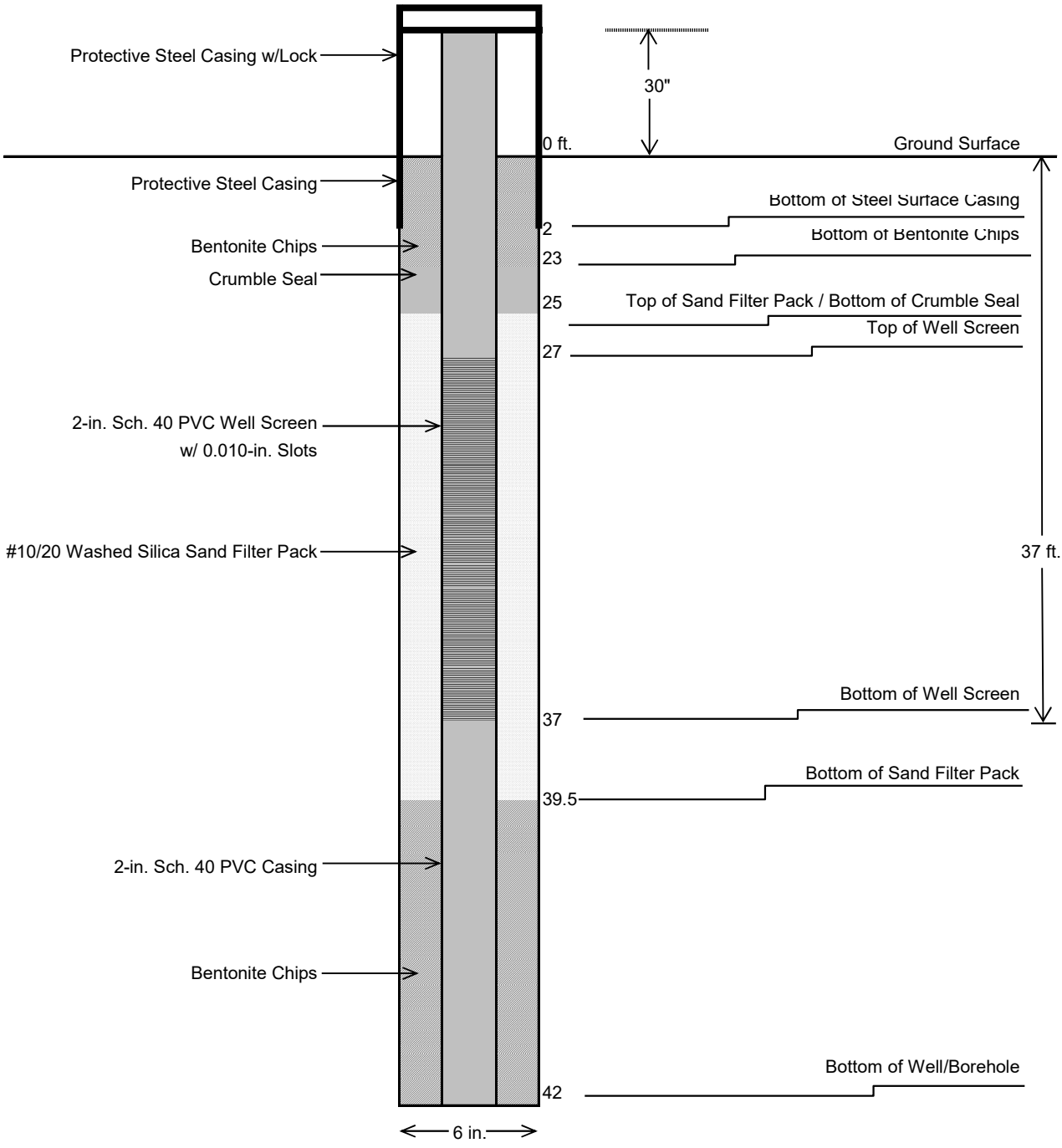
Constructed: 11/11/2015
Drilled By: HP Geotech
PVC Casing EL: 4811.89 ft amsl
Water EL: 4796.51 ft amsl (December 2015)

Monitoring Well Construction Diagram
W-6
Comanche Station
Xcel Energy



Constructed: 08/08/2017
Drilled By: Site Services Drilling, LLC
PVC Casing EL: 4806.97 ft amsl
Water EL: 4779.30 ft amsl (August 2017)

Monitoring Well Construction Diagram
MW-5
Comanche Station
Xcel Energy



Constructed: 08/07/2017
Drilled By: Site Services Drilling, LLC
PVC Casing EL: 4823.09 ft amsl
Water EL: 4793.04 ft amsl (August 2017)

Monitoring Well Construction Diagram
MW-6
Comanche Station
Xcel Energy

Appendix D

State Well Permits

Appendix D

State Well Permits

Form No.
GWS-25

OFFICE OF THE STATE ENGINEER
COLORADO DIVISION OF WATER RESOURCES

818 Centennial Bldg., 1313 Sherman St., Denver, Colorado 80203
(303) 866-3581

EXST

WELL PERMIT NUMBER 299843 - - -
DIV. 2 WD 15 DES. BASIN MD

APPLICANT

PUBLIC SERVICE COMPANY OF COLORADO
2005 LIME RD
PUEBLO, CO 81006-

(303) 571-7340

APPROVED WELL LOCATION
PUEBLO COUNTY
NE 1/4 SE 1/4 Section 20
Township 21 S Range 64 W Sixth P.M.

DISTANCES FROM SECTION LINES
1961 Ft. from South Section Line
978 Ft. from East Section Line

UTM COORDINATES (Meters,Zone:13,NAD83)
Easting: 537307 Northing: 4228492

PERMIT TO USE AN EXISTING WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT

CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of this permit does not ensure that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.
2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.
3) Approved pursuant to CRS 37-92-602(3)(b)(I) for uses as described in CRS 37-92-602(1)(f). Use of this well is limited to monitoring water levels and/or water quality sampling.
4) Approved for the use of an existing well known as W-4.
5) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as an open well. The well must be kept capped and locked at all times except during sampling or measuring.
6) Records of water level measurements and water quality analyses shall be maintained by the well owner and submitted to the Division of Water Resources upon request.
7) Upon conclusion of the monitoring program the well owner shall plug this well in accordance with Rule 16 of the Water Well Construction Rules. A Well Abandonment Report must be completed and submitted to the Division of Water Resources within 60 days of plugging.
8) The owner shall mark the well in a conspicuous place with the well permit number and name of aquifer as appropriate, and shall take necessary means and precautions to preserve these markings.
9) This well must have been constructed by or under the supervision of a licensed well driller or other authorized individual according to the Water Well Construction Rules.
10) This well must be located not more than 200 feet from the location specified on this permit.

NOTE: Issuance of this permit does not guarantee that this well can be converted to a production well under a future permit. Additionally, pursuant to Rule 14.2 of the Water Well Construction Rules (2 CCR 402-2), monitoring holes constructed pursuant to a monitoring hole notice shall not be converted to a production well. (Upon obtaining a permit from the State Engineer, a monitoring hole may be converted to a monitoring well, recovery well for remediation of the aquifer, or a dewatering system for dewatering the aquifer.)

NOTICE: This permit has been approved subject to the following changes: The distances from section lines, quarter/quarter, quarter, Section, Township, Range and P.M. were determined from UTM coordinate values provided with the permit application. You are hereby notified that you have the right to appeal the issuance of this permit, by filing a written request with this office within sixty (60) days of the date of issuance, pursuant to the State Administrative Procedures Act. (See Section 24-4-104 through 106, C.R.S.)

APPROVED
GAD

Dick Wolfe by Geoff S. Davis
State Engineer By

Receipt No. 3672803A DATE ISSUED 01-08-2016 EXPIRATION DATE N/A

Form No.
GWS-25

OFFICE OF THE STATE ENGINEER
COLORADO DIVISION OF WATER RESOURCES

818 Centennial Bldg., 1313 Sherman St., Denver, Colorado 80203
(303) 866-3581

EXST

WELL PERMIT NUMBER 299844 - - -
DIV. 2 WD 15 DES. BASIN MD

APPLICANT

PUBLIC SERVICE COMPANY OF COLORADO
2005 LIME RD
PUEBLO, CO 81006-

(303) 571-7340

APPROVED WELL LOCATION
PUEBLO COUNTY
NE 1/4 SE 1/4 Section 20
Township 21 S Range 64 W Sixth P.M.

DISTANCES FROM SECTION LINES
1795 Ft. from South Section Line
765 Ft. from East Section Line

UTM COORDINATES (Meters,Zone:13,NAD83)
Easting: 537372 Northing: 4228441

PERMIT TO USE AN EXISTING WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT

CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of this permit does not ensure that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.
2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.
3) Approved pursuant to CRS 37-92-602(3)(b)(I) for uses as described in CRS 37-92-602(1)(f). Use of this well is limited to monitoring water levels and/or water quality sampling.
4) Approved for the use of an existing well known as W-5.
5) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as an open well. The well must be kept capped and locked at all times except during sampling or measuring.
6) Records of water level measurements and water quality analyses shall be maintained by the well owner and submitted to the Division of Water Resources upon request.
7) Upon conclusion of the monitoring program the well owner shall plug this well in accordance with Rule 16 of the Water Well Construction Rules. A Well Abandonment Report must be completed and submitted to the Division of Water Resources within 60 days of plugging.
8) The owner shall mark the well in a conspicuous place with the well permit number and name of aquifer as appropriate, and shall take necessary means and precautions to preserve these markings.
9) This well must have been constructed by or under the supervision of a licensed well driller or other authorized individual according to the Water Well Construction Rules.
10) This well must be located not more than 200 feet from the location specified on this permit.

NOTE: Issuance of this permit does not guarantee that this well can be converted to a production well under a future permit. Additionally, pursuant to Rule 14.2 of the Water Well Construction Rules (2 CCR 402-2), monitoring holes constructed pursuant to a monitoring hole notice shall not be converted to a production well. (Upon obtaining a permit from the State Engineer, a monitoring hole may be converted to a monitoring well, recovery well for remediation of the aquifer, or a dewatering system for dewatering the aquifer.)

NOTICE: This permit has been approved subject to the following changes: The distances from section lines, quarter/quarter, quarter, Section, Township, Range and P.M. were determined from UTM coordinate values provided with the permit application. You are hereby notified that you have the right to appeal the issuance of this permit, by filing a written request with this office within sixty (60) days of the date of issuance, pursuant to the State Administrative Procedures Act. (See Section 24-4-104 through 106, C.R.S.)

APPROVED
GAD

Dick Wolfe by
State Engineer

Geoff L. Davis
By

Receipt No. 3672803B DATE ISSUED 01-08-2016 EXPIRATION DATE N/A

Form No.
GWS-25

OFFICE OF THE STATE ENGINEER
COLORADO DIVISION OF WATER RESOURCES

818 Centennial Bldg., 1313 Sherman St., Denver, Colorado 80203
(303) 866-3581

EXST

WELL PERMIT NUMBER 299845 - - -
DIV. 2 WD 15 DES. BASIN MD

APPLICANT

PUBLIC SERVICE COMPANY OF COLORADO
2005 LIME RD
PUEBLO, CO 81006-

(303) 571-7340

APPROVED WELL LOCATION
PUEBLO COUNTY
NE 1/4 SE 1/4 Section 20
Township 21 S Range 64 W Sixth P.M.

DISTANCES FROM SECTION LINES
1425 Ft. from South Section Line
683 Ft. from East Section Line

UTM COORDINATES (Meters,Zone:13,NAD83)
Easting: 537397 Northing: 4228328

PERMIT TO USE AN EXISTING WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT

CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of this permit does not ensure that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.
2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.
3) Approved pursuant to CRS 37-92-602(3)(b)(I) for uses as described in CRS 37-92-602(1)(f). Use of this well is limited to monitoring water levels and/or water quality sampling.
4) Approved for the use of an existing well known as W-6.
5) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as an open well. The well must be kept capped and locked at all times except during sampling or measuring.
6) Records of water level measurements and water quality analyses shall be maintained by the well owner and submitted to the Division of Water Resources upon request.
7) Upon conclusion of the monitoring program the well owner shall plug this well in accordance with Rule 16 of the Water Well Construction Rules. A Well Abandonment Report must be completed and submitted to the Division of Water Resources within 60 days of plugging.
8) The owner shall mark the well in a conspicuous place with the well permit number and name of aquifer as appropriate, and shall take necessary means and precautions to preserve these markings.
9) This well must have been constructed by or under the supervision of a licensed well driller or other authorized individual according to the Water Well Construction Rules.
10) This well must be located not more than 200 feet from the location specified on this permit.

NOTE: Issuance of this permit does not guarantee that this well can be converted to a production well under a future permit. Additionally, pursuant to Rule 14.2 of the Water Well Construction Rules (2 CCR 402-2), monitoring holes constructed pursuant to a monitoring hole notice shall not be converted to a production well. (Upon obtaining a permit from the State Engineer, a monitoring hole may be converted to a monitoring well, recovery well for remediation of the aquifer, or a dewatering system for dewatering the aquifer.)

NOTICE: This permit has been approved subject to the following changes: The distances from section lines, quarter/quarter, quarter, Section, Township, Range and P.M. were determined from UTM coordinate values provided with the permit application. You are hereby notified that you have the right to appeal the issuance of this permit, by filing a written request with this office within sixty (60) days of the date of issuance, pursuant to the State Administrative Procedures Act. (See Section 24-4-104 through 106, C.R.S.)

APPROVED
GAD

Dick Wolfe by
State Engineer

Geoff Davis
By

Receipt No. 3672803C DATE ISSUED 01-08-2016 EXPIRATION DATE N/A

RECEIVED
JUL 31 2017
WATER RESOURCES
STATE ENGINEER
COLO

GWS-51
3/2013

NOTICE OF INTENT TO CONSTRUCT MONITORING HOLE(S)

Please type or print legibly in black or blue ink or file online @ dwrpermitsonline@state.co.us
COLORADO DIVISION OF WATER RESOURCES-1313 SHERMAN ST-STE 821-DENVER-CO-80203
PHONE: 303-866-3581---FAX: 303-866-3589 WEB: www.water.state.co.us

Well Owner Name(s): Public Service Company of Colorado
Address : 6198 Franklin St., Denver, CO 80216
Phone (area code & no.): 303-571-7340
Landowner's Name: Xcel Energy - PSCo

Please check one and complete as indicated including contact info:

☐ Water Well Driller Licensed in Colorado – Lic. No. _____

☐ Professional Engineer Registered in Colorado – Reg. No. _____

■ Professional Geologist per CRS 34-1-201(3)

☐ Other -anyone directly employed by or under the supervision of a licensed driller, registered professional engineer or professional geologist

Contact / Company Richard Walther, PG / HDR
Address 1670 Broadway
City, State & Zip Denver, CO 80202
Phone (303)318-6303 Fax _____

Print Name: Richard Walther
Sign or enter full name here: Richard Walther

Location: NW ¼ SW ¼, Section 20
Township 21 ☐N ☒S, Range 64 ☐E ☒W, 06 PM
County Pueblo County
Subdivision: _____
Lot _____ Block _____ Filing Unit _____
Site/Property Address
2005 Lime Rd, Pueblo, CO 81006

GPS Location in UTM format (optional):
Set GPS unit to true north, datum NAD83, and use meters for the distance units, ☐ Zone 12 or ☐ Zone 13
Easting _____ Northing _____

# of Monitoring Hole(s) to be constructed: 1
Estimated Depth 30 Ft., Aquifer NA
Purpose of Monitoring Hole(s) Groundwater monitoring

Anticipated Date of Construction (mm/dd/yyyy) 08/07/2017

Date Notice Submitted (mm/dd/yyyy): 07/31/2017
(Must be at least 3 days prior to construction)

ACKNOWLEDGEMENT FROM STATE ENGINEER'S OFFICE

FOR OFFICE USE ONLY

56978 - MH PROCESSED BY ad

DIV. 2 WD 15 BAS _____ MD _____ DATE ACKNOWLEDGED 8-1-17

CONDITIONS OF MONITORING HOLE ACKNOWLEDGEMENT

A COPY OF THE WRITTEN NOTICE OR ACKNOWLEDGEMENT SHALL BE AVAILABLE AT THE DRILLING SITE.

1) Notice was provided to the State Engineer at least 3 days prior to construction of monitoring & observation hole(s).
2) **Construction of the hole(s) must be completed within 90 days of the date notice was given to the State Engineer.** Testing and/or pumping shall not exceed a total of 200 hours unless prior written approval is obtained from the State Engineer. Water diverted during testing shall not be used for beneficial purposes. The owner of the hole(s) is responsible for obtaining permit(s) and complying with all rules and regulations pertaining to the discharge of fluids produced during testing.
3) **All work must comply with the Water Well Construction Rules, 2 CCR 402-2.** Minimum construction standards must be met or a variance obtained. Standard permit application and work report forms, including online filing instructions, are found on the DWR website at http://www.water.state.co.us. **Well Construction and Test Reports (GWS-31)** must be completed for each hole drilled. The licensed contractor or authorized individual must submit the completed forms to this office within 60 days of monitoring hole completion.
4) **Unless a well permit is obtained, or variance approved, the hole(s) must be plugged and sealed within one (1) year after construction. An Abandonment Report (form GWS-9) must be submitted within 60 days of plugging & sealing.** The above MH acknowledgement number, owner's structure name, and owner's name and address must be provided on all well permit application(s), well construction and abandonment reports.
5) **The owner of the hole(s) shall maintain records of water quality testing and submit this data to the State Engineer upon request.**
6) **A MONITORING HOLE CANNOT BE CONVERTED TO A PRODUCTION WATER WELL, except for purposes of remediation (recovery) or as a permanent dewatering system, if constructed in accordance with the Water Well Construction Rules and policies of the State Engineer.**
7) **IF HOLES WILL NOT BE CONSTRUCTED UNDER THIS NOTICE WITHIN 90 DAYS, PLEASE WRITE, "NO HOLES CONSTRUCTED" ON A COPY OF THE ACKNOWLEDGED NOTICE WITH THE FILE NUMBER AND FAX THE COPY TO THE DIVISION OF WATER RESOURCES.**

THIS ACKNOWLEDGEMENT OF NOTICE DOES NOT INDICATE THAT WELL PERMIT(S) CAN BE APPROVED.

(Use above space for labels or additional conditions as needed)

RECEIVED
JUL 31 2017
WATER RESOURCES
STATE ENGINEER
COLO

GWS-51
3/2013

NOTICE OF INTENT TO CONSTRUCT MONITORING HOLE(S)

Please type or print legibly in black or blue ink or file online @ dwrpermitsonline@state.co.us
COLORADO DIVISION OF WATER RESOURCES-1313 SHERMAN ST-STE 821-DENVER-CO-80203
PHONE: 303-866-3581—FAX: 303-866-3589 WEB: www.water.state.co.us

Well Owner Name(s): Public Service Company of Colorado
Address : 6198 Franklin St., Denver, CO 80216
Phone (area code & no.): 303-571-7340
Landowner's Name: Xcel Energy - PSCo

Please check one and complete as indicated including contact info:

☐ Water Well Driller Licensed in Colorado – Lic. No. _____

☐ Professional Engineer Registered in Colorado – Reg. No. _____

■ Professional Geologist per CRS 34-1-201(3)

☐ Other -anyone directly employed by or under the supervision of a licensed driller, registered professional engineer or professional geologist

Contact / Company Richard Walther, PG / HDR
Address 1670 Broadway
City, State & Zip Denver, CO 80202
Phone (303)318-6303 Fax _____

Print Name: Richard Walther
Sign or enter full name here: Richard Walther

Location: SW ¼ SW ¼, Section 20
Township 21 ☐N ☒S, Range 64 ☐E ☒W, 06 PM
County Pueblo County
Subdivision: _____
Lot: _____ Block: _____ Filing Unit: _____
Site/Property Address
2005 Lime Rd, Pueblo, CO 81006

GPS Location in UTM format (optional):
Set GPS unit to true north, datum NAD83, and use meters for the distance units, ☐ Zone 12 or ☐ Zone 13.
Easting _____ Northing _____

# of Monitoring Hole(s) to be constructed: 1
Estimated Depth 30 **Ft., Aquifer** NA
Purpose of Monitoring Hole(s)
Groundwater monitoring

Anticipated Date of Construction (mm/dd/yyyy) 08/07/2017

Date Notice Submitted (mm/dd/yyyy): 07/31/2017
(Must be at least 3 days prior to construction)

ACKNOWLEDGEMENT FROM STATE ENGINEER'S OFFICE

FOR OFFICE USE ONLY

56979 - MH PROCESSED BY AW

DIV. 2 WD 15 BAS _____ MD _____ DATE ACKNOWLEDGED 8-1-17

CONDITIONS OF MONITORING HOLE ACKNOWLEDGEMENT

A COPY OF THE WRITTEN NOTICE OR ACKNOWLEDGEMENT SHALL BE AVAILABLE AT THE DRILLING SITE.

1) **Notice was provided to the State Engineer at least 3 days prior to construction of monitoring & observation hole(s).**
2) **Construction of the hole(s) must be completed within 90 days of the date notice was given to the State Engineer.** Testing and/or pumping shall not exceed a total of 200 hours unless prior written approval is obtained from the State Engineer. Water diverted during testing shall not be used for beneficial purposes. The owner of the hole(s) is responsible for obtaining permit(s) and complying with all rules and regulations pertaining to the discharge of fluids produced during testing.
3) **All work must comply with the Water Well Construction Rules, 2 CCR 402-2.** Minimum construction standards must be met or a variance obtained. Standard permit application and work report forms, including **online filing instructions**, are found on the DWR website at **http://www.water.state.co.us. Well Construction and Test Reports (GWS-31)** must be completed for each hole drilled. The licensed contractor or authorized individual must submit the completed forms to this office within 60 days of monitoring hole completion.
4) **Unless a well permit is obtained, or variance approved, the hole(s) must be plugged and sealed within one (1) year after construction. An Abandonment Report (form GWS-9) must be submitted within 60 days of plugging & sealing.** The above MH acknowledgement number, owner's structure name, and owner's name and address must be provided on all well permit application(s), well construction and abandonment reports.
5) **The owner of the hole(s) shall maintain records of water quality testing and submit this data to the State Engineer upon request.**
6) **A MONITORING HOLE CANNOT BE CONVERTED TO A PRODUCTION WATER WELL, except for purposes of remediation (recovery) or as a permanent dewatering system, if constructed in accordance with the Water Well Construction Rules and policies of the State Engineer.**
7) IF HOLES WILL NOT BE CONSTRUCTED UNDER THIS NOTICE WITHIN 90 DAYS, PLEASE WRITE, "NO HOLES CONSTRUCTED" ON A COPY OF THE ACKNOWLEDGED NOTICE WITH THE FILE NUMBER AND FAX THE COPY TO THE DIVISION OF WATER RESOURCES.

THIS ACKNOWLEDGEMENT OF NOTICE DOES NOT INDICATE THAT WELL PERMIT(S) CAN BE APPROVED.

(Use above space for labels or additional conditions as needed)

COLORADO DIVISION OF WATER RESOURCES
DEPARTMENT OF NATURAL RESOURCES
1313 SHERMAN ST., Ste 821, DENVER CO 80203
Phone: (303) 866-3581 dwrpermitsonline@state.co.us

Office Use Only

Form GWS-46 (11/2011)

MONITORING/OBSERVATION Water Well Permit Application

Review instructions on reverse side prior to completing form.
The form must be typed, completed online or in black or blue ink.

1. Well Owner Information

Name of well owner: Public Service Company of Colorado

Mailing address: 6198 Franklin St.

City	State	Zip code
Denver	CO	80216

Telephone #	E-Mail (If filing online it is required)
303-571-7340	marie.vagher@xcelenergy.com

2. Type Of Application (check applicable boxes)

- ☐ Use existing well
- ■ Construct new well
- ☐ Other:
- ■ Replacement for existing monitoring well:
  Permit no.:

3. Refer To (if applicable)

Monitoring hole acknowledgment	Well name or #
MH- 60987	MW-1B

4. Location Of Proposed Well (Important! See Instructions)

County: Pueblo

SE 1/4 of the SE 1/4

Section	Township	N or S	Range	E or W	Principal Meridian
20	21	☐ ☒	64	☐ ☒	6

Distance of well from section lines (section lines are typically not property lines)

467 Ft. from ☐ N ☒ S 2585 Ft. from ☐ E ☒ W

For replacement wells only – distance and direction from old well to new well

10 feet W direction

Well location address (Include City, State, Zip) ☐ Check if well address is same as Item 1.

2005 Lime Rd., Pueblo, CO 81006

Optional: GPS well location information in UTM format
You must check GPS unit for required settings as follows:

Format must be UTM
☐ Zone 12 or ☒ Zone 13
Units must be Meters
Datum must be NAD83
Unit must be set to true north
Was GPS unit checked for above? ■ YES

Easting 226436
Northing 559478
Remember to set Datum to NAD83

5. Property Owner Information

Name of property owner: Xcel Energy - PSCo

Mailing address: 6198 Franklin St.

City	State	Zip Code
Denver	CO	80216

Telephone #: 303-571-7340

6. Use Of Well

Use of this well is limited to monitoring water levels and/or water quality sampling

7. Well Data (proposed)

Total **depth**	Aquifer
40 feet	N/A

8. Consultant Information (if applicable)

Name of contact person: Molly Reeves

Company name: HDR, Inc.

Mailing address: 1670 Broadway

City	State	Zip Code
Denver	CO	80202

Telephone #: 734-263-7138

9. Proposed Well Driller License #(optional):

10. Name of Well Owner or Authorized Agent

The making of false statements herein constitutes perjury in the second degree, which is punishable as a class 1 misdemeanor pursuant to C.R.S. 24-4-104 (13)(a). I have read the statements herein, know the contents thereof and state that they are true to my knowledge.

Sign or enter full name here	Date (mm/dd/yyyy)
Quinn V. Kilty	09/24/2020

If signing print name. Print title if other than land owner.

Quinn V. Kilty, Environmental Services Manager

Office Use Only

USGS map name	DWR map no.	Surface elev.

Receipt area only

DIV _____ WD _____ BA _____ MD _____

COLORADO DIVISION OF WATER RESOURCES
DEPARTMENT OF NATURAL RESOURCES
1313 SHERMAN ST., Ste 821, DENVER CO 80203
Phone: (303) 866-3581 dwrpermitsonline@state.co.us

Office Use Only

Form GWS-46 (11/2011)

MONITORING/OBSERVATION Water Well Permit Application

Review instructions on reverse side prior to completing form.
The form must be typed, completed online or in black or blue ink.

1. Well Owner Information

Name of well owner: Public Service Company of Colorado

Mailing address: 6198 Franklin St.

City	State	Zip code
Denver	CO	80216

Telephone #	E-Mail (If filing online it is required)
303-571-7340	marie.vagher@xcelenergy.com

2. Type Of Application (check applicable boxes)

- ☐ Use existing well
- ■ Construct new well
- ☐ Other:
- ■ Replacement for existing monitoring well:
  Permit no.:

3. Refer To (if applicable)

Monitoring hole acknowledgment	Well name or #
MH- 60986	MW-2B

4. Location Of Proposed Well (Important! See Instructions)

County: Pueblo

NE 1/4 of the SW 1/4

Section	Township	N or S	Range	E or W	Principal Meridian
20	21	☐ ☒	64	☐ ☒	6

Distance of well from section lines (section lines are typically not property lines)

1450 Ft. from ☐ N ☒ S 2500 Ft. from ☒ E ☐ W

For replacement wells only – distance and direction from old well to new well

10 feet E direction

Well location address (Include City, State, Zip) ☐ Check if well address is same as Item 1.

2005 Lime Rd., Pueblo, CO 81006

Optional: GPS well location information in UTM format
You must check GPS unit for required settings as follows:

Format must be UTM
☐ Zone 12 or ☒ Zone 13
Units must be Meters
Datum must be NAD83
Unit must be set to true north
Was GPS unit checked for above? ■ YES

Easting 226451
Northing 560463
Remember to set Datum to NAD83

5. Property Owner Information

Name of property owner: Xcel Energy - PSCo

Mailing address: 6198 Franklin St.

City	State	Zip Code
Denver	CO	80216

Telephone #: 303-571-7340

6. Use Of Well

Use of this well is limited to monitoring water levels and/or water quality sampling

7. Well Data (proposed)

Total **depth**	Aquifer
30 feet	N/A

8. Consultant Information (if applicable)

Name of contact person: Molly Reeves

Company name: HDR, Inc.

Mailing address: 1670 Broadway

City	State	Zip Code
Denver	CO	80202

Telephone #: 734-263-7138

9. Proposed Well Driller License #(optional):

10. Name of Well Owner or Authorized Agent

The making of false statements herein constitutes perjury in the second degree, which is punishable as a class 1 misdemeanor pursuant to C.R.S. 24-4-104 (13)(a). I have read the statements herein, know the contents thereof and state that they are true to my knowledge.

Sign or enter full name here	Date (mm/dd/yyyy)
Quinn V. Kilty	09/24/2020

If signing print name. Print title if other than land owner.

Quinn V. Kilty, Environmental Services Manager

Office Use Only

USGS map name	DWR map no.	Surface elev.

Receipt area only

DIV _____ WD _____ BA _____ MD _____

COLORADO DIVISION OF WATER RESOURCES
DEPARTMENT OF NATURAL RESOURCES
1313 SHERMAN ST., Ste 821, DENVER CO 80203
Phone: (303) 866-3581 dwrpermitsonline@state.co.us

Office Use Only

Form GWS-46 (11/2011)

MONITORING/OBSERVATION Water Well Permit Application

Review instructions on reverse side prior to completing form.
The form must be typed, completed online or in black or blue ink.

1. Well Owner Information

Name of well owner: Public Service Company of Colorado

Mailing address: 6198 Franklin St.

City	State	Zip code
Denver	CO	80216

Telephone #	E-Mail (If filing online it is required)
303-571-7340	marie.vagher@xcelenergy.com

2. Type Of Application (check applicable boxes)

- ☐ Use existing well
- ■ Construct new well
- ☐ Other:
- ■ Replacement for existing monitoring well:
  Permit no.:

3. Refer To (if applicable)

Monitoring hole acknowledgment	Well name or #
MH- 60985	MW-4B

4. Location Of Proposed Well (Important! See Instructions)

County: Pueblo

SW 1/4 of the SW 1/4

Section	Township	N or S	Range	E or W	Principal Meridian
20	21	☐ ☒	64	☐ ☒	06

Distance of well from section lines (section lines are typically not property lines)

1224 Ft. from ☐ N ☒ S 110 Ft. from ☒ E ☐ W

For replacement wells only – distance and direction from old well to new well

5 feet E direction

Well location address (Include City, State, Zip) ☐ Check if well address is same as Item 1.

2005 Lime Rd., Pueblo, CO 81006

Optional: GPS well location information in UTM format
You must check GPS unit for required settings as follows:

Format must be UTM
☐ Zone 12 or ☒ Zone 13
Units must be Meters
Datum must be NAD83
Unit must be set to true north
Was GPS unit checked for above? ■ YES

Easting 223188
Northing 560239
Remember to set Datum to NAD83

5. Property Owner Information

Name of property owner: Xcel Energy - PSCo

Mailing address: 6198 Franklin St.

City	State	Zip Code
Denver	CO	80216

Telephone #: 303-571-7340

6. Use Of Well

Use of this well is limited to monitoring water levels and/or water quality sampling

7. Well Data (proposed)

Total **depth**	Aquifer
58 feet	N/A

8. Consultant Information (if applicable)

Name of contact person: Molly Reeves

Company name: HDR, Inc.

Mailing address: 1670 Broadway

City	State	Zip Code
Denver	CO	80202

Telephone #: 734-263-7138

9. Proposed Well Driller License #(optional):

10. Name of Well Owner or Authorized Agent

The making of false statements herein constitutes perjury in the second degree, which is punishable as a class 1 misdemeanor pursuant to C.R.S. 24-4-104 (13)(a). I have read the statements herein, know the contents thereof and state that they are true to my knowledge.

Sign or enter full name here	Date (mm/dd/yyyy)
Quinn V. Kilty	09/24/2020

If signing print name. Print title if other than land owner.

Quinn V. Kilty, Environmental Services Manager

Office Use Only

USGS map name	DWR map no.	Surface elev.

Receipt area only

DIV _____ WD _____ BA _____ MD _____

COLORADO DIVISION OF WATER RESOURCES
DEPARTMENT OF NATURAL RESOURCES
1313 SHERMAN ST., Ste 821, DENVER CO 80203
Phone: (303) 866-3581 dwrpermitsonline@state.co.us

Office Use Only

Form GWS-46 (11/2011)

MONITORING/OBSERVATION Water Well Permit Application

Review instructions on reverse side prior to completing form.
The form must be typed, completed online or in black or blue ink.

1. Well Owner Information

Name of well owner: Public Service Company of Colorado

Mailing address: 6198 Franklin St.

City	State	Zip code
Denver	CO	80216

Telephone #	E-Mail (If filing online it is required)
303-571-7340	marie.vagher@xcelenergy.com

2. Type Of Application (check applicable boxes)

- ☐ Use existing well
- ☐ Replacement for existing monitoring well: Permit no.:
- ■ Construct new well
- ☐ Other:

3. Refer To (if applicable)

Monitoring hole acknowledgment	Well name or #
MH- 60989	W-2A

4. Location Of Proposed Well (Important! See Instructions)

County: Pueblo

SE 1/4 of the NE 1/4

Section	Township	N or S	Range	E or W	Principal Meridian
20	21	☐ ☒	64	☐ ☒	6

Distance of well from section lines (section lines are typically not property lines)

2366 Ft. from ☒ N ☐ S 52 Ft. from ☐ E ☒ W

For replacement wells only – distance and direction from old well to new well

feet direction

Well location address (Include City, State, Zip) ☐ Check if well address is same as Item 1.

2005 Lime Rd., Pueblo, CO 81006

Optional: GPS well location information in UTM format
You must check GPS unit for required settings as follows:

Format must be UTM
☐ Zone 12 or ☒ Zone 13
Units must be Meters
Datum must be NAD83
Unit must be set to true north
Was GPS unit checked for above? ■ YES

Easting 226706
Northing 561935
Remember to set Datum to NAD83

5. Property Owner Information

Name of property owner: Xcel Energy - PSCo

Mailing address: 6198 Franklin St.

City	State	Zip Code
Denver	CO	80216

Telephone #: 303-571-7340

6. Use Of Well

Use of this well is limited to monitoring water levels and/or water quality sampling

7. Well Data (proposed)

Total **depth**	Aquifer
33 feet	N/A

8. Consultant Information (if applicable)

Name of contact person: Molly Reeves

Company name: HDR, Inc.

Mailing address: 1670 Broadway

City	State	Zip Code
Denver	CO	80202

Telephone #: 734-263-7138

9. Proposed Well Driller License #(optional):

10. Name of Well Owner or Authorized Agent

The making of false statements herein constitutes perjury in the second degree, which is punishable as a class 1 misdemeanor pursuant to C.R.S. 24-4-104 (13)(a). I have read the statements herein, know the contents thereof and state that they are true to my knowledge.

Sign or enter full name here	Date (mm/dd/yyyy)
Quinn V. Kilty	09/24/2020

If signing print name. Print title if other than land owner.

Quinn V. Kilty, Environmental Services Manager

Office Use Only

USGS map name	DWR map no.	Surface elev.

Receipt area only

DIV _____ WD _____ BA _____ MD _____

COLORADO DIVISION OF WATER RESOURCES
DEPARTMENT OF NATURAL RESOURCES
1313 SHERMAN ST., Ste 821, DENVER CO 80203
Phone: (303) 866-3581 dwrpermitsonline@state.co.us

Office Use Only

Form GWS-46 (11/2011)

MONITORING/OBSERVATION Water Well Permit Application

Review instructions on reverse side prior to completing form.
The form must be typed, completed online or in black or blue ink.

1. Well Owner Information

Name of well owner: Public Service Company of Colorado

Mailing address: 6198 Franklin St.

City	State	Zip code
Denver	CO	80216

Telephone #	E-Mail (If filing online it is required)
303-571-7340	marie.vagher@xcelenergy.com

2. Type Of Application (check applicable boxes)

- ☐ Use existing well
- ☐ Replacement for existing monitoring well: Permit no.:
- ■ Construct new well
- ☐ Other:

3. Refer To (if applicable)

Monitoring hole acknowledgment	Well name or #
MH- 60989	W-2B

4. Location Of Proposed Well (Important! See Instructions)

County: Pueblo

SE 1/4 of the NE 1/4

Section	Township	N or S	Range	E or W	Principal Meridian
20	21	☐ ☒	64	☐ ☒	06

Distance of well from section lines (section lines are typically not property lines)

2370 Ft. from ☒ N ☐ S 52 Ft. from ☐ E ☒ W

For replacement wells only – distance and direction from old well to new well

feet direction

Well location address (Include City, State, Zip) ☐ Check if well address is same as Item 1.

2005 Lime Rd., Pueblo, CO 81006

Optional: GPS well location information in UTM format
You must check GPS unit for required settings as follows:

Format must be UTM
☐ Zone 12 or ☒ Zone 13
Units must be Meters
Datum must be NAD83
Unit must be set to true north
Was GPS unit checked for above? ■ YES

Easting 226706
Northing 561931
Remember to set Datum to NAD83

5. Property Owner Information

Name of property owner: Xcel Energy - PSCo

Mailing address: 6198 Franklin St.

City	State	Zip Code
Denver	CO	80216

Telephone #: 303-571-7340

6. Use Of Well

Use of this well is limited to monitoring water levels and/or water quality sampling

7. Well Data (proposed)

Total **depth**	Aquifer
73 feet	N/A

8. Consultant Information (if applicable)

Name of contact person: Molly Reeves

Company name: HDR, Inc.

Mailing address: 1670 Broadway

City	State	Zip Code
Denver	CO	80202

Telephone #: 734-263-7138

9. Proposed Well Driller License # (optional):

10. Name of Well Owner or Authorized Agent

The making of false statements herein constitutes perjury in the second degree, which is punishable as a class 1 misdemeanor pursuant to C.R.S. 24-4-104 (13)(a). I have read the statements herein, know the contents thereof and state that they are true to my knowledge.

Sign or enter full name here	Date (mm/dd/yyyy)
Quinn V. Kilty	09/24/2020

If signing print name. Print title if other than land owner.

Quinn V. Kilty, Environmental Services Manager

Office Use Only

USGS map name	DWR map no.	Surface elev.

Receipt area only

DIV _____ WD _____ BA _____ MD _____

COLORADO DIVISION OF WATER RESOURCES
DEPARTMENT OF NATURAL RESOURCES
1313 SHERMAN ST., Ste 821, DENVER CO 80203
Phone: (303) 866-3581 dwrpermitsonline@state.co.us

Office Use Only

Form GWS-46 (11/2011)

MONITORING/OBSERVATION Water Well Permit Application

Review instructions on reverse side prior to completing form.
The form must be typed, completed online or in black or blue ink.

1. Well Owner Information

Name of well owner: Public Service Company of Colorado

Mailing address: 6198 Franklin St.

City	State	Zip code
Denver	CO	80216

Telephone #	E-Mail (If filing online it is required)
303-571-7340	marie.vagher@xcelenergy.com

2. Type Of Application (check applicable boxes)

- ☐ Use existing well
- ☐ Replacement for existing monitoring well: Permit no.:
- ■ Construct new well
- ☐ Other:

3. Refer To (if applicable)

Monitoring hole acknowledgment	Well name or #
MH- 60988	W-7

4. Location Of Proposed Well (Important! See Instructions)

County: Pueblo

SE 1/4 of the SE 1/4

Section	Township	N or S	Range	E or W	Principal Meridian
20	21	☐ ☒	64	☐ ☒	06

Distance of well from section lines (section lines are typically not property lines)

1177 Ft. from ☐ N ☒ S 73 Ft. from ☐ E ☒ W

For replacement wells only – distance and direction from old well to new well

feet direction

Well location address (Include City, State, Zip) ☐ Check if well address is same as Item 1.

2005 Lime Rd., Pueblo, CO 81006

Optional: GPS well location information in UTM format
You must check GPS unit for required settings as follows:

Format must be UTM
☐ Zone 12 or ☒ Zone 13
Units must be Meters
Datum must be NAD83
Unit must be set to true north
Was GPS unit checked for above? ■ YES

Easting 226709
Northing 560215
Remember to set Datum to NAD83

5. Property Owner Information

Name of property owner: Xcel Energy - PSCo

Mailing address: 6198 Franklin St.

City	State	Zip Code
Denver	CO	80216

Telephone #: 303-571-7340

6. Use Of Well

Use of this well is limited to monitoring water levels and/or water quality sampling

7. Well Data (proposed)

Total **depth**	Aquifer
21 feet	N/A

8. Consultant Information (if applicable)

Name of contact person: Molly Reeves

Company name: HDR, Inc.

Mailing address: 1670 Broadway

City	State	Zip Code
Denver	CO	80202

Telephone #: 734-263-7138

9. Proposed Well Driller License #(optional):

10. Name of Well Owner or Authorized Agent

The making of false statements herein constitutes perjury in the second degree, which is punishable as a class 1 misdemeanor pursuant to C.R.S. 24-4-104 (13)(a). I have read the statements herein, know the contents thereof and state that they are true to my knowledge.

Sign or enter full name here	Date (mm/dd/yyyy)
Quinn V. Kilty	09/24/2020

If signing print name. Print title if other than land owner.

Quinn V. Kilty, Environmental Services Manager

Office Use Only

USGS map name	DWR map no.	Surface elev.

Receipt area only

DIV _____ WD _____ BA _____ MD _____

COLORADO DIVISION OF WATER RESOURCES
DEPARTMENT OF NATURAL RESOURCES
1313 SHERMAN ST., Ste 821, DENVER CO 80203
Phone: (303) 866-3581 dwrpermitsonline@state.co.us

Office Use Only

Form GWS-46 (11/2011)

MONITORING/OBSERVATION Water Well Permit Application

Review instructions on reverse side prior to completing form.
The form must be typed, completed online or in black or blue ink.

1. Well Owner Information

Name of well owner: Public Service Company of Colorado

Mailing address: 6198 Franklin St.

City	State	Zip code
Denver	CO	80216

Telephone #	E-Mail (If filing online it is required)
303-571-7340	marie.vagher@xcelenergy.com

2. Type Of Application (check applicable boxes)

- ☐ Use existing well
- ☐ Replacement for existing monitoring well: Permit no.:
- ■ Construct new well
- ☐ Other:

3. Refer To (if applicable)

Monitoring hole acknowledgment	Well name or #
MH- 60988	W-8A

4. Location Of Proposed Well (Important! See Instructions)

County: Pueblo

SE 1/4 of the SE 1/4

Section	Township	N or S	Range	E or W	Principal Meridian
20	21	☐ ☒	64	☐ ☒	06

Distance of well from section lines (section lines are typically not property lines)

34 Ft. from ☐ N ☒ S 162 Ft. from ☒ E ☐ W

For replacement wells only – distance and direction from old well to new well

feet direction

Well location address (Include City, State, Zip) ☐ Check if well address is same as Item 1.

2005 Lime Rd., Pueblo, CO 81006

Optional: GPS well location information in UTM format
You must check GPS unit for required settings as follows:

Format must be UTM
☐ Zone 12 or ☒ Zone 13
Units must be Meters
Datum must be NAD83
Unit must be set to true north
Was GPS unit checked for above? ■ YES

Easting 226685
Northing 559069
Remember to set Datum to NAD83

5. Property Owner Information

Name of property owner: Xcel Energy - PSCo

Mailing address: 6198 Franklin St.

City	State	Zip Code
Denver	CO	80216

Telephone #: 303-571-7340

6. Use Of Well

Use of this well is limited to monitoring water levels and/or water quality sampling

7. Well Data (proposed)

Total **depth**	Aquifer
30 feet	N/A

8. Consultant Information (if applicable)

Name of contact person: Molly Reeves

Company name: HDR, Inc.

Mailing address: 1670 Broadway

City	State	Zip Code
Denver	CO	80202

Telephone #: 734-263-7138

9. Proposed Well Driller License # (optional):

10. Name of Well Owner or Authorized Agent

The making of false statements herein constitutes perjury in the second degree, which is punishable as a class 1 misdemeanor pursuant to C.R.S. 24-4-104 (13)(a). I have read the statements herein, know the contents thereof and state that they are true to my knowledge.

Sign or enter full name here	Date (mm/dd/yyyy)
Quinn V. Kilty	09/24/2020

If signing print name. Print title if other than land owner.

Quinn V. Kilty, Environmental Services Manager

Office Use Only

USGS map name	DWR map no.	Surface elev.

Receipt area only

DIV _____ WD _____ BA _____ MD _____

COLORADO DIVISION OF WATER RESOURCES
DEPARTMENT OF NATURAL RESOURCES
1313 SHERMAN ST., Ste 821, DENVER CO 80203
Phone: (303) 866-3581 dwrpermitsonline@state.co.us

Office Use Only

Form GWS-46 (11/2011)

MONITORING/OBSERVATION Water Well Permit Application

Review instructions on reverse side prior to completing form.
The form must be typed, completed online or in black or blue ink.

1. Well Owner Information

Name of well owner: Public Service Company of Colorado

Mailing address: 6198 Franklin St.

City	State	Zip code
Denver	CO	80216

Telephone #	E-Mail (If filing online it is required)
303-571-7340	marie.vagher@xcelenergy.com

2. Type Of Application (check applicable boxes)

- ☐ Use existing well
- ☐ Replacement for existing monitoring well: Permit no.:
- ■ Construct new well
- ☐ Other:

3. Refer To (if applicable)

Monitoring hole acknowledgment	Well name or #
MH- 60988	W-8B

4. Location Of Proposed Well (Important! See Instructions)

County: Pueblo

SE 1/4 of the SE 1/4

Section	Township	N or S	Range	E or W	Principal Meridian
20	21	☐ ☒	64	☐ ☒	06

Distance of well from section lines (section lines are typically not property lines)

34 Ft. from ☐ N ☒ S 159 Ft. from ☒ E ☐ W

For replacement wells only – distance and direction from old well to new well

feet direction

Well location address (Include City, State, Zip) ☐ Check if well address is same as Item 1.

2005 Lime Rd., Pueblo, CO 81006

Optional: GPS well location information in UTM format
You must check GPS unit for required settings as follows:

Format must be UTM
☐ Zone 12 or ☒ Zone 13
Units must be Meters
Datum must be NAD83
Unit must be set to true north
Was GPS unit checked for above? ■ YES

Easting 226685
Northing 559069
Remember to set Datum to NAD83

5. Property Owner Information

Name of property owner: Xcel Energy - PSCo

Mailing address: 6198 Franklin St.

City	State	Zip Code
Denver	CO	80216

Telephone #: 303-571-7340

6. Use Of Well

Use of this well is limited to monitoring water levels and/or water quality sampling

7. Well Data (proposed)

Total **depth**	Aquifer
55 feet	N/A

8. Consultant Information (if applicable)

Name of contact person: Molly Reeves

Company name: HDR, Inc.

Mailing address: 1670 Broadway

City	State	Zip Code
Denver	CO	80202

Telephone #: 734-263-7138

9. Proposed Well Driller License # (optional):

10. Name of Well Owner or Authorized Agent

The making of false statements herein constitutes perjury in the second degree, which is punishable as a class 1 misdemeanor pursuant to C.R.S. 24-4-104 (13)(a). I have read the statements herein, know the contents thereof and state that they are true to my knowledge.

Sign or enter full name here	Date (mm/dd/yyyy)
Quinn V. Kilty	09/24/2020

If signing print name. Print title if other than land owner.

Quinn V. Kilty, Environmental Services Manager

Office Use Only

USGS map name	DWR map no.	Surface elev.

Receipt area only

DIV _____ WD _____ BA _____ MD _____

COLORADO DIVISION OF WATER RESOURCES
DEPARTMENT OF NATURAL RESOURCES
1313 SHERMAN ST., Ste 821, DENVER CO 80203
Phone: (303) 866-3581 dwrpermitsonline@state.co.us

Office Use Only

Form GWS-46 (11/2011)

MONITORING/OBSERVATION Water Well Permit Application

Review instructions on reverse side prior to completing form.
The form must be typed, completed online or in black or blue ink.

1. Well Owner Information

Name of well owner: Public Service Company of Colorado

Mailing address: 6198 Franklin St.

City	State	Zip code
Denver	CO	80216

Telephone #	E-Mail (If filing online it is required)
303-571-7340	marie.vagher@xcelenergy.com

2. Type Of Application (check applicable boxes)

- ☐ Use existing well
- ☐ Replacement for existing monitoring well: Permit no.:
- ■ Construct new well
- ☐ Other:

3. Refer To (if applicable)

Monitoring hole acknowledgment	Well name or #
MH-	W-5B

4. Location Of Proposed Well (Important! See Instructions)

County: Pueblo

NE 1/4 of the SE 1/4

Section	Township	N or S	Range	E or W	Principal Meridian
20	21	☐ ☒	64	☐ ☒	06

Distance of well from section lines (section lines are typically not property lines)

1855 Ft. from ☐ N ☒ S 570 Ft. from ☒ E ☐ W

For replacement wells only – distance and direction from old well to new well

feet direction

Well location address (Include City, State, Zip) ☐ Check if well address is same as Item 1.

2005 Lime Rd., Pueblo, CO 81006

Optional: GPS well location information in UTM format
You must check GPS unit for required settings as follows:

Format must be UTM
☐ Zone 12 or ☒ Zone 13
Units must be Meters
Datum must be NAD83
Unit must be set to true north
Was GPS unit checked for above? ■ YES

Easting 537562
Northing 4228088
Remember to set Datum to NAD83

5. Property Owner Information

Name of property owner: Xcel Energy - PSCo

Mailing address: 6198 Franklin St.

City	State	Zip Code
Denver	CO	80216

Telephone #: 303-571-7340

6. Use Of Well

Use of this well is limited to monitoring water levels and/or water quality sampling

7. Well Data (proposed)

Total **depth**	Aquifer
35.5 feet	N/A

8. Consultant Information (if applicable)

Name of contact person: Molly Reeves

Company name: HDR, Inc.

Mailing address: 1670 Broadway

City	State	Zip Code
Denver	CO	80202

Telephone #: 734-263-7138

9. Proposed Well Driller License #(optional):

10. Name of Well Owner or Authorized Agent

The making of false statements herein constitutes perjury in the second degree, which is punishable as a class 1 misdemeanor pursuant to C.R.S. 24-4-104 (13)(a). I have read the statements herein, know the contents thereof and state that they are true to my knowledge.

Sign or enter full name here	Date (mm/dd/yyyy)

If signing print name. Print title if other than land owner.

Office Use Only

USGS map name	DWR map no.	Surface elev.

Receipt area only

DIV _____ WD _____ BA _____ MD _____

MONITORING/OBSERVATION WELL PERMIT APPLICATION INSTRUCTIONS

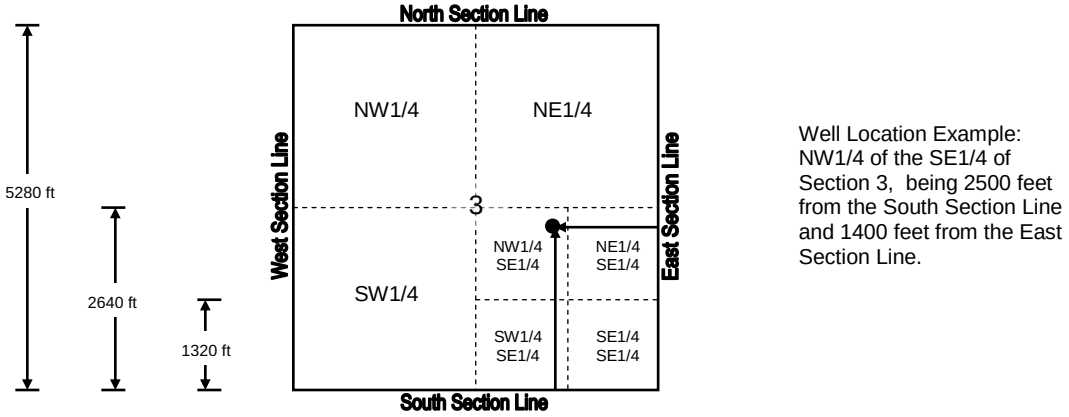
Applications must be computer generated on-line, typewritten or printed in BLACK or BLUE INK. ALL ITEMS in the application must be completed. Incomplete applications may be returned for more information. Applications are evaluated in chronological order. Please allow approximately six weeks for processing. This form may be reproduced by photocopying or computer generation. Reproductions must retain margins and print quality of the original form. If filing online, see online filing instructions for further information. You may also save, print, scan and email the completed form to: dwrpermitsonline@state.co.us

FEES: This application must be submitted with a $100 filing fee. (The fee for an application to replace or deepen an existing permitted monitoring/observation well is $100 for locations outside Designated Ground Water Basins, and $60 inside Designated Ground Water Basins.) Acceptable forms of payment are check or money order, payable to the "Colorado Division of Water Resources." Payments made by Visa, MasterCard or Discover card can be accepted by phone through the Records Section at 303.866.3581. **Fees are nonrefundable**.

USES: This form (GWS-46) is to be used when applying for a permit where the only uses are monitoring of water levels and/or water quality sampling. For well construction criteria refer to the Colorado Water Well Construction Rules, 2CCR 402-2. A copy of the Rules may be obtained from any Division of Water Resources Office for a fee of $5, or you may access them online from the State Board of Examiners' (BOE) website at http://water.state.co.us/dwripub/documents/constructionrules05.pdf

ITEM INSTRUCTIONS: (numbers correspond with those on the front of this form)

1. Provide the name of the well owner and the mailing address where all correspondence will be sent.
2. Check and complete all boxes that apply.
3. Provide the MH number assigned by the Division of Water Resources in response to the notice of intent to construct a monitoring/observation well. Complete the well name if the structure has a name or identifying number.
4. If applying for a permit to **construct a new well**, you **must** provide the county, section #, township, range and principal meridian. You **do not** need to provide the ¼ of the ¼ section designation, distances from section lines or an optional GPS location (UTM coordinates). If a permit is issued and a well constructed, the authorized individual will be required to provide an accurate GPS location (UTM coordinates) of the "as-built" well location. If applying for a permit to **use an existing well** you **must** provide the well location information stated above, as well as either a GPS location (UTM coordinates) of the existing well site, or distances from section lines **(including the ¼ of the ¼ section designation)** as follows: In a typical case, a township is comprised of 36 sections, with each section ideally one mile square, or 5,280 feet on each side. Sections are further divided into quarter sections. Each ¼ Section is 2,640 feet by 2,640 feet and comprises 160 acres. Each ¼ section can be further divided into additional quarters. Each ¼ of the ¼ Section is 1,320 feet by 1,320 feet and comprises 40 acres. The distances are measured from the section lines. In the following example, the well is located 2,500 feet from the South Section line and 1,400 feet from the East Section line:



Well Location Example: NW1/4 of the SE1/4 of Section 3, being 2500 feet from the South Section Line and 1400 feet from the East Section Line.

If providing a GPS location (UTM coordinates), the required GPS unit settings must be as indicated on this form. Colorado contains two UTM zones (12 & 13). Zone 13 covers most of Colorado. The boundary between Zone 12 and Zone 13 is the 108th Meridian (longitude). West of the 108th Meridian is UTM Zone 12 and east of the 108th Meridian is UTM Zone 13. The 108th Meridian is approximately 57 miles east of the Colorado-Utah state line. On most GPS units, the UTM zone is given as part of the Easting measurement, e.g. 12T0123456. Check the appropriate box for the zone. Provide the property address of the well location if one exists. If it is the same as the mailing address, check the box next to the well location address.

5. Provide property owner information.
6. Use of this well is limited to monitoring water levels and/or water quality sampling only.
7. The actual or anticipated total depth must be provided. Provide the name of the aquifer in which the well will be completed.
8. Provide consultant information (if applicable). Note: A consultant may sign this application on behalf of their client.
9. Monitoring/observation wells must be constructed by a Colorado licensed well construction contractor or authorized individual, as defined in the Well Construction Rules, 2CCR 402-2. Only a licensed contractor may construct any monitoring/observation well that penetrates a confining layer, or, is to be converted into a future production well. The well must be constructed in compliance with the Well Construction Rules, unless a variance has been approved allowing an alternative construction design.
10. The individual signing the application or entering their name (and title if applicable) must be the applicant or an officer of the corporation/company/agency identified as the applicant, their attorney or consultant. An authorized agent may also sign the application, if a letter signed by the applicant or their attorney is submitted with the application authorizing that agent to sign or enter their name on the applicant's behalf. Payment must be received via phone, fax or mail prior to processing the application. If filing online please call the Records Section at 303.866.3581 to pay via credit card.

IF YOU HAVE ANY QUESTIONS regarding any item on the application form, please call the Division of Water Resources Ground Water Information Desk (303-866-3587), or the nearest Division of Water Resources Field Office located in Greeley (970-352-8712), Pueblo (719-542-3368), Alamosa (719-589-6683), Montrose (970-249-6622), Glenwood Springs (970-945-5665), Steamboat Springs (970-879-0272), or Durango (970-247-1845), or refer to CDWR web site at http://www.water.state.co.us for general information.

COLORADO DIVISION OF WATER RESOURCES
DEPARTMENT OF NATURAL RESOURCES
1313 SHERMAN ST., Ste 821, DENVER CO 80203
Phone: (303) 866-3581 dwrpermitsonline@state.co.us

Office Use Only

Form GWS-46 (11/2011)

MONITORING/OBSERVATION Water Well Permit Application

Review instructions on reverse side prior to completing form.
The form must be typed, completed online or in black or blue ink.

1. Well Owner Information

Name of well owner: Public Service Company of Colorado

Mailing address: 6198 Franklin St.

City	State	Zip code
Denver	CO	80216

Telephone #	E-Mail (If filing online it is required)
303-571-7340	marie.vagher@xcelenergy.com

2. Type Of Application (check applicable boxes)

- ☐ Use existing well
- ☐ Replacement for existing monitoring well: Permit no.:
- ■ Construct new well
- ☐ Other:

3. Refer To (if applicable)

Monitoring hole acknowledgment	Well name or #
MH-	W-9

4. Location Of Proposed Well (Important! See Instructions)

County: Pueblo

SW 1/4 of the SW 1/4

Section	Township	N or S	Range	E or W	Principal Meridian
21	21	☐ ☒	64	☐ ☒	06

Distance of well from section lines (section lines are typically not property lines)

630 Ft. from ☐ N ☒ S 30 Ft. from ☐ E ☒ W

For replacement wells only – distance and direction from old well to new well

feet direction

Well location address (Include City, State, Zip) ☐ Check if well address is same as Item 1.

2005 Lime Rd., Pueblo, CO 81006

Optional: GPS well location information in UTM format
You must check GPS unit for required settings as follows:

Format must be UTM
☐ Zone 12 or ☒ Zone 13
Units must be Meters
Datum must be NAD83
Unit must be set to true north
Was GPS unit checked for above? ■ YES

Easting 537562
Northing 4228088
Remember to set Datum to NAD83

5. Property Owner Information

Name of property owner: Xcel Energy - PSCo

Mailing address: 6198 Franklin St.

City	State	Zip Code
Denver	CO	80216

Telephone #: 303-571-7340

6. Use Of Well

Use of this well is limited to monitoring water levels and/or water quality sampling

7. Well Data (proposed)

Total **depth**	Aquifer
37.35 feet	N/A

8. Consultant Information (if applicable)

Name of contact person: Molly Reeves

Company name: HDR, Inc.

Mailing address: 1670 Broadway

City	State	Zip Code
Denver	CO	80202

Telephone #: 734-263-7138

9. Proposed Well Driller License #(optional):

10. Name of Well Owner or Authorized Agent

The making of false statements herein constitutes perjury in the second degree, which is punishable as a class 1 misdemeanor pursuant to C.R.S. 24-4-104 (13)(a). I have read the statements herein, know the contents thereof and state that they are true to my knowledge.

Sign or enter full name here	Date (mm/dd/yyyy)

If signing print name. Print title if other than land owner.

Office Use Only

USGS map name	DWR map no.	Surface elev.

Receipt area only

DIV _____ WD _____ BA _____ MD _____

MONITORING/OBSERVATION WELL PERMIT APPLICATION INSTRUCTIONS

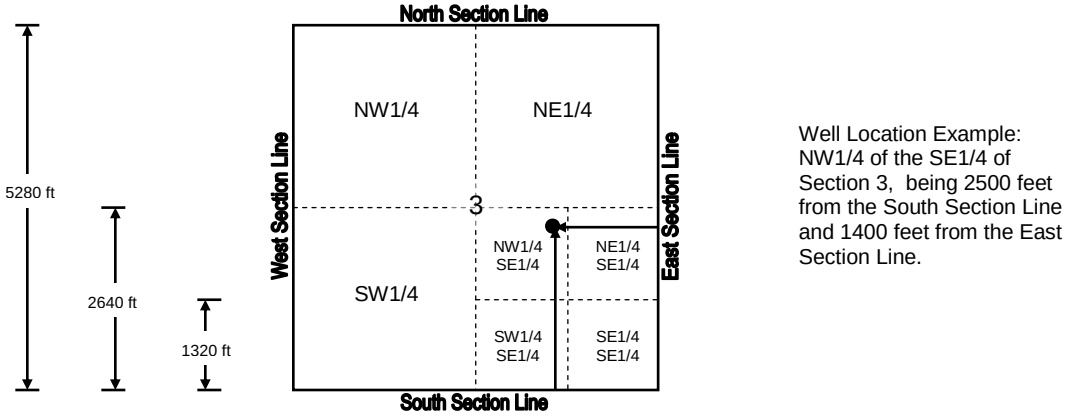
Applications must be computer generated on-line, typewritten or printed in BLACK or BLUE INK. ALL ITEMS in the application must be completed. Incomplete applications may be returned for more information. Applications are evaluated in chronological order. Please allow approximately six weeks for processing. This form may be reproduced by photocopying or computer generation. Reproductions must retain margins and print quality of the original form. If filing online, see online filing instructions for further information. You may also save, print, scan and email the completed form to: dwrpermitsonline@state.co.us

FEES: This application must be submitted with a $100 filing fee. (The fee for an application to replace or deepen an existing permitted monitoring/observation well is $100 for locations outside Designated Ground Water Basins, and $60 inside Designated Ground Water Basins.) Acceptable forms of payment are check or money order, payable to the "Colorado Division of Water Resources." Payments made by Visa, MasterCard or Discover card can be accepted by phone through the Records Section at 303.866.3581. **Fees are nonrefundable**.

USES: This form (GWS-46) is to be used when applying for a permit where the only uses are monitoring of water levels and/or water quality sampling. For well construction criteria refer to the Colorado Water Well Construction Rules, 2CCR 402-2. A copy of the Rules may be obtained from any Division of Water Resources Office for a fee of $5, or you may access them online from the State Board of Examiners' (BOE) website at http://water.state.co.us/dwripub/documents/constructionrules05.pdf

ITEM INSTRUCTIONS: (numbers correspond with those on the front of this form)

1. Provide the name of the well owner and the mailing address where all correspondence will be sent.
2. Check and complete all boxes that apply.
3. Provide the MH number assigned by the Division of Water Resources in response to the notice of intent to construct a monitoring/observation well. Complete the well name if the structure has a name or identifying number.
4. If applying for a permit to **construct a new well**, you **must** provide the county, section #, township, range and principal meridian. You **do not** need to provide the ¼ of the ¼ section designation, distances from section lines or an optional GPS location (UTM coordinates). If a permit is issued and a well constructed, the authorized individual will be required to provide an accurate GPS location (UTM coordinates) of the "as-built" well location. If applying for a permit to **use an existing well** you **must** provide the well location information stated above, as well as either a GPS location (UTM coordinates) of the existing well site, or distances from section lines **(including the ¼ of the ¼ section designation)** as follows: In a typical case, a township is comprised of 36 sections, with each section ideally one mile square, or 5,280 feet on each side. Sections are further divided into quarter sections. Each ¼ Section is 2,640 feet by 2,640 feet and comprises 160 acres. Each ¼ section can be further divided into additional quarters. Each ¼ of the ¼ Section is 1,320 feet by 1,320 feet and comprises 40 acres. The distances are measured from the section lines. In the following example, the well is located 2,500 feet from the South Section line and 1,400 feet from the East Section line:



Well Location Example: NW1/4 of the SE1/4 of Section 3, being 2500 feet from the South Section Line and 1400 feet from the East Section Line.

If providing a GPS location (UTM coordinates), the required GPS unit settings must be as indicated on this form. Colorado contains two UTM zones (12 & 13). Zone 13 covers most of Colorado. The boundary between Zone 12 and Zone 13 is the 108th Meridian (longitude). West of the 108th Meridian is UTM Zone 12 and east of the 108th Meridian is UTM Zone 13. The 108th Meridian is approximately 57 miles east of the Colorado-Utah state line. On most GPS units, the UTM zone is given as part of the Easting measurement, e.g. 12T0123456. Check the appropriate box for the zone. Provide the property address of the well location if one exists. If it is the same as the mailing address, check the box next to the well location address.

5. Provide property owner information.
6. Use of this well is limited to monitoring water levels and/or water quality sampling only.
7. The actual or anticipated total depth must be provided. Provide the name of the aquifer in which the well will be completed.
8. Provide consultant information (if applicable). Note: A consultant may sign this application on behalf of their client.
9. Monitoring/observation wells must be constructed by a Colorado licensed well construction contractor or authorized individual, as defined in the Well Construction Rules, 2CCR 402-2. Only a licensed contractor may construct any monitoring/observation well that penetrates a confining layer, or, is to be converted into a future production well. The well must be constructed in compliance with the Well Construction Rules, unless a variance has been approved allowing an alternative construction design.
10. The individual signing the application or entering their name (and title if applicable) must be the applicant or an officer of the corporation/company/agency identified as the applicant, their attorney or consultant. An authorized agent may also sign the application, if a letter signed by the applicant or their attorney is submitted with the application authorizing that agent to sign or enter their name on the applicant's behalf. Payment must be received via phone, fax or mail prior to processing the application. If filing online please call the Records Section at 303.866.3581 to pay via credit card.

IF YOU HAVE ANY QUESTIONS regarding any item on the application form, please call the Division of Water Resources Ground Water Information Desk (303-866-3587), or the nearest Division of Water Resources Field Office located in Greeley (970-352-8712), Pueblo (719-542-3368), Alamosa (719-589-6683), Montrose (970-249-6622), Glenwood Springs (970-945-5665), Steamboat Springs (970-879-0272), or Durango (970-247-1845), or refer to CDWR web site at http://www.water.state.co.us for general information.

COLORADO DIVISION OF WATER RESOURCES
DEPARTMENT OF NATURAL RESOURCES
1313 SHERMAN ST., Ste 821, DENVER CO 80203
Phone: (303) 866-3581 dwrpermitsonline@state.co.us

Office Use Only

Form GWS-46 (11/2011)

MONITORING/OBSERVATION Water Well Permit Application

Review instructions on reverse side prior to completing form.
The form must be typed, completed online or in black or blue ink.

1. Well Owner Information

Name of well owner: Public Service Company of Colorado

Mailing address: 6198 Franklin St.

City	State	Zip code
Denver	CO	80216

Telephone #	E-Mail (If filing online it is required)
303-571-7340	marie.vagher@xcelenergy.com

2. Type Of Application (check applicable boxes)

- ☐ Use existing well
- ☐ Replacement for existing monitoring well: Permit no.:
- ■ Construct new well
- ☐ Other:

3. Refer To (if applicable)

Monitoring hole acknowledgment	Well name or #
MH-	W-10A

4. Location Of Proposed Well (Important! See Instructions)

County: Pueblo

SE 1/4 of the NE 1/4

Section	Township	N or S	Range	E or W	Principal Meridian
20	21	☐ ☒	64	☐ ☒	06

Distance of well from section lines (section lines are typically not property lines)

1836 Ft. from ☒ N ☐ S 165 Ft. from ☒ E ☐ W

For replacement wells only – distance and direction from old well to new well

feet direction

Well location address (Include City, State, Zip) ☐ Check if well address is same as Item 1.

2005 Lime Rd., Pueblo, CO 81006

Optional: GPS well location information in UTM format
You must check GPS unit for required settings as follows:

Format must be UTM
☐ Zone 12 or ☒ Zone 13
Units must be Meters
Datum must be NAD83
Unit must be set to true north
Was GPS unit checked for above? ■ YES

Easting 537490
Northing 4228951
Remember to set Datum to NAD83

5. Property Owner Information

Name of property owner: Xcel Energy - PSCo

Mailing address: 6198 Franklin St.

City	State	Zip Code
Denver	CO	80216

Telephone #: 303-571-7340

6. Use Of Well

Use of this well is limited to monitoring water levels and/or water quality sampling

7. Well Data (proposed)

Total **depth**	Aquifer
17 feet	N/A

8. Consultant Information (if applicable)

Name of contact person: Molly Reeves

Company name: HDR, Inc.

Mailing address: 1670 Broadway

City	State	Zip Code
Denver	CO	80202

Telephone #: 734-263-7138

9. Proposed Well Driller License #(optional):

10. Name of Well Owner or Authorized Agent

The making of false statements herein constitutes perjury in the second degree, which is punishable as a class 1 misdemeanor pursuant to C.R.S. 24-4-104 (13)(a). I have read the statements herein, know the contents thereof and state that they are true to my knowledge.

Sign or enter full name here	Date (mm/dd/yyyy)

If signing print name. Print title if other than land owner.

Office Use Only

USGS map name	DWR map no.	Surface elev.

Receipt area only

DIV _____ WD _____ BA _____ MD _____

MONITORING/OBSERVATION WELL PERMIT APPLICATION INSTRUCTIONS

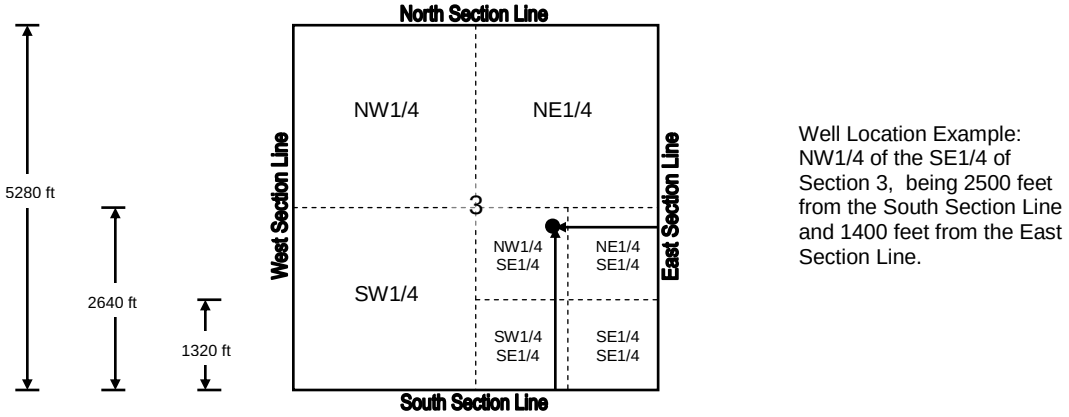
Applications must be computer generated on-line, typewritten or printed in BLACK or BLUE INK. ALL ITEMS in the application must be completed. Incomplete applications may be returned for more information. Applications are evaluated in chronological order. Please allow approximately six weeks for processing. This form may be reproduced by photocopying or computer generation. Reproductions must retain margins and print quality of the original form. If filing online, see online filing instructions for further information. You may also save, print, scan and email the completed form to: dwrpermitsonline@state.co.us

FEES: This application must be submitted with a $100 filing fee. (The fee for an application to replace or deepen an existing permitted monitoring/observation well is $100 for locations outside Designated Ground Water Basins, and $60 inside Designated Ground Water Basins.) Acceptable forms of payment are check or money order, payable to the "Colorado Division of Water Resources." Payments made by Visa, MasterCard or Discover card can be accepted by phone through the Records Section at 303.866.3581. **Fees are nonrefundable**.

USES: This form (GWS-46) is to be used when applying for a permit where the only uses are monitoring of water levels and/or water quality sampling. For well construction criteria refer to the Colorado Water Well Construction Rules, 2CCR 402-2. A copy of the Rules may be obtained from any Division of Water Resources Office for a fee of $5, or you may access them online from the State Board of Examiners' (BOE) website at http://water.state.co.us/dwripub/documents/constructionrules05.pdf

ITEM INSTRUCTIONS: (numbers correspond with those on the front of this form)

1. Provide the name of the well owner and the mailing address where all correspondence will be sent.
2. Check and complete all boxes that apply.
3. Provide the MH number assigned by the Division of Water Resources in response to the notice of intent to construct a monitoring/observation well. Complete the well name if the structure has a name or identifying number.
4. If applying for a permit to **construct a new well**, you **must** provide the county, section #, township, range and principal meridian. You **do not** need to provide the ¼ of the ¼ section designation, distances from section lines or an optional GPS location (UTM coordinates). If a permit is issued and a well constructed, the authorized individual will be required to provide an accurate GPS location (UTM coordinates) of the "as-built" well location. If applying for a permit to **use an existing well** you **must** provide the well location information stated above, as well as either a GPS location (UTM coordinates) of the existing well site, or distances from section lines **(including the ¼ of the ¼ section designation)** as follows: In a typical case, a township is comprised of 36 sections, with each section ideally one mile square, or 5,280 feet on each side. Sections are further divided into quarter sections. Each ¼ Section is 2,640 feet by 2,640 feet and comprises 160 acres. Each ¼ section can be further divided into additional quarters. Each ¼ of the ¼ Section is 1,320 feet by 1,320 feet and comprises 40 acres. The distances are measured from the section lines. In the following example, the well is located 2,500 feet from the South Section line and 1,400 feet from the East Section line:



Well Location Example: NW1/4 of the SE1/4 of Section 3, being 2500 feet from the South Section Line and 1400 feet from the East Section Line.

If providing a GPS location (UTM coordinates), the required GPS unit settings must be as indicated on this form. Colorado contains two UTM zones (12 & 13). Zone 13 covers most of Colorado. The boundary between Zone 12 and Zone 13 is the 108th Meridian (longitude). West of the 108th Meridian is UTM Zone 12 and east of the 108th Meridian is UTM Zone 13. The 108th Meridian is approximately 57 miles east of the Colorado-Utah state line. On most GPS units, the UTM zone is given as part of the Easting measurement, e.g. 12T0123456. Check the appropriate box for the zone. Provide the property address of the well location if one exists. If it is the same as the mailing address, check the box next to the well location address.

5. Provide property owner information.
6. Use of this well is limited to monitoring water levels and/or water quality sampling only.
7. The actual or anticipated total depth must be provided. Provide the name of the aquifer in which the well will be completed.
8. Provide consultant information (if applicable). Note: A consultant may sign this application on behalf of their client.
9. Monitoring/observation wells must be constructed by a Colorado licensed well construction contractor or authorized individual, as defined in the Well Construction Rules, 2CCR 402-2. Only a licensed contractor may construct any monitoring/observation well that penetrates a confining layer, or, is to be converted into a future production well. The well must be constructed in compliance with the Well Construction Rules, unless a variance has been approved allowing an alternative construction design.
10. The individual signing the application or entering their name (and title if applicable) must be the applicant or an officer of the corporation/company/agency identified as the applicant, their attorney or consultant. An authorized agent may also sign the application, if a letter signed by the applicant or their attorney is submitted with the application authorizing that agent to sign or enter their name on the applicant's behalf. Payment must be received via phone, fax or mail prior to processing the application. If filing online please call the Records Section at 303.866.3581 to pay via credit card.

IF YOU HAVE ANY QUESTIONS regarding any item on the application form, please call the Division of Water Resources Ground Water Information Desk (303-866-3587), or the nearest Division of Water Resources Field Office located in Greeley (970-352-8712), Pueblo (719-542-3368), Alamosa (719-589-6683), Montrose (970-249-6622), Glenwood Springs (970-945-5665), Steamboat Springs (970-879-0272), or Durango (970-247-1845), or refer to CDWR web site at http://www.water.state.co.us for general information.

COLORADO DIVISION OF WATER RESOURCES
DEPARTMENT OF NATURAL RESOURCES
1313 SHERMAN ST., Ste 821, DENVER CO 80203
Phone: (303) 866-3581 dwrpermitsonline@state.co.us

Office Use Only

Form GWS-46 (11/2011)

MONITORING/OBSERVATION Water Well Permit Application

Review instructions on reverse side prior to completing form.
The form must be typed, completed online or in black or blue ink.

1. Well Owner Information

Name of well owner: Public Service Company of Colorado

Mailing address: 6198 Franklin St.

City	State	Zip code
Denver	CO	80216

Telephone #	E-Mail (If filing online it is required)
303-571-7340	marie.vagher@xcelenergy.com

2. Type Of Application (check applicable boxes)

- ☐ Use existing well
- ☐ Replacement for existing monitoring well: Permit no.:
- ■ Construct new well
- ☐ Other:

3. Refer To (if applicable)

Monitoring hole acknowledgment	Well name or #
MH-	W-10B

4. Location Of Proposed Well (Important! See Instructions)

County: Pueblo

SE 1/4 of the NE 1/4

Section	Township	N or S	Range	E or W	Principal Meridian
20	21	☐ ☒	64	☐ ☒	06

Distance of well from section lines (section lines are typically not property lines)

1834 Ft. from ☒ N ☐ S 165 Ft. from ☒ E ☐ W

For replacement wells only – distance and direction from old well to new well

feet direction

Well location address (Include City, State, Zip) ☐ Check if well address is same as Item 1.

2005 Lime Rd., Pueblo, CO 81006

Optional: GPS well location information in UTM format
You must check GPS unit for required settings as follows:

Format must be UTM
☐ Zone 12 or ☒ Zone 13
Units must be Meters
Datum must be NAD83
Unit must be set to true north
Was GPS unit checked for above? ■ YES

Easting 537490
Northing 4228953
Remember to set Datum to NAD83

5. Property Owner Information

Name of property owner: Xcel Energy - PSCo

Mailing address: 6198 Franklin St.

City	State	Zip Code
Denver	CO	80216

Telephone #: 303-571-7340

6. Use Of Well

Use of this well is limited to monitoring water levels and/or water quality sampling

7. Well Data (proposed)

Total **depth**	Aquifer
20 feet	N/A

8. Consultant Information (if applicable)

Name of contact person: Molly Reeves

Company name: HDR, Inc.

Mailing address: 1670 Broadway

City	State	Zip Code
Denver	CO	80202

Telephone #: 734-263-7138

9. Proposed Well Driller License #(optional):

10. Name of Well Owner or Authorized Agent

The making of false statements herein constitutes perjury in the second degree, which is punishable as a class 1 misdemeanor pursuant to C.R.S. 24-4-104 (13)(a). I have read the statements herein, know the contents thereof and state that they are true to my knowledge.

Sign or enter full name here	Date (mm/dd/yyyy)

If signing print name. Print title if other than land owner.

Office Use Only

USGS map name	DWR map no.	Surface elev.

Receipt area only

DIV _____ WD _____ BA _____ MD _____

MONITORING/OBSERVATION WELL PERMIT APPLICATION INSTRUCTIONS

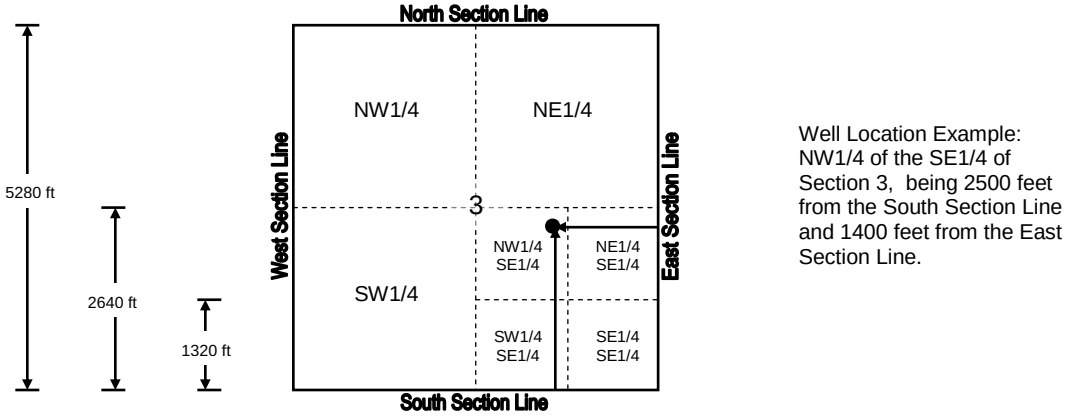
Applications must be computer generated on-line, typewritten or printed in BLACK or BLUE INK. ALL ITEMS in the application must be completed. Incomplete applications may be returned for more information. Applications are evaluated in chronological order. Please allow approximately six weeks for processing. This form may be reproduced by photocopying or computer generation. Reproductions must retain margins and print quality of the original form. If filing online, see online filing instructions for further information. You may also save, print, scan and email the completed form to: dwrpermitsonline@state.co.us

FEES: This application must be submitted with a $100 filing fee. (The fee for an application to replace or deepen an existing permitted monitoring/observation well is $100 for locations outside Designated Ground Water Basins, and $60 inside Designated Ground Water Basins.) Acceptable forms of payment are check or money order, payable to the "Colorado Division of Water Resources." Payments made by Visa, MasterCard or Discover card can be accepted by phone through the Records Section at 303.866.3581. **Fees are nonrefundable**.

USES: This form (GWS-46) is to be used when applying for a permit where the only uses are monitoring of water levels and/or water quality sampling. For well construction criteria refer to the Colorado Water Well Construction Rules, 2CCR 402-2. A copy of the Rules may be obtained from any Division of Water Resources Office for a fee of $5, or you may access them online from the State Board of Examiners' (BOE) website at http://water.state.co.us/dwripub/documents/constructionrules05.pdf

ITEM INSTRUCTIONS: (numbers correspond with those on the front of this form)

1. Provide the name of the well owner and the mailing address where all correspondence will be sent.
2. Check and complete all boxes that apply.
3. Provide the MH number assigned by the Division of Water Resources in response to the notice of intent to construct a monitoring/observation well. Complete the well name if the structure has a name or identifying number.
4. If applying for a permit to **construct a new well**, you **must** provide the county, section #, township, range and principal meridian. You **do not** need to provide the ¼ of the ¼ section designation, distances from section lines or an optional GPS location (UTM coordinates). If a permit is issued and a well constructed, the authorized individual will be required to provide an accurate GPS location (UTM coordinates) of the "as-built" well location. If applying for a permit to **use an existing well** you **must** provide the well location information stated above, as well as either a GPS location (UTM coordinates) of the existing well site, or distances from section lines **(including the ¼ of the ¼ section designation)** as follows: In a typical case, a township is comprised of 36 sections, with each section ideally one mile square, or 5,280 feet on each side. Sections are further divided into quarter sections. Each ¼ Section is 2,640 feet by 2,640 feet and comprises 160 acres. Each ¼ section can be further divided into additional quarters. Each ¼ of the ¼ Section is 1,320 feet by 1,320 feet and comprises 40 acres. The distances are measured from the section lines. In the following example, the well is located 2,500 feet from the South Section line and 1,400 feet from the East Section line:



Well Location Example: NW1/4 of the SE1/4 of Section 3, being 2500 feet from the South Section Line and 1400 feet from the East Section Line.

If providing a GPS location (UTM coordinates), the required GPS unit settings must be as indicated on this form. Colorado contains two UTM zones (12 & 13). Zone 13 covers most of Colorado. The boundary between Zone 12 and Zone 13 is the 108th Meridian (longitude). West of the 108th Meridian is UTM Zone 12 and east of the 108th Meridian is UTM Zone 13. The 108th Meridian is approximately 57 miles east of the Colorado-Utah state line. On most GPS units, the UTM zone is given as part of the Easting measurement, e.g. 12T0123456. Check the appropriate box for the zone. Provide the property address of the well location if one exists. If it is the same as the mailing address, check the box next to the well location address.

5. Provide property owner information.
6. Use of this well is limited to monitoring water levels and/or water quality sampling only.
7. The actual or anticipated total depth must be provided. Provide the name of the aquifer in which the well will be completed.
8. Provide consultant information (if applicable). Note: A consultant may sign this application on behalf of their client.
9. Monitoring/observation wells must be constructed by a Colorado licensed well construction contractor or authorized individual, as defined in the Well Construction Rules, 2CCR 402-2. Only a licensed contractor may construct any monitoring/observation well that penetrates a confining layer, or, is to be converted into a future production well. The well must be constructed in compliance with the Well Construction Rules, unless a variance has been approved allowing an alternative construction design.
10. The individual signing the application or entering their name (and title if applicable) must be the applicant or an officer of the corporation/company/agency identified as the applicant, their attorney or consultant. An authorized agent may also sign the application, if a letter signed by the applicant or their attorney is submitted with the application authorizing that agent to sign or enter their name on the applicant's behalf. Payment must be received via phone, fax or mail prior to processing the application. If filing online please call the Records Section at 303.866.3581 to pay via credit card.

IF YOU HAVE ANY QUESTIONS regarding any item on the application form, please call the Division of Water Resources Ground Water Information Desk (303-866-3587), or the nearest Division of Water Resources Field Office located in Greeley (970-352-8712), Pueblo (719-542-3368), Alamosa (719-589-6683), Montrose (970-249-6622), Glenwood Springs (970-945-5665), Steamboat Springs (970-879-0272), or Durango (970-247-1845), or refer to CDWR web site at http://www.water.state.co.us for general information.

COLORADO DIVISION OF WATER RESOURCES
DEPARTMENT OF NATURAL RESOURCES
1313 SHERMAN ST., Ste 821, DENVER CO 80203
Phone: (303) 866-3581 dwrpermitsonline@state.co.us

Office Use Only

Form GWS-46 (11/2011)

MONITORING/OBSERVATION Water Well Permit Application

Review instructions on reverse side prior to completing form.
The form must be typed, completed online or in black or blue ink.

1. Well Owner Information

Name of well owner: Public Service Company of Colorado

Mailing address: 6198 Franklin St.

City	State	Zip code
Denver	CO	80216

Telephone #	E-Mail (If filing online it is required)
303-571-7340	marie.vagher@xcelenergy.com

2. Type Of Application (check applicable boxes)

- ☐ Use existing well
- ☐ Replacement for existing monitoring well: Permit no.:
- ■ Construct new well
- ☐ Other:

3. Refer To (if applicable)

Monitoring hole acknowledgment	Well name or #
MH-	W-11

4. Location Of Proposed Well (Important! See Instructions)

County: Pueblo

NW 1/4 of the NE 1/4

Section	Township	N or S	Range	E or W	Principal Meridian
29	21	☐ ☒	64	☐ ☒	06

Distance of well from section lines (section lines are typically not property lines)

75 Ft. from ☒ N ☐ S 2130 Ft. from ☒ E ☐ W

For replacement wells only – distance and direction from old well to new well

feet direction

Well location address (Include City, State, Zip) ☐ Check if well address is same as Item 1.

2005 Lime Rd., Pueblo, CO 81006

Optional: GPS well location information in UTM format
You must check GPS unit for required settings as follows:

Format must be UTM
☐ Zone 12 or ☒ Zone 13
Units must be Meters
Datum must be NAD83
Unit must be set to true north
Was GPS unit checked for above? ■ YES

Easting 536898
Northing 4227888
Remember to set Datum to NAD83

5. Property Owner Information

Name of property owner: Xcel Energy - PSCo

Mailing address: 6198 Franklin St.

City	State	Zip Code
Denver	CO	80216

Telephone #: 303-571-7340

6. Use Of Well

Use of this well is limited to monitoring water levels and/or water quality sampling

7. Well Data (proposed)

Total **depth**	Aquifer
33 feet	N/A

8. Consultant Information (if applicable)

Name of contact person: Molly Reeves

Company name: HDR, Inc.

Mailing address: 1670 Broadway

City	State	Zip Code
Denver	CO	80202

Telephone #: 734-263-7138

9. Proposed Well Driller License #(optional):

10. Name of Well Owner or Authorized Agent

The making of false statements herein constitutes perjury in the second degree, which is punishable as a class 1 misdemeanor pursuant to C.R.S. 24-4-104 (13)(a). I have read the statements herein, know the contents thereof and state that they are true to my knowledge.

Sign or enter full name here	Date (mm/dd/yyyy)

If signing print name. Print title if other than land owner.

Office Use Only

USGS map name	DWR map no.	Surface elev.

Receipt area only

DIV _____ WD _____ BA _____ MD _____

MONITORING/OBSERVATION WELL PERMIT APPLICATION INSTRUCTIONS

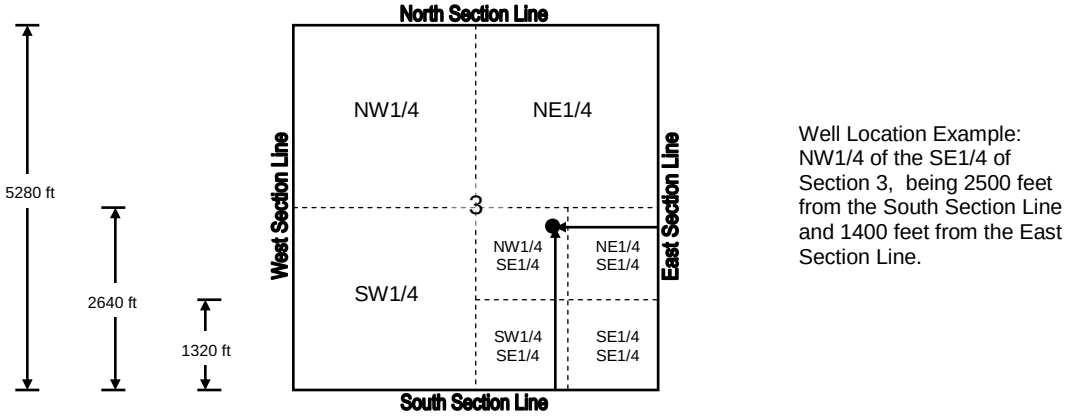
Applications must be computer generated on-line, typewritten or printed in BLACK or BLUE INK. ALL ITEMS in the application must be completed. Incomplete applications may be returned for more information. Applications are evaluated in chronological order. Please allow approximately six weeks for processing. This form may be reproduced by photocopying or computer generation. Reproductions must retain margins and print quality of the original form. If filing online, see online filing instructions for further information. You may also save, print, scan and email the completed form to: dwrpermitsonline@state.co.us

FEES: This application must be submitted with a $100 filing fee. (The fee for an application to replace or deepen an existing permitted monitoring/observation well is $100 for locations outside Designated Ground Water Basins, and $60 inside Designated Ground Water Basins.) Acceptable forms of payment are check or money order, payable to the "Colorado Division of Water Resources." Payments made by Visa, MasterCard or Discover card can be accepted by phone through the Records Section at 303.866.3581. **Fees are nonrefundable**.

USES: This form (GWS-46) is to be used when applying for a permit where the only uses are monitoring of water levels and/or water quality sampling. For well construction criteria refer to the Colorado Water Well Construction Rules, 2CCR 402-2. A copy of the Rules may be obtained from any Division of Water Resources Office for a fee of $5, or you may access them online from the State Board of Examiners' (BOE) website at http://water.state.co.us/dwripub/documents/constructionrules05.pdf

ITEM INSTRUCTIONS: (numbers correspond with those on the front of this form)

1. Provide the name of the well owner and the mailing address where all correspondence will be sent.
2. Check and complete all boxes that apply.
3. Provide the MH number assigned by the Division of Water Resources in response to the notice of intent to construct a monitoring/observation well. Complete the well name if the structure has a name or identifying number.
4. If applying for a permit to **construct a new well**, you **must** provide the county, section #, township, range and principal meridian. You **do not** need to provide the ¼ of the ¼ section designation, distances from section lines or an optional GPS location (UTM coordinates). If a permit is issued and a well constructed, the authorized individual will be required to provide an accurate GPS location (UTM coordinates) of the "as-built" well location. If applying for a permit to **use an existing well** you **must** provide the well location information stated above, as well as either a GPS location (UTM coordinates) of the existing well site, or distances from section lines **(including the ¼ of the ¼ section designation)** as follows: In a typical case, a township is comprised of 36 sections, with each section ideally one mile square, or 5,280 feet on each side. Sections are further divided into quarter sections. Each ¼ Section is 2,640 feet by 2,640 feet and comprises 160 acres. Each ¼ section can be further divided into additional quarters. Each ¼ of the ¼ Section is 1,320 feet by 1,320 feet and comprises 40 acres. The distances are measured from the section lines. In the following example, the well is located 2,500 feet from the South Section line and 1,400 feet from the East Section line:



Well Location Example: NW1/4 of the SE1/4 of Section 3, being 2500 feet from the South Section Line and 1400 feet from the East Section Line.

If providing a GPS location (UTM coordinates), the required GPS unit settings must be as indicated on this form. Colorado contains two UTM zones (12 & 13). Zone 13 covers most of Colorado. The boundary between Zone 12 and Zone 13 is the 108th Meridian (longitude). West of the 108th Meridian is UTM Zone 12 and east of the 108th Meridian is UTM Zone 13. The 108th Meridian is approximately 57 miles east of the Colorado-Utah state line. On most GPS units, the UTM zone is given as part of the Easting measurement, e.g. 12T0123456. Check the appropriate box for the zone. Provide the property address of the well location if one exists. If it is the same as the mailing address, check the box next to the well location address.

5. Provide property owner information.
6. Use of this well is limited to monitoring water levels and/or water quality sampling only.
7. The actual or anticipated total depth must be provided. Provide the name of the aquifer in which the well will be completed.
8. Provide consultant information (if applicable). Note: A consultant may sign this application on behalf of their client.
9. Monitoring/observation wells must be constructed by a Colorado licensed well construction contractor or authorized individual, as defined in the Well Construction Rules, 2CCR 402-2. Only a licensed contractor may construct any monitoring/observation well that penetrates a confining layer, or, is to be converted into a future production well. The well must be constructed in compliance with the Well Construction Rules, unless a variance has been approved allowing an alternative construction design.
10. The individual signing the application or entering their name (and title if applicable) must be the applicant or an officer of the corporation/company/agency identified as the applicant, their attorney or consultant. An authorized agent may also sign the application, if a letter signed by the applicant or their attorney is submitted with the application authorizing that agent to sign or enter their name on the applicant's behalf. Payment must be received via phone, fax or mail prior to processing the application. If filing online please call the Records Section at 303.866.3581 to pay via credit card.

IF YOU HAVE ANY QUESTIONS regarding any item on the application form, please call the Division of Water Resources Ground Water Information Desk (303-866-3587), or the nearest Division of Water Resources Field Office located in Greeley (970-352-8712), Pueblo (719-542-3368), Alamosa (719-589-6683), Montrose (970-249-6622), Glenwood Springs (970-945-5665), Steamboat Springs (970-879-0272), or Durango (970-247-1845), or refer to CDWR web site at http://www.water.state.co.us for general information.

COLORADO DIVISION OF WATER RESOURCES
DEPARTMENT OF NATURAL RESOURCES
1313 SHERMAN ST., Ste 821, DENVER CO 80203
Phone: (303) 866-3581 dwrpermitsonline@state.co.us

Office Use Only

Form GWS-46 (11/2011)

MONITORING/OBSERVATION Water Well Permit Application

Review instructions on reverse side prior to completing form.
The form must be typed, completed online or in black or blue ink.

1. Well Owner Information

Name of well owner: Public Service Company of Colorado

Mailing address: 6198 Franklin St.

City	State	Zip code
Denver	CO	80216

Telephone #	E-Mail (If filing online it is required)
303-571-7340	marie.vagher@xcelenergy.com

2. Type Of Application (check applicable boxes)

- ☐ Use existing well
- ☐ Replacement for existing monitoring well: Permit no.:
- ■ Construct new well
- ☐ Other:

3. Refer To (if applicable)

Monitoring hole acknowledgment	Well name or #
MH-	W-12

4. Location Of Proposed Well (Important! See Instructions)

County: Pueblo

NW 1/4 of the NE 1/4

Section	Township	N or S	Range	E or W	Principal Meridian
29	21	☐ ☒	64	☐ ☒	06

Distance of well from section lines (section lines are typically not property lines)

170 Ft. from ☒ N ☐ S 1405 Ft. from ☒ E ☐ W

For replacement wells only – distance and direction from old well to new well

feet direction

Well location address (Include City, State, Zip) ☐ Check if well address is same as Item 1.

2005 Lime Rd., Pueblo, CO 81006

Optional: GPS well location information in UTM format
You must check GPS unit for required settings as follows:

Format must be UTM
☐ Zone 12 or ☒ Zone 13
Units must be Meters
Datum must be NAD83
Unit must be set to true north
Was GPS unit checked for above? ■ YES

Easting 537107
Northing 4227869
Remember to set Datum to NAD83

5. Property Owner Information

Name of property owner: Xcel Energy - PSCo

Mailing address: 6198 Franklin St.

City	State	Zip Code
Denver	CO	80216

Telephone #: 303-571-7340

6. Use Of Well

Use of this well is limited to monitoring water levels and/or water quality sampling

7. Well Data (proposed)

Total **depth**	Aquifer
24 feet	N/A

8. Consultant Information (if applicable)

Name of contact person: Molly Reeves

Company name: HDR, Inc.

Mailing address: 1670 Broadway

City	State	Zip Code
Denver	CO	80202

Telephone #: 734-263-7138

9. Proposed Well Driller License #(optional):

10. Name of Well Owner or Authorized Agent

The making of false statements herein constitutes perjury in the second degree, which is punishable as a class 1 misdemeanor pursuant to C.R.S. 24-4-104 (13)(a). I have read the statements herein, know the contents thereof and state that they are true to my knowledge.

Sign or enter full name here	Date (mm/dd/yyyy)

If signing print name. Print title if other than land owner.

Office Use Only

USGS map name	DWR map no.	Surface elev.

Receipt area only

DIV _____ WD _____ BA _____ MD _____

MONITORING/OBSERVATION WELL PERMIT APPLICATION INSTRUCTIONS

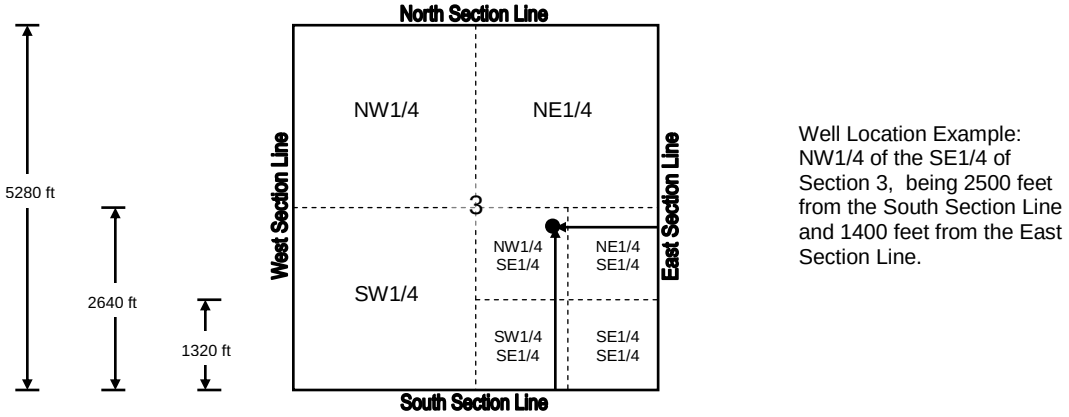
Applications must be computer generated on-line, typewritten or printed in BLACK or BLUE INK. ALL ITEMS in the application must be completed. Incomplete applications may be returned for more information. Applications are evaluated in chronological order. Please allow approximately six weeks for processing. This form may be reproduced by photocopying or computer generation. Reproductions must retain margins and print quality of the original form. If filing online, see online filing instructions for further information. You may also save, print, scan and email the completed form to: dwrpermitsonline@state.co.us

FEES: This application must be submitted with a $100 filing fee. (The fee for an application to replace or deepen an existing permitted monitoring/observation well is $100 for locations outside Designated Ground Water Basins, and $60 inside Designated Ground Water Basins.) Acceptable forms of payment are check or money order, payable to the "Colorado Division of Water Resources." Payments made by Visa, MasterCard or Discover card can be accepted by phone through the Records Section at 303.866.3581. **Fees are nonrefundable**.

USES: This form (GWS-46) is to be used when applying for a permit where the only uses are monitoring of water levels and/or water quality sampling. For well construction criteria refer to the Colorado Water Well Construction Rules, 2CCR 402-2. A copy of the Rules may be obtained from any Division of Water Resources Office for a fee of $5, or you may access them online from the State Board of Examiners' (BOE) website at http://water.state.co.us/dwripub/documents/constructionrules05.pdf

ITEM INSTRUCTIONS: (numbers correspond with those on the front of this form)

1. Provide the name of the well owner and the mailing address where all correspondence will be sent.
2. Check and complete all boxes that apply.
3. Provide the MH number assigned by the Division of Water Resources in response to the notice of intent to construct a monitoring/observation well. Complete the well name if the structure has a name or identifying number.
4. If applying for a permit to **construct a new well**, you **must** provide the county, section #, township, range and principal meridian. You **do not** need to provide the ¼ of the ¼ section designation, distances from section lines or an optional GPS location (UTM coordinates). If a permit is issued and a well constructed, the authorized individual will be required to provide an accurate GPS location (UTM coordinates) of the "as-built" well location. If applying for a permit to **use an existing well** you **must** provide the well location information stated above, as well as either a GPS location (UTM coordinates) of the existing well site, or distances from section lines **(including the ¼ of the ¼ section designation)** as follows: In a typical case, a township is comprised of 36 sections, with each section ideally one mile square, or 5,280 feet on each side. Sections are further divided into quarter sections. Each ¼ Section is 2,640 feet by 2,640 feet and comprises 160 acres. Each ¼ section can be further divided into additional quarters. Each ¼ of the ¼ Section is 1,320 feet by 1,320 feet and comprises 40 acres. The distances are measured from the section lines. In the following example, the well is located 2,500 feet from the South Section line and 1,400 feet from the East Section line:



Well Location Example: NW1/4 of the SE1/4 of Section 3, being 2500 feet from the South Section Line and 1400 feet from the East Section Line.

If providing a GPS location (UTM coordinates), the required GPS unit settings must be as indicated on this form. Colorado contains two UTM zones (12 & 13). Zone 13 covers most of Colorado. The boundary between Zone 12 and Zone 13 is the 108th Meridian (longitude). West of the 108th Meridian is UTM Zone 12 and east of the 108th Meridian is UTM Zone 13. The 108th Meridian is approximately 57 miles east of the Colorado-Utah state line. On most GPS units, the UTM zone is given as part of the Easting measurement, e.g. 12T0123456. Check the appropriate box for the zone. Provide the property address of the well location if one exists. If it is the same as the mailing address, check the box next to the well location address.

5. Provide property owner information.
6. Use of this well is limited to monitoring water levels and/or water quality sampling only.
7. The actual or anticipated total depth must be provided. Provide the name of the aquifer in which the well will be completed.
8. Provide consultant information (if applicable). Note: A consultant may sign this application on behalf of their client.
9. Monitoring/observation wells must be constructed by a Colorado licensed well construction contractor or authorized individual, as defined in the Well Construction Rules, 2CCR 402-2. Only a licensed contractor may construct any monitoring/observation well that penetrates a confining layer, or, is to be converted into a future production well. The well must be constructed in compliance with the Well Construction Rules, unless a variance has been approved allowing an alternative construction design.
10. The individual signing the application or entering their name (and title if applicable) must be the applicant or an officer of the corporation/company/agency identified as the applicant, their attorney or consultant. An authorized agent may also sign the application, if a letter signed by the applicant or their attorney is submitted with the application authorizing that agent to sign or enter their name on the applicant's behalf. Payment must be received via phone, fax or mail prior to processing the application. If filing online please call the Records Section at 303.866.3581 to pay via credit card.

IF YOU HAVE ANY QUESTIONS regarding any item on the application form, please call the Division of Water Resources Ground Water Information Desk (303-866-3587), or the nearest Division of Water Resources Field Office located in Greeley (970-352-8712), Pueblo (719-542-3368), Alamosa (719-589-6683), Montrose (970-249-6622), Glenwood Springs (970-945-5665), Steamboat Springs (970-879-0272), or Durango (970-247-1845), or refer to CDWR web site at http://www.water.state.co.us for general information.

COLORADO DIVISION OF WATER RESOURCES
DEPARTMENT OF NATURAL RESOURCES
1313 SHERMAN ST., Ste 821, DENVER CO 80203
Phone: (303) 866-3581 dwrpermitsonline@state.co.us

Office Use Only

Form GWS-46 (11/2011)

MONITORING/OBSERVATION Water Well Permit Application

Review instructions on reverse side prior to completing form.
The form must be typed, completed online or in black or blue ink.

1. Well Owner Information

Name of well owner: Public Service Company of Colorado

Mailing address: 6198 Franklin St.

City	State	Zip code
Denver	CO	80216

Telephone #	E-Mail (If filing online it is required)
303-571-7340	marie.vagher@xcelenergy.com

2. Type Of Application (check applicable boxes)

- ☐ Use existing well
- ☐ Replacement for existing monitoring well: Permit no.:
- ■ Construct new well
- ☐ Other:

3. Refer To (if applicable)

Monitoring hole acknowledgment	Well name or #
MH-	W-13

4. Location Of Proposed Well (Important! See Instructions)

County: Pueblo

NE 1/4 of the NE 1/4

Section	Township	N or S	Range	E or W	Principal Meridian
29	21	☐ ☒	64	☐ ☒	06

Distance of well from section lines (section lines are typically not property lines)

190 Ft. from ☒ N ☐ S 790 Ft. from ☒ E ☐ W

For replacement wells only – distance and direction from old well to new well

feet direction

Well location address (Include City, State, Zip) ☐ Check if well address is same as Item 1.

2005 Lime Rd., Pueblo, CO 81006

Optional: GPS well location information in UTM format
You must check GPS unit for required settings as follows:

Format must be UTM
☐ Zone 12 or ☒ Zone 13
Units must be Meters
Datum must be NAD83
Unit must be set to true north
Was GPS unit checked for above? ■ YES

Easting 537292
Northing 4227853
Remember to set Datum to NAD83

5. Property Owner Information

Name of property owner: Xcel Energy - PSCo

Mailing address: 6198 Franklin St.

City	State	Zip Code
Denver	CO	80216

Telephone #: 303-571-7340

6. Use Of Well

Use of this well is limited to monitoring water levels and/or water quality sampling

7. Well Data (proposed)

Total **depth**	Aquifer
29 feet	N/A

8. Consultant Information (if applicable)

Name of contact person: Molly Reeves

Company name: HDR, Inc.

Mailing address: 1670 Broadway

City	State	Zip Code
Denver	CO	80202

Telephone #: 734-263-7138

9. Proposed Well Driller License #(optional):

10. Name of Well Owner or Authorized Agent

The making of false statements herein constitutes perjury in the second degree, which is punishable as a class 1 misdemeanor pursuant to C.R.S. 24-4-104 (13)(a). I have read the statements herein, know the contents thereof and state that they are true to my knowledge.

Sign or enter full name here	Date (mm/dd/yyyy)

If signing print name. Print title if other than land owner.

Office Use Only

USGS map name	DWR map no.	Surface elev.

Receipt area only

DIV _____ WD _____ BA _____ MD _____

MONITORING/OBSERVATION WELL PERMIT APPLICATION INSTRUCTIONS

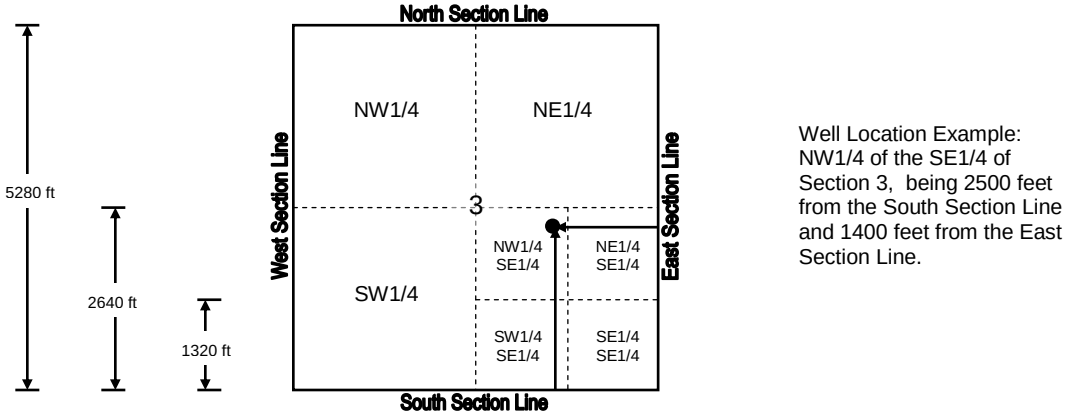
Applications must be computer generated on-line, typewritten or printed in BLACK or BLUE INK. ALL ITEMS in the application must be completed. Incomplete applications may be returned for more information. Applications are evaluated in chronological order. Please allow approximately six weeks for processing. This form may be reproduced by photocopying or computer generation. Reproductions must retain margins and print quality of the original form. If filing online, see online filing instructions for further information. You may also save, print, scan and email the completed form to: dwrpermitsonline@state.co.us

FEES: This application must be submitted with a $100 filing fee. (The fee for an application to replace or deepen an existing permitted monitoring/observation well is $100 for locations outside Designated Ground Water Basins, and $60 inside Designated Ground Water Basins.) Acceptable forms of payment are check or money order, payable to the "Colorado Division of Water Resources." Payments made by Visa, MasterCard or Discover card can be accepted by phone through the Records Section at 303.866.3581. **Fees are nonrefundable**.

USES: This form (GWS-46) is to be used when applying for a permit where the only uses are monitoring of water levels and/or water quality sampling. For well construction criteria refer to the Colorado Water Well Construction Rules, 2CCR 402-2. A copy of the Rules may be obtained from any Division of Water Resources Office for a fee of $5, or you may access them online from the State Board of Examiners' (BOE) website at http://water.state.co.us/dwripub/documents/constructionrules05.pdf

ITEM INSTRUCTIONS: (numbers correspond with those on the front of this form)

1. Provide the name of the well owner and the mailing address where all correspondence will be sent.
2. Check and complete all boxes that apply.
3. Provide the MH number assigned by the Division of Water Resources in response to the notice of intent to construct a monitoring/observation well. Complete the well name if the structure has a name or identifying number.
4. If applying for a permit to **construct a new well**, you **must** provide the county, section #, township, range and principal meridian. You **do not** need to provide the ¼ of the ¼ section designation, distances from section lines or an optional GPS location (UTM coordinates). If a permit is issued and a well constructed, the authorized individual will be required to provide an accurate GPS location (UTM coordinates) of the "as-built" well location. If applying for a permit to **use an existing well** you **must** provide the well location information stated above, as well as either a GPS location (UTM coordinates) of the existing well site, or distances from section lines **(including the ¼ of the ¼ section designation)** as follows: In a typical case, a township is comprised of 36 sections, with each section ideally one mile square, or 5,280 feet on each side. Sections are further divided into quarter sections. Each ¼ Section is 2,640 feet by 2,640 feet and comprises 160 acres. Each ¼ section can be further divided into additional quarters. Each ¼ of the ¼ Section is 1,320 feet by 1,320 feet and comprises 40 acres. The distances are measured from the section lines. In the following example, the well is located 2,500 feet from the South Section line and 1,400 feet from the East Section line:



Well Location Example: NW1/4 of the SE1/4 of Section 3, being 2500 feet from the South Section Line and 1400 feet from the East Section Line.

If providing a GPS location (UTM coordinates), the required GPS unit settings must be as indicated on this form. Colorado contains two UTM zones (12 & 13). Zone 13 covers most of Colorado. The boundary between Zone 12 and Zone 13 is the 108th Meridian (longitude). West of the 108th Meridian is UTM Zone 12 and east of the 108th Meridian is UTM Zone 13. The 108th Meridian is approximately 57 miles east of the Colorado-Utah state line. On most GPS units, the UTM zone is given as part of the Easting measurement, e.g. 12T0123456. Check the appropriate box for the zone. Provide the property address of the well location if one exists. If it is the same as the mailing address, check the box next to the well location address.

5. Provide property owner information.
6. Use of this well is limited to monitoring water levels and/or water quality sampling only.
7. The actual or anticipated total depth must be provided. Provide the name of the aquifer in which the well will be completed.
8. Provide consultant information (if applicable). Note: A consultant may sign this application on behalf of their client.
9. Monitoring/observation wells must be constructed by a Colorado licensed well construction contractor or authorized individual, as defined in the Well Construction Rules, 2CCR 402-2. Only a licensed contractor may construct any monitoring/observation well that penetrates a confining layer, or, is to be converted into a future production well. The well must be constructed in compliance with the Well Construction Rules, unless a variance has been approved allowing an alternative construction design.
10. The individual signing the application or entering their name (and title if applicable) must be the applicant or an officer of the corporation/company/agency identified as the applicant, their attorney or consultant. An authorized agent may also sign the application, if a letter signed by the applicant or their attorney is submitted with the application authorizing that agent to sign or enter their name on the applicant's behalf. Payment must be received via phone, fax or mail prior to processing the application. If filing online please call the Records Section at 303.866.3581 to pay via credit card.

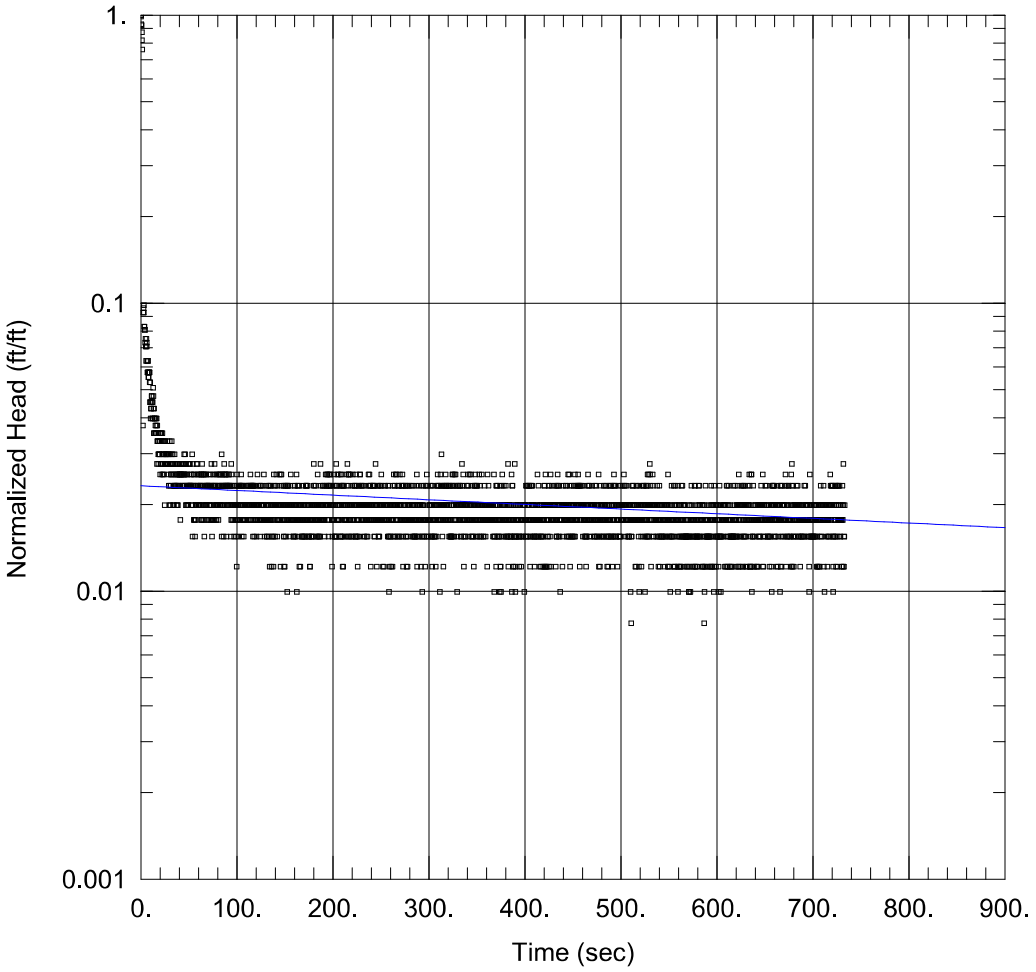
IF YOU HAVE ANY QUESTIONS regarding any item on the application form, please call the Division of Water Resources Ground Water Information Desk (303-866-3587), or the nearest Division of Water Resources Field Office located in Greeley (970-352-8712), Pueblo (719-542-3368), Alamosa (719-589-6683), Montrose (970-249-6622), Glenwood Springs (970-945-5665), Steamboat Springs (970-879-0272), or Durango (970-247-1845), or refer to CDWR web site at http://www.water.state.co.us for general information.

Appendix E

Slug Test Analyses

Appendix E

Slug Test Analyses



MW-1B (FH1)

PROJECT INFORMATION

Company: HDR
Location: Xcel_Comanche_CCR
Test Well: MW-1B
Test Date: 10/13/2020

AQUIFER DATA

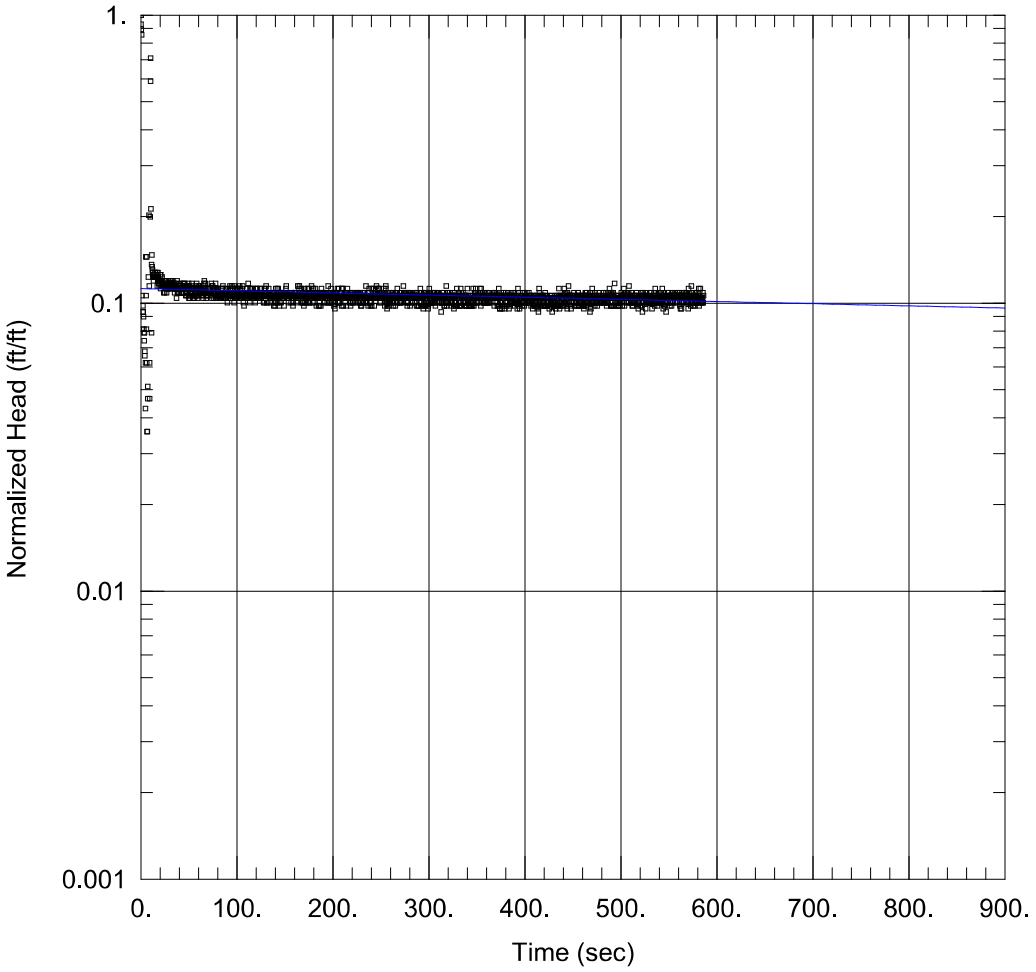
Saturated Thickness: 10.98 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-1B)

Initial Displacement: 0.905 ft
Total Well Penetration Depth: 10.98 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 10.98 ft
Screen Length: 10.98 ft
Well Radius: 0.2083 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 2.8E-5 cm/sec
y0 = 0.021 ft



MW-1B (FH2)

PROJECT INFORMATION

Company: HDR
Location: Xcel_Comanche_CCR
Test Well: MW-1B
Test Date: 10/13/2020

AQUIFER DATA

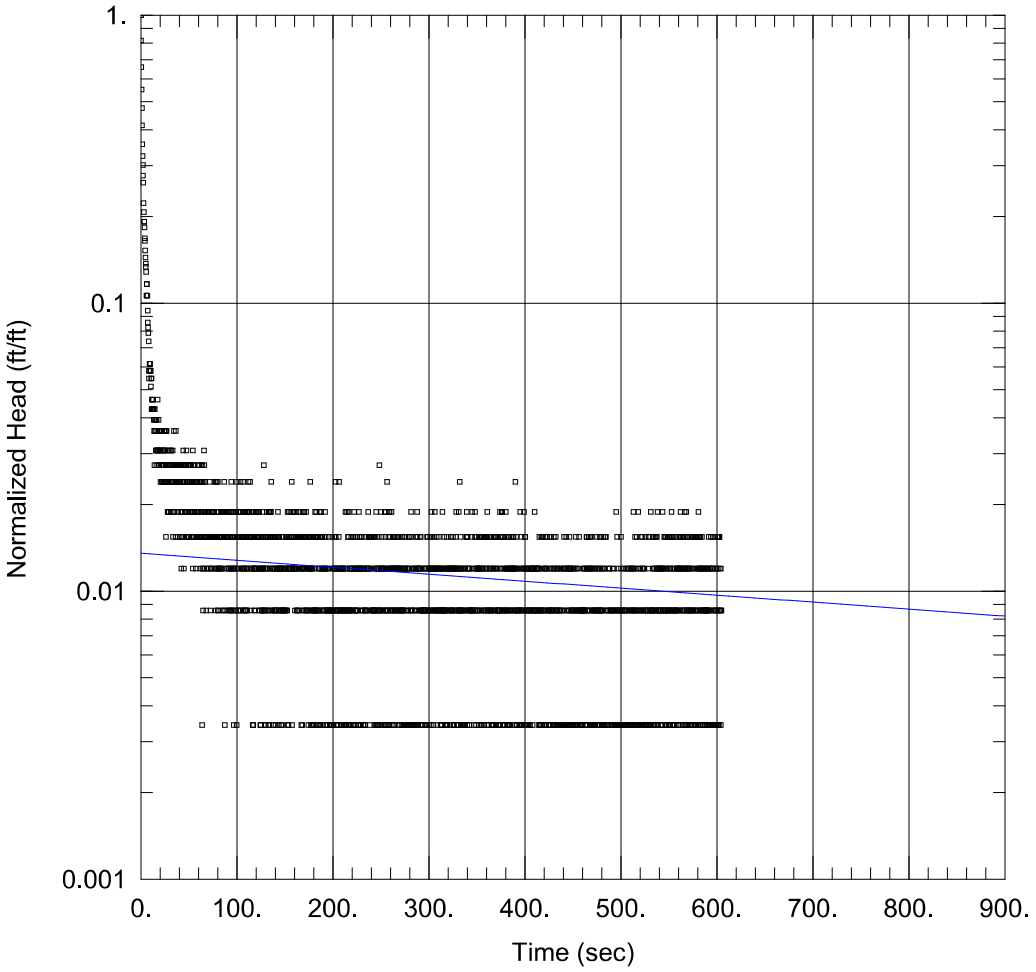
Saturated Thickness: 10.98 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-1B)

Initial Displacement: 0.837 ft
Total Well Penetration Depth: 10.98 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 10.98 ft
Screen Length: 10.98 ft
Well Radius: 0.2083 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
K = 1.3E-5 cm/sec
Solution Method: Bouwer-Rice
y0 = 0.094 ft



MW-1B (RH1)

PROJECT INFORMATION

Company: HDR
Location: Xcel_Comanche_CCR
Test Well: MW-1B
Test Date: 10/13/2020

AQUIFER DATA

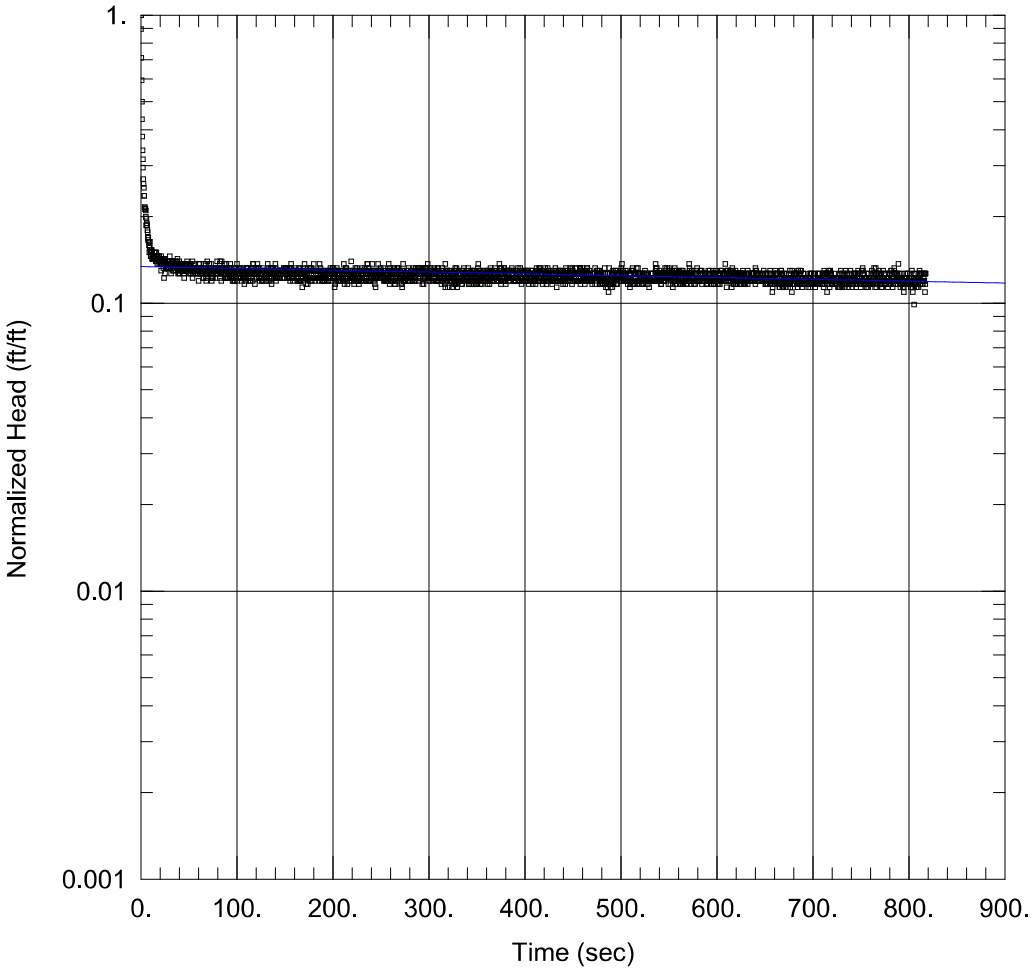
Saturated Thickness: 10.98 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-1B)

Initial Displacement: 0.584 ft
Total Well Penetration Depth: 10.98 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 10.98 ft
Screen Length: 10.98 ft
Well Radius: 0.2083 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 4.2E-5 cm/sec
y0 = 0.0079 ft



MW-1B (RH2)

PROJECT INFORMATION

Company: HDR
Location: Xcel_Comanche_CCR
Test Well: MW-1B
Test Date: 10/13/2020

AQUIFER DATA

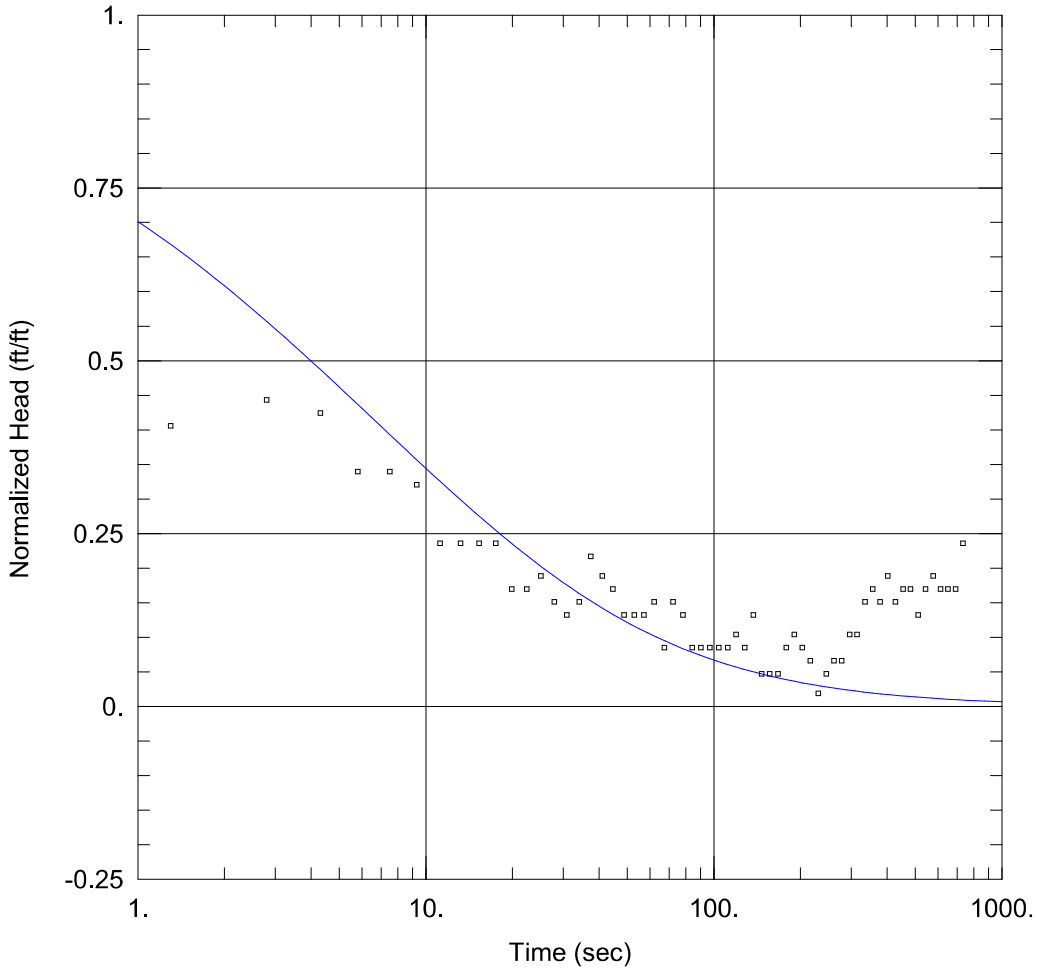
Saturated Thickness: 10.98 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-1B)

Initial Displacement: 0.687 ft
Total Well Penetration Depth: 10.98 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 10.98 ft
Screen Length: 10.98 ft
Well Radius: 0.2083 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 1.1E-5 cm/sec
y0 = 0.092 ft



MW-2B (FH1)

PROJECT INFORMATION

Company: HDR
Location: Xcel_Comanche_CCR
Test Well: MW-2B
Test Date: 10/12/2020

AQUIFER DATA

Saturated Thickness: 15. ft

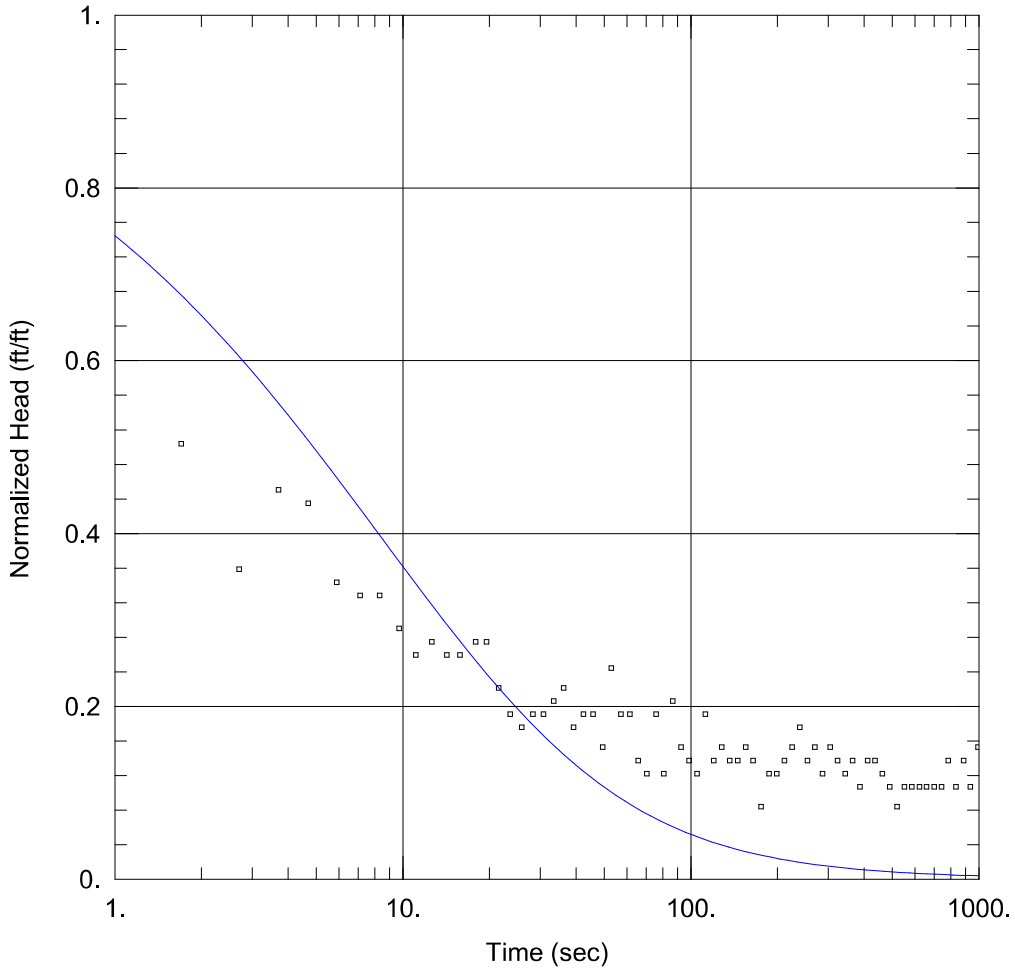
WELL DATA (MW-2B)

Initial Displacement: 0.106 ft
Total Well Penetration Depth: 10. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 14.09 ft
Screen Length: 10. ft
Well Radius: 0.333 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.00071 cm/sec
Kz/Kr = 1.
Ss = 0.0047 ft^{-1}



MW-2B (FH2)

PROJECT INFORMATION

Company: HDR
Location: Xcel_Comanche_CCR
Test Well: MW-2B
Test Date: 10/12/2020

AQUIFER DATA

Saturated Thickness: 15. ft

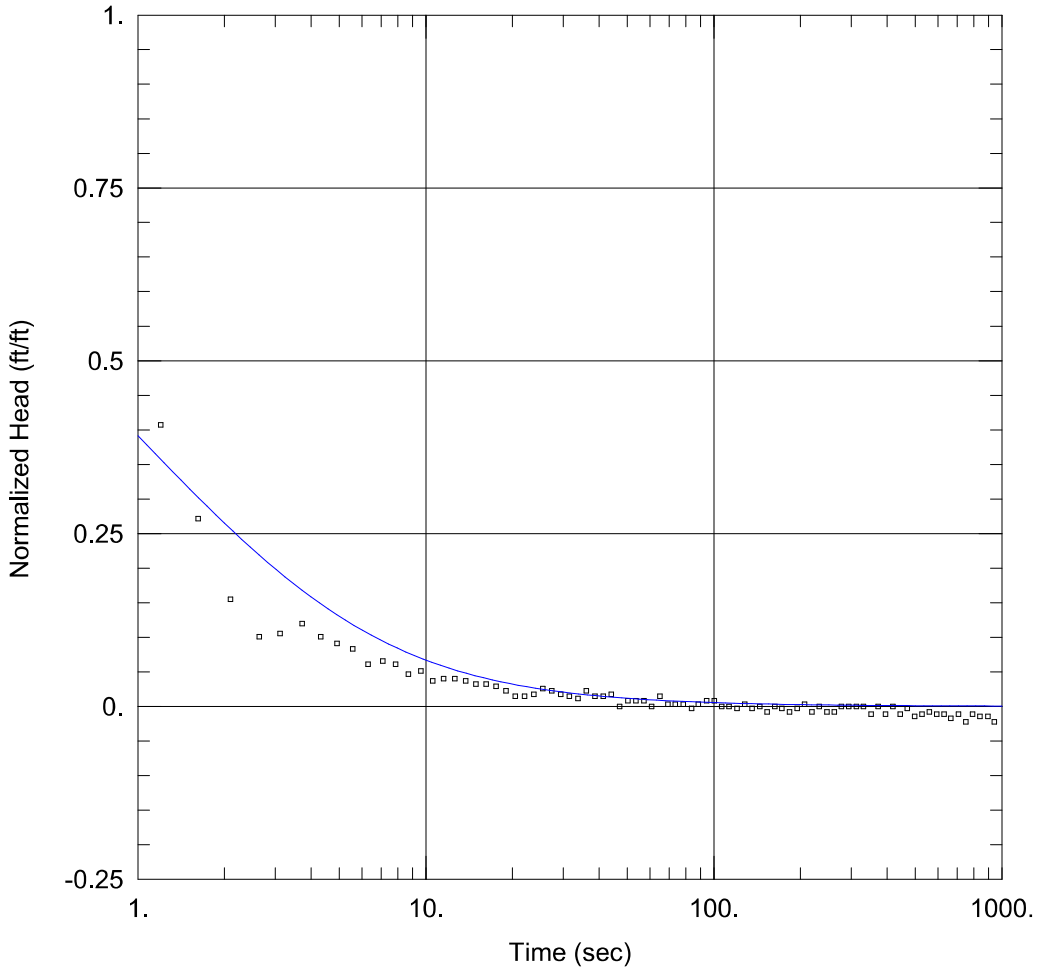
WELL DATA (MW-2B)

Initial Displacement: 0.131 ft
Total Well Penetration Depth: 10. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 14.09 ft
Screen Length: 10. ft
Well Radius: 0.333 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.0011 cm/sec
Kz/Kr = 1.
Ss = 0.0017 ft^{-1}



MW-2B (RH1)

PROJECT INFORMATION

Company: HDR
Location: Xcel_Comanche_CCR
Test Well: MW-2B
Test Date: 10/12/2020

AQUIFER DATA

Saturated Thickness: 15. ft

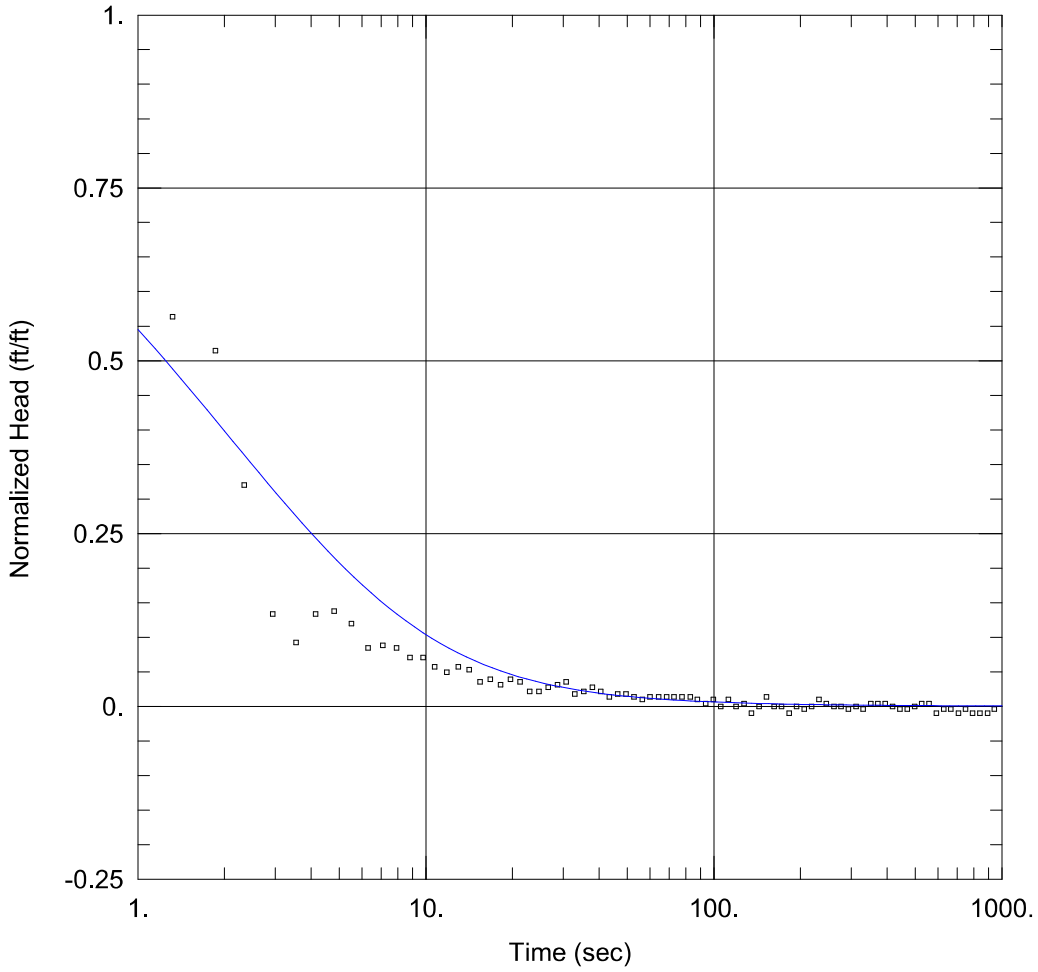
WELL DATA (MW-2B)

Initial Displacement: 0.626 ft
Total Well Penetration Depth: 10. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 14.09 ft
Screen Length: 10. ft
Well Radius: 0.333 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.0083 cm/sec
Kz/Kr = 1.
Ss = 0.0022 ft^{-1}



MW-2B (RH2)

PROJECT INFORMATION

Company: HDR
Location: Xcel_Comanche_CCR
Test Well: MW-2B
Test Date: 10/12/2020

AQUIFER DATA

Saturated Thickness: 15. ft

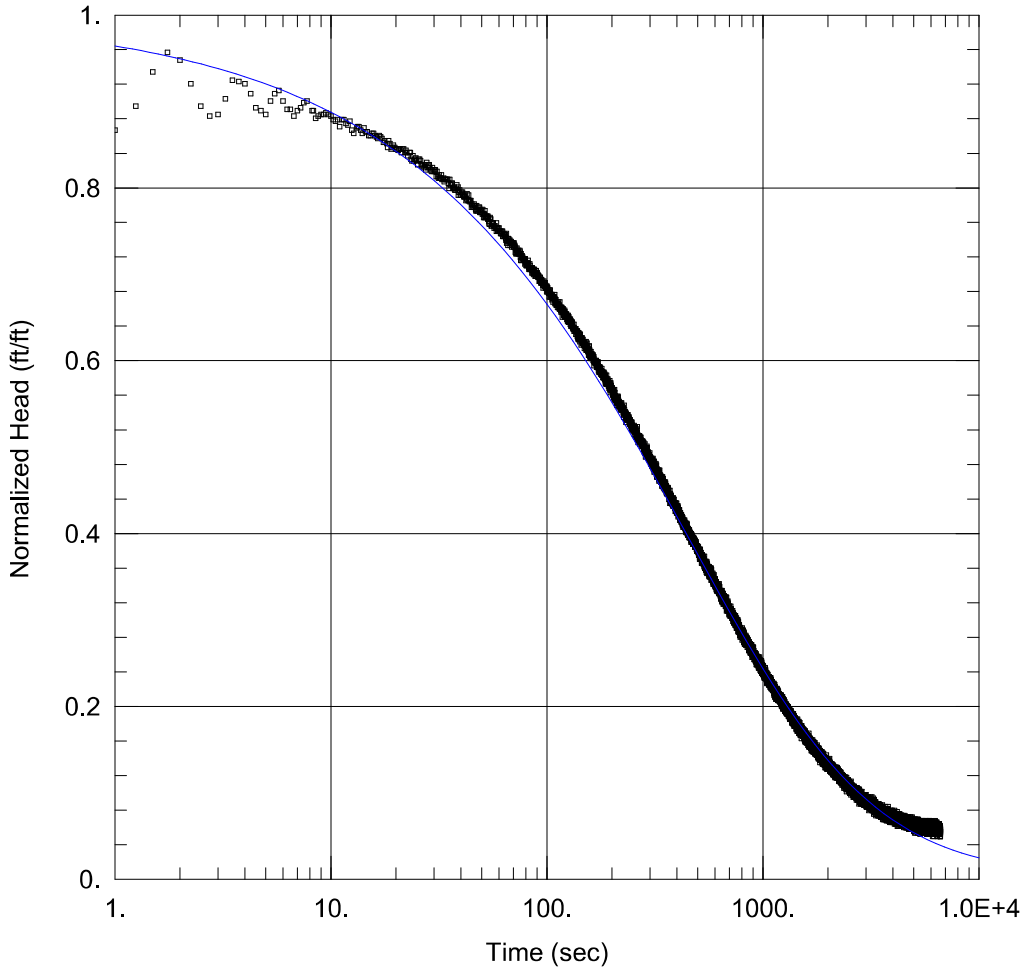
WELL DATA (MW-2B)

Initial Displacement: 0.509 ft
Total Well Penetration Depth: 10. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 14.09 ft
Screen Length: 10. ft
Well Radius: 0.333 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.0067 cm/sec
Kz/Kr = 1.
Ss = 0.00068 ft^{-1}



MW-4B (FH1)

PROJECT INFORMATION

Company: HDR
Location: Xcel_Comanche_CCR
Test Well: MW-4B
Test Date: 10/13/2020

AQUIFER DATA

Saturated Thickness: 19.58 ft

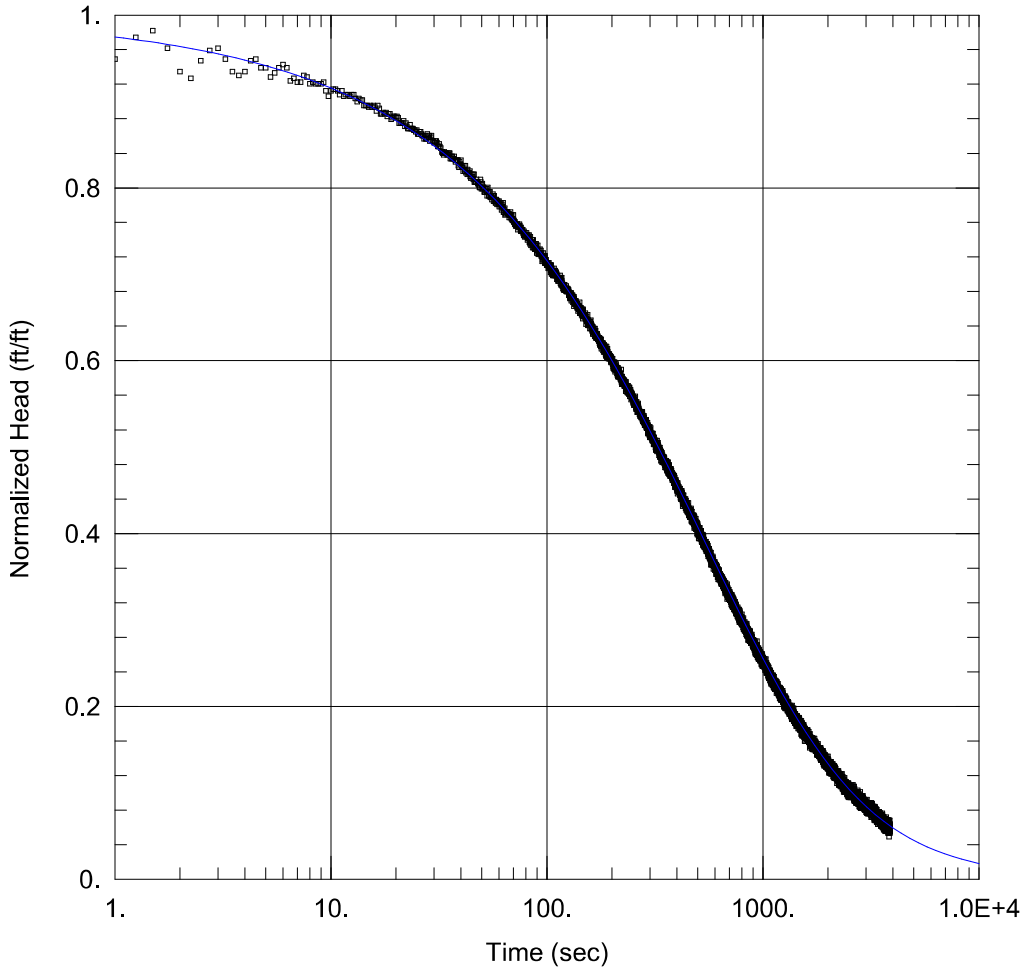
WELL DATA (MW-4B)

Initial Displacement: 1.156 ft
Total Well Penetration Depth: 19.58 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 19.58 ft
Screen Length: 19.58 ft
Well Radius: 0.333 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 1.1E-5 cm/sec
Kz/Kr = 1.
Ss = 0.00078 ft^{-1}



MW-4B (RH1)

PROJECT INFORMATION

Company: HDR
Location: Xcel_Comanche_CCR
Test Well: MW-4B
Test Date: 10/13/2020

AQUIFER DATA

Saturated Thickness: 19.58 ft

WELL DATA (MW-4B)

Initial Displacement: 1.119 ft
Total Well Penetration Depth: 19.58 ft
Casing Radius: 0.0833 ft

Static Water Column Height: 19.58 ft
Screen Length: 19.58 ft
Well Radius: 0.333 ft
Gravel Pack Porosity: 0.3

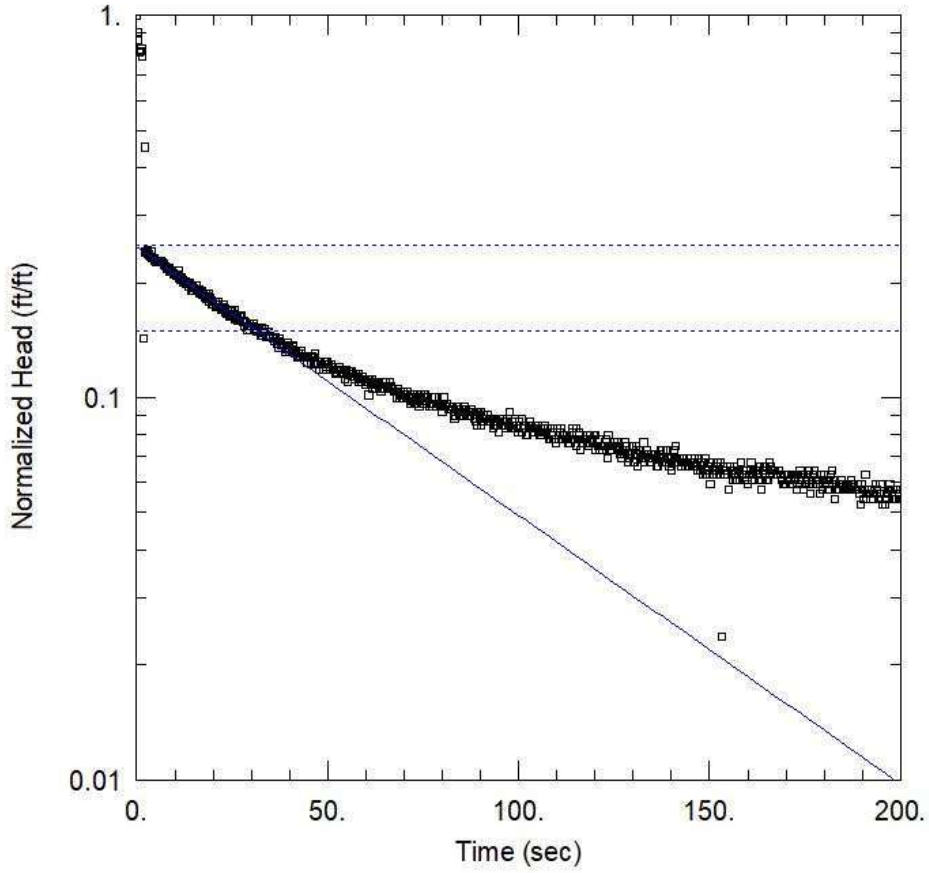
SOLUTION

Aquifer Model: Unconfined

Kr = 1.4E-5 cm/sec
Kz/Kr = 1.

Solution Method: KGS Model

Ss = 0.00029 ft^{-1}



MW-6 FALLING HEAD (SLUG IN)

Data Set:
Date: 10/29/20 Time: 11:21:39

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Project: 10025968
Location: Comanche Station
Test Well: W-6
Test Date: 10/13/2020

AQUIFER DATA

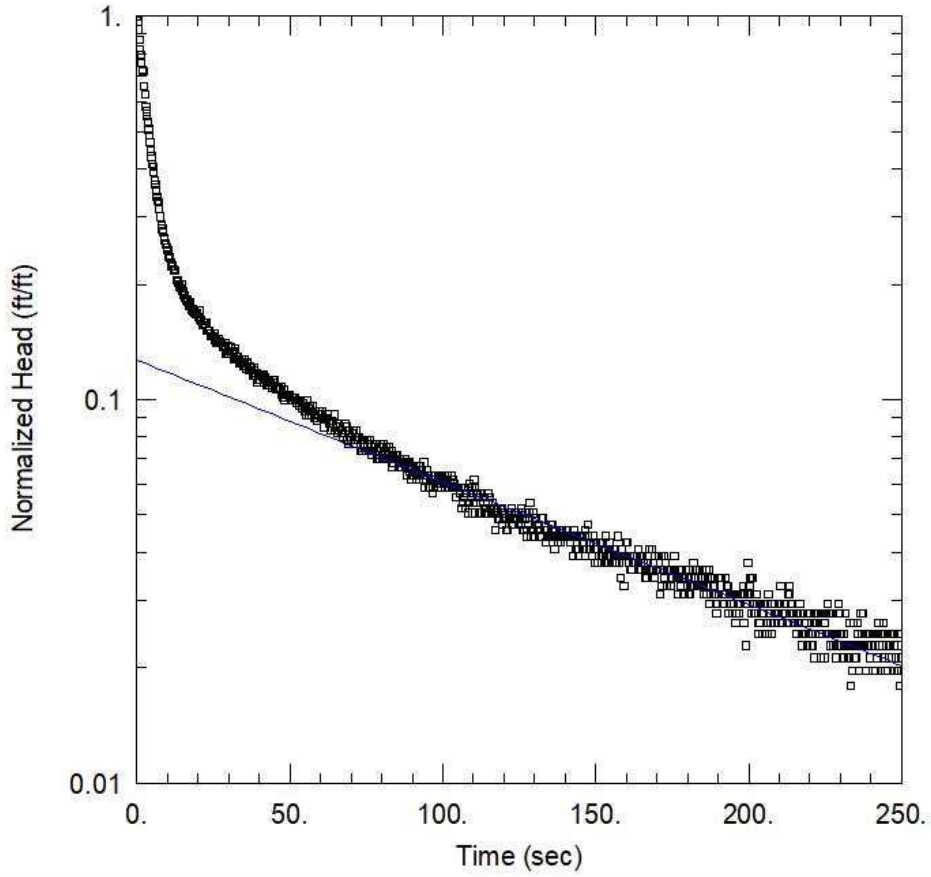
Saturated Thickness: 26.28 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-6)

Initial Displacement: 1.356 ft
Total Well Penetration Depth: 26.28 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 26.28 ft
Screen Length: 10. ft
Well Radius: 0.3333 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 0.0007013 cm/sec
y0 = 0.3364 ft



MW-6 RISING HEAD (SLUG OUT)

Data Set:
Date: 10/29/20 Time: 11:32:04

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Project: 10025968
Location: Comanche Station
Test Well: MW-6
Test Date: 10/13/2020

AQUIFER DATA

Saturated Thickness: 26.28 ft Anisotropy Ratio (Kz/Kr): 1.

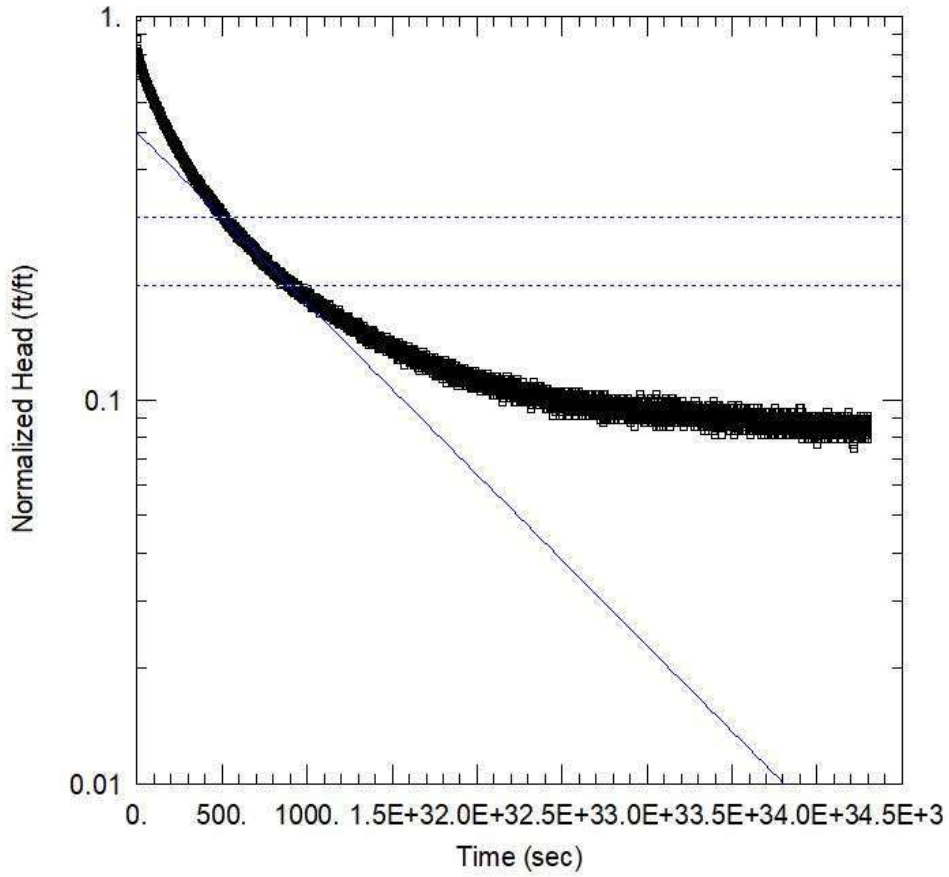
WELL DATA (MW-6)

Initial Displacement: 1.409 ft
Total Well Penetration Depth: 26.28 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 26.28 ft
Screen Length: 10. ft
Well Radius: 0.3333 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.00175 cm/sec y0 = 0.1785 ft



W-2A FALLING HEAD (SLUG IN)

Data Set:
Date: 10/29/20 Time: 09:56:24

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Project: 10025968
Location: Comanche Station
Test Well: W-2A
Test Date: 10/15/2020

AQUIFER DATA

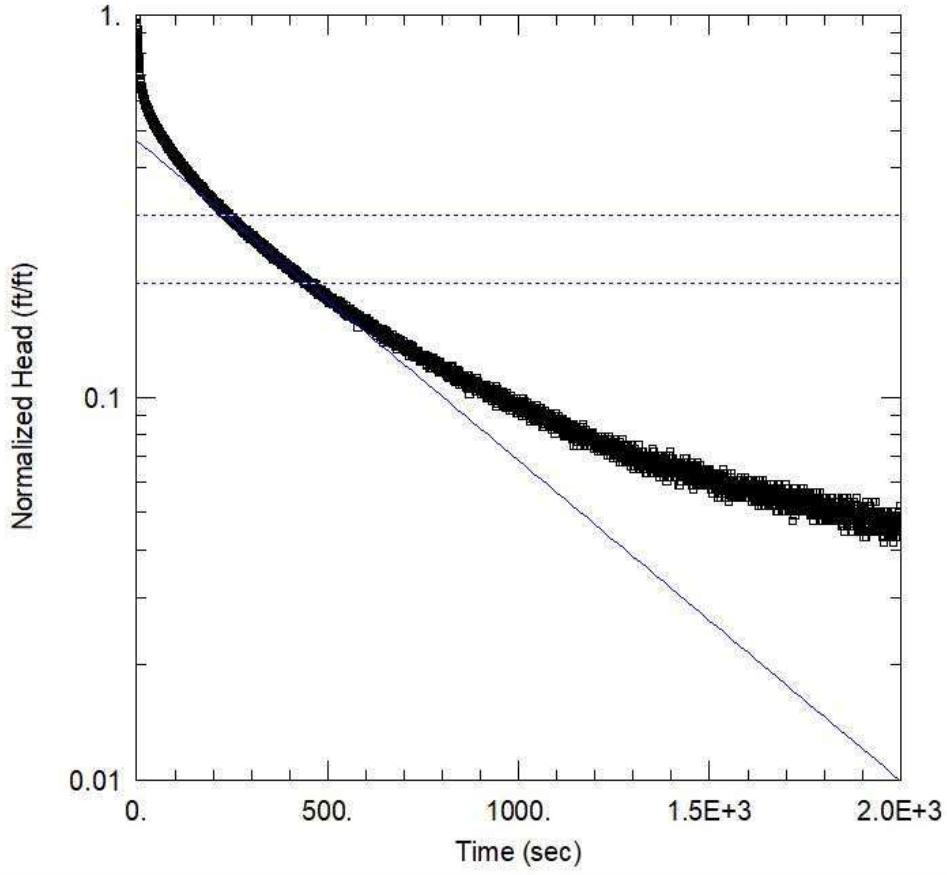
Saturated Thickness: 8.06 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (W-2A)

Initial Displacement: 1.113 ft
Total Well Penetration Depth: 8.06 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 8.06 ft
Screen Length: 8.06 ft
Well Radius: 0.2083 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice
K = 9.678E-5 cm/sec y0 = 0.5565 ft



W-2A RISING HEAD (SLUG OUT)

Data Set:
Date: 10/29/20 Time: 10:25:11

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Project: 10025968
Location: Comanche Station
Test Well: W-2A
Test Date: 10/15/2020

AQUIFER DATA

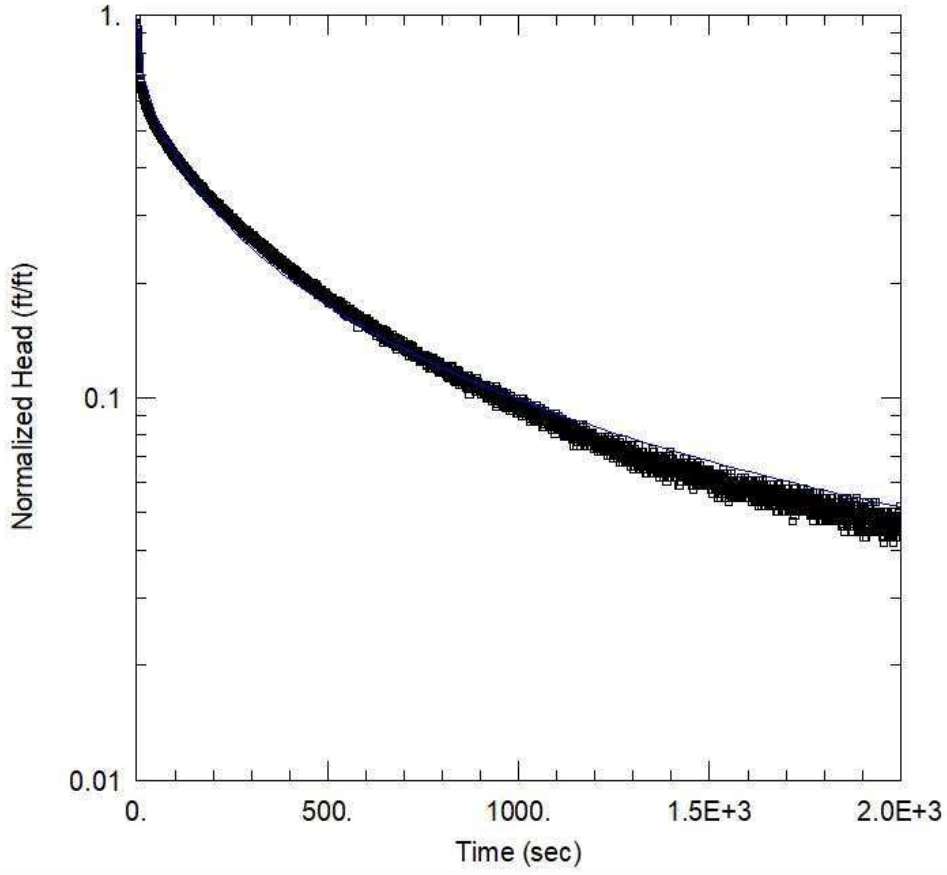
Saturated Thickness: 8.06 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (W-2A)

Initial Displacement: 1.561 ft
Total Well Penetration Depth: 8.06 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 8.06 ft
Screen Length: 8.06 ft
Well Radius: 0.2083 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.0001816 cm/sec
y0 = 0.7356 ft



W-2A RISING HEAD (SLUG OUT)

Data Set:
Date: 10/29/20 Time: 12:51:52

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Project: 10025968
Location: Comanche Station
Test Well: W-2A
Test Date: 10/15/2020

AQUIFER DATA

Saturated Thickness: 8.06 ft

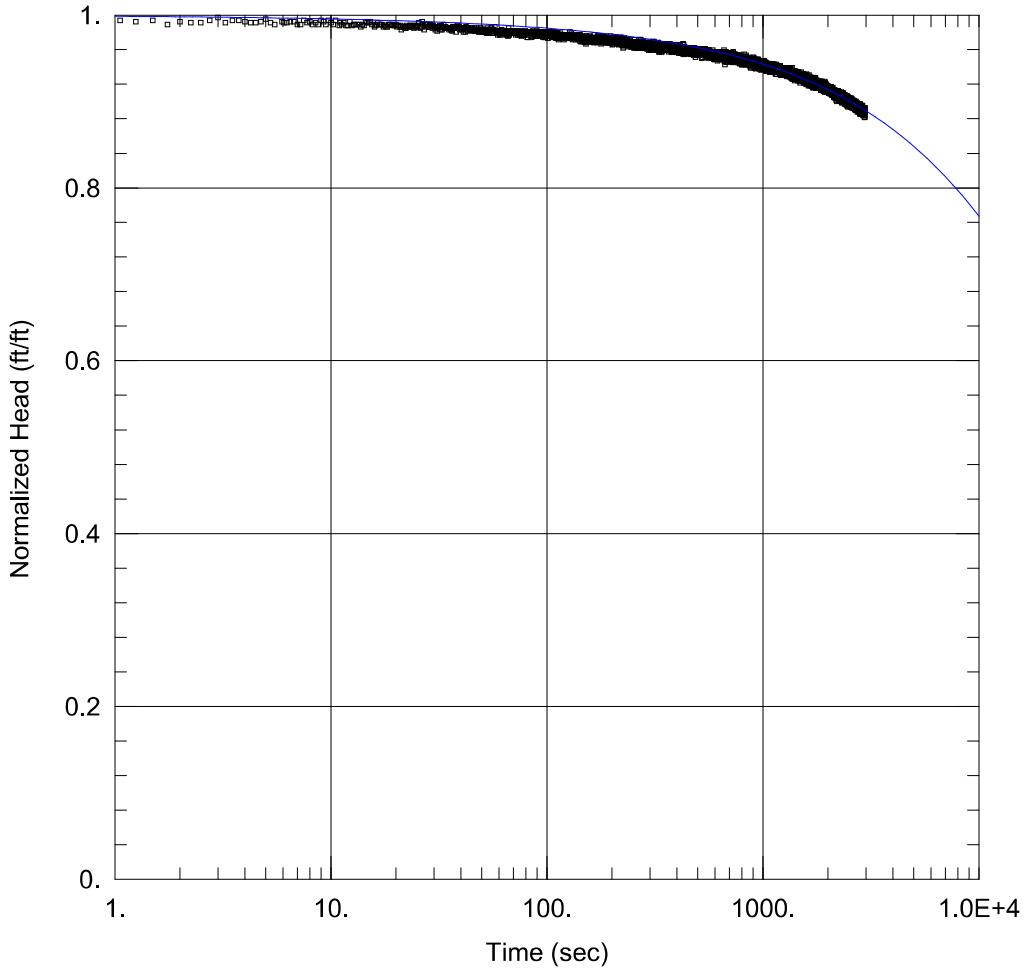
WELL DATA (W-2A)

Initial Displacement: 1.561 ft
Total Well Penetration Depth: 8.06 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 8.06 ft
Screen Length: 8.06 ft
Well Radius: 0.2083 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 5.86E-5 cm/sec
Kz/Kr = 1.
Ss = 0.01241 ft^{-1}



W-2B (RH3)

PROJECT INFORMATION

Company: HDR
Location: Xcel_Comanche_CCR
Test Well: W-2B
Test Date: 10/15/2020

AQUIFER DATA

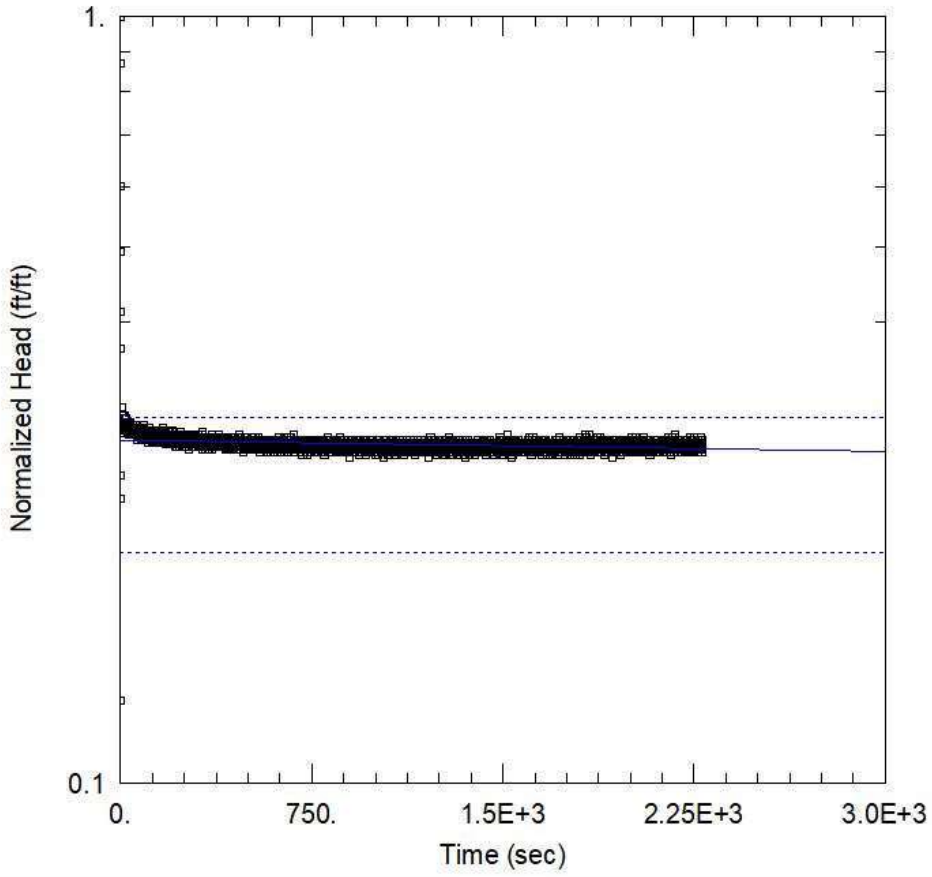
Saturated Thickness: 23.64 ft

WELL DATA (W-2B)

Initial Displacement: 1.481 ft
Total Well Penetration Depth: 23.64 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 23.64 ft
Screen Length: 20. ft
Well Radius: 0.333 ft

SOLUTION

Aquifer Model: Unconfined
Kr = 1.9E-7 cm/sec
Kz/Kr = 1.
Solution Method: KGS Model
Ss = 6.3E-5 ft^{-1}



W-5 FALLING HEAD (SLUG IN) 1

Data Set:
Date: 10/29/20 Time: 08:40:07

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Project: 10025968
Location: Comanche Station
Test Well: W-5
Test Date: 10/14/2020

AQUIFER DATA

Saturated Thickness: 7.07 ft Anisotropy Ratio (Kz/Kr): 1.

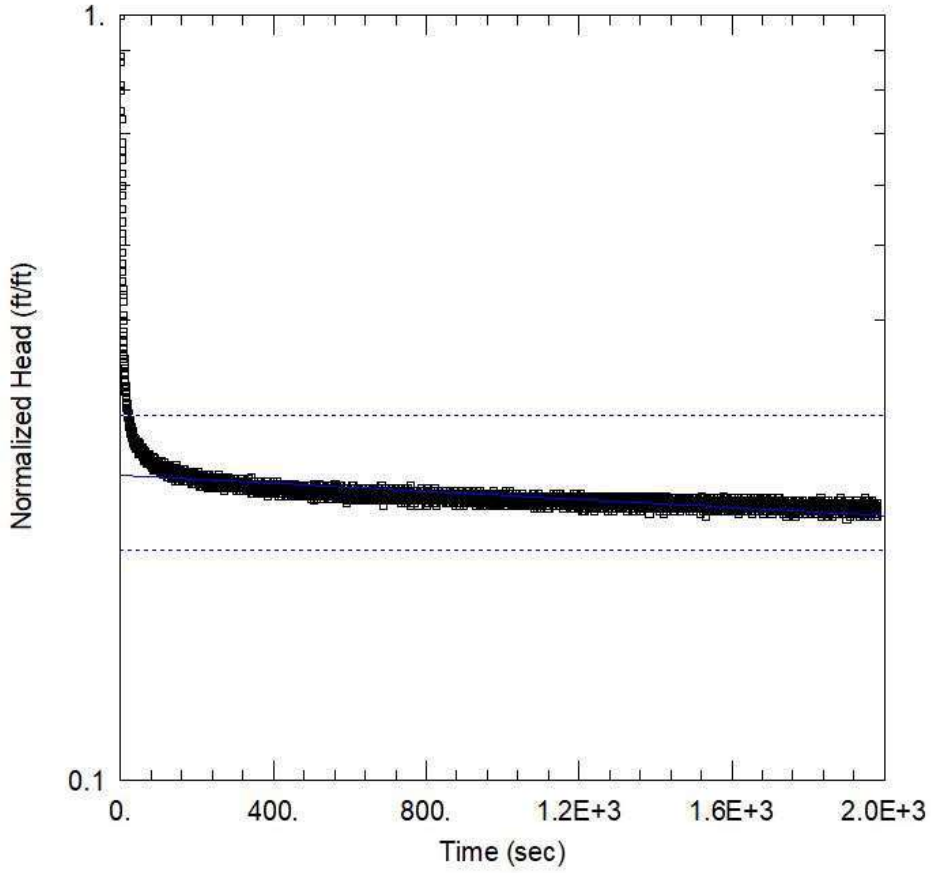
WELL DATA (W-5)

Initial Displacement: 1.111 ft
Total Well Penetration Depth: 7.07 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 7.07 ft
Screen Length: 7.07 ft
Well Radius: 0.3333 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 2.127E-6 cm/sec y0 = 0.3111 ft



W-5 RISING HEAD (SLUG OUT) 1

Data Set:
Date: 10/29/20 Time: 09:36:04

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Project: 10025968
Location: Comanche Station
Test Well: W-5
Test Date: 10/14/2020

AQUIFER DATA

Saturated Thickness: 7.07 ft Anisotropy Ratio (Kz/Kr): 1.

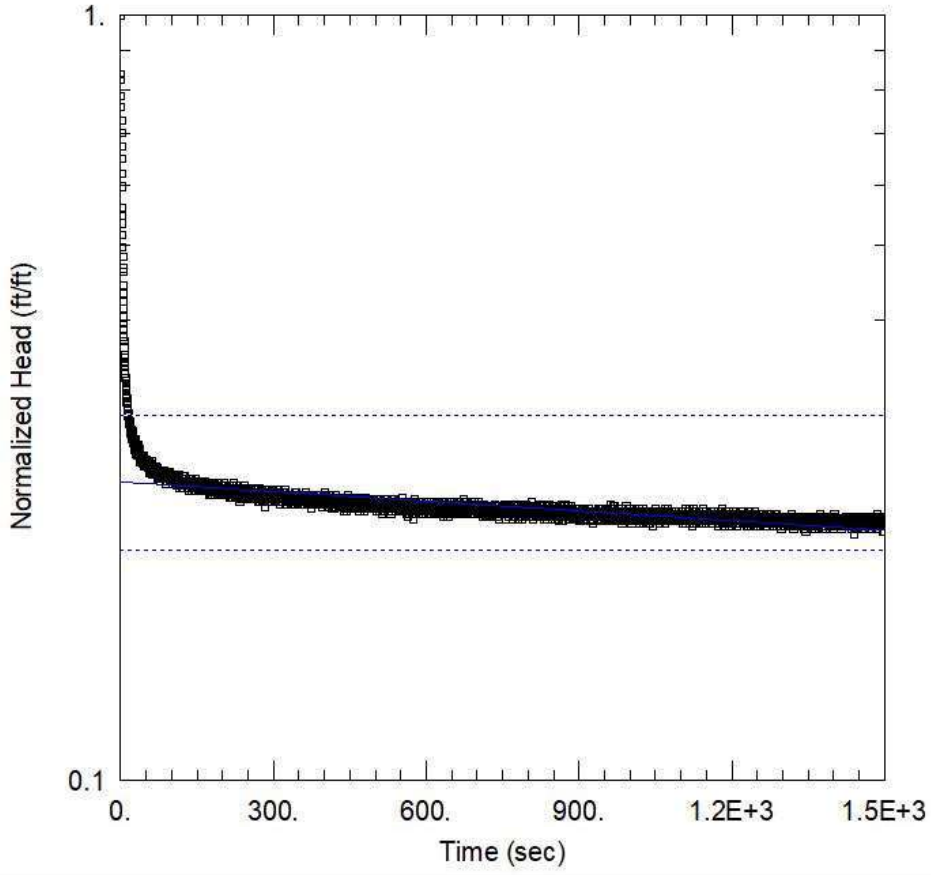
WELL DATA (W-5)

Initial Displacement: 1.314 ft
Total Well Penetration Depth: 7.07 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 7.07 ft
Screen Length: 7.07 ft
Well Radius: 0.3333 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 2.069E-6 cm/sec y0 = 0.329 ft



W-5 RISING HEAD (SLUG OUT) 2

Data Set:
Date: 10/29/20 Time: 09:43:10

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Project: 10025968
Location: Comanche Station
Test Well: W-5
Test Date: 10/14/2020

AQUIFER DATA

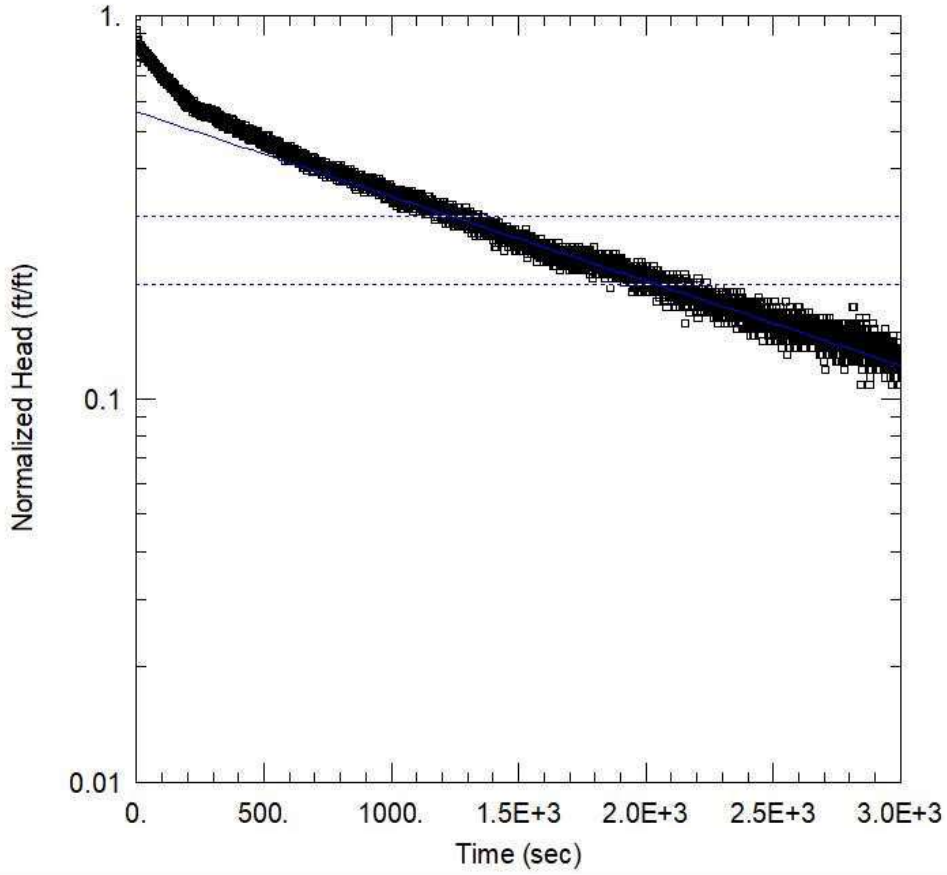
Saturated Thickness: 7.07 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (W-5)

Initial Displacement: 1.388 ft
Total Well Penetration Depth: 7.07 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 7.07 ft
Screen Length: 7.07 ft
Well Radius: 0.3333 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 3.31E-6 cm/sec
y0 = 0.3404 ft



W-6 FALLING HEAD (SLUG IN)

Data Set:
Date: 10/28/20 Time: 17:40:23

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Project: 10025968
Location: Comanche Station
Test Well: W-6
Test Date: 10/14/2020

AQUIFER DATA

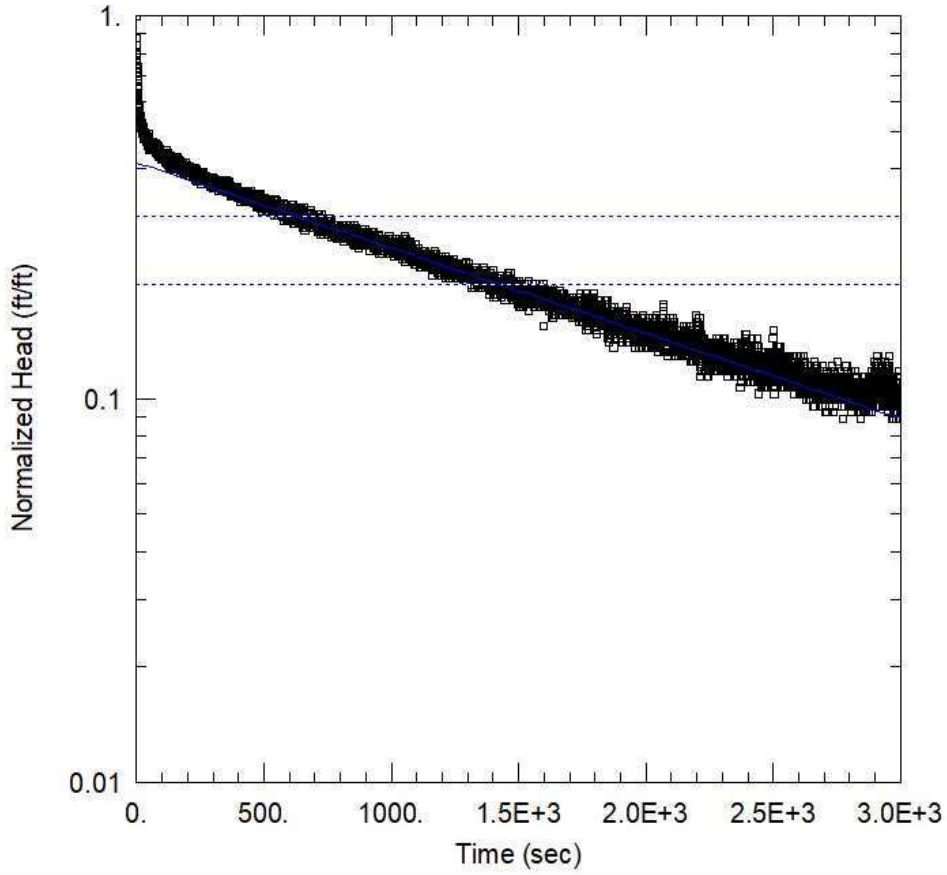
Saturated Thickness: 9.18 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (W-6)

Initial Displacement: 0.4227 ft
Total Well Penetration Depth: 9.18 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 9.18 ft
Screen Length: 9.18 ft
Well Radius: 0.3333 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 8.045E-5 cm/sec
y0 = 0.2376 ft



W-6 RISING HEAD (SLUG OUT)

Data Set:
Date: 10/28/20 Time: 17:43:25

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Project: 10025968
Location: Comanche Station
Test Well: W-6
Test Date: 10/14/2020

AQUIFER DATA

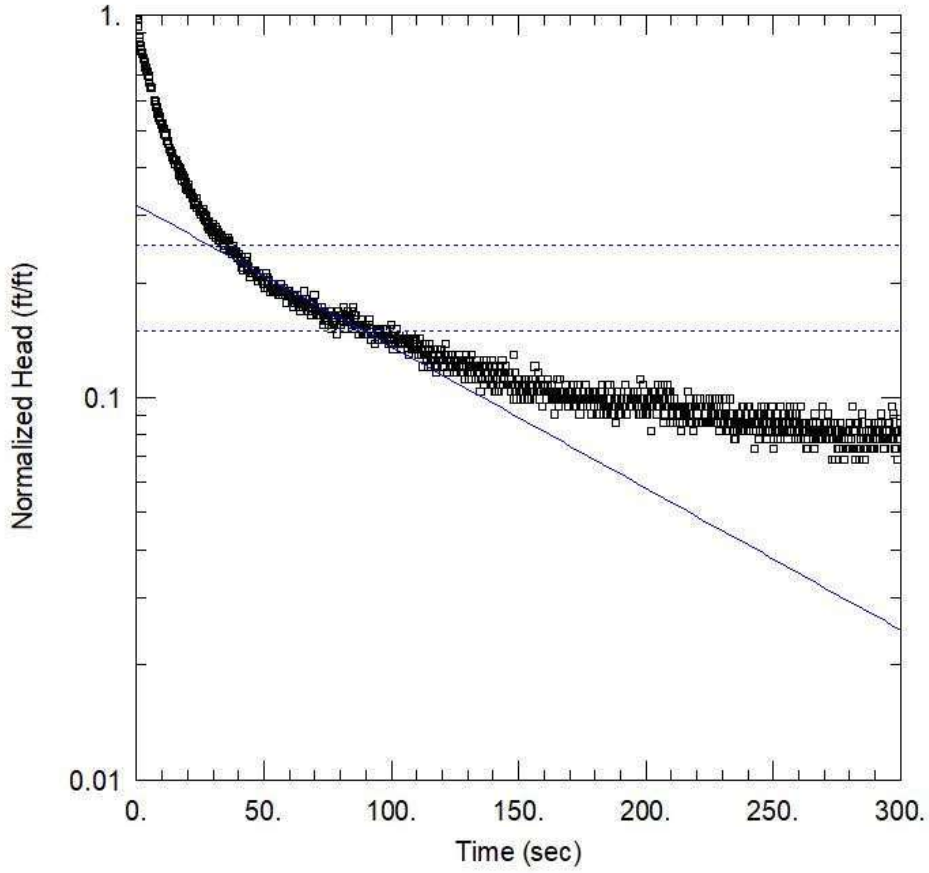
Saturated Thickness: 9.18 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (W-6)

Initial Displacement: 0.6226 ft
Total Well Penetration Depth: 9.18 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 9.18 ft
Screen Length: 9.18 ft
Well Radius: 0.3333 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 8.117E-5 cm/sec
y0 = 0.2578 ft



W-7 FALLING HEAD (SLUG IN)

Data Set:
Date: 10/28/20 Time: 16:47:21

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Project: 10025968
Location: Comanche Station
Test Well: W-7
Test Date: 10/14/2020

AQUIFER DATA

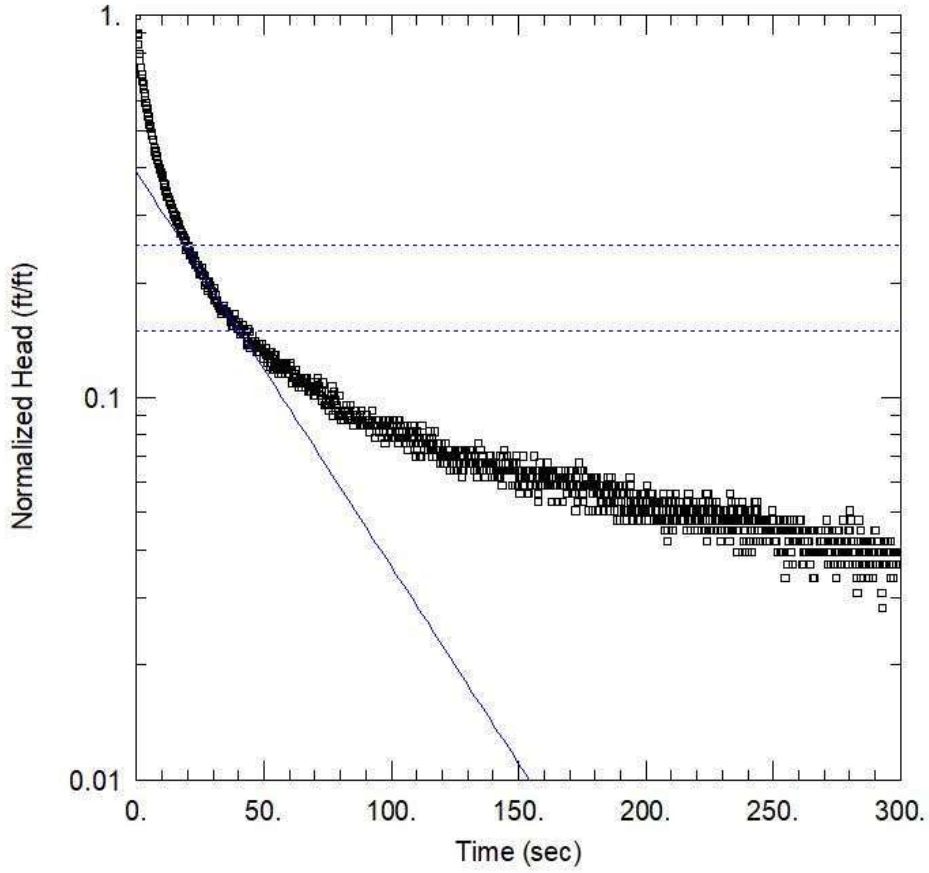
Saturated Thickness: 16.53 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (W-7)

Initial Displacement: 0.5228 ft
Total Well Penetration Depth: 16.53 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 16.53 ft
Screen Length: 15. ft
Well Radius: 0.2083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 0.0002992 cm/sec
y0 = 0.1667 ft



W-7 RISING HEAD (SLUG OUT)

Data Set:
Date: 10/28/20 Time: 16:58:22

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Project: 10025968
Location: Comanche Station
Test Well: W-7
Test Date: 10/14/2020

AQUIFER DATA

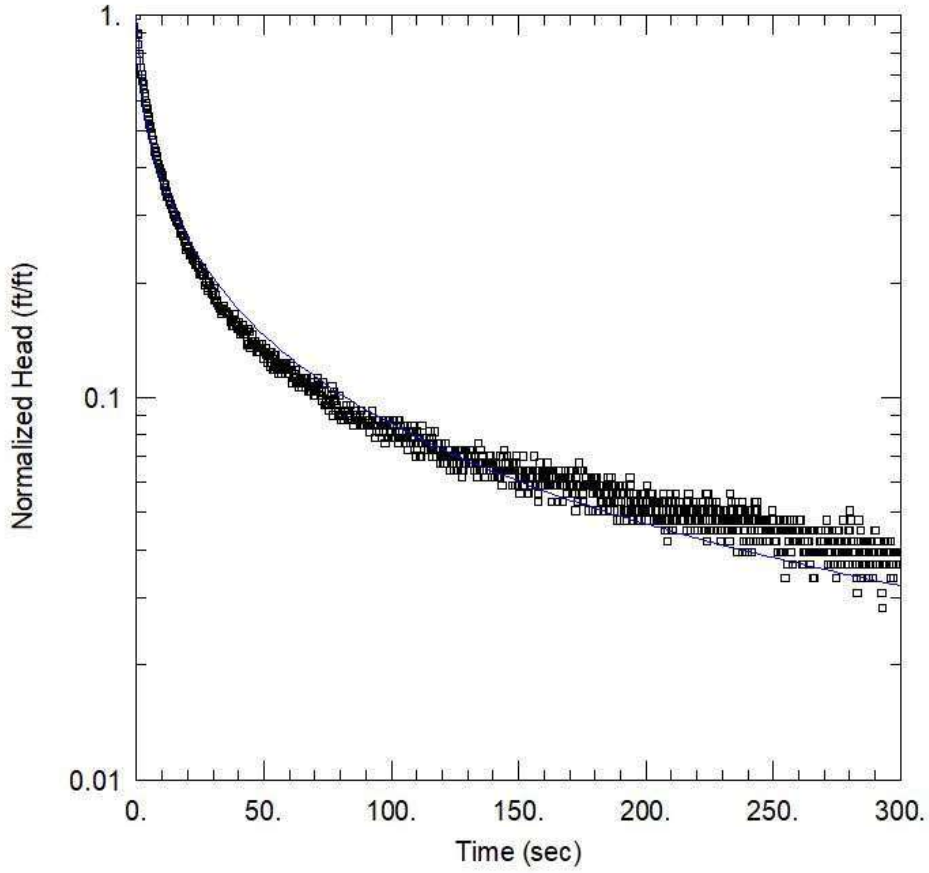
Saturated Thickness: 16.53 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (W-7)

Initial Displacement: 0.8023 ft
Total Well Penetration Depth: 16.53 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 16.53 ft
Screen Length: 15. ft
Well Radius: 0.2083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 0.0008327 cm/sec
y0 = 0.3119 ft



W-7 RISING HEAD (SLUG OUT)

Data Set:
Date: 10/28/20 Time: 17:09:35

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Project: 10025968
Location: Comanche Station
Test Well: W-7
Test Date: 10/14/2020

AQUIFER DATA

Saturated Thickness: 16.53 ft

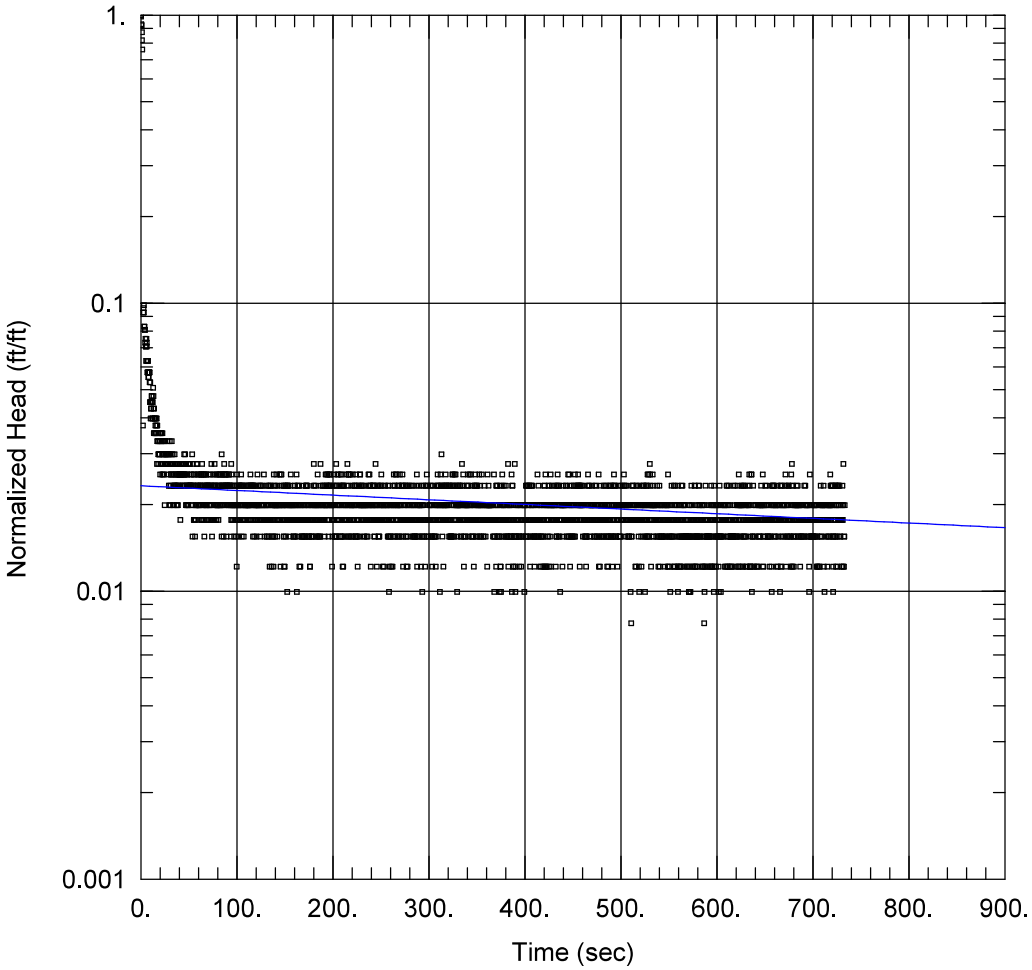
WELL DATA (W-7)

Initial Displacement: 0.8023 ft
Total Well Penetration Depth: 16.53 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 16.53 ft
Screen Length: 15. ft
Well Radius: 0.2083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 0.0003313 cm/sec
Kz/Kr = 1.
Ss = 0.01114 ft^{-1}



MW-1B (FH1)

PROJECT INFORMATION

Company: HDR
Location: Xcel_Comanche_CCR
Test Well: MW-1B
Test Date: 10/13/2020

AQUIFER DATA

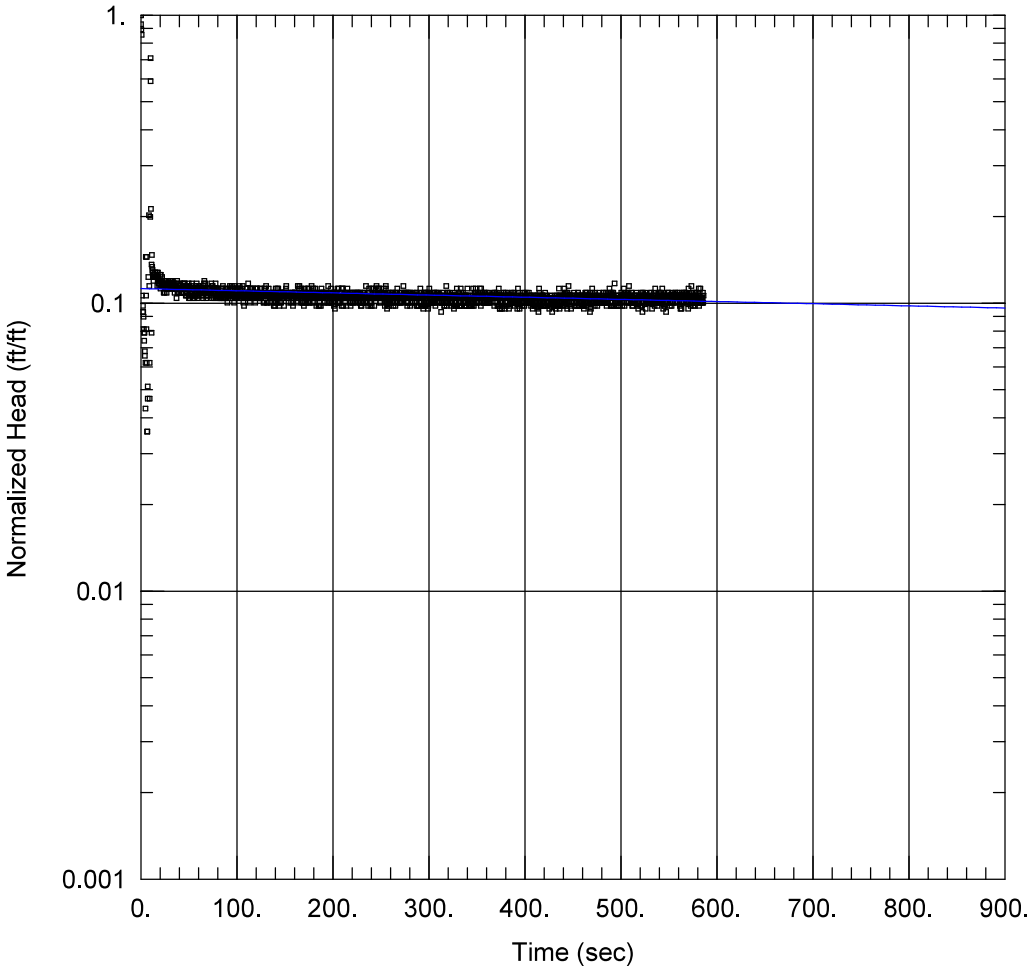
Saturated Thickness: 10.98 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-1B)

Initial Displacement: 0.905 ft
Total Well Penetration Depth: 10.98 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 10.98 ft
Screen Length: 10.98 ft
Well Radius: 0.2083 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 2.8E-5 cm/sec
y0 = 0.021 ft



MW-1B (FH2)

PROJECT INFORMATION

Company: HDR
Location: Xcel_Comanche_CCR
Test Well: MW-1B
Test Date: 10/13/2020

AQUIFER DATA

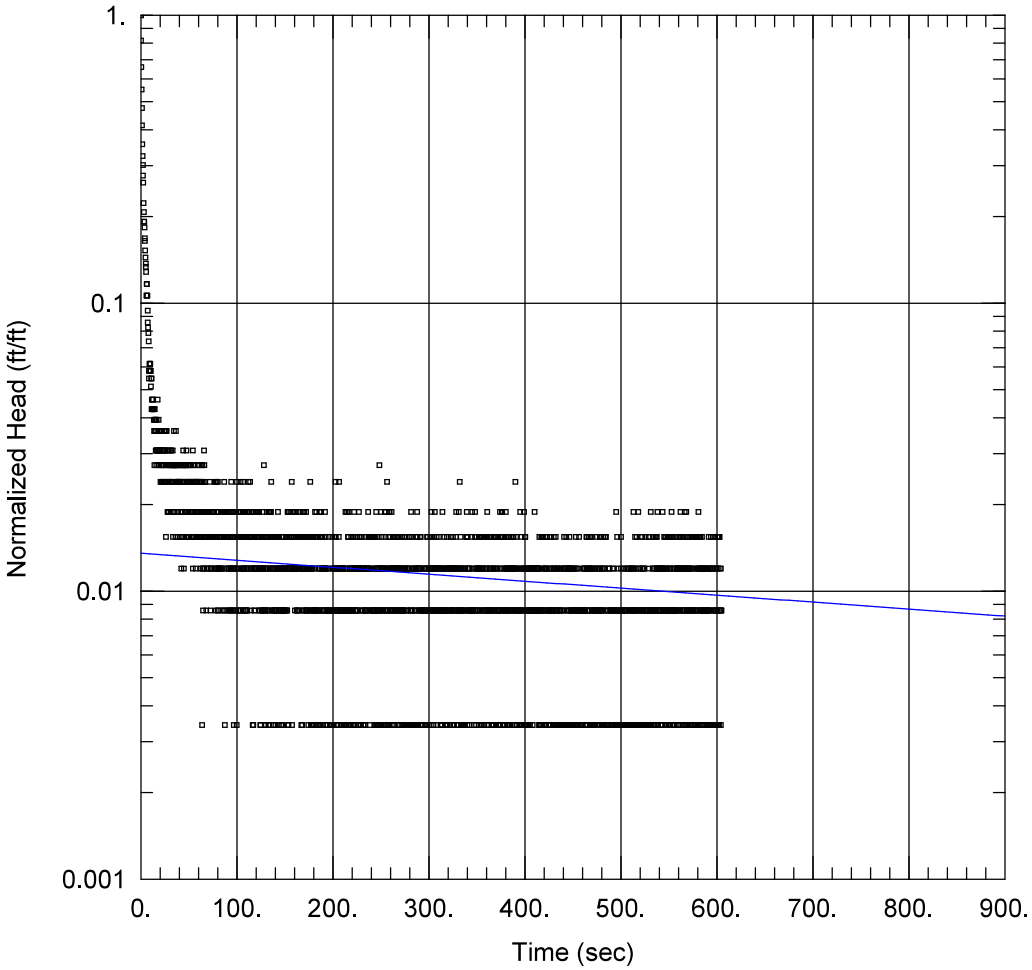
Saturated Thickness: 10.98 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-1B)

Initial Displacement: 0.837 ft
Total Well Penetration Depth: 10.98 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 10.98 ft
Screen Length: 10.98 ft
Well Radius: 0.2083 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 1.3E-5 cm/sec
y0 = 0.094 ft



MW-1B (RH1)

PROJECT INFORMATION

Company: HDR
Location: Xcel_Comanche_CCR
Test Well: MW-1B
Test Date: 10/13/2020

AQUIFER DATA

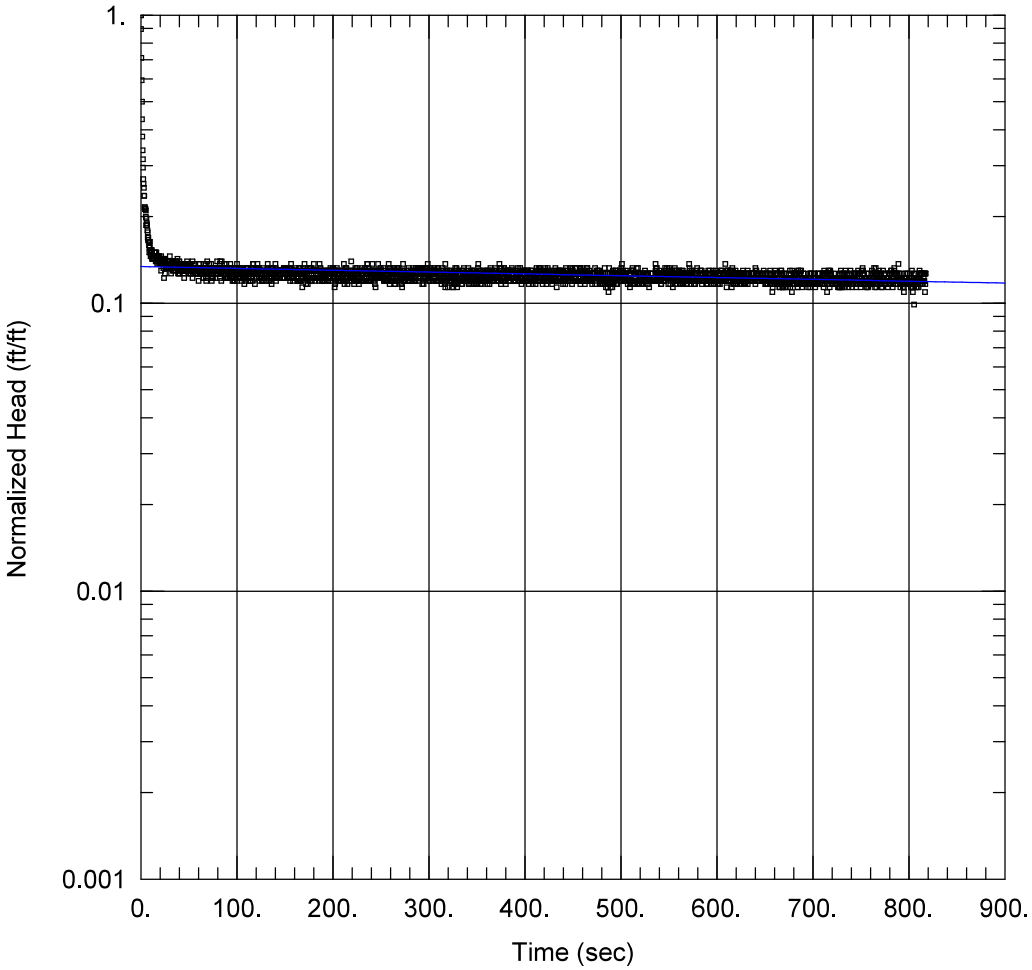
Saturated Thickness: 10.98 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-1B)

Initial Displacement: 0.584 ft
Total Well Penetration Depth: 10.98 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 10.98 ft
Screen Length: 10.98 ft
Well Radius: 0.2083 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 4.2E-5 cm/sec
y0 = 0.0079 ft



MW-1B (RH2)

PROJECT INFORMATION

Company: HDR
Location: Xcel_Comanche_CCR
Test Well: MW-1B
Test Date: 10/13/2020

AQUIFER DATA

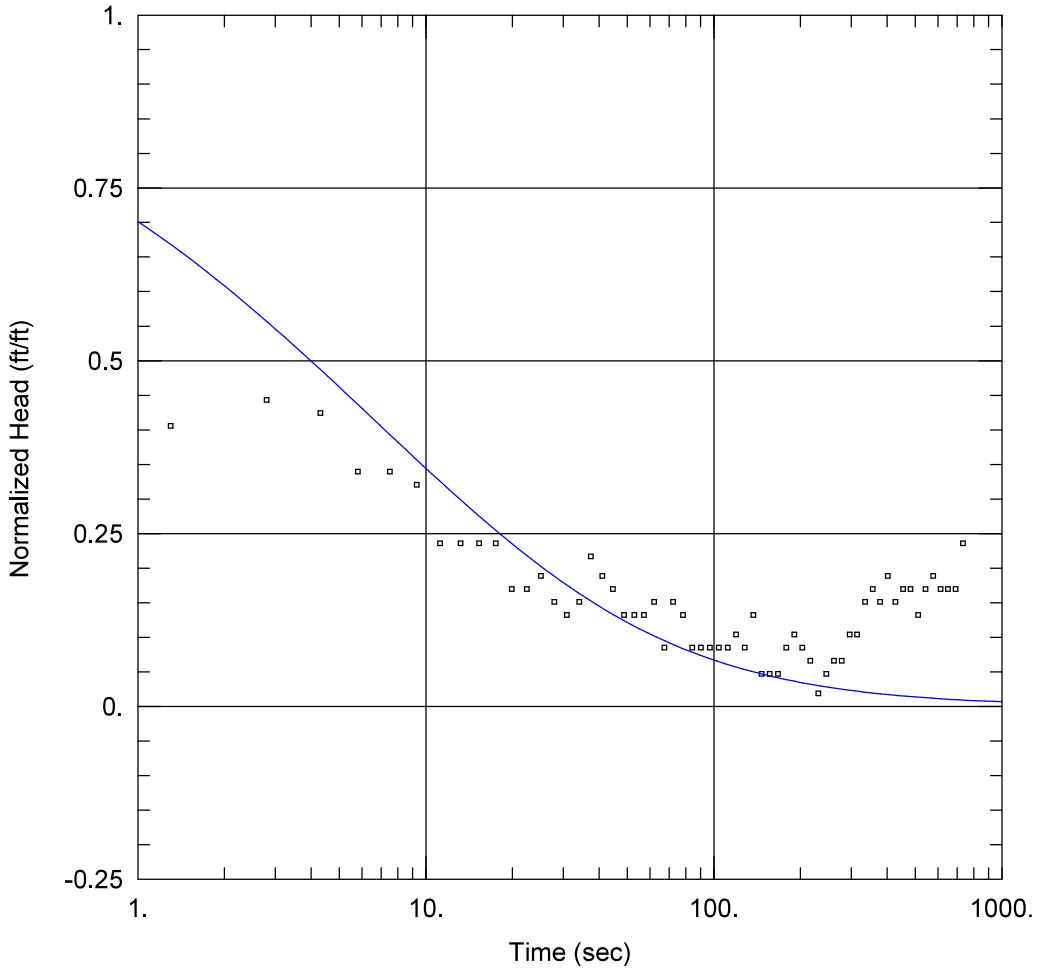
Saturated Thickness: 10.98 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-1B)

Initial Displacement: 0.687 ft
Total Well Penetration Depth: 10.98 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 10.98 ft
Screen Length: 10.98 ft
Well Radius: 0.2083 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 1.1E-5 cm/sec
y0 = 0.092 ft



MW-2B (FH1)

PROJECT INFORMATION

Company: HDR
Location: Xcel_Comanche_CCR
Test Well: MW-2B
Test Date: 10/12/2020

AQUIFER DATA

Saturated Thickness: 15. ft

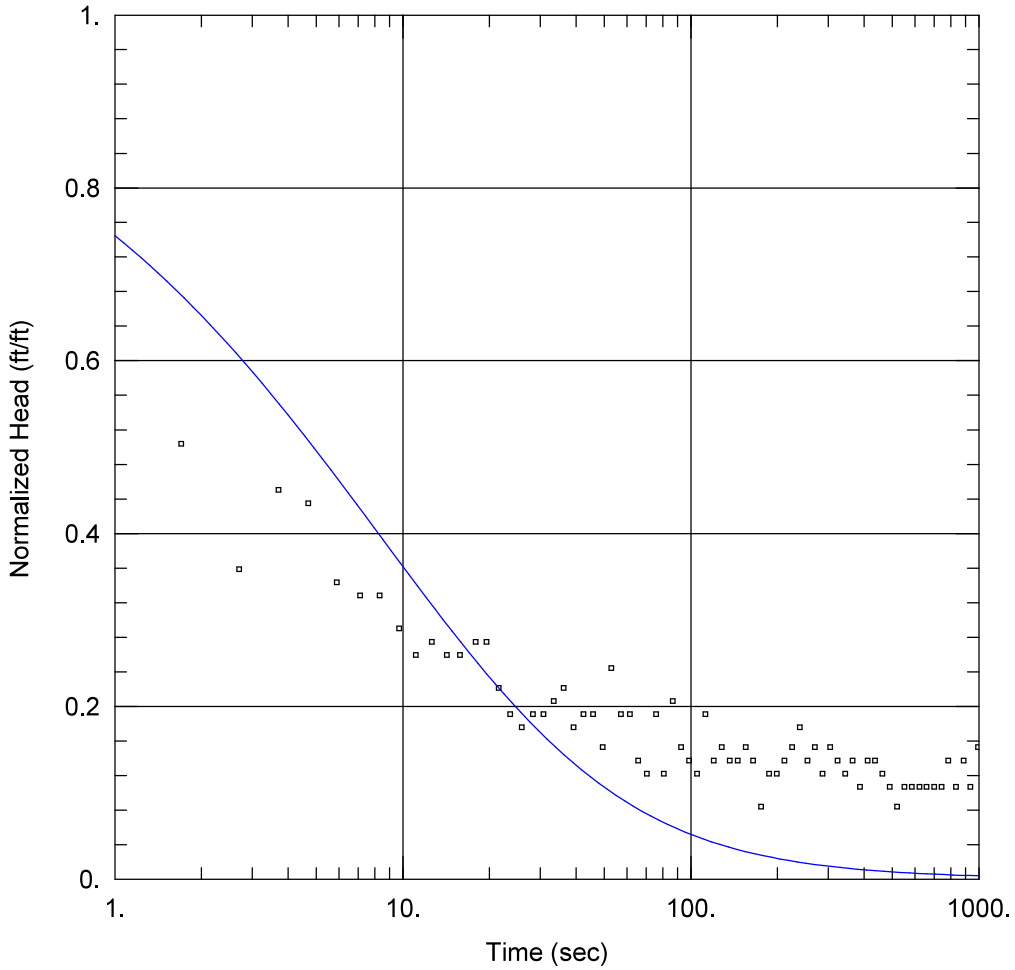
WELL DATA (MW-2B)

Initial Displacement: 0.106 ft
Total Well Penetration Depth: 10. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 14.09 ft
Screen Length: 10. ft
Well Radius: 0.333 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.00071 cm/sec
Kz/Kr = 1.
Ss = 0.0047 ft^{-1}



MW-2B (FH2)

PROJECT INFORMATION

Company: HDR
Location: Xcel_Comanche_CCR
Test Well: MW-2B
Test Date: 10/12/2020

AQUIFER DATA

Saturated Thickness: 15. ft

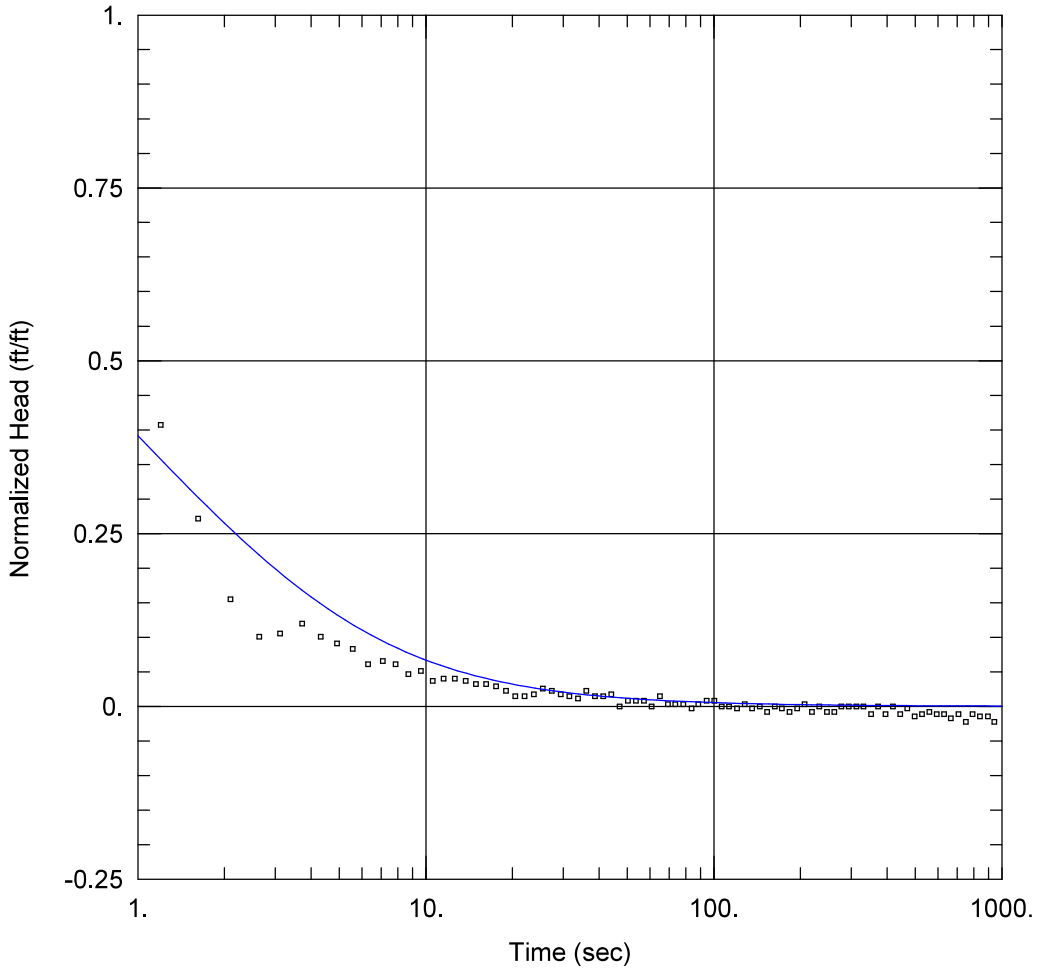
WELL DATA (MW-2B)

Initial Displacement: 0.131 ft
Total Well Penetration Depth: 10. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 14.09 ft
Screen Length: 10. ft
Well Radius: 0.333 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.0011 cm/sec
Kz/Kr = 1.
Ss = 0.0017 ft^{-1}



MW-2B (RH1)

PROJECT INFORMATION

Company: HDR
Location: Xcel_Comanche_CCR
Test Well: MW-2B
Test Date: 10/12/2020

AQUIFER DATA

Saturated Thickness: 15. ft

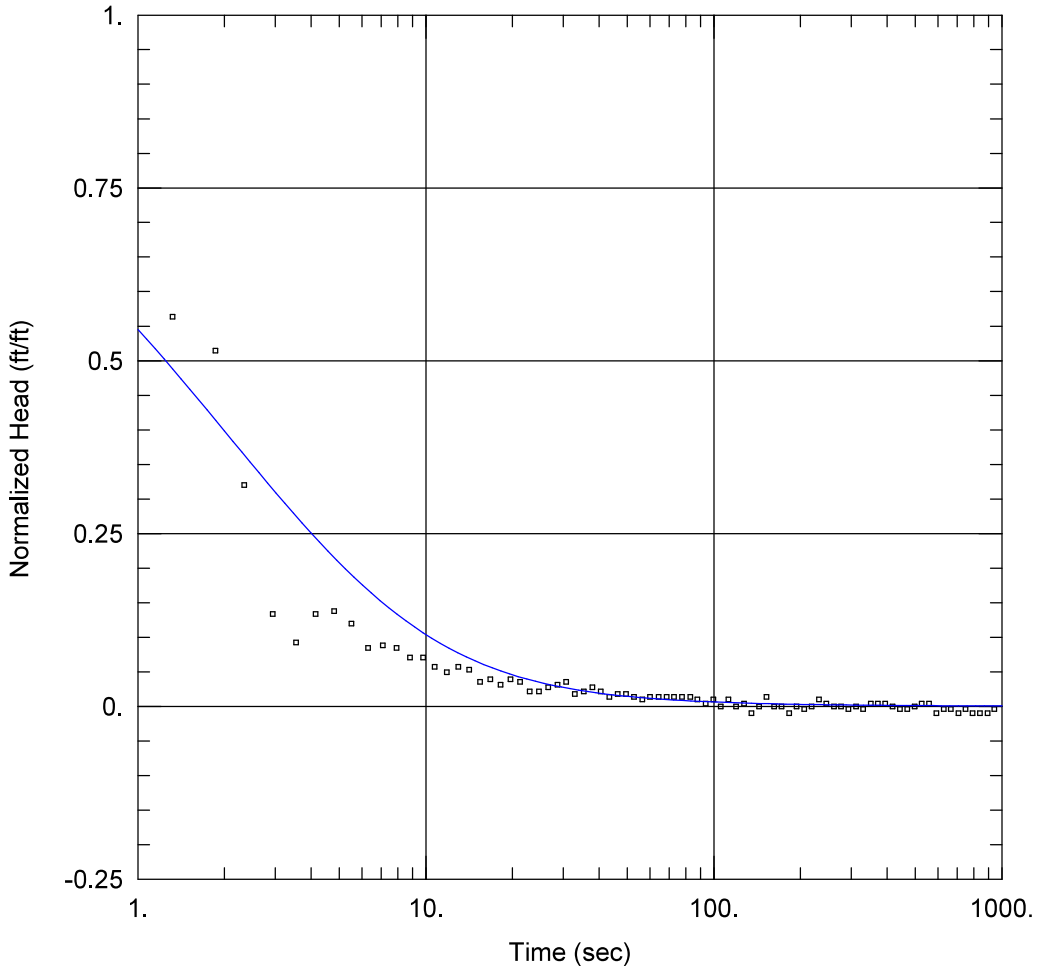
WELL DATA (MW-2B)

Initial Displacement: 0.626 ft
Total Well Penetration Depth: 10. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 14.09 ft
Screen Length: 10. ft
Well Radius: 0.333 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.0083 cm/sec
Kz/Kr = 1.
Ss = 0.0022 ft^{-1}



MW-2B (RH2)

PROJECT INFORMATION

Company: HDR
Location: Xcel_Comanche_CCR
Test Well: MW-2B
Test Date: 10/12/2020

AQUIFER DATA

Saturated Thickness: 15. ft

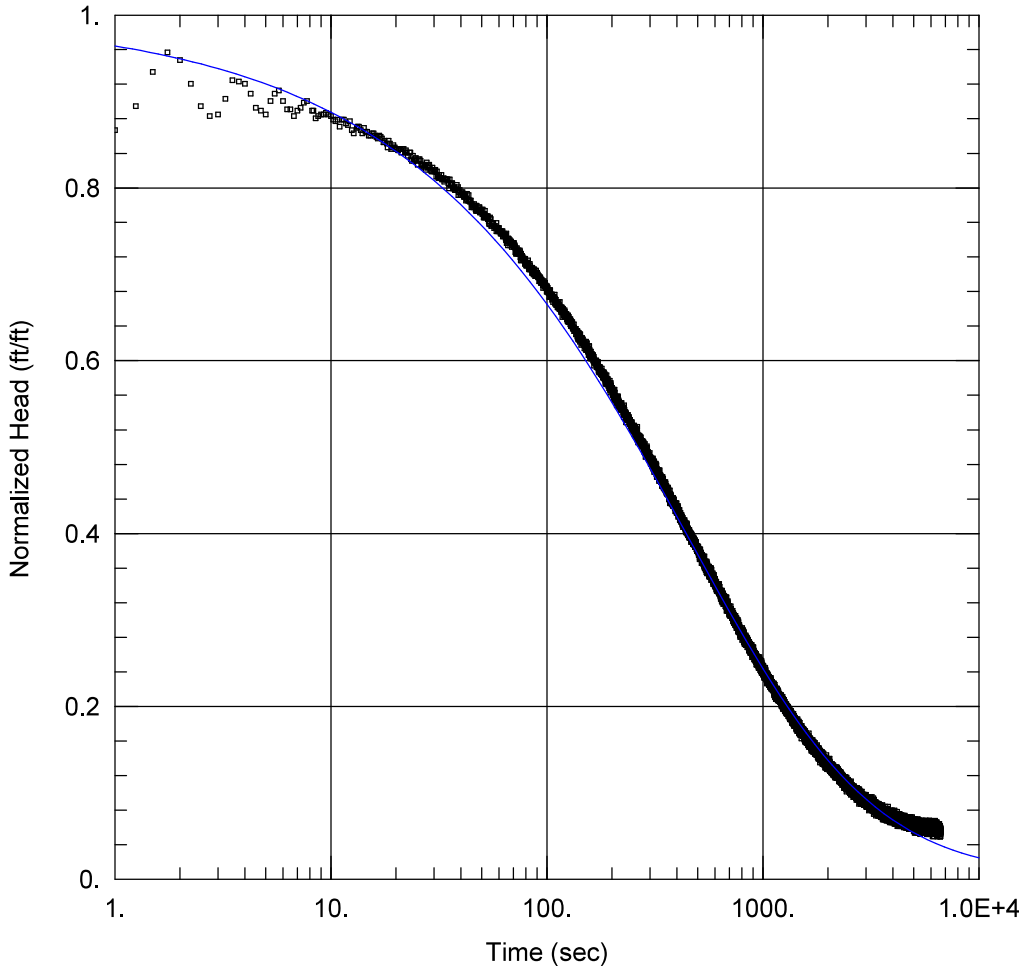
WELL DATA (MW-2B)

Initial Displacement: 0.509 ft
Total Well Penetration Depth: 10. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 14.09 ft
Screen Length: 10. ft
Well Radius: 0.333 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.0067 cm/sec
Kz/Kr = 1.
Ss = 0.00068 ft^{-1}



MW-4B (FH1)

PROJECT INFORMATION

Company: HDR
Location: Xcel_Comanche_CCR
Test Well: MW-4B
Test Date: 10/13/2020

AQUIFER DATA

Saturated Thickness: 19.58 ft

WELL DATA (MW-4B)

Initial Displacement: 1.156 ft
Total Well Penetration Depth: 19.58 ft
Casing Radius: 0.0833 ft

Static Water Column Height: 19.58 ft
Screen Length: 19.58 ft
Well Radius: 0.333 ft
Gravel Pack Porosity: 0.3

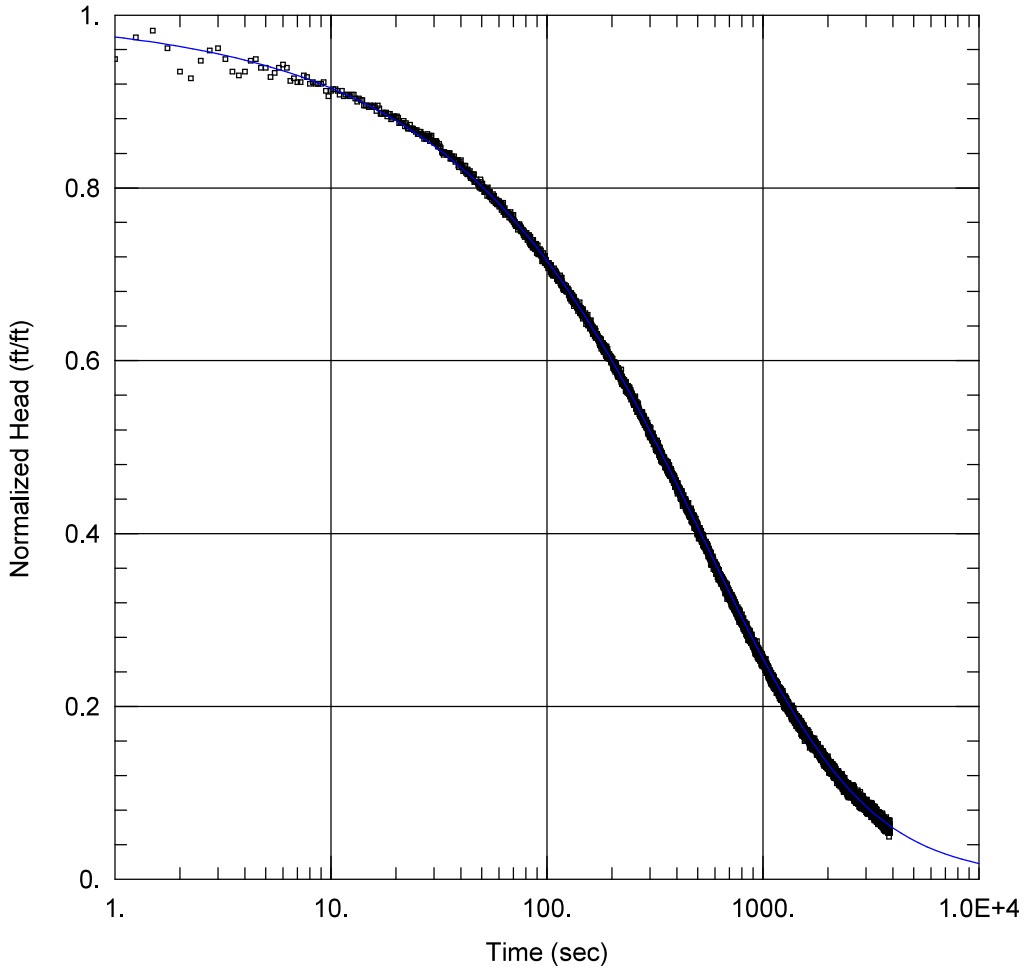
SOLUTION

Aquifer Model: Unconfined

Kr = 1.1E-5 cm/sec
Kz/Kr = 1.

Solution Method: KGS Model

Ss = 0.00078 ft^{-1}



MW-4B (RH1)

PROJECT INFORMATION

Company: HDR
Location: Xcel_Comanche_CCR
Test Well: MW-4B
Test Date: 10/13/2020

AQUIFER DATA

Saturated Thickness: 19.58 ft

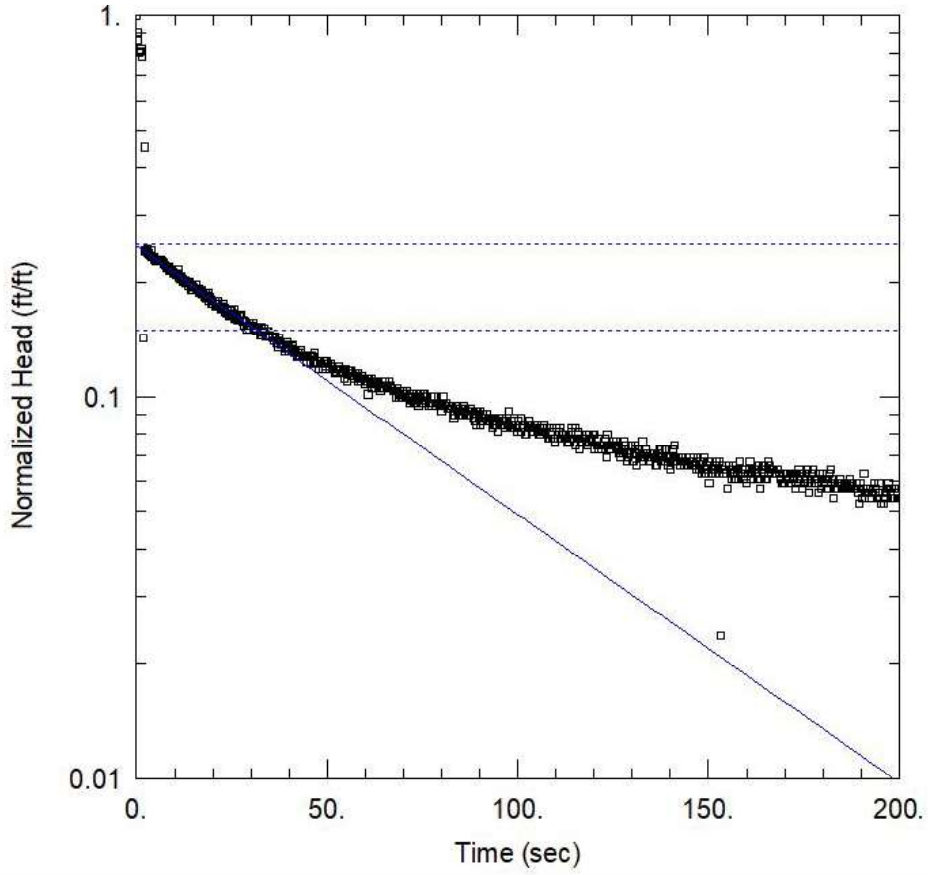
WELL DATA (MW-4B)

Initial Displacement: 1.119 ft
Total Well Penetration Depth: 19.58 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 19.58 ft
Screen Length: 19.58 ft
Well Radius: 0.333 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 1.4E-5 cm/sec
Kz/Kr = 1.
Ss = 0.00029 ft^{-1}



MW-6 FALLING HEAD (SLUG IN)

Data Set:
Date: 10/29/20 Time: 11:21:39

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Project: 10025968
Location: Comanche Station
Test Well: W-6
Test Date: 10/13/2020

AQUIFER DATA

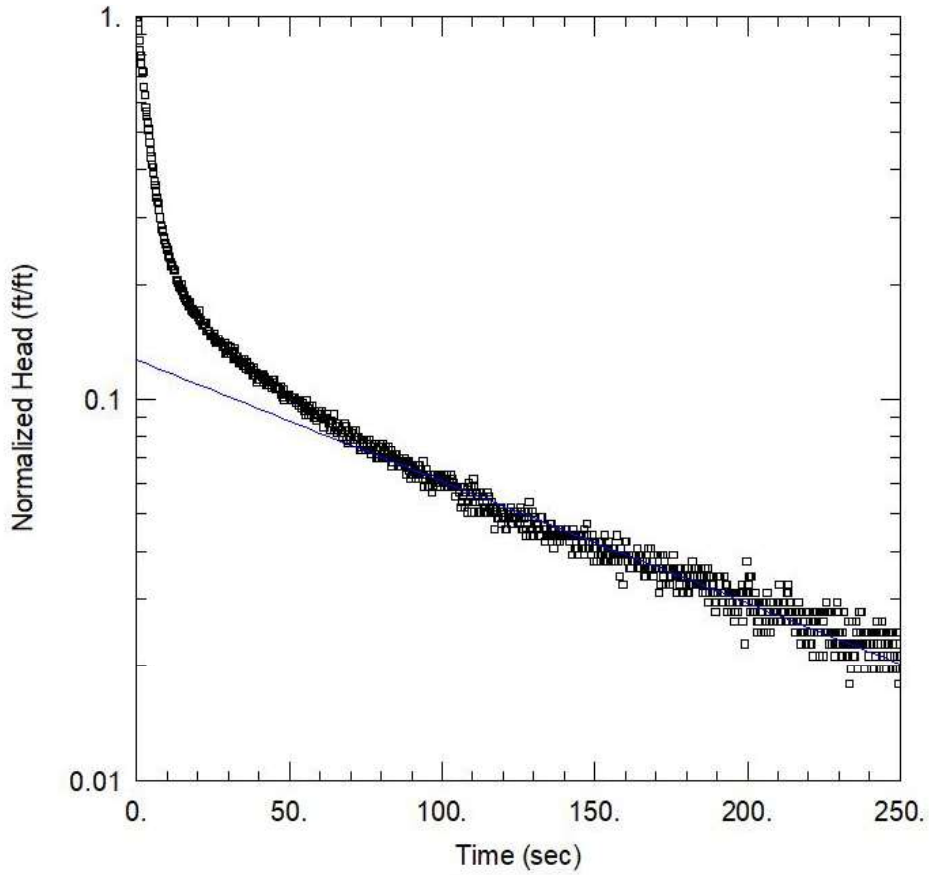
Saturated Thickness: 26.28 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-6)

Initial Displacement: 1.356 ft
Total Well Penetration Depth: 26.28 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 26.28 ft
Screen Length: 10. ft
Well Radius: 0.3333 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 0.0007013 cm/sec
y0 = 0.3364 ft



MW-6 RISING HEAD (SLUG OUT)

Data Set:
Date: 10/29/20 Time: 11:32:04

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Project: 10025968
Location: Comanche Station
Test Well: MW-6
Test Date: 10/13/2020

AQUIFER DATA

Saturated Thickness: 26.28 ft Anisotropy Ratio (Kz/Kr): 1.

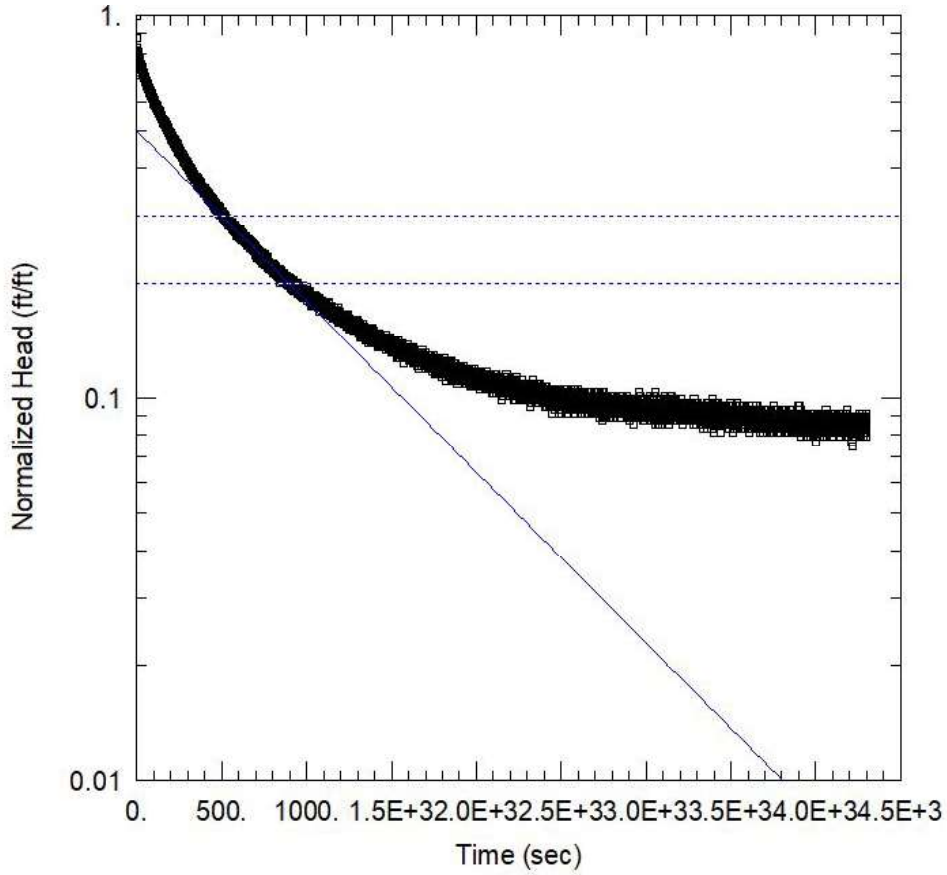
WELL DATA (MW-6)

Initial Displacement: 1.409 ft
Total Well Penetration Depth: 26.28 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 26.28 ft
Screen Length: 10. ft
Well Radius: 0.3333 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.00175 cm/sec y0 = 0.1785 ft



W-2A FALLING HEAD (SLUG IN)

Data Set:
Date: 10/29/20 Time: 09:56:24

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Project: 10025968
Location: Comanche Station
Test Well: W-2A
Test Date: 10/15/2020

AQUIFER DATA

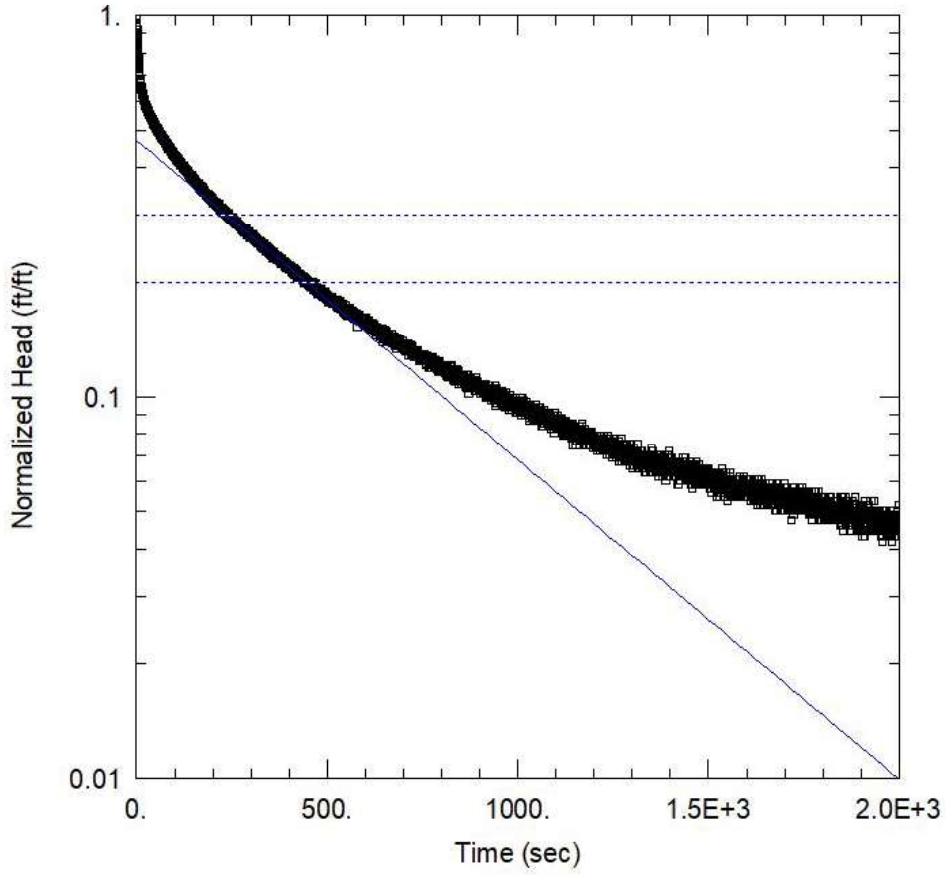
Saturated Thickness: 8.06 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (W-2A)

Initial Displacement: 1.113 ft
Total Well Penetration Depth: 8.06 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 8.06 ft
Screen Length: 8.06 ft
Well Radius: 0.2083 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice
K = 9.678E-5 cm/sec y0 = 0.5565 ft



W-2A RISING HEAD (SLUG OUT)

Data Set:
Date: 10/29/20 Time: 10:25:11

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Project: 10025968
Location: Comanche Station
Test Well: W-2A
Test Date: 10/15/2020

AQUIFER DATA

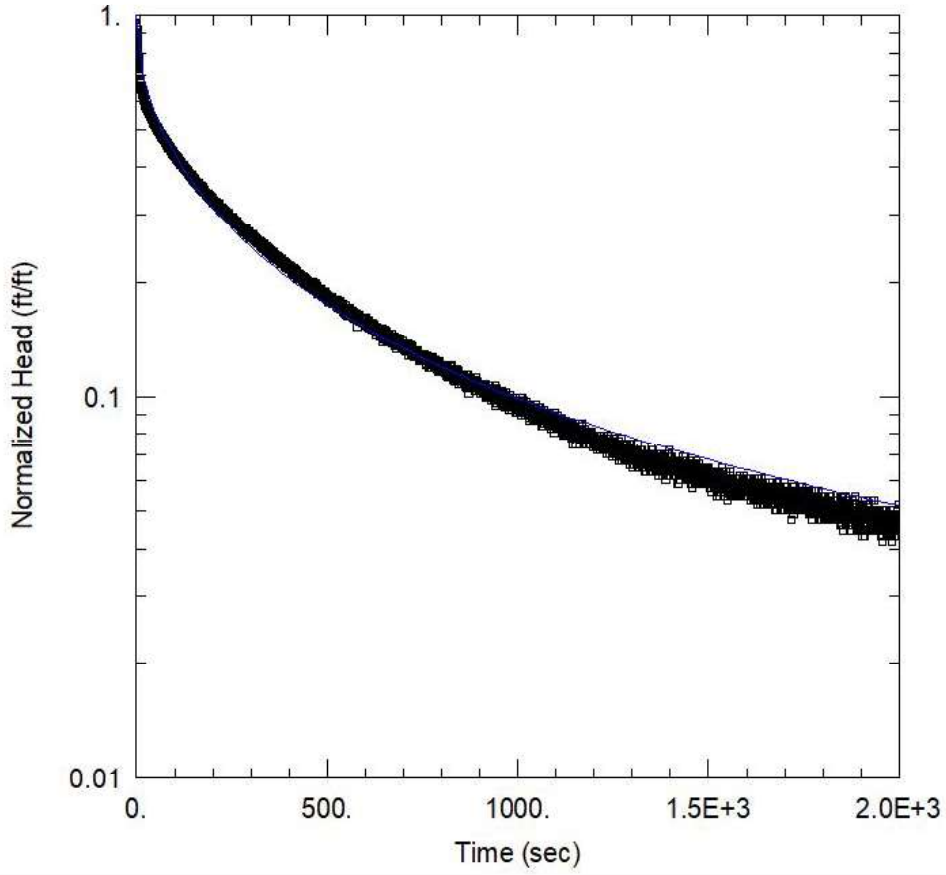
Saturated Thickness: 8.06 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (W-2A)

Initial Displacement: 1.561 ft
Total Well Penetration Depth: 8.06 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 8.06 ft
Screen Length: 8.06 ft
Well Radius: 0.2083 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.0001816 cm/sec
y0 = 0.7356 ft



W-2A RISING HEAD (SLUG OUT)

Data Set:
Date: 10/29/20 Time: 12:51:52

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Project: 10025968
Location: Comanche Station
Test Well: W-2A
Test Date: 10/15/2020

AQUIFER DATA

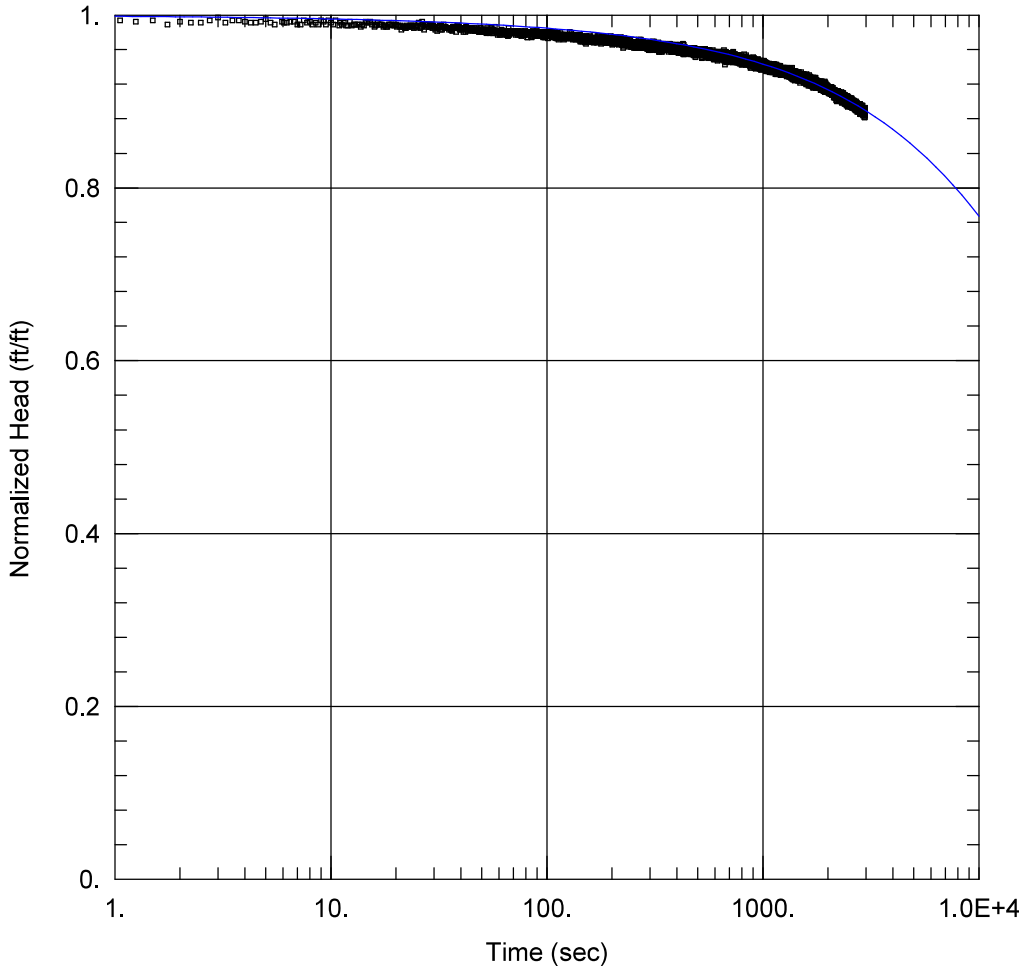
Saturated Thickness: 8.06 ft

WELL DATA (W-2A)

Initial Displacement: 1.561 ft
Total Well Penetration Depth: 8.06 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 8.06 ft
Screen Length: 8.06 ft
Well Radius: 0.2083 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model
Kr = 5.86E-5 cm/sec
Kz/Kr = 1.
Ss = 0.01241 ft^{-1}



W-2B (RH3)

PROJECT INFORMATION

Company: HDR
Location: Xcel_Comanche_CCR
Test Well: W-2B
Test Date: 10/15/2020

AQUIFER DATA

Saturated Thickness: 23.64 ft

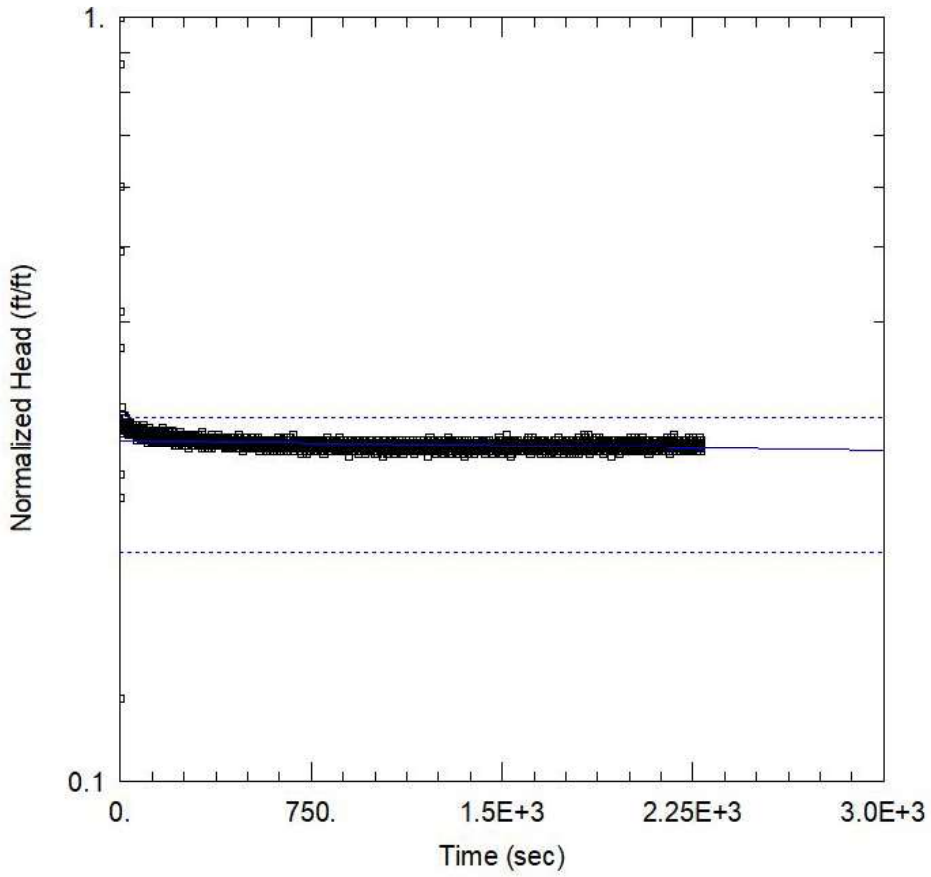
WELL DATA (W-2B)

Initial Displacement: 1.481 ft
Total Well Penetration Depth: 23.64 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 23.64 ft
Screen Length: 20. ft
Well Radius: 0.333 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 1.9E-7 cm/sec
Kz/Kr = 1.
Ss = 6.3E-5 ft^{-1}



W-5 FALLING HEAD (SLUG IN) 1

Data Set:
Date: 10/29/20 Time: 08:40:07

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Project: 10025968
Location: Comanche Station
Test Well: W-5
Test Date: 10/14/2020

AQUIFER DATA

Saturated Thickness: 7.07 ft Anisotropy Ratio (Kz/Kr): 1.

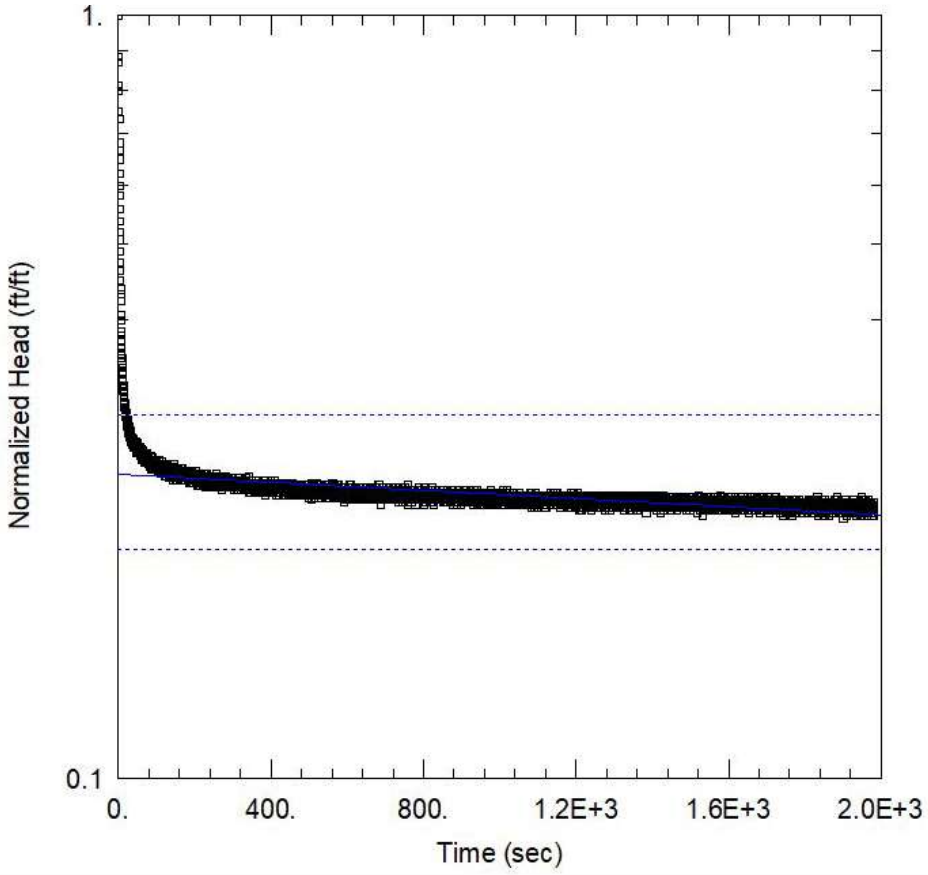
WELL DATA (W-5)

Initial Displacement: 1.111 ft
Total Well Penetration Depth: 7.07 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 7.07 ft
Screen Length: 7.07 ft
Well Radius: 0.3333 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 2.127E-6 cm/sec y0 = 0.3111 ft



W-5 RISING HEAD (SLUG OUT) 1

Data Set:
Date: 10/29/20 Time: 09:36:04

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Project: 10025968
Location: Comanche Station
Test Well: W-5
Test Date: 10/14/2020

AQUIFER DATA

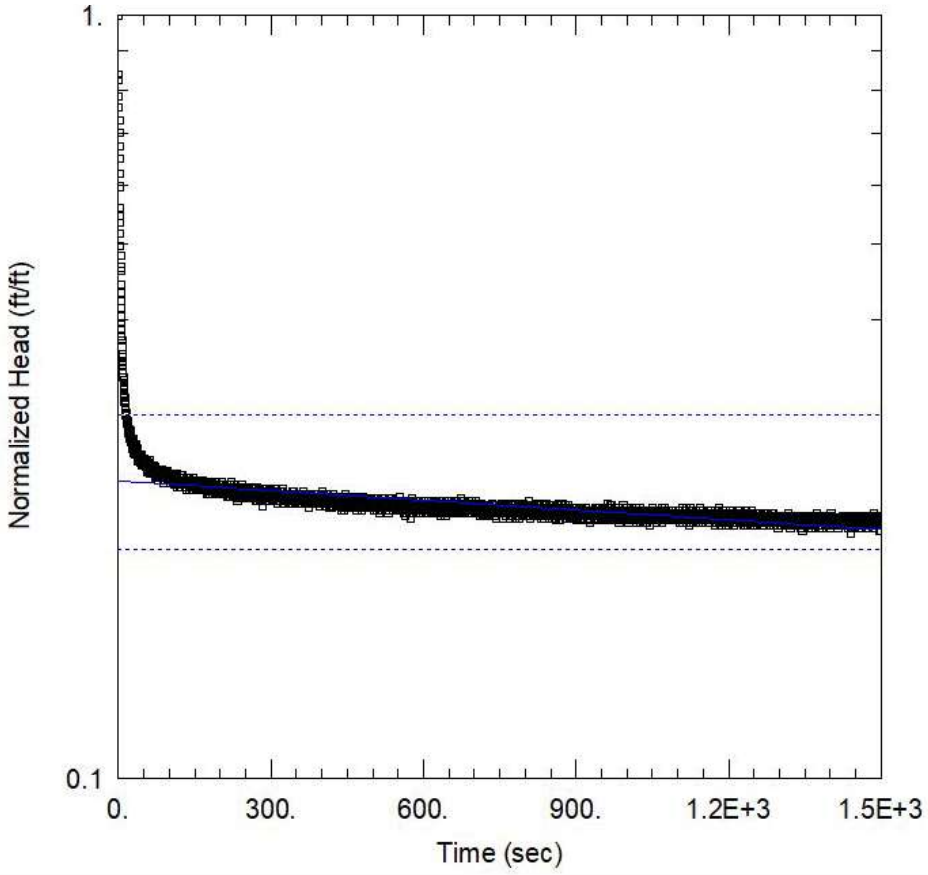
Saturated Thickness: 7.07 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (W-5)

Initial Displacement: 1.314 ft
Total Well Penetration Depth: 7.07 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 7.07 ft
Screen Length: 7.07 ft
Well Radius: 0.3333 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice
K = 2.069E-6 cm/sec y0 = 0.329 ft



W-5 RISING HEAD (SLUG OUT) 2

Data Set:
Date: 10/29/20 Time: 09:43:10

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Project: 10025968
Location: Comanche Station
Test Well: W-5
Test Date: 10/14/2020

AQUIFER DATA

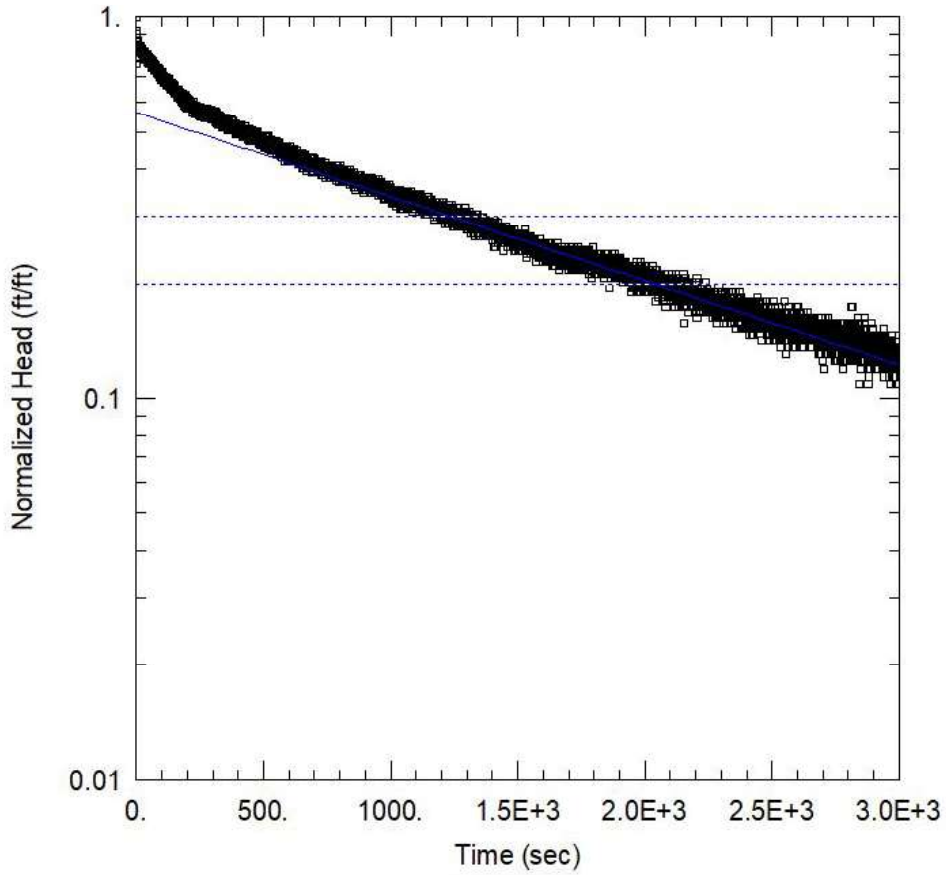
Saturated Thickness: 7.07 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (W-5)

Initial Displacement: 1.388 ft
Total Well Penetration Depth: 7.07 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 7.07 ft
Screen Length: 7.07 ft
Well Radius: 0.3333 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 3.31E-6 cm/sec
y0 = 0.3404 ft



W-6 FALLING HEAD (SLUG IN)

Data Set:
Date: 10/28/20 Time: 17:40:23

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Project: 10025968
Location: Comanche Station
Test Well: W-6
Test Date: 10/14/2020

AQUIFER DATA

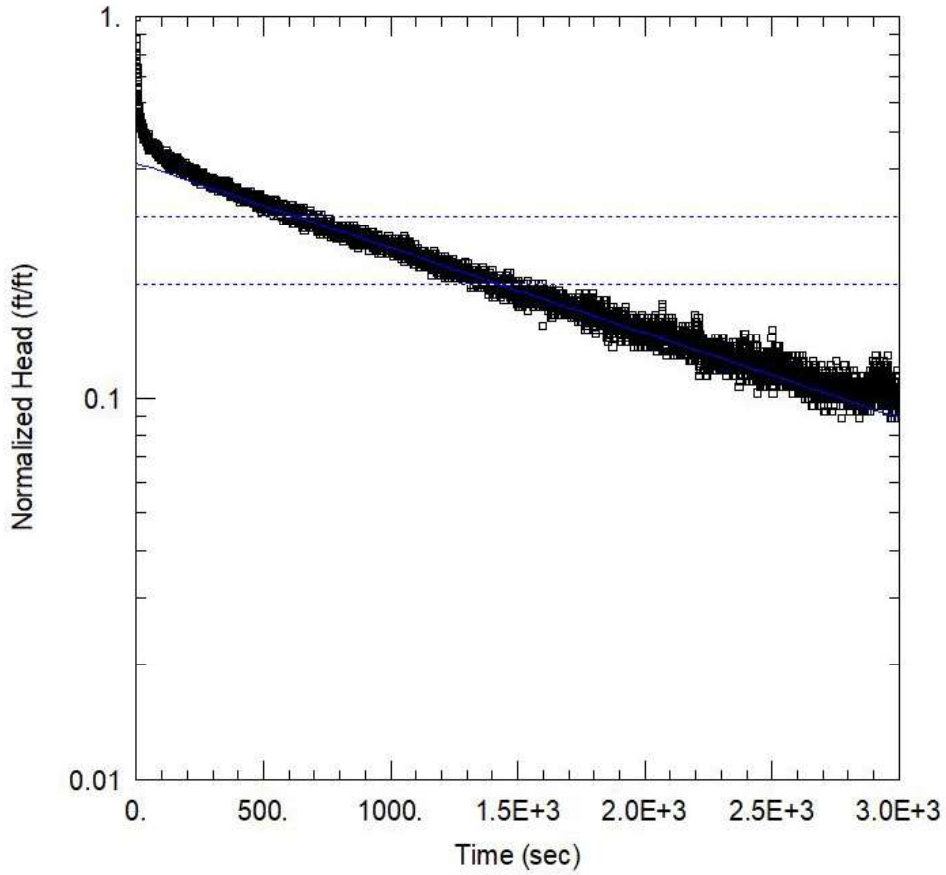
Saturated Thickness: 9.18 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (W-6)

Initial Displacement: 0.4227 ft
Total Well Penetration Depth: 9.18 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 9.18 ft
Screen Length: 9.18 ft
Well Radius: 0.3333 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 8.045E-5 cm/sec
y0 = 0.2376 ft



W-6 RISING HEAD (SLUG OUT)

Data Set:
Date: 10/28/20 Time: 17:43:25

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Project: 10025968
Location: Comanche Station
Test Well: W-6
Test Date: 10/14/2020

AQUIFER DATA

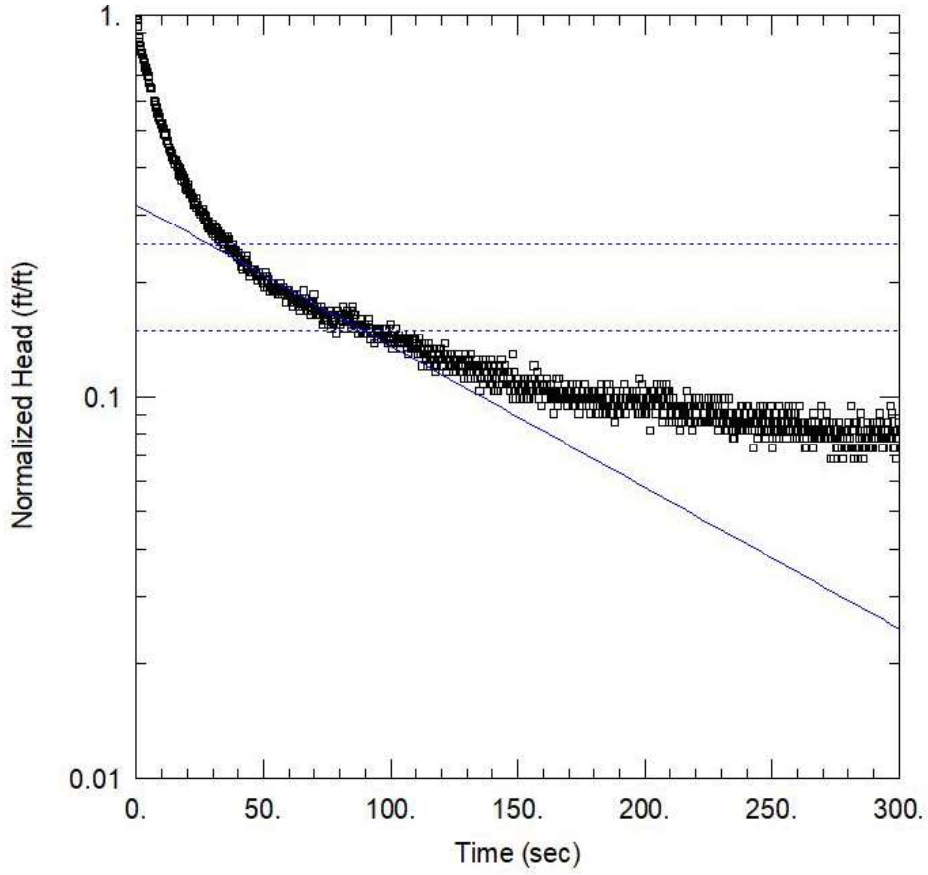
Saturated Thickness: 9.18 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (W-6)

Initial Displacement: 0.6226 ft
Total Well Penetration Depth: 9.18 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 9.18 ft
Screen Length: 9.18 ft
Well Radius: 0.3333 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 8.117E-5 cm/sec
y0 = 0.2578 ft



W-7 FALLING HEAD (SLUG IN)

Data Set:
Date: 10/28/20 Time: 16:47:21

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Project: 10025968
Location: Comanche Station
Test Well: W-7
Test Date: 10/14/2020

AQUIFER DATA

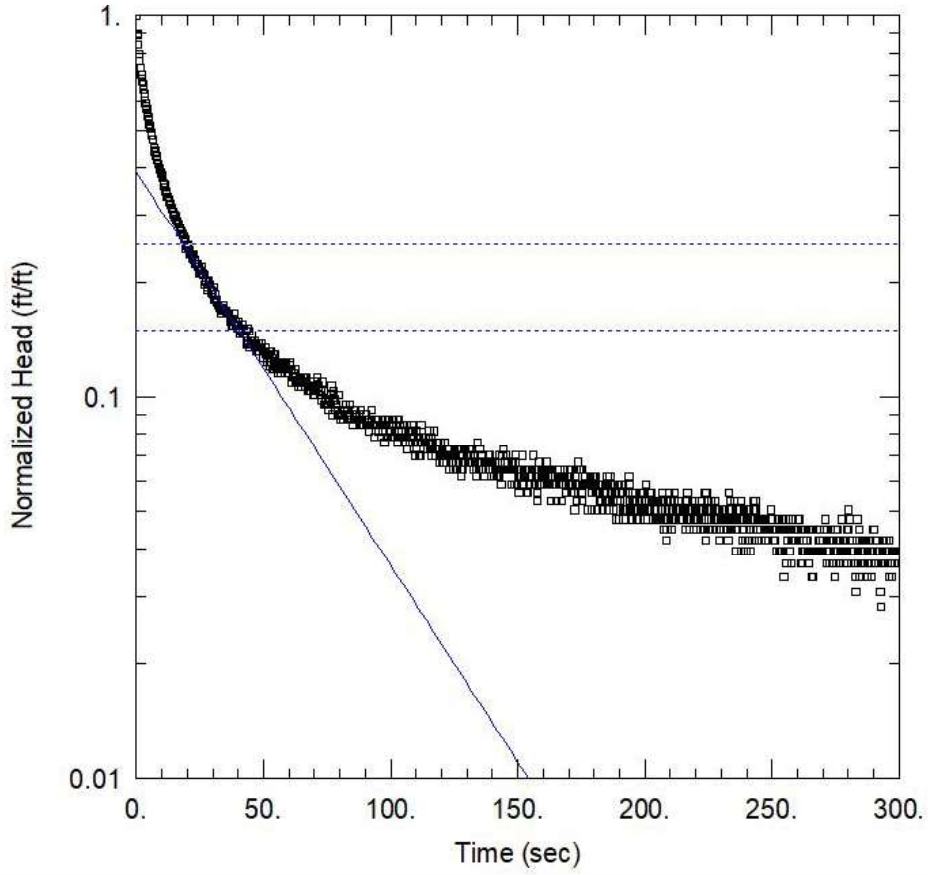
Saturated Thickness: 16.53 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (W-7)

Initial Displacement: 0.5228 ft
Total Well Penetration Depth: 16.53 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 16.53 ft
Screen Length: 15. ft
Well Radius: 0.2083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 0.0002992 cm/sec
y0 = 0.1667 ft



W-7 RISING HEAD (SLUG OUT)

Data Set:
Date: 10/28/20 Time: 16:58:22

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Project: 10025968
Location: Comanche Station
Test Well: W-7
Test Date: 10/14/2020

AQUIFER DATA

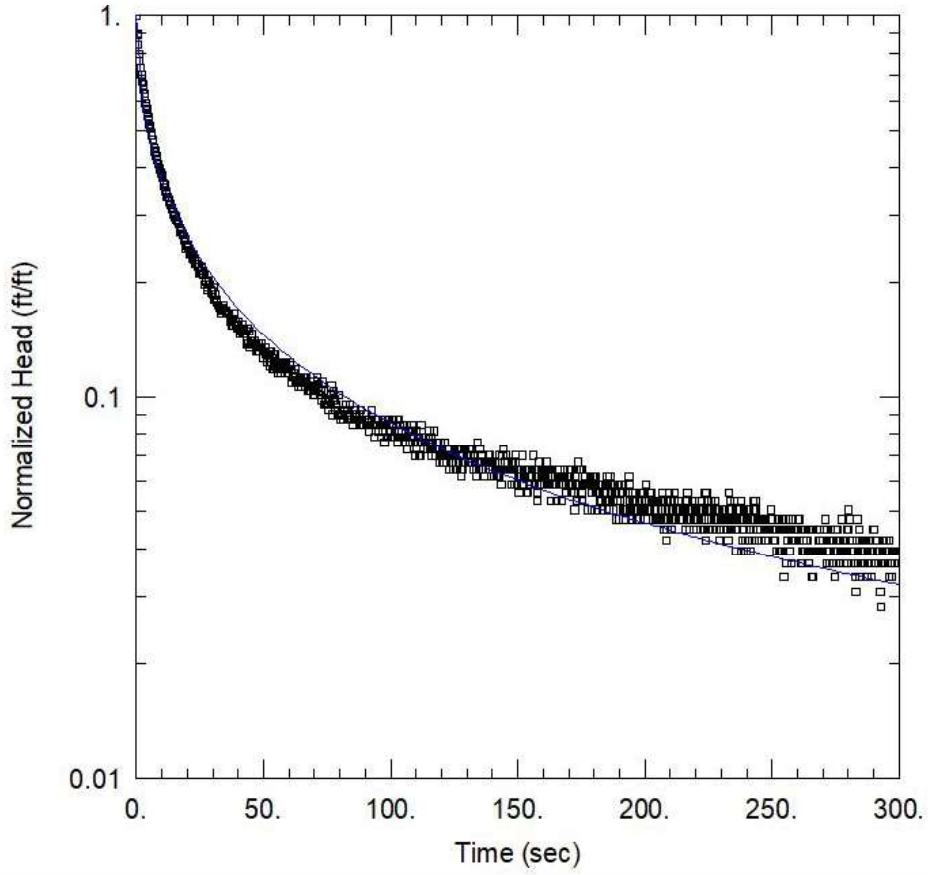
Saturated Thickness: 16.53 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (W-7)

Initial Displacement: 0.8023 ft
Total Well Penetration Depth: 16.53 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 16.53 ft
Screen Length: 15. ft
Well Radius: 0.2083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 0.0008327 cm/sec
y0 = 0.3119 ft



W-7 RISING HEAD (SLUG OUT)

Data Set:
Date: 10/28/20 Time: 17:09:35

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Project: 10025968
Location: Comanche Station
Test Well: W-7
Test Date: 10/14/2020

AQUIFER DATA

Saturated Thickness: 16.53 ft

WELL DATA (W-7)

Initial Displacement: 0.8023 ft
Total Well Penetration Depth: 16.53 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 16.53 ft
Screen Length: 15. ft
Well Radius: 0.2083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 0.0003313 cm/sec
Kz/Kr = 1.
Ss = 0.01114 ft^{-1}