Summary Report
Hydrogeologic Investigation

Drainage Problem Area
City of West Richland, Washington

for
City of West Richland

January 14, 2020

GeoEngineers
Earth Science + Technology

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Table of Contents

EXECUTIVE SUMMARY **ES-1**

1.0 INTRODUCTION **1**

2.0 SCOPE OF SERVICES **1**

2.1. Phase 1 1
2.2. Phase 2 2

3.0 PHYSIOGRAPHY **3**

4.0 CLIMATE SUMMARY **4**

5.0 LAND USE **4**

5.1. Existing Land Use 4
5.2. History of Residential Development 4

6.0 COMPILATION OF EXISTING SUBSURFACE INFORMATION **5**

6.1. Data Sources 5
6.2. Subsurface Database 6

7.0 SUMMARY OF GEOLOGIC AND HYDROGEOLOGIC SETTING **6**

7.1. Geologic Setting 6
7.2. Hydrogeologic Setting 7
7.2.1. CRBG Unit 7
7.2.2. Sedimentary Unit 8

8.0 PROJECT EXPLORATIONS **9**

8.1. General 9
8.2. Boreholes, Wells and Test Pits 9
8.3. Geophysical Survey 10

9.0 GRAIN-SIZE-BASED HYDRAULIC CONDUCTIVITY ESTIMATES **11**

10.0 BOREHOLE PERCOLATION TESTING **12**

11.0 DPA-SPECIFIC SUBSURFACE GEOLOGIC FRAMEWORK **13**

12.0 MONITORING WELL SURVEY, INSTRUMENTATION AND GROUNDWATER ELEVATIONS **14**

12.1. Survey 14
12.2. Instrumentation 15
12.3. Groundwater Elevation Data 15
12.3.1. Manual Measurements 15
12.3.2. Electronic Measurements 15

13.0 STORMWATER SYSTEM MONITORING **16**

14.0 HYDRAULIC TESTING **18**

14.1. Slug Testing 18
14.2. Pilot Infiltration Testing 19

15.0 PRECIPITATION TRENDS **19**

16.0 WATER USE AND IRRIGATION REQUIREMENTS **20**

16.1. Water Use 20

17.0 DRAINAGE COMPLAINTS **21**

18.0 CONCLUSIONS **22**

18.1. DPA 22

18.2. Potential Infiltration Facility 24

19.0 LIMITATIONS **24**

20.0 REFERENCES **24**

LIST OF FIGURES

Figure 1. Vicinity Map
Figure 2. Phase 2 Exploration Map
Figure 3. Surficial Geology Map
Figure 4. Thickness of Sediments Overlying Basalt
Figure 5. Top of Basalt Elevation
Figure 6. Depth to Top of Limiting Stratigraphic Unit
Figure 7. Hydrogeologic Cross-Section A-A'
Figure 8. Hydrogeologic Cross-Section B-B'
Figure 9. Drainage Complaints
Figure 10. Depth to Groundwater and Precipitation
Figure 11. Groundwater Elevation and Precipitation
Figure 12. Stormwater Structure Monitoring

APPENDICES

Appendix A. Development History: Oldest and Newest Permit Date Range
Appendix B. Historic Aerial Photos
    Figures B-1 through B-8. Historical Aerial Photographs
Appendix C. Water Well Reports
Appendix D. Database of Pre-Existing Subsurface Information
    Table D-1. Compilation of Water Well Report Observations
    Table D-2. Compilation of Test Pit Observations
Appendix E. Field and Laboratory Procedures
    Figure E-1 Key to Exploration Logs
    Figures E-2 through E-6, Logs of Borings B-1 to B-5
    Figures E-7 through E-14, Logs of Monitoring Wells MW-1 to MW-8
    Figure E-15, Log of Test Pit TP-1
    Figures E-16 through E-22, Sieve Analysis Results
Appendix F. Seismic Velocity Survey Report
Appendix G. Shallow Groundwater Mapping
    Table G-1. Stormwater System Groundwater Monitoring Results
    Figures G-1 through G-3. Depth to Groundwater Maps
    Figures G-4 through G-6. Groundwater Elevation Maps
Appendix H. Slug Test Plots
    Figures H-1 through H-10. Falling and Rising Head Test Plots
Appendix I. Precipitation Trends

Table I-1. Precipitation Data - Kennewick Climate Station
Table I-2. Cumulative Departure in Precipitation
Figure I-1. Monthly Precipitation
Figure I-2. Cumulative Departure in Precipitation
Appendix J. Compilation of Recent Drainage Complaints
Table J-1. Compilation of Recent Drainage Complaints
Appendix K. Report Limitations and Guidelines for Use

EXECUTIVE SUMMARY

This report summarizes results of GeoEngineers investigation characterizing the hydrogeologic conditions that underly a drainage problem area (DPA) within the City of West Richland, Washington (herein referred to as the City). Based on water levels observed within infiltration structures such as drywells and infiltration trenches, the City identified a DPA within a topographic plateau roughly bounded by Polaris Way on the south, South 54th Avenue on the east, Collins Road on the north and Onyx Avenue on the west. GeoEngineers conducted two phases of DPA hydrogeologic investigation. Our Phase 1 investigation consisted primarily of a review of existing DPA information. Our Phase 2 investigation focused on field work intended to fill gaps in the project dataset, as well as a preliminary evaluation of the feasibility of siting an infiltration facility (IF) in the northwest portion of the DPA. Based on project findings, we conclude the following:

- The DPA is underlain by a complex sequence of fine-grained sediment, caliche and cemented gravel overlying basalt.
- The sedimentary strata overlying basalt consists primarily of low permeability Ringold Formation clay, silt, sand and gravel with occasional caliche development. The matrices of Ringold Formation sedimentary deposits contain moderate to abundant cementation. This cementation forms horizontal as well as vertical boundaries to groundwater flow.
- We conclude that the stratigraphic interval limiting downwards infiltration of water, and hence supporting development of high groundwater levels in the DPA, is composed of this mix of Ringold low permeability material. The depth to limiting stratigraphic unit appears to be less than 8 feet below ground surface throughout much of the DPA.
- Prior to development, land use in the DPA consisted of dispersed rural residences and natural shrub steppe. Very little imported water was applied to the DPA. With the advent of residential development, irrigated lawns and impermeable surfaces became prevalent. The percentage of water lost to evapotranspiration significantly decreased and stormwater discharge became concentrated at specific locations. As a result, more water now infiltrates to the vadose zone within the DPA relative to pre-development conditions. Eventually this recharge exceeded the capacity of the low permeability Ringold Formation to transport the water out of the DPA.
- The increase in groundwater level within the DPA is related to residential development and associated changes in the DPA water budget. We interpret that seepage from irrigation of lawns, stormwater injection, and septic discharge each play a role in elevating the DPA groundwater table. However, the seasonal pattern in groundwater level rise (occurs in the summer) suggests that the primary control on DPA water level rise is irrigation of residential lawns.
- Groundwater mounding and associated flooding may expand, particularly during the summer/early fall irrigation season, if changes to the DPA water budget are not addressed.
- Observed infiltration rates during hydraulic testing at the IF were low. These data indicate that the IF is not feasible for disposal of water from the DPA at a scale that would justify infrastructure investment.

This summary is provided for general informational purposes and should not be solely relied upon.

1.0 INTRODUCTION

This report summarizes results of our investigation characterizing the hydrogeologic conditions that underly a drainage problem area (DPA) within the City of West Richland, Washington (herein referred to as the City). Based on water levels observed within infiltration structures such as drywells and infiltration trenches, the City identified a DPA within a topographic plateau roughly bounded by Polaris Way on the south, South 54th Avenue on the east, Collins Road on the north and Onyx Avenue on the west. The approximate DPA boundaries are shown on the Vicinity Map, Figure 1.

The City has observed shallow water levels in DPA manholes, drywells and infiltration trenches during their monitoring operations, and noted slow or restricted drainage in a number of these facilities, including ponding of water on streets around several drywells. The City has also received complaints from residents within the DPA related to flooding of basements and other structures. The observed groundwater levels and drainage problems appear to fluctuate seasonally, with levels rising through the summer lawn irrigation season.

GeoEngineers conducted two phases of DPA hydrogeologic investigation. Our Phase 1 investigation consisted primarily of a review of existing DPA information. Results of our Phase 1 investigation are described in our report entitled *Phase 1 Report, Hydrogeologic Investigation, Drainage Problem Area, City of West Richland, Washington,* dated February 14, 2019 (GeoEngineers 2019).

The Phase 2 investigation focused on field work intended to fill gaps in the project dataset that limit the City's understanding of the observed drainage problem and its cause(s). It also included a preliminary feasibility evaluation of a swale identified by the City as a possible location for discharge of stormwater from the DPA into a potential infiltration facility (IF). The approximate location of the IF is shown on Phase 2 Exploration Map, Figure 2.

Our Phase 2 investigation built on and refined the results of Phase 1. Much of the information in the Phase 1 report has been included in this summary report, though modified by Phase 2 findings. As such, this summary report replaces and supersedes our Phase 1 report.

2.0 SCOPE OF SERVICES

Our Phase 1 hydrogeologic services were conducted consistent with our proposal dated and approved by the City on October 31, 2018. Our Phase 2 hydrogeologic services were conducted consistent with our proposal dated April 10, 2019, which was approved by the City on April 17, 2019. Our hydrogeologic scope of services consisted of the following:

2.1. Phase 1

1. Review existing information regarding hydrogeologic conditions within the DPA and surrounding area.
2. Review data and information provided by the City.
3. Download historic precipitation data from the Richland, Washington (Station No. 457015) and Kennewick, Washington (Station No. 454154) climate stations.

4. Evaluate whether local precipitation trends potentially could have influenced the rise in DPA groundwater levels using cumulative departure analysis.
5. Tabulate subsurface data from previous DPA explorations regarding observed sediment stratigraphy.
6. Tabulate groundwater level data including depth to and elevation of the groundwater table beneath the DPA.
7. Create plan view maps of the DPA showing depth to/elevation of the groundwater table and the subsurface distribution of geologic features that are interpreted to have caused or contributed to the DPA.
8. Create two hydrogeologic cross sections across the DPA.
9. Review a figure, provided by the City, that presented development history within the DPA as a function of building permit date.
10. Develop a conceptual model of the shallow hydrogeologic conditions that describes the potential cause(s) of elevated groundwater water levels and the most likely water source in the DPA.
11. Identify gaps that limit our understanding of the hydrogeologic conditions causing the observed DPA groundwater level rise.

2.2. Phase 2

1. Perform a field reconnaissance of the IF property and planned project exploration locations.
2. Arrange for a public utility locate of the planned project exploration locations
3. Subcontract qualified contractors to:
    a. Drill exploratory borings, install monitoring wells, and assist with percolation testing.
    b. Survey the horizontal and vertical locations of the installed monitoring wells.
    c. Conduct a geophysical survey within the IF property and DPA study area.
4. Drill 13 borings (designated B-1 through B-5 and MW-1 through MW-8) and record a detailed log of each boring. Boring locations are shown in Figure 2.
5. Conduct borehole permeability tests at key depths within selected borings.
6. Conduct laboratory testing of selected sediment samples in accordance with ASTM International (ASTM) Method C 136.
7. Construct monitoring wells (designated MW-1 through MW-8) within selected borings.
8. Survey the horizontal and vertical locations of the installed monitoring wells relative to the ROS 3910 datum.
9. Measure static depths to groundwater within installed monitoring wells.
10. Install pressure transducers/dataloggers within monitoring wells MW-1 and MW-3 through MW-8.
11. Install pressure transducers/dataloggers within four existing City stormwater structures within the DPA. Instrumented stormwater structures are shown in Figure 2.
12. Program the datalogger for measurement of groundwater levels on a 10-minute interval.

13. Download the installed pressure transducers/dataloggers on September 20, 2019 and reduce the data for depth to groundwater and groundwater elevation.
14. In coordination with the City, excavate a test pit (designated TP-1) within the IF property and record sediment and groundwater observations during test pit excavation.
15. Conduct a pilot infiltration test within the test pit excavation and monitor groundwater elevations in monitoring wells MW-1 and MW-2 during testing.
16. Based on results of pilot infiltration testing and sediment conditions encountered during site exploration, develop an opinion regarding the feasibility of regional stormwater infiltration at the proposed IF.
17. Conduct rising- and falling-head slug tests in monitoring wells MW-3, MW-5, MW-6, MW-7 and MW-8 and analyze slug test data to estimate the saturated hydraulic conductivity of sediment encountered adjacent to monitoring well screens.
18. Conduct a geophysical survey using seismic velocity survey methods along four key transects within the DPA. Transect locations are shown in Figure 2.
19. Delineate irrigated acreage within the DPA based on aerial photographs (from 1996, 2003, 2006, 2009, 2011, 2013, 2016 and 2018) using GIS-based methods.
20. Analyze water use data provided by the City for the period from 2012 to 2019.
21. Refine Phase 1 findings and conclusions based on Phase 2 field activities.

3.0 PHYSIOGRAPHY

The DPA and surrounding area is located within the central portion of the Columbia Plateau physiographic province. The existing topography of the area developed during the Pliocene Epoch (5.3 to 2.58 million years ago [MA]), Pleistocene Epoch (about 2.58 MA to 11,700 years) and the Holocene Epoch (11,700 years to today). During the Pliocene basalt cored ridges, such as Flat Top Hill, were uplifted. In the Pleistocene a sequence of catastrophic flood events, generated by the failure of ice dams in western Montana and northern Idaho, stripped away overlying sediments across much of the area surrounding the site, leaving erosional features in the underlying basalt surface and Ringold Formation sediments and depositing coarse-grained outburst flood deposits (Whiteman et al. 1994). Holocene stream erosion and wind deposition has slightly modified this landscape.

The DPA encompasses an area of approximately 490 acres and is situated within a plateau that is somewhat isolated topographically from the surrounding area. The topography of the DPA, which varies in elevation from about 610 to 660 feet relative to the ROS 3910 datum (ROS 3910), descends in all directions except to the northeast where the DPA sits at the base of a basalt upland locally known as Flat Top Hill. Ground surface elevation on Flat Top Hill reaches 760 feet ROS 3910. The Yakima River is located about 1.5 miles northeast of the DPA and is at an elevation of about 400 feet ROS 3910.

The area surrounding the DPA is drained by the Yakima River and its perennial and intermittent tributaries. South of the DPA, the area is drained by an east-west system of discontinuous small lakes (including Lost Lake) with generally discontinuous and ephemeral natural surface drainage systems.

4.0 CLIMATE SUMMARY

The climate of the West Richland area is arid to semi-arid. Based on summary information associated with Richland Climate Station No. 457015, mean maximum temperature is 65.6 degrees Fahrenheit (°F) and mean minimum temperature is 42.6 °F. Daily high temperatures commonly exceed 100 °F in the summer and as a result lawn irrigation is very common in the DPA. Mean annual precipitation is reported at 7.1 inches per year and mean annual snowfall is reported at 7.8 inches per year. About 3.7 inches of precipitation and 7.6 inches of snowfall occur during the 4-month period from November through February. The Bureau of Reclamation reports an average annual reference evapotranspiration of 56.48 inches for the AgriMet station at Hermiston Oregon, located about 30 miles south of the DPA.

5.0 LAND USE

5.1. Existing Land Use

Existing land use within the DPA is primarily single-family residential use. West of Belmont Avenue and its extension, the DPA is characterized by dense residential development with lot sizes on the order of ¼-acre. East of Belmont Avenue and its extension, lot sizes are larger and generally in the range of 1¼ to 2½ acres. Within residential areas, impermeable surfaces and lawn irrigation systems are common. The City maintains stormwater collection and infiltration infrastructure west of Belmont Avenue and its extension. The stormwater collection system consists primarily of drywells and stormwater collection/infiltration swales. At present, stormwater is not directed outside of the DPA via subsurface drains and/or pipes.

The area surrounding the DPA is characterized by a mix of semi-arid shrub steppe grasslands, basalt outcrops, actively farmed irrigated ground, and residential subdivisions. Residential land use occurs south and southeast of the DPA within the area roughly bounded by Belmont Boulevard on the west, Paradise Way on the north, Bombing Range Road on the east, and Keene Road on the south. Dispersed residences occur to the east of the DPA. Farmed areas exist to the northwest, west and southwest of the DPA and generally consist of irrigated circles serviced by center pivots.

A summary of DPA development boundaries, as well as associated building permit dates, was provided to GeoEngineers by the City and is attached to this report within Appendix A.

5.2. History of Residential Development

GeoEngineers conducted a review of aerial photographs for the period from 1996 through 2018 as a basis for identifying the timing of DPA transition from shrub and grassland to residential use. Aerial photographs are provided in Figures B-1 through B-8 of Appendix B.

As a component of Phase 2 activities, we also conducted a detailed delineation of irrigated acreage within the DPA for each aerial photograph using GIS-based methods.

Our observations are summarized below:

- In July 1996 (Figure B-1), the DPA was largely undeveloped and consisted of shrub steppe. A total of 8 to 10 dispersed residences and a network of unimproved roadways were present. Irrigated acreage was approximately 13.2 acres.

- In June 2003 (Figure B-2), residential developments were emerging within the extreme southeast portion of the DPA (Desert Paradise and Paradise South). However, no dense residential developments were present within the remainder of the DPA. The number of dispersed residences east of Belmont Boulevard and extension had increased to approximately 30. A grid of gravel roads also was present within this portion of the DPA. Ground disturbance, apparently in anticipation of future home construction was evident in the northwest portion of the DPA (Collins Ridge/Collins Heights). Irrigated acreage was approximately 17.9 acres.
- By June 2006 (Figure B-3), residential developments were emerging within the northwest portion of the DPA (Collins Ridge) and the southeast portion of the DPA (Swanson Heights), and approximately 50 homes had been constructed in these areas. Irrigated lawns had been installed within the Desert Paradise and Paradise South developments. The number of dispersed residences within the remainder of the DPA had increased to approximately 40 homes. Enterprise Middle School had been constructed along the southeast margin of the DPA. Irrigated acreage was approximately 21.1 acres.
- By September 2009 (Figure B-4), the residential developments identified in June 2006 (Collins Ridge and Swanson Heights) had increased to approximately 70 homes. The number of dispersed residences was similar to 2006. Portions of the gridded roadways appear to have been paved. Irrigated acreage was approximately 25.7 acres.
- By November 2011 (Figure B-5), the residential developments identified in June 2009 (Collins Ridge and Swanson Heights) had increased to approximately 80 homes. Approximately 40 homes had been constructed within the Paradise Estates and Sunset Ridge developments. Many of these newer homes did not yet have irrigated lawns. The Mountain View Estates development had been constructed within the southwest portion of the DPA. Irrigated acreage had almost doubled since 2009, increasing from approximately 25.7 acres to 54.7 acres. Earthwork appeared to be in progress to expand the Collins Ridge, Paradise Estates, and Sunset Ridge developments.
- By July 2013 (Figure B-6), buildout had progressed within the Collins Ridge, Paradise Estates, and Sunset Ridge developments and most of the newer homes had irrigated lawns. Earthwork appeared ongoing within the Collins Ridge and Paradise Estates developments. Irrigated acreage had again generally doubled since 2011, from approximately 54.7 acres to 117.6 acres.
- The time period between July 2013 (Figure B-6) and August 2016 (Figure B-7) had additional residential development west of Belmont Boulevard and its extension. The Sunset Ridge, Paradise Estates, Collins Ridge, and Collins Heights developments each experienced complete or nearly-complete buildout and road paving. Westwood Estates experienced approximately 50 percent buildout. Irrigated acreage was approximately 133.7 acres.
- By July 2018 (Figure B-8), Westwood Estates experienced complete buildout and road paving. Earthwork and home construction were ongoing within the Sunset Heights development. Irrigated acreage was approximately 165.9 acres.

6.0 COMPILATION OF EXISTING SUBSURFACE INFORMATION

6.1. Data Sources

GeoEngineers reviewed and compiled subsurface information provided by the City, including:

- Geotechnical reports related to DPA development.

- Water level data associated with the City's stormwater structure monitoring program.
- Water use data for the DPA and surrounding area for the period from January 2012 through August 2019.
- Chronologic information regarding development in and around the DPA.
- A summary of the complaints received by the City related to high groundwater within the DPA.
- As-built plans for infiltration structures within the DPA, such as drywells and infiltration trenches.
- A report summarizing leak detection operations within the DPA, dated November 15, 2018 and prepared by American Leak Detection of Hayden, Idaho.

GeoEngineers reviewed water well reports (well logs) on file with the Washington State Department of Ecology (Ecology) for the following study area:

- Section 1 of Township 9 North, Range 27 East.
- The north half of Section 12 of Township 9 North, Range 27 East.
- Section 6 of Township 9 North, Range 28 East.
- The north half of Section 7 of Township 9 North, Range 28 East.

Compiled well logs within the study area are provided in Appendix C. Each well log has been assigned a designation based on its location – these designations are provided in the upper right-hand corner of the well log.

6.2. Subsurface Database

GeoEngineers developed a database of existing subsurface data. Compiled data are summarized in Appendix D, within the following tables:

- Compilation of Water Well Report Observations, Table D-1.
- Compilation of Test Pit Observations, Table D-2.

These data, as well as results of GeoEngineers' DPA explorations and testing, were used to develop the geologic and hydrogeologic setting information described below.

7.0 SUMMARY OF GEOLOGIC AND HYDROGEOLOGIC SETTING

7.1. Geologic Setting

The DPA is located within the southeastern portion of the Pasco Basin, a structural and topographic low within south-central Washington. Geologic conditions within and surrounding the DPA generally are defined by three general stratigraphic units including, from oldest to youngest: (1) Miocene-age (about 17.5 to 5.5 MA) basalt flows of the Columbia River Basalt Group (CRBG) and contemporaneous sedimentary interbeds of the Ellensburg Formation; (2) sediments associated with the Miocene-age to Pliocene-age Ringold Formation (deposited between approximately 6.0 to 2.6 MA); and (3) Pleistocene-age glaciofluvial (flood) deposits and Holocene eolian and alluvial deposits. Surficial geology within and surrounding the study area is summarized in the Surficial Geology Map, Figure 3.

A recent stratigraphic framework for the CRBG is described by Reidel and Tolan (2013). Therein, the CRBG was subdivided into five formations that include, from youngest to oldest, the Saddle Mountains Basalt, Wanapum Basalt, Grande Ronde Basalt (including the Picture Gorge Basalt), Imnaha Basalt, and the Steens Basalt (Reidel and Tolan 2013). Total CRBG thickness within the Pasco Basin is more than 15,000 feet (Drost et al. 1997). Sedimentary interbeds exist within and between specific basalt formations, members and flows within the CRBG. Collectively, these sedimentary interbeds are termed the Ellensburg Formation, despite differences in age, location, lithology and continuity (Reidel and Tolan 2013).

The uppermost CRBG unit underlying the DPA is the Saddle Mountains Basalt. Two of its youngest units, the Ice Harbor Member and the Elephant Mountain Member are exposed at the surface on Flat Top Hill and in numerous locations surrounding the DPA.

The CRBG is deformed by a series of northwest- to west-trending folds and associated faults that form the Yakima Fold Belt. The large ridge to the south and west of the DPA which is defined by Badger Mountain and Red Mountain is one of these fold/fault structures. Flat Top Hill which is on the southern boundary of the DPA is a smaller version of one of these fold/fault structures. Within the Yakima Fold Belt these highlands are uplifted folds in which the CRBG is deformed into anticlines. These anticline ridges are separated by broad lows, or synclines, in which sedimentary strata are commonly found.

In the Pasco Basin, and the project area, the primary syncline filling sedimentary strata consists of the fluvial-lacustrine Ringold Formation. The Ringold Formation consists of interbedded, variably-cemented and indurated claystone, siltstone, sand and gravel (conglomerate) that are younger than and overlie the CRBG (Lindsey 1996). The Ringold Formation is variously subdivided into sub-units referred to as the upper Ringold Formation (also mapped as the member of Savage Island and the member of Taylor Flat) and the middle Ringold Formation, the lower Ringold Formation, and the basal Ringold Formation (also collectively referred to as the member of Wooded Island) (Lindsey 1996; Drost et al. 1997; Heywood et al. 2016). Indurated conglomerate exposed on Bombing Range Road and in old gravel pits in and near the DPA are interpreted to belong to the middle Ringold Formation/member of Wooded Island. Clayey strata described on well logs as underlying the DPA are interpreted to belong to upper Ringold and/or lower Ringold.

During the Pleistocene, topography within and near the DPA was modified by cataclysmic floodwaters periodically released from Glacial Lake Missoula. Floodwaters eroded CRBG and Ringold Formation deposits and left coarse glaciofluvial sediments in excess of 200 feet in thickness within portions of the Pasco Basin (Drost et al. 1997). These glaciofluvial deposits, locally known as Pasco gravels, generally consist of unsorted mixtures of silt, sand, gravel, cobbles and boulders. In places, Pasco gravels are interbedded with relatively fine-grained deposits that are designated Touchet Beds. Collectively, Pasco gravels and Touchet Beds form the Hanford Formation. Pleistocene deposits are locally overlain by Holocene-age wind-blown dune sand deposits of limited thickness.

7.2. Hydrogeologic Setting

Groundwater underlying the DPA occurs within two primary hydrogeologic units, herein termed the CRBG unit and the sedimentary unit.

7.2.1. CRBG Unit

Groundwater in the CRBG unit is most readily transmitted through the broken, vesicular and scoriaceous interflow zones that characterize the top and/or bottom of each basalt flow (GWMA 2009, 2011; Kahle et

al. 2011; Ely et al. 2014). The interflow zones are separated by the less porous and less transmissive entablature and colonnade, which comprise 90 to 95 percent of the typical total flow volume. The flows may be locally interlayered with sedimentary deposits. The horizontal hydraulic conductivity within interflow zones is as much as six orders of magnitude greater than the flow interiors. Drost et al. (1997) reports a median horizontal hydraulic conductivity of 2.3 feet per day for the Saddle Mountains Basalt.

In general, groundwater within the CRBG unit flows from upland areas to surface drainage features such as the Columbia River and its tributaries (Kahle et al. 2011; Ely et al. 2014). Groundwater flow is controlled by topography, geologic structures, basement topography, recharge and discharge conditions, unit continuity, and permeability variations. Basalt permeability is controlled by primary rock texture and secondary jointing and fracturing. In many locations, the permeability of the CRBG interflow zones has been reduced by secondary mineralization of zeolites and/or clay infilling joints and fractures.

Recharge to shallow water-bearing zones within the CRBG is generated from precipitation, infiltration of irrigation water, and by leakage from overlying aquifers (if any). The arid to semi-arid nature of the Project Area limits the amount of available natural recharge from precipitation. Groundwater discharge from shallow water-bearing zones within the CRBG occurs as springs, base flow to surface water systems, geologically slow leakage to aquifers with lower potentiometric heads, and water supply wells.

7.2.2. Sedimentary Unit

The sedimentary unit consists of all sediment that overlies the CRBG, including the Ringold Formation and Hanford Formation. These strata exceed 800 feet in thickness within the center of the Pasco Basin in the White Bluffs along the Columbia River (Lindsey 1996; GWMA 2009; Heywood et al. 2016) and thin significantly along the basin margins.

Aquifers within the sedimentary unit range from unconfined to confined and can be in hydraulic connection with adjacent streams and rivers. Pasco gravels generally consist of free-draining sand and gravel with relatively high permeability. The Pasco gravels range from about 20 to 150 feet in thickness and, where sufficiently thick, can support relatively high-yield groundwater production wells (Drost et al. 1997; GWMA 2009, 2011; Kahle et al. 2011; Heywood et al. 2016). Drost et al. (1997) reports a median hydraulic conductivity of 880 feet per day for Pasco gravels. The Ringold Formation forms a relatively complex assemblage of perched aquifers, unconfined aquifers, confined aquifers, and confining units (GWMA 2009, 2011; Heywood et al. 2016). The combination of weakly cemented and indurated Ringold Formation that likely underlies the DPA is interpreted to have a median hydraulic conductivity of 4.1 feet per day (Drost et al. 1997).

On driller's logs and geotechnical exploration logs, differentiation of Pasco gravels from permeable portions of the Ringold Formation can be difficult (Drost et al. 1997). However, based on Ringold outcrops in the DPA area, scarcity of flood deposits in local gravel pits, and interpretation of more descriptive well logs, we interpret the majority of the sedimentary strata underlying the DPA to be the Ringold Formation, which is denser, more frequently cemented, and less permeable than Pasco gravels.

Recharge to the sedimentary unit in the DPA is primarily from infiltration of precipitation, infiltration of surface water along losing stream reaches, seepage of irrigation water from crops and lawns, septic systems, and potentially through upwards leakage from the underlying Saddle Mountains Basalt. In urban areas, like the DPA, additional recharge results from infiltration of stormwater runoff from impervious

surfaces associated with roads, parking lots, and buildings. Discharge from the sedimentary unit generally occurs as base flow to surface water such as streams, lakes and ponds located in low-lying areas and coulees. Subsurface discharge to the underlying basalt aquifer system also may occur locally.

Because of the generally poor infiltration characteristics of basalt, the sedimentary unit is of primary significance as a target for stormwater infiltration within the DPA and surrounding area. Infiltration capacity of the sedimentary unit is controlled by physical heterogeneities associated with the sediment deposits and moisture content. Vadose zone heterogeneities and moisture variations result in complex flow paths that include downward percolation, lateral movement, and perched water in the vadose zone. Perched groundwater occurs where discrete areas or lenses of fine-grained materials or bedrock exist and act to inhibit downward percolation. In coarse strata vertical moisture movement in the vadose zone can be measured at several feet per day, depending on moisture content. Vertical movement of moisture through fine vadose zone strata will be several orders of magnitude lower.

Within and adjacent to the DPA and surrounding area, the lateral extent of the sedimentary aquifer is controlled by bedrock, the Yakima River valley, and fine-grained sediment geometry. These physical controls on aquifer distribution result in a sedimentary vadose zone and aquifer system that is variable and discontinuous. Hydraulic continuity between different parts of these systems can be limited.

8.0 PROJECT EXPLORATIONS

8.1. General

DPA specific subsurface conditions were explored by drilling 13 borings (B-1 through B-5 and MW-1 through MW-8) between May 14 and May 20, 2019 using sonic drilling methods, excavating test pit (TP-1) on June 4, 2019 and conducting geophysical exploration from May 28 to 30, 2019. Descriptions of GeoEngineers' field exploration equipment and procedures, exploration and monitoring well logs, and results of laboratory testing are provided in Appendix E.

8.2. Boreholes, Wells and Test Pits

The borings were drilled to depths in the range of 20 to 30 feet. Test pit (TP-1) was excavated to a depth of 10 feet. The approximate locations of the borings and test pit are shown in Figure 2.

A total of eight 2-inch-diameter polyvinyl chloride (PVC) monitoring wells were installed during drilling operations. Monitoring wells were installed within borings MW-1 through MW-8. Borings B-1 through B-4 were abandoned after drilling in accordance with Chapter 173-160 of the Washington Administrative Code (WAC).

During sonic drilling, continuous core samples of subsurface sediment were obtained. From these continuous core samples, GeoEngineers retained a total of 25 discrete samples for submittal to GeoEngineers' laboratory for analysis of grain-size distribution per ASTM Method C 136 and moisture content by ASTM Method D2216-90.

Based on our explorations, subsurface conditions beneath the DPA generally consist of a thin sequence of dune deposits underlain by a complex sequence of sediments associated with the Ringold Formation.

Scattered caliche formation is present within the Ringold Formation. These subsurface conditions are described below.

- Dune deposits – Dune deposits generally consist of loose, gray to brown, silty fine sand. Dune deposits were absent from test pit TP-1 and borings B-1, B-2, B-5, MW-3, MW-4 and MW-7. Within the remainder of the borings, dune deposits ranged from 1 to 4 feet in thickness.
- Ringold Formation – Within DPA explorations, Ringold Formation sediments underlie dune deposits and extend to the bottom of the explorations. The majority of the observed Ringold sequence consists of gray to brown, fine to coarse gravel and sand with variable silt content. Fine-grained layers consisting of weakly-indurated silt and/or clay were observed within the Ringold Formation from 22 to 28 feet below ground surface (bgs) in B-2, 3.5 to 5 feet bgs and 16 to 17 feet bgs in B-4, and below 16 feet bgs in MW-7.

  Ringold Formation sediments are variably-indurated and weakly- to moderately-cemented and much of the observed cementation is calcareous. These sediments generally are dense. However, in places the upper portion of the Ringold sequence appears to have been reworked and is loose.
- Caliche – Calcareous cementation of Ringold Formation sediments was observed throughout much of the observed sequence. However, distinct caliche layers were less prominent. Caliche layers were only identified from a depth of 4.5 to 6.5 feet in MW-1 and 4 to 5 feet bgs in MW-7.

Within the DPA, the Ringold Formation is underlain by basalt at depth. However, basalt was not encountered to the depths explored in our project explorations.

8.3. Geophysical Survey

A surface geophysical survey (consisting of seismic P-Wave [Vp] refraction and surface shear wave [Vs} velocity profiles) was conducted by Sage Earth Science (SES) of Idaho Falls, Idaho on May 28 to 30, 2019 under subcontract to GeoEngineers. The purpose of the survey was to evaluate whether seismic velocity profiles could be used to delineate the geometry of perching layers (such as the top of the Ringold Formation, zones of cementation, or basalt bedrock). SES's report summarizing survey results is provided in Appendix F.

SES completed approximately 4,600 feet of seismic survey along four lines, designated Lines 1 through 4 in Figure 2. Results from the four geophysical lines are presented on pages 7 through 10 of SES's report (Appendix F). Two general subsurface units were differentiated during seismic data reduction. These seismic units consist of:

- Seismic Unit 1: Low density sediment with Vp velocities of less than 4,000 feet per second (fps) and Vs velocities of less than 1,250 fps. We interpret that these sediments generally consist of a combination of dune deposits and Ringold Formation. Ringold Formation sediments within this seismic unit are likely reworked or relatively uncemented. Relatively thick sequences of this low-density seismic unit were observed from approximately Station 400 to 900 of Line 1, Station 560 to 900 of Line 2, Station 840 to 1,050 of Line 3, and Station 880 to 1,280 of Line 4. For a given sediment type, sediments in this seismic unit tend to have more infiltration potential.
- Seismic Unit 2: High velocity sediment with Vp velocities greater than 4,000 fps and Vs velocities greater than 1,250 feet per second. We interpret that these sediments generally consist of dense

and/or cemented Ringold Formation. For a given sediment type, sediments in this velocity range tend to have less infiltration potential.

The seismic lines provided in Appendix F suggest that relatively favorable conditions for stormwater infiltration could occur in the specific areas where thick sequences of Seismic Unit 1 occur. However, the seismic lines also indicate that the relatively thick sequences of Seismic Unit 1 are laterally and vertically bounded by higher velocity material, suggesting that lateral migration of infiltrated stormwater could be limited by adjacent higher velocity sediment.

9.0 GRAIN-SIZE-BASED HYDRAULIC CONDUCTIVITY ESTIMATES

A total of 25 samples were submitted to GeoEngineers' laboratory for gradation analyses completed in accordance with ASTM Method C 136. GeoEngineers' laboratory test results are presented in Appendix E. The percentages of fines (silt- and clay-sized particles passing the U.S. No. 200 sieve) within the samples ranged from 2.9 percent to 65 percent and are summarized in Table 1.

TABLE 1. FINES PERCENTAGES

Exploration	Approximate Depth (feet bgs)	Sediment Type	Interpreted Stratigraphic Unit	Fines Percentage [1]	Saturated Hydraulic Conductivity [2] (inches per hour)
B-1	5 - 5.5	SM	Ringold Formation	26	NA
B-1	12 - 12.5	GW-GM	Ringold Formation	9.2	79
B-2	7.5 - 8	GP-GM	Ringold Formation	5.6	108
B-2	12 - 12.5	SM	Ringold Formation	25	NA
B-3	3 - 4	SM	Ringold Formation	22	NA
B-3	15 - 16	GP-GM	Ringold Formation	8.2	89
B-4	8 - 8.5	GP-GM	Ringold Formation	6.2	113
B-4	14 - 14.5	GP	Ringold Formation	4.7	118
B-5	6 - 7	GP-GM	Ringold Formation	9.6	77
B-5	15 - 16	SP-SM	Ringold Formation	6.2	98
MW-1	10 - 10.5	SM	Ringold Formation	27	NA
MW-2	10 - 10.5	SM	Ringold Formation	18	NA
MW-2	18 - 18.5	GM	Ringold Formation	15	NA
MW-3	6.5 - 7	GM	Ringold Formation	17	NA
MW-3	18 - 18.5	GP-GM	Ringold Formation	5.8	104
MW-4	3 - 3.5	GP	Ringold Formation	4.4	97
MW-4	17 - 17.5	ML	Ringold Formation	65	NA
MW-5	5 - 5.5	SM	Ringold Formation	15	NA
MW-5	14 - 14.5	GP-GM	Ringold Formation	6.1	101
MW-6	4 - 4.5	GM	Ringold Formation	15	NA

Exploration	Approximate Depth (feet bgs)	Sediment Type	Interpreted Stratigraphic Unit	Fines Percentage [1]	Saturated Hydraulic Conductivity [2] (inches per hour)
MW-6	17 - 17.5	GP/GP-GM	Ringold Formation	5.0	105
MW-7	6 - 7	GM	Ringold Formation	18	NA
MW-7	9 - 10	GW	Ringold Formation	2.9	159
MW-8	10 -10.5	GP-GM	Ringold Formation	8.6	81
MW-8	17 - 17.5	GP	Ringold Formation	2.9	142
			Geometric Mean	**10**	**103**

Notes: [1]Fines percentage is the percentage of sample (by weight) that consists of silt- and clay-sized sediment particles passing the U.S. No. 200 sieve.
[2]Saturated hydraulic conductivity was calculated using Equations 6.16 through 6.18 of the Stormwater Management Manual for Eastern Washington (Ecology 2019).
NA = not applicable.

Grain-size-based hydraulic conductivity analyses generally rely, in part, on the samples d_{10} value (the sieve size that would allow 10 percent of the sample to pass). For samples with d_{10} values that were defined by their respective gradation curve, GeoEngineers estimated saturated hydraulic conductivity based on Equations 6.16 through 6.18 of the Stormwater Manual Management Manual for Eastern Washington (Ecology 2019). Resulting hydraulic conductivity estimates are summarized in Table 1. Estimates range from 77 to 159 inches per hour (in/hr), with a geometric mean of approximately 103 in/hr.

Grain-size based methods of calculating hydraulic conductivity generally do not consider sediment cementation and boundary conditions (such as lateral and vertical discontinuities) and, therefore, tend to over-estimate the in-place hydraulic conductivity of cemented sediments. Based on results of in-place hydraulic testing discussed later in this report, we suspect that these grain-size based methods over-estimate hydraulic conductivity by over an order of magnitude. They are provided herein for comparison with hydraulic testing results and to demonstrate the impact that cements filling sediment pore space on hydraulic conductivity.

10.0 BOREHOLE PERCOLATION TESTING

GeoEngineers conducted simplified falling-head borehole percolation tests during drilling operations in select boring locations. The purpose of percolation testing was to characterize near-borehole soil infiltration rates at key depths during drilling. At each testing location, the following general testing procedure was used:

- Advance 6-inch-diameter steel casing to the target depth.
- Introduce clean water into the well bore until the water level in the well bore is less than 3 feet bgs.
- Maintain the constant-head level in the hole until the flow rate has stabilized for a minimum period of 10 minutes.
- Discontinue flow and monitor the decrease in head level in the borehole over a falling-head period.

Results are summarized in Table 2 for those locations where the bottom of steel casing was within the unsaturated zone. Observed infiltration rates generally were less than 5 in/hr. However, relatively permeable zones were identified at depths of 19.0 feet bgs in MW-2 and 10.7 feet bgs in MW-4, where observed infiltration rates were 16.2 in/hr and 20.4 in/hr, respectively.

TABLE 2. RESULTS OF FALLING-HEAD BOREHOLE PERCOLATION TESTING

Location	Depth of Casing (feet bgs)	Date of Testing	Infiltration Rate [1] (in/hr)
B-1	8.8	05/14/19	3.6
B-2	4.3	05/15/19	4.2
B-4	6.3	05/15/19	0.2
MW-1	10.8	05/13/19	0.0
MW-1	18.2	05/13/19	0.0
MW-2	5.6	05/13/19	1.2
MW-2	19.0	05/13/19	16.2
MW-4	10.7	05/16/19	20.4

Notes: [1]Average infiltration rate for the initial 10-minute period following termination of water injection.

11.0 DPA-SPECIFIC SUBSURFACE GEOLOGIC FRAMEWORK

Based on information compiled from previous reports and collected during this field investigation, we created a series of maps and geologic cross-sections that graphically summarize our interpreted subsurface geologic framework for the DPA. Aspects of the compiled data within the project subsurface dataset (Appendices D and E) are provided in the following figures:

- Thickness of Sediments Overlying Basalt, Figure 4: This figure presents approximate thickness of sediments overlying basalt (which is equivalent to depth to top of basalt). Data used to support this figure primarily was obtained from water well report observations (Table D-1). Hydrogeologic cross-section lines that are the basis for Figures 7 and 8 also are shown in this figure.
- Top of Basalt Elevation, Figure 5: This figure presents our interpretation of the elevation of the top of basalt surface underlying the DPA. Data used to support this figure are from water well report observations (Table D-1) and ground surface elevations from the U.S. Geologic Survey.
- Depth to Top of Limiting Stratigraphic Unit, Figure 6: This figure presents approximate depth to the uppermost layer that is likely to limit water infiltration. Data used to support this figure was obtained from existing test pit observations (Table D-2) and project explorations (Appendix E).
- Hydrogeologic Cross-Section A-A', Figure 7: This section originates near the southwest corner of the study area and trends northeast to Flat Top Hill.
- Hydrogeologic Cross-Section B-B', Figure 8: This section originates near the northwest corner of the study area and trends east across Bombing Range Road.

Sediment thickness, depth to basalt, and top of basalt elevation varies considerably over the study area (Figures 4, 5, 7 and 8). In the DPA, the top of basalt slopes to the south and east and overlying sediment

generally thickens in the same directions. Generally, the west half of the DPA consists of an elevated basalt plateau. Within the plateau, basalt is shallow – generally less than 50 feet bgs – but still significantly deeper than limiting strata encountered in boreholes and the test pit. The top of basalt surface descends to the east within roughly the east half of the DPA and exceeds 200 feet bgs below South 58th Avenue. A depression in the basalt surface, within which depth to basalt also exceeds 200 feet, originates near the southwest corner of the DPA and trends west.

In this report, the limiting stratigraphic unit (Figure 6) is the uppermost sediment that limits infiltration of water. The limiting stratigraphic unit is interpreted to occur within the Ringold Formation and, depending on location within the DPA, the limiting layer is variably composed of fine-grained sediment, caliche, and/or cementation of pore space. Shallow basalt may also contribute to the limiting layer in the northernmost part of the DPA where it is at, or near the ground surface. Depth to the top of the limiting stratigraphic unit across the DPA ranges from 0 feet bgs to more than 15 feet bgs. In project explorations (Appendix E), GeoEngineers examined sediment samples carefully for evidence of cementation, caliche formation, induration, silt/clay content and other properties that could limit infiltration. When reviewing previous test pit exploration logs (Table D-2), GeoEngineers identified the depth of the limiting stratigraphic through key observations such as cementation, silt content, and sediment density. We recognize that it is likely that previous test pit logs do not document perching characteristics to the same extent as GeoEngineers' logs. Therefore, it is likely that, in some cases, the actual depth to limiting stratigraphic unit is shallower than shown in Figure 6 for some of the test pits.

12.0 MONITORING WELL SURVEY, INSTRUMENTATION AND GROUNDWATER ELEVATIONS

12.1. Survey

Monitoring well elevations were surveyed on July 10, 2019 by Stratton Surveying and Mapping, PC of Kennewick, Washington under subcontract to GeoEngineers. Survey data are provided in Table 3.

TABLE 3. MONITORING WELL ELEVATION DATA

Location	Structure Type	TOC Elevation [1] (feet)	Ground Surface Elevation [1, 2, 3] (feet)	Depth to Groundwater [2,4] (feet bgs)	Groundwater Elevation [1] (feet)
MW-1	Monitoring Well	572.53	570.03	Dry	<541.4
MW-2	Monitoring Well	573.84	571.21	Dry	<543.8
MW-3	Monitoring Well	643.12	643.30	7.33	635.97
MW-4	Monitoring Well	649.04	649.46	Dry	<629.0
MW-5	Monitoring Well	629.54	629.68	4.94	624.74
MW-6	Monitoring Well	657.34	657.61	4.68	652.93
MW-7	Monitoring Well	654.92	655.40	3.28	652.12
MW-8	Monitoring Well	652.00	652.35	2.61	649.74
Q-13	Drywell	NA	621.88	3.30	618.58
S-32	Manhole	NA	643.16	6.00	637.16
Q-16	Drywell	NA	641.73	4.55	637.18

Location	Structure Type	TOC Elevation [1] (feet)	Ground Surface Elevation [1, 2, 3] (feet)	Depth to Groundwater [2,4] (feet bgs)	Groundwater Elevation [1] (feet)
R-116	Drywell	NA	654.50	3.80	650.70

Notes: [1]Elevations are referenced to the ROS 3910 datum.
[2]The reference for drywell and manhole structures is the ground surface (rim) elevation.
[3]Rim elevations for S-32, Q-16, and R-116 were provided by the City of West Richland.
[4]Depths to groundwater were measured on June 27, 2019.
TOC = top of north rim of PVC well casing; bTOC = below top of casing

12.2. Instrumentation

On June 27, 2019, GeoEngineers installed Solinst Model 3001 pressure transducers/dataloggers in monitoring wells MW-1, MW-3 through MW-8, and the four stormwater structures listed in Table 3. We also installed a Solinst Model 3001 barometer/datalogger at MW-1. The dataloggers were programmed to record water (or air) pressure and temperature on a 10-minute interval for the purpose of characterizing seasonal trends in DPA groundwater elevation and response to precipitation events. Associated data download, reduction, and analysis is planned for fall 2019.

12.3. Groundwater Elevation Data

12.3.1. Manual Measurements

GeoEngineers collected manual groundwater levels in MW-1 through MW-8 and the four stormwater structures listed in table 3 on June 27, 2019. Results of this groundwater monitoring event are summarized in Table 3. Monitoring wells at the IF location (MW-1 and MW-2) were dry. This indicates that groundwater elevation at these well locations was less than 541.4 feet and 543.8 feet relative to the ROS 3910 datum (ROS 3910), respectively.

Monitoring well MW-4 is located in the northwest portion of the DPA, within an area of very recent/ongoing development. MW-4 also was dry on May 29, 2019, indicating groundwater elevation in this area was less than 629.0 feet ROS 3910.

Within the remainder of the DPA monitoring locations, depth to groundwater was relatively shallow. Depth to groundwater at these locations ranged from 2.61 bgs in monitoring well MW-8 to 7.33 feet bgs in MW-3. Corresponding groundwater elevations ranged from 618.58 feet ROS 3910 in Q-13 to 652.93 feet ROS 3910 in MW-6.

12.3.2. Electronic Measurements

On September 20, 2019, GeoEngineers downloaded the pressure transducer/dataloggers in project monitoring wells, stormwater structures, and the project barometer. The project monitoring period, therefore, extends from June 27 through September 20, 2019.

We corrected the data for barometric fluctuation and reduced the data for depth to groundwater and groundwater elevation. Results are provided and compared to daily precipitation at the Richland Climate Station (Station No. US1WABT0015) in Depth to Groundwater and Precipitation, Figure 10, and Groundwater Elevation and Precipitation, Figure 11. Our observations include the following:

- Groundwater levels generally rose in project monitoring wells and structures during the portion of the monitoring period that extends from June 27 through mid-September 2019. The magnitude of the observed increase ranged from approximately 0.5 to 1.5 feet.
- After the middle of September, water levels generally decreased in the project monitoring wells and structures. The observed magnitude of decrease was on the order of 0.1 to 0.3 feet.
- The hydrographs at two monitoring locations, MW-5 and S-32, remained relatively consistent during the monitoring period and did not follow the pattern described in the two previous bullets. MW-5 is located east of the densely developed portion of the DPA and S-32 is located south of the DPA.
- Minor precipitation events (less than about 0.2 inches) generally resulted in minor to negligible short-term increases in groundwater level.
- A large precipitation event that delivered approximately 0.45 inches of precipitation occurred on August 11 and 12, 2019. This event rapidly increased groundwater elevation in most of the monitoring points. The observed increase ranged from approximately 0.3 feet in MW-3 to 3 feet in R-116. In some locations, such as Q-16 and S-32, water levels rapidly recovered to pre-precipitation event levels. In other locations, such as MW-7 and Q-13, the impact of the precipitation event persisted for the remainder of the monitoring period.
- A diurnal (daily) fluctuation in groundwater level was observed in most of the monitoring locations. The magnitude of the observed fluctuation was generally less than 0.2 feet. The observed fluctuation also generally decreased with increasing depth to groundwater. This observed diurnal fluctuation could be caused by daily uptake of water by vegetation, daily irrigation practices, and/or the transfer of water between the shallow aquifer and capillary fringe related to daily temperature and barometric fluctuation (Turk 1975).

13.0 STORMWATER SYSTEM MONITORING

The City has conducted three groundwater monitoring events consisting of water level measurements in the City's stormwater system (primarily drywells and manholes) in and around the DPA. The monitoring events took place during September 2017, October 2018 and August 2019. Tabular results of these three monitoring events are presented in Table G-1 of Appendix G.

We evaluated the City's stormwater structure observations in two ways. The first was to map depth to water and the second was to map the elevation of the associated groundwater table. Mapping static depth to water in these stormwater structures demonstrates how close to the surface shallow groundwater is and is useful to predict areas that could be vulnerable to surface or basement flooding. Mapping groundwater elevation allows us to characterize the geometry of the groundwater table and the direction of shallow groundwater flow beneath the DPA.

Depth to groundwater contour maps for September 2017, October 2018 and August 2019 are provided in Figures G-1 through G-3, respectively. Each map shows two primary zones of shallow groundwater where depth to groundwater is as shallow as 2 feet bgs. One zone (herein designated the Pinnacle zone) is located within the north-central portion of the DPA, centered around the intersection of Pinnacle Drive and Grant Street. The eastern boundary of this zone is not defined by the dataset. The second zone (herein designated the Diamond zone) is located within the southwest portion of the DPA, centered around the intersection of Belmont Boulevard and Diamond Drive.

Examination of the contour distributions presented in Figures G-1 through G-3 indicates that both the Pinnacle zone and Diamond zone expanded between the September 2017 and the August 2019 monitoring events. Expansion of the Pinnacle zone is primarily occurring to the west and southwest. Expansion of the Diamond zone is concentrated to the northwest and southeast. The Diamond zone now extends south of the DPA toward the intersection of Blackwood Street and Ironwood Drive. Because the 2019 monitoring event occurred during mid-August (more than a month before the end of irrigation season), we expect that the zones of shallow groundwater shown in Figure G-3 will continue to grow through early fall.

Groundwater elevation distribution associated with the September 2017, October 2018, and August 2019 monitoring events are shown in Figures G-4 through G-6, respectively. These figures present the geometry of the groundwater table beneath the DPA including any mounds in the groundwater table that may indicate zones of intense groundwater recharge and/or lower sediment permeability. The groundwater elevation distributions presented in Figures G-3 through G-6 suggest that one primary groundwater mound forms within the DPA during and following the summer irrigation season. This mound is centered around the intersection of Mineral Street and Amber Avenue in the southwest portion of the DPA, where groundwater elevations are as high as 655.7 feet relative to the ROS 3910 datum. The mound approximately extends to Cobalt Drive to the north, Onyx Avenue to the west, Paradise Avenue to the south, and is undefined to the east. The horizontal extent of the mound appears to be expanding year to year. Groundwater elevations descend rapidly to the north and south from the perimeter of the mound. Shallow groundwater flows radially away from the center of the mound, approximately as shown in Figures G-4 through G-6.

During the summer of 2019, the City built on the larger data set just described by periodically monitoring depths to water at two stormwater structures within the DPA's groundwater mound. These structures are situated near locations of historic flooding and include structures located within the 1500-block of Diamond Drive and the 6400-block of Sapphire Street. Associated data are provided below in Table 4 and a plot of the results is provided in Stormwater Structure Monitoring, Figure 12.

TABLE 4. STORMWATER STRUCTURE MONITORING

	Depth to Water [1]	
	1500-Block of Diamond Drive	6400-Block of Sapphire Street
Date	(inches)	(inches)
05/07/19	30	43
05/23/19	18	38.5
06/14/19	16	37
06/28/19	13	34
07/12/19	8	30
07/26/19	6	26

Note: [1]Depth to water is referenced to the top of the rim of the stormwater structure.

Water levels within the stormwater structures have risen steadily during the 80-day monitoring period. Because the observed increases in water level occurred during the summer, which is characterized by limited precipitation, the observed increases appear to be independent of specific precipitation events.

By July 26, 2019, the depths to water in these structures were extremely shallow: 6 inches at Diamond Drive and 26 inches at Sapphire Street. The average rate of increase during the monitoring period was approximately 2.1 inches per week at Diamond Drive and 1.5 inches per week at Sapphire Street.

14.0 HYDRAULIC TESTING

14.1. Slug Testing

GeoEngineers conducted rising-head and falling-head slug tests on June 27, 2019 in project monitoring wells that contained a sufficient water column (approximately 4 feet or more) to support testing. These wells included MW-3, MW-5, MW-6, MW-7 and MW-8. Slug tests were conducted as a basis for estimating saturated hydraulic conductivity within sediment adjacent to the well screens (Ringold Formation). Because slug test results are reflective of near-well aquifer conditions only, slug test results do not provide information about aquifer boundaries or variations in aquifer properties that occur at distance from the tested well.

Falling- and rising-head slug tests are performed by rapidly increasing or decreasing, respectively, the water level in a well and measuring the subsequent rate of water level change as head conditions recover. Increasing and decreasing water level is achieved by quickly inserting or removing, respectively a slug (in this case a sealed PVC pipe filled with impermeable material) of known volume into or out of the water column. We analyzed project slug test data for hydraulic conductivity using a solution introduced by Bouwer and Rice (1976) and updated by Bouwer (1989).

Slug test data are presented in Slug Test Plots, Figures H-1 through H-10 of Appendix H. Most, if not all, of the plots demonstrate the double straight-line effect recognized by Bouwer (1989). An associated recovery curve consists of two linear components: (1) an initial, steep, linear recovery pattern that reflects influence of the well's filter pack; (2) a less steep, linear recovery pattern that reflects influence of the adjacent aquifer. Where the double straight-line effect was apparent In Figures H-1 through H-10, we fit lines to the second linear component.

A narrow range in water level response to slug testing was observed in the five tested monitoring wells. Analysis of the slug test data yielded saturated hydraulic conductivity estimates that are relatively low, ranging from 1.5 in/hr in MW-3 to 2.4 in/hr in MW-8. Slug testing results are summarized in Table 5.

TABLE 5. SLUG TEST RESULTS SUMMARY

Well Identification	Saturated Hydraulic Conductivity [1] (inches per hour)
MW-3	1.5
MW-4	2.1
MW-5	2.1
MW-7	1.9
MW-8	2.4

Note: [1]The provided saturated hydraulic conductivity value represents the geometric mean of the slug testing results at each monitoring well location.

14.2. Pilot Infiltration Testing

The infiltration characteristics of the unsaturated zone at the IF location were estimated by completing a pilot infiltration test in test pit TP-1 on June 18, 2019. GeoEngineers conducted the pilot infiltration test in general accordance with Appendix 6B of the Stormwater Management Manual for Eastern Washington (Ecology 2019). Pilot infiltration testing was completed while TP-1 was 10 feet in length, 8 feet in width, and excavated to a depth of 3 feet bgs. After pilot infiltration testing, the test pit was deepened to 10 feet bgs for the purpose of characterizing sediment conditions below the test depth.

GeoEngineers used the following testing procedure:

- Installed a vertical measuring rod within the test pit marked in 1/16-inch increments.
- Added clean water to the pit at a rate that maintained a water level between 1.5 and 2 feet above the bottom of the pit. Water was injected into the pit for a period of 263 minutes.
- Measured the cumulative volume and instantaneous flow rate in gallons per minute (gpm) necessary to maintain the water level at the same point on the measuring rod.
- Terminated water discharge and recorded the rate of water level decrease in the test pit for a period of approximately 27 hours.

To maintain the constant head within the test pit, an injection rate of approximately 2.75 gpm was required. This suggests an infiltration rate of approximately 3.3 in/hr. During the falling-head period infiltration rate ranged from about 1.7 to 0.5 inches per hour. The falling-head infiltration rate diminished over time as head decreased and, potentially, the wetting front extended to zones of relatively low permeability.

Monitoring wells MW-1 and MW-2 remained dry throughout the testing and recovery periods.

15.0 PRECIPITATION TRENDS

To evaluate whether precipitation trends could be an influence on DPA groundwater levels, we obtained monthly precipitation data from the Kennewick, Washington Climate Station (No. 454154) and Richland, Washington Climate Station (No. 457015) for the period from January 1980 through July 2019 (the precipitation period of record). These data are tabulated in Table I-1 and summarized in Figure I-1 of Appendix I. We calculated the cumulative departure from average monthly precipitation in Table I-2 and plotted cumulative departure in Figure I-2. Cumulative departure is an accounting of the comparison of actual monthly precipitation at a site with average monthly values. The cumulative departure plot (Figure I-2) illustrates long-term precipitation trends, with above-average precipitation forming a graphical rise and below-average precipitation forming a graphical decline. Examination of this plot suggests the following:

- Between 1980 and 2005, the cumulative departure plot is dominated by two long-term cycles in precipitation. Approximate 6-year periods of above-average precipitation (1980 to 1986 and 1992 to 1998) are followed by approximate 6-year below-average periods (1986 to 1992 and 1998 to 2004).
- The cumulative departure is generally stable to decreasing during the period of development within the DPA (about 2005 through 2019).

- Precipitation during the first 7 months of 2019 is approximately 5 inches above average for the precipitation period of record.

We interpret that the observed increase in groundwater levels within the DPA cannot be explained (either in part or in full) by long-term trends in precipitation.

16.0 WATER USE AND IRRIGATION REQUIREMENTS

16.1. Water Use

Residential developments within the DPA are served by imported water from the West Richland water utility. A distribution of residences, and irrigated lawns, occurs west of Belmont Boulevard and its extension, within roughly the west half of the DPA. East of Belmont Boulevard and its extension, homes and associated irrigated lawns are scattered but generally spaced on the order of about 1¼ to 2½ acres.

At the end of 2019, the City provided GeoEngineers with a database of water meter records for an area that roughly corresponds with the DPA. GeoEngineers conducted detailed data reduction and analysis of the dataset, which supersedes the less detailed analysis of City water use data presented in our Phase 1 report.

The period of record within the database (herein termed the water use period of record) is from January 2012 through December 2019. GeoEngineers used the provided information to develop annual estimates of total water use within the geographic area bounded by the database. A summary of our evaluation is provided below in Table 6.

We estimate that the total quantity of imported water during the water use period of record was approximately 4,166 acre-feet, neglecting any water imported to the DPA from the Columbia Irrigation District. Water use estimates also do not include any water associated with domestic wells operated within the DPA.

Water use generally increased during the water use period of record. The annual rate of water importation increased from a minimum of approximately 283 acre-feet in 2012 to a maximum of 667 acre-feet during 2018.

TABLE 6. WATER USE SUMMARY

Year [1]	Total Water Use (acre-feet)	Equivalent Number of Homes[2]	Estimated Domestic Water Use (acre-feet)	Estimated Irrigation Water Use (acre-feet)	Estimated Irrigation Water Use per Home (acre-feet per home)
2012	283	352	61	222	0.63
2013	373	429	75	298	0.70
2014	465	492	86	379	0.77
2015	553	571	100	453	0.79
2016	602	638	111	490	0.77

Year [1]	Total Water Use (acre-feet)	Equivalent Number of Homes[2]	Estimated Domestic Water Use (acre-feet)	Estimated Irrigation Water Use (acre-feet)	Estimated Irrigation Water Use per Home (acre-feet per home)
2017	597	699	122	475	0.68
2018	667	736	129	538	0.73
2019	626	756	132	494	0.65
Total	**4,166**		**816**	**3,349**	

Notes: [1]The year assigned to a given measurement coincided with the year associated with the date of measurement. Portions of the water use for January measurements could have occurred during the previous year.
[2]The equivalent number of homes for a given period was calculated by dividing the total number of monthly meter measurements by the number of associated months.

To arrive at estimates for domestic and irrigation water use, we calculated the equivalent number of homes that reported water consumption for each respective year. This calculation is complicated by homes that are built partway through a given year and homes where water use ceases for a portion of the year (typically during the winter). To account for these complications, we summed the total number of positive (non-zero) monthly meter readings within a given period of time (typically a year) and divided the total by the number of months within the period. As shown in Table 6, the equivalent number of homes within the DPA increased steadily during the water use period of record, from a low of 352 in 2012 to a high of 756 in 2019.

We assumed the average number of people per home is 2.6 and per capita domestic water use is 60 gallons per day (Ecology 2018). As shown in Table 6, this approach yielded annual domestic water use estimates that ranged from 61 acre-feet in 2012 to 132 acre-feet in 2019, for a total of 816 acre-feet for the water use period of record.

West of Belmont Avenue and its extension, residences are served by City sewer and most of this imported domestic water exits the DPA through the City sewer system. East of Belmont Avenue and its extension, residences are primarily serviced by individual septic systems, and imported domestic water enters the DPA groundwater system through infiltration.

The domestic water use estimates presented above represent only about 20 percent of the water use total. This suggests that on the order of 80 percent of the DPA water use is used outside of the home. We assume that this outside-of-home water use is primarily used to irrigate lawns. The DPA irrigation water use estimates summarized in Table 6, therefore, range from 222 acre-feet in 2012 to 538 acre-feet in 2018, for a total of 3,349 acre-feet.

The estimated irrigation water use per home ranged from approximately 0.63 acre-feet in 2012 to 0.79 acre-feet in 2015. Annual variation in temperature and precipitation are assumed to influence at least a portion of this observed variation in irrigation water use.

17.0 DRAINAGE COMPLAINTS

The City provided GeoEngineers with summaries of five complaints they have received from residents within the DPA that are related to an elevated groundwater table. These are summarized in Drainage Complaints,

Figure 9 and Table J-1 of Appendix J. One complaint (No. 1) was received during the late summer of 2017. Three of the complaints (No. 2 through 4) were received during the fall of 2018. Complaint No. 5 was received during the spring of 2019.

Complaint Nos. 1 through 3 are located within the Paradise Estates development within the southwest portion of the DPA. Complaint No. 4 occurred within the Collins Ridge development in the northwest portion of the DPA. Complaint No. 5 is located within the northeast portion of the DPA within an area of dispersed development.

The properties associated with Complaint No. 1 through 5 are each located adjacent to one of the project monitoring wells (Table I-1). Based on observed sediment conditions within adjacent monitoring wells, the depth to limiting stratigraphic unit (Figure 6) at each complaint location is 4 feet or less.

18.0 CONCLUSIONS

18.1. DPA

The DPA area is underlain by a complex sedimentary sequence overlying basalt. Although cross-sections A-A' and B-B' (Figures 7 and 8) suggest that a sufficient thickness of sediment could be present to support infiltration of irrigation water, septic discharge, and stormwater beneath the DPA, the sediment is of variable grain-size distribution, density, and cementation and generally drains poorly. The depth to limiting stratigraphic unit (which is variably formed by basalt, fine-grained sediment, caliche, and/or cementation of pore spaces) appears to be less than 8 feet bgs throughout much of the DPA. Perching of groundwater in these areas can flood basements and other below-ground structures.

GeoEngineers reviewed 53 test pit exploration logs for the DPA and surrounding area (Table D-2), each of which was excavated during the period from February 2010 through April 2016 and prior to construction of the respective development project. None of the test pits encountered groundwater to the depth explored. After residential build-out, a rise in groundwater level has been observed within the DPA. This rise in groundwater level cannot be explained through precipitation trends (Appendix I). Because of the topographic isolation of the DPA, it also cannot be explained by large-scale farm irrigation, canal leakage, or other agricultural influences.

We conclude that the increase in groundwater level is related to residential development and associated changes in the DPA water budget. We further conclude that seepage from irrigation of lawns, stormwater injection, and septic discharge each play a role in reducing available shallow subsurface water storage beneath the DPA and causing the elevated groundwater conditions observed within the DPA. However, we suspect that the primary control on DPA water level rise is related to irrigation of residential lawns. This conclusion is based on our evaluation of water level data from the City's monitoring well and stormwater structure monitoring program, which indicates that groundwater levels within the DPA rise through the summer lawn irrigation season.

Based on project findings, our current conceptual model of the hydrogeologic conditions that support drainage problems within the DPA is as follows:

- The sediment strata overlying basalt consists primarily of low permeability Ringold Formation clay, silt, sand and gravel with occasional caliche development. These strata appear to be thinnest beneath the

central part of the DPA. Based on our project explorations and review of existing data, we conclude that the stratigraphic interval limiting downwards infiltration of water, and hence supporting development of high water levels in the DPA is composed of this mix of Ringold low permeability material.

- The matrices of Ringold Formation sedimentary deposits contain moderate to abundant cementation. This cementation perches (limits the vertical infiltration of) water. If the cementation occurred in discrete horizontal layers, infiltrated water would be able to flow laterally away from the DPA through overlying uncemented sediments. However, borehole exploration and geophysical data suggest that the observed cementation is geometrically complex and forms horizontal as well as vertical boundaries to groundwater flow.
- Prior to development, land use in the DPA consisted of dispersed rural residences and natural shrub steppe. Very little imported water was applied to this area and the primary source of aquifer recharge was precipitation, much of which was retained by near-surface soil/vegetation and ultimately lost to evapotranspiration during the summer. Irrigated agriculture was notably absent from the area now occupied by the DPA.
- With the advent of residential development, irrigated lawns and impermeable surface (paved areas, streets, and buildings) became prevalent within the DPA. The percentage of water lost to evapotranspiration significantly decreased and stormwater discharge became concentrated at points of discharge (drywells, infiltration trenches and roof downspouts). As a result, more water now infiltrates through the vadose zone within the DPA relative to pre-development conditions. The mechanisms creating increased infiltration primarily occurs through lawn watering, the removal of evapotranspiration through the loss of native vegetation, and construction of impermeable surfaces where stormwater runoff is concentrated at specific infiltration points.
- As the area of development increased, the rate and volume of water entering the subsurface increased and eventually exceeded the capacity of the low-permeability Ringold Formation to transmit the water out of the DPA. As a result, shallow groundwater rose to near-surface levels causing the observed flooding and drainage issues now occurring in the DPA.

Groundwater mounding and associated flooding may expand, particularly during the summer/early fall irrigation season, if changes to the DPA water budget are not addressed. The City's water use data suggest that DPA residents might be modifying irrigation practices in response to observed drainage problems. Despite an increase in the equivalent number of homes of 20 within the DPA, estimated irrigation water use declined by 41 acre-feet in 2019 relative to 2018 (Table 6). The associated reduction in irrigation water use per home was 0.08 acre-feet. We interpret that the City's efforts to heighten awareness of the contribution of irrigation water to DPA drainage issues contributed to the observed reduction in 2019 water use.

We recommend that the City continue a groundwater monitoring program within the DPA that includes the following:

1. Water level monitoring events within DPA stormwater structures on a 2-month interval throughout the year. Mapping of these data will allow the City to better understand the seasonal fluctuation in groundwater mounding beneath the DPA.
2. Continuous water level monitoring within DPA monitoring wells and instrumented stormwater structures. DPA dataloggers should be downloaded on a 4-month interval and the data analyzed for

shallow groundwater response to precipitation and runoff events, seasonal trends, and longer-term trends.

18.2. Potential Infiltration Facility

GeoEngineers evaluation of the preliminary feasibility of the IF for disposal of water from the DPA primarily is based on the following observations:

- Pilot infiltration testing: To maintain a constant head within the 80-square-foot test pit, an injection rate less than 3 gpm was required. Once flow to the pit was terminated, the water level within the pit decreased at an average rate of less than 0.15 inches per hour.
- Drilling exploration/borehole percolation testing in monitoring wells MW-1 and MW-2: Subsurface conditions at MW-1 and MW-2 consist of shallow dune deposits overlying a complex assemblage of Ringold Formation sand and gravel with variable silt content. Cementation of pore space was observed as shallow as 4 feet bgs. The observed infiltration rates during borehole percolation testing were 0 in/hr in MW-1 and ranged from 1.2 in/hr to 16.2 in/hr in MW-2.

This data indicate that the IF location is not conducive to efficient disposal of water from the DPA at a scale that would justify infrastructure costs.

19.0 LIMITATIONS

We prepared this report for use by the City of West Richland to assist in the characterization of the hydrogeologic conditions that underly the DPA. Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in the field of hydrogeology in this area at the time this report was prepared. No warranty or other conditions, express or implied, should be understood.

Please refer to Appendix K, “Report Limitations and Guidelines for Use” for additional information pertaining to use of this report.

20.0 REFERENCES

Bouwer, H. and R.C. Rice, 1976, A slug test for determining hydraulic conductivity of unconfined Aquifers with completely or partially penetrating wells. Water Resources Research, v. 12, pp. 423-428.

Bouwer, H., 1989. The Bouwer and Rice Slug Test - An Update. Ground Water, v. 12, No. 3, pp. 304 - 309.

Drost, B.W., S.E. Cox, and K.M. Shurr. 1997. Changes in ground-water levels and ground-water budgets, from pre-development to 1986, in parts of the Pasco Basin, Washington. U.S. Geological Survey Water-Resources Investigations Report 96-4086, 173 p.

Ely, D.M., E.R. Burns, D.S. Morgan, and J.J. Vaccaro. 2014. Numerical Simulation of Groundwater Flow in the Columbia Plateau Regional Aquifer System, Idaho, Oregon, and Washington: U.S. Geological Survey Scientific Investigations Report 2014-5127, 89 p.

Ervin, E.H. and A.J. Koski. 1998. Drought avoidance aspects and crop coefficients of Kentucky bluegrass and Tall fescue turfs in the semiarid west. Crop Sci. 38:788-795.

GeoEngineers, Inc. 2019. Phase 1 Report, Hydrogeologic Investigation, Drainage Problem Area, City of West Richland, Washington. Report prepared by GeoEngineers, Inc. of Kennewick, Wash. for the City of West Richland, Wash. February 14.

GWMA. 2009. Geologic framework of selected sedimentary and Columbia River Basalt Group units in the Columbia Basin Ground Water Management Area of Adams, Franklin, Grant, and Lincoln Counties, Washington, Edition 3: Consultant report prepared for the Columbia Basin Ground Water Management Area of Adams, Franklin, Grant, and Lincoln Counties, Washington, prepared by GSI Water Solutions, Inc., and the Franklin County Conservation District, June 2009.

GWMA, 2011, Groundwater flow model of the Columbia Basin Ground Water Management Area of Adams, Franklin, Grant, and Lincoln Counties: Model development, calibration, and application to evaluate groundwater supplies in four sub-regions. Consultant report prepared for the Columbia Basin Ground Water Management Area of Adams, Franklin, Grant, and Lincoln Counties, Washington, prepared by GSI Water Solutions, Inc., and S.S. Papadopulos & Associates, Inc., June 2011.

Heywood, C.E., Kahle, S.C., Olsen, T.D., Patterson, J.D., and Burns, Erick. 2016. Simulation of groundwater storage changes in the eastern Pasco Basin, Washington: U.S. Geological Survey Scientific Investigations Report 2016–5026, 44 p.

James, L.G., J.M. Erpenbeck, D.L. Bassett, and J.E. Middleton. 2001. Irrigation Requirements for Washington, Estimates and Methodology. Washington State University Cooperative Extension Publication No. EB1513.

Kahle, S.C., D.S. Morgan, W.B. Welch, D.M. Ely, S.R. Hinkle, J.J. Vaccaro, and L.L. Orzol. 2011. Hydrogeologic framework and hydrologic budget components of the Columbia Plateau Regional Aquifer System, Washington, Oregon, and Idaho: U.S. Geological Survey Scientific Investigations Report 2011-5124, 66 p.

Lindsey, K.L., 1996. The Miocene to Pliocene Ringold Formation and associated deposits of the ancestral Columbia River system, south-central Washington and north-central Oregon. Washington Division of Geology and Earth Resources Open File Report 96-8, 176 p.

Reidel, S.P., and Tolan, T.L., 2013. The Grande Ronde Basalt, Columbia River Basalt Group, in Reidel, S.P., Camp, V.E., Ross, M.E., Wolff, J.A., Martin, B.S., Tolan, T.L., and Wells, R.E., eds., "The Columbia River Flood Basalt Province." Geological Society of America Special Paper 497, p. 117-153.

Schulz, E.F., 1989, Applied hydrology, Revised Edition. Water Resources Publications: Littleton, Colorado, ISBN Number 0-918334-07-1, 501 p.

Thornthwaite, C.W., and J.R. Mather. 1957. Instructions and tables for computing potential evapotranspiration and the water balance. Drexel Institute of Technology Laboratory of Technology Publications in Climatology, v. 10, No. 3, p. 185-311.

Turk, L.J. 1975. Diurnal fluctuations of water tables induced by atmospheric pressure changes. Journal of Hydrology, v. 26, p. 1-16.

Washington State Department of Ecology. 2004. Stormwater Management Manual for Eastern Washington. Publication Number 04-10-076. September. 715 p.

Washington State Department of Ecology. 2018. ESSB 6091 – Streamflow Restoration, Recommendations for Water Use Estimates. Publication Number 18-11-007.June. 9 p.

FIGURES

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Feet

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Mapbox Open Street Map, 2016

Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Vicinity Map

Drainage Problem Area
City of West Richland, Washington

GeoEngineers

Figure 1

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Data Source: Aerial from ESRI

Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Legend

- MW-1 — Monitoring Well Designation and Approximate Location
- B-1 — Boring Designation and Approximate Location
- 1 — Geophysical Survey Line
- Q-13 — Instrumented Stormwater Structure Designation and Approximate Location
- Approximate Drainage Problem Area Boundary

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Feet

Phase 2 Exploration Map

Drainage Problem Area
City of West Richland, Washington

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Figure 2

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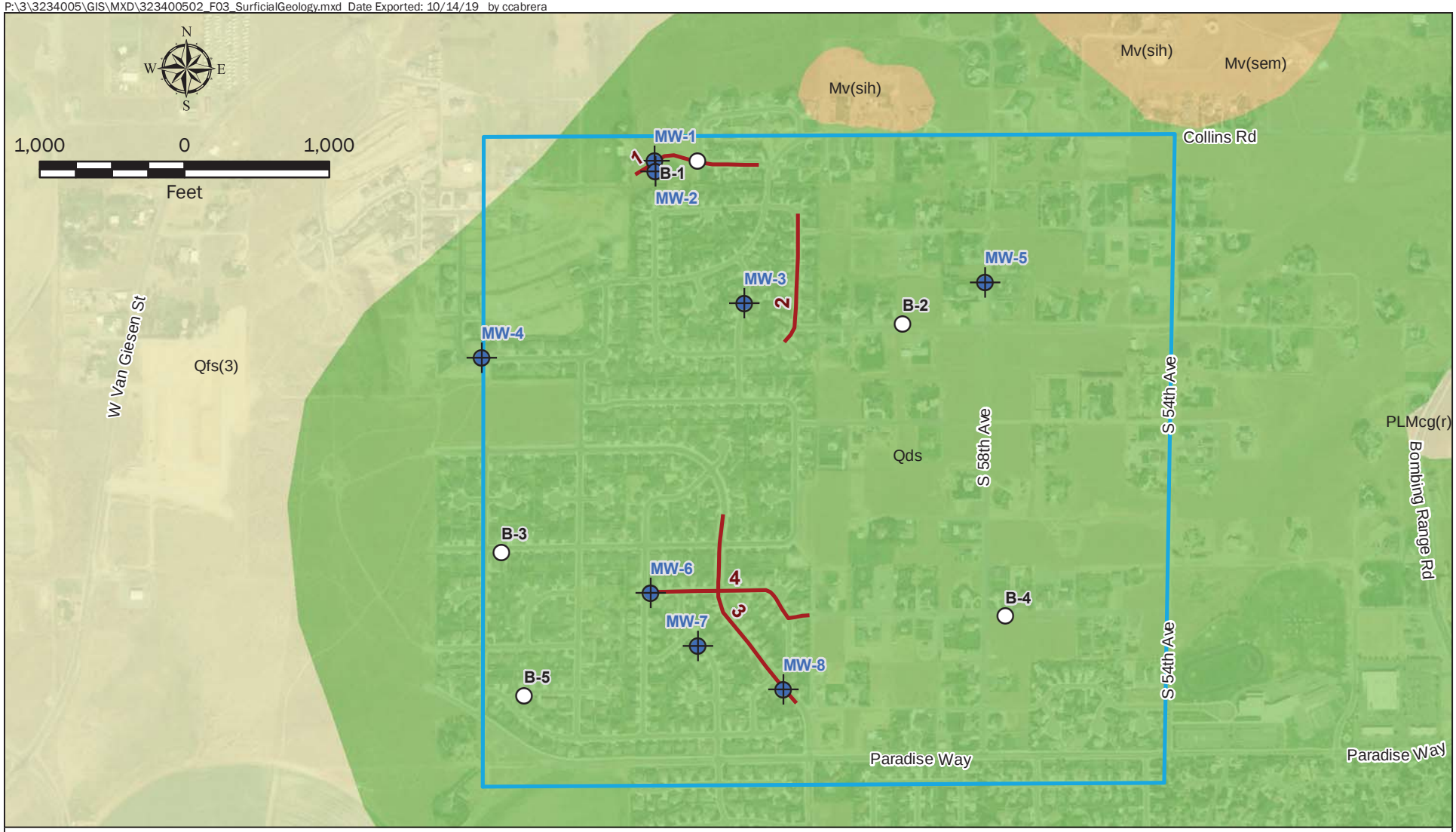

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Data Source: Aerial image from ESRI Data Online.
Geology from Washington DNR.

Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

MW-1 Monitoring Well Designation and Approximate Location

B-1 Boring Designation and Approximate Location

Geophysical Survey Line Designation and Approximate Location

Approximate Drainage Problem Area Boundary

Surficial Geologic Units - 100K

Qds	Quaternary dune sand, loess, and artificial fill
Qfs(3)	Pleistocene continental glacial, glaciolacustrine, and outburst flood deposits
PLMcg(r)	Pliocene-Miocene continental sedimentary rocks (Ringold Formation)
Mv	Miocene Columbia River Basalt Group, Saddle Mountains Basalt (sih = Ice Harbor Member; sem = Elephant Mountain Member)

Surficial Geology Map

Drainage Problem Area
City of West Richland, Washington

GeoEngineers

Figure 3

Notes:

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3. Depth to basalt data for 6D1 and 6P4 appear anomalous within the context of adjacent data. These wells could be mislocated and were omitted from contour development.
4 Basalt at or near ground surface distribution is adapted from Figure 2.

Data Source: Topo from USGS and ESRI

Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Legend

- 1D1 — Interpreted Water Well Report Location (Appendix C)
- B-1 — DPA Boring/Monitoring Well Location
- 100 — Approximate Sediment Thickness Contour (50-foot Interval)
- A — A' Cross-Section
- Approximate Drainage Problem Area Boundary
- Mv(sih) or Mv(sem) — Basalt at or near ground surface [4]

N W E S

1,000 0 1,000

Feet

Thickness of Sediments Overlying Basalt

Drainage Problem Area
City of West Richland, Washington

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Figure 4

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2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. Basalt elevation data for 6D1 and 6P4 appear anomalous within the context of adjacent data. These wells could be mislocated and were omitted from contour development.
4 Basalt at or near ground surface distribution is adapted from Figure 2.
5. Elevation contours are referenced to the North American Vertical Datum of 1988 (NAVD88)
Data Source: Topo from USGS and ESRI
Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Legend

1D1 ● Interpreted Water Well Report Location (Appendix C)

B-1 ○ DPA Boring/Monitoring Well Location

300 Approximate Top of Basalt Elevation Contour (50-foot Interval)

A — A' Cross-Section

Approximate Drainage Problem Area Boundary

Mv(sih) or Mv(sem) Basalt at or near ground surface [4]

N W E S

1,000 0 1,000
Feet

Top of Basalt Elevation

Drainage Problem Area
City of West Richland, Washington

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Figure 5

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3. bgs = below ground surface

Data Source: Aerial from ESRI

Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Legend

BHTP1/2 — Test Pit Exploration and Depth to Top of Limiting Stratigraphic Unit (feet bgs)

B-1/0 — DPA Boring/Monitoring Well Location and Depth to Top of Limiting Layer (Feet bgs)

Approximate Drainage Problem Area Boundary

A — A' Cross-Section

N W E S

1,000 0 1,000

Feet

Depth to Top of Limiting Stratigraphic Unit

Drainage Problem Area
City of West Richland, Washington

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Figure 6

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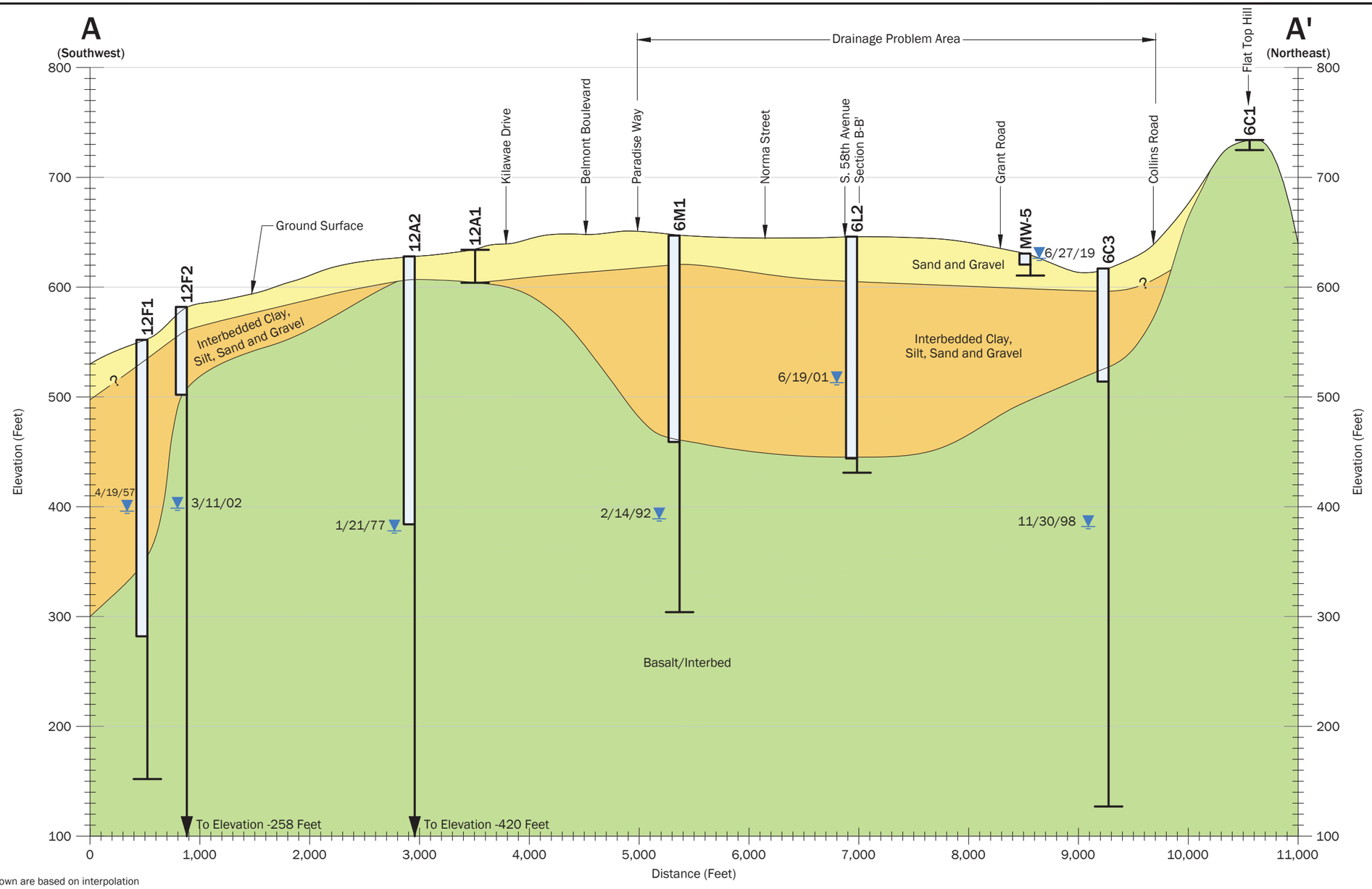

Notes:

1. The subsurface conditions shown are based on interpolation between widely spaced explorations and should be considered approximate; actual subsurface conditions may vary from those shown.
2. This figure is for informational purposes only. It is intended to assist in the identification of features discussed in a related document. Data were compiled from sources as listed in this figure. The data sources do not guarantee these data are accurate or complete. There may have been updates to the data since the publication of this figure. This figure is a copy of a master document. The hard copy is stored by GeoEngineers, Inc. and will serve as the official document of record.
3. Subsurface information is interpreted based on information provided in Water Wells Reports provided by the Washington State Department of Ecology. Well locations are approximate and based on location information within the report.

Datum: NAVD 88, unless otherwise noted.

Legend

Existing Well

Reported Water Level and Date of Measurement

Cased Interval

Open/Lined Interval

Bottom of Borehole

Sand and Gravel (Ringold Formation with Minor Overlying Hanford Formation/Dune Deposits

Interbedded Clay, Silt, Sand and Gravel (Ringold Formation)

Basalt/Interbed

Interpreted Lithologic Contact

1000 0 1000
Horizontal Scale in Feet

100 0 100
Vertical Scale in Feet
Vertical Exaggeration: 10X

Hydrogeologic Cross-Section A-A'

Drainage Problem Area
West Richland, Washington

GeoEngineers

Figure 7

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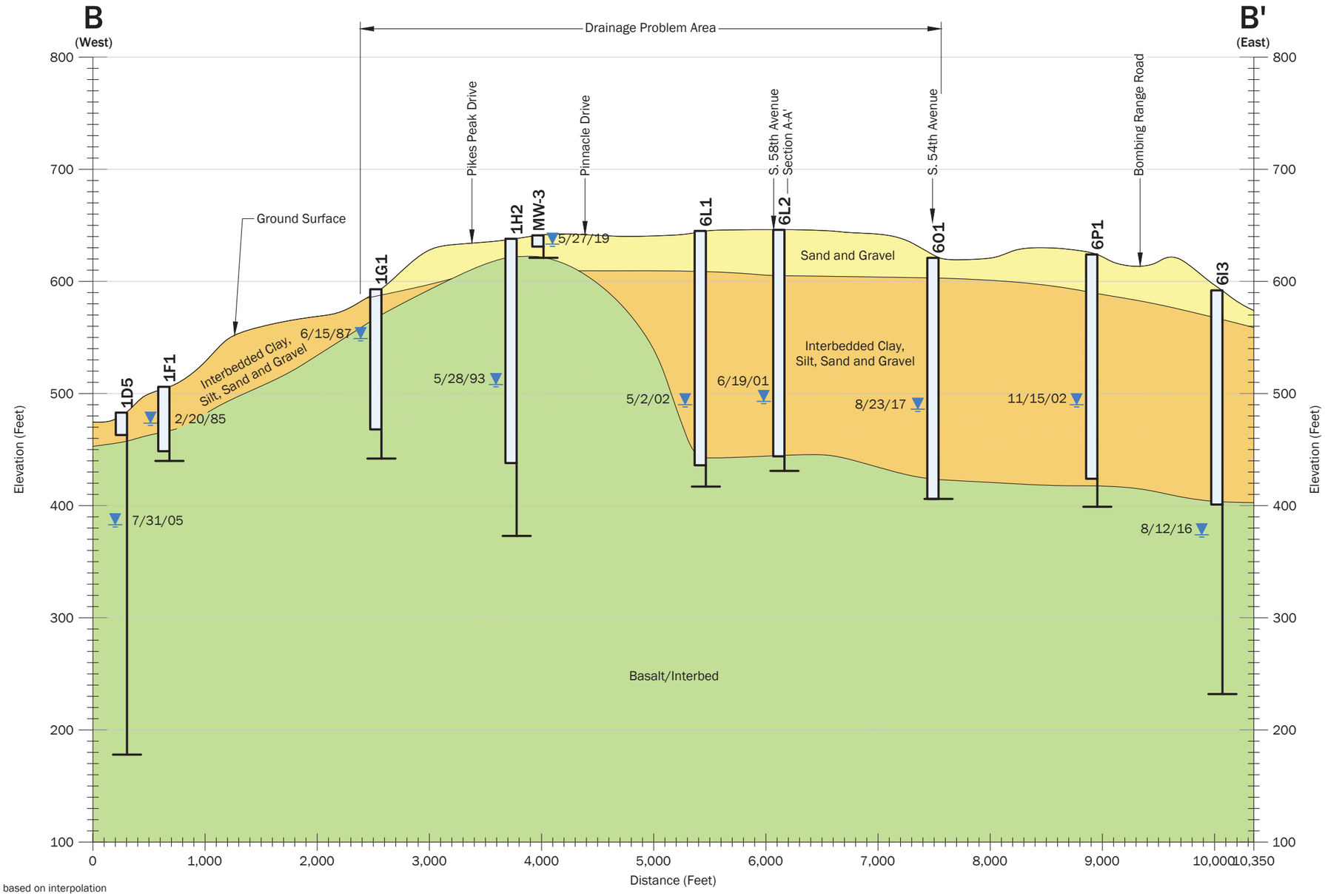

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3. Subsurface information is interpreted based on information provided in Water Wells Reports provided by the Washington State Department of Ecology. Well locations are approximate and based on location information within the report.

Datum: NAVD 88, unless otherwise noted.

Legend

Existing Well

Reported Water Level and Date of Measurement

Cased Interval

Open/Lined Interval

Bottom of Borehole

Sand and Gravel (Ringold Formation with Minor Overlying Hanford Formation/Dune Deposits

Interbedded Clay, Silt, Sand and Gravel (Ringold Formation)

Basalt/Interbed

Interpreted Lithologic Contact

1000 0 1000
Horizontal Scale in Feet

100 0 100
Vertical Scale in Feet
Vertical Exaggeration: 10X

Hydrogeologic Cross-Section B-B'

Drainage Problem Area
West Richland, Washington

GeoEngineers

Figure 8

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Notes:
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2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. bgs = below ground surface

Data Source: Aerial from ESRI

Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Legend

Drainage Complaint

Approximate Drainage Problem Area Boundary

N
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1,000 0 1,000
Feet

Drainage Complaints

Drainage Problem Area
City of West Richland, Washington

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Figure 9

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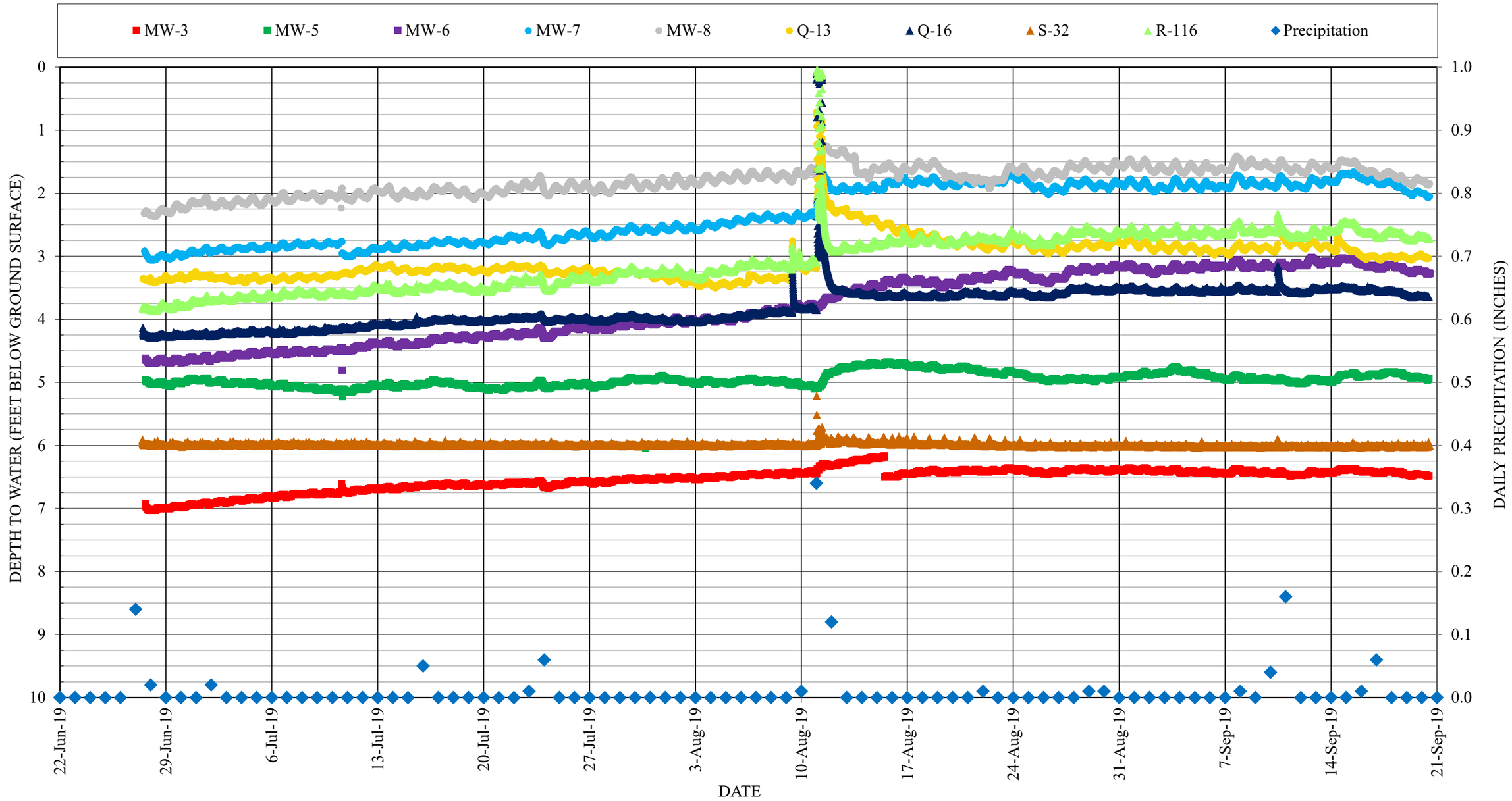

Notes:

1. Depth to water data were obtained from Solinst Levelogger transducer/dataloggers installed within City of West Richland monitoring wells and stormwater structures.
2. Daily precipitation data were obtained from the National Oceanic and Atmospheric Administration for the Richland 3.4 SSW, WA US Climate Station (Station No. US1WABT0015).

Depth to Groundwater and Precipitation

Drainage Problem Area
City of West Richland, Washington

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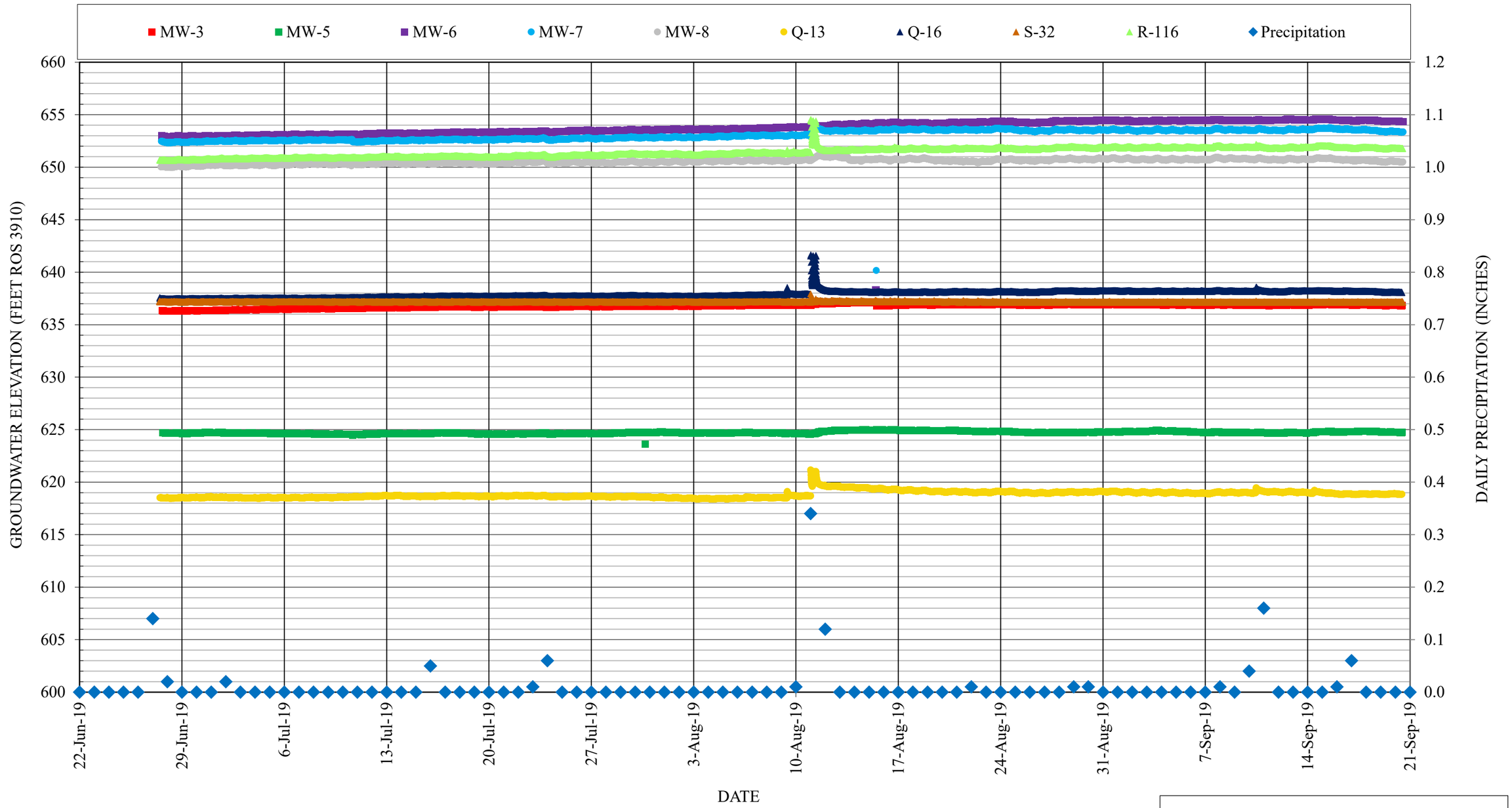
Figure 10

3234-005-00 Date Exported: 01/11/2019



Notes:

1. Groundwater elevation data were obtained from Solinst Levelogger transducer/dataloggers installed within City of West Richland monitoring wells and stormwater structures.
2. Daily precipitation data were obtained from the National Oceanic and Atmospheric Administration for the Richland 3.4 SSW, WA US Climate Station (Station No. US1WABT0015).

Groundwater Elevation and Precipitation

Drainage Problem Area
City of West Richland, Washington

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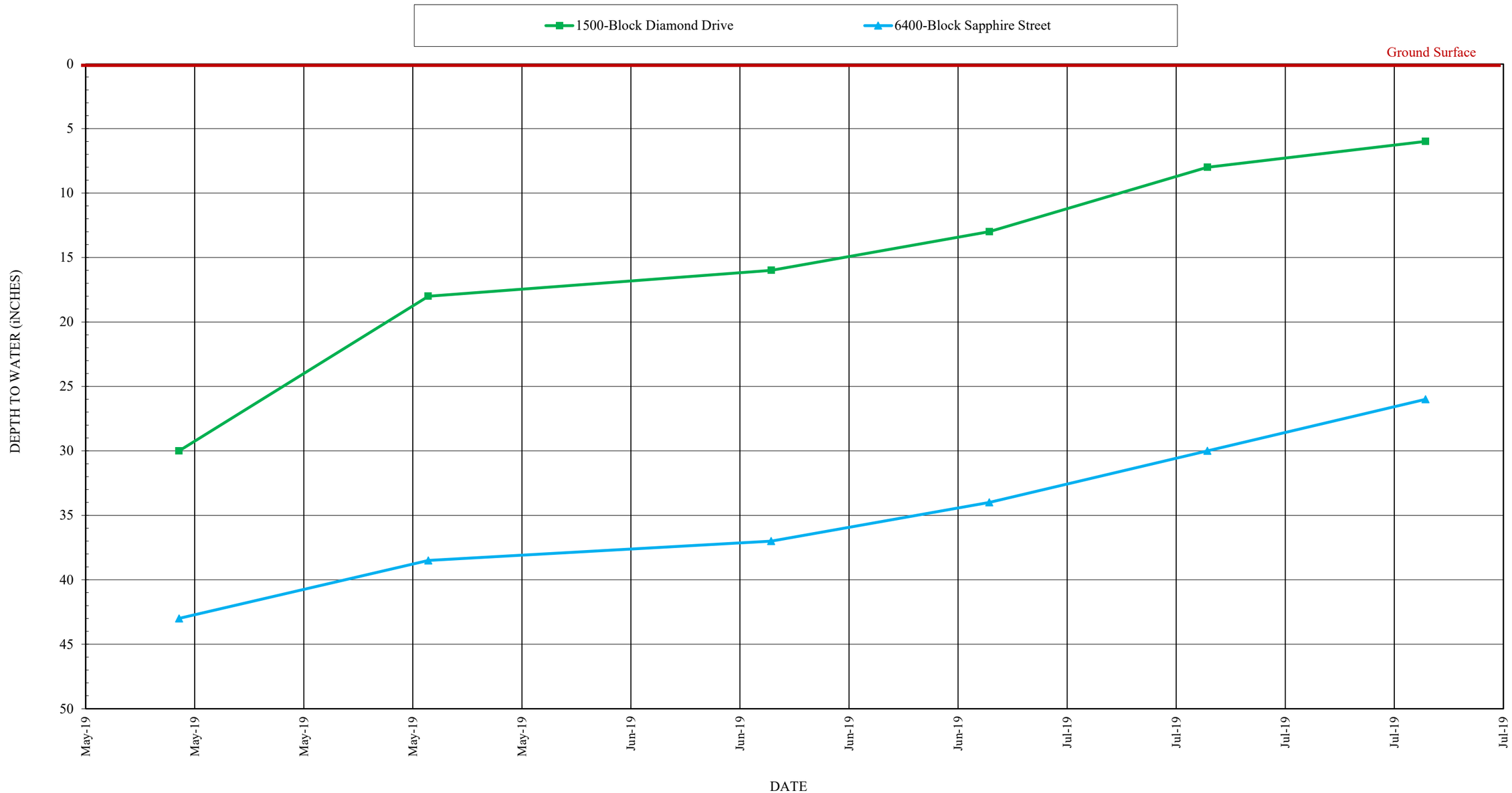
Figure 11

3234-005-00 Date Exported: 01/11/2019



Notes:
1. Depths to water were obtained from the City of West Richland's Stormwater Structure Monitoring Program.
2. Depths are referenced to the top of the rim of the stormwater structure.

Stormwater Structure Monitoring

Drainage Problem Area
City of West Richland, Washington

GEOENGINEERS

Figure 12

3234-005-00 Date Exported: 01/11/2019

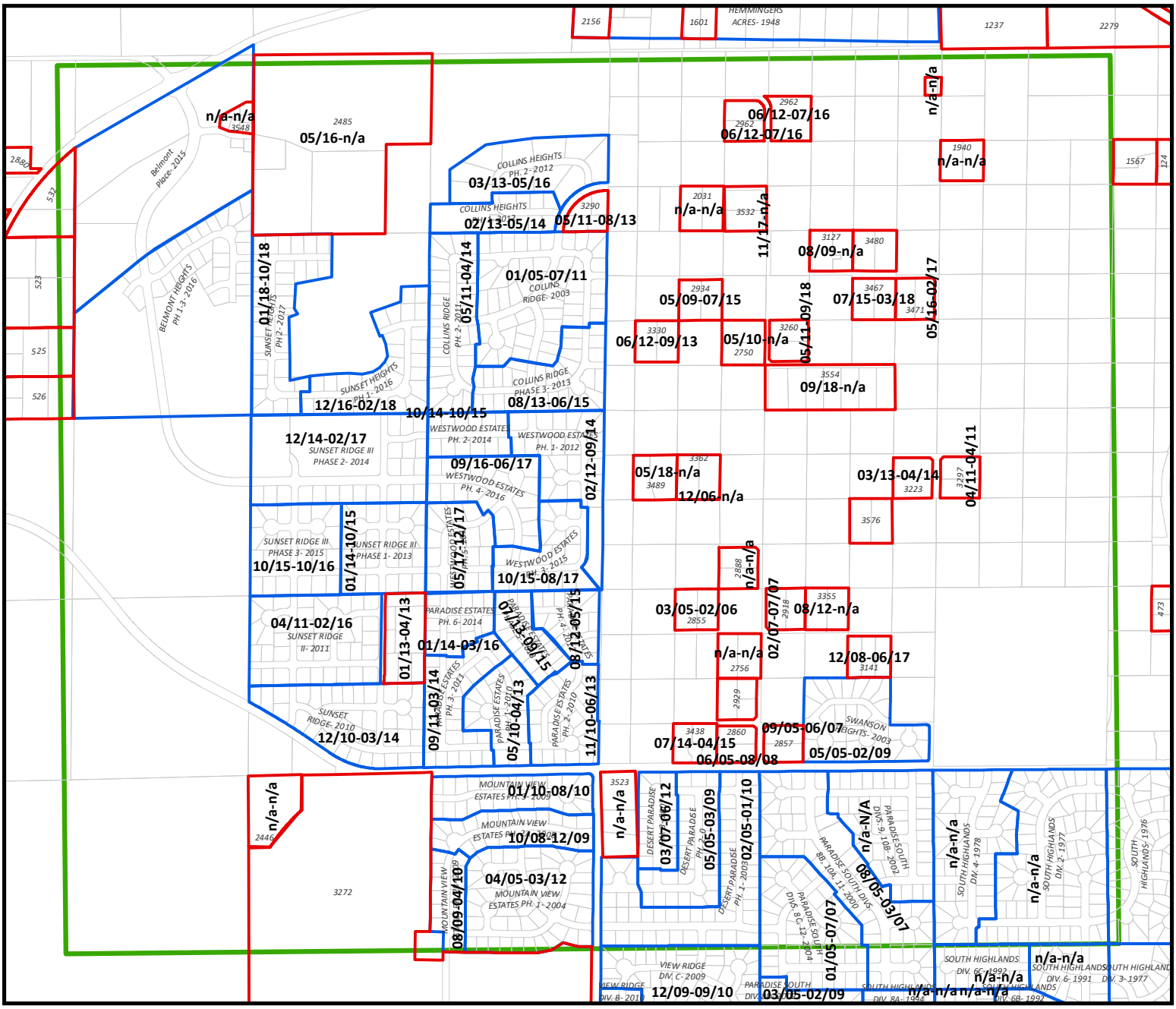
APPENDICES

GeoEngineers

APPENDIX A

Development History: Oldest and Newest Permit Date Range

DEVELOPMENT HISTORY: OLDEST AND NEWEST PERMIT DATE RANGE & YEAR OF SUBDIVISION RECORDING



Legend

- Area of Interest
- Short Plat Number
- Subdivision Name and Year Recorded
- ##/## - ##/## Oldest and Newest permit Issue Date

city of West Richland
COMMUNITY DEVELOPMENT
www.westrichland.org

N

0 0.05 0.1 0.2 0.3 0.4 Miles

Map Produced: 11/9/2018

THIS MAP IS FOR REPRESENTATION PURPOSES ONLY. PLEASE CONTACT THE COMMUNITY DEVELOPMENT DEPARTMENT AT 509.967.5902 OR cityhall@westrichland.org WITH QUESTIONS REGARDING THIS MAP OR FOR SPECIFIC QUESTIONS.

APPENDIX B
Historic Aerial Photos

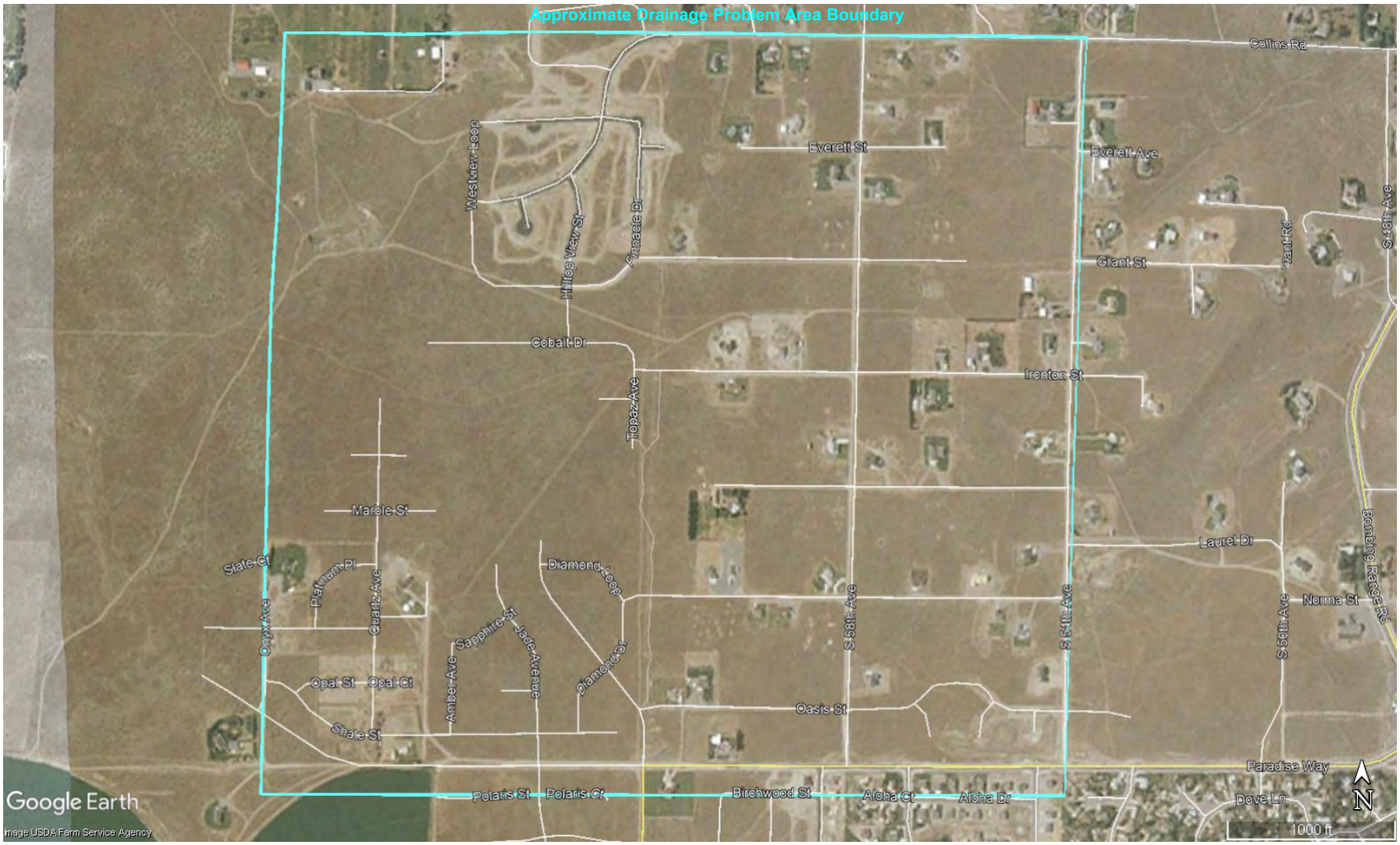
Note
1. Aerial photograph was obtained from Google Earth on February 11, 2019. Google Earth's data providers for this image are NASA and the U.S. Geological Survey.

Historic Aerial Photograph – July 1996

Drainage Problem Area
City of West Richland, Washington

GeoEngineers

Figure B-1



Historic Aerial Photograph – June 2003

Drainage Problem Area
City of West Richland, Washington

GeoEngineers

Figure B-2

Note
1. Aerial photograph was obtained from Google Earth on February 11, 2019. Google Earth's data provider for this image is the USDA Farm Service Agency.

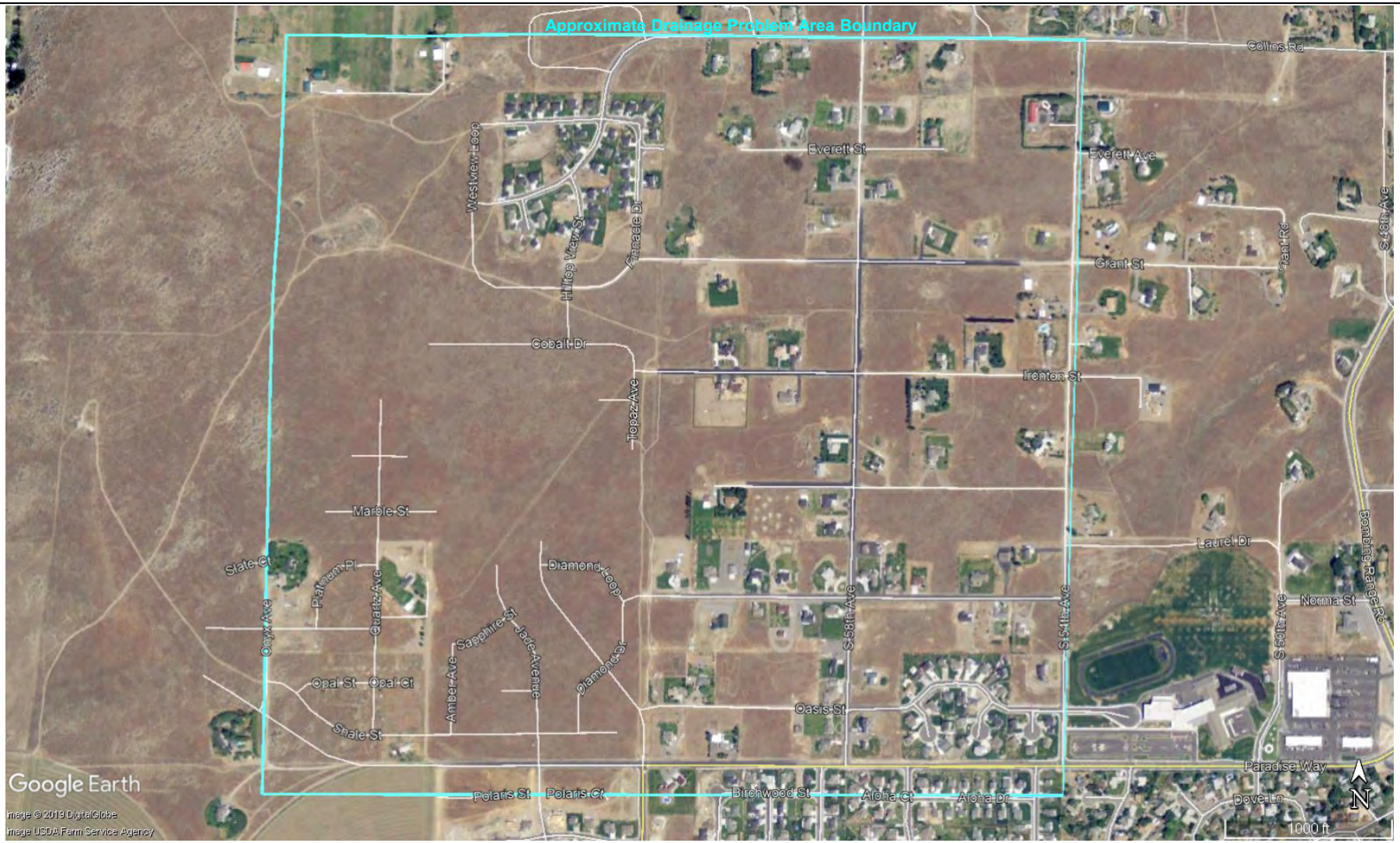
Note
1. Aerial photograph was obtained from Google Earth on February 11, 2019. Google Earth's data provider for this image is the USDA Farm Service Agency.

Historic Aerial Photograph – June 2006

Drainage Problem Area
City of West Richland, Washington

GeoEngineers

Figure B-3



Historic Aerial Photograph – September 2009

Drainage Problem Area
City of West Richland, Washington

GEOENGINEERS

Figure B-4

Note
1. Aerial photograph was obtained from Google Earth on February 11, 2019. Google Earth's data provider for this image is the USDA Farm Service Agency.

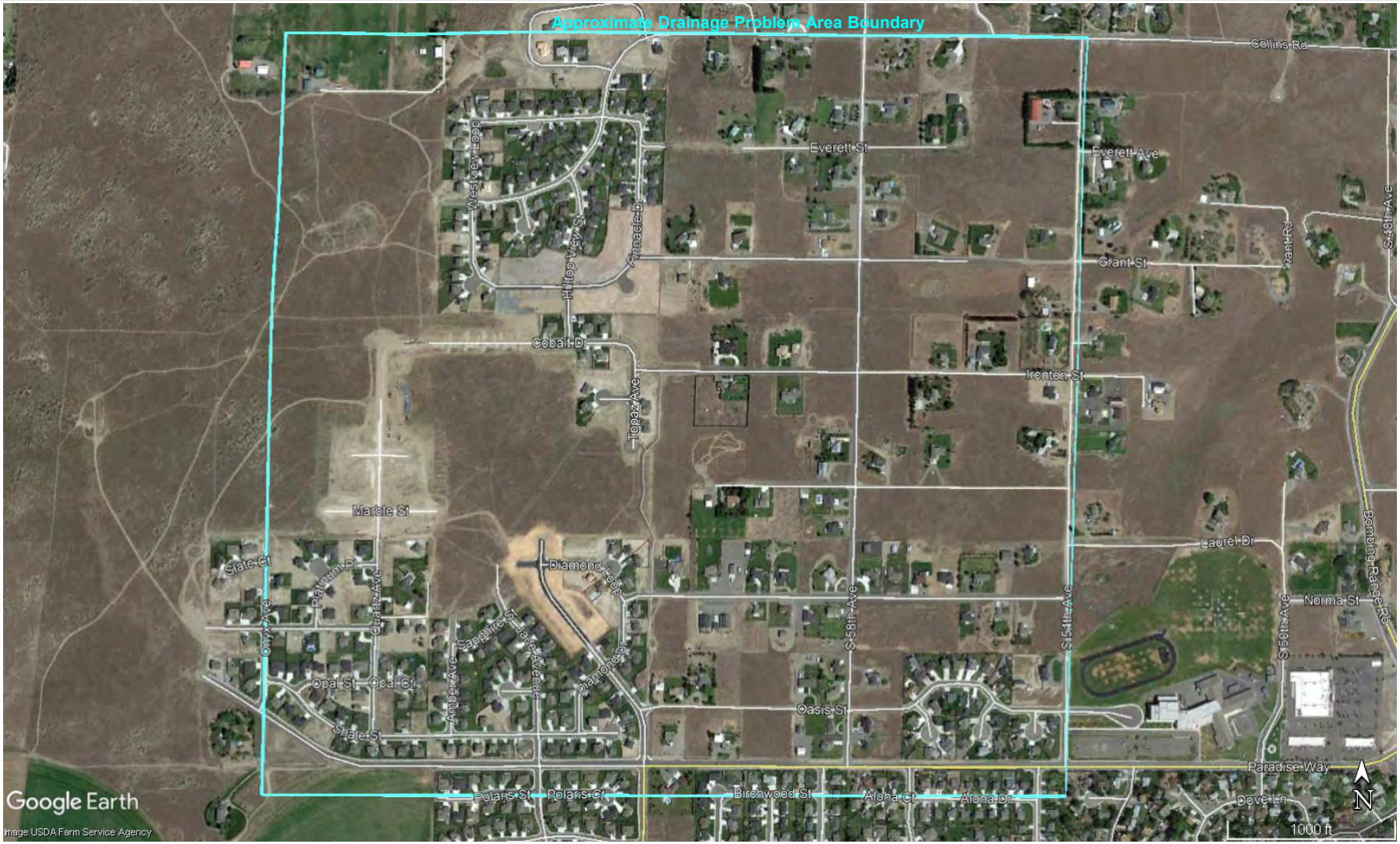
Note
1. Aerial photograph was obtained from Google Earth on February 11, 2019. Google Earth's data provider for this image is the USDA Farm Service Agency.

Historic Aerial Photograph – November 2011

Drainage Problem Area
City of West Richland, Washington

GEOENGINEERS

Figure B-5



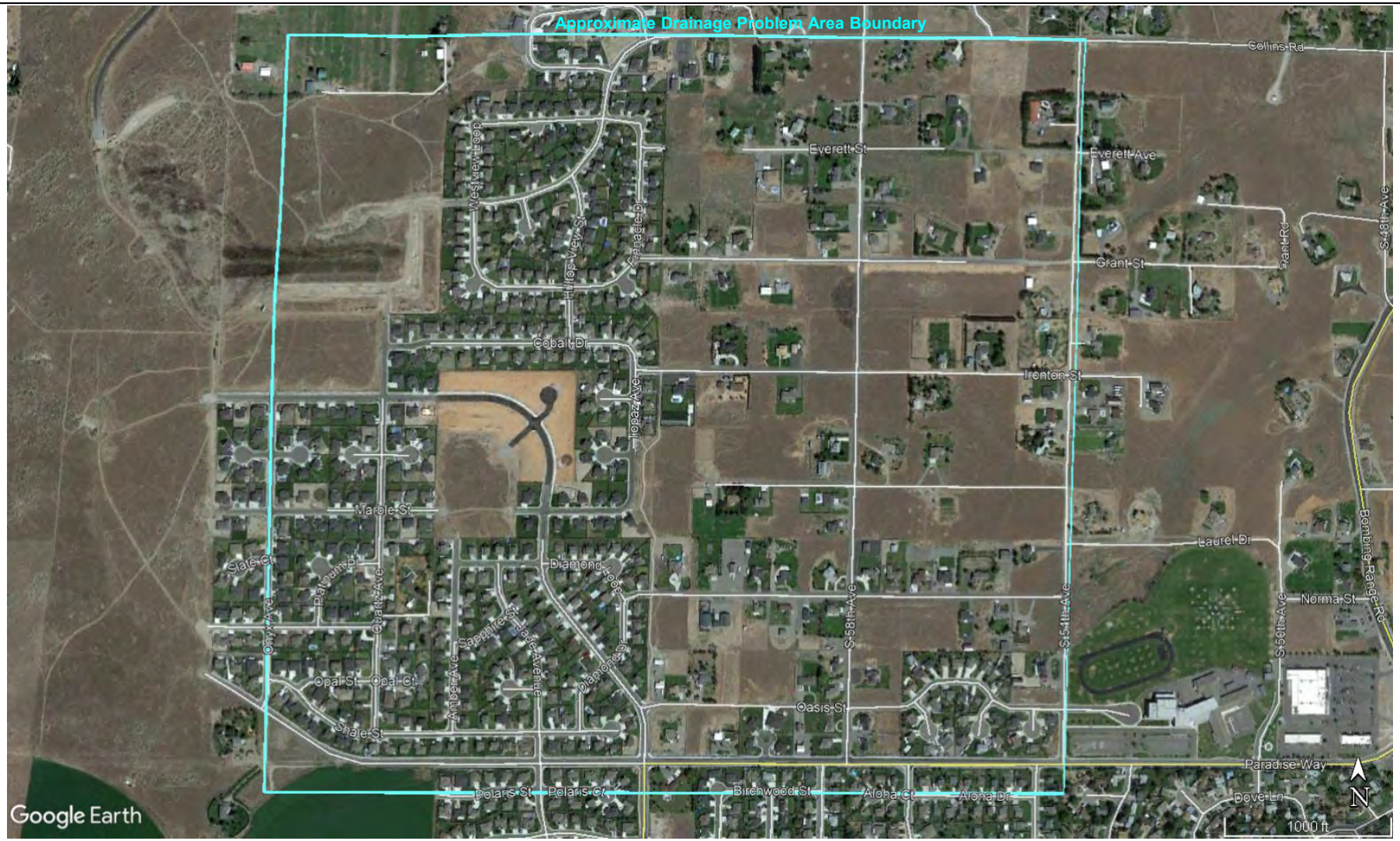
Note
1. Aerial photograph was obtained from Google Earth on February 11, 2019. Google Earth's data provider for this image is the USDA Farm Service Agency.

Historic Aerial Photograph – July 2013

Drainage Problem Area
City of West Richland, Washington

GEOENGINEERS

Figure B-6



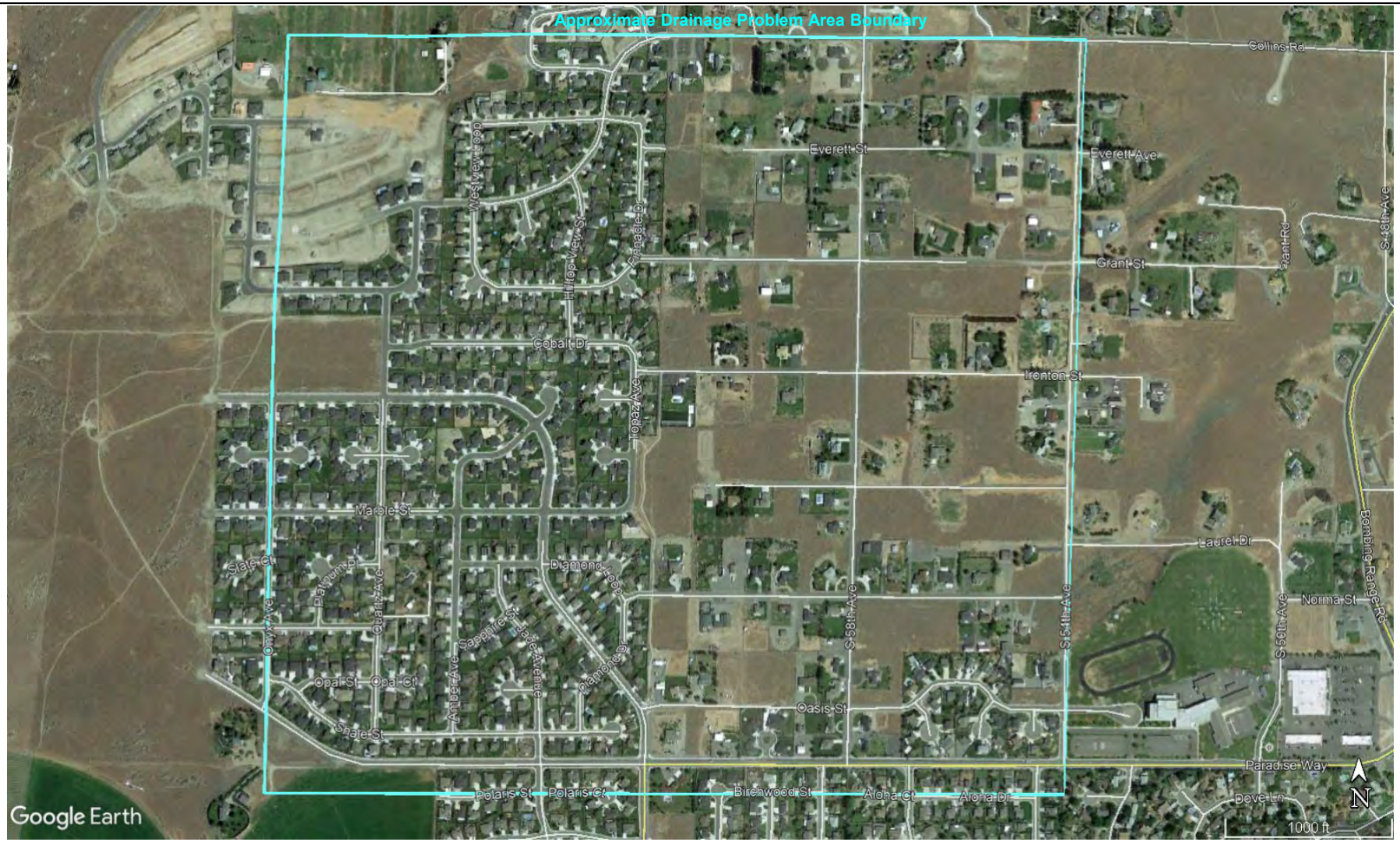
Note
1. Aerial photograph was obtained from Google Earth on February 11, 2019.

Historic Aerial Photograph – August 2016

Drainage Problem Area
City of West Richland, Washington

GeoEngineers

Figure B-7



Note
1. Aerial photograph was obtained from Google Earth on February 11, 2019.

Historic Aerial Photograph – July 2018

Drainage Problem Area
City of West Richland, Washington

GEOENGINEERS

Figure B-8

APPENDIX C
Water Well Reports

(181)

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No. /
Permit No. ....

(1) OWNER: Name NEIL SULLIVAN Address RT. 1 BOX 5056 WEST RICHLAND WASH

(2) LOCATION OF WELL: County BENTON — NW ¼ NE ¼ Sec. 1 T. 9 N., R. 27 E. W.M.

ng and distance from section or subdivision corner

(3) PROPOSED USE: Domestic ☒ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) ....
New well ☒ Deepened ☐ Reconditioned ☐
Method: Dug ☐ Bored ☐ Cable ☐ Driven ☐ Rotary ☒ Jetted ☐

(5) DIMENSIONS: Diameter of well 8 inches.
Drilled 235 ft. Depth of completed well 232 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 10" Diam. from +1 ft. to 44 ft.
8" Diam. from +1 ft. to 232 ft.
Welded ☒ " Diam. from ft. to ft.

Perforations: Yes ☒ No ☐
Type of perforator used TORCH
SIZE of perforations 4 in. by 1/8 in.
210 perforations from 212 ft. to 232 ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☐ No ☒
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☒ Size of gravel:
Gravel placed from ft. to ft.

Surface seal: Yes ☒ No ☐ To what depth? 35 ft.
Material used in seal BENTONITE
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level .... ft.
Static level 144 ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☒ If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
AIR TEST - EST. 150+ GPM "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☒

(10) WELL LOG:

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
FINE SAND	0	20
SAND, GRAVEL + SOME CLAY	20	40
SOFT FRACTURED BASALT	40	130
SOFT GREY SHALE	130	180
FRACTURED BASALT	180	190
GREY SHALE	190	202
COARSE SAND	202	205
FRACTURED BASALT	205	215
MED BASALT	215	223
FRACTURED BASALT	223	228
BLACK SHALE	228	232
WATER BETWEEN 215 + 232		

RECEIVED
NOV 17 1981
DEPARTMENT OF ECOLOGY
SPOKANE REGIONAL OFFICE

NOV 18 1981

Work started 10 15, 1981 Completed 11 6, 1981

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME NORTHWEST WATER WELLS INC. (Person, firm, or corporation) (Type or print)
Address P.O. BOX 1059 HAYDEN LAKE, IDAHO
[Signed] [signature] (Well Driller)
License No. 0291 Date 11 6, 1981

(USE ADDITIONAL SHEETS IF NECESSARY) 11/18/81

ECY 050-1-20

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

(101)

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No. ____
Permit No. ____

(1) OWNER: Name Leslie J. Woodcock Address 419 Barth, Richland, WA 99352

(2) LOCATION OF WELL: County BENTON — NW ¼ NW ¼ Sec. 1 T. 9 N., R. 27EW W.M.

Bearing and distance from section or subdivision corner

(3) PROPOSED USE: Domestic ☒ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) ____
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☒ Jetted ☐

(5) DIMENSIONS: Diameter of well 10 inches.
Drilled 80 ft. Depth of completed well 80 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 10" Diam. from +1 ft. to 55 ft.
Threaded ☐ ____" Diam. from ____ ft. to ____ ft.
Welded ☒ ____" Diam. from ____ ft. to ____ ft.

Perforations: Yes ☐ No ☒
Type of perforator used ____
SIZE of perforations ____ in. by ____ in.
____ perforations from ____ ft. to ____ ft.
____ perforations from ____ ft. to ____ ft.
____ perforations from ____ ft. to ____ ft.

Screens: Yes ☐ No ☒
Manufacturer's Name ____
Type ____ Model No. ____
Diam. ____ Slot size ____ from ____ ft. to ____ ft.
Diam. ____ Slot size ____ from ____ ft. to ____ ft.

Gravel packed: Yes ☐ No ☒ Size of gravel: ____
Gravel placed from ____ ft. to ____ ft.

Surface seal: Yes ☒ No ☐ To what depth? 20 ft.
Material used in seal bentonite
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? ____ Depth of strata ____
Method of sealing strata off ____

(7) PUMP: Manufacturer's Name ____
Type: ____ H.P. ____

(8) WATER LEVELS: Land-surface elevation above mean sea level ____ ft.
Static level 22 ft. below top of well Date 5/7/85
Artesian pressure ____ lbs. per square inch Date ____
Artesian water is controlled by ____ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☒ If yes, by whom? ____
Yield: 50 gal./min. with ____ ft. drawdown after ____ hrs.
" ESTIMATED AIREIFT "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test ____
Bailer test ____ gal./min. with ____ ft. drawdown after ____ hrs.
Artesian flow ____ g.p.m. Date ____
Temperature of water ____ Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Sand & Gravel	0	55
Basalt, medium, black	55	65
Basalt, fractured w/water	65	66
Basalt, medium, black	66	80
NO PVC LINER INSTALLED		
16" Drive shoe installed		

RECEIVED MAY 23 1985 DEPARTMENT OF ECOLOGY CENTRAL REGION OFFICE

Work started 5/6/ 19 85 Completed 5/7/85 19 ____

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME PONDEROSA DRILLING & DEVELOPMENT INC. (Person, firm, or corporation) (Type or print)

Address E. 6010 Broadway, Spokane, WA 99212

[Signed] James M. Doyle (Well Driller)
James M. Doyle

License No. 1287 Date 5/7 19 85

5/29/85

(USE ADDITIONAL SHEETS IF NECESSARY)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

(102)

36677

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. W40122
Unique Well I.D. # ABW500
Water Right Permit No.

(1) OWNER: Name WOODCOCK, LESLIE J. Address RT. 2 BOX 2261 BENTON CITY, WA 99320-

(2) LOCATION OF WELL: County BENTON - NW 1/4 NW 1/4 Sec 01 T 09 N., R 27 WM
(2a) STREET ADDRESS OF WELL (or nearest address) ,

(3) PROPOSED USE: DOMESTIC

(4) TYPE OF WORK: Owner's Number of well (If more than one)
DEEPENED Method: ROTARY

(5) DIMENSIONS: Diameter of well 10 inches
Drilled 100 ft. Depth of completed well 180 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Dia. from +1 ft. to 179 ft.
WELDED " Dia. from ft. to ft.
" Dia. from ft. to ft.

Perforations: YES
Type of perforator used TORCH
SIZE of perforations in. by in.
perforations from 160 ft. to 100 ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: NO
Manufacturer's Name
Type Model No.
Diam. slot size from ft. to ft.
Diam. slot size from ft. to ft.

Gravel packed: NO Size of gravel
Gravel placed from ft. to ft.

Surface seal: NO To what depth? ft.
Material used in seal
Did any strata contain unusable water? NO
Type of water? Depth of strata ft.
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ... ft.
Static level 90 ft. below top of well Date 04/04/95
Artesian Pressure lbs. per square inch Date
Artesian water controlled by

(10) WELL LOG

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change in formation.

MATERIAL	FROM	TO
BLACK MEDIUM BASALT	80	120
HARD BLACK BASALT	120	170
BROKEN BASALT WITH WATER	170	180
	180	

RECEIVED
APR 14 1995
DEPARTMENT OF ECOLOGY
CENTRAL REGION OFFICE

Work started 04/03/95 Completed 04/04/95

(9) WELL TESTS: Drawdown is amount water level is lowered below static level.
Was a pump test made? NO If yes, by whom?
Yield: gal./min with ft. drawdown after hrs.

Recovery data
Time Water Level Time Water Level Time Water Level

Date of test / /
Bailer test gal/min. ft. drawdown after hrs.
Air test 70 gal/min. w/ stem set at 175 ft. for 1 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? NO

WELL CONSTRUCTOR CERTIFICATION:
I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME PONDEROSA DRILLING
(Person, firm, or corporation) (Type or print)

ADDRESS E 6010 BROADWAY

[SIGNED] Lyle A. Kelly License No. 2215

Contractor's Registration No. PO-ND-EI*248JE Date 04/06/95

(103)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No. .....
Permit No. 94-25986P

(1) OWNER: Name E.O. Kraus Address RH4-130X 9420 Richland Wash

(2) LOCATION OF WELL: County Benton — NW¼ NW¼ Sec. 1 T. 9 N., R. 27 E.W.M.
Bearing and distance from section or subdivision corner

(3) PROPOSED USE: Domestic [X] Industrial ☐ Municipal ☐ Irrigation [X] Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) /
New well ☐ Method: Dug ☐ Bored ☐
Deepened ☐ Cable [X] Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled ..... ft. Depth of completed well ..... ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Diam. from 0 ft. to 20 ft.
Threaded ☐ " Diam. from ft. to ft.
Welded ☐ " Diam. from ft. to ft.

Perforations: Yes ☐ No [X]
Type of perforator used .....
SIZE of perforations ..... in. by ..... in.
..... perforations from ..... ft. to ..... ft.
..... perforations from ..... ft. to ..... ft.
..... perforations from ..... ft. to ..... ft.

Screens: Yes ☐ No [X]
Manufacturer's Name .....
Type ..... Model No. .....
Diam. ..... Slot size ..... from ..... ft. to ..... ft.
Diam. ..... Slot size ..... from ..... ft. to ..... ft.

Gravel packed: Yes ☐ No [X] Size of gravel: .....
Gravel placed from ..... ft. to ..... ft.

Surface seal: Yes [X] No ☐ To what depth? ..... ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? ..... Depth of strata .....
Method of sealing strata off .....

(7) PUMP: Manufacturer's Name Sears
Type: Jet H.P. 3

(8) WATER LEVELS: Land-surface elevation above mean sea level ..... ft.
Static level 125 ft. below top of well Date .....
Artesian pressure ..... lbs. per square inch. Date .....
Artesian water is controlled by ..... (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level.
Was a pump test made? Yes ☐ No ☐ If yes, by whom? .....
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

100 GPM at 125 ft

Date of test .....
Bailer test ..... gal./min. with ..... ft. drawdown after ..... hrs.
Artesian flow ..... g.p.m. Date .....
Temperature of water ..... Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG:
Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO	
Top Soil	0	14	
Basalt Black	14	45	TH
Basalt Red	45	95	
Sandstone	95	110	LEV
Basalt Red Broken	110	150	PAN
water at 110			

RECEIVED
MAR 19 1979
DEPARTMENT OF ECOLOGY
CENTRAL REGIONAL OFFICE

Work started 10-6, 19 78 Completed 7-5, 19 79

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME St George Drilling Co (Person, firm, or corporation) (Type or print)
Address 701 S 045 Ave. N Richland W.
[Signed] [signature] (Well Driller)
License No. 0482 Date 3-5, 1979

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

104

File Original with Department of Ecology
Second Copy - Owner's Copy
Third Copy - Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

106789

Notice of Intent W131573
UNIQUE WELL I.D. # AGH 804
Water Right Permit No. _____

(1) OWNER: Name Mark & Cindy Enghusen Address 7604 Woodford, W. Rich 99320

(2) LOCATION OF WELL: County Benton SE 1/4 NW 1/4 Sec 1 T 9 N.R. 27 WM

(2a) STREET ADDRESS OF WELL: (or nearest address) Wood ford

TAX PARCEL NO. _____

F

(3) PROPOSED USE: ☑ Domestic ☐ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐ DeWater

(4) TYPE OF WORK: Owner's number of well (if more than one) _____
☑ New Well ☐ Deepened ☐ Reconditioned ☐ Decommission
Method: ☐ Dug ☐ Cable ☑ Rotary ☐ Bored ☐ Driven ☐ Jetted

(5) DIMENSIONS: Diameter of well 6 inches
Drilled 145 feet. Depth of completed well 145 ft

(6) CONSTRUCTION DETAILS
Casing Installed:
☐ Welded 6" Diam. from +2 ft to 58 ft
☑ Liner installed 4" Diam. from -3 ft. to 145 ft
☐ Threaded " Diam. from _____ ft to _____ ft

Perforations: ☑ Yes ☐ No
Type of perforator used Saw
SIZE of perforations 1/8 in by 8 in.
90 perforations from 85 ft to 145 ft.

Screens: ☐ Yes ☑ No ☐ K-Pac Location _____
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot Size _____ from _____ ft. to _____ ft
Diam _____ Slot Size _____ from _____ ft. to _____ ft

Gravel/Filter packed: ☐ Yes ☑ No ☐ Size of gravel/sand _____
Material placed from _____ ft. to _____ ft

Surface seal: ☑ Yes ☐ No To what depth? 20 ft.
Material used in seal Bentonite
Did any strata contain unusable water? ☐ Yes ☑ No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

(7) PUMP: Manufacturer's Name _____
Type _____ H.P. _____

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft
Static level 35 ft below top of well Date 8-16-01
Artesian pressure _____ lbs per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☐ No If yes, by whom? _____
Yield _____ gal/min with _____ ft drawdown after _____ hrs
Yield _____ gal/min with _____ ft. drawdown after _____ hrs
Yield: _____ gal/min with _____ ft drawdown after _____ hrs.
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal/min with airtest ft drawdown after 2 hrs
Airtest 20-25 gal/min with _____ ft drawdown after _____ hrs
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? ☐ Yes ☐ No

(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. Indicate all water encountered.

MATERIAL	FROM	TO
Sand	0	16
Sand Gravil	16	32
Soft Brown Basalt	32	55
Red Basalt	54	57
hard Black Basalt	57	65
Brown Basalt	65	72
hard Black Basalt	72	85
Grey hard Basalt	85	113
Soft Black Basalt	113	132
hard Blue Clay	132	136
hard Tan Clay	136	145

DEPT OF ECOLOGY Received OCT 18 2001 CENTRAL REGION OFFICE

Work Started 8-15-01 Completed 8-16-01

WELL CONSTRUCTION CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Type or Print Name David Cox License No 2351
(Licensed Driller/Engineer)

Trainee Name _____ License No _____
Drilling Company R.W. Cox Drilling
(Signed) David Cox License No 2351
(Licensed Driller/Engineer)
Address P.O. Box 5524 Benton City Wa 99320
Contractor's Registration No. RWCOXDO225C Date 8-16-01

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (360) 407-6600. The TDD number is (360) 407-6006

ECY 050-1-20 (11/98)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

105

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

Construction/Decommission ("x" in circle) 185509

[x] Construction

[ ] Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

CURRENT
Notice of Intent No. w160933

Unique Ecology Well ID Tag No. AKH940

Water Right Permit No. g4-25986

Property Owner Name Jerry England

Well Street Address 7219 Van Giesen

City West Richland County Benton

Location NW1/4-1/4 NW1/4 Sec 1 Twn 9n R 27 EWM [x] or WWM [ ] circle one

Lat/Long (s, t, r Lat Deg _____ Lat Min/Sec _____

~~Still REQUIRED)~~ Long Deg _____ Long Min/Sec _____

Tax Parcel No. 101972010532002

PROPOSED USE: [x] Domestic [ ] Industrial [ ] Municipal [ ] DeWater [ ] Irrigation [ ] Test Well [ ] Other _____

TYPE OF WORK: Owner's number of well (if more than one) _____

[ ] New well [ ] Reconditioned [ ] Deepened

Method: [ ] Dug [ ] Bored [ ] Driven [ ] Cable [x] Rotary [ ] Jetted

~~**DIMENSIONS:** Diameter of well 6" inches, drilled 305 ft.~~

Depth of completed well 305 ft.

CONSTRUCTION DETAILS

Casing Installed: [x] Welded 6" Diam. from +1 ft to 20 ft
[x] Liner installed 4" Diam from 5 ft to 305 ft
[ ] Threaded _____ Diam from _____ ft to _____ ft

Perforations: [x] Yes [ ] No

Type of perforator used SAW

SIZE of perfs 1/4 in. by 7 in. and no. of perfs 20 from 220 ft to 300 ft

Screens: [ ] Yes [x] No [ ] K-Pac Location _____

Manufacturer's Name _____

Type _____ Model No. _____

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: [ ] Yes [x] No [ ] Size of gravel/sand _____

Materials placed from _____ ft to _____ ft

Surface Seal: [x] Yes [ ] No To what depth? 21 ft

Material used in seal bentonite

Did any strata contain unusable water? [ ] Yes [x] No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name MYERS

Type: 16GPM SERIES H.P. 3

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.

Static level 100 ft. below top of well Date 7-31-05

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? [x] Yes [ ] No If yes, by whom? st george well

Yield: 150 gal./min. with 280 ft. drawdown after 4 hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.

Airtest 150 gal./min. with stem set at _____ ft. for 4 hrs.

Artesian flow _____ g.p.m. Date _____

Temperature of water _____ Was a chemical analysis made? [ ] Yes [x] No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
TOP SOIL	0	26
BASALT GRAY MED	26	130
130 FRACTURED GARY BASALT	130	160
BLUE CLAY	160	165
TAN CLAY + SAND	165	170
BROWN CLAY	170	180
SOFT BASALT +H2O	180	285
BLUE CLAY STONE + BASALT H2O	285	290
TAN SHALE BASALT H2O	295	305
SHALE LIGHT GRAY CLAY	305	

Start Date 7-13-05 Completed Date 7-15-05

~~RECEIVED~~
NOV 02 2005
Water Resources Program
~~Department of Ecology~~

DEPT OF ECOLOGY
Received
NOV 07 2005
CENTRAL REGION OFFICE

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

[ ] Driller [ ] Engineer [ ] Trainee Name (Print) Thomas St. George

Driller/Engineer/Trainee Signature _____

Driller or trainee License No. 2781

Drilling Company St. George Well Drilling Co.

Address 701 S 45th Ave.

City, State, Zip West Richland, Wa, 99353

Contractor's Registration No. stgeogw954k4 Date 10-5-05

IF TRAINEE,
Driller's Licensed No. _____
Driller's Signature _____

Ecology is an Equal Opportunity Employer.

ECY 050-1-20 (Rev 3/05) **The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.**

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

1D6

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

Construction/Decommission ("x" in circle) 199984

☐ Construction

☒ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* well log id 139351

CURRENT Notice of Intent No. A112051

Unique Ecology Well ID Tag No. akh940 well replacing

Water Right Permit No. G4-25986C

Property Owner Name Jerry England

Well Street Address 7219 Van Giesen

City West Richland County Benton

Location NW 1/4-1/4 NW 1/4 Sec 1 Twn 9n R 27 EWM or WWM ☑ circle one

Lat/Long (s, t, r Still **REQUIRED**) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No. 101972010532002

PROPOSED USE: ☑ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) _____

☐ New well ☐ Reconditioned ☐ Deepened

Method: ☐ Dug ☐ Bored ☐ Driven ☑ Cable ☐ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 6" inches, drilled 155 ft.

Depth of completed well 155 ft.

CONSTRUCTION DETAILS

Casing Installed: ☑ Welded 6" Diam. from +1 ft. to 20 ft.

☐ Liner installed " Diam. from 5 ft. to _____ ft.

☐ Threaded " Diam. from _____ ft. to _____ ft.

Perforations: ☑ Yes ☐ No

Type of perforator used swedge cutter

SIZE of perfs 1/4 in. by 2 in. and no. of perfs 20 from 1 ft. to 20 ft.

Screens: ☐ Yes ☑ No ☐ K-Pac Location _____

Manufacturer's Name _____

Type _____ Model No. _____

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: ☐ Yes ☑ No ☐ Size of gravel/sand _____

Materials placed from _____ ft. to _____ ft.

Surface Seal: ☑ Yes ☐ No To what depth? 21 ft.

Material used in seal bentonite

Did any strata contain unusable water? ☐ Yes ☑ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.

Static level _____ ft. below top of well Date _____

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☑ Yes ☐ No If yes, by whom? st george well

Yield: 150 gal./min. with 280 ft. drawdown after 4 hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.

Airtest 150 gal./min. with stem set at _____ ft. for 4 hrs.

Artesian flow _____ g.p.m. Date _____

Temperature of water _____ Was a chemical analysis made? ☐ Yes ☑ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
TOP SOIL	0	26
BASALT GRAY MED	26	130
130 FRACTURED GARY BASALT	130	160
ORGINAL WELL PERFORATED FROM 2 TO 19F		
THEN PRESSURE GROUTED WITH PORTLAND		
CEMENT TO SURFACE		

Start Date 8-13-05 Completed Date 8-14-05

RECEIVED NOV 10 2005 Water Resources Program Department of Ecology

DEPT OF ECOLOGY Received NOV 16 2005 CENTRAL REGION OFFICE

DEPT OF ECOLOGY Received MAY 17 2006 CENTRAL REGION OFFICE

DEPT. OF ECOLOGY FISCAL & BUDGET '06 NOV 10 AM 8:34

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☐ Driller ☐ Engineer ☐ Trainee Name (Print) Thomas St. George

Driller/Engineer/Trainee Signature _____

Driller or trainee License No. 2781

If TRAINEE, Driller's Licensed No. _____

Driller's Signature _____

Drilling Company St. George Well Drilling Co.

Address 701 S 45th Ave.

City, State, Zip West Richland, Wa, 99353

Contractor's Registration No. stgeogw954k4 Date 10-5-05

Ecology is an Equal Opportunity Employer.

ECY 050-1-20 (Rev 3/05)

The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

(161)

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

Construction/Decommission ("x" in circle)

(X) Construction

( ) Decommission *ORIGINAL INSTALLATION Notice of Intent Number* 178921

PROPOSED USE: (X) Domestic ( ) Industrial ( ) Municipal ( ) DeWater ( ) Irrigation ( ) Test Well ( ) Other

TYPE OF WORK: Owner's number of well (if more than one)

(X) New well ( ) Reconditioned ( ) Deepened

Method: ( ) Dug ( ) Bored ( ) Driven ( ) Cable ( ) Rotary ( ) Jetted

DIMENSIONS: Diameter of well 8 inches, drilled 305 ft.

Depth of completed well 305 ft.

CONSTRUCTION DETAILS

Casing Installed: (X) Welded 8" Diam. from +2 ft. to 24 ft.

(X) Liner installed 6" Diam. from -7 ft. to 243 ft.

( ) Threaded

Perforations: ( ) Yes (X) No

Type of perforator used

SIZE of perfs in. by in. and no. of perfs from ft. to ft.

Screens: ( ) Yes (X) No ( ) K-Pac Location

Manufacturer's Name

Type Model No.

Diam. Slot size from ft. to ft.

Diam. Slot size from ft. to ft.

Gravel/Filter packed: ( ) Yes (X) No ( ) Size of gravel/sand

Materials placed from ft. to ft.

Surface Seal: (X) Yes ( ) No To what depth? 24' ft.

Material used in seal Bentonite

Did any strata contain unusable water? ( ) Yes ( ) No

Type of water? SANDY Depth of strata 123

Method of sealing strata off OVERBORE & CASING

PUMP: Manufacturer's Name

Type: H.P.

WATER LEVELS: Land-surface elevation above mean sea level ft.

Static level 130 ft. below top of well Date

Artesian pressure lbs. per square inch Date

Artesian water is controlled by (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ( ) Yes ( ) No If yes, by whom?

Yield: gal./min. with ft. drawdown after hrs.

Yield: gal./min. with ft. drawdown after hrs.

Yield: gal./min. with ft. drawdown after hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test

Bailer test 1 gal./min. with ft. drawdown after hrs.

Airtest 50 gal./min. with stem set at 280 ft. for 1 hrs.

Artesian flow g.p.m. Date

Temperature of water Was a chemical analysis made? ( ) Yes ( ) No

CURRENT

Notice of Intent No. W181849

Unique Ecology Well ID Tag No. AKA 065

Water Right Permit No.

Property Owner Name John Harris E

Well Street Address off Ruppert Rd

City W. Rich County Benton-03-

Location SW 1/4-1/4 NW 1/4 Sec 1 Twn 9 R 27 ~~EWM~~ or WWM (circle one)

Lat/Long (s, t, r Still **REQUIRED**) Lat Deg Lat Min/Sec

Long Deg Long Min/Sec

Tax Parcel No.

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
SAND	0	2
BLACK BASALT	2	18
RED BASALT	18	21
GREY BASALT	21	82
BLACK BASALT	82	100
SAND, SANDSTONE	100	123
GREY BASALT	123	264
BROKEN BASALT WATER	264	282
BLUE CLAY	282	305

DEPT. OF ECOLOGY Received AUG 22 2005 CENTRAL REGION OFFICE

Start Date 8-4-05 Completed Date 8-9-05

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

(X) Driller ( ) Engineer ( ) Trainee Name (Print) ROD COX

Driller/Engineer/Trainee Signature

Driller or trainee License No. 2302

If TRAINEE, Driller's Licensed No.

Driller's Signature

Drilling Company RW COX Drilling

Address P.O. BOX 5324

City, State, Zip Benton City, WASH 99320

Contractor's Registration No. RWCOXDO225C Date 8-9-05

Ecology is an Equal Opportunity Employer.

ECY 050-1-20 (Rev 3/05) **The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.**

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

(162)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

DEPARTMENT OF ECOLOGY State of Washington

WATER WELL REPORT

RECEIVED SEP 19 2011 DEPARTMENT OF ECOLOGY - CENTRAL REGION

Notice of Intent Number W303163 427698

Property Owner Last Name GRAY First Name Keith + PAM

Organization Name

Well Tag ID Number (e.g., AAA-001) BCJ ~~40~~ 740 Variance Granted? (Circle One) Yes No

Water Right Permit Required? (Circle One) Yes or No If Yes, enter Water Right Permit Here (Required)

Well Use (Circle All That Apply):

Agricultural Irrigation, Domestic, Individual Irrigation, Parks and recreation, Test Well, Other, Commercial, Group Domestic, Municipal, Stockwater

Type of Work (Circle One):

Alteration, Hydrofracturing, Replacement, Other, Deepened Well, New

Method (Circle One):

Cable, Dug, Jetted, Other, Driven, Hydrofracturing, Rotary

Drilling Start Date 8-30-11 **Drilling Completion Date** 9-1-11

Well Location Only (No Mailing Address, No PO Box, Cross Streets are ok)

Well Street Address 7407 VAN Giesen

Well City West Richland Well County Benton-03 Well Zip Code 99353

Tax Parcel Number 1019720105 25003

If claiming tax parcel exemption (Circle One) Tribal Federal Property Right of Way Railroad Land

NW	NE	NW	NE
SW	SE	SW	SE
NW	NE	NW	NE
~~SW~~	SE	SW	SE

Place an "X" in ¼, ¼

Township 9 N Range 27 Circle One - East or West Section 1

Lattitude Decimal Degrees; Longitude West Decimal Degrees

CONSTRUCTION INFORMATION – SECURELY ATTACH (STAPLE) ADDITIONAL SHEETS OF INFORMATION (NO DRAWINGS) AS NEEDED.

Diameter of Well ft 6X8 in, Drilled 290 ft in Depth of Completed Well 290 ft in

Casings (At least one Casing must have 6 in of stickup and all fields must be filled out for each casing entered)

Type (Circle One) Concrete Plastic Steel Other Diameter 8" inches Stickup +1' inches Depth 35' ft in, TO ft in

Type (Circle One) Concrete Plastic Steel Other Diameter 6" inches Stickup +2' inches Depth 228 ft in, TO ft in

Liners? Circle One Yes ~~No~~ (If yes, then complete the below fields that apply)

Type 1 (Circle One) PVC Steel Other Diameter in, From ft in TO ft in

Type 2 (Circle One) PVC Steel Other Diameter in, From ft in TO ft in

Perforations? Circle One Yes ~~No~~ (If yes, then complete the below fields that apply)

Type of Perforator (Circle One) Drill Mills Knife Saw cut Star Torch Cut Other Perforation size in by in Total Perforations

Perforation 1 from ft in, TO ft inches **Perforation 2** from ft in, TO ft inches

Screens? (Circle One) Yes ~~No~~ (If yes, then complete the below fields that apply)

Mfr 1 Type Diam in Slot Size From ft in TO ft in

Mfr 2 Type Diam in Slot Size From ft in TO ft in

 The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.
If you need this document in an alternate format for the visually impaired, please call the Water Resources Program at 360-407-6872. Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call 877-833-6341.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

Sand/Gravel Packing? (Circle One) Yes ~~No~~ **(If yes, then complete the below fields that apply)**

Packing Material 1 Circle One 10-20 20-40 8-12 Coarse Sand Pea Gravel From____ft ____in TO ____ft ____in
Packing Material 2 Circle One 10-20 20-40 8-12 Coarse Sand Pea Gravel From____ft ____in TO ____ft ____in

Surface Seal Was there an existing surface seal? (Yes) or No Depth of Seal 35' ft ____in
Type of Seal Material (Circle One) (Bentonite) Bentonite Slurry Concrete Dry Bentonite Neat Cement Neat Cement Grout

Pump Pump Installed? (Circle One) Yes ~~No~~ If yes, Mfr Name____ Pump Type____ HP____

Static Water Level (Circle One and fill in the blanks if needed)

Yes Measured Level (Below top of well) 140' ft ____in Date Measured 9-1-11
Flowing Artesian (Circle One) Greater Than or Equal To ____GPM ____PSI Artesian Water Controlled by (e.g. Cap, Valve, etc.)____
Dry Hole
Unusable Water Strata? (Circle One) ~~Yes~~ No **If Yes is circled, method of sealing strata off** OVERBORE CASING
Strata 1 (Specify Unusable Water Type) SANDY From____ft 138' ft TO 245' ft ____in
Strata 2 (Specify Unusable Water Type)____ From____ft ____ft TO ____ft ____in

General Well Tests (Circle all that apply and fill in the blanks)
Bailer Test Date of test____ (Circle One) Greater Than or Equal To ____GPM, with ____ Drawdown after____hrs ____min
Air Test Date of test 9/1/11 (Circle One) Greater Than or Equal To 50 GPM, with stem set at 280 ____in
Test Duration 1 hrs ____min
Pump Test Date of test____ Test performed by____
Note: Drawdown=the amount the water level is lowered below the static level
Yield ____gpm, with ____ft ____in; Drawdown after____hrs ____min Yield ____gpm, with ____ft ____in; Drawdown after____hrs ____min
Yield ____gpm, with ____ft ____in; Drawdown after____hrs ____min Yield ____gpm, with ____ft ____in; Drawdown after____hrs ____min
Yield ____gpm, with ____ft ____in; Drawdown after____hrs ____min Yield ____gpm, with ____ft ____in; Drawdown after____hrs ____min
Note: Recovery=The time taken at zero when the pump is turned off. Water level is measured from the well top to...Ask Lars for wording
Time____hrs____min; Water Level____ft____in Time____hrs____min; Water Level____ft____in Time____hrs____min; Water Level____ft____in
Time____hrs____min; Water Level____ft____in Time____hrs____min; Water Level____ft____in Time____hrs____min; Water Level____ft____in
Time____hrs____min; Water Level____ft____in Time____hrs____min; Water Level____ft____in Time____hrs____min; Water Level____ft____in

Well Lithology Details – Your lithology MUST be reported to the drilled depth of the well. Please check your "From" and "To" feet and inches for accuracy.

Layer Formation Description	From	To	Layer Formation Description	From	To
SOIL, SAND	0	28'	BLACK BASALT	225'	245'
BLACK BASALT	28	48	FRACTURED BASALT WATER	245	290
RED BASALT	48	65			
BLACK BASALT	65	~~65~~ 138			
CLAY, SAND	138	164			
BROKEN BASALT, SAND	164	225			

Comments – Enter any other important well construction and/or location details here.____

CERTIFICATION – I hereby certify that I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington Well construction standards. Materials used and the information reported within the Well Report are true to my best knowledge and belief.

(Circle One) Driller Trainee Engineer Name(Print) Rod Cox
Driller/Engineer/Trainee Signature____
Driller/Trainee/PE License No. 3302

If TRAINEE, Mentor Driller License No.____
Mentor Driller Signature____

Drilling Company RW Cox Drilling LLC
Address P.O. Box 5324
City, State, Zip Bellingham Wash 98228
Phone Number 509-627-4446
Email Address____

(1E3)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. 000181

Water Right Permit No.

(1) OWNER: Name Becan Properties Address W. 929 Sprague Spokane, WA 99204

(2) LOCATION OF WELL: County Benton SW ¼ NW ¼ Sec. 1 T. 9 N., R. 27 W.M.

(2a) STREET ADDDRESS OF WELL (or nearest address) Off old inland empire highway

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater Industrial [ ] Test Well [ ] Municipal [ ] Other [ ]

(4) TYPE OF WORK: Owner's number of well (if more than one)
Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ]
Method: Dug [ ] Cable [ ] Rotary [X] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 160 feet. Depth of completed well 160- ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6" Diam. from +1 ft. to 23 ft.
Welded [X] 4"PVC" Diam. from -6 ft. to 160 ft.
Liner installed [ ]
Threaded [ ] " Diam. from ft. to ft.

Perforations: Yes [ ] No [X]
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes [ ] No [X]
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes [ ] No [X] Size of gravel
Gravel placed from ft. to ft.

Surface seal: Yes [X] No [ ] To what depth? 22' ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes [ ] No [X]
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 30 ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [ ] No [X] If yes, by whom?
Yield: 10 gal./min. with ft. drawdown after hrs.
" Estimated airlift " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest gal./min. with stem set at ft. for hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes [ ] No [ ]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Sand	0	15
Basalt, Red, Soft	15	21
Baslat, Red honey combed, Medium	21	40
Basalt, Gray, w/water on top 2-3GPM	40	95
Basalt, Brown, w/water 2-3 GPM	95	103
Basalt, Dark gray, Medium	103	150
Basalt gravel, Tan w/water 4-6GPM	150	154
Basalt, Dark gray, Medium Hard	154	160

lea. 4" PVC Liner Installed
lea. 6" Drive shoe Utilized

RECEIVED JUN 9 1988 DEPARTMENT OF ECOLOGY CENTRAL REGION OFFICE

JUN 7 1989

Work started 05/26/88, 19. Completed 05/27/88, 19

ENTERED

WELL CONSTRUCTOR CERTIFICATION:
I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME PONDEROSA DRILLING & DEVELOPMENT INC. (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address E. 6010 Broadway Spokane, WA 99212

(Signed) (WELL DRILLER) License No. 1472

Contractor's Registration No. PO-ND-EI*248 JE Louie E. Hanner Date 05/27/88, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY-050-1-20 (10/87) -1329- 3

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

164

441011

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. W36907
Unique Well I.D. # ABL059
Water Right Permit No.

(1) OWNER: Name HOMER, HUGH W. Address 586 S. 38TH AVE. #123 W. RICHLAND, WA 99352-

(2) LOCATION OF WELL: County BENTON - SW 1/4 NW 1/4 Sec 01 T 09 N., R 27 WM
(2a) STREET ADDRESS OF WELL (or nearest address)

(3) PROPOSED USE: DOMESTIC

(4) TYPE OF WORK: Owner's Number of well (If more than one) 1
NEW WELL Method: ROTARY

(5) DIMENSIONS: Diameter of well 6 inches
Drilled 218 ft. Depth of completed well 218 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Dia. from +2 ft. to 38 ft.
WELDED 4 " Dia. from -5 ft. to 218 ft.
" Dia. from ft. to ft.

Perforations: YES
Type of perforator used SKILL SAW
SIZE of perforations in. by in.
perforations from 170 ft. to 210 ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: NO
Manufacturer's Name
Type Model No.
Diam. slot size from ft. to ft.
Diam. slot size from ft. to ft.

Gravel packed: NO Size of gravel
Gravel placed from ft. to ft.

Surface seal: YES To what depth? 18 ft.
Material used in seal BENTONITE
Did any strata contain unusable water? NO
Type of water? Depth of strata ft.
Method of sealing strata off OVERBORE

(7) PUMP: Manufacturer's Name
Type H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ... ft.
Static level 110 ft. below top of well Date 05/16/94
Artesian Pressure lbs. per square inch Date
Artesian water controlled by

(10) WELL LOG

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change in formation.

MATERIAL	FROM	TO
TOPSOIL	0	5
YELLOW CLAY	5	20
BROKEN BLACK BASALT	20	40
BLACK HARD BASALT	40	80
BLACK MEDIUM BASALT	80	110
YELLOW CLAY	110	125
GRAY CLAY	125	130
BLACK HARD BASALT	130	150
FRACTURED BASALT	150	155
BLACK MEDIUM BASALT	155	200
BLACK HARD BASALT	200	205
FRACTURED BASALT WITH WATER	205	218
	218	

Work started 05/13/94 Completed 05/16/94

RECEIVED JUN - 3 1994 DEPARTMENT OF ECOLOGY CENTRAL REGION OFFICE

(9) WELL TESTS: Drawdown is amount water level is lowered below static level.
Was a pump test made? NO If yes, by whom?
Yield: gal./min with ft. drawdown after hrs.

Recovery data

Time	Water Level	Time	Water Level	Time	Water Level

Date of test / /
Bailer test gal/min. ft. drawdown after hrs.
Air test 30+ gal/min. w/ stem set at 200 ft. for 1 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? NO

WELL CONSTRUCTOR CERTIFICATION:
I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME PONDEROSA DRILLING
(Person, firm, or corporation) (Type or print)

ADDRESS E 6010 BROADWAY

[SIGNED] Gy a Kelly License No. 2215

Contractor's Registration No. PO-ND-EI*24BJE Date 05/18/94

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

165

441010

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. W45147
Unique Well I.D. 4 ABL272
Water Right Permit No.

(1) OWNER: Name WILDENBORG, WILLIAM Address 7000 W. VAN GEISSEN LT310 W. RICHLAND, WA 99352-

(2) LOCATION OF WELL: County BENTON - SW 1/4 NW 1/4 Sec 01 T 09 N., R 27E WM

(2a) STREET ADDRESS OF WELL (or nearest address)

E

(3) PROPOSED USE: DOMESTIC

(4) TYPE OF WORK: Owner's Number of well (If more than one) 1
NEW WELL Method: ROTARY

(5) DIMENSIONS: Diameter of well 6 inches
Drilled 220 ft. Depth of completed well 220 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Dia. from +2 ft. to 48 ft.
WELDED 4 " Dia. from -4 ft. to 220 ft.
" Dia. from ft. to ft.

Perforations: YES
Type of perforator used SKILL SAW
SIZE of perforations in. by in.
perforations from 200 ft. to 220 ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: NO
Manufacturer's Name
Type Model No.
Diam. slot size from ft. to ft.
Diam. slot size from ft. to ft.

Gravel packed: NO Size of gravel
Gravel placed from ft. to ft.

Surface seal: YES To what depth? 18 ft.
Material used in seal BENTONITE
Did any strata contain unusable water? NO
Type of water? Depth of strata ft.
Method of sealing strata off OVERBORE

(7) PUMP: Manufacturer's Name
Type H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ... ft.
Static level 120 ft. below top of well Date 10/10/94
Artesian Pressure lbs. per square inch Date
Artesian water controlled by

(10) WELL LOG

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change in formation.

MATERIAL	FROM	TO
TOPSOIL	0	5
YELLOW CLAY	5	20
BROKEN BLACK BASALT	20	50
HARD BLACK BASALT	50	110
	95	
YELLOW CLAY	110	130
GRAY CLAY	130	135
HARD BLACK BASALT	135	200
BROKEN BASALT WITH WATER	200	220
	220	

eqt

RECEIVED OCT 26 1994 DEPARTMENT OF ECOLOGY

Work started 10/12/94 Completed 10/14/94

(9) WELL TESTS: Drawdown is amount water level is lowered below static level.
Was a pump test made? NO If yes, by whom?
Yield: gal./min with ft. drawdown after hrs.

Recovery data

Time	Water Level	Time	Water Level	Time	Water Level

Date of test / /
Bailer test gal/min. ft. drawdown after hrs.
Air test 30 gal/min. w/ stem set at 200 ft. for 1 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? NO

WELL CONSTRUCTOR CERTIFICATION:
I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME PONDEROSA DRILLING (Person, firm, or corporation) (Type or print)

ADDRESS E 6010 BROADWAY

[SIGNED] Ly A. Kelly License No. 2215

Contractor's Registration No. PO-ND-EI*248JE Date 10/19/94

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

(1F1)

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No. .....
Permit No. .....

(1) OWNER: Name SULLIVAN, E. Neil & William E. Address Route 1, Box 5056, W. Richland, WA 99352

(2) LOCATION OF WELL: County BENTON — NW ¼ NW ¼ Sec. 1 T. 9 N. R. 27E W.M.

Bearing and distance from section or subdivision corner

D

(3) PROPOSED USE: Domestic XX Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) .....
New well XX Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary X Jetted ☐

(5) DIMENSIONS: Diameter of well 10 inches.
Drilled 65 ft. Depth of completed well 65 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 10 " Diam. from +1 ft. to 59 ft.
Threaded ☐ " Diam. from ft. to ft.
Welded XX " Diam. from ft. to ft.

Perforations: Yes ☐ No XX
Type of perforator used .....
SIZE of perforations ..... in. by ..... in.
..... perforations from ..... ft. to ..... ft.
..... perforations from ..... ft. to ..... ft.
..... perforations from ..... ft. to ..... ft.

Screens: Yes ☐ No XX
Manufacturer's Name .....
Type ..... Model No. .....
Diam. ..... Slot size ..... from ..... ft. to ..... ft.
Diam. ..... Slot size ..... from ..... ft. to ..... ft.

Gravel packed: Yes ☐ No X Size of gravel: .....
Gravel placed from ..... ft. to ..... ft.

Surface seal: Yes X No ☐ To what depth? 20 ft.
Material used in seal bentonite
Did any strata contain unusable water? Yes ☐ No X
Type of water? ..... Depth of strata .....
Method of sealing strata off .....

(7) PUMP: Manufacturer's Name .....
Type: ..... H.P. .....

(8) WATER LEVELS: Land-surface elevation above mean sea level .... ft.
Static level 35 ft. below top of well Date 2/20/85
Artesian pressure ..... lbs. per square inch Date 2/20/85
Artesian water is controlled by ..... (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No X If yes, by whom? .....
Yield: 100+ gal./min. with ft. drawdown after hrs.
" " ESTIMATED AIRLIFT " "
" " " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test .....
Bailer test ..... gal./min. with ..... ft. drawdown after ..... hrs.
Artesian flow ..... g.p.m. Date .....
Temperature of water ..... Was a chemical analysis made? Yes ☐ No ☐

3/11/85

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Top soil	0	2
Sand	2	40
Basalt, broken w/water	40	65
~~NO PVC Liner Installed~~		
~~10" Drive shoe installed~~		

RECEIVED MAR - 9 1985

RECEIVED MAR 13 1985 DEPARTMENT OF ECOLOGY CENTRAL REGION OFFICE

Work started 2/20/, 19 85 Completed 2/20, 19 85

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME PONDEROSA DRILLING & DEVELOPMENT INC. (Person, firm, or corporation) (Type or print)

Address E. 6010 Broadway, Spokane, WA 99212

[Signed] Thomas R. Richardson (Well Driller)
Thomas R. Richardson

License No. 1295 Date 2/20, 19 85

3/19/85

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

(161)

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No. G4-29336
Permit No. 5

(1) OWNER: Name Robert Butler Address 1421 Keller, Richland, WA. 99352

(2) LOCATION OF WELL: County Benton Lot 2 of SW¼ NE¼ Sec. 1 T. 9 N., R. 27 W.M.
Bearing and distance from section or subdivision corner

(3) PROPOSED USE: Domestic ☐ Industrial ☐ Municipal ☒ Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) ....
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☒ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 5 inches.
Drilled 151 ft. Depth of completed well 151 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 5" Diam. from +1½ ft. to 125 ft.
Threaded ☐ " Diam. from ft. to ft.
Welded ☒ " Diam. from ft. to ft.

Perforations: Yes ☐ No ☒
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☐ No ☒
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☒ Size of gravel:
Gravel placed from ft. to ft.

Surface seal: Yes ☒ No ☐ To what depth? 21 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name Aeromotor
Type: Submersible H.P. 2

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 44 ft. below top of well Date 6-15-87
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☒ No ☐ If yes, by whom? Me
Yield: 27 gal./min. with 52 ft. drawdown after 2 hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test 6-15-87
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☒

(10) WELL LOG:
Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
fine brown sand	0	3
compacted gravel, silt, clay	3	12
compacted gray clay	12	21
broken black basalt	21	25½
black basalt	25½	56
fractured black basalt	56	60
black basalt	60	100
brown sand	100	125
black basalt	125	151

RECEIVED JUL 20 1987 DEPARTMENT OF ECOLOGY CENTRAL REGION OFFICE

Work started 4-23, 1987 Completed 6-15, 1987

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME B+H Drilling #2 (Person, firm, or corporation) (Type or print)
Address Box 343 Burbank, WA.
[Signed] M. L. Butler (Well Driller)
License No. 0065 Date 6-30, 1987

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY-050-1-20

(1H1)

Start Card No. W045038

UNIQUE WELL I.D. #

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

35255

WATER WELL REPORT

STATE OF WASHINGTON

Water Right Permit No.

(1) OWNER: Name HAAR Anselm Address

(2) LOCATION OF WELL: County Benton — SE 1/4 NE 1/4 Sec 1 T. 9 N., R. 27 W.M.

(2a) STREET ADDRESS OF WELL (or nearest address)

H

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater [ ] Industrial [ ] Test Well [ ] Municipal [ ] Other

(4) TYPE OF WORK: Owner's number of well (if more than one)
Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ]
Method: Dug [ ] Cable [ ] Rotary [X] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 240 feet. Depth of completed well 240 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6" Diam. from +1 ft. to 75 ft.
Welded [X] 4" Diam. from -5 ft. to 240 ft.
Liner installed [X]
Threaded [ ] " Diam. from ft. to ft.

Perforations: Yes [X] No [ ]
Type of perforator used Saw
SIZE of perforations 1/8 in. by 6 in.
126 perforations from 220 ft. to 240 ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes [ ] No [ ]
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes [ ] No [ ] Size of gravel
Gravel placed from ft. to ft.

Surface seal: Yes [X] No [ ] To what depth? 75 ft.
Material used in seal Bentonite cement
Did any strata contain unusable water? Yes [ ] No [ ]
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 87 ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [ ] No [ ] If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest 150 gal./min. with stem set at 240 ft. for 2 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes [ ] No [ ]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Brown Sand	0	6
Black Sand	6	19
Black Sand Gravel	19	27
Brocken Basalt	27	65
Hard Black Basalt	65	220
Brocken Basalt Blue Shale	220	240

RECEIVED NOV 14 1994 DEPT. OF ECOLOGY

Work Started 11-9-94, 19. Completed , 19

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME St. George Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address 701 S 45 AVE W. Richland

(Signed) [signature] (WELL DRILLER) License No. 0483

Contractor's Registration No. 601-048-715 Date 11-10-94, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

ECL 050-1-20 (2/93)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

(1H2)

8977

Start Card No. 080205

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Water Right Permit No.

(1) OWNER: Name Roger Smith Address

(2) LOCATION OF WELL: County Benton SE ¼ NE ¼ Sec 1 T. 9 N., R. 27 W.M.

(2a) STREET ADDDRESS OF WELL (or nearest address)

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater [ ] Industrial [ ] Test Well [ ] Municipal [ ] Other

(4) TYPE OF WORK: Owner's number of well (if more than one)
Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ]
Method: Dug [ ] Cable [ ] Rotary [X] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 265 feet. Depth of completed well 265 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Diam. from +1 ft. to 200 ft.
Welded [X] Liner installed [ ] Threaded [ ] " Diam. from ft. to ft.
" Diam. from ft. to ft.

Perforations: Yes [ ] No [X]
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes [ ] No [X]
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes [ ] No [X] Size of gravel
Gravel placed from ft. to ft.

Surface seal: Yes [X] No [ ] To what depth? 200 ft.
Material used in seal Bentonite + cement.
Did any strata contain unusable water? Yes [ ] No [ ]
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 130 ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [ ] No [ ] If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest 70 gal./min. with stem set at 260 ft. for hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes [ ] No [ ]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Brown Sand + Ash	0	16
Broken Brown + Black Basalt	16	25
Hard Black Basalt	25	116
Broken Black + Brown Basalt	116	126
Brown Sand + Shale Bearing water	126	131
Brown Sand	131	155
Broken Black + Brown Basalt with Brown Sand	155	169
Brown Sand	169	173
Broken Black Basalt	173	179
Hard Black Basalt	179	200
Hard Black Basalt	200	255
Broken Black Basalt Bearing water	255	265

Work started 5-28-93, 19. Completed , 19

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME St George Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address 701 5045 AVE W. Richland
(Signed) [signature] (WELL DRILLER) License No. 0487
Contractor's Registration No. 601-048-715 Date 6-2-93, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (10/87) -1329 18

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

(1K1)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original with Department of Ecology
Second Copy - Owner's Copy
Third Copy - Driller's Copy

61381

WATER WELL REPORT

STATE OF WASHINGTON

Notice of Intent W-093750
UNIQUE WELL I.D. # AET-525
Water Right Permit No.

OWNER: Name Joe & Linda picker Address P.O. Box 2792 Pasco Wa 99301

(2) LOCATION OF WELL: County Benton NE 1/4 SW 1/4 Sec 1 T 9 N.R. 27E WM

(2a) STREET ADDRESS OF WELL: (or nearest address) Paradise LN.

TAX PARCEL NO.:

(3) PROPOSED USE: ☑ Domestic ☐ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐ DeWater

(4) TYPE OF WORK: Owner's number of well (if more than one) 1
☑ New Well ☐ Deepened ☐ Reconditioned ☐ Decommission.
Method: ☐ Dug ☐ Bored ☐ Cable ☐ Driven ☑ Rotary ☐ Jetted

(5) DIMENSIONS: Diameter of well 6" inches
Drilled 220 feet. Depth of completed well 220 ft.

(6) CONSTRUCTION DETAILS
Casing Installed:
☐ Welded 6" Diam. from +1.5 ft. to 83.5 ft.
☑ Liner installed 5" Diam. from -30 ft. to 190 ft.
☐ Threaded " Diam. from ft. to ft.

Perforations: ☑ Yes ☐ No
Type of perforator used Torch Cut
SIZE of perforations 1/2" in. by 12" in.
15 perforations from 205 ft. to 220 ft.

Screens: ☐ Yes ☑ No ☐ K-Pac Location
Manufacturer's Name
Type Model No.
Diam. Slot Size from ft. to ft.
Diam. Slot Size from ft. to ft.

Gravel/Filter packed: ☐ Yes ☑ No ☐ Size of gravel/sand
Material placed from ft. to ft.

Surface seal: ☑ Yes ☐ No To what depth? +20 ft.
Material used in seal
Did any strata contain unusable water? ☐ Yes ☑ No
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 165 ft. below top of well Date 5-5-99
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☐ No If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
Yield: gal./min. with ft. drawdown after hrs.
Yield: gal./min. with ft. drawdown after hrs.
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest 30 gal./min. with ft. drawdown after 4 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? ☐ Yes ☐ No

(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. Indicate all water encountered.

MATERIAL	FROM	TO
Sand	0	3
Sand & Gravel	3	6
Brown Clay	6	10
Sand & Gravel	10	24
Brown clay	24	80
HO Gray Clay	80	92
Brown Clay	92	130
Cemented Gravel	130	160
Gray clay	160	203
Red Porous Basalt	203	220
Water Bering 30 GPM		

RECEIVED
SEP - 3 1999
DEPARTMENT OF ECOLOGY
CENTRAL REGION OFFICE

Work Started 4-30 99 Completed 5-5 99

WELL CONSTRUCTION CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Type or Print Name TODD HANEY License No. 2343
(Licensed Driller/Engineer)

Trainee Name License No.
Drilling Company STATEWIDE WELL DRILLING
(Signed) License No. 2543
(Licensed Driller/Engineer)
Address 101 KAU Trail Rd PASCO WA 99301
Contractor's Registration No. STATEWD077DQ Date 4/00

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (360) 407-6600. The TDD number is (360) 407-6006.

ECY 050-1-20 (11/98)

(1K2)

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

61397

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. W093769

Water Right Permit No. aAex 433

(1) OWNER: Name Gerald E Maggie Higgins Address

(2) LOCATION OF WELL: County Benton NE ¼ SW ¼ Sec. 1 T. 9 N., R. 27 E W.M.

(2a) STREET ADDDRESS OF WELL (or nearest address)

(3) PROPOSED USE: ☒ Domestic ☐ Irrigation ☐ DeWater Industrial ☐ Test Well ☐ Municipal ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one)
Abandoned ☐ New well ☒ Deepened ☐ Reconditioned ☐
Method: Dug ☐ Cable ☐ Rotary ☒ Bored ☐ Driven ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 12-8 inches.
Drilled 206 feet. Depth of completed well 206 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 8" Diam. from +2 ft. to 155 ft.
Welded ☒ 6" P.V.C Diam. from 28 ft. to 208 ft.
Liner installed ☒
Threaded ☐ " Diam. from ft. to ft.

Perforations: Yes ☒ No ☐
Type of perforator used Drill
SIZE of perforations 1/5" in. by in.
410 perforations from 188 ft. to 208 ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☐ No ☒
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☒ Size of gravel
Gravel placed from ft. to ft.

Surface seal: Yes ☒ No ☐ To what depth? 18 ft.
Material used in seal Bonanite
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? Depth of strata
Method of sealing strata off OVER BORE

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 150 ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☐ If yes, by whom?
Yield: 25 gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest 25 gal./min. with stem set at 180 ft. for 2 hrs.
Artesian flow g.p.m. Date
Temperature of water 65 Was a chemical analysis made? Yes ☐ No ☒

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Top Soil	0	3
Gravel	3	24
Sandy Clay	24	118
Multi Color Gravel	118	135
Hard BR. Clay	135	141
Hard Blue Clay	141	170
Soft Brown Clay	170	185
Broke Basalt	185	208
	0	
Packer was set @ 185'		

RECEIVED DEC 17 1998 DEPARTMENT OF ECOLOGY CENTRAL REGION OFFICE

Work started 11-2-98 19. Completed 11-9 19 98

WELL CONSTRUCTOR CERTIFICATION:
I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Statewide Well Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address 101 KAUTrail Rd Pasco WA 99301
(Signed) Jody L Carpenter (WELL DRILLER) License No. 1900
Contractor's Registration No. STATEW007722 Date 4/99 19

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (10/87) -1329- 3

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

(1K3)

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No. .....
Permit No. .....

(1) OWNER: Name John Harris Address Route 2 Box 2223 Benton City WA 99320

(2) LOCATION OF WELL: County Benton Lot 2 SP-523- NE ¼ SW ¼ Sec. 1 T. 9 N., R. 27 W.M.

Bearing and distance from section or subdivision corner 200 ft. NE CORNER

(3) PROPOSED USE: Domestic ☑ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) ....
New well ☑ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☑ Jetted ☐

(5) DIMENSIONS: Diameter of well 6" inches.
Drilled 285 ft. Depth of completed well 285 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Diam. from -1 ft. to 174 ft.
Threaded ☐ " Diam. from ft. to ft.
Welded ☑ " Diam. from ft. to ft.

Perforations: Yes ☐ No ☑
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☐ No ☑
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☑ Size of gravel:
Gravel placed from ft. to ft.

Surface seal: Yes ☑ No ☐ To what depth? 46 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes ☐ No ☑
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level .... ft.
Static level 90 ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☑ If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG:
Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Sand	0	3
Gray Basalt	3	15
Bracken Basalt Redish	15	33
Sand Brown	33	120
Hard Black Basalt	120	165
Bracken Basalt Boring water Apx 7 Gpm	165	185
Hard Black Basalt	185	265
Sand Stone + Shale Boring water Apx 40 Gpm	265	285

RECEIVED NOV 14 1979 DEPT. OF ECOLOGY

Work started 5-1, 19 79 Completed 10-26, 19 79

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME St. George Drilling (Person, firm, or corporation) (Type or print)
Address 701 So 45 AVE W. Richland
[Signed] Pete C. St. George Jr (Well Driller)
License No. 0483 Date 10-26, 19 79

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

IM1

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

Construction/Decommission ("x" in circle) 343083

[•] Construction

[ ] Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

CURRENT
Notice of Intent No. w242901

Unique Ecology Well ID Tag No. APW720

Water Right Permit No. _____

Property Owner Name Herold Alexander

Well Street Address 7710 W Van Geisen

City West Richland County Benton

Location SW 1/4-1/4 SW 1/4 Sec 1 Twn 9n R 27E EWM [✓] or WWM [ ] circle one

Lat/Long (s, t, r Still **REQUIRED**) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec N

Tax Parcel No. 1-01-97-300-0002-000

PROPOSED USE: [✓] Domestic [ ] Industrial [ ] Municipal [ ] DeWater [ ] Irrigation [ ] Test Well [ ] Other _____

TYPE OF WORK: Owner's number of well (if more than one) _____
[ ] New well [ ] Reconditioned [ ] Deepened
Method: [ ] Dug [ ] Bored [ ] Driven [ ] Cable [✓] Rotary [ ] Jetted

DIMENSIONS: Diameter of well 6" inches, drilled 353 ft.
Depth of completed well 353 ft.

CONSTRUCTION DETAILS
Casing Installed: [✓] Welded 6" Diam. from +1 ft. to 99 ft.
[✓] Liner installed 4" Diam. from 4 ft. to 353 ft.
[ ] Threaded _____" Diam. from _____ ft. to _____ ft.

Perforations: [ ] Yes [✓] No
Type of perforator used Unknown
SIZE of perfs _____ in. by _____ in. and no. of perfs _____ from _____ ft to _____ ft

Screens: [ ] Yes [✓] No [ ] K-Pac Location _____
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: [ ] Yes [✓] No [ ] Size of gravel/sand _____
Materials placed from _____ ft to _____ ft.

Surface Seal: [✓] Yes [ ] No To what depth? 20 ft.
Material used in seal bentonite
Did any strata contain unusable water? [ ] Yes [✓] No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

PUMP: Manufacturer's Name _____
Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 160 ft. below top of well Date 9-14-05
Artesian pressure _____ lbs per square inch Date _____
Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? [ ] Yes [✓] No If yes, by whom? st george well
Yield: _____ gal./min with _____ ft. drawdown after _____ hrs.
Yield: _____ gal./min with _____ ft. drawdown after _____ hrs.
Yield: _____ gal./min with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest 200 gal./min with stem set at 340 ft. for 6 hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? [✓] Yes [ ] No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
sand tan	0	65
sand + gravel tan and medium	65	90
basalt soft with trace h2o red	90	120
basalt medium hard gray	120	190
blue clay	190	210
soft basalt + blue comglomerent	210	240
basalt medium hard gray	240	300
hard black basalt	300	315
soft basalt + blue shale + h2o	315	340
meduim red basalt + h2o	340	348
hard black basalt	348	353

RECEIVED
MAY 22 2009
DEPARTMENT OF ECOLOGY CENTRAL REGIONAL OFFICE

Start Date 9-8-05 Completed Date 9-10-05

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

[ ] Driller [ ] Engineer [ ] Trainee Name (Print) Thomas St George
Driller/Engineer/Trainee Signature _____
Driller or trainee License No. 2781

Drilling Company St. George Well Drilling Co.
Address 701 S 45th Ave.
City, State, Zip West Richland, Wa. 99353
Contractor's Registration No stgeogw954k4 Date 8-25-05

IF TRAINEE,
Driller's Licensed No. _____
Driller's Signature _____

Ecology is an Equal Opportunity Employer.

ECY 050-1-20 (Rev 3/05) **The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.**

(IW 1)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

Please print, sign and return to the Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. SE48742

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *("x" in box)*

☒ Construction
☐ Decommission

496189

ORIGINAL INSTALLATION Notice of Intent Number:

DEPT OF ECOLOGY Received OCT 09 2013 CENTRAL REGION OFFICE

Consulting Firm STRATA

Unique Ecology Well IDTag No.

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee

Name (Print Last, First Name) DELVALLE, AARON

Driller/Engineer /Trainee Signature

Driller or Trainee License No. 3074

If trainee, licensed driller's Signature and License Number:

Type of Well *("x in box)*

☐ Resource Protection
☒ Geotech Soil Boring

Property Owner CITY OF RICHLAND

Site Address 500' WEST OF PARADISE WAY AND ONYX AVE

City RICHLAND

County BENTON-3

Location SE1/4-1/4 SW1/4 Sec 1 Twn 9N R 27

EWM ☒ or WWM ☐

Lat/Long (s, t, r still REQUIRED) Lat Deg ____ Min ____ Sec ____ Long Deg ____ Min ____ Sec ____

Tax Parcel No.

Cased or Uncased Diameter 8" Static Level

Work/Decommission Start Date 7-12-13

Work/Decommission Completed Date 7-12-13

Construction Design	Well Data	Formation Description
DRILLED TO 20' BGS WITH 8" HOLLOW STEM AUGERS	B-3	0-15.5' ALLUVIUM SAND AND GRAVEL TAN 15.5-20' ALLUVIUM SAND AND GRAVEL WITH CLAY

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

(1N2)

Please print, sign and return to the Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. SE48742

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *("x" in box)*

☒ *Construction*

☐ Decommission 496188

ORIGINAL INSTALLATION Notice of Intent Number:

DEPT OF ECOLOGY Received OCT 09 2013 CENTRAL REGION OFFICE

Consulting Firm STRATA

Unique Ecology Well IDTag No.

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee

Name (Print Last, First Name) DELVALLE, AARON

Driller/Engineer /Trainee Signature

Driller or Trainee License No. 3074

If trainee, licensed driller's Signature and License Number:

Type of Well *("x in box)*

☐ Resource Protection

☒ Geotech Soil Boring

Property Owner CITY OF RICHLAND

Site Address 500' WEST OF PARADISE WAY AND ONYX AVE

City RICHLAND

County BENTON-3

Location SE1/4-1/4 SW1/4 Sec 1 Twn 9N R 27

EWM ☒ or WWM ☐

Lat/Long (s, t, r still REQUIRED) Lat Deg ____ Min ____ Sec ____ Long Deg ____ Min ____ Sec ____

Tax Parcel No.

Cased or Uncased Diameter 8" Static Level

Work/Decommission Start Date 7-12-13

Work/Decommission Completed Date 7-12-13

Construction Design	Well Data	Formation Description
DRILLED TO 20' BGS WITH 8" HOLLOW STEM AUGERS	B-2	0-20' ALLUVIUM SAND AND GRAVEL TAN

(IN3)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

Please print, sign and return to the Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. SE48742

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *("x" in box)*

☒ Construction
☐ Decommission 496187

ORIGINAL INSTALLATION Notice of Intent Number:

DEPT OF ECOLOGY Received OCT 09 2013 CENTRAL REGION OFFICE

Type of Well *("x in box)*

☐ Resource Protection
☒ Geotech Soil Boring

Property Owner CITY OF RICHLAND

Site Address 500' WEST OF PARADISE WAY AND ONYX AVE

Consulting Firm STRATA

Unique Ecology Well IDTag No. _____

City RICHLAND

County BENTON-3

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Location SE1/4-1/4 SW1/4 Sec 1 Twn 9N R 27

EWM ☒ or WWM ☐

☒ Driller ☐ Engineer ☐ Trainee

Name (Print Last, First Name) DELVALLE, AARON

Driller/Engineer /Trainee Signature

Driller or Trainee License No. 3074

Lat/Long (s, t, r still REQUIRED) Lat Deg _____ Min ___ Sec _____

Long Deg _____ Min _____ Sec _____

Tax Parcel No. _____

Cased or Uncased Diameter 8" Static Level _____

Work/Decommission Start Date 7-12-13

Work/Decommission Completed Date 7-12-13

If trainee, licensed driller's Signature and License Number:

Construction Design	Well Data	Formation Description
DRILLED TO 20' BGS WITH 8" HOLLOW STEM AUGERS	B-1	0-20' ALLUVIUM SAND AND GRAVEL TAN

101

File Original with Department of Ecology
Second Copy - Owner's Copy
Third Copy - Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Notice of Intent W122252
UNIQUE WELL I D # AEM 784
Water Right Permit No

(1) OWNER Name TERRI Ahlers Address 1320 Adair Richland WA. 99352

(2) LOCATION OF WELL County Benton SW 1/4 SE 1/4 Sec 1 T 9 N R 27 WM

(2a) STREET ADDRESS OF WELL (or nearest address)

TAX PARCEL NO

(3) PROPOSED USE ☒ Domestic ☐ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐ DeWater

(4) TYPE OF WORK Owner's number of well (if more than one)
☒ New Well ☐ Deepened ☐ Reconditioned ☐ Decommission
Method ☐ Dug ☐ Cable ☒ Rotary ☐ Bored ☐ Driven ☐ Jetted

(5) DIMENSIONS Diameter of well 6 inches
Drilled 200 feet Depth of completed well 200 ft

(6) CONSTRUCTION DETAILS
Casing Installed
☒ Welded 6" Diam from +2 ft to 200 ft
☐ Liner installed Diam from ft to ft
☐ Threaded Diam from ft to ft

Perforations ☐ Yes ☒ No
Type of perforator used
SIZE of perforations in by in
perforations from ft to ft

Screens ☐ Yes ☒ No ☐ K-Pac Location
Manufacturer's Name
Type Model No
Diam Slot Size from ft to ft
Diam Slot Size from ft to ft

Gravel/Filter packed ☐ Yes ☒ No ☐ Size of gravel/sand
Material placed from ft to ft

Surface seal ☒ Yes ☐ No To what depth? 20 ft
Material used in seal Bentonite
Did any strata contain unusable water? ☐ Yes ☐ No
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP Manufacturer's Name
Type H P

(8) WATER LEVELS Land-surface elevation above mean sea level ft
Static level 170 ft below top of well Date 5-17-00
Artesian pressure lbs per square inch Date
Artesian water is controlled by (Cap, valve etc)

(9) WELL TESTS Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom?
Yield gal/min with ft drawdown after hrs
Yield gal/min with ft drawdown after hrs
Yield gal/min with ft drawdown after hrs
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min with ft drawdown after hrs
Airtest 5+20 gal./min with — ft drawdown after 1 hrs
Artesian flow g p m Date
Temperature of water 57° Was a chemical analysis made? ☐ Yes ☐ No

ECY 050-1-20 (11/98) 82557

(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION
Formation Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information Indicate all water encountered

MATERIAL	FROM	TO
Top Soil	0	2
Sandy Brown	2	32
Clay & Silt	32	81
Brown Silt	81	179
Sand & Gravel (Water)	179	200

JUN 12 PM 3
DEPARTMENT OF ECOLOGY WELL DRILLING SECTION

RECEIVED
JUN 14 2000
DEPARTMENT OF ECOLOGY WELL DRILLING UNIT

Work Started 5-14-00 Completed 5-17-00

WELL CONSTRUCTION CERTIFICATION

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

Type or Print Name Lyle Ames License No 1224
(Licensed Driller/Engineer)

Trainee Name License No
Drilling Company Triple A Drilling
(Signed) Lyle A. Ames License No 1224
(Licensed Driller/Engineer)
Address 2202 W Wintry Lane Kennewick, WA
Contractor's Registration No TRIPLDI025BP Date 5-20-00

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer For special accommodation needs contact the Water Resources Program at (360) 407-6600 The TDD number is (360) 407-6006

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

The Dep The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

STATE OF WASHINGTO.
DEPARTMENT OF CONSERVATION
AND DEVELOPMENT

WELL LOG No. A-6355

Date 10-15, 19 62

Record by well driller

Source driller's record

Location: State of WASHINGTON

County Benton

Area

Map

NE ¼ NE ¼ sec. 6 T. 9 N., R. 28 E.

Diagram of Section

Drilling Co. Smith & Sons Drilling Company

Address 2103 North 52nd, Pasco, Washington

Method of Drilling Date 8/20,21,22, 62

Owner Town of West Richland

Address Rt. 1, Box 222, West Richland, Wash.

Land surface datum ft above below

Color-Letter	Material	Thickness (feet)	Depth (feet)
	Silty sand and gravel	10.5	10.5
	Black sand	8.5	19
	Black sand	7	26
	Sandy gravel	9	35
	Silty sand gravel - water	13	48
	Silty sand gravel - water	10	58
	Silty sand gravel - water	9	67
	Very clean sand	2	69
	2" minus gravel and sand - water	7	76
	Cemented gravel - no water	17	93
	Clue clay - no water	4	97
	Sand and gravel - water	29	126
	Brown volcanic ash, few large cobbles - water	38	164
	Blue clay - no water	12	176
	Broken honey-comb basalt - water	13	189

Turn up (over) Sheet of sheets

6A1
Pl. of 2

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

Town of Richland
S-6, T-9, R-28
Wtr, 16,250
Benton

WELL LOG.—Continued No...../.....-.....

Consolidation	Material	Thickness (feet)	Depth (feet)
	Depth forward	——	
	Broken basalt with blue clay - water	3	192
	Broken basalt with gray shale	5	197
	Very broken basalt, sluffs in - water	12	209
	Loose broken basalt - water	36	245
	Broken basalt, volcanic ash binder - water	5	250
	PUMP TEST:		
	Dim: 16" x 250'		
	SWL: 25 ft. (8-20-62)		
	DD: 23.34 ft.		
	Yield: 1,001 gpm		
	Rapid recovery		
	CASING: 16" diam. casing from 0 to 177 ft.		
	16" diam. hole in rock from 177 to 200 ft.		
	12" diam. hole in rock from 200 to 250 ft.		
	16" Drive shoe set at 177 ft.		
	Perforated casing or screens:		
	Perforated 16" casing from 100 to 125 ft.		
	12 per ft. size 3/8 x 3		

S. F. No. 7449—OS—6-61—2M.

The Well Log Data and Image are 'As Is' with NO Warranty. Well Log ID: 146049 (page 1 of 1)

6A1 p.2 of 2

Department of Ecology Well Log Image System

epartment of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

STATE OF WASHINGTON
DEPARTMENT OF CONSERVATION
DIVISION OF WATER RESOURCES

Appli. 8214

WELL LOG

Record by Driller

Source Driller's Record

Location: State of WASHINGTON

County Benton

Area

Map

NE¼ NE¼ sec. 6 T. 9 N., R. 28 E. W.

Diagram of Section

Drilling Co. Cascade Drilling Company

Address 308 North 12th, Pasco, Washington

Method of Drilling Cable/Driven Date June 14, 1966

Owner Ray Moller

Address 1025 Cedar, Richland, Washington

Land surface, datum ft above/below

SWL: 28'7" Date June 14, 1966 Dims.: 6" x 90'2"

Correlation	Material	From (feet)	To (feet)
	(Transcribe driller's terminology literally but paraphrase as necessary, in parentheses. If material water-bearing, so state and record static level if reported. Give depths in feet below land-surface datum unless otherwise indicated. Correlate with stratigraphic column, if feasible. Following log of materials, list all casings, perforations, screens, etc.)		
	Domestic and irrigation use		
	Soil	0	28
	Gravel, fine, and sand	28	29
	Soil	29	30
	Gravel, fine	30	36
	Sand, coarse (gravel, trace)	36	42
	Sand, compact, gravel & sedi	42	63
	Clay, dirt and dec. basalt	63	73
	Basalt, sediment	73	75
	Basalt, very hard, fractured	75	90'2"
	WATER AT 82' and 88'		
	Casing: 6' from o to 7 6'		
	Surface sealed with Bentonite and cement		
	grout to depth of 3'		
	Yield: 36 gpm with 2'5" dd after 150 hrs.		
	Date of test: 6/28/66		

Turn up Sheet

6A2 p. 1 of 2

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WELL LOG.—Continued No...../.....-.....

CORRELATION	MATERIAL	From (feet)	To (feet)
	Depth forward	——	
	Bailer test: 30 gpm with 1⅓' dd after 2/3 h		
	Date: 6/28/66		
	Temp: 65⅓°		
	Pump: 2 h.p. Berkley submersible		

S. F. No. 7449—OS—12-65.

6A2

P. 2 of 2

6A3

W 045183

Start Card No.

UNIQUE WELL I.D. #

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

145086

WATER WELL REPORT

STATE OF WASHINGTON

Water Right Permit No.

(1) OWNER: Name MARK NOVITY Address 5995 40th AVE, W Richland

(2) LOCATION OF WELL: County Benton NE 1/4 NE 1/4 Sec 6 T. 9 N., R. 28 W.M.

(2a) STREET ADDRESS OF WELL (or nearest address)

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater [ ] Industrial [ ] Test Well [ ] Municipal [ ] Other

(4) TYPE OF WORK: Owner's number of well (if more than one)
Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ]
Method: Dug [ ] Cable [ ] Rotary [X] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 200 feet. Depth of completed well 200 ft.

(6) CONSTRUCTION DETAILS:
Casing Installed: 6 " Diam. from +1 ft. to 175 ft.
Welded [X] " Diam. from ft. to ft.
Liner installed [ ] " Diam. from ft. to ft.
Threaded [ ]

Perforations: Yes [ ] No [X]
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes [ ] No [X]
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes [ ] No [X] Size of gravel
Gravel placed from ft. to ft.

Surface seal: Yes [X] No [ ] To what depth? 136 ft.
Material used in seal Bentonite cement
Did any strata contain unusable water? Yes [ ] No [ ]
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 124 ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [ ] No [ ] If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest 30 gal./min. with stem set at 180 ft. for 2 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes [ ] No [ ]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Brown Sand	0	3
Brown clay	3	81
Brown Sand Gravel	81	121
Brown clay	121	136
Blue Gray clay	136	162
Broken Black Basalt	162	179
Redish Brown Basalt Broken Bearing Water	179	200

RECEIVED JUN 27 1994 DEPARTMENT OF ECOLOGY CENTRAL REGION OFFICE

Work Started 5-25-94 19. Completed 19

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME St. George Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address 701 S. 45 AVE. W. Richland

(Signed) (WELL DRILLER) License No. 0487

Contractor's Registration No. 601-048-715 Date 5-26-94 19

(USE ADDITIONAL SHEETS IF NECESSARY)

ECL 050-1-20 (2/93)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

The Dep The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

6A4

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No _____
Permit No A3-20858P

(1) OWNER Name R A PAASCH Address 207 S 46TH W RICHLAND

(2) LOCATION OF WELL County BENTON NE ¼ NE ¼ Sec 6 T 9 N R 28 W.M.

Bearing and distance from section or subdivision corner 1000' S OF NE CORNER

A

(3) PROPOSED USE. Domestic ☒ Industrial ☐ Municipal ☐ Irrigation ☒ Test Well ☐ Other ☐

(4) TYPE OF WORK. Owner's number of well (if more than one)
New well ☒ Method Dug ☒ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS Diameter of well 40 ID inches
Drilled _____ ft. Depth of completed well 60 ft.

(6) CONSTRUCTION DETAILS. CONCRETE
Casing installed. 48" OD Diam from 0 ft. to 60 ft.
Threaded ☐ _____ Diam. from _____ ft. to _____ ft.
Welded ☐ _____" Diam. from _____ ft. to _____ ft.

Perforations Yes ☐ No ☒
Type of perforator used _____
SIZE of perforations _____ in. by _____ in.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft to _____ ft

Screens: Yes ☐ No ☒
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft to _____ ft
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed. Yes ☐ No ☒ Size of gravel _____
Gravel placed from _____ ft to _____ ft.

Surface seal Yes ☒ No ☐ To what depth? 60 ft.
Material used in seal SOIL
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

(7) PUMP: Manufacturer's Name BERKELEY
Type CENTRI HP 7½

(8) WATER LEVELS Land-surface elevation above mean sea level _____ ft
Static level 50 ft. below top of well Date 11/15/74
Artesian pressure _____ lbs per square inch Date _____
Artesian water is controlled by _____ (Cap valve etc.)

(9) WELL TESTS Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☒ If yes by whom? _____
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs
" " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? Yes ☐ No ☒

(10) WELL LOG
Formation: Describe by color, character, size of material and structure and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
VOLCANIC ASH (HARDPAN)	0	2
SAND	2	10
UNCON GRAVEL/BROKEN LAVA/SAND	10	58
VOLCANIC ASH (HARD PAN)	58	60

RECEIVED
FEB 18 1976
DEPARTMENT OF ECOLOGY
CENTRAL REGIONAL OFFICE

Work started _____ 19 70 Completed _____ 19 75

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief

NAME R.A. PAASCH (Person, firm or corporation) (Type or print)
Address 207 S 46TH
[Signed] R A Paasch (Well Driller)
License No _____ Date _____, 19..

(USE ADDITIONAL SHEETS IF NECESSARY)

GK

G. P. No. 1130—OS—(Rev 4-71)

6A5

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

Please print, sign and return to the Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. ae21131

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *("x" in box)*

☒ Construction

☒ Decommission 483190

ORIGINAL INSTALLATION Notice of Intent Number: sc47720

Consulting Firm geoengineers inc

Unique Ecology Well IDTag No. _____

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee

Name (Print Last, First Name) thompson, dave

Driller/Engineer /Trainee Signature [signature]

Driller or Trainee License No. 2493

If trainee, licensed driller's Signature and License Number:

Type of Well *("x in box)*

☐ Resource Protection

☒ Geotech Soil Boring

Property Owner city of west richland

Site Address bombing range rd

City west richland

County benton-3

Location ne1/4-1/4 ne1/4 Sec 6 Twn 9 R 28

EWM ☒ or WWM ☐

Lat/Long (s, t, r still REQUIRED) Lat Deg _____ Min _____ Sec _____ Long Deg _____ Min _____ Sec _____

Tax Parcel No. _____

Cased or Uncased Diameter 7.75" Static Level n/a

Work/Decommission Start Date 3-26-2013

Work/Decommission Completed Date 3-26-2013

Construction Design	Well Data	Formation Description
Hollow stem auger backfilled using holeplug bottom of hole 25'	B / 323400200 Natural cap no groundwater	sand ,, silt 25'

25'

DEPT OF ECOLOGY Received MAY 07 2013 CENTRAL REGION OFFICE

13 APR 29 A7:03 DEPT. OF ECOLOGY FISCAL & BUDGET

SCALE: 1"= _____ PAGE _____ OF _____

(6B1.)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. [redacted]

Water Right Permit No. _____

(1) OWNER: Name Willetu Barn Address RTS Box 5015 Pasco

(2) LOCATION OF WELL: County ~~[illegible]~~ Benton NW ¼ NE ¼ Sec. 6 T. 9 N., R. 28E W.M.

(2a) STREET ADDDRESS OF WELL (or nearest address) same - dent + coorts

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater Industrial [ ] Test Well [ ] Municipal [ ] Other [ ]

(4) TYPE OF WORK: Owner's number of well (if more than one) _____
Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ]
Method: Dug [ ] Cable [ ] Rotary [X] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 261 feet. Depth of completed well 261 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Diam. from +1 ft. to 164 ft.
Welded [X] " Diam. from _____ ft. to _____ ft.
Liner installed [ ] Threaded [ ] " Diam. from _____ ft. to _____ ft.

Perforations: Yes [ ] No [X]
Type of perforator used _____
SIZE of perforations _____ in. by _____ in.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.

Screens: Yes [ ] No [X]
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: Yes [ ] No [X] Size of gravel _____
Gravel placed from _____ ft. to _____ ft.

Surface seal: Yes [X] No [ ] To what depth? 24 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes [ ] No [ ]
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

(7) PUMP: Manufacturer's Name _____
Type: _____ H.P. _____

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 45 ft. below top of well Date 1-26-92
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc.))

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [ ] No [ ] If yes, by whom? _____
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest 34 gal./min. with stem set at 240 ft. for _____ hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? Yes [ ] No [ ]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Sand TAN Trace Gravel	0	7
Gravel 6" minus sand Blk	7	19
Gravel + Sand TAN water 34	19	46
Silt TAN	46	55
Clay Blue	55	94
Sand Blue water	94	112
Sand Blue with gravel	112	
Water Bearing		123
Clay Blue	123	134
Gravel cemented Blue	134	
sand - 8gpm		139
Clay Blue	139	159
Basalt Black	159	185
Basalt Jointed 15 gpm	185	187
Basalt Black	187	232
Basalt Red scoria	232	242
Basalt Black scoria	242	
with Blk shale water		255
Basalt Red Scoria water	255	258
Basalt Black	258	261

RECEIVED FEB 27 1992 DEPARTMENT OF ECOLOGY SOUTHWEST REGIONAL OFFICE

Work started 1-24, 19. Completed 1-26, 1992

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Nelson Well Drilling Inc (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address 10036 W Argent Pasco
(Signed) James Nelson (WELL DRILLER) License No. 361
Contractor's Registration No. NELSONDI198CQ Date 1-26, 1992

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (10/87) -1329- 3

(6C1)

82478

RESOURCE PROTECTION WELL REPORT

START CARD NO. S05810 C

PROJECT NAME: W Richland Tower
WELL IDENTIFICATION NO.
DRILLING METHOD: Auger
DRILLER: 1721
FIRM: Johnson Exploration Drlg
SIGNATURE: Larry J. Johnson
CONSULTING FIRM: STI NW
REPRESENTATIVE: ~~Andy~~ Paul Nelson

COUNTY: Benton
LOCATION NE ¼ NW ¼ Sec 6 Twn 9N R 28
STREET ADDRESS OF WELL: 5390 B Astoria Rd W. Richland 99353
WATER LEVEL ELEVATION:
GROUND SURFACE ELEVATION:
INSTALLED: 10-12-00
DEVELOPED:

AS-BUILT	WELL DATA	FORMATION DESCRIPTION
silts	3" Holes 1-2-3	
Basalt		
5		
10		
15		

DEPT. OF ECOLOGY Received NOV 16 2000 CENTRAL REGION OFFICE

RECEIVED NOV - 9 2000 DEPARTMENT OF ECOLOGY EASTERN REGIONAL OFFICE

SCALE: 1" = _____ PAGE _____ OF _____

ECY 050-12 (Rev. 11/89) 82478

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

BCA-5703 Collins Rd

6C2

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

RECEIVED JAN 25 1993 DEPARTMENT OF ECOLOGY CENTRAL REGION OFFICE

8140 Start Card No. 016394

Water Right Permit No. _____

(1) OWNER: Name Bob Loveall Address 1215 Stevens Dr. Rich., WA.

(2) LOCATION OF WELL: County Benton ¼ NW¼ Sec. 6 T. 9 N., R. 28E W.M.

(2a) STREET ADDDRESS OF WELL (or nearest address) Lot 50 Collins Rd W. Rich.

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater [ ] Industrial [ ] Test Well [ ] Municipal [ ] Other

(4) TYPE OF WORK: Owner's number of well (if more than one) _____
Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ]
Method: Dug [ ] Cable [X] Rotary [ ] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 8X6X4 inches.
Drilled 332 feet. Depth of completed well 332 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 8" Diam. from +1 ft. to 100 ft.
Welded [X] 6" Diam. from +2 ft. to 268 ft.
Liner installed [X]
Threaded [ ] " Diam. from ____ ft. to ____ ft.

Perforations: Yes [ ] No [X]
Type of perforator used _____
SIZE of perforations _____ in. by _____ in.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.

Screens: Yes [ ] No [X]
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: Yes [ ] No [X] Size of gravel _____
Gravel placed from _____ ft. to _____ ft.

Surface seal: Yes [X] No [ ] To what depth? 100 ft.
Material used in seal Bentonite + cement
Did any strata contain unusable water? Yes [ ] No [X]
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

(7) PUMP: Manufacturer's Name _____
Type: _____ H.P. _____

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 28.8 ft. below top of well Date 1-13-93
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [X] No [ ] If yes, by whom? B+H
Yield: 16.6 gal./min. with 10.6 ft. drawdown after 24 hrs.
" 16.6 " 10.6 " 5 min "
" " " "
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level
Total Recovery in 5 min					

Date of test 1-13-93
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest _____ gal./min. with stem set at _____ ft. for _____ hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? Yes [ ] No [X]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
brown sand	0	1
basalt cobbles, silt	1	5
compacted gravel, cobbles + silt	5	18
basalt boulders, cobbles, silt	18	41
compacted gravel, silt	41	61
brown sand, silt	61	66
compacted gravel, silt, gray clay	66	88
gray clay	88	94
rusty black basalt med hard	94	109
rusty black basalt hard	109	117
grayish black basalt hard	117	201
sandy silty tan clay	201	209
gray clay firm	209	269
black basalt hard	269	285
broken black basalt med hard	285	292
broken black basalt porous	292	332

Work started 8-19, 19 92 Completed 1-13, 19 93

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME B+H Drilling #2 (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address Box 343 Burbank, WA.

(Signed) [signature] (WELL DRILLER) License No. 0065

Contractor's Registration No. BHDRI2X135NB Date 1-20, 19 93

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (10/87) -1329- 3

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

(6C3)

Start Card No. W091300

UNIQUE WELL I.D. # AEK 435

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

597168

WATER WELL REPORT

STATE OF WASHINGTON

Water Right Permit No.

(1) OWNER: Name Robert Loveall Address 5703 Collins Rd W Richland WA 99353

(2) LOCATION OF WELL: County Benton 1/4 NW 1/4 Sec 6 T. 9 N., R. 28 W.M.

(2a) STREET ADDRESS OF WELL (or nearest address) Same as above C, D, E, F

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater [ ] Industrial [ ] Test Well [ ] Municipal [ ] Other [ ]

(4) TYPE OF WORK: Owner's number of well (If more than one)
Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ]
Method: Dug [ ] Cable [ ] Rotary [X] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 8 x 6 inches.
Drilled 490 feet. Depth of completed well 490 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 8" Diam. from +1 ft. to 103 ft.
Welded [X] 6" Diam. from +1 ft. to 454½ ft.
Liner installed [X]
Threaded [ ] Diam. from ft. to ft.

Perforations: Yes [X] No [ ]
Type of perforator used Torch
SIZE of perforations 1/4 in. by 6 in.
perforations from ft. to ft.
80 perforations from 434 ft. to 454 ft.
perforations from ft. to ft.

Screens: Yes [ ] No [X]
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes [ ] No [X] Size of gravel
Gravel placed from ft. to ft.

Surface seal: Yes [X] No [ ] To what depth? 40 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes [ ] No [X]
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 235 ft. below top of well Date 11-30-98
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [ ] No [X] If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest 30 gal./min. with stem set at 250 ft. for 4 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes [ ] No [ ]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Sand Tan	0	2
Cobbles, gravel, sand Tan	2	21
Silt Tan Gravel	21	29
Gravel, sand Tan	29	65
Silt Tan	65	74
Clay Gray	74	91
Silt Tan	91	96
Clay Gray	96	98
Basalt Black	98	213
Basalt Brecia	213	224
Clay Blue	224	236
Clay Gray	236	249
Basalt Black	249	263
Basalt Brecia	263	265
Basalt Black	265	271
Clay Gray	271	280
Clay Blue	280	326
Basalt Black	326	332
Basalt Black Vesicular H2O source	332	337
Basalt Black	337	434
Basalt Black Some vesicular	434	453
Basalt Black	453	467
Basalt Black Vesicular H2O	467	480
Clay Blue	480	482
Clay Gray	482	490

Work Started 11-11 19 Completed 11-30 19 98

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Nelson Well Drilling Inc (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address 8200 W Argent Pasco

(Signed) [signature] (WELL DRILLER) License No. 361

Contractor's Registration No. NELSONWDC486CQ Date 11-30 19 98

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (206) 407-6600. The TDD number is (206) 407-6006.

ECY 050-1-20 (9/93)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

601

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original with Department of Ecology
Second Copy - Owner's Copy
Third Copy - Driller's Copy

101729

WATER WELL REPORT

STATE OF WASHINGTON

Notice of Intent W 136315
UNIQUE WELL I.D. # AFH-548
Water Right Permit No. AFH-548

(1) OWNER: Name Randy Powers Address P.O. Box 4285 W. Richland, WA 99353

(2) LOCATION OF WELL: County Benton NW 1/4 NW 1/4 Sec. 6 T. 9 N. R. 28 E WM

(2a) STREET ADDRESS OF WELL: (or nearest address) W. Williamette Heights W. Richland

TAX PARCEL NO.

D

(3) PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐ DeWater

(4) TYPE OF WORK: Owner's number of well (if more than one)
☒ New Well ☐ Deepened ☐ Reconditioned ☐ Decommission
Method: ☐ Dug ☐ Cable ☒ Rotary ☐ Bored ☐ Driven ☐ Jetted

(5) DIMENSIONS: Diameter of well 6 inches
Drilled 210 feet. Depth of completed well 210' ft.

(6) CONSTRUCTION DETAILS
Casing installed:
☒ Welded 6" Diam. from 12 ft. to 200' ft
☐ Liner installed " Diam from ft to ft.
☐ Threaded " Diam. from ft. to ft.

Perforations: ☐ Yes ☒ No
Type of perforator used
SIZE of perforations in. by in
perforations from ft to ft

Screens: ☐ Yes ☒ No ☐ K-Pac Location
Manufacturer's Name
Type Model No
Diam Slot Size from ft. to ft.
Diam. Slot Size from ft to ft.

Gravel/Filter packed: ☐ Yes ☒ No ☐ Size of gravel/sand
Material placed from ft to ft.

Surface seal: ☒ Yes ☐ No To what depth? 210' ft
Material used in seal Bentonite
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 135 ft. below top of well Date 5-14-01
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom?
Yield: gal./min with ft. drawdown after hrs
Yield: gal./min. with ft drawdown after hrs
Yield: gal./min. with ft. drawdown after hrs
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft drawdown after hrs.
Airtest 850 gal./min with — ft. drawdown after 1 hrs.
Artesian flow g.p.m Date
Temperature of water 56° Was a chemical analysis made? ☐ Yes ☒ No

(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION
Formation. Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. Indicate all water encountered.

MATERIAL	FROM	TO
Top Soil	0	6
Sand & Gravel	6	32
Light Brown Clay	32	79
Dark Brown clay	79	126
Dark Gray clay	126	189
Rusty clay & weathered Basalt	189	190
Porous Basalt with Yellow stringers of Hardpan (water)	190	210
Well was blowing air and gurgling when capped		

DEPT OF ECOLOGY Received SEP 17 2001 CENTRAL REGION OFFICE

RECEIVED SEP 13 2001 DEPARTMENT OF ECOLOGY WELL DRILLING UNIT

Work Started 5-11-01 Completed 5-14-01

WELL CONSTRUCTION CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Type or Print Name Lo Amos License No. 1224
(Licensed Driller/Engineer)
Trainee Name License No
Drilling Company Triple A Drilling Inc
(Signed) Lo O. Amos License No. 1224
(Licensed Driller/Engineer)
Address Benton City, WA. 99320
Contractor's Registration No. TRIPLOI025B9 Date 5-14, 01

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (360) 407-6600. The TDD number is (360) 407-6006

ECY 050-1-20 (11/98)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

2125 GD2

Start Card No. 6281

Water Right Permit No.

(1) OWNER: Name C.W. Flowers Address RT 4 P.O. Box 9805 W Richland

(2) LOCATION OF WELL: County Benton ___ ¼ ___ ¼ Sec. 6 T. 9 N., R. 28 E W.M.

(2a) STREET ADDDRESS OF WELL (or nearest address) Collins Rd Lot 44 Willamette Heights

(3) PROPOSED USE: ☒ Domestic ☐ Irrigation ☐ DeWater Industrial ☐ Test Well ☐ Municipal ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one)
Abandoned ☐ New well ☒ Deepened ☐ Reconditioned ☐
Method: Dug ☐ Cable ☐ Rotary ☒ Bored ☐ Driven ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 8" X 6" inches.
Drilled 316½ feet. Depth of completed well 316½ ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 8" Diam. from +8" ft. to 19'5" ft.
Welded ☒ 6" Diam. from +16" ft. to 316½" ft.
Liner installed ☐
Threaded ☐ " Diam. from ft. to ft.

Perforations: Yes ☒ No ☐
Type of perforator used Torch
SIZE of perforations ¼ in. by 6 in.
110 perforations from 292 ft. to 315 ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☐ No ☒
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☒ Size of gravel
Gravel placed from ft. to ft.

Surface seal: Yes ☒ No ☐ To what depth? 19'5" ft.
Material used in seal Cement Bentonite
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level
Static level 26' ft. below top of well Date 8-7-89
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☐ If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test

Bailer test gal./min. with ft. drawdown after hrs.
Airtest 20 gal./min. with stem set at 290 ft. for 2 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Sand Tan	0	1
Gravel Basalt sand Tan	1	13
Basalt Black	13	51
Basalt, Silt, Tan	51	54
Basalt Black	54	94
Silt Tan	94	102
Sand stone Tan	102	105
Clay Tan	105	120
Basalt Brechia	120	136
Basalt Black	136	144
Basalt Brechia	144	159
Basalt Black	159	286
Basalt Black Fractured Water Bearing	286	314
Basalt Gray	314	316½

RECEIVED AUG 28 1989 DEPARTMENT OF ECOLOGY CENTRAL REGION OFFICE

Work started 7-24, 19. Completed 8-7, 1989

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Nelson Well Drilling Inc (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address 10036 W Arbent Pasco
(Signed) James A Nelson (WELL DRILLER) License No. 361
Contractor's Registration No. NELSONWD148CQ Date 8-9, 1989

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (10/87) -1329- 3

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

(661)

WATER WELL REPORT
STATE OF WASHINGTON

Application No. .....
Permit No. G3-22513

(1) OWNER: Name William F. Brown Address RR#1, Box 317, Richland, Wa.

(2) LOCATION OF WELL: County Benton — SE ¼ NE ¼ Sec. 6 T. 9 N., R. 28 E W.M.

Bearing and distance from section or subdivision corner

PROPOSED USE: Domestic ☒ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) .....
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 6" inches.
Drilled 160 ft. Depth of completed well 160 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6" Diam. from 0 ft. to 130 ft.
Threaded ☐ ..." Diam. from ... ft. to ... ft.
Welded ☒ ..." Diam. from ... ft. to ... ft.

Perforations: Yes ☐ No ☒
Type of perforator used .....
SIZE of perforations ... in. by ... in.
... perforations from ... ft. to ... ft.
... perforations from ... ft. to ... ft.
... perforations from ... ft. to ... ft.

Screens: Yes ☐ No ☒
Manufacturer's Name .....
Type ..... Model No. .....
Diam. ... Slot size ... from ... ft. to ... ft.
Diam. ... Slot size ... from ... ft. to ... ft.

Gravel packed: Yes ☐ No ☒ Size of gravel: .....
Gravel placed from ... ft. to ... ft.

Surface seal: Yes ☒ No ☐ To what depth? 20 ft.
Material used in seal Puddling Clay
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? ... Depth of strata ...
Method of sealing strata off .....

(7) PUMP: Manufacturer's Name .....
Type: ..... H.P. .....

(8) WATER LEVELS: Land-surface elevation above mean sea level .... ft.
Static level 80 ft. below top of well Date .....
Artesian pressure ... lbs. per square inch Date .....
Artesian water is controlled by ..... (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☐ If yes, by whom? .....
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test .....
Bailer test ... gal./min. with ... ft. drawdown after ... hrs.
Artesian flow ... g.p.m. Date .....
Temperature of water ..... Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Sand and Gravel	0	128 ft
Basalt Black + Brown Broken	128	150 ft
Basalt - Water Bering	150	160 ft

RECEIVED NOV 26 1975 Department of Ecology Central Area

Work started 6-16-, 1973. Completed 6-23-, 1973

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME St. George Drilling Co. (Person, firm, or corporation) (Type or print)

Address 101 So. 45th Ave

[Signed] Thomas M. St. George (Well Driller)

License No. 0484 Date 3-13-, 1974

(USE ADDITIONAL SHEETS IF NECESSARY)

OK Cenc 12/1/73

S. F. No. 7356—OS—(Rev. 4-71).

6H1

WATER WELL REPORT

DEPARTMENT OF ECOLOGY State of Washington

Original & 1st copy - Ecology, 2nd copy - owner, 3rd copy - driller

RECEIVED JUL 3 2017 Dept of Ecology Central Regional Office

Construction/Decommission ("x" in circle)

[X] Construction

[ ] Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

PROPOSED USE: [X] Domestic [ ] Industrial [ ] Municipal [ ] DeWater [ ] Irrigation [ ] Test Well [ ] Other _____

TYPE OF WORK: Owner's number of well (if more than one) _____

[X] New well [ ] Reconditioned *Method:* [ ] Dug [ ] Bored [ ] Driven [ ] Deepened [ ] Cable [X] Rotary [ ] Jetted

DIMENSIONS: Diameter of well _____ inches, drilled _____ ft. Depth of completed well _____ ft.

CONSTRUCTION DETAILS

Casing Installed: [X] Welded 6 " Diam. from 0 ft. to 110 ft.

[ ] Liner installed _____ " Diam. from _____ ft. to _____ ft.

[ ] Threaded _____ " Diam. From _____ ft. to _____ ft.

Perforations: [ ] Yes [X] No

Type of perforator used _____

SIZE of perfs _____ in. by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.

Screens: [ ] Yes [X] No [ ] K-Pac Location _____

Manufacturer's Name _____

Type _____ Model No. _____

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: [ ] Yes [X] No Size of gravel/sand _____

Materials placed from _____ ft. to _____ ft.

Surface Seal: [X] Yes [ ] No To what depth? 20+ ft.

Material used in seal Bentonite

Did any strata contain unusable water? [ ] Yes [X] No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.

Static level 64 ft. below top of well Date _____

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? [ ] Yes [X] No If yes, by whom? _____

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer Test _____ gal./min. with _____ ft. drawdown after _____ hrs.

Airtest 40 gal./min. with stem set at _____ ft. for 4 hrs.

Artesian flow _____ g.p.m. Date _____

Temperature of water _____ Was a chemical analysis made? [ ] Yes [X] No

CURRENT

Notice of Intent No. WE25704

Unique Ecology Well ID Tag No. BJG-513

Water Right Permit No. _____

Property Owner Name Ricky Hamilton

Well Street Address 415 Bombing Range Rd

City West Richland County Benton

Location NE 1/4-1/4 NE 1/4 Sec 6 Twn 9 R 28 EWM [X] Or WWM [ ] Check One

(s, t, r Still REQUIRED)

Lat/Long Lat Deg _____ Lat Min/Sec _____

Long Deg _____ Long Min/Sec _____

Tax Parcel No. (Required) 106981020062000

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Top Soil, Brown	0	2
Silty Soil, Tan	2	23
Soil, Brown	23	35
Clay, Brown	35	46
Clay, Gray	46	62
Clay & Basalt	62	95
Fractured Basalt	95	109
Medium Basalt	110	

Start Date 10/17/2016 Completed Date 10/22/2016

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

[X] Driller [ ] Engineer [ ] Trainee Name (Print) Todd Haney

Driller/Engineer/Trainee Signature _____

Driller or trainee License No. 2343

IF TRAINEE: Driller's License No: _____

Driller's Signature: Todd Haney

Drilling Company Statewide Well Drilling Inc.

Address 6816 Road. 76 North

City, State, Zip Pasco , Wa , 99301

Contractor's Registration No. STATEWDO15LZ Date 5-21-2017

ECY 050-1-20 (Rev 06/08) If you need this document in an alternate format, please call the Water Resources Program at 360-407-6600. Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call 877-833-6341.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

(6I1)

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

Construction/Decommission *("x" in circle)* 185458

☒ Construction

☐ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

CURRENT Notice of Intent No. W 160935

Unique Ecology Well ID Tag No. AKH939

Water Right Permit No. _____

Property Owner Name Tracey Smith

Well Street Address 851 Bombing Range RD

City West Richland County Benton

Location NW 1/4-1/4 NE 1/4 Sec 6" Twn 9N R 28e EWM ☐ or WWM ☑ circle one

Lat/Long (s, t, r Still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No. 1-0698-402-0128-000

PROPOSED USE: ☑ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) _____

☑ New well ☐ Reconditioned ☐ Deepened

Method: ☐ Dug ☐ Bored ☐ Driven ☐ Cable ☑ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 6" inches, drilled 282 ft.

Depth of completed well 282 ft.

CONSTRUCTION DETAILS

Casing Installed: ☑ Welded 6" Diam. from +1 ft. to 138 ft.

☐ Liner installed " Diam. from ft. to ft.

☐ Threaded " Diam. from ft. to ft.

Perforations: ☐ Yes ☑ No

Type of perforator used _____

SIZE of perfs in. by in. and no. of perfs from ft. to ft.

Screens: ☐ Yes ☑ No ☐ K-Pac Location _____

Manufacturer's Name _____

Type _____ Model No. _____

Diam. Slot size from ft. to ft.

Diam. Slot size from ft. to ft.

Gravel/Filter packed: ☐ Yes ☑ No ☐ Size of gravel/sand _____

Materials placed from ft. to ft.

Surface Seal: ☑ Yes ☐ No To what depth? 20 ft.

Material used in seal bentonite

Did any strata contain unusable water? ☐ Yes ☑ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.

Static level 100 ft. below top of well Date 7-27-05

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☑ No If yes, by whom? _____

Yield: gal./min. with ft. drawdown after hrs.

Yield: gal./min. with ft. drawdown after hrs.

Yield: gal./min. with ft. drawdown after hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer test gal./min. with ft. drawdown after hrs.

Airtest 50 gal./min. with stem set at 240 ft. for 3 hrs.

Artesian flow _____ g.p.m. Date _____

Temperature of water _____ Was a chemical analysis made? ☑ Yes ☐ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
topsoil+ sand + gravel	0	30
tan sand + clay + sandstone	30	50
gray sand + meduim gravel	50	70
course gravel + fine gravel	70	80
gravel + trace H2O	80	90
Tan Clay + Sand	90	103
Gray clay	103	135
Black basalt hard	135	140
Red soft basalt	140	150
basalt shalt stone black and tan	150	158
hard gray basalt	158	238
soft basalt +brown claystone + H2O	238	250
blue shale + sand stone + H2O	250	275
soft basalt + H2O	275	282
3 ppm nitrates on site test		

Start Date 7-26-05 Completed Date 7-27-05

DEPT. OF ECOLOGY FISCAL & BUDGET MGT. NOV 10 P 8:34

RECEIVED NOV 10 2005 Water Resources Program Department of Ecology

DEPT OF ECOLOGY Received NOV 16 2005 CENTRAL REGION OFFICE

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☐ Driller ☐ Engineer ☐ Trainee Name (Print) Thomas St. George

Driller/Engineer/Trainee Signature _____

Driller or trainee License No. 2781

Drilling Company St. George Well Drilling Co.

Address 701 S 45th Ave.

City, State, Zip West Richland, Wa, 99353

Contractor's Registration No. stgeogw954k4 Date 7-27-05

If TRAINEE,

Driller's Licensed No. _____

Driller's Signature _____

Ecology is an Equal Opportunity Employer.

ECY 050-1-20 (Rev 3/05)

The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.

The Dep The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

(6I2) p.1 of 2

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No. C
Permit No.

(1) OWNER: Name FRANK PANISKO Address 1428 Steven's Drive Richland WA

(2) LOCATION OF WELL: County Benton — NE¼ SW¼ ¼ Sec. 6 T. 9 N., R. 28 E.W.M. L

Bearing and distance from section or subdivision corner Lot 154 Willamette Heights

(3) PROPOSED USE: Domestic [X] Industrial [ ] Municipal [ ]
Irrigation [X] Test Well [ ] Other [ ]

(4) TYPE OF WORK: Owner's number of well (if more than one)
New well [X] Method: Dug [ ] Bored [ ]
Deepened [ ] Cable [ ] Driven [ ]
Reconditioned [ ] Rotary [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6" inches.
Drilled 300 ft. Depth of completed well 300' ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6" Diam. from 0 ft. to 183 ft.
Threaded [ ] " Diam. from ft. to ft.
Welded [X] " Diam. from ft. to ft.

Perforations: Yes [ ] No [X]
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes [ ] No [X]
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes [ ] No [X] Size of gravel:
Gravel placed from ft. to ft.

Surface seal: Yes [X] No [ ] To what depth? 20 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes [ ] No [X]
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 180 ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [ ] No [X] If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes [ ] No [X]
OK MAB

(10) WELL LOG:
Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Sand & silt	0	3
Lt Brown clay	3	183
Small gravel		
Broken Basalt (3 gpm)	183	185
Basalt	185	280
Fractured Basalt	280	295
Blue green claystone	295	300

RECEIVED
NOV 8 1974
DEPARTMENT OF ECOLOGY
SPOKANE REGIONAL OFFICE

RECEIVED
NOV 12 1974
DEPARTMENT OF ECOLOGY
CENTRAL REGIONAL OFFICE

Work started 9/17/74, 19 Completed 9/16, 1974

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

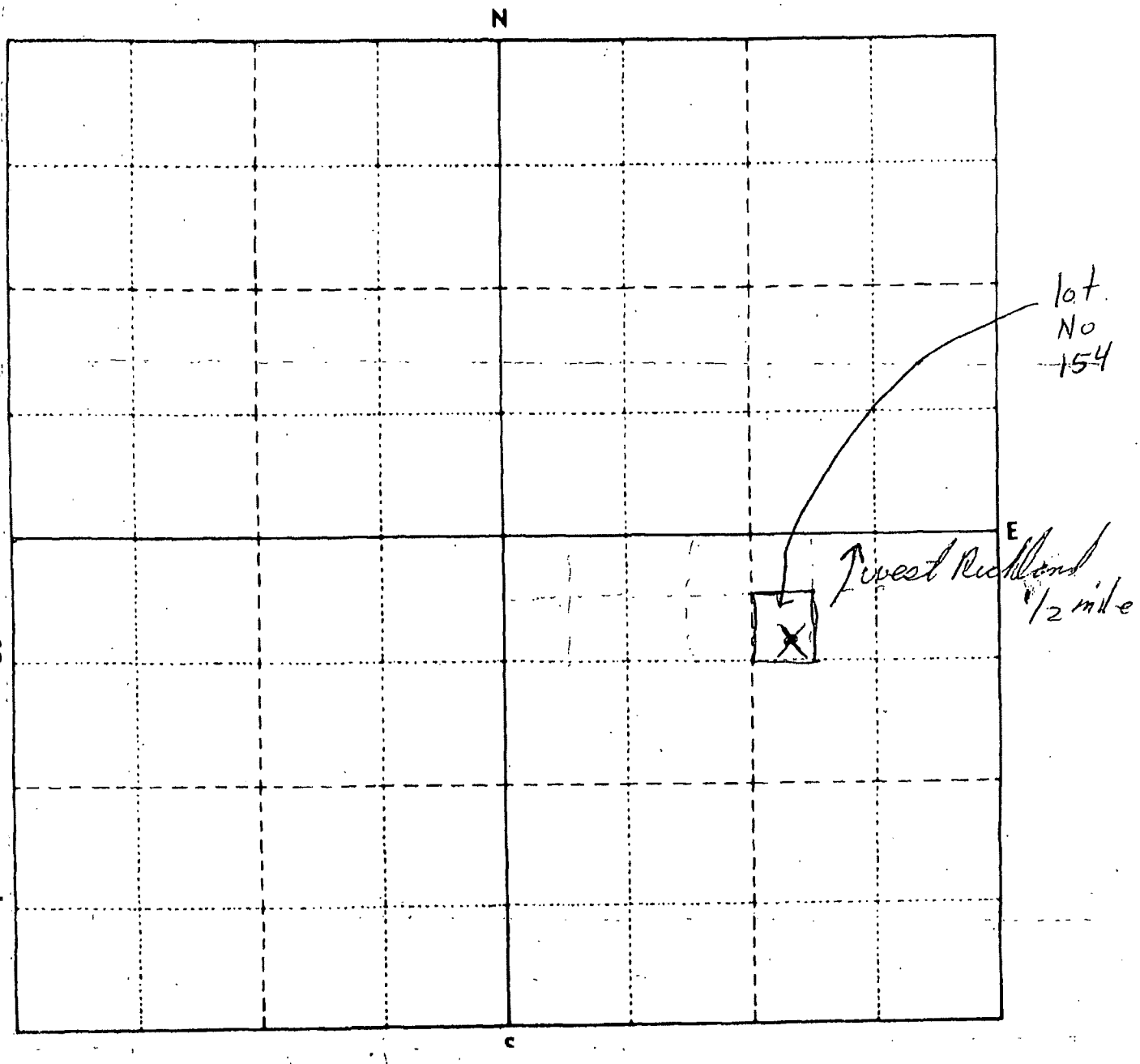
NAME Hatch Drilling Co Inc (Person, firm, or corporation) (Type or print)
Address Po Box 741 Richland
[Signed] (Well Driller)
License No. 0036 Date 9/25, 1974

(USE ADDITIONAL SHEETS IF NECESSARY)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

6I2 p. 2 of 2

Sec. 6 Twp. T 9N N. R. 28E



6I3

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

DEPARTMENT OF ECOLOGY State of Washington

Construction/Decommission *("x" in circle)*

☒ Construction

☐ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) _____

☒ New well ☐ Reconditioned *Method:* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 8 inches, drilled 360 ft. Depth of completed well 356 ft.

CONSTRUCTION DETAILS

Casing Installed: ☒ Welded 8" Diam. from +1½ ft. to 191 ft.

☒ Liner installed 6" Diam. from 156 ft. to 356 ft.

☐ Threaded. _____" Diam. From _____ ft. to _____ ft.

Perforations: ☒ Yes ☐ No

Type of perforator used SAW

SIZE of perfs ⅛ in. by 6 in. and no. of perfs 90 from 335 ft. to 355 ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location _____

Manufacturer's Name _____

Type _____ Model No. _____

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: ☐ Yes ☒ No Size of gravel/sand _____

Materials placed from _____ ft. to _____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 20 ft.

Material used in seal Bentonite

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.

Static level 218 ft. below top of well Date 8-12-16

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☒ No If yes, by whom? _____

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.

Airtest 50 gal./min. with stem set at 340 ft. for 2 hrs.

Artesian flow _____ g.p.m. Date _____

Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

DEPT OF ECOLOGY Received AUG 18 2016 ORIGINAL

CURRENT

Notice of Intent No. WE-24944

Unique Ecology Well ID Tag No. BIF-939

Water Right Permit No. —

Property Owner Name Joseph Mugo

Well Street Address Laurel Dr.

City W. Richland County Benton

Location NE 1/4-1/4 SE 1/4 Sec 6 Twn 9 R 28 EWM ☒ Or WWM ☐

(s, t, r Still REQUIRED)

Lat/Long Lat Deg _____ Lat Min/Sec _____

Long Deg _____ Long Min/Sec _____

Tax Parcel No. (Required) 106984020189003

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Tan Sand + Gravel	0	20
Brown Sand	20	26
Tan Clay	26	40
Brown Sandstone	40	80
Grey Clay	80	86
Brown Sandstone + Clay	86	126
Gravel + Tan Silt	126	146
Grey Clay	146	189
Black Basalt	189	215
Red Basalt	215	222
Black Basalt	222	298
Grey Clay	298	333
Green Clay	333	337
Black Porus Basalt - H_2O -	338	360

Start Date 8-8-16 Completed Date 8-12-16

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) Josh Burns

Driller/Engineer/Trainee Signature [signature]

Driller or trainee License No. 2846

IF TRAINEE: Driller's License No:

Driller's Signature:

Drilling Company Nelson Drilling LLC

Address 600 W. Vineyard Dr.

City, State, Zip Pasco, Wa. 99301

Contractor's Registration No. NELSODL895W9 Date 8-12-16

ECY 050-1-20 (Rev 02/10) *If you need this document in an alternate format, please call the Water Resources Program at 360-407-6872. Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call 877-833-6341.*

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report

119391

WATER WELL REPORT

ECOLOGY Original & 1st copy Ecology 2nd copy owner 3rd copy driller

Construction/Decommission (x in circle)
- [x] Construction
- [ ] Decommission *ORIGINAL CONSTRUCTION Notice of Intent Number* _____

PROPOSED USE [x] Domestic [ ] Industrial [ ] Municipal [ ] DeWater [ ] Irrigation [ ] Test Well [ ] Other _____

TYPE OF WORK Owner s number of well (if more than one) _____
[x] New Well [ ] Reconditioned *Method* [ ] Dug [ ] Bored [ ] Driven [ ] Deepened [ ] Cable [x] Rotary [ ] Jetted

DIMENSIONS Diameter of well 6 inches drilled 228 ft
Depth of completed well 225 ft

CONSTRUCTION DETAILS
Casing Installed [x] Welded 6 Diam from +1 ft to 209 ft
[ ] Liner installed _____ Diam from _____ ft to _____ ft
[ ] Threaded _____ Diam from _____ ft to _____ ft

Perforations [ ] Yes [x] No
Type of perforator used _____
SIZE of perfs _____ in by _____ in and no of perfs _____ from _____ ft to _____ ft

Screens [ ] Yes [x] No [ ] K Pac Location _____
Manufacturer's Name _____
Type _____ Model No _____
Diam _____ Slot Size _____ from _____ ft to _____ ft
Diam _____ Slot Size _____ from _____ ft to _____ ft

Gravel/Filter packed [ ] Yes [x] No [ ] Size of gravel/sand _____
Materials placed from _____ ft to _____ ft

Surface Seal [x] Yes [ ] No To what depth? 20 ft
Materials used in seal Bentonite
Did any strata contain unusable water? [ ] Yes [x] No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

PUMP Manufacturer s Name _____
Type _____ H P _____

WATER LEVELS Land surface elevation above mean sea level _____ ft
Static level 155 ft below top of well Date 5-2-02
Artesian pressure _____ lbs per square inch Date _____
Artesian water is controlled by _____ (cap valve etc)

WELL TESTS Drawdown is amount water level is lowered below static level
Was a pump test made? [ ] Yes [x] No If yes by whom? _____
Yield _____ gal./min with _____ ft-drawdown after _____ hrs
Yield _____ gal./min with _____ ft drawdown after _____ hrs
Yield _____ gal./min with _____ ft drawdown after _____ hrs
Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min with _____ ft drawdown after _____ hrs
Airtest 30 gal./min with stem set at 200 ft for 2 hrs
Artesian flow _____ g p m Date _____
Temperature of water _____ Was a chemical analysis made? [ ] Yes [ ] No

CURRENT
Notice of Intent No (W) 148999
Unique Ecology Well ID Tag No AGM 148
Water Right Permit No _____
Property Owner Name Brett + Tracy Mooney
Well Street Address Trailton
City (W) Richland County Benton
Location _____ 1/4 1/4 SW 1/4 Sec 6 Twn 9N R 28 (EWM) or WWM circle one
Lat/Long (s,t r still REQUIRED) Lat Deg _____ Lat Min/Sec _____
Long Deg _____ Long Min/Sec _____ M, N, P
Tax Parcel No 1-0698-302-0039-000

CONSTRUCTION OR DECOMMISSION PROCEDURE
Formation Describe by color character size of material and structure and the kind and nature of the material in each stratum penetrated with at least one entry for each change of information Indicate all water encountered (USE ADDITIONAL SHEETS IF NECESSARY)

MATERIAL	FROM	TO
Sand Tan	0	1
Gravel sand Tan	1	36
Silt Tan	36	132
Gravel, sand Tan	132	165
Silt Tan	165	169
Silt Gray	169	198
Silt Tan	198	203
Basalt Blk Discular	203	
Water Bearing		216
Basalt Brecha	216	
Caving		228

DEPT OF ECOLOGY Received JUL 03 2002 CENTRAL REGION OFFICE

Start Date 5-1-02 Completed Date 5-2-02

WELL CONSTRUCTION CERTIFICATION I constructed and/or accept responsibility for construction of this well and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

[x] Driller [ ] Engineer [ ] Trainee Name (Print) Jim Nelson
Driller/Engineer/Trainee Signature [signature]
Driller or Trainee License No [illegible]
Drilling Company Nelson Well Drilling Inc
Address 8203 W Argent Pa
City State Zip Pasco Wa 99301
Contractor s Registration No NELSOWD198CQ Date 5-4-02

If trainee, licensed driller s _____
Signature and License no _____

Ecology is an Equal Opportunity Employer ECY 050 1 20 (Rev 4/01)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

(642)

File Original with Department of Ecology
Second Copy - Owner's Copy
Third Copy - Driller's Copy

99388

WATER WELL REPORT

STATE OF WASHINGTON

Notice of Intent W 136319
UNIQUE WELL I D # AGB 158
Water Right Permit No

(1) OWNER Name Steve VerSteeg Address 1045 S 58th

(2) LOCATION OF WELL County Benton NW 1/4 SW 1/4 Sec 6 T 9 N R 28 E WM

(2a) STREET ADDRESS OF WELL (or nearest address) Willamette Heights, W. Richland, Wa

TAX PARCEL NO 1-0698-302-0170-000 Lot 170

M

(3) PROPOSED USE ☒ Domestic ☐ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐ DeWater

(4) TYPE OF WORK Owner's number of well (if more than one)
☒ New Well ☐ Deepened ☐ Reconditioned ☐ Decommission
Method ☐ Dug ☐ Cable ☒ Rotary ☐ Bored ☐ Driven ☐ Jetted

(5) DIMENSIONS Diameter of well 6 inches
Drilled 215 feet Depth of completed well 215 ft

(6) CONSTRUCTION DETAILS
Casing Installed
☒ Welded 6" Diam from +2 ft to 202 ft
☐ Liner installed " Diam from ft to ft
☐ Threaded " Diam from ft to ft

Perforations ☐ Yes ☒ No
Type of perforator used
SIZE of perforations in by in
perforations from ft to ft

Screens ☐ Yes ☒ No ☐ K-Pac Location
Manufacturer's Name
Type Model No
Diam Slot Size from ft to ft
Diam Slot Size from ft to ft

Gravel/Filter packed ☐ Yes ☒ No ☐ Size of gravel/sand
Material placed from ft to ft

Surface seal ☒ Yes ☐ No To what depth? 20 ft
Material used in seal Bentonite
Did any strata contain unusable water? ☐ Yes ☐ No
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP Manufacturer's Name
Type H P

(8) WATER LEVELS Land-surface elevation above mean sea level ft
Static level 153 ft below top of well Date 6-19-01
Artesian pressure lbs per square inch Date
Artesian water is controlled by (Cap, valve, etc)

(9) WELL TESTS Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom?
Yield gal /min with ft drawdown after hrs
Yield gal /min with ft drawdown after hrs
Yield gal./min with ft drawdown after hrs
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min with ft drawdown after hrs
Airtest BT. 30 gal./min with — ft drawdown after 1 hrs
Artesian flow g p m Date
Temperature of water 57° Was a chemical analysis made? ☐ Yes ☒ No

(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION
Formation Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information Indicate all water encountered

MATERIAL	FROM	TO
Top Soil	0	1
Sand + Gravel	1	41
Light Brown Clay	41	70
Sandstone (Brown)	70	126
Brown Clay	126	143
Cemented Sand + Gravel	143	165
Dark Gray Clay	165	196
Brown Clay	196	201
weathered Basalt (water)	201	215

RECEIVED
AUG 1 4 2001
DEPARTMENT OF ECOLOGY
WELL DRILLING UNIT

DEPT. OF ECOLOGY Received AUG 17 2001 CENTRAL REGION OFFICE

Work Started 6-19-01 Completed 6-19-01

WELL CONSTRUCTION CERTIFICATION

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

Type or Print Name Lo Amos License No 1224
(Licensed Driller/Engineer)

Trainee Name License No
Drilling Company Triple A Drilling
(Signed) Lo Amos License No 1224
(Licensed Driller/Engineer)
Address Benton City, WA 99320
Contractor's Registration No TRIPLDI025BB Date 6-19-01

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer For special accommodation needs, contact the Water Resources Program at (360) 407-6600 The TDD number is (360) 407-6006

ECY 050-1-20 (11/98)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

The Dep. The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

6119 (6M1)

Start Card No. 083674

Water Right Permit No. N

(1) OWNER: Name David H. Steffen Address 2037 Rainier Ave. Richland, WA

(2) LOCATION OF WELL: County Benton SE 1/4, SW 1/4 SW ¼ SW ¼ Sec. 6 T. 9 N., R. 28 W.M.

(2a) STREET ADDDRESS OF WELL (or nearest address)

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater Industrial [ ] Test Well [ ] Municipal [ ] Other [ ]

(4) TYPE OF WORK: Owner's number of well (if more than one)
Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ]
Method: Dug [ ] Cable [ ] Rotary [X] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 10" 6" inches.
Drilled 343 feet. Depth of completed well 343 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6" Diam. from +2' ft. to 188 ft.
Welded [X] 4" Diam from 163 ft to 343 ft
Liner installed [X]
Threaded [ ] ' Diam. from ft. to ft.

Perforations: Yes [X] No [ ]
Type of perforator used Skill saw
SIZE of perforations 6" long in. by 1/8" wide in.
111 perforations from -323 ft. to 343 ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes [ ] No [X]
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes [ ] No [X] Size of gravel
Gravel placed from ft. to ft.

Surface seal: Yes [X] No [ ] To what depth? 20+ ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes [ ] No [ ]
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 258 ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [ ] No [X] If yes, by whom?
Yield: 33-35 gal./min. with ft. drawdown after hrs.
" Approx. air lift 33 to 35 GPM "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest gal./min. with stem set at ft. for hrs.
Artesian flow g.p.m Date
Temperature of water Was a chemical analysis made? Yes [ ] No [ ]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information

MATERIAL	FROM	TO
Sandy soil brown soft	0	2
Caliche gravel cobbles med. hard	2	4
Sand gravel hard	4	26
Tan clay gravel medium hard	26	28
Clay green medium	28	46
Clay shale gray medium	46	74
Sandstone brown medium	74	88
Clay stone brown tan medium	88	114
Caliche gravel medium hard	114	133
Cemented gravel red/brown sand medium hard	133	150
Clay brown medium	150	156
Silt stone gray medium	156	186
Pouris basalt black hard	186	190
Basalt black hard	190	206
Burnt basalt red/brown medium	206	212
Basalt black hard	212	217
Basalt gray very hard	217	287
Fractured basalt blue shale med.	287	294
Sandstone green white gray soft-medium	294	303
Sandstone blue green soft	303	326 tra
Pouris burnt basalt red/black med.	326	343 wate
FEB 28 1992		
6" Drive shoe utilized		

Work started 2-10-92, 19. Completed 2-14, 1992

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Ponderosa Drilling & Development, Inc. (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address E. 6010 Broadway Spokane, WA 99212

(Signed) Steve Mills (WELL DRILLER) (Steve Mills) License No. 1335

Contractor's Registration No. PO-ND-EI*248JE Date 2-19, 1992

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 060-1-20 (10-87) 1329-

6N1

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No 64-24076
Permit No 64-24076P

(1) OWNER Name E.O Kraus Address Rt 1 Box 216 W Richland Wa 99352

(2) LOCATION OF WELL. County Benton SE¼ SW¼ SW¼ SE¼ Sec 9 T 9 N R 28 E WM
Bearing and distance from section or subdivision corner Lot 231 Willamette Hts

(3) PROPOSED USE Domestic ☒ Industrial ☐ Municipal ☐ Irrigation ☒ Test Well ☐ Other ☐

(4) TYPE OF WORK Owner's number of well (if more than one) 1
New well ☒ Method Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☒ Jetted ☐

(5) DIMENSIONS Diameter of well 8 inches.
Drilled 325 ft. Depth of completed well 325 ft.

(6) CONSTRUCTION DETAILS
Casing installed. 8 Diam from 0 ft to 220 ft
Threaded ☒ Diam from ft. to ft.
Welded ☐ Diam from ft. to ft.

Perforations Yes ☐ No ☒
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens. Yes ☐ No ☒
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed. Yes ☐ No ☒ Size of gravel
Gravel placed from ft. to ft.

Surface seal Yes ☒ No ☐ To what depth? 40 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP Manufacturer's Name Pulsometer
Type HP 10

(8) WATER LEVELS Land-surface elevation above mean sea level ft.
Static level 22.1 ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS Drawdown is amount water level is lowered below static level
Was pump test made? Yes ☐ No ☐ If yes by whom?
Yield gal./min with ft drawdown after hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min with ft drawdown after hr.
Artesian flow g.p.m. Date
Temperature of water Was chemical analysis made? Yes ☐ No ☐

(10) WELL LOG
Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Top Soil	0	2
Gravel, Sm Cobbles	2	40
Clay	40	78
Clay With Gravel	78	148
Sand Fine	148	168
Clay Blue	168	210
Broken Basalt	210	220
Basalt Hard, Gray	220	285
" " Broken Red	285	290
Sa Sand with Gravel	290	325
water at 295.10 GPM		
" " 290 200 GPM		

RECEIVED
AUG 24 1976
DEPARTMENT OF ECOLOGY
CENTRAL REGIONAL OFFICE

Work started 19 Completed 19

WELL DRILLER'S STATEMENT
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief

NAME St George Drilling Co (Person, firm, or corporation) (Type or print)
Address 701 S 04th W Richland W
[Signed] (Well Driller)
License No 0482 Date 19

(USE ADDITIONAL SHEETS IF NECESSARY)

F N 7316—OS—(Rev 71)
Y 070 28

(601)

WATER WELL REPORT

DEPARTMENT OF ECOLOGY State of Washington

Original & 1st copy - Ecology, 2nd copy - owner, 3rd copy - driller

RECEIVED JAN 26 2018 Dept of Ecology Central Regional Office

Construction/Decommission ("x" in circle)

[x] Construction

[ ] Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

PROPOSED USE: [x] Domestic [ ] Industrial [ ] Municipal [ ] DeWater [ ] Irrigation [ ] Test Well [ ] Other _____

TYPE OF WORK: Owner's number of well (if more than one) _____

[x] New well [ ] Reconditioned *Method:* [ ] Dug [ ] Bored [ ] Driven [ ] Deepened [ ] Cable [x] Rotary [ ] Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 215 ft.

Depth of completed well 215 ft.

CONSTRUCTION DETAILS

Casing Installed: [x] Welded 6 " Diam. from 0 ft. to 215 ft.

[ ] Liner installed _____ " Diam. from _____ ft. to _____ ft.

[ ] Threaded _____ " Diam. From _____ ft. to _____ ft.

Perforations: [ ] Yes [x] No

Type of perforator used _____

SIZE of perfs _____ in. by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.

Screens: [ ] Yes [x] No [ ] K-Pac Location _____

Manufacturer's Name _____

Type _____ Model No. _____

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: [ ] Yes [x] No Size of gravel/sand _____

Materials placed from _____ ft. to _____ ft.

Surface Seal: [x] Yes [ ] No To what depth? 20+ ft.

Material used in seal Bentonite

Did any strata contain unusable water? [ ] Yes [x] No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.

Static level 135 ft. below top of well Date 08/23/2017

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? [ ] Yes [x] No If yes, by whom? _____

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer Test _____ gal./min. with _____ ft. drawdown after _____ hrs.

Airtest 40 gal./min. with stem set at _____ ft. for 4 hrs.

Artesian flow _____ g.p.m. Date _____

Temperature of water _____ Was a chemical analysis made? [ ] Yes [x] No

CURRENT

Notice of Intent No. WE28472

Unique Ecology Well ID Tag No. BJG-527

Water Right Permit No. _____

Property Owner Name Mike & Tallia Lewis

Well Street Address Laurel & 54th

City W. Richland County Benton

Location NW 1/4-1/4 NE 1/4 Sec 6 Twn 9N R 28E EWM [x] Or WWM [ ] Check One

(s, t, r Still REQUIRED)

Lat/Long Lat Deg _____ Lat Min/Sec _____

Long Deg _____ Long Min/Sec _____

Tax Parcel No. (Required) 106983020167000

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Sand & Topsoil, Brown	0	4
Sand & Gravel	4	18
Clay & Gravel	18	67
Clay, Brown	67	138
Basalt & Gravel	138	163
Clay, Gray	163	198
Porous Basalt, Red & Black	198	215
Basalt, Black	215	

Start Date 08/18/2017 Completed Date 08/23/2017

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

[x] Driller [ ] Engineer [ ] Trainee Name (Print) Todd Haney

Driller/Engineer/Trainee Signature _____

Driller or trainee License No. 2343

IF TRAINEE: Driller's License No: _____

Driller's Signature: Todd Haney

Drilling Company Statewide Well Drilling Inc.

Address 6816 Road. 76 North

City, State, Zip Pasco , Wa , 99301

Contractor's Registration No. STATEWDO15LZ Date 3-30-2019

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report

Ken

6P1

WATER WELL REPORT

ECOLOGY Original & 1st copy Ecology 2nd copy owner 3rd copy driller

Construction/Decommission (x in circle)
- (X) Construction 126760
- ( ) Decommission *ORIGINAL CONSTRUCTION Notice of Intent Number* _____

CURRENT
Notice of Intent No W 160724

Unique Ecology Well ID Tag No AGM-579 (A)

Water Right Permit No _____

DEPT OF ECOLOGY Received NOV 25 2002 CENTRAL REGION OFFICE

Property Owner Name Hedge cuck

Well Street Address 516 CASCADE

City Richland County Benton

Location NE 1/4- 1/4 NE 1/4 Sec 6 Twn 9 R 28 EWM or WWM *circle one*

Lat/Long (s t r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No 1-0695 402 0193-000

PROPOSED USE (X) Domestic ( ) Industrial ( ) Municipal ( ) DeWater ( ) Irrigation ( ) Test Well ( ) Other _____

TYPE OF WORK Owner's number of well (if more than one) _____
(X) New Well ( ) Reconditioned *Method* ( ) Dug ( ) Bored ( ) Driven ( ) Deepened ( ) Cable (X) Rotary ( ) Jetted

DIMENSIONS Diameter of well 6 inches drilled 225 ft
Depth of completed well 225 ft

CONSTRUCTION DETAILS
Casing Installed (X) Welded 6 Diam from +1 ft to 200 ft
( ) Liner installed _____ Diam from _____ ft to _____ ft
( ) Threaded _____ Diam from _____ ft to _____ ft

Perforations ( ) Yes (X) No
Type of perforator used _____
SIZE of perfs _____ in by _____ in and no of perfs _____ from _____ ft to _____ ft

Screens ( ) Yes (X) No ( ) K Pac Location _____
Manufacturer's Name _____
Type _____ Model No _____
Diam _____ Slot Size _____ from _____ ft to _____ ft
Diam _____ Slot Size _____ from _____ ft to _____ ft

Gravel/Filter packed ( ) Yes (X) No ( ) Size of gravel/sand _____
Materials placed from _____ ft to _____ ft

Surface Seal (X) Yes ( ) No To what depth? 30 ft
Materials used in seal Bentonite
Did any strata contain unusable water? ( ) Yes ( ) No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

PUMP Manufacturer's Name _____
Type _____ H P _____

WATER LEVELS Land surface elevation above mean sea level _____ ft
Static level 134 ft below top of well Date _____
Artesian pressure _____ lbs per square inch Date _____
Artesian water is controlled by _____ (cap valve etc)

WELL TESTS Drawdown is amount water level is lowered below static level
Was a pump test made? ( ) Yes (X) No If yes by whom? _____
Yield _____ gal /min with _____ ft drawdown after _____ hrs
Yield _____ gal /min with _____ ft drawdown after _____ hrs
Yield _____ gal /min with _____ ft drawdown after _____ hrs
Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min with _____ ft drawdown after _____ hrs
Airtest 120 gal /min with stem set at 220 ft for 2 hrs
Artesian flow _____ g p m Date _____
Temperature of water _____ Was a chemical analysis made? ( ) Yes ( ) No

CONSTRUCTION OR DECOMMISSION PROCEDURE
Formation Describe by color character size of material and structure and the kind and nature of the material in each stratum penetrated with at least one entry for each change of information Indicate all water encountered (USE ADDITIONAL SHEETS IF NECESSARY)

MATERIAL	FROM	TO
Brown Sand	0	3
Cemented Gravel	3	7
Brown Sand Gravel	7	55
Brown clay	35	135
Brown clay Gravel	135	143
Gray clay	143	200
Tan clay + Brown Basalt	200	206
Brown course Basalt Bearing Water Apx 120 Gpm	206	225

Start Date 11/14/02 Completed Date 11/15/02

WELL CONSTRUCTION CERTIFICATION I constructed and/or accept responsibility for construction of this well and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

(X) Driller ( ) Engineer ( ) Trainee Name (Print) Peter E St George Drilling Company St George Drilling

Driller/Engineer/Trainee Signature Peter E St George Address 701 S 45 AVE

Driller or Trainee License No 6483 City State Zip W. Richland Wa. 99353

Contractor s Registration No. 601048-215 Date 11/15/02

If trainee, licensed driller s Signature and License no _____

Ecology is an Equal Opportunity Employer ECY 050 1 20 (Rev 4/01)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

(6P2)

WATER WELL REPORT

ECOLOGY Original & 1st copy Ecology 2nd copy owner 3rd copy driller

Construction/Decommission (x in circle)
- ☑ Construction 149140
- ○ Decommission *ORIGINAL CONSTRUCTION Notice of Intent Number* _____

CURRENT Notice of Intent No W-171095

Unique Ecology Well ID Tag No AKH-849

Water Right Permit No _____

Property Owner Name Paul & Kerry Wood K

Well Street Address 4601 Norma ST.

City W Rich County Benton

Location NW 1/4 1/4 SE 1/4 Sec 6 Twn 9 R 28 (EWM) circle one or WWM

Lat/Long (s t r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No _____

PROPOSED USE ☑ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK Owner s number of well (if more than one) _____
☑ New Well ☐ Reconditioned *Method* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☑ Rotary ☐ Jetted

DIMENSIONS Diameter of well 8 1/2 inches drilled 380 ft
Depth of completed well 380 ft

CONSTRUCTION DETAILS
Casing Installed ☑ Welded 8 Diam from 0 ft to 40 ft
☐ Liner installed 6 Diam from 0 ft to 200 ft
☐ Threaded 4 1/2" Diam from 60 ft to 380 ft

Perforations ☑ Yes ☐ No
Type of perforator used 1/2" Drill
SIZE of perfs 1/2 in by 1/2 in and no of perfs 120 from 340 ft to 380 ft

Screens ☐ Yes ☑ No ☐ K Pac Location _____
Manufacturer s Name _____
Type _____ Model No _____
Diam _____ Slot Size _____ from _____ ft to _____ ft
Diam _____ Slot Size _____ from _____ ft to _____ ft

Gravel/Filter packed ☐ Yes ☑ No ☐ Size of gravel/sand _____
Materials placed from _____ ft to _____ ft

Surface Seal ☑ Yes ☐ No To what depth? 200 ft
Materials used in seal Bentonite
Did any strata contain unusable water? ☐ Yes ☐ No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

PUMP Manufacturer s Name _____
Type _____ H P _____

WATER LEVELS Land surface elevation above mean sea level _____ ft
Static level 260 ft below top of well Date 4-22-04
Artesian pressure _____ lbs per square inch Date _____
Artesian water is controlled by _____ (cap valve etc)

WELL TESTS Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☐ No If yes by whom? _____
Yield _____ gal /min with _____ ft drawdown after _____ hrs
Yield _____ gal /min with _____ ft drawdown after _____ hrs
Yield _____ gal /min with _____ ft drawdown after _____ hrs
Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal /min with _____ ft drawdown after _____ hrs
Airtest 40 gal /min with stem set at 360 ft for 4 hrs
Artesian flow _____ g p m Date _____
Temperature of water _____ Was a chemical analysis made? ☐ Yes ☑ No

CONSTRUCTION OR DECOMMISSION PROCEDURE
Formation Describe by color character size of material and structure and the kind and nature of the material in each stratum penetrated with at least one entry for each change of information Indicate all water encountered (USE ADDITIONAL SHEETS IF NECESSARY)

MATERIAL	FROM	TO
Silty Topsoil	0	12
Tan Sand	12	30
Brown clay	30	136
Clay & Gravel	136	198
Basalt	198	295
Brown Clay	295	335
Water Bering Pourus Basalt	335	375
Basalt	375	380

DEPT OF ECOLOGY Received MAY 10 2004 CENTRAL REGION OFFICE

Start Date 4-17-04 Completed Date 4-23-04

WELL CONSTRUCTION CERTIFICATION I constructed and/or accept responsibility for construction of this well and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

☑ Driller ☐ Engineer ☐ Trainee Name (Print) Todd Haney
Driller/Engineer/Trainee Signature [signature]
Driller or Trainee License No 2343

Drilling Company Statewide Well Drilling
Address 101 Kau Trail rd
City State Zip Pasco Wa 99301
Contractor s Registration No STATEWD015LL Date 4/06

If trainee, licensed driller's Signature and License no _____

Ecology is an Equal Opportunity Employer ECY 050 1 20 (Rev 4/01)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

6P3

WATER WELL REPORT

ECOLOGY Original & 1st copy Ecology 2nd copy owner 3rd copy driller

Construction/Decommission (x in circle) 122220

☒ Construction

○ Decommission *ORIGINAL CONSTRUCTION Notice of Intent Number* _____

DEPT OF ECOLOGY Received SEP 25 2002 CENTRAL REGION OFFICE

CURRENT Notice of Intent No W 160715

Unique Ecology Well ID Tag No AGM 569

Water Right Permit No _____

Property Owner Name HOW MOON R

Well Street Address 58th Franklin

City Westlichland County Benton

Location SE 1/4- 1/4 SE 1/4 Sec 6 Twn 9 R 28 EWM or WWM (circle one)

Lat/Long (s t,r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No _____

PROPOSED USE ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK Owner's number of well (if more than one) _____

☒ New Well ☐ Reconditioned ☐ Deepened

Method ☐ Dug ☐ Bored ☐ Driven ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS Diameter of well 6 inches drilled 280 ft

Depth of completed well 280 ft

CONSTRUCTION DETAILS

Casing Installed ☒ Welded 6 Diam from +1 ft to 220 ft

☐ Liner installed _____ Diam from _____ ft to _____ ft

☐ Threaded _____ Diam from _____ ft to _____ ft

Perforations ☐ Yes ☒ No

Type of perforator used _____

SIZE of perfs _____ in by _____ in and no of perfs _____ from _____ ft to _____ ft

Screens ☐ Yes ☒ No ☐ K Pac Location _____

Manufacturer's Name _____

Type _____ Model No _____

Diam _____ Slot Size _____ from _____ ft to _____ ft

Diam _____ Slot Size _____ from _____ ft to _____ ft

Gravel/Filter packed ☐ Yes ☒ No ☐ Size of gravel/sand _____

Materials placed from _____ ft to _____ ft

Surface Seal ☒ Yes ☐ No To what depth? 30 ft

Materials used in seal Bentonite

Did any strata contain unusable water? ☐ Yes ☐ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP Manufacturer s Name _____

Type _____ H P _____

WATER LEVELS Land surface elevation above mean sea level _____ ft

Static level 155 ft below top of well Date _____

Artesian pressure _____ lbs per square inch Date _____

Artesian water is controlled by _____ (cap valve etc)

WELL TESTS Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☐ No If yes by whom? _____

Yield _____ gal./min with _____ ft drawdown after _____ hrs

Yield _____ gal./min with _____ ft drawdown after _____ hrs

Yield _____ gal./min with _____ ft drawdown after _____ hrs

Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer test _____ gal./min with _____ ft drawdown after _____ hrs

Airtest 110 gal./min with stem set at 280 ft for 2 hrs

Artesian flow _____ g p m Date _____

Temperature of water _____ Was a chemical analysis made? ☐ Yes ☐ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation Describe by color character size of material and structure and the kind and nature of the material in each stratum penetrated with at least one entry for each change of information Indicate all water encountered (USE ADDITIONAL SHEETS IF NECESSARY)

MATERIAL	FROM	TO
Brown Sand	0	2
Cemented Gravel	2	6
Brown Sand Gravel	6	37
Brown clay	37	93
Brown sand Gravel	93	135
Brown clay	135	141
Gray clay	141	220
porous Basalt	220	251
Brown Basalt		
Bearing Water		
Basalt Gray Basalt	+251	280
Bearing Water		
Approx 110 Gpm		

Start Date 9/23/02 Completed Date 9/24/02

WELL CONSTRUCTION CERTIFICATION I constructed and/or accept responsibility for construction of this well and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

☒ Driller ☐ Engineer ☐ Trainee Name (Print) Peter E St George Drilling Company St. George Drilling

Driller/Engineer/Trainee Signature Peter E St George Address 701 S 45 AVE

Driller or Trainee License No 0493 City State Zip W. Richland Wa. 99353

Contractor s Registration No 601048915 Date 9/24/02

If trainee, licensed driller s Signature and License no _____

Ecology is an Equal Opportunity Employer ECY 050 1 20 (Rev 4/01)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

The Dep The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

6P4

7918 Start Card No. 082312

Water Right Permit No. R

(1) OWNER: Name Tony Garrett Address Harrington

(2) LOCATION OF WELL: County Benton SE ¼ SE ¼ Sec. 6 T. 9 N., R. 28 W.M.

(2a) STREET ADDDRESS OF WELL (or nearest address)

(3) PROPOSED USE: ☒ Domestic ☐ Irrigation ☐ DeWater Industrial ☐ Test Well ☐ Municipal ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one)
Abandoned ☐ New well ☒ Deepened ☐ Reconditioned ☐
Method: Dug ☐ Cable ☐ Rotary ☒ Bored ☐ Driven ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 175 feet. Depth of completed well 175 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6" Diam. from +1 ft. to 22 ft.
Welded ☒ 5" Diam. from 19 ft. to 175 ft.
Liner installed ☐
Threaded ☐ " Diam. from ft. to ft.

Perforations: Yes ☒ No ☐
Type of perforator used Torch
SIZE of perforations 1/8 in. by 6 in.
240 perforations from 165 ft. to 175 ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☐ No ☒
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☒ Size of gravel
Gravel placed from ft. to ft.

Surface seal: Yes ☒ No ☐ To what depth? 22 ft.
Material used in seal Bentonite cement
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 111 ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☐ If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airlift 100 gal./min. with stem set at 160 ft. for 4 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Brown Sand	0	7
Basalt Boulders	7	11
Hard Black Basalt	11	47
Brown Sand	47	90
Broken Black Basalt with Blue Shale	90	155
Broken Black Basalt	155	162
Basalt Gravel Bearing water	162	175

RECEIVED DEC 2 1992

Work started 11-16-92, 19. Completed , 19

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME St. George Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address 201 S-45 AVE W, Richland
(Signed) [signature] (WELL DRILLER) License No. 0483
Contractor's Registration No. 601 048715 Date 10-17-92

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 060-1-20 (10/87) -1329-

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with the Division of Water Resources
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No. 12446
Permit No. G 300389 P

(1) OWNER: Name R. D. Dierks Address 319 Sanford Ave. Richland

(2) LOCATION OF WELL: County Benton — NE ¼ NW ¼ Sec. 7 T. 9 N., R. 28E W.M.
Bearing and distance from section or subdivision corner 1800 feet East and 500 feet South of the NW corner of Sect 7

(3) PROPOSED USE: Domestic ☒ Industrial ☐ Municipal ☐ Irrigation ☒ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one)
New well ☒ Deepened ☐ Reconditioned ☐
Method: Dug ☐ Bored ☐ Cable ☐ Driven ☐ Rotary ☒ Jetted ☐

(5) DIMENSIONS: Diameter of well 10 inches.
Drilled 540 ft. Depth of completed well 540 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 10" Diam. from 0 ft. to 166 ft.
Threaded ☐ " Diam. from ft. to ft.
Welded ☒ " Diam. from ft. to ft.

Perforations: Yes ☐ No ☒
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☐ No ☒
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☒ Size of gravel:
Gravel placed from ft. to ft.

Surface seal: Yes ☒ No ☐ To what depth? 40 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 24.8 ft. below top of well Date 11/28/72
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☐ If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG:
Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Sandy soil	0	3
Sandy & gravel	3	58
Brown sandy clay	58	99
Green clay	99	117
Green clay & gravel	117	133
Green clay	133	142
Grey clay	142	164
Brown basalt	164	185
Grey basalt	185	280
Green claystone (water bear	280	320
Porous basalt (water-bear)	320	325
Black basalt	325	455
Brown fractured basalt	455	460
Green claystone	460	470
Blue & brown claystone	470	505
Black basalt	505	540
Approx. 10 gpm 280-320 ft.		
20 gpm 320-325		
60-70 gpm 455-505		

Work started 6, 1972 Completed 11-25, 1972

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME H & H Drilling Inc. (Person, firm, or corporation) (Type or print)
Address Route 1, Box 13-H--Richland
[Signed] James E. Hardy (Well Driller)
License No. 6783 Date 11-28-72, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

S.F. No. 7356—(Rev. 2-66)—2-66—5M. 4516.

The Dep. The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

(701) 2263

Start Card No. 006154

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Water Right Permit No. _____

(1) OWNER: Name Ray Crissen Address 806 Willard, Rhld, wa

(2) LOCATION OF WELL: County Benton NW ¼ NW ¼ Sec. 7 T. 9 N., R. 28 E.W.M.

(2a) STREET ADDDRESS OF WELL (or nearest address) _____

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater Industrial [ ] Test Well [ ] Municipal [ ] Other [ ]

(4) TYPE OF WORK: Owner's number of well (if more than one) _____
Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ]
Method: Dug [ ] Cable [ ] Rotary [X] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 245 feet. Depth of completed well 245 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Diam. from -1 ft. to 217 ft.
Welded [X] Liner installed [ ] Threaded [ ] " Diam. from ft. to ft.
" Diam. from ft. to ft.

Perforations: Yes [ ] No [X]
Type of perforator used _____
SIZE of perforations _____ in. by _____ in.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.

Screens: Yes [ ] No [X]
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: Yes [ ] No [X] Size of gravel _____
Gravel placed from _____ ft. to _____ ft.

Surface seal: Yes [X] No [ ] To what depth? 20 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes [ ] No [ ]
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

(7) PUMP: Manufacturer's Name _____
Type: _____ H.P. _____

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 168 ft. below top of well Date _____
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [ ] No [ ] If yes, by whom? _____
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest 40 gal./min. with stem set at 245 ft. for 3 hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? Yes [ ] No [ ]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Sand Brown	0	3
Sand + Gravel	3	10
Sand Brown	10	26
Sand + Gravel / Moist	26	50
Brown Clay	50	200
Redish Brown Basalt	200	217
Heavy Black Basalt Bearing Water		

ENTERED

RECEIVED [redacted] DEPARTMENT OF ECOLOGY CENTRAL REGION OFFICE

Work started 8-24-89, 19. Completed 9/4, 1989

WELL CONSTRUCTOR CERTIFICATION:
I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME St George Drilling Co (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address 701 S. 45th Ave. W. Rhld. Wa
(Signed) [signature] (WELL DRILLER) License No. 0483
Contractor's Registration No. 601-048-715 Date 9/4, 1989

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (10/87) -1329-

12A1

RESOURCE PROTECTION WELL REPORT

DEPARTMENT OF ECOLOGY State of Washington

This is a report of the activities of a licensed Washington well driller and serves as the official record of work done within the borehole and casing and describes the amount of water encountered.

Construction

Type of Well: Geotech Soil Boring
Number of Wells: 4
Type of Work: New
Method: Auger
Drilling Start Date: 6/26/2017
Drilling Completion Date: 6/26/2017
Received by Ecology: 8/1/2017 1:55 PM

Dimensions:
Borehole Diameter: 5 in
Depth of completed well: 30 ft 0 in

Construction Details

Casings:

From Depth	To Depth	Type	Diameter	Stickup
N/A				

Perforations:

Type	Size	Total Perforations	From Depth	To Depth
N/A				

Screens:

Manufacturer	Type	Dia-meter	Slot Size	From Depth	To Depth
N/A					

Sand/Gravel Packings:

Material	From Depth	To Depth
N/A		

Individual Well Details

Well	Driller's Identifier	Water Level
1	b1	Dry Hole
2	b2	Dry Hole
3	b3	Dry Hole
4	b4	Dry Hole

Additional Well Construction Information
None

Construction Notice of Intent Number: SE62587
Decommissioning Notice of Intent Number: AE43741
Unique Ecology Well ID Tag Number: N/A
Property Owner Name: Richland School District
Property Owner Address: 300 N Valley St, Richland, WA 99352

Well Location:
Well Street Address: Galena St
City, State, Zip: West Richland, WA
County: Benton
Township: 9N Range: 27E Section: 12 in the NE 1/4 of the NE 1/4

Well Head Elevation:
Elevation Datum:
Elevation Method:
Latitude (DD): Longitude (DD):
Datum:
Horizontal Coordinate Collection Method:
Tax parcel No.:

Lithology

Layer: Describe by color, character, size of material and structure, and the kind and nature of the material in each layer penetrated, with at least one entry for each change of information.

From	To	Material
0 ft 0 in	30 ft 0 in	Sand and some gravel

Well Construction Certification: I constructed and/or accept responsibility for construction of this well and its compliance with all Washington well construction standards. Material used and information reported above are true to the best of my knowledge and belief.

Driller/Engineer/Trainee Printed Name: RITCH GIBSON
Driller or trainee License Number: 1816
If trainee, Driller's License Number:

Drilling Company: GEOLOGIC DRILL EXPLORATIONS INC
Address: 14811 W COULEE HITE RD
City, State, Zip: SPOKANE, WA, 99224

(12A2)

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No. G4259 45C
Permit No. ....

(1) OWNER: Name MILO BAUDER Address RICHLAND WASH

(2) LOCATION OF WELL: County BENTON center of: NE ¼ ¼ Sec. 12 T. 8 N., R. 27 W.M.

Bearing and distance from section or subdivision corner 1-29-90

(3) PROPOSED USE: Domestic ☐ Industrial ☐ Municipal ☐ Irrigation ☒ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) ....
New well ☒ Deepened ☐ Reconditioned ☐
Method: Dug ☐ Bored ☐ Cable ☐ Driven ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 18 inches.
Drilled 905 ft. Depth of completed well 905 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 18" Diam. from 0 ft. to 244 ft.
Threaded ☐ ..." Diam. from ... ft. to ... ft.
Welded ☒ ..." Diam. from ... ft. to ... ft.

Perforations: Yes ☐ No ☒
Type of perforator used ...
SIZE of perforations ... in. by ... in.
... perforations from ... ft. to ... ft.
... perforations from ... ft. to ... ft.
... perforations from ... ft. to ... ft.

Screens: Yes ☐ No ☒
Manufacturer's Name ...
Type ... Model No. ...
Diam. ... Slot size ... from ... ft. to ... ft.
Diam. ... Slot size ... from ... ft. to ... ft.

Gravel packed: Yes ☐ No ☒ Size of gravel: ...
Gravel placed from ... ft. to ... ft.

Surface seal: Yes ☒ No ☐ To what depth? 20 ft.
Material used in seal CEMENT
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? ... Depth of strata ...
Method of sealing strata off ...

(7) PUMP: Manufacturer's Name ...
Type: ... H.P. ...

(8) WATER LEVELS: Land-surface elevation above mean sea level .... ft.
Static level 250 ft. below top of well Date ...
Artesian pressure ... lbs. per square inch Date ...
Artesian water is controlled by ... (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☐ If yes, by whom? ...
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test ...
Bailer test ... gal./min. with ... ft. drawdown after ... hrs.
Artesian flow ... g.p.m. Date ...
Temperature of water ... Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG: ABGH

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
OVER BURDEN	0	25
Black Basalt	25	47
lt grey Basalt	47	78
Soft Black Basalt	78	92
grey Basalt	92	140
Black Basalt	140	151
Soft Bl. Basalt	152	176
Black Basalt	176	210
Grey Basalt	210	244
Brown Basalt	244	249
Grey Basalt	249	289
Black Basalt	289	307
Grey Basalt	307	323
Brown Basalt	323	325
Green clay, silica sand	325	366
Brown Basalt	366	372
Black Basalt	372	457
Grey Basalt	457	510
Black Basalt	510	575
Brown Basalt	575	581
Black Basalt	581	825
Black Basalt, pourous	825	850
Black Basalt, water	850	855
Broken Basalt	855	875
Black Basalt, pourous	875	883
grey Basalt, water	883	905

Work started 1/4 1977. Completed January 21 1977

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME ANDRICK AIR DRILLING (Person, firm, or corporation) (Type or print)

Address 2033 3RD AVE N

[Signed] [signature] (Well Driller)

License No. 001 Date 8-14, 1981

(USE ADDITIONAL SHEETS IF NECESSARY) Ok-EP 9-16-81

ECY 050-1-20

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

(12A3)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No. .....
Permit No. .....

(1) OWNER: Name Milo Bauder Address 1986 Greenbrook Blvd Richland WA 99352

(2) LOCATION OF WELL: County Benton — ¼ ¼ Sec. 12 T. 9 N., R. 27 E. W.M.

Bearing and distance from section or subdivision corner center of NE¼ JOR 11-29-94

(3) PROPOSED USE: Domestic ☐ Industrial ☐ Municipal ☐ Irrigation ☒ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) ....

New well ☐ Method: Dug ☐ Bored ☐
Deepened ☒ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☒ Jetted ☐

(5) DIMENSIONS: Diameter of well 18 inches.
Drilled ..... ft. Depth of completed well 1050 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6 " Diam. from 545 ft. to 1005 ft.
Threaded ☐ " Diam. from ft. to ft.
Welded ☒ " Diam. from ft. to ft.

Perforations: Yes ☐ No ☒
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☐ No ☒
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☒ Size of gravel:
Gravel placed from ft. to ft.

Surface seal: Yes ☐ No ☐ To what depth? ft.
Material used in seal
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ... ft.
Static level 180 ft. below top of well Date 4-14-86
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☐ If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Hard and soft green clay	920	960
Basalt	960	961
Blue clay	961	971
Basalt	971	973
Blue clay	973	1003
Black Basalt	1003	1019
Broken black porus basalt H_2O	1019	1031
Hard basalt	1031	1033
Porus basalt H_2O	1033	1050

RECEIVED
DEPARTMENT OF ECOLOGY
CENTRAL REGION OFFICE

Work started March 20, 19 86 Completed April 10, 19 86

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME BJ Exploration Co. Inc. (Person, firm, or corporation) (Type or print)

Address 1547 Ridgeview Ct. Richland WA 99352

[Signed] Larry Mc (Well Driller)

License No. 0337 Date April 15, 19 86

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

3

(12C1)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No. .....
Permit No. .....

(1) OWNER: Name Harold W. Alexander Address Route 2, Box 2207, Benton City, WA 99320

(2) LOCATION OF WELL: County: BENTON — ¼ NW ¼ Sec. 12 T. 9 N., R. 27E W.M.

Bearing and distance from section or subdivision corner

(3) PROPOSED USE: Domestic ☒ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) ....
New well ☒ Deepened ☐ Reconditioned ☐
Method: Dug ☐ Bored ☐ Cable ☐ Driven ☐ Rotary ☒ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 180 ft. Depth of completed well 180 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6" Diam. from +1 ft. to 90 ft.
Threaded ☐ ..." Diam. from ... ft. to ... ft.
Welded ☒ ..." Diam. from ... ft. to ... ft.

Perforations: Yes ☐ No ☒
Type of perforator used ....
SIZE of perforations ... in. by ... in.
... perforations from ... ft. to ... ft.
... perforations from ... ft. to ... ft.
... perforations from ... ft. to ... ft.

Screens: Yes ☐ No ☒
Manufacturer's Name ....
Type .... Model No. ....
Diam. .... Slot size .... from .... ft. to .... ft.
Diam. .... Slot size .... from .... ft. to .... ft.

Gravel packed: Yes ☐ No ☒ Size of gravel: ....
Gravel placed from .... ft. to .... ft.

Surface seal: Yes ☒ No ☐ To what depth? 19 ft.
Material used in seal bentonite
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? .... Depth of strata ....
Method of sealing strata off ....

(7) PUMP: Manufacturer's Name ....
Type: .... H.P. ....

(8) WATER LEVELS: Land-surface elevation above mean sea level .... ft.
Static level 70 ft. below top of well Date 11/20/85
Artesian pressure .... lbs. per square inch Date ....
Artesian water is controlled by .... (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☒ If yes, by whom? ....
Yield: 5 gal./min. with ft. drawdown after hrs.
" ESTIMATED AIRLIFT " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test ....
Bailer test .... gal./min. with .... ft. drawdown after .... hrs.
Artesian flow .... g.p.m. Date ....
Temperature of water .... Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Sand	0	65
Sand & Gravel	65	90
Basalt, soft w/water	90	115
Basalt, medium	115	158
Clay, blue	158	180
NO PVC Liner Installed		
6" Drive shoe installed		
NOTE: SET PUMP ABOVE 158'		

RECEIVED DEC 6 1985 DEPARTMENT OF ECOLOGY CENTRAL REGION OFFICE

Work started 11/18/85, 19.... Completed 11/20, 19 85

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME PONDEROSA DRILLING & DEVELOPMENT INC. (Person, firm, or corporation) (Type or print)

Address E. 6010 Broadway, Spokane, WA 99212

[Signed] James M. Doyle (Well Driller)
James M. Doyle

License No. 1287 Date 11/20, 19 85

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

(1262)

A B
G H

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No. .....
Permit No. .....

(1) OWNER: Name Harold W. Alexander Address Route 2, Box 2207, Benton City, WA 99320

(2) LOCATION OF WELL: County BENTON — ¼ NW ¼ Sec. 12 T. 9 N., R. 27E W.M.

Bearing and distance from section or subdivision corner

(3) PROPOSED USE: Domestic ☒ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) 2
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☒ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 195 ft. Depth of completed well 195 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6" Diam. from +1 ft. to 83 ft.
Threaded ☐ " Diam. from ft. to ft.
Welded XX " Diam. from ft. to ft.

Perforations: Yes ☐ No ☒
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☐ No ☒
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☒ Size of gravel:
Gravel placed from ft. to ft.

Surface seal: Yes ☒ No ☐ To what depth? 75 ft.
Material used in seal bentonite
Did any strata contain unusable water? Yes ☒ No ☐
Type of water? silty Depth of strata 75-80
Method of sealing strata off casing

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 60 ft. below top of well Date 2/03/87
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☒ If yes, by whom?
Yield: 45 gal./min. with ft. drawdown after hrs.
" ESTIMATED AIRLIFT " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Sand & silt	0	75
Sand & silt w/water (10-15 GPM)	75	80
Basalt, soft	80	83
Basalt, medium	83	126
Basalt, hard	126	160
Clay, gray	160	180
Basalt, fractured w/water @ 45 GPM	180	190
Basalt, medium	190	195
NO PVC Liner Installed		
6" Drive shoe utilized		
Note: Customer will install his own PVC to protect pump from clay zone at 160' to 180'		

RECEIVED FEB 19 1987 DEPARTMENT OF ECOLOGY CENTRAL REGION OFFICE

Work started 2/02/ 19 87 Completed 2/03 19 87

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME PONDEROSA DRILLING & DEVELOPMENT INC.
(Person, firm, or corporation) (Type or print)

Address E. 6010 Broadway, Spokane, WA 99212

[Signed] James M. Doyle (Well Driller)
James M. Doyle

License No. 1287 Date 2/03 19 87

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

(12E1-)

RESOURCE PROTECTION WELL REPORT Notice of Intent No 512734

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *("x" in circle)*
- (x) Construction 127108
- ( ) Decommission *Original Construction Notice of Intent Number* _____

Property Owner: city of west Richland

Unique Ecology Well ID Tag No: B-10 + B-11

Consulting Firm: Shannon + Wilson

Driller or Trainee Name: Randy Wilder

Driller or Trainee Signature: [signature]

Driller or Trainee License No: 2578

If trainee licensed driller's Signature and License no _____

DEPT OF ECOLOGY Received JAN 29 2003 CENTRAL REGION OFFICE

Type of Well *(x in circle)*
- ( ) Resource Protection
- (x) Geotech Soil Boring E

Site Address _____

City: West Richland County: Benton

Location: SW 1/4 1/4 NW 1/4 Sec 12 Twn 9N R 27 (EWM) or WWM *circle one*

Lat/Long (s t r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No _____

Cased or Uncased Diameter _____ Static Level _____

Work/Decommission Start Date: 12-17-02

Work/Decommission Completed Date: 12-17-02

Construction/Design	Well Data	Formation Description
Abandoned with Bentonite		Sand
8" Borehole		

10 — 10

20 — 20

Scale 1 = _____ Page _____ of _____

ECY 050 12 (Rev 2/01)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

(1262)

RESOURCE PROTECTION WELL REPORT

Notice of Intent No 512734

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

Construction/Decommission (x in circle)

- (X) Construction 127109
- ( ) Decommission *Original Construction Notice of Intent Number* _____

Property Owner: city of west Richland

Unique Ecology Well ID Tag No: B-10 + (B-11)

Consulting Firm: Shannon + Wilson

Driller or Trainee Name: Randy Wilder

Driller or Trainee Signature: [signature]

Driller or Trainee License No: 2578

If trainee licensed driller's Signature and License no _____

DEPT OF ECOLOGY Received JAN 29 2003 CENTRAL REGION OFFICE

Type of Well (x in circle)

- ( ) Resource Protection
- (X) Geotech Soil Boring

E

Site Address _____

City: West Richland County: Benton

Location: SW 1/4 1/4 NW 1/4 Sec 12 Twn 9N R 27 (EWM) or WWM — circle one

Lat/Long (s t r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No _____

Cased or Uncased Diameter _____ Static Level _____

(Work)/Decommission Start Date: 12-17-02

Work/(Decommission) Completed Date: 12-17-02

Construction/Design	Well Data	Formation Description
Abandoned with Bentonite		Sand
8" Borehole		

10

20

Scale 1 = _____ Page _____ of _____

ECY 050-12 (Rev 2/01)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

53

(12F1)

G423315P

9N 27E 12E

SE¼NW F

STATE OF WASHINGTON
DEPARTMENT OF CONSERVATION
AND DEVELOPMENT

LOG No. Appl. 4575

4-19-57, 19

By well driller

Driller's record

State of WASHINGTON

County Benton

NW ¼ sec. 12 T. 9 N., R. 27 E.

Co. Hall Harmon Equip. Co.

Yakima, Wash.

Date of Drilling Date , 19

John C. McElroy

Richland, Wash.

Surface, datum above below

MATERIAL	THICKNESS (feet)	DEPTH (feet)
Use driller's terminology, but modify but paraphrase as necessary in parenthesis or, water-bearing, so state and record static level if reported. Give elevation or surface datum unless otherwise indicated. Correlate with [illegible] place [illegible] following log of materials, lift and casings, perforations, [illegible]		
No log.		
PUMP TEST:		
Dim. 387'x10"-8"		
SWL: 156 ft.		
DD: 16 ft.		
Yield: 350g.p.m.		
Type & size of pump: Test pump		
6" bowls		
Type & size of motor: 110 h.p.		
Continental		
Estimated well capacity, based on test is 800 g.p.m. at 196' pumping level.		
CASING: 10" diam. from 0 to 14 ft.		
8" diam. from 14 to 270 ft.		

Sheet of sheet

WELL LOG.—Continued No. /

COORDINATION	MATERIAL	THICKNESS (feet)	DEPTH (feet)
	Depth forward	—	
	Sand Clay & Gravel	200	200
	Basalt	40	240
	Clay	30	270
	Basalt	130	400
	Note: Water Bearing from 380' to 400'		

S. F. 3 o. 7[illegible]—12-[illegible]—5M [illegible]

(12F2) p.1 of 3

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

ECOLOGY Original & 1st copy Ecology 2nd copy owner 3rd copy driller

Construction/Decommission (x in circle) 113547
- ○ Construction
- ○ Decommission *ORIGINAL CONSTRUCTION Notice of Intent Number* _____

CURRENT Notice of Intent No W 136645

Unique Ecology Well ID Tag No AGB-049

Water Right Permit No G4-23315 R

Property Owner Name HAROLD W. Alexander

Well Street Address Rt 2 Box 2207 F

City Benton City County Benton

Location SE 1/4- 1/4 NW 1/4 Sec 12 Twn 9 R 27 EWM or WWM (circle one)

Lat/Long (s t,r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No _____

PROPOSED USE ☐ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☒ Other _____

TYPE OF WORK Owner s number of well (if more than one) _____
☒ New Well ☐ Reconditioned *Method* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS Diameter of well 12 inches drilled 840 ft
Depth of completed well 840 ft

CONSTRUCTION DETAILS
Casing Installed ☒ Welded 16 Diam from +1 ft to 80 ft
☒ Liner installed 12 Diam from +1 ft to 399 ft
☐ Threaded _____ Diam from _____ ft to _____ ft

Perforations ☐ Yes ☒ No
Type of perforator used _____
SIZE of perfs _____ in by _____ in and no of perfs _____ from _____ ft to _____ ft

Screens ☐ Yes ☒ No ☐ K Pac Location _____
Manufacturer s Name _____
Type _____ Model No _____
Diam _____ Slot Size _____ from _____ ft to _____ ft
Diam _____ Slot Size _____ from _____ ft to _____ ft

Gravel/Filter packed ☐ Yes ☒ No ☐ Size of gravel/sand _____
Materials placed from _____ ft to _____ ft

Surface Seal ☒ Yes ☐ No To what depth? 30 ft
Materials used in seal Cement
Did any strata contain unusable water? ☐ Yes ☐ No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

DEPT OF ECOLOGY Received APR 2 3 2002 CENTRAL REGION OFFICE

PUMP Manufacturer s Name _____
Type _____ H P _____

WATER LEVELS Land surface elevation above mean sea level _____ ft
Static level 185 ft below top of well Date _____
Artesian pressure _____ lbs per square inch Date _____
Artesian water is controlled by _____ (cap valve etc)

WELL TESTS Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☐ No If yes by whom? _____
Yield _____ gal /min with _____ ft drawdown after _____ hrs
Yield _____ gal /min with _____ ft drawdown after _____ hrs
Yield _____ gal /min with _____ ft drawdown after _____ hrs
Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal /min with _____ ft drawdown after _____ hrs
Airtest 100 gal /min with stem set at 398 ft for 4 hrs
Artesian flow _____ g p m Date _____
Temperature of water _____ Was a chemical analysis made? ☐ Yes ☐ No

CONSTRUCTION OR DECOMMISSION PROCEDURE
Formation Describe by color character size of material and structure and the kind and nature of the material in each stratum penetrated with at least one entry for each change of information Indicate all water encountered (USE ADDITIONAL SHEETS IF NECESSARY)

MATERIAL	FROM	TO
Brown Sand	0	21
Brown Sand clay	21	46
Brown - Sand Gravel with Brown clay	46	74
Gray + Brown Basalt	74	165
Soft Gray Basalt	165	175
Blue Green clay	175	201
Gray clay	201	210
Gray Basalt Medium	210	339
Soft Gray porous Basalt	339	347
Blue Green clay + Brown	347	361
Black + Green		
Gray Shale + Gray Basalt	361	373
Gray Basalt Medium	373	480
Hard Gray Basalt	480	491
Medium Gray Basalt	491	639
Hard Gray Basalt	639	649
Black porous Basalt	649	680
Green shale Nonwater		
Hard Gray Basalt	680	779
Green Sand + Water	779	830
Hard Gray Basalt	830	840
12" Hole From +1 to 399		
8" Hole From 399 840		
1-31-02		

Start Date 1-31-02 Completed Date 3-11-02

WELL CONSTRUCTION CERTIFICATION I constructed and/or accept responsibility for construction of this well and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

☒ Driller ☐ Engineer ☐ Trainee Name (Print) Peter E Schaeffer Drilling Company P Schaeffer Drilling

Driller/Engineer/Trainee Signature [signature] Address 701 So 45 Ave

Driller or Trainee License No _____ City State Zip Kennewick 99337

Contractor s Registration No 601048715 Date 3-15-02

If trainee, licensed driller s Signature and License no _____

Ecology is an Equal Opportunity Employer ECY 050 1 20 (Rev 4/01)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

ECOLOGY

DEPARTMENT OF ECOLOGY

DEPT OF ECOLOGY SEP 05 2001 CENTRAL REGION OFFICE

Showing of Compliance with RCW 90.44 100(3)

Water Right Certificate or Permit Number 34-7331 C

Parcel tax identification number 1 1297 200 0000 000

Landowner(s) name HAROLD ALEXANDER

Part of complying with RCW 90 44 100(3) is for the project proponent to notify the Department of Ecology (Ecology) that the statutory criteria of RCW 90 44 100(3) have been satisfied Please attach to this document the water well report for the additional or replacement well and any additional information you have to support your affidavit

Affidavit

I, HAROLD ALEXANDER, do certify that I caused the well described in the attached water well report to be drilled as an additional/or replacement well(s) for use under Water Right Number G4-23315P This notice and attached documents describe and support my assertion that the replacement or additional well(s) complies with RCW 90.44 100(3) (a-g) and RCW 90 44 100(4)

a The well is an additional or replacement well(s) that will tap the same body of public ground water as the original well,

b If a replacement well is constructed, the use of the original well(s) shall be discontinued and the original well(s) shall be properly decommissioned,

c The combined withdrawal of water from the additional or replacement well(s) and the original well authorized by the water right certificate does not enlarge the water right conveyed by the original water right certificate to the extent the certificate has been developed (perfected) and maintained by use of water,

d The construction and use of the additional or replacement well(s) does not interfere with or impair water rights with an earlier priority date,

e The additional or replacement well(s) is located no closer than the original well to a well or surface water body it might interfere with,

f A specified manner of construction for the additional or replacement well(s) has been complied with, if required, and the new well was constructed in compliance with chapter 18 104 RCW and chapter 173-160 WAC,

g The additional or replacement well(s) is located within the area described as the point of withdrawal in the public notice published for the original application for water right, or the most current legal description published for the right Both the original well and the additional or replacement well(s) are located in SEE LEGAL DESCR NEXT PAGE (legal description)

Therefore the well is in compliance with the requirements for a statutorily granted amendment to the water right permit or certificate

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

I understand the acceptance of this affidavit and any attachments by the Department of Ecology shall not be construed as affirming the validity of any water right permit or certificate The responsibility to comply with RCW 90 44 100(3) is with the water right permit or certificate holder asserting an amendment pursuant to RCW 90 44 100(3)

Harold Alexander
Name

Sept 4 01
Date

Acknowledgement

State of Washington
County of Benton

I certify that I know or have satisfactory evidence that Harold Alexander *is the person who appeared before me and said person acknowledged that (he/she) signed this affidavit and acknowledged it to be (his/her) free and voluntary act for the uses and purposes mentioned in the affidavit*

Dated 9/4/01

HOWARD J ROBERTS JR
COMMISSION EXPIRES
NOTARY
PUBLIC
JUNE 1, 2004
STATE OF WASHINGTON

Howard Roberts Jr
(Signature)
Benton County
Residing in
Finance Director
Title
My appointment expires 6/1/04

If you have any questions please contact the Water Resources Section of the closest regional office Please submit copies of new well logs and decommissioned well logs along with this completed and notarized form to the nearest regional office

Northwest Regional Office
3190 – 160th Avenue SE
Bellevue WA 98008-5452
(425) 649-7000, TDD (425) 649 4259

Southwest Regional Office
P O Box 47775
Olympia, WA 98504-7775
(360) 407-6300, TDD (360) 407-6306

Eastern Regional Office
N 4601 Monroe, Suite 202
Spokane WA 99205 1295
(509) 456-2926 TDD (509) 458 2055

Central Regional Office
15 W Yakima Ave , Suite 200
Yakima, WA 98902-3452
(509) 575-2597, TDD (509) 454 7673

Vancouver Field Office
2108 Grand Boulevard
Vancouver, WA 98661-4622
(360) 690-7171 TDD (360) 690-7147

Nooksack Field Office
1204 Railroad Ave Suite 200
Bellingham, WA 98225
(360) 738-6250, TDD (425) 649-4259

12H1

Please print, sign and return to the Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. SE63146

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *("x" in box)*

☒ Construction
☐ Decommission

ORIGINAL INSTALLATION Notice of Intent Number:

Consulting Firm GPI

Unique Ecology Well IDTag No.

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee
Name (Print Last, First Name) CORN, MIKE
Driller/Engineer /Trainee Signature
Driller or Trainee License No. 2833

If trainee, licensed driller's Signature and License Number:

Type of Well *("x in box)*

☐ Resource Protection
☒ Geotech Soil Boring

Property Owner RICHLAND SCHOOL DISTRICT

Site Address West side of Belmont rd 46.281122, -119.370543

City Richland County Benton

Location SE1/4-1/4 NE1/4 Sec 12 Twn 9N R 27

EWM ☒ or WWM ☐

Lat/Long (s, t, r still REQUIRED) Lat Deg ____ Min ____ Sec ____
Long Deg ____ Min ____ Sec ____

Tax Parcel No.

Cased or Uncased Diameter 8.5" Static Level DRY

Work/Decommission Start Date 8/24/2017

Work/Decommission Completed Date 8/24/2017

Construction Design	Well Data	Formation Description
H.S.A. to a depth of 30 feet B.G.S.	B-5 Elementary school geotech	0-1.5 Sand. 1.5-6 Sand w/gravels. 6-30 Sand, tan, fine.

RECEIVED
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Central Regional Office

SCALE: 1"= NOT TO SCALE PAGE 1 OF 1

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Ecology is an Equal Opportunity Employer

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report

12H2

Please print, sign and return to the Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. AE44642

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *("x" in box)*

☐ Construction

☒ Decommission

ORIGINAL INSTALLATION Notice of Intent Number:

SE63146

Consulting Firm GPI

Unique Ecology Well IDTag No. _____

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee

Name (Print Last, First Name) CORN, MIKE

Driller/Engineer /Trainee Signature Mike C

Driller or Trainee License No. 2833

If trainee, licensed driller's Signature and License Number:

Type of Well *("x in box)*

☐ Resource Protection

☒ Geotech Soil Boring

Property Owner RICHLAND SCHOOL DISTRICT

Site Address West side of Belmont rd 46.281122, -119.370543

City Richland County Benton

Location SE1/4-1/4 NE1/4 Sec 12 Twn 9N R 27

EWM ☒ or WWM ☐

Lat/Long (s, t, r still REQUIRED) Lat Deg _____ Min _____ Sec _____

Long Deg _____ Min _____ Sec _____

Tax Parcel No. _____

Cased or Uncased Diameter 8.5" Static Level DRY

Work/Decommission Start Date 8/24/2017

Work/Decommission Completed Date 8/24/2017

Construction Design	Well Data	Formation Description
H.S.A. to a depth of 25 feet B.G.S. Pull out the auger and pour in 8 bags of 3/8" bentonite chips up to 1 foot from the surface, then cuttings to the surface.	B-1 Elementary school geotech	0-5.5 Sand w/small gravels. 5.5-10 Sand coarse, tan, dry. 10-25 Fine tan sand.

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12H3

Please print, sign and return to the Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. AE44642

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *("x" in box)*

☐ Construction

☒ Decommission

ORIGINAL INSTALLATION Notice of Intent Number:

SE63146

Consulting Firm GPI

Unique Ecology Well IDTag No. _____

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee

Name (Print Last, First Name) CORN, MIKE

Driller/Engineer /Trainee Signature [signature]

Driller or Trainee License No. 2833

If trainee, licensed driller's Signature and License Number:

Type of Well *("x in box)*

☐ Resource Protection

☒ Geotech Soil Boring

Property Owner RICHLAND SCHOOL DISTRICT

Site Address West side of Belmont rd 46.281122, -119.370543

City Richland County Benton

Location SE1/4-1/4 NE1/4 Sec 12 Twn 9N R 27

EWM ☒ or WWM ☐

Lat/Long (s, t, r still REQUIRED) Lat Deg _____ Min _____ Sec _____

Long Deg _____ Min _____ Sec _____

Tax Parcel No. _____

Cased or Uncased Diameter 8.5" Static Level DRY

Work/Decommission Start Date 8/24/2017

Work/Decommission Completed Date 8/24/2017

Construction Design	Well Data	Formation Description
H.S.A. to a depth of 25 feet B.G.S. Pull out the augers and pour in 10 bags of 3/8" bentonite chips up to 1 foot bgs, then cuttings to the surface.	B-3 Elementary school geotech	0-2 Sand. 2-6 Sand w/gravel. 6-25 Sand, tan

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ECY 050-12 (Rev. 7/06)

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1244

Please print, sign and return to the Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. AE44642

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *("x" in box)*

☐ Construction

☒ Decommission

ORIGINAL INSTALLATION Notice of Intent Number:

SE63146

Consulting Firm GPI

Unique Ecology Well IDTag No. _____

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee

Name (Print Last, First Name) CORN, MIKE

Driller/Engineer /Trainee Signature Mike C

Driller or Trainee License No. 2833

If trainee, licensed driller's Signature and License Number:

Type of Well *("x in box)*

☐ Resource Protection

☒ Geotech Soil Boring

Property Owner RICHLAND SCHOOL DISTRICT

Site Address West side of Belmont rd 46.281122, -119.370543

City Richland County Benton

Location SE1/4-1/4 NE1/4 Sec 12 Twn 9N R 27

EWM ☒ or WWM ☐

Lat/Long (s, t, r still REQUIRED) Lat Deg _____ Min _____ Sec _____

Long Deg _____ Min _____ Sec _____

Tax Parcel No. _____

Cased or Uncased Diameter 8.5" Static Level DRY

Work/Decommission Start Date 8/24/2017

Work/Decommission Completed Date 8/24/2017

Construction Design	Well Data	Formation Description
H.S.A. to a depth of 30 feet B.G.S. Pull out the augers and pour in 12 bags of 3/8" bentonite chips up to 1 foot from the surface, then cuttings to the surface.	B-5 Elementary school geotech	0-1.5 Sand. 1.5-6 Sand w/gravels. 6-30 Sand, tan, fine.

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Central Regional Office

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12H5

Please print, sign and return to the Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. AE44642

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *("x" in box)*

☐ Construction

☒ Decommission

ORIGINAL INSTALLATION Notice of Intent Number:

SE63146

Consulting Firm GPI

Unique Ecology Well IDTag No. _____

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee

Name (Print Last, First Name) CORN, MIKE

Driller/Engineer /Trainee Signature [signature]

Driller or Trainee License No. 2833

If trainee, licensed driller's Signature and License Number:

Type of Well *("x in box)*

☐ Resource Protection

☒ Geotech Soil Boring

Property Owner RICHLAND SCHOOL DISTRICT

Site Address West side of Belmont rd 46.281122, -119.370543

City Richland County Benton

Location SE1/4-1/4 NE1/4 Sec 12 Twn 9N R 27

EWM ☒ or WWM ☐

Lat/Long (s, t, r still REQUIRED) Lat Deg _____ Min _____ Sec _____ Long Deg _____ Min _____ Sec _____

Tax Parcel No. _____

Cased or Uncased Diameter 8.5" Static Level DRY

Work/Decommission Start Date 8/24/2017

Work/Decommission Completed Date 8/24/2017

Construction Design	Well Data	Formation Description
H.S.A. to a depth of 30 feet B.G.S. Pull out the auger and pour in 11 bags of 3/8" bentonite chips up to 1 foot from the surface, then cuttings to the surface.	B-2 Elementary school geotech	0-6 Sand w/small gravels. 6-30 Sand, fine, tan, dry.

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Central Regional Office

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12H6

Please print, sign and return to the Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. SE63146

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *("x" in box)*

☒ Construction
☐ Decommission

ORIGINAL INSTALLATION Notice of Intent Number:

Consulting Firm GPI

Unique Ecology Well IDTag No.

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee
Name (Print Last, First Name) CORN, MIKE
Driller/Engineer /Trainee Signature
Driller or Trainee License No. 2833

If trainee, licensed driller's Signature and License Number:

Type of Well *("x in box)*

☐ Resource Protection
☒ Geotech Soil Boring

Property Owner RICHLAND SCHOOL DISTRICT

Site Address West side of Belmont rd 46.281122, -119.370543

City Richland County Benton

Location SE1/4-1/4 NE1/4 Sec 12 Twn 9N R 27

EWM ☒ or WWM ☐

Lat/Long (s, t, r still REQUIRED) Lat Deg ____ Min ____ Sec ____
Long Deg ____ Min ____ Sec ____

Tax Parcel No.

Cased or Uncased Diameter 8.5" Static Level DRY

Work/Decommission Start Date 8/24/2017

Work/Decommission Completed Date 8/24/2017

Construction Design	Well Data	Formation Description
H.S.A. to a depth of 25 feet B.G.S.	B-1 Elementary school geotech	0-5.5 Sand w/small gravels. 5.5-10 Sand coarse, tan, dry. 10-25 Fine tan sand.

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JUL 10 2018
Dept of Ecology
Central Regional Office

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JUL 10 2018
Dept of Ecology
Central Regional Office

SCALE: 1"= NOT TO SCALE PAGE 1 OF 1

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12H7

Please print, sign and return to the Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. SE63146

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *("x" in box)*

☒ Construction
☐ Decommission

ORIGINAL INSTALLATION Notice of Intent Number:

Consulting Firm GPI

Unique Ecology Well IDTag No.

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee
Name (Print Last, First Name) CORN, MIKE
Driller/Engineer /Trainee Signature Mike C
Driller or Trainee License No. 2833

If trainee, licensed driller's Signature and License Number:

Type of Well *("x in box)*
☐ Resource Protection
☒ Geotech Soil Boring

Property Owner RICHLAND SCHOOL DISTRICT
Site Address West side of Belmont rd 46.281122, -119.370543
City Richland County Benton
Location SE1/4-1/4 NE1/4 Sec 12 Twn 9N R 27
EWM ☒ or WWM ☐
Lat/Long (s, t, r still REQUIRED) Lat Deg ____ Min ____ Sec ____
Long Deg ____ Min ____ Sec ____
Tax Parcel No.
Cased or Uncased Diameter 8.5" Static Level DRY
Work/Decommission Start Date 8/24/2017
Work/Decommission Completed Date 8/24/2017

Construction Design	Well Data	Formation Description
H.S.A. to a depth of 30 feet B.G.S.	B-2 Elementary school geotech	0-6 Sand w/small gravels. 6-30 Sand, fine, tan, dry.

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Dept of Ecology
Central Regional Office

SCALE: 1"= NOT TO SCALE PAGE 1 OF 1

ECY 050-12 (Rev. 7/06)

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(1248)

Please print, sign and return to the Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. SE63146

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *("x" in box)*

☒ Construction
☐ Decommission

ORIGINAL INSTALLATION Notice of Intent Number:

Consulting Firm GPI

Unique Ecology Well IDTag No.

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee

Name (Print Last, First Name) CORN, MIKE

Driller/Engineer /Trainee Signature

Driller or Trainee License No. 2833

If trainee, licensed driller's Signature and License Number:

Type of Well *("x in box)*

☐ Resource Protection
☒ Geotech Soil Boring

Property Owner RICHLAND SCHOOL DISTRICT

Site Address West side of Belmont rd 46.281122, -119.370543

City Richland County Benton

Location SE1/4-1/4 NE1/4 Sec 12 Twn 9N R 27

EWM ☒ or WWM ☐

Lat/Long (s, t, r still REQUIRED) Lat Deg ____ Min ____ Sec ____ Long Deg ____ Min ____ Sec ____

Tax Parcel No.

Cased or Uncased Diameter 8.5" Static Level DRY

Work/Decommission Start Date 8/24/2017

Work/Decommission Completed Date 8/24/2017

Construction Design	Well Data	Formation Description
H.S.A. to a depth of 30 feet B.G.S.	B-6 Elementary school geotech	0-2.5 Sand 2.5-12 Sand w/gravel layers. 12-30 Sand, fine, tan

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Central Regional Office

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1249

Please print, sign and return to the Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. AE44642

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *("x" in box)*

☐ Construction

☒ Decommission

ORIGINAL INSTALLATION Notice of Intent Number:

SE63146

Consulting Firm GPI

Unique Ecology Well IDTag No. _____

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee

Name (Print Last, First Name) CORN, MIKE

Driller/Engineer /Trainee Signature [signature]

Driller or Trainee License No. 2833

If trainee, licensed driller's Signature and License Number:

Type of Well *("x in box)*

☐ Resource Protection

☒ Geotech Soil Boring

Property Owner RICHLAND SCHOOL DISTRICT

Site Address West side of Belmont rd 46.281122, -119.370543

City Richland County Benton

Location SE1/4-1/4 NE1/4 Sec 12 Twn 9N R 27

EWM ☒ or WWM ☐

Lat/Long (s, t, r still REQUIRED) Lat Deg _____ Min _____ Sec _____

Long Deg _____ Min _____ Sec _____

Tax Parcel No. _____

Cased or Uncased Diameter 8.5" Static Level DRY

Work/Decommission Start Date 8/24/2017

Work/Decommission Completed Date 8/24/2017

Construction Design	Well Data	Formation Description
H.S.A. to a depth of 30 feet B.G.S. Pull out the augers and pour in 11 bags of 3/8" bentonite chips up to 1 foot bgs, then cuttings to the surface.	B-6 Elementary school geotech	0-2.5 Sand 2.5-12 Sand w/gravel layers. 12-30 Sand, fine, tan

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Central Regional Office

SCALE: 1"= NOT TO SCALE PAGE 1 OF 1

ECY 050-12 (Rev. 7/06)

Ecology is an Equal Opportunity Employer

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

442673

WATER WELL REPORT

STATE OF WASHINGTON

12410

Start Card No. W045168

Water Right Permit No. _____

(1) OWNER: Name DON KNOWLTON Address _____

(2) LOCATION OF WELL: County Benton SE ¼ NE ¼ Sec. 12 T. 9 N., R. 27 W.M.

(2a) STREET ADDDRESS OF WELL (or nearest address) Harrington

H

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater [ ] Industrial [ ] Test Well [ ] Municipal [ ] Other [ ]

(4) TYPE OF WORK: Owner's number of well (if more than one) _____

Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ]
Method: Dug [ ] Cable [ ] Rotary [X] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well _____ inches.
Drilled _____ feet. Depth of completed well _____ ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6 " Diam. from +1 ft. to 60 ft.
Welded [X] _____ " Diam. from _____ ft. to _____ ft.
Liner installed [ ] _____ " Diam. from _____ ft. to _____ ft.
Threaded [ ]

Perforations: Yes [ ] No [X]
Type of perforator used _____
SIZE of perforations _____ in. by _____ in.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.

Screens: Yes [ ] No [X]
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: Yes [ ] No [X] Size of gravel _____
Gravel placed from _____ ft. to _____ ft.

Surface seal: Yes [X] No [ ] To what depth? 20 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes [ ] No [ ]
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

(7) PUMP: Manufacturer's Name _____
Type: _____ H.P. _____

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 6/2 ft. below top of well Date _____
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [ ] No [ ] If yes, by whom? _____
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest 30 gal./min. with stem set at 55 ft. for 1 hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? Yes [ ] No [ ]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Brown Sand	0	12
Black Sand	12	40
Black Sand Gravel	40	60

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Work started 4-30-94, 19. Completed _____, 19

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME St George Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address 701 So 45 AVE W. Richland

(Signed) [signature] (WELL DRILLER) License No. 0483

Contractor's Registration No. 601-048-715 Date 4-30-94, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (10/87) -1329- 18

APPENDIX D
Database of Pre-Existing Subsurface Information

Table D-1

Compilation of Water Well Report Observations [1]

City of West Richland

Benton County, Washington

Water Well Report Designation	Owner [2]	Date Completed	Location					Well Elevation [3] (feet)	Total Depth (feet bgs)	Depth to Groundwater (feet bgs)	Depth to Basalt (feet bgs)	Top of Basalt Elevation [3] (feet)	Summary - Limiting Stratigraphic Unit		Notes
			Quarter-Quarter Section	Quarter Section	Section	Township	Range						Depth to Top of Limiting Stratigraphic Unit (feet bgs)	Type of Limiting Stratigraphic Unit	
1B1	Neil Sullivan	11/06/81	NW	NE	1	9N	27E	495	232	144	40	455	40	Basalt	
1D1	Leslie J. Woodcock	05/07/85	NW	NW	1	9N	27E	464	80	22	55	409	55	Basalt	
1D2	Leslie J. Woodcock	04/04/95	NW	NW	1	9N	27E	464	180	90	55	409	55	Basalt	Deepening of 1D1
1D3	E.O. Kraus	07/05/79	NW	NW	1	9N	27E	470	150	65	14	456	14	Basalt	
1D4	Mark and Cindy Enghusen	08/16/01	SE	NW	1	9N	27E	470	145	35	32	438	32	Basalt	
1D5	Jerry England	07/15/05	NW	NW	1	9N	27E	482	305	100	26	456	26	Basalt	
1D6	Jerry England	08/14/05	NW	NW	1	9N	27E	482	160	--	26	456	26	Basalt	
1E1	John Harris	08/09/05	SW	NW	1	9N	27E	486	305	130	2	484	2	Basalt	
1E2	Keith and Pam Gray	09/01/11	SW	SW	1	9N	27E	486	290	140	28	458	28	Basalt	
1E3	Becan Properties	05/27/88	SW	NW	1	9N	27E	493	160	30	15	478	15	Basalt	
1E4	Hugh W. Homer	05/16/94	SW	NW	1	9N	27E	493	210	110	20	473	5	Clay	
1E5	William Wildenborg	10/14/94	SW	NW	1	9N	27E	493	220	120	20	473	5	Clay	
1F1	E. Neil and William E. Sullivan	02/20/85	NW	NW	1	9N	27E	507	65	35	40	467	40	Basalt	
1G1	Robert Butler	06/15/87	SW	NE	1	9N	27E	593	151	44	21	572	12	Clay	
1H1	Hanz Anselm	11/09/94	SE	NE	1	9N	27E	637	240	87	6	631	6	Basalt	
1H2	Roger Smith	05/28/93	SE	NE	1	9N	27E	637	265	130	16	621	16	Basalt	
1K1	Joe and Linda Picker	05/05/99	NE	SW	1	9N	27E	655	220	165	203	452	6	Clay	
1K2	Gerald and Maggie Higgins	11/09/98	NE	SW	1	9N	27E	655	208	150	185	470	24	Sandy Clay	
1K3	John Harris	10/26/79	NE	SW	1	9N	27E	651	285	90	3	648	3	Basalt	
1M1	Herold Alexander	09/10/05	SW	SW	1	9N	27E	499	353	160	90	409	90	Basalt	
1N1	Aaron Delvalle	07/12/13	SE	SW	1	9N	27E	633	20	>20	>20	<613	>20		
1N2	Aaron Delvalle	07/12/13	SE	SW	1	9N	27E	633	20	>20	>20	<613	>20		
1N3	Aaron Delvalle	07/12/13	SE	SW	1	9N	27E	633	20	>20	>20	<613	>20		
1O1	Terri Ahlers	05/17/00	SW	SE	1	9N	27E	656	200	170	>200	<456	32	Clay and Silt	
6A1	Town of West Richland	10/15/62	NE	NE	6	9N	28E	416	250	25	176	240	93	Clay	
6A2	Ray Moller	06/14/66	NE	NE	6	9N	28E	431	90.2	28.6	63	368	63	Weathered Basalt	
6A3	Mark Noulty	05/25/94	NE	NE	6	9N	28E	431	200	124	162	269	3	Clay	
6A4	RA Paasch	--	NE	NE	6	9N	28E	422	60	50	>60	<362	>60		
6A5	City of West Richland	03/26/13	NE	NE	6	9N	28E	429	25	>25	>25	<404	>25		
6B1	Willetu Barm	01/26/92	NW	NE	6	9N	28E	555	261	45	159	396	46	Silt	
6C1	--	10/12/00	NE	NW	6	9N	28E	738	3	--	3	735	0	Silt	
6C2	Bob Loveall	01/13/93	--	NW	6	9N	28E	633	332	238	94	539	88	Clay	
6C3	Robert Loveall	11/30/98	--	NW	6	9N	28E	633	490	235	98	535	21	Silt and Gravel	
6D1	Randy Powers	05/14/01	NW	NW	6	9N	28E	618	210	135	189	429	32	Clay	
6D2	CW Flowers	08/07/89	--	--	6	9N	28E	628	316.5	261	13	615	13	Basalt	
6G1	William F. Brown	06/23/73	SE	NE	6	9N	28E	586	160	80	128	458	128	Basalt	
6H1	Ricky Hamilton	05/21/17	NE	NE	6	9N	28E	432	110	64	95	337	35	Clay	
6I1	Tracey Smith	07/27/05	NW	NE	6	9N	28E	544	282	100	135	409	30	Clay and Sandstone	

Water Well Report Designation	Owner [2]	Date Completed	Location					Well Elevation [3] (feet)	Total Depth (feet bgs)	Depth to Groundwater (feet bgs)	Depth to Basalt (feet bgs)	Top of Basalt Elevation [3] (feet)	Summary - Limiting Stratigraphic Unit		Notes
			Quarter-Quarter Section	Quarter Section	Section	Township	Range						Depth to Top of Limiting Stratigraphic Unit (feet bgs)	Type of Limiting Stratigraphic Unit	
6I2	Frank Panisko	09/16/74	NE	SW	6	9N	28E	587	300	180	183	404	3	Clay	
6I3	Joseph Mugo	08/12/16	NE	SE	6	9N	28E	589	360	218	189	400	26	Clay	
6L1	Brett and Tracy Mooney	05/02/02	--	SW	6	9N	28E	646	228	155	203	443	36	Silt	
6L2	Steve Versteeg	06/19/01	NW	SW	6	9N	28E	647	215	153	201	446	41	Clay	
6M1	David H. Steffen	02/14/92	SW	SW	6	9N	28E	650	343	258	186	464	26	Clay Gravel	
6N1	E.O. Kraus	--	SE	SW	6	9N	28E	646	325	221	210	436	40	Clay	
6O1	Mike and Talia Lewis	08/23/17	NW	NE	6	9N	28E	621	215	135	198	423	18	Clay and Gravel	
6P1	Hedge Cock	11/15/02	NE	NE	6	9N	28E	623	225	134	206	417	35	Clay	
6P2	Paul and Kerry Wood	04/23/04	NW	SE	6	9N	28E	611	380	260	198	413	30	Clay	
6P3	Hoiu Moon	09/30/02	SE	SE	6	9N	28E	625	280	155	220	405	37	Clay	
6P4	Tony Garrett	11/16/97	SE	SE	6	9N	28E	625	175	111	7	618	7	Basalt	
7C1	B.D. Dierks	11/25/72	NE	NW	7	9N	28E	644	540	248	185	459	58	Sandy Clay	
7D1	Ray Crissen	09/07/89	NW	NW	7	9N	28E	646	217	168	200	446	50	Clay	
12A1	Richland School District	06/26/17	NE	NE	12	9N	27E	634	30	>30	>30	<604	>30		
12A2	Milo Bauder	08/14/81	--	NE	12	9N	27E	632	905	250	25	607	25	Basalt	
12A3	Milo Bauder	04/10/86	--	--	12	9N	27E	632	1050	180	25	607	25	Basalt	Deepening of 12A2
12C1	Harold W. Alexander	11/20/85	--	NW	12	9N	27E	543	180	70	90	453	90	Basalt	
12C2	Harold W. Alexander	02/03/87	--	NW	12	9N	27E	543	195	60	80	463	80	Basalt	
12E1	City of West Richland	12/17/02	SW	NW	12	9N	27E	522	20	--	>20	<502	>20		
12E2	City of West Richland	12/17/02	SW	NW	12	9N	27E	522	20	--	>20	<502	>20		
12F1	John C. McElroy	04/19/57	SE	NW	12	9N	27E	555	400	156	200	355	200	Basalt	
12F2	Harold W. Alexander	03/11/02	SE	NW	12	9N	27E	584	399	183	74	510	21	Sandy Clay	
12H1	Richland School District	08/24/17	SE	NE	12	9N	27E	625	30	>30	>30	<595	>30		
12H2	Richland School District	08/24/17	SE	NE	12	9N	27E	625	25	>25	>25	<595	>25		
12H3	Richland School District	08/24/17	SE	NE	12	9N	27E	625	25	>25	>25	<595	>25		
12H4	Richland School District	08/24/17	SE	NE	12	9N	27E	625	30	--	>30	<595	>30		
12H5	Richland School District	08/24/17	SE	NE	12	9N	27E	625	30	--	>30	<595	>30		
12H6	Richland School District	08/24/17	SE	NE	12	9N	27E	625	25	>25	>25	<595	>25		
12H7	Richland School District	08/24/17	SE	NE	12	9N	27E	625	30	--	>30	<595	>30		
12H8	Richland School District	08/24/17	SE	NE	12	9N	27E	625	30	--	>30	<595	>30		
12H9	Richland School District	08/24/17	SE	NE	12	9N	27E	625	30	--	>30	<595	>30		
12H10	Dan Knowlton	04/30/94	SE	NE	12	9N	27E	619	60	42	>60	<559	>60		

Notes:

[1] Water well reports observations are adapted from water well reports on file with the Washington State Department of Ecology.

[2] The owner as listed on the Water Well Report, which may or may not correspond with the current well owner.

[3] Well elevations were adapted from the U.S. Geological Survey and are provided relative to the North American Vertical Datum of 1988 (NAVD 88).

bgs = below ground surface; -- = not provided

Table D-2

Compilation of Test Pit Observations [1]

City of West Richland

Benton County, Washington

Exploration Designation	Investigation [2]	Designation by Initial Investigator	Date of Exploration	Total Depth (feet bgs)	Depth to Groundwater (feet bgs)	Depth to Limiting Stratigraphic Units			Summary - Limiting Stratigraphic Unit		Notes
						Depth to Top of Basalt (feet bgs)	Depth to Cementation (feet bgs)	Depth to Fine-Grained Sediment (feet bgs)	Depth to Top of Limiting Stratigraphic Unit (feet bgs)	Type of Limiting Stratigraphic Unit	
BHTP1	HDJ Design Group (2014)	TP-1	02/20/14	2.5	>2.5	2	--	--	2	Basalt	
BHTP2	HDJ Design Group (2014)	TP-2	02/20/14	15	>15	>15	2	--	2	Cementation/Stratification	
BHTP3	HDJ Design Group (2014)	TP-3	02/20/14	16	>16	>16	8	--	8	Caliche Layer	
BHTP4	HDJ Design Group (2014)	TP-4	02/20/14	12	>12	12	--	--	12	Basalt	
BHTP5	HDJ Design Group (2014)	TP-5	02/20/14	10	>10	10	--	--	10	Basalt	
BHTP6	HDJ Design Group (2014)	TP-6	02/20/14	9	>9	9	--	--	9	Basalt	
BHTP7	HDJ Design Group (2014)	TP-7	02/20/14	5	>5	5	2.5	--	2.5	Cementation/Stratification	
BHTP8	HDJ Design Group (2014)	TP-8	02/20/14	15	>15	>15	12	--	12	Cementation	
BHTP9	HDJ Design Group (2014)	TP-9	02/20/14	15	>15	>15	--	--	>15		
BHTP10	HDJ Design Group (2014)	TP-10	02/20/14	14	>14	>14	5	--	5	Cementation	
BHTP11	HDJ Design Group (2014)	TP-11	02/20/14	14	>14	>14	6	--	6	Cementation	
BHTP12	HDJ Design Group (2014)	TP-12	02/20/14	14	>14	>14	3	--	3	Cementation	
BHTP13	HDJ Design Group (2014)	TP-13	02/20/14	14	>14	>14	10	--	10	Cementation	
BHTP14	HDJ Design Group (2014)	TP-14	02/20/14	15	>15	>15	4	--	4	Cementation	
BHTP15	HDJ Design Group (2014)	TP-15	02/20/14	15	>15	>15	4	--	4	Cementation	
BHTP16	HDJ Design Group (2014)	TP-16	02/20/14	15	>15	>15	4	--	4	Cementation	
BHTP17	HDJ Design Group (2014)	TP-17	02/20/14	15	>15	>15	--	--	>15		
BHTP18	HDJ Design Group (2014)	TP-18	02/20/14	12	>12	>12	--	--	>12		
BHTP19	HDJ Design Group (2014)	TP-19	02/20/14	14	>14	>14	--	--	>14		Strong HCL reaction noted at 10 feet bgs.
BHTP20	HDJ Design Group (2014)	TP-20	02/20/14	14	>14	>14	--	--	>14		Strong HCL reaction noted at 12 feet bgs.
BHTP21	HDJ Design Group (2014)	TP-21	02/20/14	12	>12	>12	--	--	>12		Strong HCL reaction noted at 3 feet bgs.
BHTP22	HDJ Design Group (2014)	TP-22	02/20/14	12	>12	>12	--	--	>12		
BHTP23	HDJ Design Group (2014)	TP-23	02/20/14	12	>12	>12	--	--	>12		
BHTP24	HDJ Design Group (2014)	TP-24	02/20/14	12	>12	>12	--	--	>12		
BHTP25	HDJ Design Group (2014)	TP-25	02/20/14	6	>6	6	4	--	4	Cementation	Carbonate-cemented bedrock noted at 6 feet - interpreted as basalt.
BHTP26	HDJ Design Group (2014)	TP-26	02/20/14	12	>12	>12	--	--	>12		Strong HCL reaction noted at 4 feet bgs.
CHTP1	Shannon &Wilson, Inc. (2010)	TP-1	07/22/10	8	>8	>8	--	--	>8		
CHTP2	Shannon &Wilson, Inc. (2010)	TP-2	07/22/10	6	>6	>6	--	--	>6		
CHTP3	Shannon &Wilson, Inc. (2010)	TP-3	07/22/10	2	>2	2	--	--	2	Basalt	
CHTP4	Shannon &Wilson, Inc. (2010)	TP-4	07/22/10	6	>6	>6	--	--	>6		
CHTP5	Shannon &Wilson, Inc. (2010)	TP-5	07/22/10	9	>9	>9	--	--	>9		
CHTP6	Shannon &Wilson, Inc. (2010)	TP-6	07/22/10	2	>2	2	--	--	2	Basalt	
CHTP7	Shannon &Wilson, Inc. (2010)	TP-7	07/22/10	10	>10	>10	--	--	>10		
CHTP8	Shannon &Wilson, Inc. (2010)	TP-8	07/22/10	7	>7	>7	--	--	>7		
PETP1	Intermountain (2009)	TP-1	02/03/10	12.5	>12.5	>12.5	2	--	2	Cementation	Caliche layer noted at 2 feet bgs.
PETP2	Intermountain (2009)	TP-2	02/03/10	9	>9	>9	2	--	2	Cementation	Caliche layer noted at 2 feet bgs.
PETP3	Intermountain (2009)	TP-3	02/03/10	12	>12	>12	3	--	3	Cementation	Caliche layer noted at 3 feet bgs.
PETP4	Intermountain (2009)	TP-4	02/03/10	13	>13	>13	3	--	3	Cementation	
PETP5	Intermountain (2009)	TP-5	02/03/10	12	>12	>12	2	--	2	Cementation	
SHTP1	PBS Engineering + Environmental (2016)	TP-1	04/08/16	8	>8	>8	--	--	>8		Carbonate-stained gravel noted at 5 feet bgs, with overlying moist soil.
SHTP2	PBS Engineering + Environmental (2016)	TP-2	04/08/16	6	>6	>6	--	--	>6		
SHTP3	PBS Engineering + Environmental (2016)	TP-3	04/08/16	9.5	>9.5	>9.5	--	--	>9.5		Carbonate-stained gravel noted at 5 feet bgs, with overlying moist soil.
SHTP4	PBS Engineering + Environmental (2016)	TP-4	04/08/16	8.5	>8.5	>8.5	--	--	>8.5		
SHTP5	PBS Engineering + Environmental (2016)	TP-5	04/08/16	11	>11	>11	--	--	>11		
SHTP6	PBS Engineering + Environmental (2016)	TP-6	04/08/16	10	>10	>10	--	--	>10		
SHTP7	PBS Engineering + Environmental (2016)	TP-7	04/08/16	12.5	>12.5	>12.5	--	--	>12.5		
SHTP8	PBS Engineering + Environmental (2016)	TP-8	04/08/16	14	>14	>14	--	--	>14		
SHTP9	PBS Engineering + Environmental (2016)	TP-9	04/08/16	15.5	>15.5	>15.5	--	--	>15.5		
SHTP10	PBS Engineering + Environmental (2016)	TP-10	04/08/16	9.5	>9.5	>9.5	5	--	5	Cementation	
SHTP11	PBS Engineering + Environmental (2016)	TP-11	04/08/16	10.5	>10.5	>10.5	--	--	>10.5		

Exploration Designation	Investigation [2]	Designation by Initial Investigator	Date of Exploration	Total Depth (feet bgs)	Depth to Groundwater (feet bgs)	Depth to Limiting Stratigraphic Units			Summary - Limiting Stratigraphic Unit		Notes
						Depth to Top of Basalt (feet bgs)	Depth to Cementation (feet bgs)	Depth to Fine-Grained Sediment (feet bgs)	Depth to Top of Limiting Stratigraphic Unit (feet bgs)	Type of Limiting Stratigraphic Unit	
WWTP1	Intermountain (2011)	TP-1	01/06/11	8	>8	>8	--	--	>8		Soil described as very dense below 5.5 feet bgs.
WWTP2	Intermountain (2011)	TP-2	01/06/11	9	>9	>9	--	--	>9		Soil described as very dense below 5 feet bgs.
WWTP3	Intermountain (2011)	TP-3	01/06/11	8	>8	>8	--	--	>8		Soil described as dense to very dense below 3.5 feet bgs.
WWTP4	Intermountain (2011)	TP-4	01/06/11	8	>8	>8	--	--	>8		Soil described as very dense below 2 feet bgs.

Notes:

[1] Test pit observations are adapted from geotechnical reports provided by the City of West Richland.

[2] Investigation references:

HDJ Design Group, 2014. Geotechnical investigation report, Belmont Heights, West Richland, Washington. Report prepared by HDJ Design Group, PLLC of Pasco, Wash. April.

Intermountain Materials Testing & Geotechnical, 2011. REPORT, Field Permeability Testing, Proposed Westwood Development,Ironton Drive, West Richland, WA. Reported prepared by Intermountain Materials Testing & Geotechnical, Pasco, Wash. for Hayden Homes, LLC, Redmond, Oregon. January 11.

Intermountain Materials Testing & Geotechnical, 2009. REPORT, Field Permeability Testing, Proposed Paradise Estates Development, Paradise Way and Belmont Blvd, West Richland, WA. Reported prepared by Intermountain Materials Testing & Geotechnical, Pasco, Wash. for KDS Development LLC, Issaquah, Wash. February 10.

PBS Engineering + Environmental, 2016. Preliminary Geotechnical Engineering Report, Sunset Heights Development, Benton County Parcel 101971000004000, West Richland, Washington. Reported prepared by PBS Engineering + Environmental, Richland, Wash. for Epic Development, Richland, Wash. May 31.

Shannon & Wilson, Inc., 2010. Geotechnical engineering study: Collins Heights Subdivision, Phase 1, West Richland, Washington. Report prepared by Shannon & Wilson, Inc., Richland, Wash. for Tetra Tech Engineering and Architecture Services, Richland, Wash., September 7.

bgs = below ground surface

APPENDIX E
Field and Laboratory Procedures

APPENDIX E
FIELD AND LABORATORY PROCEDURES

Site Exploration

Subsurface conditions within the DPA were explored between May 14 and May 20, 2019 by drilling 13 borings (B-1 through B-5 and MW-1 through MW-8) to depths in the range of about 20 to 30 feet using sonic drilling methods. A test pit (TP-1) was excavated on June 4, 2019 to a depth of 10 feet. The approximate locations of the explorations are shown in Figure 2. Drilling, well installation, and excavation activities were continuously monitored by a geologist from our firm who collected, examined, and classified representative sediment samples and maintained a detailed log of the explorations. During drilling, continuous core samples of sediment were obtained using a 4.5-inch-diameter sampler. The geologist took a photograph of each core sample shortly upon removal from the core sampler.

Boring locations B-1 through B-5 were determined using GPS. Monitoring well locations (MW-1 through MW-8) and elevations were surveyed by Stratton Surveying and Mapping, PC of Kennewick, Washington. Locations and elevations are referenced to the ROS 3910 datum.

Sediment was classified in general accordance with the Unified Soil Classification System described in Figure E-1. The boring and well construction logs for the borings, monitoring wells and test pit are presented in Figures E-2 through E-15.

Monitoring Well Construction and Development

Monitoring wells MW-1 through MW-8 were constructed using 2-inch-inside-diameter Schedule 40 PVC riser and well screen material. Well screen slot size was about 0.010 inches. Processed 12-20 silica sand was used as filter pack. Bentonite chips were used as impermeable backfill. At the ground surface, the wells are protected by locking, steel, flush-mount monuments (MW-1 and MW-2) or stick-up monuments (MW-3 through MW-8).

After installation, the monitoring wells that contained water were developed by a combination of pumping and surging until purge water was relatively clear and free of suspended sediment.

Laboratory Testing

Sediment samples obtained from the explorations were returned to our laboratory for further examination and testing. Gradation tests by ASTM International (ASTM) C136 were conducted on representative sediment samples. Results of ASTM C136 analyses are presented in Sieve Analysis Results, Figures E-16 through E-22.

Groundwater Levels

Manual groundwater level measurements were obtained using Solinst Model 101 electric water level meters, or equivalent. The polyethylene tapes were clearly marked allowing measurements with a precision of 0.01 feet, which was recorded in field sheets concurrent with time. Groundwater elevations were calculated by subtracting the depth to water from the reference elevations.

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% RETAINED ON NO. 200 SIEVE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS
				SP	POORLY-GRADED SANDS, GRAVELLY SAND
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% PASSING NO. 200 SIEVE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS, ROCK FLOUR, CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS AND SILTS OF MEDIUM TO HIGH PLASTICITY
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: Multiple symbols are used to indicate borderline or dual soil classifications

ADDITIONAL MATERIAL SYMBOLS

SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
	AC	Asphalt Concrete
	CC	Cement Concrete
	CR	Crushed Rock/ Quarry Spalls
	SOD	Sod/Forest Duff
	TS	Topsoil

Groundwater Contact

Measured groundwater level in exploration, well, or piezometer

Measured free product in well or piezometer

Graphic Log Contact

Distinct contact between soil strata

Approximate contact between soil strata

Material Description Contact

Contact between geologic units

Contact between soil of the same geologic unit

Sampler Symbol Descriptions

- 2.4-inch I.D. split barrel
- Standard Penetration Test (SPT)
- Shelby tube
- Piston
- Direct-Push
- Bulk or grab
- Continuous Coring

Blowcount is recorded for driven samplers as the number of blows required to advance sampler 12 inches (or distance noted). See exploration log for hammer weight and drop.

"P" indicates sampler pushed using the weight of the drill rig.

"WOH" indicates sampler pushed using the weight of the hammer.

Laboratory / Field Tests

%F	Percent fines
%G	Percent gravel
AL	Atterberg limits
CA	Chemical analysis
CP	Laboratory compaction test
CS	Consolidation test
DD	Dry density
DS	Direct shear
HA	Hydrometer analysis
MC	Moisture content
MD	Moisture content and dry density
Mohs	Mohs hardness scale
OC	Organic content
PM	Permeability or hydraulic conductivity
PI	Plasticity index
PL	Point lead test
PP	Pocket penetrometer
SA	Sieve analysis
TX	Triaxial compression
UC	Unconfined compression
VS	Vane shear

Sheen Classification

NS	No Visible Sheen
SS	Slight Sheen
MS	Moderate Sheen
HS	Heavy Sheen

NOTE: The reader must refer to the discussion in the report text and the logs of explorations for a proper understanding of subsurface conditions. Descriptions on the logs apply only at the specific exploration locations and at the time the explorations were made; they are not warranted to be representative of subsurface conditions at other locations or times.

Key to Exploration Logs

GEOENGINEERS

Figure E-1

Drilled	Start 5/14/2019	End 5/14/2019	Total Depth (ft) 20	Logged By JT / Checked By JR	Driller Environmental West	Drilling Method Sonic - 6-in-diameter casing
Surface Elevation (ft) / Vertical Datum	Undetermined / ROS 3910		Hammer Data		Drilling Equipment	Schramm Sonic Drill
Easting (X) / Northing (Y)			System Datum	ROS 3910	Groundwater not observed at time of exploration	

Notes:

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0		96					SM	Brown silty fine sand with trace gravel; weakly cemented, micaceous (dense, dry to moist) (Ringold Formation)			
	5					1 SA				12	26	
						2						
			72					GW-GM	Brown fine to coarse gravel with silt and sand; weakly cemented, micaceous (dense, moist) (Ringold Formation)			Borehole percolation test conducted with casing at 8.8 feet
	10					3 SA				5	9	
			48			4						
	15					5						
			24			6						
	20											

Note: See Figure E-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on (undetermined). Vertical approximated based on (undetermined).

Log of Boring B-1

GEOENGINEERS

Project: DPA Phase 2
Project Location: West Richland, Washington
Project Number: 3234-005-02

Figure E-2
Sheet 1 of 1

Date:8/19/19 Path:W:\PROJECTS\3\3234005\GINT\32340050 2.GPJ DBLibrary/Library:GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEI8_GEOTECH_STANDARD_%F_NO_GW

Drilled	Start 5/15/2019	End 5/15/2019	Total Depth (ft) 28	Logged By JT / Checked By JR	Driller Environmental West	Drilling Method Sonic - 6-in-diameter casing
Surface Elevation (ft) / Vertical Datum	Undetermined / ROS 3910		Hammer Data		Drilling Equipment	Schramm Sonic Drill
Easting (X) / Northing (Y)			System Datum	ROS 3910	Groundwater not observed at time of exploration	

Notes:

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0		60			1		GW-GM	Brown fine to coarse gravel with silt and sand (dense, dry) (Ringold Formation)			
						2			Weakly cemented from 3½ to 4 feet			Borehole percolation test conducted with casing 4.3 feet
	5		36									
			60			3 SA		GP	Brown to gray fine to coarse gravel with silt and sand (dense, dry) (Ringold Formation)	6	6	
						4		GM	Brown silty fine gravel with sand (dense, moist) (Ringold Formation) Red oxidation staining from 9 to 10 feet			
	10							SM	Brown silty fine sand with gravel (dense, moist) (Ringold Formation)			
						5 SA				17	25	
			66									
	15					6						
						7						
			48			8		GC	Brown to gray clayey fine gravel with silt and sand (dense, moist) (Ringold Formation)			
	20					9		SP	Brown fine to medium sand with trace silt and gravel; micaceous (dense, moist) (Ringold Formation)			
			72			10		ML	Brown silt with clay and trace sand (hard, dry to moist) (Ringold Formation)			
	25											

Note: See Figure E-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on (undetermined). Vertical approximated based on (undetermined).

Log of Boring B-2

GEOENGINEERS

Project: DPA Phase 2
Project Location: West Richland, Washington
Project Number: 3234-005-02

Figure E-3
Sheet 1 of 1

Date:8/19/19 Path:W:\PROJECTS\3\3234005\GINT\32340052.GPJ DBLibrary/Library:GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEI8_GEOTECH_STANDARD_%F_NO_GW

Drilled	Start 5/21/2019	End 5/21/2019	Total Depth (ft) 20	Logged By JT / Checked By JR	Driller Environmental West	Drilling Method Sonic - 6-in-diameter casing
Surface Elevation (ft) / Vertical Datum	Undetermined / ROS 3910		Hammer Data		Drilling Equipment	Schramm Sonic Drill
Easting (X) / Northing (Y)			System Datum	ROS 3910	Groundwater not observed at time of exploration	

Notes:

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0		60					AC	2 inches asphalt concrete pavement			
						1		SP	Brown fine to medium sand with trace silt (medium dense, moist) (dune deposits)			
								SM	Brown silty fine sand with gravel, calcareous cementation (dense, moist) (Ringold Formation)	5	22	
						2 SA						
						3 4		SP	Brown fine to medium sand with trace silt; calcareous cementation (dense, moist) (Ringold Formation)			
	5		36					GP	Brown to tan fine to coarse gravel with trace silt and sand; calcareous cementation dense, moist) (Ringold Formation)			
						5			Yellowish brown oxidation at 7 feet			
			60					GP-GM	Yellowish brown fine to coarse gravel with silt, sand and occasional cobbles; calcareous cementation (dense, moist to wet) (Ringold Formation)			
	10					6						
						7						
			84						No calcareous cementation below 13 feet			
	15					8 SA				5	8	
						9						
	20											

Note: See Figure E-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on (undetermined). Vertical approximated based on (undetermined).

Log of Boring B-3

GEOENGINEERS

Project: DPA Phase 2
Project Location: West Richland, Washington
Project Number: 3234-005-02

Figure E-4
Sheet 1 of 1

Date:8/19/19 Path:W:\PROJECTS\3\3234005\GINT\32340050 2.GPJ DBLibrary/Library:GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEI8_GEOTECH_STANDARD_%F_NO_GW

Drilled Start / End	Total Depth (ft) 25	Logged By JT / Checked By JR	Driller Environmental West	Drilling Method Sonic - 6-in-diameter casing
Surface Elevation (ft) / Vertical Datum	Undetermined / ROS 3910	Hammer Data		Drilling Equipment Schramm Sonic Drill
Easting (X) / Northing (Y)		System Datum	ROS 3910	Groundwater not observed at time of exploration
Notes:				

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0		30					SM	Dark brown silty fine sand with gravel (loose) (dune deposits)			
						1		GM	Dark brown silty fine to coarse gravel with sand (loose, moist) (Ringold Formation - reworked)			
			30			2		SM	Dark brown silty fine sand with gravel (loose) (Ringold Formation - reworked)			
						3		ML	Light brown silt with clay, sand and trace gravel (hard, moist) (Ringold Formation)			
	5		24			4						
						5		GW	Yellowish fine gravel with sand (dense, dry) (Ringold Formation)			
						6		GP-GM	Light brown fine to coarse gravel with silt and sand (dense, moist) (Ringold Formation)			Borehole percolation test conducted with casing at 6.3 feet
			60			7 SA				5	6	
						8						
	10					9						
			60					GP	Light brown fine to coarse gravel with sand and trace silt (dense, moist) (Ringold Formation)			
	15					10 SA				5	5	
						11		ML	Brown silt with sand, gravel and trace clay (medium hard, moist) (Ringold Formation)			
			72					GM	Brown silty fine to coarse gravel with sand (dense, wet) (Ringold Formation)			
	20					12						
			24									
	25					13			Thin silt layer from 23.9 to 24 feet Dry below 24 feet			

Note: See Figure E-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on (undetermined). Vertical approximated based on (undetermined).

Log of Boring B-4

GEOENGINEERS

Project: DPA Phase 2
Project Location: West Richland, Washington
Project Number: 3234-005-02

Figure E-5
Sheet 1 of 1

Date:8/19/19 Path:W:\PROJECTS\3\3234005\GINT\32340050 2.GPJ DBLibrary/Library:GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEI8_GEOTECH_STANDARD_%F_NO_GW

Drilled	Start 5/20/2019	End 5/20/2019	Total Depth (ft) 20	Logged By JT / Checked By JR	Driller Environmental West	Drilling Method Sonic - 6-in-diameter casing
Surface Elevation (ft) / Vertical Datum	Undetermined / ROS 3910		Hammer Data		Drilling Equipment	Schramm Sonic Drill
Easting (X) / Northing (Y)			System Datum	ROS 3910	Groundwater not observed at time of exploration	

Notes:

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0		60					AC	2 inches asphalt concrete pavement			
						1		GP-GM	Brown fine to coarse gravel with silt, sand and occasional cobbles; calcareous cementation (dense, moist) (Ringold Formation)			
						2						
	5		60			3 SA				7	10	
						4		SP	Brown fine to medium sand with trace silt; calcareous cementation (dense, moist) (Ringold Formation)			
						5		SP-SM	Brown fine to coarse sand with silt and gravel (dense, moist) (Ringold Formation)			
	10		96						Becomes moist to wet			
						6		SP-SM	Brown fine to coarse sand with silt and gravel; calcareous cementation (dense, moist) (Ringold Formation)			
	15					7 SA		SP-SM	Brown fine to coarse sand with silt and occasional gravel; calcareous cementation (dense, moist) (Ringold Formation)	14	6	
						8		SP-SM	Brown fine to medium sand with silt; calcareous cementation (dense, moist to wet) (Ringold Formation)			
			24			9		SP	Brown fine to medium sand with trace silt; calcareous cementation (dense, moist) (Ringold Formation)			
	20											

Note: See Figure E-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on (undetermined). Vertical approximated based on (undetermined).

Log of Boring B-5

GEOENGINEERS

Project: DPA Phase 2
Project Location: West Richland, Washington
Project Number: 3234-005-02

Figure E-6
Sheet 1 of 1

Date:8/19/19 Path:W:\PROJECTS\3\3234005\GINT\32340052.GPJ DBLibrary/Library:GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEI8_GEOTECH_STANDARD_%F_NO_GW

Drilled	Start 5/13/2019	End 5/13/2019	Total Depth (ft)	30	Logged By / Checked By	JT / JR	Driller	Environmental West	Drilling Method	Sonic - 6-in-diameter casing

Hammer Data		Drilling Equipment	Schramm Sonic Drill
Surface Elevation (ft) / Vertical Datum	570.03 / ROS 3910	Top of Casing Elevation (ft)	572.53
Easting (X) / Northing (Y)	1925589.51 / 353644.12	Horizontal Datum	ROS 3910

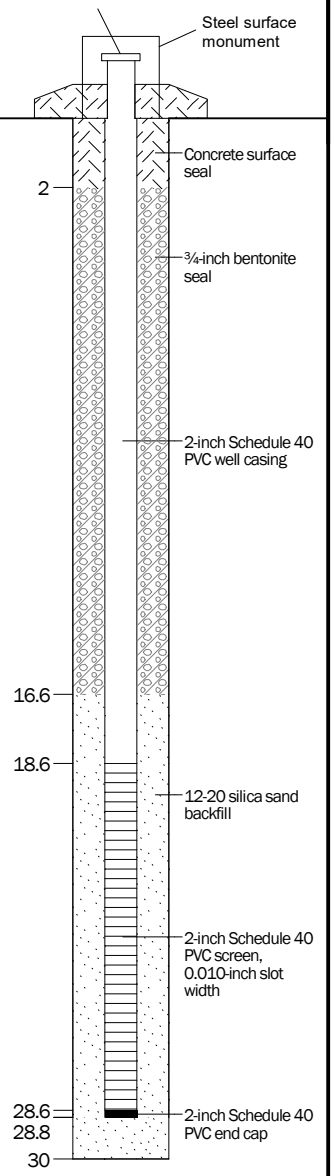
A 2-in well was installed on 5/13/2019 to a depth of 28.6 ft.

Groundwater Date Measured	Depth to Water (ft)	Elevation (ft)
5/27/19	Dry	

Notes: Borehole percolation tests were conducted with casing at 10.8 and 18.2 feet

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)
	0		78			1			GM	Brown silty fine to coarse gravel (loose, dry) (fill)		
									SP	Brown fine to medium sand with trace silt and gravel (loose, moist) (dune deposits)		
565	5		30			2			GW-GM	Light brown fine to coarse gravel with silt and sand; calcareous cementation (very dense, dry) (Ringold Formation)		
						3			SM	Brown silty fine sand; loosely cemented (dense, moist) (Ringold Formation)		
			72			4						
560	10					5 SA			SM	Brown silty fine sand; micaceous, uncemented (dense, dry) (Ringold Formation)	5	3
			48			6						
555	15					7						
			60			8			GW	Brown fine to coarse gravel with trace silt and sand; calcareous cementation (dense, dry) (Ringold Formation)		
									GW-GM	Brown fine to coarse gravel with silt and sand; loosely cemented (dense, dry) (Ringold Formation)		
550	20					9						
						10						
			24			11			SP	Dark gray medium to coarse sand with trace silt and gravel (dense, moist to wet) (Ringold Formation)		
						12			SP-SM			
545	25		60			13			GM	Brown fine sand with silt (dense, dry to moist) (Ringold Formation)		
									SP-SM	Brown silty gravel		
										Brown fine sand with silt (dense, dry to moist) (Ringold Formation)		
						14			SP-SM	Brown fine to medium sand with silt; micaceous, loosely cemented (dense, dry to moist) (Ringold Formation)		
	30											

WELL LOG



Note: See Figure E-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Locational Survey. Vertical approximated based on Locational Survey.

Log of Monitoring Well MW-1

GEOENGINEERS

Project: DPA Phase 2
Project Location: West Richland, Washington
Project Number: 3234-005-02

Figure E-7
Sheet 1 of 1

Date:8/19/19 Path:W:\PROJECTS\3\3234005\GINT\323400502.GPJ DBLibrary/Library:GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEI8_GEOTECH_WELL_%F

Drilled	Start 5/13/2019	End 5/13/2019	Total Depth (ft)	28	Logged By / Checked By	JT / JR	Driller	Environmental West	Drilling Method	Sonic - 6-in-diameter casing

Hammer Data		Drilling Equipment	Schramm Sonic Drill
Surface Elevation (ft) / Vertical Datum	571.21 / ROS 3910	Top of Casing Elevation (ft)	573.84
Easting (X) / Northing (Y)	1925604.32 / 353576.59	Horizontal Datum	ROS 3910

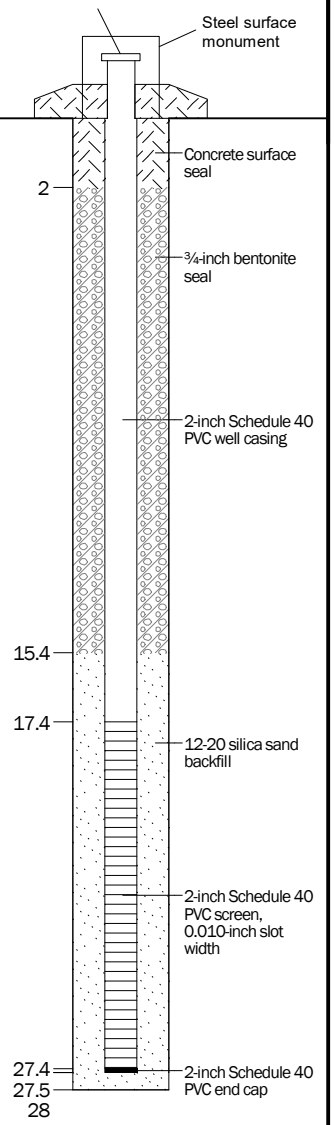
A 2-in well was installed on 5/13/2019 to a depth of 27.4 ft.

Groundwater Date Measured	Depth to Water (ft)	Elevation (ft)
5/27/19	Dry	

Notes: Borehole percolation tests were conducted with casing at 5.6 and 19.0 feet

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)
570	0		60			1			SM	Dark brown silty fine sand with gravel; micaceous (loose, wet) (dune deposits)		
						2			SM	Gray to brown silty fine sand with gravel; cemented (dense, dry to moist) (Ringold Formation)		
565	5		36			3			SP-SM	Brown fine sand with silt; micaceous, weakly cemented (dense, dry) (Ringold Formation)		
			24			4			SM	Brown silty fine sand; micaceous, uncemented (dense, moist) (Ringold Formation)		
560	10		72			5 SA					21	18
						6			GM	Light brown silty fine gravel with sand; micaceous (loose, dry) (Ringold Formation)		
						7			SM	Brown silty fine sand; micaceous, moderately cemented (dense, dry) (Ringold Formation)		
555	15		24									
			36									
550	20		48			8						
						9			GM	Brown to gray silty fine to coarse gravel with sand (dense, moist) (Ringold Formation)		
545	25		36			10						
						11 SA					7	15
						12				With trace clay		
						13			GW-GM	Brown fine to coarse gravel with silt and sand (dense, dry to moist) (Ringold Formation)		

WELL LOG



Note: See Figure E-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Locational Survey. Vertical approximated based on Locational Survey.

Log of Monitoring Well MW-2

GEOENGINEERS

Project: DPA Phase 2
Project Location: West Richland, Washington
Project Number: 3234-005-02

Figure E-8
Sheet 1 of 1

Date:8/19/19 Path:W:\PROJECTS\3\3234005\GINT\32340050 2.GPJ DBLibrary:Library:GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEI8_GEOTECH_WELL_%F

Drilled	Start 5/16/2019	End 5/16/2019	Total Depth (ft)	20	Logged By / Checked By	JT / JR	Driller	Environmental West	Drilling Method	Sonic - 6-in-diameter casing

Hammer Data		Drilling Equipment	Schramm Sonic Drill
Surface Elevation (ft) Vertical Datum	643.3 ROS 3910	Top of Casing Elevation (ft)	643.12
Easting (X) Northing (Y)	1926212.22 352623.5	Horizontal Datum	ROS 3910

A 2-in well was installed on 5/16/2019 to a depth of 20.1 ft.

Groundwater Date Measured	Depth to Water (ft)	Elevation (ft)
5/27/2019	7.33	635.97

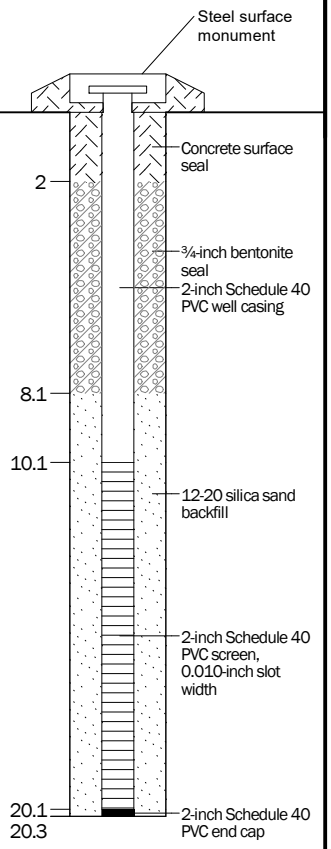
Notes:

FIELD DATA

Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)
0		84			1			GM	Brown silty fine to coarse gravel with sand (dense, dry) (Ringold Formation)		
									Weakly cemented from 3½ to 6 feet		
5		18			2 3 SA	▼				6	17
		72			4				Becomes moist at 9 feet		
10								GW	Red and yellow fine gravel with sand; oxidized (dense, wet) (Ringold Formation)		
15		66			5			GW-GM	Brown to red fine to coarse gravel with silt and sand; oxidized (dense, wet) (Ringold Formation)		
					6			GM	Brown silty fine to coarse gravel with trace sand (dense, wet) (Ringold Formation)		
								GP-GM	Dark brown to gray fine to coarse gravel with silt and sand (dense, wet) (Ringold Formation)	8	6
20					7 SA 8			GM	Brown to gray silty fine to coarse gravel with sand (dense, wet) (Ringold Formation)		

Elevation (feet): 640, 635, 630, 625

WELL LOG



Note: See Figure E-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Locational Survey. Vertical approximated based on Locational Survey.

Log of Monitoring Well MW-3

GEOENGINEERS

Project: DPA Phase 2
Project Location: West Richland, Washington
Project Number: 3234-005-02

Figure E-9
Sheet 1 of 1

Date:8/19/19 Path:W:\PROJECTS\3\3234005\GINT\32340502.GPJ DBLibrary/Library:GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEI8_GEOTECH_WELL_%F

Drilled	Start 5/16/2019	End 5/16/2019	Total Depth (ft)	20	Logged By / Checked By	JT / JR	Driller	Environmental West	Drilling Method	Sonic - 6-in-diameter casing

Hammer Data		Drilling Equipment	Schramm Sonic Drill
Surface Elevation (ft) Vertical Datum	649.46 ROS 3910	Top of Casing Elevation (ft)	649.04
Easting (X) Northing (Y)	1924403.39 352276.23	Horizontal Datum	ROS 3910

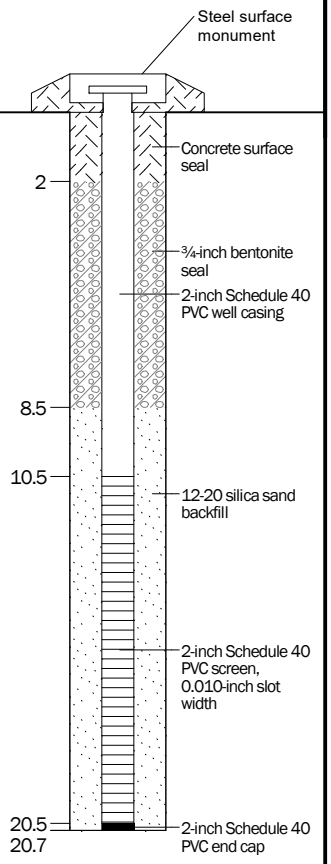
A 2-in well was installed on 5/16/2019 to a depth of 20.5 ft.

Groundwater Date Measured	Depth to Water (ft)	Elevation (ft)
5/27/19	Dry	

Notes: A borehole percolation test was conducted with casing at 10.7 feet

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)
	0		96						GP	Dark brown fine to coarse gravel with sand and trace silt; weakly cemented (loose, dry to moist) (Ringold Formation - reworked)		
645						1 SA 2			SM	Brown silty fine sand (loose, moist) (Ringold Formation - reworked)	3	4
	5								GW	Brown fine to coarse gravel with trace silt and sand; weakly cemented (loose, moist) (Ringold Formation - reworked)		
			24			3						
640												
	10		48						SM	Brown silty fine sand; uncemented (loose, dry) (Ringold Formation - reworked)		
									GW	Brown fine to coarse gravel with trace silt and sand (loose, dry) (Ringold Formation - reworked)		
						4			SM	Brown silty fine sand; uncemented (loose, dry) (Ringold Formation - reworked)		
635						5			GW-GM	Brown fine to coarse gravel with silt and sand; weakly cemented (dense, moist) (Ringold Formation)		
	15		36			6			ML	Brown sandy silt; uncemented (hard, moist) (Ringold Formation)		
			36			7 SA 8					12	7
630												
	20					9			GM	Tan silty fine to coarse gravel with sand; calcareous cementation (caliche) (dense, dry)		

WELL LOG



Note: See Figure E-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Locational Survey. Vertical approximated based on Locational Survey.

Log of Monitoring Well MW-4

GEOENGINEERS

Project: DPA Phase 2
Project Location: West Richland, Washington
Project Number: 3234-005-02

Figure E-10
Sheet 1 of 1

Date:8/19/19 Path:W:\PROJECTS\3\3234005\GINT\32340050 2.GPJ DBLibrary/Library:GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEI8_GEOTECH_WELL_%F

Drilled	Start 5/20/2019	End 5/20/2019	Total Depth (ft)	20	Logged By / Checked By	JT / JR	Driller	Environmental West	Drilling Method	Sonic - 6-in-diameter casing

Hammer Data		Drilling Equipment	Schramm Sonic Drill
Surface Elevation (ft) Vertical Datum	629.7 ROS 3910	Top of Casing Elevation (ft)	629.54
Easting (X) Northing (Y)	1927875.65 352793.57	Horizontal Datum	ROS 3910

A 2-in well was installed on 5/13/2019 to a depth of 20.1 ft.

Groundwater Date Measured	Depth to Water (ft)	Elevation (ft)
5/27/2019	4.94	624.76

Notes:

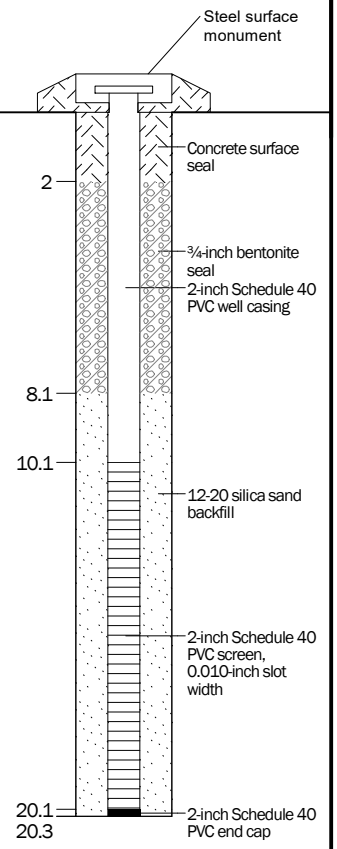
FIELD DATA

Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)
	72			1			SM	Brown fine sand with trace gravel (loose) (dune deposits)		
							GM	Dark brown silty fine to coarse gravel with sand (dense, moist) (Ringold Formation)		
				2 SA	▼		SM	Brown silty fine to coarse sand with gravel; calcareous cementation (dense, moist) (Ringold Formation)	6	15
	12									
	48			3			GW	Brown fine to coarse gravel with trace silt and sand (dense, wet) (Ringold Formation)		
				4				Reddish brown staining from 8 to 8½ feet		
							GM	Brown to gray silty fine to coarse gravel with sand (dense, moist) (Ringold Formation)		
							GP-GM	Brown fine to coarse gravel with silt and sand; micaceous (dense, moist) (Ringold Formation)		
	48			5						
				6 SA				Red staining from 14 to 16 feet	11	6
	24			7						
	36			8						
				9			SP	Yellow-brown fine to medium sand with trace silt; micaceous (dense, wet) (Ringold Formation)		

Elevation (feet): 625, 620, 615, 610

Depth (feet): 0, 5, 10, 15, 20

WELL LOG



Note: See Figure E-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Locational Survey. Vertical approximated based on Locational Survey.

Log of Monitoring Well MW-5

GEOENGINEERS

Project: DPA Phase 2
Project Location: West Richland, Washington
Project Number: 3234-005-02

Figure E-11
Sheet 1 of 1

Date:8/19/19 Path:W:\PROJECTS\3\3234005\GINT\32340502.GPJ DBLibrary/Library:GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEI8_GEOTECH_WELL_%F

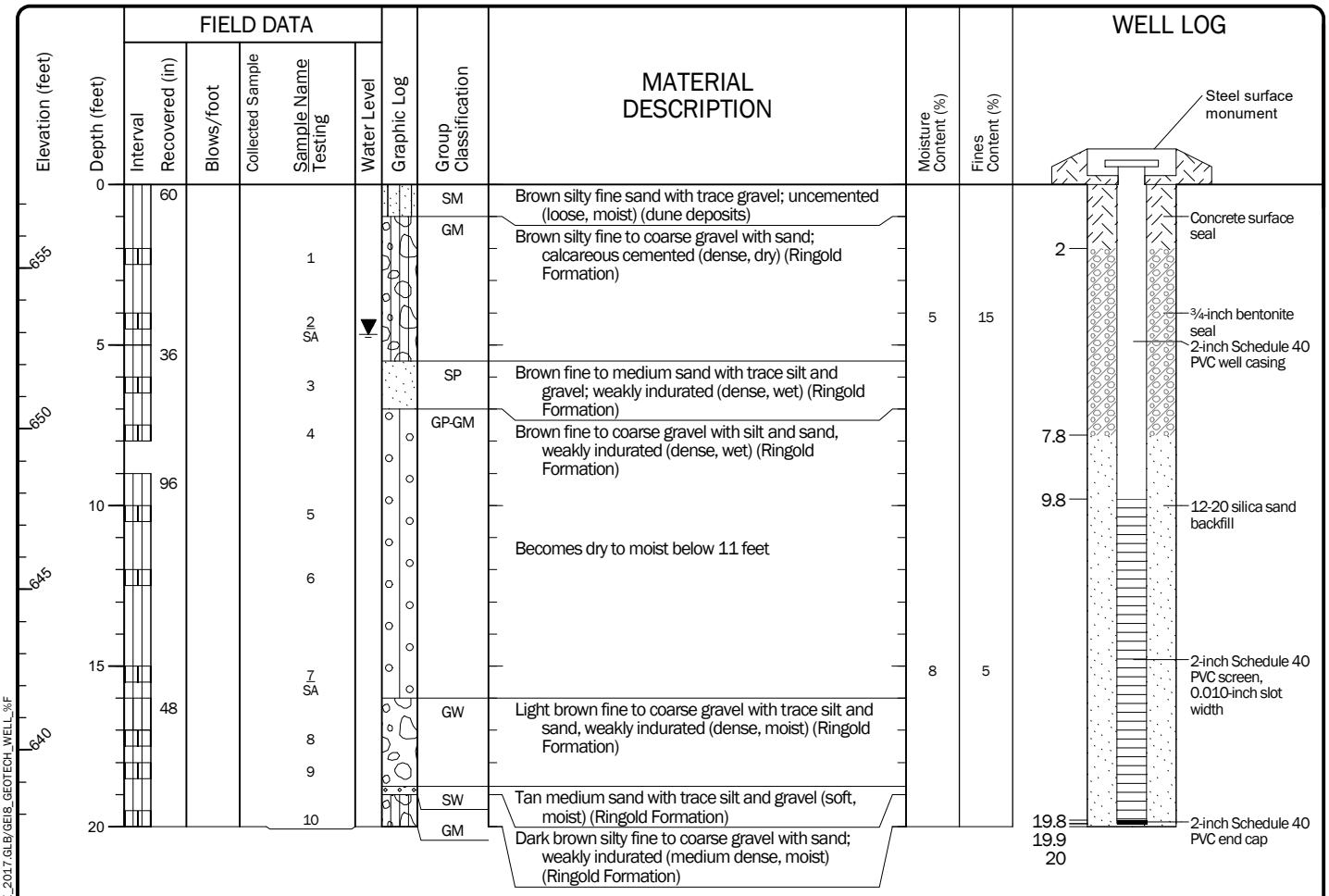
Drilled	Start 5/17/2019	End 5/17/2019	Total Depth (ft)	20	Logged By / Checked By	JT / JR	Driller	Environmental West	Drilling Method	Sonic - 6-in-diameter casing

Hammer Data		Drilling Equipment	Schramm Sonic Drill
Surface Elevation (ft) / Vertical Datum	657.61 / ROS 3910	Top of Casing Elevation (ft)	657.34
Easting (X) / Northing (Y)	1925552.12 / 350648.24	Horizontal Datum	ROS 3910

A 2-in well was installed on 5/17/2019 to a depth of 19.8 ft.

Groundwater Date Measured	Depth to Water (ft)	Elevation (ft)
5/27/2019	4.68	652.93

Notes:



Note: See Figure E-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Locational Survey. Vertical approximated based on Locational Survey.

Log of Monitoring Well MW-6

GEOENGINEERS

Project: DPA Phase 2
Project Location: West Richland, Washington
Project Number: 3234-005-02

Figure E-12
Sheet 1 of 1

Date:8/19/19 Path:W:\PROJECTS\3\3234005\GINT\32340050 2.GPJ DBLibrary/Library:GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEI8_GEOTECH_WELL_%F

Drilled	Start 5/20/2019	End 5/20/2019	Total Depth (ft)	20	Logged By / Checked By	JT / JR	Driller	Environmental West	Drilling Method	Sonic - 6-in-diameter casing

Hammer Data		Drilling Equipment	Schramm Sonic Drill
Surface Elevation (ft) Vertical Datum	655.4 ROS 3910	Top of Casing Elevation (ft)	654.92
Easting (X) Northing (Y)	1925889.48 350290.22	Horizontal Datum	ROS 3910

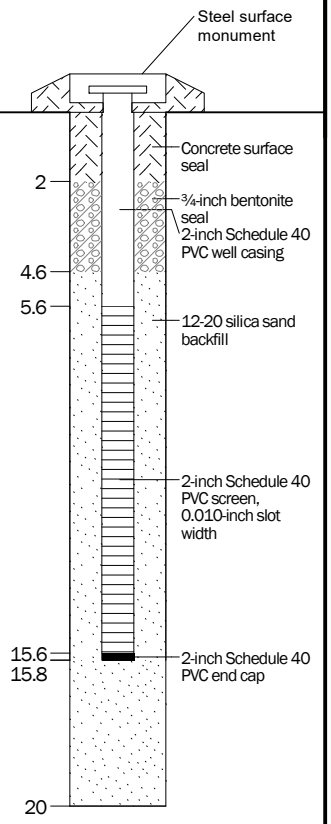
A 2-in well was installed on 5/20/2019 to a depth of 15.6 ft.

Groundwater Date Measured	Depth to Water (ft)	Elevation (ft)
5/27/2019	3.28	652.12

Notes:

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)
655	0		78			1			AC	2½ inches asphalt concrete pavement		
									GP	Gray fine to coarse gravel with trace silt and sand (moist) (base course)		
							▼		GP	Brown fine to coarse gravel with trace silt and sand (dense, moist) (Ringold Formation)		
						2			CL	White clay with gravel (dense, moist) (Ringold Formation)		
650	5		18			3 SA 4			GM	Gray silty fine to coarse gravel with sand; calcareous cementation (dense, moist) (Ringold Formation)	7	18
			84			5 SA			GW	Brown to red fine to coarse gravel with sand, trace silt and occasional cobbles; calcareous cementation, micaceous (dense, moist) (Ringold Formation)	7	3
645	10					6				No calcareous cementation below 9 feet		
640	15		60			7			CL	Brown silty clay; moderately indurated (hard, moist) (Ringold Formation)		
	20					8						

WELL LOG



Note: See Figure E-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Locational Survey. Vertical approximated based on Locational Survey.

Log of Monitoring Well MW-7

GEOENGINEERS

Project: DPA Phase 2
Project Location: West Richland, Washington
Project Number: 3234-005-02

Figure E-13
Sheet 1 of 1

Date:8/19/19 Path:W:\PROJECTS\3\3234005\GINT\32340052.GPJ DBLibrary/Library:GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEI8_GEOTECH_WELL_%F

Drilled	Start 5/17/2019	End 5/17/2019	Total Depth (ft)	20	Logged By / Checked By	JT / JR	Driller	Environmental West	Drilling Method	Sonic - 6-in-diameter casing

Hammer Data		Drilling Equipment	Schramm Sonic Drill
Surface Elevation (ft) Vertical Datum	652.35 ROS 3910	Top of Casing Elevation (ft)	652.00
Easting (X) Northing (Y)	1926491.82 349972.69	Horizontal Datum	ROS 3910

A 2-in well was installed on 5/17/2019 to a depth of 19.5 ft.

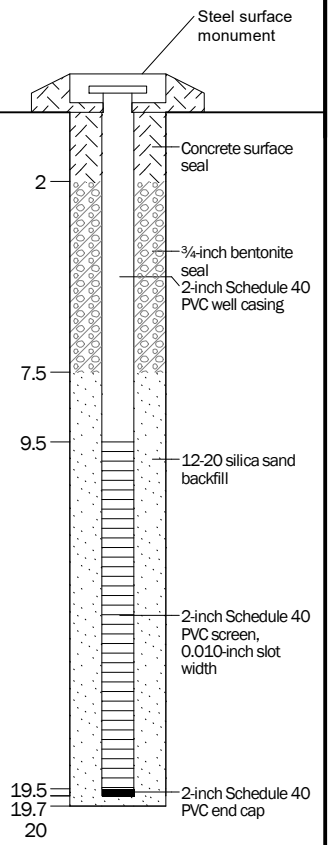
Groundwater Date Measured	Depth to Water (ft)	Elevation (ft)
5/29/2019	2.61	649.74

Notes:

FIELD DATA

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)
	0		60						SM	Gray silty fine sand with trace gravel (loose, moist) (dune deposits)		
									GW-GM	Brown to gray fine to coarse gravel with silty and sand; calcareous cementation (loose, moist) (Ringold Formation - reworked)		
650						1	▼					
						2			GM	Tan silty fine gravel; calcareous cementation, relic caliche texture (dense, moist) (Ringold Formation)		
						3			GW-GM			
	5		36							Brown to gray fine to coarse gravel with silt and sand; calcareous cementation (dense, dry to moist) (Ringold Formation)		
						4						
645						5			GP-GM	Light brown fine to coarse gravel with silt and sand; weakly indurated (dense, moist) (Ringold Formation)		
			150									
	10					6 SA					7	9
640						7			GM	Dark brown silty fine to coarse gravel; weakly indurated (dense, moist) (Ringold Formation)		
									GW-GM	Brown fine to coarse gravel with silt and sand; weakly indurated (dense, moist) (Ringold Formation)		
	15					8						
			48									
635						9 SA			GP	Brown fine to coarse gravel with sand and trace silt (dense, wet) (Ringold Formation)	11	3
						10						
	20											

WELL LOG



Note: See Figure E-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Locational Survey. Vertical approximated based on Locational Survey.

Log of Monitoring Well MW-8

GEOENGINEERS

Project: DPA Phase 2
Project Location: West Richland, Washington
Project Number: 3234-005-02

Figure E-14
Sheet 1 of 1

Date:8/19/19 Path:W:\PROJECTS\3\3234005\GINT\323400502.GPJ DBLibrary/Library:GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEI8_GEOTECH_WELL_%F

Date Excavated 6/4/2019	Total Depth (ft) 10	Logged By JR Checked By JR	Excavator City of West Richland Equipment Backhoe	Groundwater not observed Caving not observed
Surface Elevation (ft) Vertical Datum	Undetermined ROS 3910	Easting (X) Northing (Y)	Coordinate System Horizontal Datum	ROS 3910

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	1, 2				GM	Brown silty fine to coarse gravel with sand and occasional concrete debris; weakly cemented (loose to medium dense, dry to moist) (fill)			
	3, 4				GM	Brown silty fine gravel with sand; weakly cemented (dense, moist) (Ringold Formation)			
	5, 6, 7, 8				SM	Brown silty fine sand with trace gravel (loose, dry) (Ringold Formation) Increased gravel content below 7 feet			
	9, 10				SP	Gray fine sand; micaceous (loose to medium dense, dry) (Ringold Formation)			

Note: See Figure E-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on (undetermined). Vertical approximated based on (undetermined).

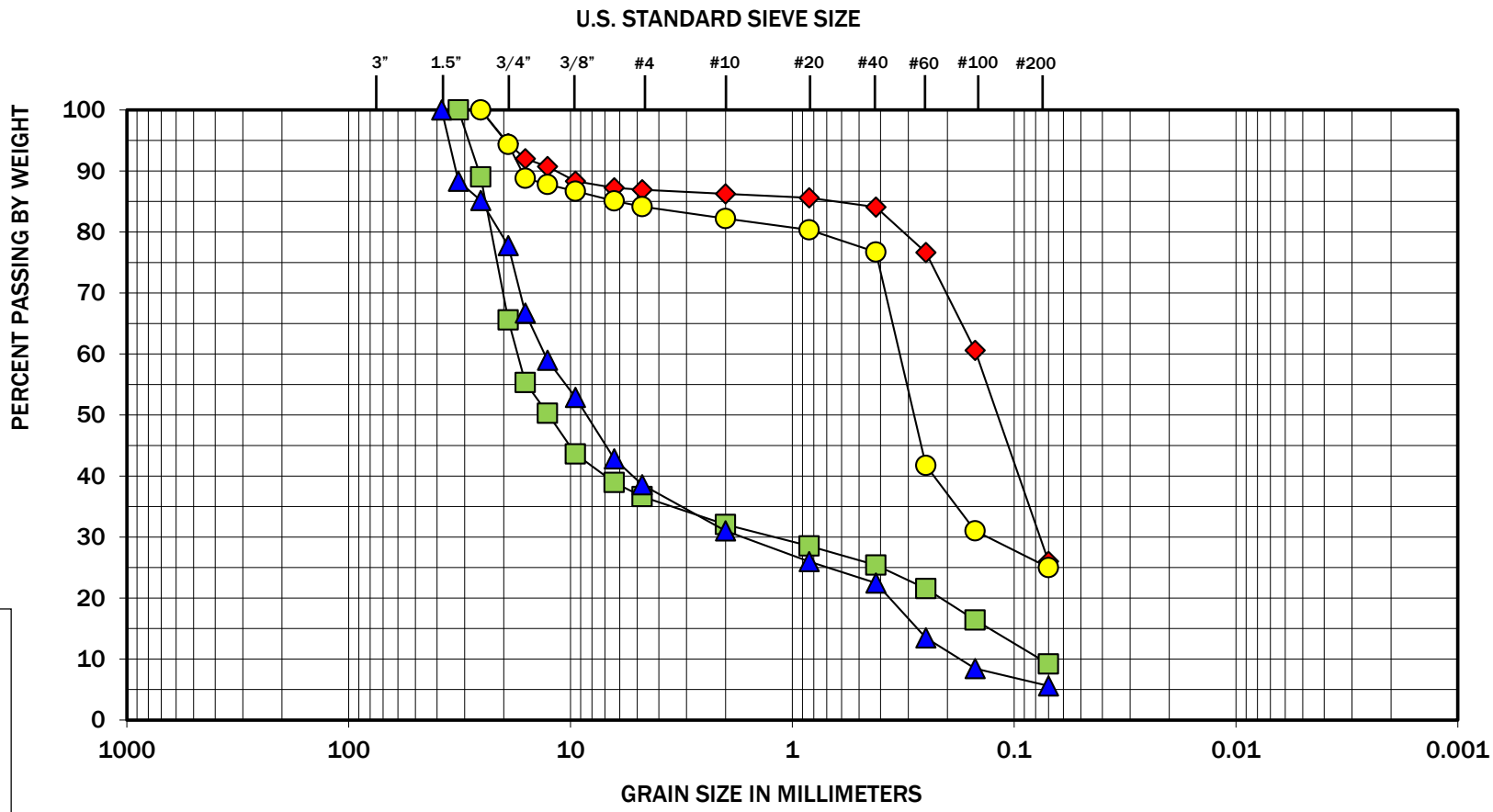
Log of Test Pit TP-1

GEOENGINEERS

Project: DPA Phase 2
Project Location: West Richland, Washington
Project Number: 3234-005-02

Figure E-15
Sheet 1 of 1

Date:8/19/19 Path:W:\PROJECTS\3\3234005\GINT\32340050 2.GPJ DBLibrary/Library:GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEI8_TESTPIT_1P_GEOTEC_%F



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Symbol	Boring Number	Depth (feet)	Moisture (%)	Soil Description
◆	B-1	5 – 5½	12	Silty fine sand with trace gravel
■	B-1	12 – 12½	5	Fine to coarse gravel with silt and sand
▲	B-2	7½ - 8	6	Fine to coarse gravel with silt and sand
●	B-2	12 – 12½	17	Silty fine sand with gravel

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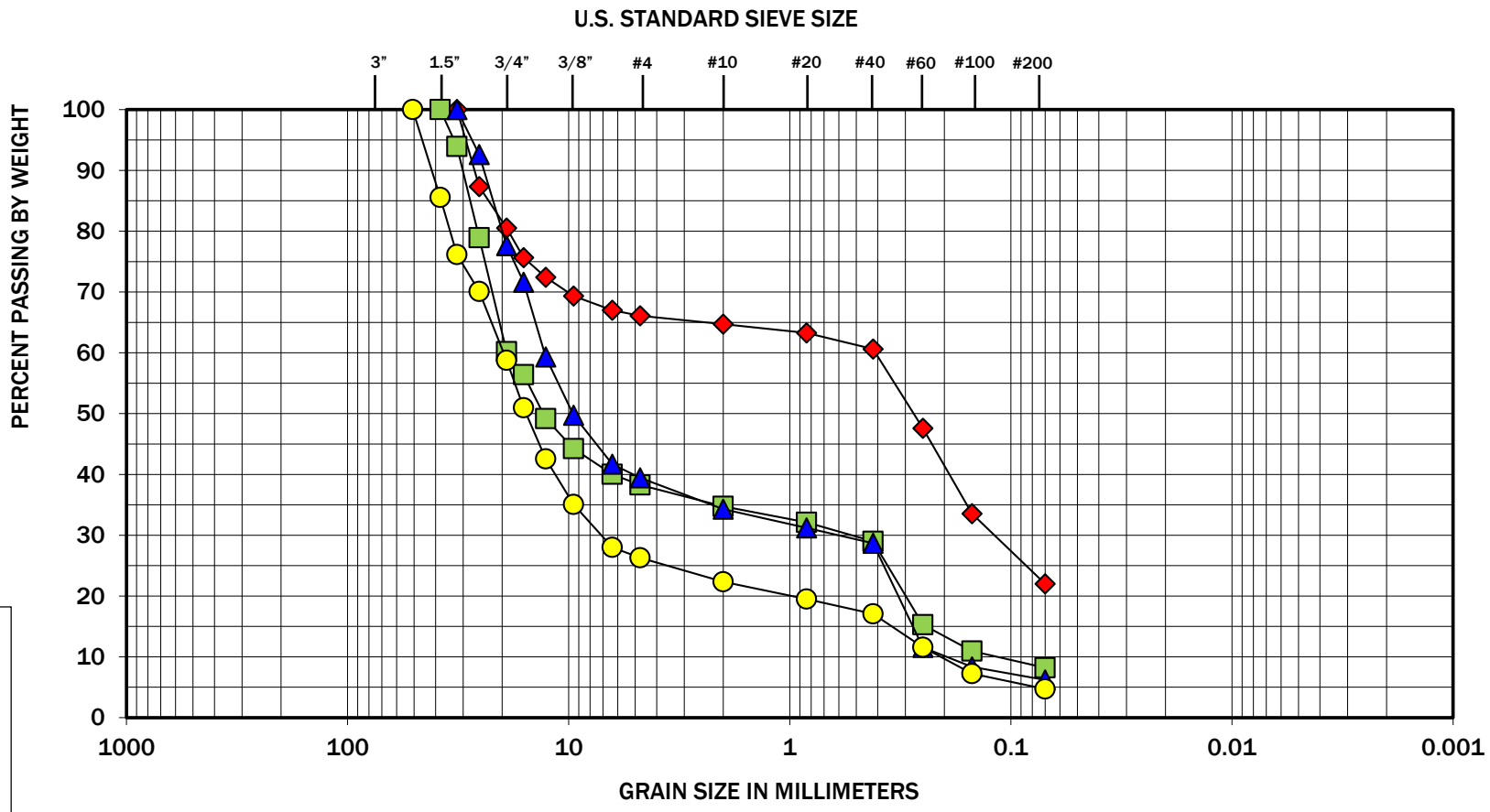
The grain size analysis results were obtained in general accordance with ASTM D 6913.

GEOENGINEERS

Regional Infiltration and Phase 2 DPA
West Richland, Washington

Sieve Analysis Results

Figure E-16



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Symbol	Boring Number	Depth (feet)	Moisture (%)	Soil Description
◆	B-3	3 - 4	5	Silty fine sand with gravel
■	B-3	15 - 16	5	Fine to coarse gravel with silt and sand
▲	B-4	8 – 8½	5	Fine to coarse gravel with silt and sand
●	B-4	14 – 14½	6	Fine to coarse gravel with sand and trace silt

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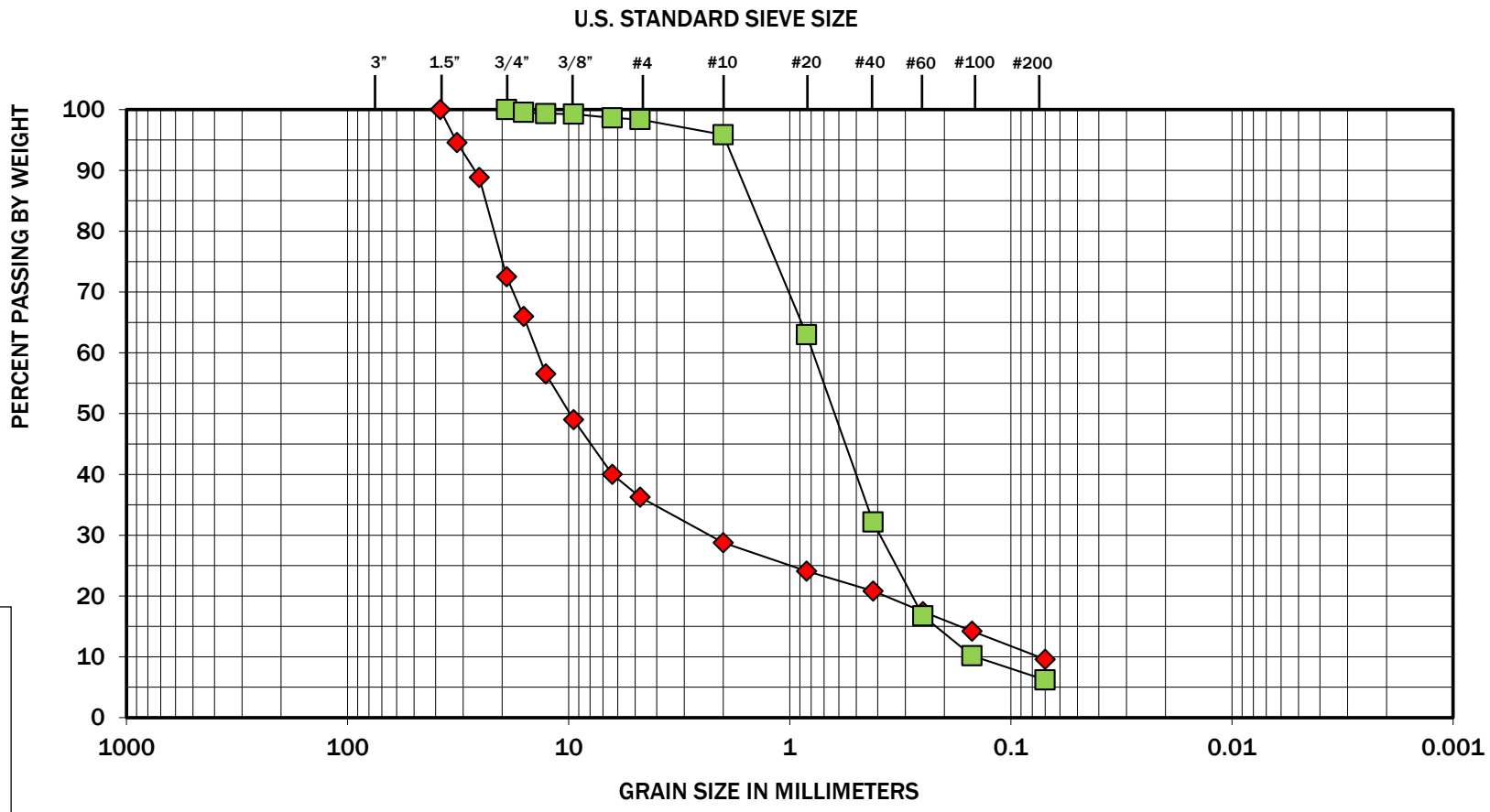
GEOENGINEERS

Regional Infiltration and Phase 2 DPA
West Richland, Washington

Sieve Analysis Results

Figure E-17



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Symbol	Boring Number	Depth (feet)	Moisture (%)	Soil Description
◆	B-5	6 - 7	7	Fine to coarse gravel with silt and sand
■	B-5	15 - 16	14	Fine to medium sand with silt and occasional fine gravel

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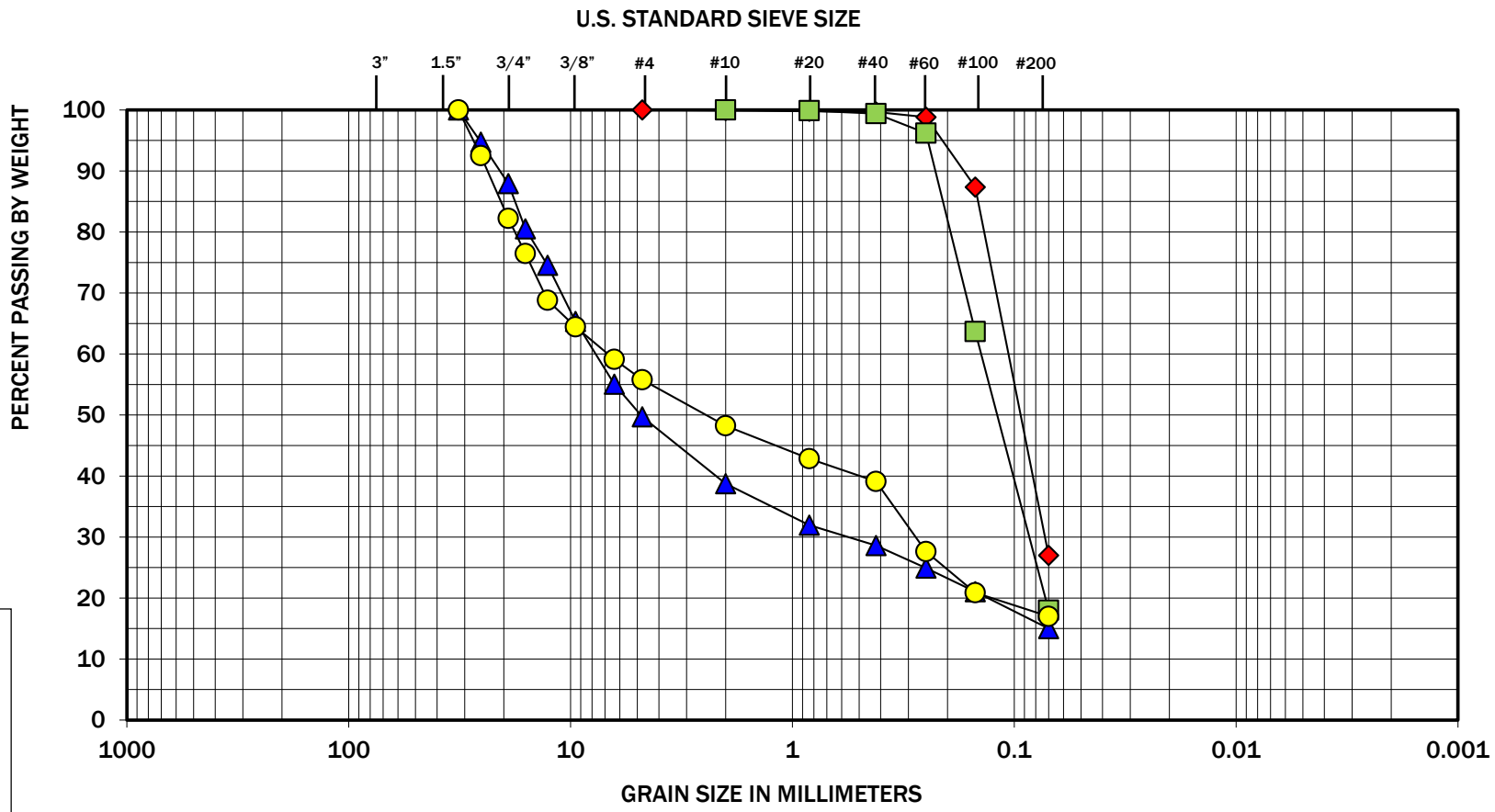
GEOENGINEERS

Regional Infiltration and Phase 2 DPA
West Richland, Washington

Sieve Analysis Results

Figure E-18



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Symbol	Boring Number	Depth (feet)	Moisture (%)	Soil Description
◆	MW-1	10 – 10½	6	Silty fine sand
■	MW-2	10 – 10½	21	Silty fine sand
▲	MW-2	25 – 25½	7	Silty fine to coarse gravel with sand
●	MW-3	6½ - 7	6	Silty fine to coarse gravel with sand

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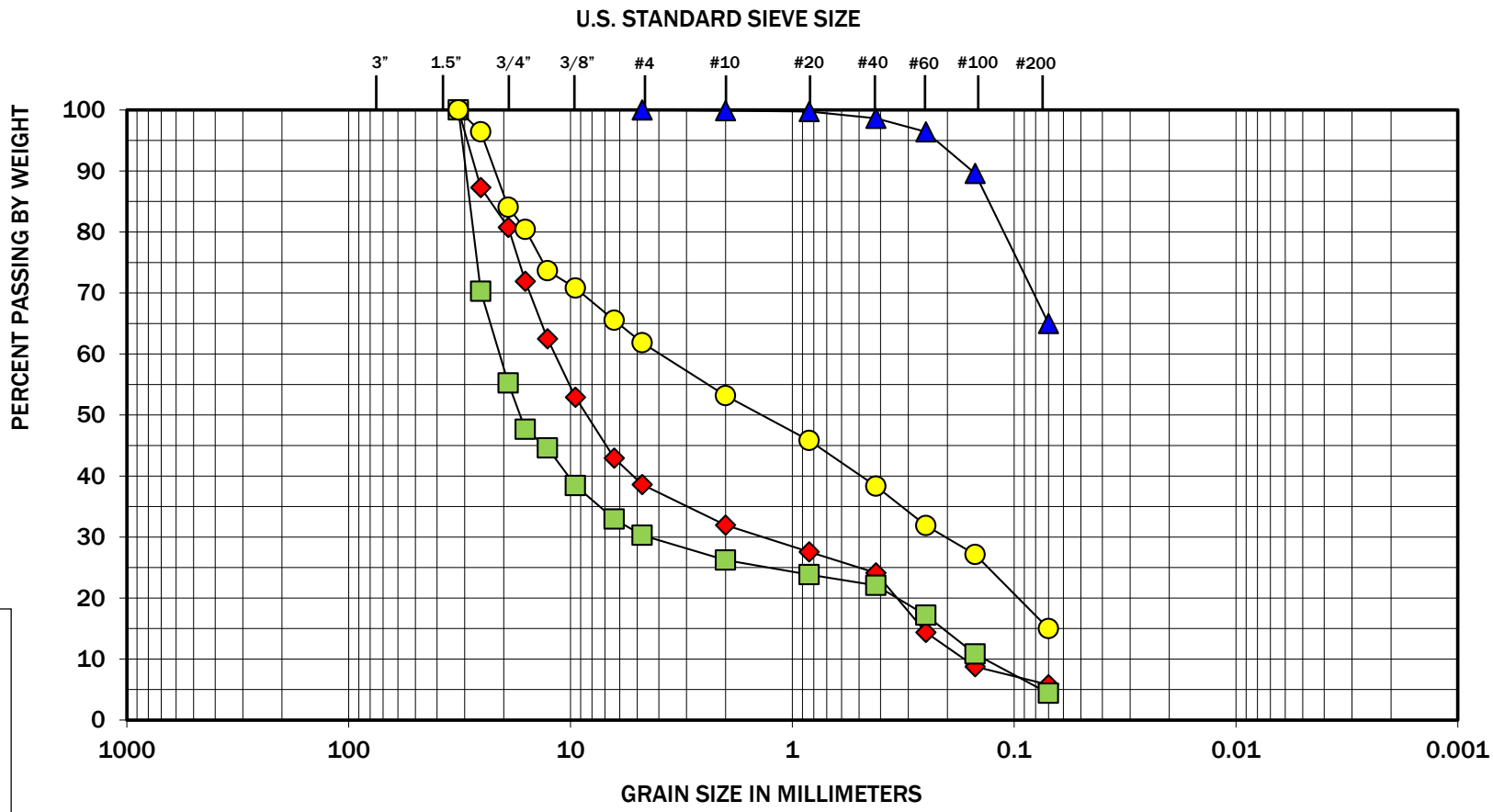
Regional Infiltration and Phase 2 DPA
West Richland, Washington

Sieve Analysis Results

Figure E-19



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Symbol	Boring Number	Depth (feet)	Moisture (%)	Soil Description
◆	MW-3	18 – 18½	8	Fine to coarse gravel with silt and sand
■	MW-4	3 – 3½	3	Fine to coarse gravel with sand and trace silt
▲	MW-4	17 – 17½	12	Fine sand silt
●	MW-5	5 – 5½	6	Silty fine to coarse sand with gravel

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The grain size analysis results were obtained in general accordance with ASTM D 6913.

GEOENGINEERS

Regional Infiltration and Phase 2 DPA
West Richland, Washington

Sieve Analysis Results

Figure E-20

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Symbol	Boring Number	Depth (feet)	Moisture (%)	Soil Description
◆	MW-6	4 – 4½	5	Silty fine to coarse gravel with sand
■	MW-6	17 – 17½	8	Fine to coarse gravel with sand and trace silt
▲	MW-7	6 – 7	7	Silty fine to coarse gravel with sand
●	MW-7	9 – 10	7	Fine to coarse gravel with sand and trace silt

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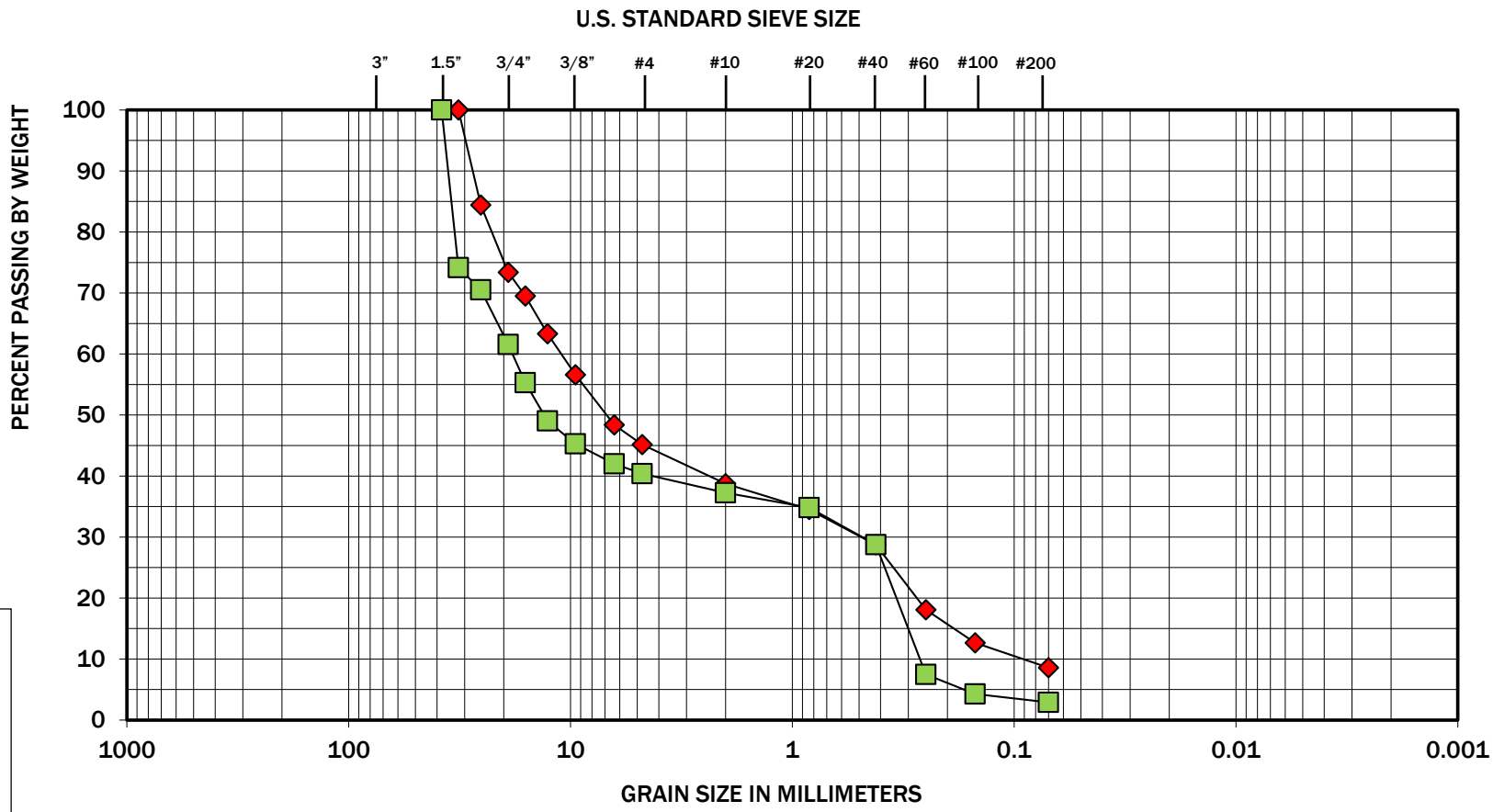
The grain size analysis results were obtained in general accordance with ASTM D 6913.

GEOENGINEERS

Figure E-21

Regional Infiltration and Phase 2 DPA
West Richland, Washington

Sieve Analysis Results



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Symbol	Boring Number	Depth (feet)	Moisture (%)	Soil Description
◆	MW-8	10 – 10½	7	Fine to coarse gravel with silt and sand
■	MW-8	17 – 17½	11	Fine to coarse gravel with sand and trace silt

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GEOENGINEERS

Regional Infiltration and Phase 2 DPA
West Richland, Washington

Sieve Analysis Results

Figure E-22

APPENDIX F
Seismic Velocity Survey Report

June 1, 2019 GeoEngineers 2019-06-01 (Vp-Vs)

RE: SEISMIC VELOCITY SURVEY WEST RICHLAND, WASHINGTON

Based on the project objective and site conditions, Sage Earth Science conducted a series of seismic P-wave (V_P) refraction and surface shear wave velocity (V_s) profiles at the central Washington site. The objective of the surveys is to determine the compression wave and shear wave velocity profile of the shallow subsurface (0-50 ft.) for the purpose of delineating potential shallow acquatards and perched groundwater zones.

P-wave survey (refraction)

Given a physical setting of increasing density with depth, and by measuring the travel time of a compression wave (*p-wave*) between known points, the seismic refraction method can be used to determine the depth to a refracting horizon(s), the seismic velocity of the refracting horizon(s), as well as thickness and velocities of the overlying materials.

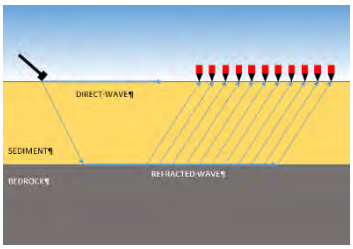


Figure 1 refraction schematic

Approximately 4,600 feet of profile were acquired. The profiles were located at the site as shown in the attached map figure 3. Data acquisition was performed in accordance with ASTM standard, **ASTM D 5777-00** *Standard Guide for Using the Seismic Refraction Method for Subsurface Investigation*. Results were reduced using PlotRefra™ seismic refraction tomographic inversion software produced by Geometrics Inc.

Shear wave velocity survey (MASW)

Using the same field records obtained for the compression wave refraction survey, approximately 4,600 feet of shear wave velocity profiles were also developed.

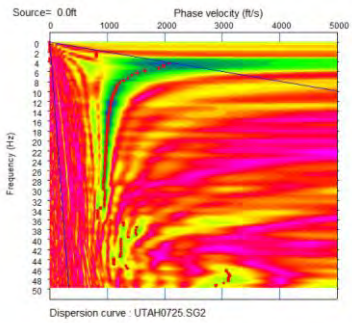


Figure 2 frequency vs velocity plot

Seismic Surface Waves methods such as MASW (Multichannel Analysis of Surface Waves) and Refraction Micro Tremor (ReMi™) use the dispersive characteristics of surface waves to determine the variation of the seismic shear wave velocity with depth. Velocity data are acquired by analyzing seismic surface waves generated by random sources or by a controlled impulsive source and received by a linear array of geophones.

A dispersion curve is calculated from the data that shows the phase velocity of the surface wave as a function of frequency or wavelength. The velocity of high frequencies is related to the density of shallow materials. The velocity of lower frequencies is related to the density of materials at depth. A shear wave velocity profile is then modeled from the dispersion curve and the shear wave velocity of the near surface is calculated.

2184 Channing Way, Suite 110, Idaho Falls, ID 83404
telephone: (208)522-5049, Fax: (208)528-6200, email: sageearthscience@yahoo.com
http://www.sageearthscience.com

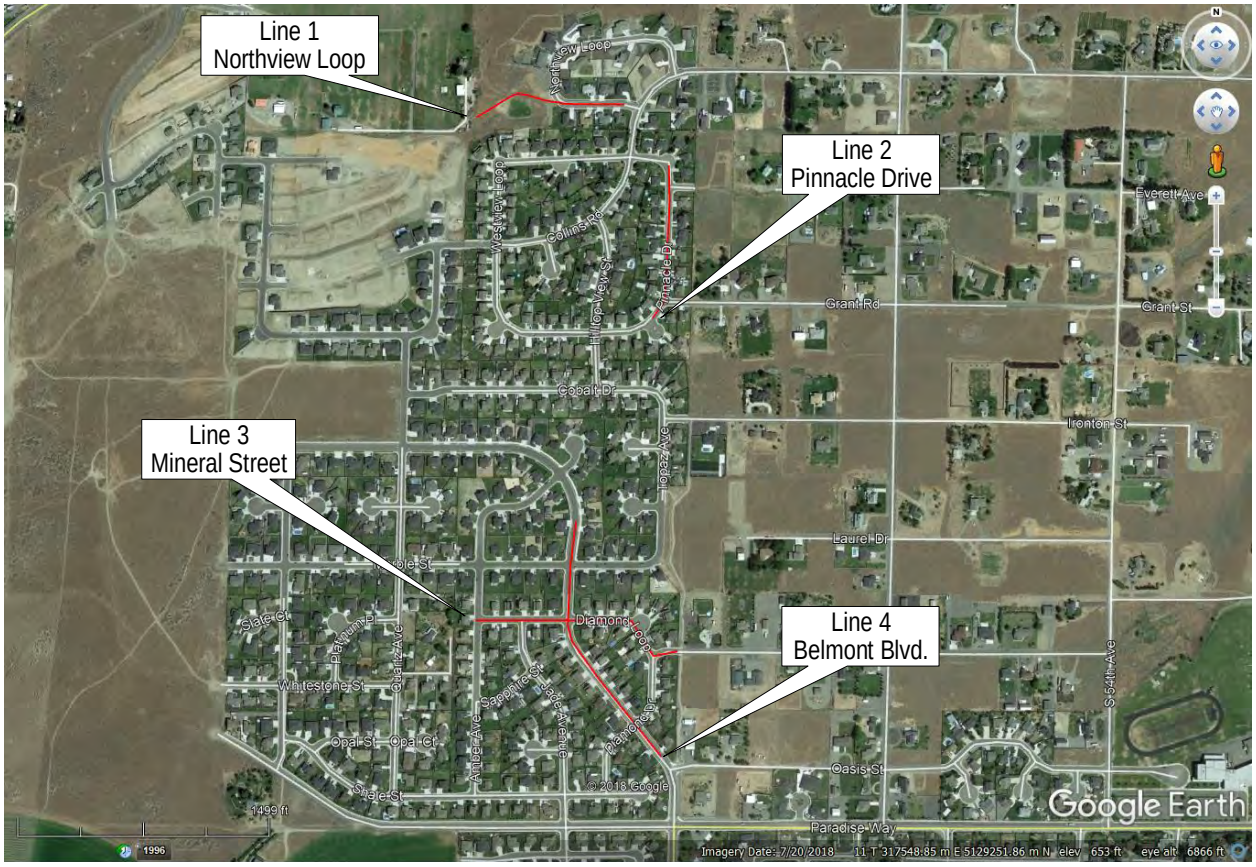


Figure 3 Profile locations (field located)

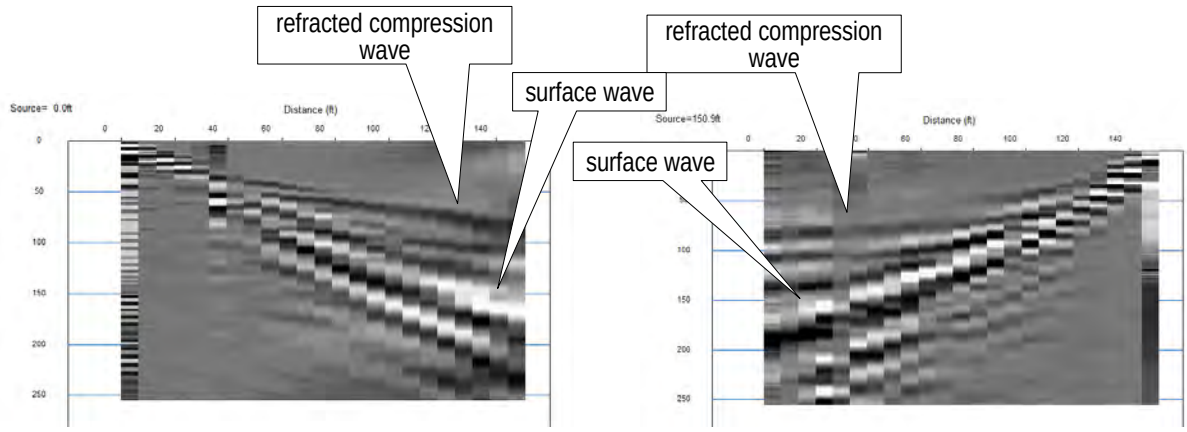


Figure 4. typical field records (truncated)

Table 1. Survey recording parameters

Test location	Reno, NV
Test Date	03/15/2019
Recording instrument	DMT Summit Extreme Pro
S/N	SUX1018
geophone natural period	4.5 Hz.
geophone/station spacing	6.56 ft. (2 meters)
number of channels	24
spread length	150 ft.
sample rate	0.5 millisecond
number of samples	4,000 per channel
record length	2 seconds
low pass filter	½ nyquist
low cut filter	1 Hz.
seismic source	16 pound sledgehammer
source location	Channels 1,5,10,15,20, and 24
Refraction Analysis software	PlotRefra™ Geometrics, Inc. tomographic inversion
Surface wave Analysis software	SurfSeis™ Geometrics, Inc.

Discussion

The figures in Appendix A show the compression wave and shear wave velocity profiles at the locations shown in figure 3.

The seismic velocities mapped across the sites are characterized by a contrast between two general velocity ranges. The first zone consists of low density materials exhibiting a velocity V_P of less than 4,000 feet per second (V_S. < 1,250 fps). This velocity is typical near surface sediments. The second zone is relative high velocity zone range of velocity averaging V_P greater than 4,000 feet per second (V_S. > 1,250 fps) and interpreted to a more dense, well cemented or in the case of elevated V_P saturated sediment.

As a general guide, quoting from the ASTM standard, **ASTM D 5777-00** *Standard Guide for Using the Seismic Refraction Method for Subsurface Investigation*

> *The seismic refraction method provides the velocity of compressional P-waves in subsurface materials. Although the P-wave velocity can be a good indicator of the type of soil or rock, it is not a unique indicator. Table 2 shows that each type of sediment or rock has a wide range of seismic velocities, and many of these ranges significantly overlap. While the seismic refraction technique measures the seismic velocity of seismic waves in earth materials, it is the interpreter who based on knowledge of the local conditions or other data, or both, must interpret the seismic refraction data and arrive at a geologically reasonable solution*

The velocity ranges, both V_P and V_S are interpreted from a range of criteria including typical values for sediment and rock and inflection points in the individual vertical velocity profiles observed in these data sets. The numbers chosen are intended to reflect the materials found at this site and are applied across all profiles. The depth of horizons should generally correlate between V_P and V_S profiles but are independent calculations and will show variability.

These velocity ranges and descriptions should be correlated with other site information including test pits, bore holes, and other available supporting information to better correlate the velocity ranges and materials encountered.

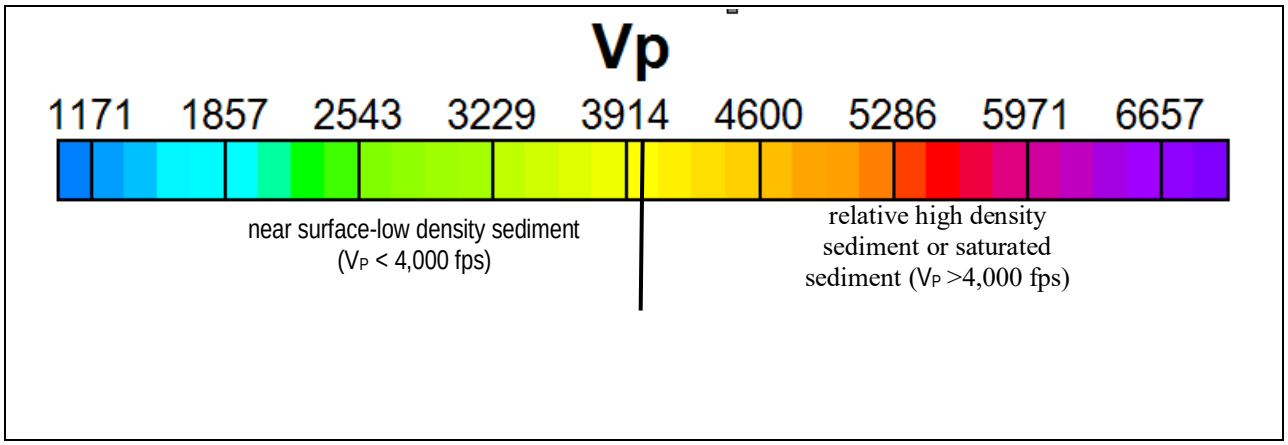


Figure 5a. General compression wave velocity range of materials

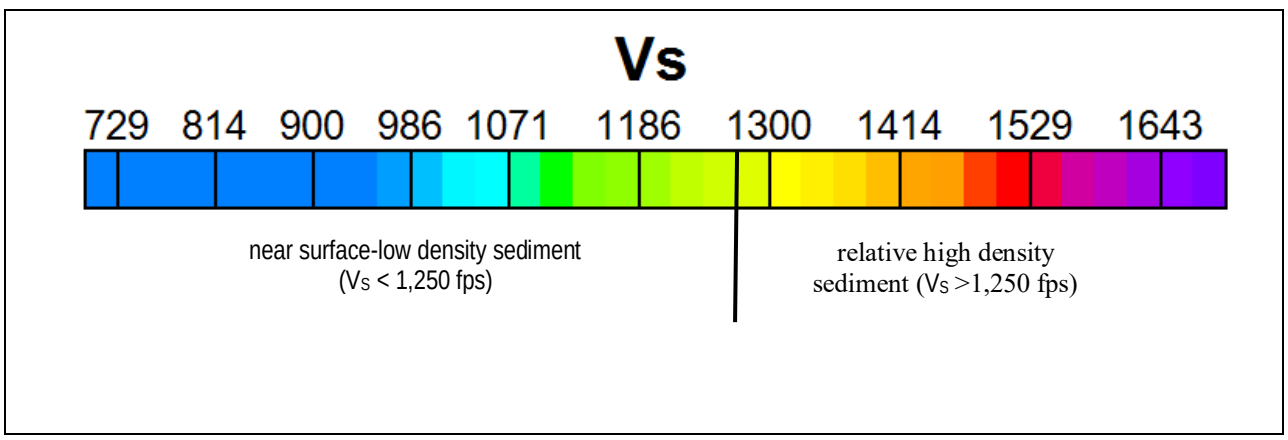


Figure 5b. General shear wave velocity range of materials

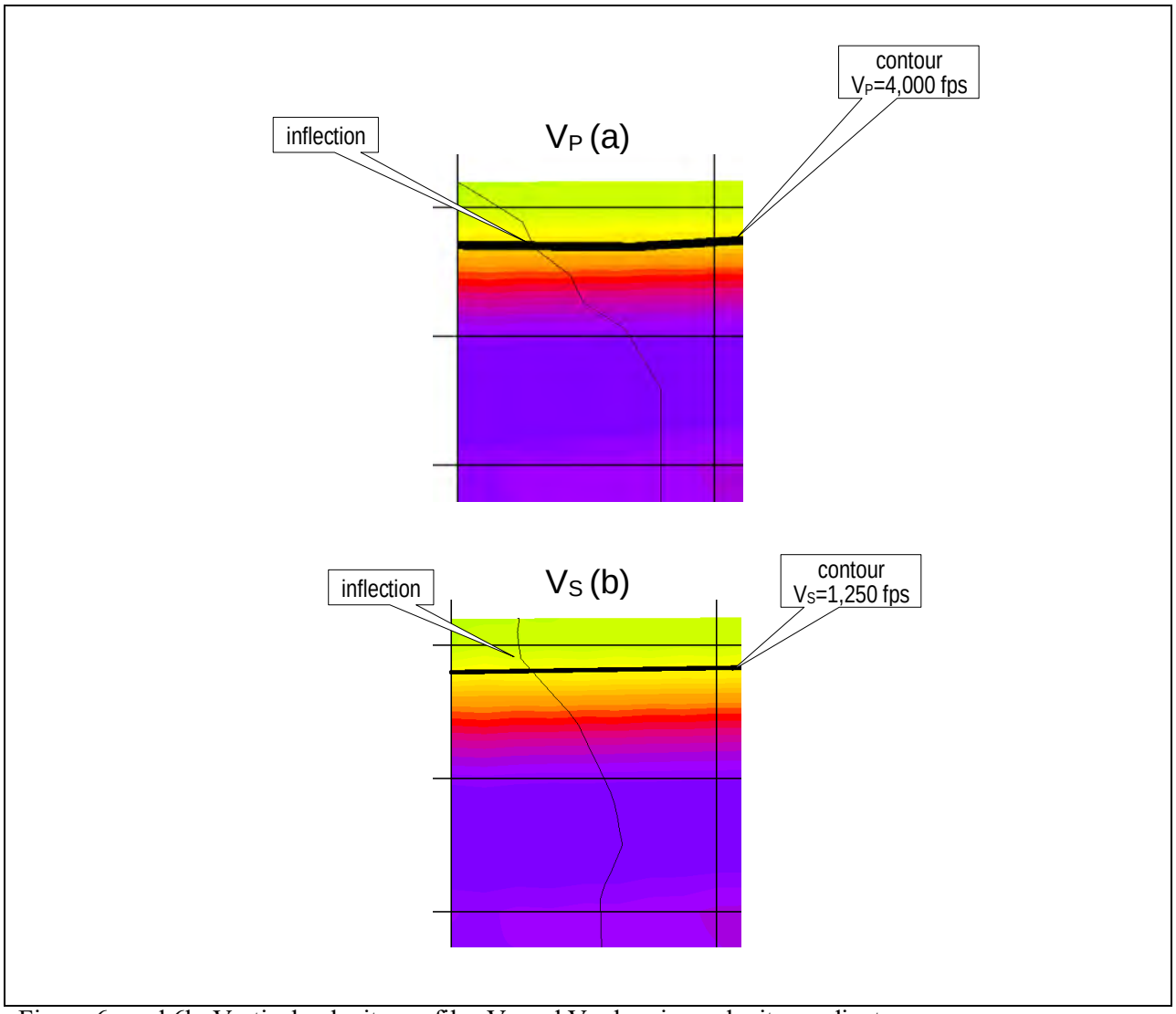


Figure 6a and 6b. Vertical velocity profiles V_P and V_S showing velocity gradients

Glen Carpenter / principal

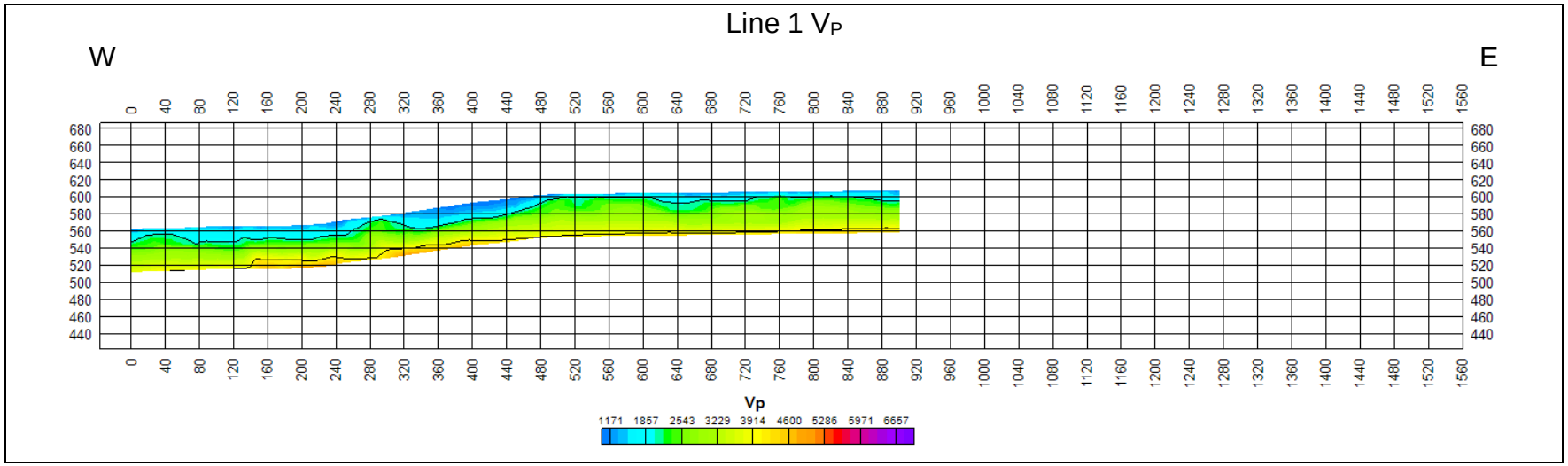
APPENDIX A

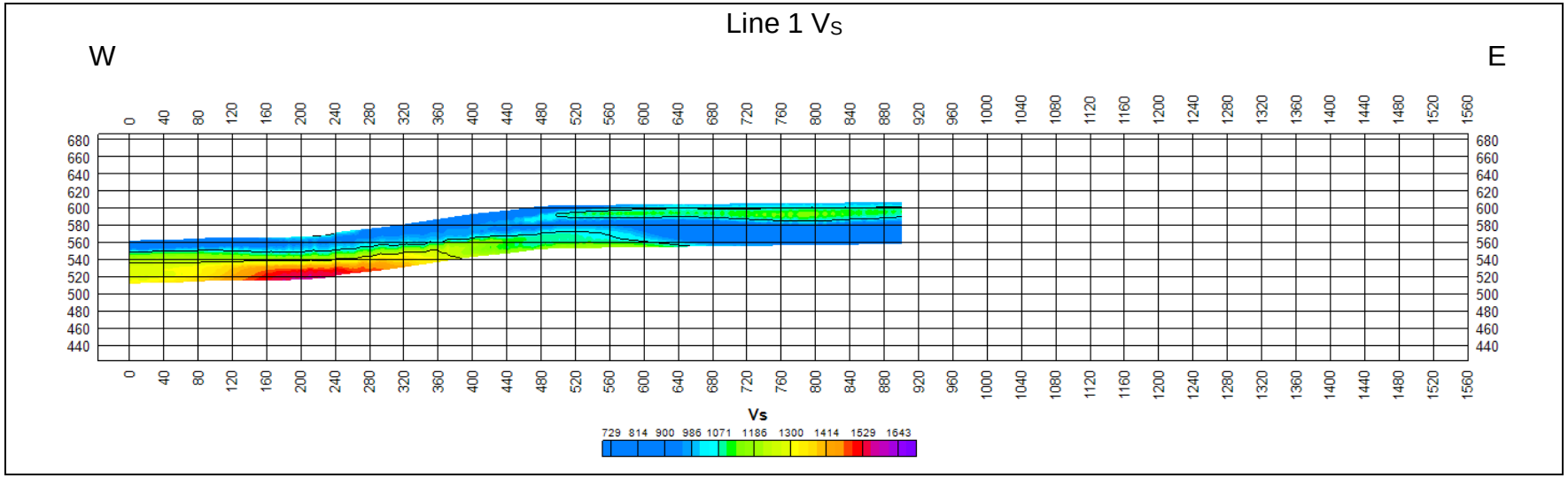
Velocity Profiles

Top profile – refracted compression wave velocity

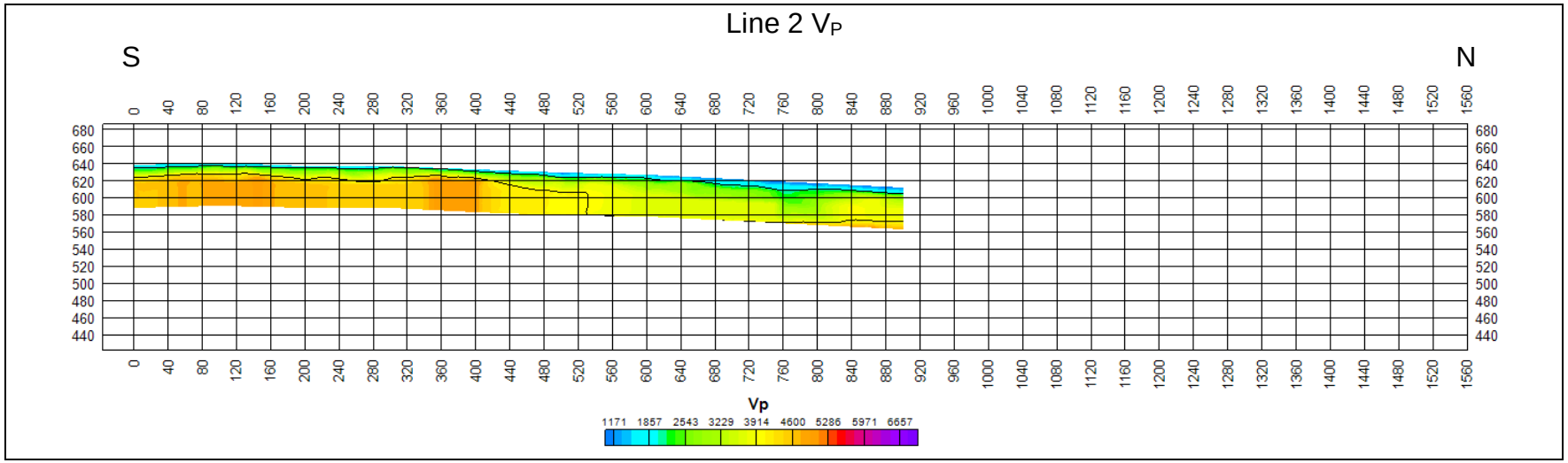
Lower profile – shear wave velocity (MASW/surface wave)

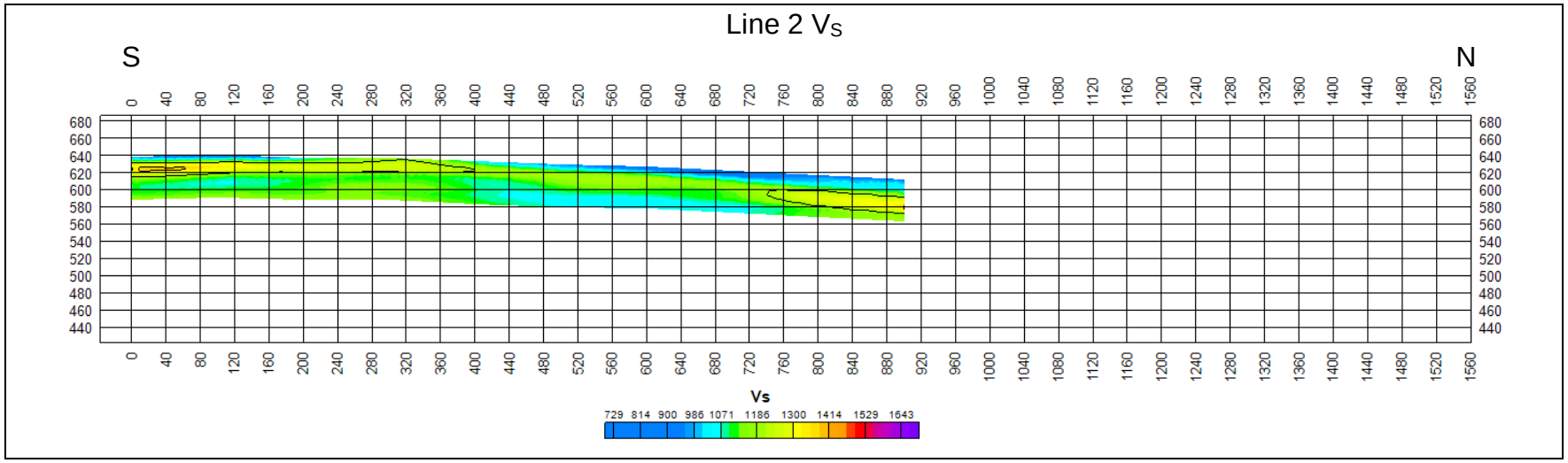
All distances/elevations are measured in feet. Velocity is reported in feet per second.)


Line 1 VP
W
E
Vp
1171 1857 2543 3229 3914 4600 5286 5971 6657

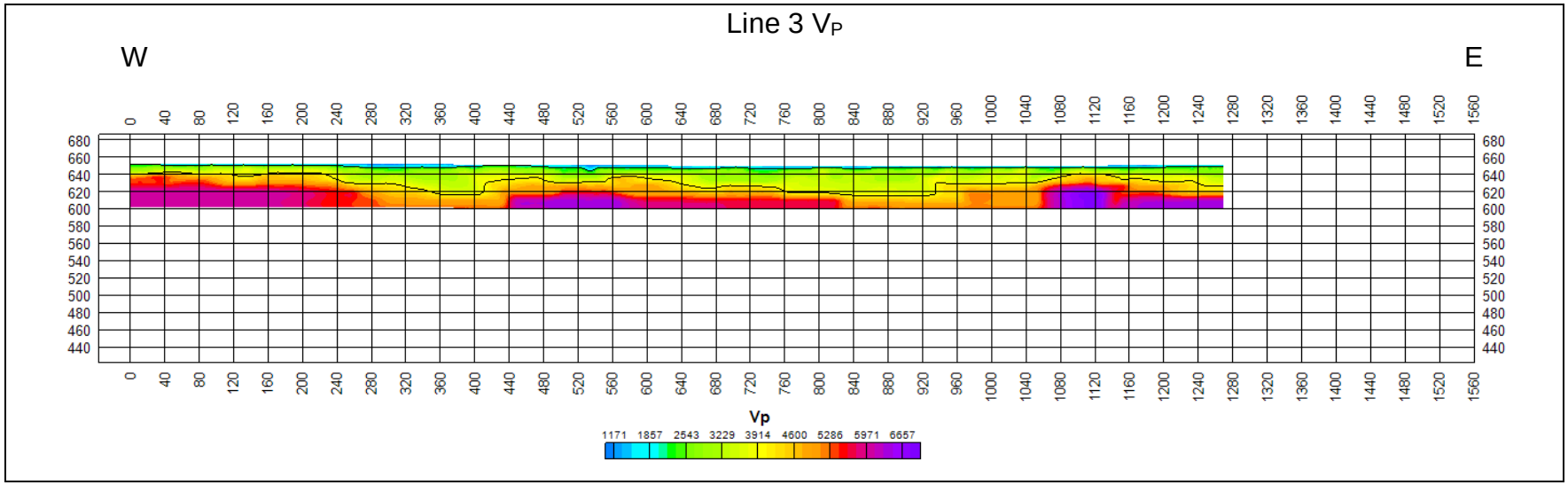

Line 1 VS
W
E
Vs
729 814 900 986 1071 1186 1300 1414 1529 1643

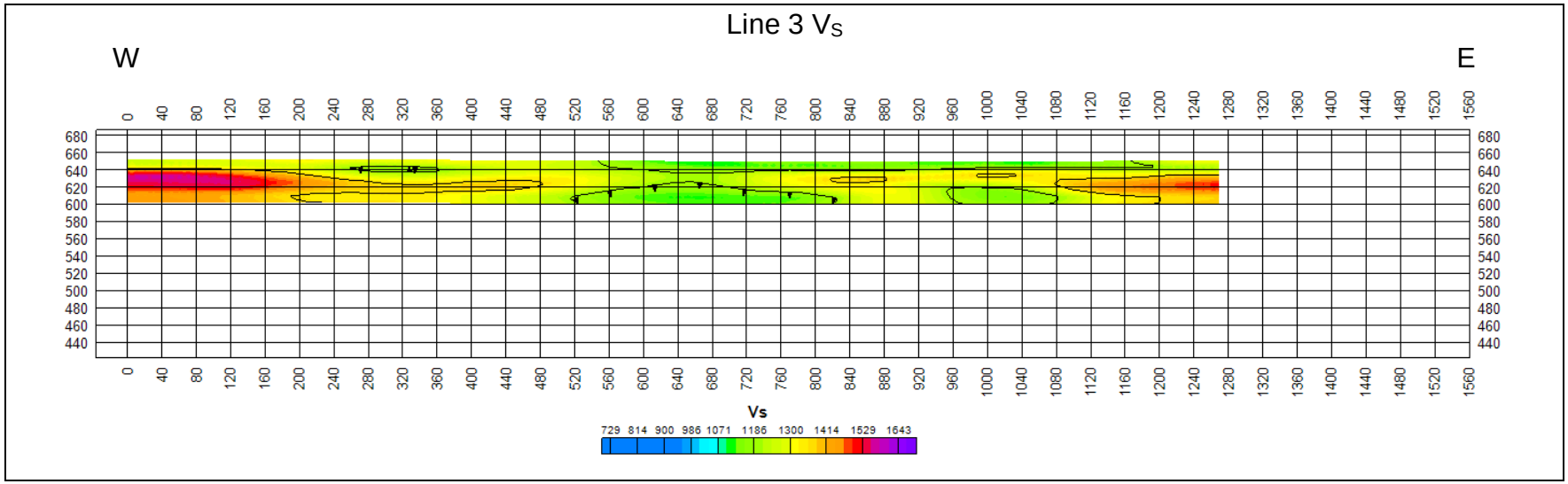
1”=200’


Line 2 VP
S
N
Vp
1171 1857 2543 3229 3914 4600 5286 5971 6657

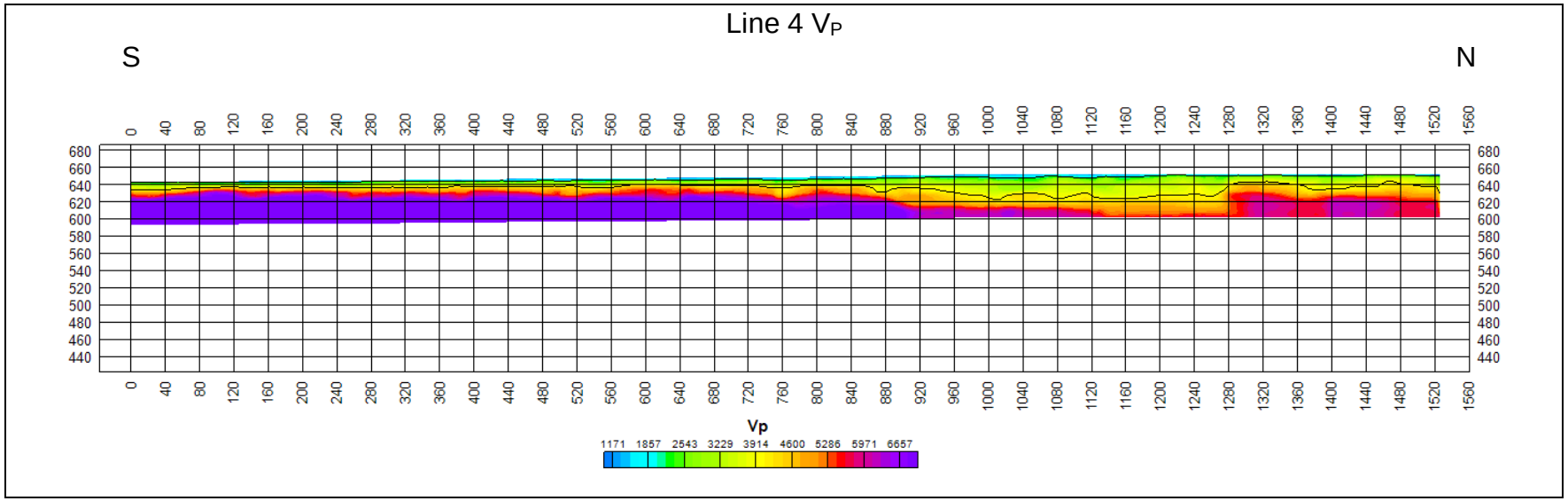

Line 2 VS
S
N
Vs
729 814 900 986 1071 1186 1300 1414 1529 1643

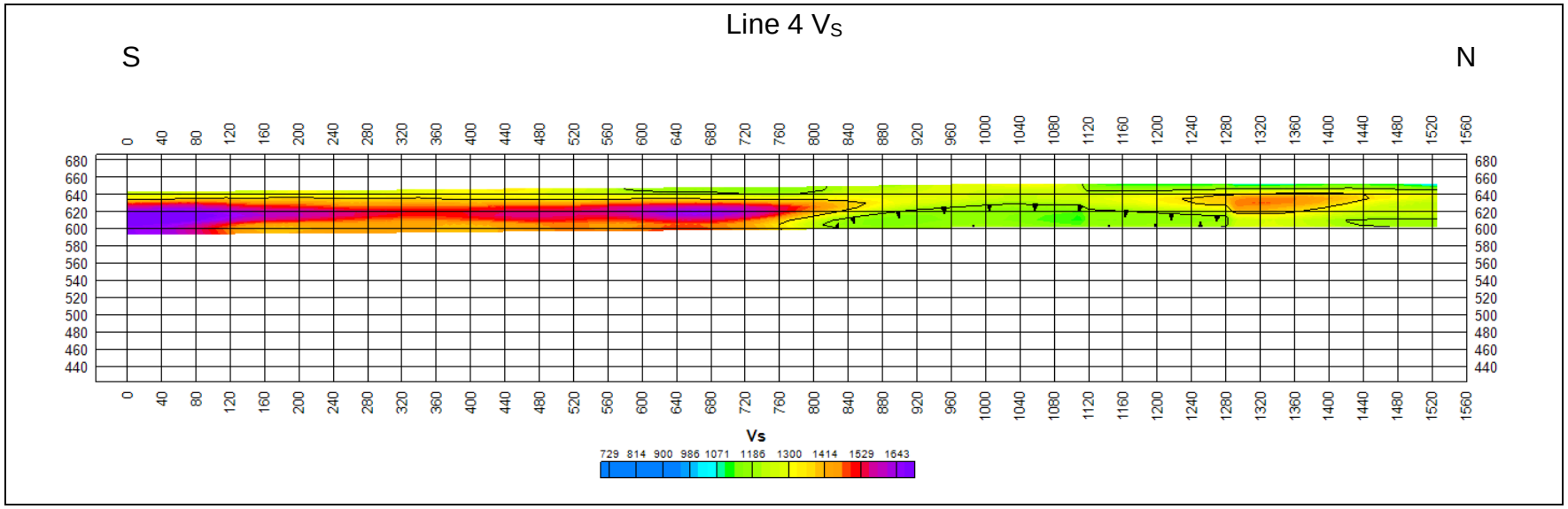
1”=200’


Line 3 VP
W
E
Vp
1171 1857 2543 3229 3914 4600 5286 5971 6657


Line 3 VS
W
E
Vs
729 814 900 986 1071 1186 1300 1414 1529 1643

1”=200’


Line 4 VP
S
N
Vp
1171 1857 2543 3229 3914 4600 5286 5971 6657


Line 4 VS
S
N
Vs
729 814 900 986 1071 1186 1300 1414 1529 1643

1”=200’

APPENDIX G
Shallow Groundwater Mapping

Table G-1

Stormwater System Groundwater Monitoring Results

Drainage Problem Area

City of West Richland, Washington

Refenence ID	Observation Location Type	Rim Elevation (ft)[1,2,3]	Depth to Water: Rim to Water (in)			Depth to Water: Rim to Water (ft)			Groundwater Elevation (ft)[1,2]		
			14-Sep-17	6-Oct-18	8/14/2019[4]	14-Sep-17	6-Oct-18	14-Aug-19	14-Sep-17	6-Oct-18	14-Aug-19
B-7	MHOB?	Could Not Locate	--	-100	-101	--	-8.3	-8.4	--	NA	NA
B-8	MHOB?	Could Not Locate	--	DRY	-110	--	DRY	-9.2	--	DRY	NA
B-9	MHOB?	Could Not Locate	--	-97	-100	--	-8.1	-8.3	--	NA	NA
B-10	DW	*640.00*	-102	DRY	-99	-8.5	DRY	-8.3	*631.50*	DRY	631.75
B-11	DW	*NA*	--	DRY	-100	--	DRY	-8.3	--	DRY	NA
B-12	DW	*648.50*	-133	-142	-125	-11.1	-11.8	-10.4	637.42	*636.67*	638.08
B-13	DW	647.00	-83	-92.5	-86	-6.9	-7.7	-7.2	640.08	639.29	639.83
B-14	DW	*649.00*	-102	-114	-106	-8.5	-9.5	-8.8	640.50	639.50	640.17
B-15	MHSB	*650.00*	--	-81	-80	--	-6.8	-6.7	--	643.25	643.33
B-17	DW	652.41	--	-53	-57	--	-4.4	-4.8	--	647.99	647.66
B-18	DW	652.18	--	-55	-62	--	-4.6	-5.2	--	647.60	647.01
B-19	DW	653.46	--	-75	-83	--	-6.3	-6.9	--	647.21	646.54
B-20	DW	653.48	--	-81	-90	--	-6.8	-7.5	--	646.73	645.98
B-21	DW	651.99	-78	-84	-92	-6.5	-7.0	-7.7	645.49	644.99	644.32
B-22	DW	*653.00*	-137	-147.5	-154	-11.4	-12.3	-12.8	641.58	640.71	640.17
B-23	DW	*641.00*	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
B-24	DW	*641.00*	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
B-25	DW	*644.00*	DRY	DRY	--	--	DRY	--	--	DRY	DRY
B-26	DW	652.25	-88	-100.5	-107	-7.3	-8.4	-8.9	644.92	643.88	643.33
C-2	DW	649.03	DRY	--	--	DRY	--	--	DRY	--	--
C-5	MHOB	642.85	--	-82.5	DRY	--	-6.9	--	--	635.98	DRY
C-6	DW	640.00	DRY	DRY	-199	DRY	DRY	-16.6	DRY	DRY	623.42
C-7	MH	640.27	--	DRY	-82	--	DRY	-6.8	--	DRY	633.44
F-1	DW	647.91	--	-180	-168	--	-15.0	-14.0	--	632.91	633.91
F-2	DW	645.40	--	DRY	DRY	--	DRY	DRY	--	DRY	DRY
F-3	DW	640.74	--	DRY	-187	--	DRY	-15.6	--	DRY	625.16
O-6	DW	643.18	-170	-168	DRY	-14.2	-14.0	DRY	629.01	629.18	DRY
O-7	DW	643.18	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
O-8	DW	643.87	DRY	DRY	-194	DRY	DRY	-16.2	DRY	DRY	627.70
O-9	DW	644.85	DRY	-165	-159	DRY	-13.8	-13.3	DRY	631.10	631.60
O-10	DW	645.99	-157	-160	-145	-13.1	-13.3	-12.1	632.91	632.66	633.91
O-11	DW	647.10	-138	-141	-130	-11.5	-11.8	-10.8	635.60	635.35	636.27
Q-3	DW(2)	617.84	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
Q-4 NORTH (Q-4a)	DW	614.45	-151.5	-154.5	-120	-12.6	-12.9	-10.0	601.83	601.58	604.45
Q-4 WEST (Q-4b)	DW		-169.5	-124	-85	-14.1	-10.3	-7.1	600.33	604.12	-7.08
Q-5	DW	613.03	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
Q-6	DW	615.63	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
Q-7	DW	628.07	--	DRY	DRY	--	DRY	DRY	--	DRY	DRY
Q-8	DW	634.50	--	-112.5	-111	--	-9.4	-9.3	--	625.13	625.25
Q-9	DW	643.85	-139.5	-134	-139	-11.6	-11.2	-11.6	632.23	632.68	632.27
Q-10	DW	UNKNOWN	--	DRY	DRY	--	DRY	DRY	--	DRY	DRY
Q-11	DW	UNKNOWN	--	-59	-50.5	--	-4.9	-4.2	--	NA	NA
Q-12	DW	UNKNOWN	-82.5	-87	-83	-6.9	-7.3	-6.9	NA	NA	NA
Q-13	DW	621.88	-23	-35	-28	-1.9	-2.9	-2.3	NA	NA	619.55
Q-14	DW	635.79	--	-52	-43	--	-4.3	-3.6	--	631.46	632.21
Q-15	DW	640.43	--	-66.5	-62	--	-5.5	-5.2	--	634.89	635.26
Q-16	DW	641.73	-53	-45.5	-44	-4.4	-3.8	-3.7	637.31	637.94	638.06
Q-17	DW	644.29	-65.5	-61.5	-63	-5.5	-5.1	-5.3	638.83	639.17	639.04
Q-69	DW	632.55	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
R-1	MHOB	658.96	--	DRY	DRY	--	DRY	DRY	--	DRY	DRY
R-2	MHOB	657.76	--	DRY	DRY	--	DRY	DRY	--	DRY	DRY
R-3	MHOB	656.05	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
R-4	MHOB	654.21	--	DRY	DRY	--	DRY	DRY	--	DRY	DRY
R-5	MHOB	655.42	--	DRY	DRY	--	DRY	DRY	--	DRY	DRY
R-6	MHOB	656.35	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
R-7	MHOS	651.17	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
R-8	MHOB	647.88	--	DRY	DRY	--	DRY	DRY	--	DRY	DRY

Refenence ID	Observation Location Type	Rim Elevation (ft)[1,2,3]	Depth to Water: Rim to Water (in)			Depth to Water: Rim to Water (ft)			Groundwater Elevation (ft)[1,2]		
			14-Sep-17	6-Oct-18	8/14/2019[4]	14-Sep-17	6-Oct-18	14-Aug-19	14-Sep-17	6-Oct-18	14-Aug-19
R-9	MHOB	651.11	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
R-10	MHOB	650.33	--	DRY	DRY	--	DRY	DRY	--	DRY	DRY
R-11	MHOB	651.61	--	DRY	DRY	--	DRY	DRY	--	DRY	DRY
R-12	MHOB	651.66	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
R-13	MHOB	653.55	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
R-14	MHOB	653.71	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
R-15	MHOB	655.14	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
R-16	MHOB	655.67	--	DRY	DRY	--	DRY	DRY	--	DRY	DRY
R-17	MHOB	657.48	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
R-18	MHOB	657.13	Below IE	-85	-90.5	Below IE	-7.1	-7.5	Below IE	650.05	649.59
R-19	MHOB	657.73	Below IE	-88	-90	Below IE	-7.3	-7.5	Below IE	650.40	650.23
R-20	MHOB	653.83	--	-58.5	-65	--	-4.9	-5.4	--	648.96	648.41
R-21	MHOB	653.05	DRY	-45	-48	DRY	-3.8	-4.0	DRY	649.30	649.05
R-22	MHOB	653.53	Below IE	-71.5	-66	Below IE	-6.0	-5.5	Below IE	647.57	648.03
R-23	MHOB	652.96	-28	-40	-43	-2.3	-3.3	-3.6	650.63	649.63	649.38
R-24	MHOB	653.54	-36	-46	-44	-3.0	-3.8	-3.7	650.54	649.71	649.87
R-25	MHOB	655.37	-31	-40.5	-38	-2.6	-3.4	-3.2	652.79	652.00	652.20
R-26	MHOB	654.33	--	-56.5	-53	--	-4.7	-4.4	--	649.62	649.91
R-27	MHOB	655.16	--	-26	-25	--	-2.2	-2.1	--	652.99	653.08
R-28	MHOB	655.61	--	-23.5	-24	--	-2.0	-2.0	--	653.65	653.61
R-29	MHOB	651.97	--	-49	-44	--	-4.1	-3.7	--	647.89	648.30
R-30	MHOB	654.18	DRY	-60	-57	DRY	-5.0	-4.8	DRY	649.18	649.43
R-31	MHOB	652.49	-24	-34	-29	-2.0	-2.8	-2.4	650.49	649.66	650.07
R-32	MHOB	652.19	-17	-26	-19	-1.4	-2.2	-1.6	650.77	650.02	650.61
R-33	DW	656.87	--	-112.5	-111	--	-9.4	-9.3	--	647.50	647.62
R-34	DW	656.90	--	-99	-103	--	-8.3	-8.6	--	648.65	648.32
R-35 EAST	DW	655.99	--	-92	-95	--	-7.7	-7.9	--	648.32	648.07
R-35 MIDDLE	DW	656.19	--	-94.5	-98	--	-7.9	-8.2	--	648.32	648.02
R-35 WEST	DW	656.54	--	-98	-101	--	-8.2	-8.4	--	648.37	648.12
R-36 NORTH	DW	655.12	-117	-109	-109	-9.8	-9.1	-9.1	645.37	646.04	646.04
R-36 SOUTH	DW	655.40		-110.5	-109	-9.8	-9.2	-9.1	645.65	646.19	646.32
R-37 EAST	DW	654.06	--	-117	-115	--	-9.8	-9.6	--	644.31	644.48
R-37 WEST	DW	653.99	--	-112	-111	--	-9.3	-9.3	--	644.66	644.74
R-38 NORTH	DW	653.74	--	-115	-113	--	-9.6	-9.4	--	644.16	644.32
R-38 SOUTH	DW	653.18	--	-116	-117	--	-9.7	-9.8	--	643.51	643.43
R-39 EAST	DW	651.21	-77	-66.5	-67	-6.4	-5.5	-5.6	644.79	645.67	645.63
R-39 NORTH	DW	651.35		-66	-67		-5.5	-5.6	651.35	645.85	645.77
R-39 WEST	DW	651.61		-66.5	-67		-5.5	-5.6	651.61	646.07	646.03
R-40	DW	653.28	--	-75.5	-79	--	-6.3	-6.6	--	646.99	646.70
R-41	DW	653.90	-89.5	-75.5	-81	-7.5	-6.3	-6.8	646.44	647.61	647.15
R-42	DW	653.94	-86.5	-78	-79	-7.2	-6.5	-6.6	646.73	647.44	647.36
R-42	DW	653.94	-87	--	--	-7.3	--	--	646.69	--	--
R-43	DW	650.40	-70	-59	-61	-5.8	-4.9	-5.1	644.57	645.48	645.32
R-44	DW	646.98	-61	-63	-70	-5.1	-5.3	-5.8	641.90	641.73	641.15
R-45	DW	648.47	-56	-62	-65	-4.7	-5.2	-5.4	643.80	643.30	643.05
R-46	DW	649.86	-87	-88	-93	-7.3	-7.3	-7.8	642.61	642.53	642.11
R-47	DW	650.57	-102	-103	-102	-8.5	-8.6	-8.5	642.07	641.99	642.07
R-48	DW	647.75	DRY	--	--	DRY	--	--	DRY	--	--
R-49	DW	645.37	DRY	--	--	DRY	--	--	DRY	--	--
R-50	DW	643.50	DRY	--	--	DRY	--	--	DRY	--	--
R-51	DW	643.16	DRY	--	--	DRY	--	--	DRY	--	--
R-52	DW	642.01	DRY	--	DRY	DRY	--	DRY	DRY	--	DRY
R-53	DW	641.69	DRY	--	--	DRY	--	--	DRY	--	--
R-54	DW	644.18	DRY	--	--	DRY	--	--	DRY	--	--
R-55	DW	642.25	DRY	--	DRY	DRY	--	DRY	DRY	--	DRY
R-56	DW	640.00	DRY	--	DRY	DRY	--	DRY	DRY	--	DRY
R-57	DW	639.98	DRY	--	--	DRY	--	--	DRY	--	--
R-58	DW	637.99	DRY	--	--	DRY	--	--	DRY	--	--
R-59	DW	635.41	DRY	--	--	DRY	--	--	DRY	--	--
R-71	MHOB	653.29	-25	-32	-24	-2.1	-2.7	-2.0	651.21	650.62	651.29
R-75	MHOB	653.99	-51	-54.5	-48	-4.3	-4.5	-4.0	649.74	649.45	649.99
R-76	MHOB	655.30	-49	-56.5	-53	-4.1	-4.7	-4.4	651.22	650.59	650.88
R-77	MHOB	657.06	-48	-47.5	-50	-4.0	-4.0	-4.2	653.06	653.10	652.89
R-78	MHOB	656.95	-47	-44.5	-47	-3.9	-3.7	-3.9	653.03	653.24	653.03
R-79	MHOB	656.76	--	-35	-38	--	-2.9	-3.2	--	653.84	653.59

Refenence ID	Observation Location Type	Rim Elevation (ft)[1,2,3]	Depth to Water: Rim to Water (in)			Depth to Water: Rim to Water (ft)			Groundwater Elevation (ft)[1,2]		
			14-Sep-17	6-Oct-18	8/14/2019[4]	14-Sep-17	6-Oct-18	14-Aug-19	14-Sep-17	6-Oct-18	14-Aug-19
R-80	MHOB	655.27	--	-28.5	-25	--	-2.4	-2.1	--	652.90	653.19
R-81	MHOB	653.56	--	-15	-6	--	-1.3	-0.5	--	652.31	653.06
R-82	MHOB	656.87	--	-32	-31	-	-2.7	-2.6	--	654.20	654.29
R-83	MHOB	656.51	-39.5	-27	-25	-3.3	-2.3	-2.1	653.22	654.26	654.43
R-84	MHOB	656.62	-43.5	-28	-28	-3.6	-2.3	-2.3	653.00	654.29	654.29
R-85	MHOB	657.15	-47	-43	-41	-3.9	-3.6	-3.4	653.23	653.57	653.73
R-86	MHOB	657.21	-51	-46.5	-44	-4.3	-3.9	-3.7	652.96	653.34	653.54
R-87	MHOB	659.35	--	-79.5	-82	--	-6.6	-6.8	--	652.73	652.52
R-88	MHOB	658.59	--	-50.5	-55	--	-4.2	-4.6	--	654.38	654.01
R-89	MHOB	659.84	Below IE	-80.5	-80.5	Below IE	-6.7	-6.7	Below IE	653.13	653.13
R-90	MHOB	658.84	--	-62	-56	--	-5.2	-4.7	--	653.67	654.17
R-91	MHOB	659.29	--	-65	-60	--	-5.4	-5.0	--	653.87	654.29
R-92	MHOB	659.15	--	-67	-68	--	-5.6	-5.7	--	653.57	653.48
R-93	MHOB	660.85	--	-84	-78	--	-7.0	-6.5	--	653.85	654.35
R-94	MHOB	661.52	--	DRY	-82	--	DRY	-6.8	--	DRY	654.69

Refenence ID	Observation Location Type	Rim Elevation (ft)[1,2,3]	Depth to Water: Rim to Water (in)			Depth to Water: Rim to Water (ft)			Groundwater Elevation (ft)[1,2]		
			14-Sep-17	6-Oct-18	8/14/2019[4]	14-Sep-17	6-Oct-18	14-Aug-19	14-Sep-17	6-Oct-18	14-Aug-19
R-95	MHOB	660.72	--	DRY	-109	--	DRY	-9.1	--	DRY	651.64
R-96	MHOB	661.89	--	DRY	DRY	--	DRY	DRY	--	DRY	DRY
R-97	MHOB	660.81	--	DRY	-94	--	DRY	-7.8	--	DRY	652.98
R-98	MHOB	659.28	DRY	DRY	-72	DRY	DRY	-6.0	DRY	DRY	653.28
R-99	MHOB	658.23	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
R-100	DW	655.48	-96	-89.5	-89	-8.0	-7.5	-7.4	647.48	648.02	648.06
R-101	DW	655.48	-96	-85	-83	-8.0	-7.1	-6.9	647.48	648.40	648.56
R-102	MHOB	658.89	--	DRY	DRY	--	DRY	DRY	--	DRY	DRY
R-103	MHOB	659.12	DRY	-72.5	-71.5	DRY	-6.0	-6.0	DRY	653.08	653.16
R-104	MHOB	659.50	--	DRY	-72	--	DRY	-6.0	--	DRY	653.50
R-105	MHOB	661.87	--	DRY	DRY	--	DRY	DRY	--	DRY	DRY
R-106	MHOB	661.90	--	DRY	DRY	--	DRY	DRY	--	DRY	DRY
R-107	DW	659.09	-105	-100.5	-97	-8.8	-8.4	-8.1	650.34	650.72	651.01
R-108	DW	659.09	-105	-98	-93	-8.8	-8.2	-7.8	650.34	650.92	651.34
R-109	DW	658.81	--	-99.5	-104	--	-8.3	-8.7	--	650.52	650.14
R-110	DW	658.88	--	-98	-101	--	-8.2	-8.4	--	650.71	650.46
R-111 EAST	DW	658.05	--	-93	-98	--	-7.8	-8.2	--	650.30	649.88
R-111 WEST	DW	657.93	--	-91	-95	--	-7.6	-7.9	--	650.35	650.01
R-112 EAST	DW	657.86	--	-79	-82	--	-6.6	-6.8	--	651.28	651.03
R-112 WEST	DW	657.97	--	-79	-82	--	-6.6	-6.8	--	651.39	651.14
R-113	DW	657.55	--	-78	-83	--	-6.5	-6.9	--	651.05	650.63
R-114 NORTH	DW	655.97	--	-46.5	-50	--	-3.9	-4.2	--	652.10	651.80
R-114 SOUTH	DW	656.07	--	-47	-51	--	-3.9	-4.3	--	652.15	651.82
R-115 EAST	DW	656.93	--	-43.5	-51	--	-3.6	-4.3	--	653.31	652.68
R-115 WEST	DW	657.05	--	-45	-51	--	-3.8	-4.3	--	653.30	652.80
R-116 EAST	DW	654.50	-42	-36	-35	-3.5	-3.0	-2.9	651.00	651.50	651.58
R-116 WEST	DW	654.39		-35	-34	-3.5	-2.9	-2.8	650.89	651.47	651.56
R-117 NORTH	DW	653.70	-82.5	-82.5	-72	-6.9	-6.9	-6.0	646.83	646.83	647.70
R-117 SOUTH	DW	653.60		-71.5	-68	-6.9	-6.0	-5.7	646.73	647.64	647.93
R-118 EAST	DW	654.91	--	-92	-91	--	-7.7	-7.6	--	647.24	647.33
R-118 WEST	DW	655.20	--	-95	-95	--	-7.9	-7.9	--	647.28	647.28
R-119	MHOB	658.18	--	-56.5	-62	--	-4.7	-5.2	--	653.47	653.01
R-120	MHOB	658.11	-62	-56.5	-63	-5.2	-4.7	-5.3	652.94	653.40	652.86
R-121	MHOB	659.66	--	-47.5	-68	--	-4.0	-5.7	--	655.70	653.99
R-122	MHOB	658.48	--	-62.5	-62	--	-5.2	-5.2	--	653.27	653.31
R-123	MHOB	658.03	--	-57	-62	--	-4.8	-5.2	--	653.28	652.86
R-124	MHOB	657.45	--	-56.5	-48	--	-4.7	-4.0	--	652.74	653.45
R-125	MHOB	657.51	--	-50.5	-55	--	-4.2	-4.6	--	653.30	652.93
S-1	MHOB	649.40	--	-72	-101	--	-6.0	-8.4	--	643.40	640.98
S-2	MHOB	648.97	--	DRY	DRY	--	DRY	DRY	--	DRY	DRY
S-3	MHOB	*647.50*	--	DRY	-100	--	DRY	-8.3	--	DRY	639.17
S-4	MHOB	UNKNOWN	--	-87.5	-85	--	-7.3	-7.1	--	NA	NA
S-5	MHOB	644.55	--	DRY	--	--	DRY	--	--	DRY	--
S-6	MHOB	UNKNOWN	--	DRY	-86	--	DRY	-7.2	--	DRY	NA
S-7	MHOB	UNKNOWN	--	-78.5	-77	--	-6.5	-6.4	--	NA	NA
S-10	MHOB	642.91	--	-82.5	-82	--	-6.9	-6.8	--	636.04	636.08
S-11	MHOB	643.70	DRY	-89.5	-88	DRY	-7.5	-7.3	DRY	636.24	636.37
S-14	MHOB	UNKNOWN	--	-97.5	DRY	--	-8.1	DRY	--	NA	NA
S-31	MHOB	Could Not Locate	--	-82.5	--	--	-6.9	--	--	NA	--
S-32	MHOB	643.16	--	-72	-71	--	-6.0	-5.9	--	637.16	637.24
S-33	MHOB	647.68	DRY	-79.5	-78	DRY	-6.6	-6.5	DRY	641.06	641.18
S-34	MHOB	646.56	--	DRY	DRY	--	DRY	DRY	--	DRY	DRY
T-34 NORTH	DW	645.59	--	DRY	DRY	--	DRY	DRY	--	DRY	DRY
T-34 SOUTH	DW	645.05	--	DRY	DRY	--	DRY	DRY	--	DRY	DRY

Refenence ID	Observation Location Type	Rim Elevation (ft)[1,2,3]	Depth to Water: Rim to Water (in)			Depth to Water: Rim to Water (ft)			Groundwater Elevation (ft)[1,2]		
			14-Sep-17	6-Oct-18	8/14/2019[4]	14-Sep-17	6-Oct-18	14-Aug-19	14-Sep-17	6-Oct-18	14-Aug-19
MW-1	MW	572.53	--	--	DRY	--	--	DRY	--	--	DRY
MW-2	MW	573.84	--	--	DRY	--	--	DRY	--	--	DRY
MW-3	MW	643.12	--	--	-76.08	--	--	-6.34	--	--	636.78
MW-4	MW	649.04	--	--	DRY	--	--	DRY	--	--	DRY
MW-5	MW	629.54	--	--	-54.72	--	--	-4.56	--	--	624.98
MW-6	MW	657.34	--	--	-38.28	--	--	-3.19	--	--	654.15
MW-7	MW	654.92	--	--	-16.8	--	--	-1.40	--	--	653.52
MW-8	MW	652.00	--	--	-15.24	--	--	-1.27	--	--	650.73

Notes:

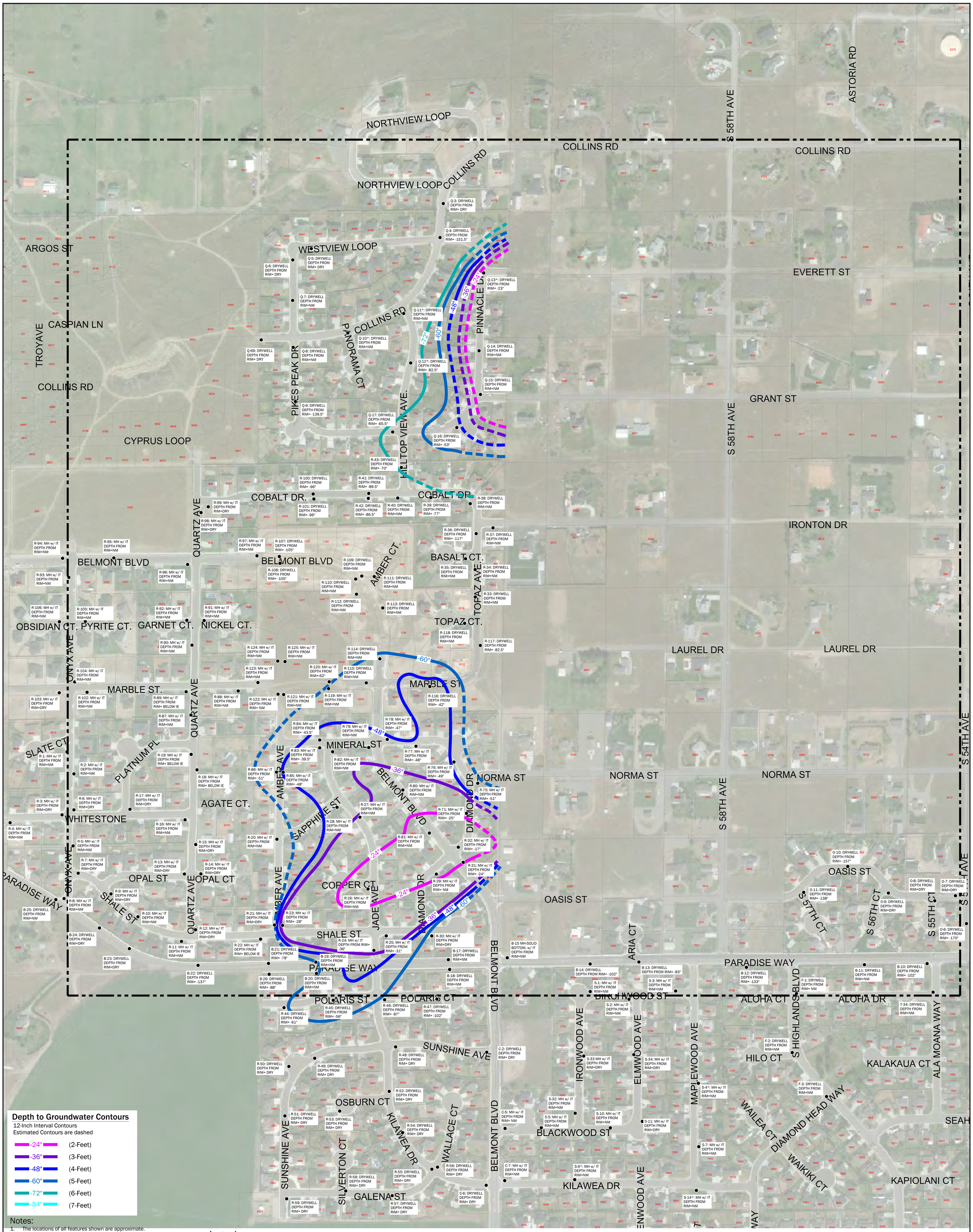
[1] *Italicized values indicate that the rim elevation value has been estimated.*

[2] Elevations are referenced to the ROS #3910 city datum.

[3] The reference for monitorng wells is the top of the north rim of PVC well casing.

[4] Monitoring well data collected on August 15, 2019.

MHOB = man hole with open bottom
DW = dry well
MHSB = man hole with sealed bottom
MW = monitoring well
IE = invert elevation
NA = Not Applicable. Assigned to values where the Rim Elevation was not available or could not be estimated.
UNKNOWN = the measument location could not be located in the as-builts provided.
in = inches; ft = feet; '-- = not measured or no value reported for monitoring event



Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. Depths are measured from the rim of the stormwater structure.

Data Source: Aerial from Bing Maps.

Projection: NAD83 Washington State Planes, South Zone, US Foot

Legend

Q-3 ● Stormwater Structure Designation

Approximate Drainage Problem Area

NM = Not Measured

*Rim Elevation Unkown

N

0 150 300

SCALE IN FEET

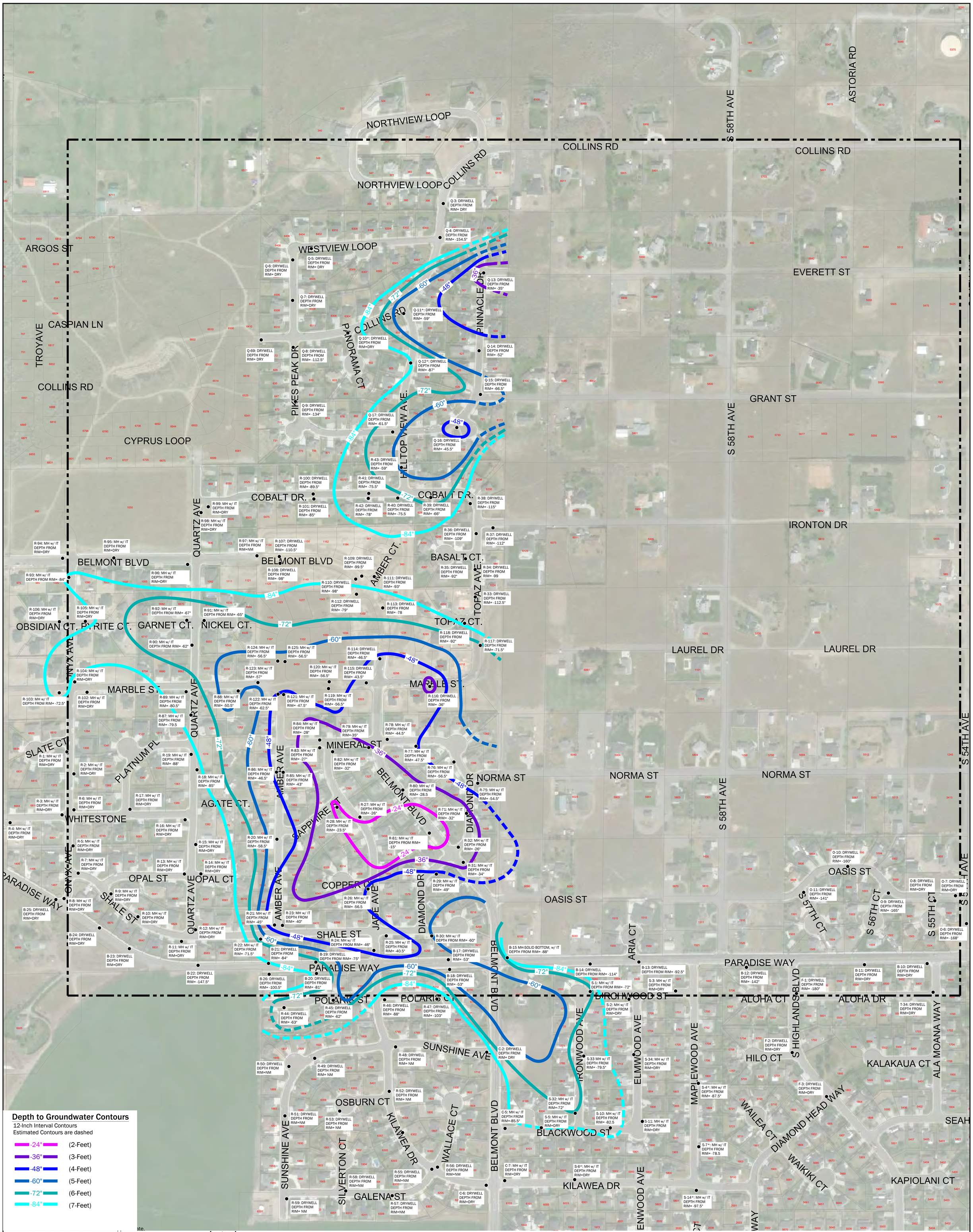
Depth to Groundwater Map
September 14, 2017

Drainage Problem Area
City of West Richland

GEOENGINEERS

Figure G-1

P:\3\3234005\CAD\02\Hydrogeologic Investigation\323400502_G-1 Groundwater Map 2017.dwg TAB:G-1 Date Exported: 08/29/19 - 12:15 by mwoods



2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. Depths are measured from the rim of the stormwater structure.

Data Source: Aerial from Bing Maps.

Projection: NAD83 Washington State Planes, South Zone, US Foot

Legend

Q-3 ● Stormwater Structure Designation

Approximate Drainage Problem Area

NM = Not Measured

*Rim Elevation Unkown

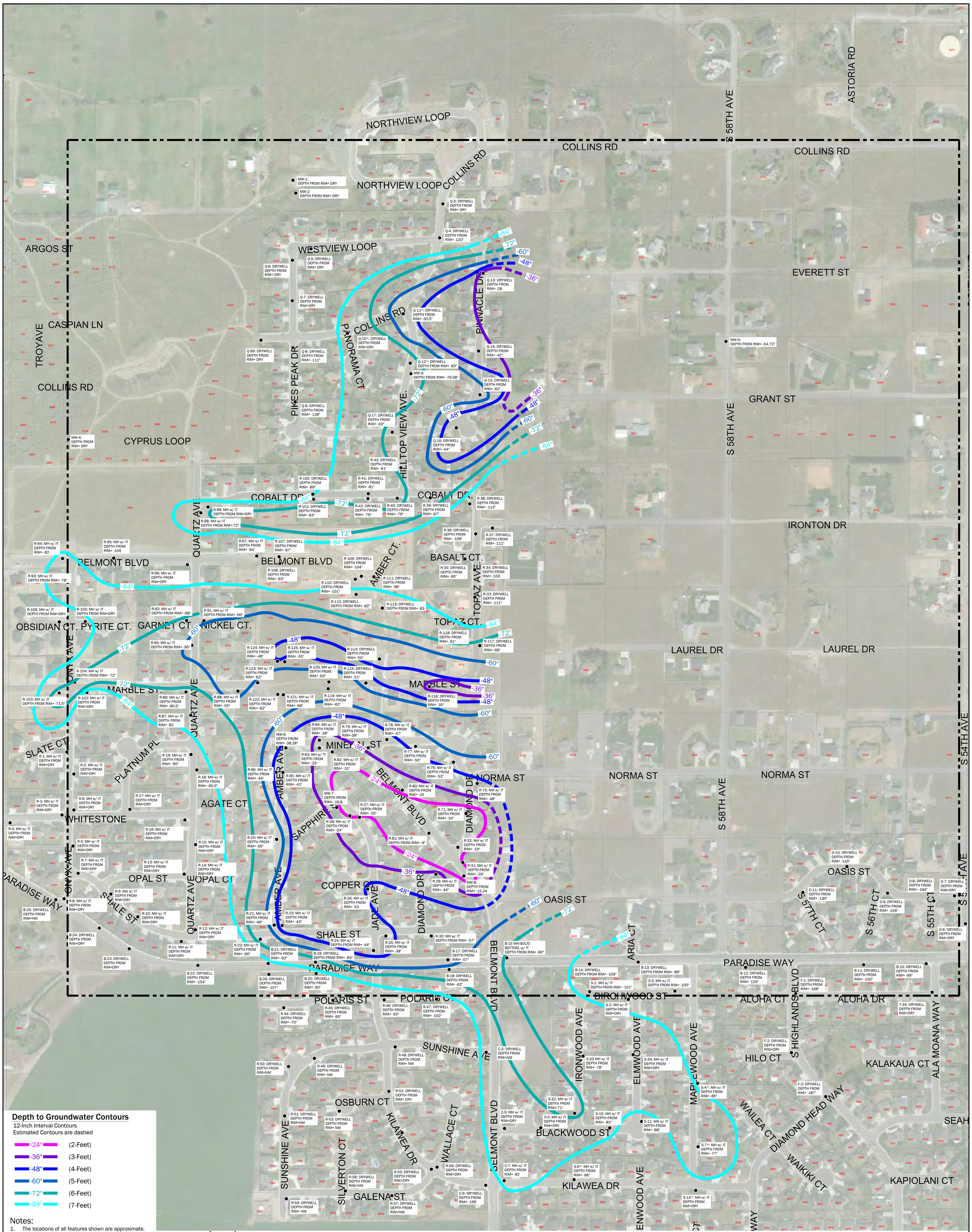
Depth to Groundwater Map
October 6, 2018

Drainage Problem Area
City of West Richland

GEOENGINEERS

Figure G-2

P:\3\3234005\CAD\02\Hydrogeologic Investigation\323400502_G-2 Groundwater Map 2018.dwg TAB:G-2 Date Exported: 08/29/19 - 12:15 by mwoods



Depth to Groundwater Contours

12-Inch Interval Contours
Estimated Contours are dashed

-24"	(2-Feet)
-36"	(3-Feet)
-48"	(4-Feet)
-60"	(5-Feet)
-72"	(6-Feet)
-84"	(7-Feet)

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. Depths are measured from the rim of the stormwater structure.

Data Source: Aerial from Bing Maps.

Projection: NAD83 Washington State Planes, South Zone, US Foot

Legend

Q-3 ● Stormwater Structure Designation

Approximate Drainage Problem Area

NM = Not Measured

*Rim Elevation Unkown

N

0 150 300
SCALE IN FEET

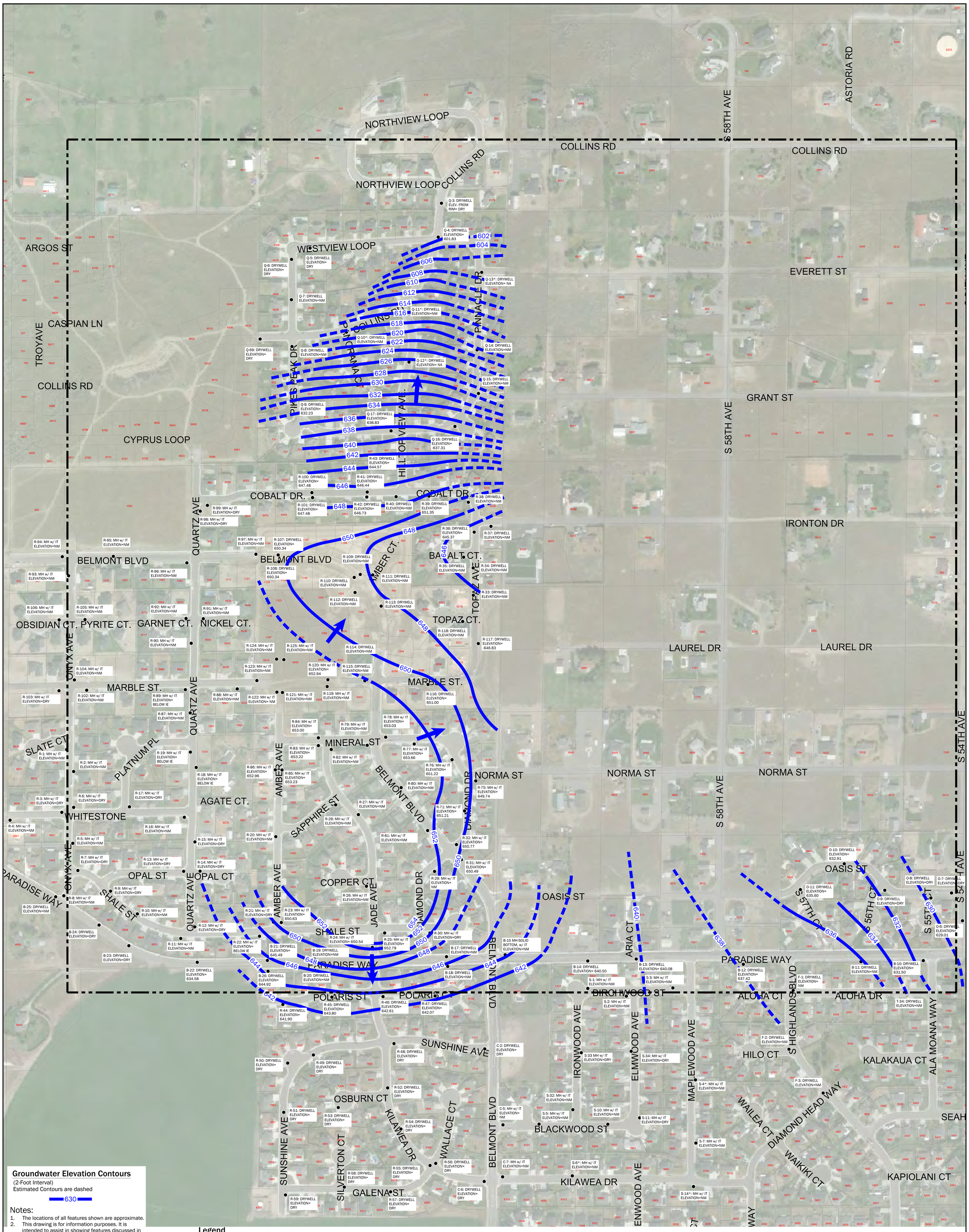
Depth to Groundwater Map
August 14, 2019

Drainage Problem Area
City of West Richland

GEOENGINEERS

Figure G-3

P:\3\3234005\CAD\02\Hydrogeologic Investigation\323400502_G-3 Groundwater Map 2019.dwg TAB:G-3 Date Exported: 09/04/19 - 14:15 by tmichaud



Groundwater Elevation Contours
(2-Foot Interval)
Estimated Contours are dashed
630

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. Elevations are referenced to the ROS 3910 Datum.

Data Source: Aerial from Bing Maps.

Projection: NAD83 Washington State Planes, South Zone, US Foot

Legend
Q-3 ● Stormwater Structure Designation
Approximate Drainage Problem Area
Interpreted Groundwater Flow Direction
NM = Not Measured
*Rim Elevation Unkown

N
0 150 300
SCALE IN FEET

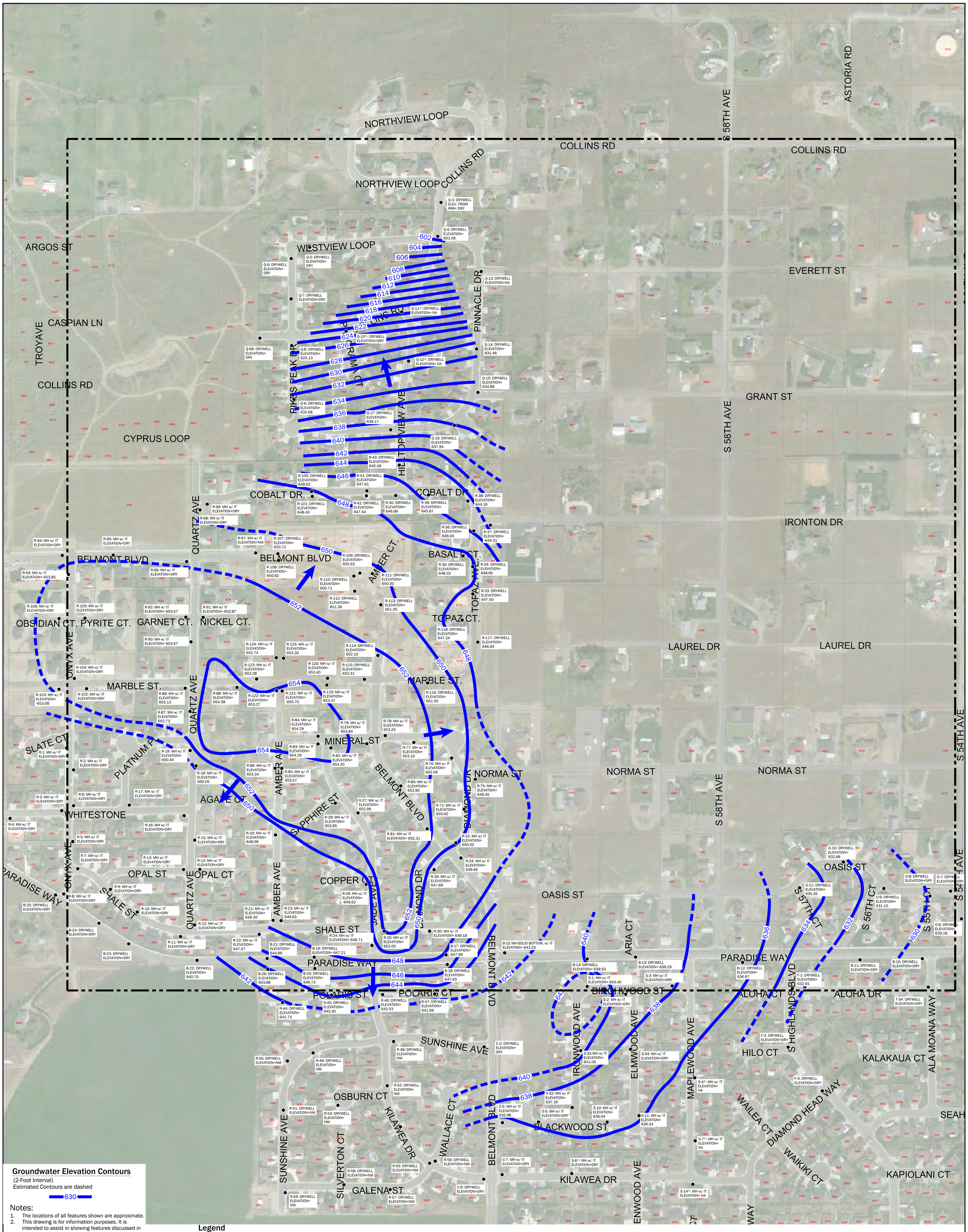
Groundwater Elevation Map
September, 14 2017

Drainage Problem Area
City of West Richland

GEOENGINEERS

Figure G-4

P:\3\3234005\CAD\02\Hydrogeologic Investigation\323400502_G-4 Potentiometric Surface Map 2017.dwg TAB:G-4 Date Exported: 08/29/19 - 12:14 by mwoods



Groundwater Elevation Contours
(2-Foot Interval)
Estimated Contours are dashed
630

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. Elevations are referenced to the ROS 3910 Datum.

Data Source: Aerial from Bing Maps.

Projection: NAD83 Washington State Planes, South Zone, US Foot

Legend
Q-3 ● Stormwater Structure Designation
Approximate Drainage Problem Area
Interpreted Groundwater Flow Direction
NM = Not Measured
*Rim Elevation Unkown

N
0 150 300
SCALE IN FEET

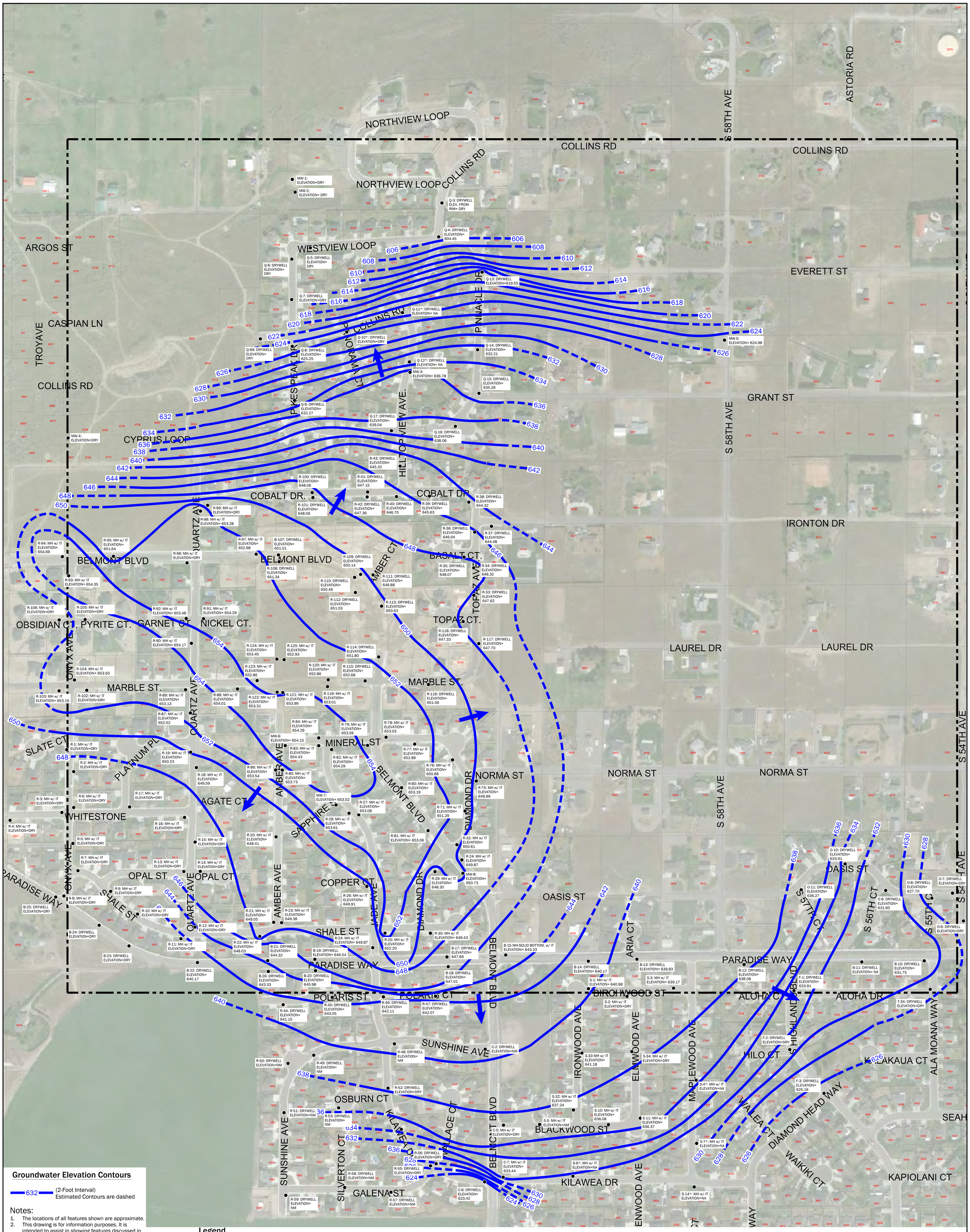
Groundwater Elevation Map
October 6, 2018

Drainage Problem Area
City of West Richland

GEOENGINEERS

Figure G-5

P:\3\3234005\CAD\02\Hydrogeologic Investigation\323400502_G-5 Potentiometric Surface Map 2018.dwg TAB:G-5 Date Exported: 08/29/19 - 12:13 by mwoods



Groundwater Elevation Contours

632 (2-Foot Interval)
Estimated Contours are dashed

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. Elevations are referenced to the ROS 3910 Datum.

Data Source: Aerial from Bing Maps.

Projection: NAD83 Washington State Planes, South Zone, US Foot

Legend

Q-3 ● Stormwater Structure Designation

Approximate Drainage Problem Area

Interpreted Groundwater Flow Direction

NM = Not Measured

*Rim Elevation Unkown

N

0 150 300
SCALE IN FEET

Groundwater Elevation Map
August 14, 2019

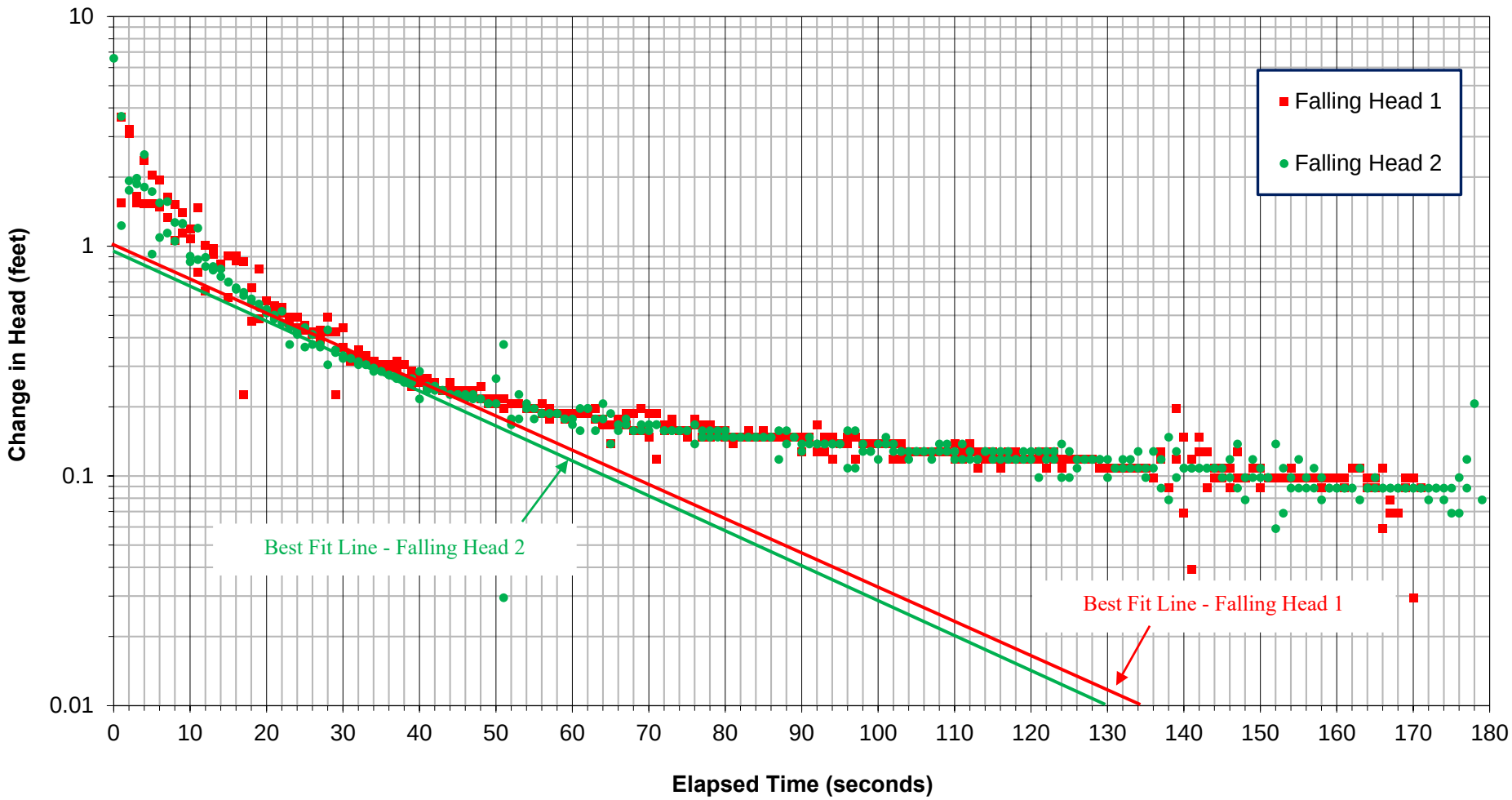
Drainage Problem Area
City of West Richland

GEOENGINEERS

Figure G-6

P:\3\3234005\CAD\02\Hydrogeologic Investigation\323400502_G-6 Potentiometric Surface Map 2019.dwg TAB:G-6 Date Exported: 09/04/19 - 14:18 by tmichaud

APPENDIX H
Slug Test Plots

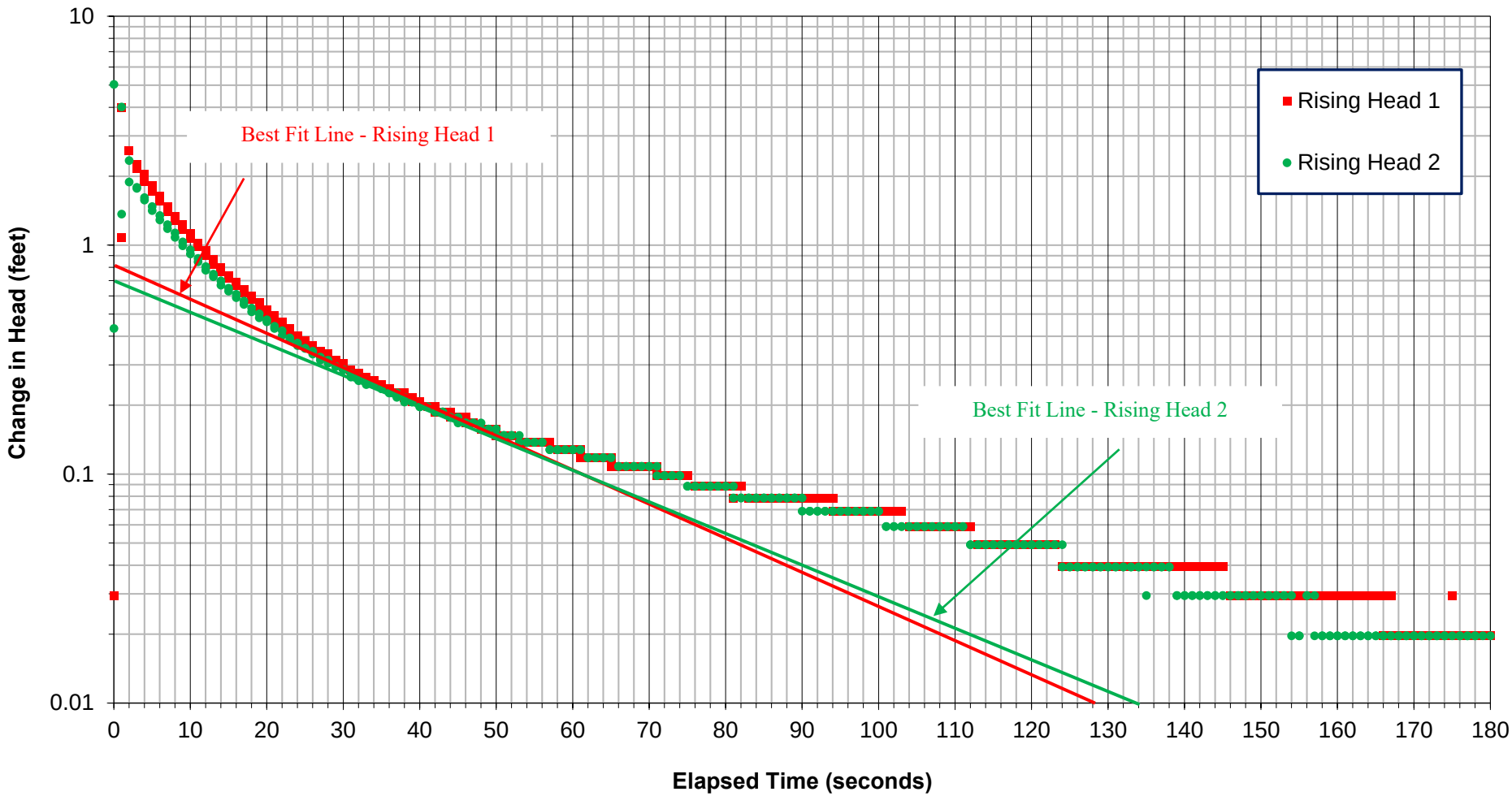


Falling-Head Test Plot
MW-3

Drainage Problem Area
City of West Richland, Washington

GeoEngineers

Figure H-1

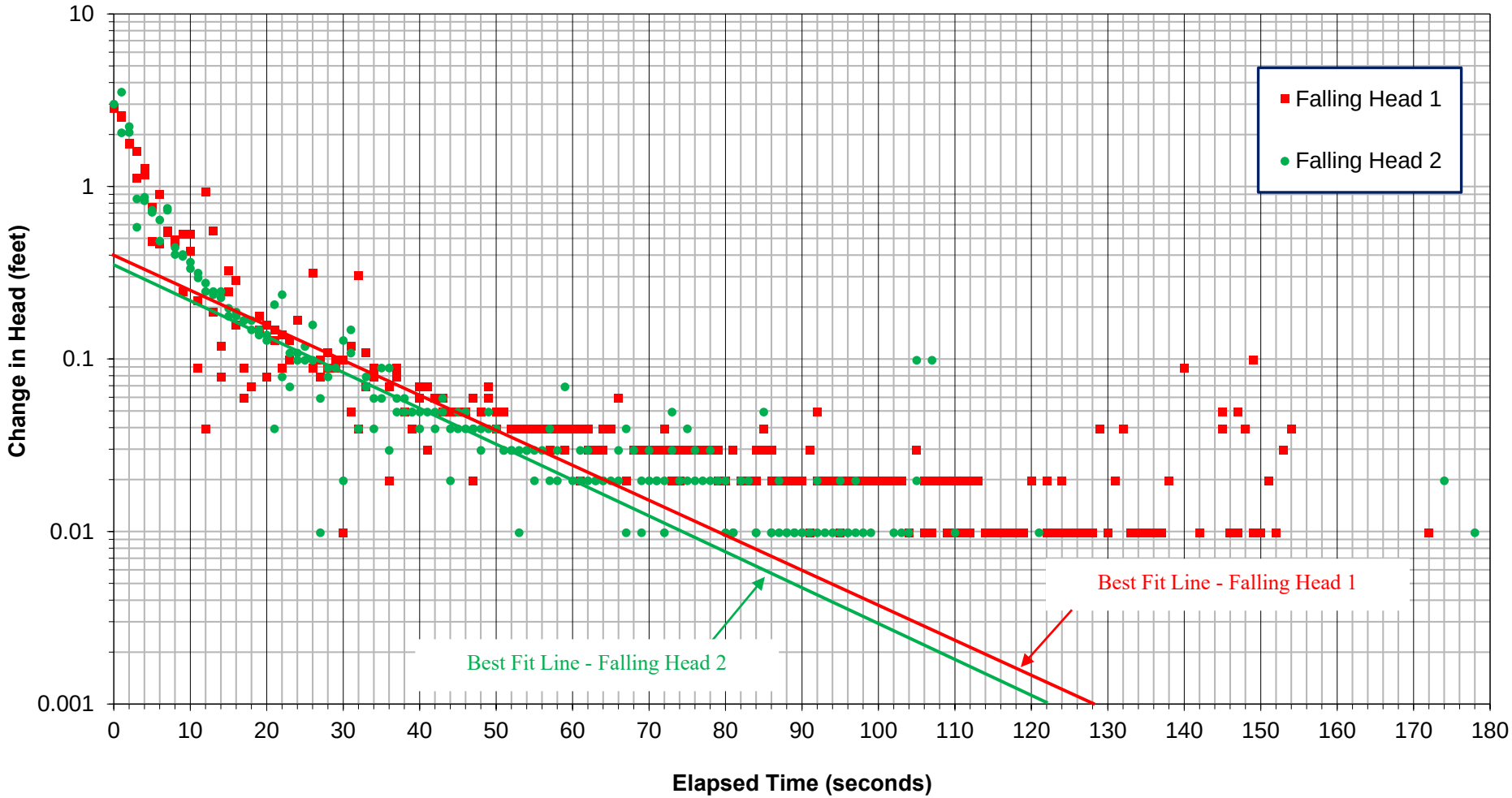


Rising-Head Test Plot
MW-3

Drainage Problem Area
City of West Richland, Washington

GeoEngineers

Figure H-2

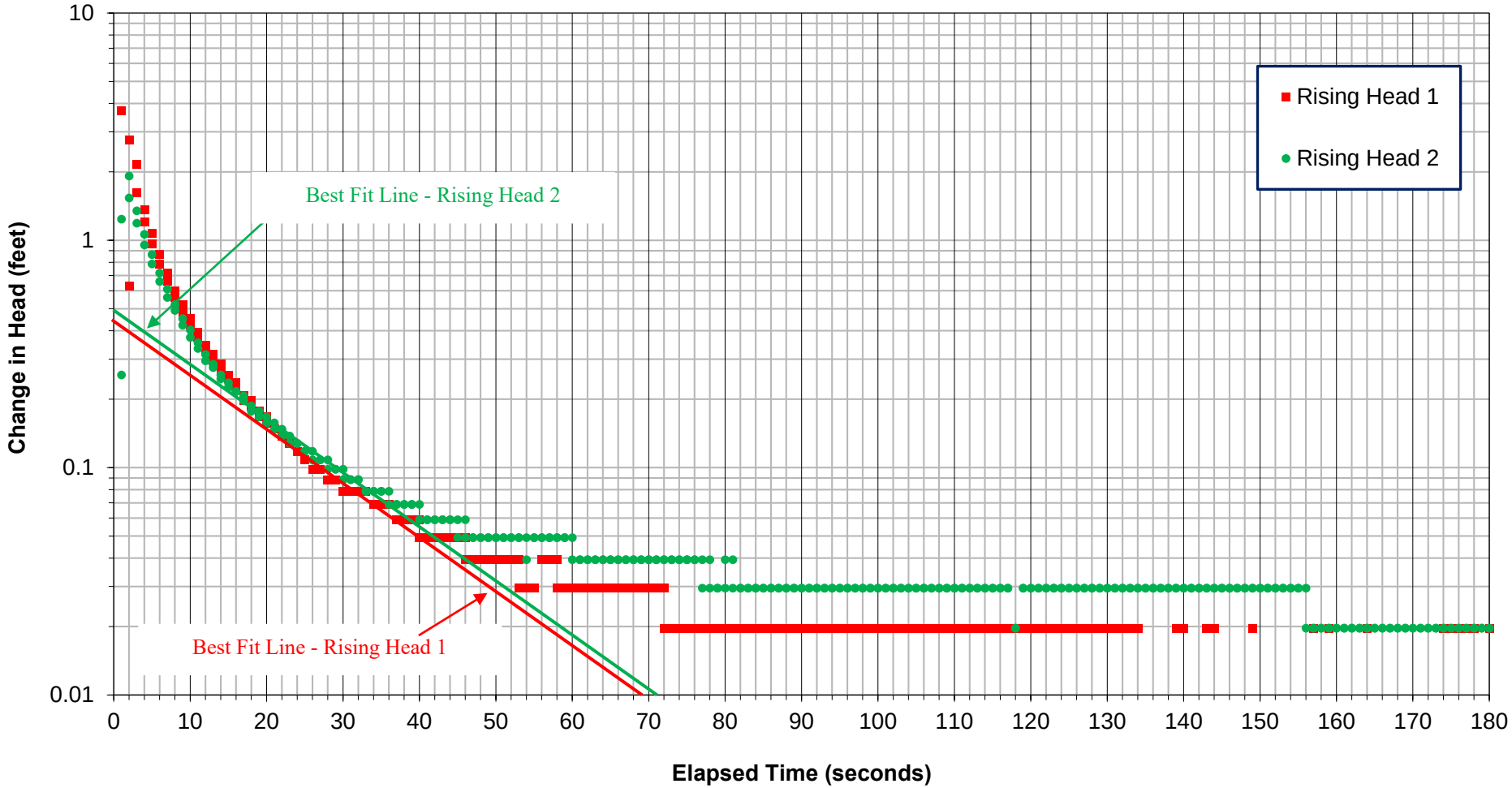


Falling Head Test Plot
MW-5

Drainage Problem Area
City of West Richland, Washington

GEOENGINEERS

Figure H-3

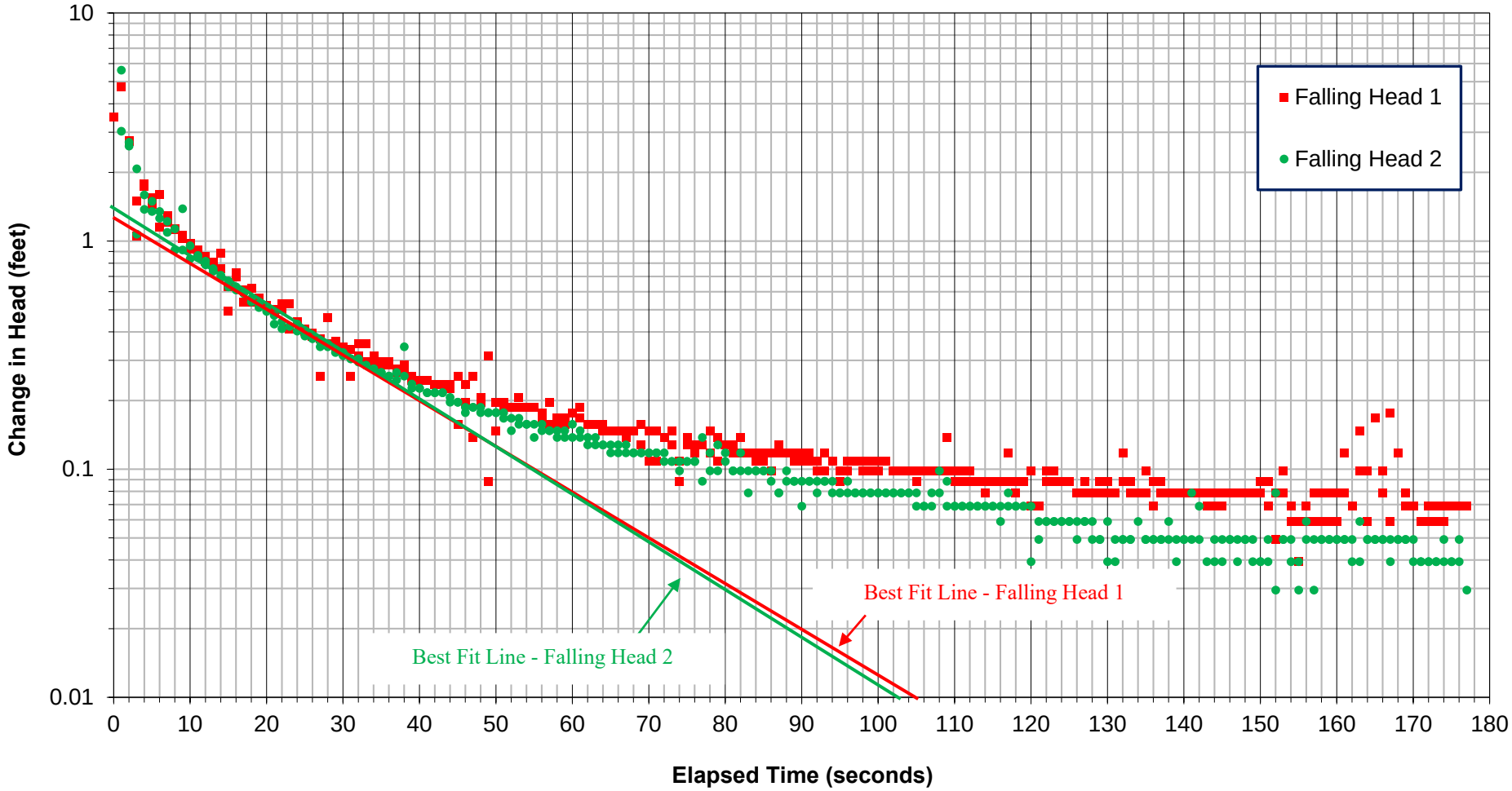


Rising Head Test Plot
MW-5

Drainage Problem Area
City of West Richland, Washington

GeoEngineers

Figure H-4

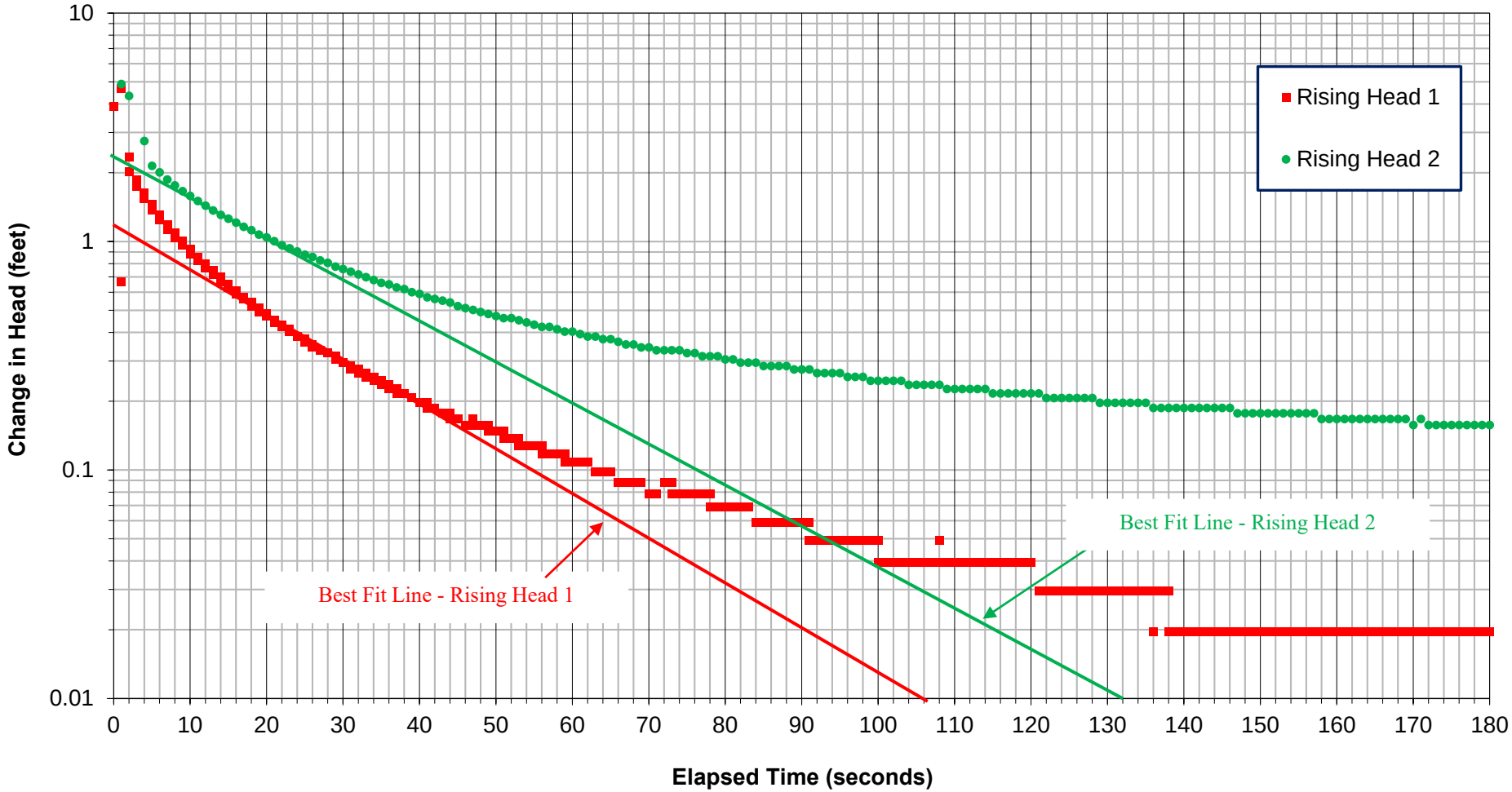


Falling Head Test Plot
MW-6

Drainage Problem Area
City of West Richland, Washington

GEOENGINEERS

Figure H-5

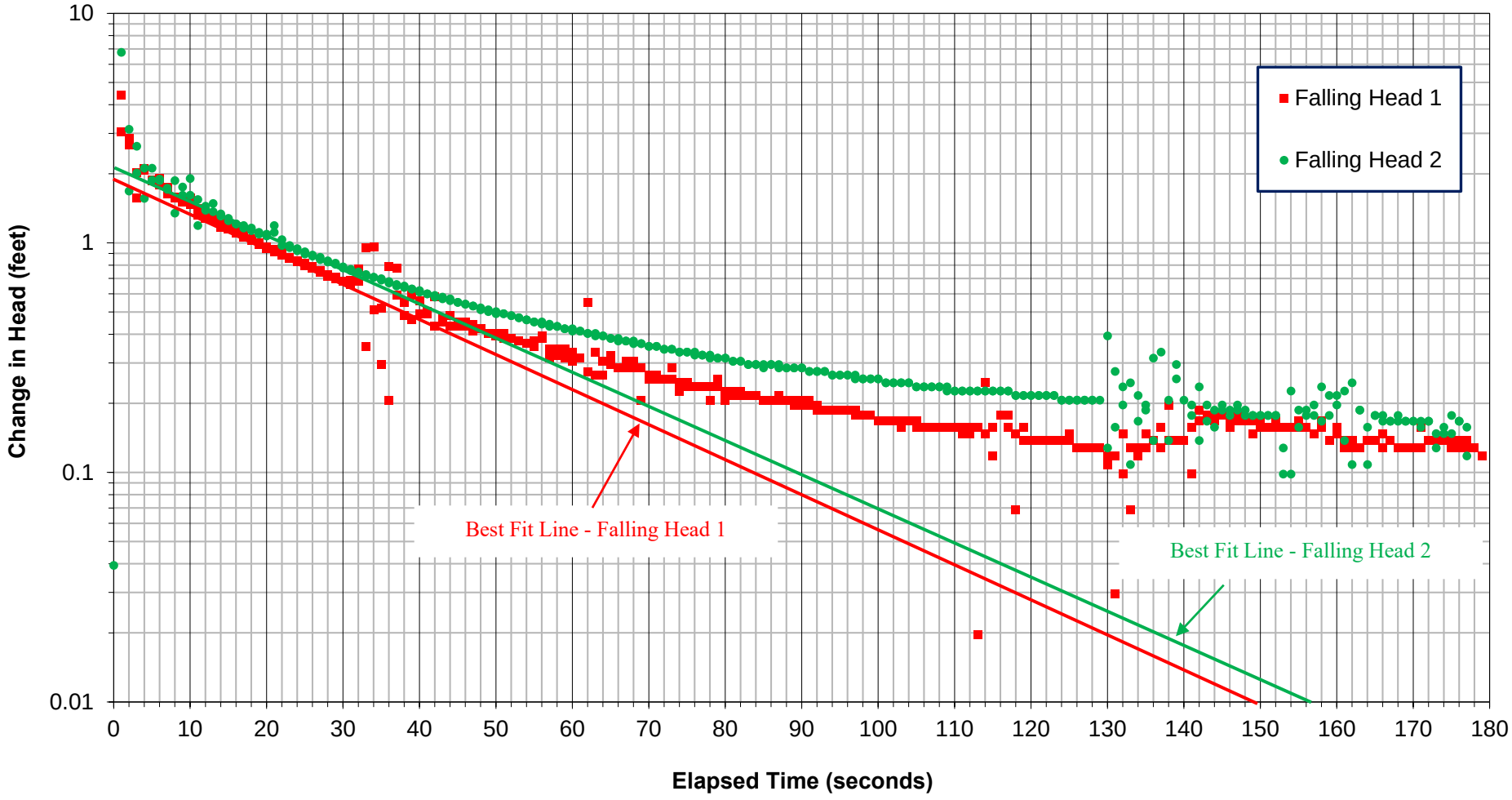


Rising Head Test Plot
MW-6

Drainage Problem Area
City of West Richland, Washington

GEOENGINEERS

Figure H-6

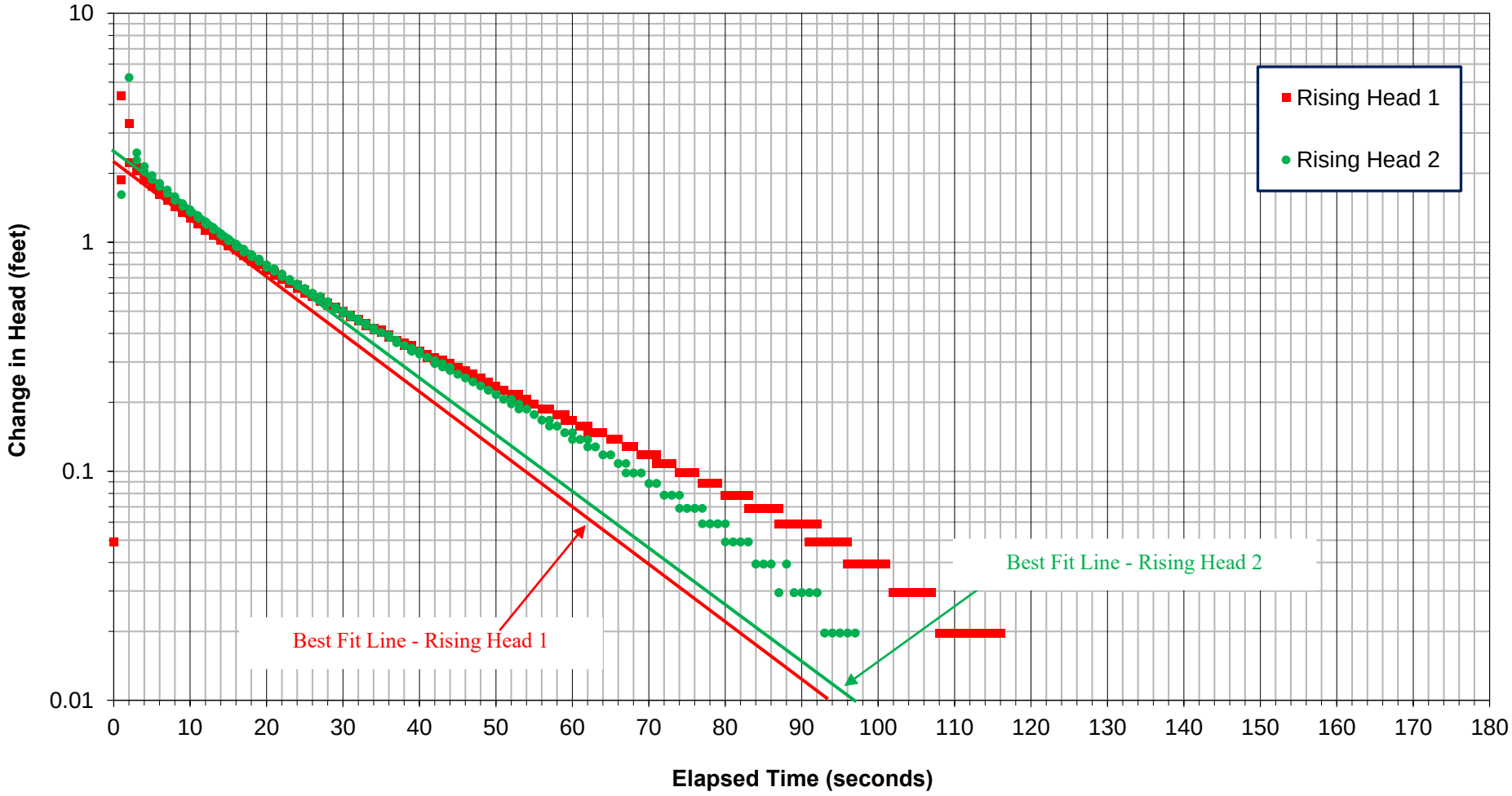


Falling Head Test Plot
MW-7

Drainage Problem Area
City of West Richland, Washington

GEOENGINEERS

Figure H-7

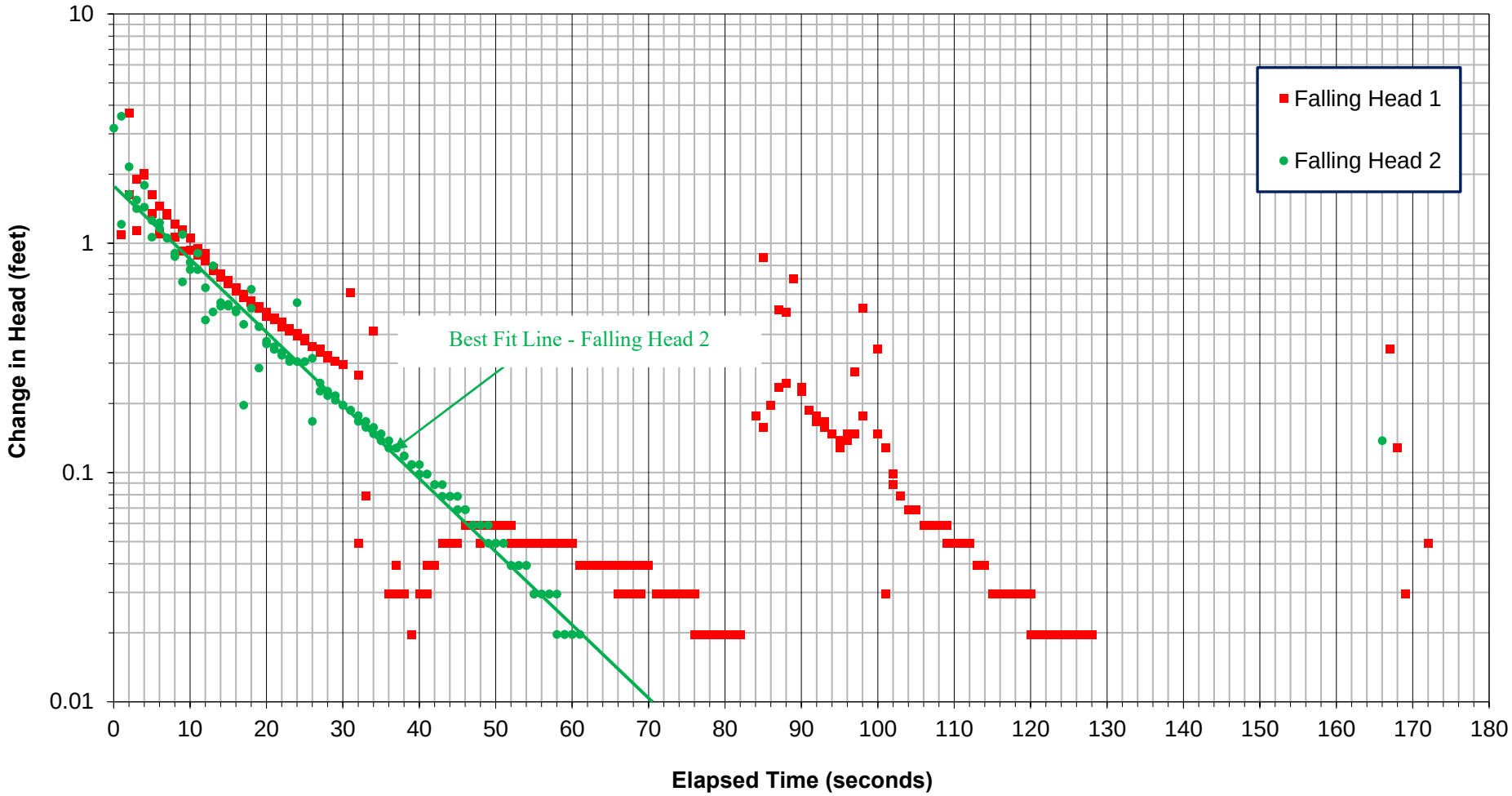


Rising Head Test Plot
MW-7

Drainage Problem Area
City of West Richland, Washington

GEOENGINEERS

Figure H-8



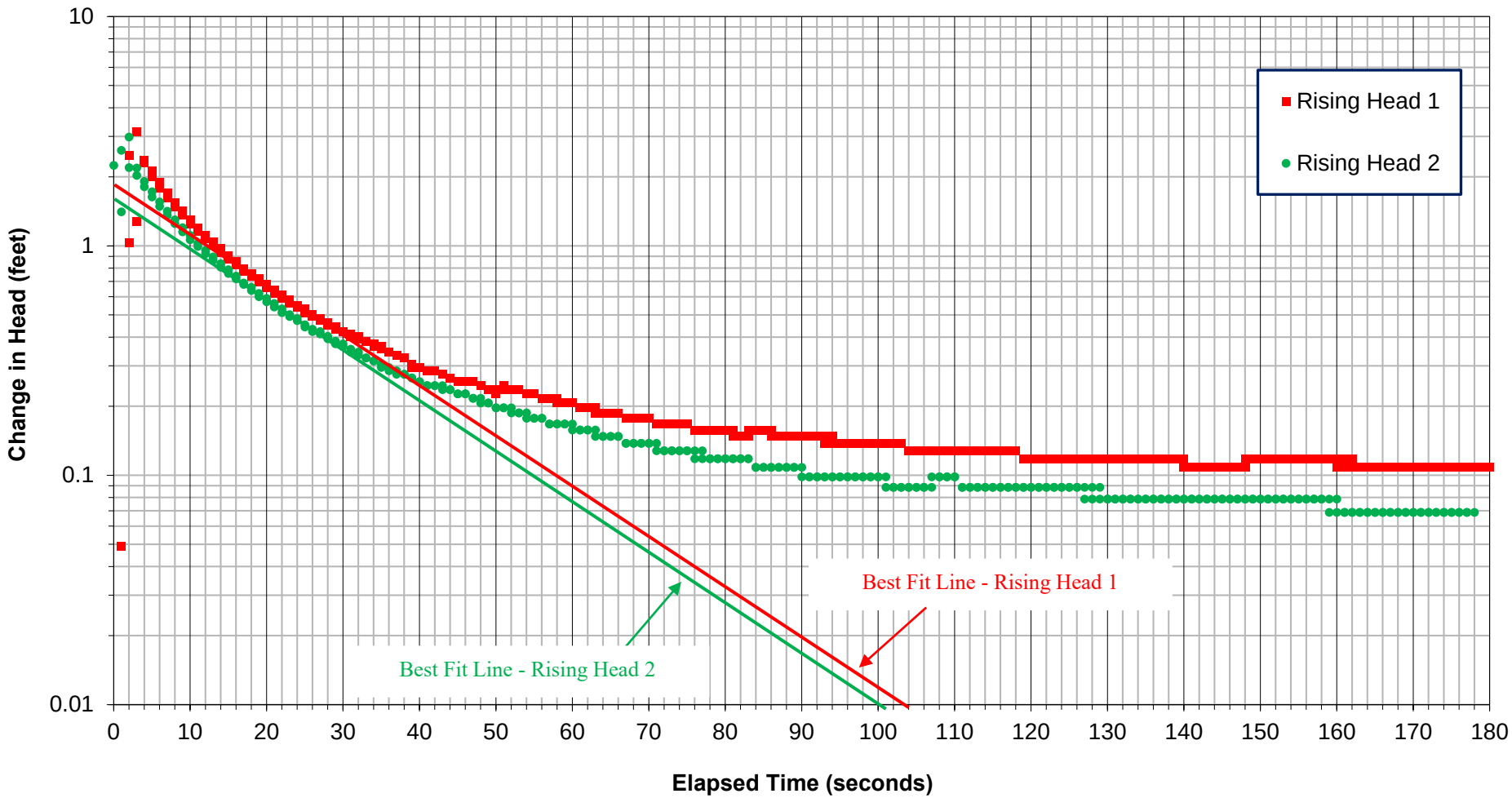
Note:
1. The Falling Head 1 test was not analyzed for hydraulic conductivity because data noise suggests the water level transducer was not vertically stable during testing.

Falling Head Test Plot
MW-8

Drainage Problem Area
City of West Richland, Washington

GeoEngineers

Figure H-9



Rising Head Test Plot
MW-8

Drainage Problem Area
City of West Richland, Washington

GEOENGINEERS

Figure H-10

APPENDIX I
Precipitation Trends

Table I-1

Precipitation Data - Kennewick Climate Station [1]

Drainage Problem Area

City of West Richland, Washington

Month	Kennewick Climate Station [1]		Richland Climate Station [2]	
	Total Monthly Precipitation (inches)	WRCC Footnote [3] (inches)	Monthly Precipitation (inches)	WRCC Footnote [3] (inches)
Jan-80	2.26		1.82	
Feb-80	1.30		1.58	
Mar-80	0.66		0.43	
Apr-80	0.29		0.50	
May-80	1.76		1.77	
Jun-80	0.62		0.89	
Jul-80	0.52		0.01	
Aug-80	0.11		0.06	
Sep-80	1.63		-----	z
Oct-80	1.05		0.81	
Nov-80	0.66		1.09	
Dec-80	1.64		1.73	
Jan-81	0.50		0.42	
Feb-81	0.77		0.70	
Mar-81	0.83		0.75	
Apr-81	0.12		0.27	
May-81	0.90		1.15	
Jun-81	0.87		0.79	
Jul-81	0.00	a	0.14	
Aug-81	0.06		0.00	
Sep-81	0.57		0.57	
Oct-81	0.14	a	0.38	
Nov-81	0.92		1.09	
Dec-81	1.47		0.91	
Jan-82	0.86		0.75	
Feb-82	0.45		0.61	
Mar-82	0.45		0.48	
Apr-82	0.83		0.71	
May-82	0.26		0.43	
Jun-82	0.75		0.70	
Jul-82	0.14		0.24	
Aug-82	0.07		0.08	
Sep-82	1.16		0.50	
Oct-82	1.90		1.59	
Nov-82	0.59		0.65	
Dec-82	1.53		1.65	
Jan-83	1.19		1.23	
Feb-83	1.48		1.61	
Mar-83	1.41		1.13	
Apr-83	0.31		0.39	
May-83	0.42		0.20	
Jun-83	0.46		0.47	
Jul-83	0.28		0.22	
Aug-83	0.18		0.07	
Sep-83	0.27		0.10	
Oct-83	0.67		0.64	
Nov-83	2.20		2.30	
Dec-83	2.22		1.47	
Jan-84	0.23		0.16	
Feb-84	0.88		0.92	
Mar-84	1.73		1.23	

Month	Kennewick Climate Station [1]		Richland Climate Station [2]	
	Total Monthly Precipitation (inches)	WRCC Footnote [3] (inches)	Monthly Precipitation (inches)	WRCC Footnote [3] (inches)
Apr-84	0.81		0.66	
May-84	0.69		0.70	
Jun-84	0.48		0.72	
Jul-84	0.00		0.05	
Aug-84	0.00		0.00	
Sep-84	0.52		0.93	a
Oct-84	0.15		0.02	
Nov-84	1.98		2.03	
Dec-84	0.79		0.75	
Jan-85	0.42		0.44	
Jan-85	0.84		0.56	a
Mar-85	0.51		0.40	
Apr-85	0.11		0.19	
May-85	0.08		0.26	
Jun-85	0.27		0.30	
Jul-85	0.02		0.01	
Aug-85	0.22		0.18	
Sep-85	0.52		0.39	
Oct-85	0.44		0.42	
Nov-85	1.33		1.14	
Dec-85	0.65		0.78	
Jan-86	2.16		2.06	a
Feb-86	1.56		1.07	
Mar-86	1.42		1.25	
Apr-86	0.05		0.08	
May-86	0.89		0.82	
Jun-86	0.00		0.06	b
Jul-86	0.20		0.39	
Aug-86	0.02		0.06	
Sep-86	0.63		0.84	
Oct-86	0.38		0.72	
Nov-86	0.93		0.73	
Dec-86	0.88		0.84	
Jan-87	1.15		1.13	
Feb-87	0.43		0.50	
Mar-87	0.89		1.36	
Apr-87	0.20		0.37	
May-87	0.40		0.75	
Jun-87	0.15		0.05	
Jul-87	0.12		0.16	a
Aug-87	0.03		0.03	
Sep-87	0.00		0.07	
Oct-87	0.00		0.00	
Nov-87	0.28		0.27	
Dec-87	1.14		1.64	
Jan-88	0.72		0.78	
Feb-88	0.02		0.07	
Mar-88	0.50		0.78	
Apr-88	0.41		0.62	
May-88	0.90		0.80	
Jun-88	0.35		0.31	
Jul-88	0.18		0.14	
Aug-88	0.00		0.00	
Sep-88	0.38		0.30	
Oct-88	0.03		0.01	
Nov-88	0.79		1.19	
Dec-88	0.38		0.53	
Jan-89	0.90		0.74	

Month	Kennewick Climate Station [1]		Richland Climate Station [2]	
	Total Monthly Precipitation (inches)	WRCC Footnote [3] (inches)	Monthly Precipitation (inches)	WRCC Footnote [3] (inches)
Feb-89	1.20		1.21	
Mar-89	1.68		1.58	
Apr-89	0.62	a	1.03	
May-89	0.48		0.90	
Jun-89	0.06		0.08	
Jul-89	0.00		0.03	
Aug-89	0.37		0.42	
Sep-89	0.00		0.00	
Oct-89	0.61		0.54	
Nov-89	1.15		1.03	
Dec-89	0.38		0.52	
Jan-90	0.53		0.70	
Feb-90	0.69		0.76	
Mar-90	0.38		0.23	
Apr-90	0.75		0.56	
May-90	0.59		0.76	
Jun-90	0.16		0.17	
Jul-90	0.07		0.15	
Aug-90	0.42		0.71	
Sep-90	0.00		0.00	
Oct-90	0.81		1.04	
Nov-90	0.22		0.45	
Dec-90	0.63		0.77	
Jan-91	0.55		0.47	a
Feb-91	0.51		0.49	
Mar-91	0.87		1.10	
Apr-91	0.24		0.39	
May-91	1.39		1.04	
Jun-91	0.22		0.57	
Jul-91	0.08		0.11	
Aug-91	0.26		0.14	
Sep-91	0.00		0.00	
Oct-91	0.60		0.60	
Nov-91	2.16		2.26	
Dec-91	0.69		0.80	
Jan-92	0.72		0.68	
Feb-92	1.11		1.32	
Mar-92	0.22		0.28	
Apr-92	1.34		1.22	
May-92	0.03		0.05	
Jun-92	0.52		0.64	
Jul-92	1.50		0.97	
Aug-92	0.63		0.50	
Sep-92	0.35		0.46	
Oct-92	0.43		0.37	
Nov-92	1.26		1.58	
Dec-92	1.11		1.06	
Jan-93	1.48		1.71	
Feb-93	0.89		0.81	
Mar-93	0.87		0.86	
Apr-93	1.58		1.41	
May-93	0.62		0.65	k
Jun-93	0.46		0.72	
Jul-93	0.34		0.45	
Aug-93	0.93		-----	z
Sep-93	0.02		0.07	
Oct-93	0.37		0.03	
Nov-93	0.15		0.17	

Month	Kennewick Climate Station [1]		Richland Climate Station [2]	
	Total Monthly Precipitation (inches)	WRCC Footnote [3] (inches)	Monthly Precipitation (inches)	WRCC Footnote [3] (inches)
Dec-93	0.93		1.12	
Jan-94	1.09		-----	z
Feb-94	0.89		0.16	g
Mar-94	0.03		0.03	
Apr-94	0.28		0.66	
May-94	1.61		1.44	f
Jun-94	0.29		0.64	
Jul-94	0.41		0.54	m
Aug-94	0.00		-----	z
Sep-94	0.07		-----	z
Oct-94	0.96		1.25	b
Nov-94	0.99		0.65	
Dec-94	1.08		0.95	
Jan-95	2.04		2.06	i
Feb-95	0.46		0.33	
Mar-95	1.16		-----	z
Apr-95	1.30		1.58	f
May-95	0.38		0.41	t
Jun-95	1.17		1.25	h
Jul-95	0.40		0.60	k
Aug-95	0.13		-----	z
Sep-95	0.41		0.38	x
Oct-95	0.58		-----	z
Nov-95	0.82		1.04	i
Dec-95	1.96		2.03	j
Jan-96	1.43		0.96	
Feb-96	1.36		1.49	f
Mar-96	1.34		1.70	d
Apr-96	0.90		0.33	e
May-96	0.98		0.98	
Jun-96	0.31		0.20	
Jul-96	-----	z	0.26	
Aug-96	0.00		0.00	
Sep-96	0.18		0.14	
Oct-96	1.15		1.05	
Nov-96	2.42		1.97	
Dec-96	3.20	a	2.29	
Jan-97	1.51		1.67	
Feb-97	0.69		0.37	
Mar-97	0.63		0.86	
Apr-97	0.77		0.73	
May-97	0.59		0.53	
Jun-97	0.29		0.26	
Jul-97	0.55		0.26	
Aug-97	0.05		0.17	a
Sep-97	0.34		0.38	
Oct-97	1.01		0.82	g
Nov-97	1.06		0.86	
Dec-97	0.31		0.47	
Jan-98	1.30		1.32	
Feb-98	0.94		0.99	
Mar-98	0.72		0.63	
Apr-98	0.17		0.17	
May-98	0.75		0.59	
Jun-98	-----	z	0.53	
Jul-98	0.09		1.63	
Aug-98	0.31		0.00	
Sep-98	0.30		0.17	

Month	Kennewick Climate Station [1]		Richland Climate Station [2]	
	Total Monthly Precipitation (inches)	WRCC Footnote [3] (inches)	Monthly Precipitation (inches)	WRCC Footnote [3] (inches)
Oct-98	0.09		0.08	
Nov-98	1.35		-----	z
Dec-98	1.04		0.37	
Jan-99	0.64		0.69	
Feb-99	0.63		0.71	
Mar-99	0.16		0.04	
Apr-99	0.21		0.20	
May-99	0.49		0.17	
Jun-99	0.17		0.00	
Jul-99	0.28		0.00	
Aug-99	0.29		0.12	
Sep-99	0.00		0.00	
Oct-99	0.60		0.43	
Nov-99	0.41		0.26	
Dec-99	0.17		0.36	
Jan-00	1.38		1.21	
Feb-00	1.60		1.38	
Mar-00	1.03		0.91	
Apr-00	0.03		0.86	
May-00	0.86		0.73	
Jun-00	0.60		0.58	
Jul-00	0.02		0.03	
Aug-00	0.00		0.11	
Sep-00	0.67		0.88	
Oct-00	1.07		0.99	
Nov-00	1.12		1.00	
Dec-00	0.53		0.48	
Jan-01	0.69		0.42	
Feb-01	0.30		0.32	
Mar-01	1.09		0.49	
Apr-01	0.92		1.00	
May-01	0.24		0.18	
Jun-01	0.35	c	0.43	
Jul-01	0.06		0.16	
Aug-01	0.28		0.27	
Sep-01	0.00		-----	z
Oct-01	0.51		0.25	
Nov-01	1.13	a	1.50	
Dec-01	0.52		0.66	
Jan-02	0.24		0.40	
Feb-02	0.78		0.69	
Mar-02	0.22		0.20	
Apr-02	0.26		0.44	
May-02	0.22		0.29	
Jun-02	0.88		0.80	
Jul-02	0.40		0.26	
Aug-02	0.22		0.03	
Sep-02	0.00		0.00	
Oct-02	0.07		0.07	
Nov-02	0.30		0.23	
Dec-02	1.61		2.42	
Jan-03	1.77		1.79	
Feb-03	0.94		0.73	
Mar-03	0.30		0.28	
Apr-03	0.79		1.32	
May-03	0.54		0.17	
Jun-03	0.00		0.00	
Jul-03	0.00		0.00	

Month	Kennewick Climate Station [1]		Richland Climate Station [2]	
	Total Monthly Precipitation (inches)	WRCC Footnote [3] (inches)	Monthly Precipitation (inches)	WRCC Footnote [3] (inches)
Aug-03	0.05		0.18	
Sep-03	0.26		0.35	
Oct-03	0.14	a	0.13	
Nov-03	0.27		0.17	
Dec-03	1.71		1.60	
Jan-04	1.00		1.27	
Feb-04	0.74		1.21	
Mar-04	0.19		0.25	
Apr-04	0.44		0.23	
May-04	0.57		1.56	
Jun-04	1.06		1.33	
Jul-04	0.02		0.00	
Aug-04	0.42		0.53	
Sep-04	0.16		0.17	
Oct-04	0.28		0.38	
Nov-04	0.58		0.32	
Dec-04	0.77		0.74	
Jan-05	0.81		0.67	
Feb-05	0.03		0.06	
Mar-05	0.36		0.44	
Apr-05	0.77		0.43	
May-05	0.36		0.72	
Jun-05	0.43		0.33	
Jul-05	0.08		0.19	
Aug-05	0.04		0.09	
Sep-05	0.08		0.60	
Oct-05	1.31		0.55	
Nov-05	0.78		0.89	
Dec-05	1.81		2.33	
Jan-06	2.16		1.67	
Feb-06	0.29		0.27	
Mar-06	0.44		0.38	
Apr-06	1.15		1.03	
May-06	1.18		0.73	
Jun-06	1.20		1.03	
Jul-06	0.01		0.05	
Aug-06	0.00		0.00	
Sep-06	0.25		0.17	
Oct-06	0.62		0.42	
Nov-06	1.17		1.17	
Dec-06	1.73		1.69	
Jan-07	0.34		0.38	
Feb-07	0.85		1.08	
Mar-07	0.57		0.79	
Apr-07	0.48		0.40	
May-07	0.38		0.33	
Jun-07	0.72		0.78	
Jul-07	0.02		0.11	
Aug-07	0.05		0.11	
Sep-07	0.17		0.50	
Oct-07	0.38		0.23	
Nov-07	0.98		1.22	
Dec-07	1.06		0.78	
Jan-08	1.50		1.14	
Feb-08	0.49		0.62	c
Mar-08	0.38		0.51	
Apr-08	0.24		0.20	
May-08	0.27		0.30	

Month	Kennewick Climate Station [1]		Richland Climate Station [2]	
	Total Monthly Precipitation (inches)	WRCC Footnote [3] (inches)	Monthly Precipitation (inches)	WRCC Footnote [3] (inches)
Jun-08	0.75		0.68	
Jul-08	0.00		0.01	
Aug-08	0.32		0.23	
Sep-08	0.05		0.10	
Oct-08	0.14		0.28	
Nov-08	0.51		0.84	
Dec-08	1.59		0.74	
Jan-09	1.28		1.12	
Feb-09	0.86		0.99	
Mar-09	1.29		1.11	
Apr-09	0.35		0.38	
May-09	0.56		0.44	
Jun-09	0.01		0.07	
Jul-09	0.08		0.14	
Aug-09	0.08		0.07	
Sep-09	0.11		0.24	
Oct-09	1.16		1.01	
Nov-09	0.35		0.45	
Dec-09	0.59		1.02	
Jan-10	1.82		1.55	
Feb-10	0.54		0.42	a
Mar-10	0.18		0.13	
Apr-10	0.35		0.21	
May-10	1.51		1.33	
Jun-10	1.33		0.73	
Jul-10	0.17		0.17	
Aug-10	0.06		0.10	
Sep-10	1.47		0.84	
Oct-10	0.87		0.98	
Nov-10	1.47		1.61	
Dec-10	2.28		1.97	a
Jan-11	0.46		0.71	
Feb-11	0.44		0.22	
Mar-11	1.02		0.92	
Apr-11	0.30		0.53	
May-11	1.30		1.19	
Jun-11	0.86		0.19	a
Jul-11	0.05		0.02	
Aug-11	0.08		0.01	
Sep-11	0.03		0.02	a
Oct-11	0.48		0.58	
Nov-11	0.14		0.27	
Dec-11	0.08		0.19	
Jan-12	0.99		0.93	
Feb-12	0.52		0.60	
Mar-12	0.96		1.04	
Apr-12	0.70		0.78	a
May-12	0.26		0.33	
Jun-12	1.62		1.84	
Jul-12	0.70		0.32	
Aug-12	0.09		0.01	
Sep-12	0.00		0.00	
Oct-12	1.16		1.00	
Nov-12	1.07		0.99	a
Dec-12	1.37		1.42	
Jan-13	0.42		0.30	
Feb-13	0.03		0.13	a
Mar-13	0.34		0.50	

Month	Kennewick Climate Station [1]		Richland Climate Station [2]	
	Total Monthly Precipitation (inches)	WRCC Footnote [3] (inches)	Monthly Precipitation (inches)	WRCC Footnote [3] (inches)
Apr-13	0.52		0.38	
May-13	0.70		0.73	
Jun-13	1.36		0.92	
Jul-13	0.00		0.00	
Aug-13	0.28		0.23	
Sep-13	1.20		0.85	
Oct-13	0.22		0.16	
Nov-13	0.31		0.42	
Dec-13	0.11		0.19	a
Jan-14	0.50		0.42	
Feb-14	0.81		0.52	
Mar-14	0.49		0.76	c
Apr-14	0.33		0.36	a
May-14	0.23		0.11	
Jun-14	0.42		0.22	
Jul-14	0.02		0.02	
Aug-14	0.36		0.34	
Sep-14	0.01		0.02	
Oct-14	0.71		0.70	
Nov-14	0.43		0.42	
Dec-14	1.28		1.13	
Jan-15	1.03		0.96	
Feb-15	0.66		0.64	
Mar-15	0.34		0.73	
Apr-15	0.15		0.03	
May-15	0.99	a	1.21	
Jun-15	0.00		0.00	
Jul-15	0.00		0.02	
Aug-15	0.00		0.00	
Sep-15	0.22		0.10	
Oct-15	0.37		0.54	
Nov-15	0.63		0.66	
Dec-15	1.78		1.90	
Jan-16	1.29		1.46	
Feb-16	0.46		0.36	
Mar-16	1.10		0.84	
Apr-16	0.21		0.09	
May-16	1.73		0.66	
Jun-16	0.43		0.41	
Jul-16	0.32		0.22	
Aug-16	0.00		0.00	
Sep-16	0.26		0.26	
Oct-16	2.53		1.82	
Nov-16	0.29		0.46	
Dec-16	0.74		0.79	
Jan-17	1.54		0.91	
Feb-17	1.84		1.82	
Mar-17	1.64		1.46	
Apr-17	1.01		1.13	
May-17	0.41		0.47	
Jun-17	0.48		0.40	
Jul-17	0.00		0.00	
Aug-17	0.02		0.04	
Sep-17	0.50		0.31	
Oct-17	0.63		0.53	
Nov-17	1.30		1.38	
Dec-17	0.94		1.07	
Jan-18	1.25	a	1.09	

Month	Kennewick Climate Station [1]		Richland Climate Station [2]	
	Total Monthly Precipitation (inches)	WRCC Footnote [3] (inches)	Monthly Precipitation (inches)	WRCC Footnote [3] (inches)
Feb-18	0.46		0.36	
Mar-18	0.53		0.27	
Apr-18	1.34		1.10	
May-18	0.58		0.36	
Jun-18	0.08		0.26	a
Jul-18	0.00	a	0.00	
Aug-18	0.00	a	0.00	
Sep-18	0.00		0.02	
Oct-18	0.86		0.38	
Nov-18	0.76	c	0.71	c
Dec-18	1.04		0.70	
Jan-19	1.62		1.54	
Feb-19	3.09		0.84	a
Mar-19	0.49		0.63	
Apr-19	0.95		0.82	
May-19	3.30		0.49	
Jun-19	0.20		0.18	
Jul-19	0.10		0.06	

Notes:

[1] Precipitation totals for Kennewick, Washington (Station No. 454154) were obtained on November 28, 2018 from the Western Regional Climate Center (www.wrcc.dri.edu).

[2] Precipitation totals for Richland, Washington (Station No. 457015) were obtained on November 28, 2018 from the Western Regional Climate Center (www.wrcc.dri.edu).

[3] Footnotes are provided the following explanation by WRCC: a = 1 day missing, b = 2 days missing, c = 3 days, etc., z = 26 or more days missing, A = Accumulations present

Table I-2

Cumulative Departure in Precipitation [1]

Drainage Problem Area

City of West Richland, Washington

Month	Total Monthly Precipitation (inches)	Average Monthly Precipitation (inches)	Departure from Average (inches)	Cumulative Departure (inches)
Jan-80	2.26	1.09	1.17	1.17
Feb-80	1.30	0.82	0.48	1.65
Mar-80	0.66	0.74	-0.08	1.57
Apr-80	0.29	0.56	-0.27	1.30
May-80	1.76	0.76	1.00	2.30
Jun-80	0.62	0.52	0.10	2.39
Jul-80	0.52	0.19	0.33	2.73
Aug-80	0.11	0.16	-0.05	2.67
Sep-80	1.63	0.33	1.30	3.97
Oct-80	1.05	0.65	0.40	4.37
Nov-80	0.66	0.90	-0.24	4.12
Dec-80	1.64	1.12	0.52	4.64
Jan-81	0.50	1.09	-0.59	4.05
Feb-81	0.77	0.82	-0.05	4.00
Mar-81	0.83	0.74	0.09	4.09
Apr-81	0.12	0.56	-0.44	3.65
May-81	0.90	0.76	0.14	3.79
Jun-81	0.87	0.52	0.35	4.14
Jul-81	0.00	0.19	-0.19	3.95
Aug-81	0.06	0.16	-0.10	3.84
Sep-81	0.57	0.33	0.24	4.09
Oct-81	0.14	0.65	-0.51	3.57
Nov-81	0.92	0.90	0.02	3.59
Dec-81	1.47	1.12	0.35	3.94
Jan-82	0.86	1.09	-0.23	3.70
Feb-82	0.45	0.82	-0.37	3.33
Mar-82	0.45	0.74	-0.29	3.05
Apr-82	0.83	0.56	0.27	3.31
May-82	0.26	0.76	-0.50	2.81
Jun-82	0.75	0.52	0.23	3.04
Jul-82	0.14	0.19	-0.05	2.99
Aug-82	0.07	0.16	-0.09	2.90
Sep-82	1.16	0.33	0.83	3.73
Oct-82	1.90	0.65	1.25	4.98
Nov-82	0.59	0.90	-0.31	4.66
Dec-82	1.53	1.12	0.41	5.07
Jan-83	1.19	1.09	0.10	5.17
Feb-83	1.48	0.82	0.66	5.82
Mar-83	1.41	0.74	0.67	6.50
Apr-83	0.31	0.56	-0.25	6.24
May-83	0.42	0.76	-0.34	5.90
Jun-83	0.46	0.52	-0.06	5.84
Jul-83	0.28	0.19	0.09	5.93
Aug-83	0.18	0.16	0.02	5.95
Sep-83	0.27	0.33	-0.06	5.89

Month	Total Monthly Precipitation (inches)	Average Monthly Precipitation (inches)	Departure from Average (inches)	Cumulative Departure (inches)
Oct-83	0.67	0.65	0.02	5.91
Nov-83	2.20	0.90	1.30	7.20
Dec-83	2.22	1.12	1.10	8.30
Jan-84	0.23	1.09	-0.86	7.44
Feb-84	0.88	0.82	0.06	7.50
Mar-84	1.73	0.74	0.99	8.49
Apr-84	0.81	0.56	0.25	8.74
May-84	0.69	0.76	-0.07	8.67
Jun-84	0.48	0.52	-0.04	8.63
Jul-84	0.00	0.19	-0.19	8.44
Aug-84	0.00	0.16	-0.16	8.27
Sep-84	0.52	0.33	0.19	8.47
Oct-84	0.15	0.65	-0.50	7.96
Nov-84	1.98	0.90	1.08	9.04
Dec-84	0.79	1.12	-0.33	8.71
Jan-85	0.42	1.09	-0.67	8.03
Jan-85	0.84	0.82	0.02	8.05
Mar-85	0.51	0.74	-0.23	7.83
Apr-85	0.11	0.56	-0.45	7.37
May-85	0.08	0.76	-0.68	6.69
Jun-85	0.27	0.52	-0.25	6.44
Jul-85	0.02	0.19	-0.17	6.27
Aug-85	0.22	0.16	0.06	6.33
Sep-85	0.52	0.33	0.19	6.52
Oct-85	0.44	0.65	-0.21	6.30
Nov-85	1.33	0.90	0.43	6.73
Dec-85	0.65	1.12	-0.47	6.26
Jan-86	2.16	1.09	1.07	7.32
Feb-86	1.56	0.82	0.74	8.06
Mar-86	1.42	0.74	0.68	8.75
Apr-86	0.05	0.56	-0.51	8.23
May-86	0.89	0.76	0.13	8.36
Jun-86	0.00	0.52	-0.52	7.84
Jul-86	0.20	0.19	0.01	7.85
Aug-86	0.02	0.16	-0.14	7.71
Sep-86	0.63	0.33	0.30	8.01
Oct-86	0.38	0.65	-0.27	7.74
Nov-86	0.93	0.90	0.03	7.76
Dec-86	0.88	1.12	-0.24	7.52
Jan-87	1.15	1.09	0.06	7.58
Feb-87	0.43	0.82	-0.39	7.19
Mar-87	0.89	0.74	0.15	7.34
Apr-87	0.20	0.56	-0.36	6.98
May-87	0.40	0.76	-0.36	6.62
Jun-87	0.15	0.52	-0.37	6.24
Jul-87	0.12	0.19	-0.07	6.18
Aug-87	0.03	0.16	-0.13	6.04
Sep-87	0.00	0.33	-0.33	5.71
Oct-87	0.00	0.65	-0.65	5.06
Nov-87	0.28	0.90	-0.62	4.44
Dec-87	1.14	1.12	0.02	4.46
Jan-88	0.72	1.09	-0.37	4.08

Month	Total Monthly Precipitation (inches)	Average Monthly Precipitation (inches)	Departure from Average (inches)	Cumulative Departure (inches)
Feb-88	0.02	0.82	-0.80	3.28
Mar-88	0.50	0.74	-0.24	3.05
Apr-88	0.41	0.56	-0.15	2.89
May-88	0.90	0.76	0.14	3.03
Jun-88	0.35	0.52	-0.17	2.86
Jul-88	0.18	0.19	-0.01	2.85
Aug-88	0.00	0.16	-0.16	2.69
Sep-88	0.38	0.33	0.05	2.74
Oct-88	0.03	0.65	-0.62	2.11
Nov-88	0.79	0.90	-0.11	2.00
Dec-88	0.38	1.12	-0.74	1.26
Jan-89	0.90	1.09	-0.19	1.06
Feb-89	1.20	0.82	0.38	1.44
Mar-89	1.68	0.74	0.94	2.39
Apr-89	0.62	0.56	0.06	2.44
May-89	0.48	0.76	-0.28	2.16
Jun-89	0.06	0.52	-0.46	1.70
Jul-89	0.00	0.19	-0.19	1.51
Aug-89	0.37	0.16	0.21	1.72
Sep-89	0.00	0.33	-0.33	1.39
Oct-89	0.61	0.65	-0.04	1.35
Nov-89	1.15	0.90	0.25	1.59
Dec-89	0.38	1.12	-0.74	0.85
Jan-90	0.53	1.09	-0.56	0.29
Feb-90	0.69	0.82	-0.13	0.16
Mar-90	0.38	0.74	-0.36	-0.20
Apr-90	0.75	0.56	0.19	-0.01
May-90	0.59	0.76	-0.17	-0.18
Jun-90	0.16	0.52	-0.36	-0.55
Jul-90	0.07	0.19	-0.12	-0.66
Aug-90	0.42	0.16	0.26	-0.41
Sep-90	0.00	0.33	-0.33	-0.74
Oct-90	0.81	0.65	0.16	-0.58
Nov-90	0.22	0.90	-0.68	-1.26
Dec-90	0.63	1.12	-0.49	-1.75
Jan-91	0.55	1.09	-0.54	-2.30
Feb-91	0.51	0.82	-0.31	-2.61
Mar-91	0.87	0.74	0.13	-2.48
Apr-91	0.24	0.56	-0.32	-2.80
May-91	1.39	0.76	0.63	-2.17
Jun-91	0.22	0.52	-0.30	-2.47
Jul-91	0.08	0.19	-0.11	-2.58
Aug-91	0.26	0.16	0.10	-2.48
Sep-91	0.00	0.33	-0.33	-2.81
Oct-91	0.60	0.65	-0.05	-2.87
Nov-91	2.16	0.90	1.26	-1.61
Dec-91	0.69	1.12	-0.43	-2.04
Jan-92	0.72	1.09	-0.37	-2.42
Feb-92	1.11	0.82	0.29	-2.13
Mar-92	0.22	0.74	-0.52	-2.64
Apr-92	1.34	0.56	0.78	-1.87
May-92	0.03	0.76	-0.73	-2.60

Month	Total Monthly Precipitation (inches)	Average Monthly Precipitation (inches)	Departure from Average (inches)	Cumulative Departure (inches)
Jun-92	0.52	0.52	0.00	-2.60
Jul-92	1.50	0.19	1.31	-1.29
Aug-92	0.63	0.16	0.47	-0.82
Sep-92	0.35	0.33	0.02	-0.80
Oct-92	0.43	0.65	-0.22	-1.02
Nov-92	1.26	0.90	0.36	-0.67
Dec-92	1.11	1.12	-0.01	-0.68
Jan-93	1.48	1.09	0.39	-0.29
Feb-93	0.89	0.82	0.07	-0.22
Mar-93	0.87	0.74	0.13	-0.09
Apr-93	1.58	0.56	1.02	0.93
May-93	0.62	0.76	-0.14	0.79
Jun-93	0.46	0.52	-0.06	0.72
Jul-93	0.34	0.19	0.15	0.88
Aug-93	0.93	0.16	0.77	1.64
Sep-93	0.02	0.33	-0.31	1.33
Oct-93	0.37	0.65	-0.28	1.05
Nov-93	0.15	0.90	-0.75	0.30
Dec-93	0.93	1.12	-0.19	0.10
Jan-94	1.09	1.09	0.00	0.10
Feb-94	0.89	0.82	0.07	0.17
Mar-94	0.03	0.74	-0.71	-0.54
Apr-94	0.28	0.56	-0.28	-0.82
May-94	1.61	0.76	0.85	0.03
Jun-94	0.29	0.52	-0.23	-0.20
Jul-94	0.41	0.19	0.22	0.02
Aug-94	0.00	0.16	-0.16	-0.15
Sep-94	0.07	0.33	-0.26	-0.40
Oct-94	0.96	0.65	0.31	-0.10
Nov-94	0.99	0.90	0.09	-0.01
Dec-94	1.08	1.12	-0.04	-0.05
Jan-95	2.04	1.09	0.95	0.89
Feb-95	0.46	0.82	-0.36	0.53
Mar-95	1.16	0.74	0.42	0.96
Apr-95	1.30	0.56	0.74	1.69
May-95	0.38	0.76	-0.38	1.31
Jun-95	1.17	0.52	0.65	1.96
Jul-95	0.40	0.19	0.21	2.17
Aug-95	0.13	0.16	-0.03	2.14
Sep-95	0.41	0.33	0.08	2.22
Oct-95	0.58	0.65	-0.07	2.15
Nov-95	0.82	0.90	-0.08	2.06
Dec-95	1.96	1.12	0.84	2.90
Jan-96	1.43	1.09	0.34	3.24
Feb-96	1.36	0.82	0.54	3.78
Mar-96	1.34	0.74	0.60	4.38
Apr-96	0.90	0.56	0.34	4.72
May-96	0.98	0.76	0.22	4.94
Jun-96	0.31	0.52	-0.21	4.72
7/1/96 [2]	0.26	0.19	0.07	4.80
Aug-96	0.00	0.16	-0.16	4.63
Sep-96	0.18	0.33	-0.15	4.48

Month	Total Monthly Precipitation (inches)	Average Monthly Precipitation (inches)	Departure from Average (inches)	Cumulative Departure (inches)
Oct-96	1.15	0.65	0.50	4.98
Nov-96	2.42	0.90	1.52	6.50
Dec-96	3.20	1.12	2.08	8.57
Jan-97	1.51	1.09	0.42	8.99
Feb-97	0.69	0.82	-0.13	8.86
Mar-97	0.63	0.74	-0.11	8.75
Apr-97	0.77	0.56	0.21	8.96
May-97	0.59	0.76	-0.17	8.79
Jun-97	0.29	0.52	-0.23	8.56
Jul-97	0.55	0.19	0.36	8.92
Aug-97	0.05	0.16	-0.11	8.80
Sep-97	0.34	0.33	0.01	8.82
Oct-97	1.01	0.65	0.36	9.17
Nov-97	1.06	0.90	0.16	9.33
Dec-97	0.31	1.12	-0.81	8.52
Jan-98	1.30	1.09	0.21	8.72
Feb-98	0.94	0.82	0.12	8.84
Mar-98	0.72	0.74	-0.02	8.83
Apr-98	0.17	0.56	-0.39	8.43
May-98	0.75	0.76	-0.01	8.42
6/1/98 [2]	0.53	0.52	0.01	8.43
Jul-98	0.09	0.19	-0.10	8.33
Aug-98	0.31	0.16	0.15	8.48
Sep-98	0.30	0.33	-0.03	8.45
Oct-98	0.09	0.65	-0.56	7.89
Nov-98	1.35	0.90	0.45	8.33
Dec-98	1.04	1.12	-0.08	8.25
Jan-99	0.64	1.09	-0.45	7.80
Feb-99	0.63	0.82	-0.19	7.61
Mar-99	0.16	0.74	-0.58	7.03
Apr-99	0.21	0.56	-0.35	6.68
May-99	0.49	0.76	-0.27	6.41
Jun-99	0.17	0.52	-0.35	6.05
Jul-99	0.28	0.19	0.09	6.15
Aug-99	0.29	0.16	0.13	6.27
Sep-99	0.00	0.33	-0.33	5.94
Oct-99	0.60	0.65	-0.05	5.89
Nov-99	0.41	0.90	-0.49	5.40
Dec-99	0.17	1.12	-0.95	4.44
Jan-00	1.38	1.09	0.29	4.73
Feb-00	1.60	0.82	0.78	5.51
Mar-00	1.03	0.74	0.29	5.80
Apr-00	0.03	0.56	-0.53	5.27
May-00	0.86	0.76	0.10	5.37
Jun-00	0.60	0.52	0.08	5.45
Jul-00	0.02	0.19	-0.17	5.28
Aug-00	0.00	0.16	-0.16	5.11
Sep-00	0.67	0.33	0.34	5.46
Oct-00	1.07	0.65	0.42	5.87
Nov-00	1.12	0.90	0.22	6.09
Dec-00	0.53	1.12	-0.59	5.50
Jan-01	0.69	1.09	-0.40	5.09

Month	Total Monthly Precipitation (inches)	Average Monthly Precipitation (inches)	Departure from Average (inches)	Cumulative Departure (inches)
Feb-01	0.30	0.82	-0.52	4.57
Mar-01	1.09	0.74	0.35	4.93
Apr-01	0.92	0.56	0.36	5.28
May-01	0.24	0.76	-0.52	4.76
Jun-01	0.35	0.52	-0.17	4.59
Jul-01	0.06	0.19	-0.13	4.46
Aug-01	0.28	0.16	0.12	4.58
Sep-01	0.00	0.33	-0.33	4.25
Oct-01	0.51	0.65	-0.14	4.11
Nov-01	1.13	0.90	0.23	4.33
Dec-01	0.52	1.12	-0.60	3.73
Jan-02	0.24	1.09	-0.85	2.88
Feb-02	0.78	0.82	-0.04	2.84
Mar-02	0.22	0.74	-0.52	2.32
Apr-02	0.26	0.56	-0.30	2.02
May-02	0.22	0.76	-0.54	1.48
Jun-02	0.88	0.52	0.36	1.83
Jul-02	0.40	0.19	0.21	2.05
Aug-02	0.22	0.16	0.06	2.10
Sep-02	0.00	0.33	-0.33	1.77
Oct-02	0.07	0.65	-0.58	1.19
Nov-02	0.30	0.90	-0.60	0.59
Dec-02	1.61	1.12	0.49	1.07
Jan-03	1.77	1.09	0.68	1.75
Feb-03	0.94	0.82	0.12	1.87
Mar-03	0.30	0.74	-0.44	1.43
Apr-03	0.79	0.56	0.23	1.66
May-03	0.54	0.76	-0.22	1.44
Jun-03	0.00	0.52	-0.52	0.92
Jul-03	0.00	0.19	-0.19	0.73
Aug-03	0.05	0.16	-0.11	0.61
Sep-03	0.26	0.33	-0.07	0.55
Oct-03	0.14	0.65	-0.51	0.03
Nov-03	0.27	0.90	-0.63	-0.60
Dec-03	1.71	1.12	0.59	-0.01
Jan-04	1.00	1.09	-0.09	-0.11
Feb-04	0.74	0.82	-0.08	-0.19
Mar-04	0.19	0.74	-0.55	-0.73
Apr-04	0.44	0.56	-0.12	-0.86
May-04	0.57	0.76	-0.19	-1.05
Jun-04	1.06	0.52	0.54	-0.51
Jul-04	0.02	0.19	-0.17	-0.68
Aug-04	0.42	0.16	0.26	-0.42
Sep-04	0.16	0.33	-0.17	-0.59
Oct-04	0.28	0.65	-0.37	-0.96
Nov-04	0.58	0.90	-0.32	-1.29
Dec-04	0.77	1.12	-0.35	-1.64
Jan-05	0.81	1.09	-0.28	-1.92
Feb-05	0.03	0.82	-0.79	-2.71
Mar-05	0.36	0.74	-0.38	-3.09
Apr-05	0.77	0.56	0.21	-2.88
May-05	0.36	0.76	-0.40	-3.28

Month	Total Monthly Precipitation (inches)	Average Monthly Precipitation (inches)	Departure from Average (inches)	Cumulative Departure (inches)
Jun-05	0.43	0.52	-0.09	-3.38
Jul-05	0.08	0.19	-0.11	-3.48
Aug-05	0.04	0.16	-0.12	-3.61
Sep-05	0.08	0.33	-0.25	-3.86
Oct-05	1.31	0.65	0.66	-3.20
Nov-05	0.78	0.90	-0.12	-3.33
Dec-05	1.81	1.12	0.69	-2.64
Jan-06	2.16	1.09	1.07	-1.57
Feb-06	0.29	0.82	-0.53	-2.10
Mar-06	0.44	0.74	-0.30	-2.40
Apr-06	1.15	0.56	0.59	-1.81
May-06	1.18	0.76	0.42	-1.39
Jun-06	1.20	0.52	0.68	-0.71
Jul-06	0.01	0.19	-0.18	-0.89
Aug-06	0.00	0.16	-0.16	-1.06
Sep-06	0.25	0.33	-0.08	-1.13
Oct-06	0.62	0.65	-0.03	-1.17
Nov-06	1.17	0.90	0.27	-0.90
Dec-06	1.73	1.12	0.61	-0.29
Jan-07	0.34	1.09	-0.75	-1.05
Feb-07	0.85	0.82	0.03	-1.02
Mar-07	0.57	0.74	-0.17	-1.18
Apr-07	0.48	0.56	-0.08	-1.27
May-07	0.38	0.76	-0.38	-1.65
Jun-07	0.72	0.52	0.20	-1.45
Jul-07	0.02	0.19	-0.17	-1.62
Aug-07	0.05	0.16	-0.11	-1.73
Sep-07	0.17	0.33	-0.16	-1.89
Oct-07	0.38	0.65	-0.27	-2.16
Nov-07	0.98	0.90	0.08	-2.09
Dec-07	1.06	1.12	-0.06	-2.15
Jan-08	1.50	1.09	0.41	-1.74
Feb-08	0.49	0.82	-0.33	-2.08
Mar-08	0.38	0.74	-0.36	-2.43
Apr-08	0.24	0.56	-0.32	-2.76
May-08	0.27	0.76	-0.49	-3.25
Jun-08	0.75	0.52	0.23	-3.02
Jul-08	0.00	0.19	-0.19	-3.21
Aug-08	0.32	0.16	0.16	-3.05
Sep-08	0.05	0.33	-0.28	-3.33
Oct-08	0.14	0.65	-0.51	-3.84
Nov-08	0.51	0.90	-0.39	-4.24
Dec-08	1.59	1.12	0.47	-3.77
Jan-09	1.28	1.09	0.19	-3.58
Feb-09	0.86	0.82	0.04	-3.54
Mar-09	1.29	0.74	0.55	-2.99
Apr-09	0.35	0.56	-0.21	-3.20
May-09	0.56	0.76	-0.20	-3.40
Jun-09	0.01	0.52	-0.51	-3.91
Jul-09	0.08	0.19	-0.11	-4.02
Aug-09	0.08	0.16	-0.08	-4.11
Sep-09	0.11	0.33	-0.22	-4.32

Month	Total Monthly Precipitation (inches)	Average Monthly Precipitation (inches)	Departure from Average (inches)	Cumulative Departure (inches)
Oct-09	1.16	0.65	0.51	-3.82
Nov-09	0.35	0.90	-0.55	-4.37
Dec-09	0.59	1.12	-0.53	-4.90
Jan-10	1.82	1.09	0.73	-4.18
Feb-10	0.54	0.82	-0.28	-4.46
Mar-10	0.18	0.74	-0.56	-5.01
Apr-10	0.35	0.56	-0.21	-5.23
May-10	1.51	0.76	0.75	-4.48
Jun-10	1.33	0.52	0.81	-3.67
Jul-10	0.17	0.19	-0.02	-3.69
Aug-10	0.06	0.16	-0.10	-3.79
Sep-10	1.47	0.33	1.14	-2.65
Oct-10	0.87	0.65	0.22	-2.44
Nov-10	1.47	0.90	0.57	-1.87
Dec-10	2.28	1.12	1.16	-0.71
Jan-11	0.46	1.09	-0.63	-1.34
Feb-11	0.44	0.82	-0.38	-1.73
Mar-11	1.02	0.74	0.28	-1.44
Apr-11	0.30	0.56	-0.26	-1.71
May-11	1.30	0.76	0.54	-1.17
Jun-11	0.86	0.52	0.34	-0.83
Jul-11	0.05	0.19	-0.14	-0.97
Aug-11	0.08	0.16	-0.08	-1.05
Sep-11	0.03	0.33	-0.30	-1.35
Oct-11	0.48	0.65	-0.17	-1.52
Nov-11	0.14	0.90	-0.76	-2.29
Dec-11	0.08	1.12	-1.04	-3.33
Jan-12	0.99	1.09	-0.10	-3.43
Feb-12	0.52	0.82	-0.30	-3.73
Mar-12	0.96	0.74	0.22	-3.51
Apr-12	0.70	0.56	0.14	-3.37
May-12	0.26	0.76	-0.50	-3.87
Jun-12	1.62	0.52	1.10	-2.78
Jul-12	0.70	0.19	0.51	-2.26
Aug-12	0.09	0.16	-0.07	-2.34
Sep-12	0.00	0.33	-0.33	-2.67
Oct-12	1.16	0.65	0.51	-2.16
Nov-12	1.07	0.90	0.17	-1.99
Dec-12	1.37	1.12	0.25	-1.74
Jan-13	0.42	1.09	-0.67	-2.42
Feb-13	0.03	0.82	-0.79	-3.21
Mar-13	0.34	0.74	-0.40	-3.60
Apr-13	0.52	0.56	-0.04	-3.65
May-13	0.70	0.76	-0.06	-3.71
Jun-13	1.36	0.52	0.84	-2.87
Jul-13	0.00	0.19	-0.19	-3.06
Aug-13	0.28	0.16	0.12	-2.94
Sep-13	1.20	0.33	0.87	-2.07
Oct-13	0.22	0.65	-0.43	-2.51
Nov-13	0.31	0.90	-0.59	-3.10
Dec-13	0.11	1.12	-1.01	-4.11
Jan-14	0.50	1.09	-0.59	-4.71

Month	Total Monthly Precipitation (inches)	Average Monthly Precipitation (inches)	Departure from Average (inches)	Cumulative Departure (inches)
Feb-14	0.81	0.82	-0.01	-4.72
Mar-14	0.49	0.74	-0.25	-4.96
Apr-14	0.33	0.56	-0.23	-5.20
May-14	0.23	0.76	-0.53	-5.73
Jun-14	0.42	0.52	-0.10	-5.83
Jul-14	0.02	0.19	-0.17	-6.00
Aug-14	0.36	0.16	0.20	-5.80
Sep-14	0.01	0.33	-0.32	-6.12
Oct-14	0.71	0.65	0.06	-6.06
Nov-14	0.43	0.90	-0.47	-6.54
Dec-14	1.28	1.12	0.16	-6.38
Jan-15	1.03	1.09	-0.06	-6.44
Feb-15	0.66	0.82	-0.16	-6.60
Mar-15	0.34	0.74	-0.40	-7.00
Apr-15	0.15	0.56	-0.41	-7.41
May-15	0.99	0.76	0.23	-7.18
Jun-15	0.00	0.52	-0.52	-7.71
Jul-15	0.00	0.19	-0.19	-7.89
Aug-15	0.00	0.16	-0.16	-8.06
Sep-15	0.22	0.33	-0.11	-8.17
Oct-15	0.37	0.65	-0.28	-8.45
Nov-15	0.63	0.90	-0.27	-8.72
Dec-15	1.78	1.12	0.66	-8.06
Jan-16	1.29	1.09	0.20	-7.87
Feb-16	0.46	0.82	-0.36	-8.23
Mar-16	1.10	0.74	0.36	-7.87
Apr-16	0.21	0.56	-0.35	-8.22
May-16	1.73	0.76	0.97	-7.25
Jun-16	0.43	0.52	-0.09	-7.34
Jul-16	0.32	0.19	0.13	-7.21
Aug-16	0.00	0.16	-0.16	-7.37
Sep-16	0.26	0.33	-0.07	-7.44
Oct-16	2.53	0.65	1.88	-5.57
Nov-16	0.29	0.90	-0.61	-6.18
Dec-16	0.74	1.12	-0.38	-6.56
Jan-17	1.54	1.09	0.45	-6.12
Feb-17	1.84	0.82	1.02	-5.10
Mar-17	1.64	0.74	0.90	-4.19
Apr-17	1.01	0.56	0.45	-3.75
May-17	0.41	0.76	-0.35	-4.10
Jun-17	0.48	0.52	-0.04	-4.14
Jul-17	0.00	0.19	-0.19	-4.33
Aug-17	0.02	0.16	-0.14	-4.47
Sep-17	0.50	0.33	0.17	-4.30
Oct-17	0.63	0.65	-0.02	-4.32
Nov-17	1.30	0.90	0.40	-3.93
Dec-17	0.94	1.12	-0.18	-4.11
Jan-18	1.25	1.09	0.16	-3.95
Feb-18	0.46	0.82	-0.36	-4.31
Mar-18	0.53	0.74	-0.21	-4.52
Apr-18	1.34	0.56	0.78	-3.74
May-18	0.58	0.76	-0.18	-3.92

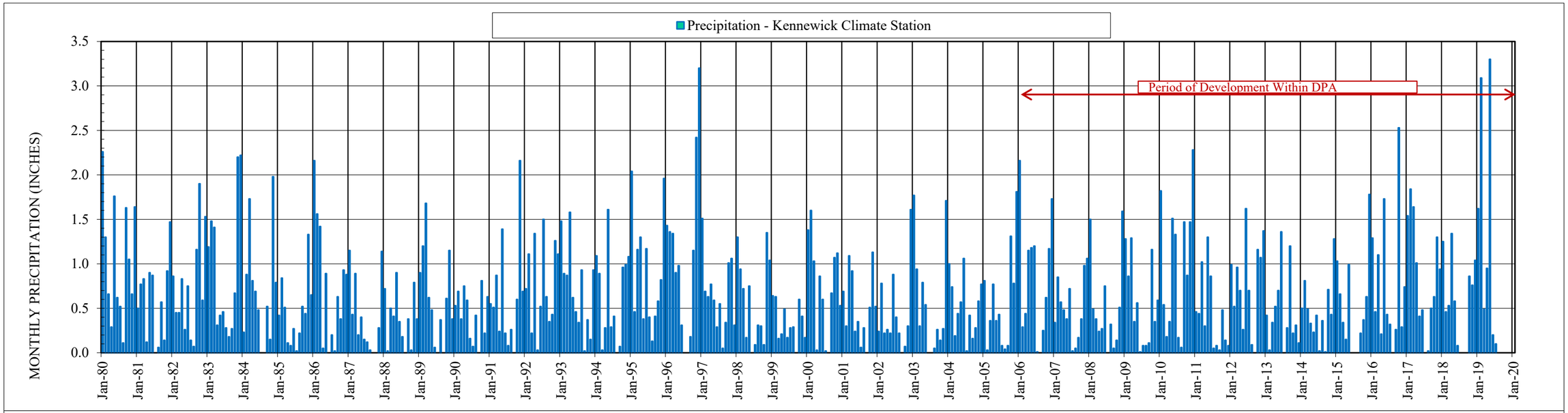
Month	Total Monthly Precipitation (inches)	Average Monthly Precipitation (inches)	Departure from Average (inches)	Cumulative Departure (inches)
Jun-18	0.08	0.52	-0.44	-4.37
Jul-18	0.00	0.19	-0.19	-4.55
Aug-18	0.00	0.16	-0.16	-4.72

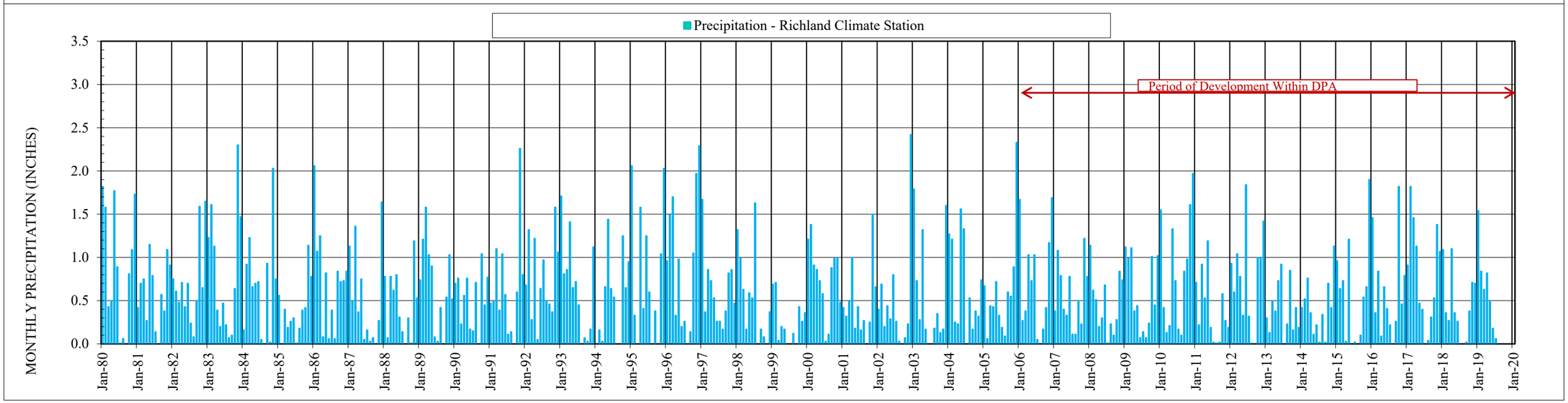
Month	Total Monthly Precipitation (inches)	Average Monthly Precipitation (inches)	Departure from Average (inches)	Cumulative Departure (inches)
Sep-18	0.00	0.33	-0.33	-5.05
Oct-18	0.86	0.65	0.21	-4.84
Nov-18	0.76	0.90	-0.14	-4.98
Dec-18	1.04	1.12	-0.08	-5.07
Jan-19	1.62	1.09	0.53	-4.54
Feb-19	3.09	0.82	2.27	-2.27
Mar-19	0.49	0.74	-0.25	-2.52
Apr-19	0.95	0.56	0.39	-2.13
May-19	3.30	0.76	2.54	0.41
Jun-19	0.20	0.52	-0.32	0.09
Jul-19	0.10	0.19	-0.09	0.00

Notes:

[1] Precipitation totals for Kennewick, Washington (Station No. 454154) were obtained on November 28, 2018 from the Western Regional Climate Center (www.wrcc.dri.edu).

[2] The monthly precipitation for Richland, Washington (Station No. 457015) were used because the monthly total for Kennewick, Washington was missing.





Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Monthly Precipitation

Drainage Problem Area
City of West Richland, Washington

GeoEngineers

Figure I-1

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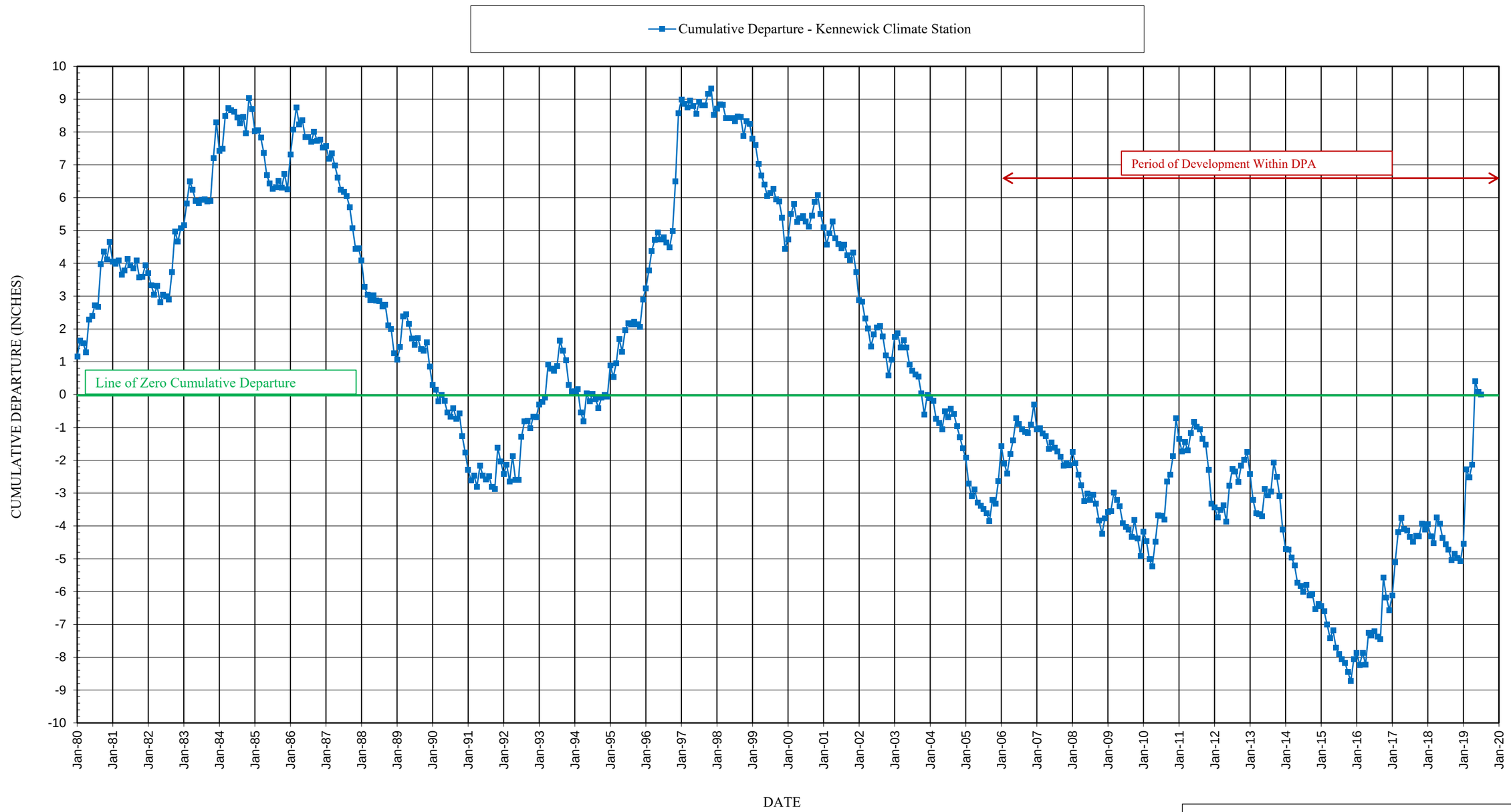

Cumulative Departure in Precipitation

Drainage Problem Area
City of West Richland, Washington

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Figure I-2

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

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APPENDIX J
Compilation of Recent Drainage Complaints

Table J-1

Compilation of Recent Drainage Complaints [1]

Drainage Problem Area

City of West Richland, Washington

Complaint Number	Date of Complaint	Address	Adjacent Project Monitoring Well [2]	Depth to Limiting Stratigraphic Unit (feet bgs)	Nature of Complaint
1	09/12/17	1508 Diamond Drive	MW-8	0	Flooding was observed in street. A broken sprinkler was initially suspected but later City investigation suggested an elevated groundwater condition.
2	09/29/18	6409 Sapphire Street	MW-7	4	Damage to evacuated pool caused by hydrostatic pressure gradient.
3	10/24/18	6500 Agate Court	MW-6	0	Flooding in basement.
4	11/13/18	604 Hilltop View Street	MW-3	3.5	Flooding in basement.
5	04/15/19	632 S. 58th Avenue	MW-5	0	Flooding in basement.
6	March-17	6021 Everett Street	NA	NA	Flooding in basement.

Notes:

[1] Drainage complaint data were provided to GeoEngineers by the City of West Richland.

[2] Adjacent project monitoring wells were installed during this study in relatively close proximity to the locations of previous drainage complaints (with the exception of Complaint No. 6).

bgs = below ground surface; NA = not applicable

APPENDIX K
Report Limitations and Guidelines for Use

APPENDIX K
REPORT LIMITATIONS AND GUIDELINES FOR USE[1]

This appendix provides information to help you manage your risks with respect to the use of this report.

Hydrogeologic and/or Geotechnical Services are Performed for Specific Purposes, Persons and Projects

This report has been prepared for use by the City of West Richland. This report may be made available in its entirety to others for information only. This report is not intended for use by others, and the information contained herein is not applicable to other sites.

GeoEngineers structures our services to meet the specific needs of our clients. For example, a hydrogeologic and/or geotechnical study conducted for a civil engineer or architect may not fulfill the needs of a construction contractor or even another civil engineer or architect that are involved in the same project. Each hydrogeologic and/or geotechnical study is unique and prepared solely for the specific client and project site. No one except the City of West Richland should rely on this report without first conferring with GeoEngineers. This report should not be applied for any purpose or project except the one originally contemplated.

A Hydrogeologic and/or Geotechnical Report Is Based on a Unique Set of Project-Specific Factors

This report has been prepared to assist with the evaluation of an area containing elevated groundwater levels within the City of West Richland, Washington. GeoEngineers considered a number of unique, project-specific factors when establishing the scope of services for this project and report. Unless GeoEngineers specifically indicates otherwise, do not rely on this report if it was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

If important changes are made after the date of this report, GeoEngineers should be given the opportunity to review our interpretations and recommendations and provide written modifications or confirmation, as appropriate.

Subsurface Conditions Can Change

This hydrogeologic and geotechnical report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by manmade events such as construction on or adjacent to the site, or by natural events such as floods, earthquakes,

[1] Developed based on material provided by ASFE, Professional Firms Practicing in the Geosciences; www.asfe.org.

slope instability or groundwater fluctuations. Always contact GeoEngineers before applying a report to determine if it remains applicable.

Most Hydrogeologic and/or Geotechnical Findings Are Professional Opinions

Our interpretations of subsurface conditions are based on field observations from widely spaced sampling locations at the site. Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. GeoEngineers reviewed field and laboratory data and then applied our professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ, sometimes significantly, from those indicated in this report. Our report, conclusions and interpretations should not be construed as a warranty of the subsurface conditions.

A Hydrogeologic and/or Geotechnical Report Could Be Subject to Misinterpretation

Misinterpretation of this report by other design team members can result in costly problems. You could lower that risk by having GeoEngineers confer with appropriate members of the design team after submitting the report. Also retain GeoEngineers to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a hydrogeologic and/or geotechnical report. Reduce that risk by having GeoEngineers participate in pre-bid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Exploration Logs

Geotechnical engineers and geologists prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering or geologic report should never be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable but recognize that separating logs from the report can elevate risk.

Read These Provisions Closely

Some clients, design professionals and contractors may not recognize that the geoscience practices (geotechnical engineering or hydrogeology) are far less exact than other engineering and natural science disciplines. This lack of understanding can create unrealistic expectations that could lead to disappointments, claims and disputes. GeoEngineers includes these explanatory “limitations” provisions in our reports to help reduce such risks. Please confer with GeoEngineers if you are unclear how these “Report Limitations and Guidelines for Use” apply to your project or site.

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