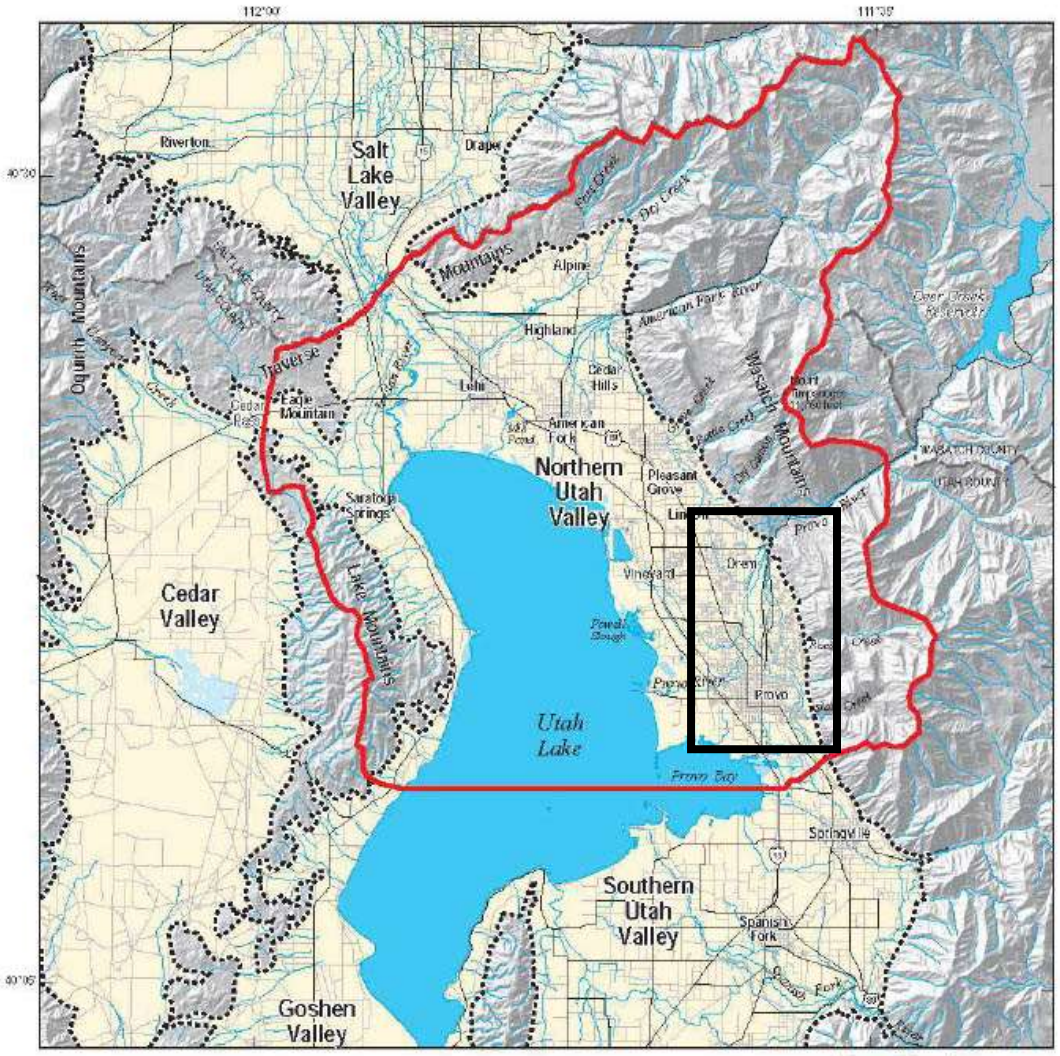
# Attachment A

General Location Map of the Provo Aquifer Storage & Recovery Project, Utah County.

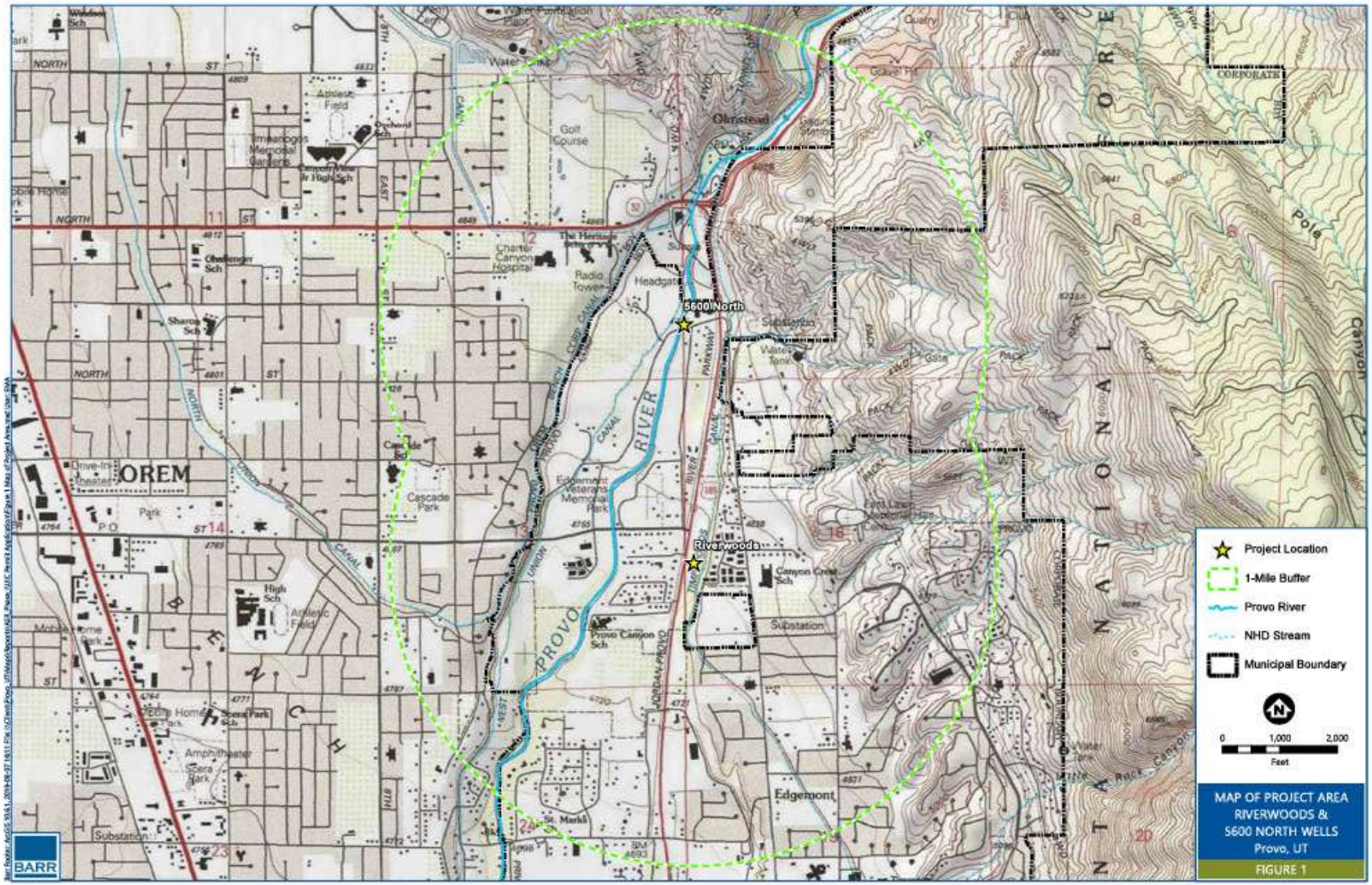



Source: Cederberg et al. (2009)

[redacted]

# Attachment B

Map of the UIC Area of Review
Including the Class V ASR
Wells and the Project Area


5600 North
Riverwoods
OREM
PROVO
RIVER
Project Location
1-Mile Buffer
Provo River
NHD Stream
Municipal Boundary
0
1,000
2,000
Feet
MAP OF PROJECT AREA
RIVERWOODS &
5600 NORTH WELLS
Provo, UT
FIGURE 1
BARR

# Attachment C

Corrective Action Plan for Artificial Penetrations into Injection Zone within Area of Review
(At the Time of the effective date of this permit no corrective action was required.)

# Attachment D

Driller's Logs for Provo City's
Riverwoods and 5600 North Well
Including Injection Well
Construction Plans and Details

Riverwoods Well
WIN 26943

# WELL DRILLER'S REPORT

State of Utah
Division of Water Rights
For additional space, use "Additional Well Data Form" and attach

RECEIVED
MAY - 6 2003
WATER RIGHTS
SALT LAKE

**Well Identification** CHANGE APPLICATION: a22983(51-1021)

**Owner** *Note any changes*
Provo City Water Resources
1377 South 350 East
Provo, UT 84603

Contact Person/Engineer: Dee Hansen

**Well Location** *Note any changes*
COUNTY: Utah
NORTH 600 feet EAST 1880 feet from the SW Corner of
SECTION 7, TOWNSHIP 6S, RANGE 3E, SLB&M.

Location Description: (address, proximity to buildings, landmarks, ground elevation, local well #) south of Hwy #52, east of Hwy. #8
~~Provo City~~

**Drillers Activity**
Start Date: March 21, 2003 Completion Date: April 25, 2003
Check all that apply: [x] New [ ] Repair [ ] Deepen [ ] Clean [ ] Replace [x] Public Nature of Use:
If a replacement well, provide the location of the new well. ____ feet north/south and ____ feet east/west of the existing well.

| DEPTH (feet) FROM | TO | BOREHOLE DIAMETER (in) | DRILLING METHOD | DRILLING FLUID |
|---|---|---|---|---|
| 0 | 19 | 48 | Rotary | Bentonite and fresh water |
| 19 | 151 | 38 | Rotary | Bentonite and fresh water |
| 151 | 1220 | 26 | Rotary | Bentonite and fresh water |

**Well Log**

| DEPTH (feet) FROM | TO | WATER | PERMEABLE high | PERMEABLE low | UNCONSOLIDATED CLAY | SILT | SAND | GRAVEL | COBBLES | BOULDER | OTHER | CONSOLIDATED ROCK TYPE | COLOR | DESCRIPTIONS AND REMARKS (e.g., relative %, grain size, sorting, angularity, bedding, grain composition, density, plasticity, shape, cementation, consistancy, water bearing, odor, fracturing, minerology, texture, degree of weathering, hardness, water quality, etc.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 20 | | | | | x | x | x | | | | Alluvium | | |
| 20 | 90 | | | | | | x | x | | | | | Brown & Black | |
| 90 | 105 | | | | x | | x | | | | | | Brown | 5% Clayey fines |
| 105 | 135 | | | | x | x | | | | | | | Brown | 20% Clayey fines |
| 135 | 420 | | | | | | | x | | | | | Brown | Angular cuttings, well graded gravel |
| 420 | 430 | | | | x | | x | | | | | | Yellow & Brown | |
| 430 | 470 | | | | | | | x | | | | | Brown | Angular cutting, well graded gravel |
| 470 | 480 | | | | x | | | x | | | | | Yellow & Brown | 40% Clayey fines |
| 480 | 525 | | | | | x | | x | | | | | Brown | Subangular gravel, 10% fines |
| 525 | 595 | | | | | | | x | | | | | Brown | Clean washed gravel, trace of fines |

**Static Water Level**
Date April 23, 2003 Water Level 220 feet Flowing? ☐ Yes ☒ No
Method of Water Level Measurement water sounded If Flowing, Capped Pressure N/A PSI
Point to Which Water Level Measurement was Referenced ground level Ground Elevation (If known) ____
Height of Water Level reference point above ground surface N/A feet Temperature cool ☐ °C ☐ °F

## Construction Information

| DEPTH (feet) FROM | DEPTH (feet) TO | CASING: CASING TYPE AND MATERIAL/GRADE | WALL THICK (in) | NOMINAL DIAM. (in) | DEPTH (feet) FROM | DEPTH (feet) TO | ☐ SCREEN ☐ PERFORATIONS ☐ OPEN BOTTOM: SCREEN SLOT SIZE OR PERF SIZE (in) | SCREEN DIAM. OR PERF LENGTH (in) | SCREEN TYPE OR NUMBER PERF (per round/interval) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 19 | Steel | .250 | 42 | | | | | |
| 0 | 151 | Steel | .375 | 30 | | | | | |
| +2 | 316 | Steel | .375 | 20 | 316 | 346 | .070 | 20 | Stainless Steel Wire Wrap |
| 346 | 387 | Steel | .375 | 20 | 387 | 417 | .070 | 20 | " |
| 417 | 437 | Steel | .375 | 20 | 437 | 457 | .070 | 20 | " |

Well Head Configuration: Locking cap  Access Port Provided? ☐ Yes ☒ No

Casing Joint Type: welded  Perforator Used: N/A

Was a Surface Seal installed? ☒ Yes ☐ No  Depth of Surface Seal: 151 feet  Drive Shoe? ☐ Yes ☒ No

Surface Seal Material Placement Method: pumped cement through trimmie pipe

Provide Seal Material description below:

## SURFACE SEAL / INTERVAL SEAL / FILTER PACK / PACKER INFORMATION

| DEPTH (feet) FROM | DEPTH (feet) TO | SEAL MATERIAL, FILTER PACK and PACKER TYPE and DESCRIPTION | Quantity of Material Used (if applicable) | GROUT DENSITY (lbs./gal.,# bag mix, gal./sack etc.) |
|---|---|---|---|---|
| 0 | 151 | Portland Cement | 6½ super sacks | 16 lb. / gal. |
| 151 | 1220 | Gravel Pack (CSI 6-9) | 82 super sacks | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

## Well Development and Well Yield Test Information

| Date | Method | Yield | Units Check One: GPM | Units Check One: CFS | DRAWDOWN (ft) | TIME PUMPED (hrs & min) |
|---|---|---|---|---|---|---|
| 4/22 & 4/23/03 | Pump test | 2800 | x | | 360 | 24 hours |
| | | | | | | |
| | | | | | | |

## Pump (Permanent)

Pump Description: _____  Horsepower: _____  Pump Intake Depth: _____ feet

Approximate maximum pumping rate: _____  Well disinfected upon completion? ☐ Yes ☐ No

## Comments

Description of construction activity, additional materials used, problems encountered, extraordinary circumstances, abandonment procedures. *Use additional well data form for more space.*

## Well Driller Statement

This well was drilled and constructed under my supervision, according to applicable rules and regulations, and this report is complete and correct to the best of my knowledge and belief.

Name Lang Exploratory Drilling  License No. 568

(Person, Firm, or Corporation - Print or Type)

Signature Alan Lang  Date 5/2/03

(Licensed Well Driller)

Construction Information (con't)

| DEPTH (feet) | | CASING | | | DEPTH (feet) | | ☐ SCREEN ☐ PERFORATIONS ☐ OPEN BOTTOM | | |
|---|---|---|---|---|---|---|---|---|---|
| FROM | TO | CASING TYPE AND MATERIAL/GRADE | WALL THICK (in) | NOMINAL DIAM. (in) | FROM | TO | SCREEN SLOT SIZE OR PERF SIZE (in.) | SCREEN DIAM. OR PERF LENGTH (in) | SCREEN TYPE OR NUMBER PERF (per round/interval) |
| 475 | 507 | Steel | .375 | 20 | 507 | 527 | .070 | 20 | Stainless Steel Wire |
| 527 | 547 | Steel | .375 | 20 | 547 | 587 | .070 | 20 | Wrap " |
| 587 | 627 | Steel | .375 | 20 | 627 | 647 | .070 | 20 | " |
| 647 | 738 | Steel | .375 | 20 | 738 | 778 | .070 | 20 | " |
| 778 | 818 | Steel | .375 | 20 | 818 | 838 | .070 | 20 | " |
| 838 | 888 | Steel | .375 | 20 | 888 | 908 | .070 | 20 | " |
| 908 | 948 | Steel | .375 | 20 | 948 | 988 | .070 | 20 | " |
| 988 | 1028 | Steel | .375 | 20 | 1018 | 1058 | .070 | 20 | " |
| 1058 | 1099 | Steel | .375 | 20 | 1099 | 1119 | .070 | 20 | " |
| 1119 | 1149 | Steel | .375 | 20 | 1149 | 1169 | .070 | 20 | " |
| 1169 | 1210 | Steel | .375 | 20 | | | | | |

| DEPTH (feet) | | FILTER PACK / GROUT / PACKER / ABANDONMENT MATERIAL | | |
|---|---|---|---|---|
| FROM | TO | ANNULAR MATERIAL, ABANDONMENT MATERIAL and/or PACKER DESCRIPTION | Quantity of Material Used (if applicable) | GROUT DENSITY (lbs./gal., # bag mix, gal./sack, etc.) |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

Comments (con't)

Well Driller Statement | This well was drilled and constructed under my supervision, according to applicable rules and regulations, and this report is complete and correct to the best of my knowledge and belief.

Name Lang Exploratory Drilling (Person, Firm, or Corporation - Print or Type) License No. 568

Signature Alan Lang (Licensed Well Driller) Date 5/2/03

# ADDITIONAL WELL DATA FORM

Water Right # a22983 (51-1021)

OWNER NAME



| Well Log DEPTH (feet) FROM | TO | WATER | PERMEABLE high | PERMEABLE low | UNCONSOLIDATED CLAY | SILT | SAND | GRAVEL | COBBLES | BOULDER | OTHER | CONSOLIDATED ROCK TYPE | COLOR | DESCRIPTIONS AND REMARKS (e.g. relative %, grain size, sorting, angularity, bedding, grain composition, density, plasticity, shape, cementation, consistency, water bearing, odor, fracturing, mineralogy, texture, degree of weathering, hardness, water quality, etc.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 595 | 680 | | | | | | | x | | | | | Brown | Clean washed, angular gravel |
| 680 | 690 | | | | | | x | x | | | | | Brown | Subangular gravel, 10% fines |
| 690 | 715 | | | | x | | | x | | | | | Yellow & Brown | Clay with minor gravel |
| 715 | 800 | | | | x | | | x | | | | | Yellow & Brown | Gravel with 10-15% clayey fines |
| 800 | 810 | | | | x | | | x | | | | | Yellow & Brown | Decreased in fines |
| 810 | 880 | | | | x | | | x | | | | | Yellow & Brown | Gravel with 10-15% clayey fines |
| 880 | 915 | | | | | | | x | | | | | Brown | Clean washed angular gravel |
| 915 | 930 | | | | x | | | x | | | | | Yellow & Brown | Gravel and clay, calcite on cuttings |
| 930 | 1000 | | | | | | | x | | | | | Brown | Gravel, angular to subangular |
| 1000 | 1080 | | | | | | | x | | | | | Brown | Clean washed angular gravel |
| 1080 | 1095 | | | | | x | | x | | | | | Brown | Gravel, trace of fines |
| 1095 | 1200 | | | | | | | x | | | | | Brown & Gray | Gravel, angular quartzite |
| 1200 | 1220 | | | | x | | | x | | | | | Yellow & Brown | Gravel, clay increase 20% |

Barr Engineering Company
170 South Main Street Suite 500
Salt Lake City, UT 84101
Telephone: 801-333-8400

# LOG OF WELL MW-RW1



| | | | | | |
|---|---|---|---|---|---|
| Project: | Provo Aquifer Storage and Recovery Pilot Study | Surface Elevation: | 4752.4 ft | Top of Casing Elev.: | 4755.1 ft |
| Project No.: | 44251008.00 | Drilling Method: | Rotosonic | | |
| Location: | Provo, Utah | Sampling Method: | Rotosonic - Continuous Coring | | |
| Coordinates: | UTM 12N N:4460798.172m, E:444162.7478m | | | | |
| Datum: | Horizontal: NAD83, Vertical: NAVD88 | Completion Depth: | 420.0 ft | | |

| Depth, feet | Sample Type & Recovery | Sample No. | USCS | Graphic Log | LITHOLOGIC DESCRIPTION | WELL OR PIEZOMETER CONSTRUCTION DETAIL | Elevation, feet |
|---|---|---|---|---|---|---|---|
| 0 | | | NONE | | (NONE): no recovery. | Top Protective Casing: 2.67 ft-ags (8' pipe) | 4755 |
| 5 | | | | | | Bottom Protective Casing: 5.33 ft-bgs | 4750 |
| 10 | | 1AB | GP | | POORLY GRADED GRAVEL (GP): fine to medium grained; 10YR 4/2 (dark grayish brown); dry; subrounded; strong HCl reaction. | | 4745 |
| 15 | | 2AB | | | | | 4740 |
| 20 | | 3AB | SP | | POORLY GRADED SAND (SP): fine grained; 10YR 6/4 (light yellowish brown); dry; weak HCl reaction. | 4"-diameter Schedule 80 PVC Casing (-2.67'-380') | 4735 |
| 25 | | 4AB | SC | | CLAYEY SAND (SC): fine grained; 10YR 6/4 (light yellowish brown); moist; weak HCl reaction; iron staining. | Bentonite Grout (0'-367') | 4730 |
| 30 | | 5AB | SP-SC | | POORLY GRADED SAND WITH CLAY (SP-SC): fine grained; 10YR 6/4 (light yellowish brown); moist; weak to moderate HCl reaction; iron staining in bands. | | 4725 |
| 35 | | 6AB | | | | | 4720 |
| 40 | | 7AB | | | | | 4715 |
| 45 | | 8AB | | | | | 4710 |
| 50 | | 9AB | SP | | POORLY GRADED SAND (SP): fine to medium grained; 10YR 6/4 (light yellowish brown); dry to moist; very loose; none to weak HCl reaction; iron staining. | | 4705 |
| 55 | | 10AB | | | | | 4700 |
| 60 | | 11AB | | | | | 4695 |
| 65 | | 12AB | | | | | 4690 |
| 70 | | 13AB | SP | | POORLY GRADED SAND (SP): fine to medium grained; 2.5Y 6/3 (light yellowish brown); dry; no HCl reaction; massive/homogenous. | | 4685 |
| 75 | | 14AB | | | | | 4680 |
| 80 | | 15AB | | | | | 4675 |
| 85 | | 16AB | | | | | 4670 |
| 90 | | 17AB | | | | | 4665 |
| 95 | | 18AB | | | | | 4660 |
| 100 | | 19AB | SP | | GEOTECHNICAL SAMPLE #1 (#19A)- (97'-102'). | | 4655 |

| | |
|---|---|
| Date Boring Started: | 5/12/20 |
| Date Boring Completed: | 5/16/20 11:30 am |
| Logged By: | CRJ2 |
| Drilling Contractor: | Cascade |
| Drill Rig: | Pro Sonic 600 |

Remarks: Composite Samples sent for Geochemical Analysis: Comp 1 (17'-135'), Comp 2 (140'-167'), Comp 3 (167'-265')*, Comp 4 (265'-317'), Comp 5 (317'-342'), Comp 6 (342'-352'), Comp 7 (352'-373'), Comp 8 (373'-389'), Comp 9 (389'-420')*
*. *= missing interval (217'-220'), (392-394')

Additional data may have been collected in the field which is not included on this log.

Barr Engineering Company
170 South Main Street Suite 500
Salt Lake City, UT 84101
Telephone: 801-333-8400

# LOG OF WELL MW-RW1



| | | | |
|---|---|---|---|
| Project: | Provo Aquifer Storage and Recovery Pilot Study | Surface Elevation: | 4752.4 ft |
| Project No.: | 44251008.00 | Drilling Method: | Rotosonic |
| Location: | Provo, Utah | Sampling Method: | Rotosonic - Continuous Coring |
| Coordinates: | UTM 12N N:4460798.172m, E:444162.7478m | Top of Casing Elev.: | 4755.1 ft |
| Datum: | Horizontal: NAD83, Vertical: NAVD88 | Completion Depth: | 420.0 ft |

| Depth, feet | Sample Type & Recovery | Sample No. | USCS | Graphic Log | LITHOLOGIC DESCRIPTION | WELL OR PIEZOMETER CONSTRUCTION DETAIL | Elevation, feet |
|---|---|---|---|---|---|---|---|
| 100 | | | | | POORLY GRADED SAND (SP): fine grained; 10YR 6/3 (pale brown); dry to moist; very loose; none to weak HCl reaction. *(continued)* | | 4650 |
| 105 | | 20AB | | | | Bentonite Grout (0'-367') | |
| | | | | | Significant iron staining, mica biotite flakes present (107'-127'). | | 4645 |
| 110 | | 21AB | | | | | |
| | | | | | | | 4640 |
| 115 | | 22AB | SP | | | 4"-diameter Schedule 80 PVC Casing (-2.67'-380') | |
| 120 | | 23AB | | | | | 4635 |
| | | | | | | | 4630 |
| 125 | | 24AB | | | | | |
| | | | | | POORLY GRADED GRAVELLY SAND (SP): fine to coarse grained; 10YR 5/4 (yellowish brown); dry to moist; rounded; no HCl reaction. | | 4625 |
| 130 | | 25AB | SP | | | | |
| 135 | | 26AB | | | | | 4620 |
| | | | | | | | 4615 |
| 140 | | | | | POORLY GRADED SANDY GRAVEL (GP): fine to medium grained; 2.5Y 6/3 (light yellowish brown); moist; very loose; subrounded; strong HCl reaction; chert and limestone present, some iron staining. | | 4610 |
| 145 | | 27AB | | | | | |
| | | | GP | | | | 4605 |
| 150 | | 28AB | | | | | |
| 155 | | 29AB | | | | | 4600 |
| | | | | | | | 4595 |
| 160 | | 30AB | | | POORLY GRADED SANDY GRAVEL (GP): fine to medium grained; 10YR 5/2 (grayish brown); moist; subrounded; strong HCl reaction; iron staining, 2 boulders encountered. | | |
| | | | GP | | | | 4590 |
| 165 | | 31AB | | | | | |
| | | | | | WELL GRADED GRAVEL WITH SILT (GW-GM): very fine to coarse grained; 7.5YR 5/1 (gray); moist; loose; subangular; moderate HCl reaction; blue limestone present, some boulders and trace clay. | | 4585 |
| 170 | | 32AB | | | | | |
| | | | | | | | 4580 |
| 175 | | 33AB | GW-GM | | | | |
| | | | | | | | 4575 |
| 180 | | 34AB | | | | | |
| | | | | | | | 4570 |
| 185 | | 35AB | | | | | |
| | | | | | WELL GRADED GRAVEL WITH CLAY (GW-GC): very fine to coarse grained; 10YR 6/3 (pale brown); wet; subrounded to subangular; moderate HCl reaction. | | 4565 |
| 190 | | 36AB | | | | | |
| | | | | | | | 4560 |
| 195 | | 37AB | GW-GC | | | | |
| | | | | | | | 4555 |
| 200 | | 38AB | | | | | |

| | |
|---|---|
| Date Boring Started: | 5/12/20 |
| Date Boring Completed: | 5/16/20 11:30 am |
| Logged By: | CRJ2 |
| Drilling Contractor: | Cascade |
| Drill Rig: | Pro Sonic 600 |

Remarks: Composite Samples sent for Geochemical Analysis: Comp 1 (17'-135'), Comp 2 (140'-167'), Comp 3 (167'-265')*, Comp 4 (265'-317'), Comp 5 (317'-342'), Comp 6 (342'-352'), Comp 7 (352'-373'), Comp 8 (373'-389'), Comp 9 (389'-420')*
*. *= missing interval (217'-220'), (392-394')

Additional data may have been collected in the field which is not included on this log.

Barr Engineering Company
170 South Main Street Suite 500
Salt Lake City, UT 84101
Telephone: 801-333-8400

# LOG OF WELL MW-RW1



| | | | | | |
|---|---|---|---|---|---|
| Project: | Provo Aquifer Storage and Recovery Pilot Study | Surface Elevation: | 4752.4 ft | Top of Casing Elev.: | 4755.1 ft |
| Project No.: | 44251008.00 | Drilling Method: | Rotosonic | | |
| Location: | Provo, Utah | Sampling Method: | Rotosonic - Continuous Coring | | |
| Coordinates: | UTM 12N N:4460798.172m, E:444162.7478m | | | | |
| Datum: | Horizontal: NAD83, Vertical: NAVD88 | Completion Depth: | 420.0 ft | | |

| Depth, feet | Sample Type & Recovery | Sample No. | USCS | Graphic Log | LITHOLOGIC DESCRIPTION | WELL OR PIEZOMETER CONSTRUCTION DETAIL | Elevation, feet |
|---|---|---|---|---|---|---|---|
| 200 | | | GW-GC | | WELL GRADED GRAVEL WITH CLAY (GW-GC): very fine to coarse grained; 10YR 6/3 (pale brown); wet; subrounded to subangular; moderate HCl reaction. *(continued)* | | 4550 |
| 205 | | 39AB | | | GEOTECHNICAL SAMPLE #2 (#42A)- (202'-224'). | Bentonite Grout (0'-367') | 4545 |
| 210 | | 40AB | GW-GM | | WELL GRADED GRAVEL WITH SILT (GW-GM): very fine to coarse grained; 10YR 6/4 (light yellowish brown); moist to wet; subrounded to subangular; moderate to strong HCl reaction; quartzite and limestone boulders encountered (16"), trace iron staining. | | 4540 |
| 215 | | 41AB | | | | 4"-diameter Schedule 80 PVC Casing (-2.67'-380') | 4535 |
| 220 | | 42C<br>42AB | GC | | CLAYEY GRAVEL (GC): very fine to fine grained; 2.5Y 7/3 (pale yellow); moist; soft to medium stiff; subrounded to subangular; low to medium plasticity; weak HCl reaction; 4 boulders encountered (max 14"). | | 4530 |
| 225 | | 43AB | GM | | SILTY GRAVEL (GM): fine to coarse grained; 2.5Y 6/4 (light yellowish brown); moist; soft; subrounded to subangular; low plasticity; moderate HCl reaction; 2 boulders encountered. | | 4525 |
| 230 | | 44AB | | | | | 4520 |
| 235 | | | | | | | 4515 |
| 240 | | 45AB | GW-GM | | WELL GRADED GRAVEL WITH SILT (GW-GM): very fine to coarse grained; 2.5Y 7/3 (pale yellow); wet; loose; subrounded to subangular; low plasticity; moderate HCl reaction; boulder encountered, traces of pyrite in quartzite, iron staining. | | 4510 |
| 245 | | 46AB | | | | | 4505 |
| 250 | | 47AB | | | | | 4500 |
| 255 | | 48AB | | | | | 4495 |
| 260 | | 49AB | | | | | 4490 |
| 265 | | 50AB | | | | | 4485 |
| 270 | | 51AB | SP | | POORLY GRADED SAND WITH GRAVEL (SP): medium to coarse grained; 10YR 5/2 (grayish brown); wet; subangular; medium plasticity; strong HCl reaction; interbedded trace clays. | | 4480 |
| 275 | | 52AB | | | | | 4475 |
| 280 | | 53AB | GP | | POORLY GRADED SANDY GRAVEL (GP): fine to coarse grained; 10YR 6/2 (light brownish gray); wet; very loose; subrounded to subangular; strong HCl reaction; boulder encountered, quartzite and limestone. | | 4470 |
| 285 | | 54AB | | | | | 4465 |
| 290 | | 55AB | | | | | 4460 |
| 295 | | 56AB | | | | | 4455 |
| 300 | | 57AB | GP | | | | |

| | |
|---|---|
| Date Boring Started: | 5/12/20 |
| Date Boring Completed: | 5/16/20 11:30 am |
| Logged By: | CRJ2 |
| Drilling Contractor: | Cascade |
| Drill Rig: | Pro Sonic 600 |

Remarks: Composite Samples sent for Geochemical Analysis: Comp 1 (17'-135'), Comp 2 (140'-167'), Comp 3 (167'-265')*, Comp 4 (265'-317'), Comp 5 (317'-342'), Comp 6 (342'-352'), Comp 7 (352'-373'), Comp 8 (373'-389'), Comp 9 (389'-420')*
*. *= missing interval (217'-220'), (392-394')

Additional data may have been collected in the field which is not included on this log.

Barr Engineering Company
170 South Main Street Suite 500
Salt Lake City, UT 84101
Telephone: 801-333-8400

# LOG OF WELL MW-RW1



| | | | |
|---|---|---|---|
| Project: | Provo Aquifer Storage and Recovery Pilot Study | Surface Elevation: | 4752.4 ft |
| Project No.: | 44251008.00 | Drilling Method: | Rotosonic |
| Location: | Provo, Utah | Sampling Method: | Rotosonic - Continuous Coring |
| Coordinates: | UTM 12N N:4460798.172m, E:444162.7478m | Completion Depth: | 420.0 ft |
| Datum: | Horizontal: NAD83, Vertical: NAVD88 | Top of Casing Elev.: | 4755.1 ft |

| Depth, feet | Sample Type & Recovery | Sample No. | USCS | Graphic Log | LITHOLOGIC DESCRIPTION | Elevation, feet |
|---|---|---|---|---|---|---|
| 300 | | | | | POORLY GRADED GRAVEL (GP): fine to medium grained; 10YR 6/2 (light brownish gray); wet; very loose; subrounded to subangular; weak HCl reaction. *(continued)* | 4450 |
| 305 | | 58AB | GP | | GEOTECHNICAL SAMPLE #3 (#58A)- (302'-307'). | 4445 |
| 310 | | 59AB | | | | 4440 |
| 315 | | 60AB | | | | 4435 |
| 320 | | 61AB | GW | | WELL GRADED GRAVEL WITH SAND (GW): fine to coarse grained; 10YR 7/2 (light gray); saturated; very loose; subangular; strong HCl reaction; cobbles encountered (max 8"), quartzite and limestone. | 4430 |
| 325 | | 62AB | | | | 4425 |
| 330 | | 63AB | GW | | WELL GRADED GRAVEL WITH SAND (GW): fine to coarse grained; 10YR 6/2 (light brownish gray); saturated; subangular to rounded; weak HCl reaction; boulder encountered, some red sandstone. | 4420 |
| 335 | | 64AB | | | | 4415 |
| 340 | | 65AB | | | | 4410 |
| 345 | | 66AB | GC | | CLAYEY GRAVEL WITH SAND (GC): fine to coarse grained; 2.5YR 6/2 (pale red); wet; very soft; subangular to subrounded; medium to high plasticity; weak HCl reaction; cobbles encountered (max 9"), sandstone and limestone. | 4405 |
| 350 | | 67AB | | | | 4400 |
| 355 | | 68AB | GW-GM | | WELL GRADED GRAVEL WITH SAND (GW-GM): fine to coarse grained; 10YR 7/3 (very pale brown); wet; subangular to subrounded; weak HCl reaction; cobbles encountered (max 8"), sandstone and limestone. | 4395 |
| 360 | | 69AB | | | | 4390 |
| 365 | | 70AB | | | | 4385 |
| 370 | | 71AB | GW-GM | | WELL GRADED GRAVEL WITH SILT AND SAND (GW-GM): fine to coarse grained; 10YR 7/3 (very pale brown); saturated; loose; subangular; weak HCl reaction; black vitreous mettalic flakes in clayey sections. | 4380 |
| 375 | | 72AB | GC | | CLAYEY GRAVEL (GC): 10YR 7/4 (very pale brown); wet; subrounded; medium to high plasticity; moderate to strong HCl reaction. | 4375 |
| 380 | | 73AB | | | | 4370 |
| 385 | | 74AB | | | GEOTECHNICAL SAMPLE #4 (#74A)- (384'-389'). | 4365 |
| 390 | | 75AB | GW-GM | | WELL GRADED GRAVEL WITH SILT AND SAND (GW-GM): fine to coarse grained; 10YR 7/3 (very pale brown); saturated; very loose; subangular to subrounded; weak HCl reaction. | 4360 |
| 395 | | 76AB | | | GEOTECHNICAL SAMPLE #5 (#76A)- (394'-400'). | 4355 |
| 400 | | | | | | |

WELL OR PIEZOMETER CONSTRUCTION DETAIL:
- Bentonite Grout (0'-367')
- 4"-diameter Schedule 80 PVC Casing (-2.67'-380')
- Vibrating Wire Piezometer (VWP) Placement @ 330'
- Bentonite Chips (367'-377.5')
- Top of Screen (380')
- 4"-diameter 0.01 Slotted Schedule 80 PVC Screen (380'-420')
- Washed 10/20 Silica Sand (377'-420')

| | |
|---|---|
| Date Boring Started: | 5/12/20 |
| Date Boring Completed: | 5/16/20 11:30 am |
| Logged By: | CRJ2 |
| Drilling Contractor: | Cascade |
| Drill Rig: | Pro Sonic 600 |

Remarks: Composite Samples sent for Geochemical Analysis: Comp 1 (17'-135'), Comp 2 (140'-167'), Comp 3 (167'-265')*, Comp 4 (265'-317'), Comp 5 (317'-342'), Comp 6 (342'-352'), Comp 7 (352'-373'), Comp 8 (373'-389'), Comp 9 (389'-420')*
*. *= missing interval (217'-220'), (392-394')

Additional data may have been collected in the field which is not included on this log.

Barr Engineering Company
170 South Main Street Suite 500
Salt Lake City, UT 84101
Telephone: 801-333-8400

# LOG OF WELL MW-RW1



| | | | |
|---|---|---|---|
| Project: | Provo Aquifer Storage and Recovery Pilot Study | Surface Elevation: | 4752.4 ft |
| Project No.: | 44251008.00 | Drilling Method: | Rotosonic |
| Location: | Provo, Utah | Sampling Method: | Rotosonic - Continuous Coring |
| Coordinates: | UTM 12N N:4460798.172m, E:444162.7478m | Completion Depth: | 420.0 ft |
| Datum: | Horizontal: NAD83, Vertical: NAVD88 | Top of Casing Elev.: | 4755.1 ft |

| Depth, feet | Sample Type & Recovery | Sample No. | USCS | Graphic Log | LITHOLOGIC DESCRIPTION | WELL OR PIEZOMETER CONSTRUCTION DETAIL | Elevation, feet |
|---|---|---|---|---|---|---|---|
| 400 | | 77AB | ML | | SAND SILT WITH GRAVEL (ML): very fine to fine grained; 7.5YR 7/6 (reddish yellow); wet; subangular; strong HCl reaction. | | 4350 |
| 405 | | 78AB | GW-GM | | WELL GRADED GRAVEL WITH SILT AND SAND (GW-GM): fine to coarse grained; 10YR 6/4 (light yellowish brown); very loose to loose; subangular to subrounded; strong HCl reaction; weak cementation; cobbles encountered (max 9"), some quartz monzanite and granite cobbles. | | 4345 |
| 410 | | 79AB | | | GEOTECHNICAL SAMPLE #6 (#78A)- (402'-407'). | | 4340 |
| 415 | | 80AB | GW | | WELL GRADED GRAVEL WITH SAND (GW): fine to coarse grained; 10YR 6/3 (pale brown); saturated; very loose; subangular; strong HCl reaction. | | 4335 |
| | | | | | GEOTECHNICAL SAMPLE #7 (#80A)- (413'-419'). | | |
| 420 | | 81AB | GC | | CLAYEY GRAVEL (GC): 10YR 6/1 (gray); saturated; soft; subangular; medium plasticity; strong HCl reaction; moderate cementation. | Base of Screen/ Well TD: 420 ft-bgs | 4330 |
| 425 | | | | | End of well 420.0 feet | | 4325 |
| 430 | | | | | | | 4320 |
| 435 | | | | | | | 4315 |
| 440 | | | | | | | 4310 |
| 445 | | | | | | | 4305 |
| 450 | | | | | | | 4300 |
| 455 | | | | | | | 4295 |
| 460 | | | | | | | 4290 |
| 465 | | | | | | | 4285 |
| 470 | | | | | | | 4280 |
| 475 | | | | | | | 4275 |
| 480 | | | | | | | 4270 |
| 485 | | | | | | | 4265 |
| 490 | | | | | | | 4260 |
| 495 | | | | | | | 4255 |
| 500 | | | | | | | |

| | |
|---|---|
| Date Boring Started: | 5/12/20 |
| Date Boring Completed: | 5/16/20 11:30 am |
| Logged By: | CRJ2 |
| Drilling Contractor: | Cascade |
| Drill Rig: | Pro Sonic 600 |

Remarks: Composite Samples sent for Geochemical Analysis: Comp 1 (17'-135'), Comp 2 (140'-167'), Comp 3 (167'-265')*, Comp 4 (265'-317'), Comp 5 (317'-342'), Comp 6 (342'-352'), Comp 7 (352'-373'), Comp 8 (373'-389'), Comp 9 (389'-420')*
*. *= missing interval (217'-220'), (392-394')

Additional data may have been collected in the field which is not included on this log.

5600 North Well

Examined ..... Recorded: B. C. ..... B. .....
Inspection Sheet .....
Copied (2-6-3) 7 cc 6

# REPORT OF WELL DRILLER
## STATE OF UTAH

Application No. A-26902
Claim No. .....
Coordinate No. .....

GENERAL STATEMENT: Report of well driller is hereby made and filed with the State Engineer, in accordance with the laws of Utah (This report shall be filed with the State Engineer within 30 days after the completion or abandonment of the well. Failure to file such reports constitutes a misdemeanor.)

**(1) WELL OWNER:**
Name Provo City
Address .....

**(2) LOCATION OF WELL:**
County Utah Ground Water Basin (leave blank)
North 953 feet, East 27 feet from SW Corner
of Section 7 T. 6 N R. 3 E SLDM (strike out words not needed) S USM

**(3) NATURE OF WORK (check):** New Well XX
Replacement Well ☐ Deepening ☐ Repair ☐ Abandon ☐
If abandonment, describe material and procedure: .....

**(4) NATURE OF USE (check):**
Domestic ☐ Industrial ☐ Municipal XX Stockwater ☐
Irrigation ☐ Mining ☐ Other ☐ Test Well ☐

**(5) TYPE OF CONSTRUCTION (check):**
Rotary ☐ Dug ☐ Jetted ☐
Cable XX Driven ☐ Bored ☐

**(6) CASING SCHEDULE:** Threaded ☐ Welded XX
24 " Diam. from 0 feet to 50 feet Gage Std.
20 " Diam. from 0 feet to 346 feet Gage Std.
16 " Diam. from 336 feet to 423 feet Gage Std.
New XX Reject ☐ Used ☐

**(7) PERFORATIONS:** Perforated? Yes XX No ☐
Type of perforator used .....
Size of perforations ..... inches by ..... inches
195 perforations from 195 feet to 212 17 feet
222 perforations from 222 feet to 337 115 feet
346 perforations from 346 feet to 402 56 feet
..... perforations from ..... feet to ..... feet
..... perforations from ..... feet to ..... feet

**(8) SCREENS:** Well screen installed? Yes ☐ No XX
Manufacturer's Name .....
Type ..... Model No. .....
Diam. ..... Slot size ..... Set from ..... ft. to .....
Diam. ..... Slot size ..... Set from ..... ft. to .....

**(9) CONSTRUCTION:**
Was well gravel packed? Yes ☐ No XX Size of gravel: .....
Gravel placed from ..... feet to ..... feet
Was a surface seal provided? Yes XX No ☐
To what depth? 50 feet
Material used in seal: Bentonite--cement
Did any strata contain unusable water? Yes ☐ No XX
Type of water: ..... Depth of strata .....
Method of sealing strata off: .....
Was surface casing used? Yes XX No ☐
Was it cemented in place? Yes XX No ☐

**(10) WATER LEVELS:**
Static level 225 feet below land surface Date Feb. 75
Artesian pressure ..... lbs. feet above land surface Date .....

LOG RECEIVED: APR 17 1975 WATER RIGHTS SALT LAKE

**(11) FLOWING WELL:**
Controlled by (check) Valve ☐
Cap ☐ Plug ☐ No Control ☐
Does well leak around casing? Yes ☐ No ☐

**(12) WELL TESTS:** Drawdown is the distance in feet the water level is lowered below static level.
Was a pump test made? Yes XX No ☐ If so, by whom? Petersen Bros.
Yield: 1032 gal./min. with 63.5 feet drawdown after 24 hours
" 1200 " " 66 " " 6 "
" ..... " " ..... " " ..... "
Bailer test ..... gal./min. with ..... feet drawdown after ..... hours
Artesian flow ..... g.p.m. Date .....
Temperature of water ..... Was a chemical analysis made? No ☐ Yes ☐

**(13) WELL LOG:** Diameter of well 20 & 16 inches
Depth drilled 469 feet. Depth of completed well ..... feet.

NOTE: Place an "X" in the space or combination of spaces needed to designate the material or combination of materials encountered in each depth interval. Under REMARKS make any desirable notes as to occurrence of water and the color, size, nature, etc., of material encountered in each depth interval. Use additional sheet if needed.

| DEPTH From | DEPTH To | Clay | Silt | Sand | Gravel | Cobbles | Boulders | Hardpan | Conglomerate | Bedrock | Other | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | | | | | | | | | | x | top soil |
| 1 | 17 | x | | | | x | x | | | | | bould.-cobb. in clay gray |
| 17 | 48 | x | | | x | x | | | | | | cobb.-gravel in clay gray |
| 48 | 80 | x | | | x | | | | | | | water gravel, gray clay |
| 80 | 140 | x | | | x | | | | | | | water gravel, gray clay |
| 140 | 204 | | | | x | | | | | | | very little clay |
| 204 | 212 | | | | x | | | | | | | water gravel |
| 212 | 222 | x | | | | | | | | | | blue |
| 222 | 304 | | | | | | | | | | x | cemented gravel |
| 304 | 400 | x | | | x | | | | | | | water gravel-clay balls |
| 400 | 402 | x | | | | | | | | | | blue clay--a little gravel |
| 402 | 403 | x | | | | | | | | | | cemented gravel--brown cla |
| 403 | 422 | x | | | | | | | | | | blue clay--a little gravel |
| 422 | 450 | x | | | | | | | | x | | bedrock-dark blue |
| 450 | 469 | x | | | | | | | | x | | bedrock-dark blue |

Work started Augest 19 74 Completed February 19 75

**(14) PUMP:**
Manufacturer's Name Peabody-Barnes
Type: Line Shaft Turbine H. P. 200
Depth to pump or bowles 330 feet

**Well Driller's Statement:**
This well was drilled under my supervision, and this report is true to the best of my knowledge and belief.
Name Petersen Bros. Drilling Co. Inc. (Person, firm, or corporation) (Type or print)
Address 1775 No. Beck St., Salt Lake City, Ut. 84116
(Signed) ..... (Well Driller)
License No. 249 Date April 17, 19 75

USE OTHER SIDE FOR ADDITIONAL REMARKS

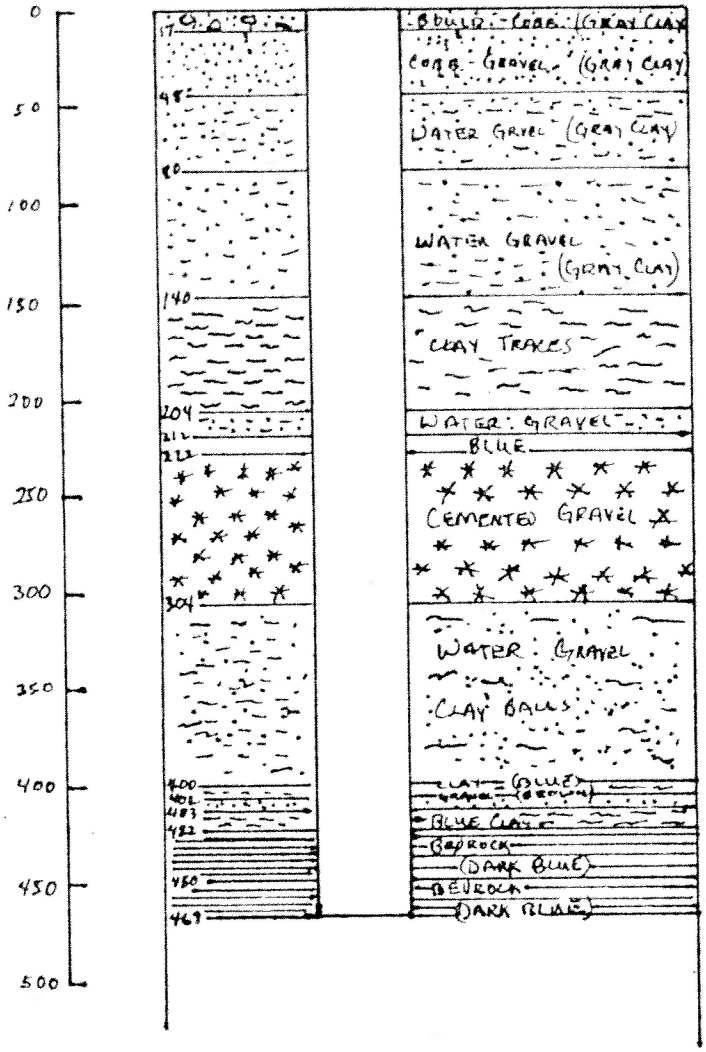
MICROFILMED

# 5600 WELL

VERTICLE SCALE 1" = 100

20" CASING 0-336'

16" CASING 336-423'



Barr Engineering Company
170 South Main Street Suite 500
Salt Lake City, UT 84101
Telephone: 801-333-8400

# LOG OF WELL MW-5600N1



| | | | | | |
|---|---|---|---|---|---|
| Project: | Provo Aquifer Storage and Recovery Pilot Study | Surface Elevation: | 4795.7 ft | Top of Casing Elev.: | 4798.2 ft |
| Project No.: | 44251008.00 | Drilling Method: | Rotosonic | | |
| Location: | Provo, Utah | Sampling Method: | Rotosonic - Continuous Coring | | |
| Coordinates: | UTM 12N N:4462065.323m, E:444128.0402m | | | | |
| Datum: | Horizontal: NAD83, Vertical: NAVD88 | Completion Depth: | 377.0 ft | | |

| Depth, feet | Sample Type & Recovery | Sample No. | USCS | Graphic Log | LITHOLOGIC DESCRIPTION | WELL OR PIEZOMETER CONSTRUCTION DETAIL | Elevation, feet |
|---|---|---|---|---|---|---|---|
| 0 | | 1 | GP | | POORLY GRADED GRAVEL WITH SAND (GP): 5YR 4/2 (dark reddish gray); moist; strong HCl reaction. Asphalt Surface. | Top Protective Casing: 2.5 ft-ags (8' pipe) | 4795 |
| 5 | | 2 | SP | | POORLY GRADED SAND (SP): medium grained; 10YR 4/2 (dark grayish brown); moist; strong HCl reaction; cobbles present. | Bottom Protective Casing: 5.5 ft-bgs | 4790 |
| 10 | | 3 | | | POORLY GRADED GRAVEL WITH SAND (GP): coarse grained; 10YR 3/3 (dark brown); moist; strong HCl reaction; limestone cobbles present (max 8"). | 10" borehole | 4785 |
| 15 | | 4 | GP | | | Bentonite Grout (0'-200') | 4780 |
| 20 | | 5 | | | Large cobbles and boulders present. | 4"-diameter Schedule 80 PVC Casing (-2.5'-270') | 4775 |
| 25 | | 6 | GP | | POORLY GRADED GRAVEL WITH SAND (GP): coarse grained; 2.5YR 4/3 (reddish brown); moist; strong HCl reaction. | | 4770 |
| 30 | | 7 | | | POORLY GRADED GRAVEL WITH SAND (GP): coarse grained; 5YR 5/1 (gray); moist; strong HCl reaction. | | 4765 |
| 35 ▽ | | 8 | | | Coarse grained; wet; coarser sand in gravel. limestone cobbles present. | | ▽ 4760 |
| 40 | | 9 | | | | | 4755 |
| 45 | | 10 | | | | | 4750 |
| 50 | | 11 | | | | | 4745 |
| 55 | | 12 | | | | | 4740 |
| 60 | | 13 | | | | | 4735 |
| 65 | | 14 | GP | | | | 4730 |
| 70 | | 15 | | | | | 4725 |
| 75 | | 16 | | | | | 4720 |
| 80 | | 17 | | | | | 4715 |
| 85 | | 18 | | | | | 4710 |
| 90 | | 19 | | | | | 4705 |
| 95 | | 20 | | | | | 4700 |
| 100 | | | | | | | |

| | |
|---|---|
| Date Boring Started: | 5/22/20 11:00 am |
| Date Boring Completed: | 6/2/20 3:00 pm |
| Logged By: | JSR |
| Drilling Contractor: | Cascade |
| Drill Rig: | Pro Sonic 600 |

Remarks: Composite Samples sent for Geochemical Analysis: Comp 1 (6'-164'), Comp 2 (164'-194'), Comp 3 (194'-213'), Comp 4 (217'-224'), Comp 5 (224'-267'), Comp 6 (267'-307'), Comp 7 (307'-337'), Comp 7 (337'-371')

Additional data may have been collected in the field which is not included on this log.

Barr Engineering Company
170 South Main Street Suite 500
Salt Lake City, UT 84101
Telephone: 801-333-8400

# LOG OF WELL MW-5600N1



| | | | | | |
|---|---|---|---|---|---|
| Project: | Provo Aquifer Storage and Recovery Pilot Study | Surface Elevation: | 4795.7 ft | Top of Casing Elev.: | 4798.2 ft |
| Project No.: | 44251008.00 | Drilling Method: | Rotosonic | | |
| Location: | Provo, Utah | Sampling Method: | Rotosonic - Continuous Coring | | |
| Coordinates: | UTM 12N N:4462065.323m, E:444128.0402m | | | | |
| Datum: | Horizontal: NAD83, Vertical: NAVD88 | Completion Depth: | 377.0 ft | | |

| Depth, feet | Sample Type & Recovery | Sample No. | USCS | Graphic Log | LITHOLOGIC DESCRIPTION | WELL OR PIEZOMETER CONSTRUCTION DETAIL | Elevation, feet |
|---|---|---|---|---|---|---|---|
| 100 | | 21 | GP | | Higher clay volume 101'-103'. | Bentonite Grout (0'-200') | 4695 |
| 105 | | 22 | SP | | POORLY GRADED SAND WITH GRAVEL (SP): medium to coarse grained; 10YR 5/3 (brown); wet; strong HCl reaction. | | 4690 |
| 110 | | 23 | | | | | 4685 |
| 115 | | 24 | GC | | CLAYEY GRAVEL WITH COBBLES (GC): 5YR 5/1 (gray); wet; strong HCl reaction. | | 4680 |
| 120 | | 25 | GP | | POORLY GRADED GRAVEL WITH SAND (GP): 5YR 5/2 (reddish gray); wet; strong HCl reaction. | | 4675 |
| 125 | | 26 | | | | | 4670 |
| 130 | | 27 | | | | | 4665 |
| 135 | | 28 | | | | 4" diameter Schedule 80 PVC Casing (-2.5'-270') | 4660 |
| 140 | | 29 | | | | | 4655 |
| 145 | | 30 | | | | | 4650 |
| 150 | | 31 | | | | | 4645 |
| 155 | | 32 | | | | | 4640 |
| 160 | | 33 | | | | | 4635 |
| 165 | | 34 | GC | | CLAYEY GRAVEL WITH COBBLES (GC): 5YR 4/1 (dark gray); wet; strong HCl reaction. | | 4630 |
| 170 | | 35 | | | | | 4625 |
| 175 | | 36 | | | | | 4620 |
| 180 | | 37 | GC | | CLAYEY GRAVEL WITH COBBLES (GC): 5YR 4/1 (dark gray); wet; strong HCl reaction. | | 4615 |
| | | | SP | | POORLY GRADED SAND (SP): medium grained; brown; wet. | | |
| 185 | | 38 | GC | | CLAYEY GRAVEL WITH COBBLES (GC): wet. | | 4610 |
| 190 | | 39 | GP | | POORLY GRADED GRAVEL (GP): wet; strong HCl reaction; limestone cobbles present. | | 4605 |
| 195 | | 40 | | | | | 4600 |
| 200 | | 41 | GC | | CLAYEY GRAVEL WITH COBBLES (GC): 7.5YR 5/2 (brown); wet. | | |

| | |
|---|---|
| Date Boring Started: | 5/22/20 11:00 am |
| Date Boring Completed: | 6/2/20 3:00 pm |
| Logged By: | JSR |
| Drilling Contractor: | Cascade |
| Drill Rig: | Pro Sonic 600 |

Remarks: Composite Samples sent for Geochemical Analysis: Comp 1 (6'-164'), Comp 2 (164'-194'), Comp 3 (194'-213'), Comp 4 (217'-224'), Comp 5 (224'-267'), Comp 6 (267'-307'), Comp 7 (307'-337'), Comp 7 (337'-371')

Additional data may have been collected in the field which is not included on this log.

Barr Engineering Company
170 South Main Street Suite 500
Salt Lake City, UT 84101
Telephone: 801-333-8400

# LOG OF WELL MW-5600N1



Project: Provo Aquifer Storage and Recovery Pilot Study
Project No.: 44251008.00
Location: Provo, Utah
Coordinates: UTM 12N N:4462065.323m, E:444128.0402m
Datum: Horizontal: NAD83, Vertical: NAVD88

Surface Elevation: 4795.7 ft
Top of Casing Elev.: 4798.2 ft
Drilling Method: Rotosonic
Sampling Method: Rotosonic - Continuous Coring
Completion Depth: 377.0 ft

| Depth, feet | Sample Type & Recovery | Sample No. | USCS | Graphic Log | LITHOLOGIC DESCRIPTION | WELL OR PIEZOMETER CONSTRUCTION DETAIL | Elevation, feet |
|---|---|---|---|---|---|---|---|
| 200 | | | | | CLAYEY GRAVEL WITH COBBLES (GC): 7.5YR 5/2 (brown); wet. *(continued)* | | 4595 |
| 205 | | 42 | GC | | | | 4590 |
| 210 | | 43 | | | | Vibrating Wire Piezometer (VWP) Placement @ 210' | 4585 |
| 215 | | 44 | GM | | SILTY GRAVEL WITH SAND (GM): 5YR 5/1 (gray); wet; strong HCl reaction. | 8" borehole | 4580 |
| 220 | | 45 | CL | | LEAN CLAY (CL): 2.5YR 2.5/1 (reddish black); wet.<br>GEOTECHNICAL SAMPLE #1 (#1000A)- (221'-222'). | 4"-diameter Schedule 80 PVC Casing (-2.5'-270') | 4575 |
| 225 | | 46 | GC | | CLAYEY GRAVEL WITH COBBLES (GC): 10YR 6/2 (light brownish gray); wet. | | 4570 |
| 230 | | 47 | | | | | 4565 |
| 235 | | 48 | GP | | POORLY GRADED GRAVEL (GP): 10YR 4/3 (brown); wet; strong HCl reaction. | Bentonite Chips (200'-268') | 4560 |
| 240 | | 49 | | | | | 4555 |
| 245 | | 50 | | | | | 4550 |
| 250 | | 51 | | | | | 4545 |
| | | | GC | | CLAYEY GRAVEL (GC): wet. | | |
| 255 | | 52 | GP | | POORLY GRADED GRAVEL (GP): gray; wet; strong HCl reaction. | | 4540 |
| 260 | | 53 | GC | | CLAYEY GRAVEL WITH SAND (GC): 10YR 4/3 (brown); wet; strong HCl reaction.<br>GEOTECHNICAL SAMPLE #2 (#53A)- (257'-262'). | | 4535 |
| 265 | | 54 | | | | | 4530 |
| 270 | | 55 | GM | | SILTY GRAVEL WITH SAND (GM): 10YR 6/2 (light brownish gray); wet.<br>GEOTECHNICAL SAMPLE #3 (#56A)- (271'-277'). | Top of Screen (270') | 4525 |
| 275 | | 56 | | | | | 4520 |
| 280 | | 57 | GP | | POORLY GRADED GRAVEL (GP): wet. | 4"-diameter 0.01 Slotted Schedule 80 PVC Screen (270'-360') | 4515 |
| 285 | | 58 | | | | | 4510 |
| | | | GC | | CLAYEY GRAVEL (GC): wet; boulder present- (287'-289'). | | |
| 290 | | 59 | GP | | POORLY GRADED GRAVEL WITH COBBLES (GP): wet. | | 4505 |
| 295 | | 60 | GC | | CLAYEY AND SILTY GRAVEL WITH COBBLES (GC): moist.<br>GEOTECHNICAL SAMPLE #4 (#61A)- (297'-303'). | | 4500 |
| 300 | | | | | | | |

Date Boring Started: 5/22/20 11:00 am
Date Boring Completed: 6/2/20 3:00 pm
Logged By: JSR
Drilling Contractor: Cascade
Drill Rig: Pro Sonic 600

Remarks: Composite Samples sent for Geochemical Analysis: Comp 1 (6'-164'), Comp 2 (164'-194'), Comp 3 (194'-213'), Comp 4 (217'-224'), Comp 5 (224'-267'), Comp 6 (267'-307'), Comp 7 (307'-337'), Comp 7 (337'-371')

Additional data may have been collected in the field which is not included on this log.

Barr Engineering Company
170 South Main Street Suite 500
Salt Lake City, UT 84101
Telephone: 801-333-8400

# LOG OF WELL MW-5600N1



| | | | | | |
|---|---|---|---|---|---|
| Project: | Provo Aquifer Storage and Recovery Pilot Study | Surface Elevation: | 4795.7 ft | Top of Casing Elev.: | 4798.2 ft |
| Project No.: | 44251008.00 | Drilling Method: | Rotosonic | | |
| Location: | Provo, Utah | Sampling Method: | Rotosonic - Continuous Coring | | |
| Coordinates: | UTM 12N N:4462065.323m, E:444128.0402m | | | | |
| Datum: | Horizontal: NAD83, Vertical: NAVD88 | Completion Depth: | 377.0 ft | | |

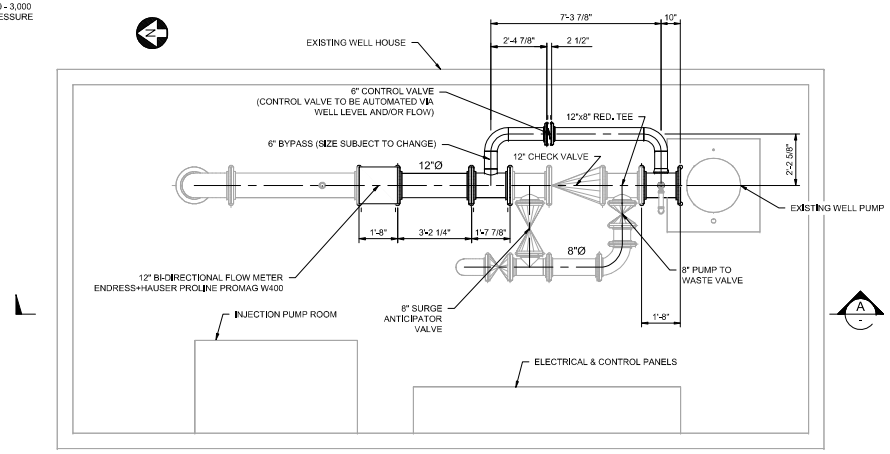
| Depth, feet | Sample Type & Recovery | Sample No. | USCS | Graphic Log | LITHOLOGIC DESCRIPTION | WELL OR PIEZOMETER CONSTRUCTION DETAIL | Elevation, feet |
|---|---|---|---|---|---|---|---|
| 300 | | 61 | GC | | CLAYEY AND SILTY GRAVEL WITH COBBLES (GC): moist. *(continued)* | | 4495 |
| 305 | | 62 | GP | | POORLY GRADED GRAVEL (GP): wet. | | 4490 |
| 310 | | 63 | GC | | CLAYEY GRAVEL WITH COBBLES (GC): 2.5Y 4/1 (dark gray); wet; strong HCl reaction. | | 4485 |
| 315 | | 64 | | | GEOTECHNICAL SAMPLE #5 (#64A)- (313'-317'). | Washed 10/20 Silica Sand (268'-362') | 4480 |
| 320 | | 65 | GP | | POORLY GRADED GRAVEL (GP): wet. | | 4475 |
| 325 | | 66 | GM | | SILTY GRAVEL WITH COBBLES (GM): wet. | | 4470 |
| 330 | | 67 | GP | | POORLY GRADED GRAVEL (GP): wet. | | 4465 |
| 335 | | 68 | GC | | CLAYEY GRAVEL WITH COBBLES (GC): wet; strong HCl reaction. | | 4460 |
| 340 | | 69 | GP | | POORLY GRADED GRAVEL (GP): wet; subangular; strong HCl reaction; limestone and quartzite cobbles present. | | 4455 |
| 345 | | 70 | | | | | 4450 |
| 350 | | 71 | QUARTZITE | | (QUARTZITE): pulverized rock. quartzite boulder. | | 4445 |
| 355 | | 72 | LIMESTONE | | (LIMESTONE): angular; limestone and quartzite interbedded. | | 4440 |
| 360 | | 73 | | | | Base of Screen (360') | 4435 |
| 365 | | 74 | QUARTZITE | | (QUARTZITE): angular; limestone and quartzite interbedded. | | 4430 |
| 370 | | 75 | | | | Bentonite Chips (362'-377') | 4425 |
| 375 | | 76 | | | | Well TD: 377 ft-bgs | 4420 |
| 380 | | | | | End of well 377.0 feet | | 4415 |
| 385 | | | | | | | 4410 |
| 390 | | | | | | | 4405 |
| 395 | | | | | | | 4400 |
| 400 | | | | | | | |

| | |
|---|---|
| Date Boring Started: | 5/22/20 11:00 am |
| Date Boring Completed: | 6/2/20 3:00 pm |
| Logged By: | JSR |
| Drilling Contractor: | Cascade |
| Drill Rig: | Pro Sonic 600 |

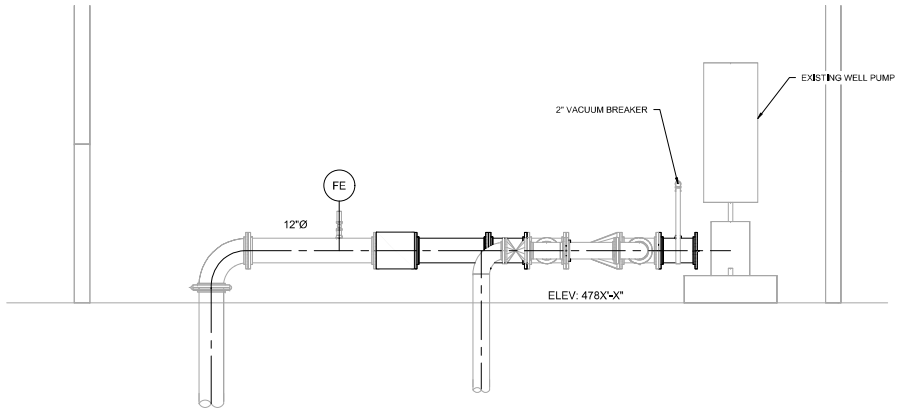
Remarks: Composite Samples sent for Geochemical Analysis: Comp 1 (6'-164'), Comp 2 (164'-194'), Comp 3 (194'-213'), Comp 4 (217'-224'), Comp 5 (224'-267'), Comp 6 (267'-307'), Comp 7 (307'-337'), Comp 7 (337'-371')

Additional data may have been collected in the field which is not included on this log.

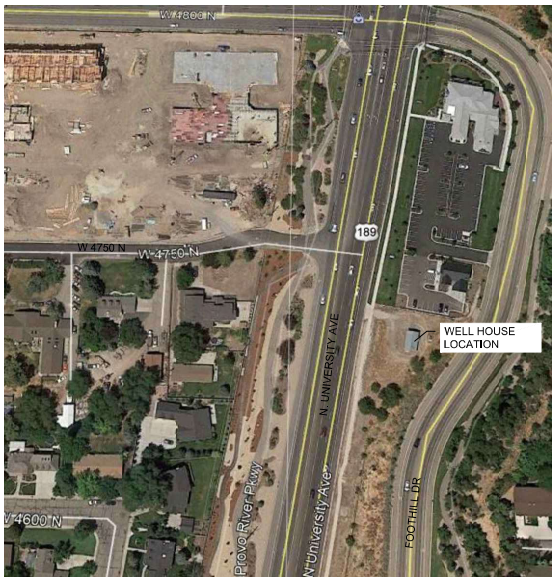
NOTES:
1. RIVERWOODS SITE ANTICIPATED WELL INFLOW RANGE 1,500 - 3,000 GPM. SYSTEM HEADER PRESSURE 110 PSIG




PLAN: RIVERWOODS WELL HOUSE (SITE 1)
SCALE: 3/8" = 1'-0"




A ELEVATION: RIVERWOODS WELL HOUSE (SITE 1)
SCALE: 3/8" = 1'-0" (FACING EAST)




PROJECT LOCATION: RIVERWOODS WELL HOUSE (SITE 1)
NTS

| BILL OF MATERIAL | | | | |
|---|---|---|---|---|
| MARK | QTY | SIZE | DESCRIPTION | LENGTH |
| 1 | 1 | 12" | PIPE, SMLS, SCH STD, ASTM A106 GR B | 4'-10" |
| 2 | 1 | 6" | PIPE, SMLS, SCH STD, ASTM A106 GR B | 7'-2" |
| 3 | 2 | 6" | 90 LR ELL, SCH STD, ASTM A234 GR WPB | |
| 4 | 1 | 12"x6" | TEE RED, SCH STD, ASTM A234 GR WPB | |
| 5 | 6 | 12" | FLG SLIP ON, 150LB, ASTM A105 | |
| 6 | 2 | 6" | FLG SLIP ON, 150LB, ASTM A105 | |
| 7 | 5 | 12" | GASKET, 150LB, 1/8" THK | |
| 8 | 2 | 6" | GASKET, 150LB, 1/8" THK | |
| 9 | 1 | 12"x2" | SOCK-O-LET, SW,3000LB, ASTM A105 | |
| 10 | 1 | 12"x6" | WELD-O-LET, BW, ASTM A105 | |
| 11 | 1 | 6" | BUTTERFLY VALVE, WAFER, 150LB | |
| 12 | 1 | 12" | BI-DIRECTIONAL FLOW METER, ENDRESS+HAUSER PROLINE PROMAG W400 | 19,69" |

*SMALL BORE ITEMS TO BE DETAILED AND ADDED IN FUTURE REVISIONS

PRELIMINARY
DRAFT

| NO. | BY | CHK. | APP. | DATE | REVISION DESCRIPTION |
|---|---|---|---|---|---|
| D | DJL | JMB | - | 11/2/22 | ISSUED FOR DESIGN |
| C | DJL | JMB | - | 12/17/21 | ISSUED FOR DESIGN |
| B | DJL | JMB | - | 01/06/21 | ISSUED FOR REVIEW |
| A | DJL | JMB | - | 11/20/20 | ISSUED FOR REFERENCE |

| RELEASED TO/FOR | DATE RELEASED |
|---|---|
| DESIGN | 12/21 11/22 |
| REVIEW | 01/21 |
| REFERENCE | 11/20 |


BARR
Project Office:
BARR ENGINEERING CO.
170 SOUTH MAIN STREET
SUITE 500
SALT LAKE CITY, UT 84101
Ph: 1-800-632-2277
Fax: (952) 832-2601
www.barr.com
Corporate Headquarters:
Minneapolis, Minnesota
Ph: 1-800-632-2277


| | |
|---|---|
| Scale | AS SHOWN |
| Date | 11/20/20 |
| Drawn | DJL |
| Checked | JMB |
| Designed | DJL |
| Approved | |

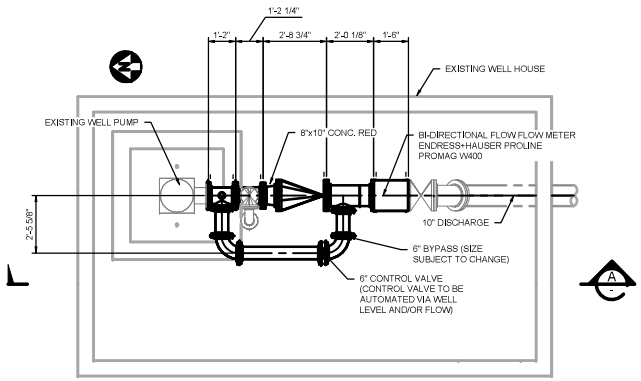
CITY OF PROVO
PROVO UTAH

PROVO CITY WATER
PROVO WELL SITE N. UNIVERSITY AVE

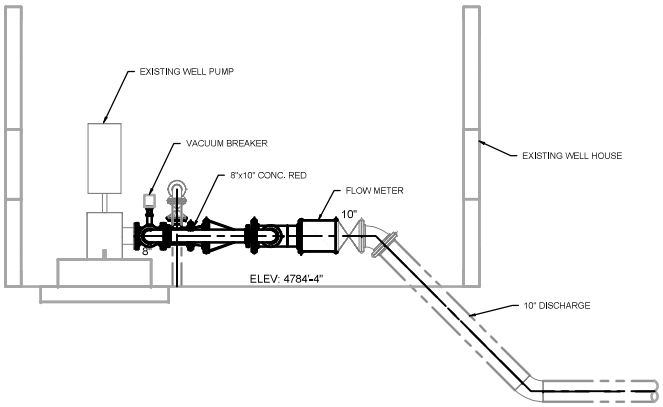
EXISITNG WELL PUMP

BARR PROJECT No. 44251008.00
CLIENT PROJECT No.
DWG. No. MECH-GA-001
REV. No. D

NOTES:
1. 5600N SITE ANTICIPATED WELL INFLOW RANGE 700 - 2,000 GPM. SYSTEM HEADER PRESSURE 60 PSIG




**PLAN: 5600 N WELL HOUSE (SITE 2)**
SCALE: 3/8" = 1'-0"




**ELEVATION: 5600 N WELL HOUSE (SITE 2)**
SCALE: 3/8" = 1'-0" (FACING EAST)


**PROJECT LOCATION: 5600 N WELL HOUSE (SITE 2)**
NTS

BILL OF MATERIAL

| MARK | QTY | SIZE | DESCRIPTION | LENGTH |
|---|---|---|---|---|
| 1 | 1 | 10" | PIPE, SMLS, SCH STD, ASTM A106 GR B | 2'-2" |
| 2 | 1 | 2" | PIPE, SMLS, SCH STD, ASTM A106 GR B | 6" |
| 3 | 1 | 6" | PIPE, SMLS, SCH STD, ASTM A106 GR B | 5'-9" |
| 4 | 1 | 10" | 45 ELL, SCH STD, ASTM A234 GR WPB | |
| 5 | 2 | 6" | 90 LR ELL, SCH STD, ASTM A234 GR WPB | |
| 6 | 1 | 10"x6" | TEE RED, SCH STD, ASTM A234 GR WPB | |
| 7 | 1 | 8"x4" | TEE RED, SCH STD, ASTM A234 GR WPB | |
| 8 | 1 | 8"x6" | TEE RED, SCH STD, ASTM A234 GR WPB | |
| 9 | 1 | 10"x8" | RED CONC, SCH STD, ASTM A234 GR WPB | |
| 10 | 1 | 4" | FLG WELD NECK, 150LB, SCH STD, ASTM A105 | |
| 11 | 5 | 10" | FLG SLIP ON, 150LB, ASTM A105 | |
| 12 | 12 | 6" | FLG SLIP ON, 150LB, ASTM A105 | |
| 13 | 5 | 8" | FLG SLIP ON, 150LB, ASTM A105 | |
| 14 | 5 | 10" | GASKET, 150LB, 1/8" THK | |
| 15 | 1 | 4" | GASKET, 150LB, 1/8" THK | |
| 16 | 7 | 6" | GASKET, 150LB, 1/8" THK | |
| 17 | 3 | 8" | GASKET, 150LB, 1/8" THK | |
| 18 | 1 | 8"x2" | SOCK-O-LET, SW,3000LB, ASTM A105 | |
| 19 | 1 | 2" | BALL VALVE, THRD, 800LB | |
| 20 | 1 | 6" | BUTTERFLY VALVE, WAFER, 150LB | |
| 21 | 1 | 10" | CHECK VALVE, FLG, 150LB | |
| 22 | 1 | 10" | GATE VALVE, FLG, 150LB | |
| 23 | 1 | 10" | BI-DIRECTIONAL FLOW FLOW METER ENDRESS+HAUSER PROLINE PROMAG W400 | |

*SMALL BORE ITEMS TO BE DETAILED AND ADDED IN FUTURE REVISIONS

PRELIMINARY DRAFT

| NO. | BY | CHK | APP | DATE | REVISION DESCRIPTION |
|---|---|---|---|---|---|
| C | DJL | JMB | | 12/17/21 | ISSUED FOR DESIGN |
| B | DJL | JMB | | 01/05/21 | ISSUED FOR REVIEW |
| A | DJL | JMB | - | 11/20/20 | ISSUED FOR REFERENCE |

DESIGN 12/20
REVIEW 01/21
REFERENCE 01/20
RELEASED TO/FOR
DATE RELEASED


BARR
Project Office:
BARR ENGINEERING CO.
170 SOUTH MAIN STREET
SUITE 500
SALT LAKE CITY, UT 84101
Ph: 1-800-632-2277
Fax: (952) 832-2601
www.barr.com
Corporate Headquarters:
Minneapolis, Minnesota
Ph: 1-800-632-2277


| | |
|---|---|
| Scale | AS SHOWN |
| Date | 11/20/20 |
| Drawn | DJL |
| Checked | JMB |
| Designed | DJL |
| Approved | |

CITY OF PROVO
PROVO UTAH

PROVO CITY WATER
PROVO WELL SITE 5600N

EXISITNG WELL PUMP

BARR PROJECT No. 44251008.00
CLIENT PROJECT No.
DWG. No. MECH-GA-002
REV. No. C

# Attachment E

Injection Well Operating Plan and Procedures

# Part I-Injection Well Operation Plan and Procedures

## 1.1 Injection Volumes

The following injection volumes and rates shown in Table I-1 and Table I-2 will be used for the full-scale injection programs in the Riverwoods and 5600 North wells. Provo City plans to maintain a constant injection rate at each well. All injection volumes and rates are subject to modification based upon aquifer reaction. Significant changes in injection volume and rates will be submitted to the DEQ for approval prior to engaging in updated activities.

**Table I-1 Riverwoods Well Injection**

| Stage | Estimated Injection Rate | Volume | Duration |
|---|---|---|---|
| Full-scale Final Project | 2,000 gpm | Up to 2.9 MGD | When excess culinary water is available and well is not needed to provide water to the culinary system (e.g., typically 6 months from mid-October to mid-April, annually) |
| **Full-scale Final Project Cumulative Total** | **2,000 gpm (may be increased with notification)** | **Up to 529 MG per 6-month period** | When excess culinary water is available and well is not needed to provide water to the culinary system (e.g., typically 6 months from mid-October to mid-April, annually) |

**Table I-2 5600 North Well Injection**

| Stage | Estimated Injection Rate | Volume | Duration |
|---|---|---|---|
| Final Project | Up to 1,500 gpm | Up to 2.2 MGD | When excess culinary water is available and well is not needed to provide water to the culinary system (e.g., typically 6 months from mid-October to mid-April, annually) |
| **Final Project Cumulative Total** | **Up to 1,500 gpm (may be increased with notification)** | **Up to 402 MG per 6-month period** | When excess culinary water is available and well is not needed to provide water to the culinary system (e.g., typically 6 months from mid-October to mid-April, annually) |

## 1.2 Injection Pressures

Culinary water injected in Riverwoods Well and 5600 North Well will flow into the wells from the distribution system through existing downhole piping and the pumps. Conservative water system modeling of a peak demand scenario indicates that under existing conditions (i.e., no injection) system pressures will be between 114 psi and 120 psi at the Riverwoods Well and between 22 psi and 24 psi at the 5600 North Well. Replacing pumping with injection at Riverwoods Well and 5600 North Well in the peak demand scenario (an occurrence that is unlikely to occur since planned operation calls for injection when the 5600 North Well and Riverwoods Well are not needed for water supply and excess culinary

water is available) indicates that the system pressure at the Riverwoods Well would be between 107 psi and 114 psi and at the 5600 North Well the system pressure would be between 11 psi and 14 psi.

## 1.3 Source of Injectate

Water from the Provo City culinary system will be used as the injection fluid in the Riverwoods and 5600 North wells.

# Attachment F

Monitoring Parameters, Schedule, Recording, and Reporting Plan

# Part J-Monitoring, Recording, and Reporting Plan

The monitoring, recording, and reporting plan below details how Provo City will demonstrate and ensure the protection of underground sources of drinking water (USDW) while implementing ASR injection at the Riverwoods and 5600 North Wells.

## Monitoring

As stated in 40 CFR 144.51(j)(1), "*Samples and Measurements taken for the purpose of monitoring shall be representative of the monitored activity*". Treated drinking water from Provo City's culinary system will be used to charge the wells for the ASR injection. Therefore, prior to initiating the full-scale injection project at each well a representative water sample will be collected from Provo City's culinary system. Following initiation of the injection projects, Provo City's routine monitoring of the culinary system will be relied upon for continued monitoring of the injectate water. A groundwater monitoring program will also be implemented. Groundwater monitoring will include the following:

- Monitoring of groundwater elevations in the injection wells and associated monitoring wells.
- Monitoring groundwater quality at Riverwoods and 5600 North site by collecting samples from the monitoring well at each site.

### Monitoring Well Network

The Riverwoods Well and 5600 North Well each have an associated monitoring well to monitor water levels and water quality. At the Riverwoods site, monitoring well MW-RW1 is located approximately 50 feet from the existing well house off University Avenue. At the 5600 North site monitoring well MW-5600N1 is located approximately 60 feet from the existing well house adjacent to the Provo River. The monitoring wells were sampled as part of the pilot injection testing at the sites to monitor water quality. Water levels in the monitoring wells have been monitored on an hourly basis using pressure transducers with onboard dataloggers since the commencement of the pilot projects. Both monitoring wells also have a water quality instrument installed that monitors turbidity, conductivity, pH, ORP, DO, and temperature.

### Sampling Frequency

When excess culinary water is available and Riverwoods Well and 5600 North Well are not needed to provide water to the culinary system (e.g., typically 6 months from mid-October to mid-April, annually) culinary water will be injected in the wells. Injectate water from Provo City's culinary system along with groundwater from the monitoring wells at the sites will be sampled on a quarterly basis during injection periods. During periods when no injection is occurring samples will not be collected for the ASR program. If water quality remains consistent over time Provo City may request the Division of Water Quality to approve a reduction in sampling frequency to annual.

## Sampling Methods

Injectate and groundwater samples will be collected in accordance with Provo City's Standard Operating Procedures (SOPs). Snap Samplers®, a QED technology, are installed in both MW-RW1 and MW-5600N1 to facilitate easy and accurate sampling. The Snap Samplers® are permanently set in each well. The Snap Sampler® bottles remain open to groundwater passing through the wells until they are pneumatically triggered at the surface using an electronic air pump. Once triggered, the sample bottles close and contain representative samples of the groundwater flowing through the wells. Sample bottles are then brought to the surface and the sample decanted into laboratory bottles. The full laboratory sample bottles will be placed on ice in a cooler. The sampling process is repeated if additional sample volume is required. Upon completion of sampling at each site, the Snap Samplers® will be redeployed into the wells to await the next sampling event. Samples in the cooler will be delivered to the laboratory under chain-of-custody procedures.

The pressure transducers with onboard dataloggers will continue to be utilized in both monitoring wells to record water level changes and the water quality instruments will continue to be used to monitor turbidity, conductivity, pH, ORP, DO, and temperature.

## Injectate Water and Groundwater Analysis and Quality Control

Injectate water and groundwater samples will be analyzed for the parameters listed in Table J-1. Samples will be analyzed by Chemtech Ford Laboratories (Chemtech), of Sandy, Utah (or other State of Utah-certified laboratory), utilizing a level 2 Quality Control (QC) data package.

**Table J-1 Injection Monitoring Parameter List**

| Analyte | CAS Number | Fraction | Units |
|---|---|---|---|
| Arsenic | 7440-38-2 | Total and Dissolved | mg/L |
| Aluminum | 7429-90-5 | Total and Dissolved | mg/L |
| Chloride | 7647-14-5 | | mg/L |
| Iron | 7439-89-6 | Total and Dissolved | mg/L |
| Sodium | | Total and Dissolved | mg/L |
| Manganese | 7439-96-5 | Total and Dissolved | mg/L |
| Sulfate | 7757-82-6 | Not Applicable | mg/L |
| Total Dissolved Solids | N/A | Not Applicable | mg/L |
| Ammonia (as Nitrogen) | 7664-41-7 | Not Applicable | mg/L |
| Total Nitrate + Nitrite (as N) | N/A | Not Applicable | mg/L |
| Turbidity | Field | Not Applicable | NTU |
| pH | Field | Not Applicable | pH units |
| Temperature | Field | Not Applicable | degrees C or F |

| Analyte | CAS Number | Fraction | Units |
|---|---|---|---|
| Dissolved Oxygen | Field | Not Applicable | mg/L |
| Specific Conductance | Field | Not Applicable | uS/cm |
| Oxidation/Reduction Potential | Field | Not Applicable | mV |
| Calcium | 7440-70-2 | Total and Dissolved | mg/L |
| Magnesium | 7439-95-4 | Total and Dissolved | mg/L |
| Potassium | 7440-09-7 | Total and Dissolved | mg/L |
| Total Hardness as $CaCO_3$ | N/A | Not Applicable | mg/L |
| Alkalinity as CaCO3 | N/A | Total | mg/L |
| Total Organic Carbon (TOC) | N/A | Not Applicable | mg/L |

## Recording

All analytical data and associated data will be recorded, kept, and reported. These records of monitoring data shall include:

- The date, exact place, and time of sampling or measurements.
- The individual(s) who performed the sampling or measurements.
- The date(s) analyses were performed.
- The individual(s) who performed the analyses.
- The analytical techniques or methods used.
- The results of such analyses.

Additional data that will be recorded, kept, and reported shall include the following:

- Static water levels in each well before and after each injection period.
- Injection pressures and rates for each well for each injection period.
- Total volumes of water injected into each well for each period.

All analytical and associated additional data will be backed up electronically and stored indefinitely.

## Reporting

During injection periods, a quarterly monitoring report containing the above-mentioned data for each well will be prepared and submitted to the Division of Water Quality. For periods when no injection is occurring a quarterly report containing static water level measurements and stating that no injection or sampling occurred during the period will be prepared and submitted to the UIC program. If the Division of Water Quality approves a reduction in sampling frequency, an annual monitoring report for each well would be prepared and submitted to the Division of Water Quality.