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WATER RESOURCES DEPT.
SALEM, OREGON

TECHNICAL MEMORANDUM

ON

HYDROGEOLOGIC FEASIBILITY OF CLACKAMAS RIVER WATER WELL NO. 1 FOR AQUIFER STORAGE AND RECOVERY

Prepared for:

Clackamas River Water
Clackamas, Oregon

Submitted by:

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February 29, 2000

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TABLE OF CONTENTS Page No.

TABLE OF CONTENTS (Cont.)

LIST OF TABLES

TABLE OF CONTENTS (Cont.)

LIST OF FIGURES

APPENDICES

1. INTRODUCTION

Clackamas River Water (CRW) is pursuing the development of an aquifer storage and recovery (ASR) system. CRW is interested in using existing Well No. 1 for ASR pilot studies and implementation. This report describes the geology and hydrogeology of the area in the vicinity of Well No. 1, provides a detailed description of geologic and hydrogeologic conditions at Well No. 1, and provides a discussion of the feasibility of using Well No. 1 as an ASR well, as well as the potential for ASR in the vicinity of Well No. 1.

1.1 Background Information

CRW is evaluating the feasibility of using its existing Well No. 1 for ASR. Well No. 1 is located near Redland Road in Oregon City (Figure 1). The well was drilled in 1973 to a depth of 560 feet using cable tool methods, and is completed in basalt. The well was pump tested at a rate of 3,150 gallons per minute (gpm) in 1973 resulting in a drawdown of 160 feet for a specific capacity of 19.7 gpm/ft, indicating that the well is completed in permeable material. The well is currently equipped with a 100 hp, 2,000 gpm line-shaft turbine pump. The well has not been used for water supply due to poor-quality (elevated TDS) water. The well is currently used as a backup water supply source.

CRW has been pursuing ASR feasibility since the early 1990's, when initial feasibility studies were completed for the Clairmont Water District, the predecessor to CRW[1]. The initial study indicated that it was feasible to use Well No. 1 for ASR, and recommended additional characterization of the regional hydrogeology and Well No. 1 to determine hydrogeologic conditions and the suitability of the well for ASR use.

1.2 Scope of Work

The scope of work for the hydrogeological characterization and ASR feasibility is as follows:

- Evaluate the geology, hydrogeology, and water quality in Well No. 1 and in other basalt wells in the vicinity of Well No. 1 to characterize the hydrogeology and water quality of the basalt aquifer;
- Conduct geophysical logging of Well No. 1, including video, caliper, spinner, fluid, and resistivity/SP logs to document the condition of the well and identify potential zones of fluid flow in the well;
- Conduct a 24-hour pumping test of Well No. 1 to determine the aquifer properties and water quality;
- Conduct a packer test in Well No. 1 to determine the aquifer properties and water quality in the upper and lower portions of the basalt aquifer; and

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[1] Clairmont Water District Aquifer Storage and Recovery Feasibility Study, CH2M Hill, November 1994.

- Prepare a hydrogeologic report summarizing the local geologic and hydrogeologic conditions in the vicinity of Well No. 1, including aquifer hydraulic properties, flow system boundaries, groundwater movement, groundwater quality, and ASR feasibility.

1.3 Report Organization

This report is organized into several sections as follows:

Section 2 describes the site setting in the vicinity of Well No. 1;

Section 3 describes the fieldwork that includes water quality sampling and testing of Well No. 1;

Section 4 describes the hydrogeologic conditions in the vicinity of Well No. 1 based on recent testing and existing regional information;

Section 5 describes the feasibility of ASR using Well No. 1 and in the basalt aquifer in the Clackamas River Water service area; and

Section 6 provides conclusions and recommendations.

Several Appendices are included with supplemental information. Appendix A contains well logs used in the construction of the geologic cross sections. Appendix B contains the results of the geophysical logging conducted in Well No. 1. Appendix C contains the results of the 24-hour pumping test and packer test conducted in Well No. 1, and Appendix D contains water quality data for Well No. 1 and recharge source(s). Appendix E contains a mixing analysis to evaluate the chemical interaction between native groundwater and recharge water.

2. SITE SETTING

This section describes the site setting, geologic units, and general groundwater occurrence in the vicinity of Well No. 1. This information is drawn from reports and studies conducted by the U.S. Geological Survey and other agencies and from well logs on file with the Oregon Water Resources Department.

2.1 Physiography

Well No. 1 is located on Redland Road, east of the Willamette River and south of the Clackamas River, near Oregon City (Figure 1). The well is located about 50 feet above the Abernethy Creek valley, a small tributary of the Willamette River. The topography rises to the north, east, and south of the well site to hills of up to 600 feet in elevation. Approximately 1 mile west of the well site, the topography flattens to the confluence of Abernethy Creek and the Willamette River.

2.2 Geologic Units

The geologic units in the vicinity of Well No. 1 include Tertiary and Quaternary volcanic and sedimentary rocks, and recent unconsolidated materials. Further information on the geologic units in the area is provided by Schlicker and Finlayson[2], and Leonard and Collins[3]. A geologic map is shown on Figure 2, and geologic cross-sections are on Figures 3 through 4. Well logs used in the construction of the cross sections are summarized on Table 1 and included in Appendix A. Well construction and depth information is summarized on Table 1 for basalt wells, and Table 2 for wells completed in the overlying sedimentary deposits. Table 2 does not include numerous shallow monitoring wells installed at the Rossman landfill, Clackamas County shop, Stimson Lumber, and other locations

2.2.1 Surfical Geologic Units

The unconsolidated materials in the vicinity of Well No. 1 include alluvial materials, terrace deposits, and silt. The unconsolidated materials are less than 100,000 years old and overlie Tertiary sedimentary deposits. Alluvial materials occur in the valleys of streams and rivers, including Abernethy Creek adjacent to the Well No. 1 site (Figure 2). The alluvial materials typically comprise sand, silt and gravel materials deposited by the streams. The thickness of these deposits is variable, and generally no more than 20 or 30 feet.

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[2] Schlicker, H.G. and C.T. Finlayson, 1979, Geology and Geologic hazards of Northwestern Clackamas County, Oregon, Oregon Department of Geology and Mineral Industries Bulletin 99.

[3] Leonard, A.R. and C.A. Collins, 1983, Groundwater in the Northern Part of Clackamas County, Oregon, U.S. Geological Survey Open-File Report 80-1049

The terrace deposits consist of boulders, cobbles, and mudflow deposits, which may be up to 200 feet thick. The terrace deposits occur along the banks of the Clackamas River north of Well No. 1.

The Willamette Silt comprises fine sand, silt, and clay deposited in a lacustrine (lake) environment. The Willamette Silt occurs on top of the bedrock surfaces in uplands to an elevation of approximately 250 feet, and ranges from less than 5 feet to about 40 feet thick. The Willamette silt is exposed in several upland areas near Well No. 1.

Groundwater occurs in all of the unconsolidated materials. Well yields are variable depending on the permeability of the material. Little water is available from the fine silty units.

2.2.2 Sedimentary Deposits

Tertiary sedimentary deposits of the Troutdale Formation and Sandy River Mudstone occur in the area of Well No. 1. The two units could not be distinguished with confidence based on the well log information. Wells completed in the coarser-grained portions or in poorly cemented zones of the sedimentary units may produce large quantities of groundwater. Wells completed in the fine-grained portions of the sedimentary deposits yield little groundwater.

2.2.2.1 Troutdale Formation

The Troutdale Formation consists of interbedded gravel, sand, and clay of variable thickness of middle Pliocene age, or about 3 million years old. In the vicinity of Well No. 1, the Troutdale Formation is exposed at or near the surface. Well No. 1 penetrated 300 feet of fine-grained sedimentary deposits, including clay and sand thought to be Troutdale Formation and Sandy River Mudstone overlying volcanic rocks (Figures 3 and 4).

In the vicinity of Well No. 1, much of the Troutdale Formation comprises clay, with thin, interbedded discontinuous lenses of sand or gravel. These coarse zones could not be correlated with confidence between wells (Figures 3 and 4), and likely represent discontinuous lenses or channel deposits.

2.2.2.2 Sandy River Mudstone

The Sandy River Mudstone underlies the Troutdale Formation in the general area of Well No. 1. Surface exposures of the Sandy River Mudstone do not appear at the well site; the nearest outcrop is approximately 2 miles southeast in the Abernethy Creek area. The Sandy River Mudstone is a lacustrine deposit comprising silt and clay with minor fine sand, and is approximately 5 million years old (late Pliocene).

Small, interbedded coarser sand or gravel lenses are present in the Sandy River Mudstone (Figures 3 and 4). These lenses are discontinuous and could not be correlated between wells on the cross sections.

2.2.3 Volcanic Rocks

2.2.3.1 Boring Lavas

The Boring Lavas are Quaternary basaltic flows and tuffs that occur as cappings on the higher elevations in the Oregon City area, to the north, east, and south of Well No. 1 (Figure 2). The Boring Lavas are approximately 2 million years old. Well No. 1 did not intersect the Boring Lavas.

2.2.3.2 Columbia River Basalt

The Columbia River Basalt is a thick series of Tertiary basalt flows. The basalt was extruded during the middle Miocene, or about 16 to 9 million years ago. In the general vicinity of the Well No. 1, the basalt is estimated to be up to 975 feet thick[4] based on regional exposures, however, the thickness is variable due to deposition over an irregular land surface. Individual basalt flows range in thickness from 15 to 150 feet thick. The interior portions of individual flows are generally unfractured to weakly fractured. The interflow zones, or contacts between flows, are generally broken, vesicular or scoriacous, weathered, and fractured, and may contain pillow basalts (formed as molten basalt flowed into water) or thin sedimentary units of sand and gravel. Groundwater in the basalt generally occurs in the interflow zones or in strongly fractured zones.

Well No. 1 is completed in the Grande Ronde and Wanapum Formations of the Columbia River Basalt. The well intersected 260 feet of basalt material below the Tertiary sedimentary deposits (Troutdale Formation and Sandy River Mudstone) at the top of the borehole (Figures 3 and 4). The full thickness of the basalt section was not penetrated by Well No. 1. The nearest outcrop of Columbia River Basalt is along the Willamette River in Oregon City.

2.2.3.3 Skamania Volcanics

The Skamania Volcanics underlie the Columbia River Basalt in the vicinity of Well No. 1. The Skamania Volcanics are a series of late Eocene to Oligocene (40 to 26 million years old) basaltic and andesitic flows and tuffs of uncertain thickness. It is uncertain if any of the deep wells in the area of Well No. 1 penetrated the Skamania Volcanics. The nearest outcrop of the Skamania Volcanics is along the Willamette River southwest of Oregon City.

2.3 Geologic History

The geologic history of the area in the vicinity of Well No. 1 begins with the extrusion of the Skamania Volcanics in the late Eocene. The Skamania Volcanics were extensively folded and eroded to an irregular topographic surface before the extrusion of the overlying Columbia River Basalts during the middle Miocene from vents in eastern

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[4] Schlicker, H.G. and C.T. Findlayson, 1979, Geology and Geologic hazards of Northwestern Clackamas County, Oregon, Oregon Department of Geology and Mineral Industries Bulletin 99.

Oregon and Washington and western Idaho. Numerous individual basalt flows were extruded over this time, with periods of erosion and sedimentation during periods of low volcanic activity.

Folding and erosion followed the extrusion of the Columbia River Basalt. Low areas were filled with sediments of the Sandy River Mudstone and Troutdale Formation. Further structural deformation and erosion occurred prior to the extrusion of the Boring Lavas over the sedimentary rocks. Quaternary unconsolidated sediments were deposited during glacial flooding events and by rivers and streams in the area.

2.4 Structural Geology

Schlicker and Finlayson[5] mapped several inferred normal faults and a syncline (broad-U-shaped fold) in bedrock in the vicinity of Wells No. 1 (Figures 2 and 4). The mapped faults follow general NW-SE and NE-SW alignments. The amount of displacement and age of these faults is uncertain. The faults may influence groundwater flow in two differing ways. If the faults are gouge-filled and impermeable, the faults will act as barriers to groundwater flow. If the faults are rubbly, they may be permeable and act as areas of enhanced groundwater flow.

The mapped syncline follows the NW-SE trend of some of the faults. Well No. 1 is located on the northeast limb of the syncline (Figures 2 and 4). The syncline may act as a barrier to groundwater flow, with the less fractured or unfractured basalt flow interiors retarding groundwater flow.

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[5] Schlicker, H.G. and C.T. Findlayson, 1979, Geology and Geologic hazards of Northwestern Clackamas County, Oregon, Oregon Department of Geology and Mineral Industries Bulletin 99.

3. INVESTIGATION PROGRAM

This section describes recent investigations conducted in support of the ASR feasibility studies. This work included completion of a well inventory in the area of Well No. 1, groundwater sampling and water level measurements, and geophysical logging and pumping and packer tests in Well No. 1.

3.1 Well Inventory

The Oregon Water Resources Department (WRD) was contacted to obtain water well logs on file for Clackamas County. The well logs are completed by the driller, and include information on the well location, geologic units encountered in the well, any well testing information, and well use information.

The well logs were sorted to obtain the well logs within an approximate 2-mile radius of Well No. 1. The logs within this area were used to identify additional wells completed in the basalt aquifer in the area of Well No. 1, and wells completed in the sedimentary deposits overlying the basalt. Information on the geology and aquifer properties in the vicinity of Well No. 1 was gathered from these logs. The wells completed in basalt are summarized on Table 1, and wells completed in the overlying sedimentary deposits within approximate 1-mile radius of Well No. 1 are summarized on Table 2. The logs were evaluated to identify wells completed in basalt that could be used to collect water quality samples and groundwater level measurements as part of the ASR feasibility work.

No springs were noted within a 1-mile radius of Well No. 1, based on examination of the Gladstone and Oregon City 7.5-minute topographic maps. Small unmapped springs seasonally occur where coarse-grained lenses in the sedimentary deposits are exposed along the sides of drainages.

3.2 Groundwater Sampling and Water Level Measurements

Several existing domestic, irrigation, or industrial wells completed in the basalt aquifer in the vicinity of Well No. 1 were selected as groundwater sample and groundwater level measurement locations. The wells were field checked to confirm the location, access, and suitability for sampling and measurement. The wells that were sampled are as follows:

- Lonestar Concrete Company (Figure 1, Well #6);
- 16200 Oak Terrace (Figure 1, Well #1);
- High School (Figure 1, Well #11); and
- Ogden Middle School (Figure 1, Well #9).

Water samples were collected by Montgomery Watson personnel using the pumping equipment installed in each well. In addition to these wells, water quality and water level data are available from monitoring well MW-1 at the Rossman Landfill. Additional information on these wells is provided in Table 1.

Groundwater quality samples were taken from these wells on August 26 and August 31, 1999. The wells were pumped for approximately 15 to 20 minutes to purge the well and any associated pressure tanks. Groundwater levels could only be measured in the Lonestar well (Figure 1, Well #6) due to limited access for a water level probe at the wellheads of the other wells.

3.3 Well No. 1 Investigations

Investigation of the conditions and hydrogeology of Well No. 1 was performed by geophysically logging the well, and performing a pumping test and a packer test. Each activity is described below.

3.3.1 Geophysical Logging

Geophysical logging was conducted in Well No. 1 to determine the condition of the well and the zones of water inflow to the well. The geophysical logs were collected using down-the-hole tools to collect data over the entire open length of the well or the entire water column. The geophysical logs were collected under static conditions, and selected logs were collected under pumping conditions with the pump intakes set at a depth of 112 to 115 feet below the top of the well casing. The geophysical logs are presented in Appendix B.

3.3.1.1 Video Log

A video log was collected from Well No. 1 prior to the pumping test. High turbidity in the water column following the removal of the pump obscured much of the borehole, making observations of the well condition difficult.

A second video log was completed to a depth of approximately 435 feet prior to the packer test, to confirm the borehole conditions at the anticipated packer depth setting. The video log shows the well casing to be clean and intact to a depth of 302 feet. Below the casing, the borehole walls are generally uniform and smooth, with some widely-spaced fractures. At approximately 430 feet, a large fractured zone, or "washout", was intersected. The depth of this fracture zone correlates with changes in fluid properties recorded on the fluid logs collected in Well No. 1 (Section 3.3.1.3).

3.3.1.2 Caliper Log

The caliper log is a measure of the well diameter and is useful for determining zones of "washout" or increased borehole diameter that often occur in broken or fractured zones. The caliper log may also detect breaks in the casing, if present.

The caliper logging indicates a uniform borehole diameter of approximately 16.5-inches in the upper 300 feet of the well, corresponding with the reported cased interval (Figure B-1). Below 350 feet, the borehole diameter is 16-inches to approximately 535 feet, where the diameter narrows to approximately 7-inches. It is uncertain if this is a result of borehole cave-in or from the original drilling.

There are several zones where the borehole diameter increases up to 18-inches. These correspond to broken or vesicular basalt as noted on the well log, particularly between 315 to 324 feet and from 487 to 530 feet. There are also several zones where the borehole diameter is less than the reported 16-inches. This may be the result of small areas of partial blockage due to caving below the casing.

3.3.1.3 Fluid Logs

Fluid logs measure the fluid conductivity, fluid resistivity, and fluid temperature of the water column in the well. These logs can be used to differentiate zones of water inflow based on differences in fluid properties and temperature. The logs were run initially with the pump off under static conditions, and repeated while the well was pumped.

Under static conditions, the fluid conductivity and fluid resistivity logs indicate a relatively constant fluid resistivity and conductivity below the casing to a depth of approximately 420 feet, indicating water of uniform conductivity is entering the well between the bottom of the casing at 302 feet and 420 feet. Below 420 feet, the fluid resistivity decreases, and the fluid conductivity increases, indicating the inflow of more conductive water in the lower portion of the well (Figures B-2 and B-3). This corresponds to a vesicular basalt zone on the driller's log. This also correlates with a large broken zone noted on the video log.

The fluid temperature decreases uniformly in the well to approximately 330 to 340 feet, where a slight increase occurs. This zone corresponds to a zone of broken basalt noted on the driller's log. The temperature decreases in the well below 340 feet in a fairly uniform fashion until 420 feet, where a drop in temperature occurs (Figure B-4). The temperature continues to decrease to the bottom of the well.

The fluid logs were run during the pumping test to determine zones of water inflow. The fluid conductivity and fluid resistivity logs run under pumping conditions indicate a slight increase in fluid conductivity below the casing to a depth of 350 feet, and then a sight decrease to approximately 420 feet. This indicates water of generally uniform conductivity and TDS is entering the well over this interval. At 420 feet, a sharp increase in fluid conductivity and a corresponding decrease in fluid resistivity occurs. The higher fluid conductivity continues to the bottom of the well (Figures B-2 and B-3). The higher fluid conductivity and lower resistivity below 420 feet indicates that water with elevated TDS is entering the borehole below this depth. The temperature log collected under pumping conditions shows a gradual decrease in temperature to a depth of 430 feet. A drop in fluid temperature occurs at approximately 430 feet, indicating inflow of water at a slightly lower temperature below that depth (Figure B-4).

3.3.1.4 Spinner Log

A spinner log measures the relative flow velocity in the well under pumping conditions, which aids in the identification of zones of water inflow in the well. The spinner logging shows a relatively uniform velocity below the casing to a depth of approximately 420 feet. Below 420 feet, the velocity apparently decreases (Figure B-5). Interpretation of the spinner log is complicated by the low fluid velocities in the well and potential fouling of the spinner tools with suspended sediment in the water column, resulting from the pulling of the permanent pump.

Further characterization of the location of the inflow zones in the well was done during the packer testing (Section 3.3.3).

3.3.1.5 Formation Resistivity and SP Logs

The formation resistivity and self-potential (SP) logs measure electrical properties of both the formation and the pore water. In general, the resistivity of the basalt will be highest in the dense flow interiors and lowest in water bearing zones. The SP will be lower in the dense basalt zones.

In Well No. 1, the highest formation resistivities and low SP response are at approximately 320, 390, and 460 feet (Figures B-6 and B-7). These areas generally coincide with areas noted as hard basalt on the well log. Lower resistivities and higher SP responses are at about 340, 400, and below 480 feet. These areas generally coincide with areas of porous or broken basalt noted on the well log.

3.3.2 24-Hour Pumping Test

A 24-hour constant-rate pumping test was conducted in Well No. 1 on August 31, 1999. The existing turbine pump was pulled from the well, and the well equipped with a temporary submersible pump to allow the geophysical logging to take place under pumping conditions. The submersible pump was set at a depth of approximately 112 to 115 feet below the top of the well casing (elevation –30 feet msl). The well was pumped at a constant rate of 300 gpm during the test. Water levels were monitored in Well No. 1 and in monitoring well MW-1 at the Rossman Landfill during the pumping test. Additional details of the pumping test are included in Appendix C.

A drawdown of 2.9 feet was observed in Well No. 1 at the end of the pumping period. The specific capacity at the end of the test was 103 gpm/ft. Note that this is approximately five times higher than the specific capacity when the well was tested at 3,150 gpm (19.7 gpm/ft) following well completion in 1973. The higher specific capacity estimated from the August 1999 test data is not unexpected, and is due to the low pumping rate, as specific capacity generally decreases with increasing pumping rate due to increased turbulent well losses. The 1979 pumping test was conducted at a rate that was greater than 10 times the rate used in the August 1999 test. A pump test hydrograph is shown on Figure 5. A semi-log test hydrograph is shown on Figure 6.

3.3.3 Packer Testing

A packer test was performed in Well No. 1 on November 29 and 30, 1999. The purpose of the packer test was to evaluate the hydraulic properties and water quality of the lower (430 to 560 feet) and upper (302 to 430 feet) portions of the open hole section of the well. An inflatable packer was set in Well No. 1 at a depth of 426 to 427.2 feet. The depth of the packer setting was confirmed prior to setting the packer by conducting a downhole video log of the well to verify borehole conditions. The video log indicated rough borehole walls below a depth of 429.5 feet, so the packer was set in an area of smooth borehole wall above this depth. A 300-gallon per minute (gpm) submersible pump was set above the packer, and a small 12.5-gpm sampling pump was set below the packer. Access was provided for water level measurements above and below the packer.

After the packer was installed, water levels measured above and below the packer indicated a water level difference of 0.04 feet, with the zone below the packer having a lower water level. This indicates that there is a small downward hydraulic gradient between the basalt aquifers above and below the packer.

Field water quality parameters (pH, temperature, specific conductivity, Eh, dissolved oxygen) were monitored during the testing, and water quality samples were collected from above and below the packer.

3.3.3.1 Upper Zone Pumping

The open borehole above the packer was pumped for approximately 6-hours at 300 gpm. Water levels were monitored in Well No. 1 above and below the packer, and in Rossman MW-1. Water levels were monitored for approximately 1-hour after the pump was shut down.

A hydrograph for the pumping test conducted in the upper portion of the well is shown on Figure 8. As shown on Figure 8, approximately 21.3 feet of drawdown occurred in the well during the test. The specific capacity at the end of the test was 14.1 gpm/ft, lower than the observed specific capacity of 103 gpm/ft at the end of the 24-hour pumping test conducted in August 1999, which involved a test of the full open interval of basalt. Much of the drawdown occurred within the first 2 to 3-minutes of pumping. Water levels above the packer stabilized after approximately 4-minutes of pumping. Water levels below the packer decreased by approximately 0.25 feet during the test. The water level response in Rossman MW-1 is shown on Figure 8. The water level in Rossman MW-1 generally decreased during the pumping test, however, it is uncertain if this decrease is due to pumping at Well No. 1 or other influences such as earth tides or barometric pressure fluctuations.

Semi-log and log-log plots of the drawdown data for Well No. 1 are shown on Figures 9 and 10. These figures show the stabilization of the drawdown after the first 3 to 4 minutes of pumping. This response is typical of a "leaky" aquifer system that receives recharge or leakage from an overlying aquifer. The test response suggests that leakage from the overlying Troutdale Formation and Sandy River Mudstone sediments is supplying water to the upper basalt aquifer. The water level recovery plot (Figure 11) shows a rapid water level recovery after the pump is shutdown, indicating a source of recharge to the aquifer. A lower permeability aquifer boundary, such as the boundary seen during the first pumping test, was not seen in this test. The lower permeability boundary seen during the first test is likely indicative of conditions in the basalt aquifer below the packer.

The drawdown data were analyzed to estimate the aquifer transmissivity and leakance. The initial two to three minutes of drawdown data are influenced by wellbore storage effects. Data collected after about four minutes of pumping are influenced by leakage effects. As a result of the wellbore storage and leakage effects, the data collected between three and four minutes were used to estimate an aquifer transmissivity. The results of the analysis indicate an aquifer transmissivity of 1,750 ft^2/d. This transmissivity is less than 10-percent of transmissivity of 22,000 ft^2/d estimated from the previous 24-hour pumping test conducted over the entire open interval in the well.

A leakage factor of 0.023 feet was estimated from the test data. This value of leakage indicates a high rate of leakage, or recharge to the aquifer from the overlying sedimentary deposits (Troutdale Formation and Sandy River Mudstone).

3.3.3.2 Lower Zone Pumping

The lower zone was pumped at a rate of 12.5 gpm for 16 hours. The pump was started one hour following the pumping test above the packer. Pumping removed about 12,000 gallons of water from below the packer, equivalent to 8.8 well volumes of the packed off zone.

Water levels in the well above the packer fluctuated by approximately 0.05 feet while the well was being pumped from below the packer. It is uncertain if pumping from below the packer affected water levels above the packer.

Water level data could not be collected while the well was pumped from below the packer due to the test equipment configuration. Based on the transmissivity of 22,000 ft^2/d estimated from the test conducted over the entire open well (Section 3.3.2) and the transmissivity of the well above the packer (1,750 ft^2/d), the transmissivity of the aquifer below the packer is estimated to be 20,000 ft^2/d. Therefore, the lower portion of the basalt aquifer at Well No. 1 is significantly more permeable that the upper portion of the aquifer.

3.3.3.3 Water Quality

Groundwater quality samples were collected from above and below the packer. Each sample was analyzed for major ions, iron, manganese, and volatile organic compounds. The results of the groundwater sampling are summarized on Table 3. No constituents were detected that exceeded primary or secondary drinking water standards, except for TDS in the zone below the packer, which exceeded the secondary standard of 500 mg/L. No organic compounds, including PCE or TCE, were detected in either sample.

Groundwater from the lower portion of the well below the packer is more mineralized (higher dissolved solids) than groundwater from above the packer. The differences in water quality above and below the packer and the entire open well are summarized in the following table:

Constituent	**Units**	**Open Well (302-560 feet)**	**Above Packer (302-428 feet)**	**Below Packer (428-560 feet)**
Conductivity	µmhos/cm	860	530	975
Total Dissolved Solids	mg/L	510	330	600
Chloride	mg/L	182	101	273
Total Alkalinity	mg/L	136	141	130
Calcium	mg/L	40.9	26	50.8
Magnesium	mg/L	7.1	5.8	8.2
Potassium	mg/L	12.3	9.3	13.9
Sodium	mg/L	108	76.9	130
Total Hardness	mg/L-$CaCO_3$	131	88.8	161

Groundwater from below the packer contains higher concentrations of sodium, chloride, potassium, calcium, and magnesium, and has lower alkalinity. This is consistent with the results of the fluid logging (Section 3.3.1) which indicated an increase in fluid conductivity below about 420 feet.

4. HYDROGEOLOGIC CONDITIONS

This section describes the hydrogeologic conditions in the basalt aquifer (the target aquifer for ASR) in the area of Well No. 1, including aquifer hydraulic properties, groundwater flow, aquifer boundaries, and groundwater quality. Information for this section was compiled from U. S. Geological Survey reports and studies, and a search of well logs on file with the Oregon Water Resources Department, as well as the recent investigations conducted in Well No. 1. Well logs used in this evaluation are included in Appendix A, and summarized on Table 1.

4.1 Groundwater Conditions

4.1.1 Groundwater Occurrence

4.1.1.1 Basalt Aquifer

Groundwater occurs in the Columbia River Basalt primarily in the interflow zones between individual basalt flows. The interflow zones are broken, vesicular (porous) and rubbly, and may contain pillow basalts or interbedded sedimentary material such as sand and gravel. The geologic log of Well No. 1 indicates that potential interflow zones are located at the following depths:

Depth	General Description
315-324	porous gray basalt, water
333-342	broken gray basalt
382-397	medium soft black basalt
487-550	porous black basalt

These intervals are separated by zones described on the log as "hard basalt", which likely represent flow interiors. Video logging of Well No. 1 indicated that the basalt between 302 and 430 feet was generally weakly fractured or unfractured. A large fracture was noted at approximately 430 feet on the video log. A review of well logs from other deep wells completed in the basalt aquifer in the vicinity of Well No. 1 indicates similar groundwater conditions, with water occurring in zones noted on the logs as soft, porous, broken, or fractured. In general, the interiors of the basalt flows are unfractured, and little groundwater occurs in the flow interiors unless zones of strong fracturing are present. Groundwater in the basalt generally occurs under confined conditions. The sedimentary rocks overlying the basalt and the dense basalt flow interiors confine the interflow zones of the basalt aquifer.

Well yields in the basalt are variable, reflecting the variability in thickness and continuity of the interflow zones, and the number of interflow zones intersected in the well. Well yields in basalt wells in the area of Well No. 1 range from less than 10 gpm to over 3,000 gpm (Well No. 1).

4.1.1.2 Sedimentary Deposits

Groundwater occurs in the sedimentary deposits overlying the basalt in coarser-grained portions or lenses of the rocks. These lenses are thin and discontinuous in the vicinity of Well No. 1, and could not be correlated between wells (Figures 3 and 4). Groundwater in these formations occurs under unconfined to confined conditions. The Troutdale Formation and Sandy River Mudstone are generally fine grained in the area of Well No. 1. Wells completed in coarser-grained lenses in the sedimentary deposits in the area of Well No. 1 generally yield less than 30 gpm. Information on wells completed in the sedimentary deposits in the vicinity of Well No. 1 is summarized on Table 2. Wells logs from these wells are included in Appendix A.

The majority of the sedimentary deposits overlying the basalt near Well No. 1 are silt and clay. The silts and clays are generally not water bearing[6] and form confining units for groundwater occurring in deeper lenses of coarse materials and in the basalt aquifer.

4.1.2 Groundwater Flow

Groundwater flow in the basalt aquifer is complex due to the continuity of the interflow zones, geologic structure such as folds and faults, and variability within the interflow zones. Many of the wells in the basalt aquifer are also open to several interflow zones and the water levels are likely affected by head differences between the zones.

Groundwater elevations in the basalt aquifer are quite variable (Table 1) due to the location of the wells in the regional flow system, the variability in the completion zones and the number of zones of differing hydraulic head where the wells are completed. A number of wells in the basalt aquifer in the vicinity of Well No. 1 have fairly consistent groundwater elevations between 20 below sea level to 20 feet above sea level (Table 1) similar to Well No. 1. This suggests that the potentiometric surface of the basalt aquifer in the area of Well No. 1 is fairly flat. A flat potentiometric surface is consistent with a high permeability aquifer.

Groundwater recharge to the basalt aquifer occurs in areas where the basalt is exposed at or near the ground surface. Recharge also likely occurs through downward leakage in areas where the hydraulic head in overlying sedimentary and unconsolidated materials is greater than the hydraulic head in the basalt. The groundwater elevation in wells completed in the sedimentary deposits overlying the basalt in the vicinity of Well No. 1 are approximately 20 to 40 feet above sea level (Table 2) indicating that vertical leakage to the basalt can occur. Due to the low permeability of the Sandy River Mudstone, this is likely a small portion of recharge to the aquifer. Groundwater upwelling from deeper sedimentary units into the basalt also may occur, as poor-quality water has been encountered in several deep basalt wells in the vicinity of Well No. 1, such as the High School and Middle School wells (Wells #9 and #11, Figure 1) without intersecting

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[6] Leonard, A.R. and C.A. Collins, 1983, Groundwater in the Northern Part of Clackamas County, Oregon, U.S. Geological Survey Open-File Report 80-1049.

sedimentary units below the basalt. This has also been reported for other deep basalt wells in the region[7,8].

Groundwater discharge from the basalt aquifer is uncertain. Groundwater discharge likely occurs to downgradient groundwater basins and to wells completed in the basalt. Groundwater also discharges to the Willamette River, as the elevation of the river is approximately 10 feet, and groundwater elevations of approximately 20 feet occur in basalt wells near the river. Basalt crops out along the river west and southwest of the well site.

Groundwater flow directions in the basalt aquifer and the overlying sedimentary rocks and alluvial materials are shown schematically on Figure 12. Groundwater recharge to the regional basalt aquifer likely occurs in the upland areas to the north, east, and south of Well No. 1. Groundwater flow in the basalt aquifer is toward the Willamette River, a regional groundwater discharge area. Groundwater recharge to the unconsolidated material and sedimentary rocks occurs where the units are exposed at the surface. Groundwater flow in the unconsolidated materials and sedimentary rocks is dependent on local topographic variations, and is generally to local discharge points such as Abernethy Creek, the Willamette River, and other surface water bodies.

4.1.3 Aquifer Boundaries

The boundaries of the basalt aquifer are uncertain. There are several geologic structures that could form boundaries of the basalt aquifer. These include faults, folds, and lateral thinning or changes in the interflow zones. Analysis of pumping test data collected from Well No. 1 indicates that an aquifer boundary of lower permeability was intersected during the test (see Section 3.3.2).

Several faults have been mapped or inferred in the area of Well No. 1, particularly north of the Clackamas River (Figure 2). These faults may be of lower permeability than the surrounding basalt, and restrict groundwater flow. Well No. 1 is drilled on the northeastern limb of a syncline (Figures 2 and 4). The syncline may act to restrict groundwater flow due to folding of the interflow and dense basalt interior zones.

The water table forms the upper boundary of the uppermost aquifer in the sedimentary rocks and alluvial materials, where recharge crosses the boundary to enter the groundwater flow system. If the water table intersects the ground surface, groundwater discharge occurs through evapotranspiration and discharge to surface water bodies or wetlands. The lower boundary to the aquifer is likely a low-permeability unit, such as marine sedimentary rocks or dense volcanic rocks.

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[7] Leonard, A.R. and C.A. Collins, 1983, Groundwater in the Northern Part of Clackamas County, Oregon, U.S. Geological Survey Open-File Report 80-1049.

[8] Hogenson, G.M., and B.L. Foxworthy, 1965, Groundwater in the east Portland Area, Oregon, U.S. Geological Survey Water Supply Paper 1793.

4.2 Aquifer Hydraulic Properties

The transmissivity of the basalt aquifer in the vicinity of Well No. 1 was estimated from available information presented on well drillers logs. The transmissivity can be estimated from specific capacity data from the short well test performed by the driller after a well is completed. The transmissivity is estimated from the following approximation[9]:

$$T = 2000*Q/s$$

where	T	is the aquifer transmissivity in gpd/ft;
	Q	is the pumping rate in gpm; and
	S	is the drawdown at the end of the test period (feet).

The transmissivity was estimated for the basalt wells used to construct the geologic cross sections. The specific capacity data were adjusted to account for well losses due to well completions (open bottom, perforations, or fracture flow) during the tests. An estimated average well efficiency of 70 percent was assumed for all wells. As shown on Table 1, the adjusted specific capacity ranges from 0.32 to 43 gpm/ft, and the estimated transmissivity of the basalt aquifer ranges from 60 to 8,750 ft^2/d. This range in estimated transmissivity reflects the heterogeneity of the aquifer and differences in the thickness, extent, and permeability of the interflow zones. Well No. 1 and a well to the northeast owned by Oregon City (Well #18, Figure 1) have the highest estimated transmissivity.

4.2.1 CRW Well No. 1

Information on the aquifer hydraulic properties was provided by a 24-hour pumping test conducted in Well No. 1 in August 1999 (Section 3.3.2) and a packer test conducted on November 29 and 30, 1999 (Section 3.3.3).

During the 24-hour test, the well was pumped at a rate of 300 gpm, with 2.9 feet of drawdown in the well at the end of the test. The estimated transmissivity for the interval 302-560 feet from the test data was 22,000 ft^2/d. This estimated transmissivity is the highest estimated transmissivity of the wells completed in the basalt aquifer in the vicinity of Well No. 1 (Table 1).

During the packer test, the well was tested over the interval between the bottom of the casing (302 feet bgs) and 426 feet. The transmissivity of this zone was estimated to be 1,750 ft^2/d, or less than 10% of the transmissivity estimated for the entire open interval of the well. This indicates that the portion of the hole below the packer (between 426 and 560 feet) has a transmissivity of approximately 20,000 ft^2/d. Therefore, the lower portion of the well is significantly more permeable than the upper portion of the well.

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[9] Driscoll, F.G., 11986, Groundwater and Wells, Johnson Filtration System, St. Paul, Minnesota.

4.3 Groundwater Quality

Groundwater quality in the basalt aquifer is variable. Several deep wells in the vicinity of Well No. 1 contain water a high total dissolved solids (TDS) content due to elevated sodium and chloride concentrations.

Water quality samples from the basalt aquifer have been historically collected at monitoring well MW-1 near the Rossman landfill. MW-1 is completed in the basalt aquifer at a depth of 204 feet. The water from MW-1 is a sodium-chloride water (Figure 13), with a TDS of approximately 290 to 380 mg/L. The water quality data from MW-1 are summarized on Table 5.

Water quality samples were collected at the end of August 1999 from several existing wells completed in the basalt aquifer, prior to the pumping test conducted on Well No. 1. The sampled wells were:

- Ogden Middle School, Figure 1, Well #9;
- High School Well, Figure 1, Well #11;
- Lonestar Well, Figure 1, Well No.#6; and
- 16200 Oak Terrace, Figure 1, Well#1

Samples were collected using the existing pumping equipment installed in each well. Further information on the wells is provided in Table 1, and the location of the wells is shown on Figure 1.

The results of the water quality sampling indicate that water from these wells is a hard to very hard sodium chloride water with a high TDS content. The results of the water quality sampling in these wells is summarized on Table 3, and shown on Figure 7.

Water from the Ogden Middle School and High School wells had the poorest water quality of the wells sampled. These wells exceeded secondary drinking water standards for chloride, and have a TDS content exceeding the secondary drinking water standard of 500 mg/L. Water from these wells also exceeds the secondary standards for iron and manganese. Water from the other two wells sampled had lower concentrations of iron, manganese, and chloride that are below the secondary drinking water standards, however, TDS exceeded the secondary standard. Water from Rossman MW-1 had the lowest TDS of the wells in the vicinity of MW-1. No organic constituents were detected in any of the wells.

The two school wells with the poor quality water are deep wells in the basalt aquifer. It is likely that that the poor-quality water is the result of upwelling of more saline water from underlying Skamania Volcanics or sedimentary rocks. Other deep wells installed in the basalt aquifer in the vicinity of Rossman MW-1 and Well No. 1 have also been noted with poor quality water[10,11].

4.3.1 Well No. 1

Groundwater samples collected from Well No. 1 over the entire open well are similar in composition to groundwater from other deep wells completed in the basalt aquifer (Figure 7). The dissolved solids content is intermediate between the two school wells, which are have a TDS content of approximately 1,000 mg/L, and Lonestar and Oak Terrace wells, which have a TDS of less than 650 mg/L.

Groundwater samples collected during the packer test indicate that groundwater in the upper portion of the aquifer contains lower total dissolved solids (primarily sodium and chloride) than the lower portion of the aquifer. The total dissolved solids of the upper portion of Well No. 1 was 330 mg/L, which is similar to the TDS content of the Lonestar, Oak Terrace, and Rossman MW-1 TDS content (Tables 3 and 5). The TDS of the lower portion of the well was 675 mg/L, which is lower than the TDS of the school wells (930 to 1,000 mg/L). This indicates that the groundwater in the lower portion of the aquifer is of poorer quality than groundwater in the upper portion of the aquifer.

Organic constituents have been detected in Well No. 1 at concentrations less than the drinking water standards. Trichloroethylene (TCE) was detected twice, in 1988 and 1991, and tetrachloroethylene (PCE) was detected once in August 1999. These organic constituents were not detected in the other basalt wells sampled during the sampling conducted in August 1999. In addition, these organic compounds were not detected in Well No. 1 during the packer testing conducted in November 1999.

4.4 Groundwater Use

There are a number of wells completed in the basalt aquifer and in the overlying sedimentary rock and alluvial materials in the vicinity of Well No. 1. Many of these wells are shallow domestic wells and do not withdraw large quantities of water. Several deep wells completed in the basalt aquifer are reported on the well logs to withdraw more than 300 gpm, in addition to Well No. 1. These wells are as follows:

Oregon City Public Schools - The School District owns two wells completed in the basalt aquifer (Well # 11 and #13, Table 1 and Figure 1). One well was drilled to a depth of 602 feet, and has been pump tested at 350 gpm. The well is used for irrigation. The other well was drilled to a depth of 578 feet, and was pump tested at 295 gpm. The use of the groundwater from this well is not known.

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[10] Leonard, A.R. and C.A. Collins, 1983, Groundwater in the Northern Part of Clackamas County, Oregon, U.S. Geological Survey Open-File Report 80-1049.

[11] Hogenson, G.M., and B.L. Foxworthy, 1965, Groundwater in the east Portland Area, Oregon, U.S. Geological Survey Water Supply Paper 1793.

Oregon City Wells - Oregon City owns two production wells completed to depths of 560 and 404 feet in the basalt aquifer (Well #3 and #18, Table 1 and Figure 1). The wells were each pump tested at 300 gpm. The well completed to 404 feet was abandoned in March of 1999. The status of the other well is not known.

Dakota Minerals Well (Willamette Falls Sand and Gravel) - This well is completed to a depth of 340 feet in the basalt aquifer (Well #5, Table 1 and Figure 1). The well was pump tested at up to 600 gpm. The current status of this well is not known.

These four wells are located within 0.5 to 1 mile of Well No. 1. The current pumping rate and use of each of these wells is not known. In addition to these wells, there are three other wells in the area that are reported to pump more than 100 gpm. The wells are:

Oregon Ready Mix This is well is 248 feet deep and was pump tested at up to 100 gpm (Well #6, Figure 1).

Garvision This is a domestic well that was pump tested at 100 gpm. The well is 180 feet deep (Well #12, Figure 1).

Publishers Paper This well is 251 feet deep and was reported to produce 230 gpm (Well #8, Figure 1).

The status of these wells is not known.

5. ASR FEASIBILITY

This section describes the feasibility of ASR in the basalt aquifer in the vicinity of Well No. 1, and the feasibility of using Well No. 1 as an ASR well.

5.1 ASR Objectives

CRW wishes to develop an ASR system utilizing water either from the CRW water treatment plant or purchased from the South Fork Water Board that will be recharged into a basalt aquifer using CRW's existing Well No. 1. The initial goal is a storage capacity of 80 MG, however, CRW is interested in evaluating the maximum ASR storage capacity of the basalt aquifer. The recharged water would typically be stored for 3 to 6 months, then recovered to meet summer peak demands or emergency needs. The recovered water will be required to have a composition similar to the recharge water, and have acceptable taste and odor. The overall objective is to design a system to maximize the recovery of recharge water while providing consistent water quality to CRW's customers.

Several items that need to be addressed in the ASR feasibility evaluation and pilot testing are as follows:

1. What rate can water be injected using Well No. 1? Are similar recharge rates likely at other locations in the basalt aquifer in the vicinity of Well No. 1?
2. How much water can be recharged at Well No. 1 over a seasonal recharge cycle? How much water can be recharged over the local area?
3. What will the water level rise in Well No. 1, locally in the basalt aquifer, and in the overlying sedimentary deposits be?
4. How far will the recharged water migrate during storage?
5. What reactions will take place in the aquifer between the recharged water and native groundwater and between the recharged water and the basalt aquifer matrix? Will vertical leakage from the overlying or underlying deposits affect water quality?
6. Are there potential sources of contamination that could affect the operation of the system?
7. Based on the conceptual model and issues, should a pilot test be performed? If a pilot test is performed, what approach should be employed to collect the necessary information for a full-scale system?

5.2 Aquifer and Well No. 1 ASR Characteristics

This section describes the characteristics of the basalt aquifer and Well No. 1 that are relevant to ASR feasibility.

5.2.1 Aquifer ASR Characteristics

Water injected into an aquifer during ASR operations will flow into the permeable zones in the aquifer, such as interflow zones present in the basalt aquifer. The water level buildup in the aquifer from recharge is a function of recharge rate and duration, the aquifer transmissivity and storativity and the aquifer boundary conditions.

A high aquifer transmissivity is favorable for recharging large quantities of water. The aquifer transmissivity in the vicinity of Well No. 1 is approximately 22,000 ft^2/d, indicating that it is highly permeable and thus capable of readily accepting recharge water. Based on the results of the packer testing, the lower portion of the well, from 430 to 560 feet, is the most permeable portion of the well, with an estimated transmissivity of 20,000 ft^2/d. The upper portion of the well, between 302 and 430 feet, has a transmissivity of 1,750 ft^2/d. The storativity of the aquifer in the vicinity of Well No. 1 is not known. The storativity of confined basalt aquifers is typically between 10^{-3} and 10^{-5}. A low storativity will transmit water level changes rapidly over large areas in a permeable aquifer such as the basalt aquifer intersected by Well No. 1.

The hydraulic properties of lower portion of Well No. 1 were used to make preliminary estimates of water level rise during recharge. For the estimate, a storativity of 10^{-4} was assumed. Under these conditions, the water level rise in the well was estimated to be less than 50 feet at a recharge rate of 2,000 gpm (i.e. 130 MG over a 90 day period). A higher storativity will result in lower buildup at the well during recharge, while a lower storativity (10^{-5}) will result in approximately 60 feet of buildup. The water level rise at a point 2,500 feet from the well is estimated to be less than 20 feet. This water level buildup is the maximum buildup that is projected to occur at the end of recharge. After recharge stops, water levels in the immediate vicinity of the well will decrease as water levels equilibrate in the aquifer during storage. A greater water level rise will occur as the result of a higher recharge rate.

The intended recharge zone is a confined part of the basalt aquifer, that is at least 100 feet below the top of the basalt. The water level rise resulting from recharge is expected to be confined to this zone, with a muted response in the zones in the upper portions of the basalt. There are five deep wells within a 1-mile radius of Well No. 1 that likely intercept the confined zone target for recharge, including the following wells:

- Ogden Middle School, Figure 1, Well #9;
- Two wells owned by Oregon City Public Schools, Figure 1, Wells #11 and 13; and
- Clackamas Housing Authority, Figure 1, Well #3; and
- Willamette Falls Sand and Gravel, Figure 1, Well # 5.

These five wells have a depth to water of greater that 100 feet except for the Willamette Falls Sand and Gravel well (Table 1), which is located approximately 1-mile northeast of Well No. 1 (Figure 1). The water level rise in this well is anticipated to be less than 15-feet. Other wells completed in the basalt the vicinity of Well No. 1 such as Rossman

MW-1 are completed in the upper portion of the basalt, and water level rises as a result of recharge are not expected in these wells.

This analysis did not consider the effects of low-permeability aquifer boundaries, which would increase the water level buildup. The extent of the highly permeable portion of the basalt aquifer that Well No. 1 is completed in is not known. There are two additional wells that have an estimated transmissivity of greater than 8,000 ft^2/d (Well #11 and #18, Figure 1 and Table 1), located 4,000 feet northeast and southwest of Well No. 1. It is uncertain if the aquifer between these wells is highly permeable.

The effects of recharge on the water levels in upper portions of the basalt and on the sedimentary deposits overlying the basalt is not known, and will be dependent on the vertical permeability of the sedimentary deposits and basalt, and the difference in hydraulic head between the basalt aquifer and the overlying aquifer in the sedimentary deposits.

5.2.2 Well No. 1 ASR Characteristics

Well No. 1 was drilled to a depth of 560 feet below ground using cable tool drilling methods. A surface seal of cement grout was installed to a depth of 30 feet into silt and clay. The well is cased to a depth of 302 feet with 16-inch diameter steel casing through the sedimentary deposits and into the top of the basalt. The caliper logging indicates the well is an open 16-inch diameter borehole below the casing. The video logging conducted prior to the packer test indicates generally unfractured basalt occurs from 302 feet to a depth of approximately 430 feet. This upper zone has a relatively low permeability. The lower zone of the well from 430 to 560 feet is highly permeable. The depth to water in Well No. 1 was approximately 61 feet below ground in November 1999.

The existing well construction is shown on Figure 14. In this condition, the well does not meet well construction standards under OAR 690-210-0150 Sealing of Wells in Consolidated Formations. A well completed in consolidated formations such as basalt must have a minimum 5-foot cement grout seal in the annulus between the well casing and formation.

Well No. 1 will need to be modified to meet seal regulations prior to usage as an ASR well. The well can be modified by telescoping 12-inch diameter steel casing in the well between a depth of 250 and 420 feet, and pressure grouting the casing in place. The proposed modification is shown on Figure 14. Starting the seal at a depth of 250 feet will provide a pump chamber that will allow a 2,000 gpm pump to be installed.

Without modifications to the well head to control leakage, the available water level buildup at Well No. 1 is limited by the depth to water in the well. The depth to water is approximately 61 feet below ground. We estimate that recharge at a rate of 2,000 gpm for 90 days will result in a water level buildup of about 50 feet in the well. This should not present a problem during ASR pilot testing and initial implementation.

5.3 Recharge Water Migration

When recharge stops, the recharge water will migrate away from the well due to the hydraulic gradient caused by the recharge mound at the well, and due to the regional hydraulic gradient in the aquifer. The groundwater velocity due to natural groundwater flow in the basalt aquifer was estimated from the following equation:

$$v = Ki/n$$

where	v	is the groundwater velocity in ft/d;
	K	is the hydraulic conductivity (ft/d),
	i	is the hydraulic gradient (ft/ft), and
	n	is the effective porosity (percent).

There is uncertainty in the input parameters. The hydraulic conductivity can be estimated by dividing the transmissivity by the thickness of the principal water bearing zones in the well below a depth of 430 feet. The thickness of the water-bearing zones is uncertain, but is less than the total thickness of basalt in the open well. The weakly fractured or unfractured basalt flow interiors do not contribute large quantities of water to the well. The hydraulic gradient can be estimated from the groundwater elevations, and the effective porosity for the basalt interflow zones is estimated to be between 15 and 25 percent.

Table 6 presents an estimate of 1-year groundwater travel distance for recharge water based on a range of the hydraulic properties estimated for the lower aquifer (430 to 560 feet). As shown on Table 6, the estimated 1-year travel distance is variable, depending on the estimated hydraulic conductivity, hydraulic gradient, and the effective porosity. The estimated travel distance based on these parameters ranges from less than 500 feet to as much as 7,700 feet. If storage is shorter than one year, groundwater migration will be less. It is therefore possible for the recharge water to migrate a considerable distance from the well during storage. The rate of migration will affect the quality of the stored water, and will be evaluated as part of the pilot test.

5.4 Water Quality

This section describes the quality of the recharge water and the basalt aquifer. It also includes a discussion of the compatibility between the groundwater and surface water with regard to potential mineral precipitates that may form as the result of mixing of recharge water and the native groundwater. Supplemental information is included in Appendices D and E.

5.4.1 Recharge Water

The recharge water that will be used is surface water that is currently utilized by CRW as it's water source. The recharge water is a calcium-sodium bicarbonate water. It is characterized by low dissolved solids (22 to 56 mg/L) and a near-neutral pH. Organic compounds have not been detected in the surface water. None of the constituents in the recharge water exceed primary or secondary water quality standards. The surface water quality is generally consistent from year to year (Table 7).

Modeling results indicate that the surface water is supersaturated with iron oxides and hydroxides. These iron (hydr)oxides, however, have a very low solubility, and water in equilibrium with these compounds contains very low levels of iron (approximately 0.005 mg/L).

5.4.2 Groundwater

Groundwater quality in the basalt aquifer is variable. Several deep wells installed in the basalt aquifer in the vicinity of Well No. 1 such as the Middle School and High School wells have high levels of dissolved solids that exceed the secondary drinking water standard. Groundwater from the upper portion of the basalt aquifer is less mineralized, with a lower dissolved solids content. The groundwater pH is slightly alkaline.

Modeling results indicates that the groundwater is supersaturated with iron oxides and hydroxides. These iron (hydr)oxides, however, have a very low solubility, and water in equilibrium with these compounds contains very low levels of iron (approximately 0.005 mg/L). Groundwater is also supersaturated with respect to several silica minerals, including quartz. In general, natural waters are oversaturated with respect to quartz because the rate of attainment of equilibrium between quartz and silicic acid (i.e. dissolved silica) is extremely slow. This generally implies that the solubility of amorphous silica represents the upper limit of dissolved aqueous silica. Groundwater in the basalt aquifer is slightly undersaturated with respect to amorphous silica. As a result, clogging of the aquifer through precipitation of silica is unlikely. Other minerals commonly found to clog aquifers or form encrustations in wells such as manganese (hydr)oxides, carbonates, and gypsum are below saturation levels and should not precipitate. Saturation indices indicate that calcite is near equilibrium within the aquifer.

5.4.3 Chemical Processes During Recharge

Recharge water injected into the basalt aquifer during ASR operations will displace the existing groundwater in the permeable interflow zones replacing it with the recharge water. Under this scenario, a zone of good quality recharge water will develop around the recharge well that can be drawn on to meet peaking or emergency demands. Groundwater quality changes during recharge and storage may occur as a result of the following:

- Advection and dispersion;
- Diffusion;
- Interaction with the aquifer mass; and
- Leakage.

These processes may modify the quality of the recharge water during the storage period. Experience has shown that based on the actual hydrogeological conditions in the storage zone that these issues can be managed during ASR operations to maximize recharge water recovery. Pilot testing will evaluate the potential water storage and recovery implications of these processes. Each process is described below.

5.4.3.1 Advection and Dispersion

Advective transport is the migration of dissolved constituents within groundwater under the prevailing hydraulic conditions. Recharge water entering the aquifer will flow at a variable velocity due to differences in flow length, pore size, and friction in the pore space. These differences cause mixing along the flow paths from the differing velocities, or dispersion. Mixing occurs both parallel and transverse to the flowpath taken by groundwater.

Changes in water quality due to advection and dispersion will likely occur on the edges of the mass of recharge water as it displaces the natural groundwater in the interflow zones. This process will likely be important during recharge, when a steep gradient exists near the recharge well due to mounding of recharge water. Advection and dispersion will be less important during storage when the recharge water moves under the natural groundwater gradient. Advection and dispersion will result in a mixing zone between the recharge water and the native groundwater at the perimeter of the zone of stored water. The size of the mixing zone will be dependent on the aquifer properties and hydraulic gradients.

The potential for the stored water to migrate under the natural hydraulic gradient was briefly discussed in Section 5.3. High groundwater velocities may transport the stored water away from the recharge well, thus potentially reducing the quality of stored water.

5.4.3.2 Diffusion

Diffusion occurs when solutes in water move from an area of high concentration to an area of low concentration. Diffusion will occur as long as a concentration gradient exists, and the mass of solute flux is proportional to the concentration gradient. In a groundwater system, diffusion is also controlled by the tortuosity of flowpaths in the pore space of the aquifer.

A concentration gradient will exist in the aquifer between the injected water and the native groundwater. The recharge water is low in dissolved solids, while the native groundwater is significantly higher in dissolved solids. Diffusion will occur between the injected water in the interflow zones and the native groundwater along the edges of the recharge water, and between the recharge water in the interflow zones and native groundwater occurring in the dense basalt zones between interflow zones during storage. Diffusion may result in a deterioration of the recharge water during the storage period.

5.4.3.3 Groundwater-Aquifer Mass Interactions

The injected water has the potential to interact with the aquifer rock mass, resulting in dissolution of minerals in the rock mass and consequent changes in water quality. The rate of dissolution will be dependent on the pH and chemistry of the recharge water, the mineralogy and alteration of the aquifer rock mass, and the residence time of the water in the aquifer.

Chemical interaction between the recharged water and the basalt aquifer mass is expected to be minor due to the short residence time of the recharged water in the aquifer, the relatively insoluble silicate minerals of the basalt aquifer matrix, and the near-neutral pH of recharge water. Experience at Salem, Oregon has shown little interaction between the rock matrix and recharge water, and little potential for clogging of the area around the well from reactions with the recharge water.

5.4.3.4 Leakage

During recharge there is likely to be an increased water level in the storage zone compared to the underlying and overlying aquifers. Depending on the permeability of the overlying sedimentary materials, vertical leakage from the storage zone may occur. In addition, during recovery when the well(s) are pumped, hydraulic gradients may be reversed. This could induce leakage either from underlying rocks such as the Skamania Volcanics or from overlying basalts and sediments into the storage water. Depending on the quality of water in the overlying and underlying aquifers, changes in water quality may occur.

5.4.4 Evaluation of Mixing between Recharge Water and Groundwater

The effects of mixing the recharge water and native groundwater were investigated to determine the potential for the formation of mineral precipitates which have the potential to clog the aquifer and/or the recharge wells. For the mixing analyses, groundwater to surface water ratios of 3:1, 1:1, and 1:3 were modeled. A detailed discussion of the mixing analysis is included in Appendix E.

The results of the modeling indicate that as increasing portions of recharge water are mixed with the native groundwater, the pH will decrease slightly, while the redox potential will decrease slightly. This will result in supersaturation of ferrihydrite, an iron (hydr)oxide. However, due to the low iron concentrations, precipitation would be minimal.

5.4 Potential Contaminant Sources

Potential sources of groundwater contamination near an ASR facility are important, as ASR operations can change groundwater flow directions and vertical gradients as water is injected or recovered from an aquifer. These changes could potentially result in the introduction of contaminants into the stored groundwater.

A potential source of contamination near Well No. 1 is the Rossman landfill. The Rossman landfill is located approximately 3,000 to 4,000 feet northeast of Well No. 1. The Rossman landfill has been associated with increased levels of iron, manganese, benzene, vinyl chloride, and trichloroethelyene in shallow groundwater at the landfill site. Remedial measures were taken at the landfill to limit infiltration and collect and treat leachate. Groundwater and surface water in the vicinity of the landfill are monitored semiannually. A deep monitoring well in the basalt (Rossman MW-1) installed near the landfill does not show evidence of impacts within the basalt from the landfill.

Trichloroethylene (TCE) has been detected twice in Well No. 1 (1988 and 1991) and tetrachloroethylene (PCE) was detected in one sample collected in August 1999. These compounds were detected at low levels, below the drinking water standards. The source of these compounds is unknown. These compounds were not detected in the deep monitoring well MW-1 at the Rossman landfill. The ASR storage zone is in the lower part of the basalt, and is therefore not expected to affect groundwater flow beneath the landfill.

Other sources of potential contaminants may exist in the vicinity of Well No. 1. A contaminant source inventory should be conducted following completion and analysis of a pilot test.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

- A review of the geologic and hydrogeologic conditions in the vicinity of Well No. 1 indicates that the basalt aquifer conditions are favorable for the development of ASR. The lower part of basalt aquifer is very permeable, confined, and is partially bounded with a low permeability boundary.
- Water quality data from wells in the basalt aquifer indicates that the water is a hard, sodium chloride type water, of variable quality. Water from several deep wells contains elevated dissolved solids and high sodium and chloride concentrations.
- Downhole geophysical logging using fluid and spinner logs indicates that Well No. 1 is completed in several interflow zones in the basalt aquifer. Water entering the well below approximately 420 feet has a higher TDS content and higher fluid conductivity than water that enters the upper portion of the well.
- Packer testing of Well No. 1 indicated that the lower portion of the well, below 430 feet, is significantly more permeable than the upper portion of the well. The aquifer response in the upper portion of the well indicates that leakage from the overlying Troutdale Formation and Sandy River Mudstone is occurring. Groundwater from the lower portion of the well is more mineralized than groundwater in the upper portion of the well.
- Well No. 1 is completed in a highly permeable portion of the basalt aquifer, indicating that the aquifer is capable of accepting recharge water readily without excessive water level buildup. Recharging 130 Mgal over 90 days would result in a water level rise of about 50 feet in the recharge well
- Migration of the injected water during storage under the natural hydraulic will occur. A preliminary estimate indicates that the injected water could migrate between 500 and 8,000 feet after 1-year. There is uncertainty in the estimates as a result of the uncertainty in aquifer hydraulic parameters, hydraulic gradient, and effective porosity. Pilot testing will help address this issue.
- Water quality changes during recharge and storage can occur from advection and dispersion (mixing), diffusion due to concentration gradients between the recharged water and native groundwater, and reactions between the aquifer rock mass and the injected water. These reactions combined with effects due to lateral groundwater flow will govern the amount of high-quality recharge water that can be recovered. Experience at other ASR sites suggests that under most conditions, management and conditioning of the storage zone can result in recovery of a large percentage of the recharge water.
- An evaluation of the water quality of the surface water and native groundwater indicates that they are both supersaturated with respect to iron (hydr)oxides. Due to the low iron concentrations in the surface water and groundwater, and the low solubilities of these compounds, precipitation of iron compounds is not

anticipated to be a concern. Mixing of these waters will cause a sight increase in redox potential and a slight decrease in the pH of the groundwater.

6.2 Recommendations

It is recommended that CRW proceed with an ASR pilot test at Well No. 1. The pilot test should target the recharge, storage, and recovery of 50 MGal or more into the lower portion of the well. Recharge of 1,200 gpm over 30-days will result in 52 MGal of water recharged into the aquifer. The components of the pilot test should include the following:

1. Well Modification

Modify Well No. 1 to comply with OAR 690-210-0150 as follows:

- Conduct a plumbness and alignment test to determine the well conditions and whether the new casing string can be placed;
- Backfill the well to a depth of 425 feet with disinfected, washed gravel;
- Backfill the well to a depth of 420 feet with bentonite pellets;
- Telescope 12-inch diameter casing inside the 16-inch casing between 250 and 420 feet;
- Pressure grout the annular space with neat cement grout;
- Clean out the gravel and bentonite with a bailer and/or air lift pumping;
- Develop the well until the water is clear; and
- Run a 4-hour step pumping test to size the permanent pump.

2. ASR Testing

- Conduct a 4 to 8-hour step recharge test to assess well performance under recharge conditions;
- Recharge and withdrawal of recharge water over several variable periods to assess aquifer response to recharge, including aquifer boundaries, water level buildup, leakage, and short-term changes in water quality;
- Recharge over a longer term period followed by a storage period of several months to assess long term water quality changes as a result of advection, dispersion, and diffusion, residual buildup, and leakage; and
- Recover the stored water while monitoring water quality. A 4 to 8-hour step pumping test should be conducted prior to the start of recovery to evaluate any changes in well performance as a result of recharge.

3. Water Quality Sampling

Water quality sampling should be conducted throughout the pilot test, particularly during recovery, to determine any changes in stored water quality. As part of the pilot test, a monitoring well network should be established to monitor water levels in the basalt aquifer.

Following evaluation of the pilot test results, and decision to proceed with full-scale implementation, a contaminant source inventory should be completed for a 1.5 mile radius around Well No. 1 to determine potential contaminant sources near the well, and for future wellhead protection work.

TABLES

TABLE 1

BASALT WELL INFORMATION

Map Number	WRD Well ID	Township-North	Range-East	Section	1/4 Sec.	1/4 Sec.	Well Owner	Ground Elevation (feet amsl)	Depth to Water (feet)	Date of Measurement	Groundwater Elevation (feet amsl)	Depth to Basalt (feet bgs)	Elevation to top of Basalt (feet msl)	Top of Open Hole (feet bgs)	Top of Open Hole Elevation (feet msl)	Bottom of Well (feet bgs)	Bottom of Well Elevation (feet msl)	Aquifer Test Type	Pumping Rate (gpm)	Drawdown (feet)	Test Duration (hours)	Modified Specific Capacity (gpm/ft)[1]	Estimated Transmissivity (ft2/d)
1	4385	2S	2E	28	nw	ne	Ferriaer	350	400	4/16/76	-50	372	-22	203	147	520	-170	na					
2	4391	2S	2E	28	nw	nw	Okita	300	307	4/16/76	-7	203	97	203	97	522	-222	bailer	10	45	1	0.32	85
3	4392	2S	2E	28	ne	nw	Clackamas Housing Authority	330	305	1/9/63	25	218	112	222	108	560	-230		300	34	8	12.6	3370
4	4382	2S	2E	28	sw	sw	Harrington	50	70	4/24/81	-20	130	-80	130	-80	154	-104	air test	20	80	1	0.36	95
5	4398	2S	2E	29	sw	ne	Willamette Falls Sand and Gravel	30	21	6/18/70	9	139	-109	139	-109	340	-310	Pump	500	79	4	9.0	2417
6	4410	2S	2E	29	sw	nw	Oregon Ready Mix	30	13 13	2/26/1966 8/31/99	17	176	-146	175	-145	248	-218	Pump	50	35	4	2.0	546
7	4396	2S	2E	29	se	se	Clairemont Water District	85	69	8/17/73	16	299	-214	301	-216	560	-475	Pump	3150	160	24	28.1	7519
8	4419	2S	2E	31	se	nw	Publisher's Paper Co.	120	49	not available	71	14	106	17	103	250	-130	Pump	230	41	na	8.0	2142
9	4425	2S	2E	32	nw	nw	Oregon City Public Schools	245	450	1/10/56	-205	429	-184	453	-208	550	-305	Pump	80	42	6	2.7	727
10	4211	2S	2E	19	sw	ne	Skyles	90	82	12/2/71	8	113	-23	120	-30	203	-113	Pump	65	118		0.79	210
11	4427	2S	2E	32	nw	nw	Oregon City Public Schools	245	236	3/23/67	9	460	-215	463	-218	602	-357	Pump	350	11	8	45.5	12164
12	4430	2S	2E	33	nw	nw	Garvison	150	60	8/14/56	90	162	-12	164	-14	180	-30	Pump	100	56	8	2.6	682
13	4431	2S	2E	33	sw	ne	Oregon City Public Schools	190	165	3/4/65	25	469	-279	472	-282	578	-388	Pump	295	131	8	3.2	860
14	4222	2S	2E	19	ne	nw	Pay 'n Pack Store	100	95	6/24/76	5	70	30	118	-18	180	-80	air test	20	80	1	0.36	95
15	4384	2S	2E	28	sw	ne	Smith	360	390	5/6/77	-30	317.0	43	317	43	455	-95	na					
16	20301	2S	2E	28	sw	ne	Hayes	360	260	5/24/95	100	448.0	-88	500	-140	500	-140	na					
17	20693	2S	2E	29	ne	sw	Rossman Landfill	30	21	9/10/84	10	176.0	-146	204	-174	204	-174	na					
18	7121	2S	2E	28	sw	nw	Park Place Water District[2]	200	184	10/10/67	16	115.0	85	158	42	404	-204	Pump	300	10	6	43	11458
19	4437	2S	2E	33	se	se	Domreis	210	30	9/14/66	180	31.0	179	40	171	90	120	bailer	40	20	1	2.9	764
20	20497	2S	2E	20	se	se	Oregon Conference of SDA	30	116	5/8/95	-86	7.0	23	203	-173	242	-212	na					
21	4429	2S	2E	33	ne	nw	King	170	40	6/6/66	130	99	71	99	71	120	50	Pump	55	70	1	1.1	300

Note:

1. The specific capacity was corrected assuming a 70 percent well efficiency.
2. Well abandoned in March 1999.

TABLE 2 (page 1 of 4)

Water Quality Summary-Basalt Wells

Parameter	Units	Drinking Water Standards Detection Limits	MCL Primary	MCL Secondary	Proposed	Odgen Middle 08/26/99	Senior High School 08/26/99	Lonestar 08/26/99	16200 Oak Terrace 08/31/99	Well 1 990901030 08/31/99	Well 1 990902018 09/01/99
Conventional Parameters											
Conductivity	umhos/cm	0.5				1570	1700	640	560	770	860
Conductivity (Field Data)	*mV/cm*										
pH						7.8	7.8	8.3	8.1	8	8
pH (Field Data)											
Temperature (Field Data)	*oC*										
Total Dissolved Solids	mg/L	1				930	1000	380	350	470	510
Turbidity	NTU	0.05	0.5 , 1.0							1.1	0.1
Turbidity (Field Data)	*NTU*										
Dissolved Oxygen (Field Data)	*mg/L*										
Oxygen Reduction Potential (Field Data)	*mV*										
Chloride	mg/L	0.1				464	506	134	86.9	167	182
Nitrate	mgN/L	0.01				ND	ND	ND	ND	ND	ND
Nitrite	mgN/L	0.01								ND	ND
Total nitrate and nitrite	mgN/L	0.02								ND	ND
Sulfate	mg/L	0.1		250	400-500	ND	ND	ND	ND	nd	ND
Fluoride (free)	mg/L	0.2								0.67	0.7
MBAS (Surfactants)	mg/L	0.01								ND	ND
Total Alkalinity	mg/L	0.5				129	123	135	150	137	136
Carbonate Alkalinity	mg/L	0.5				0.644	0.615	2.13	1.49	1.09	1.07
Hydroxide Alkalinity	mg/L	0.5				0.011	0.011	0.034	0.021	0.017	0.017
Bicarbonate Alkalinity	mg/L	0.5				157	150	164	182	167	165
Carbon Dioxide (Free)	mg/L	2				4.98	4.75	1.64	2.89	3.34	3.3
Total Phosphorus (as P)	mg/L	0.05								ND	0.02
Iodide	mg/L	0.1									
Color	ACU									3	5
Corrosivity	-										
Odor	TON									1	1
Microbiological											
Standard Plate Count	cfu/mL	-								100	2
Total Coliform	#/100 mL	-	5							>23	<1.1
E. Coli	#/100 mL	-	5							<1.1	<1.1
Metals											
Aluminum	mg/L									ND	ND
Antimony	mg/L	0.0005									ND
Arsenic	MF/L	0.005/0.00057	0.05							ND	ND
Asbestos	mg/L	0.2									
Barium	mg/L	0.0002	2							41	45
Beryllium	mg/L	0.0005								ND	ND
Cadmium	mg/L	0.001/0.00057	0.005							ND	ND
Calcium	mg/L	0.05				108	130	94.5	ND	39.3	40.9
Chromium	mg/L	0.001	0.1							7.8	11
Copper	mg/L	0.02	TT	1						ND	ND
Cyanide	mg/L	0.004								ND	ND
Iron	mg/L	0.05		0.3		0.65	0.71	83	ND	0.11	0.13
Lead	mg/L	0.001/0.00057	TT							0.645	ND
Magnesium	mg/L	0.05				10	11.5	35.6	ND	7.2	7.1
Manganese	mg/L	0.005		0.05		91	92	1600	ND	36	36
Mercury	mg/L	0.0005	0.002							ND	ND
Nickel	mg/L	0.01								ND	ND
Potassium	mg/L	1				18.3	18.6	18.4	2.6	12	12.3
Selenium	mg/L	0.005/0.0017	0.05							ND	ND
Silica (SiO2)	mg/L	0.2				54	54	69	50	49	46
Silver	mg/L	0.001/0.00057		0.1						ND	ND
Sodium	mg/L	0.55/0.17				187	185	79	118	101	108
Thallium	mg/L	0.0002								ND	ND
Total Hardness	mg/L-CaCO3	-				311	372	382	ND	128	131
Zinc	mg/L	0.025/0.027		5						0.03	ND
Radionuclides											
Gross Alpha	pCi/L	1									ND

ND Is non-detect

Water Quality Summary-Basalt Wells

Parameter	Units	Drinking Water Standards Detection Limits	MCL Primary	MCL Secondary	Proposed	Odgen Middle 08/26/99	Senior High School 08/26/99	Lonestar 08/26/99	16200 Oak Terrace 08/31/99	Well 1 990901030 08/31/99	Well 1 990902018 09/01/99
Gross Beta	mRem/yr	1									
Radium 226	pCi/L	1									
Radium 228	pCi/L	1									
Radon (Rn-222)	pCi/L	1			300					260	ND
Iodine-131	pCi/L										
Strontium-90	pCi/L									<3.3	
Tritium	pCi/L									<291	
Uranium	ug/L	0.001									
Disinfection By-Products											
Total Haloacetic Acids	ug/L	1								ND	ND
Total Trihalomethanes	ug/L	0.0005	80								
Organics											
Benzene	ug/L	0.5	5			ND	ND	ND	ND	ND	ND
Carbon tetrachloride	ug/L	0.5	5			ND	ND	ND	ND	ND	ND
Chlorobenzene	ug/L	0.5				ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ug/L	0.5				ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	ug/L	0.5	600		10**	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	ug/L	0.5	75		5**	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	ug/L	0.5	5			ND	ND	ND	ND	ND	ND
cis-1,2-Dichloroethene	ug/L	0.5				ND	ND	ND	ND	ND	ND
trans-1,2-Dichloroethene	ug/L	0.5				ND	ND	ND	ND	ND	ND
Dichloromethane	ug/L	0.5	5			ND	ND	ND	ND	ND	ND
1,2-Dichloropropane	ug/L	0.5	5			ND	ND	ND	ND	ND	ND
Ethylbenzene	ug/L	0.5	700			ND	ND	ND	ND	ND	ND
Styrene	ug/L	0.5				ND	ND	ND	ND	ND	ND
Tetrachloroethene (PCE)	ug/L	0.5				ND	ND	ND	ND	0.6	ND
Toluene	ug/L	0.5	1000			ND	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	ug/L	0.5	70			ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	ug/L	0.5	200			ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	ug/L	0.5	5			ND	ND	ND	ND	ND	ND
Trichloroethene (TCE)	ug/L	0.5				ND	ND	ND	ND	ND	ND
Vinyl chloride	ug/L	0.5	2			ND	ND	ND	ND	ND	ND
Xylene (Total)	ug/L	0.5	10,000+		20,000**, +	ND	ND	ND	ND	ND	ND
Bromobenzene	ug/L	0.5				ND	ND	ND	ND	ND	ND
Bromodichloromethane	ug/L	0.5	100		80						
Bromoform	ug/L	0.5	100		80	ND	ND	ND	ND	ND	ND
Bromomethane	ug/L	0.5				ND	ND	ND	ND	ND	ND
2-Butanone (MEK)	ug/L	5				ND	ND	ND	ND	ND	ND
Chloroethane	ug/L	0.5				ND	ND	ND	ND	ND	ND
Chloroform	ug/L	0.5				ND	ND	ND	ND	ND	ND
Chloromethane	ug/L	0.5				ND	ND	ND	ND	ND	ND
2-Chlorotoluene	ug/L	0.5				ND	ND	ND	ND	ND	ND
4-Chlorotoluene	ug/L	0.5				ND	ND	ND	ND	ND	ND
Dibromochloromethane	ug/L	0.5				ND	ND	ND	ND	ND	ND
Dibromomethane	ug/L	0.5	100		80	ND	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	ug/L	0.5				ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	ug/L	0.5									
1,3-Dichloropropane	ug/L	0.5				ND	ND	ND	ND	ND	ND
2,2-Dichloropropane	ug/L	0.5				ND	ND	ND	ND	ND	ND
1,1-Dichloropropene	ug/L	0.5				ND	ND	ND	ND	ND	ND
1,3-Dichloropropene	ug/L	0.5				ND	ND	ND	ND	ND	ND
Di-isopropyl Ether						ND	ND	ND	ND	ND	ND
4-Methyl-2-Pentanone (MIBK)	ug/L	5				ND	ND	ND	ND	ND	ND
1,1,1,2-Tetrachloroethane	ug/L	0.5				ND	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	ug/L	0.5				ND	ND	ND	ND	ND	ND
1,2,3-Trichloropropane	ug/L	0.02	0.2			ND	ND	ND	ND	ND	ND
Trichlorotrifluoroethane (Freon)	ug/L	0.5				ND	ND	ND	ND	ND	ND
EDB (Ethylene dibromide)	ug/L	1								ND	ND
DBCP	ug/L	0.1								ND	ND
Hexachlorocyclopentadiene	ug/L	0.1				ND	ND	ND	ND	ND	ND
alpha-Chlorodane	ug/l	0.05								ND	ND
Acenaphthylene	ug/l	0.1								ND	ND

ND is non-detect

TABLE 2 (page 3 of 4)

Water Quality Summary-Basalt Wells

		Drinking Water Standards				Odgen Middle	Senior High School	Lonestar	16200 Oak Terrace	Well 1 990901030	Well 1 990902018
		Detection	MCL								
Parameter	Units	Limits	Primary	Secondary	Proposed	08/26/99	08/26/99	08/26/99	08/31/99	08/31/99	09/01/99
Acifluorfen	ug/L	0.2								ND	ND
Anthracene	ug/l	0..02								ND	ND
Aroclor 1016	ug/L	0.07								ND	ND
Aroclor 1221	ug/L	0.1								ND	ND
Aroclor 1232	ug/L	0.1								ND	ND
Aroclor 1242	ug/L	0.1								ND	ND
Aroclor 1248	ug/L	0.1								ND	ND
Aroclor 1254	ug/L	0.01								ND	ND
Aroclor 1260	ug/L	0.1	0.5							ND	ND
Bentazon	ug/L	0.5								ND	ND
Alpha-BHC	ug/L	0.07								ND	ND
Beta-BHC	ug/L	0.01								ND	ND
Delta-BHC	ug/L	0.01								ND	ND
Polychlorinated Biphenyls	ug/L	0.4									
2,4-D	ug/L	0.75								ND	ND
2,4-DB	ug/L	2								ND	ND
2,4-Dinitrotoluene	ug/l	0.1								ND	ND
Dalapon	ug/L	7								ND	ND
Dicamba	ug/L	0.05								ND	ND
Dichlorprop	ug/L	0.5								ND	ND
3,5-Dichlorobenzoic Acid	ug/L	0.5								ND	ND
DCPA	ug/L	0.1								ND	ND
Dinoseb	ug/L	0.3								ND	ND
Pentachlorophenol	ug/L	0.2								ND	ND
Picloram	ug/L	0.1	2							ND	ND
2,4,5-T	ug/L	0.2								ND	ND
2,4,5-TP (Silvex)	ug/L	0.1								ND	ND
Alachlor	ug/L	0.1								ND	ND
Aldrin	ug/L	0.1								ND	ND
Atrazine	ug/L	0.5	2							ND	ND
Benzo(a)pyrene	ug/L	0.4								ND	ND
Benz(a)Anthracene	ug/L	0.05								ND	ND
Benzo(b)Fluorethane	ug/L	0.02								ND	ND
Benzo(g,h,I)Perylene	ug/L	0.05								ND	ND
Benzo(k)Fluoranthene	ug/L	0.02								ND	ND
Butylbenzylphthalate	ug/L	0.5								ND	ND
Bromacil	ug/L	0.2								ND	ND
Butachlor	ug/L	0.9								ND	ND
Caffeine	ug/L	0.02								ND	ND
Chrysene	ug/L	0.02								ND	ND
Chlordane	ug/L	0.2								ND	ND
Chlorthalonil	ug/L	0.01								ND	ND
Dibenz(a,h)Anthracene	ug/L	0.05								ND	ND
Di(2-ethylhexyl)adipate	ug/L	0.02	2							ND	ND
Di(2-ethylhexyl)phthalate	ug/L	0.04	0.4							ND	ND
Diethylphthalate	ug/L	0.5								ND	ND
Dieldrin	ug/L	0.02	0.2							ND	ND
Dimethylphthalate	ug/L	0.5								ND	ND
Dimethoate	ug/L	10								ND	ND
Di-n-Butylphthalate	ug/L	0.5								ND	ND
Endosulfan I	ug/L	0.01								ND	ND
Endosulfan II	ug/l	0.01								ND	ND
Endosulfan Sulfate	ug/L	0.01								ND	ND
Endrin	ug/L	0.1	1							ND	ND
Endrin Aldehyde	ug/l	0.01								ND	ND
Fluorene	ug/L	0.05								ND	ND
Heptachlor	ug/L	0.02	0.2							ND	ND
Heptachlor epoxide	ug/L	4	40							ND	ND
Hexachlorobenzene	ug/L	0.1								ND	ND
Indeno(1,2,3,c,d)Pyrene	ug/L	0.05								ND	ND
Isophorone	ug/L	0.5								ND	ND
Lindane (gamma-BHC)	ug/L	1	3							ND	ND

ND is non-detect

TABLE 2 (page 4 of 4)

Water Quality Summary-Basalt Wells

		Drinking Water Standards				Odgen Middle	Senior High School	Lonestar	16200 Oak Terrace	Well 1 990901030	Well 1 990902018
		Detection	MCL								
Parameter	Units	Limits	Primary	Secondary	Proposed	08/26/99	08/26/99	08/26/99	08/31/99	08/31/99	09/01/99
Methoxychlor	ug/L	1								ND	ND
Metolachlor	ug/L	2								ND	ND
Molinate	ug/L	0.2								ND	ND
Metribuzin	ug/L	2								ND	ND
4-Nitrophenol	ug/L	5								ND	ND
trans-Nonachlor	ug/L	0.05								ND	ND
p,p' DDD	ug/L	0.01								ND	ND
p,p' DDE	ug/L	0.01								ND	ND
p,p' DDT	ug/L	0.01								ND	ND
Phenanthrene	ug/L	0.02								ND	ND
Prometryn	ug/L	0.5								ND	ND
Propachlor	ug/L	0.5								ND	ND
Pyrene	ug/L	0.05								ND	ND
Simazine	ug/L	1.5								ND	ND
Thiobencarb	ug/L	0.2								ND	ND
Toxaphene	ug/L	2								ND	ND
Trifluralin	ug/L	0.1								ND	ND
Aldicarb	ug/L	10								ND	ND
Aldicarb sulfone	ug/L	20								ND	ND
Aldicarb sulfoxide	ug/L	10								ND	ND
Baygon	ug/l	2								ND	ND
Carbaryl	ug/L	1.9								ND	ND
Carbofuran	ug/L	1.9								ND	ND
3-Hydroxycarbofuran	ug/L	0.5								ND	ND
Methoicarb	ug/l	2								ND	ND
Methomyl	ug/L	0.5								ND	ND
Oxamyl (Vydate)	ug/L	0.5								ND	ND
Glyphosate	ug/L	0.5								ND	ND
Endothall	ug/L	0.5								ND	ND
Diquat	ug/L	0.5								ND	ND
Paraquat	ug/l	2								ND	ND
2,3,7,8-TCDD	ug/L	0.5								ND	ND
Total TCDD	ug/L	0.5									
1,2,3-Trichlorobenzene	ug/L	0.5				ND	ND	ND	ND	ND	ND
1,2,4-Trimethylbenzene	ug/L	0.5				ND	ND	ND	ND	ND	ND
1,2-Dibromoethane	ug/L	0.5									
1,3,5-Trimethylbenzene	ug/L	0.5				ND	ND	ND	ND	ND	ND
4-Isopropyltoluene	ug/L	0.5				ND	ND	ND	ND	ND	ND
Bromochloromethane	ug/L	0.5				ND	ND	ND	ND	ND	ND
Dichlorodifluoromethane	ug/L	0.5				ND	ND	ND	ND	ND	ND
Hexachlorobutadiene	ug/L	0.5									
Isopropylbenzene	ug/L	0.5				ND	ND	ND	ND	ND	ND
n-Butylbenzene	ug/L	0.5				ND	ND	ND	ND	ND	ND
n-Propylbenzene	ug/L	0.5				ND	ND	ND	ND	ND	ND
Naphthalene	ug/L	0.5				ND	ND	ND	ND	ND	ND
sec-Butylbenzene	ug/L	0.5				ND	ND	ND	ND	ND	ND
tert-Butylbenzene	ug/L	0.5				ND	ND	ND	ND	ND	ND
trans-1,3-Dichloropropene	ug/L	0.5				ND	ND	ND	ND	ND	ND
Trichlorofluoromethane	ug/L	0.5				ND	ND	ND	ND	ND	ND

ND is non-detect

TABLE 3 (page 1 of 2)

WATER QUALITY DATA-ROSSMAN MW-1

Date	Depth to Water (feet)	Temperature (C)	Field Conductivity (umhos/cm)	Lab Conductivity (umhos/cm)	Field pH (su)	Lab pH (su)	Color	Alkalinity (mg/L-$CaCO_3$)	Ammonia (mg/L-N)	Nitrite (mg/L-N)	Total Kjeldahl Nitrigen (mg/L-N)	Nitrate+ Nitrite (mg/L-N)	Chloride (mg/L)	Sulfate (mg/L)	Dissolved Iron (mg/L)
9/22/81	23.7			460		10.3		88.4		0.094		0.1	110	9.4	<0.05
10/27/81						8.4		144.63					96.5		
1/27/82	19.92			575		8.8		147.9		0.005		0.069	103	<4	0.02
5/5/82	18.28			510		8.9		98.6		0.013		0.051	136	<4	0.05
8/17/82	20.2			525		8.7		136.4		0.7		0.095	96.2	<1	0.12
10/13/83	20	12	396	450	9	9.2	15	51	1.03			<0.02	100	4.9	0.52
2/2/84	20.2	12		468		9.1	10	52	1.1			0.46	130	5.3	<0.05
6/13/84	16.5	14	565	590	8.4	8.3	<5	130	0.57			0.01	104	0.9	0.06

Source: Oregon Department of Environmental Quality Rossman Landfill Files

WATER QUALITY DATA-ROSSMAN MW-1

Date	Total Iron (mg/L)	Dissolved Manganese (mg/L)	Total Manganese (mg/L)	Dissolved Calcium (mg/L)	Dissolved Magnesium (mg/L)	Calcuated Hardness (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Zinc (mg/L)	Boron (mg/L)	Total Dissolved Solids (mg/L)	Chemical Oxygen Demand (mg/L)	Total Organic Carbon (mg/L-C)
9/22/81				25.1	0.71		73.5	11.2	0.006	<0.2	288	365	
10/27/81							73.1					13	
1/27/82				30.8	6.86		85.2	7.8	0.011	0.3	378	10	
5/5/82				15.9	7.04		75.9	11.5	<0.005	<0.2	258	<1	
8/17/82				30	8.23		72.3	8.64	0.008	<0.2	366	8	
10/13/83				11	2.5	38						10	4
2/2/84	1.3	0.03	0.05	12	2.9	42						13	4
6/13/84	0.08	0.12	0.12	29	8.3	110						5	<1

Source: OrSource: Oregon Department of Environmental Quality Rossman Landfill Files

ESTIMATED GROUNDWATER VELOCITY AND 1-YEAR TRAVEL DISTANCE

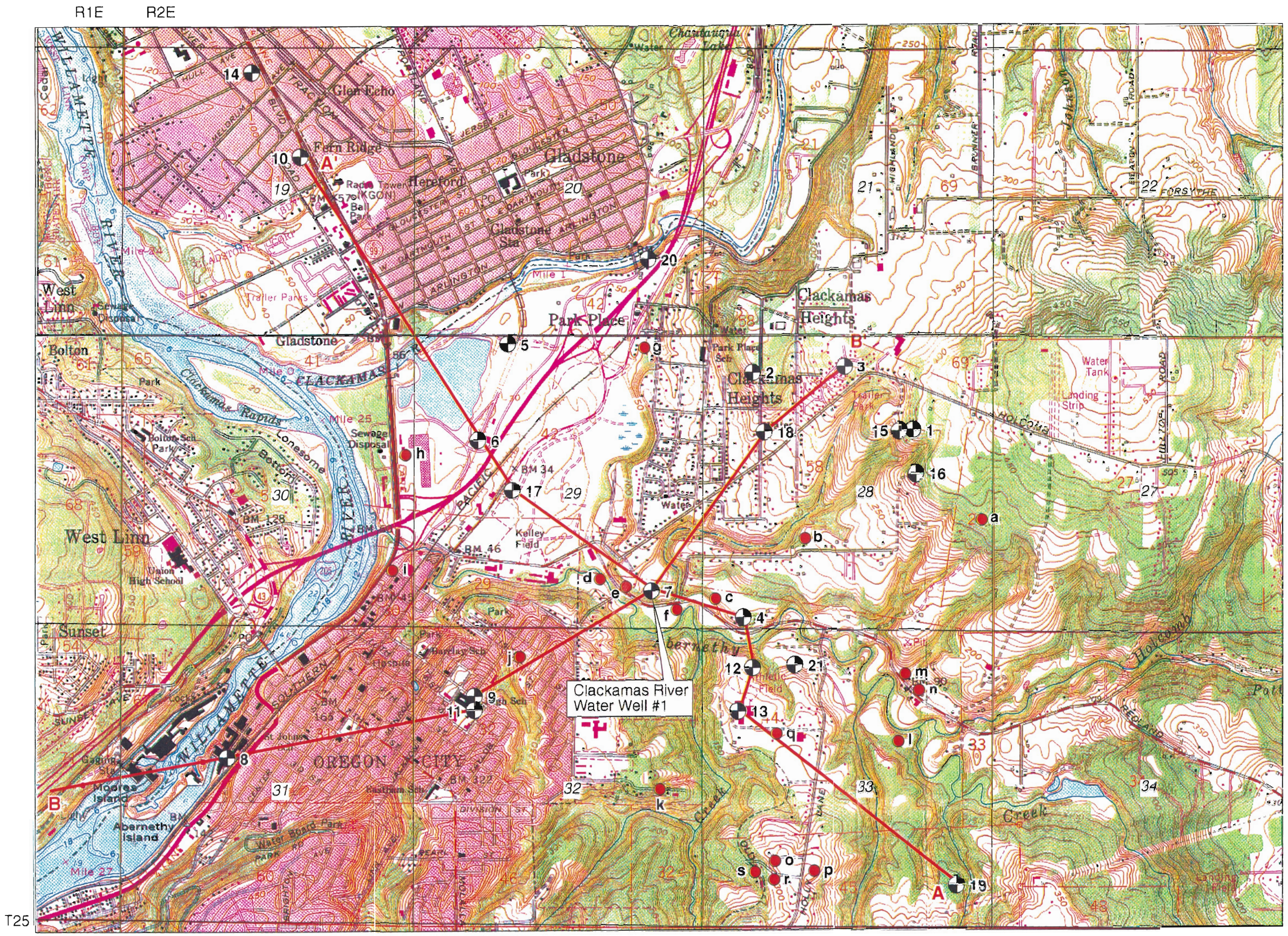
Hydraulic Conductivity[1] (ft/d)	Hydraulic Gradient (ft/ft)	Effective Porosity (percent)	Groundwater Velocity (ft/d)	1-Year Travel distance (feet)
110	0.002	0.15	1.5	535
110	0.002	0.25	0.9	321
110	0.008	0.15	5.9	2141
110	0.008	0.25	3.5	1285
220	0.002	0.15	2.9	1071
220	0.002	0.25	1.8	642
220	0.008	0.15	11.7	4283
220	0.008	0.25	7.0	2570
440	0.002	0.15	5.9	2141
440	0.002	0.25	3.5	1285
440	0.008	0.15	23.5	8565
440	0.008	0.25	14.1	5139

Note

1. The hydraulic conductivity as estimated by dividing the transmissivity of 22,000 ft^2/d by estimated interflow zone thicknesses of 50, 100, and 200 feet.

0229tab1.xls

FIGURES



Source: USGS Oregon City and Gladstone, OR
7.5 Minute Quads, dated 1961.

LEGEND

● 4	Basalt well located to nearest 1/4-1/4 section. Number corresponds to inventory number (see Table 1 and Appendix A)
● b	Wells completed in sedimentary deposits located to nearest 1/4-1/4 section (see Table 2 and Appendix A)
A A'	Geologic cross section
34	Section numbers

BASALT WELL INFORMATION

Map Number	Well Owner	Well Depth (feet)	Depth to Basalt (feet bgs)	Depth to Water (feet)	Groundwater Elevation (feet amsl)	Date of Measurement
1	Ferriaer	520	372	400	-50	4/16/1976
2	Okita	522	203	307	-7	4/16/1976
3	Clackamas Housing Authority	560	218	305	25	1/9/1963
4	Harrington	154	130	70	-20	4/24/1981
5	Willamette Falls Sand and Gravel	340	139	21 13	9	6/18/1970 2/26/1966
6	Oregon Ready Mix	248	176	13	17	8/31/99
7	Clairmont Water District	560	299	69	16	8/17/1973
8	Publisher's Paper Co.	250	14	49	71	not available
9	Oregon City Public Schools	550	429	450	-205	1/10/1956
10	Skyles	203	113	82	8	12/2/1971
11	Oregon City Public Schools	602	460	236	9	3/23/1967
12	Garvison	180	162	60	90	8/14/1956
13	Oregon City Public Schools	578	469	165	25	3/4/1965
14	Pay 'n Pack Store	180	70	95	5	6/24/1976
15	Smith	455	317.0	390	-30.0	5/6/1977
16	Hayes	500	448.0	260	100.0	5/24/1995
17	Rossman Landfill	204	176.0	21	9.5	9/10/1984
18	Park Place Water District [2]	404	115.0	184	16.0	10/10/1967
19	Domreis	90	31.0	30	180.0	9/14/1966
20	Oregon Conference of SDA	242	7.0	116	-86 0	5/8/1995
21	King	120	99	40	130	6/6/1966

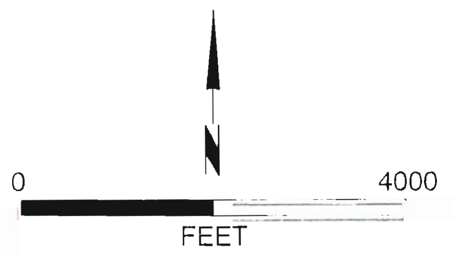


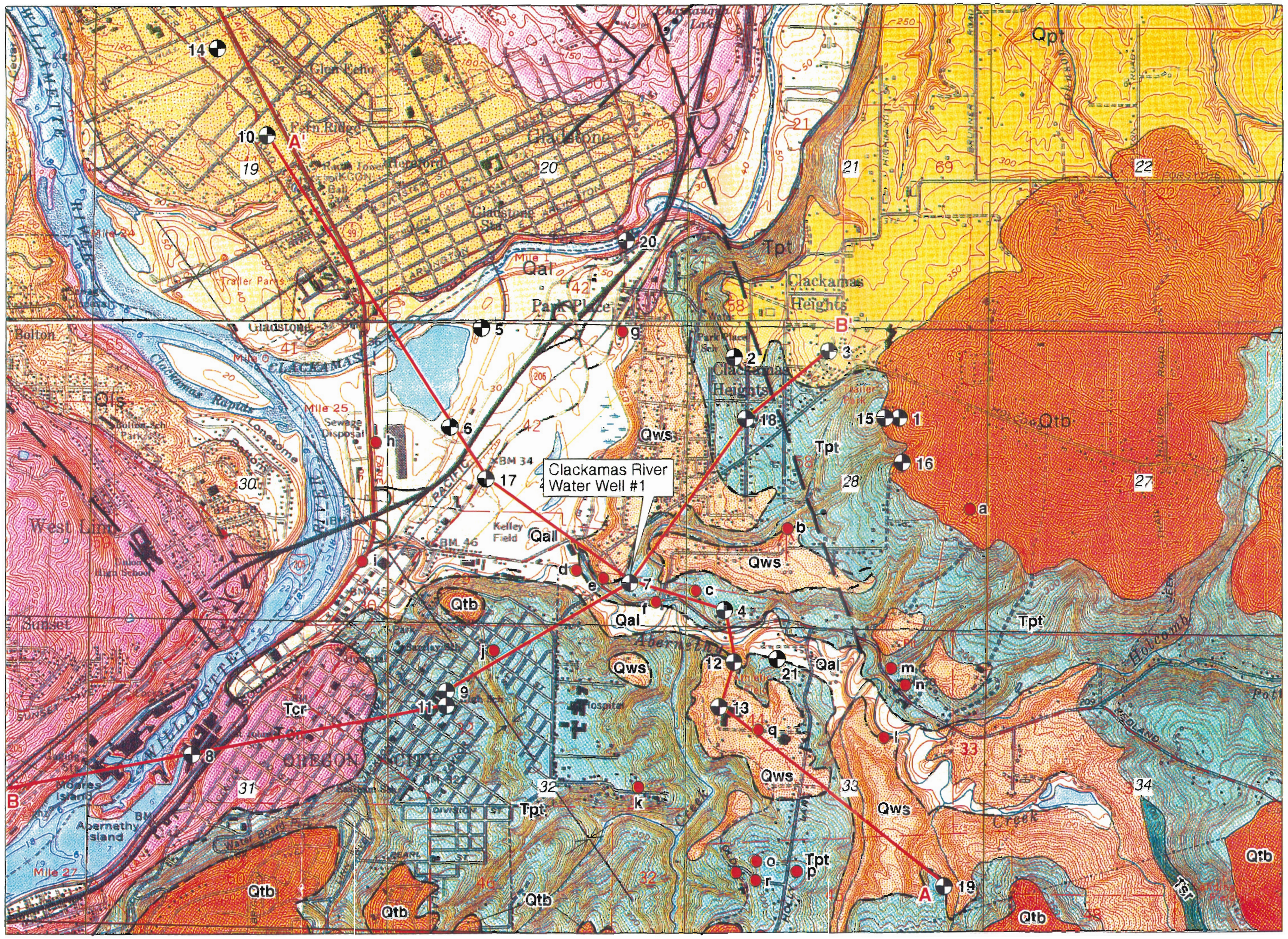
FIGURE 1

REGIONAL MAP AND BASALT WELL LOCATIONS

MONGOMERY WATSON/CLACKAMAS P. ASR/OR

PROJECT NO 993-1596.003 DRAWING NO 84960 DATE 2/10/2000 DRAWN BY EA

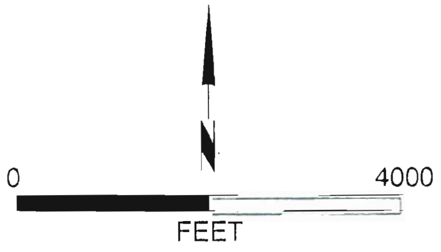
Golder Associates



Clackamas River Water Well #1

LEGEND

● 4	Basalt wells (See Table 1 and Appendix A)
● b	Wells completed in sedimentary deposits (See Table 2 and Appendix A)
A A'	Geologic Cross Section
Qal	Alluvium; unconsolidated sand, gravel and cobbles
Qws	Willamette Silt Formation; lacustrine fine sandy silt and clay
Qls	Lacustrine and fluvial unconsolidated sand in silt
Qpt	Pleistocene Terrace Deposits; unconsolidated cobbles, boulder gravel and silty mudflow deposits
Tpt	Troutdale Formation; Pliocene sandstone and conglomerate
Tsr	Sandy River Mudstone; Pliocene siltstone and fine sandstone
Qtb	Pliocene-Pleistocene lavas; light gray basalt (Boring Lava)
Tcr	Columbia River Basalt
— —	Inferred Fault
✳	Syncline Axis



Source: Oregon State Department of Geology and Mineral Industries Bulletin 99.

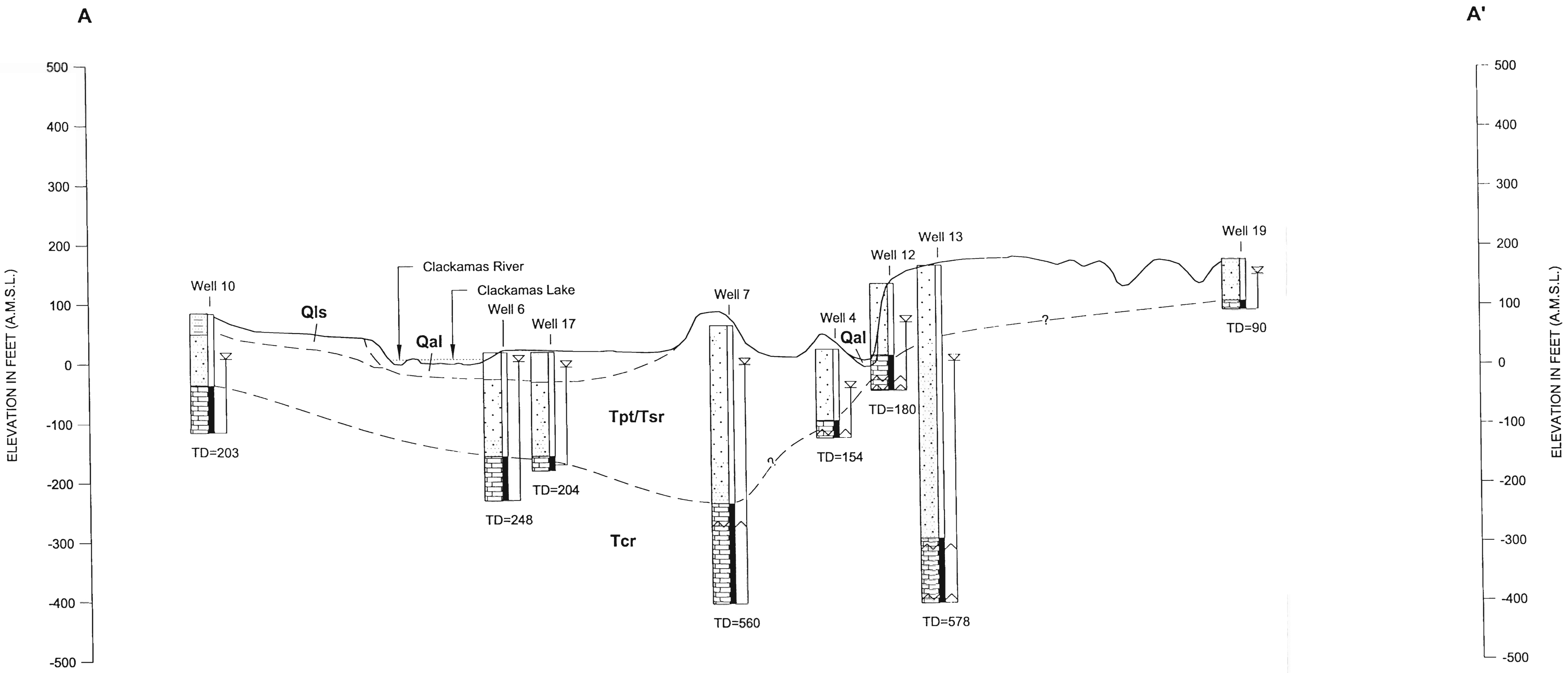
FIGURE 2

REGIONAL MAP WITH SURFICIAL GEOLOGY

MONTGOMERY WATSON/CLACKAMAS R. ASR/OR

PROJECT NO. 993 1586.003 DRAWING NO. 84981 DATE 2/10/2000 DRAWN BY IEA

Golder Associates



LEGEND

▢	Qal	ALLUVIUM: Unconsolidated sand, gravel and cobbles.
▢	Qpt	PLEISTOCENE TERRACE DEPOSITS: Unconsolidated cobbles, boulder gravel and silty mudflow deposits.
▤	Qls	Lacustrine and fluvial unconsolodated sand in silt.
▢	Tpt/Tsr	TROUTDALE FM: Pliocene sandstone and conglomerate, SANDY RIVER MUDSTONE: Pliocene siltstone and fine sandstone.
▦	Tcr	COLUMBIA RIVER BASALT
	Well 10	Well Inventory Number (see Table 1)
	^^^^	Fracture Zone in Basalt
	▽	Water Elevation
		Casing
		Open Well
	TD=203	Total Depth in Feet Below Ground Surface

NOTE:
Surface geologic information from Oregon Department of Geology and Mineral Ind. Bulletin 99. Water level information obtained from well logs.

0 2000 4000
FEET

VERTICAL EXAGGERATION = 10X

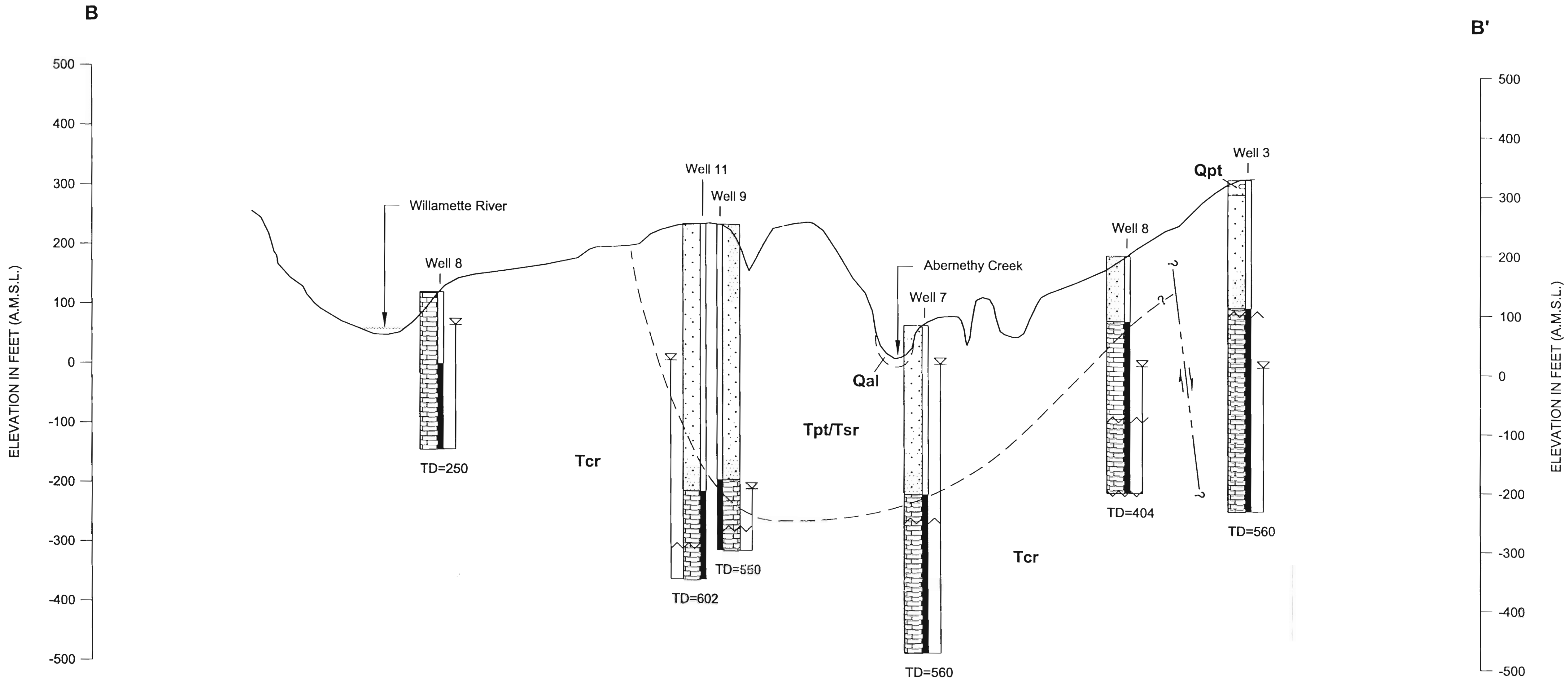
SPECIAL NOTE:
Data concerning the various strata have been obtained at exploration locations only. The interpretation between these locations has been inferred from geological evidence and so may vary from that shown.

FIGURE 3

GEOLOGIC CROSS SECTION A-A'

MW/CLACKAMAS RIVER WATER ASR/OR

Golder Associates



LEGEND

☐	Qal	ALLUVIUM: Unconsolidated sand, gravel and cobbles.
⊡	Qpt	PLEISTOCENE TERRACE DEPOSITS: Unconsolidated cobbles, boulder gravel and silty mudflow deposits.
▤	Qls	Lacustrine and fluvial unconsolodated sand in silt.
⛚	Tpt/Tsr	TROUTDALE FM: Pliocene sandstone and conglomerate, SANDY RIVER MUDSTONE: Pliocene siltstone and fine sandstone.
▦	Tcr	COLUMBIA RIVER BASALT
Well 10		Well Inventory Number (see Table 1)
∿∿∿		Fracture Zone in Basalt
▽		Water Elevation
		Casing
		Open Well
TD=203		Total Depth in Feet Below Ground Surface

SPECIAL NOTE:
Data concerning the various strata have been obtained at exploration locations only. The interpretation between these locations has been inferred from geological evidence and so may vary from that shown.

NOTE:
Surface geologic information from Oregon Department of Geology and Mineral Ind. Bulletin 99. Water level information obtained from well logs.

0 2000 4000
FEET

VERTICAL EXAGGERATION = 10X

FIGURE 4

GEOLOGIC CROSS SECTION B-B'

MW/CLACKAMAS RIVER WATER ASR/OR

Golder Associates

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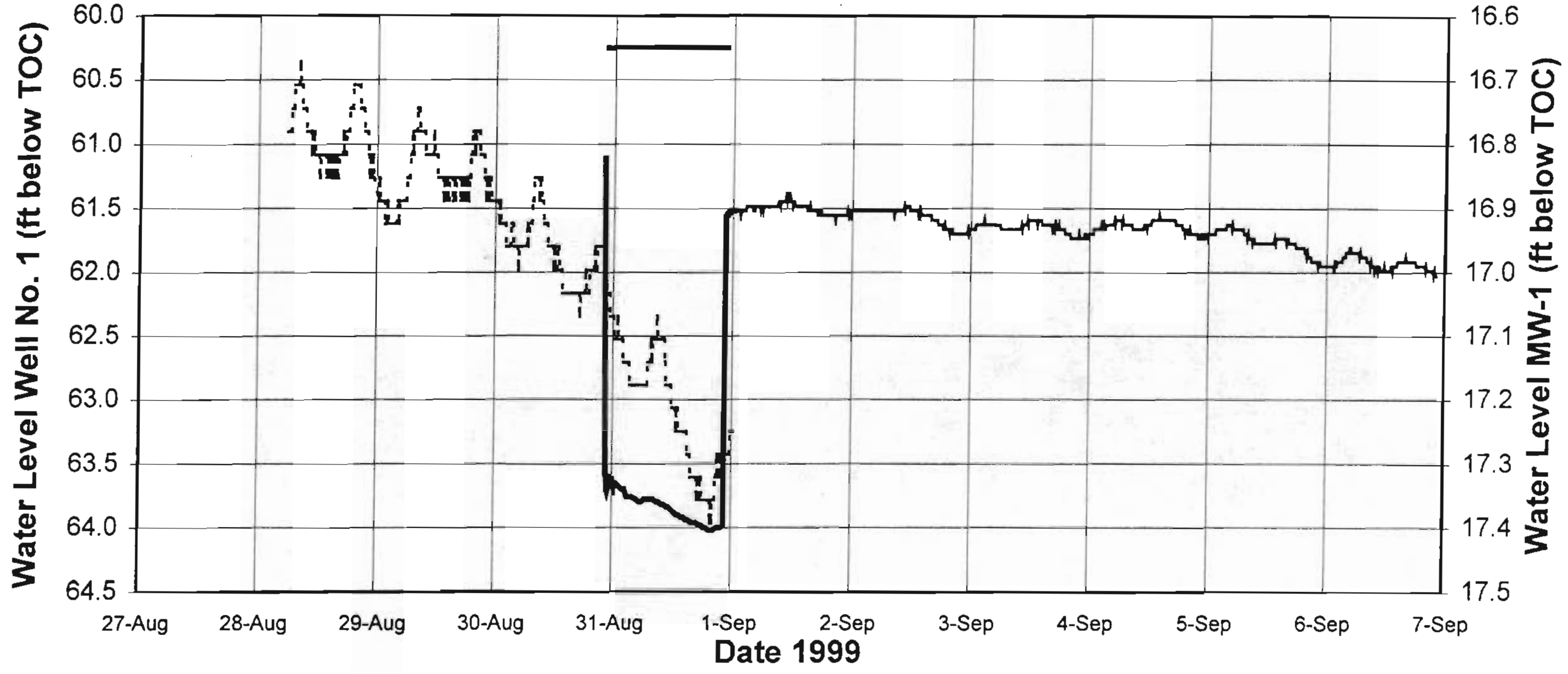
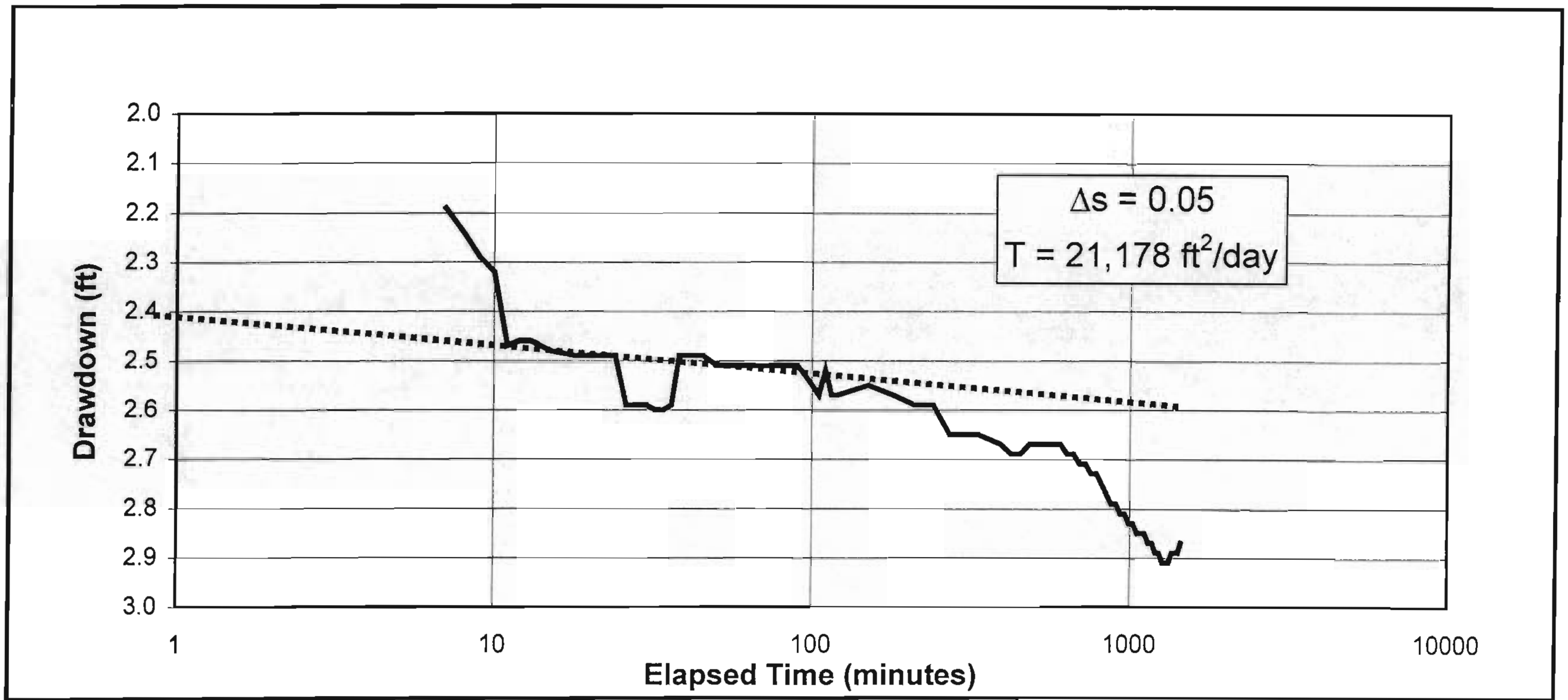


FIGURE 5:

Pumping Test Hydrograph

Montgomery Watson
CLACKAMAS RIVER ASR STUDY/OR/DB

993-1586.003, 09-07-99,
V:\enviros\project\993-1586\geophys\watlev.xls



Legend

FIGURE 6: **24-Hour Pumping Test Semi-log Hydrograph**
Montgomery Watson
CLACKAMAS RIVER ASR STUDY/OR/DB
993-1586.003, 09-07-99,
V:\enviros\project\993-1586\geophys\watlev.xls

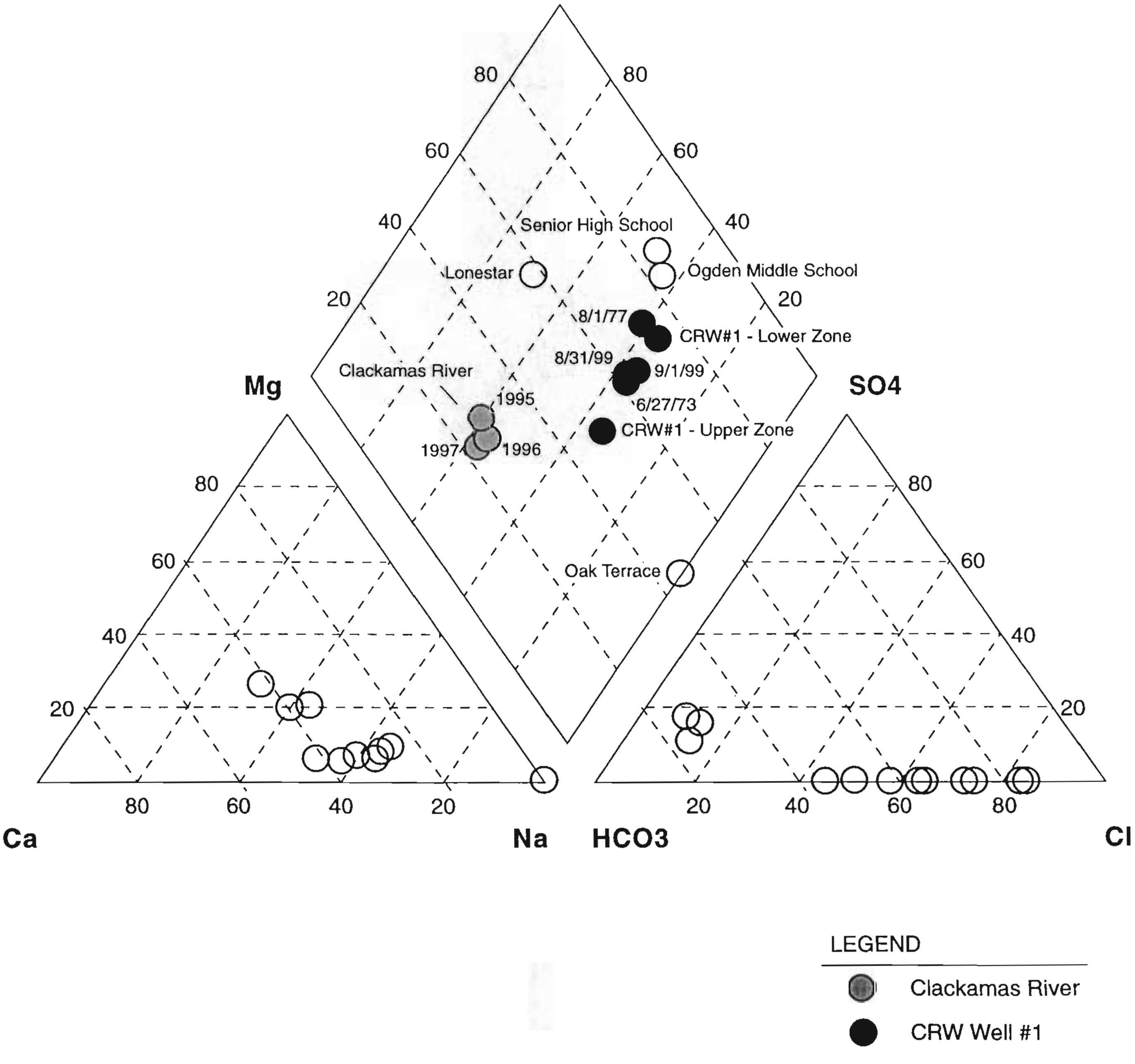


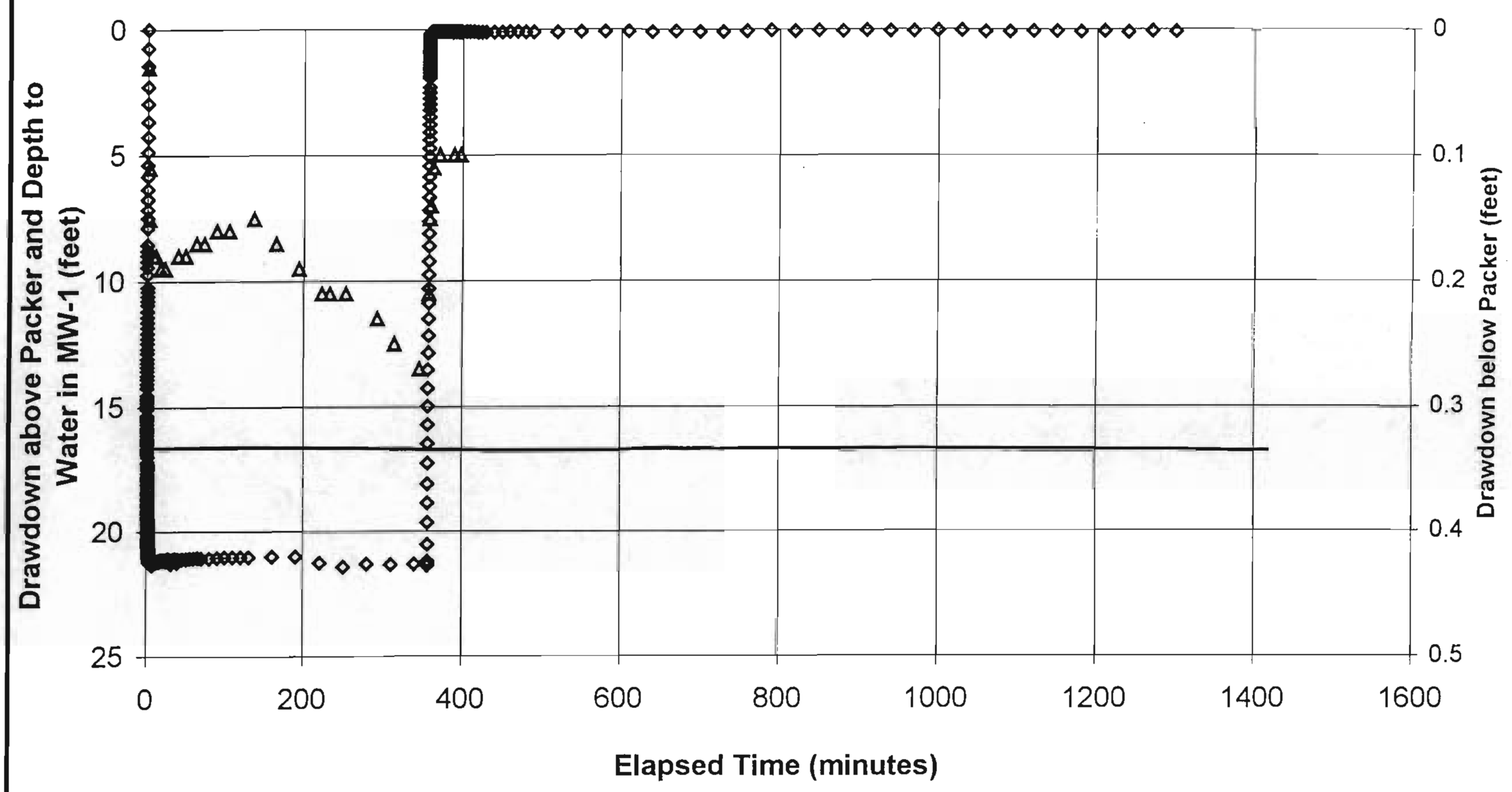
FIGURE 7

TRILINEAR PLOT WITH DATA FROM BASALT WELLS

MW CLACKAMAS/ASR/OR

PROJECT NO. 993 1586.003 DRAWING NO. 10004 DATE 2/9/2000 DRAWN BY EA

Golder Associates



◇ Drawdown Above Packer

— Depth to Water in Rossman MW-1

△ Drawdown Below Packer

Figure 8

PackerTest Hydrograph-Well No. 1 Upper Zone Pumping

Montgomery Watson

CLACKAMAS RIVER ASR STUDY/OR/DB

Golder Associates

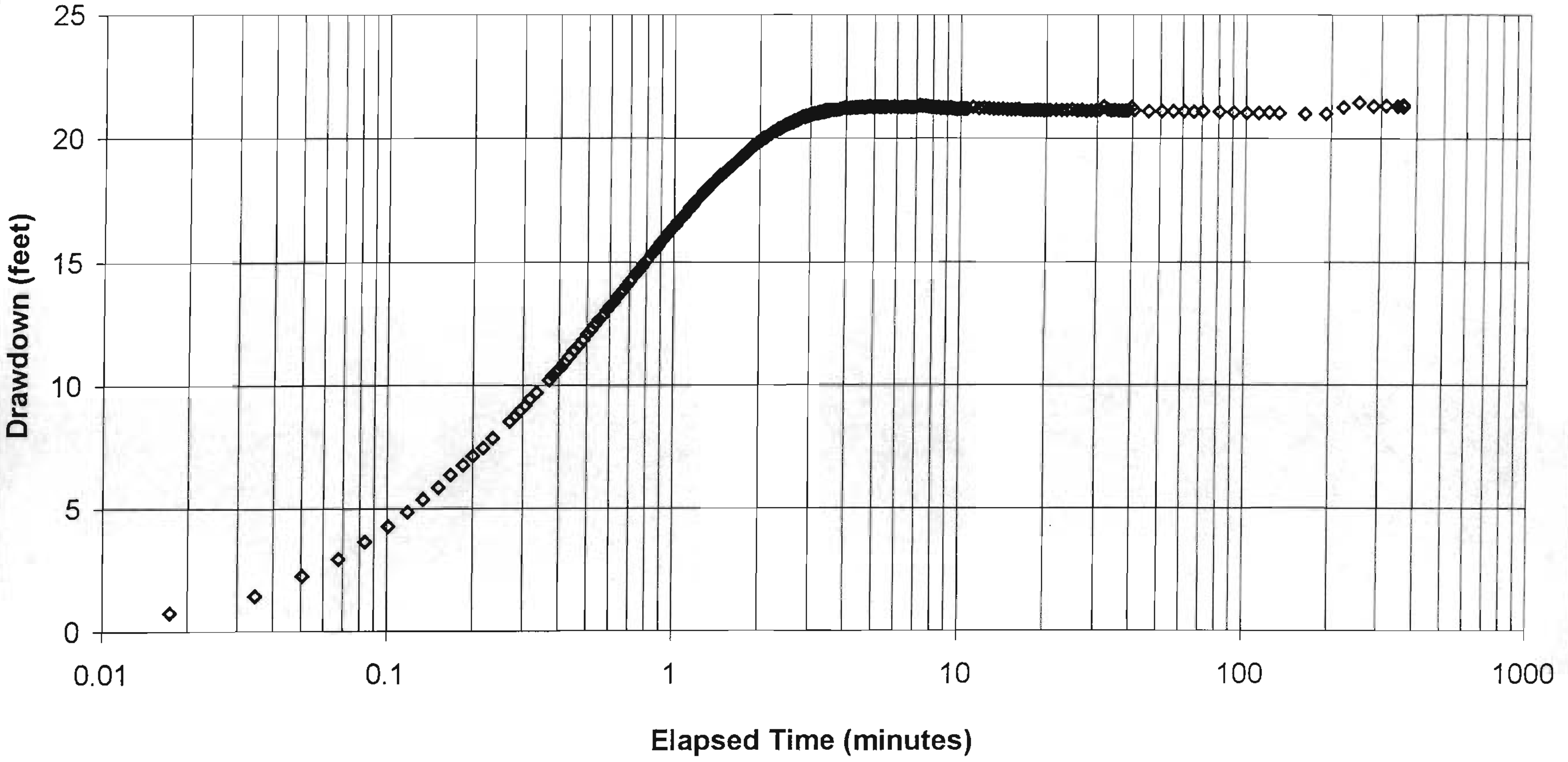


Figure 9
Semi-log Drawdown CRW Well No. 1 Packer Test
Upper Zone Pumping

Montgomery Watson
CLACKAMAS RIVER ASR
STUDY/OR/DB

Golder Associates

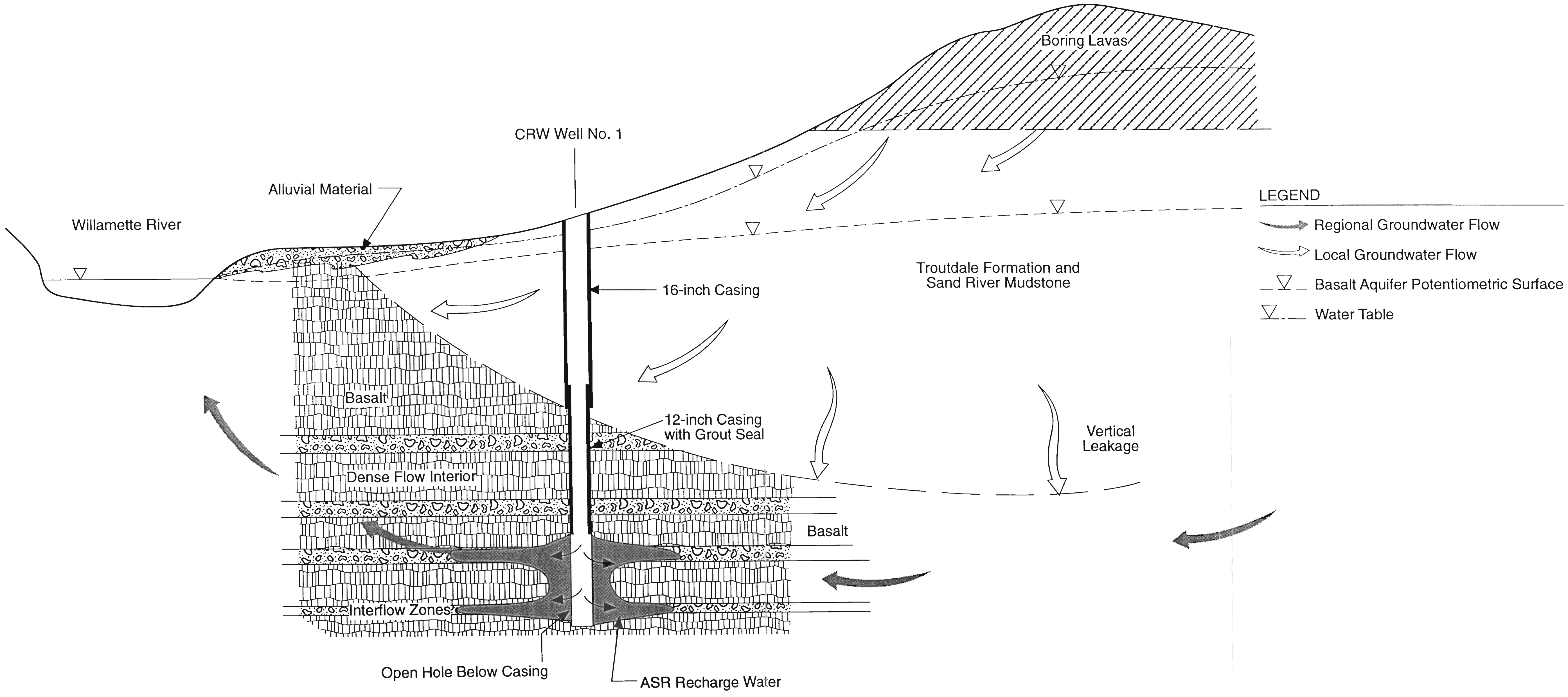


FIGURE 12

SCHEMATIC GROUNDWATER FLOW DURING RECHARGE

MONTGOMERY WATSON/CLACKAMAS R. ASR/OR

PROJECT NO. 993 1586.003 DRAWING NO. 10005 DATE 2/10/2000 DRAWN BY EA

Golder Associates

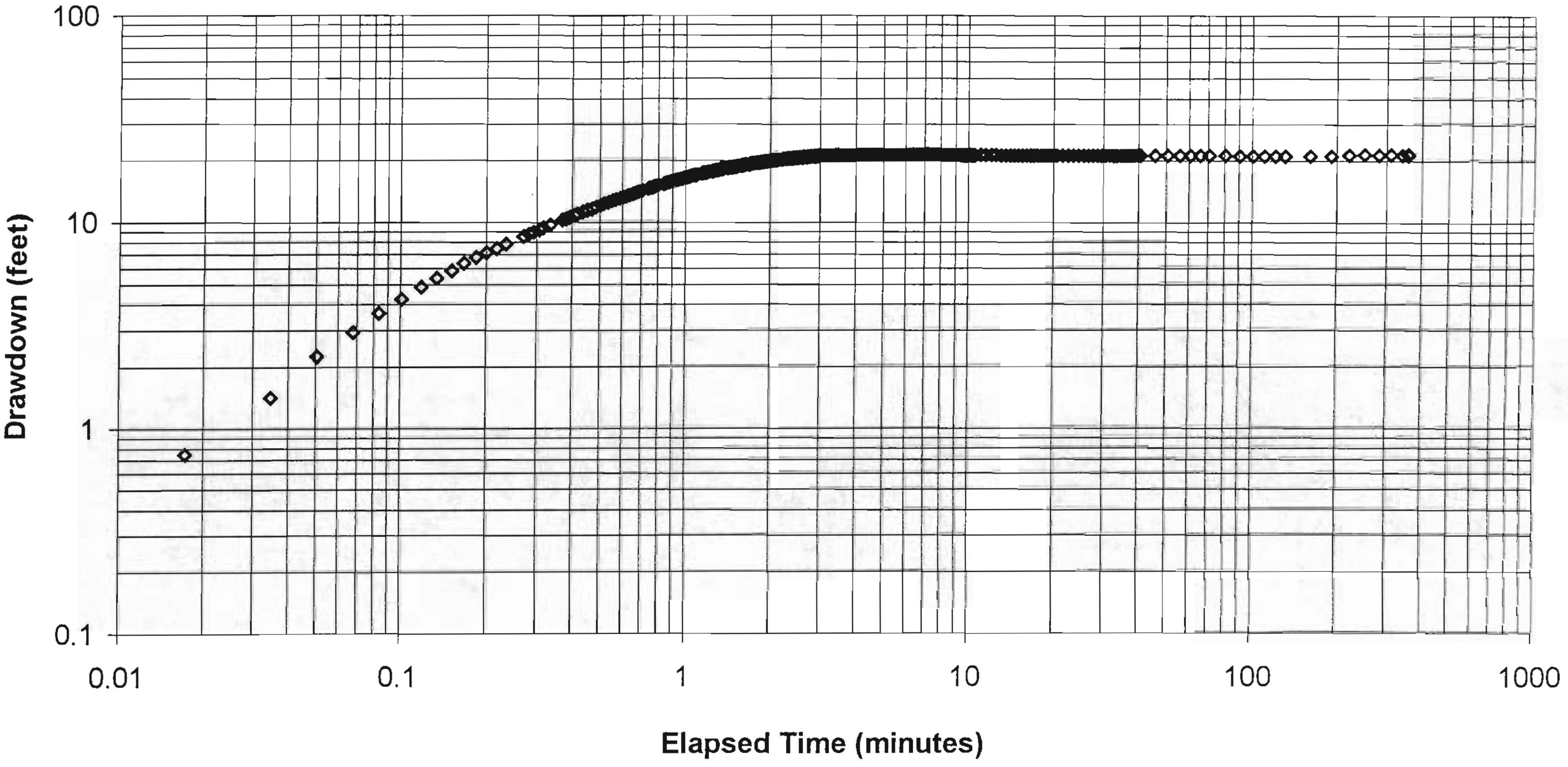
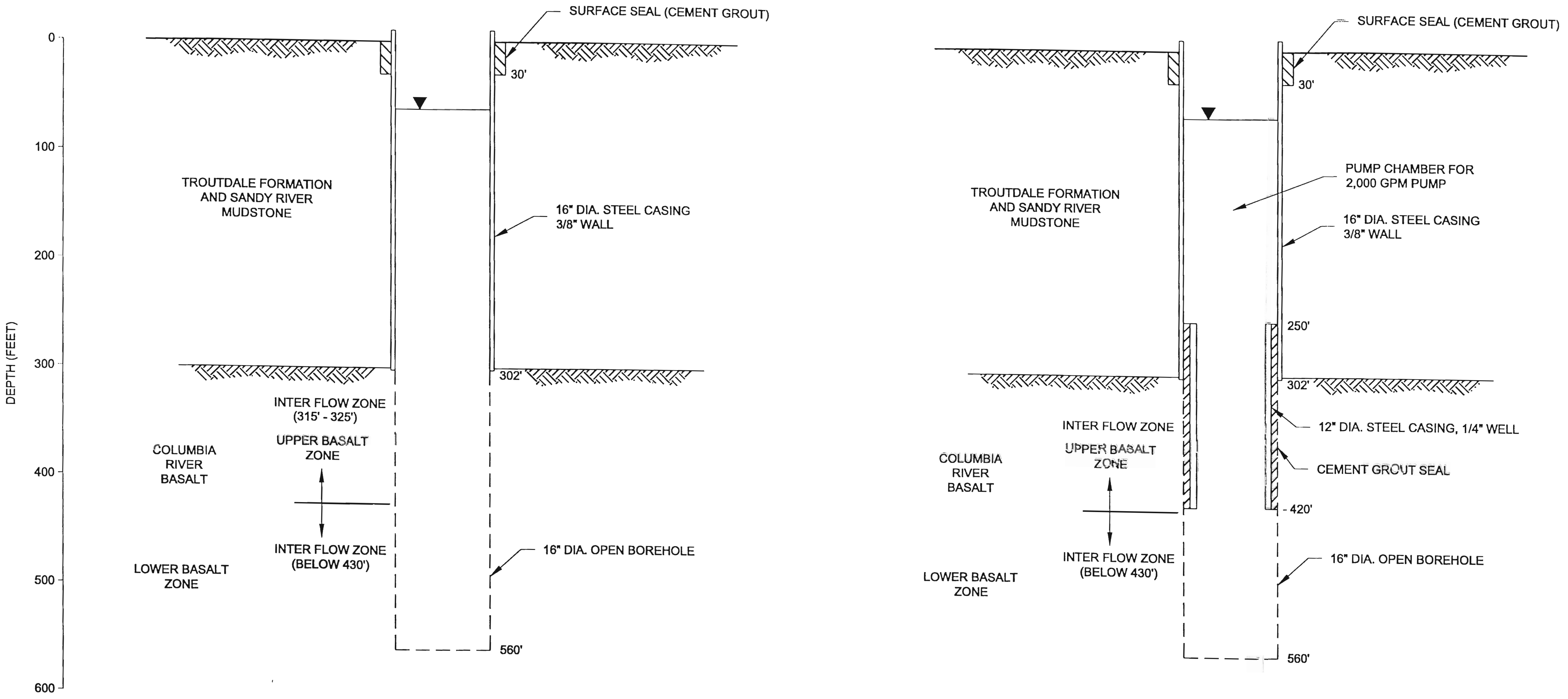


Figure 10
log-log Drawdown CRW Well No. 1 Packer Test
Upper Zone Pumping

Montgomery Watson
CLACKAMAS RIVER ASR
STUDY/OR/DB

Golder Associates



(a) EXISTING WELL CONSTRUCTION

(b) PROPOSED WELL MODIFICATION

NOTE:
LOCATION OF INTERFLOW ZONES (POTENTIAL WATER INFLOW)
FROM FORMATION RESISTIVITY/SP LOGS AND FLUID LOGS (APPENDIX B).

FIGURE **14**
CRW WELL NO. 1
EXISTING WELL CONSTRUCTION (a) AND
PROPOSED WELL MODIFICATION (b)
MW/CLACKAMAS ASR/OR

Golder Associates

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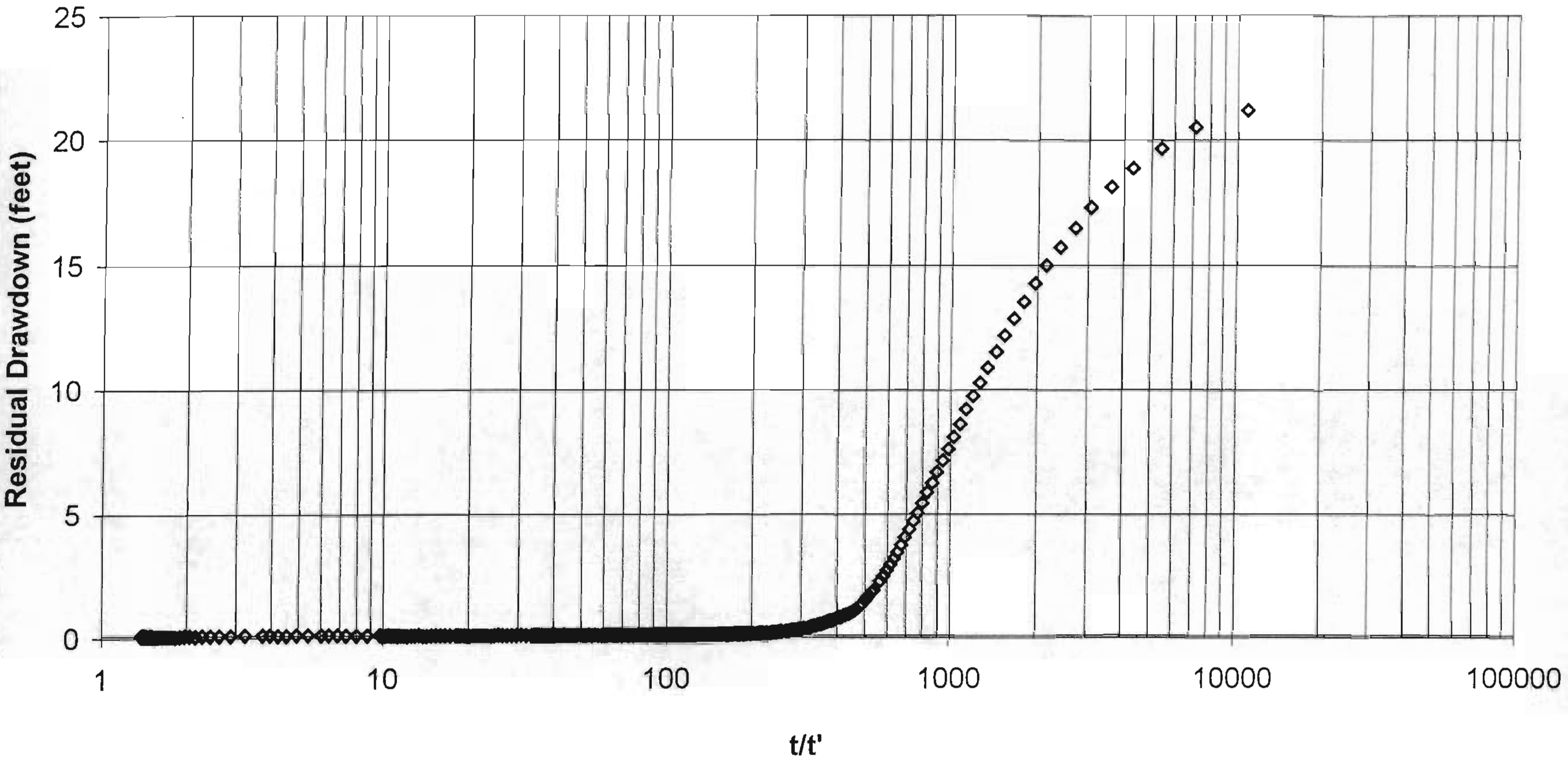


Figure 11

Water Level Recovery CRW Well No. 1

Packer Test Upper Zone Pumping

Montgomery Watson

CLACKAMAS RIVER ASR

STUDY/OR/DB

Golder Associates

Appendix A

APPENDIX A

WELL LOGS

SECTION A-A′

NOTICE TO WATER WELL CONTRACTOR
The original and first copy
of this report are to be
filed with the
STATE ENGINEER, SALEM, OREGON 97310
within 30 days from the date
of well completion.

RECEIVED
DEC 13 1971
STATE ENGINEER
SALEM, OREGON

10

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

CLAC
04211

19

State Well No. 2/2-19
State Permit No.

(1) OWNER:
Name GEORGE W. SKYLES
Address 19215 S. E. McLOUGHLIN BLVD
GLADSTONE, OREGON 97027

(2) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☒ Driven ☐
Cable ☐ Jetted ☐
Dug ☐ Bored ☐

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

CASING INSTALLED:
Threaded ☐ Welded ☒
8" Diam. from 0 ft. to 54 ft. Gage
6" Diam. from 0 ft. to 120 ft. Gage .25
" Diam. from ft. to ft. Gage

PERFORATIONS:
Perforated? ☐ 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.

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

(8) WELL TESTS:
Drawdown is amount water level is lowered below static level

Was a pump test made? ☒ Yes ☐ No If yes, by whom? Driller
Yield: gal./min. with ft. drawdown after hrs.
65 " 118 " "
" 46 " 78 " "
Bailer test 30 gal./min. with 38 ft. drawdown after hrs.
15
Artesian flow g.p.m. 18
Temperature of water Depth artesian flow encountered ft.

(9) CONSTRUCTION:
Well seal—Material used Bentonite & Cement
Well sealed from land surface to 40 ft.
Diameter of well bore to bottom of seal 12 1/4 in.
Diameter of well bore below seal 7 7/8 + 6 in in.
Number of sacks of cement used in well seal 3 sacks
Number of sacks of bentonite used in well seal 2 sacks
Brand name of bentonite National
Number of pounds of bentonite per 100 gallons of water 100 lbs./100 gals.
Was a drive shoe used? ☒ Yes ☐ No Plugs Size: location ft.
Did any strata contain unusable water? ☒ Yes ☐ No
Type of water Contaminated Depth of strata 47
Method of sealing strata off Casing (Pin) + cement
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.

(10) LOCATION OF WELL:
County CLACKAMAS Driller's well number
¼ ¼ Section 19 T. 2S R. 2E W.M.
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.
Depth at which water was first found 39 ft.
Static level 82 ft. below land surface. Date 12-6-71
Artesian pressure lbs. per square inch. Date

(12) WELL LOG:
Diameter of well below casing 6"
Depth drilled 203 ft. Depth of completed well 203 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. *Report each change in position of Static Water Level and indicate principal water-bearing strata.*

MATERIAL	From	To	SWL
BROWN CLAY	0	15	
SANDY BROWN CLAY	15	18	
BOULDERS	18	36	
BROWN CLAY	36	39	
GRAVEL	39	42	
BROWN CLAY	42	67	
RED CLAY	67	76	
BROWN CLAY	76	86	
RED CLAY	86	97	
BROWN CLAY	97	113	
BASALT, BLACK	113	145	
BASALT, GREY	145	169	
BASALT, BLACK & POROUS 5gpm	169	178	
BASALT, BLACK	178	203	
BASALT, GREY	203		

Work started Nov. 24 1971 Completed Dec. 1 1971
Date well drilling machine moved off of well Dec. 2 1971

Drilling Machine Operator's Certification:

This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.

[Signed] Eugene M. Skyles (Drilling Machine Operator) Date Dec 10, 1971
Drilling Machine Operator's License No. 271

Water Well Contractor's Certification:

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

Name SKYLES DRILLING & SUPPLY INC (Person, firm or corporation) (Type or print)
Address GLADSTONE, OREGON
[Signed] George H. Skyles (Water Well Contractor)
Contractor's License No. 58 Date 12-9-71, 1971

(USE ADDITIONAL SHEETS IF NECESSARY)

SP*44654-119

6 NC
CLAC

Should be Section 29bc

NOTICE TO WATER WELL CONTRACTOR
The original and first copy
of this report are to be
filed with the
STATE ENGINEER, SALEM, OREGON 97310
within 30 days from the date
of well completion.

WATER WELL REPORT 04410
STATE OF OREGON
(Please type or print)

State Well No. 2/2-30

State Permit No.

(1) OWNER:
Name Oregon Ready Mix
Address McLoughlin Blvd.
Oregon City, Oreg.

(2) LOCATION OF WELL:
County Clackamas Driller's well number
¼ ¼ Section 30 T. 2S R. 2E W.M.
Bearing and distance from section or subdivision corner

(3) TYPE OF WORK (check):
N Well ☑ Deepening ☐ Reconditioning ☐ Abandon ☐
Ii ..andonment, describe material and procedure in Item 12.

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

(5) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(6) CASING INSTALLED:
Threaded ☐ Welded ☒
8" Diam. from 0 ft. to 175'8" ft. Gage 250
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

(7) PERFORATIONS:
Perforated? ☐ 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.
perforations from ft. to ft.
perforations from ft. to ft.

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

(9) CONSTRUCTION: driven into
Well seal—Material used in seal Bedrock.
Depth of seal 17.5' ft. Was a packer used?
Diameter of well bore to bottom of seal 8 in.
Were any loose strata cemented off? ☐ Yes ☑ No Depth
Was a drive shoe used? ☑ Yes ☐ No
Was well gravel packed? ☐ Yes ☑ No Size of gravel:
Gravel placed from ft. to ft.
Did any strata contain unusable water? ☑ Yes ☐ No
Type of water? iron depth of strata 50'
Method of sealing strata off cased off

(10) WATER LEVELS:
Static level 13 ft. below land surface Date ~~Jan~~ Feb 26 66
Artesian pressure lbs. per square inch Date

(11) 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 35 ft. drawdown after 4 hrs.
" 70 " 50 " 1 "
" 100 " 100 " 1 "
Bailer test 40 gal./min. with 30 ft. drawdown after 2 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? ☐ Yes ☐ No

(12) WELL LOG:
Diameter of well below casing 8
Depth drilled 248 ft. Depth of completed well 248 ft.

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
fill dred	0	4
Top soil	4	18
loosely cemented gravel	18	45
water bearing gravel	45	54
blue clay	54	130
sand & clay water bearing	130	135
gray clay	135	160
soft Lava rock with clay seams.	160	176
Lava rock.	176	193
soft Lava water bearing	193	230
hard Lava rock.	230	248

Work started Jan 1966 Completed Feb 26 1966
Date well drilling machine moved off of well Feb 28 1966

(13) PUMP:
Manufacturer's Name welded cap.
Type: H.P.

Water Well Contractor's Certification:

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

NAME A. C. Olsen
(Person, firm or corporation) (Type or print)
Address 18211 S.E. Powell Gresh.
Drilling Machine Operator's License No. 215
[Signed] A. C. Olsen
(Water Well Contractor)
Contractor's License No. 282 Date March 4 1966

(USE ADDITIONAL SHEETS IF NECESSARY)

17 1/2

C

WELL REPORT
STATE OF OREGON

RECEIVED
SEP 29 1981
WATER RESOURCES DEPT
SALEM, OREGON

State Well No. 2S/2E-29

State Permit No.

Ground Water Monitoring Well # 1 ⑫

(1) OWNER:

Name Rossmans Land Fill
Address P.O. Box 149
City Oregon City State Or.

(2) TYPE OF WORK (check):

New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐

If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:

Rotary Air ☒ Driven ☐
R. Mud ☐ Dug ☐
C. ☐ Bored ☐

(4) PROPOSED USE (check):

Domestic ☐ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☒
Thermal: Withdrawal ☐ Reinjection ☐

(5) CASING INSTALLED:

Steel ☐ Plastic ☒
Threaded ☐ Welded ☐

2" Diam. from +2 ft. to 204 ft. Gauge sch 40
" Diam. from ft. to ft. Gauge

LINER INSTALLED: no

" Diam. from ft. to ft. Gauge

(6) PERFORATIONS:

Perforated? ☐ 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.

(7) SCREENS:

Well screen installed? ☒ Yes ☐ No

Manufacturer's Name PVC Hydrophilic
Type Machine slot Model No.
Diam. 2 Slot Size 040 Set from 194 ft. to 204 ft.
Diam. Slot Size Set from ft. to ft.

(8) 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 no gal./min. with drill stem at ft. hrs.
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m.
Temperature of water Depth artesian flow encountered ft.

(9) CONSTRUCTION:

Special standards: Yes ☐ No ☐

Well seal—Material used Cement
Well sealed from land surface to 178 ft.
Diameter of well bore to bottom of seal 6 in.
Diameter of well bore below seal 6 in.
Number of sacks of cement used in well seal 71 sacks
How was cement grout placed? pumped

Was pump installed? no Type HP Depth ft.
Was a drive shoe used? ☒ Yes ☐ No Plugs Size: location ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of Water? depth of strata
Method of sealing strata off
Was well gravel packed? ☒ Yes ☐ No Size of gravel: [illegible]
Gravel placed from 178 ft. to 204 ft.

(10) LOCATION OF WELL:

County Clackamas Driller's well number [illegible]
¼ ¼ Section 29 T. 2S R. 2e W.M.
Tax Lot # Lot Blk Subdivision
Address at well location: none
next to Terrys burger on Washington St

(11) WATER LEVEL: Completed well.

Depth at which water was first found 26 ft.
Static level 20.5 ft. below land surface. Date 9-108
Artesian pressure lbs. per square inch. Date

(12) WELL LOG:

Diameter of well below casing 6
Depth drilled 204 ft. Depth of completed well 204 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. Report each change in position of Static Water Level and indicate principal water-bearing strata.

MATERIAL	From	To	SWL
Soil med brn	0	1	
Clay silty med brn	1	26	
Gravel med sand brn	26	48	
Gravel med gray	48	51	
Clay silty blue	51	85	
Clay silty brn	85	114	
Clay med red	114	125	
Clay med brn	125	143	
Clay med brn, blue strks	143	155	
Clay med brn grn strks	155	178	
Basalt med brn, green	178	190	
Basalt hrd gray	190	204	

Work started 7-29 1981 Completed 8-4 1981
Date well drilling machine moved off of well 8-4 1981

Drilling Machine Operator's Certification:

This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.

[Signed] (Drilling Machine Operator) Date 9-4, 1981

Drilling Machine Operator's License No. 720

Water Well Contractor's Certification:

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

Name West Coast Drilling Co. Inc. (Person, firm or corporation) (Type or print)
Address Mt. Angel, Or. 9[illegible]
[Signed] Charles E. Stadel (Water Well Contractor)
Contractor's License No. 519 Date 9-4, 1981

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report
are to be filed with the

WATER RESOURCES DEPARTMENT,
SALEM, OREGON 97310
within 30 days from the date of well completion.

SP*12658-690

17 2/2

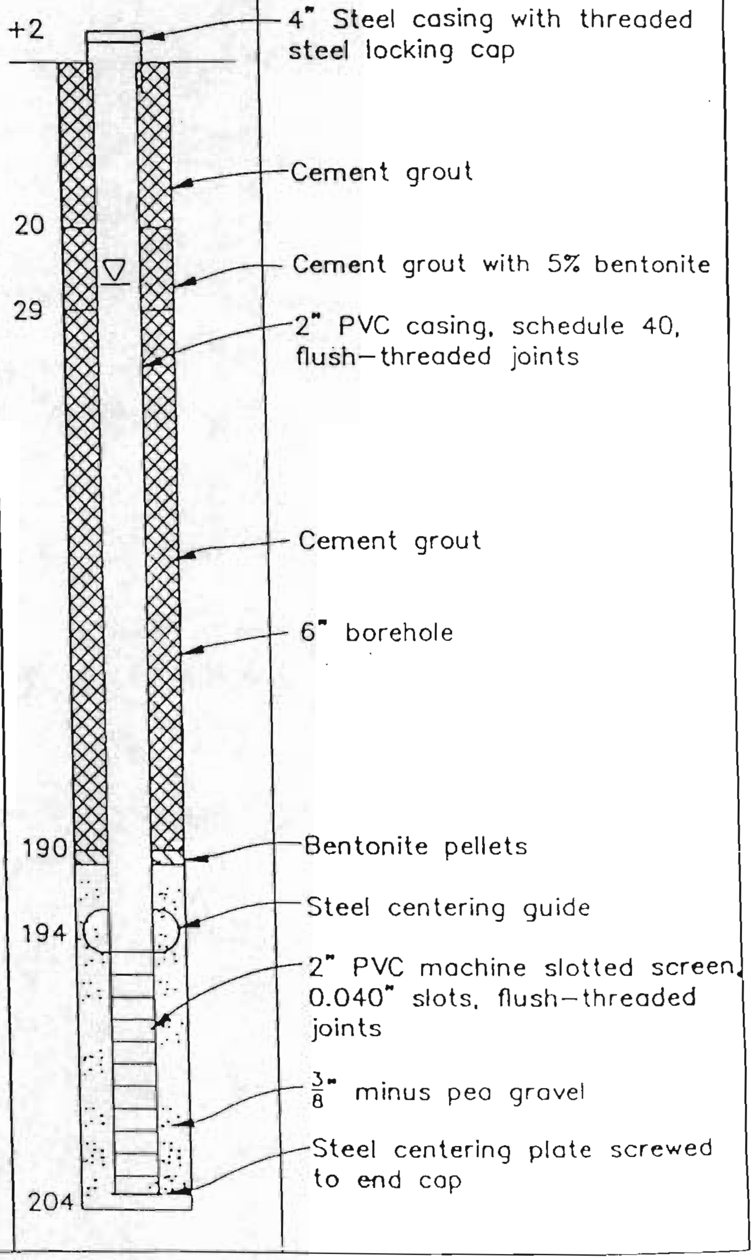
WELL CONSTRUCTION SUMMARY MW-1

CLIENT ROSSMAN'S LANDFILL
PROJECT NUMBER P12627.A0 PAGE 1 OF 1
LOCATION OREGON CITY, OREGON
START DATE 7/29/81 FINISH DATE 7/30/81
ELEVATIONS (FEET)
DRILLING METHOD PORTADRILL AIR ROTARY
MEASURING POINT 32.48
SURFACE 30.4
DRILLING CONTRACTOR CHRISTENSEN DRILLING/ VANCOUVER, WA.
WATER (DATE) 6.32 (12/28/87)
DATUM NGVD, 1929
INSPECTOR REIFENSTEIN
NOTES BOREHOLE LOGGED BY EXAMINATION OF DRILL CUTTINGS.

DEPTH (FT)	DESCRIPTION OF GEOLOGIC MATERIALS
0–2	SOIL
2–26	CLAYEY SILT, brown, trace of fine sand
26–48	SAND AND GRAVEL, some layers of silty sand, water-bearing
48–51	GRAVELLY SILT, gray
51–85	SILTY CLAY, blue-gray
85–114	SILTY CLAY, gray-brown, a little water at base
114–125	CLAY, orange-red
125–143	CLAY, orange-brown
143–155	CLAY, tan with streaks of blue clay, very tight
155–178	CLAY, tan-green
178–190	BASALT, weathered
190–204	BASALT, dark gray, solid

DEPTH (FT) RECORD DRAWING NOT TO SCALE

WELL CONSTRUCTION



NOTICE TO WATER WELL CONTRACTOR
The original and first copy
of this report are to be
filed with the
STATE ENGINEER, SALEM, OREGON 97310
within 30 days from the date
of well completion.

CLAC
04396

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

RECEIVED
SEP 13 1973
STATE ENGINEER
SALEM, OREGON

2S/2E-27dbz
Rec wwc 12-11-85 RAH

State Well No. ~~2S/3E-6~~
State Permit No.

(1) OWNER:
Name CLAIRMONT WATER DIST.
Address 15223 S. HENRICI ROAD
OREGON CITY ORE. 97045

(2) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

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

[illegible] CASING INSTALLED:
Threaded ☐ Welded ☒
16" Diam. from +2 ft. to 302 ft. Gage .375
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

[illegible] PERFORATIONS:
Perforated? ☐ 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.

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

(8) WELL TESTS:
Drawdown is amount water level is lowered below static level

Was a pump test made? ☒ Yes ☐ No If yes, by whom? STRASSER
[illegible]ld: 3150 gal./min. with 160 ft. drawdown after 24 hrs.

Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m.
[illegible]erature of water 57 Depth artesian flow encountered ft.

(9) CONSTRUCTION:
Well seal—Material used CEMENT GROUT
Well sealed from land surface to 30 ft.
Diameter of well bore to bottom of seal 22 in.
Diameter of well bore below seal 16 in.
Number of sacks of cement used in well seal 58 sacks
Number of sacks of bentonite used in well seal sacks
Brand name of bentonite
Number of pounds of bentonite per 100 gallons of water lbs./100 gals.
Was a drive shoe used? ☒ Yes ☐ No Plugs Size: location ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.

(10) LOCATION OF WELL:
County CLACK. Driller's well number 5451
SE¼ NW¼ Section 6 T. 2S R. 3E W.M.
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.
Depth at which water was first found 315 ft.
Static level 69 ft. below land surface. Date 8/17/73
Artesian pressure lbs. per square inch. Date

(12) WELL LOG:
Diameter of well below casing 16
Depth drilled 560 ft. Depth of completed well 560 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. Report each change in position of Static Water Level and indicate principal water-bearing strata.

MATERIAL	From	To	SWL
BROWN CLAY	0	41	
PACKED BROWN SAND	41	76	
BLUE AND GREY CLAY	76	192	
RED AND BROWN CLAYSTONE	192	299	
DECOMPOSED ROCK	299	301	
BLACK BASALT	301	315	
POROUS GREY BASALT	315	324	
MED HARD BLACK BASALT	324	333	
BROKEN GREY BASALT	333	342	←
HARD BLACK BASALT	342	371	
MED HARD BLACK BASALT	371	382	
MED SOFT BLACK BASALT	382	397	
MED HARD BLACK BASALT	397	402	
HARD BLACK BASALT	402	428	
MED HARD BLACK BASALT	428	462	
GREY BASALT	462	487	
POROUS BLACK BASALT	487	550	
HARD BLACK BASALT	550	560	

Work started APR 13 1973 Completed AUG 25 1973
Date well drilling machine moved off of well AUG 26 1973

Drilling Machine Operator's Certification:
This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.
[Signed] N. Johnson Date 9/10, 1973
(Drilling Machine Operator)
Drilling Machine Operator's License No. 57

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Name R J STRASSER DRILLING Co
(Person, firm or corporation) (Type or print)
Address 8110 SE SUNSET LAKE PORTLAND
[Signed] Robert L. Strasser
(Water Well Contractor)
Contractor's License No. 10 Date SEPT 10

(USE ADDITIONAL SHEETS IF NECESSARY)

RECEIVED
MAY 20 1981
WATER RESOURCES DEPT
SALEM, OREGON

04382

4

NC

WATER WELL REPORT
STATE OF OREGON

State Well No 2S/2E-28 CC
State Permit No.

⑥

(1) OWNER:
Name Patrick Harrington
Address 14161 S. Redland Rd.
City Oregon City State Oregon

(2) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary Air ☒ Driven ☐
Rotary Mud ☐ Dug ☐
☐ Bored ☐

(4) PROPOSED USE (check):
Domestic ☒ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐
Thermal: Withdrawal ☐ Reinjection ☐

(5) CASING INSTALLED:
Steel ☒ Plastic ☐
Threaded ☐ Welded ☒
6" Diam. from 0 ft. to 130 ft. Gauge .25
" Diam. from ft. to ft. Gauge

LINER INSTALLED:
" Diam. from ft. to ft. Gauge

(6) PERFORATIONS:
Perforated? ☐ 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.

(7) SCREENS:
Well screen installed? ☐ Yes ☒ No
Manufacturer's Name
Type Model No.
Diam. Slot Size Set from ft. to ft.
Diam. Slot Size Set from ft. to ft.

(8) WELL TESTS:
Drawdown is amount water level is lowered below static level
a pump test made? ☐ Yes ☒ No If yes, by whom?
gal./min. with ft. drawdown after hrs.
"75 gal/min. with drill stem at 154'"
Air test 20 gal./min. with drill stem at 80 ft. 1 hrs.
Bailer test gal./min. with ft. drawdown after hrs.
ian flow g.p.m.
perature of water Depth artesian flow encountered ft.

(9) CONSTRUCTION:
Special standards: Yes ☐ No ☒
Well seal—Material used Cement 5% Bentonite
Well sealed from land surface to 18 ft.
Diameter of well bore to bottom of seal 10 in.
Diameter of well bore below seal 6 in.
Number of sacks of cement used in well seal 4 sacks
How was cement grout placed? Pumped

Was pump installed? no Type HP Depth ft.
Was a drive shoe used? ☒ Yes ☐ No Plugs Size: location ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of Water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.

(10) LOCATION OF WELL:
County Clackamas Driller's well number 1581
SW ¼ SW ¼ Section 28 T.2S R. 2E W.M.
Tax Lot # Lot Blk Subdivision
Address at well location: 14161 S. Redland Rd.
Oregon City, Oregon 97045

(11) WATER LEVEL: Completed well.
Depth at which water was first found 142
Static level 70 ft. below land surface. Date 4-24-
Artesian pressure lbs. per square inch. Date

(12) WELL LOG:
Diameter of well below casing 6
Depth drilled 154 ft. Depth of completed well 154

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. Report each change in position of Static Water Level and indicate principal water-bearing strata.

MATERIAL	From	To	SWL
Soil	0	2	
Clay Brown	2	16	
Gravel Med	16	18	
Clay Grey	18	25	
Clay Brown w/small gravel	25	29	
Clay blue silty	29	51	
Clay grey silty	51	85	
Clay blue	85	94	
Clay grey silty	94	105	
Clay grey	105	123	
Clay grey silty	123	130	
Basalt black	130	142	
→Basalt black fractured	142	154	70

Work started 4-23-81 19 Completed 4-24- 1981
Date well drilling machine moved off of well 4-24 1981

Drilling Machine Operator's Certification:
This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.
[Signed] M. L. Skyles Date 4-24, 1981
(Drilling Machine Operator)
Drilling Machine Operator's License No. 224

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Name Skyles Drilling & Supply, Inc.
(Person, firm or corporation) (Type or print)
Address 1169 Molalla Ave. Oregon City, Ore.
[Signed] M. L. Skyles
(Water Well Contractor)
Contractor's License No. 553 Date 4-24, 1981

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the WATER RESOURCES DEPARTMENT, SALEM, OREGON 97310 within 30 days from the date of well completion.

SP*12658-690

12

ORIGINAL
File Original and Duplicate with the STATE ENGINEER, SALEM, OREGON

CLAC

C4430

WATER WELL DRILLERS REPORT
STATE OF OREGON

Do Not Fill In
State Well No 25/2E-33
State Permit No. 3366

(1) OWNER:
Name Jim Garvison
Address [illegible]
[illegible]

(2) LOCATION OF WELL:
County Clackamas Owner's number, if any—
R. F. D. or Street No.
Bearing and distance from section or subdivision corner
NW 1/4 NW 1/4 of Sec 33 T 2 S R 2E W.M.

(3) TYPE OF WORK (check):
New well ☐ Deepening ☒ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 11.

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

(5) EQUIPMENT:
Rotary ☐
Cable ☒
Dug Well ☐

(6) CASING INSTALLED:
Threaded ☐ Welded ☒

FROM	ft. to	ft.	Diam.	Gage or Wall
85	163½		6"	

If gravel packed

Diameter of Bore	from ft.	to ft.

Type and size of shoe or well ring
Size of gravel:
Describe joint Butt Weld

(7) PERFORATIONS:
Type of perforator used
SIZE of perforations in., length, by in.

FROM	ft. to	ft.	perf per foot	No. of rows

SCREENS:
Give Manufacturer's Name, Model No. and Size

(8) CONSTRUCTION:
Was a surface sanitary seal provided? ☐ Yes ☐ No To what depth ft.
Were any strata sealed against pollution? ☐ Yes ☐ No
If yes, note depth of strata
FROM ft. to ft.
METHOD OF SEALING

(9) WATER LEVELS:
Depth at which water was first found ft.
Standing level before perforating 60 ft.
Standing level after perforating no perforations ft.
Log Accepted by:
[Signed] Dated 9-5 1956
Owner

(10) WELL TESTS:
(32)
Was a pump test made? ☒ Yes ☐ No If yes, by whom? Driller
Yield: 100 gal./min. with 56 ft. draw down after 8 hrs.
Artesian flow g.p.m.
Shut-in pressure lbs. per square inch.
Bailer test g.p.m. with ft. drawdown
Temperature of water 52 Was a chemical analysis made? ☐ Yes ☐ No
Was electric log made of well? ☐ Yes ☐ No

(11) WELL LOG:
Diameter of well 6 inches.
Total depth 180 ft. Depth of completed well 180 ft.
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.*

ft.	to	ft.	
85		150	Blue clay
150		162	Blue clay & sand mixed
162		163½	Broken basalt ←
163½		165	Solid basalt
165		168	Broken basalt ←
168		174	Solid basalt
174		180	Broken basalt ←

Water from broken basalt area, Fine sand
Dead static 60 ft.

RECEIVED
JUN 10 1977
WATER RESOURCES DEPT.
SALEM, OREGON

RECEIVED
FEB - 2 1977
WATER RESOURCES DEPT
SALEM, OREGON

Ground elevation at well site feet above mean sea level
Work started Aug. 14 1956. Completed Aug/ 28 1956

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 John W. Beck Well Drilling
(Person, firm, or corporation) (Typed or printed)
Address Rt. 3, Box 45, Canby, Ore.
Driller's well number 373
[Signed] John W Beck
(Well Driller)
License No. 95 Dated Aug. 28, 1956

CLAC 13

04431

RECEIVED

(39) 33cb

NOTICE TO WATER WELL CONTRACTOR
The original and first copy
of this report are to be
filed with the
STATE ENGINEER, SALEM, OREGON 97310
within 30 days from the date
of well completion.

WATER WELL REPORT
STATE OF OREGON
(Please type or print)

State Well No. 2/2-33
State Permit No.

(1) OWNER:
Name OREGON CITY PUBLIC SCHOOLS
Address OREGON CITY, ORE.

(2) LOCATION OF WELL:
County CLACK. Driller's well number 4189
¼ ¼ Section 33 T. 2S R. 2E W.M.
Bearing and distance from section or subdivision corner

(3) TYPE OF WORK (check):
Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

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

(5) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(6) CASING INSTALLED:
Threaded ☐ Welded ☒
16" Diam. from 0 ft. to 186 ft. Gage .312
12" Diam. from 0 ft. to 472 ft. Gage .330
" Diam. from ft. to ft. Gage

(7) PERFORATIONS:
Perforated? ☐ 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.
perforations from ft. to ft.
perforations from ft. to ft.

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

(9) CONSTRUCTION:
Well seal—Material used in seal CEMENT GROUT
Depth of seal 26 ft. Was a packer used? NO
Diameter of well bore to bottom of seal 20 in.
Were any loose strata cemented off? ☐ Yes ☒ No Depth
Was a drive shoe used? ☒ Yes ☐ No
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.
Did any strata contain unusuable water? ☐ Yes ☒ No
Type of water? depth of strata
Method of sealing strata off

(10) WATER LEVELS:
Static level 165 ft. below land surface Date 3/4/65
Artesian pressure lbs. per square inch Date

(11) WELL TESTS:
Drawdown is amount water level is lowered below static level
Was a pump test made? ☒ Yes ☐ No If yes, by whom? RJ STRASSER DRILLING Co
Yield: 265 gal./min. with 131 ft. drawdown after 8 hrs.
" 280 " 119 " ½ "
" 250 " 92 " ½
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water 51 Was a chemical analysis made? ☒ Yes ☐ No

(12) WELL LOG:
Diameter of well below casing 12
Depth drilled 578 ft. Depth of completed well 578 ft.

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
BROWN CLAY AND SAND	0	20
SANDY CLAY (BROWN)	20	90
SANDY CLAY (BLUE)	90	123
SANDY CLAY (GREY)	123	130
BROWN SANDSTONE	130	135
BROWN SAND	135	148
SANDY CLAY (GREY)	148	169
GREY AND BLUE STICKY CLAY	169	320
GREY SANDY CLAY	320	336
REDDISH BROWN CLAY	336	417
BROWN CLAY	417	435
GREY CEMENTED GRAVEL	435	469
→ FRACTURED BROWN ROCK	469	473
HARD BROWN ROCK	473	494
HARD BLACK ROCK	494	507
BROWN ROCK	507	520
HARD BLACK ROCK	520	564
→ DARK RED BROKEN ROCK	564	572
HARD BLACK ROCK	572	578

Work started NOV. 30 1964 Completed MAR 26 196
Date well drilling machine moved off of well MAR. 30 196

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

Water Well Contractor's Certification:

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

NAME R.J. STRASSER DRILLING Co
(Person, firm or corporation) (Type or print)
Address 8110 SE SUNSET LANE PORTLAND OR
Drilling Machine Operator's License No. 56 AND 57
[Signed]
(Water Well Contractor)
Contractor's License No. 10 Date APR 1, 1965

(USE ADDITIONAL SHEETS IF NECESSARY)

CLAC 19

NOTICE TO WATER WELL CONTRACTOR
The original and first copy
of this report are to be
filed with the
STATE ENGINEER, SALEM, OREGON 97310
within 30 days from the date
of well completion.

WATER WELL REPORT 04437
STATE OF OREGON
(Please type or print)

(38)
State Well No. 2/2-33 R
State Permit No. 33dd

(1) OWNER:
Name Norman Domreis
Address 12312 S. E. Merrill Drive
Portland, Oregon

(2) LOCATION OF WELL:
County Clackamas Driller's well number 57-66
SE ¼ SE ¼ Section 33 T. 2S R. 2E W.M.
Bearing and distance from section or subdivision corner

(3) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
bandonment, describe material and procedure in Item 12.

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

(5) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(6) CASING INSTALLED:
Threaded ☐ Welded ☒
6" Diam. from 0 ft. to 39'6" ft. Gage 0.250
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

(7) PERFORATIONS:
Perforated? ☐ 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.
perforations from ft. to ft.
perforations from ft. to ft.

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

(9) CONSTRUCTION:
Well seal—Material used in seal Puddled clay & drill cuttings
Depth of seal 33 ft. Was a packer used? yes
Diameter of well bore to bottom of seal 12 in.
Were any loose strata cemented off? ☐ Yes ☒ No Depth
Was a drive shoe used? ☒ Yes ☐ No
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? depth of strata
Method of sealing strata off

(10) WATER LEVELS:
Static level 30 ft. below land surface Date 9-14-66
Artesian pressure lbs. per square inch Date

(11) 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.
-	-	-	-
-	-	-	-

Bailer test 40 gal./min. with 20 ft. drawdown after 1 hrs.
Artesian flow g.p.m. Date
Temperature of water 53° Was a chemical analysis made? ☐ Yes ☒ No

(12) WELL LOG:
Diameter of well below casing 6 in.
Depth drilled 90 ft. Depth of completed well 90 ft.

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
Clay, Brown	0	13
Gravel, cemented	13	31
Rock, soft grey	31	36
Rock, hard grey	36	46
Rock, decomposed, brown	46	50
Rock, soft red	50	55
Rock, hard grey	55	67
Rock, soft grey, yellow clay seams	67	83
Clay, yellow	83	86
Rock, grey, medium hard	86	90
All water coming in below 80 ft.		

Work started Sept. 8 1966 Completed Sept. 14 1966
Date well drilling machine moved off of well Sept. 14 1966

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

Water Well Contractor's Certification:

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

NAME Steinman Bros.
(Person, firm or corporation) (Type or print)
Address 15112 S.E. McLoughlin Blvd. Milwaukie, Ore
Drilling Machine Operator's License No. 68
[Signed] Steinman Bros.
(Water Well Contractor)
Contractor's License No. 1 Date Sept. 15, 1966

(USE ADDITIONAL SHEETS IF NECESSARY)

SECTION B-B′

8 1/2 A-sec 15 15

STATE ENGINEER
Salem, Oregon

CLAC

Well Record

C4419

STATE WELL NO. 2/2-31F(
COUNTY Clackamas
APPLICATION NO. GR-707

31bd (21)

OWNER: Publisher's Paper Co.

MAILING ADDRESS:

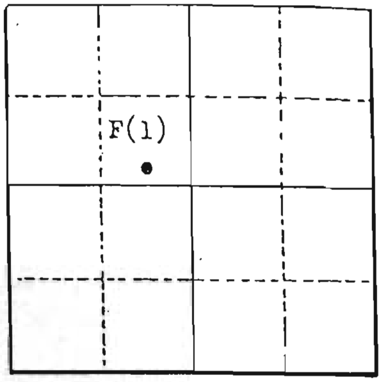
LOCATION OF WELL: Owner's No. 1

CITY AND STATE: Oregon City, Oregon

SE ¼ NW ¼ Sec. 31 T. 2 ~~N.~~ S., R. 2 E. ~~W.~~, W.M.

Bearing and distance from section or subdivision corner Approx. 3370 feet West & 2380 feet South from NE corner of Section 31, T.2 S. R. 2 E.

Altitude at well 120' Interpolated



Section 31

TYPE OF WELL: Drilled Date Constructed 1940

Depth drilled 250' Depth cased 17

CASING RECORD:

12-inch

FINISH:

AQUIFERS:

WATER LEVEL:

49 feet

PUMPING EQUIPMENT: Type Deming turgine H.P. 20

Capacity 220 G.P.M.

WELL TESTS:

Drawdown 41 ft. after hours 230 G.P.

Drawdown ft. after hours G.P.

USE OF WATER Manufacturing Temp. °F. , 19

SOURCE OF INFORMATION GR-707

DRILLER or DIGGER R.J. Strasser Drilling Co., Portland, Oregon

ADDITIONAL DATA:

Log x Water Level Measurements Chemical Analysis Aquifer Test

REMARKS:

STATE ENGINEER
Salem, Oregon

8 2/2

Well Log

State Well No. 2/2-31F(1)
County Clackamas
Application No. GR-707
31 bd ⑯

Owner: Publisher's Paper Company Owner's No. 1

Driller: R. J. Strasser Date Drilled 1940

CHARACTER OF MATERIAL	(Feet below land surface)		Thickness (feet)
	From	To	
Fill material	0	14	14
Hard rock	14	43	29
Rock, not so hard	43	76	33
Very hard rock	76	89	13
→ Honey comb w/water	89	113	24
Hard rock w/seams	113	148	35
Hard rock w/seams	148	221	73
→ Honeycomb rock w/water	221	225	4
Hard rock	225	235	10
Rock not so hard	235	242	7
Hard blue rock	242	251	9

11 1/2

Page 1 of 2

32bd (28)

NOTICE TO WATER WELL CONTRACTOR
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of this report are to be
filed with the
STATE ENGINEER, SALEM, OREGON 97310
within 30 days from the date
of well completion.

AC

04427

WATER WELL REPORT
STATE OF OREGON
(Please type or print)

State Well No. 2/2-32
State Permit No.

(1) OWNER:
Name OREGON CITY PUBLIC SCHOOLS
Address OREGON CITY, OREGON

(2) LOCATION OF WELL:
County CLACKAMAS Driller's well number 4244
SE ¼ NW ¼ Section 32 T. 2S R. 2E W.M.
Bearing and distance from section or subdivision corner

(3) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
ındonment, describe material and procedure in Item 12.

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

(5) TYPE OF WELL:
Rotary ☒ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(6) CASING INSTALLED:
Threaded ☐ Welded ☒
8" Diam. from 0 ft. to 463 ft. Gage .277
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

(7) PERFORATIONS:
Perforated? ☐ 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.
perforations from ft. to ft.
perforations from ft. to ft.

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

(9) CONSTRUCTION: BENTONITE AT 20 FT
Well seal—Material used in seal CEMENT GROUT
Depth of seal 468-463 ft. Was a packer used?
Diameter of well bore to bottom of seal 12 in.
Were any loose strata cemented off? ☐ Yes ☒ No Depth
Was a drive shoe used? ☒ Yes ☐ No
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? depth of strata
Method of sealing strata off

(10) WATER LEVELS:
Static level 236 ft. below land surface Date 3/23/67
Artesian pressure lbs. per square inch Date

(11) WELL TESTS:
Drawdown is amount water level is lowered below static level
Was a pump test made? ☒ Yes ☐ No If yes, by whom? STRASS
Yield: 160 gal./min. with 121 ft. drawdown after 8 h
" 125 " 75 " 1
" 102 " 46 " 1
Bailer test gal./min. with ft. drawdown after h
Artesian flow g.p.m. Date
Temperature of water 58° Was a chemical analysis made? ☐ Yes ☒

(12) WELL LOG:
Diameter of well below casing 8
Depth drilled 544 ft. Depth of completed well 544

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

MATERIAL	FROM	TO
TOP SOIL	0	2
RED CLAY	2	14
BLUE CLAY	14	83
BROWN CLAY	83	98
BLUE CLAY	98	132
BROWN CLAY	132	180
CEMENTED GRAVEL	180	183
GREY CLAY	183	24
STICKY BLUE GREEN CLAY	246	29
GREY AND BLUE CLAY	294	34
BROWN AND RED CLAY	343	41
STICKY CONGLOMERATE	413	44
GREY CLAY	449	46
MED SOFT BLACK BASALT	460	49
DARK GREY BASALT	498	52
SOFT BLACK BASALT	523	54

Work started OCT 17 1966 Completed MAR 24 196
Date well drilling machine moved off of well MAR 25 196

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

Water Well Contractor's Certification:

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

NAME RJ STRASSER DRILLING CO
(Person, firm or corporation) (Type or print)
Address 8110 SE SUNSET LANE PORTLAND,
Drilling Machine Operator's License No. 54 AND 39
[Signed] Robert L. Strasser
(Water Well Contractor)
Contractor's License No. 10 Date APR 5 196

(USE ADDITIONAL SHEETS IF NECESSARY)

Page 2 of 2

11 2/2 AC

(28)

NOTICE TO WATER WELL CONTRACTOR
The original and first copy
of this report are to be
filed with the
STATE ENGINEER, SALEM, OREGON 97310
within 30 days from the date
of well completion.

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

04426

State Well No. 2/2-32
State Permit No. 32bd

(1) OWNER:
Name OREGON CITY PUBLIC SCHOOLS
Address OREGON CITY, OREGON

(2) TYPE OF WORK (check):
New Well ☐ Deepening ☒ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

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

(5) CASING INSTALLED: Threaded ☐ Welded ☐
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

(6) PERFORATIONS: Perforated? ☐ 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.
perforations from ft. to ft.
perforations from ft. to ft.

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

(8) WATER LEVEL: Completed well.
Static level 236 ft. below land surface Date 7/21/67
Artesian pressure lbs. per square inch Date

(9) WELL TESTS:
Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☐ No If yes, by whom? STRASSER
Yield: 350 gal./min. with 11 ft. drawdown after 8 hrs.
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water 58° Was a chemical analysis made? ☒ Yes ☐ No

(10) CONSTRUCTION:
Well seal—Material used CEMENT GROUT
Depth of seal 463 ft.
Diameter of well bore to bottom of seal in.
Were any loose strata cemented off? ☐ Yes ☒ No Depth
Was a drive shoe used? ☒ Yes ☐ No
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.

(11) LOCATION OF WELL:
County CLACK Driller's well number 4244
SE ¼ NW ¼ Section 32 T. 2S R. 2E W
Bearing and distance from section or subdivision corner

(12) WELL LOG:
Diameter of well below casing 8
Depth drilled 602 ft. Depth of completed well 602

Formation: Describe color, texture, grain size and structure of materia and show thickness and nature of each stratum and aquifer penetrat with at least one entry for each change of formation. Report each char in position of Static Water Level as drilling proceeds. Note drilling rat

MATERIAL	From	To	SWI
BLACK BASALT	544	558	
BROKEN BLACK BASALT	558	565	
HARD BLACK BASALT	565	572	
POROUS ROCK	572	580	
BLACK BASALT	580	581	
RED POROUS ROCK	581	590	
BLACK POROUS ROCK	590	592	
MED. HARD BLACK BASALT	592	602	

Work started JULY 5 1967 Completed JULY 25 196
Date well drilling machine moved off of well RIG LEFT TO REMOVE PUM

Drilling Machine Operator's Certification:
This well was constructed under my direct supervision. Materials used and information reported above are true to my be knowledge and belief.
[Signed] (Drilling Machine Operator) Date AUG 24 196
Drilling Machine Operator's License No. 54

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report true to the best of my knowledge and belief.
NAME R. T. STRASSER DRILLING Co. (Person, firm or corporation) (Type or print)
Address 8110 SE SUNSET LANE PORTLAND OREG
[Signed] Robert T. Strasser (Water Well Contractor)
Contractor's License No. 10 Date AUG 1, 196

(USE ADDITIONAL SHEETS IF NECESSARY)

-1

ORIGINAL
File Original and
Duplicate with the
STATE ENGINEER
SALEM, OREGON

WATER WELL DRILLERS REPORT
STATE OF OREGON

Do Not Fill In
State Well No 2/2-32D
State Permit No. 32bb

04425

(29)

(1) OWNER:

Name Oregon City Junior High School

Address Oregon City Oregon

(2) LOCATION OF WELL:

County Clackamas Owner's number, if any—

R. F. D. or Street No. Athletic Field Junior High

Bearing and distance from section or subdivision corner

(3) TYPE OF WORK (check):

New well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐

If abandonment, describe material and procedure in Item 11.

(4) PROPOSED USE (check):

Domestic ☐ Industrial ☐ Municipal ☐
Irrigation ☒ Test Well ☐ Other ☐

(5) EQUIPMENT:

Rotary ☐
Cable ☒
Dug Well ☐

(6) CASING INSTALLED:

Threaded ☐ Welded ☒

Surface FROM ft. to 452 ft. 8" Diam. 25.5 Gage or Wall

If gravel packed
Diameter of Bore from ft. to ft.

Type and size of shoe or well ring Std shoe Size of gravel:

Describe joint 8" pipe pressure grouted at bottom

(7) PERFORATIONS: none

Type of perforator used

Size of perforations in., length, by in.

FROM ft. to ft. perf per foot No. of rows

SCREENS:

Give Manufacturer's Name, Model No. and Size

(8) CONSTRUCTION:

Was a surface sanitary seal provided? ☒ Yes ☐ No To what depth 36 ft.

Were any strata sealed against pollution? ☒ Yes ☐ No

If yes, note depth of strata surface water

FROM ft. to ft.

METHOD OF SEALING neat cement grout

(9) WATER LEVELS:

Depth at which water was first found 540 ft.

Standing level before perforating ft.

Standing level ~~after perforating~~ 450 ft.

Log Accepted by:

[Signed] Dated 10 JAN, 1956

(10) WELL TESTS:

Was a pump test made? ☒ Yes ☐ No If yes, by whom?

Yield:	80	gal./min. with	42	ft. draw down after	6	hrs
"	70	"	29	"	6	"
"	60	"	19	"	6	"

Artesian flow g.p.m.

Shut-in pressure lbs. per square inch.

Bailer test g.p.m. with ft. drawdown

Temperature of water 61° Was a chemical analysis made? ☐ Yes ☒ No

Was electric log made of well? ☐ Yes ☐ No

(11) WELL LOG:

Diameter of well 8 inches.

Total depth 550 ft. Depth of completed well 550 ft.

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.

surface ft. to	7	ft.	Clay
7 "	26	"	Sandy clay, some broken r
26 "	55	"	Large broken rock and cla
55 "	84	"	Brown clay, broken rock
84 "	156	"	Blue clay
156 "	161	"	Hard dark grey clay
161 "	168	"	Sandy clay
168 "	197	"	Blue clay
197 "	202	"	Hard clay some broken roc
202 "	217	"	Sandy clay
217 "	242	"	Grey silt
242 "	265		Blue clay
265 "	277	"	Sandy clay
277	289	"	Blue clay
289	292	"	Hard dark grey clay
292	305	"	Blue clay
305 "	312	"	Sandy clay
312 "	393	"	Blue clay
393 "	419	"	Brown silt
419 "	429	"	Blue shale
429 "	438	"	Hard grey rock
438 "	443	"	Silty blue clay
443 "	491	"	Hard black rock
491 "	496	"	Soft black rock
496 "	503	"	Broken black rock
503 "	517	"	Soft black rock
517 "	524	"	Hard black rock
524 "	534	"	Hard blue grey rock

~~(See attached sheet)~~ (OVER)

Ground elevation at well site feet above mean sea level.

Work started July 1955 Completed Dec. 195

Well Driller's Statement:

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

R. J. Strasser Drilling Co.
NAME Robert L. Strasser- partner
(Person, firm, or corporation) (Typed or printed)

Address 8110 SE Sunset Lane-Portland 6, O

Driller's well number 3075

[Signed] Robert L. Strasser
(Well Driller)

License No. 10 Dated Jan. 6, 1956

NOTICE TO WATER WELL CONTRACTOR
The original and first copy
of this report are to be
filed with the

STATE ENGINEER, SALEM, OREGON 97310
within 30 days from the date
of well completion.

CLAC
04396

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

RECEIVED
SEP 13 1973
STATE ENGINEER
SALEM, OREGON

2S/2E-27D[illegible]
Rewwc 12-11-85 [illegible]

State Well No. ~~2S/3E-6~~
State Permit No.

(1) OWNER:
Name CLAIRMONT WATER DIST.
Address 15223 S. HENRICI ROAD
OREGON CITY ORE. 97045

(2) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

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

[illegible] CASING INSTALLED:
Threaded ☐ Welded ☒
16" Diam. from +2 ft. to 302 ft. Gage .375
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

[illegible] PERFORATIONS:
Perforated? ☐ 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.

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

(8) WELL TESTS:
Drawdown is amount water level is lowered below static level
Was a pump test made? ☒ Yes ☐ No If yes, by whom? STRASSER
Yield: 3150 gal./min. with 160 ft. drawdown after 24 hrs.
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m.
Temperature of water 57 Depth artesian flow encountered ft.

(9) CONSTRUCTION:
Well seal—Material used CEMENT GROUT
Well sealed from land surface to 30 ft.
Diameter of well bore to bottom of seal 22 in.
Diameter of well bore below seal 16 in.
Number of sacks of cement used in well seal 58 sacks
Number of sacks of bentonite used in well seal sacks
Brand name of bentonite
Number of pounds of bentonite per 100 gallons of water lbs./100 gals.
Was a drive shoe used? ☒ Yes ☐ No Plugs Size: location ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.

(10) LOCATION OF WELL:
County CLACK. Driller's well number 5451
SE ¼ NW ¼ Section 6 T. 2S R. 3E W.M.
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.
Depth at which water was first found 315 ft.
Static level 69 ft. below land surface. Date 8/17/73
Artesian pressure lbs. per square inch. Date

(12) WELL LOG:
Diameter of well below casing 16
Depth drilled 560 ft. Depth of completed well 560 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. *Report each change in position of Static Water Level and indicate principal water-bearing strata.*

MATERIAL	From	To	SWL
BROWN CLAY	0	41	
PACKED BROWN SAND	41	76	
BLUE AND GREY CLAY	76	192	
RED AND BROWN CLAYSTONE	192	299	
DECOMPOSED ROCK	299	301	
BLACK BASALT	301	315	
POROUS GREY BASALT	315	324	
MED. HARD BLACK BASALT	324	333	
BROKEN GREY BASALT	333	342	
HARD BLACK BASALT	342	371	
MED HARD BLACK BASALT	371	382	
MED SOFT BLACK BASALT	382	397	
MED HARD BLACK BASALT	397	402	
HARD BLACK BASALT	402	428	
MED HARD BLACK BASALT	428	462	
GREY BASALT	462	481	
POROUS BLACK BASALT	481	550	
HARD BLACK BASALT	550	560	

Work started APR 13 1973 Completed AUG 25 1973
Date well drilling machine moved off of well AUG 26 1973

Drilling Machine Operator's Certification:
This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.
[Signed] Don Johnson Date 9/10, 1973
(Drilling Machine Operator)
Drilling Machine Operator's License No. 57

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Name RJ STRASSER DRILLING Co
(Person, firm or corporation) (Type or print)
Address 8110 S.E. SUNSET LANE PORTLAND
[Signed] Robert L. Strasser
(Water Well Contractor)
Contractor's License No. 10 Date SEPT 10,

(USE ADDITIONAL SHEETS IF NECESSARY)

NOTICE TO WATER WELL CONTRACTOR
The original and first copy
of this report are to be
filed with the
STATE ENGINEER, SALEM, OREGON 97310
within 30 days from the date
of well completion.

CLAC 7/1-1 10

WATER WELL REPORT

STATE OF OREGON
(Please type or print)
(Do not write above this line)

State Well No. 2/2-28 E
23ca
State Permit No.
(4)

(1) OWNER:

Name PARK PLACE WATER DIST.
Address 502 17TH ST. ORE CITY, ORE.

(2) TYPE OF WORK (check):

New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐

If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:

Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(4) PROPOSED USE (check):

Domestic ☐ Industrial ☐ Municipal ☒
Irrigation ☐ Test Well ☐ Other ☐

CASING INSTALLED:

Threaded ☐ Welded ☒

10" Diam. from 0 ft. to 158 ft. Gage .279
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

PERFORATIONS:

Perforated? ☐ 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.
perforations from ft. to ft.
perforations from ft. to ft.

(7) SCREENS:

Well screen installed? ☐ Yes ☒ No

Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(8) WATER LEVEL: Completed well.

Static level 184 ft. below land surface Date 10/10/67
sian pressure lbs. per square inch Date

(9) WELL TESTS:

Drawdown is amount water level is lowered below static level

Was a pump test made? ☒ Yes ☐ No If yes, by whom? STRASSER

300 gal./min. with 10 ft. drawdown after 6 hrs.
250 - 8 - 7 -
150 - 5 - 8 -

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

(10) CONSTRUCTION:

Well seal—Material used CEMENT GROUT
Depth of seal 158 up TO 148 ft.
Diameter of well bore to bottom of seal 12 in.
Were any loose strata cemented off? ☐ Yes ☒ No Depth
Was a drive shoe used? ☒ Yes ☐ No
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.

(11) LOCATION OF WELL:

County CLACK. Driller's well number 4259
SW ¼ NW ¼ Section 28 T. 2S R. 2E W.
Bearing and distance from section or subdivision corner

(12) WELL LOG:

Diameter of well below casing 10
Depth drilled 404 ft. Depth of completed well 404

Formation: Describe color, texture, grain size and structure of material and show thickness and nature of each stratum and aquifer penetrate with at least one entry for each change of formation. Report each chan in position of Static Water Level as drilling proceeds. Note drilling rate

MATERIAL	From	To	SWL
BROWN CLAY	0	10	
GRAVEL	10	16	
BROWN AND BLUE CLAY	16	95	
SAND	95	97	
BLUE SHALE	97	115	
BLACK ROCK	115	195	
HARD BLACK BASALT	195	218	
SOFT POROUS ROCK	218	226	
BROWN ROCK	226	237	
MED. HARD BLACK BASALT	237	262	
HARD BLACK BASALT	262	270	
BROKEN BASALT	270	275	
SOFT BLACK BASALT	275	302	
MED. HARD BLACK BASALT	302	312	
RED LAVA	312	318	
MED HARD BLACK BASALT	318	337	
HARD BLACK BASALT	337	362	
MED HARD BLACK BASALT	362	386	
BROKEN BLACK BASALT	386	404	

Work started JULY 26 1967 Completed OCT 12 196
Date well drilling machine moved off of well OCT 12 196

Drilling Machine Operator's Certification:

This well was constructed under my direct supervision. Materials used and information reported above are true to my bes knowledge and belief.

[Signed] Paul O Ryllman Date NOV 22, 196
(Drilling Machine Operator)

Drilling Machine Operator's License No. 53

Water Well Contractor's Certification:

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

NAME RJ STRASSER DRILLING Co
(Person, firm or corporation) (Type or print)

Address 8110 SE SUNSET LANE PORTLAND OR

[Signed] Robert L. Strasser
(Water Well Contractor)

Contractor's License No. 10 Date NOV 22, 1967

(USE ADDITIONAL SHEETS IF NECESSARY)

CLAC 54391

RECEIVED

MAR 24 1999

WATER RESOURCES DEPT.
SALEM, OREGON

18

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765)

Instructions for completing this report are on the last page of this form.

WELL I.D. # L
START CARD # 119990

(1) OWNER: Well Number
Name City of Oregon City
Address 320 MilNE Rd
City OREGON City State ORE Zip

(2) TYPE OF WORK
☐ New Well ☐ Deepening ☐ Alteration (repair/recondition) ☒ Abandonment

(3) DRILL METHOD:
☐ Rotary Air ☐ Rotary Mud ☒ Cable ☐ Auger
☐ Other

(4) PROPOSED USE:
☐ Domestic ☐ Community ☐ Industrial ☐ Irrigation
☐ Thermal ☐ Injection ☐ Livestock ☒ Other ABANDON

(5) BORE HOLE CONSTRUCTION:
Special Construction approval ☐ Yes ☒ No Depth of Completed Well 404 ft.
Explosives used ☐ Yes ☒ No Type Amount

HOLE			SEAL			
Diameter	From	To	Material	From	To	Sacks or pounds
			N/A			

How was seal placed: Method ☐ A ☐ B ☐ C ☐ D ☐ E
☐ Other
Backfill placed from ft. to ft. Material
Gravel placed from ft. to ft. Size of gravel

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	10	0	150	.280	☒	☐	☒	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Liner:	NO				☐	☐	☐	☐
					☐	☐	☐	☐

Final location of shoe(s)

(7) PERFORATIONS/SCREENS:
☒ Perforations Method Mills Knife
☐ Screens Type Material

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
						☐	☐
140	0	3/16x2	840			☒	☐
						☐	☐
						☐	☐
						☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour

☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
			1 hr.
	N/A		

Temperature of water Depth Artesian Flow Found
Was a water analysis done? ☐ Yes By whom
Did any strata contain water not suitable for intended use? ☐ Too little
☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other
Depth of strata: N/A

(9) LOCATION OF WELL by legal description:
County ClAck Latitude Longitude
Township 2 South N or S Range 2 East E or W. WM.
Section 28 B 1/4 D 1/4
Tax Lot 1500 Lot Block Subdivision
Street Address of Well (or nearest address) 16310 Hunter Ave Oregon City Ore.

(10) STATIC WATER LEVEL:
187 ft. below land surface. Date 3/13/99
Artesian pressure lb. per square inch. Date

(11) WATER BEARING ZONES:

Depth at which water was first found N/A

From	To	Estimated Flow Rate	SWL
	N/A		

(12) WELL LOG:
Ground Elevation UNK

Material	From	To	SWL
10" CSG to 150' as per Log			
No LINER -			
PERFORATIONS 6 per ft			
8yds CEMENT pumped			
To SURFACE.			

Date started 3/13/99 Completed 3/16/99

(unbonded) Water Well Constructor Certification:

I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

WWC Number
Signed Date

(bonded) Water Well Constructor Certification:

I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

WWC Number 549
Signed Doug Cronquist Date 3/21/99

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

S 04392 (2)

NOTICE TO WATER WELL CONTRACTOR
The original and first copy
of this report are to be
filed with the
STATE ENGINEER, SALEM 10, OREGON
within 30 days from the date
of well completion.

JAN [illegible]

WATER WELL REPORT
STATE OF OREGON
(Please type or print)

State Well No. 2/2-28C
G2540 State Permit No. G-2361

(1) OWNER:

Name CLACKAMAS HOUSING AUTHORITY
Address 500 A STREET
OREGON CITY ORE

(2) LOCATION OF WELL:

County CLACK. Driller's well number 4137
¼ ¼ Section 28 T. 2S R. 2E W.M.
Bearing and distance from section or subdivision corner

(3) TYPE OF WORK (check):

Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(4) PROPOSED USE (check):

Domestic ☐ Industrial ☐ Municipal ☒
Irrigation ☐ Test Well ☐ Other ☐

(5) TYPE OF WELL:

Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(6) CASING INSTALLED: Threaded ☐ Welded ☒

10" Diam. from 0 ft. to 222 ft. Gage .277
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

(7) PERFORATIONS: Perforated? ☐ 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.
perforations from ft. to ft.
perforations from ft. to ft.

(8) SCREENS: Well screen installed ☐ Yes ☒ No

Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(9) CONSTRUCTION:

Well seal—Material used in seal CEMENT GROUT
Depth of seal 21 ft. Was a packer used? ~~NO~~ YES
Diameter of well bore to bottom of seal 16 in.
Were any loose strata cemented off? ☒ Yes ☐ No Depth 222-231
Was a drive shoe used? ☒ Yes ☐ No
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? Depth of strata
Method of sealing strata off

(10) WATER LEVELS:

Static level 305 ft. below land surface Date JAN 9, 1963
Artesian pressure lbs. per square inch Date

(11) WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☒ Yes ☐ No If yes, by whom? RJ STRASS
Yield: 300 gal./min. with 34 ft. drawdown after 8 hrs.
" 250 " 26 " "
" 200 " 19 " "
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water 58° Was a chemical analysis made? ☒ Yes ☐ No

(12) WELL LOG: Diameter of well below casing 10

Depth drilled 560 ft. Depth of completed well 560 ft.

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
LARGE GRAVEL AND CLAY	2	14
LIGHT BROWN CLAY	14	80
BROWN CLAY AND FINE SAND	80	95
BROWN SAND	95	105
GRAVEL	105	126
REDDISH BROWN SAND	126	140
MED. BROWN SAND	140	211
GREEN SHALE	211	215
BROWN SAND	215	218
BROKEN BASALT (BLACK)	218	229*
BLACK BASALT	229	295
HARD GREY BASALT	295	324
SOFT BLACK ROCK	324	330
MED. HARD BLACK ROCK	330	345
HARD GREY BASALT	345	-39
BLACK ROCK WITH SEAMS	393	409
MED. HARD BLACK ROCK	409	472
SOFT BLACK ROCK	472	516
HARD GREY BASALT	516	530
BLACK ROCK WITH CREVICES	530	553
HARD GREY BASALT	554	558
BLACK ROCK	558	560

Opt
Tr

Work started OCT 6 1962 Completed JAN 18 196
Date well drilling machine moved off of well JAN 19 196

(13) PUMP:

Manufacturer's Name
Type: H.P.

Water Well Contractor's Certification:

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

NAME RJ STRASSER DRILLING Co
(Person, firm or corporation) (Type or print)
Address 5110 SE SUNSET LANE PORT Or

Drilling Machine Operator's License No. 56

[Signed] Robert L. Strasser
(Water Well Contractor)
Contractor's License No. 10 Date JAN 19, 1963

(USE ADDITIONAL SHEETS IF NECESSARY)

OTHER LOGS USED FOR GROUNDWATER ELEVATIONS

X

NOTICE TO WATER WELL CONTRACTOR
The original and first copy
of this report are to be
filed with the
STATE ENGINEER, SALEM, OREGON 97310
within 30 days from the date
of well completion.

CLAC
04398

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

RECEIVED
JUL 1 1970
STATE ENGINEER
SALEM, OREGON

N

State Well No. 2/2-29b
State Permit No.

(1) OWNER:
Name Rich Valley Top Soil Co
Address PO Box 30 Oregon City Ore

(2) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☒ Driven ☐
Cable ☐ Jetted ☐
Dug ☐ Bored ☐

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

CASING INSTALLED:
Threaded ☐ Welded ☒
10" Diam. from 0 ft. to 159 ft. Gage .250
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

PERFORATIONS:
Perforated? ☐ 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.
perforations from ft. to ft.
perforations from ft. to ft.

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

(8) WATER LEVEL: Completed well.
Static level 21 ft. below land surface Date 6-18-70
Artesian pressure lbs. per square inch Date

(9) WELL TESTS:
Drawdown is amount water level is lowered below static level
Was a pump test made? ☒ Yes ☐ No If yes, by whom? Driller
Yield: 500 gal./min. with 79 ft. drawdown after 4 hrs.
600 " 229 " 4 "
" " " "
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) CONSTRUCTION:
Well seal—Material used Cement
Depth of seal 159 ft.
Diameter of well bore to bottom of seal 15 in.
Were any loose strata cemented off? ☐ Yes ☒ No Depth
Was a drive shoe used? ☐ Yes ☒ No
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.

(11) LOCATION OF WELL:
County Clackamas Driller's well number
¼ NW ¼ Section 29 T. 2S R. 2E W.M.
Bearing and distance from section or subdivision corner

(12) WELL LOG:
Diameter of well below casing 10" & 6"
Depth drilled 340 ft. Depth of completed well 340 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. Report each change in position of Static Water Level as drilling proceeds. Note drilling rates.

MATERIAL	From	To	SWL
Top Soil	0	19	
Large gravel	19	37	
grey Clay	37	139	
Black Basalt	139	280	
Black Basalt (Porous)	280	330	21
Black Basalt	330	340	
10" drilled to 251			

Work started May 29 1970 Completed 6-18 1970
Date well drilling machine moved off of well 6-18 1970

Drilling Machine Operator's Certification:
This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.
[Signed] Eugene M. Skyles (Drilling Machine Operator) Date 6-23, 1970
Drilling Machine Operator's License No. 271

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
NAME Skyles Drilling + Supply (Person, firm or corporation) (Type or print)
Address Gladstone Oregon.
[Signed] George F. Skyles (Water Well Contractor)
Contractor's License No. 58 Date June 25, 1970

(USE ADDITIONAL SHEETS IF NECESSARY)

16

CLAC 20301

RECEIVED
JUN - 5 1995
WATER RESOURCES DEPT.
SALEM, OREGON

2S/2E/28ac

STATE OF OREGON
WATER WELL REPORT
(as required by ORS 537.765)

(START CARD) # 67811

Instructions for completing this report are on the last page of this form.

(1) OWNER: Well Number ____
Name Dave Hayes
Address P.O. BOX 14635
City Portland State Or Zip 97214

(2) TYPE OF WORK
☒ New Well ☐ Deepening ☐ Alteration (repair/recondition) ☐ Abandonment

(3) DRILL METHOD:
☒ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Auger
☐ Other ____

(4) PROPOSED USE:
☒ Domestic ☐ Community ☐ Industrial ☐ Irrigation
☐ Thermal ☐ Injection ☐ Livestock ☐ Other ____

(5) BORE HOLE CONSTRUCTION:
Special Construction approval ☐ Yes ☒ No Depth of Completed Well 490 ft.
Explosives used ☐ Yes ☒ No Type ____ Amount ____

HOLE			SEAL			
Diameter	From	To	Material	From	To	[✓ Sacks] or pounds
10	0	119	Portland	0	59	43
6	119	500				

How was seal placed: Method ☐ A ☐ B ☒ C ☐ D ☐ E
☐ Other ____
Backfill placed from ____ ft. to ____ ft. Material ____
Gravel placed from ____ ft. to ____ ft. Size of gravel ____

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	6	+1	119	.250	☒	☐	☒	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Liner:	5	70	470	188	☒	☐	☒	☐
					☐	☐	☐	☐

Final location of shoe(s) 119

(7) PERFORATIONS/SCREENS:
☒ Perforations Method Torch
☐ Screens Type ____ Material ____

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
290	460	3/16	110	5		☐	☒
						☐	☐
						☐	☐
						☐	☐
						☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour
☒ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
20			2 hr.

Temperature of water 55° Depth Artesian Flow Found ____
Was a water analysis done? ☐ Yes By whom ____
Did any strata contain water not suitable for intended use? ☐ Too little
☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other ____
Depth of strata: ____

(9) LOCATION OF WELL by legal description:
County Clack Latitude ____ Longitude ____
Township 2 N or [✓ S] Range 2 [✓ E] or W. WM.
Section 28 SW 1/4 NE 1/4
Tax Lot ____ Lot ____ Block ____ Subdivision ____
Street Address of Well (or nearest address) off Redland Rd

(10) STATIC WATER LEVEL:
260 ft. below land surface. Date 5-24-95
Artesian pressure ____ lb. per square inch. Date ____

(11) WATER BEARING ZONES:
Depth at which water was first found 448

From	To	Estimated Flow Rate	SWL
448	475	20+	260

(12) WELL LOG:
Ground Elevation ____

Material	From	To	SWL
TOP SOIL	0	2	
CLAY TAN	2	6	
CLAY BROWN BOULDER	6	24	
CLAY TAN	24	48	
CLAY RED BROWN	48	54	
ROCK	54	80	
CLAY BLUE	80	125	
BLUE GRAY SANDY CLAY	125	448	260
FRACTURED ROCK	448	475	
ROCK	475	500	

Date started 5-9-95 Completed 5-24-95

(unbonded) Water Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.
WWC Number ____
Signed ____ Date ____

(bonded) Water Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.
WWC Number 1229
Signed Steve Anthony Date 5-30-95

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

The original and first copy of this report
are to be filed with the

WATER RESOURCES DEPARTMENT,
SALEM, OREGON 97310
within 30 days from the date
of well completion.

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

RECEIVED
MAY 11 1977
WATER RESOURCES DEPT.
SALEM, OREGON

CLAC 04384

State Well No. 2s/2E-28
State Permit No.

(1) OWNER:
Name Barbara & Gerald Smith
Address 16267 S. Oak Tree Terrace, Oregon
(Oregon, 97045) City

(2) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☒ Driven ☐
Cable ☐ Jetted ☐
Dug ☐ Bored ☐

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

[illegible] CASING INSTALLED:
Threaded ☐ Welded ☒
6" Diam. from 0 ft. to 317 ft. Gage .250
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

[illegible] PERFORATIONS:
Perforated? ☐ 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.

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

(8) WELL TESTS:
Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom?
Yield: 12 gal./min. with Total ft. drawdown after 1 hrs.
" " " "
" " " "
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m.
[illegible]perature of water Depth artesian flow encountered ft.

(9) CONSTRUCTION:
Well seal—Material used Cement
Well sealed from land surface to 20 ft.
Diameter of well bore to bottom of seal 9 in.
Diameter of well bore below seal 6 in.
Number of sacks of cement used in well seal 4 sacks
How was cement grout placed? Poured

Was a drive shoe used? ☒ Yes ☐ No Plugs Size: location ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.

(10) LOCATION OF WELL:
County Clackamas Driller's well number D57-77
¼ ¼ Section 28 T. 2S R. 2E W.M.
Bearing and distance from section or subdivision corner
Lot 7, Holcomb Hill #2

(11) WATER LEVEL: Completed well.
Depth at which water was first found 410 ft.
Static level 39D ft. below land surface. Date 5/6/77
Artesian pressure lbs. per square inch. Date

(12) WELL LOG:
Diameter of well below casing 6"
Depth drilled 455 ft. Depth of completed well 455 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. Report each change in position of Static Water Level and indicate principal water-bearing strata.

MATERIAL	From	To	SWL
Clay, brown	0	34	
Gravel Cemented	34	67	
Clay, brown	67	83	
Sandstone, brown, soft	83	270	
Clay, blue	270	283	
Clay, brown	283	317	
Basalt, Black, hrd.	317	336	
Basalt, black, frct.	336	358	
Basalt, grey, hrd.	358	412	
Basalt, grey, fract.	412		
Water, bearing		437	
Basalt, grey, hrd.	437	455	390

Work started 5/3 1977 Completed 5/6 1977
Date well drilling machine moved off of well 5/7 1977

Drilling Machine Operator's Certification:
This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.
[Signed] (Drilling Machine Operator) Date 5/6, 1977
Drilling Machine Operator's License No. 883

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Name S & M Drilling & Supply, Inc.
(Person, firm or corporation) (Type or print)
Address 399 S.E. Walnut St., Canby, Or., 97013
[Signed] (Water Well Contractor)
Contractor's License No. 497 Date 5/6, 1977

(USE ADDITIONAL SHEETS IF NECESSARY)

SP*45656-119

The original and first copy
of this report are to be
filed with the
STATE ENGINEER, SALEM, OREGON 97310
within 30 days from the date
of well completion.

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

RECEIVED
JUN 15 1977
WATER RESOURCES DEPT.
SALEM, OREGON

CLAC
NC
04385

State Well No. 2S/2E-28 ab

State Permit No. ____

(1) OWNER:
Name John L. & Sharyl A. Ferrier
c/o Double "C" Construction Co.
Address 164 N.E. 5th St., Canby Oregon 97013

(2) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐

If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☒ Driven ☐
Cable ☐ Jetted ☐
Dug ☐ Bored ☐

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

CASING INSTALLED:
Threaded ☐ Welded ☒

6" Diam. from 0 ft. to 377 ft. Gage .250
____" Diam. from ____ ft. to ____ ft. Gage ____
____" Diam. from ____ ft. to ____ ft. Gage ____

PERFORATIONS:
Perforated? ☐ 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.

(7) SCREENS:
Well screen installed? ☐ Yes ☒ No

Manufacturer's Name ____
Type ____ Model No. ____
Diam. ____ Slot size ____ Set from ____ ft. to ____ ft.
Diam. ____ Slot size ____ Set from ____ ft. to ____ ft.

(8) WELL TESTS:
Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☒ No If yes, by whom? ____
Yield: 15 gal./min. with Total ft. drawdown after 1 hrs.
" " " "
" " " "
Bailer test ____ gal./min. with ____ ft. drawdown after ____ hrs.
Artesian flow ____ g.p.m.
Temperature of water ____ Depth artesian flow encountered ____ ft.

(9) CONSTRUCTION:
Well seal—Material used Cement
Well sealed from land surface to 38 ft.
Diameter of well bore to bottom of seal 9 in.
Diameter of well bore below seal 6 in.
Number of sacks of cement used in well seal 7 sacks
Number of sacks of bentonite used in well seal ____ sacks
Brand name of bentonite Poured
Number of pounds of bentonite per 100 gallons of water ____ lbs./100 gals.
Was a drive shoe used? ☒ Yes ☐ No Plugs ____ Size: location ____ ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? ____ depth of strata ____
Method of sealing strata off ____
Was well gravel packed? ☐ Yes ☒ No Size of gravel: ____
Gravel placed from ____ ft. to ____ ft.

(10) LOCATION OF WELL:
County Clackamas Driller's well number D68-77
NW ¼ NE ¼ Section 28 T. 2S R. 2 E W.M.
Bearing and distance from section or subdivision corner
S. Oak Tree Terrace
Tax lot 1701

(11) WATER LEVEL: Completed well.
Depth at which water was first found 190 ft.
Static level 400 ft. below land surface. Date 6/9/77
Artesian pressure ____ lbs. per square inch. Date ____

(12) WELL LOG:
Diameter of well below casing 6"
Depth drilled 520 ft. Depth of completed well 520 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. *Report each change in position of Static Water Level and indicate principal water-bearing strata.*

MATERIAL	From	To	SWL
Topsoil	0	2	
Clay, brown	2	15	
Basalt, grey	15	30	
Clay, brown	30	71	
Gravel, cemented	71	93	
Clay, brown	93	132	
Clay, blue	132	157	
Sandstone, brown	157	316	
Clay, blue, sandy	316	351	
Clay, brown, sandy	351	372	
Basalt, black, fractured	372	415	
Basalt, black, hard	415	448	
Basalt, black, fractured	448	507	
Basalt, black, hard	507	512	
Basalt, black, fractured	512		
Water bearing		520	400

Work started 6/3/ 19 77 Completed 6/9 19 77
Date well drilling machine moved off of well 6/9 19 77

Drilling Machine Operator's Certification:

This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.

[Signed] David Donnelly Date 6/9, 1977
(Drilling Machine Operator)

Drilling Machine Operator's License No. 883

Water Well Contractor's Certification:

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

Name S & M Drilling & Supply Inc.
(Person, firm or corporation) (Type or print)
Address 399 S.E. Walnut St., Canby, Ore. 97013
[Signed]
(Water Well Contractor)
Contractor's License No. 497 Date 6/9, 19 77

(USE ADDITIONAL SHEETS IF NECESSARY)

SP*45656-119

filed with the
STATE ENGINEER, SALEM, OREGON 97310
within 30 days from the date
of well completion.

CLAC

04391

STATE OF OREGON
(Please type or print)
(Do not write above this line)

MAY 5 1976
TER RESOURCES DEPT
SALEM, OREGON

State Well No. 2S/2E-28F
State Permit No.

(1) OWNER:

Name Gilbert S. OKita
Address 6708 S. E. Hazel St.
Portland, Oregon 97206

(2) TYPE OF WORK (check):

New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐

If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:

Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(4) PROPOSED USE (check):

Domestic ☒ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

[illegible] CASING INSTALLED:

Threaded ☐ Welded ☒

6" Diam. from +1 ft. to 203 ft. Gage .250
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

[illegible] PERFORATIONS:

Perforated? ☐ 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.

(7) SCREENS:

Well screen installed? ☐ Yes ☒ No

Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(8) WELL TESTS:

Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☒ No If yes, by whom?

[illegible]ield: gal./min. with ft. drawdown after hrs.
" " "
" " "

Bailer test 10 gal./min. with 45 ft. drawdown after 1 hrs.

[illegible]sian flow g.p.m.

[illegible]rature of water Depth artesian flow encountered - ft.

(9) CONSTRUCTION:

Well seal—Material used Bentonite & puddled clay
Well sealed from land surface to 48 ft.
Diameter of well bore to bottom of seal 10 in.
Diameter of well bore below seal 6 in.
Number of sacks of cement used in well seal sacks
Number of sacks of bentonite used in well seal 1 sacks
Brand name of bentonite International
Number of pounds of bentonite per 100 gallons of water 100 lbs./100 gals.
Was a drive shoe used? ☒ Yes ☐ No Plugs Size: location ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.

(10) LOCATION OF WELL:

County Clackamas Driller's well number
NW ¼ NW ¼ Section 28 T. 2S R. 2E W.M.
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.

Depth at which water was first found 505 ft.
Static level 307 ft. below land surface. Date 4/16/76
Artesian pressure lbs. per square inch. Date

(12) WELL LOG:

Diameter of well below casing 6
Depth drilled 522 ft. Depth of completed well 522 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. *Report each change in position of Static Water Level and indicate principal water-bearing strata.*

MATERIAL	From	To	SWL
Top soil & gravel	0	2	
Clay, gravel, brown	2	16	
Clay, blue & gravel	16	35	
Gravel some clay, blue	35	42	
Clay, tan & gravel	42	74	
Sandstone, brown	74	93	
Sand, brown	93	112	
Gravel, med. brown	112	178	
Sand, grey, mica	178	185	
Clay & sand, brown	185	195	
Sand, brown	195	199	
Clay, blue, hard	199	203	
Rock, black, basalt	203	243	
Rock, brown	243	255	
Rock, basalt, black	255	385	
Rock grey, hard.	385	480	
Rock, basalt, black	480	505	
Rock, black, soft	505	520	307
Rock, black, hard	520	522	

Work started 2/21 1976 Completed 4/20 1976
Date well drilling machine moved off of well 4/20 1976

Drilling Machine Operator's Certification:

This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.

[Signed] Al Boyer Date 4/26, 1976
(Drilling Machine Operator)
Drilling Machine Operator's License No. 942

Water Well Contractor's Certification:

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

Name C. G. Westerberg
(Person, firm or corporation) (Type or print)
Address Rt. 1, Box 151 Mulino, Oregon
[Signed] C. G. Westerberg
(Water Well Contractor)
Contractor's License No. 86 Date 4/26, 1976

(USE ADDITIONAL SHEETS IF NECESSARY)

SP*45656-119

NOTICE TO WATER WELL CONTRACTOR
The original and first copy
of this report are to be
filed with the
STATE ENGINEER, SALEM, OREGON 97310
within 30 days from the date
of well completion.

04429

RECEIVED
JUN 28 1966

WATER WELL REPORT
STATE OF OREGON
(Please type or print)

State Well No. 2/2-33

State Permit No.

(1) OWNER:

Name KING, John
Address Rt. 2 Box 72
Oregon City, Oregon

(2) LOCATION OF WELL:

County Clackamas Driller's well number 1966-17
¼ ¼ Section 33 T. 2 S R. 2 E W.M.

Bearing and distance from section or subdivision corner

(3) TYPE OF WORK (check):

New Well ☑ Deepening ☐ Reconditioning ☐ Abandon ☐

If abandonment, describe material and procedure in Item 12.

(4) PROPOSED USE (check):

Domestic ☑ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

(5) TYPE OF WELL:

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

(6) CASING INSTALLED:

Threaded ☐ Welded ☑

6" Diam. from 0 ft. to 99 ft. Gage .250
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

(7) PERFORATIONS:

Perforated? ☐ 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.
perforations from ft. to ft.
perforations from ft. to ft.

(8) SCREENS:

Well screen installed? ☐ Yes ☑ No

Manufacturer's Name
Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(9) CONSTRUCTION:

Well seal—Material used in seal Bentonite
Depth of seal 23 ft. Was a packer used? no
Diameter of well bore to bottom of seal 9 in.
Were any loose strata cemented off? ☐ Yes ☑ No Depth
Was a drive shoe used? ☑ Yes ☐ No
Was well gravel packed? ☐ Yes ☑ No Size of gravel:
Gravel placed from ft. to ft.
Did any strata contain unusable water? ☐ Yes ☐ No
Type of water? depth of strata
Method of sealing strata off

(10) WATER LEVELS:

Static level 40 ft. below land surface Date June 6-66
Artesian pressure lbs. per square inch Date

(USE ADDITIONAL SHEETS IF NECESSARY)

(11) WELL TESTS:

Drawdown is amount water level is lowered below static level

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

Yield: 55 gal./min. with 70 ft. drawdown after 1 hrs.
" 42 " 50 " 1 "
" 20 " 20 " 1 "
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water 54 Was a chemical analysis made? ☐ Yes ☐ No

(12) WELL LOG:

Diameter of well below casing 6
Depth drilled 120 ft. Depth of completed well 120 ft.

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
Gravel + Sand	0	3
Sand, Brown, mud	3	23
Clay, Blue, sandy	23	36
Clay, Gray, sandy	36	99
Lava	99	112
Lava, Porous (Water)	112	118
Lava	118	120

Work started June 3 1966 Completed June 6 1966
Date well drilling machine moved off of well June 7 1966

(13) PUMP:

Manufacturer's Name Fairbanks-Morse
Type: Submersible H.P. 15

Water Well Contractor's Certification:

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

NAME SKYLES DRILLING & SUPPLY
(Person, firm or corporation) (Type or print)
Address GLADSTONE, OREGON
Drilling Machine Operator's License No. 224
[Signed] George H. Skyles
(Water Well Contractor)
Contractor's License No. 58 Date June 8, 1966

of this report are to be
filed with the
STATE ENGINEER, SALEM, OREGON 97310
within 30 days from the date
of well completion.

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

CLAC

04222

JUL 21 1976
WATER RESOURCES DEPT.
SALEM, OREGON

State Well No. ____
State Permit No. 2S/2E-19ba

(1) OWNER:
Name Pay 'n' Pak Store
Address 18625 SE McLoughlin Blvd.
Milwaukie, OR 97222

(2) TYPE OF WORK (check):
New Well ☒x Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary XX Driven ☐
Cable ☐ Jetted ☐
Dug ☐ Bored ☐

(4) PROPOSED USE (check):
Domestic ☐ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other Store XX

CASING INSTALLED:
Threaded ☐ Welded ☒X
6" Diam. from +1 ft. to 71 ft. Gage .250
5" Diam. from +1 ft. to 118 ft. Gage .188
____" Diam. from ____ ft. to ____ ft. Gage ____

PERFORATIONS:
Perforated? ☒Yes ☐ No.
Type of perforator used Torch
Size of perforations ____ in. by ____ in.
____ perforations from ____ ft. to ____ ft.
____ perforations from ____ ft. to ____ ft.
____ perforations from ____ ft. to ____ ft.

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

(8) WELL TESTS:
Drawdown is amount water level is lowered below static level
Was a pump test made? ☒Yes ☐ No If yes, by whom? Driller
Air
Yield: 20 gal./min. with 80 ft. drawdown after 1 hrs.
" " " "
" " " "
Bailer test ____ gal./min. with ____ ft. drawdown after ____ hrs.
Artesian flow ____ g.p.m.
perature of water ____ Depth artesian flow encountered ____ ft.

(9) CONSTRUCTION:
Well seal—Material used Cement
Well sealed from land surface to 40 ft.
Diameter of well bore to bottom of seal 10 in.
Diameter of well bore below seal 6 in.
Number of sacks of cement used in well seal 7 sacks
Number of sacks of bentonite used in well seal 0 sacks
Brand name of bentonite none
Number of pounds of bentonite per 100 gallons of water ____ lbs./100 gals.
Was a drive shoe used? ☒Yes ☐ No Plugs ____ Size: location ____ ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? ____ depth of strata ____
Method of sealing strata off ____
Was well gravel packed? ☐ Yes ☒No Size of gravel: ____
Gravel placed from ____ ft. to ____ ft.

(10) LOCATION OF WELL:
County Clackamas Driller's well number 36-76
NE ¼ NW ¼ Section 19 T. 2S R. 2E W.M.
Bearing and distance from section or subdivision corner ____

(11) WATER LEVEL: Completed well.
Depth at which water was first found 140 ft.
Static level 95 ft. below land surface. Date 6-24-76
Artesian pressure ____ lbs. per square inch. Date ____

(12) WELL LOG:
Diameter of well below casing 6
Depth drilled 180 ft. Depth of completed well 180 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. *Report each change in position of Static Water Level and indicate principal water-bearing strata.*

MATERIAL	From	To	SWL
Topsoil	0	1	
Sandy Clay	1		
Clay brown	25	70	
Lava grey	70	73	
Lava weathered	73	118	
Lava grey with layers of weathered material	118	180	95

Work started 6-22 1976 Completed 6-24 1976
Date well drilling machine moved off of well 6-24 1976

Drilling Machine Operator's Certification:
This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.
[Signed] Eugene M. Skyles (Drilling Machine Operator) Date 7-14, 1976
Drilling Machine Operator's License No. 271

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Name Skyles Drilling and Supply
(Person, firm or corporation) (Type or print)
Address 1169 Molalla Ave., Oregon City, OR
[Signed] Marvin D. Skyles
(Water Well Contractor)
Contractor's License No. 553 Date 7-14 1976

(USE ADDITIONAL SHEETS IF NECESSARY)

SP*45656-119

CLAC 20497

RECEIVED SEP 1995 WATER RESOURCES DEPT SALEM, OREGON

16

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765)

(START CARD) # 61413

Instructions for completing this report are on the last page of this form.

(1) OWNER:
Well Number 2

Name oregon conference of

Address 13455 S.E. 97 th Ave.

City clackomas State ore. Zip 97015

(2) TYPE OF WORK
☑ New Well ☐ Deepening ☐ Alteration (repair/recondition) ☐ Abandonment

(3) DRILL METHOD:
☑ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Auger
☐ Other

(4) PROPOSED USE:
☑ Domestic ☐ Community ☐ Industrial ☐ Irrigation
☐ Thermal ☐ Injection ☐ Livestock ☐ Other

(5) BORE HOLE CONSTRUCTION:
Special Construction approval ☐ Yes ☑ No Depth of Completed Well 242 ft.

Explosives used ☐ Yes ☑ No Type Amount

HOLE			SEAL			
Diameter	From	To	Material	From	To	Sacks or pounds
10"	0	19'	cement	0	19	12 Szk
6"	19	242'				

How was seal placed: Method ☐ A ☐ B ☑ C ☐ D ☐ E
☐ Other

Backfill placed from ft. to ft. Material

Gravel placed from ft. to ft. Size of gravel

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	6"	+1	19'	250	☑	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Liner:	4"	4'	242		☐	☑	☑	☐
					☐	☐	☐	☐

Final location of shoe(s)

(7) PERFORATIONS/SCREENS:
☐ Perforations Method saw cut

☐ Screens Type Material

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
203	259	1/8	76	6" long		☐	☑
						☐	☐
						☐	☐
						☐	☐
						☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour

☐ Pump ☐ Bailer ☑ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
60 GPM		240'	1 hr.
50 GPM		220	½hr

Temperature of water 52 Depth Artesian Flow Found

Was a water analysis done? ☐ Yes By whom

Did any strata contain water not suitable for intended use? ☐ Too little

☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other

Depth of strata:

(9) LOCATION OF WELL by legal description:
County Clackomas Latitude Longitude

Township 2 S N or S Range 2 E E or W. WM.

Section 20 SE 1/4 SE 1/4

Tax Lot 00100 Lot Block Subdivision

Street Address of Well (or nearest address) 199800 S. E. oatfield Rd. clackomas ore.

(10) STATIC WATER LEVEL:
116 ft. below land surface. Date 5-8-95

Artesian pressure lb. per square inch. Date

(11) WATER BEARING ZONES:

Depth at which water was first found

From	To	Estimated Flow Rate	SWL
118	240	60 GPM	

(12) WELL LOG:
Ground Elevation

Material	From	To	SWL
Soil and Rock (Broken)	0	1	
Broken Rock & Clay	1	7	
Rock hard Basalt	7	38	
Rock broken	38	40	
ROck hard Basalt	40	118	
Broken & Honeycone Rock	118	225	
Rock with Fractures	225	236	
Rock hard Basalt	238	242	

ROBINSON DRILLING
WELLS & PUMPS
4520 Dallas-Salem Hwy.
Salem, Ore. 97304
371-1844

Date started 5-1-95 Completed 5-8-95

(unbonded) Water Well Constructor Certification:

I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

WWC Number

Signed Date

(bonded) Water Well Constructor Certification:

I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

WWC Number 0613

Signed George H Robinson Date 5-15-95

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

WELLS COMPLETED IN SEDIMENTARY DEPOSITS

A

CLAC

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the
STATE ENGINEER, SALEM, OREGON 97310
within 30 days from the date of well completion.

RECEIVED
OCT 21 1966
STATE ENGINEER
SALEM, OREGON

WATER WELL REPORT
STATE OF OREGON
(Please type or print)

04390

State Well No. 2/2-28

State Permit No.

(1) OWNER:

Name Curtis Robinson

Address Rt 2 Box 86
Oregon City Ore

(2) LOCATION OF WELL:

County Clackamas Driller's well number 1966-36

¼ ¼ Section 28 T. 2S R. 2E W.M.

Bearing and distance from section or subdivision corner

(3) TYPE OF WORK (check):

New Well ☑ Deepening ☐ Reconditioning ☐ Abandon ☐

If abandonment, describe material and procedure in Item 12.

(4) PROPOSED USE (check):

Domestic ☑ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

(5) TYPE OF WELL:

Rotary ☐ Driven ☐
Cable ☐ Jetted ☐
Dug ☐ Bored ☐

(6) CASING INSTALLED: Threaded ☐ Welded ☑

6" Diam. from 0 ft. to 247 ft. Gage .25
5" Diam. from ~~283~~ 233 ft. to 260 ft. Gage .10ga
" Diam. from ft. to ft. Gage

(7) PERFORATIONS: Perforated? ☑ Yes ☐ No

Type of perforator used Torch

Size of perforations 1/8 in. by 14 in.

60 perforations from 245 ft. to 260 ft.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

(8) SCREENS: Well screen installed? ☐ Yes ☑ No

Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(9) CONSTRUCTION:

Well seal—Material used in seal Bentonite

Depth of seal 270 ft. Was a packer used? No

Diameter of well bore to bottom of seal 9 in.

Were any loose strata cemented off? ☐ Yes ☑ No Depth

Was a drive shoe used? ☑ Yes ☐ No

Was well gravel packed? ☐ Yes ☑ No Size of gravel:

Gravel placed from ft. to ft.

Did any strata contain unusable water? ☐ Yes ☑ No

Type of water? depth of strata

Method of sealing strata off

(10) WATER LEVELS:

Static level 198 ft. below land surface Date

Artesian pressure lbs. per square inch Date

(USE ADDITIONAL SHEETS IF NECESSARY)

(11) 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 50 ft. drawdown 235 after 1 hrs.
" 15 " 40 " 238 1 "
" " " "

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

(12) WELL LOG: Diameter of well below casing

Depth drilled 260 ft. Depth of completed well 260 ft.

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
Clay, Brown	0	4
Sand " Med.	4	14
Gravel, + sand cement	14	35
Clay, tan	35	58
Clay, gray	58	106
Clay Tan	106	149
Gravel + Clay, Tan	149	181
Clay Tan	181	184
Gravel & Clay Tan	184	198
Clay, Brown	198	218
Gravel + Clay, Brown	218	220
Clay, Brown	220	229
" Gray	229	243
Sand, Coarse	243	258

Work started Oct 3 1966 Completed Oct 14 1966

Date well drilling machine moved off of well Oct 14 1966

(13) PUMP:

Manufacturer's Name

Type: H.P.

Water Well Contractor's Certification:

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

NAME SKYLES DRILLING & SUPPLY
(Person, firm or corporation) (Type or print)

Address GLADSTONE, OREGON

Drilling Machine Operator's License No. 224

[Signed] George F. Skyles
(Water Well Contractor)

Contractor's License No. 58 Date 19

NOTICE TO WATER WELL CONTRACTOR
The original and first copy
of this report are to be
filed with the
STATE ENGINEER, SALEM, OREGON 97310
within 30 days from the date
of well completion.

RECEIVED
AUG 20 1970
STATE ENGINEER
SALEM, OREGON

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

CLAC
04387

State Well No. 2/2-28
State Permit No.

B

(1) OWNER:
Name Robert Hayn
Address 14200 S. Livesay Rd., Oregon City, Ore. 97045

(2) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

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

CASING INSTALLED:
Threaded ☐ Welded ☒
6 " Diam. from 0 ft. to 140 ft. Gage .250
5 " Diam. from 135 ft. to 160 ft. Gage 10
" Diam. from ft. to ft. Gage

PERFORATIONS:
Perforated? ☒ Yes ☐ No.
Type of perforator used Torch
Size of perforations 1/4 in. by 13 in.
39 perforations from 142 ft. to 160 ft.
perforations from ft. to ft.
perforations from ft. to ft.

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

(8) 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.
" " "
" " "
Bailer test 30 gal./min. with 76 ft. drawdown after 2 hrs.
Artesian flow g.p.m.
Temperature of water Depth artesian flow encountered ft.

CONSTRUCTION:
Well seal—Material used Bentonite-Puddled Clay
Well sealed from land surface to 18 ft.
Diameter of well bore to bottom of seal 10 in.
Diameter of well bore below seal 6 in.
Number of sacks of cement used in well seal sacks
Number of sacks of bentonite used in well seal 2 sacks
Brand name of bentonite National
Number of pounds of bentonite per 100 gallons of water lbs./100 gals.
Was a drive shoe used? ☒ Yes ☐ No Plugs Size: location ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.

(10) LOCATION OF WELL:
County Clackamas Driller's well number 70-19
¼ ¼ Section 28 T. 2S R. 2E W.M.
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.
Depth at which water was first found 42 ft.
Static level 64 ft. below land surface. Date 8-8-70
Artesian pressure lbs. per square inch. Date

(12) WELL LOG:
Diameter of well below casing 6"
Depth drilled 160 ft. Depth of completed well 160 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. *Report each change in position of Static Water Level and indicate principal water-bearing strata.*

MATERIAL	From	To	SWL
Topsoil-Brown	0	2	
Clay-Sandy-Brown	2	42	
Sand-Fine-Silty Water Seeps	42	84	
Clay-Blue-Sandy	84	94	
Sand-Fine-Mica-Bl.-Water	94	98	
Sand-Bl.-Fine-Gravel-Med-Micky Water	98	100	
Clay-Blue	100	128	
Clay-Gray-Sandy	128	138	
Clay-Gray-Gravel Trace-Fine-Med-Water	138	140	42
Clay-Blue	140	156	
Sand-Med	156	160	

Work started 8-4 1970 Completed 8-7 1970
Date well drilling machine moved off of well 8-8 1970

Drilling Machine Operator's Certification:
This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.
[Signed] Kenneth Skinner Date 8-18, 1970
(Drilling Machine Operator)
Drilling Machine Operator's License No. 277

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Name S & M Drilling & Supply
(Person, firm or corporation) (Type or print)
Address Rt. 1 Box 31, Canby, Ore.
[Signed] Kenneth Skinner
(Water Well Contractor)
Contractor's License No. 520 Date 8-18, 1970

(USE ADDITIONAL SHEETS IF NECESSARY)

SP*45656-11

WATER WELL CONTRACTOR
The original and first copy of this report
are to be filed with the

WATER RESOURCES DEPARTMENT
SALEM, OREGON 97310
within 30 days from the date
of well completion.

WATER WELL REPORT
STATE OF OREGON
(Please type or print)

04386 (Do not write above this line)

CLAC

RECEIVED
APR 12 1977
WATER RESOURCES DEPT.
SALEM, OREGON

State Well No. 2S/2E-28C
State Permit No.

C

(1) OWNER:
Name George A. Munson
Address 14077 S. Redland Rd.
Oregon City, Oregon 97045

(2) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

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

CASING INSTALLED:
Threaded ☐ Welded ☒
6 " Diam. from *1 ft. to 129 ft. Gage *.250
59/16 Diam. from 123 ft. to 163 ft. Gage *.188
" Diam. from ft. to ft. Gage

PERFORATIONS:
Perforated? ☒ Yes ☐ No.
Type of perforator used Torch
Size of perforations 7 in. by 3/16 in.
~~[illegible]~~ 40 perforations from 138 ft. to 163 ft.
perforations from ft. to ft.
perforations from ft. to ft.

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

(8) 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.
" " " "
" " " "
Bailer test 25 gal./min. with 38 ft. drawdown after 1 hrs.
Artesian flow g.p.m.
Temperature of water 54 Depth artesian flow encountered ft.

(9) CONSTRUCTION:
Well seal—Material used Bentonite
Well sealed from land surface to 25 ft.
Diameter of well bore to bottom of seal 10 in.
Diameter of well bore below seal 6 in.
Number of sacks of cement used in well seal sacks
How was cement grout placed? 200lbs of
International Jel bentonite

Was a drive shoe used? ☒ Yes ☐ No Plugs Size: location ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.

(10) LOCATION OF WELL:
County Clackamas Driller's well number
SW ¼ SW ¼ Section 28 T. 2S R. 2E W.M.
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.
Depth at which water was first found 138 ft.
Static level 74 ft. below land surface. Date 3/9/77
Artesian pressure lbs. per square inch. Date

(12) WELL LOG:
Diameter of well below casing
Depth drilled 163 ft. Depth of completed well 163 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. Report each change in position of Static Water Level and indicate principal water-bearing strata.

MATERIAL	From	To	SWL
Top soil	0	3	
Clay, tan	3	6	
Gravel & clay, tan	6	14	
Clay, grey	14	29	
Clay, blue	29	57	
Clay, grey	57	82	
Clay, blue, gritty	82	108	
Clay, grey	108	111	
Clay, blue	111	123	
Clay, grey	123	138	
Sandstone, black	138	146	74
Claystone, blue	146	148	
Sandstone, black	148	163	74

Work started 3/8 1977 Completed 3/11 1977
Date well drilling machine moved off of well 3/11 1977

Drilling Machine Operator's Certification:
This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.
[Signed] (Drilling Machine Operator) Date 3/14, 1977
Drilling Machine Operator's License No. 942

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Name C. G. Westerberg (Person, firm or corporation) (Type or print)
Address Rt. 1, Box 151, Mulino, Oregon
[Signed] C G Westerberg (Water Well Contractor)
Contractor's License No. 86 Date 3/14, 1977

(USE ADDITIONAL SHEETS IF NECESSARY)

SP*45656-119

NOTICE TO WATER WELL CONTRACTOR
The original and first copy
of this report are to be
filed with the
STATE ENGINEER, SALEM, OREGON 973
within 30 days from the date
of well completion.

CLAC

RECEIVED
MAR 25 1970
STATE ENGINEER
SALEM, OREGON

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

CLAC
04401

State Well No. 2/2-29dc
State Permit No.

D

(1) OWNER:
Name Lester Yakes
Address Rt 2 Box 10 Oregon City, Ore

(2) TYPE OF WORK (check):
New Well ☐ Deepening ☑ Reconditioning ☑ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☑ Driven ☐
Cable ☐ Jetted ☐
Du ☐ Bored ☐

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

(5) CASING INSTALLED: Threaded ☐ Welded ☑
5" Diam. from 45 ft. to 65 ft. Gage 10
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

PERFORATIONS: Perforated? ☑ Yes ☐ No.
Type of perforator used Torch
Size of perforations 1/8 in. by 12 in.
72 perforations from 45 ft. to 65 ft.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

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

(8) WATER LEVEL: Completed well.
laval 27 ft. below land surface Date 3-12-70
Artesian pressure lbs. per square inch Date

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☑ Yes ☐ No If yes, by whom? Driller
: 32 gal./min. with 36 ft. drawdown after 1 hrs.
" 21 " 21 " 1/2 "
" 12 " 11 " 1/2 "
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water 50 Was a chemical analysis made? ☐ Yes ☑ No

(10) CONSTRUCTION:
Well seal—Material used 6" casing Not-Disturbed
Depth of seal ft.
Diameter of well bore to bottom of seal in.
Were any loose strata cemented off? ☐ Yes ☐ No Depth
Was a drive shoe used? ☐ Yes ☐ No
Did any strata contain unusable water? ☐ Yes ☑ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☑ No Size of gravel:
Gravel placed from ft. to ft.

(11) LOCATION OF WELL:
County Clackamas Driller's well number
SW ¼ SE ¼ Section 29 T. 2S R. 2E W.M.
Bearing and distance from section or subdivision corner

(12) WELL LOG: Diameter of well below casing 6"
Depth drilled 70 ft. Depth of completed well 65 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. Report each change in position of Static Water Level as drilling proceeds. Note drilling rates.

MATERIAL	From	To	SWL
well was gravel packed from 44'-60'			
Gravel was drilled out and well was deepend to 65'			
Sand gray medium	45	65	29
Clay gray	65	70	27

Work started March 12 1970 Completed March 12 1970
Date well drilling machine moved off of well March 12 1970

Drilling Machine Operator's Certification:
This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.
[Signed] Date 3-18, 1970
(Drilling Machine Operator)
Drilling Machine Operator's License No. 224

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
NAME Skyles Drilling & Supply Inc
(Person, firm or corporation) (Type or print)
Address Gladstone Oregon
[Signed] George H. Skyles
(Water Well Contractor)
Contractor's License No. 58 Date 3-18, 1970

(USE ADDITIONAL SHEETS IF NECESSARY)

NOTICE TO WATER WELL CONTRACTOR
The original and first copy
of this report are to be
filed with the
STATE ENGINEER, SALEM, OREGON 97310
within 30 days from the date
of well completion.

CLAC
04400

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

RECEIVED
JAN 29 1974
STATE ENGINEER
SALEM, OREGON

dc

State Well No. 2S/2E-29
State Permit No.

E

(1) OWNER:
Name DENNIS MAGNUS
Address 19671 S. McCUBBIN RD
OREGON CITY OREGON

(2) TYPE OF WORK (check):
New Well ☑ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☑ Jetted ☐
Dug ☐ Bored ☐

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

CASING INSTALLED: Threaded ☐ Welded ☑
6 " Diam. from 0 ft. to 147 ft. Gage 250
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

PERFORATIONS: Perforated? ☑ Yes ☐ No.
Type of perforator used MILLS KNIFE
Size of perforations 3/8 in. by 2 in.
240 perforations from 80 ft. to 140 ft.
perforations from ft. to ft.
perforations from ft. to ft.

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

(8) 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.
" " "
" " "
Bailer test 35 gal./min. with 25 ft. drawdown after 1 hrs.
Artesian flow g.p.m.
perature of water Depth artesian flow encountered ft.

(9) CONSTRUCTION:
Well seal—Material used CEMENT-BENTONITE
Well sealed from land surface to 47 ft.
Diameter of well bore to bottom of seal 10 in.
Diameter of well bore below seal 6 in.
Number of sacks of cement used in well seal 8 sacks
Number of sacks of bentonite used in well seal 2 sacks
Brand name of bentonite NATIONAL
Number of pounds of bentonite per 100 gallons of water #8 MASH lbs./100 gals.
Was a drive shoe used? ☑ Yes ☐ No Plugs Size: location ft.
Did any strata contain unusable water? ☐ Yes ☑ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☑ No Size of gravel:
Gravel placed from ft. to ft.

(10) LOCATION OF WELL:
County CLACKAMAS Driller's well number 284
SW ¼ SE ¼ Section 29 T. 2S R. 2E W.M.
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.
Depth at which water was first found 80 ft.
Static level 60 ft. below land surface. Date 1-17-74
Artesian pressure lbs. per square inch. Date

(12) WELL LOG: Diameter of well below casing 6"
Depth drilled 150 ft. Depth of completed well 150 ft.
Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. *Report each change in position of Static Water Level and indicate principal water-bearing strata.*

MATERIAL	From	To	SWL
TOP SOIL	0	1	
BROWN CLAY	1	6	
CLAY AND GRAVEL	6	37	
BROWN CLAY	37	57	
CEMENTED GRAVEL	57	147	60
BROWN CLAY	147	150	

Work started 1-2 1973 Completed 1-17 1974
Date well drilling machine moved off of well 1-17 1974

Drilling Machine Operator's Certification:
This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.
[Signed] OE Keller (Drilling Machine Operator) Date 1-26, 1974
Drilling Machine Operator's License No. 462

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Name KELLER WELL DRILLING Co (Person, firm or corporation) (Type or print)
Address 5365 S.E. HILLWOOD MILWAUKIE
[Signed] OE Keller (Water Well Contractor)
Contractor's License No. 462 Date 1-26, 1974

(USE ADDITIONAL SHEETS IF NECESSARY)

NOTICE TO WATER WELL CONTRACTOR
The original and first copy
of this report are to be
filed with the

STATE ENGINEER, SALEM, OREGON 97310
within 30 days from the date
of well completion.

CLAC
04402

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

RECEIVED
NOV 9 1972
STATE ENGINEER
SALEM, OREGON

State Well No. 2S/2E-29dd
State Permit No.

F

(1) OWNER:
Name FRED MITTLESTADT
Address 13771 S. REDLAND R.D.
OREGON CITY

(2) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

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

(5) CASING INSTALLED:
Threaded ☐ Welded ☒ #
6" Diam. from 0 ft. to 66 ft. Gage 17.07
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

([illegible]) PERFORATIONS:
Perforated? ☐ 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.

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

(8) 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.
" " " "
" " " "
Bailer test 27 gal./min. with 14 ft. drawdown after 1 hrs.
Artesian flow g.p.m.
[illegible]erature of water 50 Depth artesian flow encountered ft.

(9) CONSTRUCTION:
Well seal—Material used CEMENT-BENTONITE
Well sealed from land surface to 45 ft.
Diameter of well bore to bottom of seal 10 in.
Diameter of well bore below seal 6 in.
Number of sacks of cement used in well seal 10 sacks
Number of sacks of bentonite used in well seal 1 sacks
Brand name of bentonite QUICK GEL
Number of pounds of bentonite per 100 gallons of water lbs./100 gals.
Was a drive shoe used? ☒ Yes ☐ No Plugs Size: location ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.

(10) LOCATION OF WELL:
County CLACKAMAS Driller's well number
SE ¼ SE ¼ Section 29 T. 2S, R. 2E W.M.
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.
Depth at which water was first found 75 ft.
Static level 39 ft. below land surface. Date OCT 26,72
Artesian pressure lbs. per square inch. Date

(12) WELL LOG:
Diameter of well below casing 6"
Depth drilled 75 ft. Depth of completed well 75 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. *Report each change in position of Static Water Level and indicate principal water-bearing strata.*

MATERIAL	From	To	SWL
SANDY TOPSOIL	0	4	
HARD BROWN CLAY	4	15	
BROWN FINE PACKED SAND	15	35	
BROWN HARD CLAY	35	74	
NICE FINE COLORED GRAVELS AND SAND	74	75	39
WATER BEARING	74	75	

Work started OCT 24 1972 Completed OCT 26 1972
Date well drilling machine moved off of well OCT 27 1972

Drilling Machine Operator's Certification:
This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.
[Signed] William J Stennett Date Nov 8, 1972
(Drilling Machine Operator)
Drilling Machine Operator's License No. 170

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Name WILLIAM J. STENNETT
(Person, firm or corporation) (Type or print)
Address 361 WARNER MILNE RD. ORE. CITY
[Signed] William J Stennett
(Water Well Contractor)
Contractor's License No. 5 Date Nov. 8, 1972

(USE ADDITIONAL SHEETS IF NECESSARY)

SP*45656-119

STATE ENGINEER
Salem, Oregon

CLAC 04403

Well Record

STATE WELL NO. 2/2-29A
COUNTY CLACKAMAS
~~APPLICATION NO.~~ GR-2063

OWNER: Claud & Sarie M. Salisbury

MAILING ADDRESS: RT. 5 Box 29

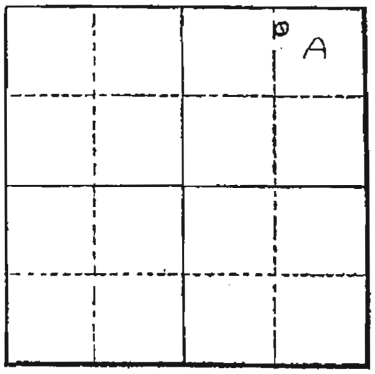
LOCATION OF WELL: Owner's No. ....

CITY AND STATE: Oregon City, Oregon

NE ¼ NE ¼ Sec. 29 T. 2 ~~N.~~ S., R. 2 E. ~~W.~~, W.M.

Bearing and distance from section or subdivision corner 1250' W & 260' S for NEcorner of Sec 29

Altitude at well ....



Section 29

⑥

TYPE OF WELL: Drilled. Date Constructed 1946

Depth drilled 90' Depth cased 90'

CASING RECORD:
6-inch

FINISH:

AQUIFERS:
soil, hard rock, sandstone

WATER LEVEL:
15'

PUMPING EQUIPMENT: Type Pacific Pump H.P. 1½
Capacity 2400 G.P.M.

WELL TESTS:
Drawdown 15 ft. after .... hours 40 G.P.M.
Drawdown .... ft. after .... hours .... G.P.M.

USE OF WATER Irrigation Temp. .... °F. ...., 19....
SOURCE OF INFORMATION GR-3870
DRILLER or DIGGER ....
ADDITIONAL DATA:
Log x Water Level Measurements .... Chemical Analysis .... Aquifer Test ....

REMARKS:

20'	soil	20'
	Hard rock	40'
	Sandstone & weathered buralt	30'

ORIGINAL
File Original, and
Duplicate with the
STATE ENGINEER,
SALEM, OREGON

WATER WELL DRILLERS REPORT

STATE OF OREGON

CLAC

04415

Do Not Fill In State Well No. 2/2-30J11

State Permit No. 30da

H

(1) OWNER:

Name T. G. Ready Mix Co.

Address P.O. Box 107,
Oregon City, Ore

(2) LOCATION OF WELL:

County Owner's number, if any—

R. F. D. or Street No. P.O. Bx 107

Bearing and distance from section or subdivision corner

In the N.E.Corner of the N.E.1/4
of the S.E.1/4 of Sec.30 R.2.E.
T.2.S.

(3) TYPE OF WORK (check):

New well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐

bandonment, describe material and procedure in Item 11.

(4) PROPOSED USE (check):

omestic ☒ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

(5) EQUIPMENT:

Rotary ☐
Cable ☒
Dug Well ☐

CASING INSTALLED:

Threaded ☐ Welded ☒

FROM	ft. to	ft. Diam.	Gage or Wall
0	52	6	.250

If gravel packed

Diameter of Bore	from ft.	to ft.

Type and size of shoe or well ring steel

Size of gravel:

Describe joint

(7) PERFORATIONS:

Type of perforator used

SIZE of perforations none in., length, by in.

FROM	ft. to	ft.	perf per foot	No. of rows

SCREENS:

Give Manufacturer's Name, Model No. and Size

none

(8) CONSTRUCTION:

Was a surface sanitary seal provided? ☐ Yes ☐ No To what depth ft.

Were any strata sealed against pollution? ☐ Yes ☐ No

If yes, note depth of strata

FROM Back filled and sealed with
" cuttings at [illegible] 37 feet

METHOD OF SEALING

(9) WATER LEVELS:

Depth at which water was first found ft.

Standing level ~~[illegible]~~ Static 16 feet ft.

Standing level after perforating ft.

Log Accepted by:

[Signed] Owner Dated 1-12, 1956

(10) WELL TESTS:

Was a pump test made? ☐ Yes ☒ No If yes, by whom?

Yield: gal./min. with ft. draw down after hr

Artesian flow g.p.m.

Shut-in pressure lbs. per square inch.

Bailer test 60 g.p.m. with 2 ft. drawdow

Temperature of water Was a chemical analysis made? ☐ Yes ☒ N

Was electric log made of well? ☐ Yes ☒ No

(11) WELL LOG:

Diameter of well 6 inches.

Total depth 52 ft. Depth of completed well 52

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

ft. to	ft.	
0	37	silt & loam
37	48	cement gravel,no water
48	52	loose gravel,lots of water

Ground elevation at well site 80 feet above mean sea leve

Work started Jan. 1956 Completed Jan. 195

Well Driller's Statement:

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

NAME Steinman Bros.
(Person, firm, or corporation) (Typed or printed)

Address 8332 S.E.16th.Ave. Portland 2,Ore

Driller's well number 256

[Signed] E. J. Steinman
(Well Driller)

License No. 1 Dated 1/17/56, 19

NOTICE TO WATER WELL CONTRACTOR
The original and first copy
of this report are to be
filed with the

STATE ENGINEER, SALEM, OREGON 97310
within 30 days from the date
of well completion.

04411

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

RECEIVED
JAN 28 1976
WATER RESOURCES DEPT.
SALEM, OREGON

State Well No. (18) I

State Permit No.

30dd

(1) OWNER:

Name Dan Onion

Address 7171 S. Barnards Rd.
Canby, OR

(2) TYPE OF WORK (check):

New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐

If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:

Rotary ☒ Driven ☐
Cable ☐ Jetted ☐
Dug ☐ Bored ☐

(4) PROPOSED USE (check):

Domestic ☒ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

(5) CASING INSTALLED: Threaded ☐ Welded ☒

6 " Diam. from 0 ft. to 246 ft. Gage .250

" Diam. from ft. to ft. Gage

" Diam. from ft. to ft. Gage

(6) PERFORATIONS: Perforated? ☐ 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.

(7) SCREENS: Well screen installed? ☐ Yes ☒ No

Manufacturer's Name

Type Model No.

Diam. Slot size Set from ft. to ft.

Diam. Slot size Set from ft. to ft.

(8) WELL TESTS: Drawdown is amount water level is lowered below static level

Air

Was a pump test made? ☒ Yes ☐ No If yes, by whom? Driller

Yield: 25 gal./min. with 98 ft. drawdown after 1 hrs.

" 20 " 90 " 1 "

" " " "

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

Artesian flow g.p.m.

Temperature of water Depth artesian flow encountered ft.

(9) CONSTRUCTION:

Well seal—Material used Bentonite and cement

Well sealed from land surface to 180 ft.

Diameter of well bore to bottom of seal 9 in.

Diameter of well bore below seal 6 in.

Number of sacks of cement used in well seal 4 sacks

Number of sacks of bentonite used in well seal 7 sacks

Brand name of bentonite Baroid

Number of pounds of bentonite per 100 gallons of water 100 lbs./100 gals.

Was a drive shoe used? ☒ Yes ☐ No Plugs Size: location ft.

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? depth of strata

Method of sealing strata off

Was well gravel packed? ☐ Yes ☒ No Size of gravel:

Gravel placed from ft. to ft.

(10) LOCATION OF WELL:

County Clackamas Driller's well number 4-76

SE ¼ SE ¼ Section 30 T. 2S R. 8E W.M

Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.

Depth at which water was first found 240 ft.

Static level 142 ft. below land surface. Date 1-22-7

Artesian pressure lbs. per square inch. Date

(12) WELL LOG: Diameter of well below casing 6

Depth drilled 248 ft. Depth of completed well 248 ft

Formation: Describe color, texture, grain size and structure of materials and show thickness and nature of each stratum and aquifer penetrated with at least one entry for each change of formation. *Report each change in position of Static Water Level and indicate principal water-bearing strata*

MATERIAL	From	To	SWL
Topsoil	0	1	
Clay brown & large boulders	1	6	
Clay brown	6	30	
Clay yellow	30	60	
Clay blue	60	240	
Sand grey	240	247	142
Clay blue	247	248	

Work started 1-21 1976 Completed 1-22 1976

Date well drilling machine moved off of well 1-22 1976

Drilling Machine Operator's Certification:

This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.

[Signed] Eugene M. Skyles Date 1-26, 1976
(Drilling Machine Operator)

Drilling Machine Operator's License No. 271

Water Well Contractor's Certification:

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

Name Skyles Drilling and Supply
(Person, firm or corporation) (Type or print)

Address 1169 Molalla Ave., Oregon City,

[Signed]
(Water Well Contractor)

Contractor's License No. 553 Date 1-26

(USE ADDITIONAL SHEETS IF NECESSARY)

ORIGINAL
File Original, and Duplicate with the STATE ENGINEER, SALEM, OREGON

CLAC 64424

WATER WELL DRILLERS REPORT

STATE OF OREGON

Do Not Fill In
State Well No. 2/2-32 C
State Permit No.

RECEIVED
NOV 25 1957
STATE ENGINEER
SALEM, OREGON

(1) OWNER:

Name O.J. Hovee, Route 5
Address Oregon City, Oregon

(2) LOCATION OF WELL:

County Clackamas Owner's number, if any—
R. F. D. or Street No.
Bearing and distance from section or subdivision corner
NE ¼ of the NW ¼ of section 32
T2S — R2E

(3) TYPE OF WORK (check):

New well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
[illegible] abandonment, describe material and procedure in Item 11.

[illegible] PROPOSED USE (check):

Domestic ☒ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

(5) EQUIPMENT:

Rotary ☐
Cable ☒
Dug Well ☐

[illegible]) CASING INSTALLED:

Threaded ☒ Welded ☐

					If gravel packed		
FROM	ft. to	ft.	Diam.	Gage or Wall	Diameter of Bore	from ft.	to ft.
0	106½		6"	.250			
"	"	"	"	"		"	"
"	105'–118'		"5" liner	3/16		"	"
"	"	"	"	"		"	"
"	"	"	"	"		"	"
"	"	"	"	"		"	"

Type and size of shoe or well ring Spring
Size of gravel:
Describe joint Welded

(7) PERFORATIONS:

Type of perforator used Slotted with cutting torch
[illegible] of perforations 6 in., length, by 1/8 in.

FROM	ft. to	ft.	perf per foot	No. of rows
106	111		3	
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"

SCREENS:

Give Manufacturer's Name, Model No. and Size

(8) CONSTRUCTION:

Was a surface sanitary seal provided? ☒ Yes ☐ No To what depth 33 ft.
Were any strata sealed against pollution? ☐ Yes ☐ No
If yes, note depth of strata
FROM ft. to ft.
" " "
METHOD OF SEALING

(9) WATER LEVELS:

Depth at which water was first found ft.
Standing level before perforating 87 ft.
Standing level after perforating 87 ft.

Log Accepted by:
[Signed] O. J. Hovee Dated Aug 14, 1957
Owner

(10) WELL TESTS:

Was a pump test made? ☐ Yes ☒ No If yes, by whom?
Yield: gal./min. with ft. draw down after hrs.
" " " "
" " " "
Artesian flow g.p.m.
Shut-in pressure lbs. per square inch.
Bailer test 15 g.p.m. with Total ft. drawdown
Temperature of water Was a chemical analysis made? ☐ Yes ☒ No
Was electric log made of well? ☐ Yes ☒ No

(11) WELL LOG:

Diameter of well, 6 inches.
Total depth 118 ft. Depth of completed well 118 ft.

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.*

0	ft. to	20	ft. Clay-yellow
20	"	49	" Gravel, clay and boulders
49	"	55	" Brown clay
55	"	60	" Sand
60	"	67	" Loose sand and gravel
~~67~~	"	~~67~~	"
67	"	98	" Course cement gravel
98	"	107	" Loosley cemented fine gravel
107	"	114	" Blue clay
114	"	118	" Grey clay

Ground elevation at well site feet above mean sea level.
Work started Aug. 1957. Completed Aug 1957

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 Steinman Bros.
(Person, firm, or corporation) (Typed or printed)
Address 15112 S.E. McLoughlin Blvd.
Milwaukie 22, Oregon
Driller's well number 22-57
[Signed] Bob McConnell
(Well Driller)
License No. 1 Dated Aug. 8, 1957

STATE OF OREGON
WATER WELL REPORT
(as required by ORS 537.765)

CLAC 04421

RECEIVED
JUN 14 1984
WATER RESOURCES DEPT
SALEM, OREGON

PLEASE TYPE or PRINT IN INK

2S/2E-32ad
(for official use only)

(1) OWNER:

Name Herman Martin
Address 17475 Harriet
City Oregon City State Oregon

(2) TYPE OF WORK (check):

New Well ☐ Deepening ☐ Reconditioning ☒ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:

Rotary Air ☒ Driven ☐
Rotary Mud ☐ Dug ☐
[illegible] ☐ Bored ☐

(4) PROPOSED USE (check):

Domestic ☒ Industrial ☐ Municipal ☐
Irrigation ☐ Thermal: Withdrawal ☐ Reinjection ☐
Other: Piezometric ☐ Grounding ☐ Test ☐

(5) CASING INSTALLED:

Steel ☐ Plastic ☐
Threaded ☐ Welded ☐

NONE

" Diam. from ft. to ft. Gauge
" Diam. from ft. to ft. Gauge

[illegible] LINER INSTALLED:

Steel ☐ Plastic ☒
Threaded ☐ Welded ☒

4 " Diam. from 200 ft. to 249 ft. Gauge 160#

(6) PERFORATIONS:

Perforated? ☒ Yes ☐ No
Size of perforations 1/4 in. by 2 in.
184 perforations from 244 ft. to 254 ft.
perforations from ft. to ft.
perforations from ft. to ft.

(7) SCREENS:

Well screen installed? ☒ Yes ☐ No
Manufacturer's Name Johnson
Type PVC Model No.
Diam. 4" Slot Size .015 Set from 249 ft. to 254 ft.
Diam. Slot Size Set from ft. to ft.

(8) WELL TESTS:

Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☒ No If yes, by whom?
[illegible]: gal./min. with ft. drawdown after hrs.

Air test 13 gal./min. with drill stem at 245 ft. 1 hrs.
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m.
[illegible]perature of water Depth artesian flow encountered ft.

(9) CONSTRUCTION:

Special standards: Yes ☐ No ☒
Well seal—Material used Seal was not changed
Well sealed from land surface to ft.
Diameter of well bore to bottom of seal in.
Diameter of well bore below seal in.
Amount of sealing material sacks ☐ pounds ☐
How was cement grout placed?

Was pump installed? yes Type sub HP Depth 245 ft.
Was a drive shoe used? ☐ Yes ☒ No Plugs Size: location ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of Water? depth of strata
Method of sealing strata off
Was well gravel packed? ☒ Yes ☐ No Size of gravel: #12filter
Gravel placed from 239 ft. to 254 ft.

(10) LOCATION OF WELL by legal description:

County Clackamas SE ¼ NE ¼ of Section 32 of
Township 2 South (Township is North or South), Range 2 East (Range is East or West) W.M.
Tax Lot Lot Block Subdivision
MAILING ADDRESS OF WELL (or nearest address) 17475 Harriet
Oregon City, OR. 97045

(11) WATER LEVEL of COMPLETED WELL:

Depth at which water was first found 240 ft.
Static level 207 ft. below land surface. Date 6-11-84
Artesian pressure lbs. per square inch. Date

(12) WELL LOG:

Diameter of well below casing 0
Depth drilled 265 ft. Depth of completed well 254 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. Report each change in position of Static Water Level and indicate principal water-bearing strata.

MATERIAL	From	To	SWL
This well was originally drilled by			
Lanz Well Drilling in Aug. 1974 for			
Gesela Goctsche of Rt. 1 Box 229 BB			
Eagle Creek, OR.			
The 6" casing was perferated opposite			
a water bearing zone from 244' to 253'			
A 4" PVC screen was then installed with			
4" PVC pipe above it to bring it above			
the static level, then #12 Monterey			
filter sand was placed betwaan the 4"			
screen and the perferations in the 6"			
casing and the well was developed.			

Date work started 6-11-84 /completed 6-12-84
Date well drilling machine moved off of well 6-12 1984

(unbonded) Water Well Constructor Certification (if applicable):

This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.

[Signed] Date , 19

(bonded) Water Well Constructor Certification:

Bond 94-97-459 (number) Issued by Fidelity & Deposit Co. (Surety Company Name)
On behalf of Marvin D. Skyles(Skyles Drilling) (type or print name of Water Well Constructor)

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

(Signed) Marvin D Skyles (Water Well Constructor)
(Dated) 6-12-84

NOTICE TO WATER WELL CONSTRUCTOR
The original and first copy of this report
are to be filed with the

WATER RESOURCES DEPARTMENT,
SALEM, OREGON 97310
within 30 days from the date of well completion.

SP*46868-690

NOTICE TO WATER WELL CONTRACTOR
The original and first copy
of this report are to be
filed with the
STATE ENGINEER, SALEM, OREGON 973
within 30 days from the date
of well completion.

CLAC 04433

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

RECEIVED
DEC 3 1973
STATE ENGINEER
SALEM, OREGON

ac

State Well No. 2S|2E-33

State Permit No.

(1) OWNER:

Name Paul Stone

Address 14084 S Redland Rd
Oragon City

(2) TYPE OF WORK (check):

New Well ☑ Deepening ☐ Reconditioning ☐ Abandon ☐

If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:

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

(4) PROPOSED USE (check):

Domestic ☑ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

) CASING INSTALLED: Threaded ☐ Welded ☑

6 " Diam. from 0 ft. to 32½ ft. Gage 250
5 " Diam. from 32 ft. to 52 ft. Gage 188
" Diam. from ft. to ft. Gage

) PERFORATIONS: Perforated? ☑ Yes ☐ No.

Type of perforator used Slot

Size of perforations ¼ in. by 7 in.

perforations from 40 ft. to 52 ft.
perforations from ft. to ft.
perforations from ft. to ft.

(7) SCREENS: Well screen installed? ☐ Yes ☑ No

Manufacturer's Name

Type Model No.

Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(8) WELL TESTS: Drawdown is amount water level is lowered below static level

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

Yield: Air 12 gal./min. with 38 ft. drawdown after 1 hrs.

Air test " "

" " " "

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

Artesian flow g.p.m.

mperature of water, 0 Depth artesian flow encountered ft.

(9) CONSTRUCTION:

Well seal—Material used Bentonite

Well sealed from land surface to 30 ft.

Diameter of well bore to bottom of seal 9 in.

Diameter of well bore below seal 6 in.

Number of sacks of cement used in well seal ~~3~~ sacks

Number of sacks of bentonite used in well seal 3 sacks

Brand name of bentonite Quik Gel

Number of pounds of bentonite per 100 gallons of water 50 lbs./100 gals.

Was a drive shoe used? ☑ Yes ☐ No Plugs Size: location ft.

Did any strata contain unusable water? ☐ Yes ☑ No

Type of water? depth of strata

Method of sealing strata off

Was well gravel packed? ☐ Yes ☑ No Size of gravel:

Gravel placed from ft. to ft.

(10) LOCATION OF WELL:

County Clackamas Driller's well number 358

SW ¼ NE ¼ Section 33 T. 2S R. 2E W.M.

Bearing and distance from section or subdivision corner

Tax Lot 03900

(11) WATER LEVEL: Completed well.

Depth at which water was first found 48 ft.

Static level 14 ft. below land surface. Date 3 Nov 73

Artesian pressure lbs. per square inch. Date

(12) WELL LOG: Diameter of well below casing —

Depth drilled 52 ft. Depth of completed well 52 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. Report each change in *position of Static Water Level and indicate principal water-bearing strata.*

MATERIAL	From	To	SWL
Brown Clay	0	10	
Blue Clay	10	18	
Gravel	18	22	
Green Shale	22	48	
Gravel	48	52	

Work started 3 Nov 1973 Completed 3 Nov 1973

Date well drilling machine moved off of well 3 Nov 1973

Drilling Machine Operator's Certification:

This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.

[Signed] Don Date 3/Nov, 1973
(Drilling Machine Operator)

Drilling Machine Operator's License No. 231

Water Well Contractor's Certification:

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

Name Swift Water Well Drilling
(Person, firm or corporation) (Type or print)

Address 4121 SW 6th Portland

[Signed] Joe
(Water Well Contractor)

Contractor's License No. 526 Date , 19

(USE ADDITIONAL SHEETS IF NECESSARY)

SP*45656-119

The original and first copy
of this report are to be
filed with the

STATE ENGINEER, SALEM, OREGON 97310
within 30 days from the date
of well completion.

CLAC
04423

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

RECEIVED
OCT 7 1974
STATE ENGINEER
SALEM, OREGON

State Well No. 2S/2E-32
State Permit No.

(1) OWNER:
Name Gesela Goctsche
Address RT1 Box 229 BB Zip 97022
Eagle creek ore

(2) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

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

[illegible]) CASING INSTALLED:
Threaded ☐ Welded ☒

6 " Diam. from 0 ft. to 263 ft. Gage .250
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

[illegible]) PERFORATIONS:
Perforated? ☐ 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.

(7) SCREENS:
Well screen installed? ☐ Yes ☒ No

Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(8) 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.
" " " "
" " " "
Bailer test 20 gal./min. with 4 ft. drawdown after 3 hrs.
Artesian flow g.p.m.
[illegible]perature of water Depth artesian flow encountered ft.

57FT 8X10" Caseing InsTalled & Removed

(9) CONSTRUCTION:
Well seal—Material used CEMENT Pudded clay & BenTonite
Well sealed from land surface to 55 ft.
Diameter of well bore to bottom of seal 8-10 in.
Diameter of well bore below seal 6 in.
Number of sacks of cement used in well seal 3 sacks
Number of sacks of bentonite used in well seal 1 sacks
Brand name of bentonite NATIONAl
Number of pounds of bentonite per 100 gallons of water 60 lbs./100 gals.
Was a drive shoe used? ☒ Yes ☐ No Plugs Size: location ft.
Did any strata contain unusable water? ☒ Yes ☐ No
Type of water? Sandy depth of strata 20FT.
Method of sealing strata off PiPE
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.

(10) LOCATION OF WELL:
County CLACK. Driller's well number
¼ ¼ Section 32 T. 2-S R. 2-E W.M.
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.
Depth at which water was first found 240 ft.
Static level 138 ft. below land surface. Date Aug/24/74
Artesian pressure lbs. per square inch. Date

(12) WELL LOG:
Diameter of well below casing 6
Depth drilled 350 ft. Depth of completed well 265 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. *Report each change in position of Static Water Level and indicate principal water-bearing strata.*

MATERIAL	From	To	SWL
ClAY Yellow	0	20	0
SAnd Yellow W.B	20	28	
Boulders & ClAY Yellow	28	73	0
ClAY Yellow SAndY	73	81	0
ClAY BlUE	81	142	0
ClAY GREY	142	184	0
ClAY BLUE	184	240	0
SAnd AND SAME GRAvel W.B.	240	253	138
ClAY GREY	253	295	138
ClAY BLUE	295	310	138
ClAY GREY	310	350	138

Work started Aug/4 1974 Completed Aug/25 1974
Date well drilling machine moved off of well Aug/26 1974

Drilling Machine Operator's Certification:

This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.

[Signed] Fran W. Brant (Drilling Machine Operator) Date Sep 27 1974

Drilling Machine Operator's License No. 246

Water Well Contractor's Certification:

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

Name LANZ WELL DRILLING (Person, firm or corporation) (Type or print)
Address 15702 S. Neibur Rd Ore. City
[Signed] Donald D. Lanz (Water Well Contractor)
Contractor's License No. 565 Date 10-2 1974

(USE ADDITIONAL SHEETS IF NECESSARY)

SP*45656-119

NOTICE TO WATER WELL CONTRACTOR
The original and first copy
of this report are to be
filed with the

STATE ENGINEER, SALEM, OREGON 97310
within 30 days from the date
of well completion.

CLAC
04432

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

RECEIVED
MAY 20 1974
STATE ENGINEER
SALEM, OREGON

ab

State Well No. 2S/2E-33
State Permit No.

(1) OWNER:
Name JIM JOHNSTON
Address 3363 SE 82ND PORTLAND

(2) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☒ Driven ☐
Cable ☐ Jetted ☐
Dug ☐ Bored ☐

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

5) CASING INSTALLED: Threaded ☐ Welded ☒
6" Diam. from +1 ft. to 39 ft. Gage .250
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

) PERFORATIONS: Perforated? ☐ 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.

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

(8) 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 Bailer test 25 gal./min. with ft. drawdown after 1 hrs.
Artesian flow g.p.m.
perature of water Depth artesian flow encountered ft.

(9) CONSTRUCTION:
Well seal—Material used CEMENT GROUT
Well sealed from land surface to 19 ft.
Diameter of well bore to bottom of seal 10 in.
Diameter of well bore below seal 6" in.
Number of sacks of cement used in well seal 5 sacks
Number of sacks of bentonite used in well seal — sacks
Brand name of bentonite
Number of pounds of bentonite per 100 gallons of water lbs./100 gals.
Was a drive shoe used? ☐ Yes ☒ No Plugs Size: location ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.

(10) LOCATION OF WELL:
County CLACKAMAS Driller's well number
NW ¼ NE ¼ Section 33 T. 2S R. 2E W.M.
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.
Depth at which water was first found 38 ft.
Static level 6 ft. below land surface. Date 4/18/74
Artesian pressure lbs. per square inch. Date

(12) WELL LOG: Diameter of well below casing 6"
Depth drilled 50 ft. Depth of completed well 50 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. *Report each change in position of Static Water Level and indicate principal water-bearing strata.*

MATERIAL	From	To	SWL
SILT	0	5	
CLAY SILTY GREY	5	38	
~~Gr~~ GRAVEL,	38	47	6
CLAY, GREY	47	50	

Work started 4/15 1974 Completed 4/18 1974
Date well drilling machine moved off of well 4/19 1974

Drilling Machine Operator's Certification:
This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.
[Signed] Patrick Gealon Date 4/19, 1974
(Drilling Machine Operator)
Drilling Machine Operator's License No. 899

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Name SWIFT WATER WELL DRILLING INC
(Person, firm or corporation) (Type or print)
Address 421 SW 6TH AVE. PORTLAND
[Signed] Joe McKnight
(Water Well Contractor)
Contractor's License No. 576 Date 4-26, 1974

(USE ADDITIONAL SHEETS IF NECESSARY)

SP*45656-119

ORIGINAL
File Original and Duplicate with the STATE ENGINEER, SALEM, OREGON

CLAC 4436

RECEIVED
FEB 5 1958
STATE ENGINEER
SALEM, OREGON

WATER WELL REPORT
STATE OF OREGON

G4435

State Well No. 3/2-33B
State Permit No.

(1) OWNER:

Name Cecil E. Jones
Address Route 2 Box 83
Oregon City, Oregon

(2) LOCATION OF WELL:

County Clackamas Owner's number, if any—
NW ¼ NE ¼ Section 33 T. 2S R. 2E W.M.
Bearing and distance from section or subdivision corner

3) TYPE OF WORK (check):

w Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
abandonment, describe material and procedure in Item 11.

) PROPOSED USE (check):

omestic ☒ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

(5) TYPE OF WELL:

Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(6) CASING INSTALLED: Threaded ☐ Welded ☒

6 " Diam. from 0 ft. to 57'-10" ft. Gage .250
5 " Diam. from 56 ft. to 59 ft. Gage 3/16 Liner
" Diam. from ft. to ft. Gage

(7) PERFORATIONS: Perforated? ☒ Yes ☐ No

Type of perforator used Slotted with cutting torch
SIZE of perforations 1/8 in. by 12 in.
perforations from 60 ft. to 90 ft.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

8) SCREENS: Well screen installed ☐ Yes ☒ No

Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

9) CONSTRUCTION:

Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.
Was a surface seal provided? ☐ 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

(10) WATER LEVELS:

Static level 38½ ft. below land surface Date 10/15/57
Artesian pressure lbs. per square inch Date

Log Accepted by:
[Signed] Cecil E Jones (Owner) Date Feb 4, 1958

(11) 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.
" " " "
" " " "
Bailer test 20 gal./min. with total ft. drawdown after 1 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? ☐ Yes ☒ No

(12) WELL LOG: Diameter of well 6 inches.

Depth drilled 120 ft. Depth of completed well 109 ft.

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
Dirt and gravel	0	15
Yellow silt	15	20
Grey clay	20	52
Blue course packed sand(mica)	52	55
Course sand with a trace of fine (6 gpm) gravel	55	57
Blue clay(sticky)	57	78
78 Blue silty clay	78	90
Grey silty clay	90	110
Grey silty sand	110	120

Work started October 1957. Completed October 1957

(13) PUMP:

Manufacturer's Name Jacuzzi
Type: Jet H.P. 1½?

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 Steinman Bros. (Person, firm, or corporation) (Type or print)
Address 15112 S.E. McLoughlin-Milwaukie, Ore.
Driller's well number 39-57
[Signed] Bob McConnell (Well Driller)
License No. 1 Date 11/7/57, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

STATE OF OREGON
WATER WELL REPORT
(as required by ORS 537.765)

CLAC 4426

RECEIVED
NOV 2 1984
WATER RESOURCES DEPT.
SALEM, OREGON

PLEASE TYPE or PRINT IN INK

04428 2S/2E-33

(for official use only)

(1) OWNER:

Name CAROL SOBRINO
Address 14072 S. MORTON RD
City ORE CITY State OR

(2) TYPE OF WORK (check):

New Well ☑ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:

Rotary Air ☑ Driven ☐
Rotary Mud ☐ Dug ☐
[illegible] ☐ Bored ☐

(4) PROPOSED USE (check):

Domestic ☑ Industrial ☐ Municipal ☐
Irrigation ☐ Thermal: Withdrawal ☐ Reinjection ☐
Other: Piezometric ☐ Grounding ☐ Test ☐

(5) CASING INSTALLED:

Steel ☑ Plastic ☐
Threaded ☐ Welded ☑
6 " Diam. from +2 ft. to 282 ft. Gauge .250
" Diam. from ft. to ft. Gauge

LINER INSTALLED:

Steel ☐ Plastic ☐
Threaded ☐ Welded ☐
" Diam. from surface to ft. Gauge

(6) PERFORATIONS:

Perforated? ☐ Yes ☑ No
Size of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

(7) SCREENS:

Well screen installed? ☑ Yes ☐ No
Manufacturer's Name JOHNSON
Type STAINLESS STEEL Model No.
Diam. 5 1/2 Slot Size .20 Set from 286 ft. to 291 ft.
Diam. Slot Size Set from ft. to ft.

(8) WELL TESTS:

Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☑ No If yes, by whom?
[illegible] gal./min. with ft. drawdown after hrs.
Air test 30+ gal./min. with drill stem at 260 ft. 2 hrs.
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m.
[illegible]perature of water Depth artesian flow encountered ft.

(9) CONSTRUCTION:

Special standards: Yes ☐ No ☑
Well seal—Material used CEMENT
Well sealed from land surface to 21 ft.
Diameter of well bore to bottom of seal 10+ in.
Diameter of well bore below seal 6 in.
Amount of sealing material 8 sacks ☑ pounds ☐
How was cement grout placed? PUMP

Was pump installed? NO Type HP Depth ft.
Was a drive shoe used? ☑ Yes ☐ No Plugs Size: location ft.
Did any strata contain unusable water? ☐ Yes ☐ No
Type of Water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☑ No Size of gravel:
Gravel placed from ft. to ft.

(10) LOCATION OF WELL by legal description:

County CLACKAMAS ¼ ¼ of Section 33 of
Township 2S (Township is North or South), Range 2E (Range is East or West), WM.
Tax Lot 05500 Lot Block Subdivision
MAILING ADDRESS OF WELL (or nearest address)
14072 S. MORTON RD
ORE CITY, OR 97045

(11) WATER LEVEL of COMPLETED WELL:

Depth at which water was first found 285 ft.
Static level 205 ft. below land surface. Date
Artesian pressure lbs. per square inch. Date

(12) WELL LOG:

Diameter of well below casing 6
Depth drilled 304 ft. Depth of completed well 296 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. Report each change in position of Static Water Level and indicate principal water-bearing strata.

MATERIAL	From	To	SWL
TOP SOIL	0	1	
BROWN CLAY	1	21	
GRAY CLAY	21	42	
GRAY CLAYSTONE	42	163	
CEMENTED GRAVEL & SAND	163	187	
GRAY CLAYSTONE	187	232	
BROWN CLAYSTONE SANDY	232	285	
SAND W/SOME SM. GRAVEL	285	295	205
GRAY CLAY & GRAVEL	295	304	

NOTE! 4 1/2 FEET of 5 INCH CASING ABOVE AND BELOW SCREEN.

Date work started 9/24/84 /completed 10/6/84
Date well drilling machine moved off of well 10/6 1984

(unbonded) Water Well Constructor Certification (if applicable):

This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.

[Signed] Date , 19

(bonded) Water Well Constructor Certification:

Bond (number) Issued by: (Surety Company Name)
On behalf of DANIEL V. WYLAND (type or print name of Water Well Constructor)

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

(Signed) Daniel V. W (Water Well Constructor)
(Dated) 10/20/84

NOTICE TO WATER WELL CONSTRUCTOR
The original and first copy of this report are to be filed with the WATER RESOURCES DEPARTMENT, SALEM, OREGON 97310 within 30 days from the date of well completion.

SP*46866-690

ORIGINAL
File Original and Duplicate with the STATE ENGINEER, SALEM, OREGON

RECEIVED
NOV 16 1955
STATE ENGINEER
SALEM, OREGON

WATER WELL DRILLERS REPORT
STATE OF OREGON

CLAC

Do Not Fill In
State Well No. ~~2/~~ 33 P(1)
State Permit No. 2/2

CLAC 04436

(1) OWNER:
Name Mr. & Mrs. Robert Moeller
Address Oregon City, Ore.
Route #3

(2) LOCATION OF WELL:
County Clackamas Owner's number, if any—
R. F. D. ~~or street~~ No. 3
Bearing and distance from section or subdivision corner
East of Oregon City about 2 miles ~~North~~ North on Beaver Creek road, North on Holly Lane to 4th house on left.

(3) TYPE OF WORK (check):
New well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 11.

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

(5) EQUIPMENT:
Rotary ☐
Cable ☒
Dug Well ☐

(6) CASING INSTALLED:
Threaded ☒ Welded ☐

FROM	ft. to	ft.	Diam.	Gage or Wall
0	354		6	5/16
351	429		4½	¼
				liner

If gravel packed

Diameter of Bore	from ft.	to ft.

Type and size of shoe or well ring threaded
Size of gravel:
Describe joint threaded sleave

(7) PERFORATIONS:
Type of perforator used
SIZE of perforations in., length, by in.

FROM	ft. to	ft.	perf per foot	No. of rows

SCREENS:
Give Manufacturer's Name, Model No. and Size

(8) CONSTRUCTION:
Was a surface sanitary seal provided? ☒ Yes ☐ No To what depth 35 ft.
Were any strata sealed against pollution? ☒ Yes ☐ No
If yes, note depth of strata
FROM 100 ft. to 354 ft.
METHOD OF SEALING

(9) WATER LEVELS:
Depth at which water was first found 426 ft.
Standing level before perforating 289 ft.
Standing level after perforating ft.

Log Accepted by:
[Signed] Owner Dated , 19

(10) WELL TESTS:
Was a pump test made? ☐ Yes ☒ No If yes, by whom?
Yield: gal./min. with ft. draw down after hrs.
Artesian flow g.p.m.
Shut-in pressure lbs. per square inch.
Bailer test 15 g.p.m. with 30 ft. drawdown
Temperature of water Was a chemical analysis made? ☐ Yes ☒ No
Was electric log made of well? ☐ Yes ☒ No

(11) WELL LOG:
Diameter of well 6 inches.
Total depth 429 ft. Depth of completed well 429 ft.

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.

ft. to		ft.
0	52	Brown sticky clay
52	100	Packed brown sand
100	172	Dark brown clay
172	327	Blue clay
327	355	Brown & green clay
355	366	Tightley packed black sand
366	378	Decomposed soft rock
378	398	Brown clay
398	429	Packed black sand (bottom two feet loose sand)

Ground elevation at well site About 135 feet above mean sea level.
Work started Sept.10 19 55 Completed Oct . 29 1955

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 Floyd Benson (Person, firm, or corporation) (Typed or printed)
Address 3710 S.E.Rockwood Ave Portland 22,Ore
Driller's well number 5
[Signed] Floyd Benson (Well Driller)
License No. 85 Dated Sept 16, 1955

16

STATE OF OREGON
WATER WELL REPORT
(as required by ORS 537.765)

CLAC 8887

RECEIVED
AUG - 7 1992
WATER RESOURCES DEPT.
SALEM, OREGON

2s/2e/33bc

(START CARD) # W-28100

(1) OWNER:
Well Number 15-92
Name Marvin A./Shirley McIntosh
Address 14130 S. Donovan Road
City Oregon City, State OR Zip 97045

(2) TYPE OF WORK:
☒ New Well ☐ Deepen ☐ Recondition ☐ Abandon

(3) DRILL METHOD:
☐ Rotary Air ☐ Rotary Mud ☒ Cable
☐ Other

(4) PROPOSED USE:
☒ Domestic ☐ Community ☐ Industrial ☐ Irrigation
☐ Thermal ☐ Injection ☐ Other

(5) BORE HOLE CONSTRUCTION:
Special Construction approval ☐ Yes ☒ No Depth of Completed Well 214 ft.
Explosives used ☐ Yes ☒ No Type Amount

HOLE			SEAL			Amount
Diameter	From	To	Material	From	To	sacks or ~~pounds~~
10"	0	32	Bentonite	0	25	22 sacks
6"	32	214				

How was seal placed: Method ☐ A ☐ B ☐ C ☐ D ☐ E
☒ Other Bentonite
Backfill placed from 25 ft. to 32 ft. Material Bentonite
Gravel placed from ft. to ft. Size of gravel

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	6"	+1	204	.250	☒	☐	☒	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Liner:	5"	198	203	.250	☒	☐	☒	☐
	5"	208	214	.250	☒	☐	☒	☐

Final location of shoe(s) 204 feet

(7) PERFORATIONS/SCREENS:
☐ Perforations Method
☒ Screens Type Telescopic Material Stainless Steel

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
203	208	20			6"	☐	☒
						☐	☐
						☐	☐
						☐	☐
						☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour
☐ Pump ☒ Bailer ☐ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
50 gpm	15 feet		1 hr.

Temperature of Water 53° Depth Artesian Flow Found
Was a water analysis done? ☐ Yes By whom
Did any strata contain water not suitable for intended use? ☐ Too little
☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other
Depth of strata:

(9) LOCATION OF WELL by legal description:
County Clackamas Latitude Longitude
Township 2-S N or S. Range 2-E E or W. WM.
Section 33 SW ¼ NW ¼
Tax Lot 01100 Lot Block Subdivision
Street Address of Well (or nearest address) 14130 S. Donovan Road, Oregon City, OR 97045

(10) STATIC WATER LEVEL:
136 ft. below land surface. Date 7/30/92
Artesian pressure lb. per square inch. Date

(11) WATER BEARING ZONES:
Depth at which water was first found 199 feet

From	To	Estimated Flow Rate	SWL
199 feet	208 feet	50 gpm	136

(12) WELL LOG:
Ground elevation

Material	From	To	SWL
Clay; brown	0	32	
Clay; silty, brown	32	91	
Clay; gray	91	94	
Sandstone; brown	94	107	
Clay; gray	107	128	
Sand and gravel; brown	128	141	
Sand; gray	141	147	
Clay; blue	147	166	
Clay; gray	166	199	
Sand; coarse and pea gravel; black	199	208	136
Clay; brown	208	214	

Date started 7/23/92 Completed 7/30/92

(unbonded) Water Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to my best knowledge and belief.
Ronald F. McConnell, dba Steinman Bros. Drilling Co. WWC Number
Signed Date

(bonded) Water Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.
WWC Number 1
Signed Ronald F. McConnell Date 7/31/92
Ronald F. McConnell

ORIGINAL & FIRST COPY - WATER RESOURCES DEPARTMENT SECOND COPY - CONSTRUCTOR THIRD COPY - CUSTOMER 9809C 10/91

AUG 23 1991

10255

STATE OF OREGON
WATER WELL REPORT
(as required by ORS 537.765)

WATER RESOURCES DEPT.
SALEM, OREGON

2S/2E/33 CC

(START CARD) # 33550

(1) OWNER:

Well Number:
Name Gabe Stark
Address 3802 SE 66th
City Portland State OR Zip 97206

(2) TYPE OF WORK:

☒ New Well ☐ Deepen ☐ Recondition ☐ Abandon

(3) DRILL METHOD

☒ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Other

(4) PROPOSED USE:

☒ Domestic ☐ Community ☐ Industrial ☐ Irrigation
☐ Thermal ☐ Injection ☐ Other

(5) BORE HOLE CONSTRUCTION:

Special Construction approval Yes ☐ No ☒ Depth of Completed Well 103 ft.
Explosives used Yes ☐ No ☒ Type Amount

HOLE			SEAL			Amount
Diameter	From	To	Material	From	To	sacks or pounds
10	0	103	Cement	0	19	8 sks.
6	103	250	Drill cutting			
				103	250	

How was seal placed: Method ☐ A ☐ B ☒ C ☐ D ☐ E
☐ Other
Backfill placed from 103 ft. to 250 ft. Material Drill cutting
Gravel placed from 19 ft. to 103 ft. Size of gravel 1/4 - 3/8

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	6	+1	20	250	☒	☐	☐	☒
	6	20	103	180	☐	☒	☒	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Liner:					☐	☐	☐	☐
					☐	☐	☐	☐

Final location of shoe(s)

(7) PERFORATIONS/SCREENS:

☒ Perforations Method Saw Cut
☐ Screens Type Material

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
20	80	1/4	80			☒	☐
80	100	1/4	40			☒	☐
						☐	☐
						☐	☐
						☐	☐
						☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour

☐ Pump ☒ Bailer ☐ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
10		103	2 hr.

Temperature of water 54°F Depth Artesian Flow Found
Was a water analysis done? ☐ Yes By whom
Did any strata contain water not suitable for intended use? ☐ Too little
☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other
Depth of strata:

(9) LOCATION OF WELL by legal description:

County Clackamas Latitude Longitude
Township 2S N or S. Range 2E E or W. WM.
Section 33 SW ¼ SW ¼
Tax Lot 200 Lot Block Subdivision
Street Address of Well (or nearest address) 17917 SW Waldow Rd.
Oregon City, OR

(10) STATIC WATER LEVEL:

30 ft. below land surface. Date 08/13/91
Artesian pressure lb. per square inch. Date

(11) WATER BEARING ZONES:

Depth at which water was first found 30

From	To	Estimated Flow Rate	SWL
30	43	6 gpm	30
62	81	4 gpm	"

(12) WELL LOG:

Ground elevation

Material	From	To	SWL
Brown clay w/rock fragments	0	11	
Gray ~~xxx~~ black basalt	11	18	
Firm brown clay & brkn basalt	18	30	
Broken brown basalt	30	43	
Gray silty clay	43	62	
Gray brown clay	62	81	
Blue gray clay	81	116	
Gray clay	116	153	
Dark gray clay	153	175	
Firm gray sandstone	175	188	
Gray & blue gray claystone	188	205	
Firm gray clay	205	241	
Firm gray brown clay	241	250	
Well completed at 103 ft.			

Date started 08/11/91 Completed 08/13/91

(unbonded) Water Well Constructor Certification:

I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to my best knowledge and belief.

WWC Number 1492
Signed Mike Bigsby Date 08/16/91

(bonded) Water Well Constructor Certification:

I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. all work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.

WWC Number 1266
Signed Date 08/16/91

The original and first copy
of this report are to be
filed with the

STATE ENGINEER, SALEM, OREGON 97310
within 30 days from the date
of well completion.

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

RECEIVED
OCT 23 1974
STATE ENGINEER
SALEM, OREGON

RECEIVED
DEC 3 1973
STATE ENGINEER
SALEM, OREGON

04434
CLAC

CC

State Well No. 2S/3E-33

State Permit No.

CLAC

(1) OWNER:
Name RICHARD HEMPHILL
Address 14161 - S-REDMAID RD O.C.

(2) TYPE OF WORK (check):
New Well ☑ Deepening ☐ Reconditioning ☐ Abandon ☐

If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☑ Driven ☐
Cable ☐ Jetted ☐
Dug ☐ Bored ☐

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

) CASING INSTALLED:
Threaded ☐ Welded ☑

6" Diam. from 0 ft. to 20 ft. Gage 250
5" Diam. from 0 ft. to 40 ft. Gage 188
" Diam. from ft. to ft. Gage

PERFORATIONS:
Perforated? ☑ Yes ☐ No.

Type of perforator used touch
Size of perforations 1/4 in. by 8 in.
22 perforations from 35 ft. to 40 ft.
perforations from ft. to ft.
perforations from ft. to ft.

(7) SCREENS:
Well screen installed? ☐ Yes ☑ No

Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(8) WELL TESTS:
Drawdown is amount water level is lowered below static level

Was a ~~pump~~ Air test made? ☐ Yes ☒ No If yes, by whom?
Yield: 12 gal./min. with 40 ft. drawdown after 1 hrs.
Air test " "
" " " "
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m.
mperature of water 50 Depth artesian flow encountered ft.

(9) CONSTRUCTION:
Well seal—Material used BENTONITE
Well sealed from land surface to 18 ft.
Diameter of well bore to bottom of seal 9 in.
Diameter of well bore below seal 6 in.
Number of sacks of cement used in well seal sacks
Number of sacks of bentonite used in well seal 2 sacks
Brand name of bentonite Quik Gel.
Number of pounds of bentonite per 100 gallons of water 50 lbs./100 gals.
Was a drive shoe used? ☑ Yes ☐ No Plugs Size: location ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.

(10) LOCATION OF WELL:
County Clackamas Driller's well number 389
SW ¼ SW ¼ Section 33 T. 2S R. 3E W.M.
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.
Depth at which water was first found 36 ft.
Static level 18 ft. below land surface. Date 2 Nov 73
Artesian pressure lbs. per square inch. Date

(12) WELL LOG:
Diameter of well below casing 6
Depth drilled 40 ft. Depth of completed well 40 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. *Report each change in position of Static Water Level and indicate principal water-bearing strata.*

MATERIAL	From	To	SWL
BROWN CLAY	0	5	
BLUE CLAY	5	36	
GRAVEL	36	40	

Work started Nov 2 1973 Completed Nov 2 1973
Date well drilling machine moved off of well Nov 2 1973

Drilling Machine Operator's Certification:

This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.

[Signed] (Drilling Machine Operator) Date 2/Nov, 1973
Drilling Machine Operator's License No. 231

Water Well Contractor's Certification:

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

Name Swift Water Well Drilling (Person, firm or corporation) (Type or print)
Address 421 SW 6th Portland
[Signed] for McKnight (Water Well Contractor)
Contractor's License No. 576 Date , 19

(USE ADDITIONAL SHEETS IF NECESSARY)

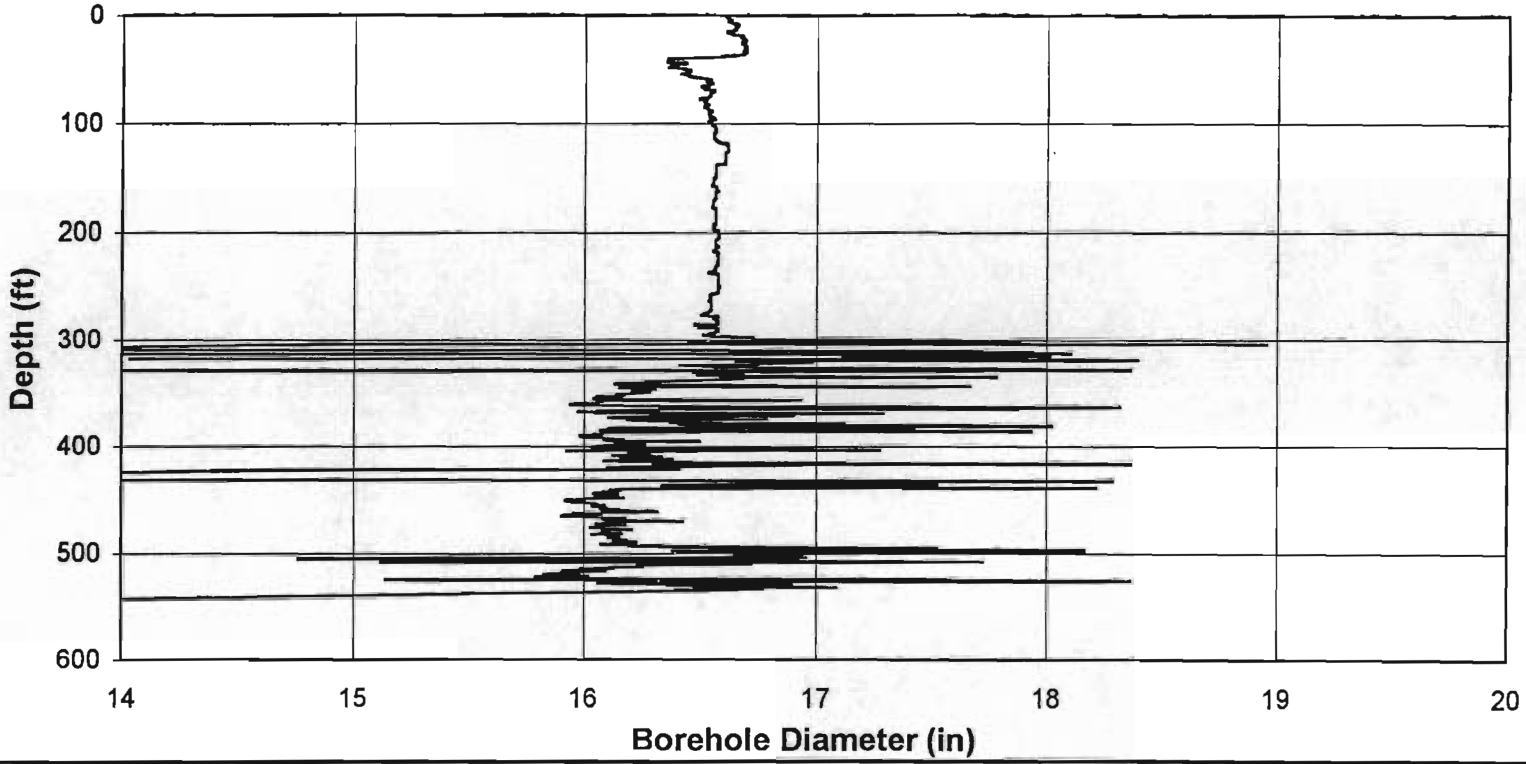
SP*45656-119

Appendix B

APPENDIX B

WELL NO. 1 GEOPHYSICAL LOGS

WELL NO. 1 GEOPHYSICAL LOGS



Legend —— Borehole Diameter

FIGURE B-1: **Caliper Log of Well No. 1**

Montgomary Watson

CLACKAMAS RIVER ASR STUDY/OR

993-1586.003, 09-07-99,

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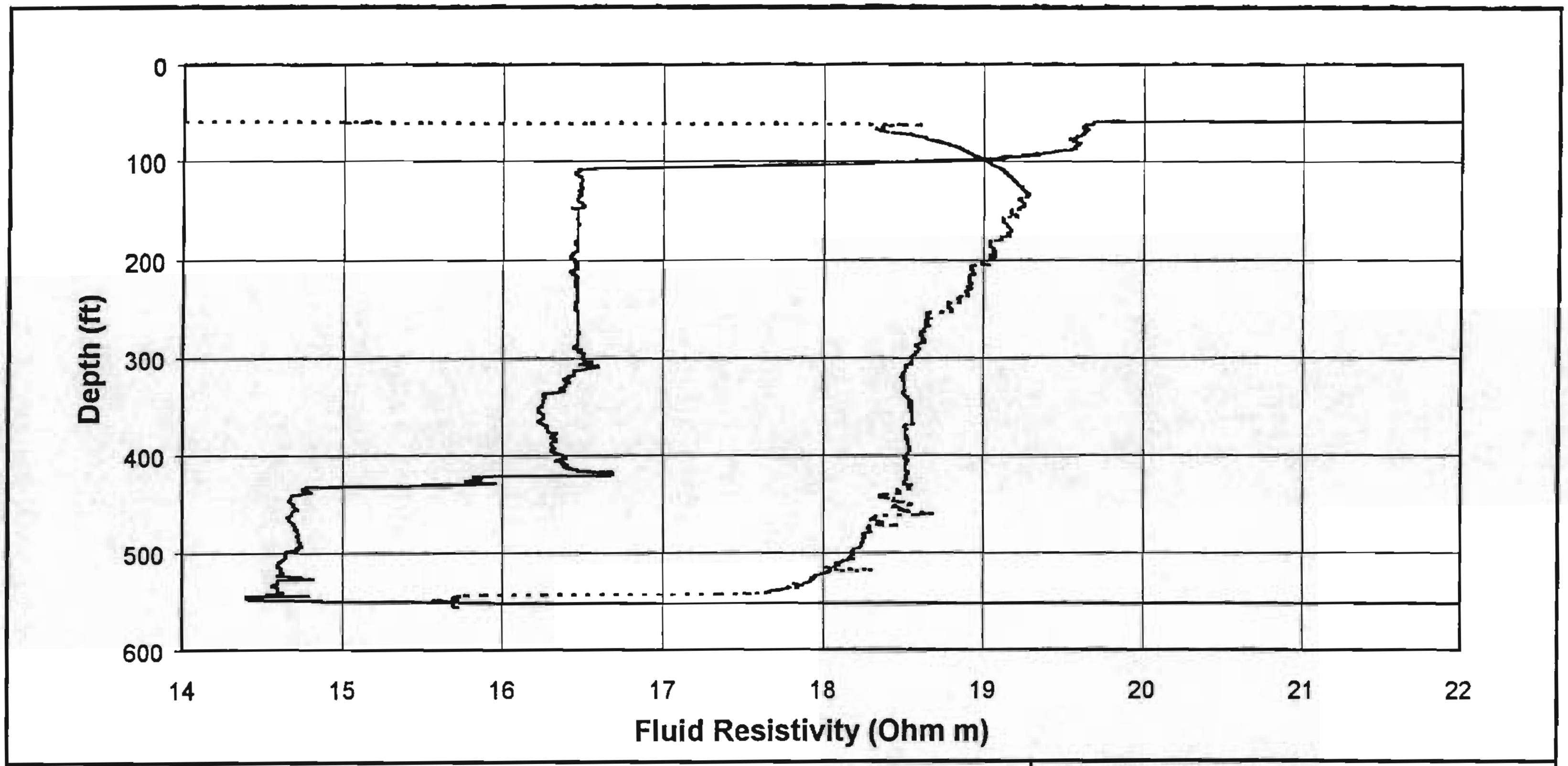

Legend

- ······ Prior to Pumping
- —— During Pumping (100 gpm)

FIGURE B-2: **Fluid Resistivity Log Well No. 1**

Montgomary Watson

CLACKAMAS RIVER ASR STUDY/OR

993-1586.003, 09-07-99,

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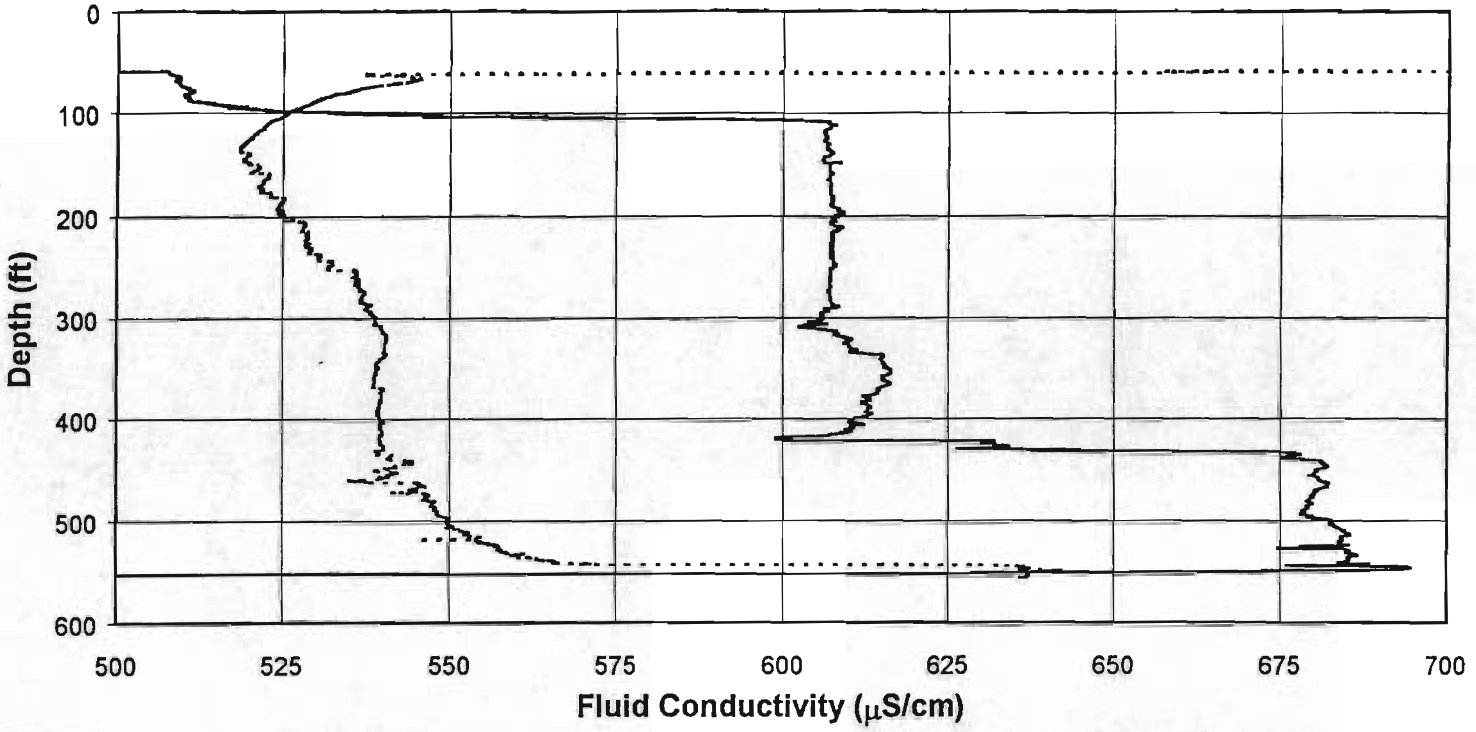


Legend

- \- - - - - - prior to pumping
- —— during pumping (100 gpm)

FIGURE B-3: **Fluid Conductivity Log of Well No. 1**

Montgomary Watson
CLACKAMAS RIVER ASR STUDY/OR
993-1586.003, 09-07-99,
V:\enviros\project\993-1586\geophys\clack.xls

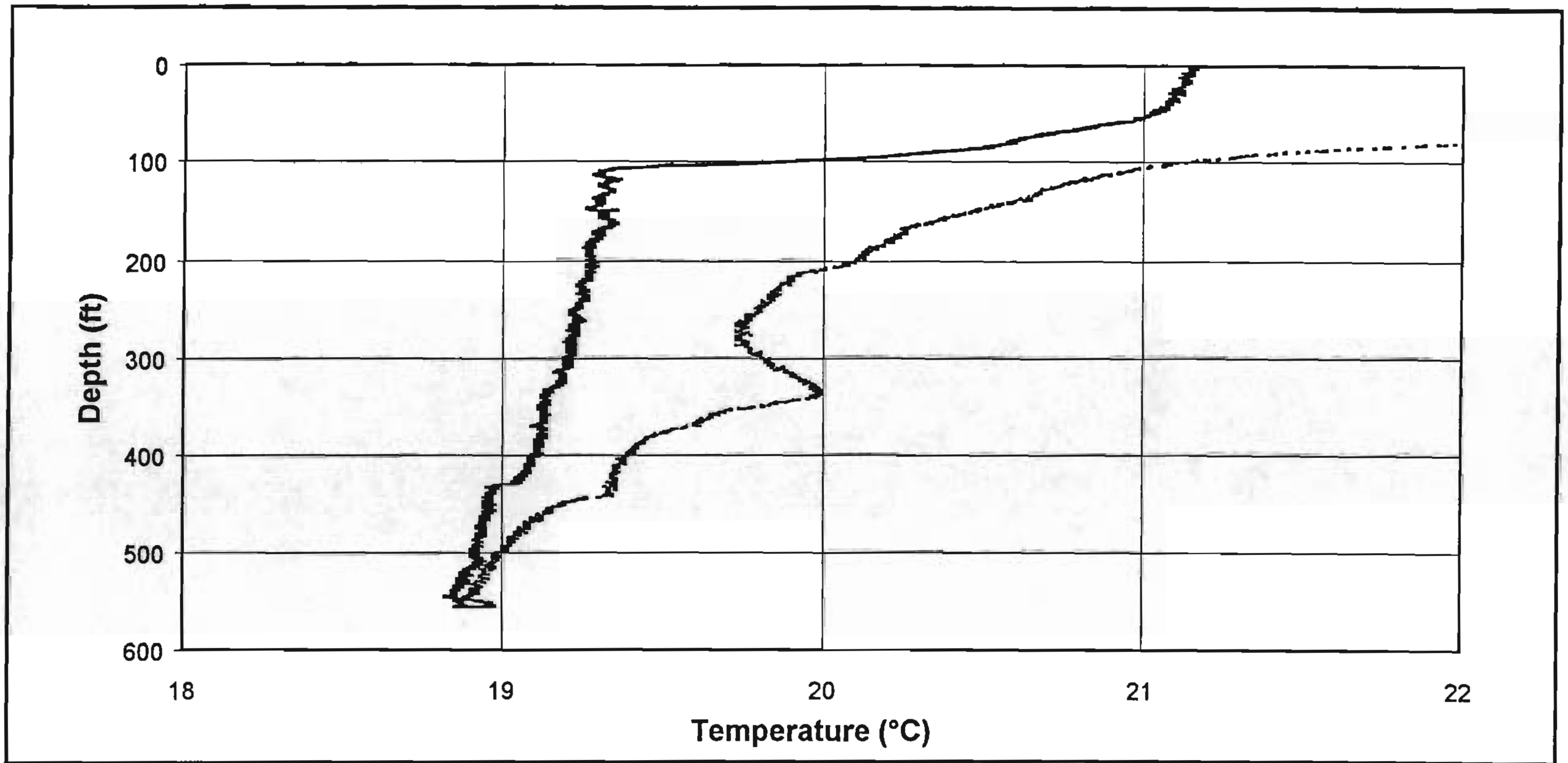
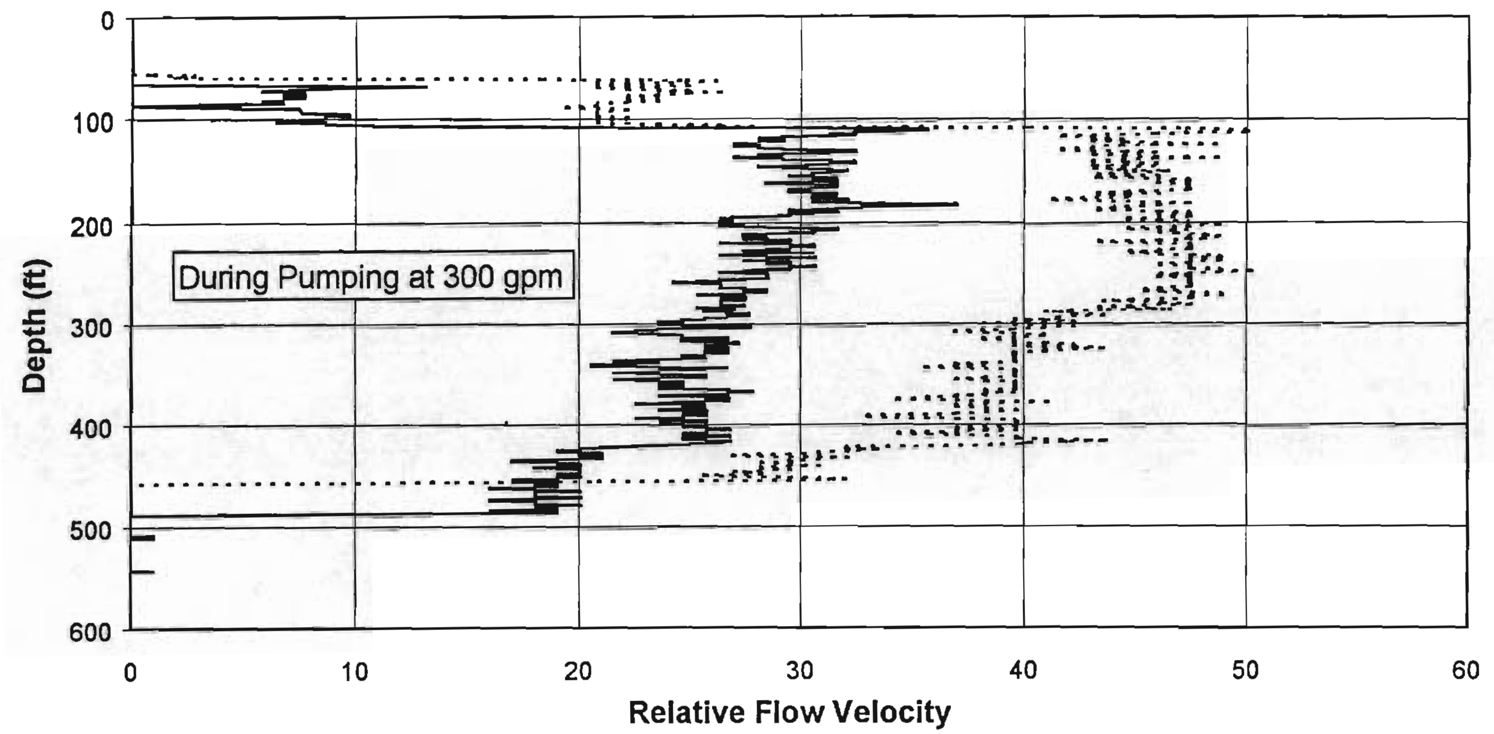


FIGURE B-4: Temperature Log Well No. 1

Montgomary Watson
CLACKAMAS RIVER ASR STUDY/OR
993-1586.003, 09-07-99,
V:\enviros\project\993-1586\geophys\clack.xls



Legend —— Descent Velocity = 45 ft/min

······ Descent Velocity = 60 ft/min

FIGURE B-5: Spinner Log of Well No. 1

Montgomary Watson
CLACKAMAS RIVER ASR STUDY/OR
993-1586.003, 09-07-99,
V:\enviros\project\993-1586\geophys\clack.xls

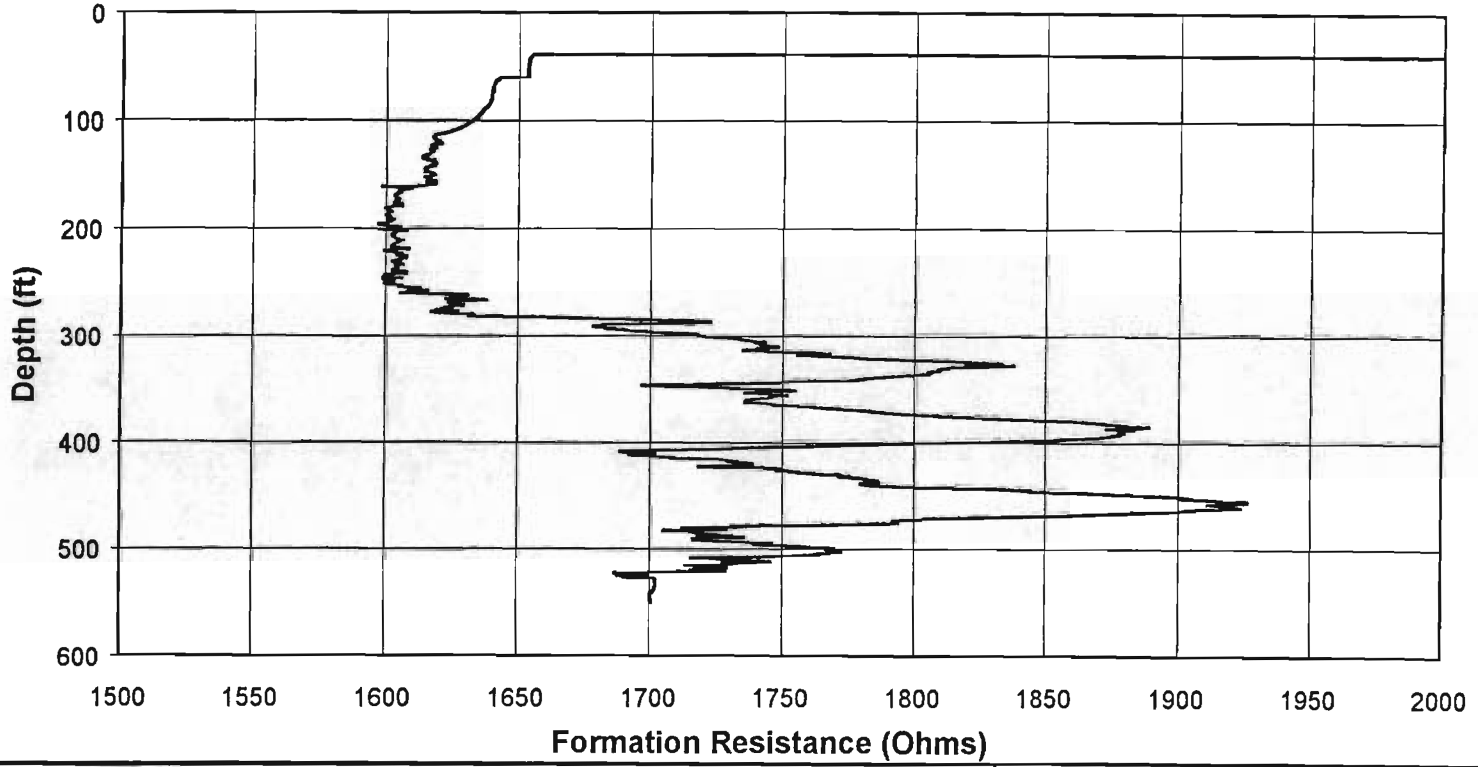
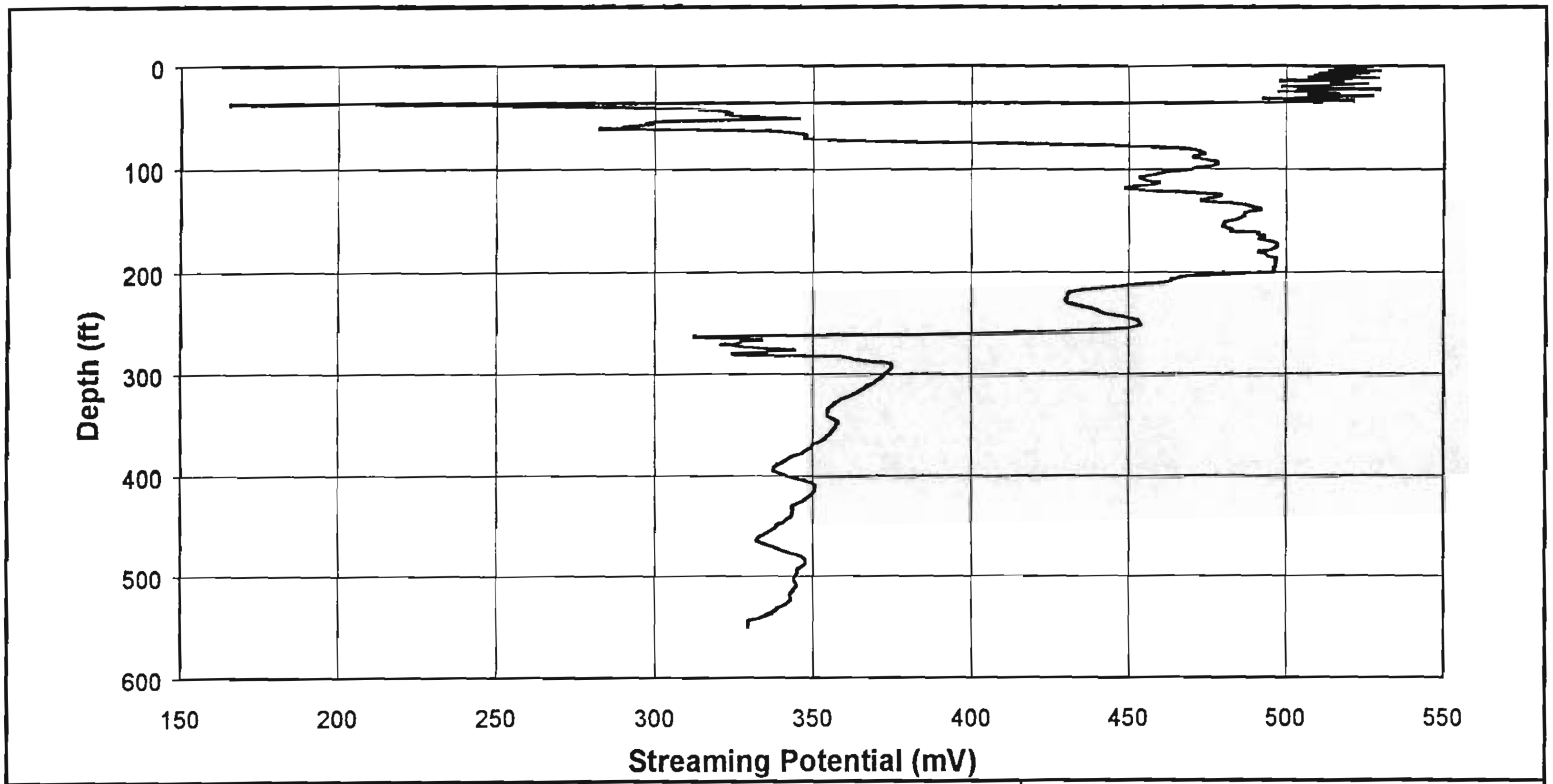


FIGURE B-6: **Formation Resistivity Log of Well No. 1**
Montgomary Watson
CLACKAMAS RIVER ASR STUDY/OR
993-1586.003, 09-07-99,
V:\enviros\project\993-1586\geophys\clack.xls



Legend

— Self Potential

FIGURE B-7: **SP Log of Well No. 1**

Montgomary Watson
CLACKAMAS RIVER ASR STUDY/OR
993-1586.003, 09-07-99,
V:\enviros\project\993-1586\geophys\clack.xls

Appendix C

APPENDIX C

24-HOUR PUMPING TEST AND PACKER TEST INFORMATION

24-HOUR PUMPING TEST AND PACKER TEST INFORMATION

WELL TEST DATA SHEET

Stettler Supply Company ◆ 1810 Lana Avenue NE ◆ Salem, OR 97303 ◆ Phone: 585-5550 Fax: 581-6799

Owner's Name Clackamas River Water
Well Location Redland Rd.
Date 8-31-99
Well Dia. 16"
Depth 560'
Static Level 61.11
Cased to
Perforated at
Test Pump Setting 120'
Test Pump Size
~~Air Line~~ Probe
Tested By Bute
Static after Test
Depth after Test
Drilled By
Test Started
Test Stopped
Max GPM
Pumping Level

Top Plate

GPM	PUMPING LEVEL	TIME OF DAY	CONDITION OF WATER	GPM	PUMPING LEVEL	TIME OF DAY	CONDITION OF WATER
	61.11	10.12	11297600	300	63.68	12:25	1133[illegible]
300		10:36	11297600		63.68	12:30	
	63.30	10:37			63.66	1.00	
	63.35	10:38			63.68	1:30	
	63.[illegible]	10:39			63.70	2:00	
	63.43	10:40			63.70	2:30	
	63.58	10:41			63.76	3.00	
	63.57	10:42		300	63.76	3:30	11388900
	63.57	10:43			63.76	[illegible]	
	63.58	10:44			63.77	4:30	
300	63.59	[illegible]	11300000		63.78	5:00	
	63.60	10:48			63.80	5:30	
	63.60	10.50			63.80	6:00	
	[illegible]	10:52			63.78	6:30	
	[illegible]	10:54			63.78	7:00	
	63.[illegible]	10:56		300	63.78	[illegible]	[illegible]467300
300	63.70	10:58	11303700		63.78	8:00	
	63.70	11:00			[illegible]	8:30	
	63.71	11:02			63.80	9:00	
	63.[illegible]	11:04			63.80	9:30	
	63.[illegible]	11:06			63.82	10:00	
	63.60	[illegible]			63.8[illegible]	10:30	
	63.60	11:10			63.84	11:00	
300	6360	[illegible]	113098[illegible]		63.84	11:30	
	63.62	11:20			63.86	12:00	
	[illegible]	[illegible]		300	[illegible]	[illegible]	11566100
	63.62	[illegible]			63.90	1:00	
	63.62	[illegible]			63.90	[illegible]	
	63.[illegible]	[illegible]			63.92	[illegible]	
300	63.62	[illegible]	[illegible]		63.93	2:30	
	63.62	11:5[illegible]			63.94	3:00	
	63.62	[illegible]			63.94	[illegible]	
	63.62	12.[illegible]		300	63.96	[illegible]	1621200
	63.64	12:05			[illegible]	[illegible]	
	63.66	12:10			63.9[illegible]	[illegible]	
	[illegible]	12.1[illegible]			63.98	[illegible]	
	63.68	12:20			63.98	[illegible]	

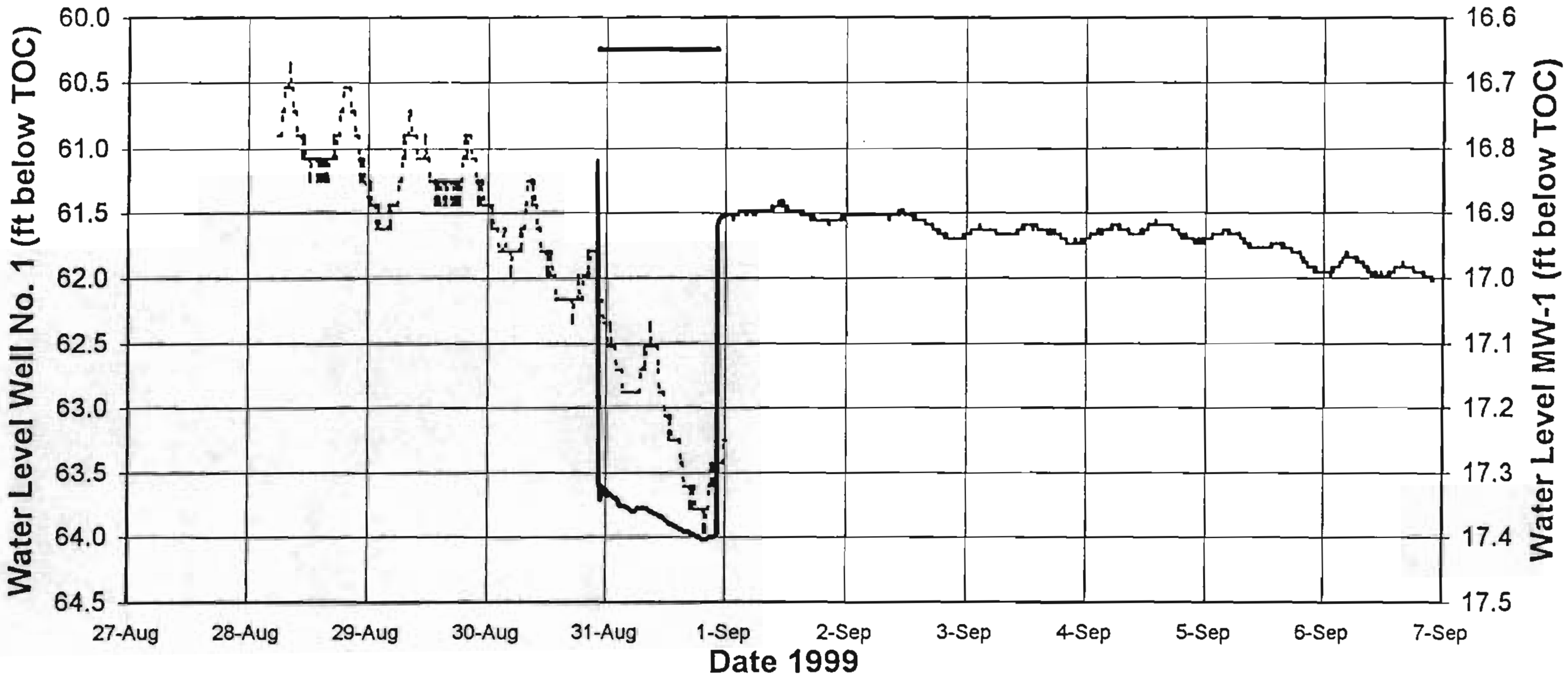
WELL TEST DATA SHEET

Stettler Supply Company ◆ 1810 Lana Avenue NE ◆ Salem, OR 97303 ◆ Phone: 585-5550 Fax: 581-6799

Owner's Name Christmas [illegible] **Well Location** Redland [illegible]
Date [illegible]-99
Well Dia. 18' Depth 560' Static Level 61.11 Cased to Perforated at
Test Pump Setting [illegible] Test Pump Size 30 [illegible] ~~Air Line~~ None Tested By [illegible]
Static after Test Depth after Test Drilled By Test Started
Test Stopped Max GPM Pumping Level

GPM	PUMPING LEVEL	TIME OF DAY	CONDITION OF WATER	GPM	PUMPING LEVEL	TIME OF DAY	CONDITION OF WATER
[illegible]	64.00	6:30	11674900		61.53	11:25	
	64.00	7:00			61.53	11:30	
	64.02	7:30			61.53	11:35	
	02	8:00			61.52	11:40	
	64.00	8:30			61.52	11:45	
	64.00	9:00	11717600		61.52	11:50	
	64.00	[illegible]			61.52	11:55	
	64.00	10:00			61.52	12:00	
[illegible]	63.98	10:30	11745900		61.52	12:13	
			Recovery				
	61.64	10:31					
	61.55	10:32					
	61.58	10:33					
	61.58	10:34					
	61.56	10:35					
	61.56	10.36					
	61.56	10:37					
	61.56	10:38					
	61.56	10:39					
	61.56	10:40					
	61.55	10:42					
	61.55	10:44					
	61.55	10:46					
	61.55	10:45					
	61.55	10:50					
	61.55	10:52					
	61.55	10:54					
	61.54	10:56					
	61.54	10:55					
	61.54	11:00					
	6154	11:05					
	61.53	11:10					
	61.53	11:15					
	61.53	11:20					

1313 - Set 10 psi transducer at ~72 ft.
Water level probe malfunctioned. No reading



Legend

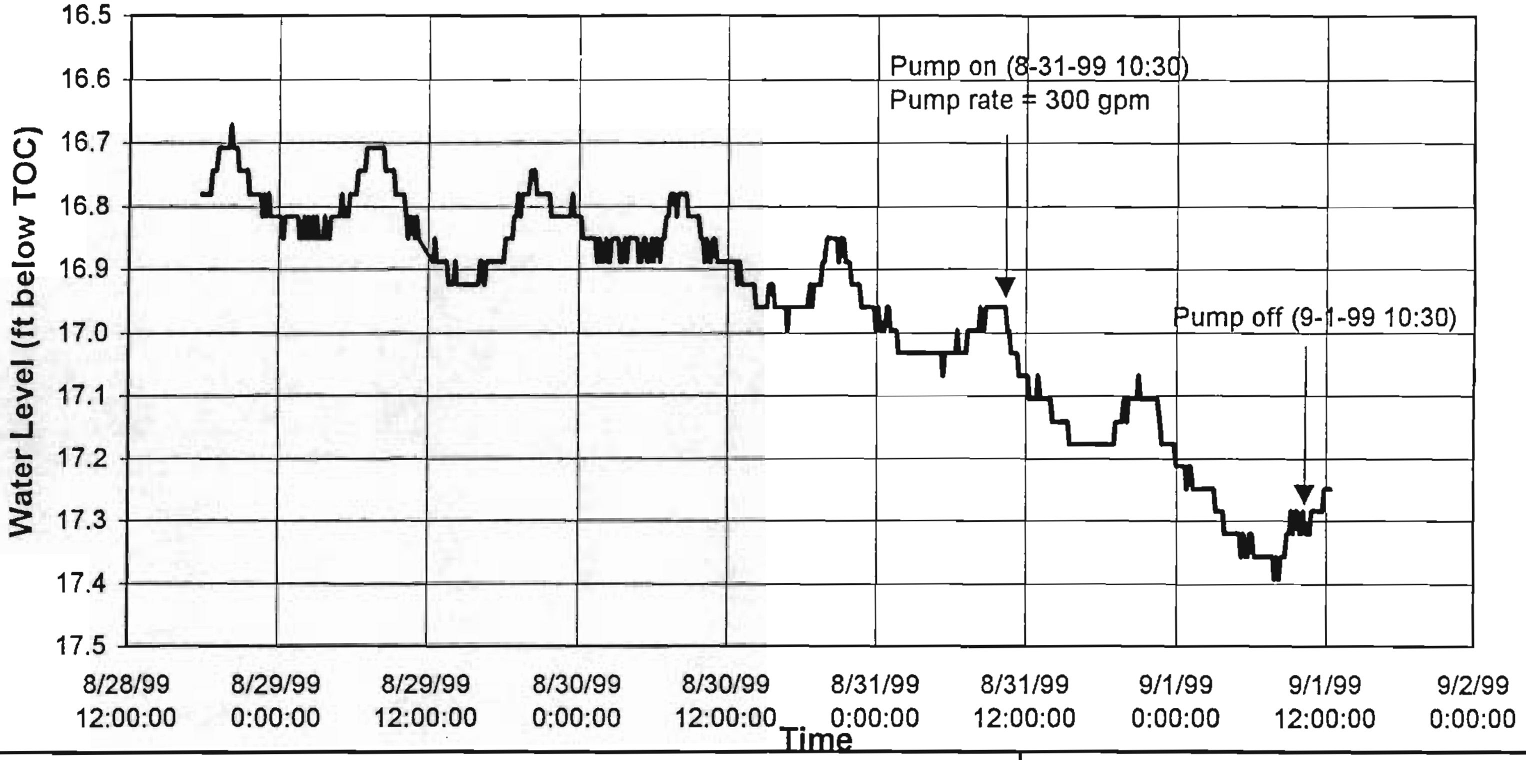
- Well No. 1 - Manual Water Level
- Well No. 1 - Datalogger Water Level Data
- Well No. 1 Pumping
- MW-1 Datalogger Water Level

FIGURE C-1:

Pumping Test Hydrograph

Montgomery Watson
CLACKAMAS RIVER ASR STUDY/OR/DB

993-1586.003, 09-07-99,
V:\enviros\project\993-1586\geophys\watlev.xls



Legend

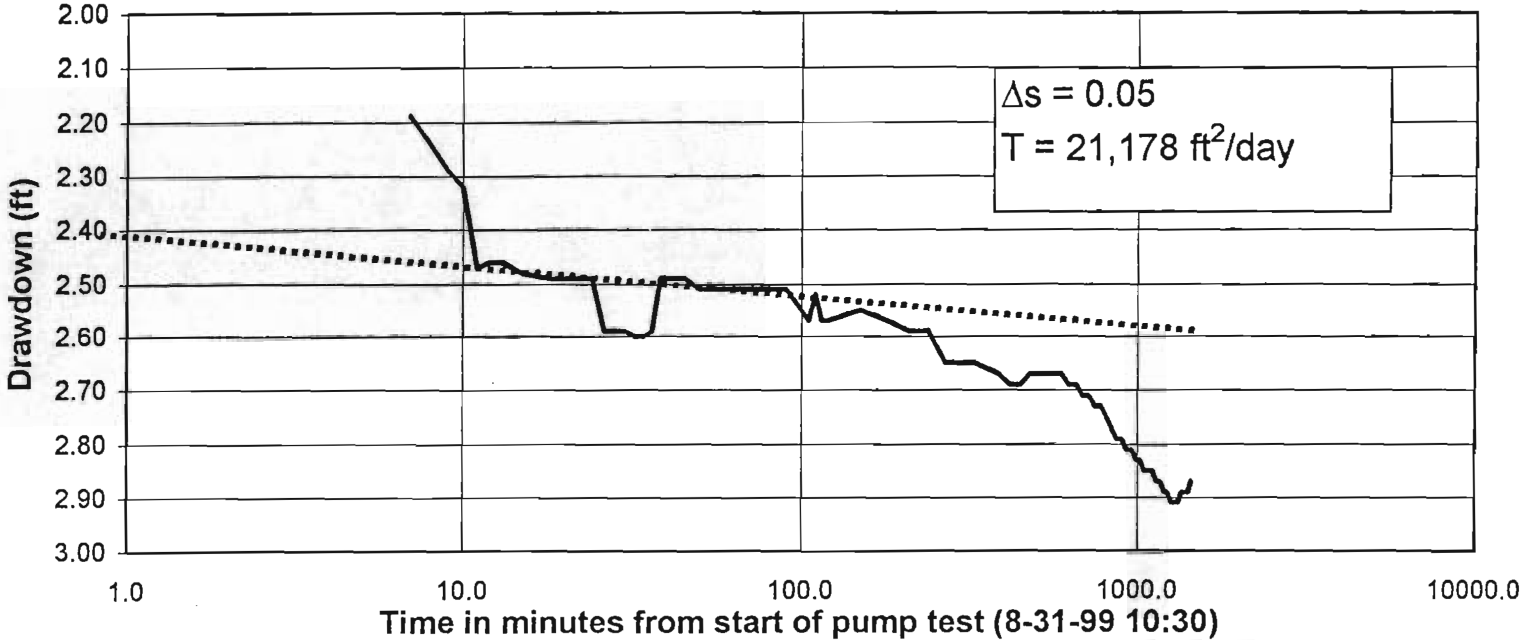
—— MW1 - Water level

FIGURE C-2:

MW 1 Water Level during pump test

Montgomery Watson
CLACKAMAS RIVER ASR STUDY/OR/DB
993-1586.003, 09-07-99,
V:\enviros\project\993-1586\geophys\watlev.xls

ASR Well #1 - manual pump data

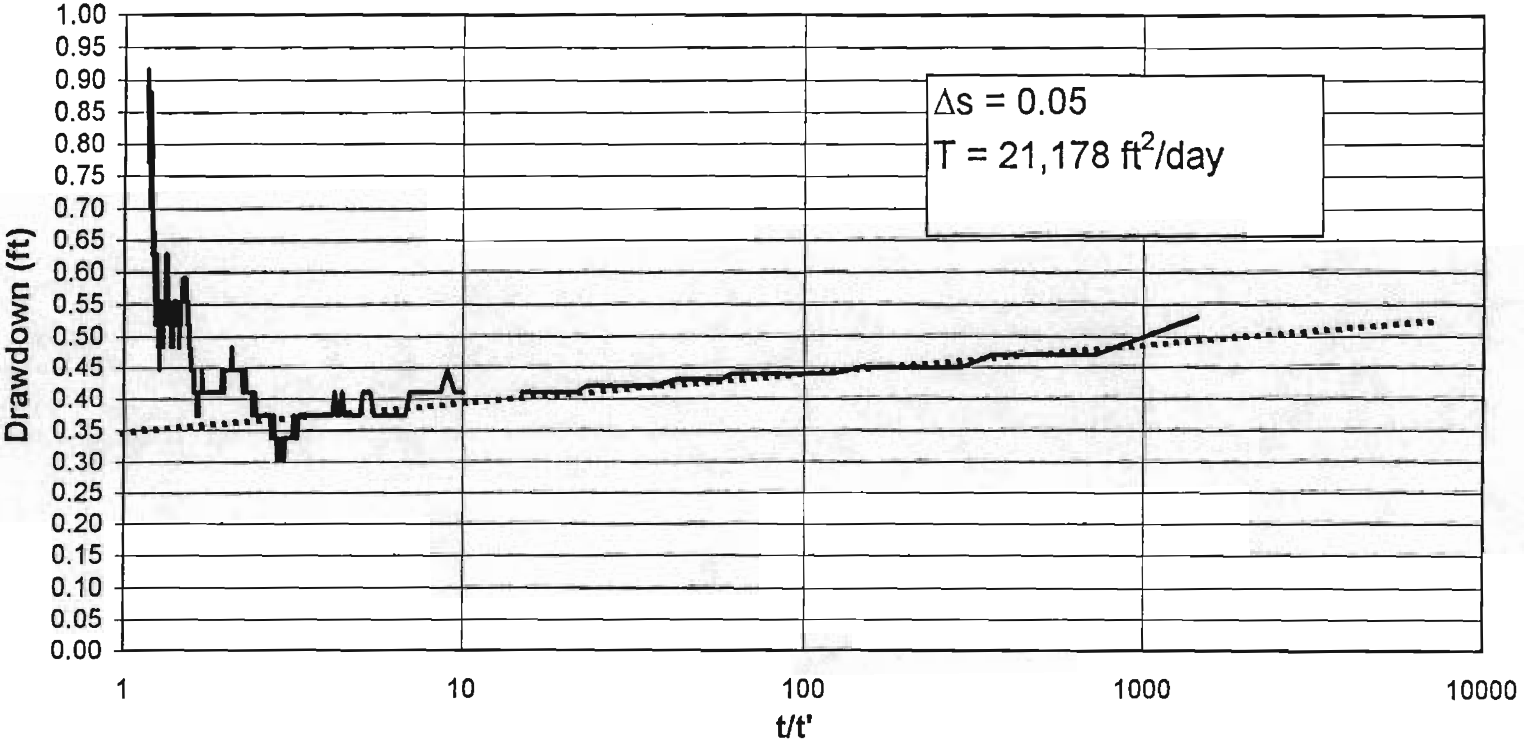


Legend

— ASR Well #1 - manual pump data

FIGURE C-3:

ASR Well 1 Drawdown during pump test
Montgomery Watson
CLACKAMAS RIVER ASR STUDY/OR/DB
993-1586.003, 09-07-99,
V:\enviros\project\993-1586\geophys\watlev.xls



Legend

- ASR Well #1 - datalogger recovery data
- ASR Well #1 - manual recovery data

FIGURE C-4:

ASR Well 1 Drawdown after pump test

Montgomery Watson
CLACKAMAS RIVER ASR STUDY/OR/DB
993-1586.003, 09-07-99,
V:\enviros\project\993-1586\geophys\watlev.xls

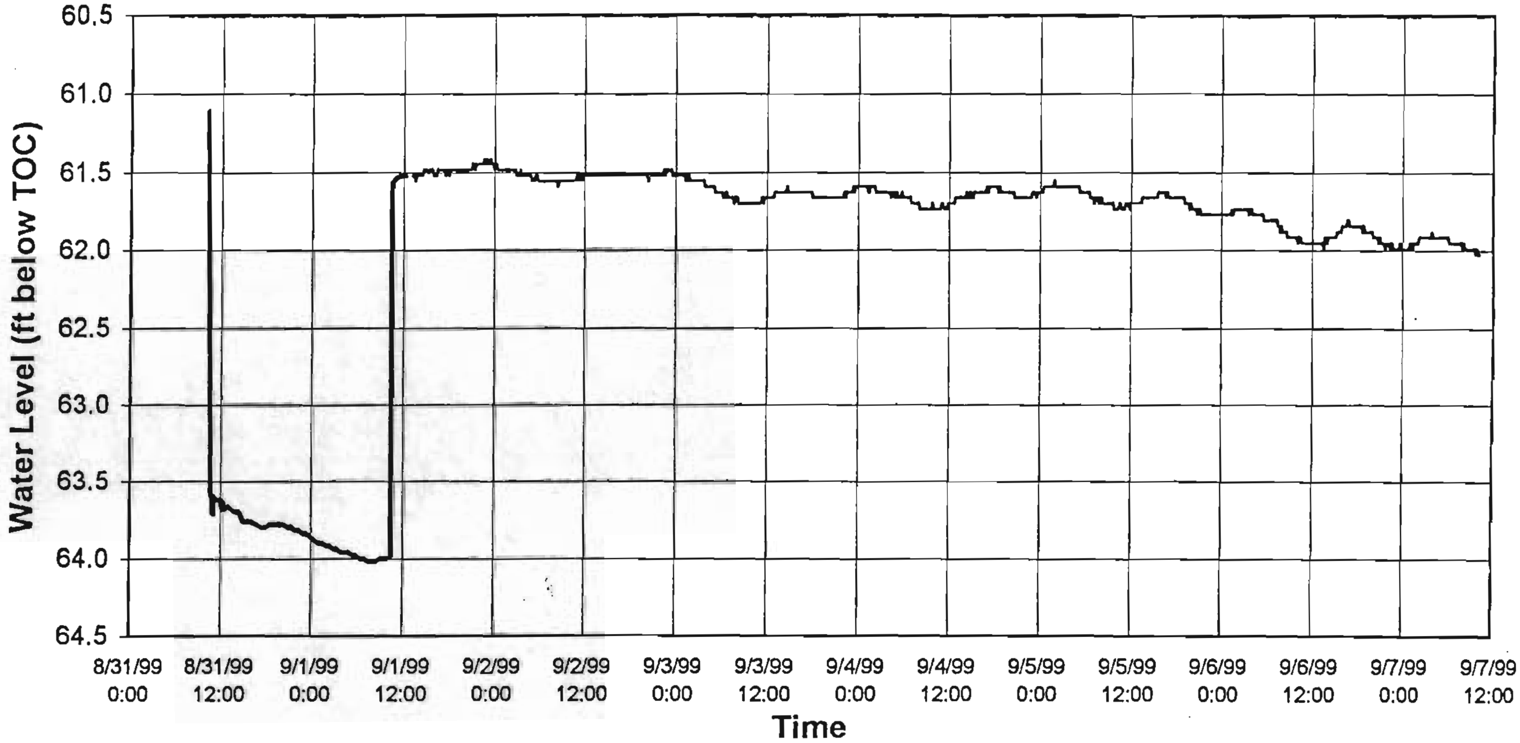
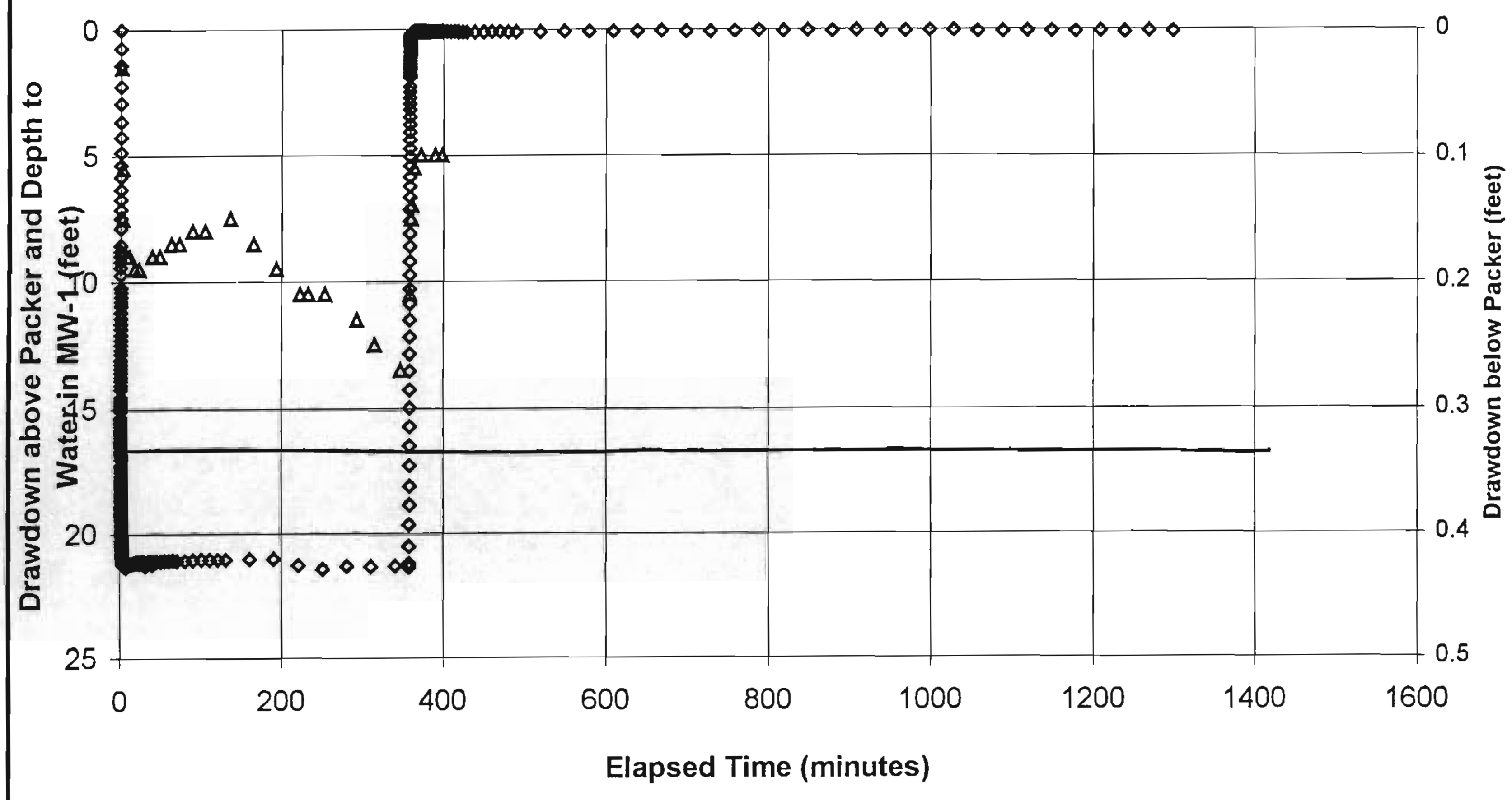


FIGURE C-5:

ASR Well 1 Water Level

Montgomery Watson
CLACKAMAS RIVER ASR STUDY/OR/DB

993-1586.003, 09-07-99,
V:\enviros\project\993-1586\geophys\watlev.xls



◇ Drawdown Above Packer

—— Depth to Water in Rossman MW-1

△ Drawdown Below Packer

Figure C-6

PackerTest Hydrograph-Well No. 1 Upper Zone Pumping

Montgomery Watson

CLACKAMAS RIVER ASR STUDY/OR/DB

Golder Associates

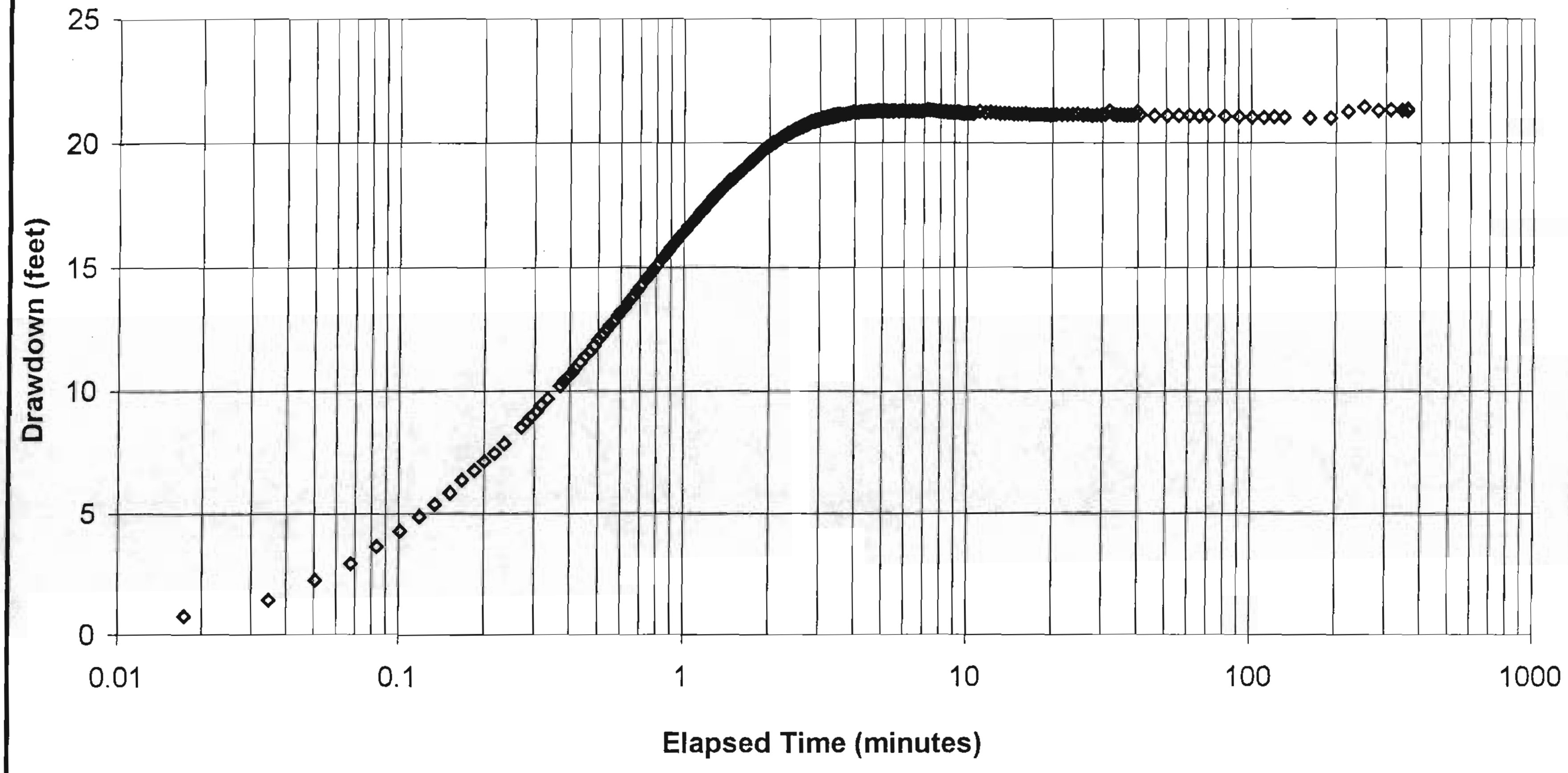


Figure C-7
Semi-log Drawdown CRW Well No. 1 Packer Test
Upper Zone Pumping

Montgomery Watson
CLACKAMAS RIVER ASR
STUDY/OR/DB

Golder Associates

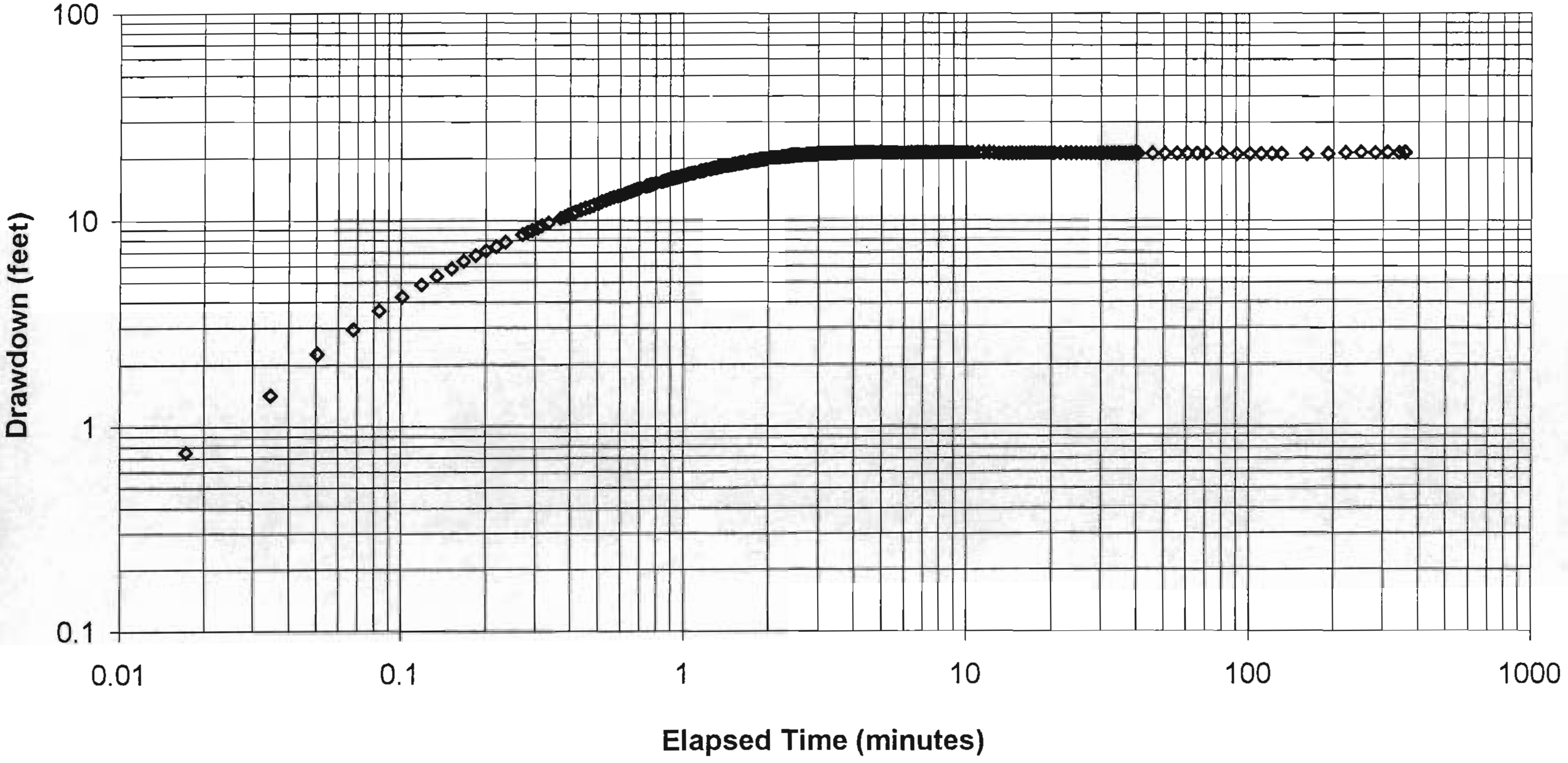


Figure C-8
log-log Drawdown CRW Well No. 1 Packer Test
Upper Zone Pumping

Montgomery Watson
CLACKAMAS RIVER ASR
STUDY/OR/DB

Golder Associates

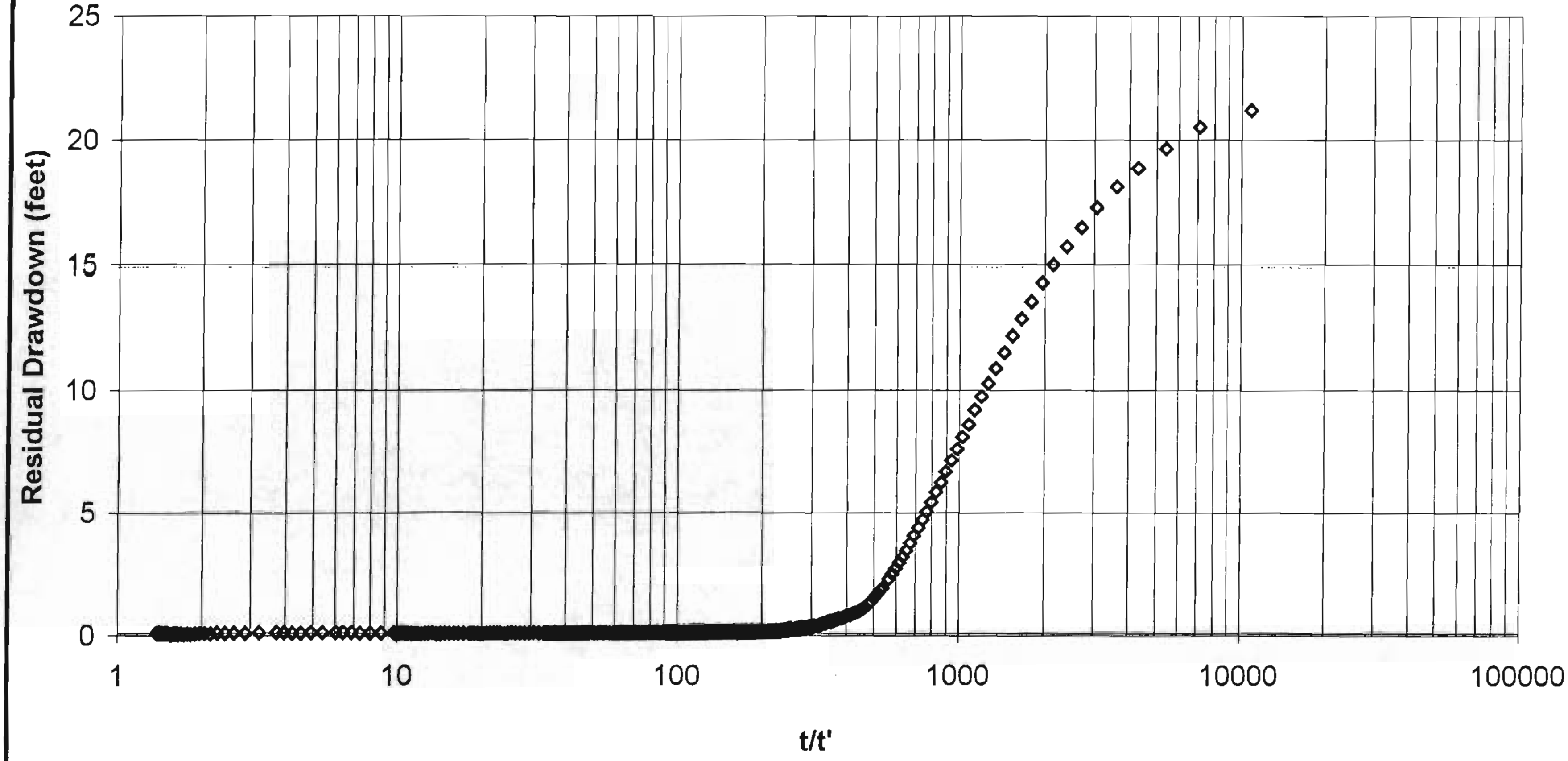


Figure C-9
Water Level Recovery CRW Well No. 1
Packer Test Upper Zone Pumping

Montgomery Watson
CLACKAMAS RIVER ASR
STUDY/OR/DB

Golder Associates

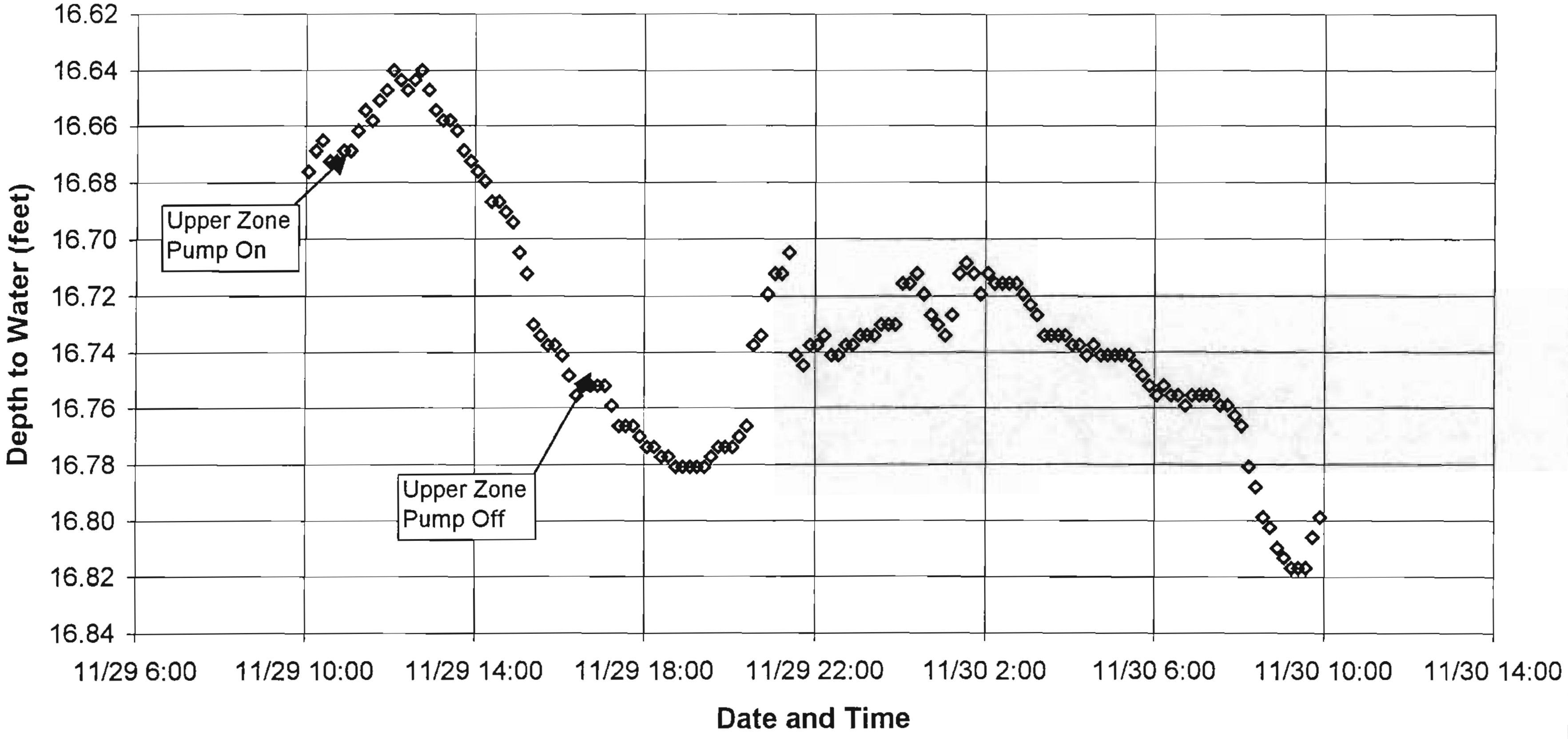


Figure C-10
Rossman MW-1 Hydrograph During Packer Test

Montgomery Watson
CLACKAMAS RIVER ASR
STUDY/OR/DB

Golder Associates

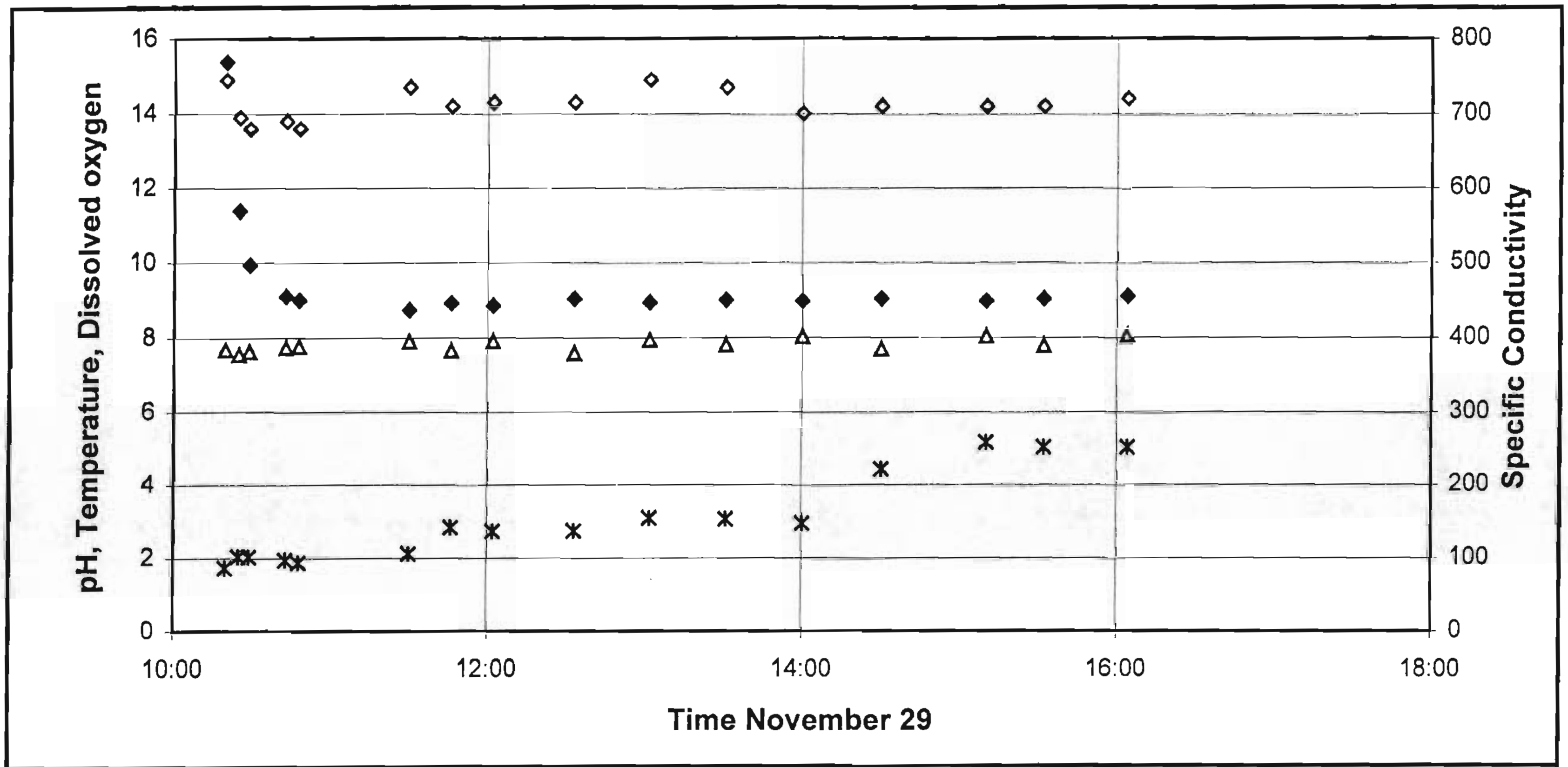


FIGURE C-11:
Field Water Quality Parameters from above the Packer

Montgomery Watson
CLACKAMAS RIVER ASR
STUDY/OR/DB

Golder Associates

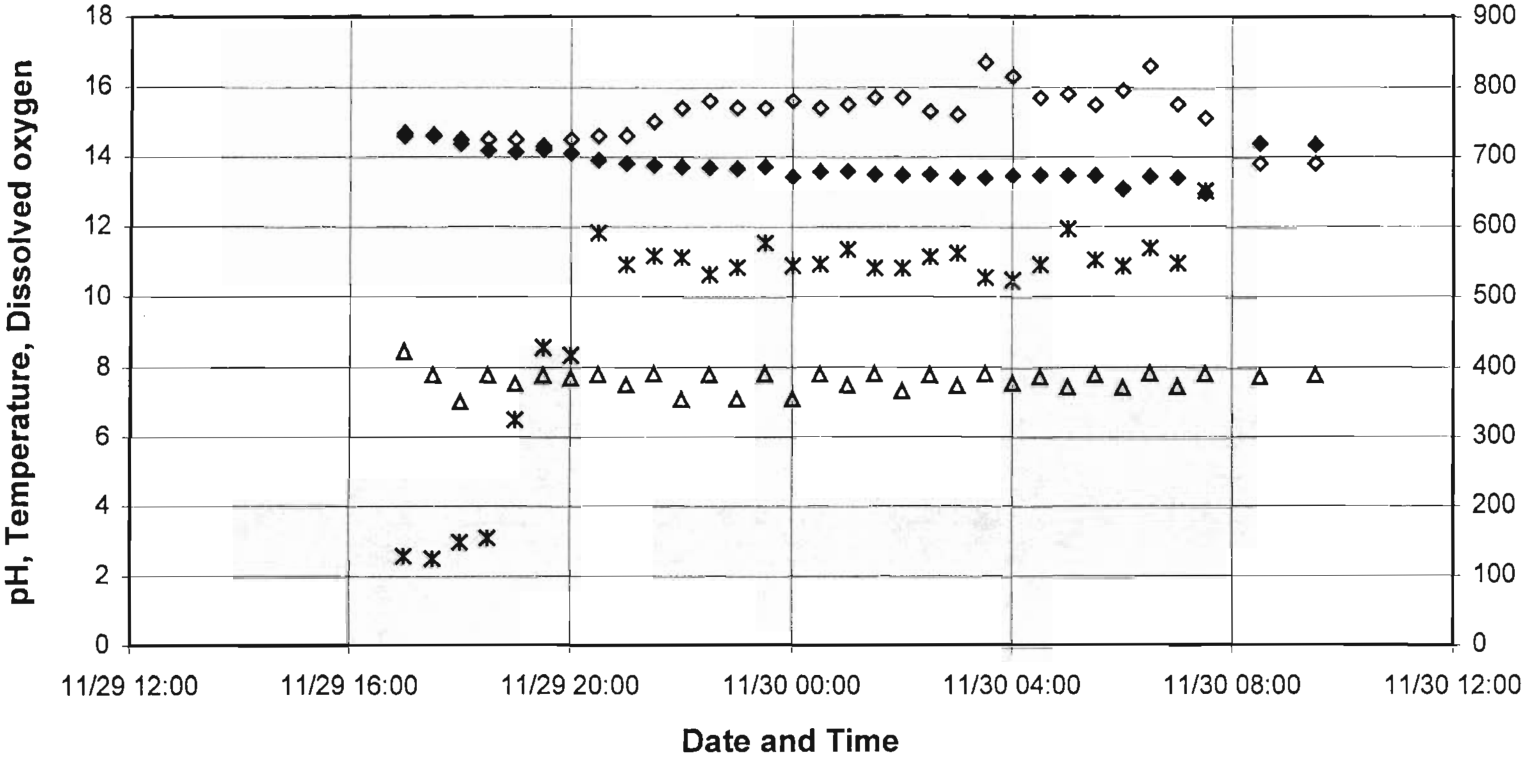


FIGURE C-12:
Field Water Quality Parameters
from below the Packer

Montgomery Watson
CLACKAMAS RIVER
ASR STUDY/OR/DB

Golder Associates

APPENDIX D

MONTGOMERY WATSON WATER QUALITY MEMORANDUM

MONTGOMERY WATSON WATER QUALITY MEMORANDUM

MEMORANDUM

MONTGOMERY WATSON

FINDINGS OF WATER QUALITY INVESTIGATIONS

This memorandum presents results of water quality testing performed on waters pertinent to the Clackamas River Water (CRW) ASR system including water from the Columbia River Basalt Aquifer and waters from the potential sources of injection water. The object of the water quality sampling was to characterize ambient groundwater quality and evaluate compatibility between groundwater and recharge water. To evaluate ambient water quality conditions in the basalt aquifer, data was collected from the following three sources:

- Historical data from Clairmont Well No. 1 (CRW-1)
- Historical data from Rossman Landfill MontoringWell No. 1
- Recent data collected as part of an initial ASR feasibility investigation from CRW-1 and four additional nearby wells drawing water from the same aquifer.

Injection water for the ASR system could potentially come from one of three different water treatment plants in the region: Clackamas River WTP, South Fork Water Board WTP and North Clackamas WTP. Historical finished water quality data was collected from each of these three plants to characterize the injection water.

Historical Water Quality Data in the Columbia Basalt Aquifer

Historical water quality data was obtained from CRW and ODEQ for CRW-1 and the Rossman Landfill Monitoring Well #1 (MW1), respectively. The Rossman well is the only monitoring well at the closed landfill that penetrates into the Columbia Basalt aquifer. No other historical water quality data from other wells in the aquifer were identified. The period of record for CRW-1 extends from 1973 to 1999 and 1981 to 1997 for MW1; both wells were sampled intermittently throughout their respective record period. Tables 1 and 2 summarize the available historical water quality data for the two wells.

General Mineral Quality. Historically, TDS levels in MW1 have remained relatively stable ranging from 310 to 365 mg/L. Most of the TDS is comprised of sodium and chloride. TDS levels in CW1 have ranged from 420 to 710 mg/L and again, is largely comprised of sodium and chloride.

Cyanide was detected in one sample at MW1 in 1988 at 0.07mg/L (MCL = 0.2 mg/L).

Metals. Historical iron concentrations at MW1 and CW1 are similar and are generally below the MCL of 0.3 mg/L. Manganese levels are generally above the MCL of 0.05 mg/L at MW1 and are generally slightly above the MCL at CW1. Trace levels of barium and selenium have been detected at CRW1 while trace levels of zinc were detected at MW1.

Organics (SOCs and VOCs). No organics were detected at MW1 over the period of record although only one set of complete VOC analyses have been performed. At CW1, tetracholorethene (PCE) was detected twice at 0.0006 and 0.00078 mg/L. No other organics other than THM species were detected at CRW1.

Radionuclides. No historical data for radon is available for MW1 or CW1. In a single sample, gross alpha was measured at 4 pCi/L at CRW1.

Recent Water Quality Results

During the initial feasibility study, well log data was obtained from Oregon Department of Environmental Quality (ODEQ) to identify wells within a two mile radius of CRW-1 that withdraw water from the basalt aquifer. Though a number of wells were identified, only four wells were currently in operation and accessible for sampling (see Table 3). A single set of water quality samples were collected from each of the wells listed and analyzed for general water quality parameters and volatile organic contaminants (VOCs). The purpose of this sampling was to evaluate spatial variability in general water quality parameters and to identify the presence of any VOCs, in particular, TCE which had been detected previously in CRW-1.

Table 3
Local Columbia River Basalt Aquifer Wells Sampled During Feasibility Study

Well Name	Year Drilled	Diameter (in)	Depth (ft)	Depth to Water (ft)
Senior High School	1976	8	544	236
Odgen Middle School	1965	16	578	165
Lonestar	1966	8	248	13
16200 Oak Tree Terrace	1977	6	455	410
Clairmont Well #1	1973	16	560	20

In addition to sampling at nearby wells, two sets of samples were collected from CRW-1 during the initial feasibility study. The first set of samples collected approximatley 1 hour after initiating a 24 hour drawdown test and the second set was collected at the end of the 24-hour test. Samples were analyzed for the full sweep of contaminants as required under the Oregon Administrative Rules (OAR) for ASR. All samples were collected by Montgomery Watson and Golder staff and analyzed by Mongomery Watson Laboratories. Procedures employed for collecting and handling water quality samples are included in Appendix A. Results of all sampling are shown in Table 4

General Mineral Quality. Mineral levels in each of the wells are relatively high and well above levels in the Clackamas River. Levels of TDS in the two school wells were substantially higher than the other three wells ranging from 900 to 1,000 mg/L. The distribution of the types of minerals in each of the wells varied significantly as well. The two school wells and the Lonestar well contained a significant amount of hardness while the Oak Tree Terrace well contained no hardness. Chloride levels comprised approximately one-half the total dissolved solids in the the two school wells while only one-third the total in the CRW1. The variation in mineral levels suggests significant variability in aquifer characteristics in the region.

Metals. Three of the five wells contained levels of iron exceeding the MCL of 0.3 mg/L. The Lonestar well contained high levels of both iron and manganese. No other metals were measured at levels of concern.

Organics (SOCs and VOCs). No VOCs were detected in any of the samples except for a trace amount of tetracholorethene (TCE) in the Test 1 sample from CRW1. The reported level of 0.0006 mg/L is below the MCL of 0.005 mg/L.

Radionuclides. Radon is commonly found in the local basalt aquifers and was detected at 220 to 260 pCi/L in Test 1 and Test 2 samples collected at CRW1.

Packer Testing

Subsequent to the initial testing, follow-up water quality testing was conducted during the Packer Testing to compare water quality in the lower and upper portions of the well (above and below the packer). The packer was set at approximately 415 foot elevation. Samples from the upper and lower portions of the well were analyzed for general water quality paramters and VOCs, but not the full sweep of regulated contaminants (Results also in Table 4). General water quality results indicated that the upper region of the aquifer contains significantly lower mineral levels than the lower portion. TDS levels in the upper zone were 330 mg/L above 415 feet and 600 mg/L below 425 feet. In general, levels of individual minerals were approximately twice as high in the lower zone than in the upper zone. Unlike the earlier testing, no VOCs were detected in either the lower or upper portion of the aquifer.

Based on hydrogeological test results, the well will be reconstructed to isolate the lower zone (i.e. exclude the upper zone) for storage and recovery of recharged water; in spite of the lower mineral quality of water in this portion of the aquifer. Thus the water quality results from the lower portion of the well, most represent the water quality of the receiving aquifer for future ASR testing.

Injection Water Quality

CRW-1 is located in the southern portion of the CRW distribution system (CRW South) but is not served by the CRW WTP. Instead, water in this region is served by the South Fork WTP (water purchased by CRW). Eventually, CRW would like to provide their own water to CRW South and are in the planning process to construct additional distribution system transmission mains to service the area. New transmission would allow water from either the CRW or Clackamas County Water Commission WTPs into the area of the well. Thus, each of these three local WTPs were considered potential sources of injection water for the CRW ASR program:

- Clackamas River Water WTP (CRW WTP) – Direct Filtration
- South Fork Water Board WTP (SFWB WTP) – Conventional Filtration
- Clackamas County Water Commission WTP (CCWC STP) – Slow Sand Filtration

All three of the plants treat Clackamas River water. The Clackamas River watershed is generally a sparsely populated and heavily forested with little agricultural activity. Thus, there are currently few sources of potential contaminants in the watershed.

Each of the three WTPs conduct finished water quality sampling for the complete list of constituents required under the Safe Drinking Water Act. A summary of water quality results for each plant is presented in Table 5. As shown in the table, pesticides, herbicides and other organic chemicals have not been found in treated water from any of the three supplies. The water is also low in naturally-occurring organic material as reflected by the low levels of disinfection by-products in the distribution system, in spite of residual disinfection with free chlorine; maximum values for trihaolmethanes and haloacetic acids were 60ug/L and 36ug/L, respectively. In all cases, no potential injection water contained any constituent concentrated above 50% of the MCLs established under OAR requirements. Use of any aforementioned waters for ASR purposes would not require a pretreatment process.

Based on the treated water quality data from each of the three plants, no constituent has been detected at levels above 50% of the corresponding MCL. Thus all three of the proposed source waters for injection meet OAR standards and no additional treatment is required prior to injection.

Table 1
CRW1 Historical Water Quality Data

		Drinking Water Standards		CRW1	CRW1	CRW1	CRW1	CRW1	CRW1	CRW1
		MCL								
Parameter	Units	Primary	Secondary	06/27/73	08/01/77	09/14/84	06/15/87	08/03/87	09/02/87	11/01/88
Conventional Parameters										
pH			6-8.5	7.8	8.1					
Total Dissolved Solids	mg/L		500	556	710					
Turbidity	NTU	0.5		<1	0.47					
Chloride	mg/L		250	188	266	185		144		
Nitrate	mgN/L	10		<0.02		<0.1	0.14			
Nitrite	mgN/L	1		<0.4						
Total nitrate and nitrite	mgN/L	10			<0.05					
Sulfate	mg/L		250	0.3	<1					
Fluoride (free)	mg/L	4	2	0.93	0.75	0.822	0.67			
MBAS (Surfactants)	mg/L		0.5		<0.05					
Total Alkalinity	mg/L			146	140					
Carbonate Alkalinity	mg/L			0	0.0					
Hydroxide Alkalinity	mg/L			0.0						
Bicarbonate Alkalinity	mg/L			146	140					
Total Phosphorus (as P)	mg/L									
Color	ACU		15	<5	<5					
Corrosivity	-		Non-Corrosive							
Odor	TON		3							
Metals										
Aluminum	mg/L		0.05-0.2							
Antimony	mg/L	0.006								
Arsenic	mg/L	0.05		<0.002	<0.001	<0.010	<0.010			
Barium	mg/L	2			<0.2	<0.2	<0.05			
Beryllium	mg/L	0.004								
Cadmium	mg/L				<0.001	<0.005	<0.005			
Calcium	mg/L			51	64					
Chromium	mg/L	0.1			<0.05	<0.001	<0.005			
Copper	mg/L	1.3	1		<0.05					
Cyanide	mg/L	0.2								
Iron	mg/L		0.3	0.28	0.44	0.25				
Lead	mg/L	0.015		0.05	<0.01	0.071	<0.010			
Magnesium	mg/L			6.5	8.5					

Table 1
CRW1 Historical Water Quality Data

		Drinking Water Standards		CRW1	CRW1	CRW1	CRW1	CRW1	CRW1	CRW1
		MCL								
Parameter	**Units**	**Primary**	**Secondary**	**06/27/73**	**08/01/77**	**09/14/84**	**06/15/87**	**08/03/87**	**09/02/87**	**11/01/88**
Manganese	mg/L		0.05	0.03	0.05					
Mercury	mg/L	0.002	0.05-0.2		<0.0005	0.0006	0.0006			
Nickel	mg/L									
Potassium	mg/L				15					
Selenium	mg/L	0.05			<0.001	0.004	<0.005			
Silica (SiO2)	mg/L			68	60.5					
Silver	mg/L	0.05	0.1		<0.05	<0.010	<0.005			
Sodium	mg/L			125	130		49.6			
Thallium	mg/L	1.3								
Total Hardness	mg/L-CaCO3	250			196					
Zinc	mg/L	0.015	5		<0.05					
Radionuclides										
Gross Alpha	pCi/L	15								
Organics										
Benzene	mg/L	0.005								ND
Carbon tetrachloride	mg/L	0.005								ND
Chlorobenzene	mg/L									ND
1,2-Dichlorobenzene	mg/L	0.6								ND
1,4-Dichlorobenzene	mg/L	0.075								ND
1,2-Dichloroethane	mg/L	0.075								ND
1,1-Dichloroethene	mg/L	50								ND
cis-1,2-Dichloroethene	mg/L	0.07								ND
trans-1,2-Dichloroethene	mg/L	0.1								ND
Dichloromethane	mg/L	0.005								ND
1,2-Dichloropropane	mg/L	20000								ND
Ethylbenzene	mg/L	0.7								ND
Styrene	mg/L	0.1								ND
Tetrachloroethene (PCE)	mg/L	0.005								ND
Toluene	mg/L	1								ND
1,2,4-Trichlorobenzene	mg/L	0.07								ND
1,1,1-Trichloroethane	mg/L	0.2								ND
1,1,2-Trichloroethane	mg/L	0.005								ND
Trichloroethene (TCE)	mg/L	0.005								0.00078

Table 1
CRW1 Historical Water Quality Data

		Drinking Water Standards		CRW1	CRW1	CRW1	CRW1	CRW1	CRW1	CRW1
		MCL								
Parameter	**Units**	**Primary**	**Secondary**	**06/27/73**	**08/01/77**	**09/14/84**	**06/15/87**	**08/03/87**	**09/02/87**	**11/01/88**
Vinyl chloride	mg/L	0.002								ND
Xylene (Total)	mg/L	10								ND
Bromobenzene	mg/L									ND
Bromodichloromethane	mg/L	0.1								ND
Bromoform	mg/L	0.1								ND
Bromomethane	mg/L									ND
Chloroethane	mg/L									ND
Chloroform	mg/L									ND
Chloromethane	mg/L									ND
2-Chlorotoluene	mg/L									ND
4-Chlorotoluene	mg/L									ND
Dibromochloromethane	mg/L									ND
Dibromomethane	mg/L	0.1								ND
1,3-Dichlorobenzene	mg/L									ND
1,1-Dichloroethane	mg/L									ND
1,3-Dichloropropane	mg/L									ND
Organics (continued)										
2,2-Dichloropropane	mg/L									ND
1,1-Dichloropropene	mg/L									ND
1,3-Dichloropropene	mg/L									ND
1,1,1,2-Tetrachloroethane	mg/L									ND
1,1,2,2-Tetrachloroethane	mg/L									ND
1,2,3-Trichloropropane	mg/L	0.2								ND
EDB (Ethylene dibromide)	mg/L	0.00005								ND
DBCP	mg/L	0.0002								ND
Hexachlorocyclopentadiene	mg/L	0.05								
Polychlorinated Biphenyls	mg/L									
2,4-D	mg/L	0.07			<0.05					
Dalapon	mg/L	0.2								
Dicamba	mg/L									
Dinoseb	mg/L	0.007								
Pentachlorophenol	mg/L	0.001								
Picloram	mg/L	0.5								
2,4,5-TP (Silvex)	mg/L	0.05			<0.005					

Table 1
CRW1 Historical Water Quality Data

		Drinking Water Standards		CRW1	CRW1	CRW1	CRW1	CRW1	CRW1	CRW1
		MCL								
Parameter	**Units**	**Primary**	**Secondary**	**06/27/73**	**08/01/77**	**09/14/84**	**06/15/87**	**08/03/87**	**09/02/87**	**11/01/88**
Alachlor	mg/L	0.002								
Aldrin	mg/L									
Atrazine	mg/L	0.003								
Benzo(a)pyrene	mg/L	0.0002								
Butachlor	mg/L									
Chlordane	mg/L	0.002								
Di(2-ethylhexyl)adipate	mg/L	0.4								
Di(2-ethylhexyl)phthalate	mg/L	0.006								
Dieldrin	mg/L	0.2								
Endrin	mg/L	0.002			<0.0001					
Heptachlor	mg/L	0.0004								
Heptachlor epoxide	mg/L	0.0002								
Hexachlorobenzene	mg/L	0.001								
Lindane (gamma-BHC)	mg/L	0.0002			<0.002					
Methoxychlor	mg/L	0.04			<0.05					
Metolachlor	mg/L									
Metribuzin	mg/L									
Propachlor	mg/L									
Simazine	mg/L	0.004								
Toxaphene	mg/L	0.003			<0.002					
Aldicarb	mg/L									
Aldicarb sulfone	mg/L									
Organics (continued)										
Aldicarb sulfoxide	mg/L									
Carbaryl	mg/L									
Carbofuran	mg/L	0.04								
3-Hydroxycarbofuran	mg/L									
Methomyl	mg/L									
Oxamyl (Vydate)	mg/L	0.2								
Glyphosate	mg/L	0.7								
Endothall	mg/L	0.1								
Diquat	mg/L	0.02								
1,2,3-Trichlorobenzene	mg/L									ND
1,2,4-Trimethylbenzene	mg/L									ND

Table 1
CRW1 Historical Water Quality Data

		Drinking Water Standards		CRW1	CRW1	CRW1	CRW1	CRW1	CRW1	CRW1
		MCL								
Parameter	Units	Primary	Secondary	06/27/73	08/01/77	09/14/84	06/15/87	08/03/87	09/02/87	11/01/88
1,3,5-Trimethylbenzene	mg/L									ND
4-Isopropyltoluene	mg/L									ND
Bromochloromethane	mg/L									ND
Dichlorodifluoromethane	mg/L									ND
Hexachlorobutadiene	mg/L									ND
Isopropylbenzene	mg/L									ND
n-Butylbenzene	mg/L									ND
n-Propylbenzene	mg/L									ND
Naphthalene	mg/L									ND
sec-Butylbenzene	mg/L									ND
tert-Butylbenzene	mg/L									ND
trans-1,3-Dichloropropene	mg/L									
Trichlorofluoromethane	mg/L									ND

Table 1
CRW1 Historical Water Quality Data

CRW1	CRW1	CRW1	CRW1	CRW1
11/16/91	11/19/91	2/12/96	2/28/96	6/29/99
		7.99		7.31
		460		420
		170		200
	<0.10	ND		ND
				ND
		0.2		ND
	0.8	0.6		0.7
		ND		ND
		130		150
		ND		
		ND		
			130	
			ND	ND
		ND		7
		0.2		-0.45
				ND
		ND		0.12
		ND		ND
	<0.002	ND		ND
	<0.020	0.042		ND
		ND		ND
	0.009	ND		ND
		37		
	<0.005	ND		ND
		ND		ND
		ND		
		0.08		ND
	0.019	ND		ND
		6.8		

Table 1
CRW1 Historical Water Quality Data

CRW1	CRW1	CRW1	CRW1	CRW1
11/16/91	11/19/91	2/12/96	2/28/96	6/29/99
		0.028		0.03
	<0.0005	ND		ND
		ND		ND
	<0.002	ND		ND
	<0.005	ND		ND
	4.78			101
		ND		ND
		120		120
		ND		ND
			4	
ND			ND	ND
ND			ND	ND
ND			ND	ND
ND			ND	ND
ND			ND	ND
ND			ND	ND
ND			ND	ND
ND			ND	ND
ND			ND	ND
ND			ND	ND
ND			ND	ND
ND			ND	ND
ND			ND	ND
ND			ND	ND
ND			ND	ND
ND			ND	ND
ND			ND	ND
ND			ND	ND
0.0009			ND	ND

Table 1
CRW1 Historical Water Quality Data

CRW1	CRW1	CRW1	CRW1	CRW1
11/16/91	11/19/91	2/12/96	2/28/96	6/29/99
ND			ND	ND
ND			ND	ND
ND			ND	ND
ND			0.0011	ND
ND			0.0099	ND
ND			ND	ND
ND			ND	ND
ND			0.0012	ND
			ND	ND
ND			ND	ND
ND			ND	ND
ND			0.0024	ND
ND			ND	ND
ND			ND	ND
ND			ND	ND
ND			ND	
ND			ND	ND
ND			ND	ND
			ND	ND
ND			ND	ND
ND			ND	ND
ND			ND	ND
ND			ND	ND
ND			ND	ND
			ND	ND
			ND	ND
			ND	ND
			ND	ND
			ND	ND
			ND	ND
			ND	ND
			ND	ND
			ND	ND

Table 1
CRW1 Historical Water Quality Data

CRW1	CRW1	CRW1	CRW1	CRW1
11/16/91	11/19/91	2/12/96	2/28/96	6/29/99
			ND	ND
			ND	ND
			ND	ND
			ND	ND
			ND	ND
			ND	ND
			ND	ND
			ND	ND
			ND	ND
			ND	ND
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			ND	ND
			ND	ND
			ND	ND
			ND	ND
ND				ND
ND				ND

Table 1
CRW1 Historical Water Quality Data

CRW1	CRW1	CRW1	CRW1	CRW1
11/16/91	11/19/91	2/12/96	2/28/96	6/29/99
ND				ND
ND				ND
ND				ND
ND				ND
ND				ND
ND				ND
ND				ND
ND				ND
ND				ND
ND				ND
ND				
ND				ND

Table 2
Rossman Landfill Monitoring Well #1 Historical Water Quality Data

		Drinking Water Standards		MW1	MW1	MW1	MW1	MW1	MW1	MW1
		MCL								
Parameter	**Units**	**Primary**	**Secondary**	**09/22/81**	**10/27/81**	**01/27/82**	**05/05/82**	**08/17/82**	**10/13/83**	**02/02/84**
Conductivity (Field Data)	umhos/cm								396	
Specific Conductance	umhos/cm			460		575	510	525	450	468
pH			6-8.5	10.3	8.4	8.8	8.9	8.7	9.2	9.1
pH (Field Data)			6.5-8.5						9	
Temperature (Field Data)	oC								12	12
(TDS) Total Dissolved Solids	mg/L		500							
(TSS) Total Suspended Solids	mg/L									
(DO) Dissolved Oxygen	mg/L		250							
(COD) Chemical Oxygen Demand	mg/L			365	13	10	<1	8	10	13
Oxygen Reduction Potential	mV									
Chloride	mg/L		250	110	96.5	103	136	96.2	100	130
Ammonia	mg N/L								1.03	1.1
Nitrate	mgN/L	10	2							
Nitrite	mgN/L	1	0.5							
Total nitrate and nitrite	mgN/L	10							10.02	
Sulfate	mg/L		250	9.4		<4.0	<4.	<1.0	4.9	5.3
Fluoride (free)	mg/L	4	2							
(TOC) Total Organic Carbon									4	4
Total Alkalinity	mg/L			88.4	144.63	147.9	90.6	136.4	51	52
Carbonate Alkalinity	mg/L									
Hydroxide Alkalinity	mg/L									
Bicarbonate Alkalinity	mg/L									
Carbon Dioxide (Free)	mg/L									
Total Phosphorus (as P)	mg/L									
Iodide	mg/L									
Color	ACU		15						15	10
Corrosivity	-		Non-Corrosive							
Odor	TON		3							
Calcium	mg/L			25.1		30.8	15.9	30	11	12
Magnesium	mg/L			0.71		6.86	7.04	8.23	2.5	2.9
Potassium	mg/L									
Sodium	mg/L									
Total Hardness	mg/L-CaCO3		250						38	42
Metals										
Aluminum	mg/L		0.05-0.2							
Antimony	mg/L	0.006								

Table 2
Rossman Landfill Monitoring Well #1 Historical Water Quality Data

		Drinking Water Standards		MW1	MW1	MW1	MW1	MW1	MW1	MW1
		MCL								
Parameter	Units	Primary	Secondary	09/22/81	10/27/81	01/27/82	05/05/82	08/17/82	10/13/83	02/02/84
Arsenic	mg/L	0.05								
Beryllium	mg/L	0.004								
Cadmium	mg/L	0.005								
Chromium	mg/L	0.1								
Copper	mg/L	1.3	1							
Cyanide	mg/L	0.2								
Iron	mg/L		0.3	<0.05		0.2	0.05	0.12	0.52	<0.05
Lead	mg/L	0.015								
Manganese	mg/L		0.05							0.03
Mercury	mg/L	0.002								
Nickel	mg/L									
Selenium	mg/L	0.05								
Silver	mg/L	0.05	0.1							
Thallium	mg/L	0.002								
Zinc	mg/L		5							

Table 2
Rossman Landfill Monitoring Well #1 Historical Water Quality Data

		Drinking Water Standards		MW1	MW1	MW1	MW1	MW1	MW1	MW1
		MCL								
Parameter	**Units**	**Primary**	**Secondary**	**09/22/81**	**10/27/81**	**01/27/82**	**05/05/82**	**08/17/82**	**10/13/83**	**02/02/84**
Organics										
Benzene	mg/L	0.005								
Carbon tetrachloride	mg/L	0.005								
Chlorobenzene	mg/L	0.1								
1,2 -DCA	mg/L									
1,2-Dichlorobenzene	mg/L	0.6								
1,4-Dichlorobenzene	mg/L	0.075								
1,2-Dichloroethane	mg/L	0.005								
1,1-Dichloroethene	mg/L	0.007								
cis-1,2-Dichloroethene	mg/L	0.07								
trans-1,2-Dichloroethene	mg/L	0.1								
Dichloromethane	mg/L	0.005								
1,2-Dichloropropane	mg/L	0.005								
Ethylbenzene	mg/L	0.7								
Styrene	mg/L	0.1								
Tetrachloroethene (PCE)	mg/L	0.005								
Toluene	mg/L	1								
Trichlorobenzene	mg/L									
1,2,4-Trichlorobenzene	mg/L	0.07								
1,1,1-Trichloroethane	mg/L	0.2								
1,1,2-Trichloroethane	mg/L	0.005								
Trichloroethene (TCE)	mg/L	0.005								
Vinyl chloride	mg/L	0.002								
Bromobenzene	mg/L									
Bromodichloromethane	mg/L	0.1								
Bromoform	mg/L									
Bromomethane	mg/L									
Chloroform	mg/L									
Chloromethane	mg/L									
2-Chlorotoluene	mg/L									
4-Chlorotoluene	mg/L									
Dibromomethane	mg/L									
1,3-Dichlorobenzene	mg/L									
1,1-Dichloroethane	mg/L									
1,3-Dichloropropane	mg/L									
2,2-Dichloropropane	mg/L									
1,1-Dichloropropene	mg/L									

Table 2
Rossman Landfill Monitoring Well #1 Historical Water Quality Data

		Drinking Water Standards		MW1	MW1	MW1	MW1	MW1	MW1	MW1
		MCL								
Parameter	**Units**	**Primary**	**Secondary**	**09/22/81**	**10/27/81**	**01/27/82**	**05/05/82**	**08/17/82**	**10/13/83**	**02/02/84**
1,1,1,2-Tetrachloroethane	mg/L									
1,1,2,2-Tetrachloroethane	mg/L									
1,2,3-Trichloropropane	mg/L	0.2								
Trichlorotrifluoroethane (Freon)	mg/L									
DBCP	mg/L	0.0002								
1,2,4-Trimethylbenzene	mg/L									
1,2-Dibromoethane	mg/L									
1,3,5-Trimethylbenzene	mg/L									
Bromochloromethane	mg/L									
Hexachlorobutadiene	mg/L									
Isopropylbenzene	mg/L									
n-Butylbenzene	mg/L									
n-Propylbenzene	mg/L									
Naphthalene	mg/L									
sec-Butylbenzene	mg/L									
tert-Butylbenzene	mg/L									
methylene chloride	mg/L									
ND - Non Detect										

Table 2

Rossman Landfill Monitoring Well #1 Historical Water Quality Data

		Drinking Water Standards		MW1	MW1	MW1	MW1	MW1
		MCL						
Parameter	**Units**	**Primary**	**Secondary**	**06/13/84**	**02/14/85**	**10/24/85**	**10/09/86**	**1988**
Conductivity (Field Data)	umhos/cm			565	428	428	530	
Specific Conductance	umhos/cm			590	440	190	566	535
pH			6-8.5	8.3	9.2	7.4	8.3	6.16
pH (Field Data)			6.5-8.5	8.4	8.9	9	8.4	
Temperature (Field Data)	oC			14	13.5	13.5	14	
(TDS) Total Dissolved Solids	mg/L		500					356
(TSS) Total Suspended Solids	mg/L							
(DO) Dissolved Oxygen	mg/L		250					
(COD) Chemical Oxygen Demand	mg/L			<5		9	5	6
Oxygen Reduction Potential	mV							
Chloride	mg/L		250	104	1	26		97.8
Ammonia	mg N/L			0.57	0.34	0.05	0.61	0.63
Nitrate	mgN/L	10	2					<0.5
Nitrite	mgN/L	1	0.5					
Total nitrate and nitrite	mgN/L	10						
Sulfate	mg/L		250	0.9	5.8	3.5	2	<1.0
Fluoride (free)	mg/L	4	2					0.49
(TOC) Total Organic Carbon				<1.0		4	2	
Total Alkalinity	mg/L			130	38	52	131	136
Carbonate Alkalinity	mg/L							
Hydroxide Alkalinity	mg/L							
Bicarbonate Alkalinity	mg/L							
Carbon Dioxide (Free)	mg/L							
Total Phosphorus (as P)	mg/L							
Iodide	mg/L							
Color	ACU		15	<5	<5	50	5	<5
Corrosivity	-		Non-Corrosive					
Odor	TON		3					
Calcium	mg/L			29	12	13	29	30.4
Magnesium	mg/L			8.3	1.9	4.8	7.7	7
Potassium	mg/L							8.6
Sodium	mg/L							79
Total Hardness	mg/L-CaCO3		250	110	38	52	100	
Metals								
Aluminum	mg/L		0.05-0.2					
Antimony	mg/L	0.006						<0.5

Table 2

Rossman Landfill Monitoring Well #1 Historical Water Quality Data

		Drinking Water Standards		MW1	MW1	MW1	MW1	MW1
		MCL						
Parameter	**Units**	**Primary**	**Secondary**	**06/13/84**	**02/14/85**	**10/24/85**	**10/09/86**	**1988**
Arsenic	mg/L	0.05						<0.005
Beryllium	mg/L	0.004						<0.05
Cadmium	mg/L	0.005						<0.0005
Chromium	mg/L	0.1						<0.005
Copper	mg/L	1.3	1					<0.05
Cyanide	mg/L	0.2						0.07
Iron	mg/L		0.3	0.06	<0.05	0.29	0.2	
Lead	mg/L	0.015						<0.005
Manganese	mg/L		0.05	0.12		0.06	0.1	0.12
Mercury	mg/L	0.002						<0.0005
Nickel	mg/L							<0.05
Selenium	mg/L	0.05						<0.005
Silver	mg/L	0.05	0.1					<0.005
Thallium	mg/L	0.002						<0.1
Zinc	mg/L		5					0.016

Table 2
Rossman Landfill Monitoring Well #1 Historical Water Quality Data

		Drinking Water Standards		MW1	MW1	MW1	MW1	MW1
		MCL						
Parameter	**Units**	**Primary**	**Secondary**	**06/13/84**	**02/14/85**	**10/24/85**	**10/09/86**	**1988**
Organics								
Benzene	mg/L	0.005						
Carbon tetrachloride	mg/L	0.005						
Chlorobenzene	mg/L	0.1						
1,2 -DCA	mg/L							
1,2-Dichlorobenzene	mg/L	0.6						
1,4-Dichlorobenzene	mg/L	0.075						
1,2-Dichloroethane	mg/L	0.005						
1,1-Dichloroethene	mg/L	0.007						
cis-1,2-Dichloroethene	mg/L	0.07						
trans-1,2-Dichloroethene	mg/L	0.1						
Dichloromethane	mg/L	0.005						
1,2-Dichloropropane	mg/L	0.005						
Ethylbenzene	mg/L	0.7						
Styrene	mg/L	0.1						
Tetrachloroethene (PCE)	mg/L	0.005						
Toluene	mg/L	1						
Trichlorobenzene	mg/L							
1,2,4-Trichlorobenzene	mg/L	0.07						
1,1,1-Trichloroethane	mg/L	0.2						
1,1,2-Trichloroethane	mg/L	0.005						
Trichloroethene (TCE)	mg/L	0.005						
Vinyl chloride	mg/L	0.002						
Bromobenzene	mg/L							
Bromodichloromethane	mg/L	0.1						
Bromoform	mg/L							
Bromomethane	mg/L							
Chloroform	mg/L							
Chloromethane	mg/L							
2-Chlorotoluene	mg/L							
4-Chlorotoluene	mg/L							
Dibromomethane	mg/L							
1,3-Dichlorobenzene	mg/L							
1,1-Dichloroethane	mg/L							
1,3-Dichloropropane	mg/L							
2,2-Dichloropropane	mg/L							
1,1-Dichloropropene	mg/L							

Table 2
Rossman Landfill Monitoring Well #1 Historical Water Quality Data

		Drinking Water Standards		MW1	MW1	MW1	MW1	MW1
		MCL						
Parameter	Units	Primary	Secondary	06/13/84	02/14/85	10/24/85	10/09/86	1988
1,1,1,2-Tetrachloroethane	mg/L							
1,1,2,2-Tetrachloroethane	mg/L							
1,2,3-Trichloropropane	mg/L	0.2						
Trichlorotrifluoroethane (Freon)	mg/L							
DBCP	mg/L	0.0002						
1,2,4-Trimethylbenzene	mg/L							
1,2-Dibromoethane	mg/L							
1,3,5-Trimethylbenzene	mg/L							
Bromochloromethane	mg/L							
Hexachlorobutadiene	mg/L							
Isopropylbenzene	mg/L							
n-Butylbenzene	mg/L							
n-Propylbenzene	mg/L							
Naphthalene	mg/L							
sec-Butylbenzene	mg/L							
tert-Butylbenzene	mg/L							
methylene chloride	mg/L							
ND - Non Detect								

Table 2
Rossman Landfill Monitoring Well #1 Historical Water Quality Data

		Drinking Water Standards		MW1	MW1	MW1	MW1	MW1	MW1	MW1
		MCL								
Parameter	Units	Primary	Secondary	4/1/92	10/1/92	4/1/93	10/1/93	4/1/94	9/20/94	3/1/95
Conductivity (Field Data)	umhos/cm								430	
Specific Conductance	umhos/cm						600	630	670	527
pH			6-8.5						8.1	
pH (Field Data)			6.5-8.5							
Temperature (Field Data)	oC								14.4	
(TDS) Total Dissolved Solids	mg/L		500	364		356	353	390	335	329
(TSS) Total Suspended Solids	mg/L								<10	
(DO) Dissolved Oxygen	mg/L		250						0.05	
(COD) Chemical Oxygen Demand	mg/L			<7		<7	<7	<25	<25	<25
Oxygen Reduction Potential	mV									
Chloride	mg/L		250	101		117	101	98.7	104	103
Ammonia	mg N/L									
Nitrate	mgN/L	10	2						<0.02	
Nitrite	mgN/L	1	0.5							
Total nitrate and nitrite	mgN/L	10								
Sulfate	mg/L		250	0.613		0.566	<0.4	<0.5	<0.1	<0.1
Fluoride (free)	mg/L	4	2							
(TOC) Total Organic Carbon										
Total Alkalinity	mg/L			134		140	141	143	136	136
Carbonate Alkalinity	mg/L									
Hydroxide Alkalinity	mg/L									
Bicarbonate Alkalinity	mg/L									
Carbon Dioxide (Free)	mg/L									
Total Phosphorus (as P)	mg/L									
Iodide	mg/L									
Color	ACU		15							
Corrosivity	-		Non-Corrosive							
Odor	TON		3							
Calcium	mg/L									
Magnesium	mg/L									
Potassium	mg/L								8.47	
Sodium	mg/L						66.9	71.2	69.4	63.5
Total Hardness	mg/L-CaCO3		250						108	
Metals										
Aluminum	mg/L		0.05-0.2							
Antimony	mg/L	0.006								

Table 2

Rossman Landfill Monitoring Well #1 Historical Water Quality Data

		Drinking Water Standards		MW1	MW1	MW1	MW1	MW1	MW1	MW1
		MCL								
Parameter	**Units**	**Primary**	**Secondary**	**4/1/92**	**10/1/92**	**4/1/93**	**10/1/93**	**4/1/94**	**9/20/94**	**3/1/95**
Arsenic	mg/L	0.05								
Beryllium	mg/L	0.004								
Cadmium	mg/L	0.005								
Chromium	mg/L	0.1								
Copper	mg/L	1.3	1							
Cyanide	mg/L	0.2								
Iron	mg/L		0.3	0.093		0.136	0.0892	0.0943	0.0674	0.0995
Lead	mg/L	0.015								
Manganese	mg/L		0.05				0.114	0.129	0.117	0.116
Mercury	mg/L	0.002								
Nickel	mg/L									
Selenium	mg/L	0.05								
Silver	mg/L	0.05	0.1							
Thallium	mg/L	0.002								
Zinc	mg/L		5							

Table 2
Rossman Landfill Monitoring Well #1 Historical Water Quality Data

		Drinking Water Standards		MW1	MW1	MW1	MW1	MW1	MW1	MW1
		MCL								
Parameter	**Units**	**Primary**	**Secondary**	**4/1/92**	**10/1/92**	**4/1/93**	**10/1/93**	**4/1/94**	**9/20/94**	**3/1/95**
Organics										
Benzene	mg/L	0.005							<0.001	
Carbon tetrachloride	mg/L	0.005							<0.001	
Chlorobenzene	mg/L	0.1							<0.001	
1,2 -DCA	mg/L								<0.001	
1,2-Dichlorobenzene	mg/L	0.6							<0.001	
1,4-Dichlorobenzene	mg/L	0.075							<0.001	
1,2-Dichloroethane	mg/L	0.005							<0.001	
1,1-Dichloroethene	mg/L	0.007							<0.001	
cis-1,2-Dichloroethene	mg/L	0.07							<0.001	
trans-1,2-Dichloroethene	mg/L	0.1							<0.001	
Dichloromethane	mg/L	0.005							<0.001	
1,2-Dichloropropane	mg/L	0.005							<0.001	
Ethylbenzene	mg/L	0.7							<0.001	
Styrene	mg/L	0.1							<0.001	
Tetrachloroethene (PCE)	mg/L	0.005							<0.001	
Toluene	mg/L	1								
Trichlorobenzene	mg/L								<0.001	
1,2,4-Trichlorobenzene	mg/L	0.07							<0.001	
1,1,1-Trichloroethane	mg/L	0.2							<0.001	
1,1,2-Trichloroethane	mg/L	0.005							<0.001	
Trichloroethene (TCE)	mg/L	0.005							<0.001	
Vinyl chloride	mg/L	0.002				<0.001	<0.001		<0.001	
Bromobenzene	mg/L								<0.001	
Bromodichloromethane	mg/L	0.1							<0.001	
Bromoform	mg/L								<0.001	
Bromomethane	mg/L								<0.001	
Chloroform	mg/L								<0.001	
Chloromethane	mg/L								<0.001	
2-Chlorotoluene	mg/L								<0.001	
4-Chlorotoluene	mg/L								<0.001	
Dibromomethane	mg/L								<0.001	
1,3-Dichlorobenzene	mg/L								<0.001	
1,1-Dichloroethane	mg/L								<0.001	
1,3-Dichloropropane	mg/L								<0.001	
2,2-Dichloropropane	mg/L								<0.001	
1,1-Dichloropropene	mg/L								<0.001	

Table 2

Rossman Landfill Monitoring Well #1 Historical Water Quality Data

		Drinking Water Standards		MW1	MW1	MW1	MW1	MW1	MW1	MW1
		MCL								
Parameter	**Units**	**Primary**	**Secondary**	**4/1/92**	**10/1/92**	**4/1/93**	**10/1/93**	**4/1/94**	**9/20/94**	**3/1/95**
1,1,1,2-Tetrachloroethane	mg/L								<0.001	
1,1,2,2-Tetrachloroethane	mg/L								<0.001	
1,2,3-Trichloropropane	mg/L	0.2							<0.001	
Trichlorotrifluoroethane (Freon)	mg/L								<0.001	
DBCP	mg/L	0.0002							<0.001	
1,2,4-Trimethylbenzene	mg/L								<0.001	
1,2-Dibromoethane	mg/L								<0.001	
1,3,5-Trimethylbenzene	mg/L								<0.001	
Bromochloromethane	mg/L								<0.001	
Hexachlorobutadiene	mg/L								<0.001	
Isopropylbenzene	mg/L								<0.001	
n-Butylbenzene	mg/L								<0.001	
n-Propylbenzene	mg/L								<0.001	
Naphthalene	mg/L								<0.001	
sec-Butylbenzene	mg/L								<0.001	
tert-Butylbenzene	mg/L								<0.001	
methylene chloride	mg/L								<0.001	
ND - Non Detect										

Table 2

Rossman Landfill Monitoring Well #1 Historical Water Quality Data

		Drinking Water Standards		MW1	MW1	MW1	MW1	MW1
		MCL						
Parameter	Units	Primary	Secondary	9/1/95	4/1/96	9/1/96	3/1/97	9/16/97
Conductivity (Field Data)	umhos/cm							
Specific Conductance	umhos/cm			491	428			404
pH			6-8.5					7.9
pH (Field Data)			6.5-8.5					
Temperature (Field Data)	oC							14.3
(TDS) Total Dissolved Solids	mg/L		500	311	239			269
(TSS) Total Suspended Solids	mg/L							
(DO) Dissolved Oxygen	mg/L		250					
(COD) Chemical Oxygen Demand	mg/L			<25				
Oxygen Reduction Potential	mV							
Chloride	mg/L		250	116	76.7			66.7
Ammonia	mg N/L							0.5
Nitrate	mgN/L	10	2					<0.05
Nitrite	mgN/L	1	0.5					
Total nitrate and nitrite	mgN/L	10						
Sulfate	mg/L		250	<0.1	1.83			2.43
Fluoride (free)	mg/L	4	2					
(TOC) Total Organic Carbon								
Total Alkalinity	mg/L			140	108			110
Carbonate Alkalinity	mg/L							<10
Hydroxide Alkalinity	mg/L							
Bicarbonate Alkalinity	mg/L							110
Carbon Dioxide (Free)	mg/L							
Total Phosphorus (as P)	mg/L							
Iodide	mg/L							
Color	ACU		15					
Corrosivity	-		Non-Corrosive					
Odor	TON		3					
Calcium	mg/L							24.3
Magnesium	mg/L							7.21
Potassium	mg/L							6.98
Sodium	mg/L			68.4	47.1			50.1
Total Hardness	mg/L-CaCO3		250					
Metals								
Aluminum	mg/L		0.05-0.2					
Antimony	mg/L	0.006						

Table 2

Rossman Landfill Monitoring Well #1 Historical Water Quality Data

		Drinking Water Standards		MW1	MW1	MW1	MW1	MW1
		MCL						
Parameter	Units	Primary	Secondary	9/1/95	4/1/96	9/1/96	3/1/97	9/16/97
Arsenic	mg/L	0.05						
Beryllium	mg/L	0.004						
Cadmium	mg/L	0.005						
Chromium	mg/L	0.1						
Copper	mg/L	1.3	1					
Cyanide	mg/L	0.2						
Iron	mg/L		0.3	0.0891	0.0598			0.173
Lead	mg/L	0.015						
Manganese	mg/L		0.05	0.126	0.117			0.159
Mercury	mg/L	0.002						
Nickel	mg/L							
Selenium	mg/L	0.05						
Silver	mg/L	0.05	0.1					
Thallium	mg/L	0.002						
Zinc	mg/L		5					

Table 2
Rossman Landfill Monitoring Well #1 Historical Water Quality Data

		Drinking Water Standards		MW1	MW1	MW1	MW1	MW1
		MCL						
Parameter	Units	Primary	Secondary	9/1/95	4/1/96	9/1/96	3/1/97	9/16/97
Organics								
Benzene	mg/L	0.005						
Carbon tetrachloride	mg/L	0.005						
Chlorobenzene	mg/L	0.1						
1,2 -DCA	mg/L							
1,2-Dichlorobenzene	mg/L	0.6						<0.001
1,4-Dichlorobenzene	mg/L	0.075						
1,2-Dichloroethane	mg/L	0.005						
1,1-Dichloroethene	mg/L	0.007						
cis-1,2-Dichloroethene	mg/L	0.07						
trans-1,2-Dichloroethene	mg/L	0.1						
Dichloromethane	mg/L	0.005						
1,2-Dichloropropane	mg/L	0.005						
Ethylbenzene	mg/L	0.7						
Styrene	mg/L	0.1						
Tetrachloroethene (PCE)	mg/L	0.005						
Toluene	mg/L	1						
Trichlorobenzene	mg/L							<0.001
1,2,4-Trichlorobenzene	mg/L	0.07						<0.001
1,1,1-Trichloroethane	mg/L	0.2						
1,1,2-Trichloroethane	mg/L	0.005						
Trichloroethene (TCE)	mg/L	0.005						
Vinyl chloride	mg/L	0.002		<0.001				<0.001
Bromobenzene	mg/L							
Bromodichloromethane	mg/L	0.1						
Bromoform	mg/L							
Bromomethane	mg/L							
Chloroform	mg/L							
Chloromethane	mg/L							
2-Chlorotoluene	mg/L							
4-Chlorotoluene	mg/L							
Dibromomethane	mg/L							
1,3-Dichlorobenzene	mg/L							
1,1-Dichloroethane	mg/L							
1,3-Dichloropropane	mg/L							
2,2-Dichloropropane	mg/L							
1,1-Dichloropropene	mg/L							

Table 2

Rossman Landfill Monitoring Well #1 Historical Water Quality Data

		Drinking Water Standards		MW1	MW1	MW1	MW1	MW1
		MCL						
Parameter	Units	Primary	Secondary	9/1/95	4/1/96	9/1/96	3/1/97	9/16/97
1,1,1,2-Tetrachloroethane	mg/L							
1,1,2,2-Tetrachloroethane	mg/L							
1,2,3-Trichloropropane	mg/L	0.2						<0.001
Trichlorotrifluoroethane (Freon)	mg/L							
DBCP	mg/L	0.0002						
1,2,4-Trimethylbenzene	mg/L							<0.001
1,2-Dibromoethane	mg/L							<0.001
1,3,5-Trimethylbenzene	mg/L							
Bromochloromethane	mg/L							
Hexachlorobutadiene	mg/L							
Isopropylbenzene	mg/L							
n-Butylbenzene	mg/L							
n-Propylbenzene	mg/L							
Naphthalene	mg/L							
sec-Butylbenzene	mg/L							
tert-Butylbenzene	mg/L							
methylene chloride	mg/L							
ND - Non Detect								

Table 4
Initial Feasibility Study Water Quality Results

		Drinking Water Standards		Odgen Middle School	Senior High School	Lonestar	16200 Oak Tree Terrace
		MCL					
Parameter	**Units**	**Primary**	**Secondary**	**08/26/99**	**08/26/99**	**08/26/99**	**08/31/99**
Conventional Parameters							
Conductivity	umhos/cm			1570	1700	640	560
pH			6.5-8.5	7.8	7.8	8.3	8.1
Temperature (Field Data)	*oC*						
Total Dissolved Solids	mg/L		500	930	1000	380	350
Turbidity	NTU	0.5					
Chloride	mg/L		250	464	506	134	86.9
Nitrate	mgN/L	10		ND	ND	ND	ND
Nitrite	mgN/L	1					
Total nitrate and nitrite	mgN/L	10					
Sulfate	mg/L		250	ND	ND	ND	ND
Fluoride (free)	mg/L	4	2				
MBAs (Surfactants)	mg/L		0.5				
Total Alkalinity	mg/L			129	123	135	150
Carbonate Alkalinity	mg/L			0.644	0.615	2.13	1.49
Hydroxide Alkalinity	mg/L			0.011	0.011	0.034	0.021
Bicarbonate Alkalinity	mg/L			157	150	164	182
Carbon Dioxide (Free)	mg/L			4.98	4.75	1.64	2.89
Total Phosphorus (as P)	mg/L						
Color	ACU		15				
Corrosivity	-		Non-Corrosive				
Odor	TON		3				
Calcium	mg/L			108	130	94.5	ND
Magnesium	mg/L			10	11.5	35.6	ND
Potassium	mg/L			18.3	18.6	18.4	2.6
Silica (SiO2)	mg/L			54	54	69	50
Sodium	mg/L			187	185	79	118
Total Hardness	mg/L-CaCO3		250	311	372	382	ND
Microbiological							
Standard Plate Count	cfu/mL						
Total Coliform	#/100 mL	<5% positive samples					
E. Coli	#/100 mL	<5% positive samples					
Metals							
Aluminum	mg/L		0.05-0.2				
Antimony	mg/L	0.006					

Table 4
Initial Feasibility Study Water Quality Results

		Drinking Water Standards		Odgen Middle School	Senior High School	Lonestar	16200 Oak Tree Terrace
		MCL					
Parameter	Units	Primary	Secondary	08/26/99	08/26/99	08/26/99	08/31/99
Arsenic	mg/L	0.05					
Barium	mg/L	2					
Beryllium	mg/L	0.004					
Cadmium	mg/L	0.005					
Chromium	mg/L	0.1					
Copper	mg/L	1.3	1				
Cyanide	mg/L	0.2					
Iron	mg/L		0.3	0.65	0.71	83	ND
Lead	mg/L	0.015					
Manganese	mg/L		0.05	0.091	0.092	1.6	ND
Mercury	mg/L	0.002					
Nickel	mg/L						
Selenium	mg/L	0.05					
Silver	mg/L	0.05	0.1				
Thallium	mg/L	0.002					
Zinc	mg/L		5				
Radionuclides							
Gross Alpha	pCi/L	15					
Gross Beta	pCi/L	50					
Radon (Rn-222)	pCi/L						
Iodine-131	pCi/L	3					
Strontium-90	pCi/L	8					
Tritium	pCi/L	20000					
Disinfection By-Products							
Total Haloacetic Acids	mg/L	0.060					
Total Trihaolmethanes	mg/L	0.080					
Organics							
1,1,1-Trichloroethane	mg/L	0.2		ND	ND	ND	ND
1,1,2-Trichloroethane	mg/L	0.005		ND	ND	ND	ND
1,1-Dichloroethene	mg/L	0.007		ND	ND	ND	ND
1,2,4-Trichlorobenzene	mg/L	0.07		ND	ND	ND	ND
1,2-Dichlorobenzene	mg/L	0.6		ND	ND	ND	ND
1,2-Dichloroethane	mg/L	0.075		ND	ND	ND	ND
1,2-Dichloropropane	mg/L	0.005		ND	ND	ND	ND

Table 4
Initial Feasibility Study Water Quality Results

		Drinking Water Standards		Odgen Middle School	Senior High School	Lonestar	16200 Oak Tree Terrace
		MCL					
Parameter	**Units**	**Primary**	**Secondary**	**08/26/99**	**08/26/99**	**08/26/99**	**08/31/99**
1,4-Dichlorobenzene	mg/L	0.075		ND	ND	ND	ND
2,3,7,8-TCDD	mg/L	0.00000003					
2,4,5-TP (Silvex)	mg/L	0.05					
2,4-D	mg/L	0.07					
Alachlor	mg/L	0.002					
Atrazine	mg/L	0.003					
Benzene	mg/L	0.005		ND	ND	ND	ND
Benzo(a)pyrene	mg/L	0.0002					
Carbofuran	mg/L	0.04					
Carbon tetrachloride	mg/L	0.005		ND	ND	ND	ND
Chlordane	mg/L	0.002					
Chlorobenzene	mg/L	0.1		ND	ND	ND	ND
cis-1,2-Dichloroethene	mg/L	0.07		ND	ND	ND	ND
Dalapon	mg/L	0.2					
DBCP	mg/L	0.0002					
Di(2-ethylhexyl)adipate	mg/L	0.4					
Di(2-ethylhexyl)phthalate	mg/L	0.006					
Dichloromethane	mg/L	0.005		ND	ND	ND	ND
Dinoseb	mg/L	0.007					
Diquat	mg/L	0.02					
EDB (Ethylene dibromide)	mg/L	0.00005					
Endothall	mg/L	0.1					
Endrin	mg/L	0.002					
Ethylbenzene	mg/L	0.7		ND	ND	ND	ND
Glyphosate	mg/L	0.7					
Heptachlor	mg/L	0.0004					
Heptachlor epoxide	mg/L	0.0002					
Hexachlorobenzene	mg/L	0.001					
Hexachlorocyclopentadiene	mg/L	0.05		ND	ND	ND	ND
Lindane (gamma-BHC)	mg/L	0.0002					
Methoxychlor	mg/L	0.04					
Oxamyl (Vydate)	mg/L	0.2					
Pentachlorophenol	mg/L	0.001					
Picloram	mg/L	0.5					
Polychlorinated Biphenyls	mg/L	0.0005					
Simazine	mg/L	0.004					

Table 4
Initial Feasibility Study Water Quality Results

		Drinking Water Standards		Odgen Middle School	Senior High School	Lonestar	16200 Oak Tree Terrace
		MCL					
Parameter	Units	Primary	Secondary	08/26/99	08/26/99	08/26/99	08/31/99
Styrene	mg/L	0.1		ND	ND	ND	ND
Tetrachloroethene (PCE)	mg/L	0.005		ND	ND	ND	ND
Toluene	mg/L	1		ND	ND	ND	ND
Toxaphene	mg/L	0.003					
trans-1,2-Dichloroethene	mg/L	0.1		ND	ND	ND	ND
Trichloroethene (TCE)	mg/L	0.005		ND	ND	ND	ND
Vinyl chloride	mg/L	0.002		ND	ND	ND	ND
Xylene (Total)	mg/L	10		ND	ND	ND	ND
1,1,1,2-Tetrachloroethane	mg/L			ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	mg/L			ND	ND	ND	ND
1,1-Dichloropropene	mg/L			ND	ND	ND	ND
1,2,3-Trichlorobenzene	mg/L			ND	ND	ND	ND
1,2,3-Trichloropropane	mg/L			ND	ND	ND	ND
1,2,4-Trimethylbenzene	mg/L			ND	ND	ND	ND
1,3,5-Trimethylbenzene	mg/L			ND	ND	ND	ND
1,3-Dichlorobenzene	mg/L			ND	ND	ND	ND
1,3-Dichloropropane	mg/L			ND	ND	ND	ND
1,3-Dichloropropene	mg/L			ND	ND	ND	ND
2,2-Dichloropropane	mg/L			ND	ND	ND	ND
2,4-DB	mg/L						
2,4-Dinitrotoluene	mg/L						
2-Butanone (MEK)	mg/L			ND	ND	ND	ND
2-Chlorotoluene	mg/L			ND	ND	ND	ND
3,5-Dichlorobenzoic Acid	mg/L						
3-Hydroxycarbofuran	mg/L						
4-Chlorotoluene	mg/L			ND	ND	ND	ND
4-Isopropyltoluene	mg/L			ND	ND	ND	ND
4-Methyl-2-Pentanone (MIBK)	mg/L			ND	ND	ND	ND
4-Nitrophenol	mg/L						
Acenaphthylene	mg/L						
Acifluorfen	mg/L						
Aldicarb	mg/L						
Aldicarb sulfone	mg/L						
Aldicarb sulfoxide	mg/L						
Aldrin	mg/L						
Alpha-BHC	mg/L						

Table 4
Initial Feasibility Study Water Quality Results

		Drinking Water Standards		Odgen Middle School	Senior High School	Lonestar	16200 Oak Tree Terrace
		MCL					
Parameter	**Units**	**Primary**	**Secondary**	**08/26/99**	**08/26/99**	**08/26/99**	**08/31/99**
alpha-Chlorodane	mg/L						
Anthracene	mg/L						
Aroclor 1016	mg/L						
Aroclor 1221	mg/L						
Aroclor 1232	mg/L						
Aroclor 1242	mg/L						
Aroclor 1248	mg/L						
Aroclor 1254	mg/L						
Aroclor 1260	mg/L						
Baygon	mg/L						
Bentazon	mg/L						
Benz(a)Anthracene	mg/L						
Benzo(b)Fluorethane	mg/L						
Benzo(g,h,I)Perylene	mg/L						
Benzo(k)Fluoranthene	mg/L						
Beta-BHC	mg/L						
Bromacil	mg/L						
Bromobenzene	mg/L			ND	ND	ND	ND
Bromochloromethane	mg/L			ND	ND	ND	ND
Bromoform	mg/L			ND	ND	ND	ND
Bromomethane	mg/L			ND	ND	ND	ND
Butachlor	mg/L						
Butylbenzylphthalate	mg/L						
Caffeine	mg/L						
Carbaryl	mg/L						
Chloroethane	mg/L			ND	ND	ND	ND
Chloroform	mg/L			ND	ND	ND	ND
Chloromethane	mg/L			ND	ND	ND	ND
Chlorthalonil	mg/L						
Chrysene	mg/L						
DCPA	mg/L						
Delta-BHC	mg/L						
Dibenz(a,h)Anthracene	mg/L						
Dibromochloromethane	mg/L			ND	ND	ND	ND
Dibromomethane	mg/L			ND	ND	ND	ND
Dicamba	mg/L						

Table 4
Initial Feasibility Study Water Quality Results

		Drinking Water Standards		Odgen Middle School	Senior High School	Lonestar	16200 Oak Tree Terrace
		MCL					
Parameter	Units	Primary	Secondary	08/26/99	08/26/99	08/26/99	08/31/99
Dichlorodifluoromethane	mg/L			ND	ND	ND	ND
Dichlorprop	mg/L						
Dieldrin	mg/L						
Diethylphthalate	mg/L						
Di-isopropyl Ether	mg/L			ND	ND	ND	ND
Dimethoate	mg/L						
Dimethylphthalate	mg/L						
Di-n-Butylphthalate	mg/L						
Endosulfan I	mg/L						
Endosulfan II	mg/L						
Endosulfan Sulfate	mg/L						
Endrin Aldehyde	mg/L						
Fluorene	mg/L						
Indeno(1,2,3,c,d)Pyrene	mg/L						
Isophorone	mg/L						
Isopropylbenzene	mg/L			ND	ND	ND	ND
Methoicarb	mg/L						
Methomyl	mg/L						
Metolachlor	mg/L						
Metribuzin	mg/L						
Molinate	mg/L						
Naphthalene	mg/L			ND	ND	ND	ND
n-Butylbenzene	mg/L			ND	ND	ND	ND
n-Propylbenzene	mg/L			ND	ND	ND	ND
p,p' DDD	mg/L						
p,p' DDE	mg/L						
p,p' DDT	mg/L						
Paraquat	mg/L						
Phenanthrene	mg/L						
Prometryn	mg/L						
Propachlor	mg/L						
Pyrene	mg/L						
sec-Butylbenzene	mg/L			ND	ND	ND	ND
tert-Butylbenzene	mg/L			ND	ND	ND	ND
Thiobencarb	mg/L						
trans-1,3-Dichloropropene	mg/L			ND	ND	ND	ND

Table 4
Initial Feasibility Study Water Quality Results

		Drinking Water Standards		Odgen Middle School	Senior High School	Lonestar	16200 Oak Tree Terrace
		MCL					
Parameter	**Units**	**Primary**	**Secondary**	**08/26/99**	**08/26/99**	**08/26/99**	**08/31/99**
trans-Nonachlor	*mg/L*						
Trichlorofluoromethane	mg/L			ND	ND	ND	ND
Trichlorotrifluoroethane (Freon)	mg/L			ND	ND	ND	ND
Trifluralin	mg/L						

Table 4
Initial Feasibility Study Water Quality Results

CRW-1 Pre-Pump Test	CRW1 Post- Pump Test	CRW1 Packer Test Upper Zone	CRW1 Packer Test Lower Zone
08/31/99	09/01/99	11/30/99	11/30/99
770	860	530	975
8	8	8.2	8
470	510	330	600
1.1	0.1		
167	182	101	273
ND	ND	ND	ND
ND	ND		
ND	ND		
ND	ND	ND	ND
0.67	0.7		
ND	ND		
137	136	141	130
1.09	1.07	1.76	1.03
0.017	0.017	0.02	0.017
167	165	171	158
3.34	3.3	2.16	3.16
ND	0.02		
3	5		
0.4	0.4		
1	1		
39.3	40.9	26	50.8
7.2	7.1	5.8	8.2
12	12.3	9.3	13.9
49	46	45	45
101	108	76.9	130
128	131	88.8	161
100	2		
>23	<1.1		
<1.1	<1.1		
ND	ND		
ND	ND		

Table 4

Initial Feasibility Study Water Quality Results

CRW-1 Pre-Pump Test	CRW1 Post- Pump Test	CRW1 Packer Test Upper Zone	CRW1 Packer Test Lower Zone
08/31/99	09/01/99	11/30/99	11/30/99
ND	ND		
0.041	0.045		
ND	ND		
ND	ND		
0.0078	0.011		
ND	ND		
ND	ND		
0.11	0.13	ND	ND
0.000645	ND		
0.036	0.036	0.024	0.038
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		
0.03	ND		
<3.27	<4.08		
<2.88	11.7		
260	220		
<3.3	0.306		
<291			
ND	ND		
ND	ND		
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND	ND	ND

Table 4
Initial Feasibility Study Water Quality Results

CRW-1 Pre-Pump Test	CRW1 Post- Pump Test	CRW1 Packer Test Upper Zone	CRW1 Packer Test Lower Zone
08/31/99	09/01/99	11/30/99	11/30/99
ND	ND	ND	ND
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND	ND	ND
ND	ND		
ND	ND		
ND	ND	ND	ND
ND	ND		
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND	ND	ND
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND	ND	ND
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND	ND	ND
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		

Table 4

Initial Feasibility Study Water Quality Results

CRW-1 Pre-Pump Test	CRW1 Post- Pump Test	CRW1 Packer Test Upper Zone	CRW1 Packer Test Lower Zone
08/31/99	09/01/99	11/30/99	11/30/99
ND	ND	ND	ND
0.0006	ND	ND	ND
ND	ND	ND	ND
ND	ND		
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND		
ND	ND		
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND		
ND	ND		
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		

Table 4
Initial Feasibility Study Water Quality Results

CRW-1 Pre-Pump Test	CRW1 Post- Pump Test	CRW1 Packer Test Upper Zone	CRW1 Packer Test Lower Zone
08/31/99	09/01/99	11/30/99	11/30/99
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND		

Table 4
Initial Feasibility Study Water Quality Results

CRW-1 Pre-Pump Test	CRW1 Post- Pump Test	CRW1 Packer Test Upper Zone	CRW1 Packer Test Lower Zone
08/31/99	09/01/99	11/30/99	11/30/99
ND	ND	ND	ND
ND	ND		
ND	ND		
ND	ND		
ND	ND	ND	ND
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND	ND	ND
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND		
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND		
ND	ND	ND	ND

Table 4
Initial Feasibility Study Water Quality Results

CRW-1 Pre-Pump Test	CRW1 Post- Pump Test	CRW1 Packer Test Upper Zone	CRW1 Packer Test Lower Zone
08/31/99	**09/01/99**	**11/30/99**	**11/30/99**
ND	ND		
ND	ND	ND	ND
ND	ND	ND	ND
ND	ND		

Table 6
Clackamas River Water - Historical Injection Water Quality

		Drinking Water Standards		Clackamas River Water District			South Fork Water Bo	
		MCL		No. of			No. of	
Parameter	**Units**	**Primary**	**Secondary**	**Samples**	**Min**	**Max**	**Samples**	**Min**
Conventional Parameters								
Chloride	mg/L		250	7	1.8	23	1	10
Color	ACU		15	1	10	10		
Corrosivity	-		Non-Corrosive					
Fluoride (free)	mg/L	4	2	7	ND	ND	7	ND
MBAS (Surfactants)	mg/L		0.5	7	ND	0.04		
Odor	TON		3					
pH			6.5-8.5	7	6.76	7.69	1	6.7
Sulfate	mg/L		250	7	3	5.8	7	ND
Total Dissolved Solids	mg/L		500	7	22	76		
Total Hardness	mg/L-CaCO3		250	7	16	32	1	76
Nitrite	mgN/L	1		7	ND	ND	7	ND
Nitrate	mgN/L	10		7	0.04	0.7	13	ND
Total nitrate and nitrite	mgN/L	10						
Turbidity	NTU	0.5						
Calcium	mg/L			4	4.1	5.7		
Conductivity	umhos/cm							
Magnesium	mg/L			3	1.5	1.6		
Potassium	mg/L							
Silica (SiO2)	mg/L							
Sodium	mg/L			6	5.8	6.9	7	4.6
Total Alkalinity	mg/L			6	20	26		
Microbiological								
Total Coliform	#/100 mL	<5% positive samples		Monthly	0%	2%	Monthly	0%
E. Coli	#/100 mL	<5% positive samples			0%	0%		0%
Metals								
Aluminum	mg/L		0.05-0.2	7	ND	0.06		
Antimony	mg/L	0.006		7	ND	ND	7	ND
Arsenic	mg/L	0.05		7	ND	ND	7	ND
Barium	mg/L	2		7	0.002	0.003	7	ND
Beryllium	mg/L	0.004		7	ND	ND	7	ND
Cadmium	mg/L	0.005		7	ND	ND	7	ND
Chromium	mg/L	0.1		7	ND	ND	7	ND
Copper	mg/L	1.3	1	7	ND	ND	6	0.1

Table 6
Clackamas River Water - Historical Injection Water Quality

		Drinking Water Standards		Clackamas River Water District			South Fork Water Bo	
		MCL						
Parameter	Units	Primary	Secondary	No. of Samples	Min	Max	No. of Samples	Min
Cyanide	mg/L	0.2		7	ND	ND	7	ND
Iron	mg/L		0.3	7	ND	ND	1	ND
Lead	mg/L	0.015		2	ND	ND	6	0.002
Manganese	mg/L		0.05	7	ND	0.01	1	ND
Mercury	mg/L	0.002		7	ND	ND	7	ND
Nickel	mg/L	0.1		7	ND	ND	7	ND
Selenium	mg/L	0.05		7	ND	ND	7	ND
Silver	mg/L	0.05	0.1	7	ND	0.0048		
Thallium	mg/L	0.002		7	ND	ND	7	ND
Zinc	mg/L		5	7	ND	0.06	1	0.02
Radionuclides								
Gross Alpha	pCi/L	15					2	ND
Gross Beta	pCi/L	50						
Radon (Rn-222)	pCi/L							
Iodine-131	pCi/L	3						
Strontium-90	pCi/L	8						
Tritium	pCi/L	20000						
Disinfection By-Products								
Total Haloacetic Acids	mg/L	0.060						
Total Trihaolmethanes	mg/L	0.080		7	0.01732	0.0332	Quarterly	0.0149
Organics								
VOCs								
1,1,1-Trichloroethane	mg/L	0.2		7	ND	ND	8	ND
1,1,2-Trichloroethane	mg/L	0.005		6	ND	ND	8	ND
1,1-Dichloroethene	mg/L	0.007		7	ND	ND	8	ND
1,2,4-Trichlorobenzene	mg/L	0.07		6	ND	ND	8	ND
1,2-Dichlorobenzene (ortho)	mg/L	0.6		7	ND	ND	8	ND
1,4-Dichlorobenzene (para)	mg/L	0.075		7	ND	ND	8	ND
1,2-Dichloroethane	mg/L	0.075		7	ND	ND	8	ND
1,2-Dichloropropane	mg/L	0.005		6	ND	ND	8	ND
cis-1,2-Dichloroethene	mg/L	0.07		7	ND	ND	8	ND
trans 1,2-Dichloroethene	mg/L	0.1		7	ND	ND	8	ND
Benzene	mg/L	0.005		7	ND	ND	8	ND

Table 6
Clackamas River Water - Historical Injection Water Quality

		Drinking Water Standards		Clackamas River Water District			South Fork Water Bo	
		MCL		No. of			No. of	
Parameter	Units	Primary	Secondary	Samples	Min	Max	Samples	Min
Carbontetrachloride	mg/L	0.005		7	ND	ND	8	ND
Chlorobenzene (monochlorobenzene)	mg/L	0.1		7	ND	ND	8	ND
Dichloromethane	mg/L	0.005		5	ND	ND	8	ND
Ethylbenzene	mg/L	0.7		7	ND	ND	8	ND
Styrene	mg/L	0.1		7	ND	ND	8	ND
Tetrachloroethene (PCE)	mg/L	0.005		7	ND	ND	8	ND
Toluene	mg/L	1		6	ND	ND	8	ND
Toxaphene	mg/L	0.003		6	ND	ND	8	ND
Trichloroethene (TCE)	mg/L	0.005		7	ND	ND	8	ND
Vinyl chloride	mg/L	0.002		7	ND	ND	8	ND
Xylene (Total)	mg/L	10		7	ND	ND	8	ND
SOCs								
2,4,5-TP(Silvex)	mg/L	0.05		5	ND	ND	7	ND
2,4-D	mg/L	0.07		5	ND	ND	7	ND
Alachlor	mg/L	0.002		6	ND	ND	7	ND
Atrazine	mg/L	0.003		6	ND	ND	7	ND
Benzo(a)pyrene	mg/L	0.0002		3	ND	ND	7	ND
Carbofuran	mg/L	0.04		3	ND	ND	7	ND
Chlordane	mg/L	0.002		6	ND	ND	7	ND
Dalapon	mg/L	0.2		3	ND	ND	7	ND
Dibromochloropropane (DBCP)	mg/L	0.0002		6	ND	ND	7	ND
Di(2-ethylhexyl)adipate	mg/L	0.4		4	ND	ND	7	ND
Di(2-ethylhexyl)phthalate	mg/L	0.006		4	ND	ND	7	ND
Dinoseb	mg/L	0.007		3	ND	ND	7	ND
Dioxin (2,3,7,8-TCDD)	mg/L	.00000003					7	ND
Diquat	mg/L	0.02		3	ND	ND	7	ND
EDB (Ethylenedibromide)	mg/L	0.00005		6	ND	ND	7	ND
Endothall	mg/L	0.1		4	ND	ND	7	ND
Endrin	mg/L	0.002		6	ND	ND	7	ND
Glyphosate	mg/L	0.7		4	ND	ND	7	ND
Heptachlor	mg/L	0.0004		6	ND	ND	7	ND
Heptachlorepoxide	mg/L	0.0002		6	ND	ND	7	ND
Hexachlorobenzene	mg/L	0.001		4	ND	ND	7	ND
Hexachlorocyclopentadiene	mg/L	0.05		1	ND	ND	7	ND
Lindane (gamma-BHC)	mg/L	0.0002		6	ND	ND	7	ND
Methoxychlor	mg/L	0.04		6	ND	ND	7	ND

Table 6

Clackamas River Water - Historical Injection Water Quality

		Drinking Water Standards		Clackamas River Water District			South Fork Water Bo	
		MCL		No. of			No. of	
Parameter	Units	Primary	Secondary	Samples	Min	Max	Samples	Min
Oxamyl (Vydate)	mg/L	0.2		2	ND	ND	7	ND
Pentachlorophenol	mg/L	0.001		4	ND	ND	7	ND
Picloram	mg/L	0.5		3	ND	ND	7	ND
Polychlorinated Biphenyls (PCBs)	mg/L	0.0005		6	ND	ND	7	ND
Simazine	mg/L	0.004		4	ND	ND	7	ND

ND = Non Detect

Table 6

Clackamas River Water - Historical Injection Water Quality

		Drinking Water Standards		rd	Calackamas County Water Commission Slow Sand WTP		
		MCL			No. of		
Parameter	Units	Primary	Secondary	Max	Samples	Min	Max
tional Parameters							
Chloride	mg/L		250				
Color	ACU		15				
Corrosivity	-		Non-Corrosive				
Fluoride (free)	mg/L	4	2	0.37			
MBAS (Surfactants)	mg/L		0.5				
Odor	TON		3				
pH			6.5-8.5				
Sulfate	mg/L		250	11.2			
Total Dissolved Solids	mg/L		500				
Total Hardness	mg/L-CaCO3		250				
Nitrite	mgN/L	1			1	ND	ND
Nitrate	mgN/L	10		1.0	2	ND	ND
Total nitrate and nitrite	mgN/L	10			1	ND	ND
Turbidity	NTU	0.5			Daily	0.19	0.64
Calcium	mg/L						
Conductivity	umhos/cm						
Magnesium	mg/L						
Potassium	mg/L						
Silica (SiO2)	mg/L						
Sodium	mg/L			7.3			
Total Alkalinity	mg/L						
iological							
Total Coliform	#/100 mL	<5% positive samples		3.3%	Monthly	0%	2%
E. Coli	#/100 mL	<5% positive samples		0%		0%	0%
Aluminum	mg/L		0.05-0.2				
Antimony	mg/L	0.006			1	ND	ND
Arsenic	mg/L	0.05			1	ND	ND
Barium	mg/L	2		0.003	1	0.0022	0.0022
Beryllium	mg/L	0.004			1	ND	ND
Cadmium	mg/L	0.005			1	ND	ND
Chromium	mg/L	0.1			1	ND	ND
Copper	mg/L	1.3	1	0.39	1	ND	ND

Table 6

Clackamas River Water - Historical Injection Water Quality

		Drinking Water Standards		rd	Calackamas County Water Commission Slow Sand WTP		
		MCL			No. of		
Parameter	Units	Primary	Secondary	Max	Samples	Min	Max
Cyanide	mg/L	0.2			1	ND	ND
Iron	mg/L		0.3				
Lead	mg/L	0.015		0.013	1	ND	ND
Manganese	mg/L		0.05				
Mercury	mg/L	0.002			1	ND	ND
Nickel	mg/L	0.1			1	ND	ND
Selenium	mg/L	0.05			1	ND	ND
Silver	mg/L	0.05	0.1				
Thallium	mg/L	0.002			1	ND	ND
Zinc	mg/L		5				
uclides							
Gross Alpha	pCi/L	15		0.2	2	ND	ND
Gross Beta	pCi/L	50			2	1.5	2.1
Radon (Rn-222)	pCi/L						
Iodine-131	pCi/L	3					
Strontium-90	pCi/L	8					
Tritium	pCi/L	20000					
ction By-Products							
Total Haloacetic Acids	mg/L	0.060			4	0.015	0.036
Total Trihaolmethanes	mg/L	0.080		0.06	4	0.013	0.016
cs							
Cs							
1,1,1-Trichloroethane	mg/L	0.2		ND	1	ND	ND
1,1,2-Trichloroethane	mg/L	0.005		ND	1	ND	ND
1,1-Dichloroethene	mg/L	0.007		ND	1	ND	ND
1,2,4-Trichlorobenzene	mg/L	0.07		ND	1	ND	ND
1,2-Dichlorobenzene (ortho)	mg/L	0.6		ND	1	ND	ND
1,4-Dichlorobenzene (para)	mg/L	0.075		ND	1	ND	ND
1,2-Dichloroethane	mg/L	0.075		ND	1	ND	ND
1,2-Dichloropropane	mg/L	0.005		ND	1	ND	ND
cis-1,2-Dichloroethene	mg/L	0.07		ND	1	ND	ND
trans 1,2-Dichloroethene	mg/L	0.1		ND	1	ND	ND
Benzene	mg/L	0.005		ND	1	ND	ND

Table 6

Clackamas River Water - Historical Injection Water Quality

		Drinking Water Standards		rd	Calackamas County Water Commission Slow Sand WTP		
		MCL					
Parameter	**Units**	**Primary**	**Secondary**	**Max**	**No. of Samples**	**Min**	**Max**
Carbontetrachloride	mg/L	0.005		ND	1	ND	ND
Chlorobenzene (monochlorobenzene)	mg/L	0.1		ND	1	ND	ND
Dichloromethane	mg/L	0.005		ND	1	ND	ND
Ethylbenzene	mg/L	0.7		ND	1	ND	ND
Styrene	mg/L	0.1		ND	1	ND	ND
Tetrachloroethene (PCE)	mg/L	0.005		ND	1	ND	ND
Toluene	mg/L	1		ND	1	ND	ND
Toxaphene	mg/L	0.003		ND	1	ND	ND
Trichloroethene (TCE)	mg/L	0.005		ND	1	ND	ND
Vinyl chloride	mg/L	0.002		ND	1	ND	ND
Xylene (Total)	mg/L	10		ND	1	ND	ND
s							
2,4,5-TP(Silvex)	mg/L	0.05		ND	1	ND	ND
2,4-D	mg/L	0.07		ND	1	ND	ND
Alachlor	mg/L	0.002		ND	1	ND	ND
Atrazine	mg/L	0.003		ND	1	ND	ND
Benzo(a)pyrene	mg/L	0.0002		ND	1	ND	ND
Carbofuran	mg/L	0.04		ND	1	ND	ND
Chlordane	mg/L	0.002		ND	1	ND	ND
Dalapon	mg/L	0.2		ND	1	ND	ND
Dibromochloropropane (DBCP)	mg/L	0.0002		ND	1	ND	ND
Di(2-ethylhexyl)adipate	mg/L	0.4		ND	1	ND	ND
Di(2-ethylhexyl)phthalate	mg/L	0.006		ND	1	ND	ND
Dinoseb	mg/L	0.007		ND	1	ND	ND
Dioxin (2,3,7,8-TCDD)	mg/L	.00000003		ND	1	ND	ND
Diquat	mg/L	0.02		ND	1	ND	ND
EDB (Ethylenedibromide)	mg/L	0.00005		ND	1	ND	ND
Endothall	mg/L	0.1		ND	1	ND	ND
Endrin	mg/L	0.002		ND	1	ND	ND
Glyphosate	mg/L	0.7		ND	1	ND	ND
Heptachlor	mg/L	0.0004		ND	1	ND	ND
Heptachlorepoxide	mg/L	0.0002		ND	1	ND	ND
Hexachlorobenzene	mg/L	0.001		ND	1	ND	ND
Hexachlorocyclopentadiene	mg/L	0.05		ND	1	ND	ND
Lindane (gamma-BHC)	mg/L	0.0002		ND	1	ND	ND
Methoxychlor	mg/L	0.04		ND	1	ND	ND

Table 6
Clackamas River Water - Historical Injection Water Quality

		Drinking Water Standards		rd	Calackamas County Water Commission Slow Sand WTP		
		MCL					
Parameter	**Units**	**Primary**	**Secondary**	**Max**	**No. of Samples**	**Min**	**Max**
Oxamyl (Vydate)	mg/L	0.2		ND	1	ND	ND
Pentachlorophenol	mg/L	0.001		ND	1	ND	ND
Picloram	mg/L	0.5		ND	1	ND	ND
Polychlorinated Biphenyls (PCBs)	mg/L	0.0005		ND	1	ND	ND
Simazine	mg/L	0.004		ND	1	ND	ND

ND - Non Detect

Appendix E

APPENDIX E

MIXING ANALYSIS

MIXING ANALYSIS

E-1. GEOCHEMICAL MODELING

Geochemical modeling is a useful tool for evaluating mineral precipitation and dissolution in groundwater systems. With regard to ASR, geochemical modeling is used to assess the potential for clogging of the aquifer by mineral precipitation. The geochemical model applied in this study was PHREEQC (Parkhurst et al. 1990). PHREEQC is an equilibrium mass-balance geochemical model developed by the U.S. Geological Survey that can be used to calculate the aqueous speciation and the stability of solid phases with respect to dissolved constituents. The program performs speciation calculations by simultaneously solving equations representing the formation of ion pairs, complex ions, and solids using an extensive thermodynamic database, in this case the MINTEQ database. The potential for mineral precipitation or dissolution is assessed using a saturation index (SI), which is based on the relation between actual analyte activities (the ion activity product, IAP) and the thermodynamic calculation of the solubility product (K_T). The saturation index of a mineral is determined using the following equation:

$$SI = \log_{10}[IAP]/[K_T]$$

When SI > 0, the solution is theoretically oversaturated with respect to the solid, and the solid may precipitate. When SI < 0, the solution is theoretically undersaturated with respect to the solid, and, if present in the system, the solid should dissolve. Kinetic effects may result in deviations from dissolution/precipitation behavior predicted solely based on thermodynamic considerations. An advantage of PHREEQC over similar geochemical modeling programs is that it allows mixing of two solutions in varying proportions. This feature is particularly useful for determining the potential effects of aquifer recharge and storage on the existing groundwater characteristics in the aquifer.

E-1.1 Modeling Input

5.4.5 Groundwater

Both historic water quality data and water quality data collected during the course of this study exist for Well No. 1, the proposed injection well. Water quality sampling during the packer test however, illustrated distinct differences in the water quality of the upper and lower aquifer. Because recharge will occur to the lower portion of the aquifer, the water quality sample collected from this zone was considered to be most representative of the groundwater quality that will mix with the recharge water.

Redox potential is an important variable in geochemical modeling as the solubility of potential soil phases, particularly iron-bearing compounds, is sensitive to the redox state of the groundwater. Throughout the packer test, the redox potential of the lower aquifer zone was recorded at 30-minute intervals. Redox measurements over this period ranged from 120 mV to 150 mV. An Eh of 135 mV was therefore assigned to the groundwater for geochemical modeling. This value falls within the range typically reported for groundwater systems (Appelo and Potsma, 1994). Although dissolved oxygen was also recorded at concentrations up to 11 mg/L, these concentrations are believed to be erroneous due to instrument drift. Dissolved oxygen was not included in modeling as this resulted in Eh adjustments by PHREEQC to values above what typical groundwaters exhibit.

The packer test samples from both the upper and lower aquifer reported iron concentrations below detectable limits (<0.05 mg/L). Historically, iron concentrations for Well No. 1 have ranged from 0.08 mg/L to 0.44 mg/L. Because the precipitation of iron (oxy)hydroxides is possible when oxidized surface water is mixed with less oxidized groundwater containing iron, iron concentrations are an important input in geochemical modeling. Modeling was therefore conducted using two iron concentrations to represent both historical and current conditions, as indicated during the packer test. In the first simulation, an initial groundwater iron concentration equivalent to the concentration that would result from groundwater in equilibrium with ferrihydrite was applied. For the second simulation, an iron concentration equal to the average of the historic concentrations was assigned (0.20 mg/L).

Sulfate was also below detectable limits in the lower zone packer test sample. Sulfate was assumed to be equal to the detection limit (0.1 mg/L) in model simulations. Historically sulfate concentrations have been low (<0.3 mg/L). Nitrate, also below detectable limits (<0.01 mg/L) was not included in model runs. At a redox potential of 135 mV, nitrate would not be expected to be present.

5.4.6 Recharge Water

Annual water quality for the Clackamas River for the period 1995 to 1999 is generally consistent for most reported parameters; however, in 1995 and 1996 aluminum and silver concentrations respectively were higher than previous years. Sulfate values for 1998 and 1999 (10 mg/L) are also four times higher than those from 1995 to 1997 (~ 2.5 mg/L).

Due to the similarity in historical water quality data, the most recent sample for which a compete analysis was available, was used in geochemical modeling. Because calcium and magnesium were not reported in 1998 and 1999, the 1997 sample was chosen.

No Eh data is available for the Clackamas river water samples. A value of 500 mV was therefore assigned; consistent with generalized Eh-pH relationships for surface water in contact with the atmosphere presented in Appelo and Potsma (1994). Iron, copper, manganese and zinc were all below detectable limits in the 1997 Clackamas River sample. Copper, manganese and zinc were set at concentrations equal to their respective detection limits. An iron concentration representative of equilibrium conditions with ferrihydrite was assigned.

E-1.2 Modeling Results and Discussion

5.4.7 Groundwater

For both modeling simulations, groundwater is supersaturated with respect to a number of iron (hydr)oxides and silica minerals. The iron (hydr)oxides include such minerals as goethite (FeOOH), hematite (Fe_2O_3), maghemite (γ-Fe_2O_3), magnetite (Fe_3O_4), and lepidocrocite (γ-FeOOH). However, despite the very low solubilities of these compounds, the role of most of these minerals in equilibrium control of the iron activity in freshwater natural systems is very minor (Hem 1992). Instead, the solubility of iron is usually controlled by the most soluble (hydr)oxide present (Lindsay 1979), which is ferrihydrite ($Fe(OH)_3$). This compound is known to play a major role in iron-rich aqueous systems such as acid rock drainage (e.g., Nordstrom 1982), and is a familiar cause for well failure by encrustation (e.g., Driscoll 1989). For simulation one, groundwater in equilibrium with ferrihydrite results in an iron concentration of 0.001 mg/L. For the second simulation, an iron concentration of 0.20 mg/L results in supersaturation of ferrihydrite.

The groundwater is also supersaturated with respect to various silica minerals, the only one of relevance being quartz (SiO_2). In general, natural waters are oversaturated with respect to quartz because the rate of attainment of equilibrium between quartz and silicic acid (i.e. dissolved silica) is extremely slow (Stumm and Morgan 1981). This generally implies that the solubility of amorphous silica represents the upper limit of dissolved aqueous silica. Groundwater is slightly undersaturated with respect to amorphous silica. This is in good agreement with the observation made by Hem (1992) that natural waters tend to have dissolved silica concentrations between the quartz equilibrium value and the amorphous silica value. Consequently, clogging through precipitation of silica is unlikely. Other minerals commonly found to clog aquifers or form encrustations in wells such as manganese (hydr)oxides, carbonates, and gypsum are below saturation levels and should not precipitate. Saturation indices indicate that calcite is near equilibrium within the aquifer.

5.4.8 Recharge Water

Recharge water at equilibrium with respect to ferrihydrite results in an iron concentration of 0.005 mg/L. In theory, therefore, under equilibrium conditions dissolved iron cannot be present in measurable concentrations in the recharge water. Historical sampling indicates that concentrations are below 0.05 mg/L. The modeling results show that the recharge water is supersaturated with essentially the same iron oxides as the groundwater: ferrihydrite, goethite, hematite, maghemite, magnetite, and lepidocrocite. It is undersaturated with respect to carbonates, gypsum, and amorphous aluminum hydroxide. Surface water is at equilibrium with gibbsite.

6. MIXING

After injection of the recharge water, at any given time all possible groundwater to recharge water mixing ratios will occur in the aquifer. Immediately following injection, the mixing zone between the two waters will be very narrow, and two discrete water bodies will exist with essentially unaltered compositions. As time progresses, the mixing zone will become broader and an increasing volume of the aquifer will contain mixed groundwater/recharge water in various proportions. To cover this range of possible mixing ratios, the effects of mixing were modeled with PHREEQC using three groundwater to recharge water ratios: 3:1, 1:1, and 1:3.

As the proportion of recharge water mixed with groundwater increases, geochemical modeling indicates that groundwater pH will decline and Eh will demonstrate small increases. Simulation one indicates that this slight decline in pH and increase in Eh will result in slight supersaturation of ferrihydrite. Due to the small concentration of iron assumed to be initially present (0.001 mg/L), precipitation would be minimal.

For simulation two, an initial iron concentration of 0.2 mg/l resulted in supersaturation with respect to ferrihydrite. Supersaturated conditions will persist during mixing with recharge water, despite the influx of water with a lower iron concentration.

Supersaturation with respect to ferrihydrite at an iron concentration of 0.2 mg/L is most likely insignificant in terms of clogging of the aquifer. The following semi-quantitative approach may serve as an example. Consider a worst-case scenario in which virtually all available dissolved iron (0.2 mg/L = 0.0036 mmol/L, M_{Fe} = 55.8 g/mole) precipitates as ferrihydrite. Assume a density of approximately 2.4 g/cm^3 for ferrihydrite (CRC, 1981), which equates to a molar volume of approximately 45 cm^3/mole ($M_{Fe(OH)3}$ = 106.8 g/mole). Per liter of groundwater, 0.0036 mmole of ferrihydrite therefore occupies approximately 1.6×10^{-4} cm^3. Assume that the porosity of the interflow zone for the basalt is approximately 15%, representative of a worst case scenario. This equates to approximately 150 cm^3 of porewater per 1 liter of aquifer, in which approximately 2.4×10^{-5} cm^3 ferrihydrite precipitates. This amounts to approximately 1.6×10^{-5}% of the available pore space, which is a negligible reduction in porosity. The reduction percentage as calculated above is constant and independent of actual porosity. Although this calculation contains some considerable uncertainties, it does serve to demonstrate that clogging of the aquifer through precipitation of ferrihydrite is not likely to have a significant impact on groundwater flow and porosity. The above approach is valid for static conditions (i.e. no groundwater movement).

In addition to precipitation through inorganic mechanisms, microbial mediation can also result in formation of ferrihydrite. Various forms of iron bacteria, such as the *Thiobacillus* and *Gallionella* genera, have the capability to oxidize ferrous iron (Driscoll 1989; Nordstrom 1982). This may lead to accumulation of substantial amounts of ferric hydroxide slimes, which can reduce porosity outside the well (biofouling). To prevent this from occurring, iron bacteria can be controlled through a variety of chemical and physical applications, such as addition of oxidizing/acidifying agents as bactericides.

The potential for iron bacteria to adversely affect aquifer properties is difficult to ascertain. The different types of iron bacteria can occur in water with a wide variety of chemical and physical characteristics. However, the low iron content of the groundwater (0.2 mg/L) may be a retardant to growth of these bacteria, as they are typically found in water that has an iron concentration in excess of 1 mg/L (Driscoll 1989). Since mixing of groundwater with recharge water will reduce dissolved iron concentrations even further, it is not anticipated that iron bacteria will be a major concern for the ASR system.

7. REFERENCES

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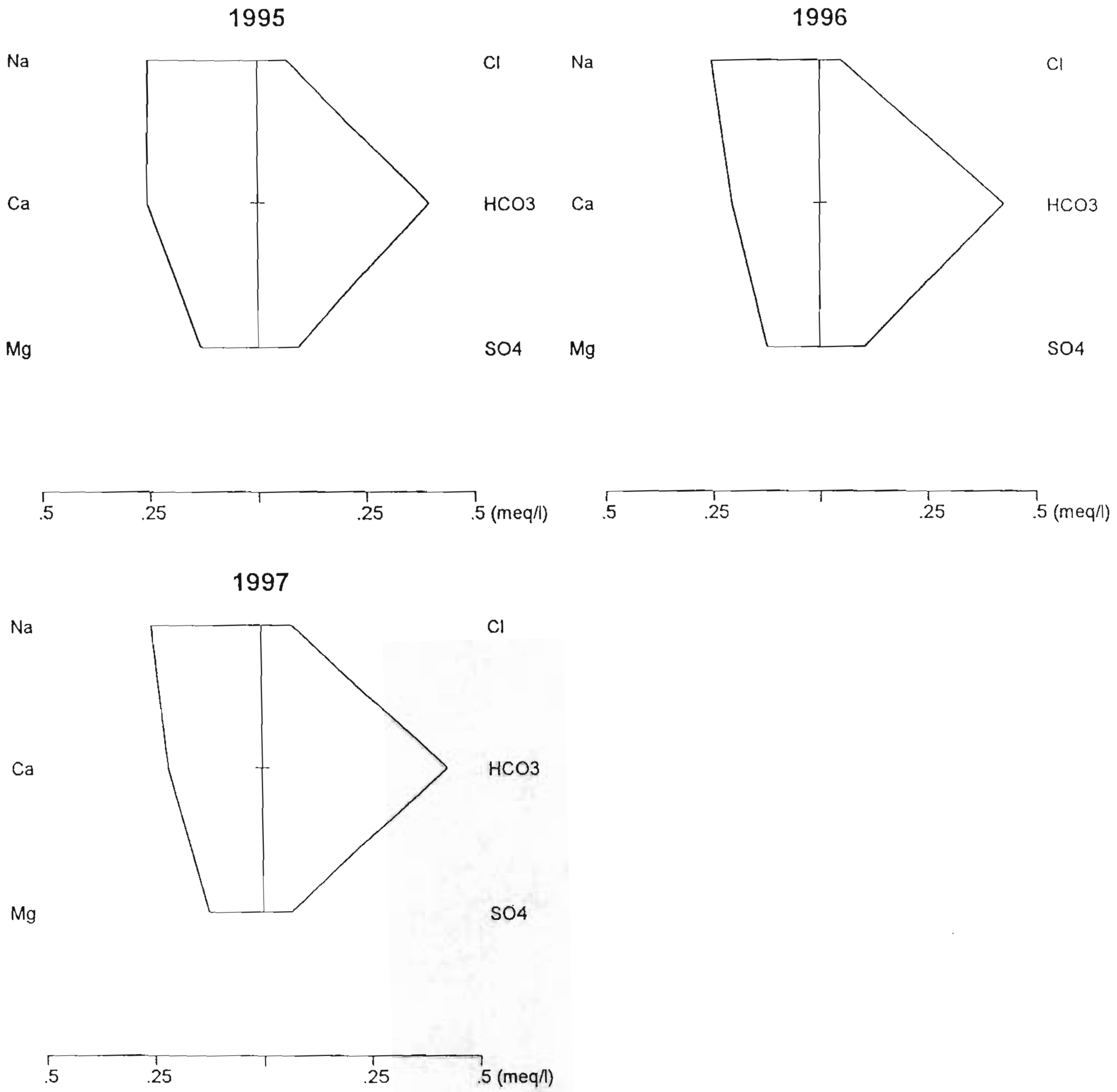

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Clackamas River Water Stiff Diagrams

Concentrations plotted in meq/L. Non-detect values assumed equal to detection limit.

993-1586

February 3, 2000

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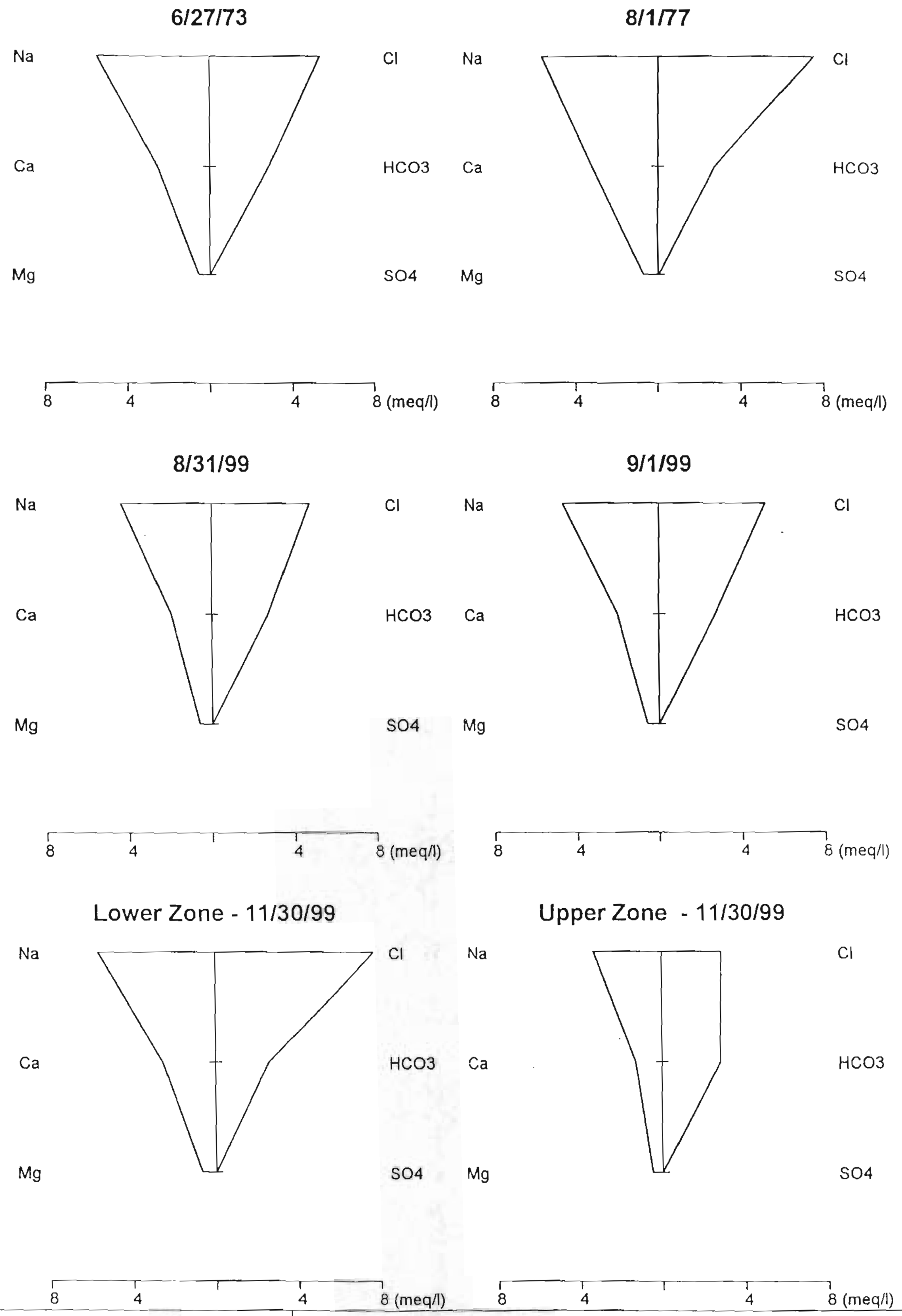


6/27/73

8/1/77

8/31/99

9/1/99

Lower Zone - 11/30/99

Upper Zone - 11/30/99

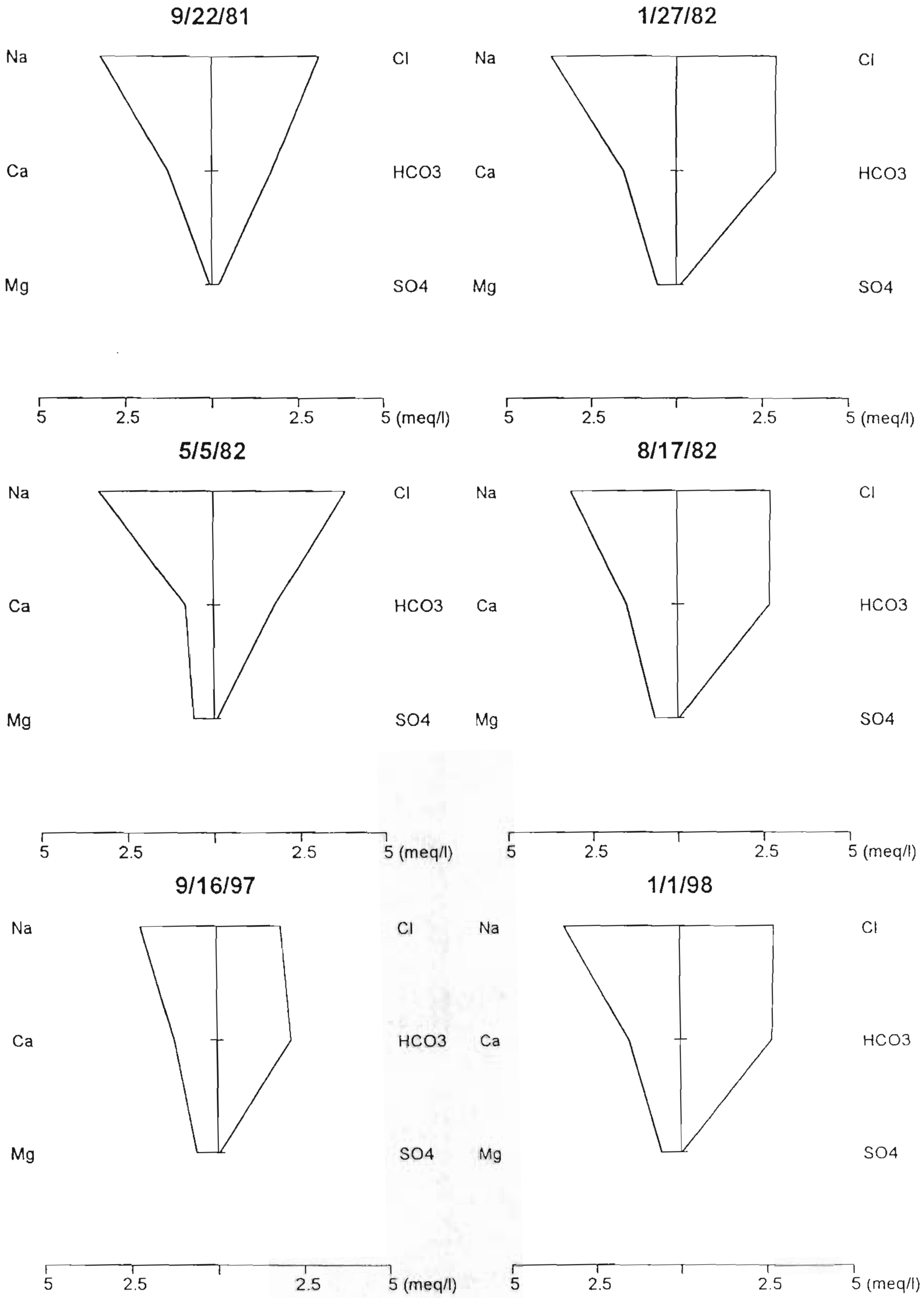
Golder Associates

CRW Well 1 Stiff Diagrams

Concentrations plotted in meq/L. Non-detect values plotted at the detection limit.

993-1586

FEBRUARY 3, 2000



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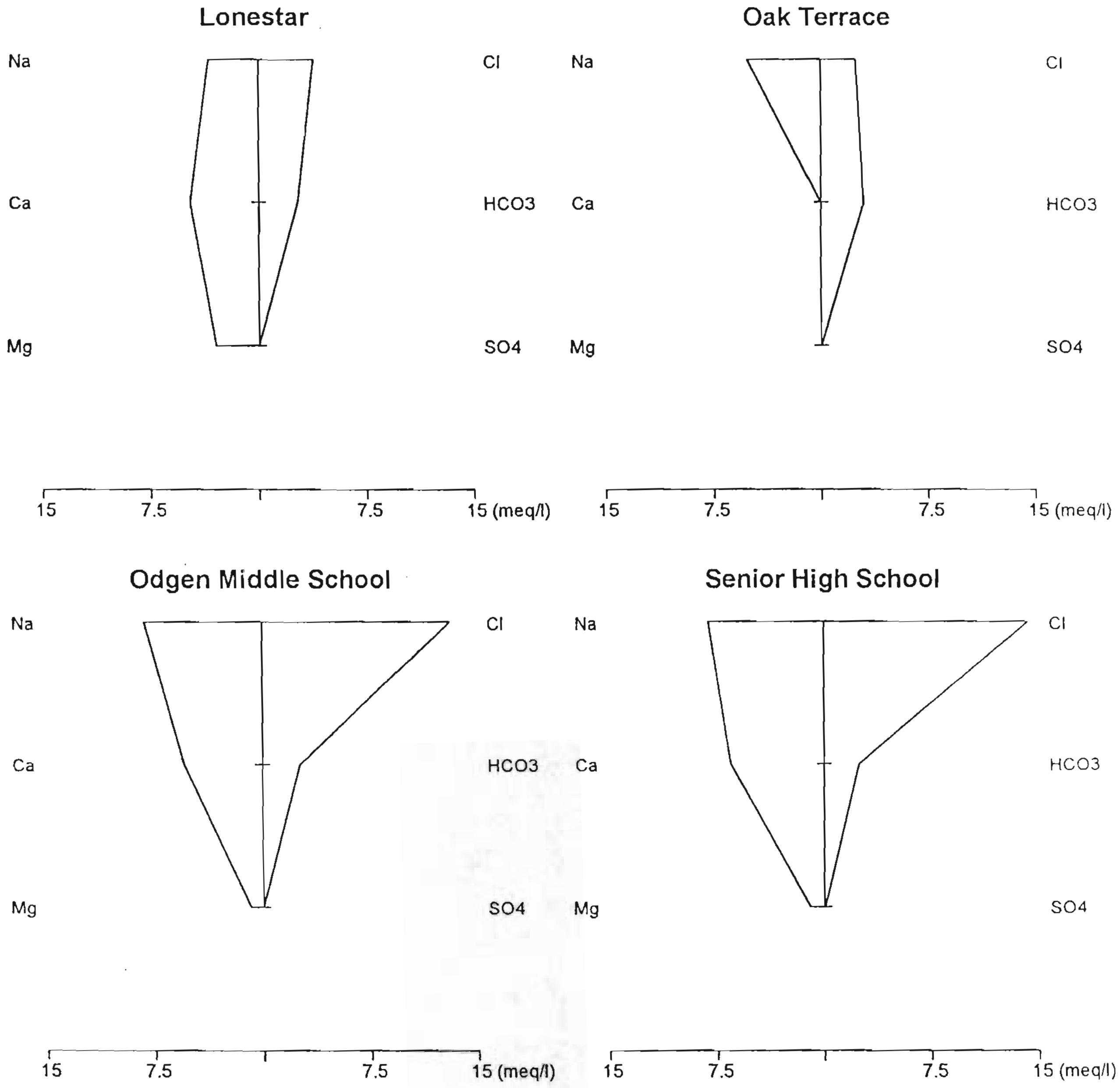
Rossman Landfill Well 1 Stiff Diagrams

Concentrations plotted in meq/L. Non-detect values plotted at the detection limit.

993-1586	FEBRUARY 3, 2000



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Basalt Wells Stiff Diagrams

Concentrations plotted in meq/L. Non-detect values plotted at the detection limit.

993-1586	FEBRUARY 3, 2000