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JAN 07 2008

**DEPARTMENT OF
WATER RESOURCES**

January 4, 2008

Idaho Department of Water Resources
Attn: Debbie Gibson
PO Box 83720
Boise, ID 83720-0098

RE: Lewiston Orchards Irrigation District (LOID) Well No. 4

Dear Debbie:

Attached are the plans for the completion of Lewiston Orchards Irrigation District Well No. 4. Construction was completed in February of 2005 per the attached plan.

Please let me know if you need any additional information.

Sincerely,

J-U-B ENGINEERS, Inc.

Cory R. Baune, PE
Project Engineer

Enc: Plans (1 set)--LOID 2005 Well No. 4 and Well House

cc: Barney Metz, Letter Only
File-21-04-023



Lewiston Orchards Irrigation District



Well #4 Final Report

Progressive Engineering Group, Inc.
1208 Idaho Street
Lewiston, Idaho 83501
Phone (208) 746-5406 Fax (208) 746-9732

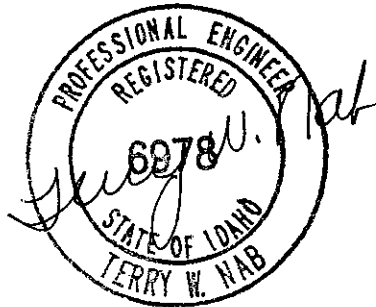
CERTIFICATION BY ENGINEER

I hereby certify that the Final Report and as-built drawing for L.O.I.D. Well No. 4 was prepared by me or under my direct supervision and that I am a duly registered Engineer under the laws of the State of Idaho.

Professional Engineer's
License: 6978

Terry W. Nab
TERRY W. NAB, P.E.

Date: Feb. 14, 2003



Feb 14, 2003

PROGRESSIVE ENGINEERING GROUP, INC.

Consulting Engineers

1208 Idaho Street

Lewiston, Idaho 83501

Ph (208) 746-5406

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INTRODUCTION

The purpose of this report is to present information pertinent to the location, design, construction and testing of the new Lewiston Orchards Irrigation District (LOID) Well No. 4, which is located in Lewiston, Idaho. LOID Well No. 4 will contribute to a dual domestic and irrigation water supply for residents of the Orchards portion of the City of Lewiston. The domestic portion of the water supply for the LOID is supplied from deep wells. The new LOID Well No. 4 is located immediately south of the LOID office complex and about 300 feet from LOID Well No. 3, which is no longer in use (see Figure 1).

This report is divided into seven (7) major sections. The first section presents a history of locating the well site and taking bids for the project. The second section presents information on the design and construction of the well. The third section is a summary of project costs. The fourth section of the report is a geologic analysis of the materials penetrated by the well. The fifth portion presents a hydrologic analysis, including the results of the hydraulic injection testing of the well completed both during construction and after the construction of the well was completed. The sixth section discusses well productivity. The last section presents conclusions and recommendations with respect to pump design and operation as well as long-term data collection efforts.

POWERS AVENUE

**L.O.I.D.
OFFICES**

**EXISTING
2.5 MILLION
GALLON RESERVOIR**

**EXISTING
WELL NO. 1
(NOT IN USE)**

WELL NO. 4 SITE

SCALE: 1" = 60'

**FIGURE 1
WELL NO. 4
SITE LOCATION, MAP
LEWISTON, IDAHO**

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SCALE: 1" = 60'

FIGURE 1
WELL NO. 4
SITE LOCATION, MAP
LEWISTON, IDAHO

PROJECT HISTORY

In May, 2001, the LOID Board of Directors authorized Progressive Engineering Group, Inc. (PEG) to begin the preliminary work required to determine the best site for a new supply well for the District. The targeted design flow for the proposed well would be in the 1,000 to 1,500 gpm range. PEG retained the services of Ralston Hydrologic Services, Inc. (RHS) to complete a hydrogeologic analysis of the area to determine the best location for the proposed well. RHS completed a report titled "Hydrogeologic Analysis in Support of the Design and Construction of Lewiston Orchards Irrigation District Well No. 4, Lewiston, Idaho" in September, 2001. A copy of this report is included in Appendix A. The report was presented to the LOID board at their September 2001 meeting. Two proposed well sites were suggested in the report. The District Board approved the well site located immediately south of the LOID office complex in Hereth Park and directed PEG to proceed with the design, specifications and bidding documents for the proposed well.

Based on the recommendations presented in the RHS report, PEG began preparation of the design, specifications and bidding documents for the proposed well in September, 2001. Applications for the required "Drilling Permit" and "Permit to Appropriate Public Waters of the State of Idaho" were sent to the Idaho Department of Water Resources on October 02, 2001. The completed plans and specifications for the proposed well were submitted to the State of Idaho Department of Environmental Quality (IDEQ) for review and approval on September 28, 2001. The plans and specifications were approved by IDEQ on October 26, 2001. A copy of IDEQ's approval letter is included in Appendix B.

The advertisement for bids for the proposed well was published on October 18 and November 01, 2001, with the bid opening scheduled for November 16, 2001 at 2:00 p.m. One bid was received for the project from Western Water Development from Redmond, Oregon for the amount of \$540,755.10.

After reviewing Western Water Developments Bid, the LOID Board decided to reject the bid and re-bid the project in early 2002 at their November 21, 2001 meeting. The reasons for rejecting the bid were as follows:

1. The LOID Board felt the bid could be lower based on the cost of drilling LOID Well No. 3 in 1994.
2. The bid price might be more competitive with more bids submitted.

Since the need for Well No. 4 was not immediate, it was felt that a better bid might be obtained if the project was re-bid in early 2001. In hopes of obtaining better bids, the LOID Board decided to use LOID forces to do as much of the work required for the new well as possible. With this in mind, all of the site preparation work, including the waste water holding ponds, would be constructed by LOID forces. Any restoration work required would also be completed by LOID forces in the spring of 2003. In addition, the requirement for test pumping was removed from the drillers portion of the work. This basically allowed the driller to concentrate on drilling and constructing the proposed well and left the unrelated work to others, which would keep the drilling cost to a minimum. The plans and specifications were revised accordingly.

The second advertisement for bids for the proposed well was published on March 20 and 27, 2002, with the bid opening scheduled for April 12, 2002 at 2:00 p.m. This time, two (2) bids were received for the project. The bids were as follows:

Geo-Tech Explorations, Inc., Tualatin, Oregon	\$ 444,454.00
Layne Western, Aurora, Colorado	\$ 446,892.00

Copies of the Advertisement for Bids and the bids from each drilling contractor are included in Appendix C. Since there were two (2) bids this time, and both bids were similar and considerably lower than the original bid submitted by Western Water Development, the LOID Board decided to award the contract to Geo-Tech Explorations at their April 17, 2002 meeting. Geo-Tech indicated they would start work on the proposed well sometime in August/September of 2002. The contract for the project was signed on September 12, 2002 and the Notice to Proceed was signed on September 13, 2002. Copies of the Contract and the Notice to Proceed are included in Appendix D. Geo-Tech arrived on the well site on September 12, 2002 and began work immediately. The new well was completed and Geo-Tech pulled off of the site on December 16, 2002.

The approved "Drilling Permit" and "Permit to Appropriate Public Waters of the State of Idaho" were received by LOID on July 26, 2002. Copies of the "Drilling Permit" and the "Permit to Appropriate Public Waters of the State of Idaho" are included in Appendix E.

WELL DESIGN AND CONSTRUCTION

LOID Well No. 4 was designed to yield between 1,000 to 1,500 gallons per minute (gpm), with a total well depth as great as 2,100 feet. The anticipated depth to static water level in the proposed well was approximately 850 feet below the ground surface. The original design of the well consisted of the following:

- a. 24-inch diameter hole drilled to 160 feet.
- b. 20-inch diameter steel casing grouted in place to 160 feet.
- c. 19.2-inch diameter hole drilled from 160 feet to 400 feet.
- d. 18-inch diameter steel casing placed from 150 feet to 400 feet.
- e. 17.2-inch diameter hole drilled from 400 feet to 866 feet.
- f. 16-inch diameter steel casing placed from 390 feet to 866 feet.
- g. 15.2-inch diameter hole drilled from 866 feet to 1,300 feet.
- h. 14-inch diameter steel casing with 120 feet of slotted screen from 856 feet to 1,300 feet.
- i. 10 or 12-inch diameter hole drilled from 1,300 feet to bottom of hole (maximum depth expected to be 2,100 feet).

As designed, the surface seal would extend from the ground surface to a depth of 160 feet. The pump chamber was designed to be 14-inches in diameter and extend from 855 feet to 1,300 feet deep. The water would enter the well through slots in the 14-inch diameter casing and from the uncased 10 or 12-inch diameter hole below the 1,300-foot depth.

Geo-Tech Explorations, Inc. elected to drill the well using the direct air rotary method of drilling. Based on the drilling procedures used, the geological formations encountered during the drilling and input from Geo-Tech and RHS, the design of the well was revised several times, both before and during the drilling activities. The 20 inch and 18 inch diameter casings were extended to greater depths than the original design. This allowed the placement of the grout seal to a greater depth and allowed the pump chamber to be increased from 14-inch diameter to 16-inch diameter. Based on input from Geo-Tech and an evaluation of the cost of the materials, the slotted screen was replaced with a mild steel welded wire-wrapped screen. The wire-wrapped screen provides substantially more open area than the slotted screen, which will not only make the well more efficient, but will also reduce the velocity of the water through the screen and prolong the life of the well. The larger diameter pump chamber casing will allow for greater flexibility with respect to the selection of the pump/motor assembly. An as-built drawing of the well, including the well driller's description of the geologic units penetrated during the drilling is shown in Figure 2.

The actual steps involved in the construction of the well were as follows:

- a. A 24-inch diameter hole was drilled to a depth of 270 feet using direct rotary air drilling. Due to unstable soil conditions, the 24-inch diameter open hole could not be advanced beyond the 270-foot depth.

- b. To penetrate the unstable soil conditions encountered at the 270-foot depth, 20-inch diameter steel casing was installed to the 270-foot depth, then a 20-inch diameter rotary air bit was lowered to the 270-foot depth inside of the 20-inch diameter steel casing. Then, using dual rotary drilling equipment (the 20-inch diameter steel casing was rotated and advanced along with the rotary drill bit), the 20-inch diameter hole and 20-inch diameter steel casing were advanced simultaneously to a depth of 457 feet. The use of the dual rotary method penetrated the unstable soil conditions in the drill hole without any further difficulties.
- c. The open annular space between the 20-inch diameter steel casing and the 24-inch diameter hole from the surface to a depth of 265 feet was then filled with a grout mixture using a 2-inch tremie pipe (grout pumped through pipe to bottom of hole filling hole from bottom up). A total of 405 cubic feet of grout was required to fill the open space.
- d. A 19.2-inch diameter hole was then advanced from the bottom of the 20-inch steel casing at 457 feet to a depth of 700 feet where an unexpected water bearing formation and unstable soils were encountered. To seal off the water bearing zone and stabilize the formation, the drill hole was filled with grout from the 700-foot depth back up to a depth of approximately 640 feet. After allowing the grout to set for 24 hours, the hole was then re-drilled back to 700 feet through the grout. Once it was determined that the grout had stabilized the formation and most of the water bearing zone was sealed off, the 19.2-inch hole was then advanced to a depth of 866 feet without any further difficulties encountered.
- e. 18-inch diameter steel casing was then installed in the well from 446 feet to the bottom of the 19.2-inch drill hole at 866 feet. To ensure the water-bearing zone encountered at the 700-foot depth was completely sealed out of the well, the bottom 10 feet of the 19.2-inch drill hole was filled with grout before the 18-inch diameter steel casing was lowered to the bottom of the hole. The grout was placed into the drill hole just before the 18-inch diameter steel casing was lowered the last few feet into place. The top of the 18-inch diameter steel casing is located 11 feet above the bottom of the 20-inch diameter steel casing, which is located at 457 feet deep.
- f. After allowing the grout seal at the 866-foot depth to set for 24 hours, a 17.2-inch diameter drill bit was centered in the bottom of the 18-inch diameter steel casing using a plywood template. The 17.2-inch diameter drill bit was then advanced to a depth of 1268 feet using direct rotary air drilling. No water was encountered in the 17.2-inch drill hole immediately after beginning the drilling operation at the 866-foot depth, indicating that the water-bearing zone encountered at the 700-foot depth had been successfully sealed out of the well.

During this portion of the drilling operation, the water producing zones encountered were identified by the formation encountered and the amount of water produced from the rotary air drilling operation. Hydraulic injection tests were also run at various depths to investigate the productivity of the water producing zones.

- g. The drill hole was then advanced from 1,268 feet deep to 1,417 feet deep with a 12-inch diameter drill bit using direct rotary air drilling. At 1,417-feet deep, the well was producing too much water to be able to continue drilling the 12-inch diameter hole with direct rotary air, so the 12-inch diameter drill bit was replaced with a 10-inch diameter drill bit and the hole was advanced to a depth of 1,625 feet. The last water bearing formation encountered was at a depth of 1,577 feet to 1,601 feet. The drill hole was advanced to a total depth of 1,625 feet to provide a 24-foot deep sump below the lowest water bearing formation. This sump will allow for the accumulation of waste materials in the bottom of the well without interfering with the lowest water bearing formation.

Additional hydraulic injection tests were run while the hole was advanced from 1,268-feet deep to the total depth of 1,625-feet to evaluate the productivity of the various water bearing formations encountered.

- h. As soon as the drilling was completed, Geo-Tech Exploration had the entire bore hole video taped to determine the condition of the drill hole and casing in place and to refine the identification of the water-producing zones to allow the proper placement of the well screen sections in the casing string. The video taping of the well found a section of what appeared to be columnar basalt that had slipped out of the side of the drill hole and had lodged in the drill hole, partially (approximately 1/3) blocking the drill hole at a depth of 1,460 feet.
- i. The rock blocking the drill hole was then removed by pushing down on it with the 10-inch drill bit. Then the 10-inch drill bit was run all the way to the bottom of the hole at 1,625 feet deep to ensure the hole was clear all the way to the bottom.
- j. 16-inch diameter steel casing and welded wire screen were then installed in the well from 848 feet to 1,268 feet deep, a total of 420 feet. Of the 420 feet, 120 feet was welded wire screen and 300 feet was steel casing. The 120 feet of welded wire screen was placed between 1,029 feet and 1,049 feet and 1,164 feet and 1,264 feet.
- k. The well was then developed (cleaned) using air surging. Following the air surging, a cap was placed on the well. The drilling equipment was then removed from the site.
- l. A final hydraulic injection test was conducted on the completed well.

Water for both the drilling and the hydraulic injection testing was provided to the drill site from LOID's existing domestic water system. A four (4) inch PVC water line and a 4-inch water meter were installed by the LOID work crew to the well site. The water, foam and cuttings from the drilling operations were captured in a pond constructed adjacent to the well site by the LOID work crew. Following settling of the waste products in the pond area, the clean water was pumped from the north end of the pond to an adjacent park and ball field and allowed to seep into the ground there.

SUMMARY OF PROJECT COSTS

The original contract amount, based on the bids received on April 12, 2002 was for \$ 444,454.00. During the course of the contract, two (2) periodic estimate for partial payments and three (3) change orders were processed. Copies of both of the periodic estimates for partial payments and all three (3) change orders are included in Appendix E.

Change order number 1 was a result of the changes resulting from the problems with penetrating the unstable formation conditions encountered at the 270-foot depth and advancing the drill hole through this formation and on to 457 feet (see item b. in the preceding).

Items number 1 and 2 on change order number 2 accounted for the changes required to seal off the unexpected water encountered in the drill hole at a depth of approximately 700 feet (see item d. in the preceding). Item number three was the result of drilling the 17.2-inch diameter hole at a deeper depth than the original design called for. Items number 4 and 5 were the result of different sized casings at different depths than called for in the original design. Item number 6 was the result of changing from slotted 14-inch diameter casing to welded wire 16-inch diameter casing. Item number 7 was required to clear the rock out of the bore hole at the 1,460 foot depth (see item i. in the preceding).

The purpose of change order number 3, the final change order, was to adjust all of the contract amounts to correspond to the amount of work actually done to complete the well.

As per the Analysis of Adjusted Contract Amount to Date for periodic estimate for partial payment number 2 (see page 2), the actual adjusted contract amount at the completion of construction was \$433,381.00, which was \$11,073.00 less than the original contract amount. Considering that the completed well has a 16-inch diameter pump chamber instead of the 14-inch proposed in the original design and has a welded wire screen instead of the slotted casing screen shown in the original design, the completed well is superior to the original design and the total cost of the completed well was less than the original contract price.

GEOLOGIC ANALYSIS

LOID Well No. 4 is located at an elevation of approximately 1,560 feet above sea level and penetrated mostly basalt to an elevation approximately 65 feet below sea level. Approximately 94 percent of the material penetrated by the well is basalt with the remaining 6 percent either surface sediments or one of several sedimentary interbeds. The geologic units as noted by Geo-Tech Explorations, Inc. are shown in Figure 2. A copy of the Well Driller's Report and Lithologic Log are included in Appendix G. A summary of this geologic information is as follows:

<u>Depth Range (feet)</u>	<u>Material Description</u>
0 to 18	sediments
18 to 60	basalt
60 to 76	clay
76 to 320	basalt
320 to 371	claystone
371 to 423	basalt
423 to 456	basalt and claystone, caving
456 to 640	basalt
640 to 680	claystone
680 to 1,625	basalt

Dr. John H. Bush, Professor Emeritus of Geology at the University of Idaho, examined the drill cutting samples obtained from the well. His stratigraphic analysis is based on a visual review of the material and does not include either rock chemistry data or comparison with nearby wells. Dr. Bush's general interpretation of the stratigraphic section penetrated by the well is as follows:

<u>Depth Range (feet)</u>	<u>Stratigraphic Identification</u>
0 to 423	Saddle Mountains Formation
423 to 456	Sweetwater Interbed
456 to 640	Priest Rapids Member of the Wanapum Formation
640 to 680	Vantage Interbed Equivalent
680 to 1,625	Grande Ronde Formation

All of the materials encountered are part of the Columbia River Basalt Group.

Approximately eight (8) basalt flows were identified based on the drilling cutting samples and the well driller's log. These flows are in the approximate depth intervals of 680 to 759 feet, 759 feet to 900 feet, 900 feet to 1,028 feet, 1,028 feet to 1,168 feet, 1,168 feet to 1,229 feet, 1,229 feet to 1,254 feet, 1,254 feet to 1,390 feet and below 1,390 feet. Flows of basalt within the Grande Ronde Formation average 100 to 200 feet thick. The possible flow contact zone identified at about 1,254 feet below land surface may, or may not, be correctly identified.

HYDROLOGIC ANALYSIS

Ground water producing zones (aquifers) occur predominantly at the contacts between successive basalt flows. These zones tend to be laterally continuous with a high fracture density. The fractures were created during emplacement of the basalt by the rapid cooling of the top of the underlying flow as it was exposed to the atmosphere. Vesicular zones (holes created by emanation of the gas during cooling) also are present near the top of the basalt flows. These zones tend to be highly porous, but the small holes often are poorly connected thus limiting the flow of ground water. Fracture density also is great along the bottom of the overlying flow, again because of rapid cooling. Rubble zones may be present along the bottom of some basalt flows. The interiors of basalt flows tend to have low fracture density and do not produce large quantities of ground water. The centers of basalt flows act mostly as confining layers for the flow-contact aquifers. The basalt sequence underlying the LOID Well No. 4 site hosts a layered sequence of thin aquifers (flow contact zones) separated by thick confining layers (flow interiors).

The density of fractures and the thickness of the fracture zone control the transmissivity of a given flow-contact aquifer. A successful, high-yield well in basalt generally obtains water from a number of flow-contact zones. Thus, transmissivity of the sequence is the sum of the transmissivity values of the flow contact zones that are penetrated by the well. LOID Well No. 4 was designed to obtain water from flow-contact aquifers at depths below 866 feet from the basalts of the Grande Ronde Formation.

Care was taken to identify the water-producing zones during the drilling of Well No. 4. Identification of these zones during drilling with the rotary-air method is based on noting increases in the amount of water being air-pumped out of the well during the drilling operation and/or increases in the air pressure required to operate the drill rig. The driller uses this information, along with his analysis of the cuttings from the drilling operation, to identify flow contact aquifers. The driller's depths to the flow contact zones were checked against the videotape of the borehole before the 16-inch casing screen assembly was constructed and installed. The combined understanding from these information sources was used to select the depth intervals for the placement of the well screen. The dominant water producing zones penetrated by LOID Well No. 4 are in the following depth ranges: 1,027 feet to 1,047 feet, 1,166 feet to 1,182 feet, 1,227 feet to 1,234 feet, 1,250 feet to 1,260 feet, 1,390 feet to 1,425 feet and 1,577 feet to 1,601 feet. The well drilling was terminated at 1,625 feet to provide a sump below the lowest water-producing zone. Hydraulic injection test information indicated that the desired yield of 1,500 gpm could be obtained from the well without drilling to greater depths.

Measurements of the static water level were taken in the borehole at various times during the construction of LOID Well No. 4. The measurements were taken either with an electric tape furnished by the driller or with an electric tape owned by the engineer. Measurements were referenced to the bottom of the discharge pipe where it joined the surface casing. A water-producing zone that was penetrated beginning at a depth of approximately 680 feet had a static water level of approximately 540 feet. Grout was placed in the borehole in the depth range of 640 feet to 700 feet in an effort to seal this water-producing zone out of the well. In addition, grout was placed at the bottom of the 18-inch casing between 856 feet and 866 feet. A water level of approximately 590 feet below ground surface was measured in the well at a drilled depth of 966 feet. The water level dropped to about 840 feet when the first major water-producing zone (1,027 feet to 1,047 feet) was intercepted. A static depth to water of between 840 and 845 feet was measured in the well at various times as the drilling progressed.

Hydraulic injection tests were conducted as various stages of the drilling of Well No. 4 in an effort to determine the relative productivity of each aquifer penetrated. The hydraulic injection tests consisted of injecting a known amount of water into the well and measuring the associated rise in the water level in the well. The water for the hydraulic injection testing, as well as the water required for the drilling operations, was supplied to the drilling site through a 4-inch PVC pipe that was connected to the existing 8-inch LOID domestic water supply line that crosses Hereth Park just to the east of the drilling site. Two gate valves to control the flow of water and a flow meter to measure the volume of water were installed in the 4-inch pipeline. The water used for the hydraulic injection testing was supplied from the existing LOID domestic water supply system (Hereth Park Storage Reservoir); therefore, it meets all of the required drinking water standards. All of the hydraulic injections tests were performed as per the procedures outlined below. A Solinst Levelogger (model no. 3001, LT F300M100) was attached to the end of a 1,000-foot electric tape and lowered into the well to monitor the water level during each injection test. The electric tape was used to measure the static water level at the start and end of each test. The procedures for the hydraulic injection tests are as follows:

1. Turn the data logger on and preprogram it at the site using a lap top computer to take water level measurements on minute intervals.
2. Attach the data logger to the 1,000-foot electric tape and lower it into the well. Use the electric tape to measure the static water level in the well, then lower the data logger to a pre-selected depth below the static water level (a minimum of 30 feet to 60 feet to reduce turbulence on the data logger) by lowering the electric tape below the static water level.
3. Connect a 2-inch flexible hose to the end of the 4-inch pvc water supply line. Insert the discharge end of the 2-inch hose approximately 5 feet into the well casing to ensure it wouldn't dislodge from the well during the test. This procedure was followed during all of the tests completed during the construction of the well. The tests that were conducted after the drill rig was removed from the site were set up slightly differently. For these tests, the 4-inch water supply line was extended all of the way into the well so that more water could be supplied for the test.

4. Read the gallon register on the flow meter, then open the gate valve(s) on the water supply line to allow water to flow into the well. Allow the water to run into the well for 30 minutes. Read the flow meter register at various times during the test to ensure the flow of water is uniform throughout the test. The lengths of the tests run after the drill rig was removed from the site were longer.
5. Allow the well to recover (at least as long as the length of time the water was allowed to run into the well) before removing the electric tape and data logger from the well. Read the static water level in the well before removing the electric tape from the well. Record the flow meter register reading at the end of the test.
6. Turn the data logger off and download the data at the site using a lap top computer.
7. Combine the data from the data logger and the water flow data into a spreadsheet and analyze the results of the hydraulic injection tests.

The first hydraulic injection test was run on October 29, 2002 approximately 25 minutes after the drilling operations were completed at the end of the day. The depth of the well at that time was 1,244 feet. The drill bit and stem were left in the drill hole. An estimated 300 gallons per minute (gpm) was being air pumped from the well during the drilling operation during the day. Water was injected into the well at a rate of approximately 300 gpm from 5:00 p.m. to 5:30 p.m. Figure 3 shows the water level record obtained during the first hydraulic injection test. The water level prior to the start of the test was between 820 and 830 feet below the ground surface and was declining at that time. The injection of the 300 gpm of water caused an initial rise in the water level in the well of approximately 60 feet. The rise in the water level then stabilized at about 45 feet. Four minutes after the completion of the test, the water level dropped back to a depth of 841 feet.

The second hydraulic injection test was run on October 30, 2002 about 60 minutes after the drilling operations had ceased for the day. The depth of the well was at 1,275 feet and the drill bit and stem were left in the drill hole. Water was injected into the well at a rate of about 330 gpm from 4:33 p.m. to 5:03 p.m. Figure 4 shows the water level record for the second injection test. The water level was dropping with time prior to the beginning of the second test. The injection of 330 gpm caused the water level in the well to rise 56 feet; however, the water level then dropped as the injection test continued.

The results of the first two hydraulic injection tests are difficult to interpret because other factors were influencing the water level in the well to change during the course of the tests. Air pumping of the water during the drilling operations previous to the tests should have caused the water level to decline in the aquifer adjacent to the well. The water level in the well should have been rising (recovering) during the injection tests; however, as the data shows, the water level in the well was declining prior to the beginning of both test no's. 1 and 2. Direct rotary air drilling results in the loss of air into the formation adjacent to the drill hole in the uncased portion of the well (below a depth of 866 feet). The movement of the air (bubbles) from the formation back into the drill hole likely was occurring during both of the first 2 injection tests. This resulted in the drill hole being filled with air-saturated water, which was considerably less dense than the water in the unaffected portions of the formation. This "less dense" water would "float" on top of the more dense water and would result in a water level within the drill hole that would be higher (above) the water level in the aquifer. The water level in the drill hole would decline with time as the movement of the air from the formation into the well gradually decreased. This effect caused the higher than anticipated water levels and the water level decline observed in the well during both of the first two tests and makes the interpretation of the test data very difficult and unreliable.

To eliminate the air-saturation problem discussed in the preceding, the remaining injection tests were run after the drilling operation had been shut down for at least several hours.

The third injection test was run on November 01, 2002, after the drilling operation had been shut down for approximately 24 hours. The well depth was still at 1,275 feet and the drill stem and bit had been removed from the hole. The plot of the data from this test, which is shown in Figure 5, shows that the static water level measured in the drill hole was stable prior to the start of the test. This is further evidence that the air-saturation/density theory for the problems encountered in the first two tests is likely correct. Figure 5 can be interpreted to reliably predict the hydraulic efficiency of the well under short-term pumping conditions. The test results clearly show that the water level in the well rose approximately 13 feet when 300 gpm of water was injected into the well for 30 minutes. Based on this, the specific capacity of the well (discharge rate of water into the well divided by the rise in the water level in the well) during the third injection test was approximately 23 gpm/ft. The specific capacity of a well will decrease both at higher pumping rates and at longer pumping times. Based on the data, it appears that pumping the well at 1,000 gpm would cause a short-term draw down of less than 100 feet.

The fourth injection test was run on November 8, 2002 approximately 4 hours after the drilling operation had been shut down. The depth of the well at this time was 1,415 feet. The drill bit and stem had been removed from the well. The data from this test, shown in Figure 6, clearly shows that the water level in the well was stable prior to the beginning of the test. The test data indicates that a water level rise of approximately 8.2 feet occurred from the injection of approximately 300 gpm for 30 minutes. This results in a specific well capacity of about 37 gpm/ft. The increase in specific capacity from the third to the fourth injection test reflects the additional yield from the aquifer in the depth interval from 1,390 feet to 1,415 feet. Based on the data from injection test number four, it appears that pumping the well at 1,800 gpm would cause a short-term (30 minute) draw down of less than 100 feet.

The fifth injection test was run on November 18, 2002 when the well was at the completed depth of 1,625 feet. The drill bit and stem had been removed from the well. The data from test number 5, which is shown in Figure 7, again shows that the water level in the well was stable prior to the beginning of the test. The test data indicate that a water level rise of approximately 4.4 feet occurred from the injection of approximately 300 gpm for 30 minutes. This results in a specific well capacity of about 68 gpm/ft. The large increase in the specific capacity from test number 4 to test number 5 (37 gpm/ft to 68 gpm/ft) represents the penetration of the aquifer in the depth interval below 1,577 feet. Based on this, the decision to drill to 1,625 feet was well worth the extra cost of the additional drilling.

A sixth hydraulic injection test was run for 24 hours on December 30-31, 2002 after the well construction had been completed and the drill rig had been removed from the site. The 4-inch water supply line to the well site had been extended so that the water could be discharged directly into the well. This allowed a much larger volume of water to be discharged into the well than with the previous tests, where a 2-inch flexible hose had been used to run the water from the 4-inch pipe into the well. The initial flow of water into the well with the control valve wide open was 850 gpm. The gate valve was then partially closed to reduce the flow rate to an average rate of 630 gpm for the remainder of the test. The flow was reduced by LOID staff to ensure that sufficient water remained in the Hereth Park storage reservoir to meet the demands of the system. From the test data shown in Figure 8, the injection of 630 gpm into the well resulted in a water level rise of approximately 10 feet, which gives a specific well capacity of approximately 63 gpm/ft.

The seventh, and last, hydraulic injection test was run on January 03, 2003 using the same piping arrangement used for test no. 6. Water was injected into the well for 3 hours at an average flow rate of 810 gpm. From the test data shown in Figure 9, the water level in the well raised 24 feet during the test. This gives a specific capacity of approximately 34 gpm/ft.

Figure 3 LOID Well #4 Depth to Water Plot for 10-29-02 Injection Test

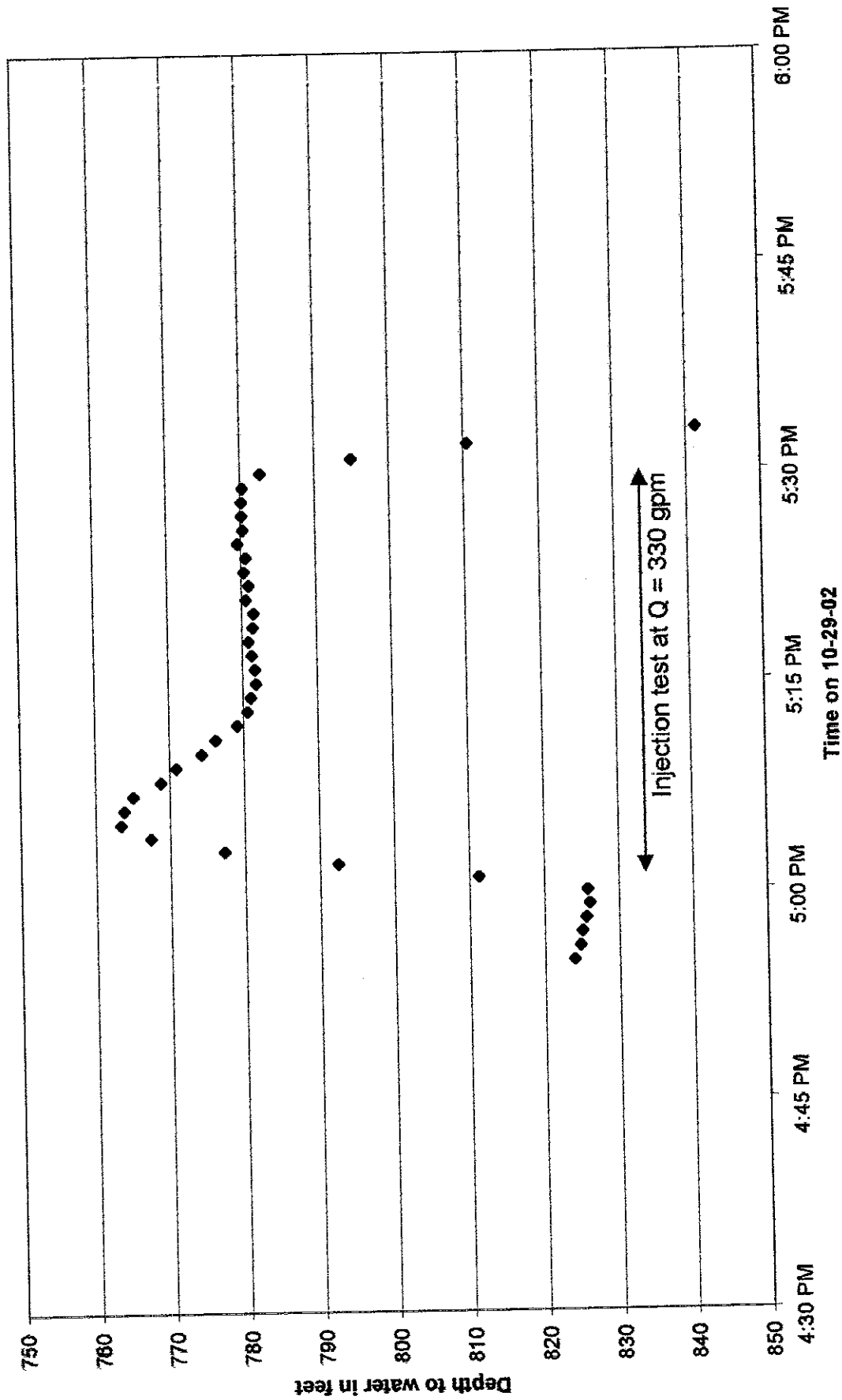


Figure 4 LOID Well #4 Depth to Water Plot for 10-30-02 Injection Test

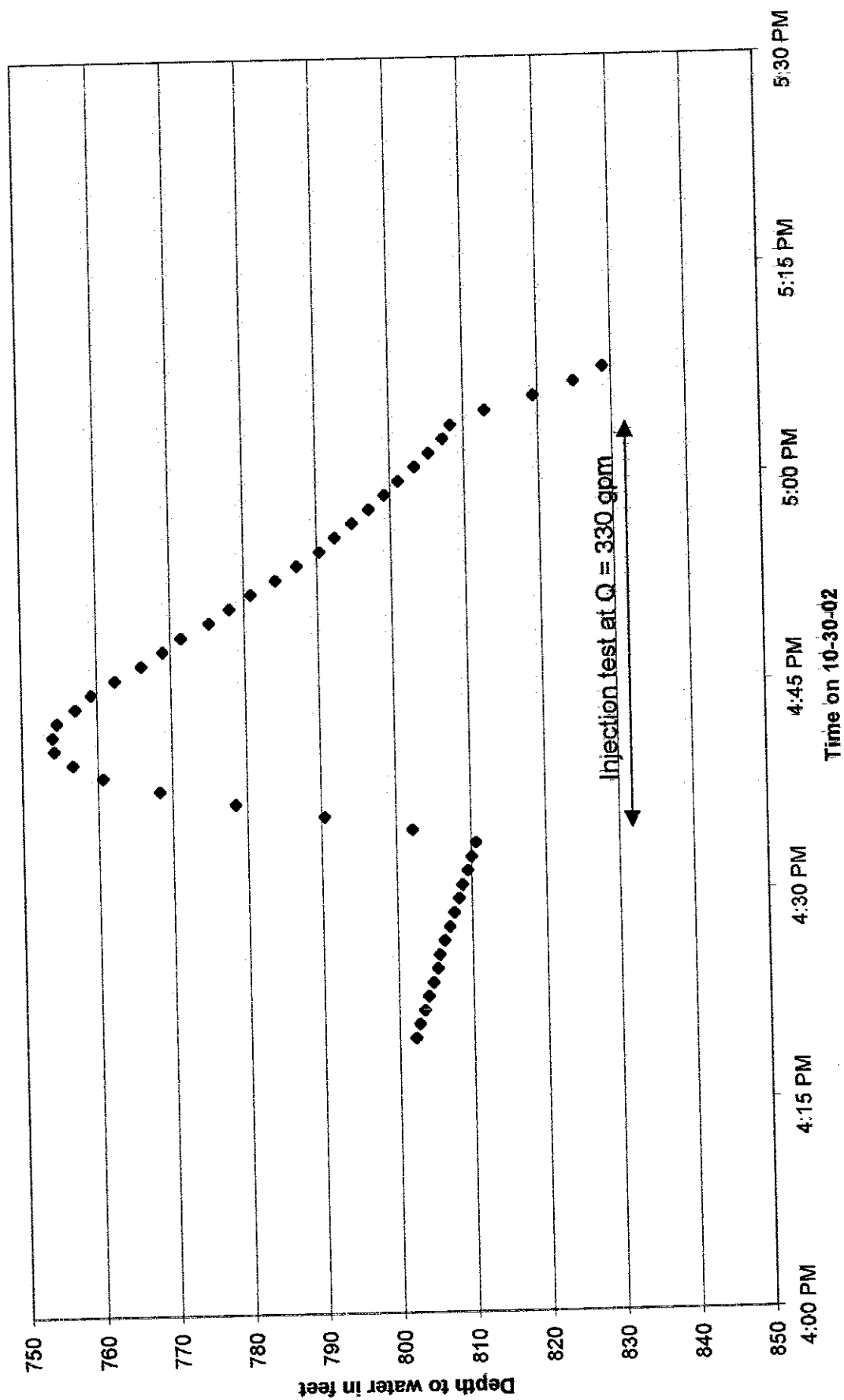


Figure 5 LOID Well #4 Depth to Water Plot for 11-1-02 Injection Test

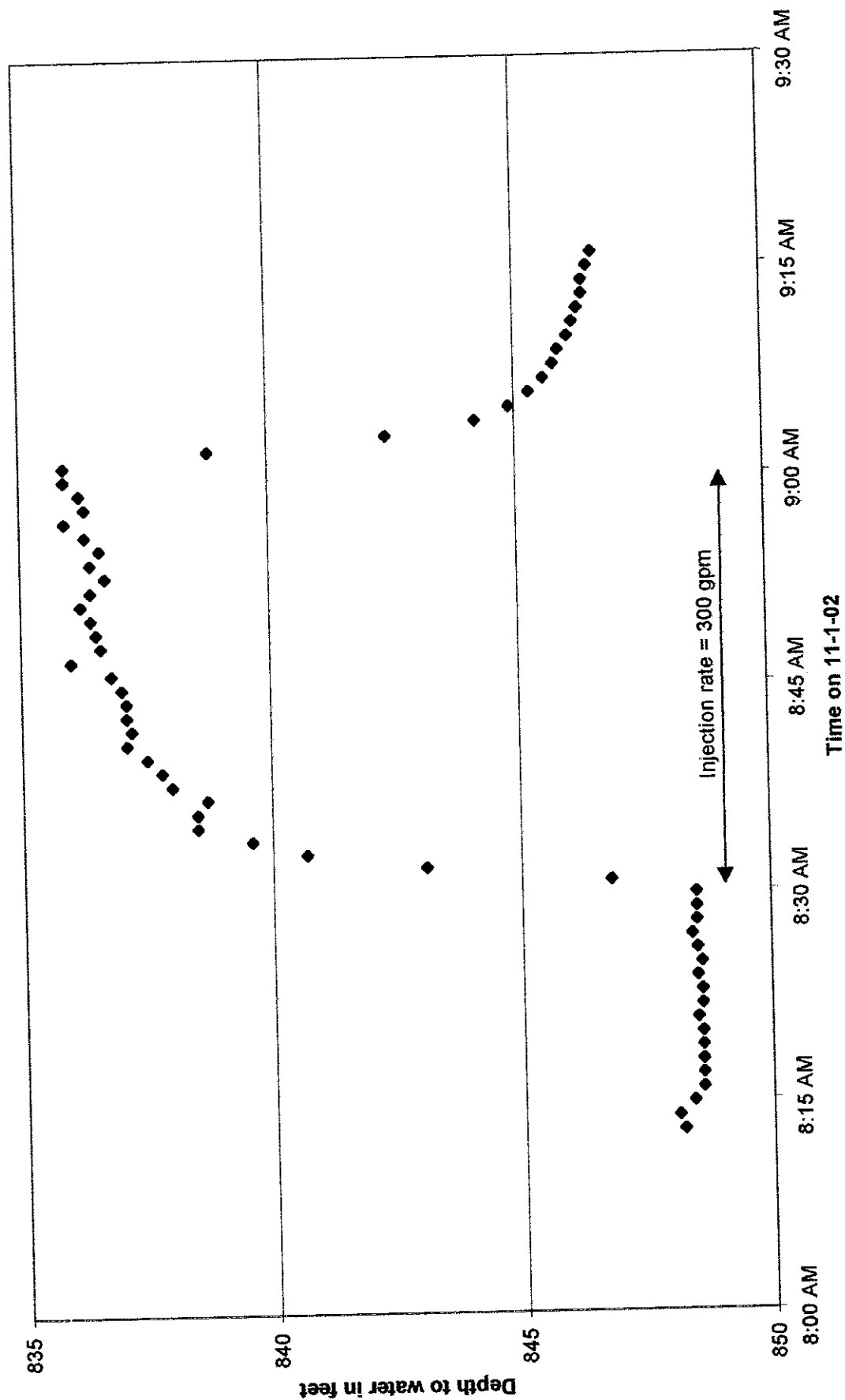


Figure 6 LOID Well #4 Depth to Water Plot for 11-8-02 Injection Test

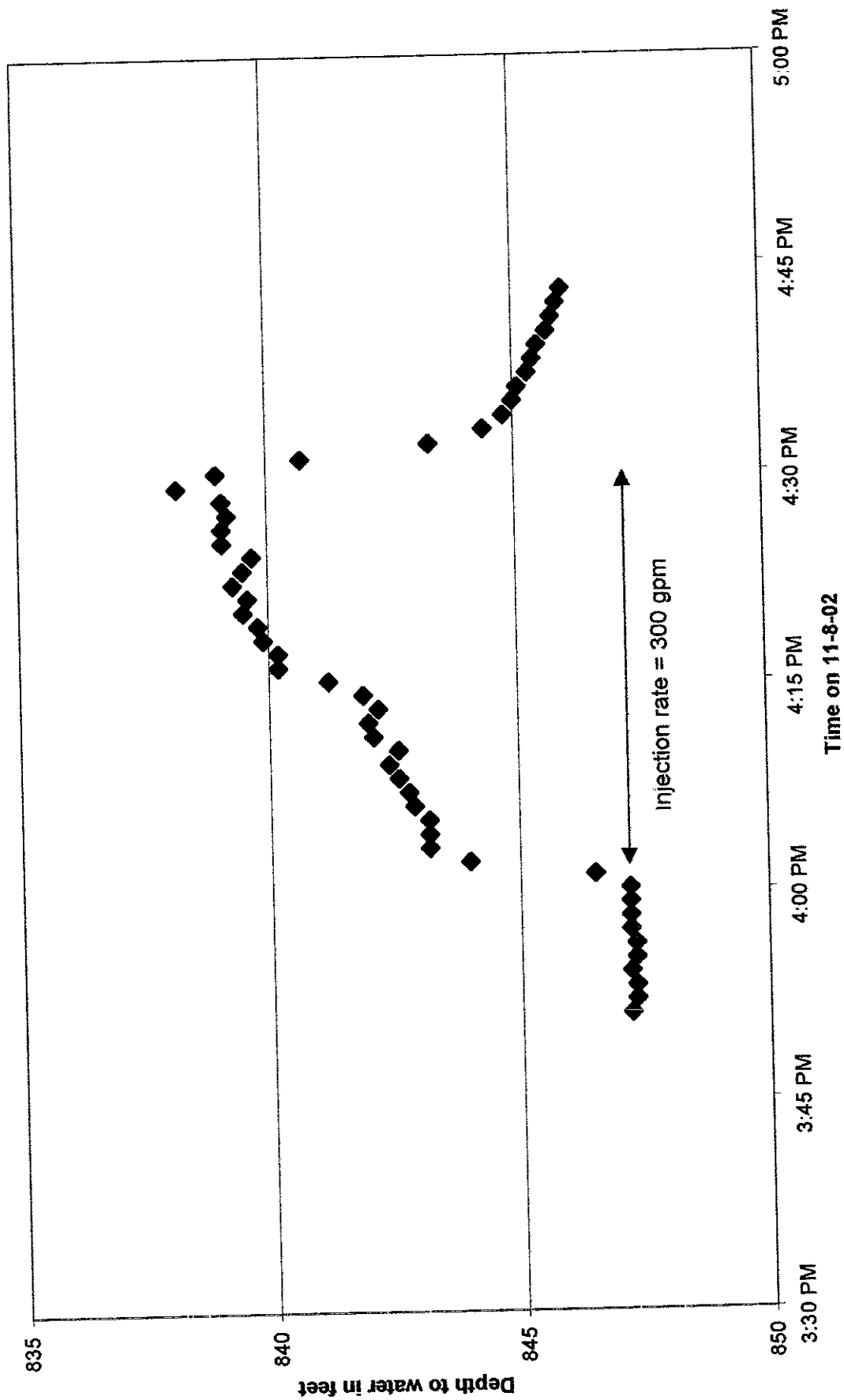


Figure 7 LOID Well #4 Depth to Water Plot for 11-18-02 Injection Test

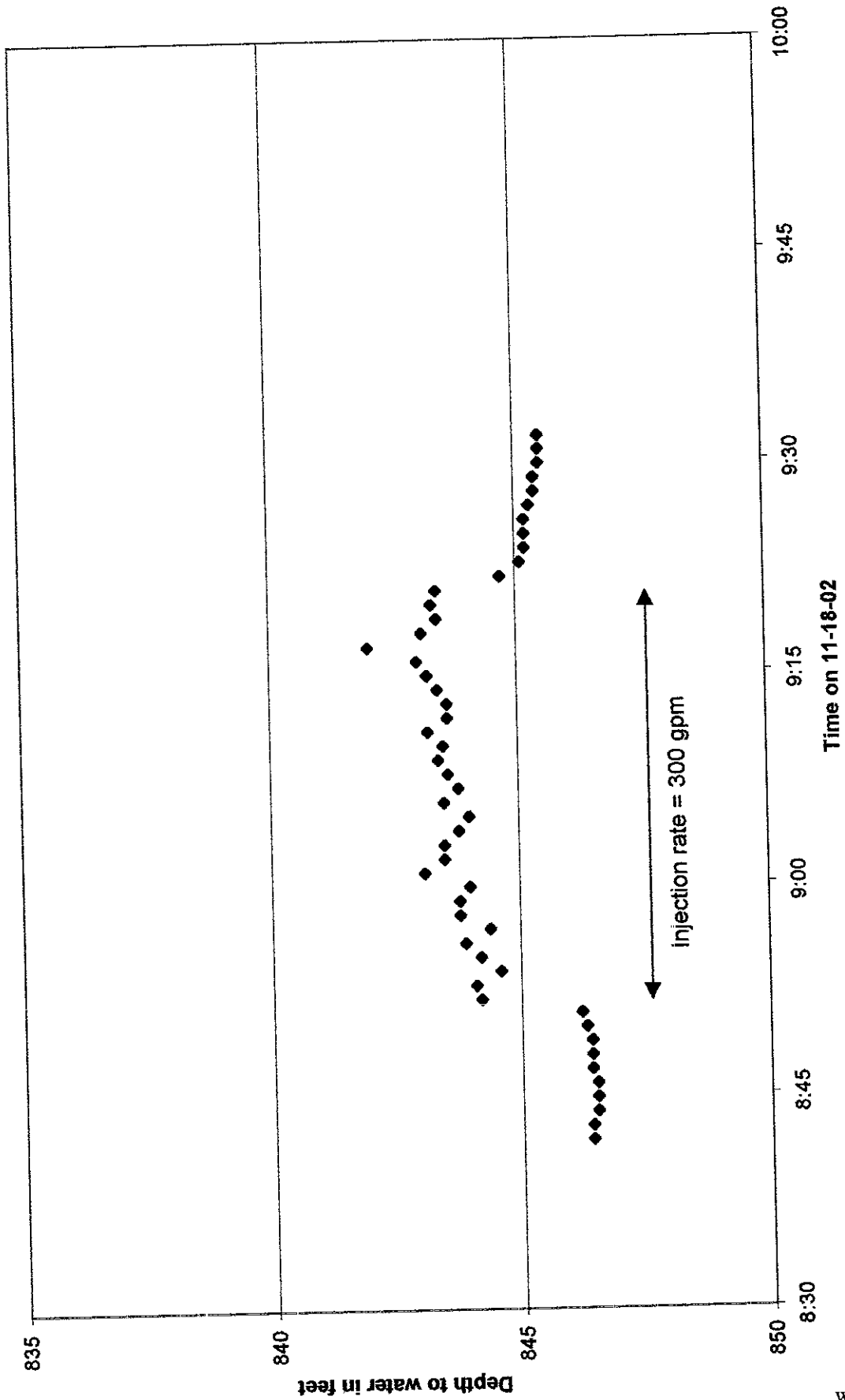


Figure 8 LOID Well #4 Depth to Water Plot for 12/30-31/02 Injection Test

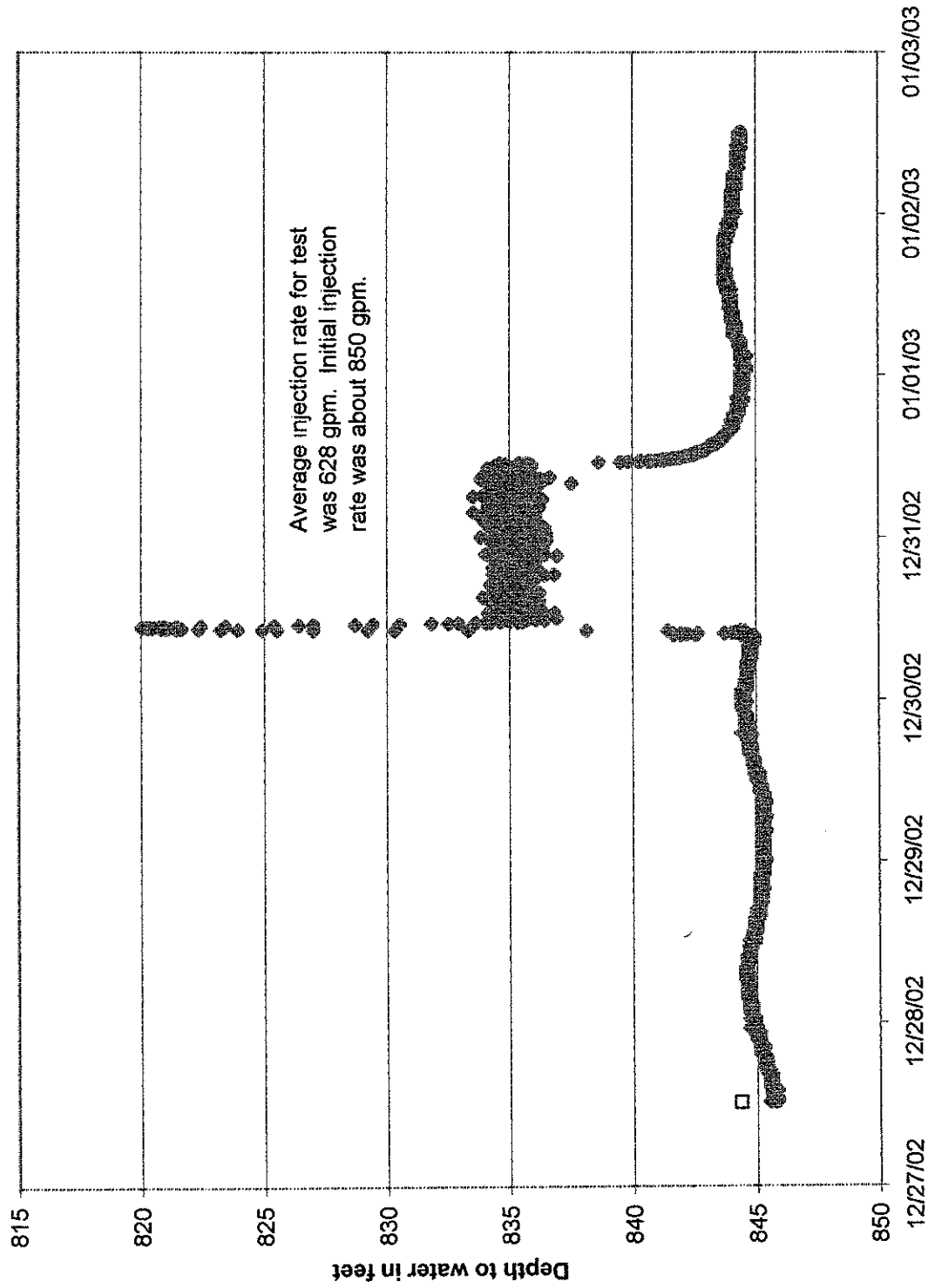
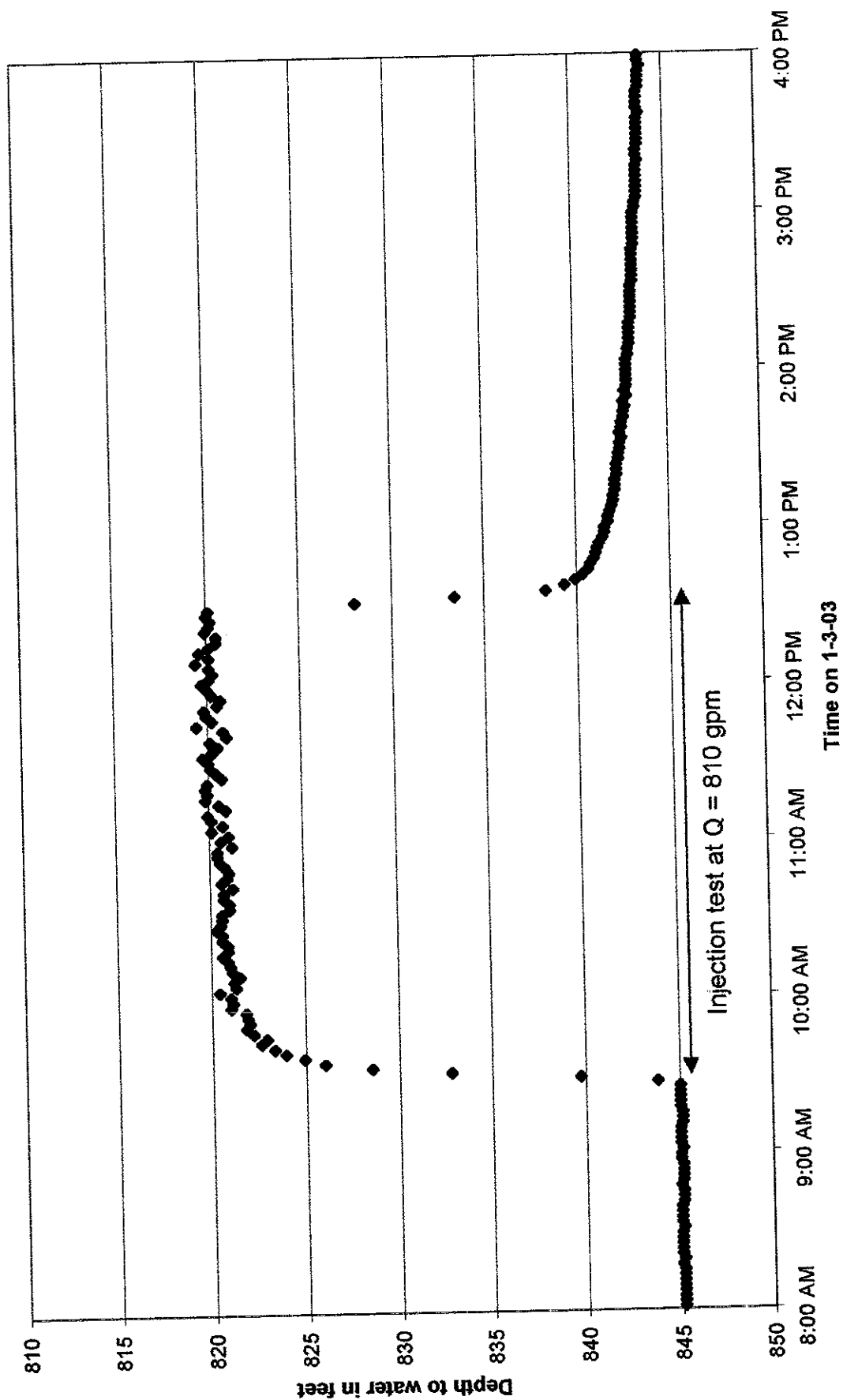


Figure 9 LOID Well #4 Depth to Water Plot for 1-3-03 Injection Test



WELL PRODUCTIVITY

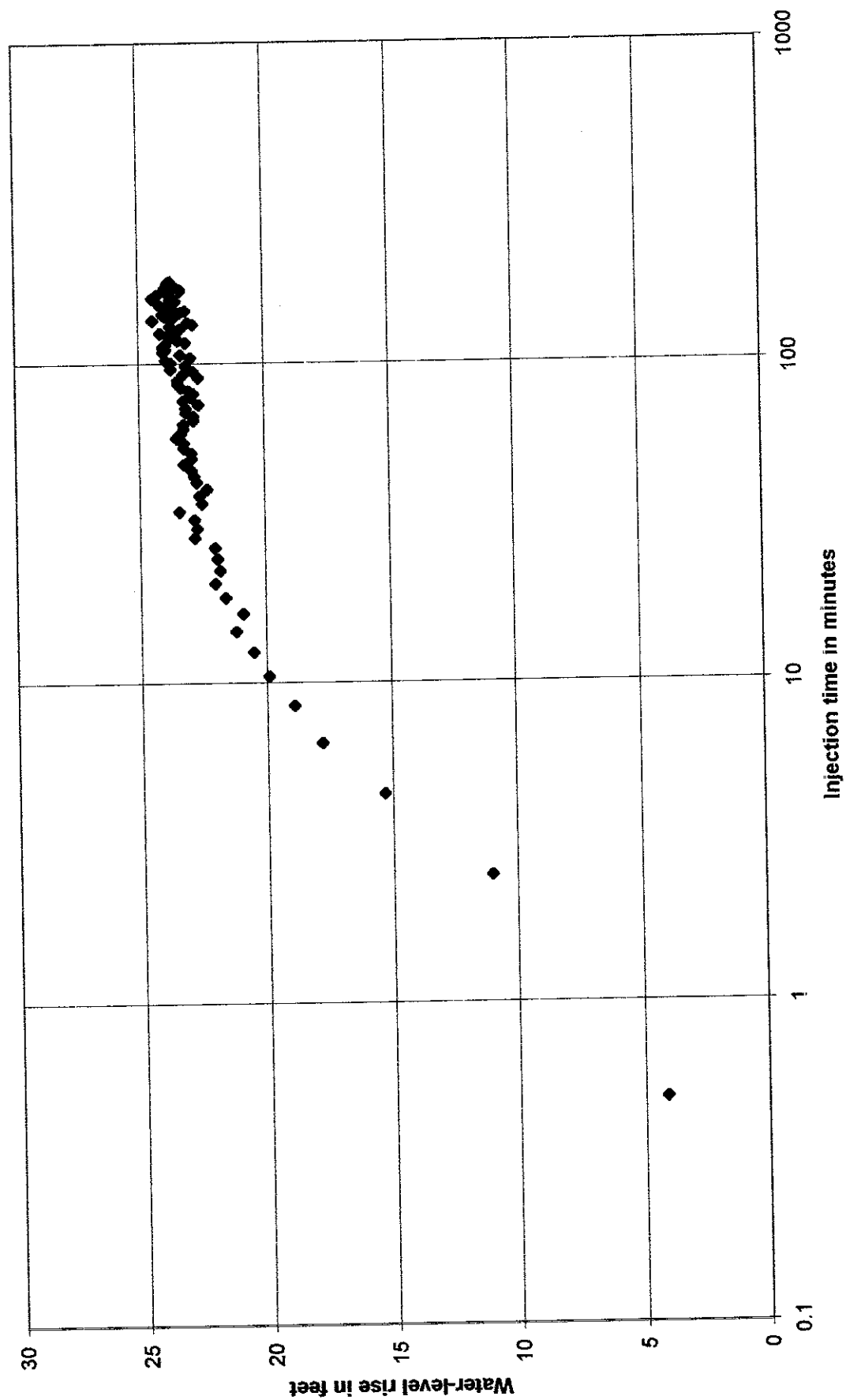
The results of the hydraulic injection testing provide a basis to assess the yield characteristics of the completed well. A summary of the hydraulic injection test results is as follows:

<u>Well Depth and Completion</u>	<u>Injection Rate(gpm)</u>	<u>Specific Capacity(gpm/ft)</u>
1,275 feet open hole	300	23
1,415 feet open hole	300	37
1,625 feet open hole	300	68
1,625 feet cased and screened	630	63
1,625 feet cased and screened	810	34

The last injection test (run on January 03, 2003) provides the basis for estimating the draw down that can be expected from the operation of the well at pumping rates of 1,000 to 1,500 gpm. Figure 10 is a draw down plot for the last injection test. The projected draw down after one day of injecting 810 gpm is approximately 25 feet. Projecting this trend results in a draw down of less than 27 feet after 10 days of continuous pumping. Based on this, operation of the well at a discharge rate of 1,000 gpm should result in a 10-day draw down of less than 35 to 40 feet. Pumping the well at 1,500 gpm should result in a 10-day draw down of less than 80 feet.

The potential draw down needs to be compared to the available draw down with respect to various pump settings to assess the long-term productivity of the new well. In most cases, the pump should be set above the top of the uppermost screen section within the well. Figure 2 shows that the top of the uppermost screen section in the new well is at a depth of about 1,029 feet. Based on this, the deepest the pump should be set is about 1,020 feet. The available draw down within the well is the distance between the static water level and the deepest possible pump setting. The static water level in the new well is approximately 845 feet below the ground surface. Positioning the pump at a depth of 1,020 feet would provide about 175 feet of available draw down. This is more than twice the estimated 10-day draw down within the well for a pumping rate of 1,500 gpm. This information suggests that a 1,500 gpm pumping rate is attainable from the new Well Number 4 for an extended period of time.

Figure 10 Drawdown Plot for LOID Well #4 for 1/3/03 Injection Test



CONCLUSIONS AND RECOMMENDATIONS

The new Well Number 4 has the capacity to produce 1,000 to 1,500 gpm for an extended period of time. The yield characteristics of the well have been determined by conducting hydraulic injection tests both during and after well construction. The injection tests provide adequate information to select a pump/motor assembly for installation in the well. The installed pump can then be used to run additional aquifer tests as needed to confirm the draw down values at the selected pumping rate for longer periods of time.

Both constant and variable rate pumps should be considered for installation in the new well. A constant rate pump will have higher overall efficiency than a variable rate pump; however, the variable rate pump has operational advantages both for water production and for matching the best yield for the completed well. A cost analysis will be needed to determine the best pump selection for the well.

A program for long-term data collection and analysis will be needed for the new well. A minimum of two (2) access tubes (1-inch pvc tubing) should be installed when the pump/drop pipe assembly is placed into the well. These tubes will allow both hand water level measurement as well as installation of data logger equipment for continuous water level measurement. Water level and well discharge data should be reviewed and analyzed at three (3) and six (6) months after the well has been placed into service and annually thereafter.



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**HYDROGEOLOGIC ANALYSIS IN SUPPORT
OF THE DESIGN AND CONSTRUCTION OF
LEWISTON ORCHARDS IRRIGATION
DISTRICT WELL #4, LEWISTON, IDAHO**

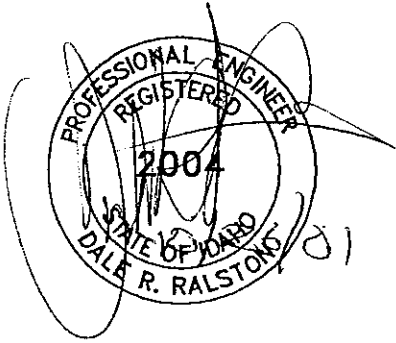
Prepared for
PROGRESSIVE ENGINEERING GROUP, INC.
Lewiston, Idaho

October 2001

CERTIFICATION BY ENGINEER

I hereby certify that the Hydrogeologic Analysis in support at the Design and Construction of LOID Well No. 4 was prepared by me and that I am a duly registered Engineer under the laws of the State of Idaho.

Professional Engineer's
License: 2004



A large, stylized handwritten signature of Dale R. Ralston, P.E., written in black ink.

DALE R. RALSTON, P.E.

Date: 10/26/01

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INTRODUCTION

The purpose of this report is to present information in support of the location, design and construction of a new well for the Lewiston Orchards Irrigation District (LOID) located in Lewiston, Idaho. LOID provides a dual domestic and irrigation water supply for residents of the Orchards portion of the City of Lewiston. The domestic portion of the water supply is supplied from deep wells.

This report is divided into three major sections. The first section presents an overview of the hydrogeologic setting of the Lewiston area with specific reference to the deep aquifers that are available for the development. The second section includes an analysis of the three existing LOID wells. The third portion of the report presents specific recommendations with respect to the location, design and construction of a new LOID well. The analysis presented in this report is based on a review of all available information plus personal knowledge of both the Lewiston basin and well design/construction methodologies.

The primary references used for this report are listed below

- Bond, J., 1997, Summary Report for the Drilling, Construction and Test Pumping of LOID #3 Well: Unpublished consulting report prepared for Holman Drilling, Inc., Moscow, Idaho.
- Bush, J. and D. Garwood, 2001, Bedrock Geologic Map of the Lapwai Quadrangle, Nez Perce County, Idaho: Idaho Geological Survey, Moscow, Idaho.
- Cohen, P. and D. Ralston, 1980, Reconnaissance Study of the "Russell" Basalt Aquifer in the Lewiston Basin of Idaho and Washington: Idaho Water Resources Research Institute, Moscow, Idaho.
- Cutshaw, L., 1998, Engineering Report for Lewiston Orchards Irrigation District Pump, Piping, Pump House and Disinfection for Municipal Potable Water Well #3: Unpublished consulting report, Wyatt Engineering, Inc., Lewiston, Idaho.
- Garwood, D. and J. Bush, 2001, Bedrock Geologic Map of the Lewiston Orchards North Quadrangle, Nez Perce County, Idaho: Idaho Geological Survey, Moscow, Idaho.
- Unpublished pumping, water level and water quality records for the LOID wells.
- Unpublished drawings showing well construction details for LOID wells #1, #2 and #3 and for Lewiston well #6.
- Borehole television tapes for LOID wells #1 and #3 and for Lewiston well #6.
- Wyatt, D., J. Bond, J. Eliason, D. Ralston and G. Stephens, 1994, Lewiston Basin Deep Aquifer Study: Unpublished consulting report, Wyatt-Jaykim Engineerings, Lewiston, Idaho.

HYDROGEOLOGIC SETTING

The LOID service area is located within the Lewiston Basin, which is a broad synclinal trough underlain to great depth by layers of basalt and sediments (Figure 1). The Lewiston Hill is the northern boundary of the basin; this feature includes the steep

northern flank of the syncline and several small faults. A northeast trending fault separates the basin from the uplifted Craig Mountain to the south. The structural basin is dominated by an east-west trending syncline that forms a shallow bowl with the lowest portion near the center of Lewiston. The confluence of the Snake and Clearwater Rivers is near the lowest portion of the structural basin.

Deep wells in the Lewiston Basin penetrate and obtain ground water from basalt aquifers within Grande Ronde Formation (Figure 2). These wells include three for LOID, five for the City of Lewiston, seven for the Asotin County Public Utility District #1 and two for the City of Asotin. These wells penetrate to depths as great as several hundred feet below sea level. The depth of these wells depends on the starting elevations. The deepest of the production wells is LOID well #3 at a total depth of more than 2,600 feet. Ground water is obtained from zones of fracturing located primarily at contacts between individual basalt flows. The total yield of a given well is the sum of the yields of each of the flow contact aquifers penetrated by the perforated or open-hole portions of the well.

The static water level in most of the deep wells is near the elevation of the Snake and Clearwater River (700 to 720 feet). This is because the aquifers within the Grande Ronde Formation are hydraulically connected to the rivers because of the synclinal nature of the basin (shown on Figure 2). Long-term water level decline has been minimal within the deep wells because of this hydraulic connection with the river system. The LOID #2 well has a water level elevation that is considerably higher than any of the other deep wells. Potential reasons for this water-level difference are presented later in the report.

DESCRIPTION AND ANALYSIS OF LOID WELLS

Three deep wells have been drilled to provide domestic water supply for the LOID. Well #1 was drilled initially in 1978 and subsequently deepened. Well #2 was drilled in 1986 and well #3 was completed in 1997. The construction and operational history of these wells are presented in the following sections.

Well #1

A summary of construction details for well #1 based on engineering drawings is given below.

Well	Depth	Casing Summary	Perforated or Open Intervals
#1	1,795'	16" 0' to 1,003'	Open hole 1,003' to 1,233'
		8" 1,233' to 1,520'	Perforated casing 1,233' to 1,496'
			Open hole 1,520' to 1,795'

The borehole television tape of well #1 taken in February 2001 shows the bottom of the first section of casing is at a depth of 990 feet. The top of the liner is at a depth of 1,240 feet with the bottom of the liner at a depth of 1,502 feet. The tape shows that the slots in the upper portion of the liner in well #1 are about 80 percent open. The slots at a depth of

about 1,400 feet appear to be only about 40 to 50 percent open. The deeper slots (at about 1,430 feet) appear to be nearly completely plugged. The static water level is given at a depth of 827 feet, which gives a water level elevation of about 734 feet above sea level.

The discharge history of LOID well #1, presented in Figure 3, shows a decrease in well yield from about 800 gpm (gallons per minute) in the early 1980's to less than 400 gpm in the late 1990's. The well was taken out of service in July 1998. The decrease in yield likely was due to the gradual plugging of the slots in the casing in the depth interval from about 1,300 feet to about 1,500 feet.

Ground water level data are not available for well #1 for most of the life of the well. The report by Wyatt and others (1994) presents water level data for LOID well #1 from 1960 to 1993. This plot (presented as Figure 4) shows no long-term water level decline after 1987. The reliability of these water level data is unknown.

Well #2

A summary of construction details for well #2 based on engineering drawings is given below.

Well	Depth Casing Summary	Perforated or Open Intervals
#2	1,957' 16" 0' to 524' 14" 520' to 1,376'	Open hole from 1,376' to 1,957'

A borehole television tape is not available for this well. Thus, the accuracy of the casing depths is not known.

The discharge history of well #2 is presented in graphical form in Figure 5. This figure shows a variation in discharge rate from about 600 to 800 gpm for most of the period of record. A higher discharge rate was recorded in 1987 shortly after the well was drilled. The discharge also dropped below 600 gpm for a period in late 1999 and early 2000. There does not appear to be a long-term decrease in discharge in well #2.

The discharge data presented in Figure 5 show an interesting fluctuation pattern that appears to be correlated with annual recharge events. The average monthly discharge rate from well #2 appears to increase in late spring (May and June) then decrease gradually over the fall and winter. This annual pattern is markedly different than the relatively constant rate shown in Figure 3 for well #1.

The limited water level data presented by Wyatt and others (1994) for well #2 are shown graphically in Figure 6. This plot shows a decrease in water level in 1986 and 1987 with little additional decline. Again, the reliability of the water level data for this well is unknown.

The water level elevation given on the engineering drawings for well #2 (1,229 feet) is almost 500 feet above any of the other deep wells in the Lewiston Basin. This anomalous water level elevation is difficult to explain given the relatively simple hydrogeologic conceptual model of a layered synclinal basalt basin presented earlier in this report. The only viable explanation for the well #2 water level elevation is the presence of mapped northwest-southeast trending folds within the overall structural basin. The geologic maps created by Bush and Garwood in 2001 show these folds. Several of these folds likely bound well #2 intersect northwest of the well site. This effectively isolates the Grande Ronde Formation aquifers penetrated by well #2 from the Clearwater River to the north, Lapwai Creek to the east and the remainder of the basin and the Snake River to the west. With this hypothesis, recharge to the aquifers feeding well #2 would occur in a relatively small area to the southeast. The cyclical well yield pattern suggests that recharge originates from a temporal surface water source such as Sweetwater Creek. Additional field investigation is needed to confirm or refute this concept.

Well #3

A summary of construction details for well #3 based on engineering drawings is given below.

Well	Depth Casing Summary	Perforated or Open Intervals
#3	2,617' 16" 0' to 1,023' 13" 1,003' to 1,433'	Perforated casing 1,038' to 1,058' Perforated casing 1,133' to 1,153' Perforated casing 1,218 to 1,238' Perforated casing 1,253' to 1,273' Perforated casing 1,378' to 1,393' Open hole from 1,423' to 2,617'

The borehole television tape of well #3, obtained in September 1997 was difficult to interpret for the cased portion of the well because the water was cloudy. Use of the side view camera only showed perforations at a depth of 1,375 feet. No perforations could be seen using the side view camera at depths of 1,378 feet, 1,395 feet and 1,410 feet. The end of the casing could be seen at a depth of 1,440 feet.

The only water level data for well #3 are from the engineering drawing (depth to water of 680 feet) and from the borehole television log (depth to water of 687 feet). This gives water level elevations of 731 and 738 feet above sea level. Well discharge data are not available for well #3.

Water Quality Data

The water quality data that are available for the three LOID wells are presented on Table 1. Water quality data for Lewiston well #6, the nearest of the other deep wells are also included on the table. The most complete comparison of results is between LOID

well #3 and Lewiston well #6. In this case, the total dissolved solids (TDS) level is higher in LOID #3 than in Lewiston #6 with sodium and chloride contributing to this difference. The water quality in both wells is good. A comparison of water quality between LOID wells is not possible because of the limited available data

Analysis of the LOID Wells

The use of perforated casing in well #1 opposite the uppermost flow contact zones in the Grande Ronde Formation likely contributed to lower overall well yields and the graduate decline in the pumping rate. Slot perforated casing has a very low percentage open area (typically less than three percent – *Groundwater Manual, 1984*). This limits water entry into the casing and results in very high entrance velocities. The high entrance velocities often result in chemical precipitation, which further limits the amount of open area. The chemical plugging of the slots in the casing in that can be seen in the borehole television tape of well #1 appears to confirm this problem. In-situ perforation of the casing in well #1 opposite producing zones is a potential rehabilitation program for this well.

The perforated sections in the depth interval of 1,038 to 1,398 feet in well #3 do not appear to be effective in providing water to the well. This conclusion is based on the cloudy nature of the water within the cased portion of the well. The water was much clearer below the casing, which indicates a higher rate of ground water movement. The perforations likely are not yet plugged because the well is relatively new. Careful monitoring of the yield from this well is needed to determine if plugging of the perforations in well #3 does become a problem.

FACTORS CONTROLLING CONSTRUCTION OF A NEW LOID WELL

Three factors control the yield of a new production well for LOID: 1) the yield characteristics of the aquifers penetrated by the well, 2) the design of the well and 3) the construction of the well including the method of drilling. These three factors are discussed in the following sections.

Yield Characteristics of the Aquifers

The total yield of a new production well will be the combined yield of each aquifer or producing zone penetrated. There are no techniques available to determine the relative productivity of a given flow contact zone at one site versus another site several hundred feet away. However, there are some general guidelines that can be used in an effort to construct a high yield well.

The first guideline is that yields can be expected to be higher if the well is located near the axis of a fold in the sequence of basalt flows, particularly a syncline. Basalt is a relatively brittle rock and fracturing is greater near the axis of folds than in relatively undisturbed rock. Relative to LOID, this translates to a desire to locate the new well near the trace of one of the synclines shown on the geologic maps published by Bush and

Garwood in 2001. These mapped features are shown on Figure 7. A potential drilling site is shown on Figure 7 where the nearest syncline crosses the pipeline leading from well #2 to the main portion of the distribution system. The alternative drilling site recommended by LOID personnel is near the location of well #1 (also shown on Figure 7)

The second guideline is that yields from individual flow contacts tend to decrease with depth. This pattern was observed in a 2,222-foot test well drilled in the Grande Ronde Basalt Formation in Pullman and also appears to be the case in the Lewiston Basin. This suggests that considerable care should be taken to obtain as much water as possible from the highest flow contact zones beneath the regional water table. LOID wells #1 and #3 are constructed with slot perforated casing opposite these producing zones. These zones are cased out in well #2. The use of casing or screen with a higher percentage open area for these zones appears to be warranted in an effort to obtain the maximum yield possible from a new LOID well.

Documentation of the yield characteristics of the flow contact zone aquifers during drilling is a very important aspect of construction of the well. This can either be done by using a direct air rotary drilling rig (that has sufficient air pressure and volume) and/or by sequential hydraulic testing as drilling progresses. The collection of yield information as drilling progresses is very important and is addressed later in the report.

Design of the Well

A well consists of several major components: 1) pump chamber, 2) cement grout seal and 3) screen or open hole. The diameter of the pump chamber is selected based on the pump to be used, which in turn is controlled by the desired and attainable yield. The depth of the pump chamber normally is controlled by the maximum anticipated location of the pump. The engineering drawings show that the pump in well #2 is set at 1,040 feet while the pump chamber casing extends to 1,376 feet. However, well #3 was designed to have the pump set within the slot-perforated casing located below the pump chamber casing. Thus, the pump chamber casing extends several hundred feet into the Grande Ronde Formation but above the planned pump setting depth. According to the engineering drawings, the pump in well #1 was located in an uncased portion of the well below the pump chamber casing. *A design question for the new well is the depth of the pump chamber and whether well screen should be installed opposite aquifers located above the anticipated pump setting.*

A cement grout seal is installed surrounding the pump chamber casing in order to keep surface and near-surface contaminants from entering the well and to eliminate any hydraulic connection of shallow and deeper aquifers. The surface seal extended to a depth of 1,023 feet in well #3. *A design question for the new well is the planned depth of placement of the cement grout seal.*

A production well should be designed to allow the entry of water with the minimum friction loss. The most efficient well completion is a stable, uncased hole. The

next most efficient is placement of a wire wrapped or louvered screen opposite the producing zones. The percent open area for the wire-wrapped screen can be as great as 35 percent with a maximum of about 20 percent for louvered screen. Factory or field slotted casing typically provides less than three percent open area for water entry to the well. A design question for the new well pertains to the length and placement of wire-wrapped screen or louvered casing in selected portions of the well.

Construction of the Well

The type of drill rig used and the steps followed in construction of the well can have major impacts on the yield characteristics. The upper portion of the well where the cement grout seal will be placed can be drilled using a variety of methods. A mud rotary rig probably is the optimum rig of choice for this interval because temporary casing is not required in the alternating layers of sediments and basalt. The mud rotary rig should not be used for the lower portion of the well because of the high probability that mud loss into the fractured rock will result in much lower well yields. A direct air and/or reverse air rotary rig probably is the rig types of choice for the lower portion of the well. A design question for the new well is the selection of drilling methods and drilling steps in the preparation of a set of bid documents.

On-site monitoring of drilling as the well progresses is an essential aspect of the well construction process. The field geologist/engineer collects cutting samples, monitors drilling progress and inspects and measures materials installed in the well.

WELL DESIGN AND SPECIFICATIONS FOR THE NEW LOID WELL

This portion of the report presents recommendations relative to the design and construction of a new LOID well. The design of the well is the same regardless of which of the two alternative well locations is selected.

The well design is based on the following assumptions:

- A direct mud rotary rig will be used to drill the upper portion of the well (above a depth of about 860 feet).
- Either a direct air rotary or a reverse air rotary rig will be used to drill the lower portion of the well (below a depth of about 860 feet).
- An 18-inch diameter pump chamber casing will be installed to house the pump.
- A suitable cement grout seal can be placed around the pump chamber casing in a 22 to 24-inch diameter drilled hole.
- The water level elevation in the new well will be about the same as in wells #1 and #3.

The steps involved in the well construction project are outlined below.

- 1 Prepare the site for well construction.

2. Move the mud rotary rig on site. The driller can use an air rotary rig to start the hole if desired (no additional costs will be allowed).
3. Install a temporary surface casing if desired (no additional costs will be allowed).
4. Drill a nominal 22 or 24-inch diameter hole to approximately 860 feet.
5. Furnish and install 18-inch diameter casing 0.375-inch wall thickness to approximately 860 feet with a cement float shoe attached to the bottom.
6. Pump cement grout into the annular space outside of the 18-inch casing via the float shoe until grout of suitable consistency appears at land surface. Remove any temporary casing that was installed at the start of drilling during the grouting program. Redundant grout pumps are needed to insure that the seal placement occurs over the entire thickness at one time.
7. Change the rig over from mud rotary to direct or reverse air rotary. Drill a nominal 17-inch diameter hole to approximately 1,300 feet or as directed by the field geologist/engineer. Conduct injection tests as needed to determine productivity of well. The injection tests will consist of discharging a measured flow (perhaps 300 gpm) into the pump chamber casing at land surface and measuring the resultant water level rise. The injection tests will be of about one-hour duration.
8. Furnish and install nominal 14-inch diameter wire-wrapped or louvered screen plus blank casing as directed by the field geologist/engineer. The total screen length shall be about 150 feet with the entire casing/screen length about 450 feet.
9. Drill a nominal 10 or 12-inch diameter open hole to approximately 2,000 feet or as directed by the field geologist/engineer. Conduct injection tests as needed to determine productivity of well.
10. Develop the well using high velocity water jetting as directed by the field geologist/engineer (maximum of 12 hours).
11. Conduct borehole geophysical logging (including dynamic flow meter log) plus borehole television logging of well.
12. Remove the drilling rig and clean up the drilling site.

The bid document would be prepared based on the steps described above.

CONCLUSIONS

A properly designed and constructed new well for LOID has a good potential of yielding 1,000 to 1,500 gpm over an extended period. The primary differences between design and construction of the new well versus the existing three LOID wells are as follows:

- Either direct or reverse air drilling methods will be used within the potential aquifer zones. This will avoid aquifer-clogging problems often associated with mud rotary well construction in fractured rock systems.
- Either wire-wrapped or louvered screen will be used rather than slotted casing in the producing zones between the water table and the planned pump setting depth. This will make the well more efficient both now and in the future.

- The cement grout seal in the new well will be installed in a single pass. The existing wells have additional grout seals and additional surface casing. The additional casing and seal serves no purpose.
- Injection hydraulic testing will be done several times during construction of the lower portion of the well. This will allow estimation of well yield during drilling. This information will be used to determine the final depth of the well.

The optimum location for the new well is along the axis of one of the northwest-southeast trending synclines that have been mapped by Bush and Garwood (2001) in the area. However, a suitable well also can be constructed near well #1. However, the new well should be located at least 200 feet from well #1 to avoid possible formation damage caused by mud invasion during drilling.

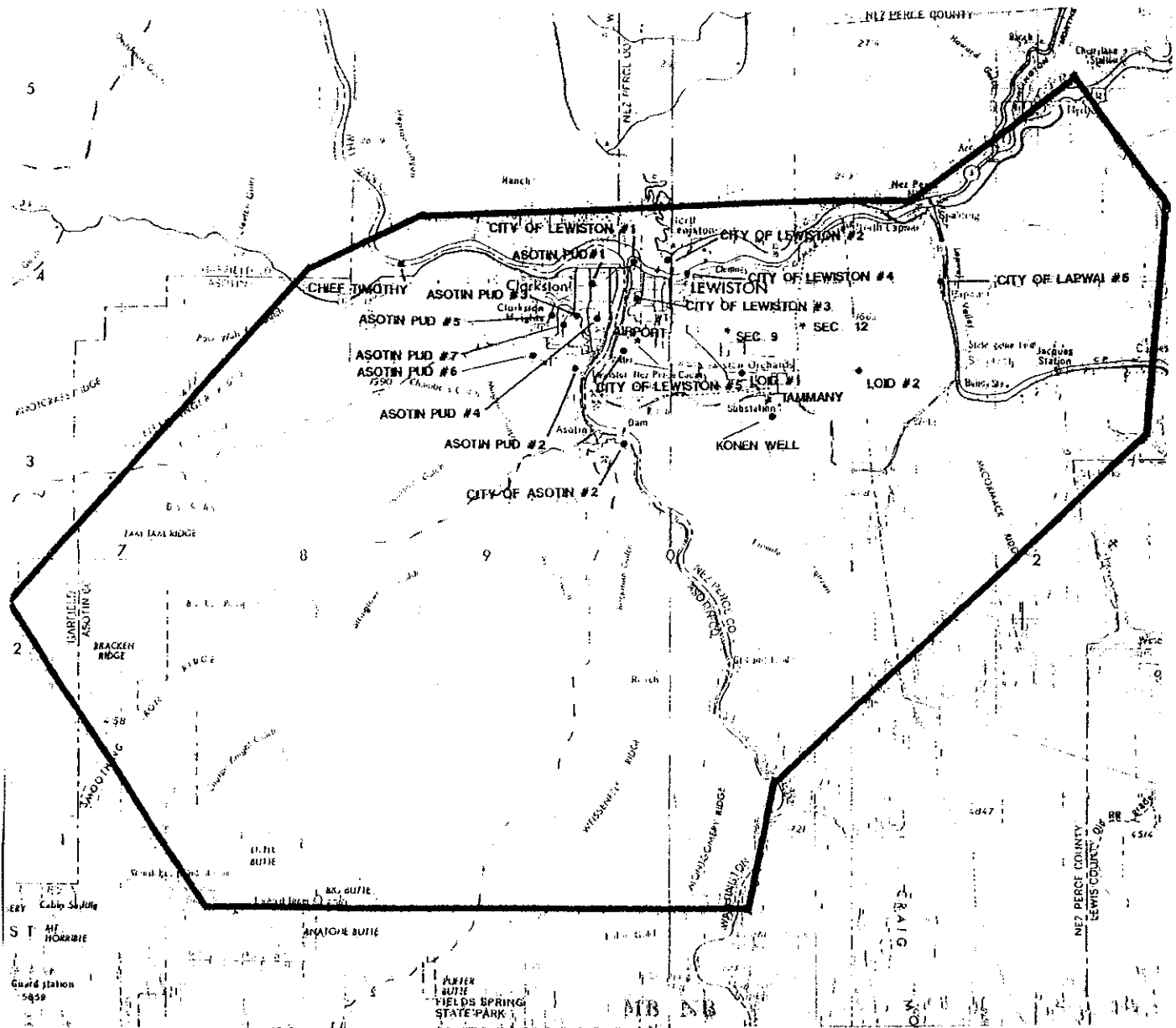
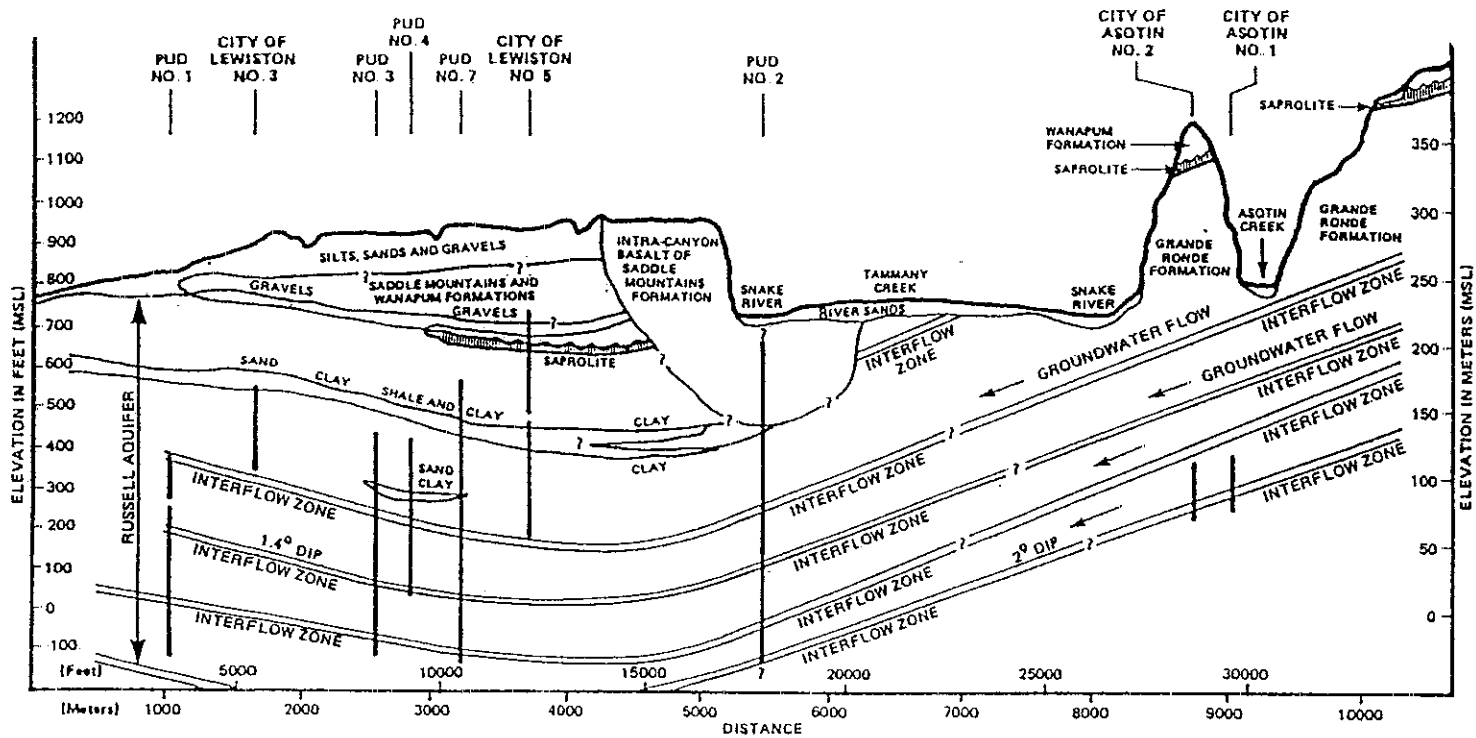


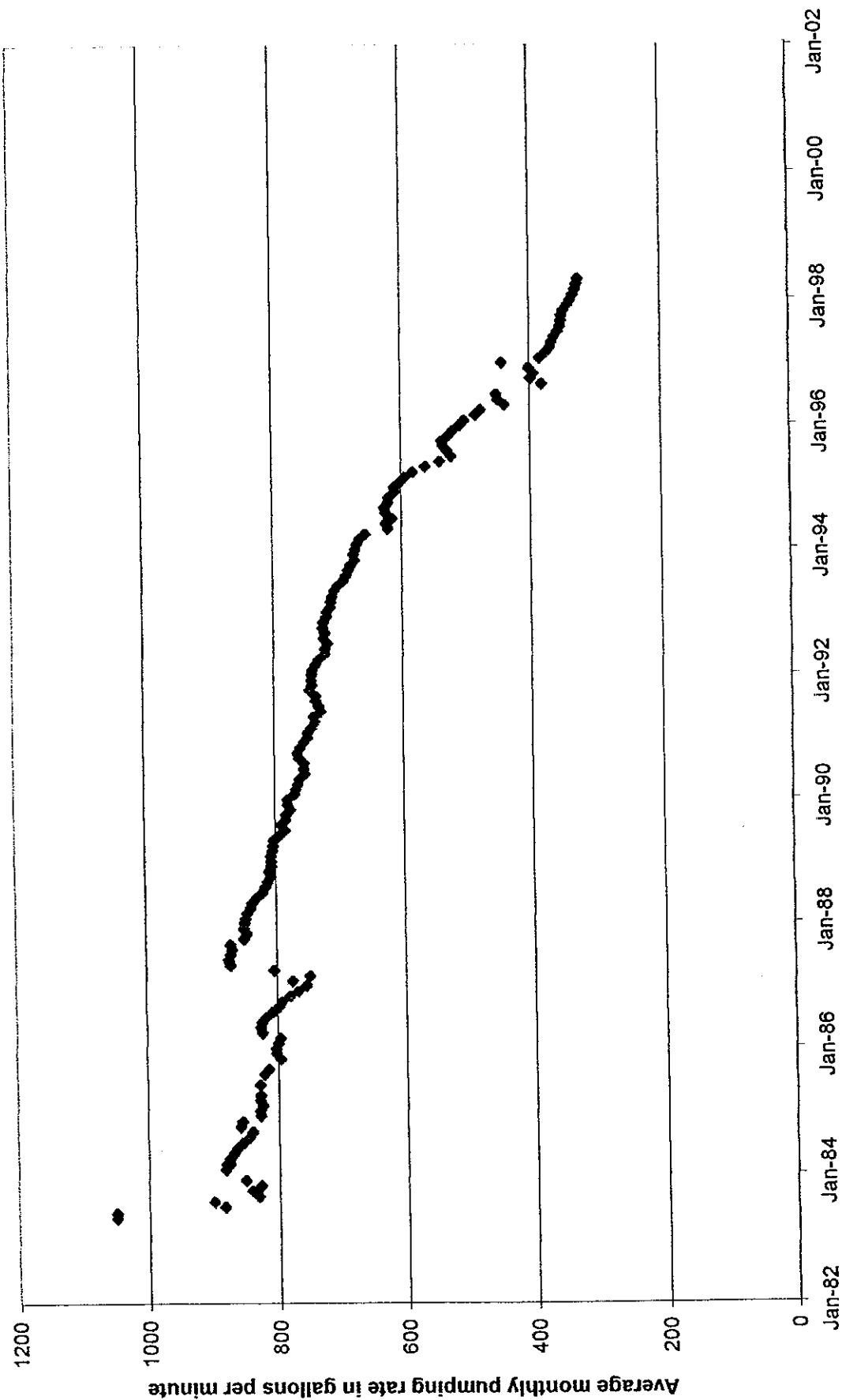
Figure 1 Location Map (from Wyatt and others, 1994)



SOURCE: Modified from Cohen and Ralston 1980

Figure 2 Diagrammatic North-South Cross Section (from Wyatt and others, 1994)

Figure 3 LOID Well #1 Pumping Rate Plot



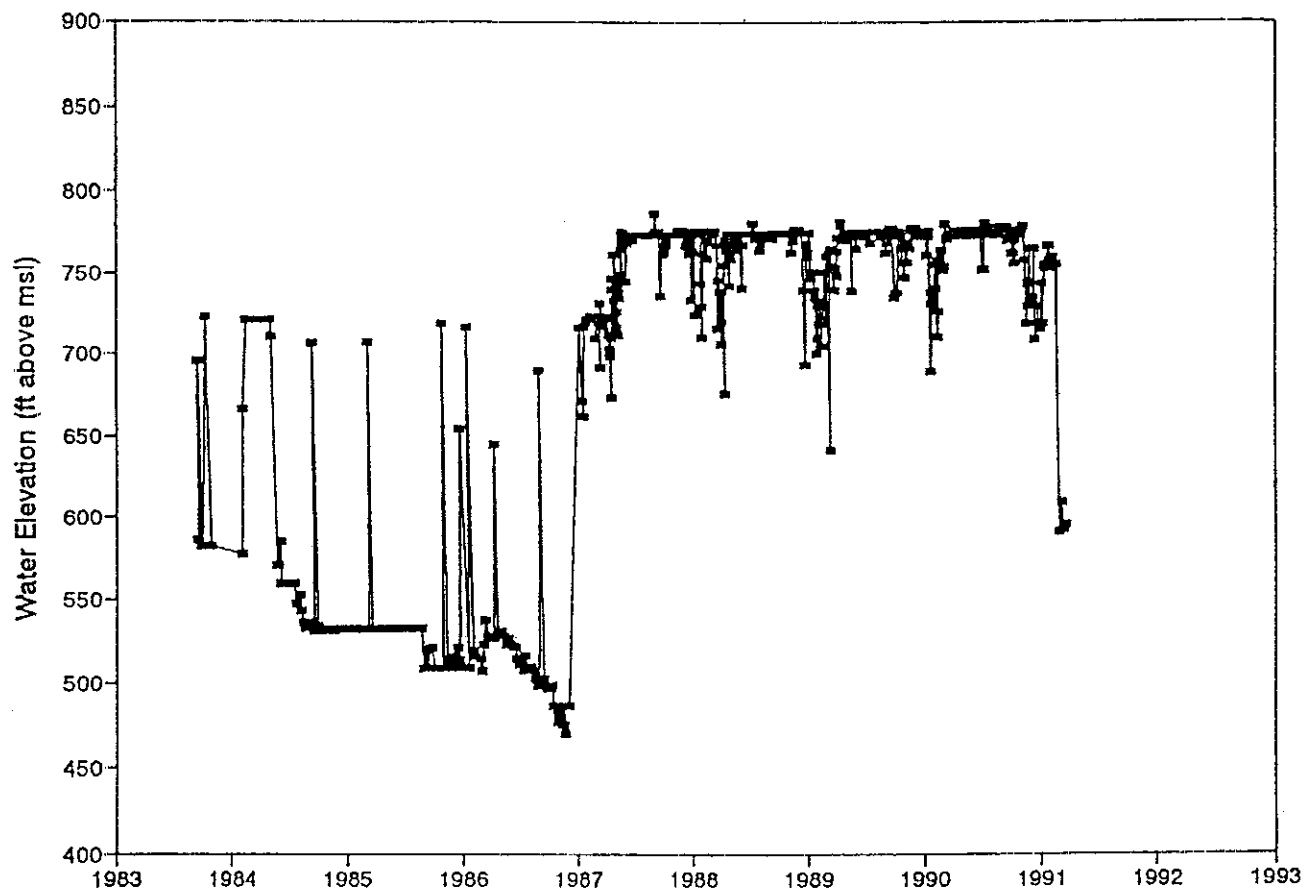
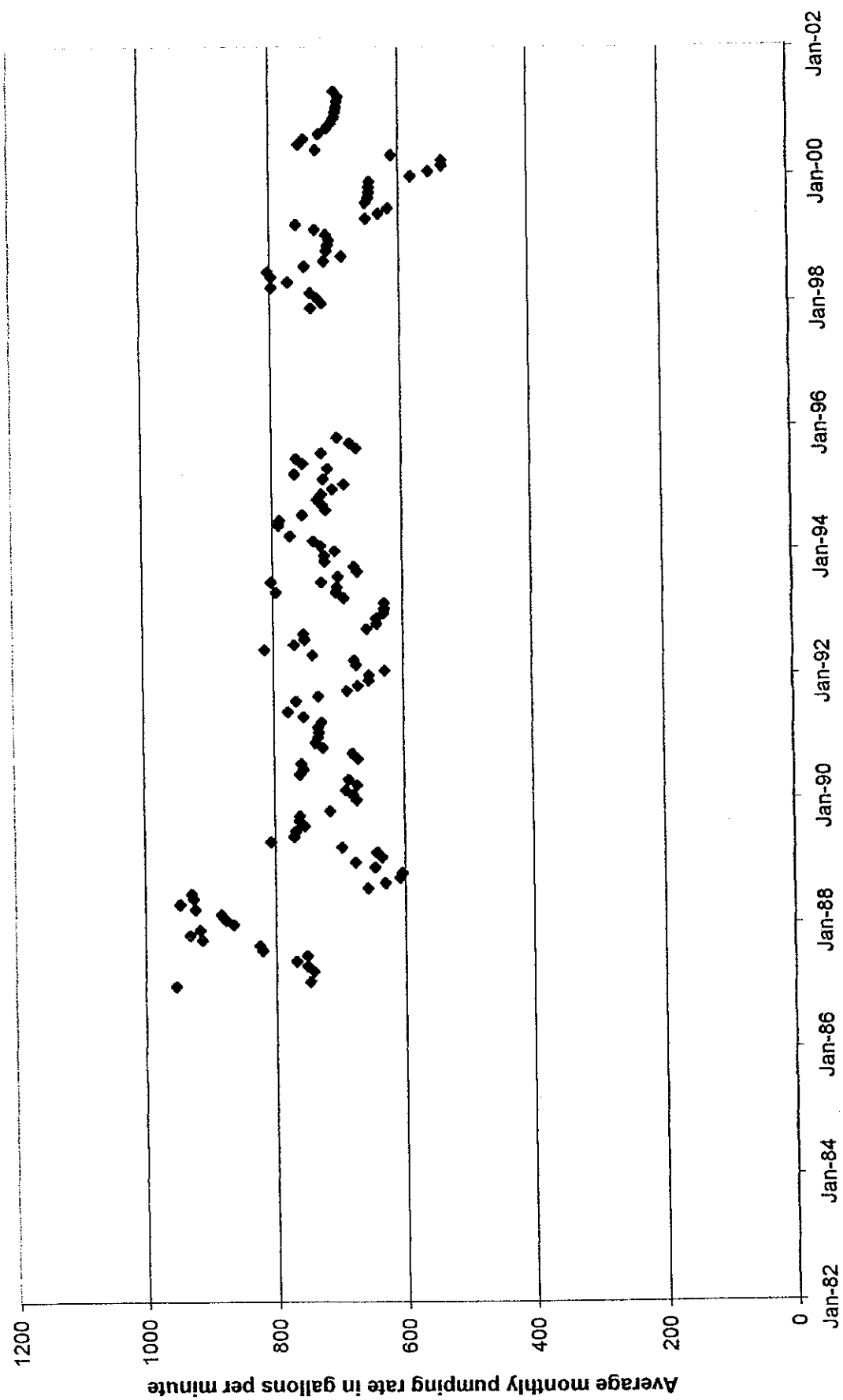


Figure 4 LOID Well #1 Water Level Plot (from Wyatt and others, 1994)

Figure 5 LOID Well #2 Pumping Rate Plot



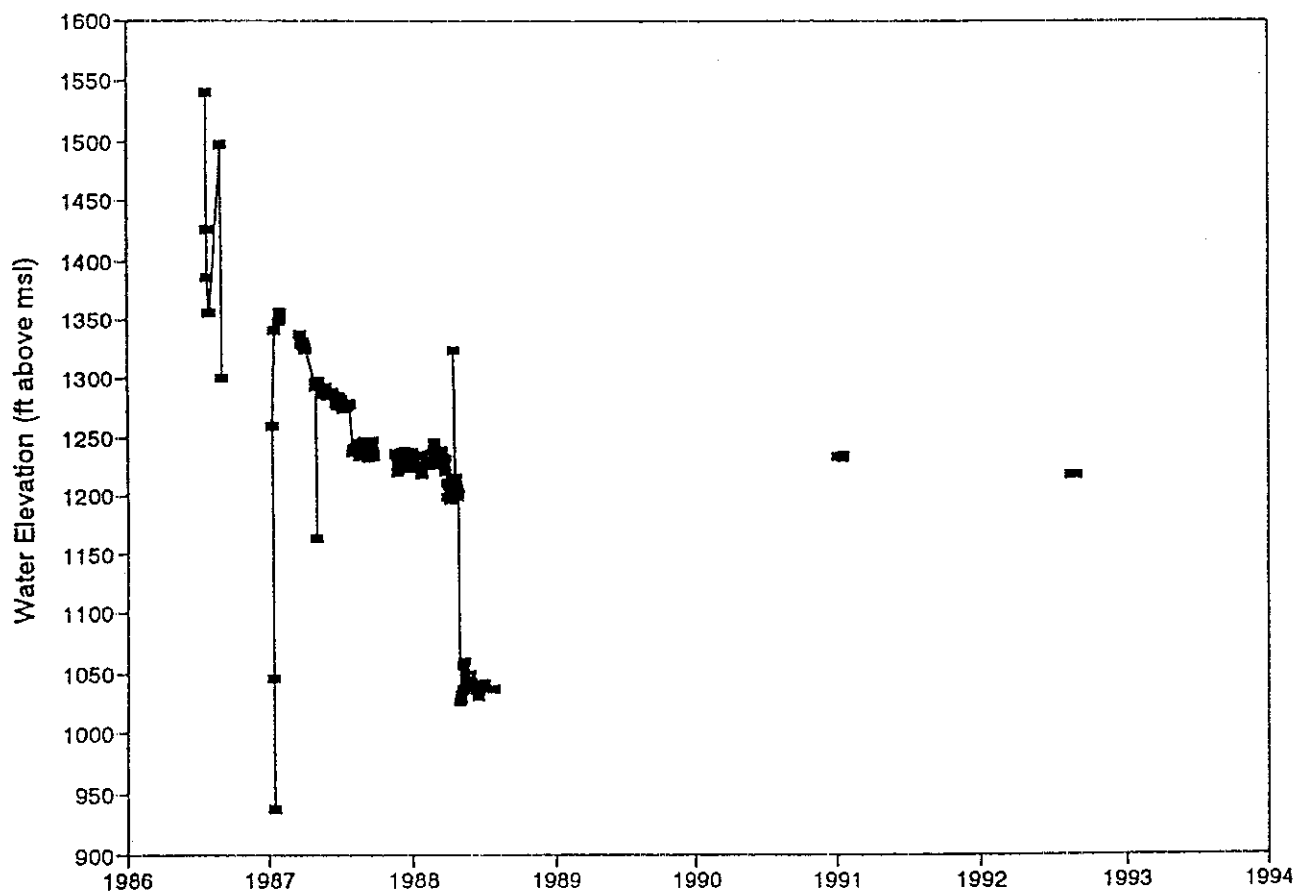


Figure 6 LOID Well #2 Water Level Plot (from Wyatt and others, 1994)

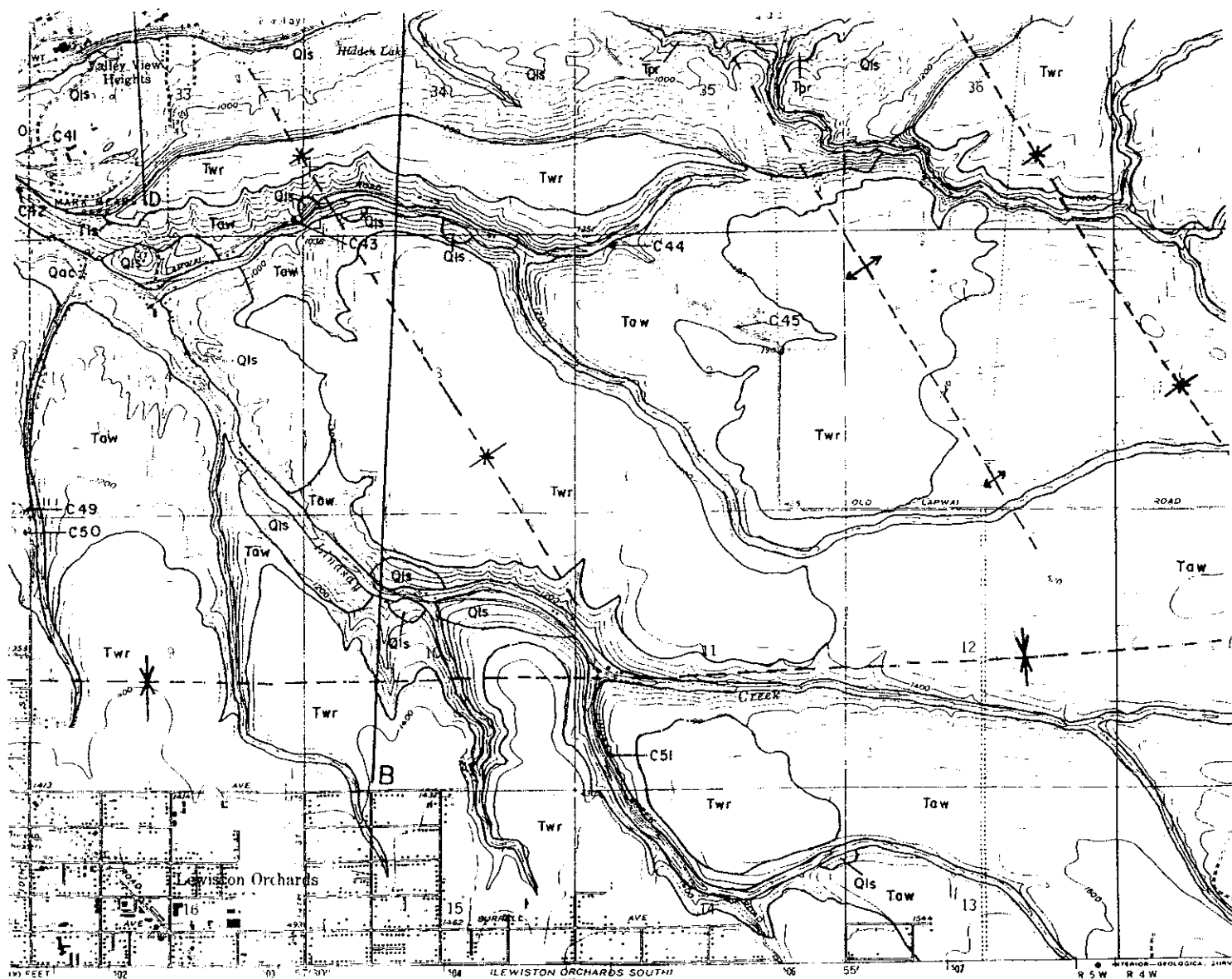


Figure 7 **Geologic Structures Map (from Garwood and Bush, 2001)**

Table 1 Water Quality Data for LOID Wells #1, #2 and #3 and Lewiston Well #6

Well Year Lab	LOID #1 1993 IDHW	LOID #1 1997 Alchem	LOID #2 1993 IDHW	LOID #3 1998 Anatek	LOID #3 1999 Anatek	Lewiston #6 1995 Anatek	Lewiston #6 1999 Alchem	Lewiston #6 2001 Alchem
Temperature Celcius	26.1		25.6					
pH	8.2		7.8	7.5			8.3	
Conductivity ug/l				640			248	
TDS ppm				390			205	
Alkalinity mg/l				75			105	
Hardness mg/l				35			56.3	
Sodium mg/l	28.1	56.3	11.1	109	98	45.2	25.4	28.9
Potassium mg/l	29.6		24.2	13.6			7.55	
Calcium mg/l	4.85		20.7	12.9			40.1	
Magnesium mg/l	1.8		6.6	0.85			3.94	
Iron mg/l	<.05		0.05	0.18			nd	
Manganese mg/l				0.003			0.01	
Chloride mg/l	21.3		1.5	145			13.7	
Sulfate mg/l	<1.0		70	42			2.83	
Bicarbonate mg/l	91.6		143					
Fluoride mg/l		1.52		0.7	1.8	0.94	4	0.63
Silica mg/l	54		51	5.2			77.9	
Barium mg/l				0.014	0.02	0.04	nd	nd
Chromium mg/l				0.005	nd	nd	nd	nd
Selenium mg/l				0.008	nd	nd	0.05	
Zinc mg/l				0.005			0.001	
Copper mg/l				0.004		0.03	nd	



STATE OF IDAHO
DEPARTMENT OF
ENVIRONMENTAL QUALITY

1118 "F" Street • Lewiston, Idaho 83501-1930 • (208) 799-4370

Dirk Kempthorne, Governor
C. Stephen Allred, Director

October 26, 2001

Mr. Ted Whiteman
LOID
1520 Powers Avenue
Lewiston, ID 83501

RE: Record #1893.01; LOID Well No. 4 Contract Documents

Dear Mr. Whiteman:

The Report, Plans and Specifications for the subject project appear to meet State of Idaho standards and are approved based on the conditions listed below.

STANDARD CONDITIONS:

1. The standard conditions on the Department of Environmental Quality (DEQ) review stamp are part of this approval. This approval will expire October 26, 2002. If construction is not completed by this expiration date, plans and related documents must be resubmitted to DEQ for review and approval before further construction may proceed.
2. This approval may be rescinded if the subject project is improperly constructed, operated, or maintained; or if it fails to function as designed.
3. Any major changes or changes which would result in violations of Idaho regulations must be reviewed by this office prior to construction.
4. Construction must be done under the supervision of an Idaho registered professional engineer. Within thirty days after construction, this engineer must provide either as-built plans to DEQ, or a letter of certification to DEQ stating that the project was installed substantially according to the approved plans.

SPECIFIC CONDITIONS

1. None

Please don't hesitate to contact me if you have questions or comments. My phone number is 208-799-4370 and e-mail address is tmoore@deq.state.id.us.

Sincerely,

A handwritten signature in black ink, appearing to read 'T. Moore', written over a horizontal line.

Thomas J. Moore, P.E.
Staff Engineer

cc: Terry Nab, Progressive Engineers, Inc.
Kerby Cole, P.E. IDEQ-LRO
Jerry Shaffer, P.E. IDEQ-LRO

**INVITATION TO BID
LEWISTON ORCHARDS IRRIGATION DISTRICT**

Sealed bids will be received by the Lewiston Orchards Irrigation District (LOID) in a sealed envelope clearly marked "WELL NO. 4 BID" until 2:00 p.m. local time on April 12, 2002 at the LOID Office located at 1520 Powers Avenue, Lewiston, Idaho 83501 for the following work:

WELL NO. 4

A single bid is requested for all work.

The project will consist of constructing one large diameter cased well approximately 2,100 deep. Well can be constructed at any time within one (1) year of bid date; however, all work must be completed within 60 calendar days after the notice to proceed has been issued. Liquidated damages shall be \$450.00/day.

Bids will be opened publicly at the LOID office, located at 1520 Powers Avenue, Lewiston, Idaho 83501 at 2:00 p.m. local time on April 12, 2002 and read aloud. Bidders and other interested parties are invited to be present at the bid opening.

Bids received after the aforementioned time will not be considered.

A valid Well Drillers License for the State of Idaho is required to bid on this work. All bids shall be submitted in accordance with the project bidding and contract requirements and shall be accompanied by a Bid Bond in the amount of not less than 10 percent of the total base bid. The Bid Bond shall be in the form of Cash, Cashier Check, Certified Check or Bid Bond executed by a qualified surety company, any of which shall be made payable to Lewiston Orchards Irrigation District.

Bid Documents can be obtained free of charge by Prime Bidders from Progressive Engineering Group, Inc., 1208 Idaho Street, Lewiston, Idaho 83501, (208) 746-5406. Bid documents are available for review at the following locations:

LOID, 1520 Powers Avenue, Lewiston, Idaho
Progressive Engineering Group, Inc., 1208 Idaho Street, Lewiston, Idaho

The LOID Board of Directors may by resolution reject any and all bids and make further calls for bids in the same manner as the original call. The District also reserves the right to waive any informalities in the bids received.

INVITATION TO BID (Cont.)

Award of contract will be made to the lowest responsive, responsible bidder.

No bidder may withdraw his bid after the hour set forth for the opening thereof, unless the award of contract is delayed more than thirty (30) days.

By Order of the board of LEWISTON ORCHARDS IRRIGATION DISTRICT, Lewiston, Idaho

By: Karyn Grimm, Secretary
Lewiston Orchards Irrigation District

Dated: March 20, 2002

Published Dates: March 20, 2002
March 27, 2002

**INVITATION TO BID
LEWISTON ORCHARDS
IRRIGATION DISTRICT**

Sealed bids will be received by the Lewiston Orchards Irrigation District (LOID) in a sealed envelope clearly marked "WELL NO. 4 BID" until 2:00 p.m. local time on April 12, 2002 at the LOID Office located at 1520 Powers Avenue, Lewiston, Idaho 83501 for the following work:

WELL NO. 4

A single bid is requested for all work.

The project will consist of constructing one large diameter cased well approximately 2,100 deep.

Well can be constructed at any time within one (1) year of bid date; however, all work must be completed within 60 calendar days after the notice to proceed has been issued. Liquidated damages shall be \$450.00/day.

Bids will be opened publicly at the LOID office, located at 1520 Powers Avenue, Lewiston, Idaho 83501 at 2:00 p.m. local time on April 12, 2002 and read aloud. Bidders and other interested parties are invited to be present at the bid opening.

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Award of contract will be made to the lowest responsive, responsible bidder.

No bidder may withdraw his bid after the hour set forth for the opening thereof, unless the award of contract is delayed more than thirty (30) days.

By Order of the board of LEWISTON ORCHARDS IRRIGATION DISTRICT, Lewiston, Idaho

By: Karyn Grimm, Secretary
Lewiston Orchards
Irrigation District

Dated: March 20, 2002

BID FORM

TO: Lewiston Orchards Irrigation District
 1520 Powers Avenue
 Lewiston, Idaho 83501

BID FROM: Geo-Tek Explorations Inc
19700 SW Teton
Tulatin OR 97062

STATE WELL DRILLERS LICENSE NO.: 610

The undersigned hereby certifies that he has personally examined the location and construction details of the work as outlined on the contract plans and specifications for the construction of Well No. 4, and has read and thoroughly understands the plans and specifications and contract governing the work embraced in this improvement, and the method by which payment will be made for said work, and hereby proposes to undertake and complete the work embraced in this improvement in accordance with said plans, specifications and contract at the following schedule of rates and prices:

BID SCHEDULE**LOID WELL NO. 4**

<u>Item No.</u>	<u>Description</u>	<u>Estimated Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Item Price</u>
1	Mobilization	-	L.S.		\$ <u>71,074.00</u>
2	24" dia. Drill Hole	160	L.F.	\$ <u>148.00</u>	\$ <u>23,680.00</u>
3	19.2" dia. Drill Hole	240	L.F.	\$ <u>150.00</u>	\$ <u>36,000.00</u>
4	17.2" dia. Drill Hole	466	L.F.	\$ <u>109.00</u>	\$ <u>50,794.00</u>
5	15.2" dia. Drill Hole	434	L.F.	\$ <u>137.00</u>	\$ <u>59,458.00</u>
6	10" or 12" dia. Drill Hole	800	L.F.	\$ <u>137.00</u>	\$ <u>109,600.00</u>
7	Furnish and Install 20" dia. Steel Casing	163	L.F.	\$ <u>56.00</u>	\$ <u>9,128.00</u>
8	Furnish and Install 20" dia. Drive & Setting Shoes	2	EA	\$ <u>300.00</u>	\$ <u>600.00</u>
9	Furnish and Install 18" dia. Steel Casing	250	L.F.	\$ <u>93.00</u>	\$ <u>23,250.00</u>

BID SCHEDULE (continued)

LOID WELL NO. 4

Item No.	Description	Estimated Quantity	Unit	Unit Price	Item Price
10	Furnish and Install 18" dia. Drive & Setting Shoes	2	EA	\$ <u>600.00</u>	\$ <u>1,200.00</u>
11	Furnish and Install 16" dia. Steel Casing	475	L.F.	\$ <u>37.00</u>	\$ <u>17,575.00</u>
12	Furnish and Install 16" dia. Drive & Setting Shoes	2	EA	\$ <u>600.00</u>	\$ <u>1,200.00</u>
13	Furnish and Install 14" dia. Steel Casing	325	L.F.	\$ <u>50.00</u>	\$ <u>16,250.00</u>
14	Furnish and Install 14" dia. Slotted Screen	120	L.F.	\$ <u>60.00</u>	\$ <u>7,200.00</u>
15	Furnish and Install 14" Drive & Setting Shoes	2	EA	\$ <u>500.00</u>	\$ <u>1,000.00</u>
16	Grouting	230	C.F.	\$ <u>33.00</u>	\$ <u>7,590.00</u>
17	Stand-by Time for Hydraulic Injection Testing and Bore Hole Geophysics	15	Hours	\$ <u>283.00</u>	\$ <u>4,245.00</u>
18	Air Lift Pumping	10	Hours	\$ <u>386.00</u>	\$ <u>3,860.00</u>
19	Sand Content Analysis	1	L.S.	\$ <u>750.00</u>	\$ <u>750.00</u>

**TOTAL BASE BID INCLUDING
ALL SALES TAX**

\$ 444,454.00

BID FORM

TO: Lewiston Orchards Irrigation District
1520 Powers Avenue
Lewiston, Idaho 83501

BID FROM: LAYNE WESTERN COMPANY
17800 E. 22nd Ave
AURORA, CO 80011

STATE WELL DRILLERS LICENSE NO.:

512

The undersigned hereby certifies that he has personally examined the location and construction details of the work as outlined on the contract plans and specifications for the construction of Well No. 4, and has read and thoroughly understands the plans and specifications and contract governing the work embraced in this improvement, and the method by which payment will be made for said work, and hereby proposes to undertake and complete the work embraced in this improvement in accordance with said plans, specifications and contract at the following schedule of rates and prices:

BID SCHEDULE

LOID WELL NO. 4

Item No.	Description	Estimated Quantity	Unit	Unit Price	Item Price
1	Mobilization	-	L.S.		\$ <u>73,000</u>
2	24" dia. Drill Hole	160	L.F.	\$ <u>316</u>	\$ <u>50,560</u>
3	19.2" dia. Drill Hole	240	L.F.	\$ <u>150</u>	\$ <u>36,000</u>
4	17.2" dia. Drill Hole	466	L.F.	\$ <u>125</u>	\$ <u>58,250</u>
5	15.2" dia. Drill Hole	434	L.F.	\$ <u>125</u>	\$ <u>54,250</u>
6	10" or 12" dia. Drill Hole	800	L.F.	\$ <u>95</u>	\$ <u>76,000</u>
7	Furnish and Install 20" dia. Steel Casing	163	L.F.	\$ <u>49</u>	\$ <u>7,987</u>
8	Furnish and Install 20" dia. Drive & Setting Shoes	2	EA	\$ <u>1200</u>	\$ <u>2400</u>
9	Furnish and Install 18" dia. Steel Casing	250	L.F.	\$ <u>37.50</u>	\$ <u>9,375</u>

BID SCHEDULE (continued)

LOID WELL NO. 4

Item No.	Description	Estimated Quantity	Unit	Unit Price	Item Price
10	Furnish and Install 18" dia. Drive & Setting Shoes	2	EA	\$ <u>1,100</u>	\$ <u>2,200</u>
11	Furnish and Install 16" dia. Steel Casing	475	L.F.	\$ <u>34.20</u>	\$ <u>16,245</u>
12	Furnish and Install 16" dia. Drive & Setting Shoes	2	EA	\$ <u>800</u>	\$ <u>1,600</u>
13	Furnish and Install 14" dia. Steel Casing	325	L.F.	\$ <u>29</u>	\$ <u>9,425</u>
14	Furnish and Install 14" dia. Slotted Screen	120	L.F.	\$ <u>49</u>	\$ <u>5,880</u>
15	Furnish and Install 14" Drive & Setting Shoes	2	EA	\$ <u>800</u>	\$ <u>1,600</u>
16	Grouting	230	C.F.	\$ <u>129</u>	\$ <u>29,670</u>
17	Stand-by Time for Hydraulic Injection Testing and Bore Hole Geophysics	15	Hours	\$ <u>450</u>	\$ <u>6,750</u>
18	Air Lift Pumping	10	Hours	\$ <u>540</u>	\$ <u>5,400</u>
19	Sand Content Analysis	1	L.S.	\$ <u>300</u>	\$ <u>300</u>

**TOTAL BASE BID INCLUDING
ALL SALES TAX**

\$ 446,892

CONTRACT

THIS AGREEMENT, made this the 11th day of September, 2002 by and between the Lewiston Orchards Irrigation District, hereinafter called "Owner" and Geo-Tech Exploration, Inc., doing business as a corporation located in the City of Tualatin and State of Oregon hereinafter called "Contractor".

WITNESSETH: That for and in consideration of the payments and agreements hereinafter mentioned, to be made and performed by the Owner, the Contractor hereby agrees with the Owner to commence and complete the construction of Well No. 4, hereinafter called the "project", for the sum of four hundred forty four thousand, four hundred fifty four U.S. Dollars (\$444,454.00) and all extra work in connection therewith, under the terms as stated in the General and Special Conditions of the contract; and at his (its or their) own proper cost and expense to furnish all the materials, supplies, machinery, equipment, tools, superintendence, labor, insurance, and other accessories and services necessary to complete the said project in accordance with the conditions and prices stated in the Proposal, the General Conditions, Supplemental General Conditions, and Special Conditions of the contract, the plans, which include all maps, plats, blueprints, and other drawings and printed or written explanatory matter thereof, the specifications and contract documents therefore as prepared by Progressive Engineering Group, Inc., herein entitled the Engineer, all of which are made a part hereof and collectively evidence and constitute the contract.

The Contractor hereby agrees to commence work under this contract on or before a date to be specified in written "Notice to Proceed" of the Owner and to fully complete the project within 60 consecutive calendar days thereafter. The Contractor further agrees to pay, as liquidated damages, the sum of \$ 450.00 for each consecutive calendar day thereafter as hereinafter provided in Section 12 of the General Conditions.

The Owner agrees to pay the Contractor in current funds for the performance of the contract, subject to additions and deductions, as provided in the General Conditions of the contract, and to make payments on account thereof as provided in Section 14, "Payment to Contractor." of the General Conditions.

CONTRACT (Cont.)

IN WITNESS WHEREOF, the parties to these presents have executed this contract in six (6) counterparts, each of which shall be deemed an original, in the year and day first mentioned above.

Lewiston Orchards Irrigation District
(Owner)
BY: Eugene B. [Signature]
TITLE: Financial Officer

Geo-Tech Explorations, Inc.
(Contractor)
BY: Ben Klotzmann
TITLE: GENERAL MANAGER

NOTICE TO PROCEED

TO: Geo-Tech Explorations, Inc.

Date: September 13, 2002

19700 S.W. Teton Ave.

Project: L.O.I.D. Well No. 4

Tualatin, Oregon 97062

You are hereby notified to commence WORK in accordance with the Agreement dated September 11th, 2002, on or before September 16th, 2002 and you are to complete the work within 60 consecutive calendar days thereafter. The date of completion of all work is, therefore, November 15th, 2002.

OWNER: Lewiston Orchards Irrigation District

By: Ken M. Casey

Title: Manager

ACCEPTANCE OF NOTICE

Receipt of the above NOTICE TO PROCEED is hereby acknowledged on September 13th, 2002.

Contractor: Geo-Tech Explorations, Inc.

By: Ar Rotary Manager

Title: Ar Rotary Manager



State of Idaho

DEPARTMENT OF WATER RESOURCES

NORTHERN REGION, Suite No. 210 • 1910 Northwest Blvd. • Coeur d'Alene, Idaho 83814-2615

(208) 769-1450

Fax (208) 769-1454

DIRK KEMPTHORNE
GOVERNOR

KARL J. DREHER
DIRECTOR

August 27, 2002

Lewiston Orchards Irrigation
District
1520 Powers Avenue
Lewiston, ID 83501

Re: Well ID Tag No. D22736

Gentlemen:

The State of Idaho has started a Well Identification Program to protect Idaho's ground water. This Program will help protect your well, your health, and your property values. Building a record of good well and water quality protection is money in the bank.

Your well has been assigned a well identification number. It is imprinted on the stainless steel tag that Geo Tech Exploration, the drilling firm you have selected, will be attaching to the wellhead at the time of completion. The well drilling firm is also responsible for having the Well Tag and a copy of the Application in the possession of the driller during all phases of well construction. This tag has been forwarded to Terry Nab, of the Progressive Engineering Group. **You, however, are responsible to see that the driller has the tag and permit in his possession before construction begins** so that the tag is attached to the wellhead at the time of completion. This unique well number should remain affixed to your well forever and should be written on all information about your well and referenced in all inquires about your well.

Your well identification number will assist you in tracking water quality and water quantity changes in your well. It also establishes a link between well construction and public health records. In addition to using your well identification number, we recommend the following protection practices for your well to preserve the quality of your drinking water:

DO:

Test your well for bacteria annually and for nitrates every three years (especially if you have an infant under the age of six months.) Be sure to write your well identification number on each lab slip.

Keep your well tightly capped with a sanitary seal to keep surface contaminants and small animals or insects out. Maintain screening on any vents or openings on top of you well casing.

Keep the area around your well clean.

Newiston Orchards Irrigation District
Page 2

August 27, 2002

DON'T:

Remove the well identification tag.

Store hazardous materials such as paint, oil, gasoline, anti-freeze, garden chemical, rat poison, and trash near your well or in your well house.

Let farm animals pasture around your well, particularly if the well is in a low spot where water can collect.

If you have any questions about testing your well, please contact your local Health Department. If you have questions about the Well Identification Program call Tom King or Carolyn Monitz at the Department of Water Resources, Northern Region at (208) 769-1450. We all have a stake in clean ground water. With your help, we can protect our ground water for your use and for future generations.

Sincerely,

Carolyn Monitz, Records Clerk

Tom King, Sr. Water Resource Agent

encl.

Cc: Geo Tech Exploration

Terry W. Nab, Progressive Engineering Group, Inc. ✓

Printed 08/27/2002
Drilling Permit No. 784458
Well Tag No. D0022736
Well ID # 355519
Water Right No. 85-15356
Receipt # N014703
Approved Date 08/27/2002

**STATE OF IDAHO
DEPARTMENT OF WATER RESOURCES
DRILLING PERMIT**

Relationship: Owner/Operator
Name: LEWISTON ORCHARDS IRRIGATION DISTRICT
Address: 1520 POWERS AVE
LEWISTON ID 83501

Phone: (208)746-8235

Proposed Well Location: Township 35N, Range 05W, Section 22, NW, NE, NW
COUNTY NEZ PERCE

Street Address of Well Site: 1520 POWERS AVENUE
LEWISTON ID

Proposed Use of Well: Municipal

Well Construction Information:

- A. New Well
- B. Proposed Surface Diameter: 18 Inches. Proposed Depth 2100 Feet.
- C. Anticipated Bottom Hole Temperature: 85F and less

Construction Start Date: Aug 27 2002

Anticipated Well Drilling Company: GEO-TECH EXPLORATION INC (No. 610)

Applicant's Signature: _____ Date _____

Title: _____

Well ID # 355519

Well Tag No. D0022736

ACTION OF THE DEPARTMENT OF WATER RESOURCES

This permit is Approved on Tuesday, August 27, 2002.

1. This drilling permit is valid for two (2) months from the approval date for the start of construction and is valid for one (1) year from the approval date for completion of the well unless an extension has been granted.
2. This permit does not constitute an approval of the District Health Department or the Idaho Department of Health and Welfare which may be required prior to construction of this well. The local Health Department should be contacted for septic tank/drainfield locations. Domestic wells must not be drilled closer than 100 ft. from any drainfield and 50 ft. from any septic tank. Public Water Supply wells must not be drilled closer than 100 ft. from any drainfield or septic tank.
3. The well shall be constructed by a driller currently licensed in the state of Idaho who must maintain a copy of the drilling permit at the drilling site.
4. Approval of this drilling permit does not authorize trespass on the land of another party.
5. This permit does not constitute other local, county, state or federal approvals which may be required for construction of a well.
6. This drilling permit does not represent a right to divert and use the water of the State of Idaho.
7. If a bottom hole temperature of 85 Degrees F (29.44 oC) or greater is encountered, well construction shall cease and the well driller and the well owner shall contact the Department immediately.
8. Idaho Code, S 55-2201 - 55-2210 requires the applicant and/or his contractors to contact "Digline" (DigLine is a one-call center for utility notification) not less than 2 working days prior to the start of any excavation for this project. The "Dig Line " Number for your area is &DIG-LINE-NUMBER
9. Please be advised that this drilling permit should be considered and treated as a preliminary permit. If you are in disagreement with this preliminary permit you have fourteen (14) days of the service date of this permit to petition the Department for reconsideration pursuant to Section 67-5243, Idaho Code.
10. The well tag for the drilling permit/start card shall be securely and permanently attached to the well casing through welding or by the use of four closed end domed stainless steel pop rivets. The tag attachment will be done at the time of completion of the well, and prior to removing the drill rig from the drill site.



Signature of Authorized Dept. Representative

REGIONAL MANAGER

Title



State of Idaho

DEPARTMENT OF WATER RESOURCES

1301 North Orchard Street, Boise, ID 83706 - P.O. Box 83720, Boise, ID 83720-0098

Phone: (208) 327-7900 Fax: (208) 327-7866 Web Site: www.idwr.state.id.us

DIRK KEMPTHORNE
Governor

KARL J. DREHER
Director

July 26, 2002

LEWISTON ORCHARDS IRRIGATION DISTRICT
1520 POWERS AVE
LEWISTON ID 83501

RE: Permit No. 85-15356

Permit Approval Notice

Dear Permit Holder:

The Department of Water Resources has issued the enclosed permit authorizing you to establish a new water right. Please be sure to thoroughly review the conditions of approval and remarks listed on your permit.

The permit is a PRELIMINARY ORDER issued by the Department pursuant to Section 67-5243, Idaho Code. It can and will become a final order without further action by the Department unless a party petitions for reconsideration or files an exception and/or brief within fourteen (14) days of the service date as described in the enclosed information sheet.

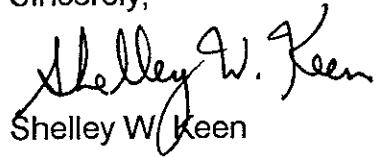
Enclosed is a form entitled 'Instructions for Proof of Beneficial Use.' Please read the instructions carefully since you must take further action to develop this permit into a licensed water right. Also enclosed is a form entitled 'Proof of Beneficial Use.' If your project is already completed, you should complete and submit this form immediately.

The right to drill a well is not a part of this permit to appropriate water. Beginning in July of 1987, a statute was enacted which requires a drilling permit for new well construction and deepening of existing wells. If the well(s) proposed for use under this water right permit were drilled or deepened after July 1, 1987, a separate drilling permit must be obtained from this Department. Please contact the Ground Water Protection Section located here at this office or our regional office nearest you.

Also, please note that water right owners are required to report any change of water right ownership and/or mailing address to the Department within 120 days of the change. Failure to report these changes could result in a \$100 late filing fee. Contact any office of the Department or visit the Department's homepage on the Internet to obtain the proper forms and instructions.

If you have any questions, please contact me at 208-327-7946.

Sincerely,

A handwritten signature in black ink that reads "Shelley W. Keen". The signature is fluid and cursive, with the first name being the most prominent.

Shelley W. Keen

Water Rights Supervisor

SWK:klt

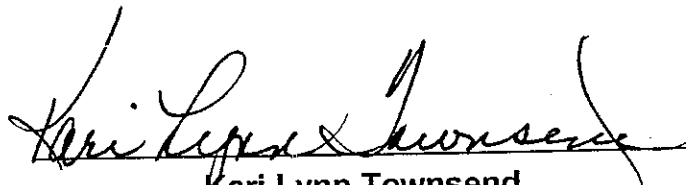
Enclosure(s)

CERTIFICATE OF SERVICE

I hereby certify that on July 26, 2002 I mailed a true and correct copy, postage prepaid, of the foregoing PRELIMINARY ORDER(Approved Permit) to the person(s) listed below:

RE: WATER RIGHT NO. 85-15356

LEWISTON ORCHARDS IRRIGATION DISTRICT
1520 POWERS AVE
LEWISTON ID 83501



Kari Lynn Townsend
Secretary

State of Idaho
Department of Water Resources
Permit to Appropriate Water

NO. 85-15356

Priority: 04/03/2002

Maximum Diversion Rate: 3.34 CFS

This is to certify, that LEWISTON ORCHARDS IRRIGATION DISTRICT
1520 POWERS AVE
LEWISTON ID 83501

has applied for a permit to appropriate water from:

Source: GROUND WATER

and a permit is APPROVED for development of water as follows:

<u>BENEFICIAL USE</u>	<u>PERIOD OF USE</u>	<u>RATE OF DIVERSION</u>
MUNICIPAL	01/01 to 12/31	3.34 CFS

LOCATION OF POINT(S) OF DIVERSION:

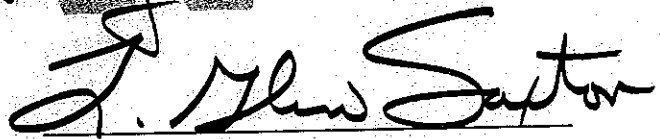
GROUND WATER NE $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 22, Twp 35N, Rge 05W, B.M. NEZ PERCE County

PLACE OF USE: Place of use is within the boundary of Lewiston Orchards Irrigation District

CONDITIONS OF APPROVAL

1. Proof of application of water to beneficial use shall be submitted on or before August 1, 2003.
2. Subject to all prior water rights.
3. Right holder shall comply with the drilling permit requirements of Section 42-235, Idaho Code.
4. After specific notification by the Department, the right holder shall install a suitable measuring device or shall enter into an agreement with the Department to determine the amount of water diverted from power records and shall annually report the information to the Department.
5. Point of diversion is also known as Well No. 4.

This permit is issued pursuant to the provisions of Section 42-204, Idaho Code. Witness the signature of the Director, affixed at Boise, this 25 day of July, 2002


for KARL J DREHER, Director

Progressive Engineering Group, Inc. 1208 Idaho Street Lewiston, Idaho 83501		PERIODIC ESTIMATE FOR PARTIAL PAYMENT NO. 2 (Final)		PROJECT NO. 1743 Page 1 of 2 Pages						
NAME AND LOCATION OF PROJECT: Well No. 4 Lewiston Orchards Irrigation District		NAME AND ADDRESS OF CONTRACTOR: Geo-Tech Explorations, Inc. 19700 SW Teton Tualatin, OR. 97062		NAME AND ADDRESS OF OWNER: Lewiston Orchards Irrigation District 1520 Powers Avenue Lewiston, ID. 83501						
DATE OF COMPLETION: Original: November 15, 2002 Revised: December 15, 2002		AMOUNT OF CONTRACT: Original: \$ 444,454.00 Revised: \$ 433,381.00		DATES OF ESTIMATE: From: October 12, 2002 To: December 06, 2002						
1. COST OF WORK COMPLETED TO DATE										
Item No.	Description of Item	CONTRACT ITEMS		WORK THIS PERIOD		TOTAL WORK TO DATE				
		Quantity	Cost / Unit	Total Amount	Quantity	Amount	Quantity	Amount		
1	Mobilization	1	L.S.	71,074.00	0.375	L.S.	26,629.00	1.0	L.S.	71,074.00
2	24" dia. Drill Hole	160	L.F.	148.00						0.00
3	19.2" dia. Drill Hole	240	L.F.	150.00						61,350.00
4	17.2" dia. Drill Hole	466	L.F.	109.00						0.00
5	15.2" dia. Drill Hole	434	L.F.	137.00						0.00
6	10" or 12" dia. Drill Hole	800	L.F.	137.00						0.00
7	Furnish & Install 20" dia Steel Casing	163	L.F.	56.00						48,909.00
8	Furn & Install 20" dia Drive & Set Shoes	2	EA	300.00						600.00
9	Furnish & Install 18" dia Steel Casing	250	L.F.	93.00						0.00
10	Furn & Install 18" dia Drive & Set Shoes	2	EA	600.00						1,200.00
11	Furnish & Install 16" dia. Steel Casing	475	L.F.	37.00						0.00
12	Furn & Install 16" dia Drive & Set Shoes	2	EA	600.00						1,200.00
13	Furnish & Install 14" dia Steel Casing	325	L.F.	50.00						0.00
14	Furnish & Install 14" dia Slotted Screen	120	L.F.	60.00						0.00
15	Furn & Install 14" dia Drive & Set Shoes	2	EA	500.00						0.00
16	Grouting	230	C.F.	33.00						13,365.00
17	Shndby Time: Hyd Inj Tst/Bore Hle Geoph	15	HR	283.00						0.00
18	Air Lift Pumping	10	HR	386.00						772.00
19	Sand Content Analysis	1	L.S.	750.00						0.00
JOB TOTAL:							101,360.00			224,062.00

2. SCHEDULE OF CONTRACT CHANGE ORDERS			ADDITIONS TO CONTRACT PRICE AS SHOWN ON CHANGE ORDERS	DEDUCTIONS FROM CONTRACT PRICE AS SHOWN ON CHANGE ORDERS
CONTRACT CHANGE ORDER		DESCRIPTION		
NO.	DATE			
1	10/16/02	Misc. Revisions for completed well (less 18" stl. Casing from 447' to 715') to 715' depth.	\$ 77,795.00	
2	11/20/02	Misc. Revisions for completed well from 715' to 1625'.	131,524.00	
3	11/20/02	Revisions to adjust contract costs to match actual work completed		220,392.00
CHANGE ORDER TOTALS:			\$ 209,319.00	\$ 220,392.00

3. ANALYSIS OF ADJUSTED CONTRACT AMOUNT TO DATE:

(a) Original contract amount	\$ 444,454.00
(b) Plus: additions scheduled above	\$ 209,319.00
(c) Less: deductions scheduled above	\$ (220,392.00)
(d) Adjusted contract amount to date	\$ 433,381.00

4. ANALYSIS OF WORK PERFORMED:

(a) Cost of contract work performed to date, <u>100%</u> completed	\$ 224,062.00
(b) Extra work performed to date	\$ 209,319.00
(c) Total cost of work performed to date	\$ 433,381.00
(d) Less: amount retained in accordance with the contract	\$ -
(e) Net amount earned on contract and extra work to date	\$ 433,381.00
(f) Less: amount of previous payments	\$ 190,472.15
(g) BALANCE DUE THIS PAYMENT	\$ 242,908.85

5. CERTIFICATION OF CONTRACTOR

According to the best of my knowledge and belief, I certify that all items and amounts shown on the face of this Periodic Estimate for Partial Payment are correct; that all work has been performed in full accordance with the requirements of the referenced

Geo-Teel Explorations
(Contractor)

BY: [Signature]

Dec 5th, 20 02

TITLE: Air Rotary Manager

6. ENGINEER'S APPROVAL OF PERIODIC ESTIMATE

I have reviewed the above Periodic Estimate and to the best of my knowledge and belief it is a true and correct statement of work performed by the contractor, that all work and/or material included in this Periodic Estimate has been performed in accordance

Signed by: [Signature] Date: 12-05-02

7. OWNER'S APPROVAL

Signed by: [Signature] Date: 12/5/02

Progressive Engineering Group, Inc. 1208 Idaho Street Lewiston, Idaho 83501		PERIODIC ESTIMATE FOR PARTIAL PAYMENT NO. <u>1</u>		PROJECT NO. <u>1743</u> Page <u>1</u> of <u>2</u> Pages				
NAME AND LOCATION OF PROJECT: Well No. 4 Lewiston Orchards Irrigation District		NAME AND ADDRESS OF CONTRACTOR: Geo-Tech Explorations, Inc. 19700 SW Teton Tualatin, OR. 97062		NAME AND ADDRESS OF OWNER: Lewiston Orchards Irrigation District 1520 Powers Avenue Lewiston, ID. 83501				
DATE OF COMPLETION: Original: <u>November 15, 2002</u> Revised: _____		AMOUNT OF CONTRACT: Original: \$ <u>444,454.00</u> Revised: \$ <u>522,249.00</u>		DATES OF ESTIMATE: From: <u>September 16, 2002</u> To: <u>October 11, 2002</u>				
1. COST OF WORK COMPLETED TO DATE								
Item No.		Description of Item	CONTRACT ITEMS		WORK THIS PERIOD		TOTAL WORK TO DATE	
			Quantity	Cost / Unit	Total Amount	Quantity	Amount	Quantity
1		Mobilization	1	L.S.	71,074.00	0.625	L.S.	44,445.00
2		24" dia. Drill Hole	160	L.F.	148.00			0.00
3		19.2" dia. Drill Hole	240	L.F.	150.00	258	L.F.	38,700.00
4		17.2" dia. Drill Hole	466	L.F.	109.00			0.00
5		15.2" dia. Drill Hole	434	L.F.	137.00			0.00
6		10" or 12" dia. Drill Hole	800	L.F.	137.00			0.00
7		Furnish & Install 20" dia Steel Casing	163	L.F.	56.00	457	L.F.	25,592.00
8		Furn & Install 20" dia Drive & Set Shoes	2	EA	300.00	2	EA	600.00
9		Furnish & Install 18" dia Steel Casing	250	L.F.	93.00			0.00
10		Furn & Install 18" dia Drive & Set Shoes	2	EA	600.00			0.00
11		Furnish & Install 16" dia. Steel Casing	475	L.F.	37.00			0.00
12		Furn & Install 16" dia Drive & Set Shoes	2	EA	600.00			0.00
13		Furnish & Install 14" dia Steel Casing	325	L.F.	50.00			0.00
14		Furnish & Install 14" dia Slotted Screen	120	L.F.	60.00			0.00
15		Furn & Install 14" dia Drive & Set Shoes	2	EA	500.00			0.00
16		Grouting	230	C.F.	33.00	405	C.F.	13,365.00
17		Stndby Time: Hyd Inj Tst/Bore Hle Geoph	15	HR	283.00			0.00
18		Air Lift Pumping	10	HR	386.00			0.00
19		Sand Content Analysis	1	L.S.	750.00			0.00
JOB TOTAL:					444,454.00	122,702.00		122,702.00

2 SCHEDULE OF CONTRACT CHANGE ORDERS			ADDITIONS TO CONTRACT PRICE AS SHOWN ON CHANGE ORDERS	DEDUCTIONS FROM CONTRACT PRICE AS SHOWN ON CHANGE ORDERS
CONTRACT CHANGE ORDER		DESCRIPTION		
NO.	DATE			
1	10/16/02	Misc Revisions for completed well (less 18" stl. Casing from 447' to 715') to 715' depth.	\$ 77,795.00	
CHANGE ORDER TOTALS:			\$ 77,795.00	\$ -

3 ANALYSIS OF ADJUSTED CONTRACT AMOUNT TO DATE:

(a) Original contract amount	\$ 444,454.00
(b) Plus: additions scheduled above	\$ 77,795.00
(c) Less: deductions scheduled above	\$ -
(d) Adjusted contract amount to date	\$ 522,249.00

4 ANALYSIS OF WORK PERFORMED:

(a) Cost of contract work performed to date, <u>28%</u> completed	\$ 122,702.00
(b) Extra work performed to date	\$ 77,795.00
(c) Total cost of work performed to date	\$ 200,497.00
(d) Less: amount retained in accordance with the contract <u>5%</u>	\$ 10,024.85
(e) Net amount earned on contract and extra work to date	\$ 190,472.15
(f) Less: amount of previous payments	\$ -
(g) BALANCE DUE THIS PAYMENT	\$ 190,472.15

5 CERTIFICATION OF CONTRACTOR

According to the best of my knowledge and belief, I certify that all items and amounts shown on the face of this Periodic Estimate for Partial Payment are correct; that all work has been performed in full accordance with the requirements of the referenced

Gco-Tec Explorations
(Contractor)

BY: [Signature]

11-1, 20 02

TITLE: Asst. Rotary Manager

6 ENGINEER'S APPROVAL OF PERIODIC ESTIMATE

I have reviewed the above Periodic Estimate and to the best of my knowledge and belief it is a true and correct statement of work performed by the contractor; that all work and/or material included in this Periodic Estimate has been performed in accordance

Signed by: [Signature]

Date: Nov. 05, 2002

7. OWNER'S APPROVAL

Signed by: [Signature]

Date: 11/5/02

CONTRACT CHANGE ORDER

PROJECT LOID Well No. 4

CHANGE ORDER NO. 3 (Final) DATE December 05, 2002

OWNER Lewiston Orchards Irrigation District

ENGINEER Progressive Engineering Group, Inc.

CONTRACTOR Geo-Tech Explorations, Inc.

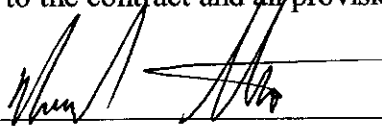
The following changes are hereby made to the Contract Documents:

ITEM NO.	COMPLETE DESCRIPTION OF CHANGES	DECREASE CONTRACT	INCREASE CONTRACT
2	Delete 160 L.F. of 24" dia. drill hole @ \$148.00/L.F., a reduction of \$23,680.00	\$23,680.00	
3	Add 169 L.F. of 19.2" dia. drill hole @ \$150.00/L.F., an increase of \$25,350.00		\$25,350.00
4	Delete 466 L.F. of 17.2" dia. drill hole @ \$109.00/L.F., a reduction of \$50,794.00	\$50,794.00	
5	Delete 434 L.F. of 15.2" dia. drill hole @ \$137.00/L.F., a reduction of \$59,458.00	\$59,458.00	
6	Delete 443 L.F. of 10" or 12" dia. drill hole @ \$137.00/L.F., a reduction of \$60,691.00	\$60,691.00	
7	Add 294 L.F. of 20" dia. steel casing @ \$56.00/L.F., an increase of \$16,464.00		\$16,464.00
9	Delete 250 L.F. of 18" dia. steel casing @ \$93.00/L.F., a reduction of \$23,250.00	\$23,250.00	
11	Delete 475 L.F. of 16" dia. steel casing @ \$37.00/L.F., a reduction of \$17,575.00	\$17,575.00	
13	Delete 325 L.F. of 14" dia. steel casing @ \$50.00/L.F., a reduction of \$16,250.00	\$16,250.00	
14	Delete 120 L.F. of 14" dia. slotted screen @ \$60.00/L.F., a reduction of \$7,200.00	\$7,200.00	
15	Delete (2) 14" dia. drive and set shoes @ \$500.00 ea., a reduction of \$1,000.00	\$1,000.00	
16	Add 175 C.F. of grout @ \$33.00/C.F., an increase of \$5,775.00		\$5,775.00
17	Delete 15 hr. of standby time for hyd. inj. testing @ \$283.00/hr., a reduction of \$4,245.00	\$4,245.00	

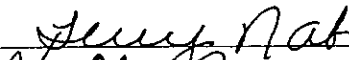
18	Delete 8 hr. of air lift pumping @ \$386.00/hr., a reduction of \$3,088.00	\$3,088.00	
19	Delete sand content analysis, a reduction of \$750.00	\$750.00	
	TOTAL DECREASE TOTAL INCREASE	<u>\$267,981.00</u>	<u>\$47,589.00</u>
	NET DECREASE TO CONTRACT	<u>\$220,392.00</u>	

The sum of \$220,392.00 is hereby deducted from the total contract price, and the total adjusted contract price to date thereby is \$433,381.00.

The time provided for completion in the contract is increased by 30 calendar days. This document shall become an amendment to the contract and all provisions of the contract will apply hereto.

Accepted by Contractor 

Date 12-05-02

Recommended by Engineer 

Date 12-05-02

Approved by Owner 

Date 12/5/02

CONTRACT CHANGE ORDER

PROJECT LOID Well No. 4

CHANGE ORDER NO. 2 DATE December 05, 2002

OWNER Lewiston Orchards Irrigation District

ENGINEER Progressive Engineering Group, Inc.

CONTRACTOR Geo-Tech Explorations, Inc.

The following changes are hereby made to the Contract Documents:

ITEM NO.	COMPLETE DESCRIPTION OF CHANGES	DECREASE CONTRACT	INCREASE CONTRACT
1	Grouting and redrilling from 640' to 700' to seal off unexpected water bearing zone		\$13,588.00
2	Grouting to seal off bottom of 18" casing @ 866'		\$2,412.00
3	Add 402 L.F. of 17.2" hole @ \$155.00/L.F.		\$62,310.00
4	Add 420 L.F. of 18" dia. steel casing @ \$47.00/L.F.		\$19,740.00
5	Add 300 L.F. of 16" dia. steel casing @ \$58.00/L.F.		\$17,400.00
6	Add 120 L.F. of 16" dia. welded wire screen @ \$105.00/L.F.		\$12,600.00
7	Add 9 hr. of drill rig time to remove rock from well @ 1460' level @ \$386.00/hr.		\$3,474.00
	NET INCREASE TO CONTRACT		\$131,524.00

The sum of \$131,524.00 is hereby added to the total contract price, and the total adjusted contract price to date thereby is \$653,773.00.

The time provided for completion in the contract is unchanged. This document shall become an amendment to the contract and all provisions of the contract will apply hereto.

Accepted by Contractor [Signature]

Date 12-05-02

Recommended by Engineer [Signature]

Date 12-05-02

Approved by Owner [Signature]

Date 12/5/02

CONTRACT CHANGE ORDER

PROJECT LOID Well No. 4

CHANGE ORDER NO. 1 DATE October 16, 2002

OWNER Lewiston Orchards Irrigation District

ENGINEER Progressive Engineering Group, Inc.

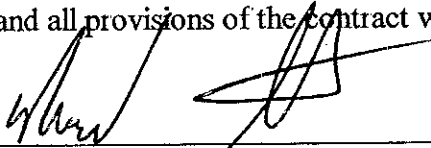
CONTRACTOR Geo-Tech Explorations, Inc.

The following changes are hereby made to the Contract Documents:

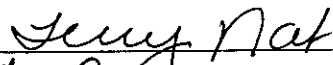
ITEM NO.	COMPLETE DESCRIPTION OF CHANGES	DECREASE CONTRACT	INCREASE CONTRACT
1	Add 270 L.F. of 24" Nominal Open Hole @ \$160.00/L.F.		\$43,200.00
2	Add 187 L.F. of 20" Dual Rotary Hole @ \$185.00/L.F.		\$34,595.00
	TOTAL INCREASE		\$77,795.00
	NET INCREASE TO CONTRACT		\$77,795.00

The sum of \$77,795.00 is hereby deducted from the total contract price, and the total adjusted contract price to date thereby is \$522,249.00.

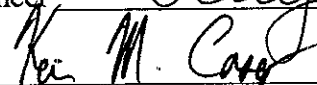
The time provided for completion in the contract is unchanged. This document shall become an amendment to the contract and all provisions of the contract will apply hereto.

Accepted by Contractor 

Date 11-1-02

Recommended by Engineer 

Date 11-05-02

Approved by Owner 

Date 11/5/02



Geotech Explorations Inc
19700 SW Teton
Tualatin, OR 97062
Ph: (503) 692-6400, Fax: (503) 692-4759

Well Name:	Lewiston Orchards Irrigation District Well No. 4
Well Tag No.	D0022736
Drilling Permit #	784458
Well ID #	355519
Water Right No.	85-15356

Bore Dia.	From	To	LITHOLOGIC LOG	Water	
				Yes	No
24"	0	2	Fill Rock		x
"	2	3	Top Soil		x
"	3	18	Silty Clay, Brown, some gravels		x
"	18	60	Basalt weathered fractured		x
"	60	76	Clay brown sticky		x
"	92	260	Basalt fractured medium		x
"	260	265	Basalt fractured lenses of shale black coal like		x
20"	265	283	Basalt fractured lenses of shale black coal like		x
"	283	310	Basalt fractured with gray claystone		x
"	310	320	Basalt medium		x
"	320	371	Claystone soft green some tan		x
"	371	396	Basalt cuttings rounded gray with clay foam color brown to green		x
"	396	423	Med soft cuttings same as above foam color brown		x
"	423	456	Extremely soft holding back on bit cuttings same as above foam color brownish		x
"			gray. Large chunks of gray claystone on bit when removed. Caving problems		x
"			from 230' to 456'		x
"	456	465	Basalt vesicular black		x
"	465	487	Basalt gray to black medium		x
"	487	492	Basalt vesicular black		x
"	492	640	Basalt fractured black		x
"	640	680	Claystone brown		x
"	680	701	Basalt broken weathered		x
"	701	735	Basalt fractured black		x
"	735	759	Basalt gray hard		x
"	759	767	Basalt vesicular black		x
"	767	837	Basalt fractured black		x
"	837	866	Basalt fractured black some red		x
18"	866	952	Basalt black		x
"	952	963	Basalt black with brown claystone		x
"	963	988	Basalt black fractured		x
"	988	1028	Basalt black	x	
"	1028	1049	Basalt black with brown scoria		x
"	1049	1060	Basalt black		x
"	1060	1110	Basalt black with brown		x
"	1110	1168	Basalt black	x	
"	1168	1182	Basalt black with brown scoria		x
"	1182	1208	Basalt black		x
"	1208	1229	Basalt black with gray	x	
"	1229	1246	Basalt black with brown scoria		x
"	1246	1252	Basalt black		x
"	1252	1264	Scoria black		x
"	1264	1266	Basalt black with gray		x
12"	1266	1390	Basalt black with gray	x	
"	1390	1415	Scoria brown		x
10"	1417	1577	Basalt black	x	
"	1577	1601	Basalt black with brown		x
"	1601	1625	Basalt black		x

Production zone screen and blank as built for LOID well # 4

