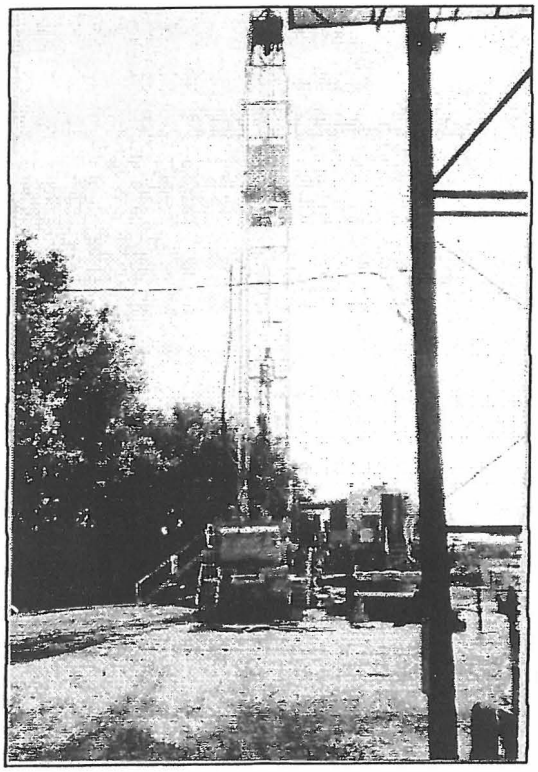
RESULTS OF DRILLING AND TESTING

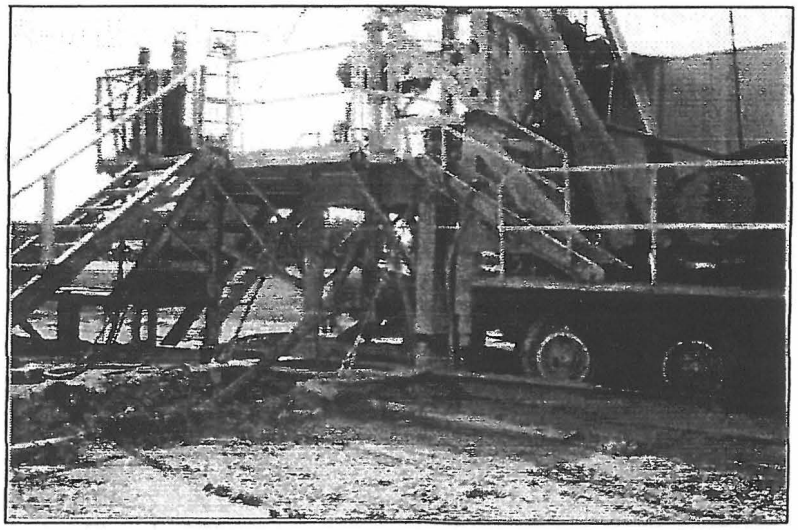
Sky Lake Water Treatment Plant

Production Well No. 3



Prepared for:

Orlando Utilities Commission and Post Buckley Schuh and Jernigan, Inc.



Prepared by:

Barnes, Ferland and Associates, Inc.

RESULTS OF DRILLING AND TESTING

Orlando Utilities Commission
Sky Lake Water Plant Production Well No. 3

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2.0 WELL CONSTRUCTION SUMMARY

Construction and testing of Well No. 3 occurred between March 25, 2002 through August 20, 2002 (148 days), which is relatively quick for a well of this size and depth. Figure 3 shows the new well site location. The well was drilled using conventional mud-rotary within the unconsolidated sand, shell and clay materials and with reverse-air rotary within the consolidated limestone and dolomite of the Floridan aquifer system. No difficulties were experienced while drilling through the formations.

The construction details of Well No. 3 are shown in Figure 4. The well was constructed with four telescoped steel casings 42/36/30/24 inch diameter to depths of 56/100/220/1000 feet below land surface, respectively. The top of the 24-inch casing was cut off at 190 feet depth to allow a greater casing diameter where the pump is installed. Approximately 187 cubic yards of cement were used to construct and seal these well casings. The Contractor conducted a plumbness test within the 24-inch middle well casing to a depth of 190 feet. Results of the test were observed to be within the specified requirements.

Once the inner casing was installed to 1,000 feet, the borehole was drilled to a depth of 1,400 feet. Based on reverse-air discharge measurements, it was felt that the well had a relatively low yield and it was decided to deepen the borehole hole to a depth of 1,450 feet. A higher capacity was observed and the open borehole was completed at this depth of 1,450 feet. Much of the flow into this well comes from a cavity between 1,429-1,432 feet, which is confirmed by caliper, video and pumping flow logs, and discussed later. The South Florida Water Management District Well Construction Permit and the Drilling Contractor's Well Completion Report are included in Appendix 1. Submittals for well construction materials are contained in Appendix 2.

Sampling and testing were performed during well construction to determine casing setting depths and formation rock/flow properties. Formation cuttings were collected every ten foot interval and the lithologic log is provided in Appendix 3. Geophysical logs were performed within the pilot hole to 1,000 feet and then within the completed well to 1,450 feet. These logs are contained in

Appendix 4 and discussed in Section 3. A TV video log was performed in the completed well to confirm proper well construction.

Once Well No. 3 was constructed, a test pump was installed to develop the well, perform a variable rate pumping test and to collect water samples for analysis. The well was developed by pumping and surging for about 16 hours. At the end of well development, the groundwater appeared visibly clear and no sediment was observed in the samples. Turbidity was less than 1 NTU. Variable rate test data are included in Appendix 5 and discussed in Section 4. After the variable rate test, water samples were collected for Florida Drinking Water Parameters (Ch. 62-550 F.A.C.) required by the Florida Department of Environmental Protection for new wells. Water quality results are provided in Appendix 6 and discussed in Section 5.

The Contractor's total cost for constructing Well No. 3 was $326,778.50, as detailed in Table 1. This does not include outfitting the well with the permanent pumping equipment.

3.0 BOREHOLE GEOPHYSICAL LOGGING

Borehole geophysical logs measure various well and aquifer properties by wire-line traverses of a borehole using multiple probes. Appendix 5 contains copies of all geophysical logs that were obtained for this project. Two suites of borehole geophysical logs were obtained for Well No. 3. The first suite, consisting of a caliper log, was performed on July 1, 2002 when the pilot hole was drilled to a total depth of 1,000 feet. The purpose of this log was to determine the 24-inch diameter casing setting depth and to develop a grouting plan for the casing. The second suite of geophysical logs was obtained on August 16, 2002 when the completed well was cased to 1,000 feet and finished to a total depth of 1,450 feet. The second suite consists of caliper, gamma ray, multipoint electric, and static and pumped fluid flow, fluid resistivity and temperature. The purpose of the second suite was to confirm that the well was properly constructed and to determine aquifer properties. Interpretive summaries of logging results are provided below.

3.1. Sky Lake Well Field Hydrogeologic Units

Interpretation of hydrogeologic units at OUC Sky Lake Well No. 3 is based on the two suites of logs, formation cuttings and TV video logs to a depth of about 1,450 feet. Based on this information, the approximate depths of the hydrogeologic units at the Sky Lake WTP site are summarized as follows:

- Surficial aquifer system – 5 to 50 feet;
- Intermediate confining unit – 50 to 170 feet;
- Upper Floridan aquifer – 170 to 460 feet;
- Middle semi-confining unit – 460 to 1,110 feet;
- Upper zone of the Lower Floridan aquifer – 1,110 to about 1,450 feet;

The hydrogeologic units penetrated are further described as follows. The surficial aquifer, composed primarily of sandy material, occurs from the water table to depths of about 50 feet, where clayey materials begin to predominate. The proportion of clay increases downward and the intermediate confining unit occurs from about 50 feet to base of the Hawthorn Formation at about 170 feet. The gamma-ray logs obtained within the well casing define these two upper most hydrogeologic units.

Caliper and lithologic logs were most useful in defining the underlying hydrogeologic units within the Floridan aquifer. The Upper Floridan aquifer occurs from depths of about 170 to 460 feet. Relatively soft limestone, with few fractures and solution cavities, occurs from bottom of casing (220 feet) to about 335 feet. From 335 feet to about 390 feet depth, more fractures and cavities are noted. From 390 feet to base of the Upper Floridan aquifer at about 460 feet, the rock appears more dolomitic and there are numerous fracture and solution zones. All of the Upper Floridan aquifer in this area is commonly assigned to the Avon Park formation, but the 200-335 feet interval in this borehole may be composed of the Ocala Limestone.

The contact between the base of the Upper Floridan aquifer and the top of the middle semiconfining unit is picked at about 460 feet depth where the lithology changes from a brownish dolomitic limestone containing some fracture and solution zones to a lighter colored limestone or dolomite, which is more massive (homogeneous and unfractured). This

semiconfining unit continues to depth of about 1,110 feet and, though generally less permeable than the overlying and underlying aquifers, contains some zones of fractures and cavities that probably could be developed as moderately productive aquifers. The thicker massive zones, which occur in the intervals between 635-690 feet, 770-850 feet, 870-950 feet, and 1,020-1,110 feet appear to be the most confining parts of this hydrogeologic unit, and should function to maintain hydraulic isolation between the Upper and Lower Floridan aquifers in this area. The top of the Lower Floridan aquifer is at about 1,110 feet, with occurrence of more prominent solution features in dolomitic limestones, which continue to bottom of hole at 1,450 feet.

3.2 Distribution of Formation Yield

Fluid flow, temperature and resistivity logs, along with the caliper logs, were used to determine the distribution of yield zones in the Floridan aquifer and their relative yields. These interpretations are discussed below for each suite of logs obtained at Well No. 3.

Visual reference to the flowmeter and caliper logs indicates that significant increments of flow entered the borehole at depths of about 1,165, 1,245, 1,320, 1,395, 1,420 and 1,430 feet, when Well No. 3 was pumped at approximately 4,000 gpm on August 18, 2002. This simple visual comparison is usually a quite reliable indicator of depths at which major increments of flow enter the borehole.

Borehole fluid resistivity and temperature logs can also give useful indications of depths at which significant increments of flow enter a borehole, if the entering fluid has different resistivity-temperature characteristics. The fluid resistivity and temperature logs obtained under pumping conditions for Well No. 3 indicate that fluids with different resistivity-temperature characteristics entered the borehole at depths of about 1,220, 1,370, 1,420 and 1,430 feet.

The flowmeter analysis log for Well No. 3 was obtained by use of computer software, which produces a continuing vertical record of approximate fluid flow volumes by computation based on comparing cross-sectional flow areas to relative fluid velocities throughout the borehole. Flowmeter analysis logs generally result in a reliable representation of approximate flow distribution for a borehole similar to that of Well No. 3, which does not have any thick zones of

widely varying diameter. The general percentage distribution of yield at various depths is summarized as:

- Virtually 100 percent of the total flow is present in the borehole above about 1,040 feet depth;
- About 80-85 percent of total flow is present in the borehole above about 1,250 feet depth;
- Approximately 40-45 percent of total flow is present in the borehole above about 1,390 feet depth, and;
- Approximately 25-30 percent of total flow is present in the borehole above about 1,435 feet depth.

4.0 VARIABLE RATE TEST RESULTS

A variable rate test was conducted for Well No. 3 to determine the specific capacity and drawdown information for final pump size and setting selection. A flow meter was used to measure the discharge rates. Water levels were measured within the well using data logger and transducer equipment and backed up with an electronic water level sounder/tape. Appendix 5 contains measurement of water levels data made during testing. Results of variable rate analyses are summarized as follows:

Specific capacity, or the quotient of pumping rate and drawdown for a well, is an empirical determination, which is necessary for proper pump selection and setting. The basic purpose of variable rate (also called step-drawdown) well and aquifer tests is to determine the drawdown at various pumping rates in order to establish a range of specific capacities and the optimal pumping rate for the production well. On August 21, 2002, drawdown measurements were made while Well No. 3 was pumped about 4 hours with the pump set at a depth of 125 feet. Results were:

Pumping Rate (gpm)	Pumping Level (feet bmp)	Static Level (feet bmp)	Drawdown (feet)	Specific Capacity (gpm/ft)
1,967	55.80	51.01	4.79	410
3,117	60.07	51.01	9.06	344
4,200	64.98	51.01	13.97	300
5,250	69.79	51.01	18.78	280

This test consisted of four one-hour pumping steps at rates of about 1,967, 3,117, 4,200 and 5,250 gpm. Specific capacity values computed from the test data are shown above, which indicates that they ranged from 410 gpm/ft at the lowest pumping rate (1,967 gpm) to 280 gpm/ft at the highest pumping rate (5,250 gpm).

5.0 GROUNDWATER QUALITY

Lower Floridan aquifer groundwater samples were collected during reverse air drilling and field-tested for selected parameters (Appendix 7). The following range of concentrations resulted at the end of the variable rate test: pH range 7.7-7.92; conductivity range 285-299 uS/cm and chloride range 11.0-11.6 mg/l.

Additional water samples were collected and tested by OUC at the end of the variable rate test for Florida Drinking Water Parameter (Appendix 6). Laboratory results for samples collected from Well No. 3 appear to meet all Florida Department of Environmental Protection (FDEP) requirements (Chapter 62-550 F.A.C). Fresh groundwater with relatively low concentrations of total dissolved solids (180 mg/l), chloride (9.66 mg/l) and sulfate (10.9 mg/l) were reported for completed wells. Concentrations of hydrogen sulfide are elevated (3.7 mg/l), which is typical of the Lower Floridan aquifer in the Orlando area.

6.0 SUMMARY AND CONCLUSIONS

1) One high capacity production well (Well No. 3) was constructed into the lower Floridan aquifer at the OUC Sky Lake WTP. Diversified Drilling Corporation, from Orlando, constructed this well during the period March 25 2002 to August 20, 2002. The well was constructed with four telescoped steel casings 42/36/30/24 inch diameter to depths of about 56/100/220/1,000 feet, respectively. The open borehole interval was drilled to 1,450 feet.. The well appears to be constructed in accordance with the design specifications based on field observations, TV video logs, geophysical logs and results of plumbness tests.

2) The Contractor's total cost for constructing and testing Well No. 3 was $326,778.50. This does not include outfitting the well with the permanent pumping equipment.

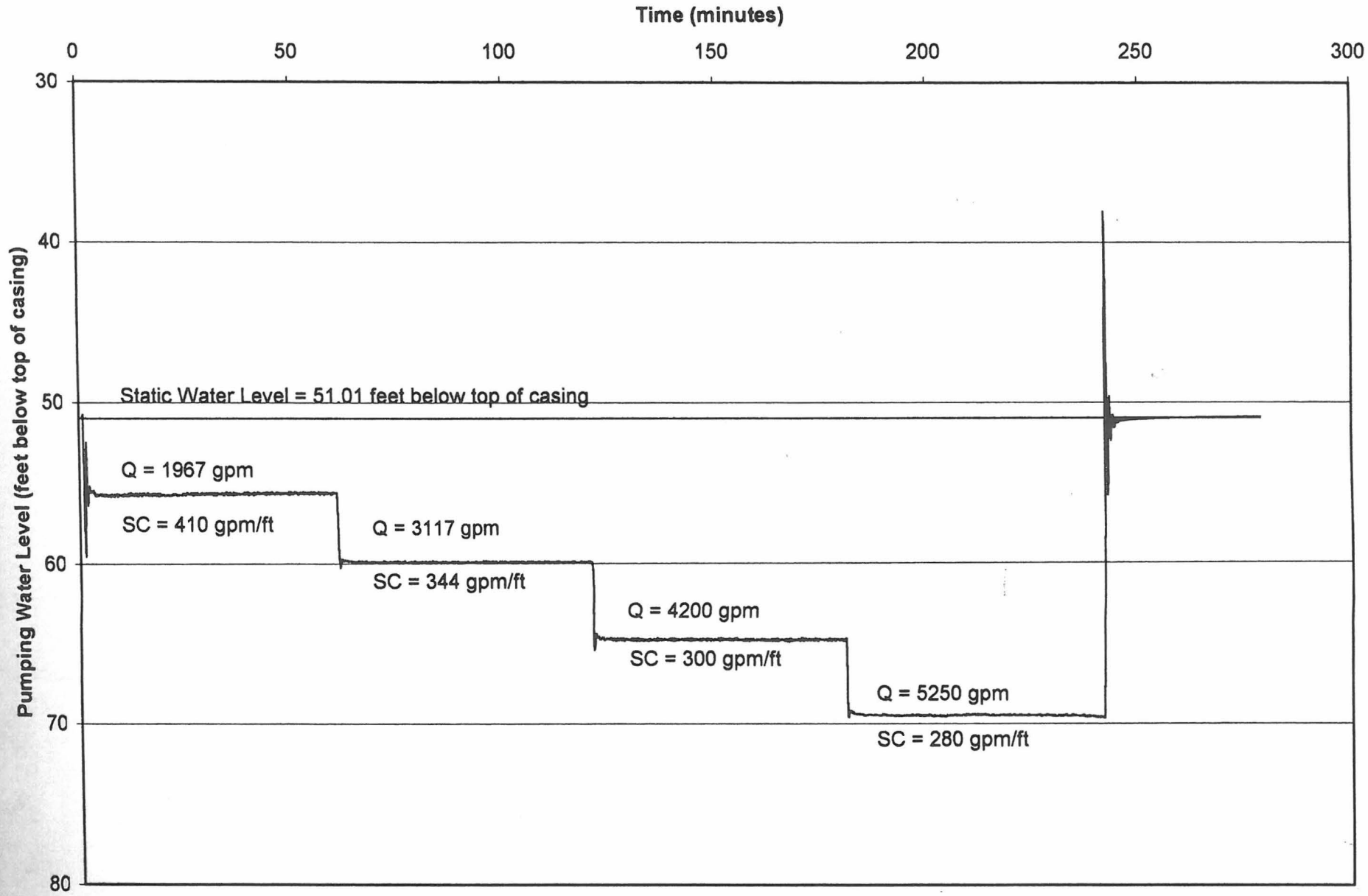
3) Based on the lithology and the geophysical logs, the hydrogeologic units and depths at the Sky Lake WTP are summarized as follows: surficial aquifer system (to 50 feet); intermediate confining unit (50 to 170 feet); Upper Floridan aquifer (170 to 460 feet); middle semi-confining unit (460 to 1,110 feet); upper zone of the Lower Floridan aquifer (1,110 to about 1450 feet).

4) A variable rate pumping test was conducted for completed Well No. 3 (open interval 1,000-1,450 feet). The specific capacity was found to be 410 gpm/ft at a pumping rate of 1,967 gpm and decreases to 280 gpm/ft at a pumping rate of 5,250 gpm.

5) The geophysical logs performed on completed of Well No. 3 show that the major cavities occur at depths of 1,165, 1,245, 1,320, 1,395, 1,420 and 1,430.

6) Groundwater quality Well 3 appears to meet OUC's treatment goals and compliance with FDEP's regulations. Fresh groundwater with relatively low concentrations of total dissolved solids (180 mg/L), chlorides (9.66 mg/L) and sulfates (10.9 mg/L) were reported. However, hydrogen sulfide (3.7 mg/L) concentrations are relatively high.

FIGURE 5 - OUC SKYLAKE WTP Well No. 3
Step Drawdown Test Results (8/15/02)



LITHOLOGIC DESCRIPTION
OUC SKYLAKE WELL NO. 3

Depth (Ft)	Description
0 – 10	Sand, fine grained, dark brown, angular and minor organic matter.
10 – 20	Sand, fine grained, brown, angular and minor organic matter.
20 – 30	Sand, as above.
30 – 40	Sand, as above, but with some clay.
40 – 50	Clay, greenish gray, overall plasticity high.
50 – 60	Clay, as above.
60 – 70	Clay, as above, traces shell.
70 – 80	Clay, as above, some shell.
80 – 90	Clay and shell as above.
90 – 100	Clay and shell as above.
100 – 110	Clay, greenish gray, overall plasticity high, trace shell.
110 – 120	Clay and Shell as above.
120 – 130	Clay and Shell as above.
130 – 140	Clay and Shell as above.
140 – 150	Clay and Shell as above.
150 – 160	Clay and Shell as above.
160 – 170	Clay, Shell and trace white Limestone. (Hit cap rock at 168')
170 – 180	Limestones, light brown, fine grained, traces Shell. (Lost circulation)
180 – 190	No Sample but drilling hard.
190 – 200	No Sample but drilling hard.
200 – 210	No Sample but drilling hard.
210 – 220	No Sample but drilling hard
220 – 230	No Sample but drilling hard and soft.

LITHOLOGIC DESCRIPTION
OUC SKYLAKE WELL NO. 3

(Continued)

Depth (Ft)	Description
230 – 240	Limestone, tan, fine grained, soft. (Circulation return at 228')
240 – 250	Limestone, as above.
250 – 260	Limestone, tan and white, fine grained, soft.
260 – 270	Limestone, creamy, fine grained, soft.
270 – 280	Limestone, as above.
280 – 290	Limestone, as above.
290 – 300	Limestone, tan, fine grained, soft.
300 – 310	Limestone, as above.
310 – 320	Limestone, as above.
320 – 330	Limestone, as above.
330 – 340	Limestone, as above.
340 – 350	Limestone, as above.
350 – 360	Limestone, as above, some fossils.
360 – 370	Limestone, as above.
370 – 380	Limestone, as above.
380 – 390	Limestone, as above, trace Clay.
390 – 400	Limestone, creamy and dark brown, fine grained.
400 – 410	Limestone, as above, trace Clay
410 – 420	Limestone and Clay, as above.
420 – 430	Limestone, creamy, dark brown, fine grained, vugs.
430 – 440	Limestone, as above.
440 – 450	Limestone, as above, some Dolomite.
450 – 460	Limestone and Dolomite, as above.

LITHOLOGIC DESCRIPTION
OUC SKYLAKE WELL NO. 3

(Continued)

Depth (Ft)	Description
460 – 470	Dolomite, light brown, vugs, trace limestone creamy.
470 – 480	Dolomite, dark brown, vugs, trace Chert.
480 – 490	Dolomite, as above.
490 – 500	Limestone, brown, fine grained.
500 – 510	Limestone, tan fine grained.
510 – 520	Limestone, as above.
520 – 530	Limestone, tan, and light gray, fine grained.
530 – 540	Limestone, tan, fine grained.
540 – 550	Limestone, as above.
550 – 560	Limestone, as above.
560 – 570	Limestone, as above.
570 – 580	Limestone, as above.
580 – 590	Limestone, as above.
590 – 600	Limestone, as above.
600 – 610	Limestone, as above.
610 – 620	Limestone, as above.
620 – 630	Limestone, as above.
630 – 640	Limestone, as above.
640 - 650	Limestone, as above.
650 - 660	Limestone as above.
660 - 670	Limestone, as above.
670 - 680	Limestone, as above.
680 - 690	Limestone, as above.
690 - 700	Limestone, as above.

LITHOLOGIC DESCRIPTION
OUC SKYLAKE WELL NO. 3

(Continued)

Depth (Ft)	Description
700 - 710	Limestone, as above.
710 - 720	Limestone, as above.
720 - 730	Limestone, as above.
730 - 740	Limestone, as above.
740 - 750	Limestone, as above.
750 - 760	Limestone, as above.
760 - 770	Limestone, as above.
770 - 780	Limestone, as above.
780 - 790	Limestone, as above.
790 - 800	Limestone, as above.
800 - 810	Limestone, as above.
810 - 820	Limestone, as above.
820 - 830	Limestone, tan, fine grained, some Dolomite
830 - 840	Limestone, tan, fine grained.
840 - 850	Limestone, as above.
850 - 860	Limestone, as above.
860 - 870	Limestone, as above.
870 - 880	Limestone, as above.
880 - 890	Limestone, as above.
890 - 900	Limestone, as above.
900 - 910	Limestone, as above.
910 - 920	Limestone, as above.
920 - 930	Limestone, as above.

LITHOLOGIC DESCRIPTION
OUC SKYLAKE WELL NO. 3

(Continued)

Depth (Ft)	Description
930 – 940	Limestone, as above.
940 – 950	Limestone, as above.
950 – 960	Limestone, as above.
960 – 970	Limestone, as above.
970 – 980	Limestone, as above.
980 – 990	Limestone, as above.
990 – 1000	Limestone, as above.
1000 – 1010	Limestone, as above.
1010 – 1020	Limestone, as above.
1020 – 1030	Limestone, as above.
1030 – 1040	Limestone, as above.
1040 – 1050	Limestone, as above.
1050 – 1060	Limestone, as above.
1060 – 1070	Limestone, as above.
1070 – 1080	Limestone, creamy, fine grained.
1080 – 1090	Limestone, as above, some limestone, tan, fine grained.
1090 – 1100	Limestone, creamy, fine grained.
1100 – 1110	Limestone, tan, fine grained and Dolomite, dark brown, micritic.
1110 - 1120	Dolomite, dark brown, micritic, hard.
1120 - 1130	Dolomite, as above.
1130 - 1140	Dolomite, as above.
1140 - 1150	Dolomite, as above.
1150 - 1160	Dolomite, as above.
1160 - 1170	Dolomite, as above.

LITHOLOGIC DESCRIPTION
OUC SKYLAKE WELL NO. 3

(Continued)

Depth (Ft)	Description
1170 – 1180	Dolomite, gray, micritic.
1180 – 1190	Dolomite, gray and dark brown, micritic.
1190 – 1200	Dolomite, dark brown, micritic.
1200 – 1210	Dolomite, as above.
1210 – 1220	Dolomite, as above.
1220 – 1230	Dolomite, as above.
1230 – 1240	Dolomite, as above.
1240 – 1250	Dolomite, as above.
1250 – 1260	Dolomite, as above, some Chert.
1260 – 1270	Dolomite, as above, no Chert.
1270 – 1280	Dolomite, as above.
1280 – 1290	Dolomite, as above.
1290 – 1300	Dolomite, as above.
1300 – 1310	Dolomite, as above.
1310 – 1320	Dolomite, as above, some Chert.
1320 – 1330	Dolomite, as above, no Chert, little Calcium Carbonate.
1330 – 1340	Dolomite, as above.
1340 – 1350	Dolomite, as above, some Dolomite, gray, micritic, hard
1350 - 1360	Dolomite, gray, micritic, hard.
1360 - 1370	Dolomite, as above.
1370 - 1380	Dolomite, as above
1380 - 1390	Dolomite, as above
1390 - 1405	Dolomite, as above
1405 - 1410	Dolomite, as above.

LITHOLOGIC DESCRIPTION
OUC SKYLAKE WELL NO. 3

(Continued)

Depth (Ft)	Description
1410 – 1420	Dolomite, as above.
1420 – 1430	Dolomite, gray and dark brown, micritic.
1430 – 1440	Dolomite, dark brown, micritic.
1440 - 1450	Dolomite, as above.