HAZEN AND SAWYER
Environmental Engineers & Scientists

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HOL-IW1
HOL-IW2
HOL-MW1

April 30, 2003

need complete WCR of injection
- new completion diagrams for multi-nodes
- Litho IW-1 only
- Packers/case

Joseph R. May, P.G.
Groundwater Section
Florida Department of Environmental Protection
U. I. C. Permitting
400 North Congress Avenue
West Palm Beach, Florida 33401

City of Hollywood
UIC Class I Injection Well
Permit Number 156419-001-UC
Request to Conduct Injection Test at IW-1 and IW-2

Dear Mr. May:

Enclosed please find our request to conduct an injection test at Injection Well No. 1 and 2 (IW-1 & IW-2) for the referenced project. As stipulated in the permit, this item requires approval by the Florida Department of Environmental Protection (FDEP). Our request is attached.

As always, please feel free to call should you have any questions.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

STATE OF FLORIDA PROFESSIONAL ENGINEER
ALBERT MUNIZ
35587

4/30/03

Albert Muniz, P.E.
No. 35587

Whitfield Van Cott, P.E.
Utilities Director

Very truly yours,

Hazen and Sawyer, P.C.

Albert Muniz, P.E.
Project Manager

c: *George Heuler/FDEP-TAL*
Garth Hinckle/BCDNRP-FTL
Bill Benko/City of Hollywood
Glenn Cunningham/H&S-HWD
John Largey/H&S
Ron Reese/USGS-MIA
Nancy Marsh/EPA-ATL
Tom Weston/City of Hollywood
Paul Vinci/H&S-HWD
H&S – 4304
Steve Anderson/SFWMD-WPB
Heidi Vandor/FDEP-WBP
Patti Hart/City of Hollywood
Jim Wheatley/WTA-WPB

City of Hollywood

Request for 24-Hour Injection Test
Permit Number 156419-001-UC
April 30, 2003

REQUEST

In accordance specific condition 5.h of the permit we are requesting Department approval for conducting the 24-hour injection test at Injection Well No. 1 (IW-1) and Injection Well No. 2 (IW-2). This request is based on interpretation of data from the drilling and testing of IW-1, Monitor Well No. 1 (MW-1), and IW-2. Testing data has been collected to depths of 3,500 feet below pad level (bpl).

Significant confinement has been identified throughout out the interval from 1,390 feet bpl (base of the Underground Source of Drinking Water (USDW)) to 2,550 feet bpl. The interpretation of data included a review of a combination of lithologic descriptions, core data, geophysical logs and packer test results from the drilling program.

The source of water to be used to create a buoyant bubble in the injection zone will be the treated effluent from the treatment plants clarifier. A copy of the water quality analyses of the source water has previously been submitted.

SUPPORTING DATA

The following list identifies supporting data used in support of the injection test request. Most of the information has been previously submitted to the TAC, and some is resubmitted for convenience:

- Cement bond Logs (Submitted to the TAC in Weekly Summary Report No. 17, October 7, 2002 (IW-1) and Weekly Summary Report No. 44, April 15, 2003 (IW-1 & IW-2)).

- Cement top temperature Logs. (IW-1 data submitted 34-inch casing submitted to the TAC in Weekly Summary Report No. 10 August 19, 2002. The IW-1 24-inch casing was submitted to the TAC in Weekly Summary Report No. 15, September 23, 2003; IW-2 for the 34-inch was submitted with Weekly Summary Report No. 35, February 10, 2003. The 24-inch for IW-2 was submitted with Weekly Summary Report No. 42, March 31, 2003).

- Casing cementing records showing theoretical versus actual cement calculations for each cementing stage (Attachment No. 1).

- Final borehole video log (Attachment No. 2).

- Geologic logs for each well (Attachment No. 3).

- Geophysical logs from the pilot hole, for the 1,000 to 2,000 feet bpl interval at IW-1 (caliper, gamma ray, dual induction, sonic w/vdl, temperature, and fluid conductivity) were submitted to the TAC in Weekly Summary Report No. 4, July 15, 2002. The logs for IW-2 were submitted to the TAC in Weekly Summary Report No. 29, December 30, 2002.

- Geophysical logs from the pilot hole, for the 2,000 to 3,000 feet bpl interval at IW-1 (caliper, gamma ray, dual induction, sonic w/vdl, temperature, and fluid conductivity)

were submitted to the TAC in Weekly Summary Report No. 11, August 26, 2002. The logs for IW-2 were submitted in Weekly Summary Report No. 37, February 24, 2003.

- Water Quality analyses of IW-1 injection zone MW-1 upper monitoring zone, MW-1 lower monitoring zone and source water (Attachment No. 4 contains a summary of the laboratory results, laboratory reports submitted February 3, 2003).

- Core hydrologic conductivity analyses (Attachment No. 5).

- Summary of packer test analysis (Attachment No. 6).

- Proposed procedures for the injection test and a schematic of the pumping setup is included in (Attachment No. 7).

- Summary of RTS test conducted at IW-1 is included in Attachment No. 8. RTS testing at IW-2 are anticipated to occur next week and will be conducted prior to running the injection test at IW-2.

INTERPRETATION

Identification of Confining Units

The approach to the evaluation of vertical confinement at the City of Hollywood Southern Regional WWTP injection well IW-1 location is as follows. Available borehole geophysical, geological data and open hole testing data were used to identify intervals from 1,390 (base of the USDW) to 3,000 feet bpl, which exhibit confining properties. The vertical confinement provided by each interval was then evaluated. Particular attention was paid to locating beds of limestone, dolomite, clay or marl that have low matrix vertical hydraulic conductivities and are not penetrated by fractures and/or solution cavities. Such tight beds provide the primary vertical confinement of the injected effluent.

Testing Quality Control Quality Assurance

For each of the testing procedures conducted (geophysical logging, packer testing on IW-1) quality control and quality assurance procedures were implemented and documented.

Geophysical Logs

The wire line geophysical logs for IW-1 were examined in detail for the presence of units of rock that could provide vertical confinement for injected fluids. A combination of sonic, caliper and resistivity logs were used to identify well-cemented limestone and/or dolomite beds that would be expected to have low matrix porosities and hydraulic conductivities. Borehole televiewer logs were used to locate fractures and/or cavernous zones that could be conduits for vertical fluid flow. Information on the orientation and thickness of beds was also obtained from the borehole televiewer logs.

The development and conditioning of the wells prior to logging is not an issue for the sonic, caliper, gamma ray, temperature, resistivity and borehole televiewer logs as these logs were designed to and are often run in mudded boreholes. Fine scale features, such as bed contacts, are readily distinguishable on the borehole televiewer log, which indicates that borehole conditions did not have a significant adverse effect on log quality.

Characterization of Well Cuttings

Cuttings collected during the pilot hole drilling of in IW-1 (land surface to 3,500 feet bpl) were examined in detail for lithology, macroporosity (visible porosity) and apparent matrix hydraulic conductivity using a stereomicroscope. A copy of the geologic log is attached. The cuttings were grab samples collected at 10-foot intervals during the construction of the well. The lithology of the limestones cuttings was characterized using the limestone classification scheme of Dunham (1962). The most common grain types were silt to fine-sand sized rounded carbonate grains that are described as either peloids (fecal pellet-shaped grains of indeterminate origin) or as bioclasts (transported fossil fragments). The mineralogy of the samples (calcite versus dolomite) was confirmed by reaction with dilute hydrochloric acid. Dolomite was classified according to crystal size as being microcrystalline (crystals are not visible with the low-powered microscope), finely crystalline (1/64 to 1/16 mm) or medium crystalline (1/16 to 1/4 mm).

The macroporosity (visible porosity) of the samples was characterized as being either very low (< 2%), low (2-5%), moderate (5-15%), high (15-25%), or very high (>25%). The apparent matrix hydraulic conductivity was qualitatively evaluated as being very low to high based on the porosity, size of the pores, and likely degree of interconnection of the pores.

Core Examination and Data Analysis

The seven cores were taken from 1,700 to 2,042 feet bpl in IW-1. The lithology of the cores was evaluated in order to determine if there were any significant biases in the cutting samples. The well cuttings appeared to have somewhat less intergranular carbonate mud than the cores. In some limestone cuttings, the carbonate mud appeared to have been washed out of the samples during drilling. Some limestone cuttings, particularly grainstone and packstone lithologies, thus appear to be more porous than they actually are. The cores were also examined for the presence of fractures or solution features (vugs) that might be conduits for vertical fluid flow. A copy of the core descriptions is attached. Results from the laboratory core analysis are attached.

Packer Test Data

Straddle packer test data collected during the drilling of IW-1 were analyzed for information on the hydraulic conductivity of potential confining units. The straddle packer data were analyzed using the Cooper and Jacob (1946) modification of the Theis (1935) non-equilibrium equation (i.e., the straight line method). The transmissivity values calculated from both the pumping and recovery phase data for each test were very similar. The summarization of the results of the packer tests is attached.

It should be noted that the transmissivity and average hydraulic conductivities values calculated from the packer test data are largely a function of horizontal hydraulic conductivities. Packer test data thus tend to over estimate of vertical hydraulic conductivities. For example, a packer test performed on an interval containing one or more high hydraulic conductivity beds interbedded between very low hydraulic conductivity beds would give a high transmissivity and average hydraulic conductivity value whereas the interval would have a very low vertical hydraulic conductivity. Copies of packer test data from IW-1 are attached.

CONFINEMENT ANALYSIS

Criteria for Identification of Confinement Intervals

Beds or intervals of rock that are likely to offer good vertical confinement were identified using the following criteria.

- Low sonic transit times and derived sonic porosities.

- Variable density log (VDL) pattern consisting of either straight parallel vertical bands, where lithology is relatively uniform, or a "chevron" pattern of continuous parallel bands, where the formation consists of interbedded rock with differing densities and/or degrees of consolidation. Fractured rock typically has an irregular VDL log pattern.

- Low hydraulic conductivities calculated using packer pump test data.

- Low macroporosity (i.e., visible pore spaces) and a high degree of cementation (hardness) as observed in microscopic examination of cuttings and core samples.

- Borehole diameters on caliper logs close to the bit size. Fractured dolomite and limestone is commonly manifested by an enlarged bore hole.

- Relatively high resistivities, which in the middle and lower Floridan Aquifer System are often indicative of tight dolomite and or limestone beds.

- Absence of evidence of fractures on the television survey video and borehole televiewer log.

Confinement Intervals

The confinement properties of the strata between the base of the USDW (1,390 feet bpl) and 3,000 feet bpl was evaluated using the above criteria and data. The confining intervals are discussed below.

Interval From 1,500 to 1,900 Feet BPL

This interval consists predominantly of light-colored limestone and dolomitic limestones. Grainstones and packstones are the most common lithologies. The grainstones and packstones are interbedded with subsidiary beds of carbonate-mud rich lithologies (fossiliferous mudstones and wackestones). The borehole televiewer log indicates that the beds are horizontal and range in thickness from approximately 0.5 to 10 feet. The bedding appears to consist of stacked sequences of carbonate sand-rich (grainstones and packstones) and carbonate mud-rich (packstones to mudstones) limestones. The mudstone and wackestone beds, which have low macroporosities and are well cemented, can provide better vertical confinement than the thicker grainstone and packstone beds.

A packer tests was performed over the interval 1,679-1,695, 1,731-1,747 and 1,811-1,827 feet bpl within this confinement interval and yielded hydraulic conductivities ranging from 1.4×10^{-4} to 2.3×10^{-4} cm/sec. Laboratory analyses of hydraulic conductivities of cores collected over this interval ranged from 4.6×10^{-5} to 2.5×10^{-8} cm/sec. No evidence of vertical fractures or solution cavities was visible on the borehole televiewer log or the television survey video. The geological and geophysical data for this interval are characteristic of good vertical confinement.

Interval From 2,040, to 2,550 Feet BPL

This interval consists of interbedded light-colored limestones and dolomites. Grainstones and packstones are the most common lithologies. The grainstones and packstones are interbedded with subsidiary beds of carbonate-mud rich lithologies (fossiliferous mudstones and wackestones). The borehole televiewer log indicates that the beds are horizontal and range in thickness from approximately 0.5 to 10 feet. The bedding appears to consist of stacked sequences of carbonate sand-rich (grainstones and packstones) and carbonate mud-rich (packstones to mudstones) limestones. The mudstone and wackestone beds, which have low macroporosities and are well cemented, can provide better vertical confinement than the thicker grainstone and packstone beds.

A packer test was performed over the interval 1,931-1,947 feet bpl within this confinement interval and yielded hydraulic conductivities ranging from 3.7×10^{-5} to 4.1×10^{-5} cm/sec. Laboratory analyses of hydraulic conductivities of cores collected over this interval ranged from 1.1×10^{-3} to 6.0×10^{-10} cm/sec. No evidence of vertical fractures or solution cavities was visible on the borehole televiewer log or the television survey video. The geological and geophysical data for this interval are characteristic of good vertical confinement.

Cement Bond Logs

Cement bond logs are used to assess the quality of the bond between the casing and the cement grout. The resulting curve of the log is a function of casing size and thickness, cement strength and thickness, degree of cement bonding and tool centering.

The travel time curve (left log track) is run to determine if the tool is properly centered. The critical travel time is the time recorded when the tool is absolutely centralized in high signal areas, areas with no cement (free pipe). Factors affecting the travel time curve are cycle skipping that can be caused by fast formation arrivals and formations that are so dense they actually have a faster transit time than the casing. The basic transit time of steel is slower than some dolomites and limestones.

On the amplitude curves (center log track), a time gate is set at the time corresponding to the expected arrival of the casing signal, and the amplitude of the signal in that gate is recorded. A high amplitude indicates a larger casing signal, and therefore a poorer cement bond; a low amplitude indicates a good bond.

The variable density display (left log track) displays the entire wave signal. If there is no bond, an arrival is seen at the time corresponding to the casing velocity. As the cement becomes thicker and stronger (compressive strength), the casing signal becomes weaker.

On April 12, 2003, a cement bond log was performed in the injection well 24-inch casing. From the travel time log it can be seen that good tool centralization was maintained for the entire log. The variable density display shows no strong casing signal on any section of the 24-inch casing. The cement bond log conducted in IW-1 demonstrated that there is a good cement seal around the 24-inch diameter casing and that there are no channels or conduits that would allow fluid movement adjacent to the casing.

On January 7, 2002, a cement bond log was performed in the monitor well 16-inch casing. From the travel time log it can be seen that good tool centralization was maintained for the entire log. The variable density display shows no strong casing signal on any section of the 16-inch casing. The cement bond log conducted in MW-1 demonstrated that there is a good cement seal around the 16-inch diameter casing and that there are no channels or conduits that would allow fluid movement adjacent to the casing.

On November 15, 2002, a cement bond log was performed in the monitor well 6 5/8-inch FRP casing before being cemented. The casing was then cemented and a final cement bond log was conducted on December 12, 2002. The logs were then compared and shower the presents of cement behind the 6 5/8 casing. The cement bond logs conducted in MW-1 demonstrated that there is a good cement seal around the 6 5/8-inch diameter casing and that there are no channels or conduits that would allow fluid movement adjacent to the casing.

Final Down-hole Television Survey

A copy of the final downhole television interpretation log is attached.

ATTACHMENT No. 1
Cement Logs

APPENDIX L
CEMENT REPORTS
INJECTION WELL IW-1
CITY OF HOLLYWOOD

Conductor Casing

Casing Diameter: 52-inches
Casing Depth: 200 feet below pad level
Bit Size: Nominal 58-inch diameter
Cement Specification: ASTM C 150 Type II
Number of Stages: 1

Cement Blend:	Neat
	12% Bentonite
Cement Density:	Neat – 15.6 lb./gal
	12% Bentonite – 12.7 lb./gal
Theoretical Fill From Caliper Log: 1,200 cubic feet	
Volume Pumped:	Neat – 533 cubic feet
	12% Bentonite – 561 cubic feet
	Total – 1,094 cubic feet
Percent Difference:	8.8%

The 52-inch casing was cemented in one stage. The cement was circulated to surface and was visually confirmed. A temperature log was run downhole after the cement stage. The difference in the theoretical and actual volume pumped is due to caliper tool limitations.

APPENDIX L
CEMENT REPORTS
INJECTION WELL IW-1
CITY OF HOLLYWOOD

Surface Casing

Casing Diameter: 42-inches
Casing Depth: 999 feet below pad level
Bit Size: Nominal 50-inch diameter
Cement Specification: ASTM C 150 Type II
Number of Stages: 2
Cement Blend: Neat
12% Bentonite
Cement Density: Neat – 15.6 lb./gal
12% Bentonite – 12.6 lb./gal
Theoretical Fill From Caliper Log: 4,164
Volume Pumped: Neat – 729 cubic feet
12% Bentonite – 2,905 cubic feet
Total – 3,634 cubic feet
Percent Difference: 13%

The 42-inch casing was cemented in two stages. After each stage a temperature log was run downhole. The cement physically tagged to determine the actual fill after the first stage. On the final stage the cement was circulated to surface and was visually confirmed. The difference in the theoretical and actual volume pumped is due to limitations of the caliper tool in very soft formations.

APPENDIX L
CEMENT REPORTS
INJECTION WELL IW-1
CITY OF HOLLYWOOD

Intermediate Casing

Casing Diameter: 34-inches
Casing Depth: 1990 feet below pad level
Bit Size: Nominal 42-inch diameter
Cement Specification: ASTM C 150 Type II
Number of Stages: 6
Cement Blend: Neat
12% Bentonite
Cement Density: Neat – 15.6 lb./gal
12% Bentonite – 12.6 lb./gal
Theoretical Fill From Caliper Log: 6,476
Volume Pumped: Neat – 970 cubic feet
12% Bentonite – 8,065 cubic feet
Total – 9,065 cubic feet
Percent Difference: 28.5%

The 34-inch casing was cemented in six stages. After each stage a temperature log was run downhole and the cement physically tagged to determine the actual fill. On the final stage the cement was circulated to surface and was visually confirmed. The difference in the theoretical and actual volume pumped is due to additional cement utilized to fill spaces that exceed the maximum opening of the caliper tool and small irregularities in the borehole wall.

APPENDIX L
CEMENT REPORTS
MONITOR WELL MW-1
CITY OF HOLLYWOOD

Inner Casing

Casing Diameter: 24-inches
Casing Depth: 2,880 feet below pad level
Bit Size: Nominal 34-inch diameter
Cement Specification: ASTM C 150 Type II
Number of Stages: 6
Cement Blend: Neat
12% Bentonite
Cement Density: Neat – 15.7 lb./gal
12% Bentonite – 12.6 lb./gal
Theoretical Fill From Caliper Log: 8,458 cubic feet
Volume Pumped: Neat – 1,683 cubic feet
12% Bentonite – 8,156 cubic feet
Total – 9,839 cubic feet
Percent Difference: 14.0%

The 24-inch casing was cemented in six stages. After each stage a temperature log was run downhole and the cement physically tagged to determine the actual fill. On the final stage the cement was circulated to surface and was visually confirmed. The difference in the theoretical and actual volume pumped is due to additional cement utilized to fill spaces that exceed the maximum opening of the caliper tool and small irregularities in the borehole wall.

APPENDIX L
CEMENT REPORTS
INJECTION WELL IW-2
CITY OF HOLLYWOOD

Conductor Casing

Casing Diameter: 50-inches
Casing Depth: 199 feet below pad level
Bit Size: Nominal 58-inch diameter
Cement Specification: ASTM C 150 Type II
Number of Stages: 1

Cement Blend:	Neat
	12% Bentonite
Cement Density:	Neat – 15.6 lb./gal
	12% Bentonite – 12.6 lb./gal
Theoretical Fill From Caliper Log:	1,414 cubic feet
Volume Pumped:	Neat – 555 cubic feet
	12% Bentonite – 595 cubic feet
	Total – 1,150 cubic feet
Percent Difference:	18.7%

The 50-inch casing was cemented in one stage. The cement was circulated to surface and was visually confirmed. A temperature log was run downhole after the cement stage. The difference in the theoretical and actual volume pumped is due to caliper tool limitations.

APPENDIX L
CEMENT REPORTS
INJECTION WELL IW-2
CITY OF HOLLYWOOD

Surface Casing

Casing Diameter: 42-inches
Casing Depth: 999 feet below pad level
Bit Size: Nominal 50-inch diameter
Cement Specification: ASTM C 150 Type II
Number of Stages: 1
Cement Blend: Neat
12% Bentonite
Cement Density: Neat – 15.6 lb./gal
12% Bentonite – 12.6 lb./gal
Theoretical Fill From Caliper Log: 3,433
Volume Pumped: Neat – 651 cubic feet
12% Bentonite – 2,519 cubic feet
Total – 3,170 cubic feet
Percent Difference: 8.3%

The 42-inch casing was cemented in one stage. The cement was circulated to surface and was visually confirmed. A temperature log was run downhole after the cement stage. The difference in the theoretical and actual volume pumped is due to caliper tool limitations in soft formations.

Intermediate Casing

Casing Diameter: 34-inches
Casing Depth: 1990 feet below pad level
Bit Size: Nominal 42-inch diameter
Cement Specification: ASTM C 150 Type II
Number of Stages: 5
Cement Blend: Neat
12% Bentonite
Cement Density: Neat – 15.6 lb./gal
12% Bentonite – 12.6 lb./gal
Theoretical Fill From Caliper Log: 6,121 cubic feet
Volume Pumped: Neat – 348 cubic feet
12% Bentonite – 7,993 cubic feet
Total – 8,341 cubic feet
Percent Difference: 23.4%

The 34-inch casing was cemented in five stages. After each stage a temperature log was run downhole and the cement physically tagged to determine the actual fill. On the final stage the cement was circulated to surface and was visually confirmed. The difference in the theoretical and actual volume pumped is due to additional cement utilized to fill spaces that exceed the maximum opening of the caliper tool and small irregularities in the borehole wall.

APPENDIX L
CEMENT REPORTS
INJECTION WELL IW-2
CITY OF HOLLYWOOD

Inner Casing

Casing Diameter: 24-inches
Casing Depth: feet below pad level
Bit Size: Nominal 32-inch diameter
Cement Specification: ASTM C 150 Type II
Number of Stages: 7
Cement Blend: Neat
12% Bentonite
Cement Density: Neat – 15.7 lb./gal
12% Bentonite – 12.7 lb./gal
Theoretical Fill From Caliper Log: 8,835 cubic feet
Volume Pumped: Neat – 1,083 cubic feet
12% Bentonite – 9,610 cubic feet
Total – 10,693 cubic feet
Percent Difference: 17.4%

The 24-inch casing was cemented in seven stages. After each stage a temperature log was run downhole and the cement physically tagged to determine the actual fill. On the final stage the cement was circulated to surface and was visually confirmed. The difference in the theoretical and actual volume pumped is due to additional cement utilized to fill spaces that exceed the maximum opening of the caliper tool and small irregularities in the borehole wall.

APPENDIX L
CEMENT REPORTS
MONITOR WELL MW-1
CITY OF HOLLYWOOD

Conductor Casing

Casing Diameter: 24-inches
Casing Depth: 200 feet below pad level
Bit Size: Nominal 32-inch diameter
Cement Specification: ASTM C 150 Type II
Number of Stages: 1
Cement Blend: Neat
Cement Density: Neat – 15.7 lb./gal
Theoretical Fill From Caliper Log: 813 cubic feet
Volume Pumped: Neat – 797 cubic feet
Total – 797 cubic feet
Percent Difference: 2%

The 24-inch casing was cemented in one stage. The cement was circulated to surface and was visually confirmed. A temperature log was run downhole after the cement stage. The difference in the theoretical and actual volume pumped is due to caliper tool limitations.

Intermediate Casing

Casing Diameter: 16-inches
Casing Depth: 1250 feet below pad level
Bit Size: Nominal 24-inch diameter
Cement Specification: ASTM C 150 Type II
Number of Stages: 2
Cement Blend: Neat
12% Bentonite
Cement Density: Neat – 15.7 lb./gal
12% Bentonite – 12.7 lb./gal
Theoretical Fill From Caliper Log: 1,831 cubic feet
Volume Pumped: Neat – 387 cubic feet
12% Bentonite – 1,369 cubic feet
Total – 1,756 cubic feet
Percent Difference: 4%

The 16-inch casing was cemented in two stages. After each stage a temperature log was run downhole. The cement was physically tagged to determine the actual fill after the first stage. On the final stage the cement was circulated to surface and was visually confirmed. The difference in the theoretical and actual volume pumped is due to limitations of the caliper tool in very soft formations.

APPENDIX L
CEMENT REPORTS
MONITOR WELL MW-1
CITY OF HOLLYWOOD

Inner Casing

Casing Diameter: 6⅝-inches
Casing Depth: 1,750 feet below pad level
Bit Size: Nominal 16-inch diameter
Cement Specification: ASTM C 150 Type II
Number of Stages: 3
Cement Blend: Neat
Cement Density: Neat – 15.7 lb./gal
Theoretical Fill From Caliper Log: 718 cubic feet
Volume Pumped: Neat – 920 cubic feet
Total – 920 cubic feet
Percent Difference: 22%

The 6⅝-inch casing was cemented in three stages. After each stage a temperature log was run downhole and the cement physically tagged to determine the actual fill. The difference in the theoretical and actual volume pumped is due to additional cement utilized to fill spaces that exceed the maximum opening of the caliper tool and small irregularities in the borehole wall.

ATTACHMENT No. 2
Final Borehole Television Survey

Injection Well No. 1 – Drilling Data

Video Survey

VIDEO SURVEYS
CITY OF HOLLYWOOD EFFLUENT DISPOSAL SYSTEM
SOUTHERN REGIONAL WASTEWATER TREATMENT PLANT
INJECTION WELL No. 1 (IW – 1)

Interval (feet bpl)	Observations
1048–1073	**Light colored generally massive Limestone:** No fractures or caverns. Generally well indurated, weakly vuggy, finer grained thin bed at 1,054, minor washout at 1,062, lighter colored thin vuggy bed at 1,064.
1073–1083	**Light colored Limestone:** No fractures or caverns. Dominantly light gray vuggy mudstone interbedded with light colored limestone as above.
1083–1106	**Light colored massive Limestone:** No fractures, vugs or caverns. Generally very well indurated, few dark gray mudstone inclusions at 1,092.
1106–1120	**Light colored Limestone:** No fractures, or caverns. Generally well indurated with few mudstone clasts from 1,106 to 1,107, thin gray mudstone bed at 1,107, few mudstone clasts from 1,107 to 1,108, weakly vuggy bed from 1,109 to 1,111.
1120–1213	**Light colored generally massive Limestone:** No fractures or caverns. Generally well indurated with few minor washouts. Few gray mudstone clasts from 1,120 to 1,121, thin dark horizontal lamination at 1,125, slightly washed out from 1,152 to 1,153, washouts at 1,175 and 1,182.
1213–1349	**Light colored generally massive Limestone:** No fractures or caverns. Generally well to very well indurated. Thin gray wackestone/mudstone bed and lenses at 1,215, dark horizontal mudstone laminations at 1,219 and 1,227, dark gray mudstone lens at 1,231, thin dark gray mudstone beds at 1,255 and 1,256, gray mudstone lens at 1,264. Minor washout at 1,282. Borehole predominantly coated with filter cake from 1,288 to 1,349.
1349–1450	**Light colored generally massive Limestone:** No fractures or caverns. Observation partially obscured by filter cake. Dominantly well indurated, thin horizontal gray wackestone bed at 1,349, thin gray vuggy horizontal mudstone bed at 1,366, minor washout at 1,368, light gray very well indurated wackestone/mudstone bed at 1,369, weakly vuggy at 1,425, minor washouts at 1,423 and 1,442.
1450–1478	**Light orange colored generally massive Limestone:** No fractures or caverns. Generally well indurated, thin gray horizontal bed at 1,475.
1478–1482	**Gray colored massive Limestone:** No fractures, vugs or caverns. Well indurated, weakly vuggy.
1482–1487	**Light colored massive Limestone:** No fractures, vuggs or caverns. Well to very well indurated.

Interval (feet bpl)	Observations
1487–1496	**Gray to dark gray colored massive Limestone:** No fractures, vugs or caverns. Well indurated, minor washout at 1,491.
1496–1504	**Light colored generally massive Limestone:** No fractures, vugs or caverns. Generally well indurated, thin very light colored bed at 1,499.
1504–1506	**Very light colored massive Limestone:** No fractures, vugs or caverns. Very fine grained, very well indurated.
1506–1524	**Light colored massive Limestone:** No fractures, vugs or caverns. Well indurated.
1524–1563	**Light colored generally massive Limestone:** No fractures, vugs or caverns. Very well indurated, dominantly light colored interbedded with darker beds and laminations. Few dark horizontal laminations at 1,524, minor washout at 1,542, thin dark beds at 1,530 and 1,547 thin mudstone bed at 1,549.
1563–1700	**Light colored Limestone:** No fractures or caverns. Observation partially obscured by filter cake. Generally very well indurated, dominantly light colored interbedded with darker beds and laminations. Thin dark horizontal mudstone beds at 1,569 and 1,569, dark mudstone lenses at 1,581 and 1,583, dark thin laminations at 1,605, weakly vuggy and micritic at 1,612, Thin horizontal mudstone beds at 1,617, dark thin horizontal lamination at 1,619, mudstone clasts common at 1,620 and 1,626, thin dark horizontal lamination at 1,637, few mudstone clasts at 1,655, thin dark mudstone beds at 1,644, 1,661 and 1,664, mudstone lenses at 1,669 and 1,673, gray poorly indurated mudstone bed at 1,678, mudstone lenses at 1,684, mudstone bed from 1,692 to 1,694.
1700–1900	**Light colored Limestone:** No fractures or caverns. Generally well to very well indurated, dominantly light colored occasionally interbedded with darker beds and laminations. Thin gray horizontal beds at 1,720 and 1,722, thin gray horizontal rough textured beds at 1,735 and 1,738, few gray clasts at 1,740, gray horizontal laminations at 1,740, gray wavy laminations at 1,745, gray horizontal bed at 1,753, thin gray beds at 1,755 and 1,761, laminated light orange and gray limestone from 1,764 to 1,765, gray mudstone lens at 1,781, gray lamination at 1,784, minor washouts at 1,786 and 1,791, thin coarser grained bed at 1,805, very well indurated below 1,851, few minor to moderate washout from 1,851 to 1,877, darker mudstone lens at 1,882, few mudstone clasts at 1,895, sharp low angle contact at 1,897.
1900-1905	**Light colored massive Limestone:** No fractures, vugs or caverns. Well indurated with few minor washouts, gray mudstone lens at 1,902.
1905–1907	**Laminated light colored Limestone and dark colored Dolomite:** No fractures, vugs or caverns. Very well indurated with horizontal laminations.
1907–1985	**Light colored generally massive Limestone:** No fractures or caverns. Very well to moderately well indurated, minor washouts at 1,911, minor to moderate washouts from 1,913 to 1,923 thin coarser grained bed at 1,933, thin vuggy zone at 1,944, few moderate vugs at 1,951, washouts at 1.976, thin coarser grained bed at 1,983.
1985–2022	**No Video**
2022–2028	**Light colored generally massive Limestone:** No fractures, vugs or caverns. Well indurated. Thin dark bed at 2,025.

Interval (feet bpl)	Observations
2028–2044	**Dark colored massive Dolomite:** Minor cavern at 2,029, light colored very well indurated bed from 2,030 to 2,031, thin washed out bed at 2,032, open vertical fracture from 2,033 to 2,034, closed high angle fracture at 2,035, poorly indurated and partially washed out from 2,035 to 2,039. Moderate to large cavern from 2,036 to 2,038, closed low angle fracture at 2,039, darker colored dominantly weakly vuggy to vuggy from 2,040 to 2,044. Sharp wavy lower contact at 2,044.
2044–2062	**Light colored generally massive Limestone:** Dominantly very well indurated, thin wavy washed out bed at 2,046, well to moderately indurated at 2,052 and 2,055, minor washout at 2,055. Sharp horizontal lower contact at 2,062.
2062–2091	**Dark colored generally massive Dolomite:** Generally very well indurated, minor caverns and fractures at 2,064, 2,070 and 2,076, weakly vuggy to vuggy with minor caverns at 2,076, high angle fracture at 2,077, minor low angle to high angle closed fractures from 2,078 to 2,079, moderate cavern with blue gray clay colored clay at 2,079, weakly vuggy at 2,079 and 2,081, moderate cavern at 2,081 with low angle to high angle moderately open fractures, closed horizontal fractures at 2,082, weakly vuggy with high angle open fractures at 2,083, closed horizontal fracture and minor cavern at 2,084, closed high angle fracture and vuggy at 2,085, minor cavern and occasional large vugs at 2,085, blocky texture at 2,087.
2091–2556	**Light colored dominantly massive Limestone:** No fractures or caverns. Dominantly very well to well indurated, dolomitic or micritic from 2,090 to 2,093, faint darker lamination at 2,100, moderately indurated with minor washouts from 2,123, to 2,130, minor washouts at 2,158, dark lens at 2,170, fossil cast at 2,175, minor washout at 2,184, few dark lenses from 2,190 to 2,191, minor washout at 2,195, fossil cast at 2,219, thin dark lamination at 2,278, minor washout at 2,282, few light colored clasts at 2,308, very small very dark lenses at 2,312 and 2,317, thin dark lamination and small dark lenses at 2,324, thin dark lamination at 2,368, shell fragments at 2,373, light colored rounded clasts at 2,377, dark wavy lamination at 2,383, thin darker lens at 2,385, shell fragments at 2,391,thin darker bed at 2,413, molds at 2,444, minor washout at 2,453, small dark lens at 2,458 and 2,496, dark lamination at 2,503, molds at 2,520 and2,521, dark lamination at 2,548.
2556–2596	**Light to moderately light colored massive Limestone:** No fractures or caverns. Dominantly very well indurated, dark lenses at 2,556 and 2,560, light gray lenses at 2,565, weakly vuggy at 2,572 and 2,571, minor washouts at 2,572, 2,591 and 2,593.
2596–2607	**Light colored massive Limestone:** No fractures or caverns. Well indurated, locally weakly to moderately vuggy.
2607–2616	**Gray to light gray colored Limestone:** No fractures or caverns. Faint bedding features, generally very well indurated with occasional vugs.
2616–2633	**Light colored weakly bedded Limestone:** No caverns. Generally very well indurated, minor washout at 2,620, dark gray vuggy bed from 2,624 to 2,625 fully healed horizontal fracture at 2,626.

Interval (feet bpl)	Observations
2633–2660	**Light gray and light orange colored interbedded Limestone:** Micritic from 2,632 to 2635, vuggy at 2,638, light gray colored and very well indurated from 2,638 to 2,640, dark to light gray colored, very well indurated to weakly vuggy from 2,640 to 2,641, rough texture at 2,641, light colored and very well indurated from 2,641 to 2,643, gray colored and very well indurated from 2,643 to 2,645, light colored and very well indurated from 2,645 to 2,647, sharp horizontal contact at 2,647, shallow cavern, moderately fractured with blocky texture at 2,648, gray very well indurated mudstone bed at 2,656.
2660-2871	**Light colored weakly bedded Limestone:** No fractures or caverns. Generally well to very well indurated, thin gray moderately vuggy bed at 2,661, thin gray mudstone bed at 2,668, very light colored thin beds at 2,669 and 2,670 very light colored thin wavy lamination at 2,672, weakly vuggy from 2,672 to 2,673, dark colored lenses at 2,675 and 2,684, very light mudstone or marl lenses at 2,687, mudstone bed at 2,715 weakly vuggy from 2,719 to 2,722, mudstone lenses at 2,727, thin dark colored beds at 2,732, and 2,735 minor washout at 2,736, thin dark bed at 2,737, thin weakly vuggy bed at 2,774, thin coarser grained bed at 2,777, very well indurated at 2,800, thin mudstone bed at 2,805, few dark lenses at 2,807, very well indurated from 2,810 to 2,822, minor washout at 2,863, thin dark vuggy dolomite and dolomitic limestone bed at 2,866, dolomitic limestone at 2,871.
2871–2875	**Dark colored massive Dolomite:** Very well indurated, Vuggy with occasional variable fractures and blocky texture, shallow cavern at 2,874.
2875-2890	**Light colored Limestone and Dolomite:** No fractures vugs or caverns. Very well to well indurated. Dolomitic limestone from 2,875 to 2,876, thin dolomite bed at 2,877, limestone and dolomite from 2,877 to 2,878, dark colored laminations at 2,880, thin light colored wavy bed at 2,882.
2890-2931	**Dark colored Dolomite:** Generally very well indurated to weakly vuggy. Cavernous and highly fractured with blocky texture from 2,892 to 2,898, shallow cavern at 2,900, light colored lens at 2,901, thin breccia beds at 2,904 and 2,905, crystal lined vugs at 2,907, shallow cavern with crystal lined vugs at 2,911, shallow cavern at 2,913, variable angle closed fractures at 2,914, thin washed out limestone bed at 2,920, shallow cavern with closed fractures at 2,921, shallow cavern at 2,925, open vertical fracture and shallow cavern with crystal lined vugs at 2,927.
2931-2936	**Light to dark colored Dolomite**: Weakly laminated and vuggy at 2,930 and 2,936.
2936-2946	**Moderately light colored Dolomite**: Generally well indurated to weakly vuggy. High angle closed fracture at 2940, pen vertical fracture at 2,942.
2946-2948	**Dark colored cavernous Dolomite:** Highly fractured with blocky texture.
2948-2955	**Moderately light to moderately dark colored Dolomite:** Generally very well indurated to weakly vuggy with closed fractures common. Moderately closed horizontal fracture at 2,949, closed vertical fracture at 2,949, closed vertical fracture at 2,950, thin breccia bed at 2,953, very well indurated from 2,953 to 2,954
2955-2967	**Moderately dark colored generally massive Dolomite:** Moderately vuggy to vuggy from 2,954 to 2,959, open high angle to horizontal fractures at 2,960, closed variable angle fractures from 2,960 to 2,962, open horizontal fractures at 2,962, few closed low to high angle from 2,963 to 2,967.

Interval (feet bpl)	Observations
2967-2970	**Dark colored cavernous Dolomite:** Highly fractured with blocky texture, moderate caverns from 2,967 to 2,969.
2970-3003	**Moderately dark colored Dolomite:** Generally massive to weakly bedded, moderately vuggy to very well indurated. Sharp horizontal contacts at 2971 and 2972, crystal lined vugs at 2,972, variable angle closed fractures at 2974 and 2978, open horizontal fracture with minor cavern at 2989, open horizontal fracture at 2995.
3003-3011	**Moderately dark colored Dolomite:** Generally massive, dominantly well indurated to weakly vuggy, light colored wavy laminations at 3010, open high angle fracture at 3011.
3011-3016	**Dark colored cavernous Dolomite:** Highly fractured with blocky texture.
3016-3025	**Light colored Dolomite:** Generally massive and vuggy, vuggs commonly lines with crystals. Few closed variable angle fractures. Dark lenses at 3018.
3025-3035	**Light colored massive Dolomite:** Weakly vuggy to very well indurated, fully healed high angle and horizontal fractures at 3030, closed horizontal fractures at 3033.
3035-3057	**Light colored Dolomite:** Generally massive to locally weakly bedded, closed fractures common, moderately vuggy to well indurated, vuggy from 3035 to 3037, thin dark beds at 3038 and 3039, few dark laminations at 3040 moderate angled moderately open fracture at 3054.
3057-3059	**Dark colored Dolomite:** Massive, well indurated to weakly vuggy, closed fractures common.
3059-3067	**Dark colored Dolomite:** Generally massive and vuggy, closed fractures common. Highly vuggy at 3062, wavy laminations at 3064, open horizontal fracture at 3065, open moderate angle fracture at 3066.
3067-3095	**Light colored Dolomite:** Generally massive, moderately to highly vuggy. Moderate angle fracture at 3068, open horizontal fracture at 3085, fully healed high angle fractures at 3089, closed low angle fracture at 3089, open horizontal fractures at 3090 and 3093, closed variable angle fractures from 3094 to 3095.
3095-3096	**Dark colored cavernous Dolomite:** Highly fractured with blocky texture.
3096-3109	**Light to dark colored massive Dolomite:** Moderately to highly vuggy, vugs commonly lined with crystals, variable angle moderately open to closed fractures common.
3109-3130	**Dark colored highly cavernous Dolomite:** Highly fractured with blocky texture.
3130-3135	**Dark colored Dolomite:** Generally massive, highly vuggy, local blocky texture, variable angle closed fractures common.
3135-3144	**Dark colored Dolomite:** Well indurated to vuggy, healed horizontal fracture at 3137, laminated from 3140 to 3141 and from 3143 to 3144
3144-3200	**Light to dark colored massive Dolomite:** Generally vuggy to highly vuggy, large vugs lined with crystals common. . Shallow cavern at 3150, wavy laminations at 3151, open low angle fracture at 3156, thin clastic bed with dark gray matrix at 3173, closed high angle fracture at 3187, dark mottles at 3188, and 3191, closed horizontal fracture at 3195, dark mottles at 3196.

Interval (feet bpl)	Observations
3200-3225	**Moderately dark colored massive Dolomite:** Weakly vuggy to well indurated. Few closed vertical to high angle fractures, vuggy at 3219, fully healed high angle fracture at 3221, thin dark wavy bed at 2225.
3225-3230	**Dark colored weakly bedded Dolomite:** Highly vuggy to vuggy. Wavy laminations at 3226, closed horizontal fracture at 3227, faint thin darker bed at 3228.
3230-3248	**Moderately dark colored Dolomite:** Generally massive, dominantly well indurated to weakly vuggy. Thin dark horizontal bed at 3232, very well indurated at 3237, minor cavern at 3237, fully healed vertical fracture at 3238, closed low angle fracture at 3240, closed horizontal fracture at 3241, closed moderate angle fracture at 3246.
3248-3251	**Moderately dark colored massive Dolomite:** Highly vuggy with large crystal lined vugs.
3251-3268	**Light colored generally massive Dolomite:** Moderately vuggy to vuggy, vugs occasionally lined with crystals. Thin dark laminations at 3255, open horizontal fracture at 3259, faint thin gray horizontal bed at 3265.
3268-3293	**Dark colored generally massive Dolomite:** Dominantly very well indurated to locally weakly vuggy. Closed vertical fracture at 3268, thin light beds at 3270 and 3274, darker lamination at 3280, minor cavern at 3283, vuggy from 3286 to 3287.
3293-3310	**Light colored generally massive Dolomite:** Dominantly moderately vuggy. Highly vuggy at 3293, healed high angle fracture at 3293, open horizontal fracture at 3298, closed hi angle fracture at 3300, healed low angle fracture at 3301, moderate cavern at 3307, laminations at 3310.
3310-3328	**Moderately dark colored generally massive Dolomite**: Very well to well indurated, closed to moderately open fractures common. Thin light colored wavy lamination at 3311, open horizontal fracture with minor cavern at 3318, open vertical fractures from 3322 to 3326.
3328-3355	**Light colored massive Dolomite with little Limestone:** Highly vuggy to vuggy. High angle moderately open fractures at 3347, open vertical fractures from 3351 to 3353, light Limestone lenses and thin bed at 3354.
3335-3468	**Light colored Dolomite interbedded with dark colored Dolomite:** Vuggy to very well indurated. Dark beds at 3356 and 3358, sharp horizontal contact at 3358, light colored limestone lenses from 3358 to 3360, high angle closed fractures at 3359, very well indurated from 3363 to 3365, faint laminations at 3366, dark laminations at 3369, dark bed at 3375, vuggy at 3375, closed horizontal fracture at 3375, vuggy at 3375, closed horizontal at 3378, wavy contact at 3380, dark laminations at 3382, moderately vuggy with crystal lined vugs at 3388, 3391, 3393 and 3396, sharp horizontal contact at 3409, blocky texture at 3410. light colored limestone lens at 3411, weakly to moderately vuggy from 3411 to 3418, closed horizontal fracture at 3418, dark colored laminations at 3419 and from 3423 to 3424, wavy contact at 3424, highly fractured with blocky texture at 3433, closed variable angle fractures from 3433 to 3436, minor cavern at 3441, closed fractures common from 3445 to 3450, hi angle moderately open fracture at 3456, sharp horizontal contact at 3456, open variable angle fractures from 3458 to 3460 and at 3462, closed high to low angle fractures from 3463 to 3464, open fracture at 3467.
3468-3492	**Light colored massive Dolomite:** Very well indurated to locally vuggy with vugs lined with crystals. Occasional closed vertical fractures from 3490 to 3491.

Interval (feet bpl)	Observations
3492-3500	**Dark colored massive Dolomite:** Highly vuggy to vuggy, vugs commonly lines with crystals with occasional gray lenses.

Injection Well No. 2 – Drilling Data

Video Survey

VIDEO SURVEY
CITY OF HOLLYWOOD EFFLUENT DISPOSAL SYSTEM
SOUTHERN REGIONAL WASTEWATER TREATMENT PLANT
INJECTION WELL No. 2 (IW – 2)

Interval (feet bpl)	Observations
1,018–1,072	**Light colored generally massive Limestone:** No fractures vugs or caverns. Generally well to very well indurated. Thin light colored bed at 1,028, thin light lamination at 1,038, minor washouts at 1,045 and 1,049, coarser grained beds at 1,050 and 1,061, rougher texture at 1,069, wavy contacts at 1,117 and 1,121, trace gray mudstone clasts at 1,123, few faint laminations from 1,123 to 1,124, trace mudstone clasts at 1,125 and 1,126
1,072–1,080	**Light colored Limestone:** No fractures or caverns. Dominantly light gray massive, vuggy mudstone interbedded with light colored very well indurated limestone as above from 1,076 to 1,078. Sharp horizontal contact at 1,078.
1,080–1,106	**Light colored generally massive Limestone:** No fractures or caverns. Generally very well indurated, minor washout at 1,082, thin weakly vuggy bed at 1,090, faint wavy laminations at 1,097, weakly vuggy at 1,101, minor washout at 1,103.
1,106–1,115	**Light colored generally massive Limestone:** No fractures, or caverns. Generally well indurated to locally weakly vuggy with few minor washouts. Thin light colored bed at 1,111.
1,115–1,217	**Light colored generally massive Limestone:** No fractures or caverns, locally weakly bedded. Generally very well indurated. Wavy contacts at 1,117 and 1,121, minor washouts at 1,123, gray mudstone clast at 1,123, few faint laminations from 1,123 to 1,124, trace gray mudstone clasts at 1,125 and 1,126, weakly vuggy and washed out at 1,150, thin vuggy bed at 1,165, minor washout at 1,172, faint wavy lamination at 1,187, vuggy with minor washout at 1,194, faint laminations at 1,199, washout at 1,201, thin light colored horizontal bed at 1,209, weakly vuggy with minor washout at 1,212, minor washout at 1,217.
1,217–1,365	**Light colored Limestone:** No fractures or caverns, massive to weakly bedded. Generally well to very well indurated. Observations partially obscured by filter cake. Thin light colored bed at 1,223, vuggy bed at 1,228, weakly vuggy to vuggy mudstone/wackestone from 1,252 to 1,254, low angle dark brown wavy laminations at 1,270, gray weakly vuggy mudstone bed at 1,273, faint laminations at 1,287, washout at 1,332, thin dark colored wavy laminations at 1,333, weakly laminated at 1,335, gray lenses at 1,346, light gray vuggy mudstone bed at 1,348, gray vuggy mudstone lens at 1,363.
1,365–1,421	**Light colored generally massive Limestone:** No fractures vugs, or caverns, locally weakly bedded. Dominantly well indurated, observation partially obscured by filter cake. Gray lenses at 1,375, minor washouts at 1,380 and 1,387, thin gray mudstone beds at 1,390 and 1,410, weakly washed out bed from 1,419 to 1,421.

Interval (feet bpl)	Observations
1,421-1,423	**Gray colored massive Limestone:** No caverns, generally vuggy to well indurated.
1,423-1,438	**Light colored generally massive Limestone** No caverns, generally well indurated. Thin washed out bed at 1,424, closed horizontal fracture at 1,425, thin gray weakly vuggy mudstone bed at 1,429, thin gray well indurated mudstone bed at 1,432, gray mudstone lenses at 1,435.
1,438-1,441	**Gray colored massive Limestone:** No fractures or caverns. Locally vuggy with locally blocky texture.
1,441–1,460	**Light colored generally massive Limestone:** No fractures or caverns. Generally well indurated, observations partially obscured by filter cake. Thin light colored very well indurated bed at 1,451, thin gray vuggy mudstone bed from 1,452 to 1,453, weakly vuggy gray mudstone bed at 1,458.
1,460-1,465	**Gray colored massive Limestone:** No fractures or caverns. Generally weakly vuggy with locally blocky texture.
1,465-1,484	**Interbedded light to gray colored Limestone:** No fractures, vuggs or caverns. Dominantly light colored, well to very well indurated. Thin gray mudstone beds at 1,466, 1,473, 1,476, and 1,477, dark gray lenses at 1,478, thin washed out bed at 1,478.
1,484–1,487	**Gray colored massive Limestone:** No fractures, vugs or caverns. Well indurated mudstone.
1,487–1,492	**Light colored generally massive Limestone:** No fractures, vuggs or caverns. Well to very well indurated, observations partially obscured by filter cake. Thin light colored lamination at 1,489
1,492–1,498	**Gray to dark gray colored massive Limestone:** No fractures or caverns. Well indurated, minor washout at 1,495, vuggy from 1,496 to 1,498 with rough texture, sharp horizontal contact at 1,498.
1,498–1,599	**Light colored generally massive Limestone:** No fractures, vugs or caverns. Generally well indurated. Dark gray mudstone bed at 1,505, darker colored very well indurated, faintly laminated bed from 1,522 to 1,524, faint horizontal contact at 1,524, gray colored inclusions at 1,5401, gray very well indurated bed from 1,45 to 1,546, wavy horizontal contact at 1,546, thin gray coarse grained beds at 1,547, thin light colored coarse grained beds at 1,555, moderately thin gray bed at 1,580.

Interval (feet bpl)	Observations
1,599–1,837	**Light colored Limestone interbedded with gray colored Limestone:** No fractures or caverns. Generally very well indurated, dominantly light colored interbedded with darker beds and laminations. Dark colored laminations at 1,602 and 1,608, gray colored bed with sharp upper contact at 1,612, wavy laminations at 1,619, thin gray mudstone bed at 1,621, thin gray weakly vuggy mudstone bed at 1,627, weakly vuggy at 1,631, faint laminations from 1,634 to 1,635, dark to light gray wavy laminations at 1,638, weakly vuggy at 1,639, light gray bed with locally blocky texture from 1,645 to 1,646, gray mudstone bed from 1,653 to 1,655, gray weakly vuggy mudstone bed from 1,664 to 1,665, thin light colored locally weakly vuggy bed at 1,670, gray weakly vuggy bed from 1,678 to 1,679, gray vuggy mudstone bed from 1,683 to 1,685, light gray mudstone beds with sharp upper contacts at 1,687 and 1689,light gray weakly vuggy beds at 1,693, 1,698 and from 1,701 to 1,702, light gray mudstone lenses at 1,704, 1,707 and 1,710, light gray well indurated bed at 1,713, light gray vuggy mudstone bed at 1,719, light gray well indurated bed at 1,721, gray mudstone lenses at 1,723 and 1,724,weakly vuggy mudstone bed at 1,738,gray weakly vuggy to vuggy mudstone lenses at 1,744, 1.746, 1,752 and 1,754, gray colored clasts at 1,756, gray laminations from 1,760 to 1,761, gray laminations to thin beds from 1,763 to 1,765,laminated at 1,767 and 1,768, very dark gray laminations at 1,772 and 1,777, light gray well indurated bed from 1,780 to 1,781, light gray vuggy bed at 1,783, light gray mudstone lenses at 1,792, thin mudstone bed with wavy upper contact at 1,798, gray to dark gray mudstone beds at 1,798 and from 1,800 to 1,801, gray clasts at 1,805, mudstone bed with minor washouts at 1,808, thin gray bed at 1,814, gray mudstone lenses at 1,822 and 1,828, thin gray weakly vuggy beds at 1,831, dark gray weakly vuggy mudstone bed at 1,834.
1,837–1,904	**Light colored Limestone:** No fractures or caverns. Generally very well to well indurated, dominantly light colored interbedded with thin darker beds and laminations, observation partially obscured by filter cake. Gray very well indurated mudstone bed at 1,838, dark gray lenses from 1,840 to 1,841, thin gray bed at 1,844, gray mudstone bed with sharp horizontal contact at 1,845, gray mudstone clasts at 1,851, thin dark gray mudstone bed at 1,870, thin coarser grained bed at 1,881,coarser textured from 1,894 to 1,896, gray very well indurated mudstone bed at 1,899, vuggy from 1,900 to 1,903.
1,904–1,907	**Laminated light colored Limestone and dark colored Dolomite:** No fractures, vugs or caverns. Very well indurated with horizontal laminations.
1,907–1,911	**Gray colored generally massive Limestone:** No fractures, vugs or caverns. Well indurated mudstone. Very thin dark laminations at 1,908
1,911–1,990	**Light colored Limestone:** No fractures or caverns, generally massive with thin gray beds common. Generally well to very well indurated, observations partially obscured by filter cake. Moderately indurated from 1,911 to 1,920, gray lenses at 1,917 and 1,919, minor washouts from 1,921 to 1,922, gray lenses at 1,923, gray weakly vuggy bed at 1,925, moderately indurated with larger sized grains at 1,925 and 1,927, gray clasts at 1,928 and 1,930, gray vuggy mudstone bed at 1,934, weakly vuggy with gray lenses at 1,938, small mudstone clasts at 1,941, thin light gray moderately vuggy bed at 1,944, moderately indurated at 1,945 and 1,950, thin moderately vuggy mudstone bed with sharp wavy lower contact at 1,952,thin gray mudstone beds at 1,953, 1,954 and 1,955, thin coarser grained bed at 1,958, thin gray vuggy bed at 1,960, gray mudstone inclusions at 1,977,minor washout at 1,979, thin vuggy bed at 1,981, gray mudstone lenses at 1,983.

ATTACHMENT No. 3

Lithologic Logs

Injection Well No. 1 – Lithology

Geologic Log

GEOLOGIC LOG
(Drill Cuttings)
CITY OF HOLLYWOOD EFFLUENT DISPOSAL SYSTEM
SOUTHERN REGIONAL WWTP
INJECTION WELL IW - 1

Depth (ft)	Thickness (ft)	Sample Description
0 - 10	10	LIMESTONE – 100%; 90% Dark yellowish brown (10YR 4/2), cryptocrystalline, hard, slightly sandy carbonate mudstone. 10% Very pale orange (10YR 8/2), very fine grained, sandy, partly sparry packstone. Trace Sandstone.
10 - 20	10	LIMESTONE – 100% Very pale orange (10YR 8/2), fine to medium grained, moderately soft, pelloidal, partly sparry packstone with shell and shell fragments.
20 – 30	10	SANDSTONE – 100% Light greenish gray (5GY 8/1), fine to medium grained, subangular, poorly cemented with calcite. Trace Sandy Limestone.
30 – 40	10	SANDSTONE AND LIMESTONE – Sandstone 90%, yellowish gray (5Y 7/2), medium to fine grained subangular to subrounded, well sorted, moderately cemented with calcite with trace detrital carbonate. Limestone 10%, moderate yellowish brown (10YR 5/4), coarse grained, moderately hard, sparry, fossiliferous packstone.
40 – 50	10	SANDSTONE AND LIMESTONE – Sandstone 60%, as above. Limestone 40%; 30% yellowish gray (5Y 8/1), medium grained, moderately hard pelloidal, partly sparry packstone. 10% Pale yellowish brown (10YR 6/2), microcrystalline to cryptocrystalline, sparry, hard carbonate mudstone.
50 – 80	30	SANDSTONE – 100% Yellowish gray (5Y 7/2), fine to medium grained, moderately hard to hard, moderately well to well cemented with some detrital carbonate.
80 – 140	60	SANDSTONE AND SANDY LIMESTONE – Sandstone 80%, as above. Sandy Limestone 20% yellowish gray (5Y 8/1), fine to medium grained, hard, sparry packstone with medium grained angular to subangular quartz sand.
140 – 160	20	SANDY LIMESTONE AND LIMESTONE – Sandy Limestone 90%, yellowish gray (5Y 7/2), medium to occasionally coarse grained, hard highly sparry fossiliferous wackestone with very fine to medium grained quartz sand. Limestone 10%, grayish yellow (5Y 8/4), cryptocrystalline, hard sparry carbonate mudstone.
160 – 210	50	LIMESTONE AND SANDY LIMESTONE – Limestone 80%, yellowish gray (5Y 7/2) to grayish orange (10YR 7/4), fine to coarse grained, hard pelloidal, fossiliferous, highly sparry, slightly sandy packstone. Sandy Limestone 20%, yellowish gray (5Y 7/2), medium grained, hard, pelloidal packstone with medium grained quartz sand. Trace tests.

Depth (ft)	Thickness (ft)	Sample Description
210 – 230	20	LIMESTONE AND SANDY LIMESTONE – Limestone 80%, yellowish gray (5Y 8/1), fine to coarse grained, hard, slightly sandy, sparry packstone with shell fragments. Sandy Limestone 20%, yellowish gray (5Y 7/2), medium grained, moderately soft grainstone/packstone with medium grained quartz sand. Trace coarse shell fragments.
230 – 290	60	LIMESTONE – 100% Yellowish gray (5Y 8/1), fine to medium grained, hard sparry, slightly sandy packstone/wackestone with trace fine grained phosphorite. Trace coarse shell fragments. Trace Clay below 270'.
290 – 350	60	LIMY SANDSTONE AND LIMESTONE – Limy Sandstone 90%, medium light gray (N6) to medium gray (N5), fine to medium grained with sparry matrix. Limestone 10%, yellowish gray (5Y 7/2), fine to medium grained, hard, sparry, slightly sandy packstone with trace fine grained phosphorite. Trace medium gray (N5) clay.
350 – 360	10	SANDY CLAYEY LIMESTONE AND LIMY SANDSTONE – Sandy Clayey Limestone 50%, light olive gray (5Y 5/2), fine to medium grained, moderately soft, phosphatic packstone with abundant fine grained quartz sand and Clay. Limy Sandstone 50%, light gray (N7) to light olive gray (5Y 5/2), fine to rarely coarse grained, moderately hard with abundant detrital carbonate and little clay. Trace large shell fragments.
360 – 440	80	CLAYEY SANDY LIMESTONE – 100% Pale olive (10Y 6/2), very fine to fine grained, moderately soft, slightly phosphatic wackestone with abundant clay and fine grained quartz sand.
440 – 500	60	SANDY CLAY AND CLAYEY LIMESTONE – Sandy Clay 50% to 60%, pale olive gray (10Y 6/2) to grayish yellow green (5GY 7/2), very soft, plastic, weakly calcareous, weakly phosphatic. Clayey Limestone 40% to 50%, pale olive gray (10Y 6/2), medium grained, moderately soft, friable, slightly phosphatic wackestone. Trace coarse shell fragments.
500 – 550	50	LIMY CLAY – 100% Pale olive (10Y 6/2), firm, non-plastic with abundant very fine to fine grained detrital carbonate and little to some very fine grained quartz sand.
550 – 560	10	SANDY CLAY – 100% Pale olive (10Y 6/2), firm, friable, non-plastic, highly calcareous with very fine grained quartz sand.
560 – 590	30	LIMY SANDY CLAY – 100% Pale olive (10Y 6/2), firm, friable, non-plastic with abundant very fine to fine grained detrital carbonate and very fine grained quartz sand.
590 – 610	20	SANDY LIMY CLAY – 100% Pale olive (10Y 6/2), firm to soft, non-plastic to rarely plastic, slightly phosphatic with abundant very fine to fine grained quartz sand and fine grained detrital carbonate.
610 – 670	30	SANDY LIMY CLAY – 100% Pale olive (10Y 6/2), firm, non-plastic, slightly phosphatic with abundant very fine to fine grained quartz sand and fine grained detrital carbonate.
670 – 700	30	SANDY CLAY – 100% Pale olive (10Y 6/2), soft, low plasticity, calcareous, slightly phosphatic with abundant very fine to fine grained sand.

Depth (ft)	Thickness (ft)	Sample Description
700 - 720	20	SANDY CLAY – 100% Pale olive (10Y 6/2), very soft, moderately plastic, cohesive, calcareous, phosphatic with very fine to fine grained quartz sand.
720 – 750	30	SANDY CLAY – 100% Pale olive (10Y 6/2), moderately firm to soft, low plasticity, calcareous, slightly phosphatic with very fine to fine grained quartz sand.
750 – 760	10	SANDY CLAY – 100% Pale olive (10Y 6/2), very soft, plastic, cohesive, calcareous, slightly phosphatic with very fine to fine grained quartz sand.
760 – 770	10	SANDY CLAY – 100% Pale greenish yellow (10Y 8/2), soft moderately plastic, calcareous, moderately phosphatic, with very fine grained quartz sand.
770 – 780	10	SANDY CLAY – 100% Pale olive (10Y 6/2), very soft, plastic, cohesive, calcareous, slightly phosphatic with very fine to fine grained quartz sand.
780 – 810	30	SANDY CLAY – 100% Pale greenish yellow (10Y 8/2), soft, moderately plastic, calcareous, moderately phosphatic, with very fine grained quartz sand.
810 – 830	20	CLAY, CHERT AND CLAYEY LIMESTONE – Clay 90%, pale olive (10Y 6/2), soft to very soft, moderately plastic, calcareous, slightly phosphatic, with some very fine grained quartz sand. Chert 5%, olive gray (5Y 6/1) to olive black (5Y 2/1), fine grained with cryptocrystalline matrix, very hard. Clayey Limestone 5%, greenish gray (5GY 6/1), fine to medium grained, moderately hard, phosphatic wackestone/packstone with abundant Clay.
830 - 840	10	SANDY CLAY – 100% Grayish olive green (5GY 3/2), very stiff, low plasticity, phosphatic to highly phosphatic with very fine grained quartz sand and fine grained detrital carbonate.
840 - 860	20	CLAY – 100% Grayish olive (10Y 4/2), cohesive, very soft, high plasticity, slightly calcareous.
860 - 870	10	LIMESTONE - 100% White (N9) to olive gray (5Y 4/1), fine grained moderately hard, phosphatic packstone with micritic to sparry matrix, shell fragments and molds common.
870 - 890	20	LIMESTONE AND CLAY – Limestone 40% to 60%, as above. Clay 40% to 60%, pale olive (10Y 6/2), soft to very soft, moderately plastic to plastic, calcareous, slightly phosphatic. Trace black (N1) Chert.
890 - 900	10	CLAYEY LIMESTONE AND LIMESTONE – Clayey Limestone 70%, very light gray (N8) to pale olive (10Y 6/2), very fine to medium grained, soft to very soft, phosphatic wackestone. Limestone 30%; 20%, light olive gray (5Y 6/1) to olive gray (5Y 4/1), medium grained, moderately hard, phosphatic, partly sandy packstone/wackestone. 10% Yellowish gray (5Y 7/2), very fine grained, hard wackestone.

Depth (ft)	Thickness (ft)	Sample Description
900 - 910	10	LIMESTONE - 100%; 50% Yellowish gray (5Y 7/2), fine grained, moderately hard, sandy, phosphatic packstone. 30% Yellowish gray (5Y 8/1), medium to coarse grained, moderately hard, pelloidal fossiliferous packstone. 20% Medium light gray (N6), medium grained, hard, fossiliferous wackestone.
910 - 920	10	LIMESTONE - 100%; 70% Medium light gray (N6), medium to coarse grained, fossiliferous, slight sparry, micritic wackestone. 30% Packstone as above.
920 - 970	50	LIMESTONE - 100%; 80% Yellowish gray (5Y 8/1), fine to occasionally medium grained, hard, fossiliferous wackestone to mudstone. 20% Wackestone as above.
970 - 990	20	LIMESTONE - 100%; 80% Very pale orange (10YR 8/2), medium grained, moderately hard, fossiliferous packstone. 20% Very light gray (N8), fine to very coarse grained, hard, fossiliferous wackestone. Trace to few forams. Trace olive black (5Y 2/1), fine grained hard Limy Dolomite at 980'.
990 - 1,000	10	LIMESTONE - 100% Yellowish gray (5Y 8/1), medium grained, soft to moderately hard, pelloidal packstone with few forams.
1,000 – 1,060	60	LIMESTONE AND SANDY LIMESTONE – Limestone 90% to 95%, yellowish gray (5Y 8/1), medium to coarse grained, soft to moderately hard, pelloidal packstone. Sandy Limestone 10% to 5%, moderate yellowish green (5GY 7/4), medium to coarse grained, moderately hard, sparry, weakly vuggy packstone with medium grained quartz sand, shell molds, casts and shell fragments. Forams common.
1,060 – 1,070	10	LIMESTONE - 100%; 70% Limestone, light greenish gray (5G 8/1), medium to coarse grained, hard to moderately hard, vuggy packstone. 30% Yellowish gray (5Y 8/1), medium to coarse grained, moderately hard, pelloidal packstone with calcite lined vugs and forams.
1,070 – 1,080	10	LIMESTONE – 100% Yellowish gray (5Y 8/1) to light greenish gray (5GY 8/1), microcrystalline to fine grained, moderately soft, locally vuggy mudstone to wackestone with trace phosphorite.
1,080 – 1,170	90	LIMESTONE – 100%; 80% Yellowish gray (5Y 7/2) to grayish orange (10YR 7/4), fine to medium grained, moderately soft to hard, pelloidal packstone. 20% Pale yellowish brown (10YR 6/2), cryptocrystalline hard carbonate mudstone. Trace Dolomitic Limestone at 1,160'. Few large fossils and shell fragments.
1,170 – 1,260	90	LIMESTONE 100% - Grayish orange (10YR 7/4) to rarely dark yellowish orange (10YR 6/6), medium to coarse grained, moderately soft, pelloidal packstone to grainstone with abundant unconsolidated forams.
1,260 – 1,300	40	LIMESTONE – 100%; 90% Yellowish gray (5Y 8/1), cryptocrystalline to fine grained, soft to moderately hard, mudstone to packstone with abundant forams. 10% Yellowish gray (5Y 7/2), fine to medium grained soft wackestone. Trace light olive gray (5Y 6/1), cryptocrystalline, hard, carbonate mudstone.

Depth (ft)	Thickness (ft)	Sample Description
1,300 – 1,390	90	LIMESTONE – 100%; 60% to 70% Dominantly yellowish gray (5Y 8/1) packstone as above. 30% to 40% Medium light gray (N6), fine grained, hard to moderately hard, slightly sandy wackestone to packstone with fine grained quartz sand. Few fossils and shell fragments.
1,390 – 1,410	20	LIMESTONE - 100%; 80% Very pale orange (10YR 8/2), fine grained, moderately hard pelloidal packstone. 20% Pale yellowish brown (10YR 6/2), cryptocrystalline, hard, weakly vuggy packstone. Trace tests.
1,410 – 1,440	30	LIMESTONE – 100%; 80% to 60% Grayish orange (10YR 7/4), medium grained, moderately hard, pelloidal grainstone. 20% to 40% Pale yellowish brown (10YR 6/2) to light olive gray (5Y 6/1), cryptocrystalline, hard, partly weakly vuggy carbonate mudstone.
1,440 – 1,450	10	LIMESTONE - 100%; 60% Yellowish gray (5Y 8/1), medium grained, soft to moderately soft packstone. 20% Yellowish gray (5Y 8/1) to medium light gray (N6), very fine to fine grained, moderately hard, fossiliferous, micritic packstone. 20% Yellowish gray (5Y 8/1), cryptocrystalline to rarely very fine grained, hard, very weakly vuggy carbonate mudstone.
1,450 – 1,470	20	LIMESTONE – 100% Very pale orange (10YR 8/2), medium grained, soft pelloidal packstone with abundant forams.
1,470 – 1,500	30	LIMESTONE – 100%; 70% Very pale orange (10YR 8/2), medium grained, moderately soft packstone. 30% Yellowish gray (5Y 7/2), cryptocrystalline, hard, carbonate mudstone with medium gray (N5), very fine grained to microcrystalline, hard packstone.
1,500 – 1,510	10	LIMESTONE – 100%; 50% Yellowish gray (5Y 8/1), fine to medium grained, moderately soft, pelloidal grainstone/packstone. 40% Yellowish gray (5Y 8/1), cryptocrystalline to rarely very fine grained, hard carbonate mudstone with trace crystalline carbonate. 10% White (N9), very fine to fine grained, very soft carbonate marl.
1,510 – 1,520	10	LIMESTONE – 100% Yellowish gray (5Y 8/1), fine to medium grained, moderately soft, pelloidal packstone to wackestone with few forams.
1,520 – 1,530	10	LIMESTONE – 100%; 70% Medium light gray (N6) to medium gray (N5), fine to medium grained, moderately hard, fossiliferous grainstone to wackestone. 30% as above. Unconsolidated forams common.
1,530 – 1,540	10	LIMESTONE – 100%; 70% Yellowish gray (5Y 8/1), fine to medium grained, soft, pelloidal grainstone. 30% Olive black (5Y 2/1), cryptocrystalline, hard, silty carbonate mudstone. Abundant forams and few tests.
1,540 – 1,560	20	LIMESTONE – 100% Very pale orange (10YR 8/2), medium grained, soft pelloidal grainstone to wackestone with abundant forams and trace crystalline carbonate.

Depth (ft)	Thickness (ft)	Sample Description
1,560 – 1,600	40	LIMESTONE – 100%; 80% Very pale orange (10YR 8/2), fine grained, moderately soft, pelloidal, slightly fossiliferous packstone. 20% Yellowish gray (5Y 8/1) to medium light gray (N6), cryptocrystalline to very fine grained, hard, fossiliferous carbonate mudstone to wackestone. Forams common to abundant.
1,600 – 1,620	20	LIMESTONE – 100% Pale yellowish brown (10YR 6/2) to very pale orange (10YR 8/2), fine to medium grained, soft pelloidal packstone. Forams and tests common. Trace shell fragments and crystalline carbonate.
1,620 – 1,630	10	LIMESTONE – 100% Very pale orange (10YR 8/2), fine to medium grained, soft to moderately soft pelloidal grainstone.
1,630 – 1,640	10	LIMESTONE – 100% Grayish orange (10YR 7/4) to light olive gray (5Y 6/1), fine grained, moderately soft packstone with forams.
1,640 – 1,660	20	LIMESTONE - 100%; 90% Very pale orange (10 YR 8/2), very fine to medium grained, moderately soft, pelloidal carbonate mudstone to packstone. 10% Light olive gray (5Y 6/1), cryptocrystalline hard carbonate mudstone. Forams common
1,660 – 1,670	10	LIMESTONE – 100% Very pale orange (10YR 8/2), dominantly fine to medium grained, moderately hard, partly weakly vuggy wackestone to packstone. Forams common.
1,670 – 1,720	50	LIMESTONE – 100%; 80% to 60% As above, percentage decreasing with depth. 20% to 40% Light olive gray (5Y 6/1) to medium light gray (N6), cryptocrystalline to fine grained, hard, partly weakly vuggy carbonate mudstone to wackestone, percentage increasing with depth. Unconsolidated forams common.
1,720 – 1,730	10	LIMESTONE – 100% Grayish orange (10YR 7/4), fine to medium grained, soft, pelloidal packstone to wackestone. Abundant unconsolidated forams and tests. Trace Dolomitic Limestone.
1,730 – 1,740	10	LIMESTONE – 100%; 70% As above. 30% Light gray (N7), fine grained, hard to rarely soft, partly weakly vuggy, partly micritic packstone to wackestone. Abundant unconsolidated forams.
1,740 – 1,750	10	LIMESTONE – 100%; 80% Yellowish gray (5Y 8/1) to very pale orange (10YR 8/2), very fine to medium grained, moderately hard to soft grainstone to packstone. 20% Very pale orange (10YR 8/2), cryptocrystalline, hard, partly weakly vuggy, rarely slightly sparry carbonate mudstone. Trace white (N9), very soft carbonate marl. Abundant forams.
1,750 – 1,760	10	LIMESTONE – 100%; 80% Very pale orange (10YR 8/2), fine to coarse grained, moderately soft, pelloidal grainstone to packstone. 20% Very pale orange (10YR 8/2), cryptocrystalline to very fine grained, hard, weakly vuggy carbonate mudstone. Abundant forams.
1,760 – 1,780	20	LIMESTONE – 100%; 90% Moderate yellowish brown (10YR 5/4), fine to medium grained, moderately soft, locally slightly Dolomitic packstone. 10% Light olive gray (5Y 6/1), coarse grained, hard wackestone with molds filled with crystalline carbonate.

Depth (ft)	Thickness (ft)	Sample Description
1,780 – 1,790	10	LIMESTONE AND SILTY LIMESTONE – Limestone 80%; 70% Moderate yellowish brown (10YR 5/4), medium grained, moderately hard grainstone. 10% Very pale orange (10YR 8/2), fine grained, moderately hard packstone. Forams common. Silty Limestone 20%; Black (N1), medium grained, moderately hard, silty, pelloidal packstone.
1,790 – 1,800	10	LIMESTONE – 100%; 90% Very pale orange (10YR 8/2), fine to medium grained, moderately soft to soft, pelloidal packstone to wackestone with occasional molds. 10% Light olive gray (5Y 6/1), fine grained, hard, micritic carbonate mudstone.
1,800 – 1,810	10	LIMESTONE – 100%; 80% Yellowish gray (5Y 7/2), fine to medium grained, soft, pelloidal to highly sparry packstone with dominantly grayish blue green (5BG 5/2) intraclasts. 20% Pale greenish yellow (10Y 8/2) to grayish yellow (5Y 8/4), microcrystalline to fine grained, slightly vuggy to vuggy, moderately hard wackestone to packstone. Trace white (N9), fine grained, hard carbonate mudstone and medium dark gray (N4), very soft argillaceous carbonate marl.
1,810 – 1,820	10	LIMESTONE – 100% Pale greenish yellow (10Y 8/2), fine to medium grained, soft, pelloidal wackestone. Trace medium light gray (N6), microcrystalline, slightly vuggy, hard carbonate mudstone.
1,820 – 1,840	20	LIMESTONE – 100%; 70% Yellowish gray (5Y 8/1), fine grained, soft, pelloidal wackestone. 30% Light greenish gray (5GY 8/1), fine grained, moderately hard, vuggy wackestone to packstone. Few unconsolidated forams.
1,840 – 1,850	10	LIMESTONE – 100; 80% Yellowish gray (5Y 8/1) to light greenish gray (5GY 8/1), fine grained, partly vuggy, locally oolitic/pelloidal wackestone. 20% Greenish gray (5G 6/1), cryptocrystalline to microcrystalline, hard, fossiliferous, sparry wackestone. Trace light olive gray (5Y 6/1) to yellowish gray (5Y 8/1), cryptocrystalline, hard, micritic carbonate mudstone.
1,850 – 1,870	20	LIMESTONE – 100%; 70% Yellowish gray (5Y 7/2) to medium gray (N5), medium to coarse grained, hard grainstone to rarely packstone. 30% Yellowish gray (5Y 8/1) to light olive gray (5Y 6/1), cryptocrystalline, hard, locally weakly vuggy carbonate mudstone. Forams common.
1,870 – 1,880	10	LIMESTONE – 100% Very pale orange (10YR 9/2), fine to very fine grained, moderately hard, locally weakly vuggy wackestone to carbonate mudstone.
1,880 – 1,890	10	LIMESTONE – 100%; 70% As above. 30% Very pale orange (10YR 8/2), very fine to medium grained, soft to moderately soft packstone. Trace crystalline carbonate.
1,890 – 1,900	10	DOLOMITE AND LIMESTONE - Dolomite 50%, moderate yellowish brown (10YR 5/4), cryptocrystalline, hard, slightly limy. Limestone 50%; 40% very pale orange (10YR 8/2), very fine to medium grained, soft to moderately hard wackestone to carbonate mudstone with few forams and tests. 10% Medium light gray (N6), fine grained, hard grainstone.

Depth (ft)	Thickness (ft)	Sample Description
1,900 – 1,910	10	LIMESTONE AND DOLOMITIC LIMESTONE – Limestone 80%, yellowish gray (5Y 8/1), very fine grained, hard, locally vuggy carbonate mudstone to wackestone. Trace white (N9), very soft carbonate marl. Dolomitic Limestone 20%, moderate yellowish brown (10YR 5/4) to pale yellowish brown (10YR 6/2), fine grained, soft carbonate mudstone with very thin to 4 mm dark yellowish brown (10YR 4/2) Dolomite laminations.
1,910 – 1,920	10	LIMESTONE – 100%; 60% Very pale orange (10YR 8/2), medium grained, moderately soft, pelloidal, locally vuggy grainstone to packstone. 40% Grayish orange (10YR 7/4), medium to coarse grained, hard, highly sparry packstone/wackestone. Few forams.
1,920 – 1,930	10	LIMESTONE – 100% Very pale orange (10YR 8/2), fine to medium grained, moderately hard, pelloidal packstone with few forams.
1,930 – 1,940	10	LIMESTONE – 100% Yellowish gray (5Y 8/1), fine to very fine grained, moderately soft to moderately hard, pelloidal, fossiliferous packstone.
1,940 – 1,970	30	LIMESTONE - 100%; 50% to 60% White (N9) to very pale orange (10YR 8/2), microcrystalline to fine grained, moderately soft, pelloidal locally sparry, fossiliferous packstone. 40% to 50% Light greenish gray (5GY 8/1), fine to medium grained, moderately hard to hard, pelloidal wackestone. Trace greenish gray (5G 6/1) to medium bluish gray (5B 5/1), cryptocrystalline to very fine grained, hard carbonate mudstone. Abundant foram tests.
1,970 – 1,980	10	LIMESTONE – 100% White (N9) to very pale orange (10YR 8/2), microcrystalline to fine grained, moderately soft, pelloidal, locally sparry, fossiliferous packstone. Trace greenish gray (5G 6/1) to medium bluish gray (5B 5/1), hard, microcrystalline carbonate mudstone and light greenish gray (5GY 8/1), fine to medium grained, moderately hard, pelloidal wackestone.
1,980 – 2,010	30	LIMESTONE – 100% Light greenish gray (5GY 8/1), fine to medium grained, moderately hard, pelloidal, locally sparry wackestone to packstone. Trace greenish gray (5GY 8/1), hard microcrystalline carbonate mudstone.
2,010 – 2,020	10	LIMESTONE – 100%; 80% Yellowish gray (5Y 8/1), fine to medium grained, soft to moderately hard, pelloidal packstone. 20% Yellowish gray (5Y 8/1), cryptocrystalline, hard carbonate mudstone.
2,020 – 2,040	20	DOLOMITE AND LIMESTONE – Dolomite 80%; 60% Light olive gray (5Y 5/2) moderate yellowish brown (10YR 5/4) and olive black (5Y 2/1), fine grained to cryptocrystalline, hard to very hard, sucrosic, locally weakly vuggy. 10% Dark yellowish brown (10YR 4/4), medium grained to cryptocrystalline, hard. 10% Light olive gray (5Y 6/1), cryptocrystalline, very hard, weakly vuggy, vugs lined with very fine grained euhedral dolomite rhombs. Limestone 20%; 10% Yellowish gray (5Y 8/1), fine to medium grained, soft to moderately hard, pelloidal packstone. 10% Yellowish gray (5Y 8/1), fine to medium grained, soft to moderately hard, pelloidal, slightly to moderately Dolomitic packstone.

Depth (ft)	Thickness (ft)	Sample Description
2,040 – 2,050	10	DOLOMITE AND LIMESTONE – Dolomite 70% light olive gray (5Y 6/1) to dusky yellowish brown (10YR 2/2), very fine grained to cryptocrystalline, very hard, sucrosic. Limestone 30% very pale orange (10YR 8/2), medium to fine grained, moderately soft, rarely Dolomitic packstone. Trace medium gray (N5) to olive black (5Y 2/1) Limy Dolomite.
2,050 – 2,060	10	LIMESTONE – 100%; 70% Very pale orange (10YR 9/2), very fine grained to cryptocrystalline, hard carbonate mudstone. 30 % Very pale orange (10YR 8/2), medium to fine grained, moderately soft pelloidal packstone/grainstone.
2,060 - 2,070	10	DOLOMITE – 100%; 70% Moderate yellowish brown (10YR 5/4) to dark yellowish brown (10YR 4/2), very fine grained to cryptocrystalline, hard to very hard, locally very weakly vuggy, sucrosic. 30% Pale yellowish brown (10YR 6/2), fine to medium grained, moderately hard.
2,070 – 2,080	10	DOLOMITE AND CLAY – Dolomite 90% moderate yellowish brown (10YR 5/4) to dark yellowish brown (10YR 4/2), very fine grained to cryptocrystalline, hard to very hard, locally very weakly vuggy, sucrosic. Clay 10% olive gray (5Y 4/1) to medium bluish gray (5B 5/1), soft to moderately firm, moderately plastic, non calcareous, cohesive.
2,080 – 2,090	10	DOLOMITE AND LIMY DOLOMITE – Dolomite 60%, dark yellowish brown (10YR 4/2), cryptocrystalline, hard to very hard. Limy Dolomite 40%, grayish brown (5YR 3/2), cryptocrystalline to fine grained, hard to very hard with euhedral crystals common and with 5% very pale orange (10YR 8/2), carbonate mudstone matrix and trace tests. Trace Dolomitic Limestone.
2,090 – 2,120	30	LIMESTONE – 100% Grayish orange (10YR 7/4), fine to coarse grained, moderately soft to moderately hard, well indurated, pelloidal, partly Dolomitic packstone with few tests and fossils. Few to common forams.
2,120 – 2,160	40	LIMESTONE – 100% Grayish orange (10YR 7/4), medium to fine grained, moderately hard to moderately soft, well indurated, pelloidal, fossiliferous packstone to grainstone. Trace white (N9), very soft carbonate marl to 2140'. Trace to few forams. Trace Dolomite.
2,160 – 2,240	80	LIMESTONE – 100% Yellowish gray (5Y 8/1), fine to medium grained, moderately hard, moderately to well indurated, pelloidal, partly sparry slightly fossiliferous packstone with few forams.
2,240 – 2,250	10	LIMESTONE – 100% Very pale orange (10YR 8/2), dominantly fine to medium grained, moderately hard to hard, well indurated, pelloidal partly fossiliferous packstone with trace casts and molds.
2,250 – 2,310	10	LIMESTONE – 100% Yellowish gray (5Y 8/1), fine to medium grained, moderately hard, well indurated, pelloidal, partly fossiliferous, partly sparry packstone. Few to common forams. Trace tests. Trace white (N9), very soft carbonate marl at 2,300'.

Depth (ft)	Thickness (ft)	Sample Description
2,310 – 2,340	30	LIMESTONE – 100%; 85% As above. 15% Light greenish gray (5GY 8/1), fine to medium grained, moderately hard to moderately soft, fossiliferous packstone. Abundant fossils.
2,340 – 2,350	10	LIMESTONE – 100% Very pale orange (10YR 8/2), dominantly fine to medium grained, moderately hard, partly fossiliferous packstone. Trace Dolomitic Limestone.
2,350 – 2,370	20	LIMESTONE – 100%, 90% Very pale orange (10YR 8/2), dominantly fine to medium grained, moderately hard, partly fossiliferous packstone. 10% Light gray (N7) to dark gray (N5), fine grained to microcrystalline, moderately hard to hard, slightly Dolomitic mudstone.
2,370 – 2,400	30	LIMESTONE – 100% Very pale orange (10YR 8/2), dominantly fine to medium grained, moderately hard, partly fossiliferous packstone. Few echinoid fossils to 10mm in diameter. Trace very light gray (N8), very soft carbonate marl.
2,400 – 2,410	10	LIMESTONE – 100%; 60% Very pale orange (10YR 8/2), dominantly fine to medium grained, moderately hard, partly fossiliferous packstone. 40% Light greenish gray (5GY 8/1), cryptocrystalline to microcrystalline moderately soft, well indurated wackestone to locally mudstone with few fossils. Few 5mm to 10 mm echinoid tests and shell fragments.
2,410 - 2,440	30	LIMESTONE - 100%; 90% to 95% Very pale orange (10YR 8/2), dominantly fine to medium grained, moderately hard, partly fossiliferous, weakly pelloidal to pelloidal packstone with trace tests. 10% to 5% Very pale orange (10YR 8/2) to light greenish gray (5GY 8/1), dominantly microcrystalline to cryptocrystalline, hard to moderately hard carbonate mudstone to wackestone. Trace grayish orange (10YR 7/4), cryptocrystalline, very hard Dolomite and white (N9) carbonate marl. Few echinoids up to 10mm in diameter. Trace Dolomitic Limestone at 2,440'.
2,440 - 2,470	30	LIMESTONE – 100%, Very pale orange (10YR 8/2), medium to fine grained, moderately hard, well indurated, pelloidal, partly fossiliferous packstone. Trace yellowish gray (5Y 7/2), fine grained, hard carbonate mudstone at 2,450'. Sparry at 2,470'.
2,470 - 2,490	20	LIMESTONE – 100%; 90% As above. 10% Dark greenish gray (5GY 4/1), cryptocrystalline, hard carbonate mudstone. Trace white (N9), remineralized shell fragments (calcite) at 2,490'.
2,490 - 2,500	10	LIMESTONE – 100%; Grayish orange (10YR 7/2) to pale yellowish brown (10YR 6/2), medium to fine grained, moderately soft to moderately hard, pelloidal, fossiliferous, locally sparry, well indurated packstone. Trace crystalline carbonate.
2,500 - 2,510	10	LIMESTONE AND DOLOMITIC LIMESTONE - Limestone 80%, very pale orange (10YR 8/2), fine to medium grained, moderately soft, well indurated, pelloidal packstone. Dolomitic Limestone 20%, Grayish orange (10YR 7/2) to pale yellowish brown (10YR 6/2), medium to fine grained, moderately soft to moderately hard, pelloidal, fossiliferous, locally sparry, well indurated packstone with 5% to 10% fine grained euhedral Dolomite crystals.

Depth (ft)	Thickness (ft)	Sample Description
2,510 – 2,520	10	LIMESTONE – 100% Very pale orange (10YR 8/2), fine to medium grained, moderately hard to hard, very well indurated, pelloidal, fossiliferous packstone to wackestone with little crystalline carbonate.
2,520 – 2,540	20	LIMESTONE AND DOLOMITIC LIMESTONE – Limestone 80%, As above. Dolomitic Limestone 20%, grayish orange (10 YR 7/4), fine to medium grained, hard, fossiliferous packstone with tests and 20% to 50% fine grained euhedral to anhedral Dolomite crystals.
2,540 – 2,550	10	LIMESTONE - 100%; 90% Very pale orange (10YR 8/2), fine to medium grained, hard, pelloidal, fossiliferous packstone. 10% Medium gray (N5), cryptocrystalline, hard carbonate mudstone. Trace Dolomitic Limestone as above.
2,550 – 2,560	10	LIMESTONE - 100% Yellowish gray (5Y 7/2), dominantly fine to medium grained, hard to rarely soft, well indurated, pelloidal, locally weakly Dolomitic packstone.
2,560 – 2,570	10	LIMY DOLOMITE AND LIMESTONE – Limy Dolomite 70%, moderate yellowish brown (10YR 5/4), fine grained, hard with 10% to 50% very pale orange (10YR 8/2), cryptocrystalline to medium grained Limestone and tests. Limestone 30%, very pale orange (10YR 8/2), fine grained, moderately hard to moderately soft, pelloidal packstone.
2,570 – 2,580	10	LIMESTONE – 100% Pale yellowish brown (10YR 6/2), fine to medium grained, moderately soft to moderately hard, well indurated, pelloidal, fossiliferous packstone with few tests. Trace Dolomitic Limestone.
2,580 – 2,590	10	LIMESTONE – 100% Very pale orange (10YR 8/2) to grayish orange (10YR 7/4), fine to medium grained, moderately hard, well indurated, pelloidal packstone.
2,590 – 2,610	20	LIMESTONE – 100% Very pale orange (10YR 8/2) to grayish orange (10YR 7/4), fine grained, moderately hard, very well indurated, packstone to wackestone with forams common. Trace to little medium gray (N5), cryptocrystalline hard carbonate mudstone.
2,610 – 2,620	10	LIMESTONE – 100%; 80% Yellowish gray (5Y 8/1), fine grained, moderately soft to moderately hard, pelloidal, fossiliferous packstone to rarely grainstone. 10% Moderate yellowish brown (10YR 5/4), cryptocrystalline, very hard carbonate mudstone. 10% Medium light gray (N6), very fine grained, moderately hard carbonate mudstone.
2,620 – 2,640	20	LIMESTONE – 100%; 50% Yellowish gray (5Y 8/1), fine to medium grained, moderately hard to hard, well indurated, fossiliferous packstone to grainstone. 30% Medium gray (N5), fine grained, hard, pelloidal packstone with few mudstone clasts. 20% Olive black (5Y 4/1), dominantly cryptocrystalline to rarely fine grained, very hard carbonate mudstone.
2,640 – 2,650	10	LIMESTONE – 100%; 80% Medium dark gray (N4), dark gray (N3), olive gray (5Y 4/1) and yellowish gray (5Y 8/1), cryptocrystalline, hard to very hard, locally very weakly vuggy carbonate mudstone. 20% Yellowish gray (5Y 8/1), fine to medium grained, moderately hard packstone. Trace galuconite.

Depth (ft)	Thickness (ft)	Sample Description
2,650 – 2,660	10	LIMESTONE – 100%; 80% Yellowish gray (5Y 8/1), medium grained, moderately hard, pelloidal packstone. 20% Yellowish gray (5Y8/1), cryptocrystalline, hard carbonate mudstone.
2,660 – 2,670	10	LIMESTONE – 100% Grayish orange (10TR 7/3), very fine to fine grained, moderately hard, very well to well indurated, pelloidal packstone with little grainstone. Trace light olive gray (5Y 6/1), microcrystalline, moderately soft carbonate mudstone. Forams common.
2,670 – 2,710	40	LIMESTONE – 100%; 90% Very pale orange (10YR 8/2), fine to medium grained, moderately hard to hard, dominantly very well indurated, locally sparry packstone. 10% Yellowish gray (5Y 8/1), cryptocrystalline, hard carbonate mudstone. Few forams. Trace white (N9), very fine grained, very soft wackestone with carbonate marl matrix at 2,610'. Trace olive black (5Y 2/1), cryptocrystalline, hard carbonate mudstone below 2,700'.
2,710 – 2,720	10	LIMESTONE – 100% Yellowish gray (5Y 8/1), cryptocrystalline, hard, very well indurated, very weakly vuggy carbonate mudstone.
2,720 – 2,730	10	LIMESTONE – 100%; 80% As above. 20% Yellowish gray (5Y 8/1), fine grained, moderately hard pelloidal packstone.
2,730 – 2,740	10	LIMESTONE – 100%; 70% Very pale orange (10YR 8/2), fine grained, moderately soft, well indurated, pelloidal packstone. 30% Yellowish gray (5Y 8/1), cryptocrystalline, hard, very well indurated, very weakly vuggy carbonate mudstone.
2,740 – 2,770	30	LIMESTONE – 100% Very pale orange (10YR 8/2), dominantly fine to medium grained, moderately soft, pelloidal packstone.
2,770 – 2,780	10	LIMESTONE – 100%; 80% Very pale orange (10YR 8/2) to grayish orange (10YR 7/4), fine to medium grained, moderately soft packstone. 20% Light olive gray (5Y 6/1) to olive black (5Y 2/1), cryptocrystalline to microcrystalline, hard, locally vuggy carbonate mudstone.
2,780 – 2,810	30	LIMESTONE – 100%; 70% to 80% Very pale orange (10YR 9/2), microcrystalline to very fine grained, moderately soft, moderately indurated carbonate mudstone/wackestone. 20% to 30% Very pale orange (10YR 8/2), dominantly fine to medium grained, moderately hard, pelloidal, partly fossiliferous packstone. Few forams. Trace to little medium gray (N5) to dark gray (N4), microcrystalline Dolomitic carbonate marl with few prominent mottles.
2,810 – 2,830	20	LIMESTONE – 100%; 95% Very pale orange (10YR 8/2), dominantly fine to medium grained, moderately soft to moderately hard, pelloidal, partially weakly fossiliferous packstone. 5% Very pale orange (10YR 9/2) to yellowish gray (5Y 8/1), fine grained to microcrystalline, moderately hard mudstone to wackestone. Trace medium gray (N5), carbonate marl.

Depth (ft)	Thickness (ft)	Sample Description
2,830 – 2,840	10	LIMESTONE – 100%; 80% Very pale orange (10YR 8/2), microcrystalline to very fine grained, moderately soft, moderately indurated carbonate mudstone/wackestone. 15% Medium dark gray (N4), microcrystalline, hard carbonate mudstone. 5% Very pale orange (10YR 8/1),, microcrystalline to very fine grained, hard to moderately hard, locally pelloidal carbonate mudstone to wackestone.
2,840 – 2,850	10	LIMESTONE – 100%; 80% Very pale orange (10YR 8/2), dominantly fine to medium grained, moderately soft to moderately hard, pelloidal, partially weakly fossiliferous packstone. 15% Light olive gray (5Y 6/1) to greenish gray (5GY 6/1), microcrystalline to very fine grained, moderately soft to moderately hard, weakly vuggy, slightly argillaceous carbonate mudstone. 5% Very pale orange (10YR 8/2), microcrystalline to very fine grained, hard to moderately hard, locally pelloidal mudstone to wackestone.
2,850 – 2,870	20	LIMESTONE - 100%; 60% Very pale orange (10YR 8/2), dominantly fine to medium grained, moderately soft to moderately hard, pelloidal, partially weakly fossiliferous packstone. 40% White (N9),, dominantly medium to coarse grained, soft, slightly fossiliferous, pelloidal packstone. Trace foram tests.
2,870 - 2,880	10	LIMESTONE AND DOLOMITE – Limestone 60%, white (N9), dominantly medium to coarse grained, soft to moderately hard pelloidal packstone. Dolomite 40%, pale yellowish brown (10YR 6/2) to locally dark greenish gray (5GY 4/1), varying to dark gray (N3), coarse grain sized crystals, hard to very hard, partly sucrosic.
2,880 - 2,890	10	DOLOMITE AND LIMESTONE – Dolomite 60%; 50% dark greenish gray (5GY 4/1) to dark gray (N3), microcrystalline, hard to very hard, sucrosic. 10% Pale yellowish brown (10YR 6/2), coarse grain sized, crystalline, hard. Limestone 40% very pale orange (10YR 8/2), fine to locally medium grained, soft to moderately hard packstone.
2,890 - 2,900	10	LIMESTONE AND DOLOMITE – Limestone 90%, white (N9), medium to coarse grained, soft to moderately hard, well indurated, pelloidal packstone. Dolomite 10%, dark greenish gray (5GY 4/1) to dark gray (N3), microcrystalline, very hard.
2,900 -2,910	10	DOLOMITE AND LIMESTONE – Dolomite 60%, light gray (N7) to greenish gray (5GY 6/1), cryptocrystalline to microcrystalline, very hard, very well indurated. Limestone 40%, very pale orange (10YR 8/2), medium to coarse grained, soft to moderately hard, pelloidal to oolitic packstone. Few shell fragments within matrix ranging from 2 mm to 10 mm.
2,910 - 2,920	10	DOLOMITIC LIMESTONE, LIMY DOLOMITE AND DOLOMITE – Dolomitic Limestone 80%, yellowish gray (5Y 8/1), cryptocrystalline to microcrystalline, hard, very well indurated, moderately vuggy mudstone to wackestone, vugs filled with grayish orange (10YR 7/4) Dolomite. Limy Dolomite 15%, medium gray (N5) to dark greenish gray (5GY 4/1), microcrystalline, hard, well indurated. Dolomite 5%, light olive gray (5Y 6/1) to very pale orange (10YR 8/2), microcrystalline to fine grained, very hard, locally sucrosic with thin Dolomite laminations.

Depth (ft)	Thickness (ft)	Sample Description
2,920 - 2,930	10	DOLOMITE AND LIMESTONE – Dolomite 95%, yellowish gray (5Y 8/1) to very pale orange (10YR 8/2), microcrystalline to fine grained, partially sucrosic, very hard, locally weakly vuggy. Limestone 5%, white (N9), cryptocrystalline to medium grained, moderately hard, partially pelloidal packstone.
2,930 - 2,940	10	DOLOMITE – 100%, 50% Yellowish gray (5Y 8/1) as above. Dolomite 50%; 30% Light olive gray (5Y 6/1), microcrystalline to fine grained crystalline carbonate, very hard, very well indurated. 20%, Grayish orange (10YR 7/4), microcrystalline to coarse grained, very hard euhedral crystals.
2,940 - 2,950	10	DOLOMITE AND LIMESTONE – Dolomite 80%, grayish orange (10YR 7/3), microcrystalline, very hard. Limestone 10%, very pale orange (10YR 8/2), fine grained, moderately hard to moderately soft, pelloidal packstone. 10% Limestone, very pale orange (10YR 8/2), very fine grained, hard wackestone.
2,950 - 2,960	10	DOLOMITE AND LIMESTONE – Dolomite 70%; 40% yellowish gray (5Y 8/2), dominantly cryptocrystalline to very fine grained, very hard, weakly vuggy, vugs filled with moderate yellowish brown (10YR 5/4), very fine grained Dolomite crystals. Occasional fully healed fractures filled with Dolomite crystals as above. Occasionally encrusted with medium grained subhedral to anhedral Dolomite crystals. 20% Dark yellowish brown (10YR 4/2), microcrystalline, very well indurated, very hard. 10% Light olive gray (5Y 6/1), microcrystalline, very hard, weakly vuggy. Limestone 30%, very pale orange (10YR 8/2), fine to medium grained, moderately hard packstone to grainstone with few forams.
2,960 – 3,000	40	DOLOMITE AND LIMESTONE – Dolomite 70% to 60%, pale yellowish brown (10YR 6/2), microcrystalline to cryptocrystalline, very hard, very well indurated. Limestone 30% to 40%, 20% to 30%, very pale orange (10YR 8/2), fine to medium grained, moderately soft to hard, pelloidal packstone to grainstone with trace molds. 10% Very pale orange (10YR 8/2), cryptocrystalline to very fine grained, hard, very well indurated carbonate mudstone. Trace foram tests.
3,000 – 3,010	10	DOLOMITE – 100% Yellowish brown (10YR 6/4), cryptocrystalline to fine grained, very hard.
3,010 – 3,020	10	DOLOMITE – 100%; 80% Grayish orange (10YR 8/4), cryptocrystalline to rarely very fine grained, very hard, weakly vuggy, vugs lined and filled with Dolomite crystals, local fractures fully healed with Dolomite crystals. 20% Olive gray (5Y 3/2) to light olive gray (5Y 5/2), microcrystalline to cryptocrystalline, very hard.
3,020 - 3,030	10	DOLOMITE – 100%; 80% Grayish orange (10YR 8/4), cryptocrystalline to rarely very fine grained, very hard, weakly vuggy, vugs lined and filled with Dolomite crystals, local fractures fully healed with Dolomite crystals. 20% Yellowish brown (10YR 6/4), coarse grained to cryptocrystalline, very hard, locally very weakly vuggy.

Depth (ft)	Thickness (ft)	Sample Description
3,030 - 3,040	10	DOLOMITE – 100% Yellowish gray (5Y 8/1 to 5Y 7/1), microcrystalline to cryptocrystalline, very hard, slightly calcareous, locally weakly vuggy, vugs lined with fine to very fine grained euhedral Dolomite crystals with trace white (N9) Limestone inclusions.
3,040 - 3,060	20	DOLOMITE – 100% Moderate yellowish brown (10YR 5/4) to pale yellowish brown (10YR 6/2), microcrystalline to rarely locally medium grained, very hard, dominantly sucrosic with trace white (N9), Limestone. Few prominent mottles at 3,060'.
3,060 - 3,080	20	DOLOMITE – 100% Dark yellowish brown (10YR 4/2), light olive gray (5Y 6/1) and yellowish gray (5Y 8/1), cryptocrystalline to coarse grained euhedral crystals, very hard, local fractures fully healed with Dolomite crystals. Trace very light gray (N8), fractured hard Limestone at 3,070', fractures fully healed with very fine to fine grained Dolomite crystals. Trace white (N9) carbonate mudstone lenses at 3,080.
3,080 - 3,090	10	DOLOMITE – 100%; 60% Pale yellowish brown (10YR 6/2) to dark yellowish brown (10YR 6/2), cryptocrystalline to fine grained, very hard, locally fossiliferous. 40% Pale yellowish brown (10YR 6/2), cryptocrystalline, very hard, local fractures fully healed with Dolomite crystals.
3,090 - 3,110	20	DOLOMITE – 100%; 90% Light olive gray (5Y 6/1), cryptocrystalline, very hard. 10% Moderate yellowish brown (10YR 5/4), cryptocrystalline to medium grained, very hard euhedral to anhedral crystals.
3,110 - 3,120	10	DOLOMITE – 100% Dark yellowish brown (10YR 4/2) to pale yellowish brown (10YR 6/2), dominantly very fine grained to cryptocrystalline, rarely coarse grained, subhedral crystals, very hard, sucrosic.
3,120 - 3,130	10	DOLOMITE – 100%, Yellowish brown (10YR 5/2) to dark yellowish brown (10YR 4/2), cryptocrystalline to microcrystalline, very hard. Rare fractures healed with fine to medium euhedral Dolomite crystals.
3,130 - 3,140	10	DOLOMITE – 100%, Olive gray (5Y 5/1), dominantly cryptocrystalline vuggy with vugs filled with euhedral to subhedral, medium to coarse Dolomite crystals.
3,140 - 3,150	10	DOLOMITE – 100%; 70% Pale yellowish brown (10YR 6/2), fine grained to microcrystalline, sucrosic, very hard, slightly calcareous with few limestone inclusions. 30% Light olive gray (5Y 7/1), very fine grained to microcrystalline, very hard, slightly calcareous. Trace light olive gray (5Y 4/2 to 5/2),, fine grained, very hard, locally weakly vuggy Dolomite with coarse grained Dolomite crystals filling vugs.
3,150 - 3,160	10	DOLOMITE – 100%, Yellowish gray (5Y 8/1 to 7/1), microcrystalline to cryptocrystalline, very hard, slightly calcareous, locally weakly vuggy with vugs lined with fine to medium euhedral Dolomite crystals.

Depth (ft)	Thickness (ft)	Sample Description
3,160 - 3,180	20	DOLOMITE – 100%, 70% Yellowish gray (5Y 7/2), microcrystalline to cryptocrystalline, very hard with few limestone inclusions. 20% Yellowish gray (5Y 7/2), cryptocrystalline to fine grained, commonly weakly vuggy and fractured, vugs and fractures healed with euhedral Dolomite crystals. 10% Light olive gray (5Y 5/2), medium grain sized, subhedral, very hard crystals. Trace white (N9), soft carbonate mudstone at 3,160'.
3,180 - 3,190	10	DOLOMITE – 100%, Yellowish gray (5Y 8/1) to light olive gray (5Y 7/1), cryptocrystalline, very hard with few distinct mottles and with fine to medium grained euhedral Dolomite crystals filling vugs and fractures.
3,190 - 3,210	20	DOLOMITE – 100%, Yellowish brown (10YR 5/2), dominantly cryptocrystalline to very fine grained, very hard, sucrosic.
3,210 - 3,220	10	DOLOMITE – 100%, Pale yellowish brown (10YR 6/2) to light olive gray (5Y 6/1), dominantly cryptocrystalline to very fine grained, very hard. Rare medium light gray (N6), very fine grained Limy Dolomite inclusions.
3,220 - 3,240	20	DOLOMITE – 100%, Dark yellowish brown (10YR 4/2 to 5/2), dominantly very fine grained to microcrystalline, rarely medium grained, very hard with little pale yellowish brown (10YR 6/2) and grayish orange (10YR 7/4), very fine grained to microcrystalline, hard Dolomite and rare fractures filled with euhedral to subhedral Dolomite crystals.
3,240 - 3,260	20	DOLOMITE - Olive gray (5Y 4/1 to 5/1), dominantly fine grained, hard, anhedral to subhedral crystals. Trace medium gray (N5), fine to medium grained, moderately hard, sucrosic, subhedral Dolomite crystals.
3,260 - 3,280	20	DOLOMITE – 100%, Dark yellowish brown (10YR 4/2) to yellowish brown (10YR 5/2), dominantly fine grained to very fine grained, locally medium grained, partially weakly vuggy, moderately hard with rare calcareous inclusions.
3,280 - 3,290	10	DOLOMITE – 100%, Pale orange (10YR 7/2), dominantly fine to very fine grained, locally coarse grained euhedral crystals, moderately hard, weakly indurated. Trace white (N9), microcrystalline, moderately soft carbonate mudstone.
3,290 - 3,300	10	DOLOMITE – 100%; 60% Pale orange (10YR 7/2) to very pale orange (10YR 8/2), dominantly fine grained, moderately hard subhedral crystals, locally weakly vuggy. 40% Dark yellowish brown (10YR 4/2) to yellowish brown (10YR 5/2), mostly fine grained, rarely coarse grained, moderately hard.
3,300 - 3,310	10	DOLOMITE – 100%; 60% Dark yellowish brown (10YR 4/2) to yellowish brown (10YR 5/2), dominantly fine grained, rarely subhedral coarse grained, hard, locally weakly vuggy with few very fine grained Dolomitic inclusions. 40% Pale orange (10YR 7/2), mostly fine grained to medium grained, moderately hard.

Depth (ft)	Thickness (ft)	Sample Description
3,310 - 3,320	10	DOLOMITE – 100%, 90% Yellowish brown (10YR 5/2), dominantly fine grained anhedral to locally medium grained subhedral, moderately hard. 10% Dark yellowish brown (10YR 5/4), fine grained, hard.
3,320 - 3,340	20	DOLOMITE – 100% Moderate yellowish brown (10YR 5/4) to dark yellowish brown (10YR 4/2) and grayish orange (10YR 7/4), dominantly fine grained to microcrystalline, very hard, vuggy with vugs locally lined with medium grained euhedral Dolomite crystals. Few pale orange (10YR 7/2), fine grained, hard Dolomitic inclusions.
3,340 - 3,350	10	DOLOMITE – 100% Dark yellowish brown (10YR 4/2) to pale yellowish brown (10YR 6/2), microcrystalline to cryptocrystalline, very hard and sucrosic.
3,350 - 3,360	10	DOLOMITE – 100%; 50% Moderate yellowish brown (10YR 5/4), microcrystalline to very fine grained, moderately hard. 30% Dusky yellowish brown (10YR 2/2) to dark yellowish brown (10YR 4/2), very fine grained to microcrystalline, hard to very hard, weakly laminated, sucrosic with trace white (N9) Limestone inclusions. 20% Yellowish brown (10YR 4/4), fine grained, moderately hard, vuggy. Trace greenish black (5GY 2/1), fine to medium grained, hard, weakly vuggy Dolomite.
3,360 – 3,380	20	DOLOMITE – 100% Pale yellowish brown (10YR 4/2) to moderate yellowish brown (10 YR 5/4), microcrystalline to cryptocrystalline, hard to very hard, sucrosic.
3,380 – 3,390	10	DOLOMITE – 100% Dark yellowish brown (10YR 3/2), cryptocrystalline to microcrystalline, very hard, very weakly vuggy.
3,390 – 3,400	10	DOLOMITE – 100%; 80% Dusky yellowish brown (10YR 6/2 to 10YR 7/2), dominantly microcrystalline to cryptocrystalline, hard, locally weakly vuggy. 20% Yellowish brown (10YR 7/2), cryptocrystalline to microcrystalline, hard, weakly vuggy.
3,400 – 3,410	10	DOLOMITE – 100% Pale yellowish brown (10YR 6/2 to 10YR 7/2), dominantly cryptocrystalline to microcrystalline, hard, with rare closed fractures and vugs, vugs lined with medium to coarse grained euhedral to subhedral Dolomite crystals
3,410 – 3,420	10	DOLOMITE – 100%; 60% Dark yellowish brown (10YR 4/2), cryptocrystalline to microcrystalline, hard, with subhedral crystals. 40% Dark gray (N3), dominantly cryptocrystalline to microcrystalline, hard, with trace very pale orange (10YR 8/2), microcrystalline, hard, Limestone inclusions.
3,420 – 3,430	10	DOLOMITE – 100%; 85% Dark yellowish brown (10YR 4/2 to 10YR 5/2), dominantly fine grained to microcrystalline, very hard, sucrosic. 15% Pale yellowish brown (10YR 6/2), fine grained, moderately hard subhedral crystals, locally weakly laminated. Trace very pale orange (10YR 8/2), fine grained, moderately hard, sucrosic, slightly calcareous Dolomite

Depth (ft)	Thickness (ft)	Sample Description
3,430 – 3,440	10	DOLOMITE – 100% Dusky yellowish brown (10YR 2/2) to dark yellowish brown (10YR 4/2), dominantly microcrystalline to cryptocrystalline, locally fine grained subhedral crystals, hard with rare Limestone inclusions. Trace dusky yellowish brown (10YR 2/2) to black (N1), coarse to medium grained, hard Dolomite.
3,440 – 3,450	10	DOLOMITE 100%; 90% Pale yellowish brown (10YR 6/2 to 10YR 7/2), microcrystalline to fine grained, hard, subhedral crystals. 10% Dark yellowish brown (10YR 4/2), microcrystalline to cryptocrystalline, rarely locally vuggy with rare fully healed fractures filled with dark yellowish brown (10YR 3/2), euhedral to subhedral coarse to medium grained Dolomite crystals.
3,450 – 3,460	10	DOLOMITE – 100%; 90% Pale yellowish brown (10YR 7/2), very fine grained to microcrystalline, hard, locally weakly vuggy, partly sucrosic. 10% Dark yellowish brown (10YR 4/2), dominantly microcrystalline to very fine grained subhedral crystals, hard to very hard, thinly laminated and fractured.
3,460 – 3,500	40	DOLOMITE – 100%; 70% Grayish orange (10YR 7/4), very fine grained to microcrystalline, hard, sucrosic, locally weakly vuggy. 30% Pale yellowish brown (10YR 6/2), fine grained, moderately hard, partly vuggy. Trace yellowish gray (5Y 8/1) to white (N9), very fine grained, moderately hard, slightly calcareous Dolomite.

Injection Well No. 2 – Lithology

Geologic Log

GEOLOGIC LOG
(Drill Cuttings)
CITY OF HOLLYWOOD EFFLUENT DISPOSAL SYSTEM
SOUTHERN REGIONAL WWTP
INJECTION WELL IW - 2

Depth (ft)	Thickness (ft)	Sample Description
0 - 10	10	LIMESTONE AND ORGANICS – Limestone 95% very pale orange (10YR 8/2 to yellowish gray (5Y 8/1) very fine grained to microcrystalline, hard, locally slightly sandy wackestone to packstone. Organics 5% brownish black (5YR 2/1), soft. Trace medium grained quartz sand, crystalline carbonate and shell fragments.
10 - 20	10	LIMESTONE – 100% Very pale orange (10YR 8/2) to yellowish gray (5Y 8/1) fine to medium grained, hard, pelloidal packstone to rarely wackestone with trace tests.
20 - 30	10	SANDSTONE AND LIMESTONE – Sandstone 80%, yellowish gray (5Y 7/2), fine to coarse grained dominantly medium grained, subangular quartz sand, well cemented with calcite, slightly phosphatic. Limestone 20% as above.
30 - 40	10	LIMESTONE – 100%; 80% Pale yellowish brown (10YR 6/2) to moderate yellowish brown (10YR 5/4), microcrystalline to fine grained, moderately hard to hard, locally slightly sandy wackestone. 20% Pale yellowish brown (10YR 6/2) fine to medium grained, hard, fossiliferous, highly sparry packstone. Trace to little crystalline carbonate.
40 - 50	10	SANDY LIMESTONE AND LIMESTONE – Sandy Limestone 80% pale yellowish brown (10YR 6/2) to yellowish gray (5Y 7/2), fine to medium grained, hard, highly sparry, locally weakly phosphatic grainstone to locally packstone with abundant colorless fine grained quartz sand. Limestone 20% white (N9) to yellowish gray (5Y 9/1), microcrystalline to fine grained locally cryptocrystalline, moderately hard to hard, fossiliferous packstone to locally grainstone.
60 - 90	30	LIMESTONE – 100% Yellowish gray (5Y 7/2) to locally dusky yellow (5Y 5/4 to 5Y 6/4), fine to coarse grained dominantly medium grained, hard, subhedral to euhedral calcite crystals, locally phosphatic, highly sparry porous grainstone to locally packstone rarely wackestone with abundant colorless fine grained quartz sand. Trace white (N9) cryptocrystalline, very soft marl. Trace fine grained quartz Sandstone well cemented with calcite. Trace shell fragments and forams.
90 – 130	40	LIMESTONE – 100% Yellowish gray (5Y 6/2 to 5Y 7/2) fine to medium grained, hard sparry grainstone to locally wackestone. Trace to little fine grained quartz sandstone cemented with calcite. Trace shell fragments.
130 – 150	20	SANDY LIMESTONE – 100% Yellowish gray (5Y 7/2 to 5Y 8/2) dominantly coarse to medium grained, moderately hard to hard, sparry partially pelloidal, locally slightly phosphatic packstone to grainstone with medium grained subangular to subrounded quartz

Depth (ft)	Thickness (ft)	Sample Description
		sand.
150 – 170	20	LIMESTONE AND SANDY LIMESTONE – Limestone 80% to 70% yellowish gray (5Y 7/2) to grayish orange (10YR 7/4) fine to coarse grained, hard pelloidal, fossiliferous, highly sparry, slightly phosphatic packstone. Sandy Limestone 20% to 30% yellowish gray (5Y 7/2) medium grained, hard, pelloidal packstone with medium grained quartz sand and few shell fragments.
170 – 180	10	SANDY LIMESTONE AND LIMY SANDSTONE – Sandy Limestone 60% light greenish gray (5GY 8/1) medium to coarse grained, hard pelloidal, fossiliferous, slightly phosphatic packstone with fine to medium grained quartz sand. Limy Sandstone 40% light olive gray (5Y 6/1) fine grained, hard, well cemented with calcite and with detrital carbonate.
180 – 190	10	LIMESTONE – 100% Yellowish gray (5Y 7/2) fine to coarse grained, hard, pelloidal fossiliferous, highly sparry, locally weakly vuggy, slightly phosphatic wackestone to packstone.
190 – 200	10	SANDY LIMESTONE AND LIMESTONE – Sandy Limestone 60% yellowish gray (5Y 7/2) to light greenish gray (5GY 8/1) fine to medium grained, pelloidal, slightly phosphatic packstone with fine to medium grained angular quartz sand. Limestone 40% As Above.
200 – 210	10	LIMESTONE AND SHELL FRAGMENTS – Limestone 95% light greenish gray (5GY 8/1) dominantly medium grained to microcrystalline, moderately hard, fossiliferous packstone to locally grainstone with abundant fine grained quartz sand. 5% Shell fragments and forams.
210 – 230	20	LIMESTONE – 100%; 70% Yellowish gray (5Y 8/1) medium to coarse grained, moderately hard, sparry packstone. 30% Yellowish gray (5Y 7/2) microcrystalline to cryptocrystalline, hard wackestone with little to abundant medium to coarse grained quartz sand. Shell fragments common.
230 - 250	20	LIMESTONE – 100% Yellowish gray (5Y 8/1) fine to coarse grained, hard sparry, weakly phosphatic, locally slightly sandy packstone.
250 – 260	10	SANDY LIMESTONE AND LIMESTONE – Sandy Limestone 60% greenish gray (5GY 6/1) to 5GY 7/1) microcrystalline to cryptocrystalline, hard, weakly phosphatic wackestone with fine grained angular quartz sand. Limestone 40% As Above.
260 - 350	90	LIMY SANDSTONE – 100% Greenish gray (5GY 6/1 to 5GY 7/1) fine grained, hard, well sorted, subangular to subrounded, well cemented with calcite, weakly phosphatic with fine to medium grained detrital carbonate. Locally weakly glauconitic at 330. Few shell fragments at 350.
350 - 360	10	LIMY SANDSTONE, CLAY AND SANDY LIMESTONE – Limy Sandstone 40% greenish gray (5GY 6/1 to 5GY 7/1) as above. Clay 40% pale olive (10Y 6/2), soft to moderately soft, moderately plastic, calcareous, slightly sandy and phosphatic. Sandy Limestone 20% yellowish gray (5Y 7/2), cryptocrystalline to microcrystalline, hard, slightly phosphatic wackestone to packstone with abundant colorless fine to medium grained, subangular, moderately sorted quartz sand.

Depth (ft)	Thickness (ft)	Sample Description
		Trace euhedral crystals of calcite. Trace shell fragments.
360 - 370	10	SANDY LIMESTONE – 100% Yellowish gray (5Y 7/2) cryptocrystalline to microcrystalline, hard, phosphatic wackestone to packstone with abundant colorless fine to medium grained rarely coarse grained, subangular, moderately sorted quartz sand. Few medium gray (N5) to medium light gray (N6), fine grained, well sorted, angular quartz sand well cemented with calcite.
370 - 380	10	CLAYEY SANDY LIMESTONE AND LIMY SANDSTONE – Clayey Sandy Limestone 60% pale olive (10Y 6/2) very fine to fine grained, moderately soft, slightly phosphatic wackestone with abundant clay and fine grained quartz sand. Limy Sandstone 40% light medium gray (N6), fine grained, hard to very hard, well sorted, subangular to subrounded, well cemented with calcite, weakly phosphatic to locally phosphatic with little detrital carbonate.
380 - 450	70	CLAYEY LIMESTONE – 100% Pale olive (10Y 6/2) to pale greenish yellow (10Y 8/2), very fine to fine grained, moderately soft, slightly phosphatic to locally phosphatic wackestone with little clay.
450 - 500	50	CLAYEY SANDY LIMESTONE – 100% Pale olive (10Y 6/2) very fine to fine grained, moderately soft, slightly phosphatic to locally phosphatic wackestone to packstone with little clay and abundant very fine grained quartz sand.
500 - 520	20	LIMY CLAY AND CLAYEY SANDY LIMESTONE – Limy Clay 70%, pale olive (10Y 6/2), moderately soft to soft, non-plastic, slightly phosphatic with abundant very fine grained sand and detrital carbonate. Clayey Sandy Limestone 30% as above. Trace olive black (5Y 2/1) chert at 510'.
520 - 550	30	LIMY CLAY – 100% Pale olive (10Y 6/2), moderately soft to soft, non-plastic to weakly plastic, slightly phosphatic with little very fine grained quartz sand and detrital carbonate.
550 - 690	140	SANDY LIMY CLAY – 100% Pale olive (10Y 6/2), moderately soft to firm, non-plastic, slightly phosphatic to locally little phosphatic, friable with abundant very fine grained quartz sand and very fine to fine grained detrital carbonate matrix.
690 - 700	10	SANDY CLAY – 100% Light olive gray (5Y 6/1), very soft to soft, non-plastic, non-cohesive, with very fine grained quartz sand and very fine to fine grained detrital carbonate.
700 - 730	30	SANDY CLAY – 100% Light olive gray (5Y 6/1), firm to soft, locally plastic, highly calcareous with abundant very fine grained quartz sand.
730 - 740	10	SANDY LIMY CLAY – 100% Pale olive (10Y 6/2), firm to soft, friable, non-plastic to low plasticity, slightly phosphatic with abundant very fine grained quartz sand and very fine to fine grained detrital carbonate. Trace crystalline quartz.
740 - 750	10	SANDY LIMY CLAY – 100% Pale olive (10Y 6/2), firm to very soft, non-plastic to moderate plasticity, slightly phosphatic with abundant very fine grained quartz sand and very fine to fine grained detrital carbonate.

Depth (ft)	Thickness (ft)	Sample Description
750 - 760	10	SANDY LIMY CLAY – 100% Pale olive (10Y 6/2), firm to soft, non-plastic to low plasticity, slightly phosphatic with abundant very fine grained quartz sand and very fine to fine grained detrital carbonate.
760 - 780	20	SANDY LIMY CLAY – 100% Pale olive (10Y 6/2), very soft, moderately plastic to plastic, non-cohesive, slightly phosphatic, highly calcareous with little very fine grained quartz sand.
780 - 800	20	LIMY CLAY AND PHOSPHORITE – Limy Clay 90% pale olive (10Y 6/2), very soft to locally firm, low-plasticity to plastic, phosphatic, calcareous. Phosphorite 10% brownish black (5YR 2/1) to black (N1), microcrystalline to cryptocrystalline, hard to very hard, clayey and slightly calcareous.
800 - 820	20	SANDY LIMY CLAY – 100% Pale greenish yellow (10Y 7/2), firm to very soft, non-plastic to plastic, cohesive to non-cohesive, moderately phosphatic to highly phosphatic, calcareous with little very fine grained quartz sand and abundant fine grained detrital carbonate. Trace olive gray (5Y 3/2) cryptocrystalline, very hard chert.
820 - 830	10	CLAY AND PHOSPHORITE – Clay 90% grayish olive (10Y 5/2), soft, cohesive, highly plastic, locally weakly phosphatic, weakly calcareous, glauconitic. Phosphorite 10% brownish black (5YR 2/1) to black (N1), microcrystalline to cryptocrystalline, hard to very hard, slightly bituminous and weakly calcareous.
830 - 850	20	CLAY AND CHERT – Clay 90% As above. Chert 10% olive gray (5Y 3/2), cryptocrystalline, very hard.
850 - 880	30	CLAY – 100% As above. Trace olive gray (5Y 3/2) cryptocrystalline, very hard chert and phosphorite.
880 - 900	20	LIMESTONE – 100% Light greenish gray (5GY 7/1 to 5GY 8/1) microcrystalline to very fine grained, moderately hard, locally slightly sandy, weakly clayey packstone with abundant fine grained phosphorite
900 - 920	20	LIMESTONE – 100% Greenish gray (5GY 6/1 to 5Y 7/1) to light bluish gray (5B 8/1) microcrystalline to coarse grained, moderately hard to hard, locally sandy, locally highly phosphatic fossiliferous packstone. Trace fossil burrows and white (N9) to very light gray (N8), cryptocrystalline, very soft, plastic marl. Trace forams.
920 - 940	20	LIMESTONE – 100%; 80% Medium light gray (N6) medium to coarse grained, hard, fossiliferous, slightly sparry, partly micritic packstone to wackestone. 20% Light olive gray (5Y 6/1) to yellowish gray (5Y 8/1), fine to medium grained, hard, fossiliferous wackestone. Trace forams and brownish black (5Y 2/1), cryptocrystalline, very hard dolomite, and white (N9), very soft, plastic marl.
940 – 970	30	LIMESTONE AND MARL – Limestone 80%; 50% yellowish gray (5Y 8/1) fine to coarse grained, hard, pelloidal, locally sparry, slightly phosphatic packstone. 30% Light bluish gray (5B 7/1) fine to medium grained, hard, pelloidal wackestone to carbonate mudstone. Trace casts. Marl 20% white (N9) very soft.

Depth (ft)	Thickness (ft)	Sample Description
970 – 980	10	LIMESTONE – 100%; 70% Yellowish gray (5Y 7/2) medium grained, hard, pelloidal packstone/wackestone. 30% Light bluish gray (5B 7/1) microcrystalline to fine grained, very hard, slightly phosphatic carbonate mudstone. Trace to few forams.
980 - 1000	20	LIMESTONE – 100%; 60% Yellowish gray (5Y 8/1) fine to coarse grained, moderately soft, pelloidal, fossiliferous grainstone to packstone. 20% Yellowish gray (5Y 8/1) cryptocrystalline, hard carbonate mudstone. 20% Light bluish gray (5B 7/1) medium to very fine grained hard, phosphatic wackestone. Forams common.
1000 - 1020	20	LIMESTONE – 100% Very pale orange (10YR 8/2) medium to fine grained, moderately soft, pelloidal grainstone/packstone.
1020 - 1040	20	LIMESTONE – 100% Very pale orange (10YR 8/2) coarse to fine grained, moderately hard, pelloidal, slightly fossiliferous, locally sparry grainstone to packstone. Molds and burrows common at 1040.
1040 - 1050	10	LIMESTONE – 100%; 60% Very pale orange (10YR 8/2) fine grained, hard, fossiliferous, locally weakly vuggy wackestone to carbonate mudstone. 40% As above.
1050 - 1070	20	LIMESTONE – 100%; 70% Pale grayish orange (10YR 8/4) very fine to fine grained, moderately soft wackestone. 30% Grayish orange (10YR 7/4) medium grained, soft, pelloidal grainstone. Abundant forams. Trace very pale orange (19YR 9/2) very soft carbonate marl.
1070 - 1080	10	LIMESTONE – 100% Medium gray (N5) to medium light gray (N6) to rarely to yellowish gray (5Y 7/2) medium to fine grained, moderately hard, pelloidal, fossiliferous, locally weakly vuggy grainstone to wackestone. Forams common.
1080 - 1090	10	LIMESTONE – 100%; 80% As above. 20% Very pale orange (10YR 9/2), cryptocrystalline, hard, weakly vuggy carbonate mudstone.
1090 - 1100	10	LIMESTONE – 100% Grayish orange (10YR 7/4) very fine to medium grained, moderately hard, fossiliferous packstone to wackestone.
1100 - 1110	10	LIMESTONE – 100% Pale yellowish brown (10YR 7/2), microcrystalline, hard, weakly vuggy carbonate mudstone.
1110 - 1150	40	LIMESTONE – 100% Yellowish gray (5Y 8/1) to pale yellowish brown (10YR 6/2), fine to medium grained, moderately soft to hard, pelloidal, locally fossiliferous packstone to wackestone with some casts and molds. Few forams to common echinoids to 10 mm from 1130 to 1150.
1150 - 1160	10	LIMESTONE – 100% Moderate yellowish brown (10YR 5/4) fine to medium grained, moderately hard, pelloidal, fossiliferous packstone with abundant forams.
1160 - 1170	10	LIMESTONE – 100%; 60% As above. 40% Pale yellowish brown (10YR 6/2) fine to medium grained, hard, fossiliferous, weakly vuggy wackestone to carbonate mudstone. Abundant forams.

1170 - 1180	10	LIMESTONE – 100% Pale yellowish brown (10YR 6/2 to 10YR 7/2) fine to medium grained, hard, pelloidal, fossiliferous, locally weakly vuggy packstone with abundant forams and common up to 10 mm echinoids. Common fossil casts and molds.
1180 - 1200	20	LIMESTONE – 100%; 90% Pale yellowish brown (10YR 7/2) fine to medium grained, moderately hard to hard, pelloidal, fossiliferous, weakly vuggy packstone to locally wackestone with abundant forams. 10% Very light gray (N8) to white (N9), microcrystalline to fine grained, hard, locally vuggy to weakly vuggy, partly fossiliferous, pelloidal wackestone to locally packstone. Trace very pale orange (10YR 8/2 to 10YR 7/2), microcrystalline to cryptocrystalline, locally vuggy carbonate mudstone.
1200 - 1210	10	LIMESTONE – 100% Pale yellowish brown (10YR 7/2) to very pale orange (10YR 8/2), fine to medium grained, hard, pelloidal, weakly vuggy, fossiliferous to locally highly fossiliferous packstone.
1210 - 1250	40	LIMESTONE – 100%; 50% to 60% Pale yellowish brown (10YR 7/2) to very pale orange (10YR 8/2) fine to medium grained, hard, pelloidal, fossiliferous, weakly vuggy packstone. 50% to 40% Very pale orange (10YR 8/2 to 10YR 9/1) microcrystalline to very fine grained, hard, rarely weakly vuggy carbonate mudstone to locally wackestone. Abundant forams.
1250 - 1270	20	LIMESTONE – 100% Yellowish gray (5Y 8/1 to 5Y 9/1) microcrystalline to very fine grained, hard, partially pelloidal, wackstone to rarely packstone. Few forams.
1280 - 1330	50	LIMESTONE – 100% Very pale orange (10YR 8/2 to 10YR 9/1) microcrystalline to fine grained, moderately hard, vuggy, fossiliferous packstone to locally wackstone. Abundance forams to 5 mm and few echinoids to 10 mm.
1330 - 1370	40	LIMESTONE – 100%; 70% Very pale orange (10YR 8/2) microcrystalline to very fine grained, hard, locally weakly to vuggy carbonate mudstone to wackestone. 40% Very pale orange (10YR 8/2 to 10YR 9/2) to yellowish gray (5Y 8/1), fine to medium grained, moderately hard, vuggy, fossiliferous packstone with abundant forams. Trace white (N9), very soft carbonate marl.
1370 - 1410	10	LIMESTONE – 100%; 40% Yellowish gray (5Y 8/1) microcrystalline to very fine grained, hard, weakly vuggy wackestone. 30% Very pale orange (10YR 8/2), fine to medium grained, moderately hard, vuggy, fossiliferous packstone with forams. 30% Pale yellowish brown (10YR 6/2 to 10YR 7/2), cryptocrystalline to very fine grained, locally weakly vuggy carbonate mudstone. Trace medium dark gray (N4) to medium gray (N5), microcrystalline to fine grained, hard wackstone to carbonate mudstone and white (N9), cryptocrystalline, very soft carbonate marl.
1410 - 1420	10	LIMESTONE – 100%; 70% Grayish orange (10YR 7/4) microcrystalline to fine grained, soft to moderately soft, pelloidal packstone. 30% Very pale orange (10YR 8/2) fine grained, soft to very soft, locally weakly vuggy wackestone. Trace white (N9) very soft carbonate marl.

1420 - 1440	20	LIMESTONE – 100%; 80% to 60% Grayish orange (10YR 7/4) medium to fine grained, moderately hard, pelloidal packstone to grainstone. 20% to 40% 0% Pale yellowish brown (10YR 6/2) to light olive gray (5Y 6/1), cryptocrystalline, hard, locally vuggy carbonate mudstone.
1440 - 1450	10	LIMESTONE – 100%; 50% Yellowish gray (5Y 8/1) medium grained, soft to moderately soft packstone to grainstone. 40% Yellowish gray (5Y 8/1), very fine to fine grained, moderately hard packstone to wackestone. Trace white (N9) very soft carbonate marl. 10% Light olive gray (5Y 8/1), fine to medium grained, hard, slightly phosphatic, slightly sandy packstone to wackestone.
1450 - 1460	10	LIMESTONE – 100%; 50% Very pale orange (10YR 9/2) fine to medium grained, moderately hard, pelloidal fossiliferous packstone/wackestone. 50% Pale yellowish brown (10YR 7/2) cryptocrystalline to fine grained, hard, pelloidal, weakly vuggy carbonate mudstone.
1470 - 1480	10	LIMESTONE – 100%; 60% Medium light gray (N6) to dark gray (N3), very fine to fine grained, hard, micritic packstone to wackestone. 20% Light gray (N7), medium grained, moderately hard grainstone. 20% Yellowish gray (5Y 8/1), fine grained, hard, weakly vuggy carbonate mudstone. Trace Dolomite, dark yellowish brown (10YR 4/2) very fine grained, hard.
1480 - 1490	10	LIMESTONE – 100%; 70% Very pale orange (10YR 8/2) medium to fine grained, moderately soft packstone. 20% Light olive gray (5Y 7/1), medium grained, hard, micritic, locally vuggy wackestone/mudstone. Forams common.
1490 - 1500	10	LIMESTONE – 100%; 50% Medium light gray (N6) to grayish black (N2), cryptocrystalline to fine grained, hard, locally weakly vuggy carbonate mudstone. 50% Yellowish gray (5Y 8/1) very fine to fine grained, moderately hard wackestone.
1500 - 1510	10	LIMESTONE AND LIMY CLAY – Limestone 90%; 70% Very pale orange (10YR 8/2) fine grained, moderately hard wackestone with trace casts. 20% Light olive gray (5Y 7/1) to very light gray (N8), very fine grained, hard carbonate mudstone. Limy Clay 10% dark yellowish brown (10YR 4/2), very soft, non-plastic with abundant fine grained detrital carbonate.
1510 - 1520	10	LIMESTONE – 100%; 80% Yellowish gray (5Y 8/1) cryptocrystalline to very fine grained, hard, locally weakly vuggy carbonate mudstone. 20% Yellowish gray (5Y 8/1) to very pale orange (10YR 8/2), fine to medium grained, hard, fossiliferous, locally pelloidal packstone. Little foams. Trace light gray (N7) fine grained, hard wackestone to packstone and yellowish gray (5Y 8/1) microcrystalline, very soft carbonate marl.
1520 - 1530	10	LIMESTONE – 100% Very pale orange (10YR 8/2) fine grained, hard, vuggy, pelloidal packstone to grainstone. Trace yellowish gray (5Y 8/1 to 5Y 9/1) microcrystalline to fine grained, hard, slightly vuggy carbonate mudstone to wackestone.

1530 - 1540		LIMESTONE AND LIGNITE – Limestone 90%; 70% Very pale orange (10YR 8/2) as above. 20% Very light gray (N7) cryptocrystalline to microcrystalline, hard, moderately vuggy carbonate mudstone to wackestone with bitumen stains. Lignite 10%, black (N1) microcrystalline to fine grained, moderately hard, calcareous. Little forams up to 10 mm.
1540 - 1550	10	LIMESTONE – 100% Very pale orange (10YR 8/2) fine grained, hard, vuggy, pelloidal packstone to grainstone. Trace yellowish gray (5Y 9/1) to light gray (N7) microcrystalline to fine grained, hard, slightly vuggy carbonate mudstone to wackestone.
1550 - 1560	10	LIMESTONE – 100%; 50% Yellowish gray (5Y 9/1) cryptocrystalline to microcrystalline, hard, weakly vuggy wackestone to locally carbonate mudstone. 40% Very pale orange (10YR 8/2), fine grained, hard, vuggy, locally pelloidal packstone to grainstone. 10% Medium light gray (N6) to light gray (N7) microcrystalline to fine grained, hard, vuggy, moderately fossiliferous packstone with bitumen stains.
1560 – 1570	10	LIMESTONE – 100%; 80% Very pale orange (10YR 8/2) very fine to fine grained, hard, vuggy pelloidal packstone. 10% Yellowish gray (5Y 8/1) fine grained, moderately hard, vuggy pelloidal packstone. 10% Medium light gray (N6) to light gray (N7) cryptocrystalline to fine grained, weakly vuggy to locally vuggy carbonate mudstone to wackestone.
1570 – 1580	10	LIMESTONE – 100% Very pale orange (10YR 8/2) fine grained, moderately hard, vuggy, pelloidal packstone with abundant forams to 10mm.
1580 – 1590	10	LIMESTONE – 100%; 50% Very pale orange (10YR 8/2) As above. 30% Very pale orange (10YR 8/2) to light olive gray (5Y 6/1 moderately hard, weakly vuggy, locally pelloidal, locally weekly glauconitic wackestone. 10% Medium gray to medium light gray (N6) fine grained, hard wackestone.
1590 – 1610	20	LIMESTONE – 100%; 85% Yellowish gray (5Y 8/1) fine grained, moderately hard to hard, weekly vuggy to locally moderately vuggy, partly pelloidal packstone. 15% Grayish black (N2) to rarely black (N1) fine to medium grained, hard, vuggy bituminous grainstone.
1610 – 1620	10	LIMESTONE – 100%; 50% Grayish orange (10YR 7/4 to 10YR 8/4) fine to medium grained, moderately hard, highly fossiliferous, vuggy pelloidal packstone to locally grainstone. 40% Grayish black (N2) to rarely black (N1) fine to medium grained, hard, vuggy bituminous grainstone. 10% White (N9) cryptocrystalline to microcrystalline, hard calcareous mudstone. Trace light gray (N7) to very light gray (N8) vuggy, bituminous packstone to grainstone. Abundant forams.
1620 – 1630	10	LIMESTONE – 100%; 90% Very pale orange (10YR 8/2 to 10YR 9/2) very fine to fine grained, moderately hard to hard, weakly vuggy to vuggy, partially pelloidal packstone to rarely wackestone. 10% Pale yellowish brown (10YR 6/2) fine grained, hard, vuggy to highly vuggy pelloidal grainstone to locally packstone. Trace medium dark gray (N4) fine to medium grained, hard slightly bituminous grainstone.

1630 – 1640	10	LIMESTONE – 100%; 60%% Very pale orange (10YR 8/2 to 10YR 9/2) very fine to fine grained, moderately hard to hard, weakly vuggy to vuggy, partially pelloidal packstone to rarely wackestone. 40% Light gray (N6) fine grained, hard, pelloidal packstone to carbonate mudstone. Abundant forams.
1640 - 1650	10	LIMESTONE – 100%; 80% Medium gray (N5) very fine grained, hard locally partly pelloidal and vuggy packstone/wackestone. 20% Very pale orange (10YR 8/2) fine grained, moderately hard, vuggy pelloidal, highly fossiliferous packstone. Abundant forams.
1650 – 1660	10	LIMESTONE – 100%; 90% Yellowish gray (5Y 8/1) to very pale orange (10YR 9/2) fine to medium grained, moderately hard, weekly vuggy, pelloidal packstone. 10% Light olive gray (5Y 7/1) microcrystalline, hard, locally slightly vuggy carbonate mudstone. Abundant forams.
1660 - 1670	10	LIMESTONE – 100%; 85% Yellowish gray (5Y 9/1) to white (N9), very fine grained to microcrystalline, hard, vuggy to locally weakly vuggy carbonate mudstone, locally vugs filled with medium light gray (N6) grainstone and bitumen. 10% Very pale orange (10YR 7/2 to 10YR 9/2) fine grained, moderately hard, fossiliferous, locally phosphatic, vuggy to weakly vuggy, pelloidal packstone to grainstone with abundant forams. 10% Pale yellowish brown (10YR 6/2 to 10YR 7/2), fine grained, hard, locally weakly vuggy grainstone with little shell.
1670 – 1690	20	LIMESTONE – 100%; 50% Medium light gray (N6) to medium dark gray (N4), microcrystalline to very fine grained, hard, locally vuggy carbonate mudstone to locally wackestone. 50% Very pale orange (10YR 7/2 to 10YR 9/2) as above. Abundant forams.
1690 – 1710	20	LIMESTONE 100%; 90% Very pale orange (10YR 8/2) to grayish orange (10YR 7/4) fine to medium grained, moderately soft to moderately hard, pelloidal packstone to rarely grainstone. 10% Medium dark gray (N7) to yellowish gray (5Y 8/1) microcrystalline to rarely fine grained, hard weakly vuggy carbonate mudstone to wackestone. Abundant forams.
1710 – 1720	10	LIMESTONE – 100%; 70% Grayish orange (10YR 7/4) cryptocrystalline to fine grained, moderately hard, locally weakly vuggy carbonate mudstone to packstone. 20% Light olive gray (5Y 6/1) cryptocrystalline, hard, vuggy carbonate mudstone. 10% Very pale orange 10YR 9/2) cryptocrystalline, moderately hard carbonate mudstone.
1720 – 1730	10	LIMESTONE AND MARL – Limestone 80% grayish orange (10YR 7/4) very fine grained, moderately soft to moderately hard, locally sparry packstone. Marl 20% bluish gray (5B 6/1) very soft, with detrital carbonate. Abundant forams.1730 to 1750.
1730 – 1750	20	Limestone – 100%; 90% Grayish orange (10YR 7/4) to yellowish gray (5Y 8/1) fine to medium grained, moderately hard packstone to wackestone. 10% Medium gray (N5) cryptocrystalline, hard carbonate mudstone. Abundant forams.

1750 – 1770	20	LIMESTONE – 100%; 80% Yellowish gray (5Y 8/1) to pale yellowish brown (10YR 6/2) fine grained, moderately soft to moderately hard packstone to rarely grainstone. 10% Light olive gray (5GY 6/1 to 5GY 7/1) cryptocrystalline to fine grained, hard carbonate mudstone to wackestone.
1770 - 1780	10	LIMESTONE – 100% Pale yellowish brown (10YR 6/2 to 10YR 7/2) very fine grained, soft, pelloidal packstone. Forams common.
1780 - 1810	30	LIMESTONE – 100%; 70% Very pale orange (10YR 8/2) to grayish orange (10YR 7/4) very fine to fine grained, moderately soft, pelloidal packstone to weakly vuggy wackestone with few forams. 30% Light olive gray (5Y 6/1) to medium light gray (N6), very fine grained to cryptocrystalline, moderately hard, partly micritic wackestone to carbonate mudstone. Trace dolomitic limestone, crystalline carbonate and tests at 1810.
1810 - 1830	20	LIMESTONE – 100%; 70% Very pale orange (10YR 8/2) to pale yellowish brown (10YR 7/2) fine to medium grained, soft, pelloidal fossiliferous packstone. 20% Yellowish gray (5Y 7/1) very fine grained to microcrystalline, soft wackestone. 10% Medium light gray (N6) cryptocrystalline, hard, locally vuggy carbonate mudstone. Abundant forams and tests.
1830 - 1840	10	LIMESTONE – 100%; 70% Yellowish gray (5Y 8/1) microcrystalline, hard, locally vuggy carbonate mudstone. 20% Yellowish gray (5Y 8/1), microcrystalline to fine grained, hard, weakly fossiliferous, partially pelloidal, slightly vuggy packstone/wackestone. 10% Medium gray (N5), fine grained, soft to moderately hard, slightly pelloidal packstone. Abundant forams.
1840 - 1860	20	LIMESTONE – 100% Yellowish gray (5Y 8/1) to light olive gray (5Y 6/1), cryptocrystalline to microcrystalline, hard, slightly vuggy to vuggy carbonate mudstone. Abundant unconsolidated forams.
1860 - 1890	30	LIMESTONE – 100%; 70% to 80% Yellowish gray (5Y 8/1) to light olive gray (5Y 6/1) as above. 10% Yellowish gray (5Y 8/1), microcrystalline to fine grained, hard, weakly fossiliferous, partially pelloidal, slightly vuggy to vuggy packstone/wackestone. 10% to 20% Medium gray (N5), fine grained, moderately hard, moderately vuggy, partially pelloidal packstone/wackestone. Trace to little light bluish gray (5B 7/1 to 5B 8/1) to light gray (N7), cryptocrystalline to very fine grained, very soft, plastic, marl with little detrital carbonate between 1870 and 1890. Abundant forams.
1890 - 1900	10	LIMESTONE – 100%; 40% Grayish orange (10YR 7/4) to pale orange (10YR 7/2) microcrystalline to very fine grained, moderately hard, carbonate mudstone to wackestone with little detrital carbonate. 40% Yellowish gray (5Y 8/1) to light olive gray (5Y 6/1), cryptocrystalline to microcrystalline, hard, weakly vuggy to vuggy carbonate mudstone. 10% Yellowish gray (5Y 8/1), microcrystalline to fine grained, hard, weakly fossiliferous, partly pelloidal, slightly vuggy to vuggy packstone/wackestone. 10% Medium gray (N5) fine medium gray (N6), cryptocrystalline to fine grained, hard, locally vuggy, locally partly pelloidal carbonate mudstone to locally packstone. Trace pale yellowish gray (10YR 6/2) to pale orange (10YR 7/2), microcrystalline, very soft, slightly plastic, cohesive marl.

		Forams common
1900 - 1940	40	LIMESTONE – 100%; 70% Yellowish gray (5Y 8/1) to very pale orange (10YR 8/2) microcrystalline to fine grained, hard, weakly fossiliferous, partly pelloidal, slightly vuggy to locally vuggy packstone, carbonate mudstone/wackestone. 30% Medium gray (N5) to medium light gray (N6), cryptocrystalline to microcrystalline, very hard, locally weakly vuggy carbonate mudstone locally slightly dolomitic with thin laminations of dark gray (N3) dolomitic grainstone. Forams common. Trace echinoid fossils between 1940 and 1950.
1940 - 1990	50	LIMESTONE – 100%; 60% to 70% Yellowish gray (5Y 8/1), cryptocrystalline to microcrystalline, hard, locally slightly vuggy carbonate mudstone. 40% to 30% Very pale orange (10YR 8/2) to pale orange (10YR 7/2), fine grained, moderately hard to hard, fossiliferous, moderately vuggy to vuggy, pelloidal packstone. Trace light olive gray (N7), cryptocrystalline, hard carbonate mudstone. Forams common.
1990 - 2000	10	LIMESTONE – 100% Yellowish gray (5Y 9/1) to very pale orange (10YR 9/2), locally pale yellowish brown (10YR 6/2), fine grained, moderately hard, fossiliferous, locally weakly vuggy, pelloidal packstone to locally sparry grainstone. Trace yellowish gray (5Y 9/1), cryptocrystalline, hard carbonate mudstone. Few forams and echinoid fossils.
2000 - 2010	10	DOLOMITE AND LIMESTONE – Dolomite 60% light olive gray (5Y 6/1) microcrystalline to very fine grained, hard to very hard, locally sucrosic, locally limy. Limestone 40% very pale orange (10YR 8/2) fine to medium grained, moderately hard, locally sparry pelloidal packstone with some tests and trace forams.
2010 - 2020	10	LIMY DOLOMITE, LIMESTONE AND DOLOMITE – Limy Dolomite 50% olive gray (5Y 4/1) to light olive gray (5Y 6/1) cryptocrystalline to fine grained, hard to very hard, locally fossiliferous. Limestone 30% as above. Dolomite 20% as above.
2020 - 2030	10	LIMESTONE AND DOLOMITE – Limestone 70%; 50% very pale orange (10YR 8/2) fine to medium grained, moderately soft, pelloidal packstone to grainstone. 20% Light olive gray cryptocrystalline to fine grained, hard fossiliferous wackestone. Dolomite 30% yellowish gray (5Y 8/1) cryptocrystalline, very hard.
2030 - 2040	10	DOLOMITE – 100%; 60% Pale grayish orange (10YR 8/4) fine grained, hard to very hard, weakly vuggy, sucrosic. 40% Pale yellowish brown (10YR 6/2) to dark yellowish brown (10YR 4/2) microcrystalline to fine grained, very hard, locally partly sucrosic.
2040 - 2050	10	LIMY DOLOMITE, DOLOMITE AND LIMESTONE – Limy Dolomite 50% light olive gray (5Y 6/1) very fine grained to cryptocrystalline, hard weakly vuggy. Dolomite 30% yellowish gray (5Y 8/1) cryptocrystalline, hard. Limestone 20% very pale orange (10YR 8/2) fine to medium grained, moderately hard, pelloidal packstone with forams common.
2050 - 2060	10	LIMESTONE AND DOLOMITE – Limestone 80%; 50% Yellowish gray (5Y 8/1), fine to medium grained, moderately hard, pelloidal, fossiliferous packstone with abundant medium grain sized forams. 30% Very light gray (N8) cryptocrystalline to microcrystalline, hard, very well indurated, locally vuggy slightly dolomitic carbonate

		mudstone. Dolomite 20%; 10% Medium gray (N5) to medium dark gray (N4) hard, vuggy. 10% Light olive gray (5Y 5/2) to yellowish gray (5Y 6/2), fine to medium grained, locally microcrystalline, hard, well indurated to locally vuggy, locally sucrosic.
2060 - 2080	20	DOLOMITE – 100%; 50% Moderate yellowish brown (10YR 5/4), very fine grained to fine grained, hard, weakly vuggy, sucrosic. 40% Olive gray (5Y 4/1) to light olive gray (5Y 6/1), microcrystalline to fine grained, hard to very hard, very well indurated to vuggy. 10% Grayish black (N2) to dark gray (N3), microcrystalline, very hard, very well indurated.
2080 - 2090	10	DOLOMITE – 100%; 50% Moderate yellowish brown (10YR 5/4), as above. 30% Olive gray (5Y 4/1) to locally dark yellowish brown (10YR 4/2), microcrystalline to very fine grained, very hard, very well indurated to locally weakly vuggy. 20% Pale yellowish brown (10YR 6/2) to yellowish brown (10YR 5/2), microcrystalline to cryptocrystalline, very hard, very well indurated to locally weakly vuggy.
2090 - 2110	20	LIMESTONE – 100% Grayish orange (10YR 7/4) to pale yellowish brown (10YR 6/2) fine to medium grained, soft to moderately hard packstone/grainstone with abundant forams. Trace Dolomitic Limestone and trace medium gray (N5) carbonate mudstone.
2110 - 2170	60	LIMESTONE – 100%; 70% as above. 30% Grayish orange (10YR 7/4) fine to medium grained, moderately hard, locally sparry packstone. Forams common. Trace molds and casts. Trace medium dark gray (N4) carbonate mudstone at 2140.
2170 – 2270	100	LIMESTONE – 100% Very pale orange (10YR 8/2) fine to coarse grained, moderately hard to moderately soft, well indurated, pelloidal, fossiliferous packstone to grainstone. Trace black (N1) lignite at 2180; trace medium gray (N5) Dolomite at 2190. Trace molds at 2220, trace white (N9) very soft carbonate marl at 2230 and 2250
2270 – 2300	30	LIMESTONE – 100% Very pale orange (10YR 8/2) fine to medium grained, moderately hard, pelloidal, partly fossiliferous, partly sparry, well indurated packstone
2300 – 2320	20	LIMESTONE – 100%; 90% As above. 10% Very pale orange (10YR 8/2) very fine to cryptocrystalline, hard wackestone to carbonate mudstone. Few to common tests. Trace crystalline carbonate.
2320 – 2330	10	LIMESTONE – 100% Yellowish gray (5Y 8/1) fine to coarse grained, moderately hard, pelloidal, fossiliferous grainstone to packstone.
2330 – 2360	30	LIMESTONE – 100% Yellowish gray (5Y 8/1) fine to medium grained, moderately hard, pelloidal, fossiliferous grainstone to rarely packstone. Trace crystalline carbonate.
2360 – 2400	40	LIMESTONE – 100%; 70% As above. 30% Yellowish gray (5Y 8/1) fine to medium grained, moderately hard pelloidal packstone. Trace tests and echinoids to 10 mm in diameter.
2400 – 2430	30	LIMESTONE – 100% Very pale orange (10YR 8/2) fine to medium grained, moderately hard, pelloidal, fossiliferous packstone.
2430 – 2440	10	LIMESTONE – 100% Very pale orange (10YR 8/2) fine to medium grained, moderately soft to moderately hard, pelloidal packstone to grainstone. Trace Dolomitic Limestone. Trace olive gray (5Y 4/1)

		very fine grained, soft silty sandstone.
2440 – 2490	50	LIMESTONE – 100%; 70% As above. 30% Yellowish gray (5Y 8/1) very fine to fine grained, hard, well indurated wackestone to packstone. Abundant tests and forams. Sparry at 2470.
2490 – 2500	10	LIMESTONE – 100% Yellowish gray (5Y 8/1) fine to medium grained, moderately hard, pelloidal, fossiliferous, locally sparry, generally well indurated packstone. Forams common.
2500 – 2510	10	LIMESTONE – 100% Grayish orange (10YR 7/4) fine grained, moderately hard to hard, pelloidal, fossiliferous packstone. Trace white (N9) remineralized (calcite) shell fragments.
2510 – 2520	10	LIMESTONE AND DOLOMITIC LIMESTONE – Limestone 80% very pale orange (10YR 8/2) to yellowish gray (5Y 8/1) fine grained, moderately soft to hard, pelloidal, fossiliferous, locally sparry, well indurated packstone. Dolomitic Limestone 20% pale yellowish brown (10YR 6/2) to grayish orange (10YR 7/4) fine grained, moderately soft pelloidal packstone with 5% to 10% fine grained, euhedral dolomite crystals.
2520 – 2530	10	LIMESTONE – 100% Very pale orange (10YR 8/2) fine to medium grained, hard to moderately hard, fossiliferous, locally very weakly vuggy, locally sparry wackestone/packstone.
2530 – 2560	30	LIMESTONE AND DOLOMITIC LIMESTONE – Limestone 80% yellowish gray (5Y 7/2) fine grained, moderately hard to moderately soft, pelloidal packstone. Dolomitic Limestone 20% pale yellowish brown (10YR 6/2) to grayish orange (10YR 7/4) fine grained, moderately soft pelloidal packstone with 10% to 40% euhedral to anhedral dolomite crystals.
2560 – 2570	10	LIMESTONE, DOLOMITIC LIMESTONE AND LIMY DOLOMITE – Limestone 40% pale grayish orange (10YR 8/4) fine to medium grained, moderately hard to moderately soft, pelloidal, fossiliferous, very well indurated packstone with tests common. Dolomitic Limestone 40% as above. Limy Dolomite 20% pale yellowish brown (10YR 6/2) to moderate yellowish brown (10YR 5/4) very fine to medium grained, hard. Trace dark yellowish brown (10YR 4/2) hard cryptocrystalline to very fine grained Dolomite.
2570 - 2590	20	LIMESTONE – 100% Very pale orange (10YR 8/1) to pale grayish orange (10YR 8/4) fine to medium grained, moderately hard, well indurated, pelloidal, fossiliferous packstone. Trace white (N9), very soft Marl.
2590 - 2610	20	LIMESTONE – 100%; 80% Yellowish gray (5Y 8/1) dominantly medium grained, moderately hard, pelloidal packstone. 10% Light olive gray (5Y 7/1), very fine to medium grained, hard, fossiliferous packstone to wackestone. 10% Dark gray (N3) fine to medium grained, hard, highly fossiliferous packstone to locally cryptocrystalline carbonate mudstone. Trace medium light gray (N6) to medium gray (N5) very soft marl. Trace to little olive gray (5Y 4/1) cryptocrystalline, very hard Dolomite.
2610 - 2620	10	LIMESTONE AND DOLOMITE; Limestone 90%; 80% Medium dark gray (N4), dark gray (N3), olive gray (5Y 4/1), and yellowish gray (5Y 8/1) cryptocrystalline, hard to very hard, locally weakly vuggy carbonate mudstone. 10% Yellowish gray (5Y 8/1) fine to medium

		grained, moderately hard packstone. Dolomite 10% brownish gray (5YR 4/1) to olive gray (5Y 3/2) cryptocrystalline, very hard.
2620 - 2630	10	LIMESTONE AND DOLOMITE; Limestone 90% as above. Dolomite 10%; 5% brownish gray (5YR 4/1) as above. 5% Yellowish gray (5Y 8/1) microcrystalline to cryptocrystalline, very hard. Trace dark yellowish brown (10YR 4/2) Dolomite with subhedral crystals. Trace white (N9) very soft carbonate Marl.
2630 - 2640	10	LIMESTONE – 100%; 80% As above. 20% Very light gray (N8) medium to coarse grained, very soft wackestone with carbonate Marl matrix
2640 - 2670	30	LIMESTONE - 100%; 60% Medium dark gray (N4), dark gray (N3), olive gray (5Y 4/1), and yellowish gray (5Y 8/1), cryptocrystalline, hard to very hard, locally weakly vuggy carbonate mudstone. 40% Yellowish gray (5Y 8/1) fine to very fine grained, moderately hard, pelloidal, weakly fossiliferous packstone.
2670 - 2700	30	LIMESTONE - 100%; 80% Medium dark gray (N4), dark gray (N3), olive gray (5Y 4/1), and yellowish gray (5Y 8/1), cryptocrystalline, hard to very hard, locally weakly vuggy carbonate mudstone. 20% Light olive gray (5Y 6/1) to pale yellowish brown (10YR 6/2) fine to medium grained, moderately hard, pelloidal, fossiliferous grainstone to packstone. Trace few forams and echinoids.
2700 - 2710	10	LIMESTONE – 100% Very pale orange (10YR 9/2) medium grained, moderately hard to rarely soft, pelloidal, fossiliferous packstone with few tests.
2710 - 2720	10	LIMESTONE - 100%; 90% As above. 10% Very pale orange (10YR 8/2) fine grained, hard, very weakly vuggy carbonate mudstone to wackestone. Trace medium dark gray (N4) hard carbonate mudstone.
2720 - 2730	10	LIMESTONE - 100%; 70% Very pale orange (10YR 9/2) medium grained, moderately hard to rarely soft, pelloidal, fossiliferous packstone with few tests. 30% Yellowish gray (5Y 8/1) fine grained, moderately hard, pelloidal packstone. Trace dark greenish gray (5GY 4/1) firm, weakly glauconitic Clay.
2730 - 2750	20	LIMESTONE – 100%; 60% to 70% Very pale orange (10YR 9/2) cryptocrystalline, hard carbonate mudstone. 40% to 30% Grayish orange (10YR 6/4) to very pale orange (10YR 8/2) fine to medium grained, hard, pelloidal packstone/grainstone. Trace white (N9) very soft carbonate Marl at 2740. Trace light olive gray (5Y 6/1) cryptocrystalline, hard carbonate mudstone.
2750 - 2770	20	LIMESTONE – 100%; 50% Very pale orange (10YR 8/2) fine to medium grained, moderately hard, pelloidal grainstone/packstone. 40% Very pale orange (10YR 8/2) fine grained, hard, well indurated packstone to wackestone. 10% Olive gray (5Y 6/1) and very pale orange (10YR 8/2) cryptocrystalline carbonate mudstone. Forams and tests common. Trace glauconite at 2760. Trace white (N9) very soft, carbonate marl at 2770.
2770 - 2780	10	LIMESTONE - 100%; 80% Very pale orange (10YR 8/2) to grayish orange (10YR 7/4) medium grained, hard, pelloidal, slightly fossiliferous packstone to grainstone. 20% Very pale orange (10YR 8/2) cryptocrystalline to very fine grained packstone to wackestone.

		Trace mudstone as above.
2780 - 2790	10	LIMESTONE - 100%; 70% Very pale orange (10YR 8/2) fine grained, hard, pelloidal, packstone/wackestone. 30% Very pale orange (10YR 8/2) fine to medium grained, moderately hard, pelloidal packstone. Trace olive gray (5Y 4/1) cryptocrystalline hard carbonate mudstone.
2790 - 2810	20	LIMESTONE - 100% Very pale orange (10YR 8/2) fine to medium grained, soft to moderately soft, pelloidal, packstone to grainstone.
2810 - 2820	10	LIMESTONE – 100%; 70% Grayish orange (10YR 7/4) medium to rarely coarse grained, hard to moderately soft, pelloidal, fossiliferous grainstone to packstone. 30% Very pale orange (10YR 8/2) cryptocrystalline, hard, very weakly vuggy carbonate mudstone.
2820 - 2840	20	LIMESTONE – 100%; 90% Very pale orange (10YR 8/2) fine to medium grained, moderately hard, pelloidal, locally highly fossiliferous packstone. 10% mudstone as above.
2840 - 2870	30	LIMESTONE – 100% Very pale orange (10YR 8/2) fine to medium grained, moderately hard, pelloidal, locally highly fossiliferous packstone.
2870 - 2880	10	LIMY DOLOMITE AND LIMESTONE – Limy Dolomite 60% yellowish gray (5Y 8/1) medium grained, hard, euhedral to anhedral crystals. Limestone 40% very pale orange (10YR 8/2) fine grained, moderately soft, pelloidal packstone.
2880 - 2900	20	LIMESTONE – 100%; 60% Very pale orange (10YR 8/2), cryptocrystalline, hard, locally weakly vuggy carbonate mudstone with rare fractures fully healed with fine to medium grained euhedral Dolomite crystals. 40% Very pale orange (10YR 8/2) very fine grained, hard, pelloidal, locally very weakly dolomitic packstone. Trace Limy Dolomite as above at 2890. Trace light olive gray (5Y 6/1) cryptocrystalline, hard, fractured Dolomite at 2900.
2900 - 2920	20	LIMESTONE – 100%; 70% Very pale orange (10YR 8/2) to yellowish gray (5Y 8/1) fine to medium grained, moderately hard to moderately soft, pelloidal packstone to rarely grainstone. 30% Very pale orange (10YR 8/2), cryptocrystalline, hard, weakly vuggy carbonate mudstone with rare fractures fully healed with fine to medium grained euhedral Dolomite crystals. Trace molds.
2920 - 2940	20	DOLOMITE AND LIMESTONE – Dolomite 80% yellowish brown (10YR 6/4) to dark yellowish brown (10YR 4/2) to light olive gray (5Y 6/1) cryptocrystalline to very fine grained, very hard with trace fractures. Limestone 20% very pale orange (10YR 8/2) very fine to fine grained, hard, pelloidal packstone. Trace tests.
2940 - 2970	30	DOLOMITE AND LIMESTONE – Dolomite 90% dark yellowish brown (10YR 4/2) to dark grayish orange (10YR 7/4) cryptocrystalline to microcrystalline to fine grained, very hard, sucrosic. Limestone 10% very pale orange (10YR 8/2) fine grained, moderately hard, pelloidal packstone to wackestone. Trace tests.
2970 - 2990	20	DOLOMITE AND LIMESTONE – Dolomite 90% yellowish gray (5Y 8/1) to grayish orange (10YR 7/4) cryptocrystalline to medium grained, very hard, locally very weakly vuggy. Limestone 10% very pale orange (10YR 8/2) fine grained, moderately hard pelloidal packstone.

2990 - 3000	10	DOLOMITE – 100% Light olive gray (5Y 6/1) cryptocrystalline to coarse grained, very hard, locally weakly fossiliferous.

Monitor Well No. 1 – Lithology

Geologic Log

GEOLOGIC LOG
(Drill Cuttings)

CITY OF HOLLYWOOD EFFLUENT DISPOSAL SYSTEM
SOUTHERN REGIONAL WWTP

DUAL-ZONE MONITOR WELL MW-1

Depth (ft)	Thickness (ft)	Sample Description
0 - 20	20	LIMESTONE, AND ORGANICS - Limestone 97%, very pale orange (10YR 8/2) to yellowish gray (5Y 8/1), very fine grained to microcrystalline, hard, wackestone to packstone. Trace colorless, medium to coarse grained, angular to subrounded quartz sand. Organics 3%, brownish black (5YR 2/1) to black (N1), soft to moderately hard.
20 - 30	10	LIMESTONE – 100%; 60% Yellowish gray (5Y 7/2), very fine to fine grained, hard, sucrosic grainstone. 20% Very pale orange (10YR 8/2) to yellowish gray (5Y 8/1), very fine grained to microcrystalline, hard wackestone to packstone. Trace coarse grained crystalline carbonate. 20% Light olive gray (5Y 5/2) to dusky yellow (5Y 6/4), microcrystalline, hard, locally moderately vuggy mudstone to wackestone. Trace shell molds.
30 - 110	90	LIMESTONE – 100% Pale greenish yellow (10Y 8/2) to yellowish gray (5Y 7/2), dominantly medium, fine to coarse grained, hard, porous grainstone. Little dusky yellow (5Y 6/4) to olive gray (5Y 3/2), fine to medium grained, hard grainstone between 40' and 60'. Trace burrow molds between 40' and 50'. Trace yellowish gray (5Y 8/1 to 9/1), cryptocrystalline very hard packstone.
110 - 130	20	LIMESTONE – 100%; 50% to 60 As above. 50% to 40% Light yellowish gray (5Y 7/1 to 5Y 8/1), fine grained to locally microcrystalline, hard to very hard grainstone. Trace fossil coral fragments.
130 - 170	30	SANDY LIMESTONE AND LIMESTONE - Sandy Limestone 70%, light greenish gray (5GY 8/1), fine to coarse grained, moderately hard, sparry, partially pelloidal, locally phosphatic grainstone. Little colorless, medium to coarse grained, angular quartz sand. Limestone 30%, yellowish gray (5Y 7/1 to 5Y 8/1), very fine grained, very hard grainstone between 140' and 150'. Little white (N9), microcrystalline to cryptocrystalline, hard, locally vuggy carbonate mudstone.
170 - 190	20	LIMESTONE AND SANDY LIMESTONE – Limestone 70%, yellowish gray (5Y 7/2) to grayish orange (10YR 7/4), fine to coarse grained, hard, pelloidal, fossiliferous, highly sparry, slightly phosphatic packstone. Sandy Limestone 30%, yellowish gray (5Y 7/2), medium grained, hard, pelloidal packstone with medium grained quartz sand and few shell fragments. Trace tests.

Depth (ft)	Thickness (ft)	Sample Description
190 - 200	10	SANDY LIMESTONE AND LIMESTONE – Sandy Limestone 70%, yellowish gray (5Y 7/2) to light greenish gray (5GY 8/1), dominantly medium grained, vuggy, slightly phosphatic, partially pelloidal packstone to grainstone with medium grained angular quartz sand and trace shell fragments. Limestone 20%, pale yellowish orange (10YR 9/6) to white (N9), microcrystalline to cryptocrystalline, moderately hard, highly fossiliferous, slightly sandy, highly vuggy locally well indurated packstone with shell fragments, fossil coral and forams. 10% Very pale orange (10YR 7/2 to 10YR 8/2), fine grained, very hard, slightly phosphatic grainstone.
200 - 210	10	LIMESTONE – 100% Light greenish gray (5GY 8/1) to yellowish gray (5Y 8/1), medium grained, moderately hard to hard, slightly sandy, locally vuggy, fossiliferous, partially pelloidal packstone to grainstone with colorless medium grained quartz sand and shell fragments.
210 - 220	10	CLAY AND LIMESTONE – Clay 80%, yellowish gray (5Y 7/2) to light olive gray (5Y 5/2), very soft. Limestone 20%, 15% yellowish gray (5Y 8/1), microcrystalline to cryptocrystalline, hard wackestone to packstone. 5% Grayish yellow green (5GY 6/2 to 5GY 7/2), fine grained, moderately soft, clayey, locally vuggy, highly phosphatic packstone to grainstone.
220 - 240	20	LIMESTONE AND SHELL FRAGMENTS – Limestone 90%, light greenish gray (5GY 8/1), fine to medium grained, moderately hard, fossiliferous, slightly sandy packstone to locally grainstone. Shell Fragments 10%, mollusks, foram fossils and other shell fragments.
240 - 250	10	LIMY SAND – 100% Colorless, dominantly medium grained, unconsolidated, mostly subrounded, well sorted quartz sand with 10% yellowish gray (5Y 8/1), fine to dominantly medium grained, hard, unconsolidated detrital carbonate. Few shell fragments.
250 - 310	60	LIMY SANDSTONE AND LIMESTONE – Limy Sandstone 90%, medium gray (N5) to medium light gray (N6), dominantly medium grained to fine, hard, well sorted, subangular well cemented phosphatic quartz sand, with abundant detrital carbonate. Induration increasing with depth. Limestone 10%, yellowish gray, microcrystalline to medium grained, hard, partially fossiliferous to fossiliferous, locally sparry, phosphatic packstone to locally grainstone. Trace shell fragments.
310 - 340	30	PHOSPHATIC LIMY SANDSTONE AND SANDY LIMESTONE – Phosphatic Sandy Limestone 70% to 80%, colorless, dominantly fine grained, hard, well sorted, dominantly subrounded quartz sand with light greenish gray (5GY 7/1 to 5GY 8/1), phosphatic limy matrix. . Limestone 20% to 30%, medium gray (N6), microcrystalline to medium grained, very hard, sandy, slightly phosphatic grainstone to locally packstone. Trace forams
350 - 360	10	LIMY SANDSTONE AND LIMESTONE – Limy Sandstone 80% medium light gray (N6) to medium gray (N7), fine to medium grained with sparry matrix. Limestone 20% yellowish gray (5Y 7/2), fine to medium grained, hard, sparry, sandy packstone with trace to little fine grained phosphorite. Trace shell fragments.

Depth (ft)	Thickness (ft)	Sample Description
360 - 370	10	SANDY CLAYEY LIMESTONE AND LIMY SANDSTONE – Sandy Clayey Limestone 60%, light olive gray (5Y 5/2), fine to medium grained, moderately soft phosphatic packstone with abundant fine grained quartz sand and clay. Limy Sandstone 40%, light gray (N7) to light olive gray (5Y 5/2), fine to rarely coarse grained, moderately hard with abundant detrital carbonate and little clay. Trace shell fragments.
370 - 440	70	CLAYEY SANDY LIMESTONE – 100% Pale olive (10Y 6/2), very fine to fine grained, moderately soft, slightly phosphatic wackestone with abundant clay and fine grained quartz sand. Clay content increasing with depth.
440 - 450	10	SANDY CLAY AND CLAYEY LIMESTONE – Sandy Clay 50% to 60%, pale olive gray (10Y 6/2) to grayish yellow green (5GY 7/2), very soft, plastic, weakly calcareous, weakly phosphatic. Clayey Limestone 40% to 50%, pale olive gray (10Y 6/2), medium grained, moderately soft, friable, slightly phosphatic wackestone.
450 - 480	30	CLAYEY SANDY LIMESTONE – 100% Pale olive (10Y 6/2), very fine to fine grained, moderately soft, slightly phosphatic wackestone with abundant clay and fine grained quartz sand. Clay content increasing with depth.
480 - 550	80	LIMY CLAY – 100% Pale olive (10Y 6/2), moderately soft to soft, non-plastic, slightly phosphatic with abundant very fine grained quartz sand and detrital carbonate.
550 - 700	150	SANDY LIMY CLAY – 100% Pale olive (10Y 6/2), firm to soft, non-plastic to low plasticity, slightly phosphatic to locally moderately phosphatic, friable with abundant very fine to fine grained quartz sand and very fine to fine grained detrital carbonate.
700 - 730	30	SANDY LIMY CLAY – 100% Pale olive (10Y 6/2), firm to very soft, low plasticity to plastic, slightly phosphatic to phosphatic, calcareous with very fine grained quartz sand.
730 - 760	30	SANDY LIMY CLAY – 100% Pale olive (10Y 6/2), firm to soft, non-plastic to low plasticity, slightly phosphatic, friable with abundant very fine to fine grained quartz sand and very fine to fine grained detrital carbonate.
760 - 780	20	SANDY LIMY CLAY – 100% Pale olive (10Y 6/2), firm to very soft, low-plasticity to plastic, slightly phosphatic to locally phosphatic, calcareous, with very fine grained quartz sand.
780 - 790	10	LIMY CLAY AND PHOSPHORITE – Limy Clay 80% pale olive (10Y 6/2), firm to very soft, low plasticity to plastic, phosphatic, calcareous. Phosphorite 20% brownish black (5YR 2/1) to black (N1), microcrystalline to cryptocrystalline, very hard, well cemented, clayey and slightly calcareous.
790 - 830	40	SANDY CLAY – 100% Pale greenish yellow (10Y 7/2), soft, moderately plastic, calcareous, moderately phosphatic to phosphatic with very fine grained quartz sand.

Depth (ft)	Thickness (ft)	Sample Description
830 – 860	30	SANDY CLAY – 100% Grayish olive (10Y 5/2), very soft, cohesive, highly plastic, slightly calcareous with very fine grained quartz sand. Trace olive black (5Y 2/1) very hard Chert at 860'.
860 – 870	10	CLAY, LIMESTONE AND CHERT – Clay 60% As above. Limestone 20%, olive gray (5Y 4/1), fine grained, moderately hard, phosphatic, sparry packstone. Chert 10% black (N1), microcrystalline, weakly fossiliferous, very hard.
870 – 890	20	LIMESTONE – 100% Greenish gray (5GY 6/1) to light bluish gray (5B 7/1), fine grained, moderately hard, slightly sandy, slightly phosphatic packstone.
890 – 910	20	LIMESTONE - 100%; 50% Yellowish gray (5Y 7/2), fine grained, moderately hard, sandy, phosphatic packstone. 30% Yellowish gray (5Y 8/1), medium to coarse grained, moderately hard, pelloidal, fossiliferous packstone. 20% Medium light gray (N6), medium grained, hard, fossiliferous wackestone.
910 – 920	10	LIMESTONE - 100%; 70% Medium light gray (N6), medium to coarse grained, fossiliferous, slight sparry, micritic wackestone. 30% Yellowish gray (5Y 7/2), fine grained, moderately hard, sandy, phosphatic packstone.
920 - 940	20	LIMESTONE – 100%; 70% Greenish gray (5GY 6/1), medium to coarse grained, hard, fossiliferous, partly micritic packstone. 30% Yellowish gray (5Y 8/1), fine to medium grained, hard, fossiliferous wackestone. Trace shell casts.
940 - 980	40	LIMESTONE – 100%; 60% Yellowish gray (5Y 8/1) to bluish gray (5B 6/1), fine to coarse grained, hard, locally sparry, locally micritic packstone to wackestone. Trace white (N9), very soft carbonate marl. Trace shell molds at 970' and casts at 980'.
980 – 1,000	20	LIMESTONE – 100%; 40% Yellowish gray (5Y 8/1), fine grained, moderately soft, pelloidal, fossiliferous grainstone to packstone. 40% Light bluish gray (5B 7/1), medium to coarse grained, moderately hard, phosphatic, slightly glauconitic packstone to wackestone. 20% Yellowish gray (5Y 8/1), cryptocrystalline, moderately hard carbonate mudstone. Trace to little crystalline carbonate. Trace shell casts.
1,000 – 1,020	20	LIMESTONE – 100% Yellowish gray (5Y 7/1), medium grained, moderately soft to moderately hard, pelloidal, locally fossiliferous packstone with few forams.
1,020 – 1,040	20	LIMESTONE, SANDY LIMESTONE AND CHERT – Limestone 90%, yellowish gray (5Y 8/1), dominantly medium to coarse grained, moderately soft to moderately hard, pelloidal packstone. Sandy Limestone 5%, moderate yellowish green (5GY 7/4), medium to coarse grained, moderately hard to hard, sparry, phosphatic, weakly vuggy packstone with fine to medium grained quartz sand. Chert 5%, olive gray (5Y 6/1) to olive black (5Y 2/1), fine grained with cryptocrystalline matrix, very hard. Common fossils between 10 mm and 15 mm.

Depth (ft)	Thickness (ft)	Sample Description
1,040 – 1,050	10	LIMESTONE – 100% Light greenish gray (5G 8/1), medium to coarse grained, hard to moderately hard packstone.
1,050 – 1,070	20	LIMESTONE – 100%; 70% Limestone light greenish gray (5G 8/1), fine to dominantly medium grained, hard to moderately hard, weakly clayey packstone. 30% Yellowish gray (5Y 8/1), medium to coarse grained, moderately hard pelloidal packstone. Trace to little white (N9), very soft carbonate marl.
1,070 – 1,110	30	LIMESTONE –100% Yellowish gray (5Y 8/1) to light greenish gray (5GY 8/1), fine to medium grained, moderately soft, to moderately hard, locally sparry pelloidal packstone to wackestone with few forams. Locally phosphatic at 1090.
1,110 – 1,170	60	LIMESTONE –100% Yellowish gray (5Y 8/1) to pale yellowish brown (10YR 6/2), fine to medium grained, moderately soft to hard, pelloidal, locally fossiliferous packstone to wackestone with some casts and molds. Trace yellowish gray (5Y 7/2) to white (N9), carbonate marl at 1,120'. Trace pale yellowish brown ((10YR 6/2) to dark yellowish brown (10YR 4/2), microcrystalline to cryptocrystalline, hard glauconitic Limestone at 1,140'. Trace white (N9), very soft carbonate marl at 1,150'. Trace Dolomite at 1,170'.
1,170 – 1,220	50	LIMESTONE – 100% Moderate yellowish brown (10YR 5/4) to grayish orange (10YR 7/4), dominantly fine to medium grained, rarely coarse grained, moderately soft to hard, pelloidal packstone with few fossils and few to common forams. Trace Dolomitic Limestone from 1,180' to 1,190'.
1,220 – 1,260	40	LIMESTONE AND MARL – Limestone 80% to 90%; 50% to 70% grayish orange (10YR 7/4), medium to rarely coarse grained, moderately soft, pelloidal packstone to wackestone. 30% to 10% Pale yellowish brown (10YR 6/2) to light olive gray (5Y 4/1), cryptocrystalline to medium grained, hard, locally weakly vuggy, locally fossiliferous carbonate mudstone. Marl 20% to 10%, white (N9), very soft, carbonate marl with abundant forams.
1,260 – 1,280	20	LIMESTONE – 100%; 80% Yellowish gray (5Y 7/1 to 5Y 8/1), very fine to fine grained, locally weakly vuggy to vuggy, moderately hard packstone to wackestone with few forams. 20% Grayish orange (10YR 7/4), cryptocrystalline, hard, carbonate mudstone. Trace crystalline carbonate and few forams.
1,280 – 1,300	20	LIMESTONE – 100%; 80% Yellowish gray (5Y 8/1), cryptocrystalline to fine grained, moderately hard to moderately soft, locally vuggy wackestone to packstone. 10% to 20% Light olive gray (5Y 6/1, cryptocrystalline, hard carbonate mudstone. Abundant forams. Trace Dolomitic Limestone.
1,300 – 1,330	30	LIMESTONE – 100%; 80% Yellowish gray (5Y 8/1) wackestone to packstone as above. 20% Pale yellowish brown (10YR 6/2), medium to fine grained, moderately hard packstone to grainstone.

Depth (ft)	Thickness (ft)	Sample Description
1,330 – 1,390	60	LIMESTONE – 100%; 60% Grayish orange (10YR 8/4), very fine to fine grained, moderately soft to moderately hard wackestone to packstone. 20% Light olive gray (5Y 6/1) to yellowish gray (5Y 8/1), to medium light gray (N6), cryptocrystalline to very fine grained, hard, locally vuggy carbonate mudstone. Trace forams at 1,370'.
1,390 – 1,400	10	LIMESTONE – 100%; 80% Very pale orange (10YR 8/2), fine grained, moderately hard pelloidal packstone. 20% Light gray (N7), fine to medium grained, hard, carbonate mudstone to wackestone.
1,400 – 1,410	10	LIMESTONE – 100%; 60% Grayish orange (10YR 8/4), medium grained, moderately hard pelloidal packstone. 20% Grayish orange (10YR 8/4), fine to medium grained, moderately hard wackestone. 20% Yellowish gray (5Y 7/1), cryptocrystalline, hard, carbonate mudstone. Trace forams.
1,410 – 1,440	30	LIMESTONE – 100%; 80% to 60% Grayish orange (10YR 7/4), medium to fine grained, moderately hard pelloidal packstone to grainstone. 20% to 40% Pale yellowish brown (10YR 6/2) to light olive gray (5Y 6/1), cryptocrystalline, hard, partly vuggy carbonate mudstone.
1,440 – 1,450	10	LIMESTONE – 100%; 50% Yellowish gray (5Y 8/1), medium grained, soft to moderately soft packstone. 20% Yellowish gray (5Y 8/1) to medium light gray (N6), very fine to fine grained, moderately hard, fossiliferous, micritic packstone/wackestone. 20% Yellowish gray (5Y 8/1), cryptocrystalline to fine grained, hard, weakly vuggy carbonate mudstone. 10% Light olive gray (5Y 8/1), fine to medium grained, hard, fossiliferous packstone with fine to coarse grained colorless quartz sand. Forams common.
1450 – 1,460	10	LIMESTONE – 100% Very pale orange (10YR 8/2), fine to medium grained, moderately hard to moderately soft, pelloidal packstone to wackestone.
1,460 – 1,470	10	LIMESTONE – 100%; 60% Very pale orange (10YR 8/2), medium grained, moderately soft packstone. 30% Yellowish gray (5Y 7/2), cryptocrystalline, hard carbonate mudstone. 10% Medium gray (N5), very fine grained to microcrystalline, hard wackestone. Formas common
1,470 – 1,480	10	LIMESTONE – 100%; 50% Medium light gray (N6) to black (N1), cryptocrystalline to fine grained, hard, locally weakly vuggy carbonate mudstone with trace casts. 50% Yellowish gray (5Y 8/1), very fine to fine grained, moderately soft to moderately hard, rarely weakly Dolomitic wackestone to packstone.
1,480 – 1,500	20	LIMESTONE – 100%; 70% Very pale orange (10YR 8/2), medium to fine grained, moderately soft packstone. 20% Yellowish gray (5Y 7/2), cryptocrystalline, hard, carbonate mudstone. 10% Pale yellowish brown (10YR 6/2) to medium gray (N5), fine grained carbonate mudstone.
1,500 – 1,520	20	LIMESTONE – 100% Yellowish gray (5Y 8/1), fine to medium grained, moderately soft, pelloidal packstone to wackestone with few forams.

Depth (ft)	Thickness (ft)	Sample Description
1,520 – 1,550	30	LIMESTONE – 100%; 90% Pale yellowish brown (10YR 6/2) to pale orange (10YR 7/1), fine to medium grained, moderately soft to moderately hard, locally weakly vuggy to vuggy, pelloidal packstone to wackestone. 10% Yellowish gray (5Y 8/1), fine grained to locally cryptocrystalline, moderately hard to hard carbonate mudstone to wackestone.
1,550 – 1,590	40	LIMESTONE – 100%; 90% Pale orange (10YR 7/1) to very pale orange (10YR 8/2), fine grained, moderately soft, pelloidal, slightly fossiliferous packstone. 10% Light gray (N7) to medium dark gray (N4), cryptocrystalline to very fine grained, hard fossiliferous carbonate mudstone to wackestone. Forams common to abundant
1,590 – 1,600	10	LIMESTONE – 100%; 90% Medium light gray (N6), cryptocrystalline to very fine grained, hard, fossiliferous carbonate mudstone to wackestone. 10% Pale orange (10YR 7/1) to very pale orange (10YR 8/2), fine grained, moderately soft, pelloidal, slightly fossiliferous packstone.
1,600 – 1,620	20	LIMESTONE – 100%; 80% Pale orange (10YR 7/1) to very pale orange (10YR 8/2), fine grained, moderately soft, pelloidal, slightly fossiliferous packstone. 20% Medium light gray (N6), cryptocrystalline to very fine grained, hard fossiliferous carbonate mudstone to wackestone.
1,620 – 1,630	10	LIMESTONE – 100% Very pale orange (10YR 8/2), fine to medium grained, moderately soft pelloidal, slightly fossiliferous grainstone.
1,630 – 1,640	10	LIMESTONE – 100%; 90% Medium light gray (N6), cryptocrystalline to very fine grained, hard, fossiliferous carbonate mudstone to wackestone. 10% Pale orange (10YR 7/1), moderately soft, pelloidal packstone. Abundant forams.
1,640 – 1,670	30	LIMESTONE – 100% Pale orange (10YR 7/1) to very pale orange (10YR 8/2), fine to medium grained, moderately soft, pelloidal, fossiliferous packstone. Trace medium light gray (N6) Limestone. Few to abundant forams.
1,670 – 1,680	10	LIMESTONE – 100% Medium light gray (N6) to medium dark gray (N4), microcrystalline to very fine grained, hard, locally vuggy carbonate mudstone to locally wackestone with little pale orange (10YR 8/1), fossiliferous packstone and few forams.
1,680 – 1,710	30	LIMESTONE - 100%; 95% Pale orange (10YR 7/1) to very pale orange (10YR 8/2), fine to medium grained, moderately soft, pelloidal fossiliferous packstone. 5% Medium light gray (N6) to very light gray (N8), cryptocrystalline to microcrystalline, hard, locally vuggy carbonate mudstone. Abundant forams.
1,710 – 1,730	20	LIMESTONE – 100% Very pale orange (10YR 8/2) to white (N9), microcrystalline to very fine grained, moderately hard, partly weakly vuggy carbonate mudstone to wackestone. Forams common. Trace light gray (N7), fine grained, hard to soft, partly micritic packstone to wackestone.

Depth (ft)	Thickness (ft)	Sample Description
1,730 – 1,740	10	LIMESTONE – 100% Grayish orange (10YR 7/4), fine to medium grained, moderately soft, pelloidal packstone to wackestone. Abundant unconsolidated forams and tests.
1,740 – 1,750	10	LIMESTONE – 100%; 80% Very pale orange (10YR 8/2), fine to medium grained, moderately hard. 20% Very pale orange (10YR 8/2), cryptocrystalline, hard, partly weakly vuggy, rarely slightly sparry carbonate mudstone. Forams common. Trace to little crystalline carbonate.
1,750 – 1,790	40	LIMESTONE – 100%; 80% to 70% Yellowish gray (5Y 8/1) to very pale orange (10YR 8/2), fine to medium grained, moderately hard to moderately soft packstone to rarely grainstone. 20% to 30% Light olive gray (5GY 6/1), cryptocrystalline, hard, locally weakly vuggy carbonate mudstone. Trace yellowish gray (5Y 7/2), microcrystalline to cryptocrystalline, very soft carbonate mudstone at 1,760'. Forams common to abundant.
1,790 – 1,800	10	LIMESTONE – 100%; 90% Very pale orange (10YR 8/2), very fine to fine grained moderately hard wackestone. 10% Light olive gray (5GY 6/1), cryptocrystalline, hard, locally weakly vuggy carbonate mudstone. Abundant forams and tests.

ATTACHMENT No. 4
Water Quality Summary

PRIMARY DRINKING WATER STANDARDS

Analytical Results for City of Hollywood

Parameter	Units	Maximum Contaminant Level	Injection Well No. 1 10/05/02	Source Water (Injection Test) 11/25/02	Monitor Well Upper Zone 11/25/02	Monitor Well Lower Zone 11/25/02
Inorganic Compounds						
Antimony	mg/L	0.006	<0.005	<0.005	<0.005	<0.005
Arsenic	mg/L	0.05	<0.008	<0.0050	<0.0050	0.088
Asbestos	MFL	7	see COC	<0.190	<0.190	<0.174
Barium	mg/L	2	<0.05	<0.05	<0.05	<0.05
Beryllium	mg/L	0.004	<0.002	<0.002	<0.002	<0.002
Cadmium	mg/L	0.005	<0.005	<0.005	<0.005	<0.005
Chromium	mg/L	0.1	0.026	<0.005	<0.005	0.018
Copper	mg/l	1.3	0.16	<0.01	<0.01	0.07
Cyanide	mg/L	0.2	<0.004	<0.004	<0.004	0.069
Fluoride	mg/L	4.0	6.25	0.92	1.24	<0.04
Lead	mg/L	0.015	<0.001	<0.001	<0.001	0.005
Mercury	mg/L	0.002	<0.001	<0.001	<0.001	<0.001
Nickel	mg/L	0.1	<0.002	<0.002	<0.002	0.12
Nitrate	mg/L as N	10	<0.05	0.56	<0.05	<0.05
Nitrite	mg/L as N	1	122	<0.05	<0.05	<0.05
Total Nitrate & Nitrite	mg/L as N	10	122	0.56	<0.05	<0.05
Selenium	mg/L	0.05	<0.010	<0.010	<0.010	<0.010
Sodium	mg/L	160	10500	680	1151	28000
Thallium	mg/L	0.002	<0.002	<0.0020	<0.0020	<0.0020
Pesticides & Polychlorinated Compounds						
2,4,5-TP (Silvex)	mg/L	0.05	<0.000200	<0.000200	<0.000200	<0.000200
2,4-D	mg/L	0.07	<0.000200	<0.000200	<0.000200	<0.000200
Alachlor	mg/L	0.002	<0.000010	<0.000010	<0.000010	<0.000010
Atrazine	mg/L	0.003	<0.000200	<0.000200	<0.000200	<0.000200
Benzo (a) pyrene	mg/L	0.0002	<0.000200	<0.000200	<0.000200	<0.000200
Carbofuran	mg/L	0.04	<0.00500	<0.00050	<0.00050	<0.00050
Chordane	mg/L	0.002	<0.000010	<0.000010	<0.000010	<0.000010
Dalapon	mg/L	0.2	<0.001300	<0.001300	<0.001300	<0.001300
Di (2-ethylhexyl) adipate	mg/L	0.4	<0.005000	<0.005000	<0.005000	<0.005000
Di (2-ethylhexyl) phthalate	mg/L	0.006	<0.005000	<0.005000	<0.005000	<0.005000
Dibromochloropropane (DBCP)	mg/L	0.0002	<0.000010	<0.000010	<0.000010	<0.000010
Dinoseb	mg/L	0.007	<0.000200	<0.000200	<0.000200	<0.000200
Dioxin (2, 3 ,7, 8, -TCDD)	mg/L	0.00000003	<0.00000000120	<0.0000000019	<0.0000000029	<0.0000000022
Diquat	mg/L	0.02	<0.000500	<0.00044	<0.00044	<0.00044
Endothall	mg/L	0.1	<0.0100	<0.0115	<0.0115	<0.0115
Endrin	mg/L	0.002	<0.000010	<0.000010	<0.000010	<0.000010
Ethylene dibromide (EDB)	mg/L	0.00002	<0.000010	<0.000010	<0.000010	<0.000010
Glyphosate	mg/L	0.7	<0.010000	<0.010000	<0.010000	<0.010000
Heptachlor	mg/L	0.0004	<0.000010	<0.000010	<0.000010	<0.000010
Heptachlor epoxide	mg/L	0.0002	<0.000010	<0.000010	<0.000010	<0.000010
Hexachlorobenzene	mg/L	0.001	<0.000010	<0.000010	<0.000010	<0.000010
Hexcachlorocyclopentadiene	mg/L	0.05	<0.000010	<0.000010	<0.000010	<0.000010
Lindane	mg/L	0.0002	<0.000010	<0.000010	<0.000010	<0.000010
Methoxychlor	mg/L	0.04	<0.000010	<0.000010	<0.000010	<0.000010
Oxamyl (vydate)	mg/L	0.2	<0.000500	<0.00050	<0.00050	<0.00050
Pentachlorophenol	mg/L	0.001	<0.000200	<0.000200	<0.000200	<0.000200
Picloram	mg/L	0.5	<0.000200	<0.000200	<0.000200	<0.000200
Polychlorinated biphenyl (PCB)	mg/L	0.0005	see report	see report	see report	see report
Simazine	mg/L	0.004	<0.000500	<0.000500	<0.000500	<0.000500
Toxaphene	mg/L	0.003	<0.000010	<0.000010	<0.000010	<0.000010

mg/L - milligrams per liter

MFL- million fibers per liter greater than 10 microns

PRIMARY DRINKING WATER STANDARDS

Analytical Results for City of Hollywood

Parameter	Units	Maximum Contaminant Level	Injection Well No. 1 10/05/02	Source Water (Injection Test) 11/25/02	Monitor Well Upper Zone 11/25/02	Monitor Well Lower Zone 11/25/02
Volatile Organic Compounds						
1,1,1-Trichloroethane	mg/L	0.2	<0.000500	<0.000500	<0.000500	<0.000500
1,1,2-Trichloroethane	mg/L	0.005	<0.000500	<0.000500	<0.000500	<0.000500
1,1-Dichloroethylene	mg/L	0.007	<0.000500	<0.000500	<0.000500	<0.000500
1,2,4-Trichlorobenzene	mg/L	0.07	<0.000500	<0.000500	<0.000500	<0.000500
1,2-Dichlorethane	mg/L	0.003	<0.000500	<0.000500	<0.000500	<0.000500
1,2-Dichloropropane	mg/L	0.005	<0.000500	<0.000500	<0.000500	<0.000500
Benzene	mg/L	0.001	<0.000500	<0.000500	<0.000500	<0.000500
Carbon tetrachloride	mg/L	0.003	<0.000500	<0.000500	<0.000500	<0.000500
cis-1,2,-Dichloroethylene	mg/L	0.07	<0.000500	<0.000500	<0.000500	<0.000500
Dichloromethane	mg/L	0.005	<0.000500	<0.000500	<0.000500	<0.000500
Ethylbenzene	mg/L	0.7	<0.000500	<0.000500	<0.000500	<0.000500
Monochlorobenzene	mg/L	0.1	<0.000500	<0.000500	<0.000500	<0.000500
o-Dichlorobenzene	mg/L	0.6	<0.000500	<0.000500	<0.000500	<0.000500
para-Dichlorobenzene	mg/L	0.075	<0.000500	<0.000500	<0.000500	<0.000500
Styrene	mg/L	0.1	<0.000500	<0.000500	<0.000500	<0.000500
Tetrachloroethylene	mg/L	0.003	<0.000500	<0.000500	<0.000500	<0.000500
Toluene	mg/L	1	<0.000500	<0.000500	<0.000500	<0.000500
Total trihalomethanes (TTHM)	mg/L	0.10	<0.000500	<0.000500	<0.000500	0.133
trans-1,2-Dichlorethylene	mg/L	0.1	<0.000500	<0.000500	<0.000500	<0.000500
Trichloroethylene	mg/L	0.003	<0.000500	<0.000500	<0.000500	<0.000500
Vinyl chloride	mg/L	0.001	<0.000500	<0.000500	<0.000500	<0.000500
Xylenes (total)	mg/L	10	<0.000500	<0.000500	<0.000500	<0.000500
Physical Characteristics						
Turbidity	NTU	1	29.9	3.82	17.90	5.16
Microbiological Characteristics						
Total Coliform		<1	<1.0	27000	<1.0	<1.0
Fecal Coliform		<1	<1.0	11000	<1.0	<1.0
Radionuclides						
Combined Radium 226 & 228	pCi/L	5	see report	see report	see report	see report
Gross Alpha	pCi/L	15	see report	see report	see report	see report
Man-made beta & photon emitters	mRem/yr	4	see report	see report	see report	see report
Treatment Chemicals						
Acrylamide	mg/L	0.05% @1	<0.100	<0.100	<0.100	<0.100
Bromate	mg/L	0.000010	<50	<0.5	<0.5	<0.5
Chlorite	mg/L	0.0001	<500	<5	<5	<5
Haloacetic acids (HAAS)	mg/L	0.000060	see report	see report	see report	see report
Epichlorohydrin	mg/l	0.01% @20	<0.0050	<0.0050	<0.0050	<0.0050

mg/L - milligrams per liter

pCi/L - picocurie per liter

m/Rem/yr - millirem per year

NTU - nephelometric turbidity unit

SECONDARY DRINKING WATER STANDARDS

Analytical Results for City of Hollywood

Parameter	Units	Maximum Contaminant Level	Injection Well No. 1 10/05/02	Source Water (Injection Test) 11/25/02	Monitor Well Upper Zone 11/25/02	Monitor Well Lower Zone 11/25/02
Aluminum	mg/L	0.2	<0.1	<0.1	<0.1	0.62
Chloride	mg/L	250	19640	1305	2580	19116
Color	color units	15	13	25	5	12.5
Copper	mg/L	1	0.16	<0.01	<0.01	0.07
Corrosivity (Langelier Index)			0.71	-0.24	0.94	1.13
Fluoride	mg/L	2	6.25	0.92	1.24	<0.04
Foaming Agents	mg/L	0.5	<0.01	0.09	<0.01	<0.01
Iron	mg/L	0.3	2.18	0.13	0.44	0.40
Manganese	mg/L	0.05	0.05	<0.05	0.08	<0.05
Odor	TON	3	2	1	<1.0	<1.0
pH	---	6.5-8.5	7.69	6.76	8.76	7.74
Silver	mg/L	0.1	0.092	<0.001	<0.001	0.10
Sulfate	mg/L	250	2643	190	537	2814
Total Dissolved Solids (TDS)	mg/L	500	34040	2360	4320	33660
Zinc	mg/L	5	<0.01	<0.01	<0.01	0.01

mg/L - milligrams per liter

TON - threshold odor number

ATTACHMENT No. 5

Core Data

Injection Well No. 1 – Lithology

Core Geologic Log

CITY OF HOLLYWOOD EFFLUENT DISPOSAL SYSTEM

SOUTHERN REGIONAL WWTP INJECTION WELLS

GEOLOGIC LOG

WELL IW - 1

CORE #1

Depth (ft)	Sample Description
1700.0 – 1711.0	No Recovery
1711.0 – 1712.0	LIMESTONE (100%) yellowish gray (5Y 8/1) massive, fine to medium grained, soft, well indurated packstone with forams. Indistinct lower contact.
1712.0 – 1712.3	LIMESTONE (100%) yellowish gray (5Y 7/2) massive, very fine to fine grained, moderately soft, well indurated, wackestone. Poor core quality.
1712.3 – 1713.1	LIMESTONE (100%) very pale orange (10YR 8/2)) massive, fine to medium grained, moderately soft to moderately hard, well indurated, packstone with medium to coarse grain sized forams common in upper portion of unit to abundant in lower portion. Trace light gray (N7) to medium light gray (N^) hard, carbonate mudstone clasts from dominantly 1mm in diameter to rarely 4 mm in diameter throughout unit.
1713.1 – 1713.2	LIMESTONE (100%) yellowish gray (5Y 7/2) massive dominantly very fine to fine grained soft, well indurated packstone/wackestone with medium to coarse grain sized forams common. Indistinct lower contact.
1713.2 – 1713.7	LIMESTONE (100%), yellowish gray (5Y 8/1), massive, massive fine to medium grained moderately hard packstone with abundant fine to coarse grain sized forams. Gradational contact lower through lower .2 feet of unit..
1713.7 – 1713.8	LIMESTONE (100%) medium dark gray (N4) massive cryptocrystalline, hard, vuggy carbonate mudstone.

1713.8 – 1714.0	LIMESTONE (100%) Yellowish gray (5Y 8/1) massive, fine grained, soft well indurated packstone/wackestone.

End of Core

CITY OF HOLLYWOOD EFFLUENT DISPOSAL SYSTEM

SOUTHERN REGIONAL WWTP INJECTION WELLS

GEOLOGIC LOG

WELL IW - 1

CORE #2

Depth (ft)	Sample Description
1750.0 – 1750.2	LIMESTONE (100%) yellowish gray (5Y 8/1) massive, fine grained to cryptocrystalline, moderately hard, vuggy with vugs to 1 mm in diameter carbonate mudstone with occasional molds and few forams. Indistinct lower contact. No Recovery
1750.2 – 1751.1	LIMESTONE (100%) yellowish gray (5Y 8/1) massive, fine to medium grained, soft, well indurated wackestone with trace light gray (N7) cryptocrystalline hard carbonate mudstone clasts to 5 mm in diameter.
1751.1 – 1765.0	No Recovery

End of Core

CITY OF HOLLYWOOD EFFLUENT DISPOSAL SYSTEM

SOUTHERN REGIONAL WWTP INJECTION WELLS

GEOLOGIC LOG

WELL IW - 1

CORE #3

Depth (ft)	Sample Description
1800.0 – 1804.3	No Recovery
1804.3 – 1805.4	LIMESTONE (100%) yellowish gray (5Y 8/1) massive, medium grained, moderately hard to moderately soft, moderately indurated packstone. Weakly vuggy in upper .4' of section. Trace to few forams and trace moderately soft mudstone clasts to 4mm in diameter throughout section. Indistinct lower contact.
1805.4 – 1805.8	LIMESTONE (100%) yellowish gray (5Y 7/2) massive, medium to coarse grained, moderately soft, moderately to poorly indurated packstone with coarse grained to 5mm in diameter forams and tests common. Indistinct lower contact.
1805.8 – 1805.9	LIMESTONE (100%) medium light gray (N6) cryptocrystalline, hard angular medium grained to 15mm carbonate mudstone clasts with yellowish gry (5Y 7/2) medium grained, moderately soft packstone matrix. Indistinct lower contact.
1805.9 – 1806.1	LIMESTONE (100%0 medium gray (N5) to medium light gray (N6) massive, dominantly very fine to medium grained, soft, moderately well indurated wackestone. Sharp horizontal lower contact.
1806.1 – 1806.9	LIMESTONE (100%) yellowish gray (5Y 8/1) massive, fine to medium grained, moderately hard, moderately indurated, weakley vuggy packstone with coarse grain sized forams.
1806.9 – 1807.3	LIMESTONE (100%) yellowish gray (5Y 8/1) massive, very fine grained, hard, well indurated, moderately vuggy with vugs dominantly 1 mm to

	rarely 5 mm in diameter. Wackestone to carbonate mudstone. Poor core quality
1807.3 – 1807.5	LIMESTONE (100%) medium to light gray (N6) and yellowish gray (5Y 8/1) massive to weakly laminated, moderately hard, well indurated, weakly vuggy packstone. Sharp horizontal lower contact.
1807.5 – 1807.7	LIMESTONE (100%) very pale orange (10YR 8/2) massive, fine grained, moderately hard, well indurated, vuggy with vugs generally< 1 mm in diameter, packstone.
1807.7 – 1808.2	LIMESTONE (100%) very pale orange (10YR 8/2) massive, fine grained, soft, friable, well indurated packstone. Poor core quality
1808.2 – 1809.5	LIMESTONE (100%) yellowish gray (5Y 7/2) massive, very fine to fine grained, grain size increasing with depth, soft to moderately hard, hardness increasing with depth, very well to well indurated packstone with 5% to 10% medium gray (N5) coarse grained grading with depth to 5 mm hard carbonate mudstone clasts. Indistinct lower contact.
1809.5 – 1810.0	LIMESTONE (100%) yellowish gray (5Y 8/1) massive, fine to medium grained, soft, well indurated, locally micritic and vuggy packstone
1810.0 – 1815.0	No Recovery

End of Core

CITY OF HOLLYWOOD EFFLUENT DISPOSAL SYSTEM

SOUTHERN REGIONAL WWTP INJECTION WELLS

GEOLOGIC LOG

WELL IW - 1

CORE #4

Depth (ft)	Sample Description
1850.0 – 1854.2	No Recovery
1854.2 – 1854.6	LIMESTONE (100%) yellowish gray (5Y 8/1) massive, fine to medium grained, soft, very well indurated packstone. Indistinct lower contact.
1854.6 – 1854.7	LIMESTONE (100%) yellowish gray (5Y 8/1) massive, medium to coarse grained, hard, moderately indurated packstone with medium light gray (N6) hard, coarse grained to 10 mm in diameter angular carbonate mudstone clasts. Indistinct lower contact.
1854.7 – 1857.4	LIMESTONE (100%) yellowish gray (5Y 8/1) to yellowish gray (5Y 7/2) massive, fine to coarse grained, moderately soft to soft, well indurated, very weakly vuggy with vugs 1 mm to 3 mm in diameter, packstone to wackestone with few forams. Indistinct lower contact.
1857.4 – 1861.8	LIMESTONE (100%) yellowish gray (5Y 7/2) generally massive, dominantly coarse grained grading to medium grain sized with depth, moderately hard, moderately to well indurated with induration increasing with depth grainstone grading to packstone with depth with abundant forams, 10mm thick wackestone lamination at 1857.6 and thin, medium gray (N5) moderately hard carbonate mudstone laminations at 1860.0. Indistinct lower contact.
1861.8 – 1862.0	LIMESTONE (100%) yellowish gray (5Y 8/1) massive, fine grained, hard, moderately indurated, wackestone to carbonate udstone with vertical boreholes to 2mm in diameter. Poor core quality.

1862.0 – 1862.9	LIMESTONE (100%) light gray (N7) weakly bedded, dominantly fine grained, hard, well indurated wackestone with few medium to coarse grained micritic packstone laminations to 15mm thick and yellowish gray (5Y 7/2) medium grained, soft packstone lenses in lower .5' of unit.

End of Core

CITY OF HOLLYWOOD EFFLUENT DISPOSAL SYSTEM

SOUTHERN REGIONAL WWTP INJECTION WELLS

GEOLOGIC LOG

WELL IW - 1

CORE #5

Depth (ft)	Sample Description
1900.0 – 1901.0	LIMESTONE (100%) yellowish gray (5Y 8/1) massive, very fine to medium grained, moderately soft, well indurated packstone to wackestone. Poor core quality.
1901.0 – 1901.3	LIMESTONE (100%) yellowish gray (5Y 8/1) generally massive, very fine grained, moderately soft, very well indurated wackestone with thin pale yellowish brown (10YR 6/2) dolomitic laminations in lower .1' of unit. Indistinct lower contact.
1901.3 – 1901.6	DOLOMITE AND LIMESTONE Dolomite (70%) dark yellowish brown (10YR 4/2) cryptocrystalline, moderately hard moderately indurated interlaminated with Limestone (30%) as above. Indistinct lower contact.
1901.6 – 1901.9	LIMESTONE (100%) yellowish gray (5Y 8/1) generally massive, very fine grained, moderately soft, well indurated, wackestone with few moderate yellowish brown (10YR 5/4) dolomitic laminations to 3 mm thick. Indistinct lower contact.
1901.9 – 1903.0	LIMESTONE (100%) yellowish gray (5Y 8/1) generally massive, medium grained grading with depth to very fine grained, moderately soft moderately well indurated, packstone grading with depth to well indurated wackestone. Unit exhibits rare thin >1 mm dolomitic laminations. Indistinct lower contact.
1903.0 – 1903.8	LIMESTONE (100%) yellowish gray (5Y 8/1), fine grained, soft, well indurated, packstone with thin (10 mm) cryptocrystalline, moderately hard carbonate mudstone beds with trace vertical burrows to 3 mm in diameter.

1903.8 – 1904.1	DOLOMITE (100%) yellowish gray (5Y 7/2) with light olive gray (5Y 5/2) wavy laminations common, cryptocrystalline, very hard, moderately vuggy with vugs generally <1 mm in diameter to rarely 5 mm in diameter..

End of Core

CITY OF HOLLYWOOD EFFLUENT DISPOSAL SYSTEM

SOUTHERN REGIONAL WWTP INJECTION WELLS

GEOLOGIC LOG

WELL IW - 1

CORE #6

Depth (ft)	Sample Description
1950.0 – 1957.6	No Recovery
1957.6 – 1958.6	LIMESTONE (100%) very pale orange (10YR 8/2) massive, fine grained, soft, well indurated wackestone. Sharp horizontal lower contact.
1958.6– 1958.9	LIMESTONE (100%) yellowish gray (5Y 7/2) massive, fine grained, hard, micritic, weakly vuggy carbonate mudstone to wackestone. Indistinct lower contact.
1958.9 – 1959.2	LIMESTONE (100%) very pale orange (10YR 8/2) massive, fine grained, moderately hard, well indurated, weakly vuggy wackestone. Poor core quality.
1959. 2– 1961.1	LIMESTONE (100%) yellowish gray (5Y 8/1) massive, fine to medium grained, moderately soft, well indurated, packstone to wackestone with few tests. Hard carbonate mudstone lens at 1960.1. Sharp horizontal lower contact.
1961.1 – 1961.4	LIMESTONE (100%) yellowish gray (5Y 7/2), massive, medium grained, moderately soft, moderately indurated, packstone with few clasts to 5 mm in diameter. Sharp horizontal lower contact.
1961.4 – 1962.0	LIMESTONE (100%) very pale orange (10YR 8/2) massive, fine grained, hard, moderately indurated, weakly vuggy with vugs generally 1 mm in diameter packstone with molds common. Indistinct lower contact.

1962.0 – 1965.0	LIMESTONE (100%) very pale orange (10YR 8/2) generally massive, fine to medium grained, moderately soft, well indurated packstone with light olive gray (5Y 6/1) soft wackestone lamination at 1963.6

End of Core

CITY OF HOLLYWOOD EFFLUENT DISPOSAL SYSTEM

SOUTHERN REGIONAL WWTP INJECTION WELLS

GEOLOGIC LOG

WELL IW - 1

CORE #7

Depth (ft)	Sample Description
2032.0 – 2032.8	DOLOMITE (100%) Slightly limy, pale yellowish brown (10YR 6/2) to olive gray (5Y 4/1) massive, cryptocrystalline, very hard, moderately vuggy, vugs dominantly <1mm in diameter to rarely 5mm in diameter. Indistinct lower contact.
2032.8 – 2033.6	DOLOMITE AND LIMESTONE Dolomite (95%) light bluish gray (5B 8/1) to light olive gray (5Y 5/2) weakly laminated, cryptocrystalline, very hard, weakly vuggy to vuggy, vugs 2mm to 4mm in diameter with olive gray (5Y 4/2) inclusions and 5 mm lamination in upper .15' of section. Limestone (5%) very pale orange (10YR 8/2) very fine grained, moderately soft packstone occurring as occasional lenses with maximum thickness of 10mm. Indistinct lower contact.
2033.6 – 2034.8	DOLOMITE (100%) Medium bluish gray (5B 5/1) to light olive gray (5Y 6/1) massive dominantly cryptocrystalline to fine grained very hard, vuggy, vugs to 10mm in diameter in upper .2' of section trending to weakly vuggy with vugs generally 1mm to 2mm with depth. Indistinct lower contact.
2034.8 – 2.35.7	DOLOMITE AND LIMY DOLOMITE Dolomite 90% medium bluish gray (5B 5/1) to light olive gray (5Y 6/1) cryptocrystalline, very hard, weakly to moderately vuggy with Limy Dolomite (10%) grayish orange (10YR 7/4) microcrystalline to very fine grained, very hard occurring as lenses
2035.7 – 2040.0	No Recovery

2040.0 – 2041.3	DOLOMITE (100%) Grayish orange (10YR 6/4) massive, cryptocrystalline, very hard, weakly vuggy, vugs generally 1mm in diameter
2041.3 – 2041.9	DOLOMITE (100%) Dark yellowish orange (10YR 6/6) to moderate yellowish brown (10YR 5/4) cryptocrystalline, very hard, weakly vuggy with distinct mottles common.

End of Core

Injection Well No. 2 – Lithology

Core Geologic Log

CITY OF HOLLYWOOD EFFLUENT DISPOSAL SYSTEM

SOUTHERN REGIONAL WWTP INJECTION WELLS

GEOLOGIC LOG

WELL IW - 2

CORE #5

Depth (ft)	Sample Description
2050.0 – 2051.0	LIMESTONE (100%) yellowish gray (5Y 8/1) massive, dominantly fine to medium grained, soft, well indurated, pelloidal, fossiliferous, locally sparry packstone with abundant fine to medium grain sized forams. Trace shell fragments.
2051.0 – 2051.2	LIMESTONE (100%) medium light gray (N6) to medium gray (N5), massive, microcrystalline to fine grained, moderately hard to hard, pelloidal, weakly fossiliferous, packstone with forams common. Common coarse grain sized yellowish gray (5Y 8/1), microcrystalline to cryptocrystalline carbonate mudstone to wackestone clasts and medium dark gray (N4), cryptocrystalline carbonate mudstone inclusions.
2051.2 – 2054.0	LIMESTONE (100%) yellowish gray (5Y 8/1), massive, dominantly fine to medium grained, moderately soft to moderately hard, well indurated, pelloidal, fossiliferous packstone with abundant fine to medium grain sized forams. Trace shell fragments. Sharp horizontal lower contact.
2054.0 – 2054.5	LIMESTONE (100%) very light gray (N8) to yellowish gray (5Y 8/1), massive, microcrystalline to very fine grained, moderately hard to hard, pelloidal, weakly fossiliferous, moderately vuggy packstone to wackestone. Trace very light gray (N8), microcrystalline carbonate mudstone inclusions and shell molds. Medium gray (N5), microcrystalline carbonate mudstone lenses to 5mm thick at 2054.3.
2054.5 – 2054.9	LIMESTONE (100%) massive, 50% yellowish gray (5Y 8/1), cryptocrystalline, hard, moderately vuggy carbonate mudstone with 50% light gray (5YR 6/1), microcrystalline to cryptocrystalline, moderately hard, weakly vuggy to vuggy carbonate mudstone to wackestone.

2054.9 – 2055.1	LIMESTONE (100%) massive 60% very light gray (N8) microcrystalline to very fine grained, hard carbonate mudstone with 40% light gray (N7) cryptocrystalline, hard angular carbonate mudstone inclusions to 25mm in diameter.
2055.1 – 2063.5	No Recovery.

End of Core

CITY OF HOLLYWOOD EFFLUENT DISPOSAL SYSTEM

SOUTHERN REGIONAL WWTP INJECTION WELLS

GEOLOGIC LOG

WELL IW - 2

CORE #6

Depth (ft)	Sample Description
2065.0 – 2065.5	No Recovery
2065.5 – 2066.2	LIMESTONE (100%) yellowish gray (5Y 8/1) to very pale orange (10YR 8/2) massive, dominantly fine to medium grained, moderately soft pelloidal, weakly fossiliferous packstone with abundant medium grain sized forams. Indistinct lower contact.
2066.2 – 2066.5	DOLOMITE AND LIMESTONE olive gray (5Y 4/2), cryptocrystalline, very hard, weakly to moderately vuggy with yellowish gray (5Y 8/1) 2 mm to 5 mm diameter Dolomite inclusions and yellowish gray (5Y 8/1), cryptocrystalline, very hard, locally weakly vuggy 10 mm thick Limestone laminations intercalated into the Dolomite bedding. Few medium gray (N5) thin Limy Dolomite laminations at base of unit. Gradational lower contact.
2066.5 – 2068.4	LIMESTONE (100%) very pale orange (10YR 8/2) massive, very fine to medium grained, soft to moderately soft very well indurated pelloidal packstone. Gradational lower contact.
2068.4 – 2068.6	DOLOMITE (100%) grayish orange (10YR 7/4), cryptocrystalline, moderately hard to hard, weakly to moderately vuggy, sucrosic with sharp wavy lower contact.
2068.6 – 2069.7	DOLOMITE (100%) pale yellowish brown (10YR 6/2), generally massive, cryptocrystalline, very hard, locally weakly vuggy, locally weakly sucrosic with yellowish gray (5Y 8/1) Dolomite bedding 15 mm to 30 mm thick at 2068.7 and inclusions at 2068.9. Prominent brownish gray (5YR 4/1)

	mottles common from 2069.2 to 2069.7. Closed local vertical fracture 50mm in length at 2068.7. Sharp wavy lower contact.
2069.7 – 2070.0	DOLOMITE (100%) yellowish gray (10YR 7/2) massive, microcrystalline to cryptocrystalline, very hard, weakly vuggy to locally vuggy with sucrosic texture. Indistinct lower contact.
2070.0 – 2072.1	DOLOMITE (100%) pale yellowish brown (10YR 6/2) to locally olive gray (5Y 3/2) massive, cryptocrystalline, very hard, locally weakly vuggy with sucrosic texture. Indistinct lower contact.
2072.1 – 2074.0	DOLOMITE (100%) 50% to 60% pale orange (10YR 7/2) cryptocrystalline, very hard, locally sucrosic and vuggy. 50% to 40% Dark gray (N3) to locally medium light gray (N6) cryptocrystalline, very hard, vuggy to locally highly vuggy. Trace to few medium light gray (N6) Dolomitic Limestone inclusions. Thin 2 mm to 3 mm yellowish gray (5Y 8/1) dolomitic limestone laminations and inclusions at 2072.5. Gradational lower contact.
2074.0 – 2074.4	DOLOMITE (100%) Light olive gray (5Y 5/7) with prominent dark gray (N3) mottles common, massive, dominantly cryptocrystalline to microcrystalline, very hard, locally weakly vuggy.
2074.4 – 2077.0	No Recovery.

End of Core

CITY OF HOLLYWOOD EFFLUENT DISPOSAL SYSTEM

SOUTHERN REGIONAL WWTP INJECTION WELLS

GEOLOGIC LOG

WELL IW - 2

CORE #7

Depth (ft)	Sample Description
2078.0 – 2078.7	DOLOMITE (100%) pale yellowish brown (10YR 6/2 to dark yellowish brown (10YR 4/2) massive, cryptocrystalline, very hard, moderately vuggy, slightly sucrosic. Sharp horizontal lower contact.
2078.7 – 2078.8	DOLOMITE (100%) yellowish gray (5Y 8/1) to very pale orange (10YR 8/2) cryptocrystalline, very hard, very well indurated, with few medium dark gray (N4) lenses up to 2 mm. Sharp horizontal lower contact.
2078.8 – 2079.9	DOLOMITE (100%) olive gray (5Y 4/1) to dark yellowish brown (10YR 4/2) massive, cryptocrystalline, very hard, locally sucrosic texture, moderately vuggy with some 10 mm to 15 mm vugs. Indistinct lower contact
2080.0 – 2080.5	DOLOMITE (100%) moderate yellowish brown (10YR 5/4) to locally dark yellowish brown (10YR 4/2) massive, cryptocrystalline, very hard, weakly to moderately vuggy. Sharp horizontal lower contact.
2080.5 – 2080.7	DOLOMITE (100%) pale yellowish brown (10YR 6/2) massive, cryptocrystalline to fine grained, very hard, vuggy.
2080.7 – 2081.5	DOLOMITE (100%) olive gray (5Y 4/1) to locally pale orange (10YR 7/2) massive, cryptocrystalline, very hard, locally weakly vuggy. Sharp horizontal lower contact.
2081.5 – 2082.4	DOLOMITE (100%) medium gray (N5) to medium light gray (N6) massive, cryptocrystalline, very hard, locally very weakly vuggy with vugs decreasing with depth. Grayish orange (10YR 7/4) cryptocrystalline,

very hard vuggy 5mm thick lens at 2082.1. Sharp horizontal lower contact.

2082.4 – 2082.5 CLAY (100%) dark gray (N3) to medium dark gray (N4), slightly silty, firm, moderately plastic, very well indurated non-calcareous. Sharp horizontal lower contact.

2082.5 – 2082.8 DOLOMITE BRECCIA (100%) yellowish gray (5Y 7/2) cryptocrystalline, very hard generally subangular to subrounded clasts from 5mm to approximately 30 mm in diameter with light olive gray (5Y 6/1) very firm non-calcareous clay matrix. Indistinct lower contact.

2082.8 – 2084.2 DOLOMITE (100%) yellowish brown (10YR 6/2) massive, cryptocrystalline, very hard, very weakly vuggy with very pale orange (10YR 8/2), cryptocrystalline, very hard inclusions at 2083.2. Sharp horizontal lower contact.

2084.2 – 2084.8 DOLOMITE (100%) pale yellowish brown (10YR 6/2) to moderately yellowish brown (10YR 5/4) to locally dark yellowish brown (10YR 4/2) massive, cryptocrystalline, very hard, and weakly vuggy. Gradational lower contact.

2084.8 – 2085.9 DOLOMITE (100%) pale yellowish brown (10YR 6/2 to 10YR 7/2) massive, cryptocrystalline, very hard, very weakly vuggy to well indurated. Sharp horizontal lower contact.

2085.9 – 2088.0 DOLOMITE (100%) grayish orange (10YR 7/4) grading with depth to pale yellowish brown (10YR 6/2) massive, cryptocrystalline, very hard, moderately vuggy to 2086.3 grading with depth to very well indurated. Trace dusky yellowish brown (10YR 2/2) Dolomite inclusions and 1 mm to 2 mm laminations at 2087.0.

2088.0 – 2091.0 No Recovery.

End of Core

CITY OF HOLLYWOOD EFFLUENT DISPOSAL SYSTEM

SOUTHERN REGIONAL WWTP INJECTION WELLS

GEOLOGIC LOG

WELL IW - 2

CORE #8

Depth (ft)	Sample Description
2098.0 – 2102.5	LIMESTONE (100%) grayish orange (10YR 7/4 to 10YR 8/4)) massive, dominantly fine grained, moderately soft to moderately hard, very well indurated, pelloidal, partially fossiliferous packstone with fine to medium grain sized forams common. Trace coarse grain sized forams and sparry shell fragments. Trace burrows partially healed with sparry calcite at 2099.3, and 2101.0. Few pale yellowish brown (10YR 6/2 to 10YR 7/2), microcrystalline, hard carbonate mudstone inclusions to 3mm at 2101.9, and 2103.0.
2102.5 – 2113.0	No recovery.

End of Core

CITY OF HOLLYWOOD EFFLUENT DISPOSAL SYSTEM

SOUTHERN REGIONAL WWTP INJECTION WELLS

GEOLOGIC LOG

WELL IW - 2

CORE #10

Depth (ft)	Sample Description
2420.0 – 2424.3	LIMESTONE (100%) very pale orange (10YR 8/2) massive, dominantly fine to locally medium grained, moderately hard, pelloidal, fossiliferous, and very well indurated packstone locally grainstone. Medium to pebble grain sized forams and sparry shell fragments common to locally abundant. Trace burrows partially healed with sparry calcite and fossil casts. Pale yellowish brown (10YR 7/2), microcrystalline, hard carbonate mudstone pebble grain sized inclusions at 2420.2, 2421.0, and 2421.5.
2424.3 – 2426.1	LIMESTONE (100%) very pale orange (10YR 8/2) massive, dominantly very fine to locally fine to medium grained, moderately hard, pelloidal, well indurated packstone. Medium to pebble grain sized forams and sparry shell fragments common to locally abundant. Trace burrows, fossil molds and casts. Pebble grain sized, very pale orange (10YR 8/2) to pale yellowish brown (10YR 6/2), microcrystalline, hard carbonate mudstone inclusions at 2424.7, and 2425.3.
2426.1 – 2428.0	LIMESTONE (100%) very pale orange (10YR 8/2) massive, dominantly very fine, locally fine to medium grained, moderately soft to moderately hard, partially pelloidal, well indurated packstone to rarely grainstone. Few coarse to pebble grain sized forams. Trace shell fragments.
2428.0 – 2435.0	No Recovery.

End of Core

ATTACHMENT No. 6

Hydraulic Conductivity Data

Injection Well Nos. 1 & 2 (IW-1 & IW-2)
Hydraulic Conductivity Derived from Packer Tests
City of Hollywood Effluent Disposal System – Southern Regional WWTP

Depth Interval (feet bpl)	Well	Pumping Rate (gpm)	Maximum Drawdown (feet)	Drawdown Hydraulic Conductivity (cm/sec)	Drawdown Transmissivity (gpd/ft)	Recovery Hydraulic Conductivity (cm/sec)	Recovery Transmissivity (gpd/ft)
1,354 – 1,370[(1)]	IW-1	70	96.5	9.4×10^{-4}	319	6.2×10^{-4}	212
1,390 – 1,400	IW-2	77	31	2.2×10^{-3}	2,032	1.3×10^{-2}	5,028
1,404 – 1,420[(1)]	IW-1	73	43.2	2.1×10^{-3}	741	1.5×10^{-3}	507
1,510 – 1,528	IW-2	66	56	1.8×10^{-3}	44	1.2×10^{-3}	470
1,760 – 1,778	IW-2	16	129	1.1×10^{-4}	4	1.0×10^{-4}	39
1,769 – 1,785	IW-1	30	77	3.8×10^{-4}	132	3.5×10^{-4}	121
1,810 – 1,828	IW-2	34	87	3.6×10^{-4}	10	3.4×10^{-4}	32
1,894 – 1,910	IW-1	6.4	144.5	3.8×10^{-5}	13	4.3×10^{-5}	15
1,959 – 1,975	IW-1	27	132.2	2.0×10^{-4}	68	1.8×10^{-4}	65
2,046 – 2,062	IW-1	12	135	8.9×10^{-5}	30	8.5×10^{-5}	29
2,093 – 2,111	IW-2	9	125	6.1×10^{-5}	24	6.1×10^{-5}	24
2,193 – 2,209	IW-1	61	119.0	4.9×10^{-4}	167	5.6×10^{-4}	191
2,265 – 2,283	IW-2	33	103	3.0×10^{-4}	114	3.3×10^{-4}	128
2,300 – 2,318	IW-2	23	100	2.2×10^{-4}	87	2.2×10^{-4}	84
2,410 – 2,428	IW-2	24	86	2.7×10^{-4}	105	3.2×10^{-4}	121

(1) - Packer test used to obtain water quality data

Injection Well IW-1
Hydraulic Conductivity Derived from Cores
City of Hollywood Effluent Disposal System
Southern Regional WWTP

Core	Interval	Vertical (cm/sec)	Horizontal (cm/sec)
Core #1	1,712.3 – 1713.1	3.0×10^{-3}	3.7×10^{-3}
Core #3	1,804.7 – 1805.4	1.3×10^{-3}	4.3×10^{-3}
	1,806.0 – 1,806.5	1.1×10^{-3}	1.3×10^{-3}
	1,808.2 – 1,808.9	5.7×10^{-6}	5.1×10^{-6}
Core #4	1,862.0 – 1862.5	6.3×10^{-4}	3.2×10^{-3}
	1,862.5 – 1,862.9	2.7×10^{-4}	1.8×10^{-3}
Core #5	1,901.6 – 1,901.9	3.1×10^{-7}	6.7×10^{-6}
	1,902.1 – 1,902.5	3.0×10^{-5}	6.3×10^{-5}
	1,902.5 – 1,903.0	1.5×10^{-5}	2.8×10^{-5}
Core #6	1,962.4 – 1,962.9	5.7×10^{-4}	6.3×10^{-4}
	1,962.9 – 1,963.4	1.6×10^{-4}	na
Core #7	2,032.4 – 2,032.7	1.7×10^{-7}	2.6×10^{-5}
	2,033.2 – 2,033.6	1.1×10^{-3}	8.0×10^{-4}
	2,034.0 – 2,034.4	1.4×10^{-8}	8.2×10^{-9}
	2,034.8 –2,035.4	1.1×10^{-7}	2.0×10^{-6}
	2,041.2 – 2,041.9	2.7×10^{-8}	1.2×10^{-8}

ATTACHMENT No. 7

Proposed Injection Test Procedures

Youngquist Brothers, Inc.
15465 Pine Ridge Road
Fort Myers, Florida 33908
239-489-4444

April 9, 2003

Hazen & Sawyer
Southern Regional WWTP
1621 North 14th Avenue
Hollywood, Florida 33020

Re: City o Hollywood - Injection Testing

Attn: Glenn Cunningham

Dear Mr. Cunningham,

Please find documentation on proposed injection test including the following.

- Installation Procedures
- Testing and Operation Procedures
- Piping Layout, Section & Details Drawings.

Installation Procedures:

1. Install both IW Feed pumps in Clarifier effluent channel as shown on diagram. Both diesel driven hydraulic pumps are required to operate simultaneously to provide design flow of 16,000 GPM.

2. Weld support & install pipe as shown on attached drawings. Piping will be 20-inch and 34-inch steel casing pipe.

3. Injection well pump will be installed approximately 50' from injection well. A calibrated propeller type flowmeter will be used. Calibration certificate will be provided, prior to starting injection test.

4. System will be checked for leaks before placing into operation.

5. Adjacent roadway shall be blocked off a total of 7 days to facilitate each test.

Testing Procedures & Operation:

1. After testing pumps & auxiliary equipment a pretest run will be schedule with the city and engineers.

2. The pretest will be full operation of the test equipment to establish setting for flow equipment & rates. Pretest duration shall be 12 – 24 hrs.

3. A 24-hour test at design flow 16,000 GPM will be completed in accordance with the contract documents.

4. Test will start at 2am and will continue non-stop for 24 hours @ 16,000 GPM.

5. Results will be documented in accordance with contract documents and DEP requirements.

If you required additional information or documentation please call our office.

Respectfully,

Cameron Webster,
Superintendent

Attachments: Detail Sheet, Drawings

HAZEN AND SAWYER
Environmental Engineers & Scientists

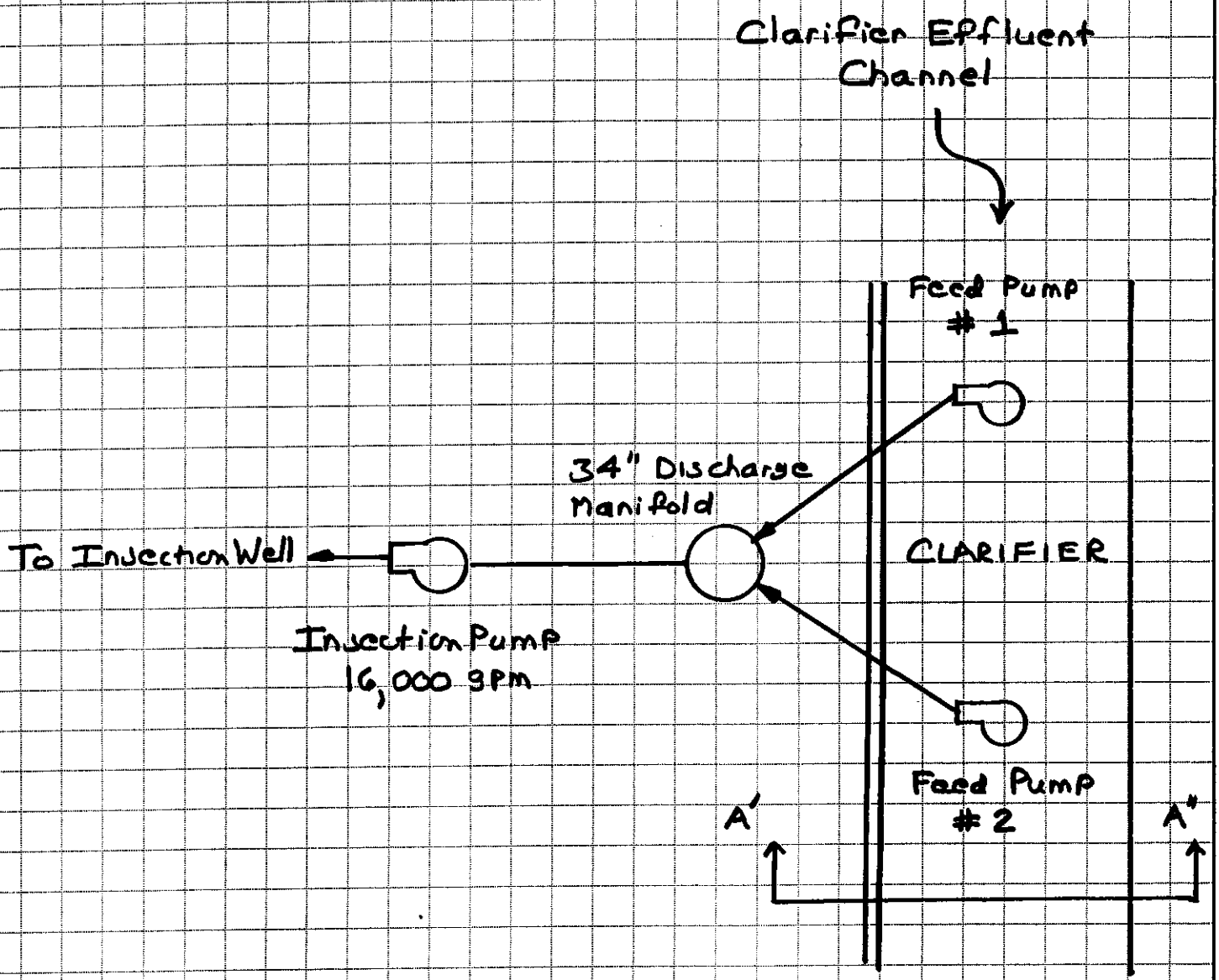
JOB _____

SHEET NO. _____ OF _____

CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

SCALE _____



YB1 Pump Setup Detail

N.T.S.

HAZEN AND SAWYER
Environmental Engineers & Scientists

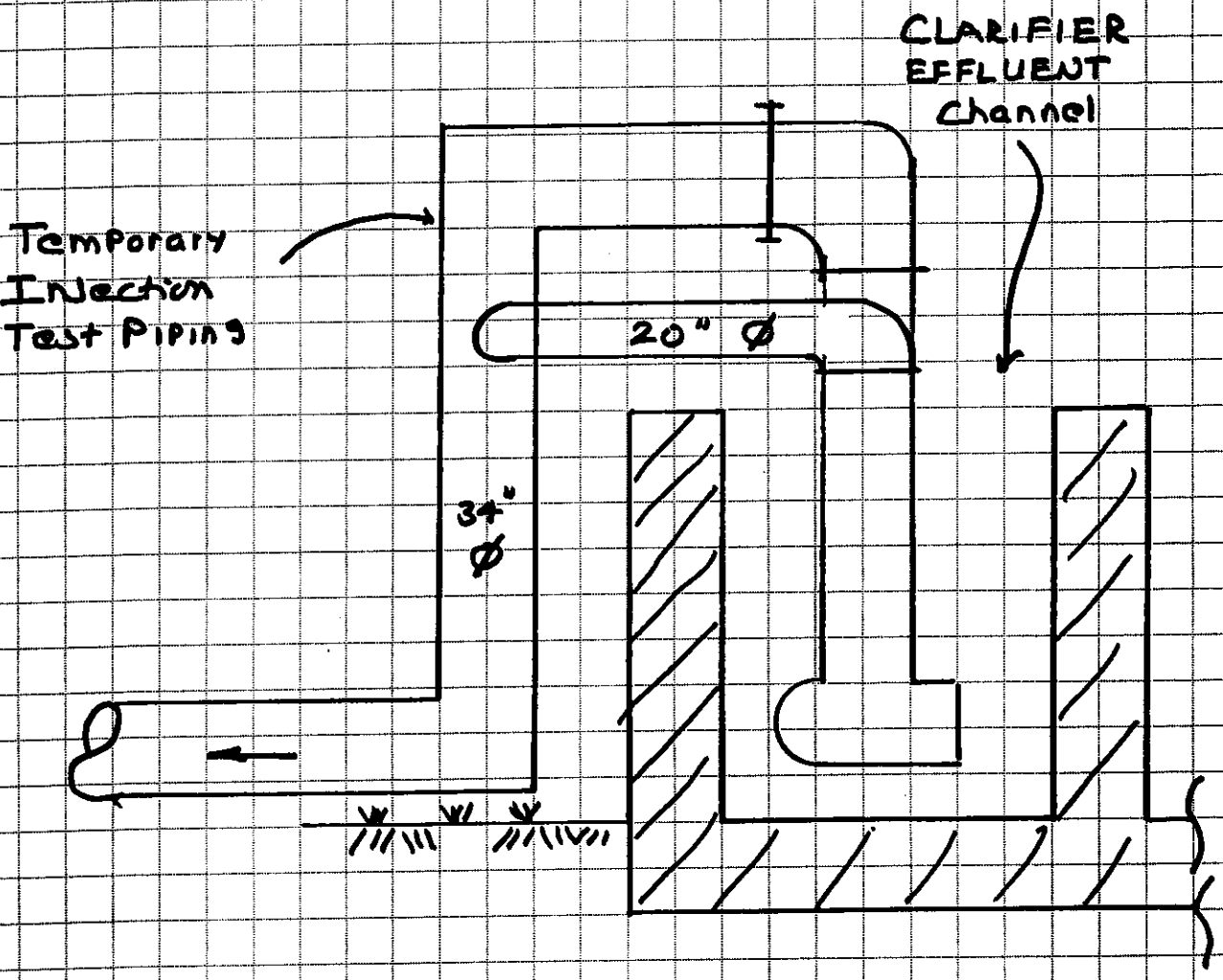
JOB _____

SHEET NO. _____ OF _____

CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

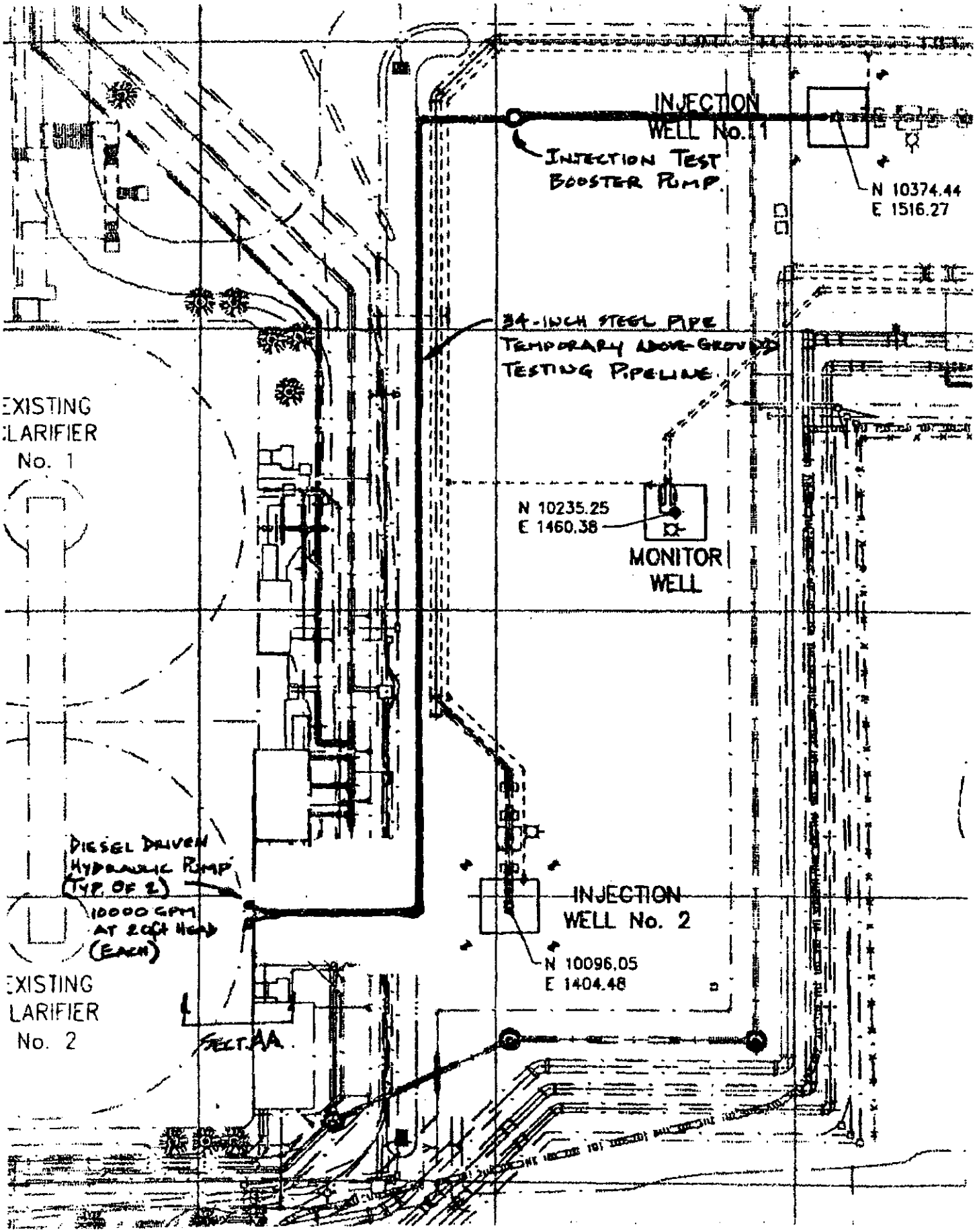
SCALE _____



Diesel Driven Hydraulic Pump (TYP of 2)

YBI Section A'-A"

N.T.S.


INJECTION WELL No. 1
INJECTION TEST BOOSTER PUMP
N 10374.44
E 1516.27
24-INCH STEEL PIPE TEMPORARY ABOVE-GROUND TESTING PIPELINE
EXISTING CLARIFIER No. 1
N 10235.25
E 1460.38
MONITOR WELL
DIESEL DRIVEN HYDRAULIC PUMP (TYP OF 2) 10000 GPM AT 200ft HEAD (EACH)
INJECTION WELL No. 2
N 10096.05
E 1404.48
EXISTING CLARIFIER No. 2
FELT AA

ATTACHMENT No. 8

Summary of IW-1 RTS Test

Radioactive Tracer Survey for Injection Well No. 1 (IW-1)
City of Hollywood Southern Regional WWTP Effluent Disposal System

Radioactive Tracer Survey

On January 14, 2003, a radioactive tracer survey was conducted on IW-1. A detailed description and interpretation of the radioactive tracer survey is presented in the following text. The test began with Florida Geophysical Logging, Inc., conducting a background Gamma Ray Log (GRL) and a casing collar locator (CCL). The background GRL, which was "memorized", was reprinted on each "out of position" logging run to serve as a means of comparison. A schematic diagram of the logging tool is represented at the top of the radioactive tracer survey Log. Each logging run is identified at the top of the log run. After the completion of the background Gamma Ray Log the logging tool ejector was calibrated to a 0.25 millicuries (MCI) per second discharge, and the reservoir was loaded with 10 millicuries of radioactive Iodine 131. The radioactive tracer survey was witnessed by Len Fishkin, P.G., from FDEP, and by James A. Wheatley, P.G.

The first test conducted (TEST #1) injected at a rate of 100 gallons per minute (gpm) using potable water. The test was conducted by positioning the tracer ejector 5 feet above the bottom of the casing, setting the recorder in the time drive mode, and ejecting a 1.5 MCI slug of tracer material. The readings from the middle gamma ray detector began to increase from background within seconds of ejection. The readings from the bottom detector increased from background approximately 2 minutes after ejection. No increase in gamma detection by the top gamma ray detector was seen during the 60-minute monitoring period. The tools were then logged out of position (LOP #1) to a depth of 2,650 feet below pad level. The results of the log out of position showed no indication of tracer material movement up hole. The injection casing was then flushed with potable water. Following the flushing an out of position log was conducted (LAF #1) from below the casing to 2,650 feet below pad level. This log shows that no tracer material had moved up behind the casing. These results are interpreted as providing evidence that the casing integrity is sound and there are no channels behind the casing.

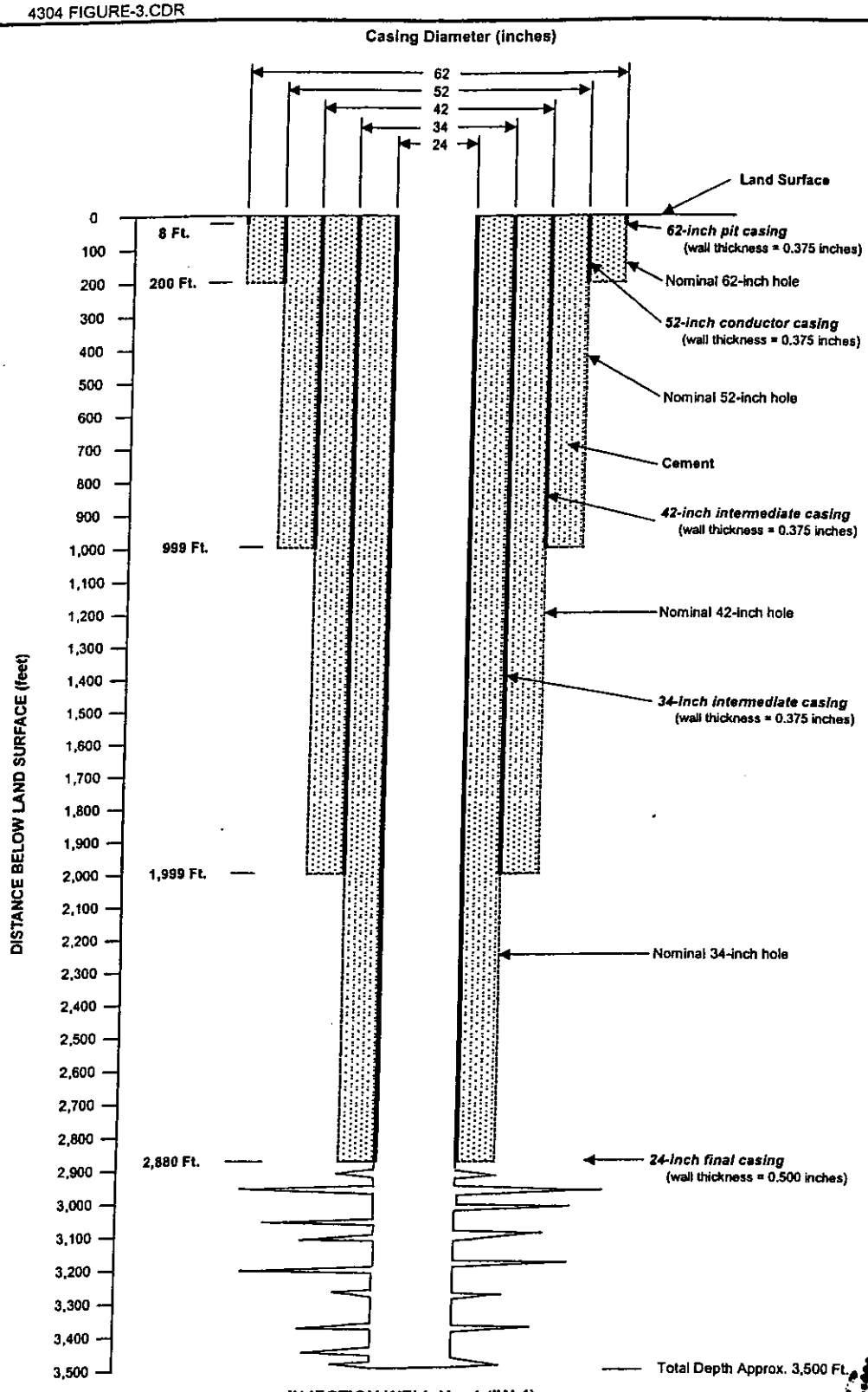
A second test (TEST #2) was then conducted at an injection rate of 100 gpm. This test also used potable water as the injection fluid. The tracer ejector was positioned 5 feet above the bottom of the casing and the recorder was placed in the time drive mode. A 1.5 MCI slug of tracer material was then ejected. The readings from the middle gamma ray detector began to increase from background within seconds of ejection. The readings from the middle gamma ray detector returned to background approximately 11 minutes after ejection. The readings from the bottom detector increased from background approximately 4 minutes after ejection. No detection of the tracer material was seen at the upper gamma ray detector any time during 60 minutes of

time drive monitoring. The tools were logged out of position (LOP #2) to a depth of 2,650 feet below pad level after the 60-minute test period. The results of the log out of position showed no indication of tracer material movement up hole. The injection casing was then flushed with potable water. Following the flushing, an out of position log was conducted (LAF #2) from below the casing to 2,600 feet below pad level. This log shows that all tracer material had been flushed out of the casing because the gamma ray levels on all three detectors returned to background levels. These results are interpreted as providing evidence that the casing integrity is sound.

For the next test (TEST #3), an injection rate of 200 gallons per minute (gpm) was established using plant effluent. The tracer ejector was positioned 5 feet above the bottom of the casing, and the recorder was placed in the time drive mode. A 2 MCI slug of tracer material was then ejected. The readings from the middle gamma ray detector began to increase from background within seconds of ejection. The readings from the middle gamma ray detector returned to background approximately 10 minutes after ejection. The readings from the bottom detector increased from background approximately 1 minute after ejection. No detection of the tracer material was seen at the upper gamma ray detector any time during 30 minutes of time drive monitoring. The tools were then logged out of position (LOP #2) to a depth of 2,650 feet below pad level. The results of the log out of position showed no indication of tracer material movement up hole. These results are interpreted as providing evidence that the casing integrity is sound.

A final background log was conducted (FINAL GAMMA RAY) on the total depth of the well upon the completion of all the abovementioned tests. The background logs were recorded over traces of the initial background log and showed excellent repeatability on all detectors except for the area around the base of the casing (2,880 feet to 2,900 feet). The difference in repeatability around the bottom of the casing is most likely the result of tracer staining around the base of the casing. It can also be seen where the remaining tracer material was dumped (3,050 - 3,100 feet).

4304 FIGURE-3.CDR



INJECTION WELL No. 1 (IW-1)

City of Hollywood
Southern Regional WWTP Injection Wells

ALBERT MUNIZ
CERTIFICATE
8/12/93
No. 35287
STATE OF FLORIDA

ALBERT MUNIZ, P.E.
Registration No. 35287

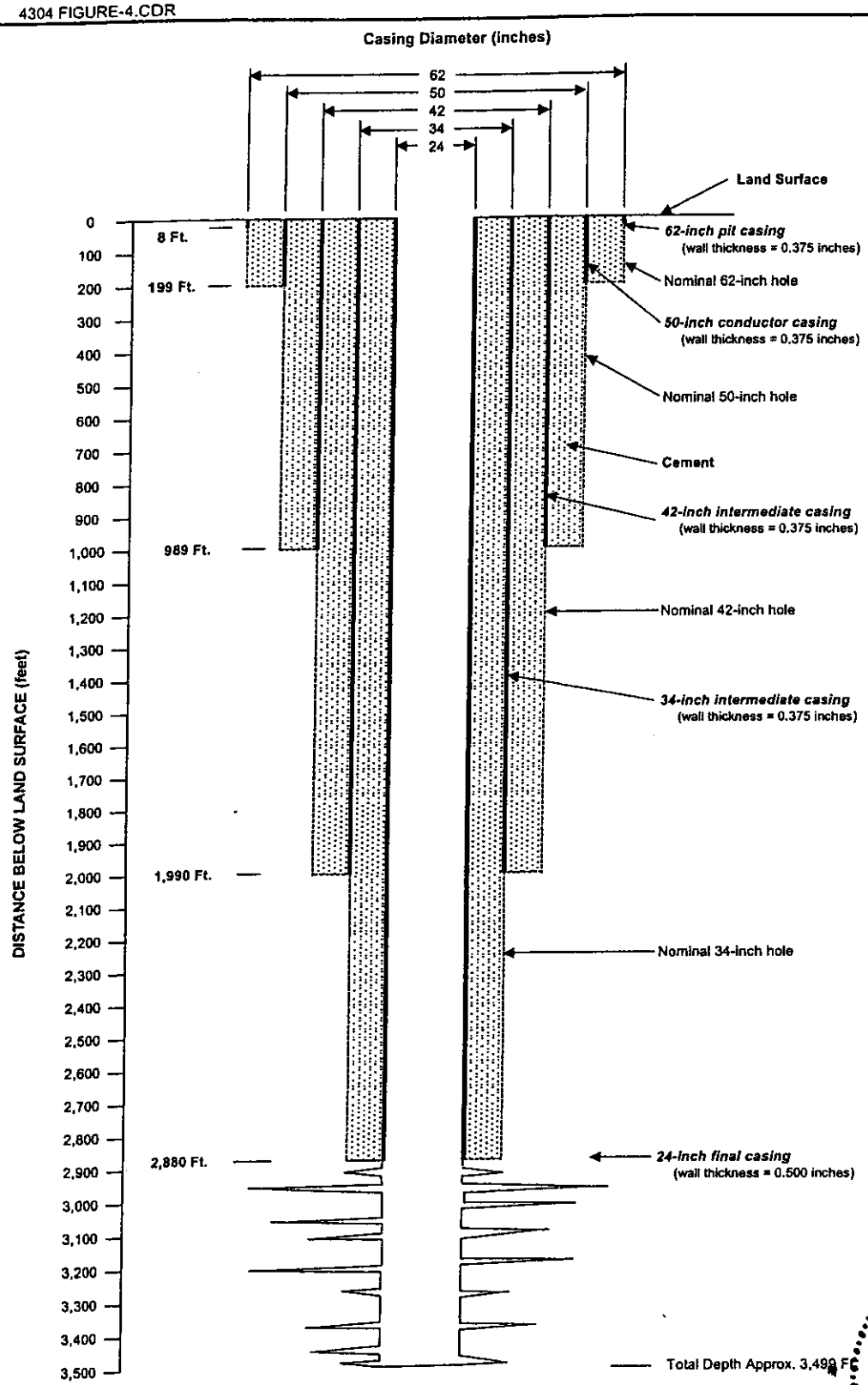
HAZEN AND SAWYER
Environmental Engineers & Scientists

CITY OF HOLLYWOOD EFFLUENT DISPOSAL SYSTEM
SOUTHERN REGIONAL WWTP INJECTION WELLS

Injection Well No. 1 As-Built Well Profile

FIGURE
3

4304 FIGURE-4.CDR



INJECTION WELL No. 2 (IW-2)

City of Hollywood
Southern Regional WWTP Injection Wells

ALBERT MUNIZ
CERTIFICATE
8/12/03
No. 35587
STATE OF FLORIDA
ENGINEER

ALBERT MUNIZ, P.E.
Registration No. 35587

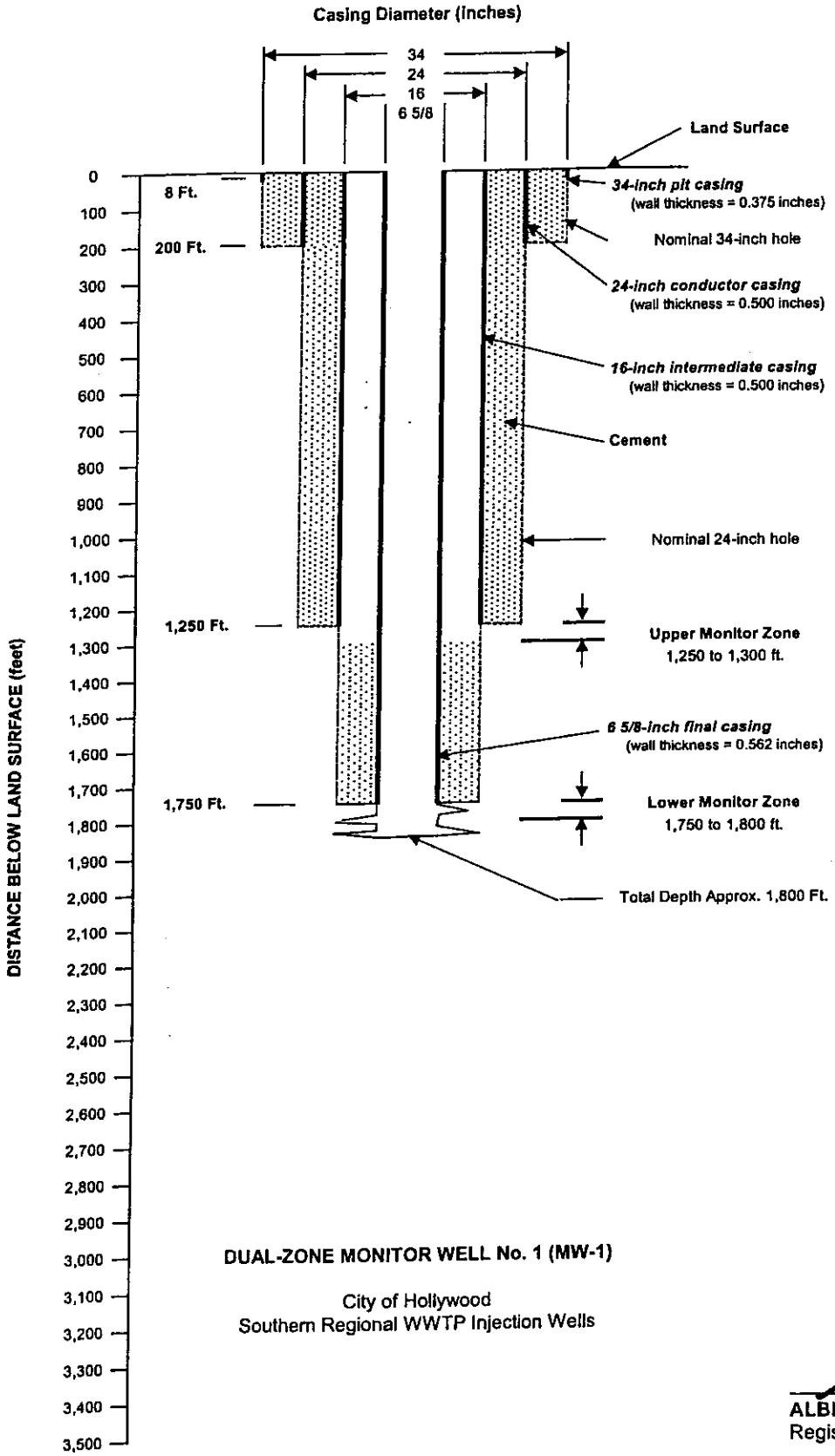
HAZEN AND SAWYER
Environmental Engineers & Scientists

CITY OF HOLLYWOOD EFFLUENT DISPOSAL SYSTEM
SOUTHERN REGIONAL WWTP INJECTION WELLS

Injection Well No. 2 As-Built Well Profile

FIGURE
4

4304 FIGURE-5.CDR



DUAL-ZONE MONITOR WELL No. 1 (MW-1)

City of Hollywood
Southern Regional WWTP Injection Wells

ALBERT MUNIZ, P.E.
Registration No. 35587

HAZEN AND SAWYER
Environmental Engineers & Scientists

CITY OF HOLLYWOOD EFFLUENT DISPOSAL SYSTEM
SOUTHERN REGIONAL WWTP INJECTION WELLS

FIGURE 5

Monitor Well No. 1 As-Built Well Profile