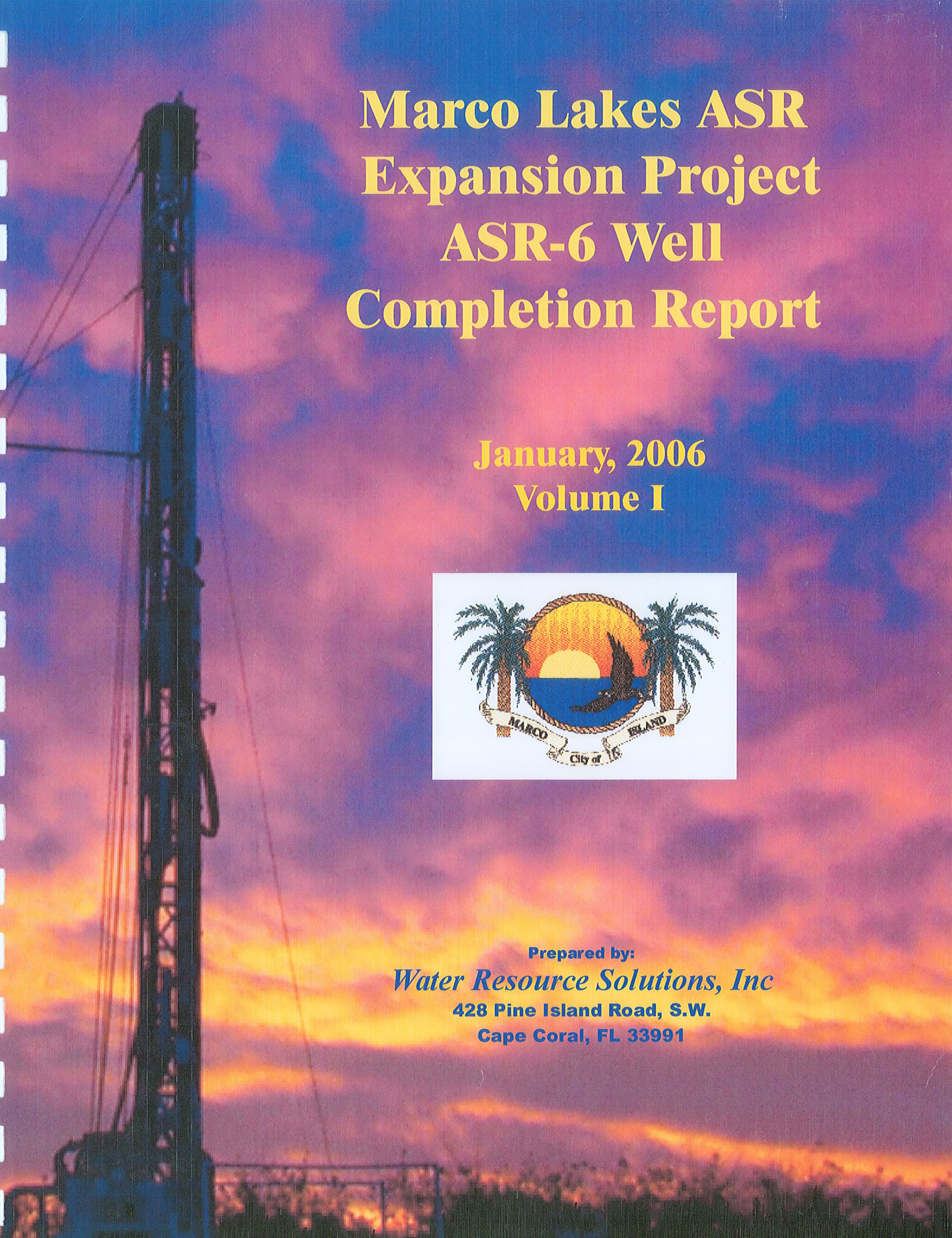

Marco Lakes ASR Expansion Project ASR-6 Well Completion Report

January, 2006
Volume I

Prepared by:
Water Resource Solutions, Inc
428 Pine Island Road, S.W.
Cape Coral, FL 33991

MARCO LAKES ASR- 6
EXPANSION PROJECT
WELL COMPLETION REPORT

Prepared for:

Marco Island Utilities
Marco Island, Florida

January 2006

Prepared by:

Water Resource Solutions, Inc.
428 Pine Island Road, S.W.
Cape Coral, Florida 33991

Project No. 01-04773.01

Mark S. Pearce, Ph.D.
Senior Scientist

Andrew W. McThenia
Licensed Professional Geologist #2318
Date: 01/30/06

Lloyd E. Horvath, P.E.
Licensed Professional Engineer #25260
Engineering Certificate No. 8027
Date: 1-30-06

EXECUTIVE SUMMARY

This report summarizes the construction and testing of the sixth Aquifer Storage and Recovery (ASR) well, ASR-6, at Marco Island Utility's Marco Lakes Facility. Ultimately, a total of nine ASR wells are proposed to be operational at this site. All wells constructed and proposed at this site will be completed to store water within the basal Hawthorn and upper Suwannee Formations. The storage zone in this well is located between approximately 740 and 780 feet below land surface.

Construction of ASR-6 included an 8 5/8-inch O.D. Certa-Lok SDR 17 PVC liner set between the depths of 594 and 746 feet inside of a 17.4-inch O.D. Certa-Lok SDR 17 PVC casing set between land surface and 695 feet below land surface. The storage zone is intersected by ASR-6 from 740 to 775 feet below land surface. Tests performed on ASR-6 indicate that this well can operate at the design rate of 1,000 gpm with a drawdown of approximately 91 feet neglecting interference from the off-set wells.

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1.0 INTRODUCTION

This Well Completion Report summarizes the construction of Well ASR-6 at Marco Island Utility's raw water facility at Marco Lakes (Figure 1-1). The drilling, construction, and testing activities conducted to complete ASR-6 are documented in this report.

Construction of ASR-6 was authorized by the Florida Department of Environmental Protection as part of a permit to expand the existing ASR wellfield (Figure 1-2) to nine wells. Permission to construct the additional eight (8) Class V Group Seven Aquifer Storage and Recovery injection wells at this site was originally granted by the FDEP on April 22, 1999. The FDEP renewed the construction permits for Marco Island Utilities and assigned permit numbers 141218-024-UC through 141218-031-UC (Appendix 1.1). The permit number for ASR-6 is 141218-028-UC. Collier County also issued a permit for construction of ASR-6 on February 23, 2005. (Appendix 1.2).

The current expansion is designed to increase the ultimate storage capacity of the wellfield to approximately 780 MG. It is anticipated that the newly-expanded wellfield will eventually be able to deliver 540 TO 580 million gallons of water for use at Marco Island on a seasonal basis assuming a 100-MG cycle storage volume per well. This recovery is based on historical site recovery data.

2.0 HYDROGEOLOGY

2.1 Geology

The description of the geology at the project site is based on the analyses of drill cuttings, geophysical logs (Appendix 2.1), and hydrologic tests conducted during the construction of ASR-6. A lithologic log for ASR-6 is provided in Appendix 2.2. The borehole was terminated within the upper Suwannee Limestone at a depth of 775.5 feet below pad level (bpl). A general stratigraphic description of the site is summarized below and is illustrated as a hydrostratigraphic column on Figure 2-1. A hydrogeologic cross-section based on correlated gamma logs from wells ASR-2, ASR-5, and ASR-8, is provided on Figure 2-2.

The geologic formations penetrated during drilling operations range in age from Holocene (8000 years ago to present) to Oligocene (33.7 to 23.8 million years ago). They consist of undifferentiated Quaternary deposits, the Tamiami Formation, the Peace River and Arcadia formations of the Hawthorn Group, and the Suwannee Limestone Formation. The ASR storage zone, which is intersected from 746 to 775 feet bpl by this well, occurs within carbonate rocks in the basal portion of the Arcadia Formation and the uppermost strata of the Suwannee Limestone.

Undifferentiated Quaternary Deposits

Undifferentiated sediments of Pleistocene to Holocene age (1.8 million years ago to present) range from less than 10 feet to over 20 feet thick across the site, and form the uppermost strata encountered. These surficial deposits consist mainly of organics, clay, and limestone. A distinctive layer of consolidated limestone "caprock" was encountered in the uppermost section of surficial deposits from 4 to 8 feet below pad level. This limestone consists mainly of bivalve shells and shell fragments cemented in a matrix of recrystallized calcite.

Tamiami Formation

The Pliocene age Tamiami Formation (1.8 to 5.3 million years in age) unconformably underlies the undifferentiated surficial sediments. The Tamiami Formation extends from approximately 20 to 120 feet bpl at this site. The Tamiami can be subdivided into upper and lower limestone units (Pinecrest and Ochopee members), that are separated by a gray to green marl or marly limestone (Bonita Springs member). The limestones generally exhibit good to excellent moldic porosity, and become increasingly sandy with depth. The combined thickness of the Tamiami Formation members is approximately 100 feet.

Peace River Formation (Hawthorn Group)

The predominantly Miocene-age Hawthorn Group (5.3 to 23.8 million years in age) in south Florida is divided into an upper unit of mainly siliciclastic sediments, referred to as the Peace River Formation; and a lower unit consisting predominantly of carbonate rocks, termed the Arcadia Formation (Scott, 1988). The Peace River Formation extends from approximately 120 to 295 feet bpl at this site. This unit is composed of upper and lower phosphatic clay/limestone sequences with an intermediate quartz sand layer. The uppermost layer at this site is a phosphatic clay whose base is defined by coarse phosphatic sands from 130 to 140 feet bpl. A distinctive light brown siltstone from 145 to 150 feet bpl separates the phosphatics from an intermediate sequence of quartz sand between 153 and 195 feet bpl. The quartz sand layers in this unit are often very coarse and poorly sorted and contain abundant frosted and opaque grains. This unit is underlain by a thick sequence of phosphatic clays with interlayered limestones. Stringers of discoidal quartz, sand to pebble size, are present within the clays from 195 to approximately 218 feet bpl.

Arcadia Formation (Hawthorn Group)

The top of the Arcadia Formation is marked by a transition from a green clay to a phosphatic limestone at a depth of approximately 295 feet bpl at this site. The base of the formation is picked at approximately 735 feet bpl at this site.

The Arcadia Formation consists of an interbedded sequence of phosphatic carbonate rocks and lime mud. Porosity of the limestone is variable, tending to be best developed where fossil shell has dissolved to form molds. The lower portion of the Arcadia Formation contains a sequence of dolosilt, clay, and marly limestone that form the confining beds above the ASR storage zone. The more porous section at the base of the Arcadia Formation consists of very pale orange limestone with excellent moldic porosity and is included in the ASR storage zone. The thickness of the Arcadia Formation is approximately 440 feet.

Suwannee Limestone Formation

The Suwannee Limestone is early to middle Oligocene in age (23.8 to 28 million years in age). The upper 40 feet of strata in the Suwannee are included in the ASR storage zone and consist predominantly of yellowish gray to very pale orange limestone (packstone) with excellent to good moldic porosity and low gamma ray activity.

2.2 Aquifer Designations

The strata penetrated are grouped into three principal systems: the surficial aquifer system, intermediate aquifer system, and the Floridan aquifer system. The aquifers and confining units identified at the site are illustrated on Figure 2-1. The surficial aquifer system includes the water table and lower Tamiami aquifers. The intermediate aquifer system includes a series of aquifers and confining units within the Hawthorn Group. The upper section of the Floridan aquifer includes the carbonate strata of the basal portion of the Arcadia Formation and the upper portion of the Suwannee Limestone and is the hydraulic unit identified as the ASR zone at this site.

2.3 Storage and Confining Interval Description

The ASR storage interval at this site occurs within permeable limestones present in the lowermost section of the Arcadia Formation and the uppermost section of the Suwannee Limestone (730 to 780 feet bpl). The limestone present within the storage interval is generally a packstone containing abundant fossil molds. These fossil molds are the dissolution remnants of imbricated bivalve shells whose close proximity and interconnectedness facilitate the excellent hydraulic permeability exhibited by this zone.

The confining beds overlying the storage zone consist of approximately 110 feet of phosphatic, low-permeability dolosilt and clay with interbeds of more permeable carbonates in the lower portion of the Arcadia Formation. Natural gamma ray activity is generally high within this interval.

2.4 Formation Water Quality

Fresh water resources in the region surrounding the site are generally limited to the water table aquifer and the upper portion of the lower Tamiami aquifer. Groundwater in deeper aquifers is brackish to saline. Water quality of the ASR storage zone at this site is dependent on the timing of the ongoing ASR cycles and on the distance from the various active wells. Mixing of stored and native water is inherent in the process of ASR and has been taking place at this site since 1997.

Water samples were collected approximately every ten feet at ASR-6 during reverse-air drilling of the open hole from 750 to 775 feet bpl. The samples were field-tested for conductivity and chloride concentration (Table 2-1).

Formation water from the injection zone of the new well was again sampled after construction was completed and the well had been fully developed. The water samples were analyzed for all primary and secondary drinking water standard parameters, including unregulated chemicals, by Harbor Branch Laboratories, Inc. A review of the laboratory analytical results (Appendix 2.3) indicates mixing of injected water from existing ASR wells with the native formation water has occurred based on conductivity and TDS levels. The presence of the mixed water was expected since ASR-6 is only 400 feet away from ASR-3.

The base of the underground source of drinking water (USDW), defined in applicable state and federal regulations as 10,000 mg/l total dissolved solids, was not penetrated at the project site. The USDW was picked at a depth of 1,095 feet in well CO-2080, located about 2 miles south of the Marco Lakes facility (ViroGroup, 1996b). Native groundwater in the storage interval is brackish and most appropriately classified a G-II, groundwater with a TDS content between 3,000 and 10,000 mg/l (F.A.C. 62-520.410). Native water quality in the ASR storage zone has a TDS concentration approaching 6,000 mg/l.

3.0 WELL CONSTRUCTION PROGRAM

Well ASR-6 was completed in the basal Arcadia/Upper Suwannee formations (ASR zone). Weekly summary reports were prepared for the FDEP and TAC during well construction and testing (Appendix 3.1). Daily drilling reports were prepared by the contractor and were previously submitted with the weekly summary reports.

3.1 Site Preparation

An initial site survey was conducted by Metron, Inc. of Fort Myers, Florida to stake the well position on the site and to establish reference elevations. Removal of brush, ground foliage, and rocks was necessary at this site prior to the start of well construction.

3.1.1 Produced Water Discharge

Prior to beginning the reverse-air drilling phase of this well, a temporary discharge line was connected to an existing 8-inch diameter pipeline that outfalls at a point downstream of the Henderson Creek weir at the intersection of U.S. 41 and Henderson Creek (Figure 1-2).

Discharge below the weir at Henderson Creek was permitted under the State of Florida's Generic NPDES permit for the discharge of produced water from a non-contaminated site activity. All drilling solids were either hauled from the site for disposal as drilling mud or used as fill material for site restoration.

3.1.2 Temporary Drill Pad Construction

A temporary drilling pad approximately 60 feet long by 20 feet wide, surrounded by a two-foot-high berm, was constructed at the well site to contain water and drilling fluids at the wellhead and around the drilling rig. The well pad was graded to provide stability for the drilling rig. A 10-millimeter-thick polyethylene liner was installed prior to installation of a gravel bed inside the pad. Plywood tracks were laid on the gravel bed inside the pad to support the drilling rig as it was moved into the pad area. Excess water and drilling fluids were pumped from the containment pad to fluid storage tanks as needed.

3.1.3 Pad Monitor Well Construction

The contractor received a permit from Collier County to construct two pad monitor wells prior to drilling ASR-6 (Appendix 3.2). The two wells are approximately 16 feet in depth (Figure 3-1), and were installed at the northwest and southwest corners of the drilling pad prior to drilling, to monitor for excess spills and leakage of salt water from the containment pad during drilling operations. The two 4-inch wells were drilled using the mud-rotary method and were gravel packed, grouted, and developed. Measurements of the static water levels were recorded and the pad monitor wells were purged and sampled weekly for the duration of the drilling and construction phase of the project. Field-testing results for chloride, conductivity, pH, and temperature are summarized in Tables 3-1 and 3-2.

3.2 ASR-6 Well Construction

Well construction at ASR-6 commenced on April 4, 2005 and the drilling rig was moved off the well on December 8, 2005. Final wellhead adjustments were completed on December 9, 2005. A schematic of the final construction of ASR-6 is included as Figure 3-2.

3.2.1 Pit Casing Installation

Well construction began with the installation of a 26-inch O.D., steel pit casing set into a nominal 35-inch wellbore drilled to 50 feet bpl. A single length of 26-inch, spiral welded, 0.375-inch wall, steel casing was set to a depth of 49 feet bpl and pressure grouted in place using neat Portland, Type II cement. Mill certificates for this pipe are provided in Appendix 3.3.

3.2.2 Production Casing Installation

After installation of the pit casing, a 12½ -inch diameter bit was used to drill to a depth of 405 feet bpl. After experiencing complications due to highly permeable and flowing artesian limestone from 293 to 380 feet bpl, the driller requested that he be allowed to start drilling the 25-inch borehole rather than continue to fight the flowing conditions in the pilot hole. Permission to drill the 25-inch hole was authorized by the FDEP on May 16, 2005.

The pilot borehole was reamed to a diameter of 25 inches from 50 to 405 feet bpl. The 25-inch-diameter borehole was then advanced to a depth of 745 feet bpl. Inclination surveys were completed in the pilot hole and the reamed hole every 90 feet, with the exceptions of depth intervals 570 and 720 feet bpl (Table 3-3). A tally of the pipe string used during the reaming phase of drilling is included as Table 3-4. The borehole was re-reamed and circulated with conditioned drilling fluid in preparation for setting casing. Natural gamma, XY-caliper, dual induction, and borehole compensated sonic logs were run in the reamed hole to determine the final casing setting depth and to provide an estimation of annular borehole volume.

The contractor then prepared the borehole for running the production casing. The contractor notified WRS that they were ready to run casing. WRS requested that they not start running the casing until a WRS representative was onsite.

However, the driller began running the casing without a WRS representative onsite. When the WRS representative arrived on-site, the driller informed him that there were ten joints of casing in the hole. Although this was not acceptable, it was decided to continue running the casing based on the driller's tally. This option was taken due to the history of this hole that the well would begin to flow if mud was not periodically circulated.

The casing tally by the driller was determined to be incorrect after setting the casing and resulted in the casing being set 40 feet above the target depth of 735 feet. CertainTeed, Certa-Lok 17.4-inch O.D. SDR 17 PVC casing was set to a depth of 695 feet bpl (Table 3-5A). Specifications for the production casing are included as Appendix 3.4.

Neat cement grout was emplaced in the annulus during an initial pressure grout stage followed by two successive tremie grout stages. Approximately 2,000 cubic feet of cement was used during the grouting operations. An estimated 500 cubic feet of cement was flushed with drilling mud from the casing immediately after cement returned to the surface during the second cement stage. This cement was removed from the annulus in order to insure that a competent cement seal would be located in the clay unit located immediately above the artesian flow unit at approximately 300 feet. Details of the cementing operations were recorded in a cementing log (Table 3-5B). Table 3-6 summarizes the volume of cement pumped and the estimated annular height for each stage. Fluid temperature logs were performed inside the casing to estimate the annular grout surface.

3.2.3 Open-Hole Construction

Reverse-air drilling of the open-hole section of ASR-6 commenced on August 20, 2005, using a 15-inch-diameter bit. A tally was prepared of the drill string and is presented as Table 3-7. Drill cuttings were collected at five-foot depth intervals and described in the field. Formation water samples were collected at four separate depths from 750 to 775 feet bpl, and field-tested for conductivity and chloride concentration. The borehole was advanced to a total depth of 775.5 feet.

3.2.4 Well Development and Suppression

The well was developed by reverse-air through the drill string for two hours as the string was raised and lowered through the open-hole section of the well. At the completion of well development, the water appeared clear and free of visible sediment. All water produced during reverse-air drilling and development was retained in storage tanks for settling prior to being discharged to Henderson Creek downstream of the weir. At the completion of well development, the artesian flow of the well was suppressed using a salt solution to facilitate installation of a video camera and geophysical logging equipment.

3.3 Geophysical Logging and Video Survey

The initial video survey of the well showed that the casing depth was 695 feet, which was 40 feet short of the desired 735-foot setting depth. Geophysical logs also performed at that time included the following: caliper/gamma, fluid resistivity/temperature, dual induction, and borehole compensated sonic. For the purpose of viewing the liner installation and inspecting the finished well, an additional video survey was conducted by MV Geophysical on December 5, 2005. A final suite of geophysical logs was also conducted on December 5, 2005. This logging suite included caliper, natural gamma ray, and static/dynamic flow logs (Appendix 2.1). Results of the video survey indicated that the casing, liner, and open hole appeared to be satisfactorily completed.

3.4 Casing Liner Installation

On August 29, 2005, the FDEP granted a request to amend the original construction plan for ASR-6 allowing installation of an 8.625-inch O.D. liner. Table 3-8 provides a drill string tally for the liner installation. A tally of the liner installed is presented as Table 3-9. Specifications for the liner are presented in Appendix 3.5. The liner was required to extend the cased portion of the well to a depth of 746 feet bpl and isolate the well from the other flow intervals above the ASR storage zone. The liner was installed inside the 17.4-inch O.D. casing from 594 to 746 feet bpl. The liner overlaps the cased portion of the hole from 594 to 695 feet bpl and extends to the base of the 25-inch-diameter borehole at 746 feet bpl (Figure 3-2). Three cement baskets were installed around the bottom of the liner tailpiece. A temporary cap and cement plug were installed at the base of the liner to facilitate pressure testing. Details of the liner cementing operations are provided in Table 3-10.

3.5 Casing and Liner Pressure Test

On November 2, 2005, a one-hour pressure test of the production casing and liner was conducted at an initial pressure of 103 psi and a final pressure of 98.5 psi. The pressure inside the casing was recorded at 5-minute intervals and the official record was signed and witnessed by WRS and Southern Well Services (Appendix 3.6). A recorded pressure loss of 4.4% during the 60-minute test is below the maximum 5% limit specified in FAC 62-528.410. The accuracy of the pressure gauge was certified by prior testing against a pressure standard deadweight tester (Appendix 3.7). The FDEP verbally authorized the performance of this test without their presence.

3.6 Plumbness and Alignment Test

On December 7, 2005, the contractor conducted a plumbness and alignment test inside the production casing to a depth of 250 feet. A 1.80-foot-long, 1.22-inch-diameter (O.D.), steel plummet was suspended with a steel cable (plumb line) centered above the well casing at a height of 16.6 feet. The height represents the distance between the apex of the plumb line and the top edge of the well casing. A template scaled in inches from the well center and aligned with marks defining arbitrary north, south, east, and west was used to directly measure horizontal deflection of the plumb line from center. Horizontal deflection was measured in two planes perpendicular to one another at 10-foot depth intervals as the plummet was lowered from the top of the well riser to a depth of 250 feet. The drift (horizontal deviation) of the well casing at each recorded depth was calculated by using the following formula:

drift = deflection (height + depth)/height

Where:

Drift = calculated horizontal deviation of casing from the vertical, in feet

Deflection = measured horizontal deflection of the plumb line from center of the top of casing, in feet

Height = height of apex above the top of casing, in feet

Depth = depth of plummet below the top of casing, in feet

Results of the plumbness and alignment test indicate noticeable drift in the arbitrary south and east directions below a depth of 160 feet. Maximum calculated drift values in both the arbitrary south and east directions of 0.66 feet were derived from horizontal deflection values measured at a depth of 250 feet. As shown in Table 3-11, calculated drift values generally increase with depth below 160 feet. The methodology used in the plumbness and alignment test and the interpretation of test results followed procedures outlined by the American Water Well Association (AWWA). It should be noted that a turbine pump column was run in the well to 200 feet without incident.

3.7 Wellhead and Pad Completion

At the completion of well construction and testing, the well was killed using a solution of brine in preparation for wellhead installation. On December 9, 2005, the contractor installed a 16-inch by 12-inch Schedule 40, 316 stainless steel tee with a 12-inch butterfly valve. The tee was connected to the well column with a stainless steel-to-Certa-Lok flange adaptor. The top of the 16-inch tee was temporarily completed with a blind flange. Two 2.5-inch and one 3-inch-diameter access ports with ball valves were provided on the wellhead assembly (Figure 3-3). The final well pad was completed at an elevation of 7.5 feet NGVD by Wright Construction.

4.0 FLOW TESTS AND ANALYSES

On November 30th, after pumping out approximately 6,800 gallons of kill fluid composed of brine, a 4-step drawdown test was initiated at ASR-6 by allowing natural flow to discharge through an in-line flow meter (certified calibrated) and out to Henderson Creek. Before starting the test, water samples collected from the test pump discharge and annulus were field-tested for conductivity to confirm stabilization. Combination pressure transducers and data recorders manufactured by In-Situ, Inc. were set in the pumping well (to 41.3 feet bpl) and wells ASR-5 and DZ-2 located approximately 400 feet and 1,200 feet from ASR-6, respectively. A submersible pump was set in the well casing at a depth of approximately 100 feet bpl. Pressure changes due to pumping were recorded at a frequency of one reading per minute in the pumping well and in each of the observation wells (Appendix 4.1). Pressure transducers were set above land surface in each of the observation wells as each well was under positive pressure at the time of the test. The recording of the pressure data was initiated in each observation well prior to starting the pump test for the purpose of recording background data. Average pumping rates for the four steps were recorded at 250, 512, 667, and 848 gpm. Water levels were recorded manually using an electronic water level indicator during the last step as drawdown in the pumping well fell below the transducer. A total volume of 100,730 gallons of water was pumped during the 3-hour pump test.

The step drawdown test was performed primarily to establish the specific capacity of the test interval for pump sizing and to determine the drawdown at adjacent observation wells. Results of the 4-step drawdown test indicate specific capacity values in the pumping well of 14.8 gpm/ft at 255 gpm, 12.9 gpm/ft at 542 gpm, 11.3 gpm/ft at 656 gpm, and 11.7 gpm/ft at 828 gpm. A summary of the test results is provided in Table 4-1. A plot of drawdown versus time is provided on Figure 4-1. A plot of pumping rate versus specific capacity is presented as Figure 4-2. By extrapolating the pumping rate versus specific capacity curve to the production rate of 1,000 gpm, it is estimated that the specific capacity of ASR-6 at the production rate will be approximately 11 gpm/ft.

5.0 REFERENCES

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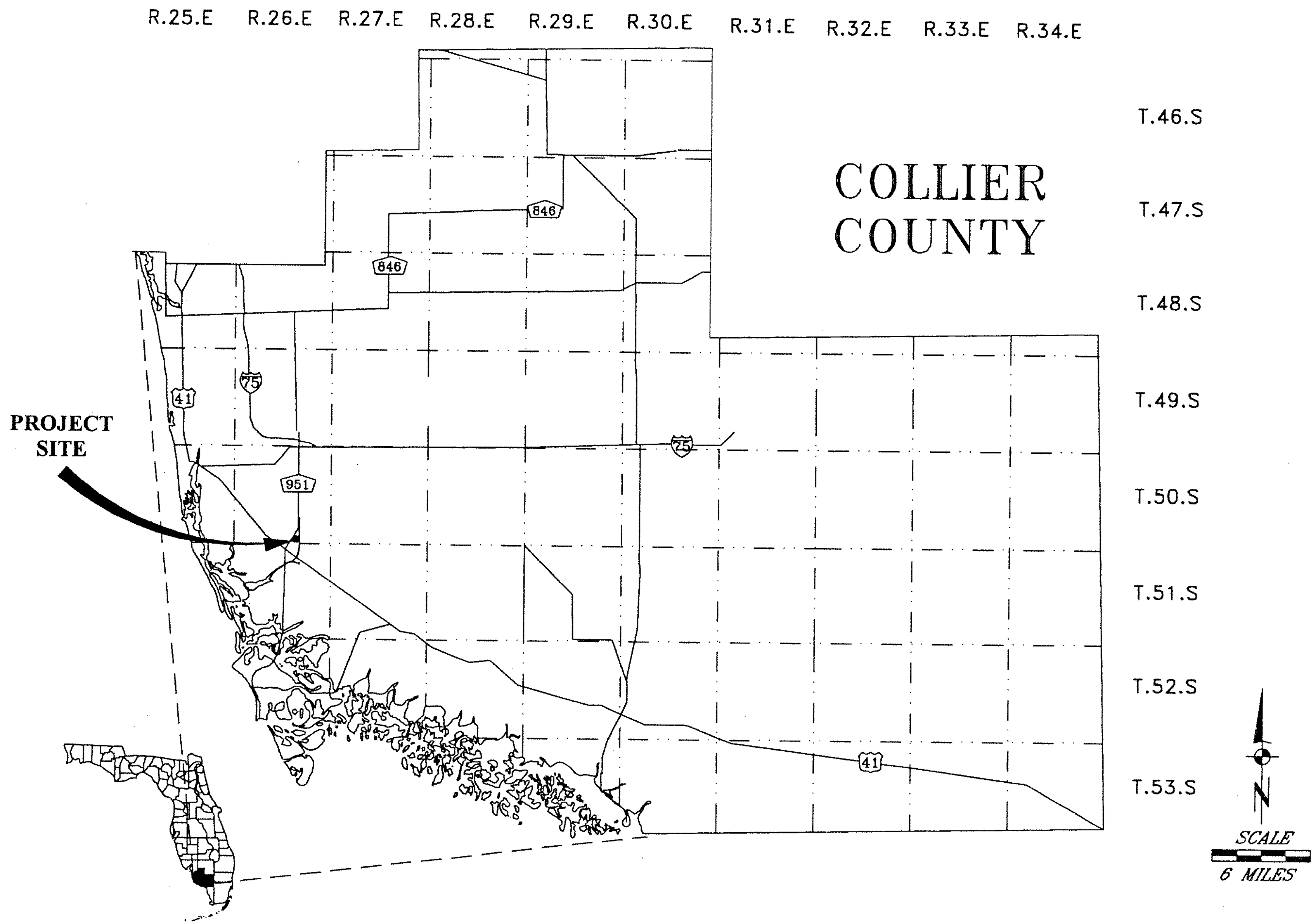
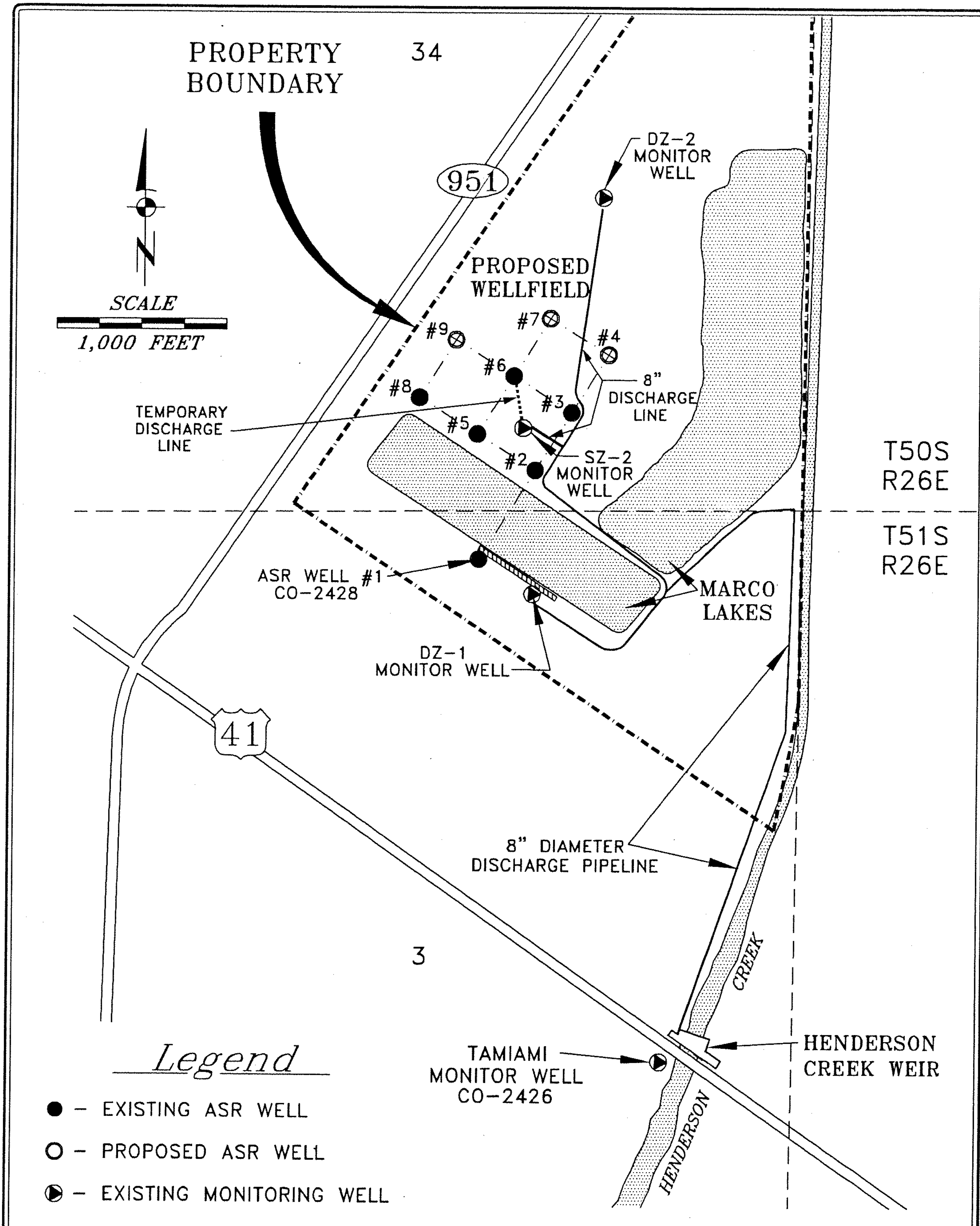


Water Resource Solutions	PROJECT NAME: MARCO ISLAND UTILITIES PROJECT NUMBER: 01-04773.05
	DWG. NUMBER: A-014773M3 DATE: 12/15/05

FIGURE 1-1. GENERAL SITE LOCATION MAP.



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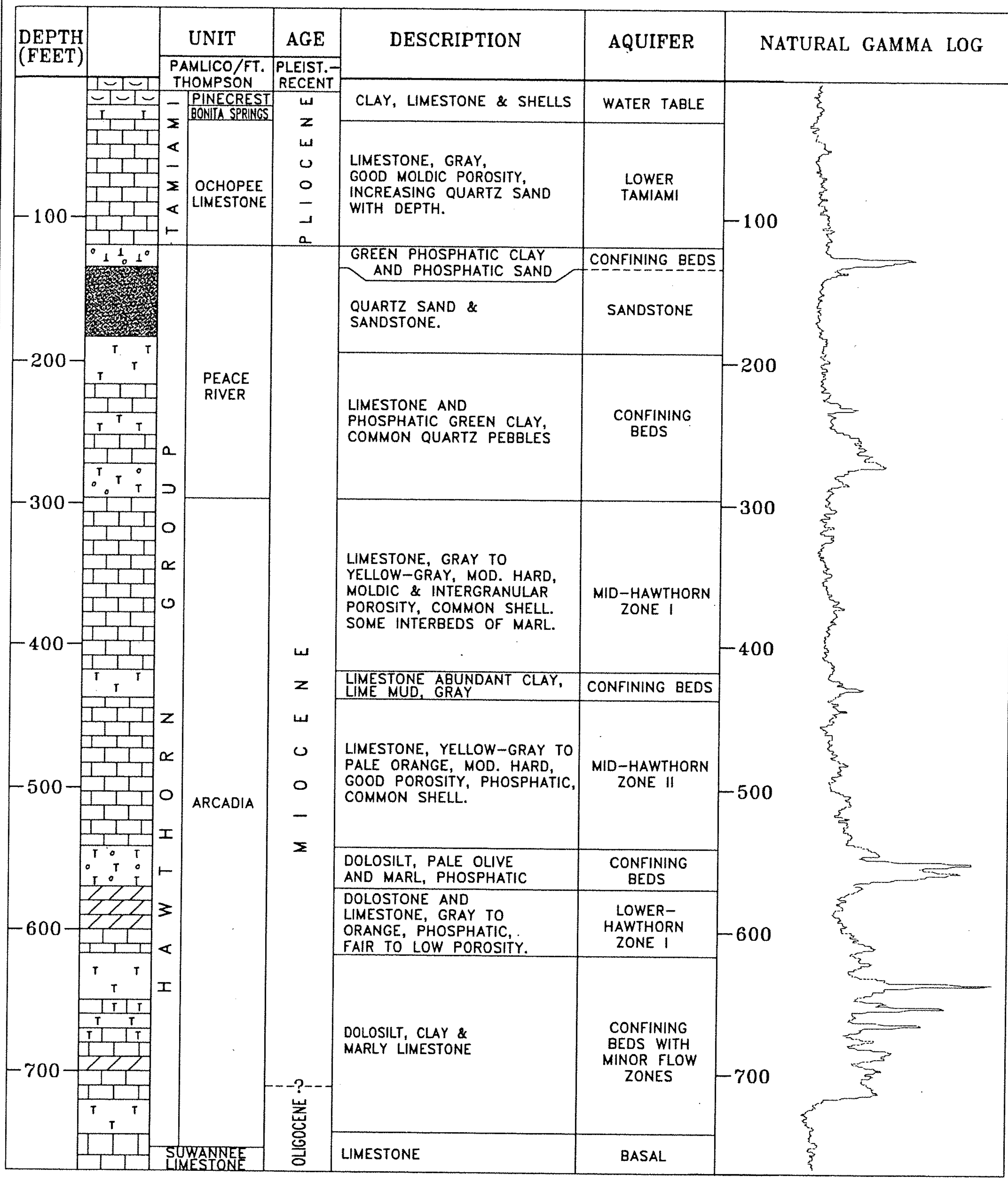
	PROJECT NUMBER: 01-04773.05	DATE: 12/15/05

FIGURE 1-2. MARCO LAKES ASR EXPANSION SITE DETAIL.



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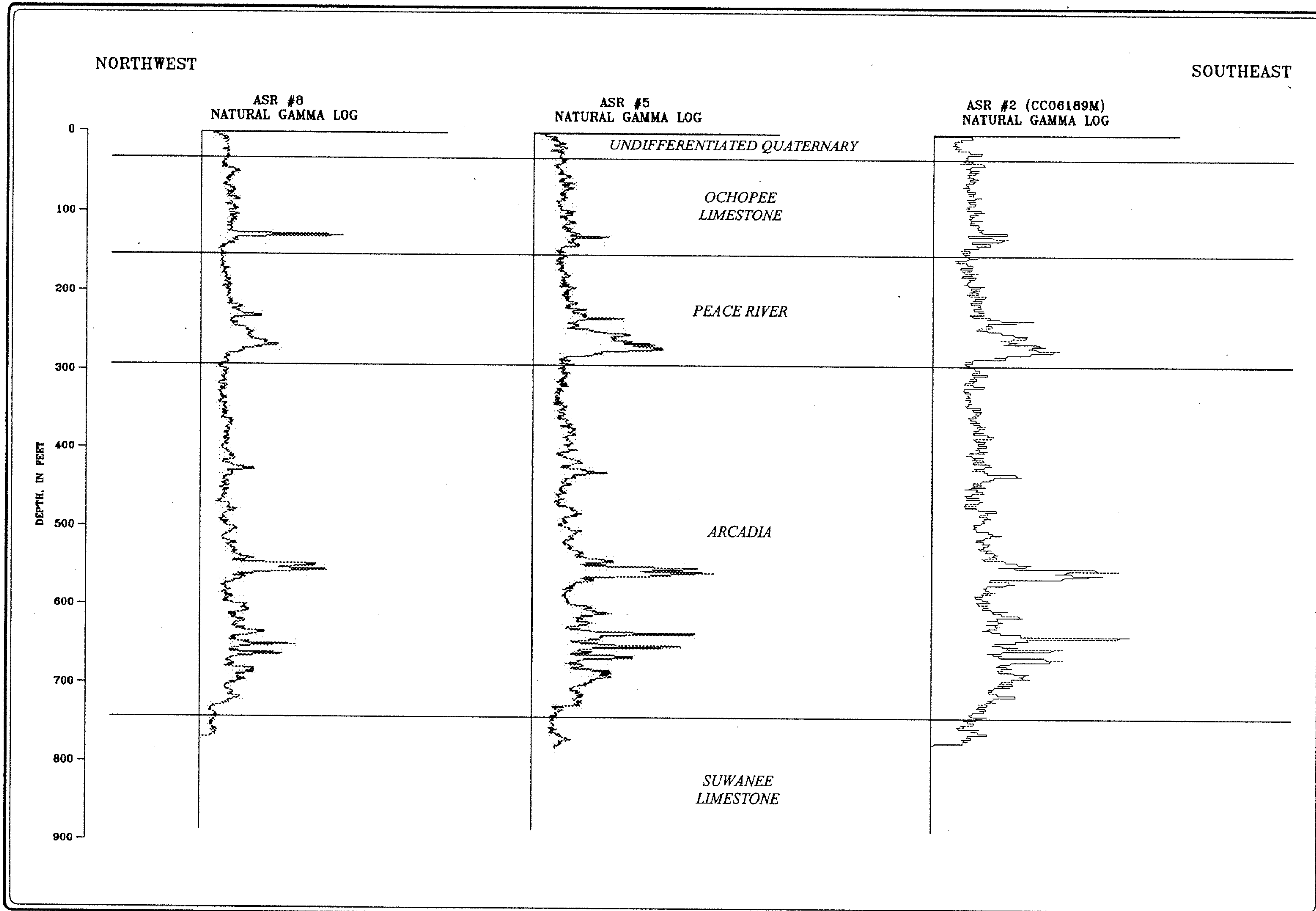
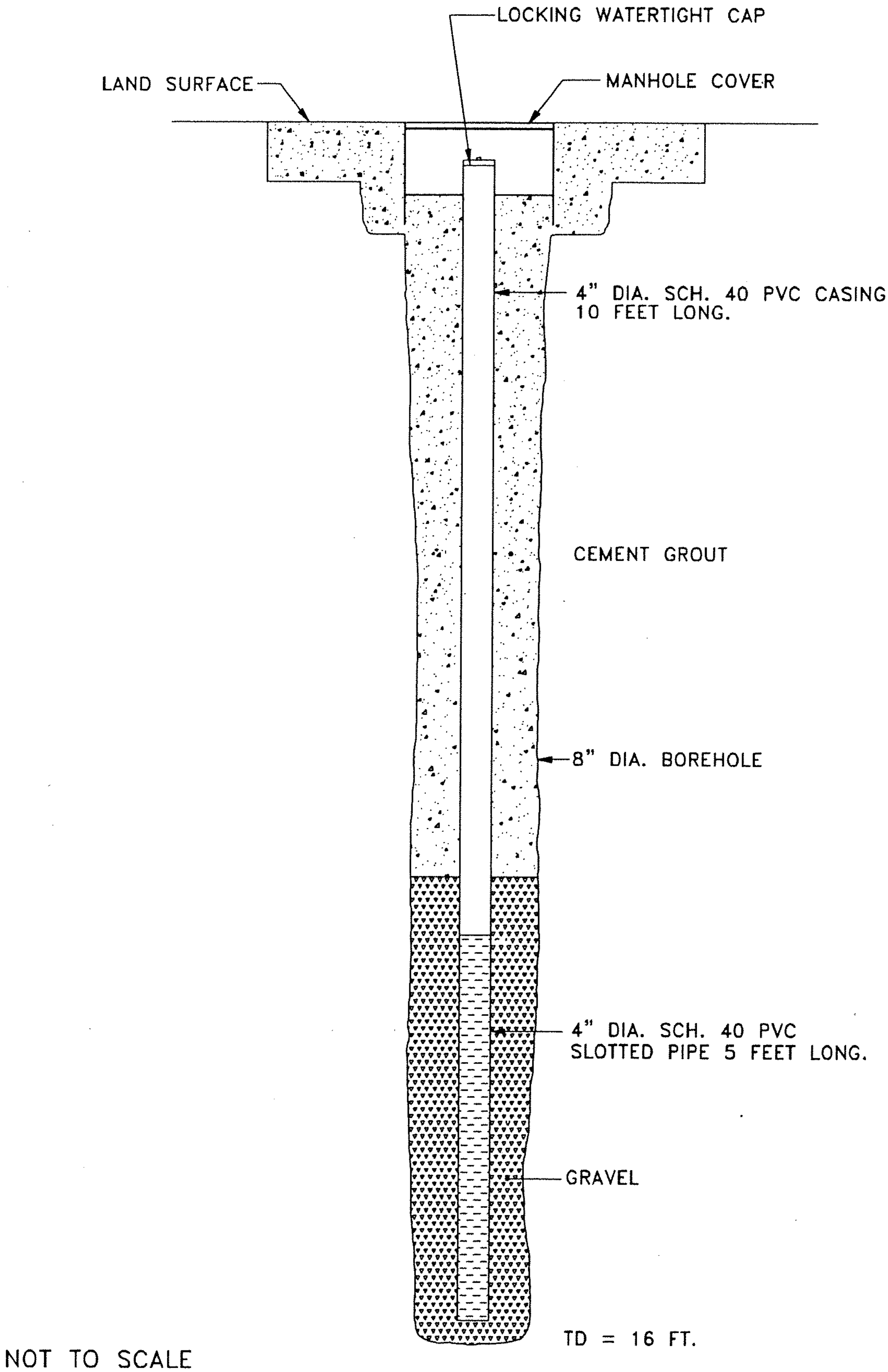
	PROJECT NUMBER: 01-04773.05	DATE: 12/15/05

FIGURE 2-1. HYDROSTRATIGRAPHIC COLUMN MARCO LAKES ASR-6.



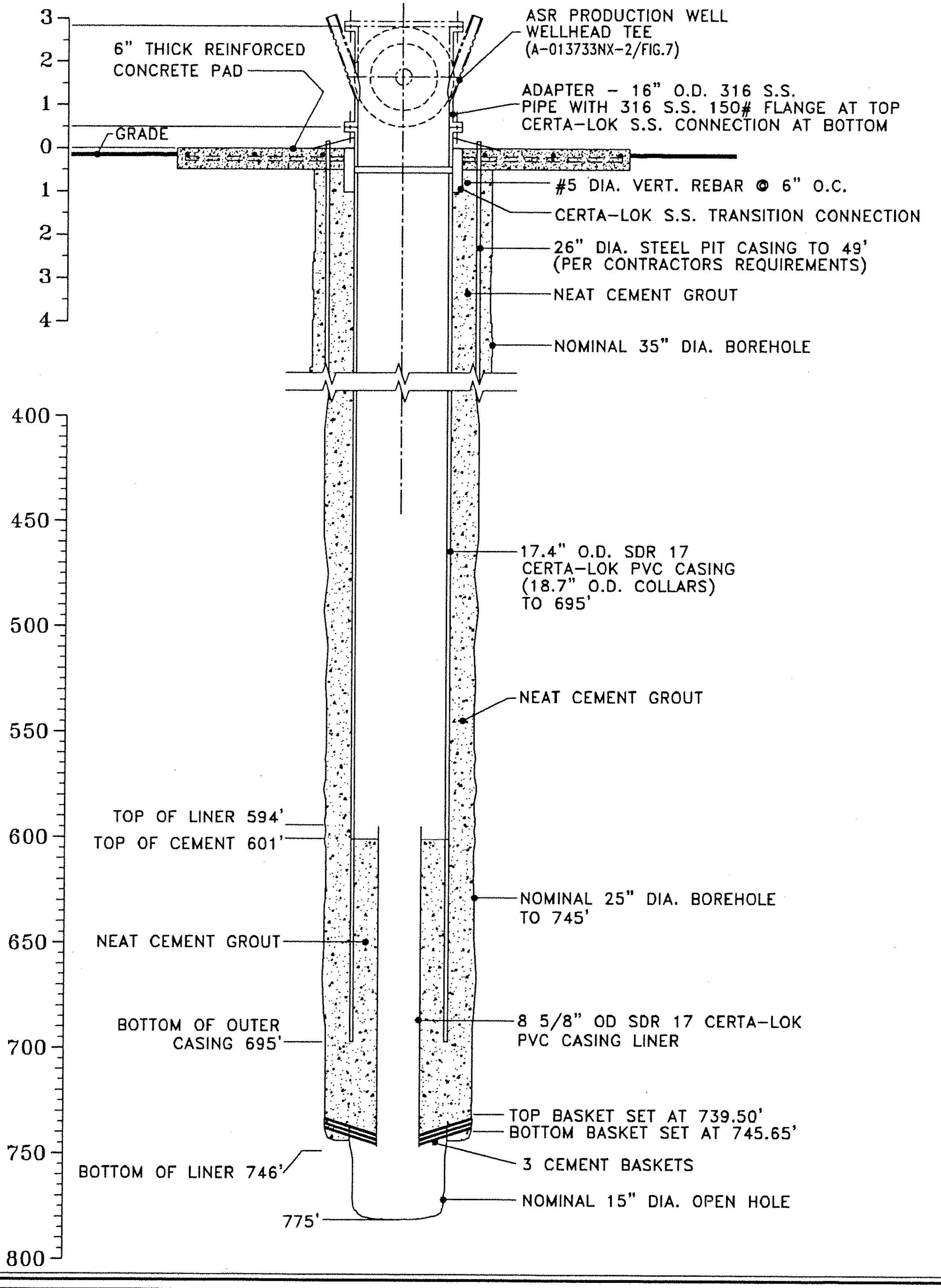
Water Resource Solutions	PROJECT NAME: MARCO ISLAND UTILITIES	DWG. NUMBER: A-014773E41
	PROJECT NUMBER: 01-04773.02	DATE: 04/18/05

FIGURE 2-2. NORTHWEST-SOUTHEAST GEOLOGIC CROSS-SECTION THROUGH SITE BASED ON GEOPHYSICAL LOGS.



Water Resource Solutions	PROJECT NAME: MARCO ISLAND UTILITIES	DWG. NUMBER: A-014773E5
	PROJECT NUMBER: 01-04773.05	DATE: 11/29/05

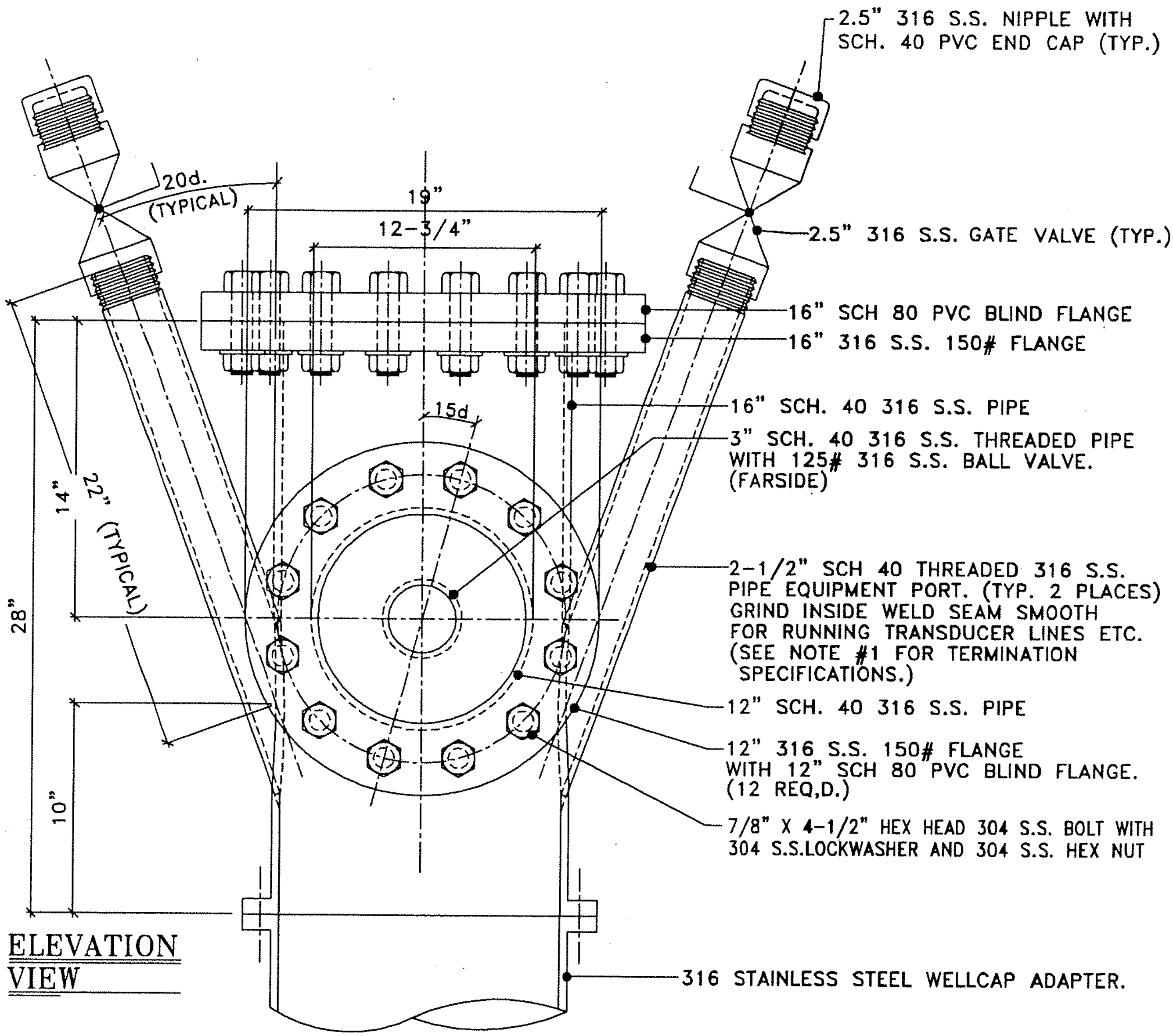
FIGURE 3-1. PAD MONITOR WELL CONSTRUCTION SCHEMATIC.



Water Resource Solutions	PROJECT NAME: MARCO ISLAND UTILITIES	DWG. NUMBER: A-014773E5
	PROJECT NUMBER: 01-04773.05	DATE: 01/09/06

FIGURE 3-2. ASR-6 WELL CONSTRUCTION SCHEMATIC.

NOTE:
1. CONTRACTOR SHALL TERMINATE EACH EQUIPMENT PORT WITH A THREADED 2-1/2" 125# 316 S.S. BALL VALVE, A THREADED 316 S.S. NIPPLE AND A THREADED SCH 40 PVC PIPE CAP.



Water Resource Solutions	PROJECT NAME: MARCO ISLAND UTILITIES	DWG. NUMBER: A-014773E3
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FIGURE 3-3. ASR PRODUCTION WELLHEAD DIAGRAM.

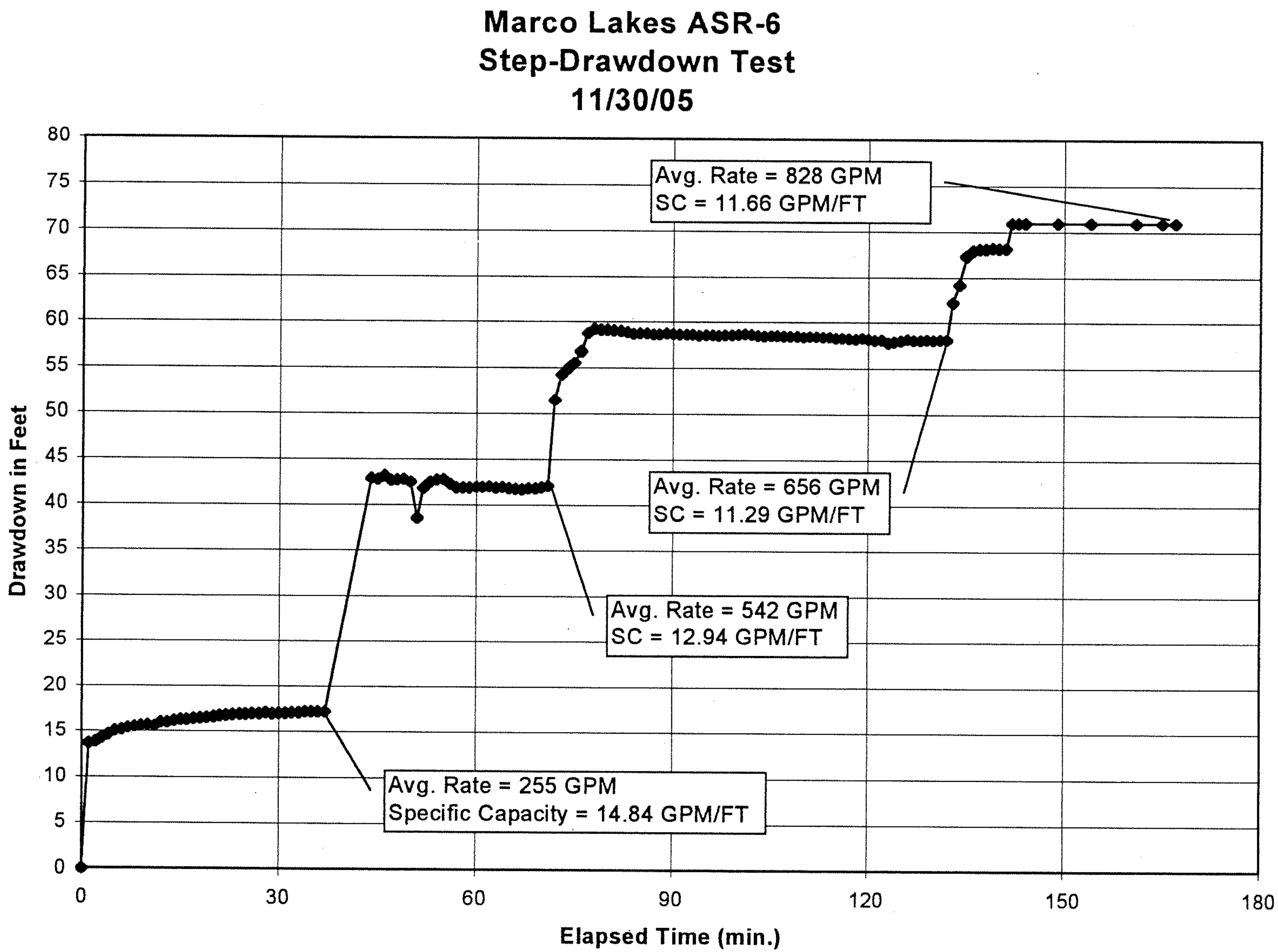

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Figure 4-1. Step-Drawdown Plot

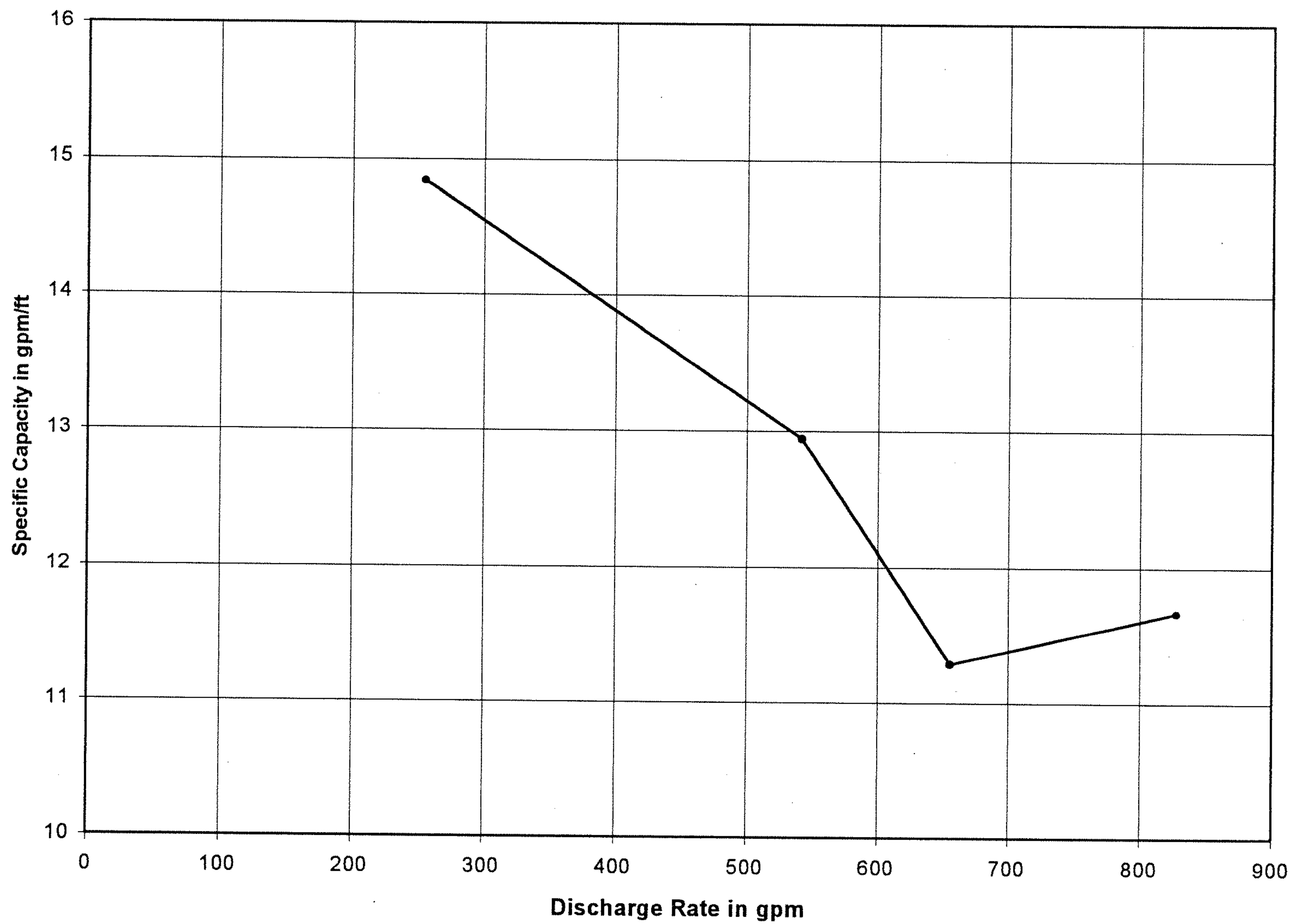

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Figure 4-2. Specific Capacity vs. Discharge at ASR-6

Table 2-1

Water Quality Analysis of Formation Water
08/20/05

Sample Time	Depth of 15-inch Bit (feet bpl)	CHLORIDE (mg/l)	CONDUCTIVITY (*u*S/cm)
11:40	750	400	7740
11:53	755	350	2150
12:30	765	360	2140
13:00	775	420	2470

Table 3-1

Pad Well No. 1 Weekly Monitoring Summary

Sample Date	Depth to Water Below Top of Casing (ft.)*	Elevation of Water Level (NGVD)	CHLORIDE (mg/l)	CONDUCTIVITY (µmhos/cm)	pH (standard units)	TEMPERATURE (°C)
3/31/05	4.71	1.64	22	608	6.85	24.4
4/7/05	4.83	1.52	28	612	6.88	23.9
4/14/05	4.63	1.72	30	601	6.65	23.6
4/21/05	4.89	1.46	30	603	6.81	23.8
4/28/05	5.04	1.31	24	604	6.62	24.2
5/5/05	5.22	1.13	22	607	6.76	23.8
5/12/05	5.48	0.87	32	599	6.81	24.8
5/19/05	5.66	0.69	23	603	6.56	23.8
5/26/05	5.91	0.44	28	631	6.78	24.3
6/2/05	5.12	1.24	136	927	7.16	24.5
6/9/05	3.79	2.56	30	618	6.97	24.7
6/14/05	2.25	4.1	50	673	6.9	25.5
6/23/05	1.36	4.99	39	623	6.78	25.7
6/30/05	0.56	5.79	39	615	6.85	25.8
7/7/05	1.42	4.93	42	612	6.84	24.9
7/14/05	0.8	5.55	36	613	6.82	25.9
7/21/05	1.4	4.95	40	645	6.9	25.8
7/28/05	2.14	4.21	39	602	6.79	25.4
8/4/05	2.83	3.52	32	601	6.86	25.5
8/11/05	2.97	3.38	45	612	6.84	25.6
8/19/05	1.92	4.43	42	611	6.95	29
8/31/05	1.48	4.87	260	1330	7.05	27.2
9/8/05	1.78	4.57	100	903	6.97	29.3
9/14/05	2.42	3.93	115	896	6.98	28.6
9/21/05	2.55	3.80	290	1412	6.97	27.7
9/28/05	2.81	3.54	630	2400	7.04	30.6
10/05/05	1.94	4.41	680	2480	6.99	27.1
10/14/05	1.25	5.10	960	3270	6.85	ND
10/19/05	1.79	4.56	760	2670	7.06	27.5
10/27/05	0.57	5.78	840	2900	6.99	29.3
11/04/05	0.70	5.65	800	3000	6.86	29
11/08/05	1.04	5.31	660	2390	7.07	27.3
11/16/05	1.4	4.95	700	2440	7.03	29
11/22/05	1.50	4.85	620	2270	7.02	28.1
11/29/05	1.35	5.00	600	2220	7.04	25
12/06/05	1.67	4.68	680	2400	6.69	25.2
12/13/05	1.90	4.45	450	1975	6.93	29.0

Table 3-1

Pad Well No. 1 Weekly Monitoring Summary

12/29/05	2.35	4.00	250	1417	7.01	25.2
1/3/06	NM	NM	460	1939	6.75	26.6
1/5/06	2.62	3.73	240	1266	6.68	23.6

NM: Not Measured
*Top of Casing Elevation = 6.35 Feet NGVD

Table 3-2

Pad Well No. 2 Weekly Monitoring Summary

Sample Date	Depth to Water Below Top of Casing (ft.)*	Elevation of Water Level (NGVD)	CHLORIDE (mg/l)	CONDUCTIVITY (µmhos/cm)	pH (standard units)	TEMPERATURE (°C)
3/31/05	4.88	1.61	36	664	6.87	24.0
4/7/05	4.92	1.57	34	647	6.92	23.9
4/14/05	4.80	1.69	34	625	6.73	23.5
4/21/05	5.03	1.46	36	634	6.84	23.7
4/28/05	4.95	1.54	32	633	6.78	23.8
5/5/05	5.39	1.10	26	635	6.82	24.3
5/12/05	5.63	0.86	34	628	6.79	24.1
5/19/05	5.83	0.66	34	633	6.54	24.0
5/26/05	6.05	0.44	42	680	6.84	24.6
6/2/05	4.02	1.65	40	651	6.92	25.2
6/9/05	3.94	2.55	88	802	7.00	24.7
6/14/05	2.42	4.07	120	939	7.30	26.4
6/23/05	1.53	4.96	110	925	6.83	26.6
6/30/05	0.75	5.74	120	895	6.84	27.2
7/7/05	1.56	4.93	138	960	6.78	26.5
7/14/05	0.96	5.53	106	933	6.79	25.6
7/21/05	1.55	4.94	144	951	6.79	25.7
7/28/05	1.55	4.94	144	916	6.78	25.9
8/4/05	2.97	3.52	204	1125	6.92	26.5
8/11/05	3.04	3.45	274	1310	6.78	26.3
8/18/05	2.25	4.24	372	1723	6.84	26.0
8/24/04	1.65	4.84	390	1621	6.87	26.8
8/31/05	1.66	4.83	300	1484	6.89	28.4
9/8/05	1.97	4.52	240	1340	7.04	27.0
9/14/05	2.60	3.89	200	1231	6.98	26.5
9/21/05	2.79	3.70	180	1173	7.08	26.7
9/28/05	3.01	3.48	190	1216	7.01	27.8
10/05/05	2.35	4.14	235	1324	7.13	27.2
10/14/05	1.72	4.77	250	1305	6.83	ND
10/19/05	1.98	4.51	218	1202	6.95	28.3
10/27/05	0.78	5.71	245	1232	6.77	27.1
11/04/05	0.88	5.61	268	1404	7.10	27.1
11/08/05	1.18	5.31	240	1272	6.98	28.5
11/16/05	1.40	4.92	220	1189	6.97	28.1
11/22/05	1.67	4.82	220	1235	7.00	27.0
11/29/05	1.70	4.79	220	1285	7.05	25.9
12/06/05	1.85	4.64	240	1360	6.74	26.2
12/13/05	2.06	4.43	280	1381	7.01	23.5

Table 3-2

Pad Well No. 2 Weekly Monitoring Summary

12/29/05	2.35	ND	340	1400	7.04	25.7
1/3/06	NM	NM	280	1448	7.42	30.1
1/5/06	NM	NM	280	1515	6.65	24.5

NM: Not Measured
ND: Not Determined
*Elevation = 6.49 Feet NGVD

Table 3-3
Inclination Survey Log

Date	Bit Diameter (inches)	Depth (feet bpl)	Inclination (degrees)
4/21/05	12.5	90	0.50
4/22/05	12.5	180	0.50
4/26/05	12.5	270	0.50
5/3/05	12.5	360	0.00
5/18/05	25.0	90	0.50
5/19/05	25.0	180	0.00
5/31/05	25.0	270	0.75
6/9/05	25.0	360	0.50
6/9/05	25.0	450	0.50
7/23/05	25.0	630	0.50

Table 3-4

Drill String Tally for 25-Inch Reamed Hole Drilling

Description	Unit Length (feet)	Total String Length (feet)	TD (ft) w/Kelly Down 35' BPL
14.75-Inch Bit	1.20		
25-Inch Hole Opener	5.70	6.90	
25-Inch Stabilizer	4.59	11.49	
Sub	2.10	13.59	48.59
8-Inch Collar 1	29.60	43.19	78.19
25-Inch Stabilizer	7.03	50.22	85.22
C 2	29.22	79.44	114.44
C 3	30.73	110.17	145.17
Sub	2.00	112.17	147.17
C 4	30.30	142.47	177.47
Heavyweight 1	29.92	172.39	207.39
HW 2	30.95	203.34	238.34
HW 3	29.30	232.64	267.64
Drill Pipe 1	31.40	264.04	299.04
DP 2	31.30	295.34	330.34
DP 3	31.78	327.12	362.12
DP 4	30.65	357.77	392.77
DP 5	31.40	389.17	424.17
DP 6	31.20	420.37	455.37
DP 7	30.60	450.97	485.97
DP 8	31.53	482.50	517.50
DP 9	31.92	514.42	549.42
DP 10	30.10	544.52	579.52
DP 11	30.70	575.22	610.22
DP 12	31.45	606.67	641.60
DP 13	31.30	637.97	672.97
DP 14	31.20	669.17	704.17
DP 15	31.25	700.42	735.42
DP 16	31.79	732.12	767.12

Table 3-5A

Production Casing Tally

Sequence No.	Length (ft)	Total Length (feet)	Time of Submergence	Centralizers Depth
Tailpiece 1	14.0	14.00	UNKNOWN	
SWS reports installing 10 joints of casing without WRS witness onsite. Prior instructions to SWS to wait for WRS were disregarded. The total string tally is based on SWS pipe count when WRS arrived onsite and using 20' per length of pipe for joints not measured by WRS.				
11	Not Meas.	214	10:58	
12	19.96	233.96	11:25	
13	19.95	253.91	11:40	
14	19.95	273.86	NR	
15	19.97	293.83	12:00	
16	19.96	313.79	12:15	5' off bott.
17	19.96	333.75	12:22	
18	19.98	353.73	12:36	
19	20.00	373.73	12:41	
20	20.00	393.73	1:07	
21	19.95	413.68	1:18	
22	19.98	433.66	NR	
23	19.97	453.63	1:30	5' off bott.
24	20.00	473.63	1:47	
25	20.00	493.63	1:54	
26	19.98	513.61	2:10	
27	19.98	533.59	2:26	
28	19.99	553.58	2:31	
29	19.99	573.57	2:41	
30	19.98	593.55	NR	
31	19.99	613.54	NR	
32	19.97	633.51	NR	
33	19.96	653.47	NR	
34	19.97	673.44	NR	
35	20.00	693.44	3:18	
SWS driller and helper repeat statements that they twice counted 37 X 20' staged joints of casing prior to cutting tailpiece to 14'. Based upon that count, the total casing length installed would be734'. WRS unable to confirm or deny this number because SWS had set a number of casing joints without permission and without WRS present.				

Table 3-5B
Production Casing Cementing Log

Stage	Date	Time	Weight (ppg)	Volume Pumped (sks)or(gals)	Comments
1	8/4/04	20:00			1.25-inch tremie tripped in to 714 feet bpl
1	8/4/04	20:05			Begin circulating water down tremie
1	8/4/04	20:15			Stop circulation, start mixing cement in tub
1	8/4/04	20:20			Begin pumping neat cement with trailer mounted grouter piston pump
1	8/4/04	20:30	14.8		Continue mixing and pumping cement
1	8/4/04	20:35	14.5		Sample for 72-Hour Compressive Strength
1	8/4/04	20:49	14.5		Continue mixing and pumping cement
1	8/4/04	20:53	13.5		Continue mixing and pumping cement
1	8/4/04	20:58	14.3		Continue mixing and pumping cement
1	8/4/04	21:02	13.5		Continue mixing and pumping cement
1	8/4/04	21:25	14.0		Continue mixing and pumping cement
1	8/4/04	21:36	14.8		Continue mixing and pumping cement
1	8/4/04	21:44	14.5		Continue mixing and pumping cement
1	8/4/04	22:06		235 sks.	Finish pumping cement
1	8/4/04	22:07			Begin pumping displacement chase
1	8/4/04	22:11		300 gals.	Finish pumping displacement chase
1	8/4/04	22:20			Pressure up casing to 60 psi, shut in.
2	8/5/05	8:30			Begin tripping in 1.25-inch tremie
2	8/5/05	10:35			Finish tripping/jetting tremie to tag at 480 ft.
2	8/5/05	10:50			Mix 100 lbs of bentonite and 600 gal. water in plastic tank
2	8/5/05	11:00			Begin circulating water down tremie.
2	8/5/05	12:00			Stop circulation. Pull tremie up to 457 ft. bpl.
2	8/5/05	12:20			Pressure up casing, bolt on header leaks
2	8/5/05	13:37			Rinker truck with 154 of neat cement arrives
2	8/5/05	13:38			Pump 300 gallons of bentonite slurry into mixing truck. Spin and mix
2	8/5/05	13:41		300 gals.	Finish adding bentonite slurry
2	8/5/05	13:44			Begin pumping cement/bentonite slurry
2	8/5/05	13:47	13.8		Sample for 72-Hour Compressive Strength
2	8/5/05	13:55			Stop pumping cement, pump 30 gals water
2	8/5/05	14:00			Break loose cement header, pull 1 double
2	8/5/05	14:03			Resume pumping cement, tremie at 415'
2	8/5/05	14:19	13.9		
2	8/5/05	14:22		154 sks.	Rinker truck empty, stop cementing.
2	8/5/05	14:24			Pump 50 gallons of freshwater chase
2	8/5/05	14:25		50 gals.	Finish chase. Break loose header
2	8/5/05	14:26			Pull 1 double, tremie at 373 feet bpl
2	8/5/05	14:33	14.3		Second Rinker truck here with 154 sks. neat
2	8/5/05	14:34			Add 300 gallons of bentonite slurry to mixer
2	8/5/05	14:37	13.5	300 gals.	Finish adding bentonite slurry
2	8/5/05	14:38			Start pumping cement
2	8/5/05	14:43	13.5		
2	8/5/05	14:53			Stop pumping cement, pump 30 gallon flush, pull 1 double, tremie at 331 ft.
2	8/5/05	15:00			Resume pumping cement
2	8/5/05	15:07	13.7		Sample for 72-Hour Compressive Strength
2	8/5/05	15:08			Discharge thickens and darkens wt. 10.3
2	8/5/05	15:21		154 sks.	Cement returns at surface from annulus. Finish cementing. Rinker truck almost empty
2	8/5/05	15:22			Begin pumping water displacement
2	8/5/05	15:24		300 gals.	Finish pumping displacement chase
2	8/5/05	15:25			Pull 1 double, tremie at 289 feet bpl
	8/5/05	15:30-17:30		7000 gals.	Held tremie at 273 feet bpl and circulated 7000 gls. of mud to flush out cement.
3	8/9/05	9:45			Drillers report tremie washed down down to 280'. Pull tremie bottom up to 252 ft. bpl
3	8/9/05	17:20			Rinker truck arrives onsite
3	8/9/05	17:25			Circulate water using rig diaphram pump
3	8/9/05	17:30			Begin pumping cement
3	8/9/05	17:38	14.5		Sample for 72-Hour Compressive Strength
3	8/9/05	17:43			
3	8/9/05	17:50		~116 sks.	Cement returns at surface from annulus. Finish cementing. Cement truck driver says ~1/4 of load remains in truck.
3	8/9/05	18:05			Pump 100 gallon displacement flush
3	8/9/05				Rinker truck is ~1/4 full.
3	8/9/05	18:10			Begin pulling tremie

Table 3-6
Production Casing Cement Stage and Volume Summary

Stage	Date	Cement additives	Yield (cf/sk)	Theoretical Fill Interval	Theoretical Fill Footage	Theoretical Fill Volume (cf)	Actual Fill Interval	Actual Fill Footage	Actual Fill Volume (cf)	Tag Depth (ft bpl)	Percent Filled (I/Fx100)	Cum. Total (cu ft)	Observer Init.
1	8/4/04	Neat	1.28	743 to 599	144	301	743 to 480	263	528	480	183%	528	AWM
2	8/5/05	0.3 % Bentonite	1.28	480 to 260	220	394	480 to 0	480	914	0	218%	1442	AWM
3	8/9/05	Neat	1.28	278 to 220	58	148	278 to 0	278	562	0	479%	2004	AWM

Table 3-7

Drill String Tally for 15-Inch Open-Hole Drilling

Description	Unit Length (feet)	Total String Length (feet)	TD (ft) w/Kelly Down 35' BPL
14-inch Lead Bit	2.50	2.50	37.50
15-inch Hole Opener	2.00	4.50	39.50
Sub	1.50	6.00	41.00
Heavyweight 1	31.00	37.00	72.00
HW-2	30.20	67.20	102.20
Pipe 1	31.40	98.60	133.60
Pipe 2	30.10	128.70	163.70
Pipe 3	31.20	159.90	194.90
Pipe 4	31.40	191.30	226.30
Pipe 5	31.25	222.55	257.55
Pipe 6	31.00	253.55	288.55
Pipe 7	31.30	284.85	319.85
Pipe 8	31.80	316.65	351.65
Pipe 9	31.70	348.35	383.35
Pipe 10	31.70	380.05	415.05
Pipe 11	30.60	410.65	445.65
Pipe 12	31.65	442.30	477.30
Pipe 13	31.40	473.70	508.70
Pipe 14	31.60	505.30	540.30
Pipe 15	30.42	535.72	570.72
Pipe 16	31.32	567.04	602.04
Pipe 17	30.70	597.74	632.74
Pipe 18	30.50	628.24	663.24
Pipe 19	30.30	658.54	693.54
Pipe 20	30.32	688.86	723.86
Pipe 21	32.00	720.86	755.86
Pipe 22	30.94	751.80	786.80

Table 3-8

Drill String Tally for Liner Installation
10/12/05

Description	Unit Length (feet)	Total String Length (feet)
Sub atop Reverse-Thread Adapter	3.29	3.29
Pipe 1	30.65	33.94
Pipe 2	31.30	65.24
Pipe 3	31.45	96.69
Pipe 4	30.18	126.87
Pipe 5	32.09	158.96
Pipe 6	31.25	190.21
Pipe 7	31.78	221.99
Pipe 8	30.95	252.94
Pipe 9	31.55	284.49
Pipe 10	31.20	315.69
Pipe 11	29.05	344.74
Pipe 12	31.00	375.74
Pipe 13	31.03	406.77
Pipe 14	31.68	438.45
Pipe 15	31.50	469.95
Pipe 16	31.70	501.65
Pipe 17	31.42	533.07
Pipe 18	31.60	564.67
Pipe 19	30.71	595.38

Top of drill pipe No. 19 is positioned one foot above pad level

Table 3-9

8.625-Inch PVC Liner Tally
10/12/05

Sequence No.	Length (feet)	String Length (feet)	Time Installed
Tailpiece	11.7	11.7	13:42
2	20	31.7	13:53
3	20	51.7	14:01
4	20	71.7	14:09
5	20	91.7	14:14
6	20	111.7	14:38
7	20	131.7	14:45
8	20	151.7	16:00
Reverse-Threaded Stainless Adapter	0.25	151.95	16:07

Table 3-10
Liner Cementing Summary

Date	Cement Stage	Volume of Cement (ft^3)*	Tag Depth (ft bpl)	Theoretical Fill (ft)**	Actual Fill	Actual Fill/Theoretical Fill
10/13/05	1	22	733.5	8.8	4.0	45%
10/13/05	2	20	728	9.5	5.5	58%
10/14/05	3	30	724	23.5	4.0	17%
10/14/05	4	30	687	28.0	37.0	132%
10/17/05	5	38	641	44.0	46.0	105%
10/18/05	6	11	619.6	13.0	21.4	165%
10/18/05	7	8	601	9.6	18.6	194%

* Volume of Cement based on estimated yield of 1.28 cubic feet per 94-pound sack of cement mixed with 6 gallons of water

** Theoretical fill calculated: Total borehole volume from caliper log minus pipe volume equals annular volume

Table 3-11
Plumbness and Alignment Test
12/07/05

Depth of Plummet Below Top of Well Casing (ft)	Horizontal Deflection of Plumb Line (ft)				Calculated Drift of Well (ft)			
	North	South	East	West	North	South	East	West
10	0	0	0	0				
20	0.041	0	0	0.020	0.09			0.04
30	0.041	0	0	0.020	0.12			0.06
40	0.041	0	0	0.031	0.14			0.11
50	0.020	0	0	0.020	0.08			0.08
60	0	0	0	0.010				0.05
70	0	0	0	0.010				0.05
80	0	0	0	0				
90	0	0	0	0				
100	0	0	0	0				
110	0	0	0	0				
120	0	0	0.010	0			0.08	
130	0	0.010	0	0		0.09		
140	0	0.010	0	0		0.09		
150	0	0	0	0				
160	0	0.010	0	0		0.11		
170	0	0.020	0.010	0		0.22	0.11	
180	0	0.031	0.020	0		0.37	0.24	
190	0	0.020	0.020	0		0.25	0.25	
200	0	0.020	0.031	0		0.26	0.40	
210	0	0.031	0.041	0		0.42	0.56	
220	0	0.041	0.041	0		0.58	0.58	
230	0	0.041	0.041	0		0.61	0.61	
240	0	0.041	0.041	0		0.63	0.63	
250	0	0.041	0.041	0		0.66	0.66	

Table 4-1
Specific Capacity Data Summary

Time	Elapsed Time (minutes)	Drawdown in Pumping Well (feet)	Totalizer Reading (gallons)	Calculated Flow Rate between Readings (gpm)	Specific Capacity (gpm/ft)
15:36	0	0.0	81,531,200	0	NA
16:14	38	17.21	81,540,650	255	14.8
16:46	70	41.89	81,558,000	542	12.9
17:47	131	58.08	81,598,000	656	11.3
18:28	172	70.95	81,631,930	828	11.7