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North Carolina Department of
Environment and Natural Resources

**Report on the Construction and Testing of an
Upper Yorktown Aquifer Test Well at
Replacement Production Well Site #9
(Skyco Water Plant)
Dare County, North Carolina**

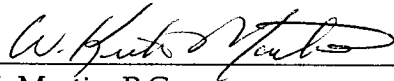
November 2003

Report

North Carolina Department of Environment and Natural Resources

Report on the Construction and Testing of an Upper Yorktown Aquifer Test Well at Replacement Production Well Site #9 (Skyco Water Plant) Dare County, North Carolina

November 2003

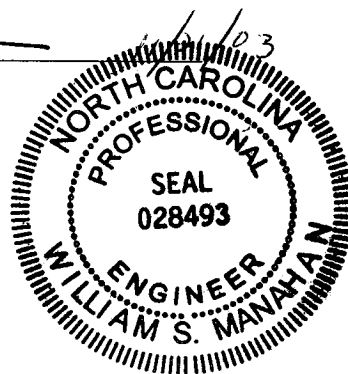


W. Kirk Martin, P.G.
North Carolina Registered
Professional Geologist #1112



Wm. Scott Manahan, P.E.
North Carolina Registered
Professional Engineer #28493

CDM Missimer
9311 College Parkway, Suite 1
Fort Myers, Florida 33919



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Section 1

Introduction

The Dare County Water Department operates a water treatment plant (Skyco water plant) on Roanoke Island, North Carolina that produces potable water for public supply purposes (Figure 1). The raw water source for the plant is supplied by 9 active Upper Yorktown (Principal) aquifer production wells. The raw water supplied to the plant is fresh and an ion exchange process is used to treat the water. Currently, the plant has a maximum finished water production capacity of approximately 5 million gallons per day (MGD), with an average daily production of approximately 1.5 MGD. The typical pumping rate for each of the existing supply wells ranges between 400 and 500 gallons per minute (gpm). The Skyco water plant and production well locations are shown on Figure 2.

The state of North Carolina is responsible for maintenance dredging of the Manteo to Wanchese and North navigation channels located just east of Roanoke Island. The North Carolina Department of Environment and Natural Resources (NCDENR) desires to use an upland area adjacent to NC Highway 345 near the Skyco water plant for disposal of the dredge spoils. Dare County production well #9 is located within the proposed disposal area. The NCDENR has agreed to pay Dare County to relocate well #9 approximately 800 feet east of its current location. The current and proposed future site of well #9 are shown on Figure 2. A site plan showing the proposed layout of the disposal area is provided in the appendix.

CDM Missimer was authorized by the NCDENR to construct a test well on the proposed new well site east of existing production well #9. The purpose of this project was to evaluate aquifer yield and water quality conditions within the Principal aquifer to determine the feasibility of relocating existing production well #9. The scope of the project included well construction, aquifer testing, water quality sampling, data analysis, and preparation of this summary report. In addition, an engineering study/conceptual design report for relocation of the well was prepared and provided under separate cover. The methods and procedures used during the investigation and the results obtained are presented herein.

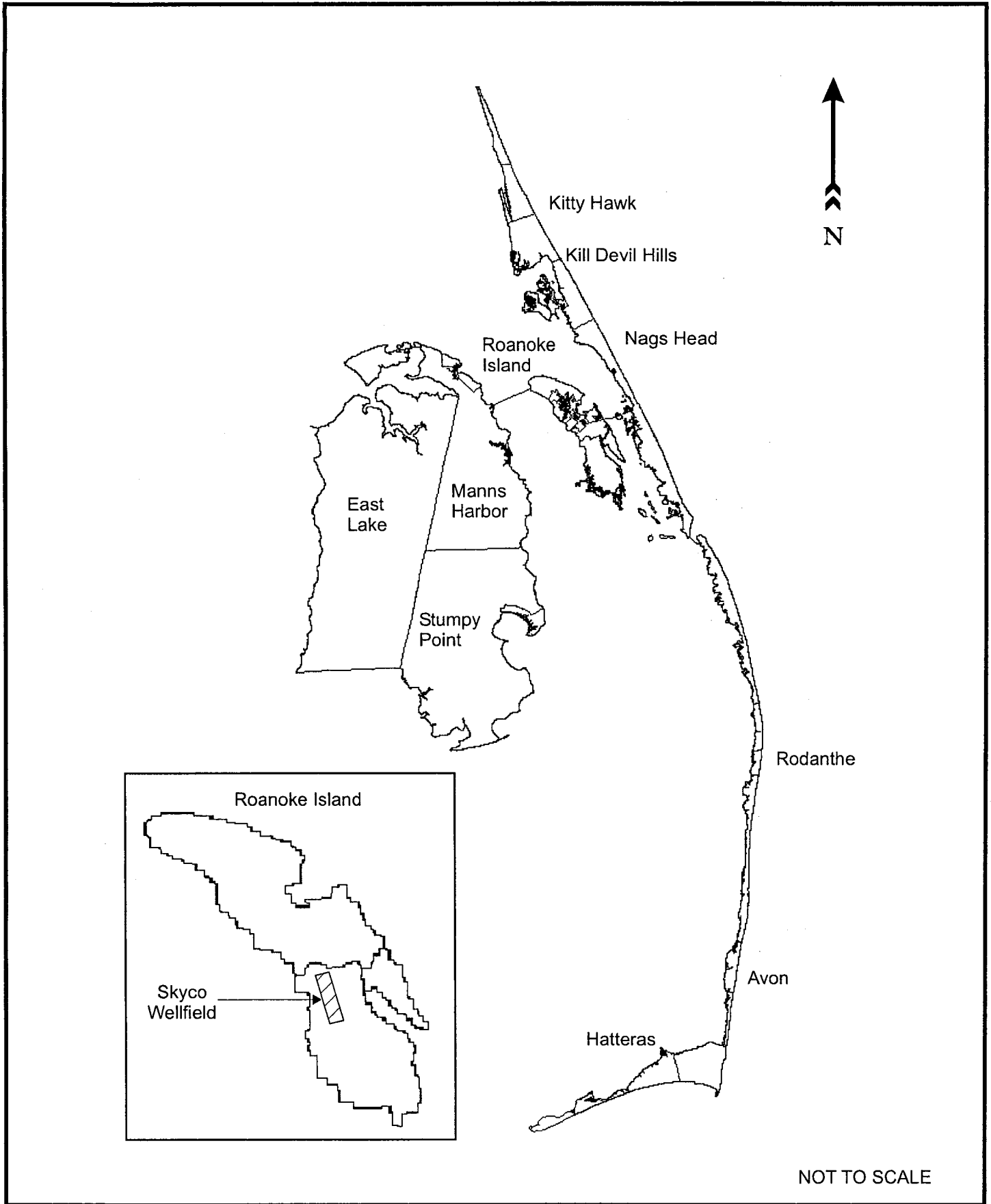
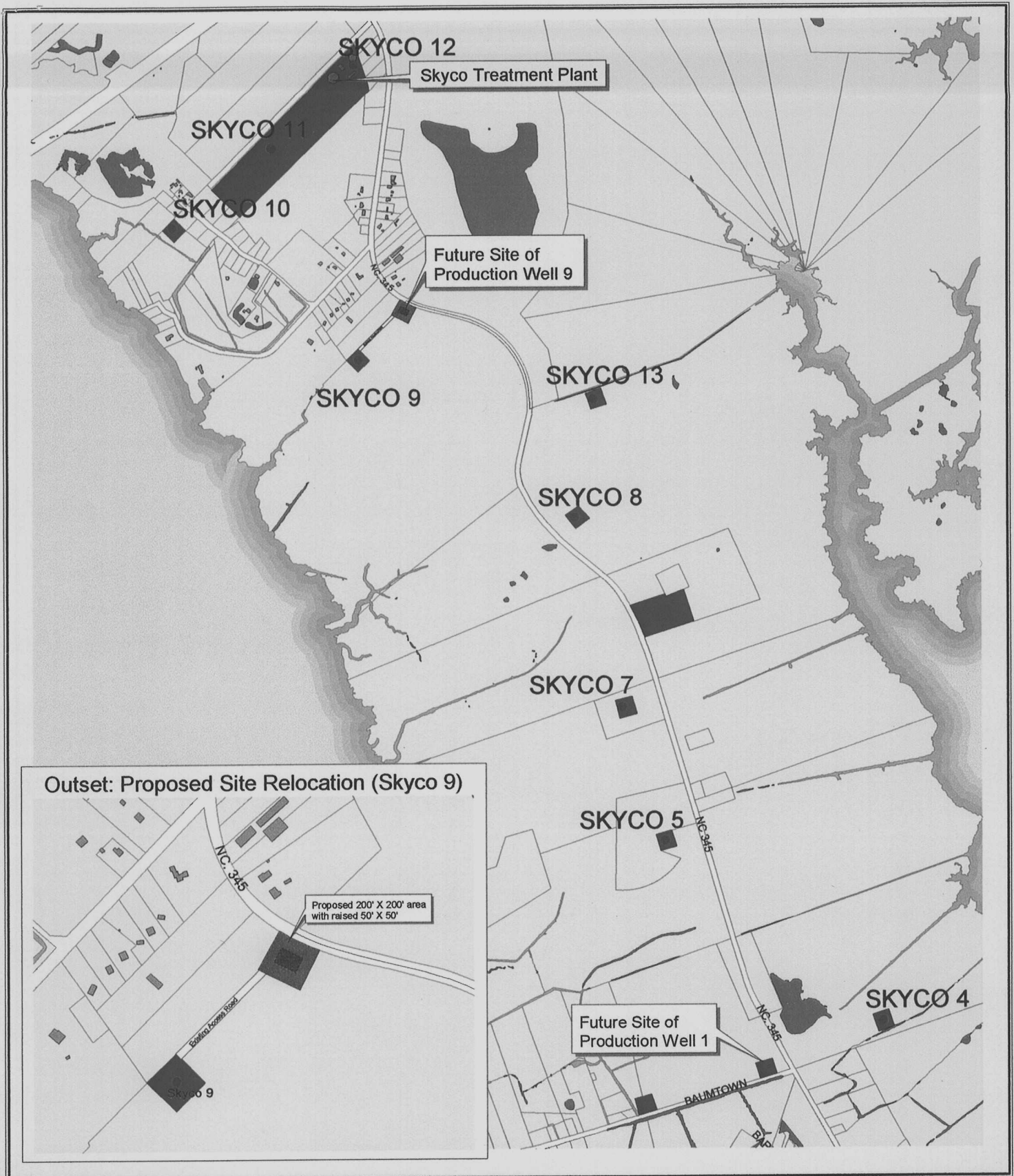


Figure 1
Site Map Showing the Skyco Wellfield on Roanoke Island
Dare County, North Carolina



DARE COUNTY WATER
GIS
MATTHEW HIBLER
JULY 23, 2003

Skyco Well Field
Wanchese, NC
400 0 400 800 1200 Feet



LEGEND	
	Skyco Plant
	Production Well
	Dare Property

Figure 2
Detailed Site Map Showing the Water Plant and Wellfield Locations

Section 2

Conclusions and Recommendations

A single test well tapping the Upper Yorktown aquifer was constructed at the proposed production well #9 relocation site in the Skyco Wellfield on Roanoke Island, North Carolina, to evaluate the feasibility of relocating existing production well #9. Production well #9 is currently used to supply raw water to the Dare County Skyco water treatment plant. The conclusions and recommendations presented below are based on the results of the test well construction project.

2.1 Conclusions

- One 4-inch diameter test well (#9R) was installed at the proposed production well relocation site approximately 800 feet east of the existing well. The test well was completed within the Upper Yorktown (Principal) aquifer with a screened interval between approximately 160 and 230 feet below land surface.
- Step-drawdown testing was performed on test well #9R after drilling and development were completed. A specific capacity value of 6.8 gpm/ft was calculated for the well at a pumping rate of 98 gpm.
- The transmissivity of the Principal aquifer at the test well site is estimated to be approximately 80,000 gpd/ft based on analysis of test data obtained during a 24-hour constant rate pumping test conducted on well #9R.
- Water samples were obtained from test well #9R near the end of the 24-hour pumping test and sent to the STL Tampa laboratory for analysis. A dissolved chloride concentration of 44 mg/l and total dissolved solids of 350 mg/l were determined for the samples. These values are similar to those of the existing production well #9.
- Water quality at the production well #9 relocation site is similar to that from the existing well site. Calculated transmissivity values indicate the relocation site should be comparable to the existing site. The proposed well relocation is feasible based on the data collected.

2.2 Recommendations

- The proposed relocated production well should be constructed with 10-inch diameter SDR 17 PVC casing to a depth of approximately 160 feet below land surface. The well should be screened with 8-inch diameter stainless steel continuous wrap screen from the casing bottom to the final screen depth of approximately 230 feet below land surface. An appropriately sized coarse sand filter pack should be placed around the screen. A hydrogeologist should supervise construction of the well and select final cased and total depths based on lithologic analysis of formation samples obtained during drilling. The well should be

thoroughly developed by compressed air pumping and horizontal jetting of the screen after the drilling is complete.

- A step-drawdown test should be conducted on the new production well. Specific capacity values calculated based on the test results can be used to assess well yield and select a pump setting depth and withdrawal rate. The new well should be disinfected following development and pump testing.
- The vertical shaft turbine well pump currently in use on the existing production well #9 should be installed in the new production well. Piping from the well would be connected to the existing PVC raw water transmission main going to the water treatment plant.
- The test well should be included in the on-going water level and water quality monitoring program conducted by NCDENR and the County. Water quality and water levels should also be monitored in the proposed relocated production well. The data collected will enable an evaluation of the performance of the new well and help to identify potential problems.

Section 3

Field Investigation Methods

3.1 Drilling

Test well #9R was installed approximately 800 feet east of the existing Skyco production well #9 (Figure 2). Skipper's Well Drilling from Leland, North Carolina was subcontracted to construct the well, conduct geophysical logging, and perform step-drawdown and 24-hour constant rate pumping tests on the newly installed well. CDM Missimer staff provided on-site supervision during drilling, selected cased and total depths for the well, and collected formation samples for lithologic analysis.

The boring was advanced with a nominal 9-inch diameter bit using the mud rotary method. Electric and natural gamma ray geophysical logs were conducted on the bentonite mud filled borehole after the drill pipe had been removed. Drilling and well construction activities are discussed below. Copies of the geologist's log and geophysical logs are provided in Appendix B and C, respectively.

Drilling began at the test well #9R site on August 11, 2003. A well to moderately graded, medium to coarse-grained sand unit was encountered from approximately 150 to 235 feet below land surface (bls). Based on the geologist's log and the geophysical logs, the well screen interval was set between 160 and 230 feet bls.

A well string consisting of 70 feet of 4-inch diameter, 0.030-inch slotted, Schedule 40 PVC screen was placed in the borehole from 160 to 230 feet bls, followed by 160 feet of 4-inch diameter Schedule 40 PVC casing to land surface. A coarse sand gravel pack was placed around the screen. The well was developed with compressed air on August 12, 2003 for 7 hours and subsequently grouted with neat Portland cement from the top of the gravel pack to land surface. Well construction details are shown on Figure 3.

3.2 Aquifer Testing

A 5-hp electric submersible pump was placed in test well #9R with the pump intake set at 83 feet bls. The well was pumped at three separate rates ranging from 60 to 98 gpm. Drawdown in the well was measured with a pressure transducer coupled to an electronic data logger. Results of the step-drawdown test are summarized in Table 3-1. A specific capacity value of 6.8 gpm/ft was calculated for the well at a pumping rate of 98 gpm. Pumping test data are shown on graphs and tables in Appendix D.

Following the step drawdown test, an additional constant rate pump test was conducted. The well was pumped at 98 gpm for a period of approximately 24 hours. Drawdown in the well was measured at closely spaced time intervals and a semi-log plot of drawdown vs. time was constructed for analysis purposes. At the completion of the constant rate pump test recovery data were collected. The water level recovery was measured at closely spaced time intervals and a semi-log graph of recovery vs.

Test Well #9R

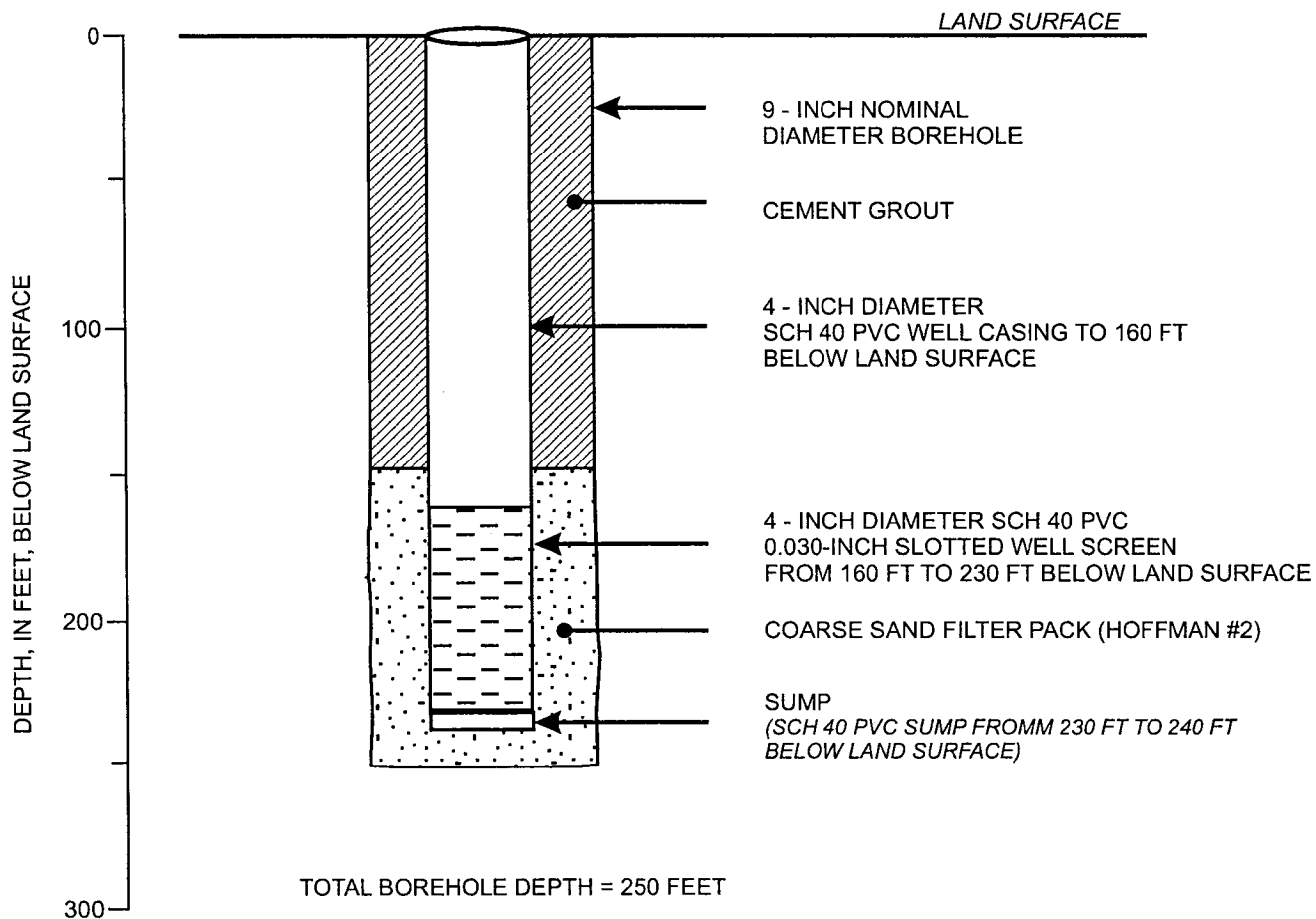


Figure 3

Skyco Production Well #9 Replacement
Schematic Diagram Showing Construction Details of Test Well #9R

**Table 3-1
Step-Drawdown Test Results
Skyco Well #9 Replacement
Manteo, North Carolina**

Test Well #9R				
Test Date: 13 August 2003				
Recorded by: M. Colone				
Static Water Level: 25.87 feet Below Top of Casing (btoc)				
Pumping Rate (GPM)	Time (Minutes)	Water Level (btoc)	Drawdown (feet)	Specific Capacity (gpm/ft)
60	0	25.87	0	
	5	32.03	6.16	
	10	32.05	6.18	
	20	31.86	5.99	
	30	31.99	6.12	
	40	32.36	6.49	
	50	31.92	6.05	
	60	32.04	6.17	
80	0	32.04	6.17	
	5	35.85	9.98	
	10	35.84	9.97	
	20	35.76	9.89	
	30	35.84	9.97	
	40	36.04	10.17	
	50	35.97	10.10	
	60	35.90	10.03	
98	0	35.90	10.03	
	5	39.57	13.70	
	10	39.73	13.86	
	20	39.64	13.77	
	30	39.93	14.06	
	40	39.94	14.07	
	50	39.78	13.91	
	60	40.23	14.36	

*Reference Point is Top of Casing, approximately 3 feet above land surface.

time was constructed for analysis. Copies of the semi-log drawdown and recovery graphs are provided in Appendix D.

3.3 Water Quality Sampling

Water samples were obtained near the end of the constant rate pumping test. Dare County Water Department staff and STL Laboratories in Tampa, Florida conducted independent detailed analyses of the samples. Analytical reports with the analysis results are included in Appendix E. A discussion of the water quality sampling results is included in the following section of this report.

Section 4

Hydrogeology

4.1 Geology

Various government agencies and private consultants, including CDM Missimer, have investigated the geology of Dare County. A general description of the sediments underlying the test well site is provided herein. Detailed discussions of the geologic conditions at Skyco and throughout Dare County are provided in the reports included in the reference section of this report.

Generally, the uppermost strata encountered during test drilling include undifferentiated very fine to medium pebble sized sand units with shell beds and small clay lenses. Permeable sediments within these deposits form the surficial aquifer, which is about 100 feet thick at the site.

The Yorktown formation of Miocene age lies beneath the surficial sand deposits. The formation consists of beds of fine to coarse grained sand and dense clay units with a thickness that can exceed 500 feet in eastern Dare County. The Yorktown formation is described in more detail below, beginning with the upper confining beds.

At the site, the upper part of the Yorktown formation includes olive-gray to medium dark gray marine clay units with varying amounts of fine sand, shell, and phosphate material. The thickness of the upper confining unit at the site is approximately 25 feet. Typically, the clay beds have a very low hydraulic conductivity and provide confinement between the surficial sands and underlying aquifer units.

Beneath the upper Yorktown confining beds is a unit of very fine to very coarse grained sand with minor amounts of interbedded shells and clay. The Principal or Upper Yorktown aquifer occurs within this unit which ranges from a thickness of 100 feet or more in some locations to very thin or absent in southern Dare County. The Principal aquifer is approximately 100 feet thick at the #9R test well site based on the test drilling results. The Principal aquifer is the unit tapped by the Skyco wellfield and is also the source of water to many domestic wells on Roanoke Island and the Dare County mainland.

A low permeability dense marine clay layer that contains minor amounts of silt, sand, and shells lies beneath the Upper Yorktown aquifer and separates it from the underlying Mid-Yorktown aquifer. This confining unit was encountered at a depth of approximately 237 feet below land surface at the test well site.

4.2 Aquifer Hydraulic Characteristics

The method developed by Jacob (1952) was used to analyze the data collected during the constant rate pumping test. A straight line segment is selected from a semi-log plot of drawdown vs. time (Appendix D) and the change in drawdown over one log

cycle is determined and substituted into equation (1) to calculate the aquifer transmissivity.

$$T = \frac{264 Q}{\Delta S} \quad (1)$$

where,

T = transmissivity (gpd/ft)

Q = pumping rate (gpm)

ΔS = head difference between log cycles (feet)

A transmissivity value of approximately 80,000 gpd/ft was calculated for the Principal aquifer at the test site using the time and drawdown data obtained during constant rate pump testing.

4.3 Water Quality

The laboratory analysis results for the sample obtained from the test well indicate that the water quality in the Principal aquifer at the relocation site is fresh, and similar to the water obtained from the existing production well #9. Salinity parameters for both the test well and production well are summarized in Table 4-1.

Table 4-1. Water Quality - Skyco Test Well #9R (August 2003)

Well	Dissolved Chloride Concentration (mg/l)		Total Dissolved Solids (mg/l)	
	Dare County Lab	STL Tampa Lab	Dare County Lab	STL Tampa Lab
#9R	52	44	311	350
#9	41	N/A	310	N/A

Complete laboratory reports from the Dare County Lab and the STL-Tampa lab are provided in Appendix E. The proposed replacement production well should have water quality similar to the existing production well based on the water quality analysis results for test well #9R.

Section 5

Water Supply Evaluation

Data collected during the installation and testing of test well #9R indicate that the raw water supply potential of the subject parcel is likely similar to that of the existing production well #9 site. A transmissivity value of approximately 80,000 gpd/ft was calculated for the Upper Yorktown aquifer at the test well site. The aquifer transmissivity at the test site is greater than the transmissivity of 60,000 gpd/ft reported for the aquifer at Roanoke Island by the state of North Carolina (Peck, 1972). A drawdown of 30 to 50 feet is anticipated in a production well at the site with a pumping rate of 450 gpm. Pumping water levels of 50 to 80 feet below land surface may be expected based on the static water level in the aquifer and anticipated interference drawdown effects. The anticipated drawdowns and pumping water levels in the proposed replacement production well are similar to those experienced in the existing Skyco production wells. It should be noted that these are estimated pumping water levels based on yields of existing production wells and aquifer test results at the test well #9R site. The actual replacement production well yield and pumping water levels may vary. Step-drawdown testing of the replacement production well would be required to accurately assess the production well yield.

Hydraulic groundwater flow modeling to estimate regional drawdown effects due to the proposed well relocation was beyond the scope of this investigation. However, the proposed replacement well location does not significantly alter the overall wellfield alignment and a separation distance of over 2000 feet will be maintained between the replacement well and other existing wells. Relocation of well #9 is feasible based on the data collected and analyses conducted.

An engineering study and conceptual design report for the relocation of production well #9 has been prepared and provided under separate cover. The report outlines requirements for: removal of the well pump and other salvageable equipment from the existing wells; abandonment of the existing well; construction of a replacement production well and well house; installation of the well pump, piping, and electrical service to the new well site; and other tasks needed to bring the well on-line and ready for use. An opinion of probable construction costs for the well relocation project is included with the conceptual design report.

Section 6

Selected References

CDM Missimer. September 2000. Report on the Construction and Testing of a Mid-Yorktown Aquifer Test Well at Future Production Well Site 17 (North RO Plant): Report to the Dare County Water Department, Kill Devil Hills, North Carolina, 17 p.

CDM Missimer. 2000. Report on the Construction and Testing of a Mid-Yorktown Aquifer Test Well at the Wright Brothers Memorial Park: Report to the Dare County Water Department, Kill Devil Hills, North Carolina, 17 p.

Jacob, C.E., and Lohman, S.W. 1952. Nonsteady flow to a well of constant drawdown in an extensive aquifer: *A Geophysical Union Trans.*, v. 33, p. 559-569.

Missimer & Associates, Inc. 1987, Modeling of pumping induced groundwater quality changes at the Dare County, North Carolina wellfield (Kill Devil Hills site): Report to Black & Veatch, Inc., Asheboro, North Carolina, 177 p.

Missimer & Associates, Inc., Investigation and predictive modeling of water quality changes within the Yorktown Aquifer, Dare County, North Carolina, V. 1: Report to the County of Dare Water Production Department, Kill Devil Hills, North Carolina, 129 p.

Missimer International, Inc. 1998. Dare County-Wide Hydrogeological Study and Groundwater Resources Evaluation: Report to the Dare County Water Department, Kill Devil Hills, North Carolina, 98p.

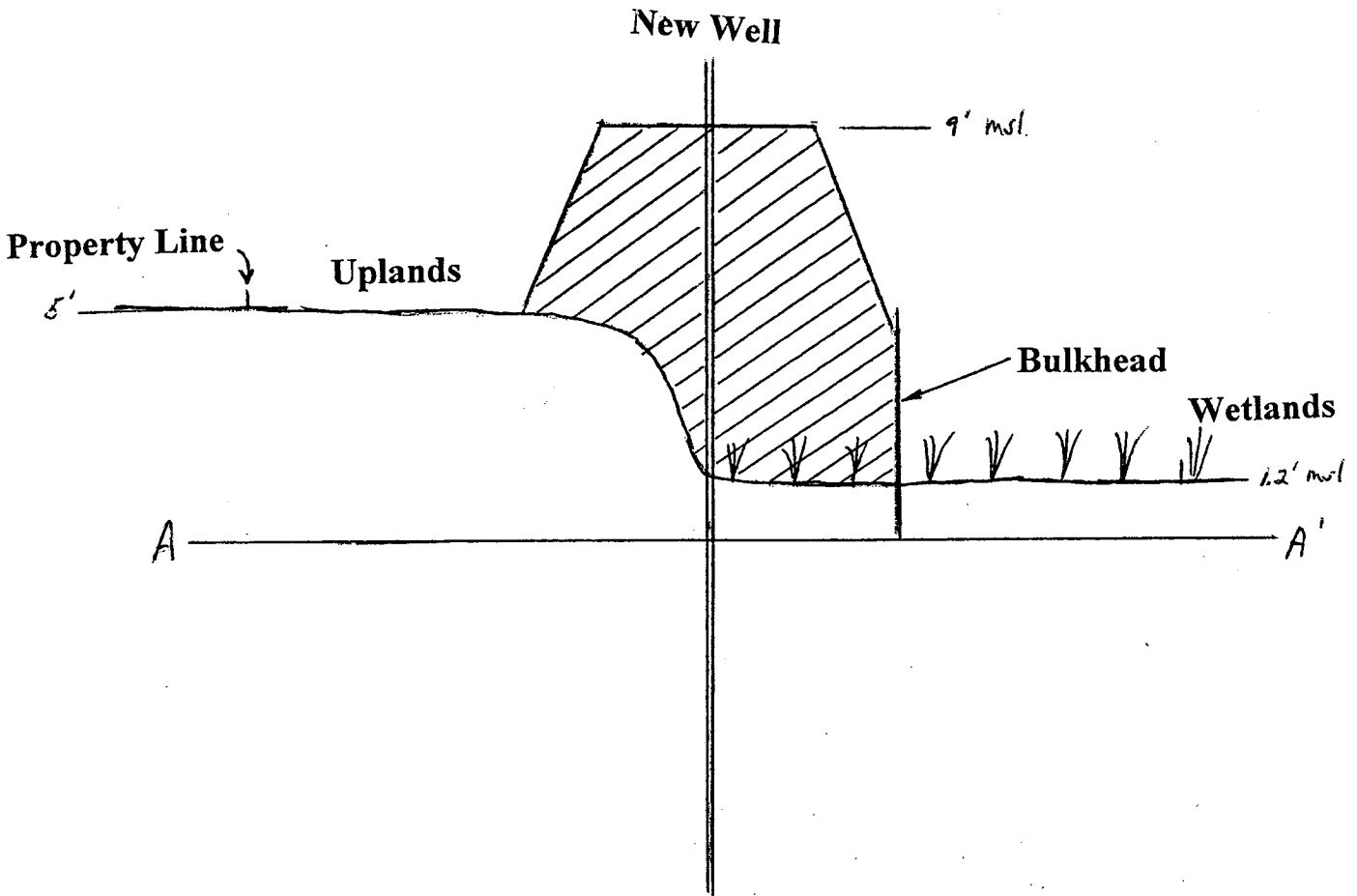
Peek, H.M., Register, L.A., and Nelson, P.F. 1972. Potential Ground-Water Supplies for Roanoke Island and the Dare County Beaches, North Carolina: Report of investigations No. 9, Ground Water Division Office of Water and Air Resources, North Carolina Department of Natural and Economic Resources, Raleigh, North Carolina, 26 p.

ViroGroup, Inc. 1994. Report on the construction and testing of the Dare County Water Production Department Reverse Osmosis Wells #9 and #10, Dare County, North Carolina: Report to the Dare County Water Production Department, Kill Devil Hills, North Carolina, 39 p.

APPENDIX A

Proposed Disposal Area Site Plan

**BUILDING PAD FOR NEW WELL #9
SKYCO DISPOSAL SITE
DARE COUNTY, NC**

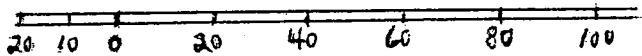


NORTH ← → SOUTH

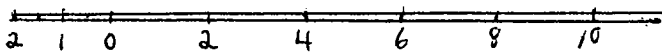
80'x80' Total Pad

50'x50' Area for Well house

Horizontal Scale (In feet)



Vertical Scale (In feet)



N.C. Division of Water Resources
October 16, 2003



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 2002
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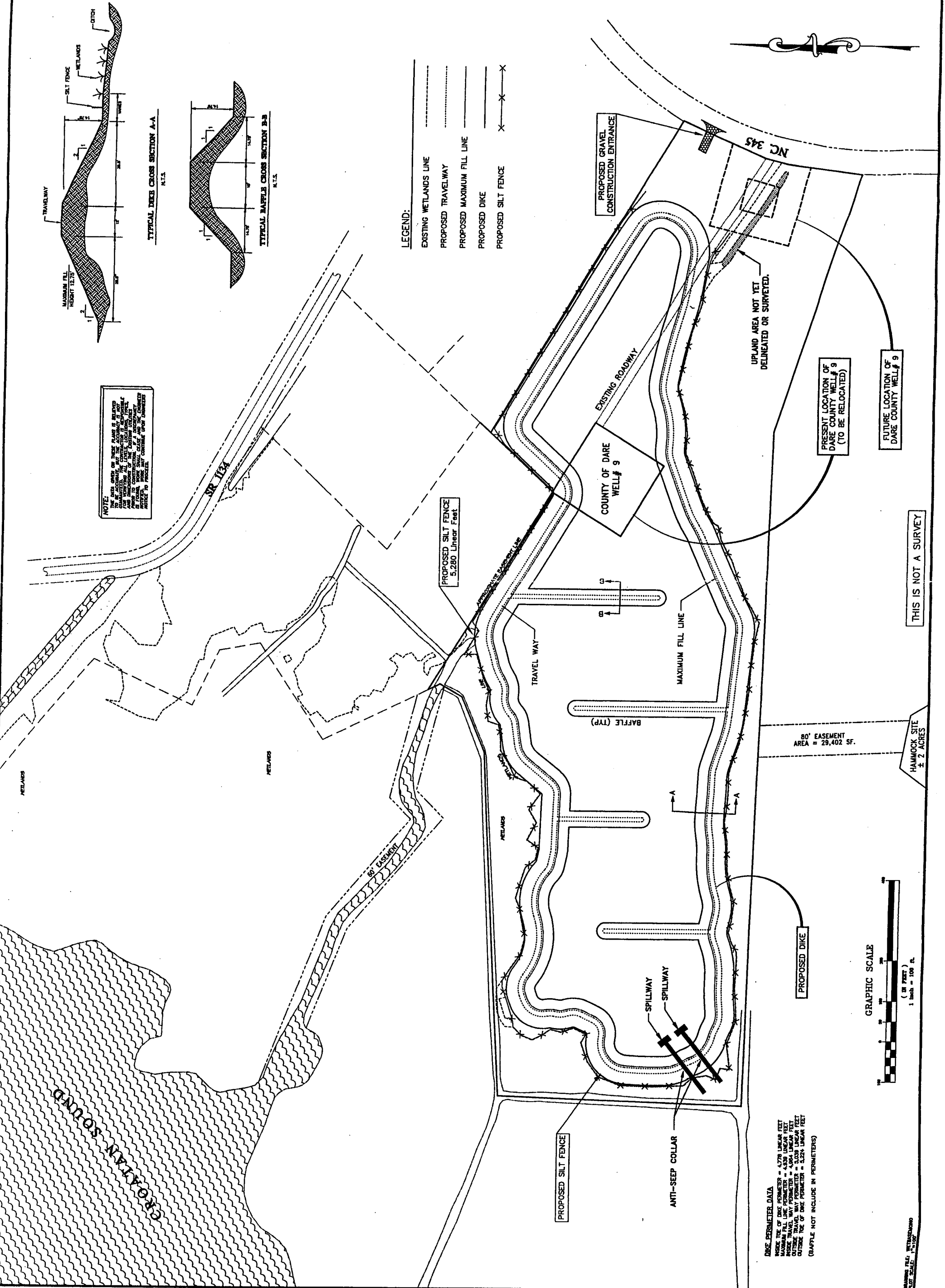
SKYCO DEVELOPMENT COMPANY LLC
 MANCHESE
 DARE COUNTY
 NORTH CAROLINA

Quible & Associates, P.C.
 ENGINEERING • PLANNING • ENVIRONMENTAL SERVICES • P.O. DRAWER 870 BERRY HILLS, NC 27816 • Phone: (919) 486-8800 • Fax: (919) 486-8801

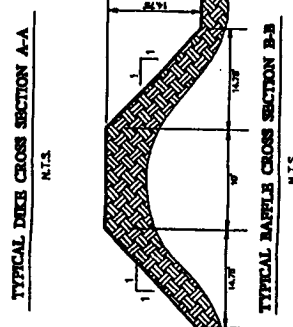
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 DRAWN BY OTHERS
 CHECKED BY EJV
 ISSUE DATE 06/30/03

SHEET NO. **01**
 OF 2 SHEETS

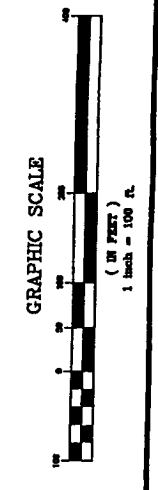
SOIL EROSION and SEDIMENTATION CONTROL PLAN



NOTE:
 THE DATA ON THESE PLANS IS BELIEVED TO BE ACCURATE. THE CLIENT HAS BEEN ADVISED OF THE LIMITATIONS OF THIS SURVEY AND HAS ACCEPTED THE DATA FOR THE PURPOSES OF THIS PROJECT. THE CLIENT HAS BEEN ADVISED THAT THIS SURVEY DOES NOT CONSTITUTE A WARRANTY OF ANY KIND, AND THAT THE CLIENT SHOULD CONSULT WITH AN ATTORNEY FOR FURTHER INFORMATION.



- LEGEND:**
- EXISTING WETLANDS LINE
 - PROPOSED TRAVEL WAY
 - PROPOSED MAXIMUM FILL LINE
 - PROPOSED DIKE
 - PROPOSED SILT FENCE



DIKE PERIMETER DATA
 INSIDE TOP OF DIKE PERIMETER = 4,776 LINEAR FEET
 MAXIMUM FILL LINE PERIMETER = 4,330 LINEAR FEET
 TRAVEL WAY PERIMETER = 4,364 LINEAR FEET
 OUTSIDE TOP OF DIKE PERIMETER = 4,204 LINEAR FEET
 (BAFFLE NOT INCLUDE IN PERIMETERS)

THIS IS NOT A SURVEY

HAMMOCK SITE
 ± 2 ACRES

80' EASEMENT
 AREA = 29,402 SF.

PROPOSED SILT FENCE
 5,280 Linear Feet

PRESENT LOCATION OF
 DARE COUNTY WELL # 9
 (TO BE RELOCATED)

FUTURE LOCATION OF
 DARE COUNTY WELL # 9

UPLAND AREA NOT YET
 DELINEATED OR SURVEYED.

EXISTING ROADWAY

BAFFLE (TYP)

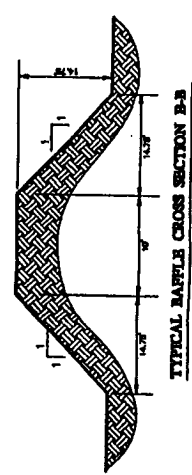
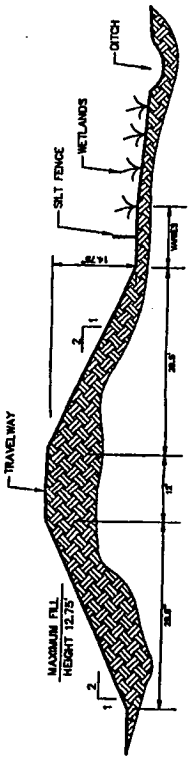
MAXIMUM FILL LINE

TRAVEL WAY

COUNTY OF DARE
 WELL # 9

NC 345

PROPOSED GRAVEL
 CONSTRUCTION ENTRANCE



TYPICAL DIKE CROSS SECTION A-A
 N.T.S.

TYPICAL BAFFLE CROSS SECTION B-B
 N.T.S.

WETLANDS

WETLANDS

WETLANDS

WETLANDS

GRAVELLY SAND

DRAWING FILE: WTRSDM000
 PLOT SCALE: 1"=100'

APPENDIX B

Geologist's Log

GEOLOGIST'S LOG
TEST WELL SITE #9R
SKYCO WELLFIELD
DARE COUNTY, NORTH CAROLINA
AUGUST 2003

<u>Depth (feet)</u>	<u>Lithology</u>
0 - 1	SAND and SILT, grayish black (N2), tree roots, organics.
1 - 12	SAND, dark yellowish orange (10 YR 6/6), very fine to fine grained quartz, moderately sorted.
12 - 24	SAND, moderate yellowish brown (10 YR 5/4), medium to coarse grained quartz, well sorted.
24 - 26	CLAY, medium gray (N5), some sand, fine to coarse, quartz.
26 - 59	SAND with shell fragments, olive gray (5Y 4/1).
59 - 70	SHELL hash, olive gray (5Y 4/1), trace to little very fine to fine sand.
70 - 107	SAND and shell fragments, medium dark gray (N4) to olive gray (5Y 4/1), medium to coarse quartz, increasing clay with depth.
107 - 133	CLAY, medium dark gray (N4) to olive gray (5Y 4/1), with sand, fine to medium quartz, poorly sorted, some shell fragments.
133 - 146	SAND, olive gray (5Y 4/1), medium to coarse quartz, rounded, moderately sorted, trace clay.
146 - 163	SAND, olive gray (5Y 4/1) medium to coarse quartz, rounded, moderately sorted, some clay.
163 - 175	SAND, medium dark gray (N4), medium to coarse quartz, rounded, well sorted, trace to no clay.
175 - 208	SAND, medium gray (N5), coarse quartz, well sorted, rounded to sub-angular, some medium sand.
208 - 225	SAND, medium light gray (N6), medium quartz, very well sorted, some very fine phosphate.
225 - 237	SAND, olive gray (5Y 4/1), medium to coarse quartz, rounded, moderately sorted, and CLAY, medium light gray (N6).

GEOLOGIST'S LOG
TEST WELL SITE #9R
SKYCO WELLFIELD
DARE COUNTY, NORTH CAROLINA
AUGUST 2003

Depth

Lithology

237 - 250

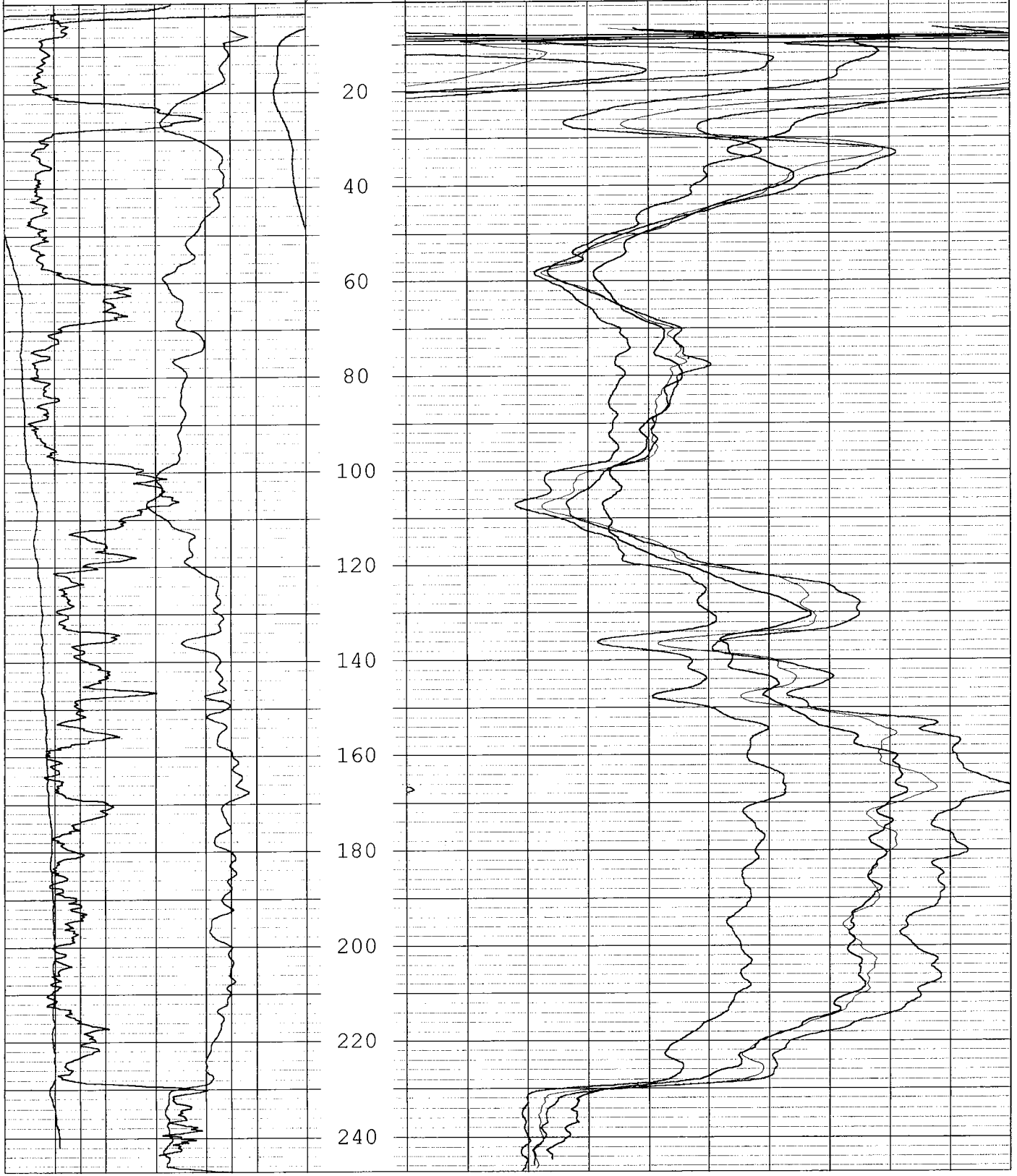
CLAY, medium light gray (N4), soft, some very fine phosphate and fine to medium quartz sand.

Total Depth of Boring = 250 feet Below Land Surface

APPENDIX C

Geophysical Log

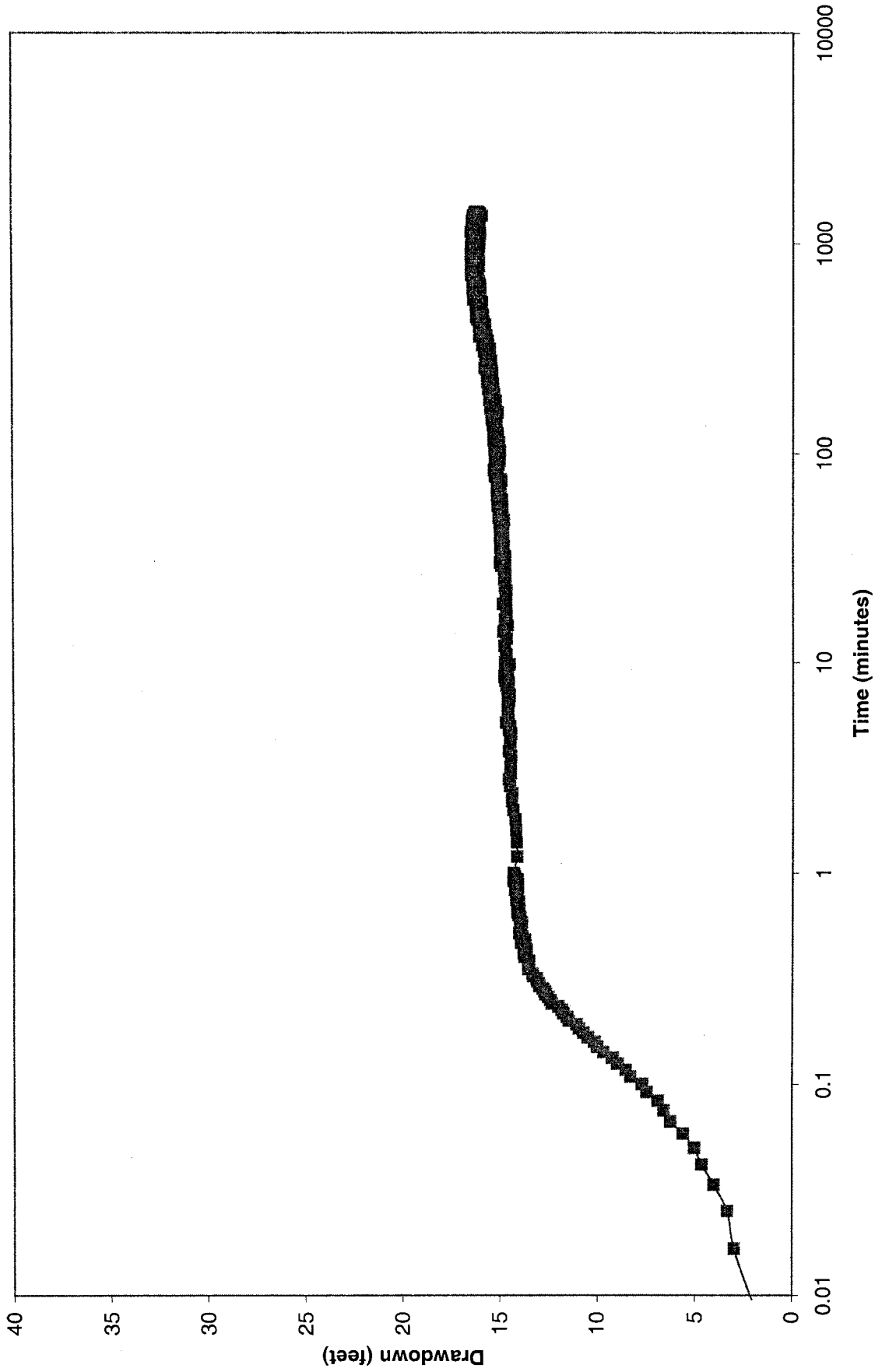
0	Gamma (CPS)	100	1	0	R8 (Ohm-m)	100
0	SP (mV)	300		0	R16 (Ohm-m)	100
0	Current (mA)	200		0	R32 (Ohm-m)	100
0	SPR (ohm)	100	350	0	R64 (Ohm-m)	100



APPENDIX D

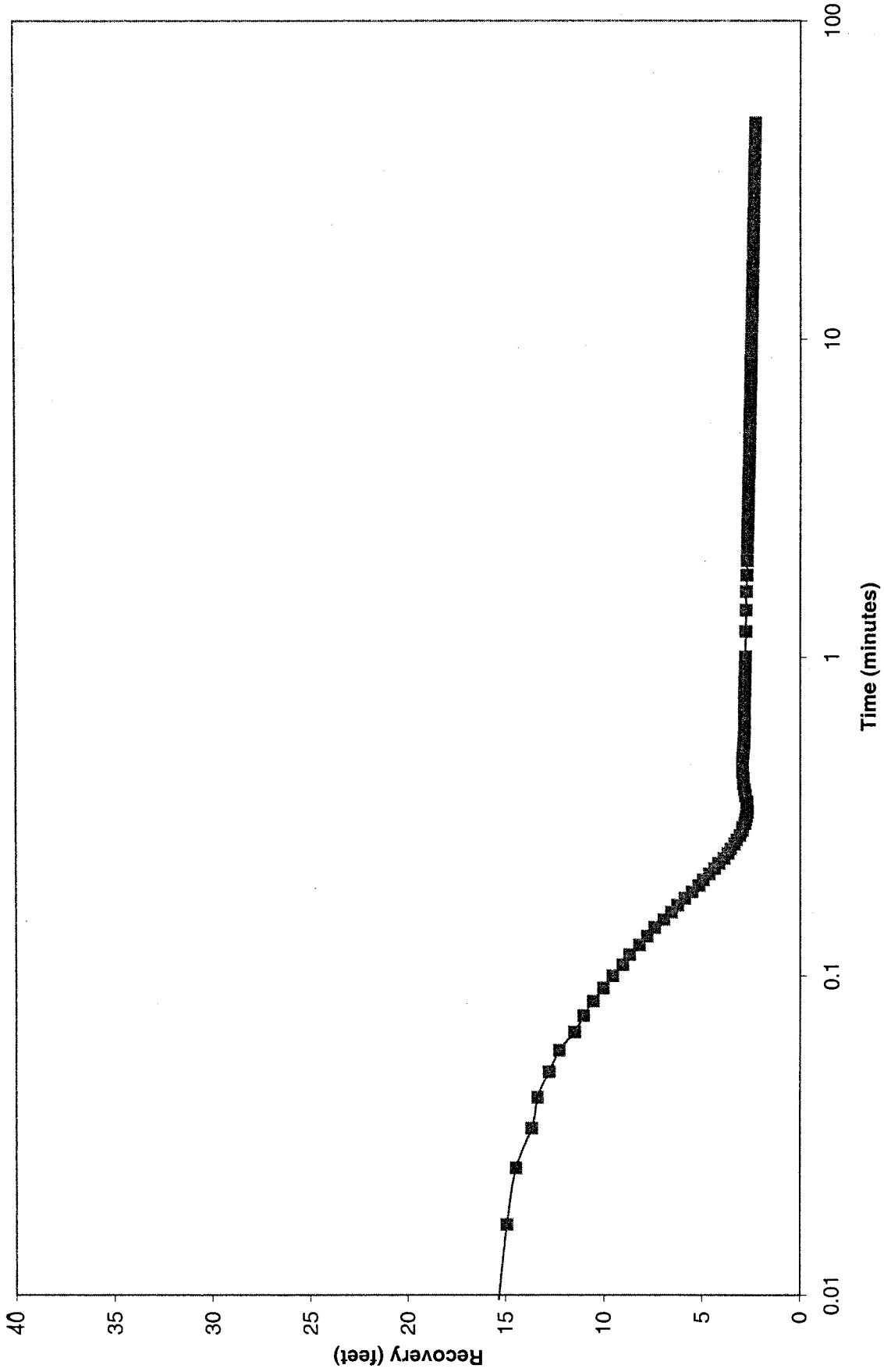
Pump Test Graphs

Future Production Well Site 9R Test Well
24-Hour Constant Rate Test Results



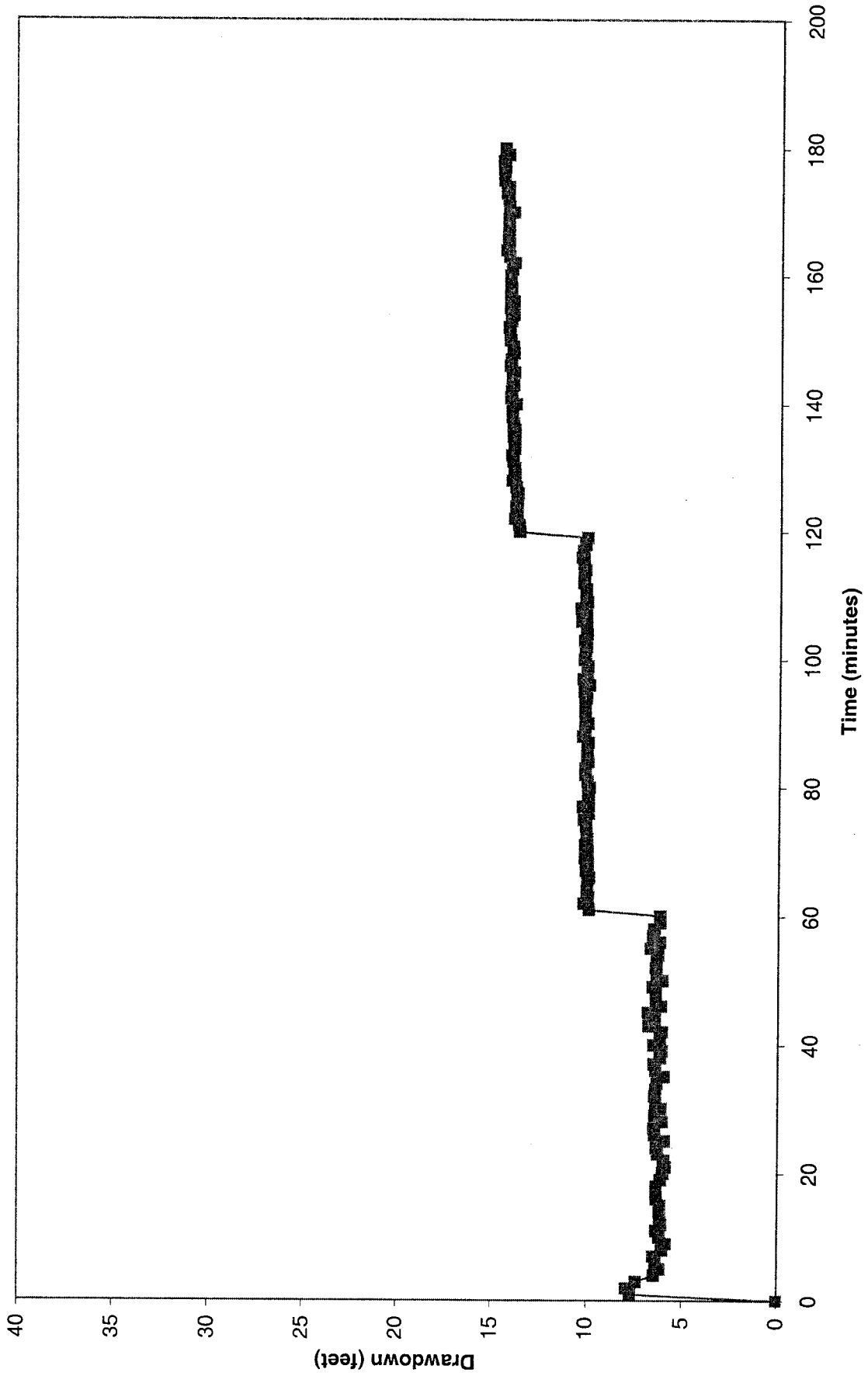
Skyco Well 9 Replacement
Semi-log Graph Showing Drawdown vs. Time in Test Well 9R
While Pumping at 98 GPM

Future Production Well Site 9R Test Well
Recovery Test Results



Skyco Well 9 Replacement
Semi-log Graph Showing Recovery vs. Time in Test Well 9R

Future Production Well Site 9R Test Well
3-Hour Step Test Results



Skyco Production Well 9 Replacement
Graph Showing Drawdown in Test Well 9R
While Pumping at Rates of 60, 80, and 98 GPM

APPENDIX E

Analytical Laboratory Results



COUNTY OF DARE

Date Sample Drawn 10-6-03

Date Analyses Completed: 10-6-03

By Whom: GL

Wells running:9

Water Treatment Plant: **Skyco**

	#9 Well Water Quality	MCL
P - Alkalinity as CaCO ₃ , mg/l	0	N/A
Total Alkalinity CaCO ₃ , mg/l	250	N/A
Bicarbonate as HCO ₃ , mg/l	304	N/A
Carbonate as CO ₃ , mg/l	0	N/A
Hydroxide as OH, mg/l	0	N/A
Total Hardness as CaCO ₃ , mg/l	210	150*
Calcium Hardness as CaCO ₃ , mg/l	176	N/A
Magnesium as CaCO ₃ , mg/l	34	N/A
Calcium as Ca, mg/l	55.2	60.0*
Color, C.U. (Color Units)	17	15*
Silica as SiO ₂ , mg/l	38.4	N/A
Conductivity as μmho/cm	577	N/A
Iron, Fe, mg/l	.39	0.300☐
Potassium, K, mg/l	8.8	N/A
Copper, Cu, mg/l	<0.070	1.300☐
Manganese, Mn, mg/l	.022	0.050☐
Phosphate as PO ₄ , mg/l	.75	5.00*
Chloride as Cl ₂ mg/l	41	250.0*
Fluoride as F, mg/l	.20	2.00* 4.00☐
Nitrate as NO ₃ , mg/l	0	10.00☐
Zinc as Zn, mg/l	.023	5.000☐
Chlorine (free Cl ₂), mg/l	0	0.20* 4.0☐
Lead as Pb, mg/l	<0.005	0.015☐
Corrosiveness	- .22	N/A
pH	7.2	6.5 - 8.5*
pHs	7.4	N/A
Turbidity, N.T.U.	.51	1.0☐
Total Suspended Solids, mg/l	0	N/A
Total Dissolved Solids, mg/l	310	500*
Sulfate as SO ₄ , mg/l	0	250.0
Sodium as Na, mg/l (est.)	8.43	250.00☐
Sulfide as S, mg/l	0	N/A
Temperature (Deg. F-)	64	N/A

Reviewed and Approved by: _____

MCL - Maximum Contaminant Level
 mg/l = parts per million (ppm)
 N/A- Not Available; No Limit

Recommended Maximum

★ Mandatory Minimum

☐ Mandatory Maximum

◆ Mandatory Range



COUNTY OF DARE

Date Sample Drawn 8-12-2003
By Whom: CE

Date Analyses Completed: 8-14-2003

Wells running: **NA**

Water Treatment Plant: **Skyco**

	Test Well #9R Water Quality	MCL
P - Alkalinity as CaCO ₃ , mg/l	0	N/A
Total Alkalinity CaCO ₃ , mg/l	246	N/A
Bicarbonate as HCO ₃ , mg/l	300	N/A
Carbonate as CO ₃ , mg/l	0	N/A
Hydroxide as OH, mg/l	0	N/A
Total Hardness as CaCO ₃ , mg/l	186	150*
Calcium Hardness as CaCO ₃ , mg/l	166	N/A
Magnesium as CaCO ₃ , mg/l	20	N/A
Calcium as Ca, mg/l	66.4	60.0*
Color, C.U. (Color Units)	26	15*
Silica as SiO ₂ , mg/l	28.9	N/A
Conductivity as μmho/cm	622	N/A
Iron, Fe, mg/l	.53	0.300☐
Potassium, K, mg/l	4.8	N/A
Copper, Cu, mg/l	<0.070	1.300☐
Manganese, Mn, mg/l	.09	0.050☐
Phosphate as PO ₄ , mg/l	.42	5.00*
Chloride as Cl ₂ mg/l	52	250.0*
Fluoride as F, mg/l	.19	2.00* 4.00☐
Nitrate as NO ₃ , mg/l	0	10.00☐
Zinc as Zn, mg/l	.01	5.000☐
Chlorine (free Cl ₂), mg/l	0	0.20* 4.0☐
Lead as Pb, mg/l	<0.005	0.015☐
Corrosiveness	.182	N/A
pH	7.5	6.5 - 8.5*
pHs	7.3	N/A
Turbidity, N.T.U.	.98	1.0☐
Total Suspended Solids, mg/l	.1	N/A
Total Dissolved Solids, mg/l	311	500*
Sulfate as SO ₄ , mg/l	0	250.0
Sodium as Na, mg/l (est.)	29.92	250.00☐
Sulfide as S, mg/l	0	N/A
Temperature (Deg. F-)	75	N/A

Reviewed and Approved by: _____

MCL - Maximum Contaminant Level
mg/l = parts per million (ppm)
N/A - Not Available; No Limit

Recommended Maximum

★ Mandatory Minimum

☐ Mandatory Maximum

• Mandatory Range

Analytical Report

For: Mr. Scott Manahan
CDM Missimer
9311 College Parkway Suite 1
Fort Myers, FL 33919
CC:

Order Number: B353121
SDG Number:
Client Project ID:
Project: SKYCO WELL #9 REP.
Report Date: 08/27/2003
Sampled By: Client
Sample Received Date: 08/15/2003
Requisition Number:
Purchase Order:
Revised Date: 09/05/2003



Michael F. Valder, Project Manager
mvalder@stl-inc.com

The test results in this report meet all NELAP requirements for parameters for which accreditation is required or available. Any exceptions to NELAP requirements are noted in this report. Pursuant to NELAP, this report may not be reproduced, except in full, without the written approval of the laboratory.

Sample Summary

Order: B353121
Date Received: 08/15/2003

Client: CDM Missimer
Project: SKYCO WELL #9 REP.

Client Sample ID
WELL #9R

Lab Sample ID
B353121*1

Matrix
Liquid

Date Sampled
08/14/2003 10:30

Analytical Data Report

Lab Sample ID	Description	Matrix	Date Received	Date Sampled	SDG#
53121-1	WELL #9R	Liquid	08/15/03	08/14/03 10:30	

Parameter	Units	53121-1	Lab Sample IDs
ICP Metals (200.7)			
Calcium	mg/l	65	
Iron	mg/l	0.59	
Magnesium	mg/l	7.0	
Sodium	mg/l	51	
Zinc	mg/l	<0.020	
Arsenic	mg/l	<0.010	
Copper	mg/l	<0.020	
Nickel	mg/l	<0.040	
Boron	mg/l	0.12	
Strontium	mg/l	0.41	
Prep Date		08/15/03	
Analysis Date		08/19/03	
Hardness as CaCO3 (2340B)			
Hardness as CaCO3	mg/l	190	
Prep Date		08/15/03	
Analysis Date		08/19/03	
Noncarbonate Hardness as CaCO3 (2340B)			
Hardness as CaCO3	mg/l	<3.3	
Analysis Date		08/26/03	
Silica as SiO2 (6010)			
Silica as SiO2	mg/l	27	
Prep Date		08/20/03	
Analysis Date		08/20/03	
Chloride (325.3)			
Chloride	mg/l	44	
Analysis Date		08/20/03	

Analytical Data Report

Lab Sample ID	Description	Matrix	Date Received	Date Sampled	SDG#
53121-1	WELL #9R	Liquid	08/15/03	08/14/03 10:30	

Parameter	Units	53121-1	Lab Sample IDs
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Fluoride (340.2)

Fluoride	mg/l	<0.20
Analysis Date		08/25/03

Sulfate as SO4 (375.4)

Sulfate as SO4	mg/l	<5.0
Analysis Date		08/20/03

Solids, Total Dissolved (160.1)

Solids, Total Dissolved	mg/l	350
Analysis Date		08/15/03

Alkalinity (to pH 4.5) as CaCO3 (310.1)

Alkalinity (to pH 4.5) as CaCO3	mg/l	230
Analysis Date		08/20/03

Sulfide (376.1)

Sulfide	mg/l	<1.0
Analysis Date		08/20/03

Color (110.2)

Color	PCU	5
Analysis Date		08/15/03

Bromide (300.0)

Bromide	mg/l	<1.0
Prep Date		08/18/03
Analysis Date		08/18/03

Analytical Data Report

Lab Sample ID	Description	Matrix	Date Received	Date Sampled	SDG#
53121-1	WELL #9R	Liquid	08/15/03	08/14/03 10:30	

Parameter	Units	Lab Sample IDs
		53121-1

Bicarbonate Alkalinity as CaCO₃ (SM2320B)

Bicarbonate Alkalinity as

CaCO₃

mg/l

230

Analysis Date

08/20/03

Analytical Data Report

Lab Sample ID	Description	Matrix	Date Received	Date Sampled	SDG#
53121-2	Method Blank	Liquid	08/15/03		
53121-3	Accuracy (%Rec)	Liquid	08/15/03		
53121-4	LCS Accuracy Control Limit (%R)	Liquid	08/15/03		
53121-5	Precision (%RPD)	Liquid	08/15/03		
53121-6	LCS Precision Control Limit (Advisory) %RPD	Liquid	08/15/03		

Parameter	Units	Lab Sample IDs				
		53121-2	53121-3	53121-4	53121-5	53121-6

ICP Metals (200.7)

Calcium	mg/l	<0.50	105 %	75-125 %	1.7 %	<20 %
Iron	mg/l	<0.050	114 %	75-125 %	0.90 %	<20 %
Magnesium	mg/l	<0.50	110 %	75-125 %	1.0 %	<20 %
Sodium	mg/l	<0.50	110 %	75-125 %	0.10 %	<20 %
Zinc	mg/l	<0.020	102 %	75-125 %	1.8 %	<20 %
Arsenic	mg/l	<0.010	101 %	75-125 %	1.1 %	<20 %
Copper	mg/l	<0.020	104 %	75-125 %	0.40 %	<20 %
Nickel	mg/l	<0.040	100 %	75-125 %	1.4 %	<20 %
Boron	mg/l	<0.050	104 %	75-125 %	0.10 %	<20 %
Strontium	mg/l	<0.010	100 %	75-125 %	0.60 %	<20 %
Prep Date		08/15/03	08/15/03		08/15/03	
Analysis Date		08/19/03	08/19/03		08/19/03	

Silica as SiO2 (6010)

Silica as SiO2	mg/l	<0.50	99 %	75-125 %	1.0 %	<20 %
Prep Date		08/20/03	08/20/03		08/20/03	
Analysis Date		08/20/03	08/20/03		08/20/03	

Chloride (325.3)

Chloride	mg/l	<1.0	101 %	75-125 %	1.0 %	<30 %
Analysis Date		08/20/03	08/20/03		08/20/03	

Fluoride (340.2)

Fluoride	mg/l	<0.20	96 %	85-115 %	3.3 %	<30 %
Analysis Date		08/25/03	08/25/03		08/25/03	

Analytical Data Report

Lab Sample ID	Description	Matrix	Date Received	Date Sampled	SDG#
53121-2	Method Blank	Liquid	08/15/03		
53121-3	Accuracy (%Rec)	Liquid	08/15/03		
53121-4	LCS Accuracy Control Limit (%R)	Liquid	08/15/03		
53121-5	Precision (%RPD)	Liquid	08/15/03		
53121-6	LCS Precision Control Limit (Advisory) %RPD	Liquid	08/15/03		

Parameter	Units	Lab Sample IDs				
		53121-2	53121-3	53121-4	53121-5	53121-6

Sulfate as SO4 (375.4)

Sulfate as SO4	mg/l	<5.0	103 %	75-125 %	2.9 %	<30 %
Analysis Date		08/20/03	08/20/03		08/20/03	

Solids, Total Dissolved (160.1)

Solids, Total Dissolved	mg/l	<5.0	103 %	80-120 %	0.58 %	<25 %
Analysis Date		08/15/03	08/15/03		08/15/03	

Alkalinity (to pH 4.5) as CaCO3 (310.1)

Alkalinity (to pH 4.5) as CaCO3	mg/l	<1.0	106 %	80-120 %	0.80 %	<30 %
Analysis Date		08/20/03	08/20/03		08/20/03	

Sulfide (376.1)

Sulfide	mg/l	<1.0	96 %	75-125 %	0 %	<30 %
Analysis Date		08/20/03	08/20/03		08/20/03	

Color (110.2)

Color	PCU	<5	100 %		0 %	<40 %
Analysis Date		08/15/03	08/15/03		08/15/03	

Bromide (300.0)

Bromide	mg/l	<1.0	100 %	90-110 %	4.9 %	<30 %
Prep Date		08/18/03	08/18/03		08/18/03	
Analysis Date		08/18/03	08/18/03		08/18/03	

Method: EPA SW-846, 40 CFR Part 136, 600/4-79-020, 600/4-77-027B, EPA SM 18th Edition
DOH Certification #:E84282

These test results meet all the requirements of NELAC. All questions regarding this test report should be directed to the STL Project Manager who signed this test report.

The estimated uncertainty associated with these reported results is available upon request.

STL Savannah, 5102 LaRoche Ave., Savannah, GA 31404
Certification #E87052.



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2005 Tier Designations

TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
ALLEGHANY	ANSON	ALEXANDER	ALAMANCE	BRUNSWICK
BEAUFORT	BLADEN	ASHE	CABARRUS	BUNCOMBE
BERTIE	BURKE	AVERY	CRAVEN	CARTERET
EDGECOMBE	CALDWELL	CAMDEN	CUMBERLAND	CHATHAM
GATES	CASWELL	CATAWBA	DAVIDSON	DAVIE
GRAHAM	CLEVELAND	CHEROKEE	GUILFORD	DURHAM
HALIFAX	COLUMBUS	CHOWAN	HARNETT	FORSYTH
HERTFORD	MCDOWELL	CLAY	HAYWOOD	FRANKLIN
HYDE	MITCHELL	CURRITUCK	LEE	HENDERSON
JONES	ROBESON	DARE	LINCOLN	IREDELL
MARTIN	ROCKINGHAM	DUPLIN	NASH	JOHNSTON
NORTHAMPTON	RUTHERFORD	GASTON	PENDER	MECKLENBURG
PERQUIMANS	SWAIN	GRANVILLE	PITT	MOORE
RICHMOND		GREENE	RANDOLPH	NEW HANOVER
SCOTLAND		HOKE	WATAUGA	ONSLOW
TYRRELL		JACKSON	WILKES	ORANGE
VANCE		LENOIR		UNION
WARREN		MACON		WAKE
WASHINGTON		MADISON		
YANCEY		MONTGOMERY		
		PAMLICO		
		PASQUOTANK		
		PERSON		
		POLK		
		ROWAN		
		SAMPSON		
		STANLY		
		STOKES		
		SURRY		
		TRANSYLVANIA		
		WAYNE		
		WILSON		
		YADKIN		

Over County

Tier 3

\$ 42,411 median household income

8% poverty

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Gary Hartong

From: Rural Partners [ruralpartners@NCRURALCENTER.ORG]
Sent: Wednesday, March 01, 2006 3:56 PM
Subject: February 2006 Rural Partners UPDATE



February 2006

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News

Center calls for \$1 billion bond referendum to help meet \$16.6 billion in water and sewer needs statewide

The Rural Center announced last week that it would work to put a \$1 billion bond referendum before North Carolina voters in response to a documented \$16.6 billion capital need on water, sewer and stormwater infrastructure. The announcement came Feb. 23 as the center brought together more than 200 of the state's leading water resource professionals and policy experts at a conference that capped the center's Water 2030 Initiative, a three-year project designed to arm state leaders with information essential to protecting the environment, preserving quality of life and spurring job growth in North Carolina. The conference featured the release of four reports that detail the impact of the 1998 Clean Water Bonds, track state infrastructure investments from 1994 to 2005, examine new infrastructure data from a recent water and wastewater inventory, and present a state water budget with supply and demand projections through 2030. Those reports are now available on the center's [website](#). A panel of speakers that included state Sen. John Kerr and Reps. Pryor Gibson and Bill Owens detailed how North Carolina's booming population and aging water and sewer systems, coupled with stricter environmental regulations and cuts in federal grant programs, will threaten prosperity in cities, towns and communities across the state in years to come, particularly in rural and distressed areas. In addition to infrastructure bonds, center President Billy Ray Hall said the state should create a permanent revenue source for water, sewer and stormwater improvements. For a summary of the Water 2030 Initiative findings, [click here](#). For more information on the initiative, contact project director [Jean Crews-Klein](#) at (919) 250-4314.

Rural Center and partners to hold state's first Entrepreneurship Policy Summit April 19

More than 350 state leaders and public policy experts will come together in Chapel Hill April 19 for North Carolina's first-ever policy summit on entrepreneurship. There, they will examine the critical role of entrepreneurship in state and local economies, discuss how the state can more fully invest in entrepreneurship as a viable economic development strategy, and set a course to strengthen the foundational system that underpins entrepreneurship on the state and local level. A panel of entrepreneurs will share their personal accounts of struggle, sacrifice and the road to success. The summit will conclude with a call to action as the state's foremost experts on entrepreneurship lead others in forming work groups that will meet over the next year to further develop and refine strategies and recommendations for boosting entrepreneurship in North Carolina. The event is hosted by the Rural Entrepreneurship Development System Project – a Rural Center-led team working to create a comprehensive entrepreneurship development system to serve rural and minority entrepreneurs in low-wealth areas of the state – as well as the N.C. Business Resource Alliance and the N.C. Entrepreneurial Association. Funding for the event is provided by the W.K. Kellogg Foundation and North Carolina's Touchstone Energy Cooperatives. Other sponsorships are still available. Registration for the summit is \$100, which includes lunch. The event will be held at