S&ME, Inc.
9751 Southern Pine Boulevard
Charlotte, North Carolina 28273
Telephone: 704-523-4726
Fax: 704-525-3953

ENGINEERING • TESTING
ENVIRONMENTAL SERVICES

1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.
2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

Project: **Oconee Nuclear Station**			**Boring No. GM-9**
Location: **Seneca, SC**		Number: **1264-07-234**	Sheet No. 1 of 2
Boring Depth (ft): **43.3**	Elevation (ft): **780.6**	Driller: **Jay Little, SC Cert No. B1575**	Date Drilled: **10/8/07**
Logged By: **Julie Petersen**	Water Level: **Stabilized Water Level at 33.32 ft bls**		Drilling Method: **Mud Rotary**

Elev. (Feet)	Depth (Feet)	Lith-ology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
780			**ASPHALT**		
			GRAVEL		
			FILL (F): Tan, Brown, and Reddish-Brown, Micaceous, Silty, Medium to Fine **SAND**, With White, Medium to Fine Sand Lenses and Rock Fragments		
775	5				
			FILL (F): **BIOTITE GNEISS** Boulders		
770	10				
765	15		FILL (F): Brown and Orange, Micaceous, Silty, Medium to Fine **SAND** With Rock Fragments		
	20				
760			FILL (F): **BIOTITE GNEISS** Boulders		
755	25				
750	30		FILL (F): Brown, Fine Sandy, Silty, **CLAY** With Rock Fragments, Roots, and Wood		

BORING LOG WITH WELL RECOVERED ONS LOG.GPJ LAGWGN01.GDT 7/23/08

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Project: **Oconee Nuclear Station**			**Boring No. GM-9**
Location: **Seneca, SC**		Number: **1264-07-234**	Sheet No. 2 of 2
Boring Depth (ft): **43.3**	Elevation (ft): **780.6**	Driller: **Jay Little, SC Cert No. B1575**	Date Drilled: **10/8/07**
Logged By: **Julie Petersen**	Water Level: **Stabilized Water Level at 33.32 ft bls**		Drilling Method: **Mud Rotary**

Elev. (Feet)	Depth (Feet)	Lith-ology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
745			FILL (F): Brown and Gray, Micaceous, Silty, Medium to Fine Sandy, **CLAY**		
			FILL (F): Red and Gray, Silty, High Plasticity **CLAY**		
	40		FILL (F): Orange, Tan, and Red, Coarse to Fine Sandy, **CLAY**		
740					
			Lithologic Description Obtained From GM-9R **Boring Terminated at 43.30 ft bls**		

BORING LOG WITH WELL RECOVERED_ONS LOG.GPJ LAGWGN01.GDT 7/23/08

COMPLETION REPORT OF WELL No. GM-9

PROJECT: **Oconee Nuclear Station**
PROJECT NO: **1264-07-234**
PROJECT LOCATION: **Seneca, SC**

DRILLING CONTRACTOR: **S&ME, Inc.**
DRILLING METHOD: **Mud Rotary**
DATE DRILLED: **10/8/07**

WATER LEVEL: **Stabilized Water Level at 33.32 ft bls**
LATITUDE: **34°47'40.524"**
LONGITUDE: **82°53'48.389"**
TOP OF CASING ELEVATION: **780.36**
DATUM: **MSL**
LOGGED BY: **Julie Petersen**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)
				0.00	GS	780.60
ASPHALT / **GRAVEL** / FILL (F): Tan, Brown, and Reddish-Brown, Micaceous, Silty, Medium to Fine **SAND**, With White, Medium to Fine Sand Lenses and Rock Fragments		0 – 5				
FILL (F): **BIOTITE GNEISS** Boulders		10				
FILL (F): Brown and Orange, Micaceous, Silty, Medium to Fine **SAND** With Rock Fragments		15 – 20				
FILL (F): **BIOTITE GNEISS** Boulders		25		24.00		756.60
				26.00		754.60
FILL (F): Brown, Fine Sandy, Silty, **CLAY** With Rock Fragments, Roots, and Wood		30				

WELL CONSTRUCTION DETAILS

PROTECTIVE CASING
Diameter:
Type:
Interval:

RISER CASING
Diameter: **2"**
Type: **Sch. 40 PVC**
Interval: **0 to 28 ft bls**

GROUT
Type: **Neat Cement**
Interval: **0 to 24 ft bls**

SEAL
Type: **Bentonite**
Interval: **24 to 26 ft bls**

FILTERPACK
Type: **#1 Silica Sand**
Interval: **26 to 43.3 ft bls**

SCREEN
Diameter: **2"**
Type: **0.010 Slotted PVC**
Interval: **28 to 43 ft bls**

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL RECOVERED_ONS LOG.GPJ S&ME.GDT 7/23/08

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COMPLETION REPORT OF WELL No. GM-9

Sheet 1 of 2

PROJECT: **Oconee Nuclear Station**
PROJECT NO: **1264-07-234**
PROJECT LOCATION: **Seneca, SC**

GROUND SURFACE ELEVATION: **780.6**
LOGGED BY: **Julie Petersen**
CHECKED BY:

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)
FILL (F): Brown and Gray, Micaceous, Silty, Medium to Fine Sandy, **CLAY**		35		42.50		738.10
FILL (F): Red and Gray, Silty, High Plasticity **CLAY**		40		43.00		737.60
FILL (F): Orange, Tan, and Red, Coarse to Fine Sandy, **CLAY**				43.30		737.30

WELL CONSTRUCTION DETAILS

(See Page 1)

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL RECOVERED_ONS LOG.GPJ S&ME.GDT 7/23/08

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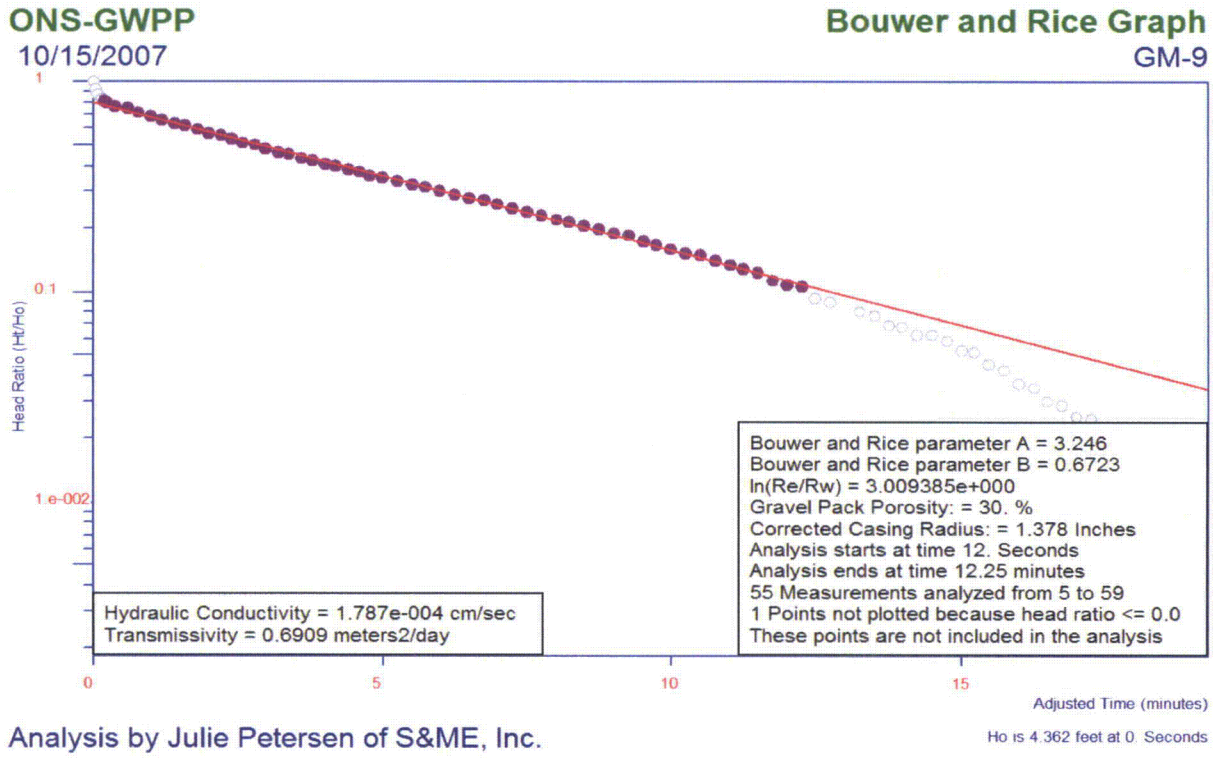
COMPLETION REPORT OF WELL No. GM-9

Calculation of Permeability By The Rising Head Method (Slug Test)

Site Name:	ONS-GWPP
Test Date:	10/15/2007
Well Label:	GM-9
Aquifer Thickness:	14.68 feet
Screen Length:	15. feet
Casing Radius:	1. Inches
Effective Radius:	2. Inches
Gravel Pack Porosity:	30.00%
Corrected Casing Radius:	1.378 Inches
Static Water Level:	33.32 feet
Water Table to Screen Bottom:	9.68 feet
Anisotropy Ratio:	1

Time Adjustment: 0. Seconds
Test starts with trial 0
There are 86 time and drawdown measurements
Maximum head is 4.362 feet
Minimum head is 0. feet

Calculation by Bouwer and Rice Graphical Method



PERMEABILITY

1.79×10^{-4} cm/sec

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Project: **Oconee Nuclear Station**				**Boring No. GM-9R**
Location: **Seneca, SC**			Number: **1264-07-234**	Sheet No. 1 of 3
Boring Depth (ft): **80.3**	Elevation (ft): **780.4**		Driller: **Jay Little, SC Cert No. B1575**	Date Drilled: **10/2/07**
Logged By: **Courtney Withers/David Klemm**	Water Level: **Stabilized Water Level at 30.43 ft bls**			Drilling Method: **Mud Rotary**

Elev. (Feet)	Depth (Feet)	Lith-ology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
780			**ASPHALT**		
			GRAVEL		
			FILL (F): Tan, Brown, and Reddish-Brown, Micaceous, Silty, Medium to Fine **SAND**, With White, Medium to Fine Sand Lenses and Rock Fragments		10
775	5				
			FILL (F): **BIOTITE GNEISS** Boulders		50/5 >>
770	10		Auger Refusal at 9.80 ft bls		50/1 >>
765	15		FILL (F): Brown and Orange, Micaceous, Silty, Medium to Fine **SAND** With Rock Fragments		
			Roller Cone Refusal at 22.20 ft bls		50/2 >>
760	20				
			FILL (F): **BIOTITE GNEISS** Boulders		
755	25				
			FILL (F): Brown, Fine Sandy, Silty, **CLAY** With Rock Fragments, Roots, and Wood	▼	
750	30				

BORING LOG WITH WELL RECOVERED_ONS LOG.GPJ LAGWGN01.GDT 7/23/08

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Project: **Oconee Nuclear Station**			**Boring No. GM-9R**
Location: **Seneca, SC**		Number: **1264-07-234**	Sheet No. 2 of 3
Boring Depth (ft): **80.3**	Elevation (ft): **780.4**	Driller: **Jay Little, SC Cert No. B1575**	Date Drilled: **10/2/07**
Logged By: **Courtney Withers/David Klemm**	Water Level: **Stabilized Water Level at 30.43 ft bls**		Drilling Method: **Mud Rotary**

Elev. (Feet)	Depth (Feet)	Lith-ology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
745			FILL (F): Brown and Gray, Micaceous, Silty, Medium to Fine Sandy, **CLAY**		7
			FILL (F): Red and Gray, Silty, High Plasticity **CLAY**		15
	40		FILL (F): Orange, Tan, and Red, Coarse to Fine Sandy, **CLAY**		
740					16
	45				
735			SOIL/SAPROLITE (M1): Tan and White, Micaceous, Slightly Clayey, Silty, Coarse to Fine **SAND**		12
	50				
730					30
			SOIL/SAPROLITE (M1): Brown, Very Micaceous, Fine Sandy, **SILT**		
	55		SOIL/SAPROLITE (M1): Dark Gray and White, Silty, Coarse to Fine **SAND**		
725					50/3 >>
			SOIL/SAPROLITE (M1): Dark Gray and Brown, Micaceous, Silty, Fine **SAND**		
	60		SOIL/SAPROLITE (M1): Gray, Silty, Fine **SAND**		
720			WEATHERED ROCK (M2): When Sampled Becomes Tan, Silty, Fine **SAND**		
			Roller Cone Refusal at 60.60 ft bls		
			PARTIALLY WEATHERED/FRACTURED ROCK (WF): Medium-Grained **GRANITIC GNEISS** With Intermittent Medium-Grained **BIOTITE HORNBLENDE GNEISS** Intensely Fractured, Low Angle Joints With No Staining		
	65				
715			SOUND ROCK (D): Medium-Grained **GRANITIC GNEISS** With Intermittent **BIOTITE HORNBLENDE GNEISS** Slightly Fractured, Low Angle and High Angle Joints With Moderate to No Staining		

BORING LOG WITH WELL RECOVERED_ONS LOG.GPJ LAGWGN01.GDT 7/23/08

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Project: **Oconee Nuclear Station**				**Boring No. GM-9R**
Location: **Seneca, SC**			Number: **1264-07-234**	Sheet No. 3 of 3
Boring Depth (ft): **80.3**	Elevation (ft): **780.4**		Driller: **Jay Little, SC Cert No. B1575**	Date Drilled: **10/2/07**
Logged By: **Courtney Withers/David Klemm**	Water Level: **Stabilized Water Level at 30.43 ft bls**			Drilling Method: **Mud Rotary**

Elev. (Feet)	Depth (Feet)	Lith-ology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
710			PARTIALLY WEATHERED/FRACTURED ROCK (WF): Medium-Grained **GRANITIC GNEISS** With Intermittent **BIOTITE HORNBLENDE GNEISS** Intensely Fractured, Low Angle and High Angle Joints With No Staining		
			SOUND ROCK (D): Medium-Grained **BIOTITE HORNBLENDE GNEISS** Slightly Fractured, Horizontal and High Angle Joints With No Staining		
	75				
705			SOUND ROCK (D): Medium-Grained **GRANITIC GNEISS**; Unfractured		
			PARTIALLY WEATHERED/FRACTURED ROCK (WF): Medium-Grained **BIOTITE HORNBLENDE GNEISS**; Intensely Fractured Low Angle and High Angle Joints With No Staining		
	80				
			PARTIALLY WEATHERED/FRACTURED ROCK (WF): Medium-Grained **GRANITIC GNEISS** With Intermittent **BIOTITE HORNBLENDE GNEISS** Intensely Fractured, Low Angle Joints With No Staining		
			Boring Terminated at 80.30 ft bls		

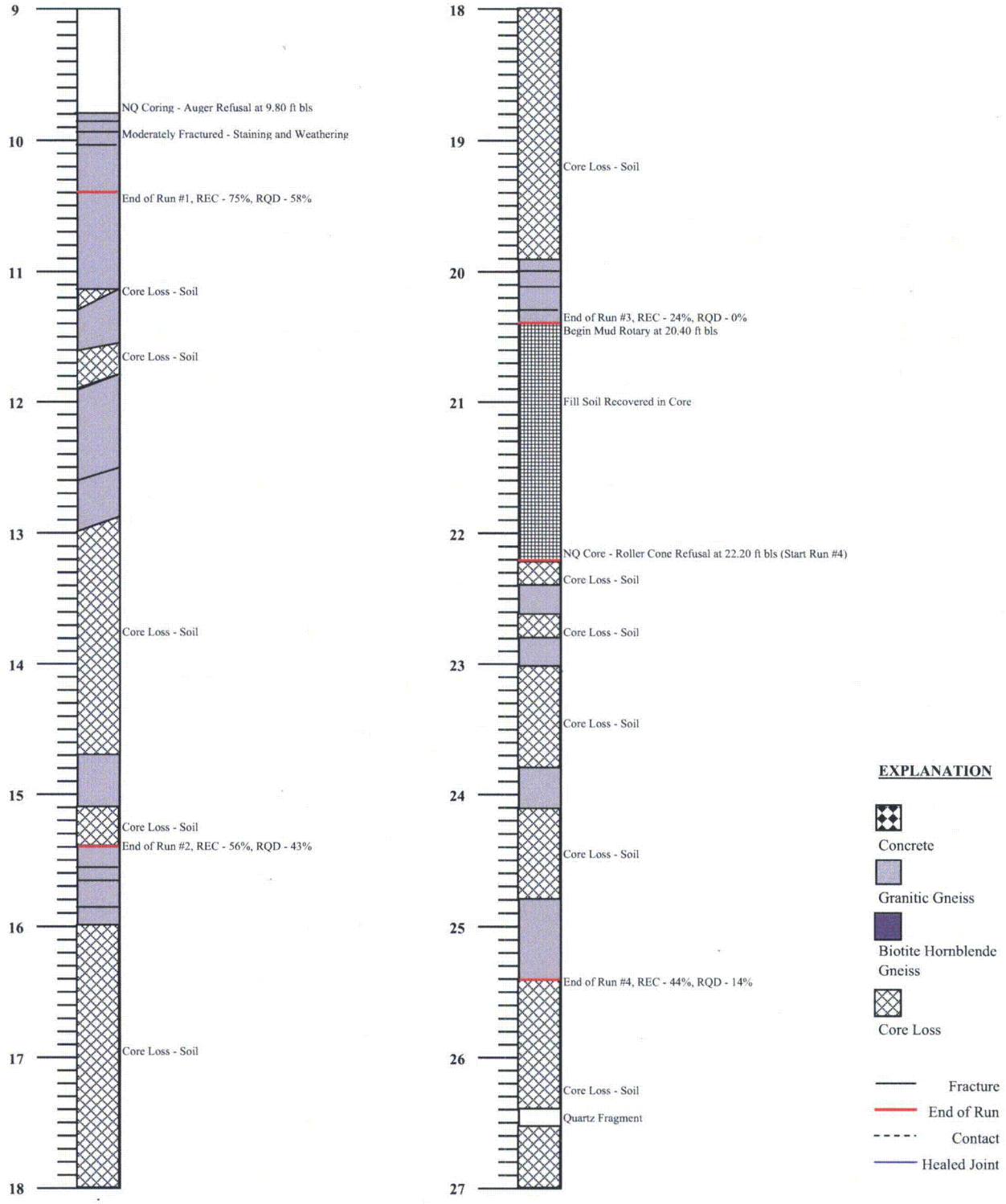
BORING LOG WITH WELL RECOVERED_ONS LOG.GPJ LAGWGN01.GDT 7/23/08

FIELD ROCK CORE LOG

Oconee Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-07-234

Core Location: GM-9R

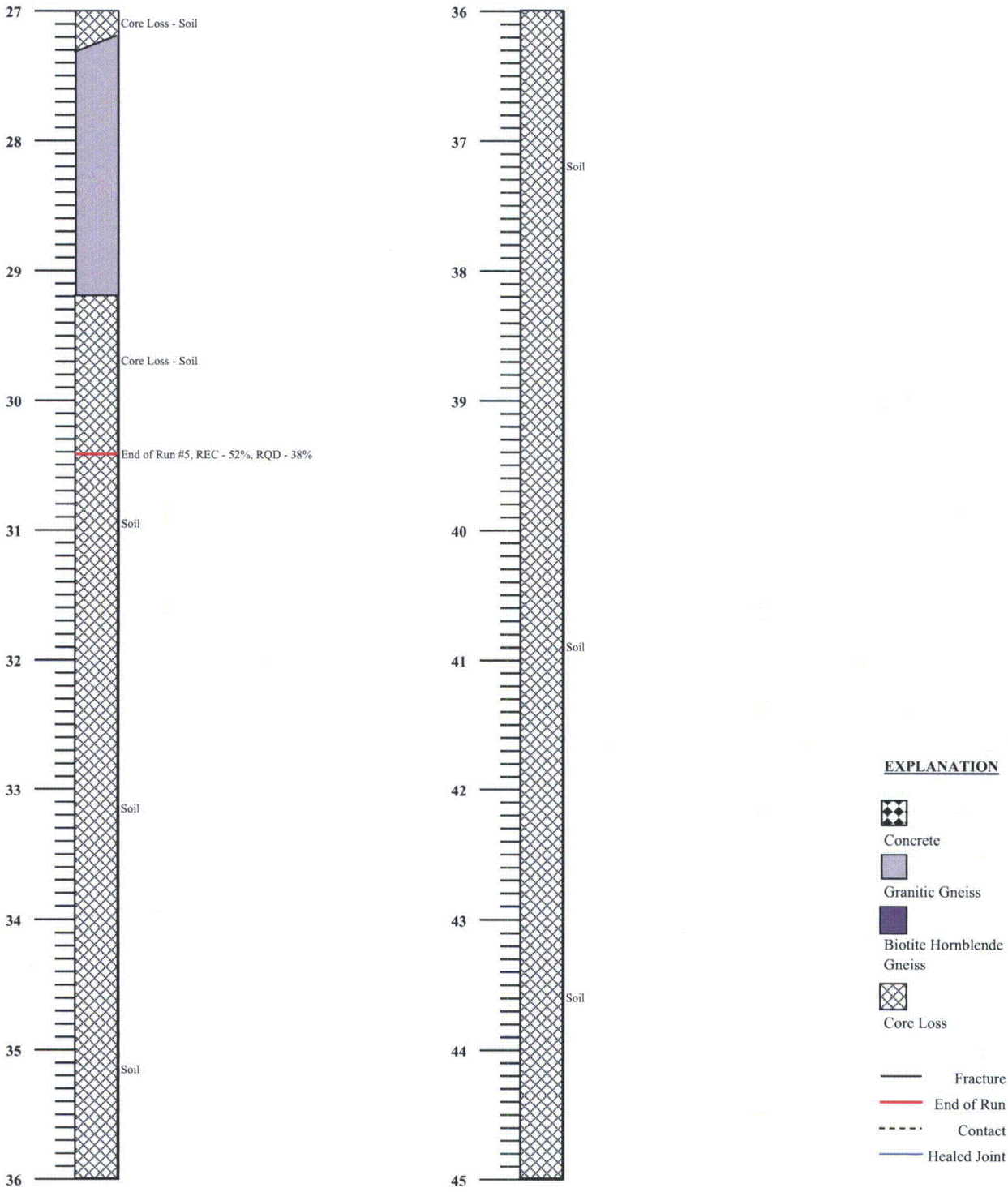


FIELD ROCK CORE LOG

Oconee Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-07-234

Core Location: GM-9R

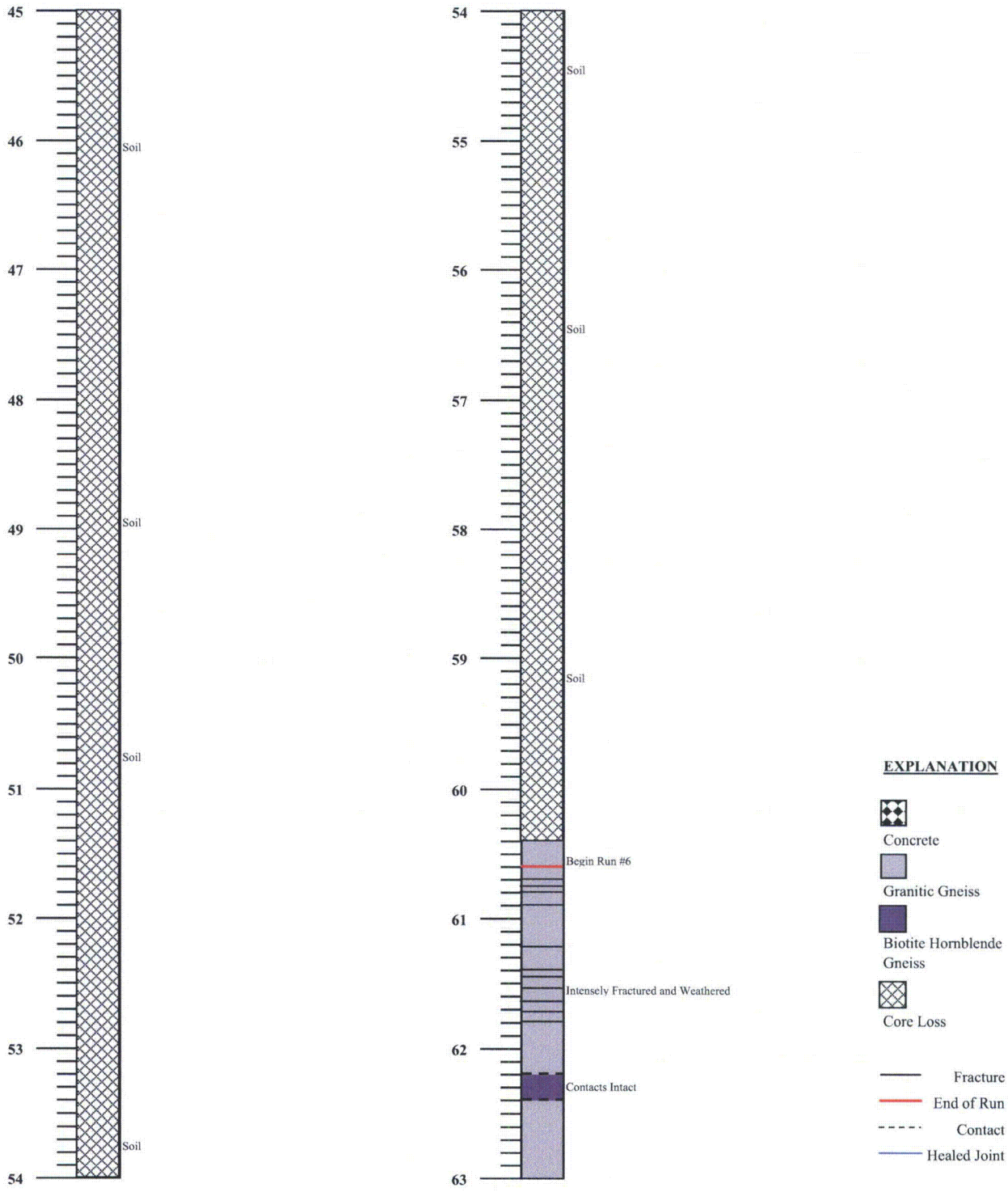


FIELD ROCK CORE LOG

Oconee Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-07-234

Core Location: GM-9R

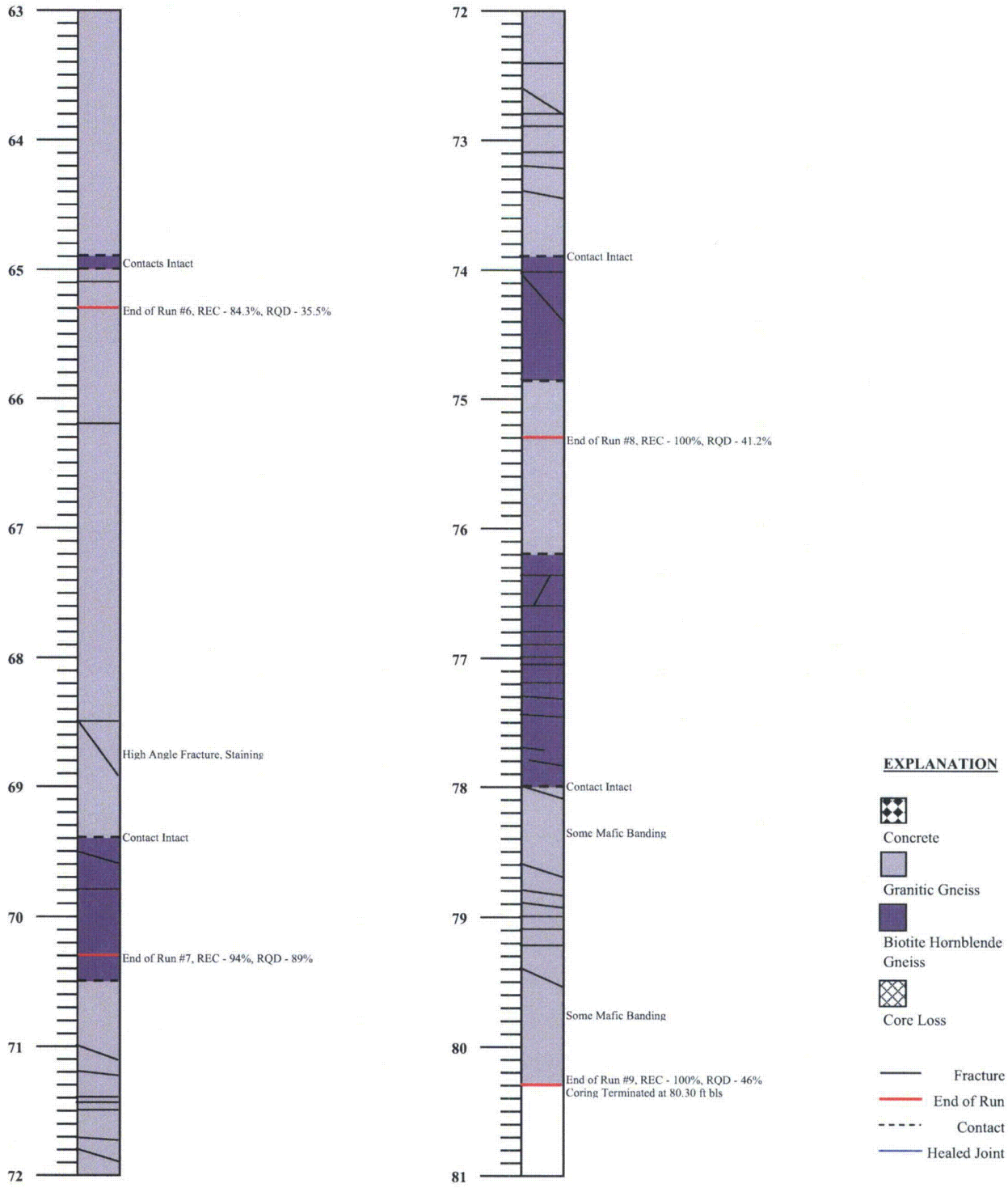


FIELD ROCK CORE LOG

Oconee Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-07-234

Core Location: GM-9R



COMPLETION REPORT OF WELL No. GM-9R

PROJECT: **Oconee Nuclear Station**
PROJECT NO: **1264-07-234**
PROJECT LOCATION: **Seneca, SC**

DRILLING CONTRACTOR: **S&ME, Inc.**
DRILLING METHOD: **Mud Rotary**
DATE DRILLED: **10/2/07**

WATER LEVEL: **Stabilized Water Level at 30.43 ft bls**
LATITUDE: **34°47'40.463"**
LONGITUDE: **82°53'48.364"**
TOP OF CASING ELEVATION: **780.19**
DATUM: **MSL**
LOGGED BY: **Courtney Withers/David Klemm**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)
				0.00	GS	780.42
ASPHALT		0				
GRAVEL						
FILL (F): Tan, Brown, and Reddish-Brown, Micaceous, Silty, Medium to Fine **SAND**, With White, Medium to Fine Sand Lenses and Rock Fragments		5				
FILL (F): **BIOTITE GNEISS** Boulders Auger Refusal at 9.80 ft bls		10				
FILL (F): Brown and Orange, Micaceous, Silty, Medium to Fine **SAND** With Rock Fragments Roller Cone Refusal at 22.20 ft bls		15 20				
FILL (F): **BIOTITE GNEISS** Boulders		25				
FILL (F): Brown, Fine Sandy, Silty, **CLAY** With Rock Fragments, Roots, and Wood		30	▼			

WELL CONSTRUCTION DETAILS

PROTECTIVE CASING
Diameter:
Type:
Interval:

RISER CASING
Diameter: **2"**
Type: **Sch. 40 PVC**
Interval: **0 to 68.7 ft bls**

GROUT
Type: **Neat Cement**
Interval: **0 to 66 ft bls**

SEAL
Type: **K-packer**
Interval: **67.9 to 68.1 ft bls**

FILTERPACK
Type:
Interval:

SCREEN
Diameter: **2"**
Type: **0.010 Slotted PVC**
Interval: **68.7 to 73.7 ft bls**

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- ▼ STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL RECOVERED_ONS LOG.GPJ S&ME.GDT 7/23/08

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COMPLETION REPORT OF WELL No. GM-9R

PROJECT: **Oconee Nuclear Station**
PROJECT NO: **1264-07-234**
PROJECT LOCATION: **Seneca, SC**

GROUND SURFACE ELEVATION:
LOGGED BY: **780.4**
CHECKED BY: **Courtney Withers/[**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)
FILL (F): Brown and Gray, Micaceous, Silty, Medium to Fine Sandy, **CLAY**		35				
FILL (F): Red and Gray, Silty, High Plasticity **CLAY**		40				
FILL (F): Orange, Tan, and Red, Coarse to Fine Sandy, **CLAY**		45				
SOIL/SAPROLITE (M1): Tan and White, Micaceous, Slightly Clayey, Silty, Coarse to Fine **SAND**		50				
SOIL/SAPROLITE (M1): Brown, Very Micaceous, Fine Sandy, **SILT**		55				
SOIL/SAPROLITE (M1): Dark Gray and White, Silty, Coarse to Fine **SAND**						
SOIL/SAPROLITE (M1): Dark Gray and Brown, Micaceous, Silty, Fine **SAND**		60				
SOIL/SAPROLITE (M1): Gray, Silty, Fine **SAND**						
WEATHERED ROCK (M2): When Sampled Becomes Tan, Silty, Fine **SAND**		65		66.00		714.42
				67.90		712.52
				68.10		712.32
PARTIALLY WEATHERED/FRACTURED ROCK (WF): Medium-Grained **GRANITIC GNEISS** With Intermittent Medium-Grained **BIOTITE HORNBLENDE GNEISS**; Intensely Fractured, Low Angle Joints With No Staining		70		68.70		711.72
				73.20		707.22
				73.70		706.72
		75		75.00		705.42
SOUND ROCK (D): Medium-Grained						

(See Page 1)

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL RECOVERED_ONS LOG.GPJ S&ME.GDT 7/23/08

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COMPLETION REPORT OF WELL No. GM-9R

PROJECT: **Oconee Nuclear Station**
PROJECT NO: **1264-07-234**
PROJECT LOCATION: **Seneca, SC**

GROUND SURFACE ELEVATION:
LOGGED BY: **780.4**
CHECKED BY: **Courtney Withers/D**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)	WELL CONSTRUCTION DETAILS
							(See Page 1)
GRANITIC GNEISS With Intermittent **BIOTITE HORNBLENDE GNEISS**; Slightly Fractured, Low Angle and High Angle Joints With Moderate to No Staining		80		80.30		700.12	
PARTIALLY WEATHERED/FRACTURED ROCK (WF): Medium-Grained **GRANITIC GNEISS** With Intermittent **BIOTITE HORNBLENDE GNEISS**; Intensely Fractured, Low Angle and High Angle Joints With No Staining							
SOUND ROCK (D): Medium-Grained **BIOTITE HORNBLENDE GNEISS**; Slightly Fractured, Horizontal and High Angle Joints With No Staining							
SOUND ROCK (D): Medium-Grained **GRANITIC GNEISS**; Unfractured							
PARTIALLY WEATHERED/FRACTURED ROCK (WF): Medium-Grained **BIOTITE HORNBLENDE GNEISS**; Intensely Fractured Low Angle and High Angle Joints With No Staining							
PARTIALLY WEATHERED/FRACTURED ROCK (WF): Medium-Grained **GRANITIC GNEISS** With Intermittent **BIOTITE HORNBLENDE GNEISS**; Intensely Fractured, Low Angle Joints With No Staining *(continued)*							

LEGEND

FILTER PACK		TOC	TOP OF CASING
BENTONITE		GS	GROUND SURFACE
CEMENT GROUT		BS	BENTONITE SEAL
CUTTINGS / BACKFILL		FP	FILTER PACK
STATIC WATER LEVEL		TSC	TOP OF SCREEN
		BSC	BOTTOM OF SCREEN
		TD	TOTAL DEPTH
		CG	CEMENT GROUT

MONITORING WELL RECOVERED_ONS LOG.GPJ S&ME.GDT 7/23/08

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COMPLETION REPORT OF WELL No. GM-9R

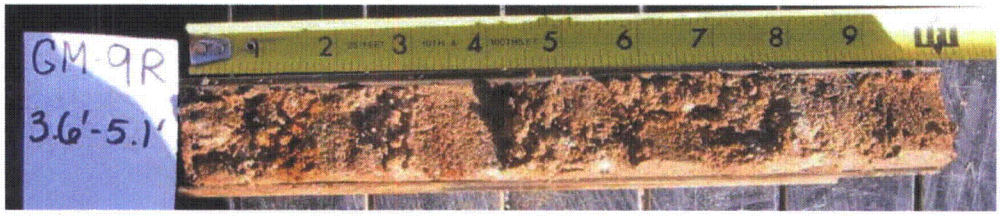
SPLIT SPOON SAMPLE PICTURES

Oconee Nuclear Station - Groundwater Protection Project

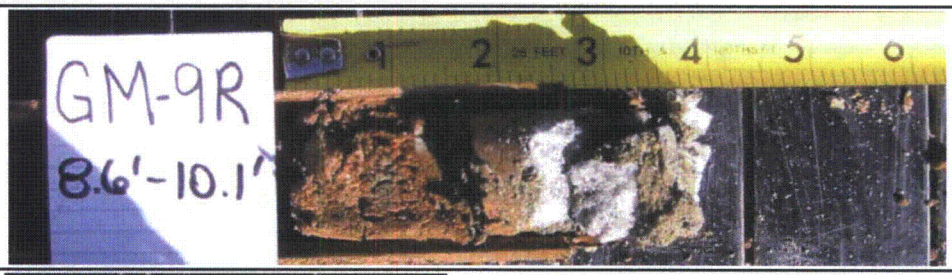
S&ME Project No: 1264-07-234

Boring Number: GM-9R

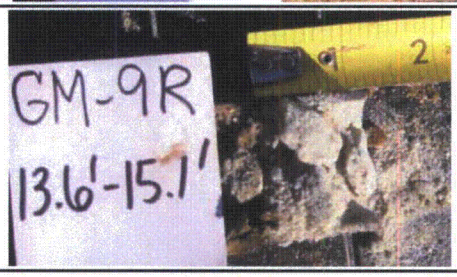
Sample No:	**1**
Depth (ft-bls):	**3.6 - 5.1**
Blow Count:	**4 * 5 * 5**



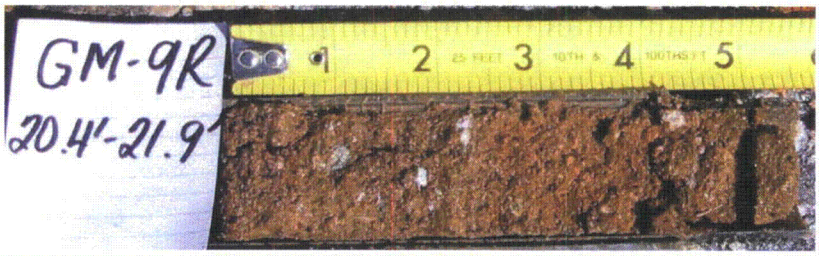
Sample No:	**2**
Depth (ft-bls):	**8.6 - 10.1**
Blow Count:	**50/5**



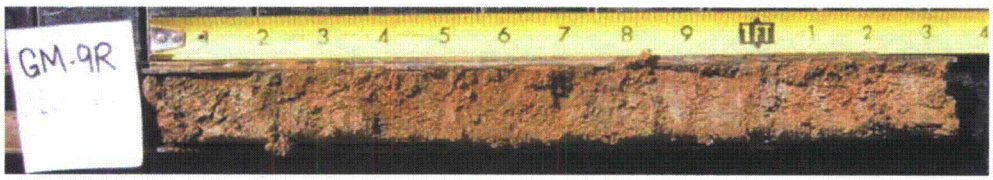
Sample No:	**3**
Depth (ft-bls):	**13.6 - 15.1**
Blow Count:	**50/1**



Sample No:	**4**
Depth (ft-bls):	**20.4 - 21.9**
Blow Count:	**7 * 50/2**



Sample No:	**5**
Depth (ft-bls):	**35.4 - 36.9**
Blow Count:	**2 * 3 * 4**



Sample No:	**6**
Depth (ft-bls):	**37.7 - 39.2**
Blow Count:	**4 * 6 * 9**

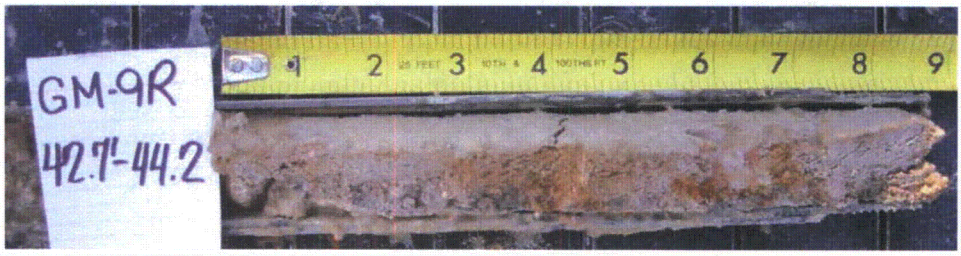
SPLIT SPOON SAMPLE PICTURES

Oconee Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-07-234

Boring Number: GM-9R

Sample No:	**7**
Depth (ft-bls):	**42.7 - 44.2**
Blow Count:	**7 * 7 * 9**



Sample No:	**8**
Depth (ft-bls):	**47.7 - 49.2**
Blow Count:	**4 * 4 * 8**

Sample No:	**9**
Depth (ft-bls):	**52.7 - 54.2**
Blow Count:	**12 * 12 * 18**

Sample No:	**10**
Depth (ft-bls):	**57.7 - 59.2**
Blow Count:	**10 * 23 * 50/3**

ROCK CORE PICTURES

Oconee Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-07-234

Core Location: GM-9R

ROCK CORE PICTURES

Oconee Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-07-234

Core Location: GM-9R

CLASSIFICATION:

9.80' to 47.00': FILL - Granitic Gneiss Boulders and Soil

60.60' to 80.30': Medium-Grained Granitic Gneiss With Intermittent Biotite Hornblende Gneiss

BOREHOLE PERMEABILITY TEST USING PACKERS CALCULATIONS

PROJECT NAME AND NO.: ONS - GWPP
LOCATION: Seneca, SC
TEST DATE: 10/4/2007
TESTED BY: Jay Little/David Klemm
GROUND ELEV (ft MSL): 780.4

BOREHOLE NO.: GM-9R
TEST INTERVAL: 66.9 to 71.9 bgs
TEST INTERVAL: 713.5 to 708.5 EL

TEST METHOD: Double Packer Method using Multiple Pressure Tests
METHOD REFERENCE: Ground Water Manual, US Bureau of Reclamation, 1995, Chapter 10

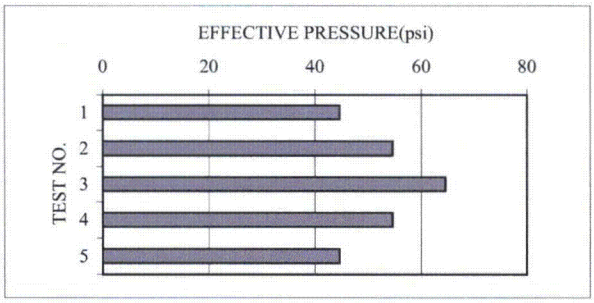
RESULTS OF PERMEABILITY CALCULATIONS
MULTIPLE STEP TEST

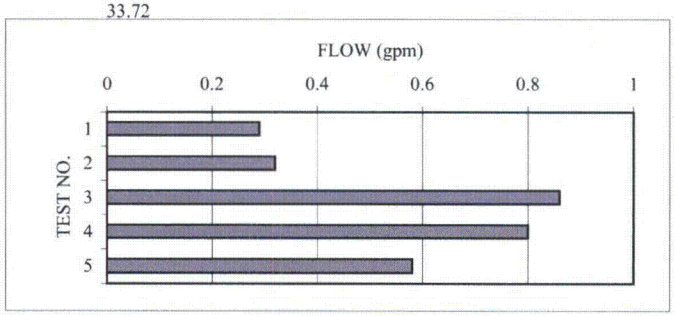
Step	Flow (Q) (gpm)	Pressure (psi) Gauge	mud Effective	Lugeons	Permeability (ft/sec)	Permeability (cm/sec)
1	0.29	30	45	2	7.84E-07	2.4E-05
2	0.32	40	55	2	7.1E-07	2.2E-05
3	0.86	50	65	5	1.6E-06	4.9E-05
4	0.8	40	55	5	1.8E-06	5.4E-05
5	0.58	30	45	5	1.6E-06	4.8E-05
			AVERAGE	4	1.3E-06	3.9E-05
			SELECTED VALUES			

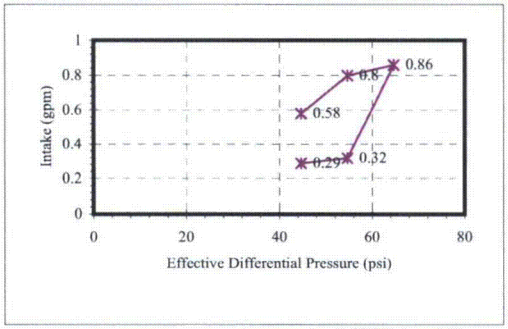
Rock Description of Tested Interval:
Moderately Fractured Granitic Gneiss With Intermittent Biotite Hornblende Gneiss

3.77
TEST INTERPRETATION 66.9

33.72







PERMEABILITY CALCULATIONS FOR EACH STEP OF TEST

S&ME

CALCULATED PERMEABILITY FOR STEP 1

Gauge Pressure, **h2**		30	psi	69.3	feet of water
	30	0.29	gpm	0.001	ft^3/sec
	30	0.0	psi		(per tables)
	30	0.0	psi	0.0	feet of water
	30	33.7	feet		
	30	33.7	feet		
	30	103.0	feet	44.6	psi
	30		-		
Select Zone 1, 2, or 3		3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H		61.1	feet	0.29	
X = (H/Tu)*100		168.7	%		
Tu/A		12.2			
	40				
	40	-		Value for Zone 1 analysis	
	40	-		Value for Zone 1 analysis	
	40	40		Value for Zone 2 and 3 analysis	
	40			Cu for Zone 1	
	40	64		Cs for Zones 2 and 3	
	40	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using single packer (Method 1)		-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)		-	ft/sec	-	0.32
Calculate K if Zone 3 and using single packer (Method 1)		-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)		7.84E-07	ft/sec	2.39E-05	cm/sec
	50				
	50				
	50	Calculate a, the total open area of the test section:			3.9 square feet
	50	Is Q/a * (estimated porosity) > 10??			True, Test Valid
	50				
	50				
	50	40	psi	92.4	feet of water
Flow Rate, **Q**:		0.32	gpm	0.001	ft^3/sec
Head loss per TEN foot section of pipe:		0.0	psi		0.86
Head Loss, ***L*** :		0.0	psi	0.0	feet of water
Distance from pressure gauge to bottom of test section, h_1:		33.7	feet		
	40	33.7	feet		
	40	126.1	feet	54.6	psi
	40		-		
	40	3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H		84.1	feet		
X = (H/Tu)*100		149.9	%		0.8
Tu/A		16.8			
Determine Conductivity Coefficient					
	30	-		Value for Zone 1 analysis	
	30	-		Value for Zone 1 analysis	
	30	40		Value for Zone 2 and 3 analysis	
	30			Cu for Zone 1	
Cs for Zone 2 and 3 tests:		64		Cs for Zones 2 and 3	
Calculate K if Zone 1 and using single or double packer		-	ft/sec	-	0.58
Calculate K if Zone 2 and using single packer (Method 1)		-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)		-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using single packer (Method 1)		-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)		7.07E-07	ft/sec	2.15E-05	cm/sec
Is this step valid?					
If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow					
		Calculate a, the total open area of the test section:			3.9 square feet
		Is Q/a * (estimated porosity) > 10??			True, Test Valid

CALCULATED PERMEABILITY FOR STEP 3

Gauge Pressure, **h2**:	50	psi	115.5	feet of water
Flow Rate, **Q**:	0.86	gpm	0.002	ft^3/sec
Head loss per TEN foot section of pipe:	0.0	psi		(per tables)
Head Loss, ***L*** :	0.0	psi	0.0	feet of water
Distance from pressure gauge to bottom of test section, h_1:	33.7	feet		
Value of h_1:	33.7	feet		
Effective Head, ***H*** where ***H = h1+h2-L*** :	149.2	feet	64.6	psi
Determine Saturation Zone:		-		
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H	107.2	feet		
X = (H/Tu)*100	139.1	%		
Tu/A	21.4			
Determine Conductivity Coefficient				
H/r	-		Value for Zone 1 analysis	
A/H	-		Value for Zone 1 analysis	
A/r	40		Value for Zone 2 and 3 analysis	
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1	
Cs for Zone 2 and 3 tests:	64		Cs for Zones 2 and 3	
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)	1.61E-06	ft/sec	4.89E-05	cm/sec

Is this step valid?

If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow

Calculate a, the total open area of the test section: 3.9 square feet

Is Q/a * (estimated porosity) > 10?? True, Test Valid

CALCULATED PERMEABILITY FOR STEP 4

Gauge Pressure, **h2**:	40	psi	92.4	feet of water
Flow Rate, **Q**:	0.80	gpm	0.002	ft^3/sec
Head loss per TEN foot section of pipe:	0.0	psi		(per tables)
Head Loss, ***L*** :	0.0	psi	0.0	feet of water
Distance from pressure gauge to bottom of test section, h_1:	33.7	feet		
Value of h_1:	33.7	feet		
Effective Head, ***H*** where ***H = h1+h2-L*** :	126.1	feet	54.6	psi
Determine Saturation Zone:		-		
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H	84.1	feet		
X = (H/Tu)*100	149.9	%		
Tu/A	16.8			
Determine Conductivity Coefficient				
H/r	-		Value for Zone 1 analysis	
A/H	-		Value for Zone 1 analysis	
A/r	40		Value for Zone 2 and 3 analysis	
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1	
Cs for Zone 2 and 3 tests:	64		Cs for Zones 2 and 3	
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)	1.77E-06	ft/sec	5.39E-05	cm/sec

Is this step valid?

If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow

Calculate a, the total open area of the test section: 3.9 square feet

Is Q/a * (estimated porosity) > 10?? True, Test Valid

CALCULATED PERMEABILITY FOR STEP 5

Gauge Pressure, **h2**:	30	psi	69.3	feet of water
Flow Rate, **Q**:	0.58	gpm	0.001	ft^3/sec
Head loss per TEN foot section of pipe:	0.0	psi		(per tables)
Head Loss, ***L*** :	0.0	psi	0.0	feet of water
Distance from pressure gauge to bottom of test section, $\mathbf{h_1}$:	33.7	feet		
Value of h_1:	33.7	feet		
Effective Head, ***H*** where ***H = h1+h2-L*** :	103.0	feet	44.6	psi
Determine Saturation Zone:		-		
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H	61.1	feet		
X = (H/Tu)*100	168.7	%		
Tu/A	12.2			
Determine Conductivity Coefficient				
H/r	-		Value for Zone 1 analysis	
A/H	-		Value for Zone 1 analysis	
A/r	40		Value for Zone 2 and 3 analysis	
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1	
Cs for Zone 2 and 3 tests:	64		Cs for Zones 2 and 3	
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)	1.57E-06	ft/sec	4.78E-05	cm/sec

Is this step valid?

If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow

Calculate a, the total open area of the test section:	3.9 square feet
Is Q/a * (estimated porosity) > 10??	True, Test Valid

BOREHOLE PERMEABILITY TEST USING PACKERS CALCULATIONS

PROJECT NAME AND NO.: ONS - GWPP
LOCATION: Seneca, SC
TEST DATE: 10/4/2007
TESTED BY: Jay Little/David Klemm
GROUND ELEV (ft MSL): 780.4

BOREHOLE NO.: GM-9R
TEST INTERVAL: 71.9 to 76.9 bgs
TEST INTERVAL: 708.5 to 703.5 EL

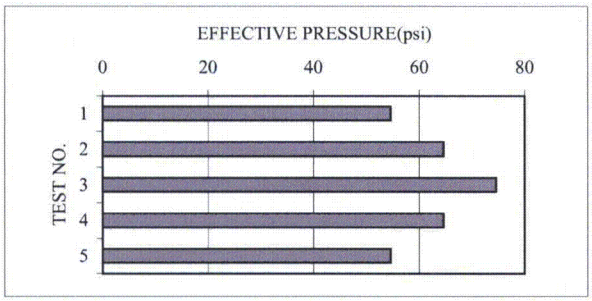
TEST METHOD: Double Packer Method using Multiple Pressure Tests
METHOD REFERENCE: Ground Water Manual, US Bureau of Reclamation, 1995, Chapter 10

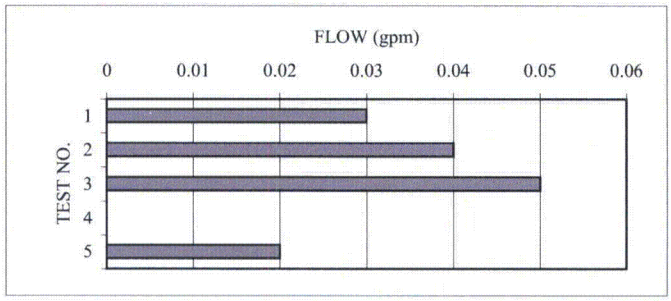
RESULTS OF PERMEABILITY CALCULATIONS
MULTIPLE STEP TEST

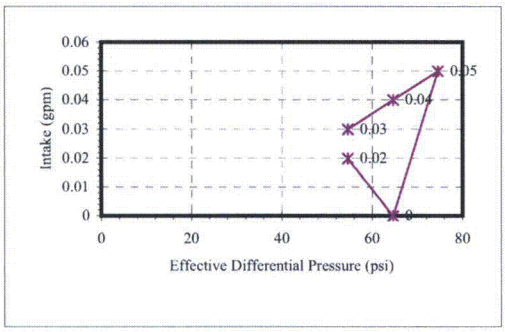
Step	Flow (Q) (gpm)	Pressure (psi) Gauge	Pressure (psi) Effective	Lugeons	Permeability (ft/sec)	Permeability (cm/sec)
1	0.03	40	55	0	6.63E-08	2.0E-06
2	0.04	50	65	0	7.5E-08	2.3E-06
3	0.05	60	75	0	8.1E-08	2.5E-06
4	0	50	65	0	0.0E+00	0.0E+00
5	0.02	40	55	0	4.4E-08	1.3E-06
			AVERAGE	0	5.3E-08	1.6E-06
			SELECTED VALUES			

Rock Description of Tested Interval:
Moderately Fractured Granitic Gneiss With Intermittent Biotite Hornblende Gneiss

TEST INTERPRETATION







PERMEABILITY CALCULATIONS FOR EACH STEP OF TEST

S&ME

CALCULATED PERMEABILITY FOR STEP 1

Gauge Pressure, **h2**:	40	psi	92.4	feet of water	
Flow Rate, **Q**:	0.03	gpm	0.000	ft^3/sec	
Head loss per TEN foot section of pipe:	0.0	psi		(per tables)	
Head Loss, ***L*** :	0.0	psi	0.0	feet of water	
Distance from pressure gauge to bottom of test section, h_1:	33.7	feet			
Value of h_1:	33.7	feet			
Effective Head, ***H*** where ***H = h1+h2-L*** :	126.0	feet	54.6	psi	
Determine Saturation Zone:		-			
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated		
Tu = U-D+H	79.1	feet		0.03	
X = (H/Tu)*100	159.4	%			
Tu/A	15.8				
Determine Conductivity Coefficient					
H/r	-		Value for Zone 1 analysis		
A/H	-		Value for Zone 1 analysis		
A/r	40		Value for Zone 2 and 3 analysis		
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1		
Cs for Zone 2 and 3 tests:	64		Cs for Zones 2 and 3		
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	cm/sec	
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec	
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	0.04	
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec	
Calculate K if Zone 3 and using double packer (Method 2)	6.63E-08	ft/sec	2.02E-06	cm/sec	
Is this step valid?					
If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow					
Calculate a, the total open area of the test section:				3.9	square feet
Is Q/a * (estimated porosity) > 10??				True, Test Valid	

CALCULATED PERMEABILITY FOR STEP 2

Gauge Pressure, **h2**:	50	psi	115.5	feet of water	
Flow Rate, **Q**:	0.04	gpm	0.000	ft^3/sec	
Head loss per TEN foot section of pipe:	0.0	psi		0.05	
Head Loss, ***L*** :	0.0	psi	0.0	feet of water	
Distance from pressure gauge to bottom of test section, h_1:	33.7	feet			
Value of h_1:	33.7	feet			
Effective Head, ***H*** where ***H = h1+h2-L*** :	149.1	feet	64.6	psi	
Determine Saturation Zone:		-			
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated		
Tu = U-D+H	102.2	feet			
X = (H/Tu)*100	145.9	%		0	
Tu/A	20.4				
Determine Conductivity Coefficient					
H/r	-		Value for Zone 1 analysis		
A/H	-		Value for Zone 1 analysis		
A/r	40		Value for Zone 2 and 3 analysis		
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1		
Cs for Zone 2 and 3 tests:	64		Cs for Zones 2 and 3		
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	0.02	
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec	
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	cm/sec	
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec	
Calculate K if Zone 3 and using double packer (Method 2)	7.47E-08	ft/sec	2.28E-06	cm/sec	
Is this step valid?					
If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow					
Calculate a, the total open area of the test section:				3.9	square feet
Is Q/a * (estimated porosity) > 10??				True, Test Valid	

CALCULATED PERMEABILITY FOR STEP 3

Gauge Pressure, **h2**:	60	psi	138.6	feet of water
Flow Rate, **Q**:	0.05	gpm	0.000	ft^3/sec
Head loss per TEN foot section of pipe:	0.0	psi		(per tables)
Head Loss, ***L*** :	0.0	psi	0.0	feet of water
Distance from pressure gauge to bottom of test section, h_1:	33.7	feet		
Value of h_1:	33.7	feet		
Effective Head, ***H*** where ***H = h1+h2-L*** :	172.2	feet	74.6	psi
Determine Saturation Zone:		-		
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H	125.3	feet		
X = (H/Tu)*100	137.5	%		
Tu/A	25.1			
Determine Conductivity Coefficient				
H/r	-		Value for Zone 1 analysis	
A/H	-		Value for Zone 1 analysis	
A/r	40		Value for Zone 2 and 3 analysis	
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1	
Cs for Zone 2 and 3 tests:	64		Cs for Zones 2 and 3	
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)	8.08E-08	ft/sec	2.46E-06	cm/sec
Is this step valid?				
If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow				
Calculate a, the total open area of the test section:			3.9	square feet
Is Q/a * (estimated porosity) > 10??			True, Test Valid	

CALCULATED PERMEABILITY FOR STEP 4

Gauge Pressure, **h2**:	50	psi	115.5	feet of water
Flow Rate, **Q**:	0.00	gpm	0.000	ft^3/sec
Head loss per TEN foot section of pipe:	0.0	psi		(per tables)
Head Loss, ***L*** :	0.0	psi	0.0	feet of water
Distance from pressure gauge to bottom of test section, h_1:	33.7	feet		
Value of h_1:	33.7	feet		
Effective Head, ***H*** where ***H = h1+h2-L*** :	149.1	feet	64.6	psi
Determine Saturation Zone:		-		
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H	102.2	feet		
X = (H/Tu)*100	145.9	%		
Tu/A	20.4			
Determine Conductivity Coefficient				
H/r	-		Value for Zone 1 analysis	
A/H	-		Value for Zone 1 analysis	
A/r	40		Value for Zone 2 and 3 analysis	
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1	
Cs for Zone 2 and 3 tests:	64		Cs for Zones 2 and 3	
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)	0.00E+00	ft/sec	0.00E+00	cm/sec
Is this step valid?				
If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow				
Calculate a, the total open area of the test section:			3.9	square feet
Is Q/a * (estimated porosity) > 10??			True, Test Valid	

CALCULATED PERMEABILITY FOR STEP 5

Gauge Pressure, **h2**	40	psi	92.4	feet of water
Flow Rate, **Q**:	0.02	gpm	0.000	ft^3/sec
Head loss per TEN foot section of pipe:	0.0	psi		(per tables)
Head Loss, ***L*** :	0.0	psi	0.0	feet of water
Distance from pressure gauge to bottom of test section, h_1:	33.7	feet		
Value of h_1:	33.7	feet		
Effective Head, ***H*** where ***H = h1+h2-L*** :	126.0	feet	54.6	psi
Determine Saturation Zone:		-		
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H	79.1	feet		
X = (H/Tu)*100	159.4	%		
Tu/A	15.8			
Determine Conductivity Coefficient				
H/r	-		Value for Zone 1 analysis	
A/H	-		Value for Zone 1 analysis	
A/r	40		Value for Zone 2 and 3 analysis	
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1	
Cs for Zone 2 and 3 tests:	64		Cs for Zones 2 and 3	
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)	4.42E-08	ft/sec	1.35E-06	cm/sec

Is this step valid?

If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow

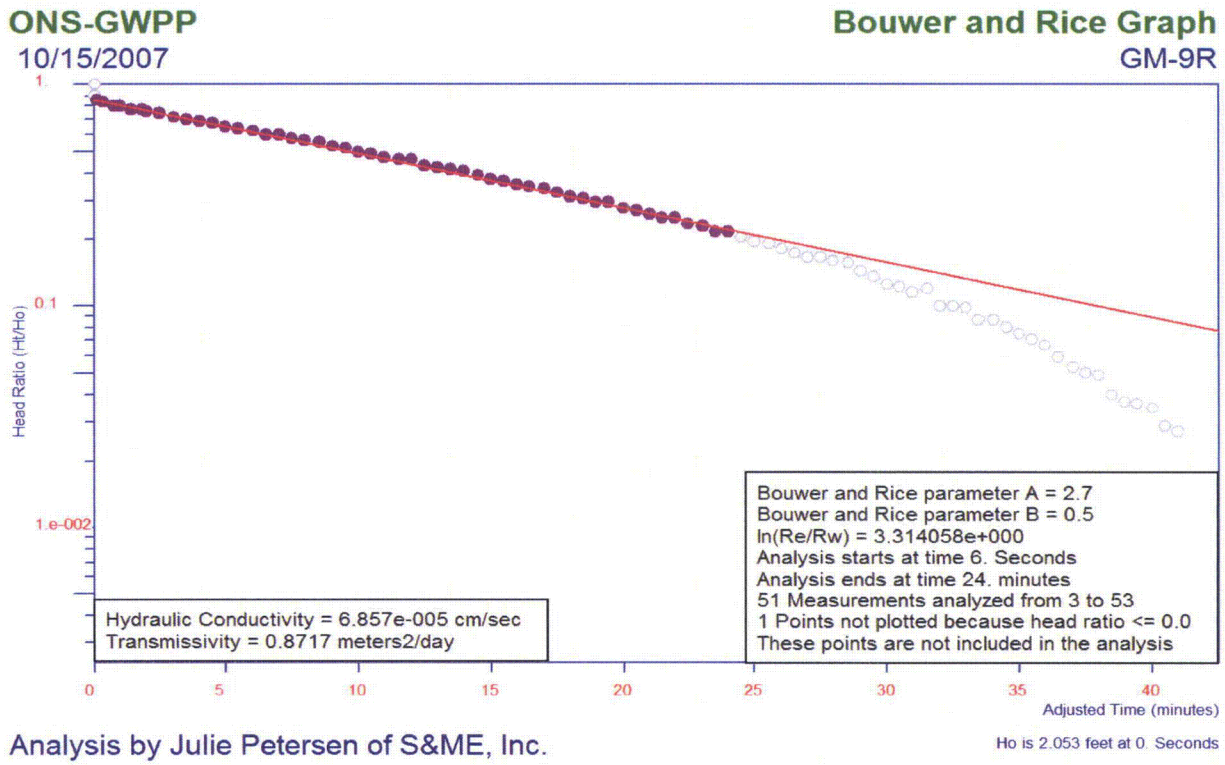
Calculate a, the total open area of the test section:	3.9 square feet
Is Q/a * (estimated porosity) > 10??	True, Test Valid

Calculation of Permeability By The Rising Head Method (Slug Test)

Site Name:	ONS-GWPP
Test Date:	10/15/2007
Well Label:	GM-9R
Aquifer Thickness:	48.27 feet
Screen Length:	5. feet
Casing Radius:	1. Inches
Effective Radius:	1.5 Inches
Static Water Level:	30.43 feet
Water Table to Screen Bottom:	43.27 feet
Anisotropy Ratio:	1

Time Adjustment: 0. Seconds
Test starts with trial 0
There are 90 time and drawdown measurements
Maximum head is 2.053 feet
Minimum head is 0. feet

Calculation by Bouwer and Rice Graphical Method



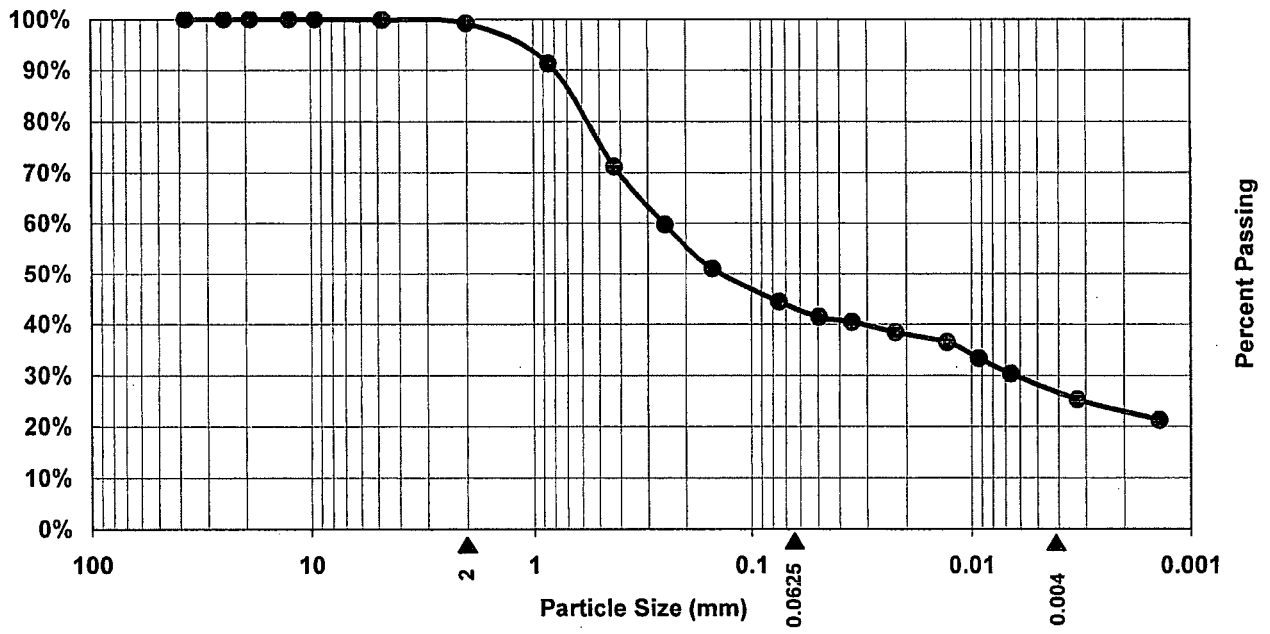
PERMEABILITY

6.86×10^{-5} cm/sec

PARTICLE SIZE ANALYSIS OF SOILS
FOR USE IN FETTER AND BEAR DIAGRAMS

Boring No.:	Sample No.:	Depth:
GM-9R	SS-7	42.7 to 44.2 ft bls

Sample Description:
F: Orange, Tan, and Red, Silty, Clayey, Medium to Fine Sand (SC)



	> 2 mm	2 mm - 0.0625 mm	0.0625 mm - 0.004 mm	<0.004 mm
From Graph:	% Gravel 0.8%	% Sand 56.0%	% Silt 16.9%	% Clay 26.3%
Adjusted for Calculations	**0%**	**56%**	**17%**	**27%**

Notes:
Grain size distribution taken from grain size with hydrometer data located in Appendix II.
Gravel, sand, silt and clay sizes based on Wentworth Scale.

S&ME Project:
Oconee Nuclear Station - GWPP

S&ME Project No.:
1264-07-234

S&ME

FETTER AND BEAR DIAGRAMS

S&ME PROJECT: Oconee Nuclear Station - GWPP
S&ME PROJECT NO.: 1264-07-234

Boring No. GM-9R

Boring Depth: 42.7 to 44.2 ft bls

% Sand: 56%

% Silt: 17%

% Clay: 27%

Estimated Specific Yield: 5%

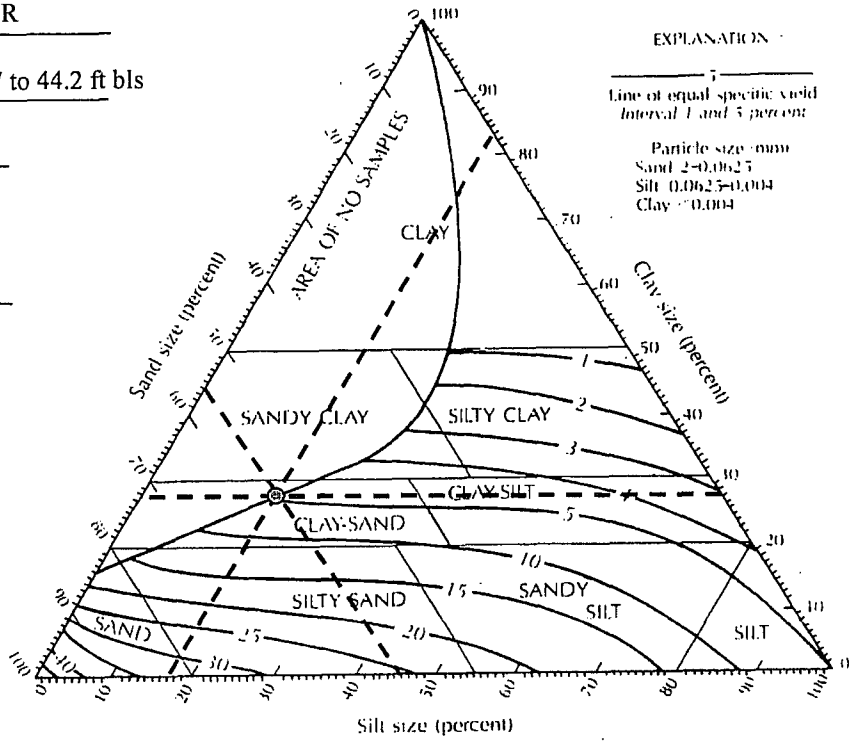
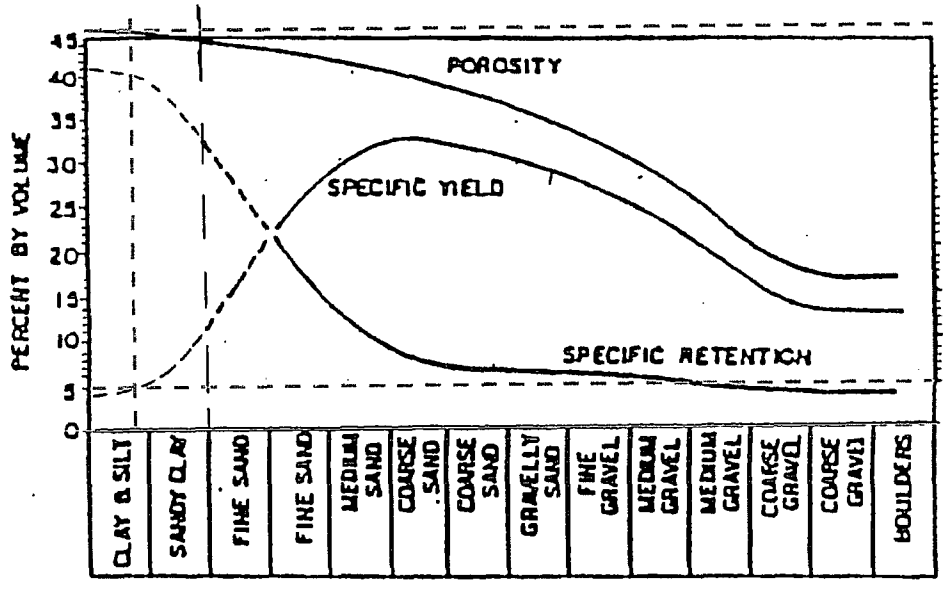


FIGURE 4.11 Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A. I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.



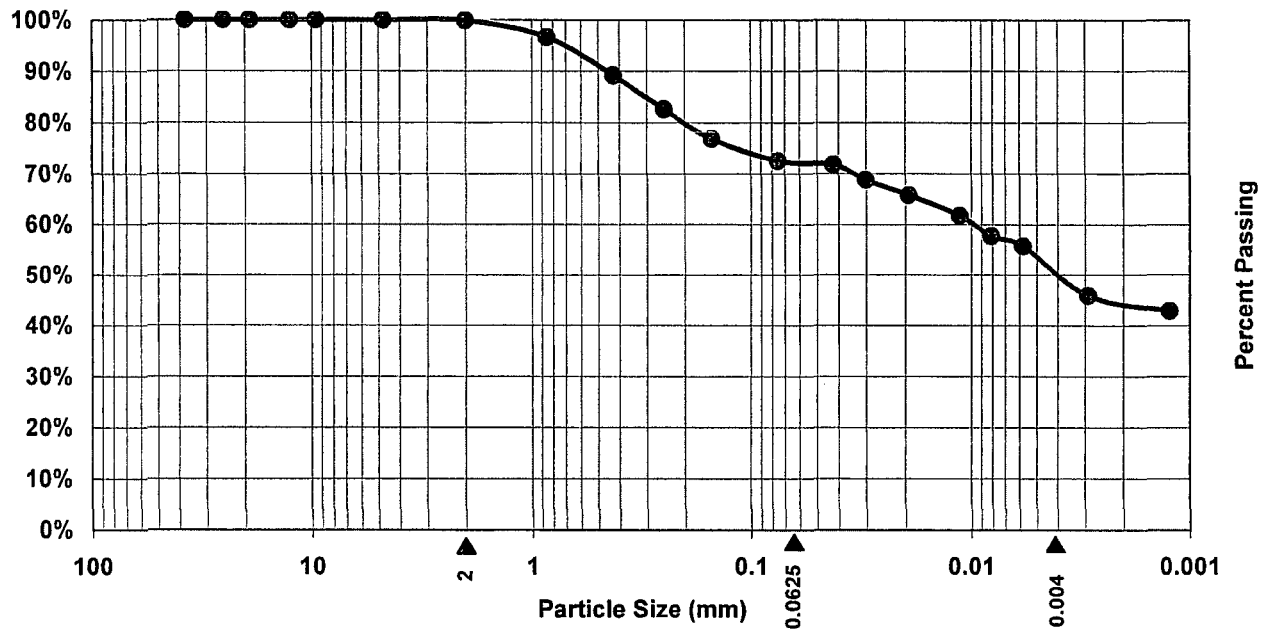
Estimated Porosity: 46%

Variation of Porosity, Specific Yield, and Specific Retention with Grain Size (after Bear, 1972)

PARTICLE SIZE ANALYSIS OF SOILS
FOR USE IN FETTER AND BEAR DIAGRAMS

Boring No.:	Sample No.:	Depth:
GM-9R	SS-6	37.7 to 38.2 ft bls

Sample Description:
F: Red and Gray, Silty, Clay, With Medium to Fine Sand (CL)



	> 2 mm	2 mm - 0.0625 mm	0.0625 mm - 0.004 mm	<0.004 mm
From Graph:	% Gravel 0.1%	% Sand 27.6%	% Silt 22.6%	% Clay 49.6%
Adjusted for Calculations	**0%**	**28%**	**23%**	**50%**

Notes:
Grain size distribution taken from grain size with hydrometer data located in Appendix II.
Gravel, sand, silt and clay sizes based on Wentworth Scale.

S&ME Project:
Oconee Nuclear Station - GWPP

S&ME Project No.:
1264-07-234

S&ME

FETTER AND BEAR DIAGRAMS

S&ME PROJECT: Oconee Nuclear Station - GWPP
S&ME PROJECT NO.: 1264-07-234

Boring No. GM-9R

Boring Depth: 37.7 to 38.2 ft bls

% Sand: 28%

% Silt: 23%

% Clay: 50%

Estimated Specific Yield: 1%*

* Estimated Value

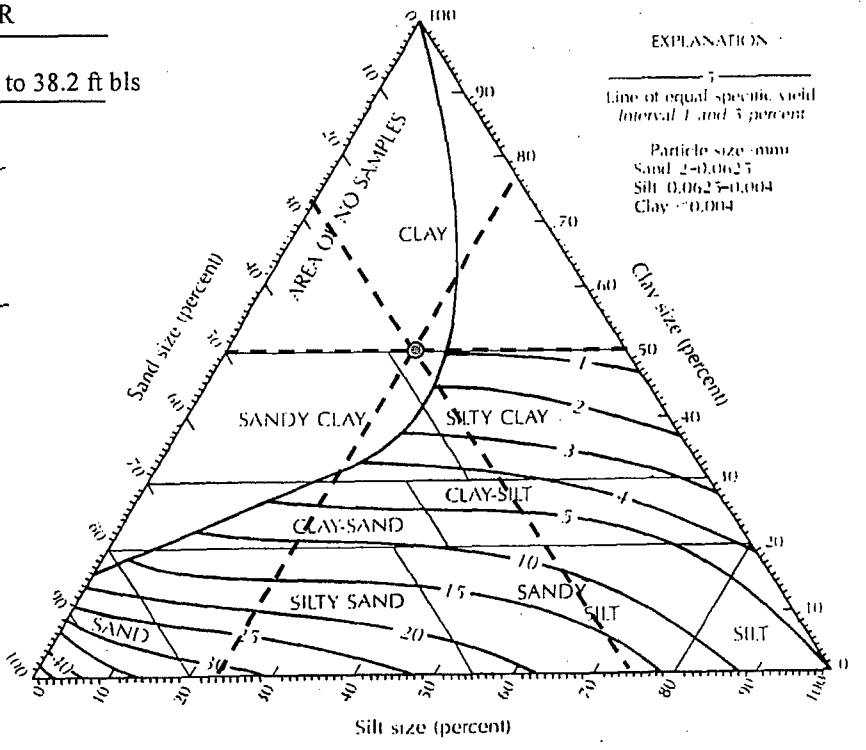
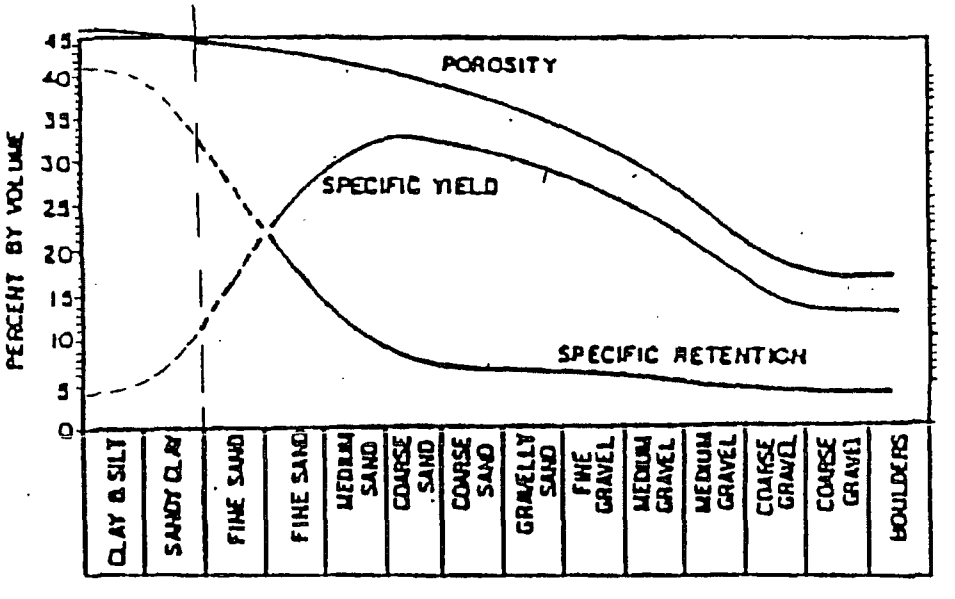


FIGURE 4.11 Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A. I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.



Estimated Porosity: 49%**

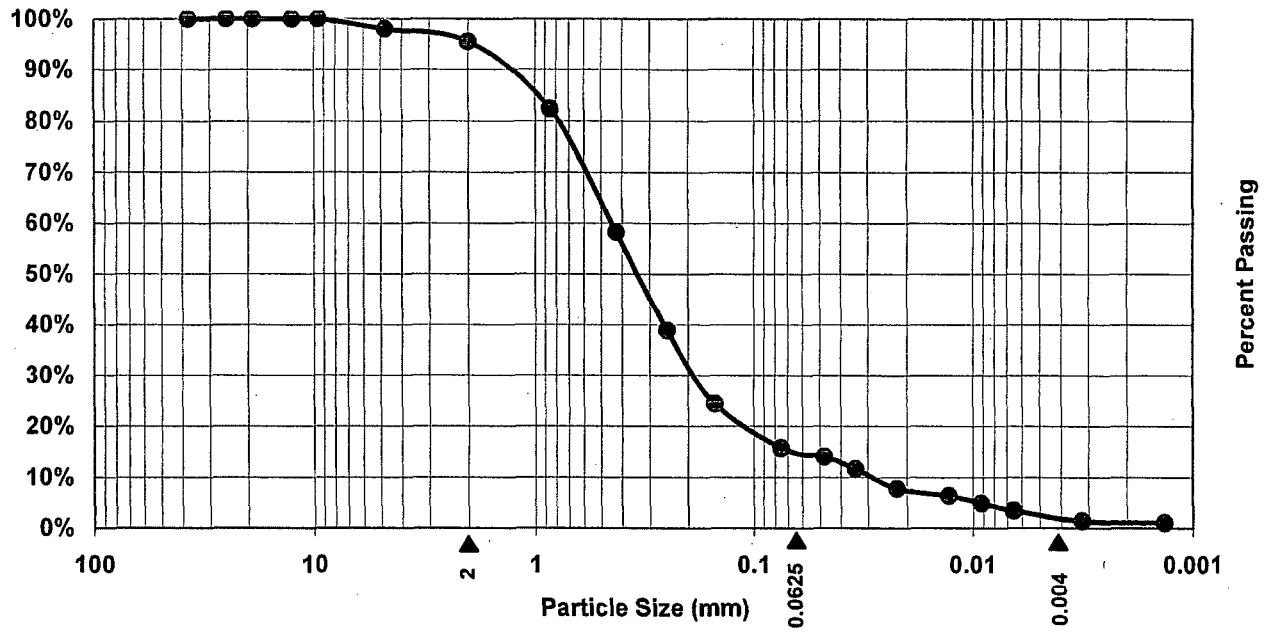
**Based on Table of Selected Values of Porosity, Specific Yield and Specific Retention, USGS Water Supply Paper 2220.

Variation of Porosity, Specific Yield, and Specific Retention with Grain Size (after Bear, 1972)

PARTICLE SIZE ANALYSIS OF SOILS
FOR USE IN FETTER AND BEAR DIAGRAMS

Boring No.:	Sample No.:	Depth:
GM-9R	SS-10	57.7 to 59.2 ft bls

Sample Description:
M2: Tan, Micaceous, Silty, Coarse to Fine Sand (SM)



	> 2 mm	2 mm - 0.0625 mm	0.0625 mm - 0.004 mm	<0.004 mm
From Graph:	% Gravel 4.6%	% Sand 80.3%	% Silt 13.2%	% Clay 1.9%
Adjusted for Calculations	**0%**	**84%**	**14%**	**2%**

Notes:
Grain size distribution taken from grain size with hydrometer data located in Appendix II.
Gravel, sand, silt and clay sizes based on Wentworth Scale.

S&ME Project:
Oconee Nuclear Station - GWPP

S&ME Project No.:
1264-07-234

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FETTER AND BEAR DIAGRAMS

S&ME PROJECT: Oconee Nuclear Station - GWPP
S&ME PROJECT NO.: 1264-07-234

Boring No. GM-9R

Boring Depth: 57.7 to 59.2 ft bls

% Sand: 84%

% Silt: 14%

% Clay: 2%

Estimated Specific Yield: 30%

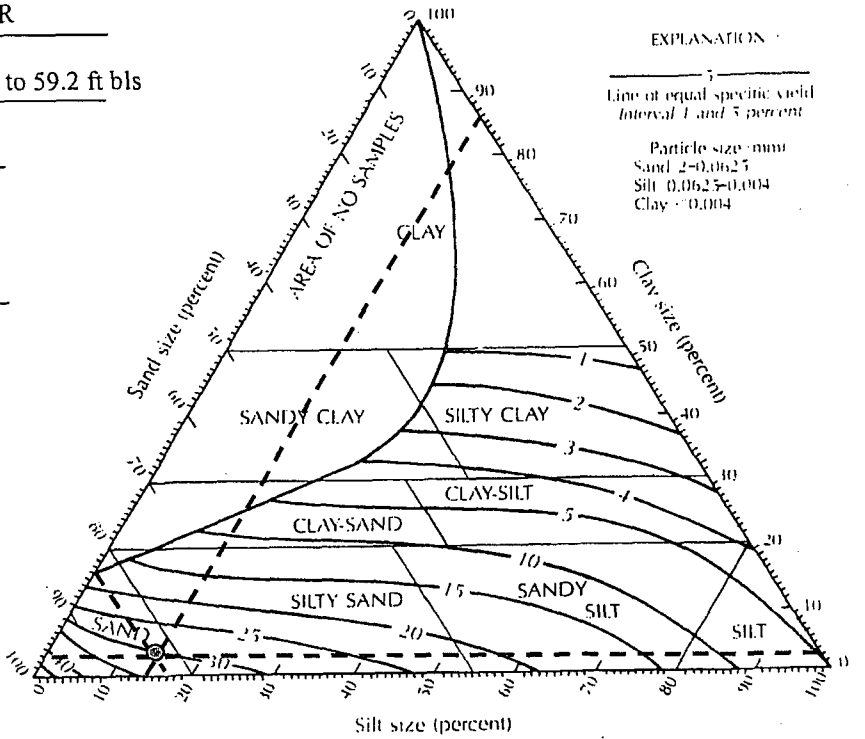
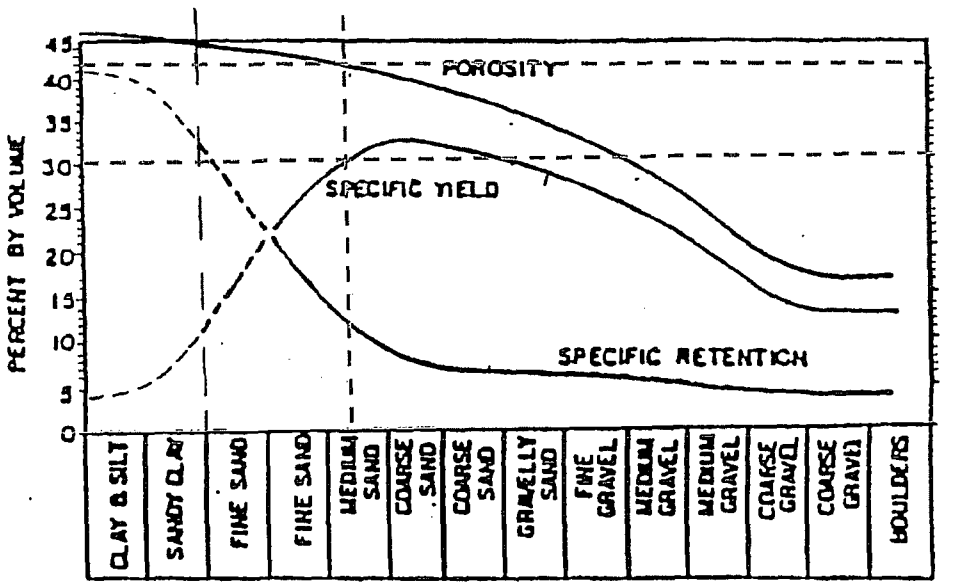


FIGURE 4.11 Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A. I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.



Estimated Porosity: 42%

Variation of Porosity, Specific Yield, and Specific Retention with Grain Size (after Bear, 1972)

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1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.
2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

Project: **Oconee Nuclear Station**			**Boring No. GM-10**
Location: **Seneca, SC**		Number: **1264-07-234**	Sheet No. 1 of 1
Boring Depth (ft): **30.0**	Elevation (ft): **735.3**	Driller: **Jay Little, SC Cert No. B1575**	Date Drilled: **10/25/07**
Logged By: **Scott Dacus**	Water Level: **Stabilized Water Level at 6.00 ft bls**		Drilling Method: **4¼" H.S.A.**

Elev. (Feet)	Depth (Feet)	Lith-ology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
735			PRE-DUG HOLE FOR UTILITY CLEARANCE: **FILL**		
730	5		FILL (F): Brown, Micaceous, Clayey, Silty, Medium to Fine **SAND**		
725	10		SOIL/SAPROLITE (M1): Red, Tan, and Brown, Micaceous, Medium to Fine Sandy, **SILT**		
720	15		SOIL/SAPROLITE (M1): Reddish-Orange, Micaceous, Clayey, **SILT**		
715	20		SOIL/SAPROLITE (M1): Orange, Micaceous, Clayey, **SILT** With Manganese Nodules		
710	25		SOIL/SAPROLITE (M1): White, Brown, and Gray, Micaceous, Silty, Medium to Fine **SAND**		
	30		SOIL/SAPROLITE (M1): Orange, Micaceous, Clayey, **SILT** With Manganese Staining and White, Medium to Fine Sand Seam at 29.90 ft bls		
			Lithologic Information Obtained From GM-10R **Boring Terminated at 30.00 ft bls**		

BORING LOG WITH WELL RECOVERED_ONS LOG.GPJ LAGWGN01.GDT 7/23/08

COMPLETION REPORT OF WELL No. GM-10

PROJECT: **Oconee Nuclear Station**
PROJECT NO: **1264-07-234**
PROJECT LOCATION: **Seneca, SC**

DRILLING CONTRACTOR: **S&ME, Inc.**
DRILLING METHOD: **4¼" H.S.A.**
DATE DRILLED: **10/25/07**

WATER LEVEL: **Stabilized Water Level at 6.00 ft bls**
LATITUDE: **34°47'38.220"**
LONGITUDE: **82°53'40.225"**
TOP OF CASING ELEVATION: **737.89**
DATUM: **MSL**
LOGGED BY: **Scott Dacus**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)
				0.00	GS	735.27
PRE-DUG HOLE FOR UTILITY CLEARANCE: **FILL**		0				
		5				
FILL (F): Brown, Micaceous, Clayey, Silty, Medium to Fine **SAND**						
SOIL/SAPROLITE (M1): Red, Tan, and Brown, Micaceous, Medium to Fine Sandy, **SILT**		10		9.80		725.47
				11.80		723.47
SOIL/SAPROLITE (M1): Reddish-Orange, Micaceous, Clayey, **SILT**		15				
		20				
SOIL/SAPROLITE (M1): Orange, Micaceous, Clayey, **SILT** With Manganese Nodules		25				
				28.30		706.97
SOIL/SAPROLITE (M1): White, Brown, and Gray, Micaceous, Silty, Medium to Fine **SAND**		30		28.80		706.47
				30.00		705.27
SOIL/SAPROLITE (M1): Orange, Micaceous, Clayey, **SILT** With						

WELL CONSTRUCTION DETAILS

PROTECTIVE CASING
Diameter:
Type:
Interval:

RISER CASING
Diameter: **2"**
Type: **Sch. 40 PVC**
Interval: **0 to 13.8 ft bls**

GROUT
Type: **Neat Cement**
Interval: **0 to 9.8 ft bls**

SEAL
Type: **Bentonite**
Interval: **9.8 to 11.8 ft bls**

FILTERPACK
Type: **#1 Silica Sand**
Interval: **11.8 to 28.8 ft bls**

SCREEN
Diameter: **2"**
Type: **0.010 Slotted PVC**
Interval: **13.8 to 28.8 ft bls**

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL RECOVERED_ONS LOG.GPJ S&ME.GDT 7/23/08

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COMPLETION REPORT OF WELL No. GM-10

PROJECT: **Oconee Nuclear Station**
PROJECT NO: **1264-07-234**
PROJECT LOCATION: **Seneca, SC**

GROUND SURFACE ELEVATION:
LOGGED BY: **735.3**
CHECKED BY: **Scott Dacus**

STRATA			WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)	WELL CONSTRUCTION DETAILS
DESCRIPTION	SYMBOL	DEPTH (ft.)					
							(See Page 1)
Manganese Staining and White, Medium to Fine Sand Seam at 29.90 ft bls							

LEGEND

	FILTER PACK	TOC	TOP OF CASING
	BENTONITE	GS	GROUND SURFACE
	CEMENT GROUT	BS	BENTONITE SEAL
	CUTTINGS / BACKFILL	FP	FILTER PACK
	STATIC WATER LEVEL	TSC	TOP OF SCREEN
		BSC	BOTTOM OF SCREEN
		TD	TOTAL DEPTH
		CG	CEMENT GROUT

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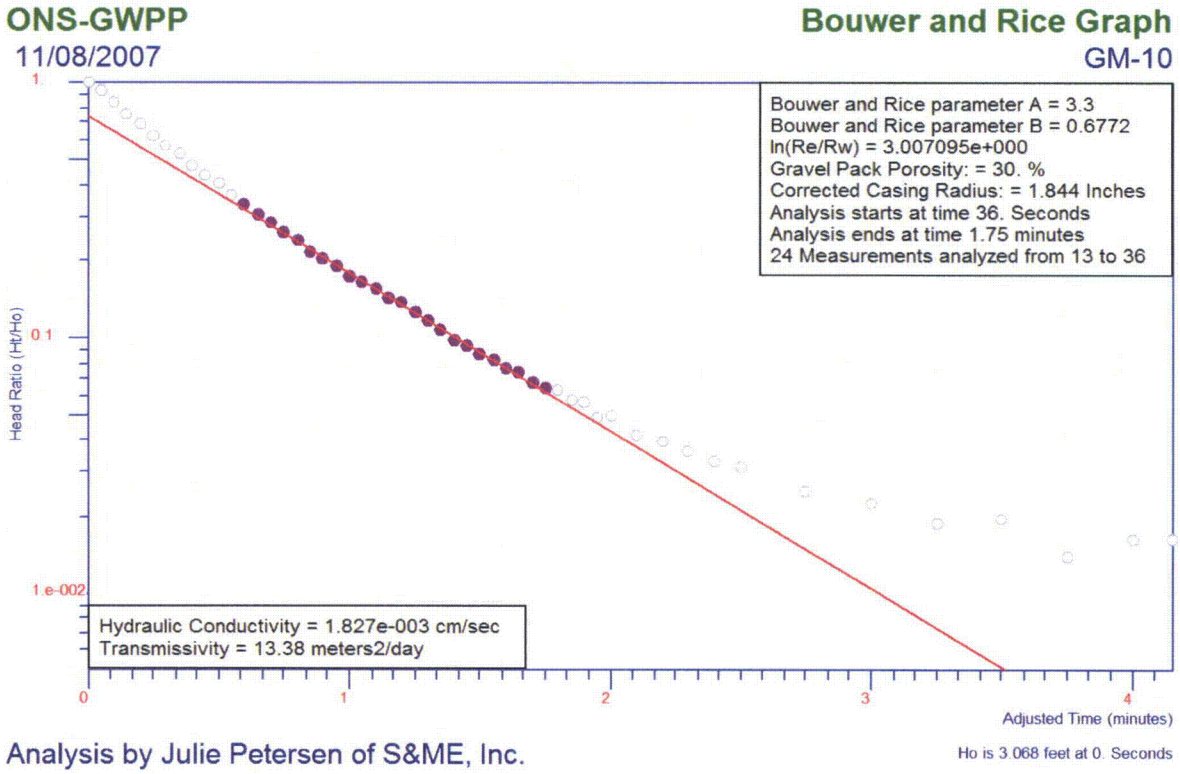
COMPLETION REPORT OF WELL No. GM-10

Calculation of Permeability By The Rising Head Method (Slug Test)

Site Name:	ONS-GWPP
Test Date:	11/8/2007
Well Label:	GM-10
Aquifer Thickness:	27.8 feet
Screen Length:	15. feet
Casing Radius:	1. Inches
Effective Radius:	3. Inches
Gravel Pack Porosity:	30.00%
Corrected Casing Radius:	1.844 Inches
Static Water Level:	6. feet
Water Table to Screen Bottom:	22.8 feet
Anisotropy Ratio:	1

Time Adjustment: 0. Seconds
Test starts with trial 0
There are 53 time and drawdown measurements
Maximum head is 3.068 feet
Minimum head is 0. feet

Calculation by Bouwer and Rice Graphical Method



PERMEABILITY

1.83×10^{-3} cm/sec

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Fax: 704-525-3953

ENGINEERING • TESTING
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1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.
2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

Project: **Oconee Nuclear Station**			**Boring No. GM-10R**
Location: **Seneca, SC**		Number: **1264-07-234**	Sheet No. 1 of 3
Boring Depth (ft): **88.0**	Elevation (ft): **735.3**	Driller: **Jay Little, SC Cert No. B1575**	Date Drilled: **10/22/07**
Logged By: **Scott Dacus**	Water Level: **Stabilized Water Level at 7.59 ft bls**		Drilling Method: **4¼" H.S.A.**

Elev. (Feet)	Depth (Feet)	Lith-ology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
735			PRE-DUG HOLE FOR UTILITY CLEARANCE:**FILL**		
730	5		FILL (F): Brown, Micaceous, Clayey, Silty, Medium to Fine **SAND**		
725	10		SOIL/SAPROLITE (M1): Red, Tan, and Brown, Micaceous, Medium to Fine Sandy, **SILT**	▼	7
720	15		SOIL/SAPROLITE (M1): Reddish-Orange, Micaceous, Clayey, **SILT**		12
715	20		SOIL/SAPROLITE (M1): Orange, Micaceous, Clayey, **SILT** With Manganese Nodules		4
710	25		SOIL/SAPROLITE (M1): White, Brown, and Gray, Micaceous, Silty, Medium to Fine **SAND**		4
705	30		SOIL/SAPROLITE (M1): Orange, Micaceous, Clayey, **SILT** With Manganese Staining and White, Medium to Fine Sand Seam at 29.90 ft bls		7
			SOIL/SAPROLITE (M1): Tan and White, Micaceous, Silty, Medium to Fine **SAND**		

BORING LOG WITH WELL RECOVERED_ONS LOG.GPJ LAGWGN01.GDT 7/23/08

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ENGINEERING • TESTING
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1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.
2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

Project: **Oconee Nuclear Station**			**Boring No. GM-10R**
Location: **Seneca, SC**		Number: **1264-07-234**	Sheet No. 2 of 3
Boring Depth (ft): **88.0**	Elevation (ft): **735.3**	Driller: **Jay Little, SC Cert No. B1575**	Date Drilled: **10/22/07**
Logged By: **Scott Dacus**	Water Level: **Stabilized Water Level at 7.59 ft bls**		Drilling Method: **4¼" H.S.A.**

Elev. (Feet)	Depth (Feet)	Lith-ology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
700					
	40				18, 24
695					
	45		SOIL/SAPROLITE (M1): Black and Orange, Silty, Medium to Fine **SAND** With Manganese Staining		17
690					
	50		SOIL/SAPROLITE (M1): Tan and White, Micaceous, Silty, Medium to Fine **SAND**		47
685					
	55		SOIL/SAPROLITE (M1): Black and Tan, Micaceous, Silty, Medium to Fine **SAND**		38
680					
	60		**Auger Refusal at 61.20 ft bls** **Resume Auger Drilling at 61.40 ft bls**		
675					
			ROCK LENSE: Medium-Grained **GRANITIC GNEISS**		
	65		WEATHERED ROCK (M2): When Sampled Becomes Black and Tan, Micaceous, Silty, Medium to Fine **SAND**		
670					
			Auger Refusal at 70.00 ft bls		

BORING LOG WITH WELL RECOVERED_ONS LOG.GPJ LAGWGN01.GDT 7/23/08

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ENGINEERING • TESTING
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2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

Project: **Oconee Nuclear Station**				**Boring No. GM-10R**
Location: **Seneca, SC**			Number: **1264-07-234**	Sheet No. 3 of 3
Boring Depth (ft): **88.0**	Elevation (ft): **735.3**		Driller: **Jay Little, SC Cert No. B1575**	Date Drilled: **10/22/07**
Logged By: **Scott Dacus**		Water Level: **Stabilized Water Level at 7.59 ft bls**		Drilling Method: **4¼" H.S.A.**

Elev. (Feet)	Depth (Feet)	Lith-ology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
665			WEATHERED ROCK (M2): When Sampled Becomes Black and Tan, Micaceous, Silty, Medium to Fine **SAND**; Mostly Core Loss		
660	75		WEATHERED ROCK (M2): Few Small Pieces of Medium-Grained **GRANITIC GNEISS** Recovered; Mostly Core Loss due to Soil Seams		
655	80		PARTIALLY WEATHERED/FRACTURED ROCK (WF): Medium-Grained **GRANITIC GNEISS** Intensely Fractured, Low Angle, High Angle and Horizontal Joints With Slight to No Staining		
650	85		**Boring Terminated at 88.00 ft bls**		

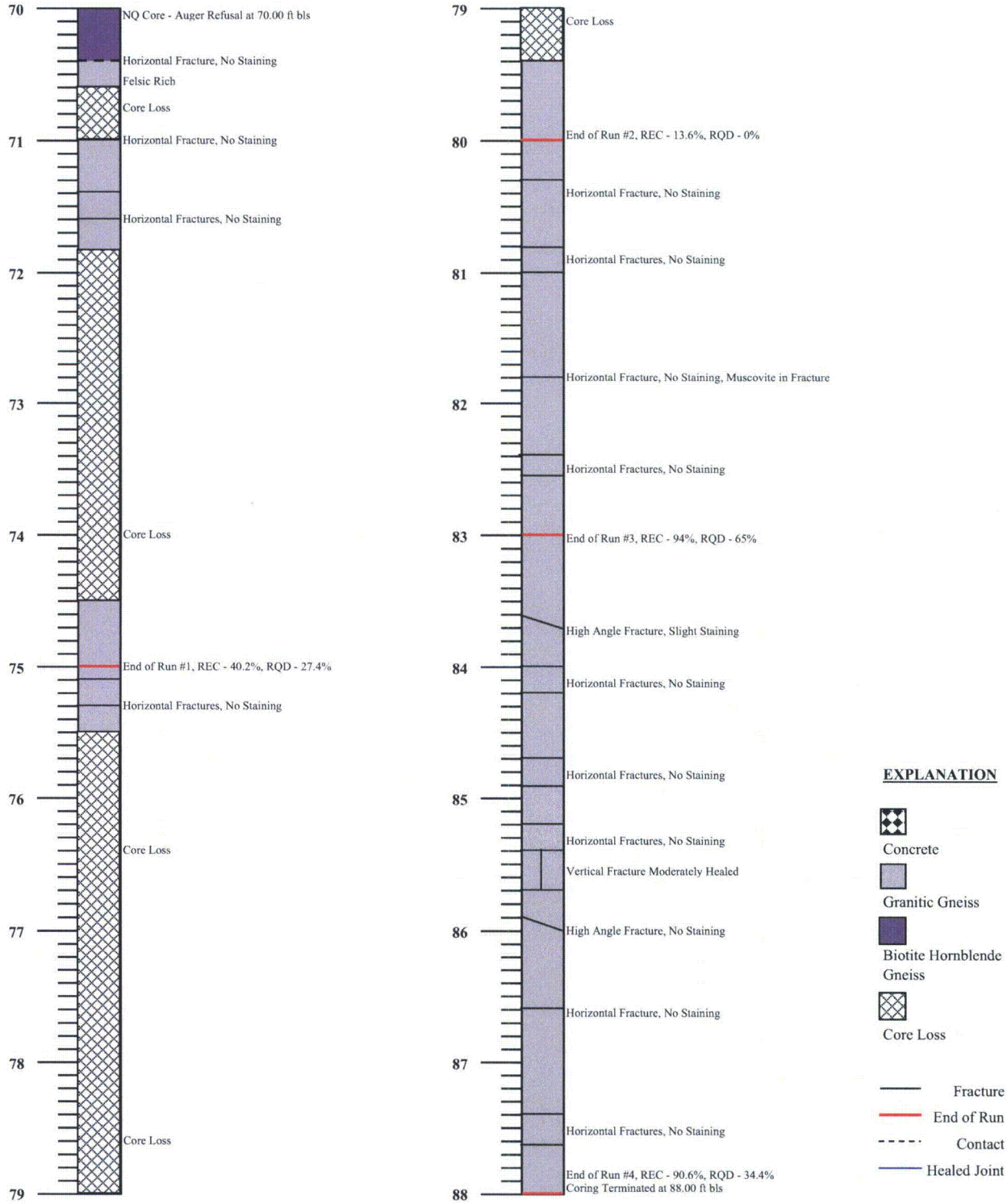
BORING LOG WITH WELL RECOVERED_ONS LOG.GPJ LAGWGN01.GDT 7/23/08

FIELD ROCK CORE LOG

Oconee Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-07-234

Core Location: GM-10R



COMPLETION REPORT OF WELL No. GM-10R

PROJECT: **Oconee Nuclear Station**
PROJECT NO: **1264-07-234**
PROJECT LOCATION: **Seneca, SC**

DRILLING CONTRACTOR: **S&ME, Inc.**
DRILLING METHOD: **4¼" H.S.A.**
DATE DRILLED: **10/22/07**

WATER LEVEL: **Stabilized Water Level at 7.59 ft bls**
LATITUDE: **34°47'38.229"**
LONGITUDE: **82°53'40.175"**
TOP OF CASING ELEVATION: **737.91**
DATUM: **MSL**
LOGGED BY: **Scott Dacus**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)
				0.00	GS	735.29
PRE-DUG HOLE FOR UTILITY CLEARANCE: **FILL**		0				
FILL (F): Brown, Micaceous, Clayey, Silty, Medium to Fine **SAND**		5				
SOIL/SAPROLITE (M1): Red, Tan, and Brown, Micaceous, Medium to Fine Sandy, **SILT**		10				
SOIL/SAPROLITE (M1): Reddish-Orange, Micaceous, Clayey, **SILT**		15				
		20				
SOIL/SAPROLITE (M1): Orange, Micaceous, Clayey, **SILT** With Manganese Nodules		25				
SOIL/SAPROLITE (M1): White, Brown, and Gray, Micaceous, Silty, Medium to Fine **SAND**		30				
SOIL/SAPROLITE (M1): Orange, Micaceous, Clayey, **SILT** With						

WELL CONSTRUCTION DETAILS

PROTECTIVE CASING
Diameter:
Type:
Interval:

RISER CASING
Diameter: **2"**
Type: **Sch. 40 PVC**
Interval: **0 to 83 ft bls**

GROUT
Type: **Neat Cement**
Interval: **0 to 80 ft bls**

SEAL
Type: **K-packer**
Interval: **82.43 to 82.63**

FILTERPACK
Type:
Interval:

SCREEN
Diameter: **2"**
Type: **0.010 Slotted PVC**
Interval: **83 to 88 ft bls**

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

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COMPLETION REPORT OF WELL No. GM-10R

PROJECT: **Oconee Nuclear Station**
PROJECT NO: **1264-07-234**
PROJECT LOCATION: **Seneca, SC**

GROUND SURFACE ELEVATION:
LOGGED BY: **735.3**
CHECKED BY: **Scott Dacus**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)	WELL CONSTRUCTION DETAILS
							(See Page 1)
Manganese Staining and White, Medium to Fine Sand Seam at 29.90 ft bls SOIL/SAPROLITE (M1): Tan and White, Micaceous, Silty, Medium to Fine **SAND** *(continued)*		35 40					
SOIL/SAPROLITE (M1): Black and Orange, Silty, Medium to Fine **SAND** With Manganese Staining		45					
SOIL/SAPROLITE (M1): Tan and White, Micaceous, Silty, Medium to Fine **SAND**		50					
SOIL/SAPROLITE (M1): Black and Tan, Micaceous, Silty, Medium to Fine **SAND**		55 60					
ROCK LENSE: Medium-Grained **GRANITIC GNEISS** WEATHERED ROCK (M2): When Sampled Becomes Black and Tan, Micaceous, Silty, Medium to Fine **SAND**		65					
WEATHERED ROCK (M2): When Sampled Becomes Black and Tan, Micaceous, Silty, Medium to Fine **SAND**; Mostly Core Loss		70 75					

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL RECOVERED_ONS LOG.GPJ S&ME.GDT 7/23/08

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COMPLETION REPORT OF
WELL No. GM-10R

PROJECT: **Oconee Nuclear Station**
PROJECT NO: **1264-07-234**
PROJECT LOCATION: **Seneca, SC**

GROUND SURFACE ELEVATION:
LOGGED BY: **735.3**
CHECKED BY: **Scott Dacus**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)
WEATHERED ROCK (M2): Few Small Pieces of Medium-Grained **GRANITIC GNEISS** Recovered; Mostly Core Loss due to Soil Seams *(continued)*		80		80.00		655.29
				82.43		652.86
				82.63		652.66
				83.00		652.29
PARTIALLY WEATHERED/FRACTURED ROCK (WF): Medium-Grained **GRANITIC GNEISS** Intensely Fractured, Low Angle, High Angle and Horizontal Joints With Slight to No Staining		85		87.50		647.79
				88.00		647.29

WELL CONSTRUCTION DETAILS

(See Page 1)

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL RECOVERED_ONS LOG.GPJ S&ME.GDT 7/23/08

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COMPLETION REPORT OF WELL No. GM-10R

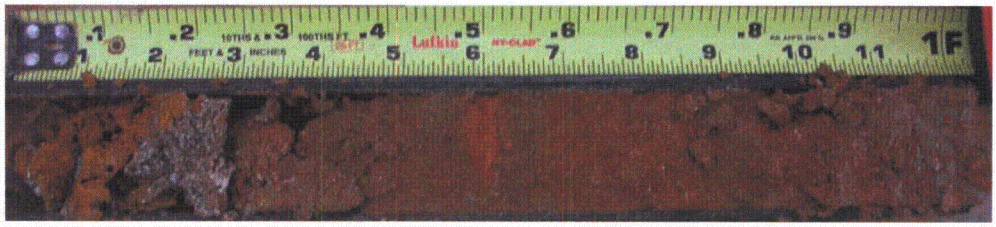
SPLIT SPOON SAMPLE PICTURES

Oconee Nuclear Station - Groundwater Protection Project

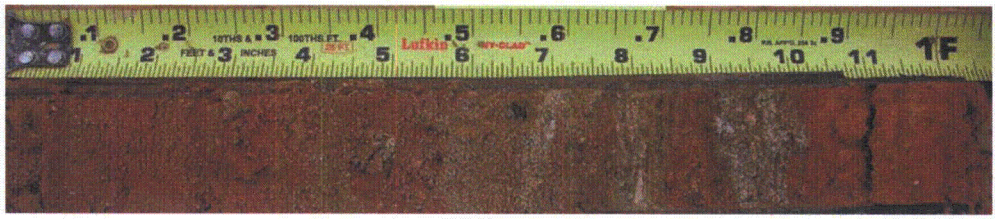
S&ME Project No: 1264-07-234

Boring Number: GM-10R

Sample No:	**1**
Depth (ft-bls):	**8.5 - 10**
Blow Count:	**1 * 3 * 4**



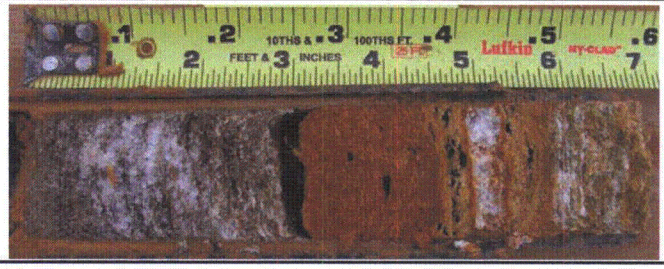
Sample No:	**2**
Depth (ft-bls):	**13.5 - 15**
Blow Count:	**1 * 5 * 7**



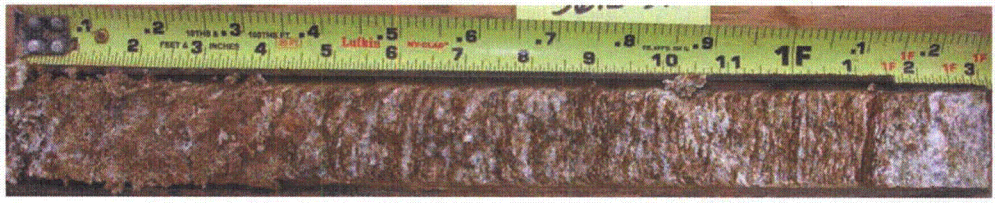
Sample No:	**3**
Depth (ft-bls):	**18.5 - 20**
Blow Count:	**1 * 2 * 2**

Sample No:	**4**
Depth (ft-bls):	**23.5 - 25**
Blow Count:	**2 * 2 * 2**

Sample No:	**5**
Depth (ft-bls):	**28.5 - 30**
Blow Count:	**2 * 3 * 4**



Sample No:	**6**
Depth (ft-bls):	**36.5 - 38**
Blow Count:	**7 * 8 * 10**



SPLIT SPOON SAMPLE PICTURES

Oconee Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-07-234

Boring Number: GM-10R

Sample No: 7 **Depth (ft-bls):** 38.5 - 40 **Blow Count:** 9 * 11 * 13	
Sample No: 8 **Depth (ft-bls):** 43.5 - 45 **Blow Count:** 5 * 7 * 10	
Sample No: 9 **Depth (ft-bls):** 48.5 - 50 **Blow Count:** 9 * 14 * 33	
Sample No: 10 **Depth (ft-bls):** 53.5 - 55 **Blow Count:** 12 * 16 * 22	

ROCK CORE PICTURES

Oconee Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-07-234

Core Location: GM-10R

CLASSIFICATION:

70.00' to 75.00': Soil

75.00' to 80.00': Medium-Grained Granitic Gneiss With Soil Seams

80.00' to 88.00': Medium-Grained Granitic Gneiss

CALCULATION OF PERMEABILITY BY THE FALLING HEAD METHOD (Open Hole in Uniform Material)

S&ME

Site Name:	ONS - GWPP	
Date:	10/24/2007	
Boring I.D.	GM-10R	
Test Interval:	70' to 75'	(Weathered Rock)
Total Depth of Hole:	75 ft	2286.59 cm
Length of Open Hole:	5 ft	152.44 cm
Transformation Ratio m=	1	
Performed by:	Scott Dacus	

Time (sec)	Head (cm)	Permeability (cm/sec)
0	984.09	
60	975.88	2.45E-05
120	971.13	1.43E-05
180	967.59	1.07E-05
240	964.79	8.50E-06
300	962.38	7.32E-06
360	960.30	6.31E-06
420	958.48	5.58E-06
480	956.80	5.13E-06
540	955.24	4.76E-06
600	953.81	4.39E-06
900	947.50	3.89E-06
1200	941.98	3.42E-06
1500	936.89	3.17E-06
1800	932.10	3.00E-06
2400	923.72	2.65E-06
3000	916.80	2.20E-06
3600	911.22	1.79E-06

Calculations

$$K_h = \frac{d^2 \cdot \ln\left(\frac{2mL}{D}\right)}{8 \cdot L \cdot (t_2 - t_1)} \cdot \ln\frac{H_1}{H_2}$$

for $\frac{mL}{D} > 4$

Where:

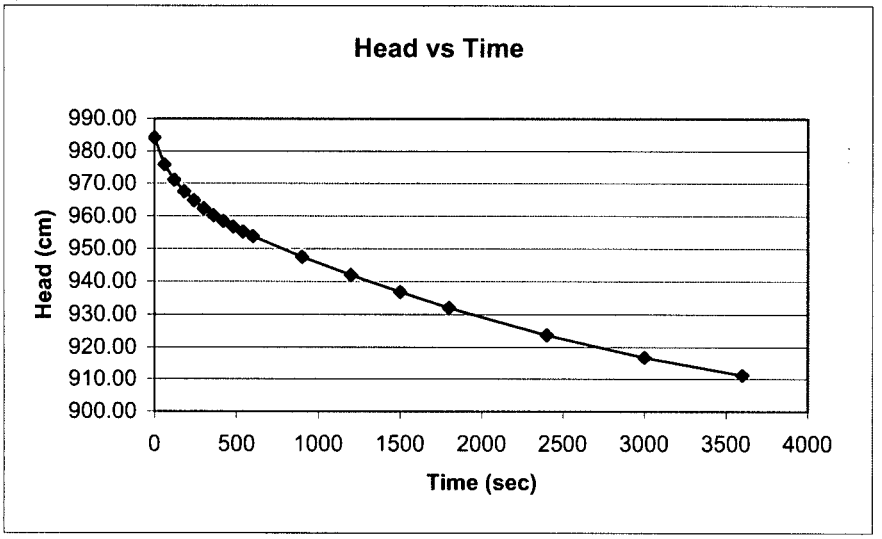
- K_h is the Horizontal Coefficient of Permeability (cm/sec)
- H_1 is the Piezometric Head for time; $t = t_1$ (cm)
- H_2 is the Piezometric Head for time; $t = t_2$ (cm)
- D is the Diameter of the Standpipe (cm)
- d is the diameter of the Open Length (cm),
- m is the Transformation Ratio, Where $m = \sqrt{K_h / K_v}$
  - K_h is the Horizontal Permeability
  - K_v is the Vertical Permeability
- L is the Open Length of Hole (cm)

Spreadsheet assumes 3" ID Pipe; NQ Hole, OD = 3"

MEAN PERMEABILITY (cm/sec)

6.56E-06

Graph of Field Data



CALCULATION OF PERMEABILITY BY THE FALLING HEAD METHOD (Open Hole in Uniform Material)

S&ME

Site Name:	ONS - GWPP		
Date:	10/23/2007		
Boring I.D.	GM-10R		
Test Interval:	33.5' to 36.5'	(Soil Saprolite)	
Total Depth of Hole:	36.5 ft	1112.8 cm	
Length of Open Hole:	3 ft	91.46 cm	
Transformation Ratio m=	1		
Performed by:	Scott Dacus		

Time (sec)	Head (cm)	Permeability (cm/sec)
0	486.40	
60	482.87	3.07E-05
120	480.73	1.86E-05
180	478.84	1.66E-05
240	477.16	1.47E-05
300	475.58	1.40E-05
360	474.18	1.24E-05
420	472.87	1.16E-05
480	471.65	1.09E-05
540	470.49	1.03E-05
600	469.42	9.54E-06
900	464.73	8.45E-06
1200	460.79	7.15E-06
1500	457.38	6.25E-06
1800	454.27	5.74E-06
2400	448.81	5.08E-06
3000	444.02	4.51E-06
3600	439.76	4.06E-06

Calculations

$$K_h = \frac{d^2 \cdot \ln\left(\frac{2mL}{D}\right)}{8 \cdot L \cdot (t_2 - t_1)} \cdot \ln\frac{H_1}{H_2}$$

for $\frac{mL}{D} > 4$

Where:

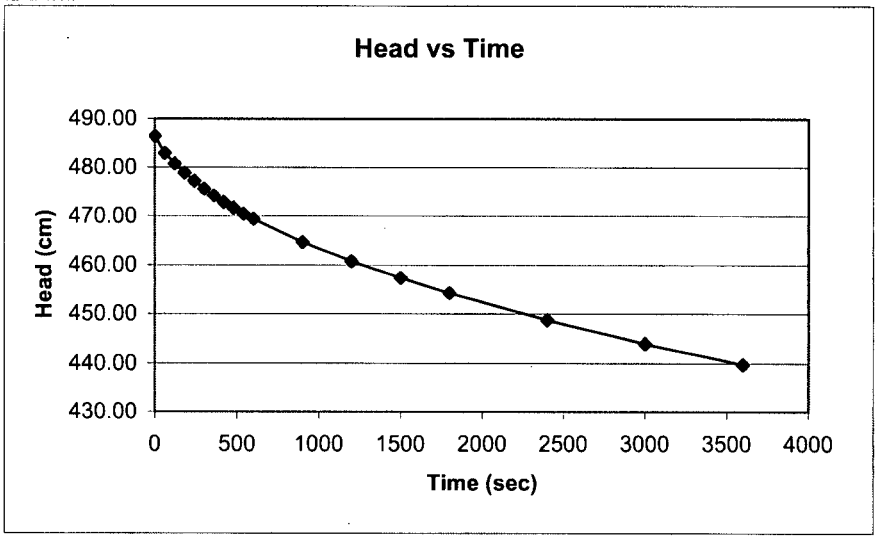
- K_h is the Horizontal Coefficient of Permeability (cm/sec)
- H_1 is the Piezometric Head for time; $t = t_1$ (cm)
- H_2 is the Piezometric Head for time; $t = t_2$ (cm)
- D is the Diameter of the Standpipe (cm)
- d is the diameter of the Open Length (cm),
- m is the Transformation Ratio, Where $m = \sqrt{K_h / K_v}$
  - K_h is the Horizontal Permeability
  - K_v is the Vertical Permeability
- L is the Open Length of Hole (cm)

Spreadsheet assumes 3" ID Pipe; NQ Hole, OD = 3"

MEAN PERMEABILITY (cm/sec)

1.12E-05

Graph of Field Data



CALCULATION OF PERMEABILITY BY THE FALLING HEAD METHOD (Open Hole in Uniform Material)

S&ME

Site Name:	ONS - GWPP	
Date:	10/24/2007	
Boring I.D.	GM-10R	
Test Interval:	70' to 80'	(Weathered Rock)
Total Depth of Hole:	80 ft	2439.02 cm
Length of Open Hole:	10 ft	304.88 cm
Transformation Ratio m=	1	
Performed by:	Scott Dacus	

Time (sec)	Head (cm)	Permeability (cm/sec)
0	1132.38	
15	1094.97	2.34E-04
30	1072.93	1.41E-04
45	1059.42	8.81E-05
60	1050.18	6.09E-05
75	1043.48	4.46E-05
90	1038.45	3.36E-05

Calculations

$$K_h = \frac{d^2 \cdot \ln\left(\frac{2mL}{D}\right)}{8 \cdot L \cdot (t_2 - t_1)} \cdot \ln\frac{H_1}{H_2}$$

for $\frac{mL}{D} > 4$

Where:

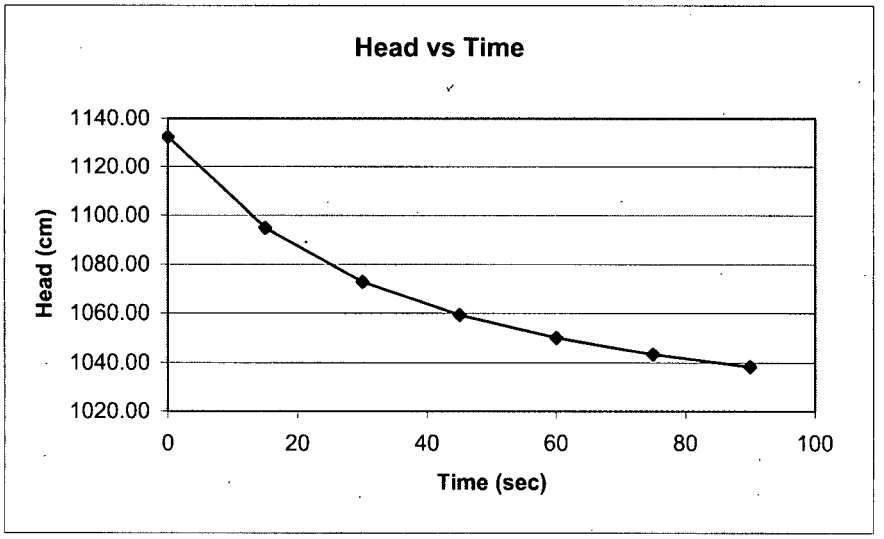
- K_h is the Horizontal Coefficient of Permeability (cm/sec)
- H_1 is the Piezometric Head for time; $t = t_1$ (cm)
- H_2 is the Piezometric Head for time; $t = t_2$ (cm)
- D is the Diameter of the Standpipe (cm)
- d is the diameter of the Open Length (cm),
- m is the Transformation Ratio, Where $m = \sqrt{K_h / K_v}$
  - K_h is the Horizontal Permeability
  - K_v is the Vertical Permeability
- L is the Open Length of Hole (cm)

Spreadsheet assumes 3" ID Pipe; NQ Hole, OD = 3"

MEAN PERMEABILITY (cm/sec)

1.00E-04

Graph of Field Data

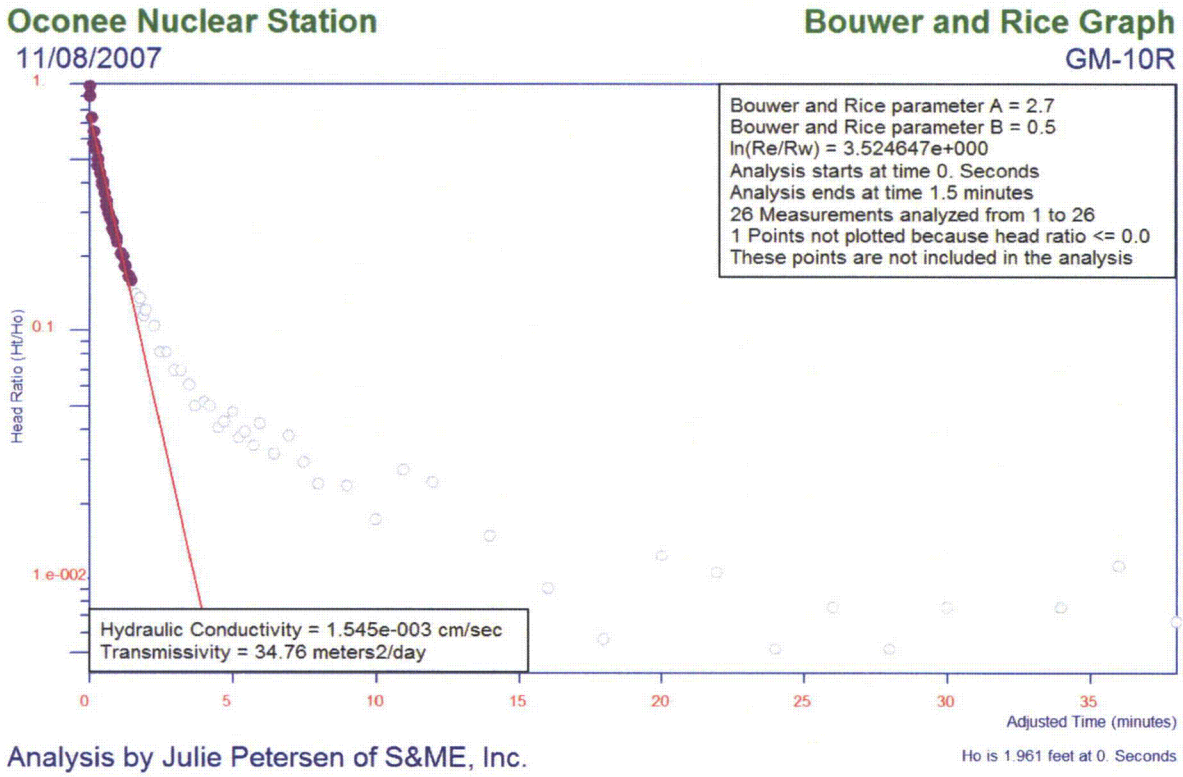


Calculation of Permeability By The Rising Head Method (Slug Test)

Site Name:	ONS-GWPP
Test Date:	11/8/2007
Well Label:	GM-10R
Aquifer Thickness:	85.41 feet
Screen Length:	5. feet
Casing Radius:	1. Inches
Effective Radius:	1.5 Inches
Static Water Level:	7.59 feet
Water Table to Screen Bottom:	80.41 feet
Anisotropy Ratio:	1

Time Adjustment: 0. Seconds
Test starts with trial 0
There are 68 time and drawdown measurements
Maximum head is 1.961 feet
Minimum head is 0. feet

Calculation by Bouwer and Rice Graphical Method



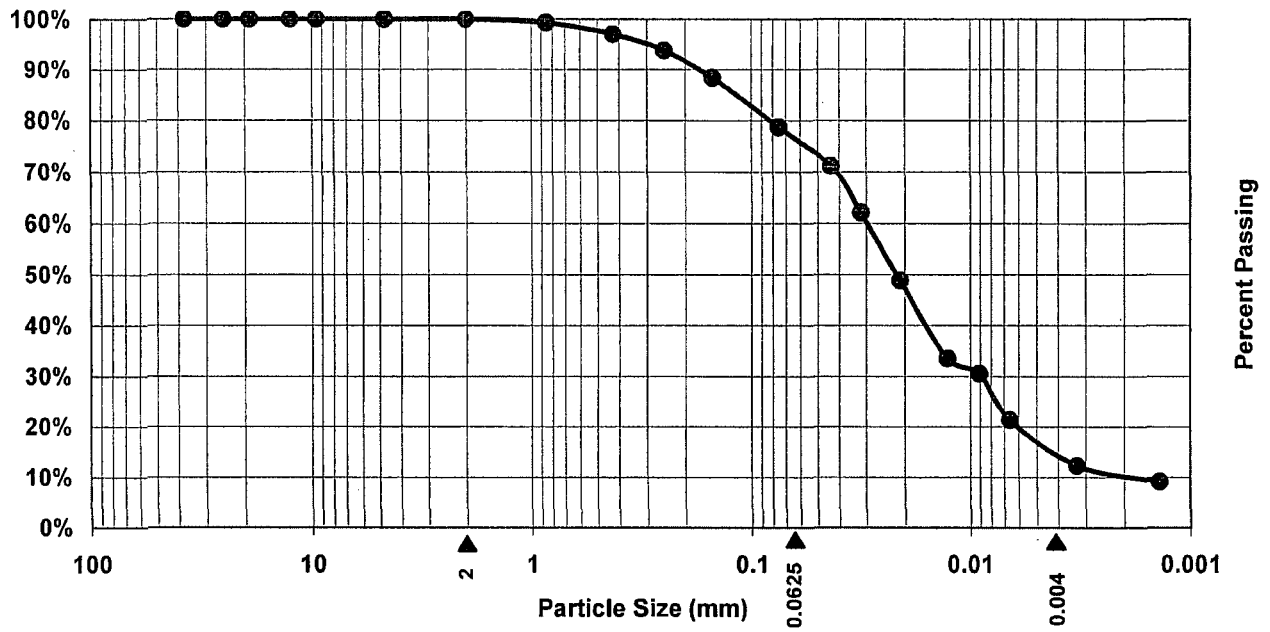
PERMEABILITY

1.55×10^{-3} cm/sec

PARTICLE SIZE ANALYSIS OF SOILS
FOR USE IN FETTER AND BEAR DIAGRAMS

Boring No.:	Sample No.:	Depth:
GM-10R	SS-4	23.5 to 25 ft bls

Sample Description:
M1: Orange, Clayey, Silt, With Medium to Fine Sand (ML)



	> 2 mm	2 mm - 0.0625 mm	0.0625 mm - 0.004 mm	<0.004 mm
From Graph:	% Gravel 0.0%	% Sand 23.7%	% Silt 62.1%	% Clay 14.2%
Adjusted for Calculations	**0%**	**24%**	**62%**	**14%**

Notes:
Grain size distribution taken from grain size with hydrometer data located in Appendix II.
Gravel, sand, silt and clay sizes based on Wentworth Scale.

S&ME Project:
Oconee Nuclear Station - GWPP

S&ME Project No.:
1264-07-234

S&ME

FETTER AND BEAR DIAGRAMS

S&ME PROJECT: Oconee Nuclear Station - GWPP
S&ME PROJECT NO.: 1264-07-234

Boring No. GM-10R

Boring Depth: 23.5 to 25 ft bls

% Sand: 24%

% Silt: 62%

% Clay: 14%

Estimated Specific Yield: 9%

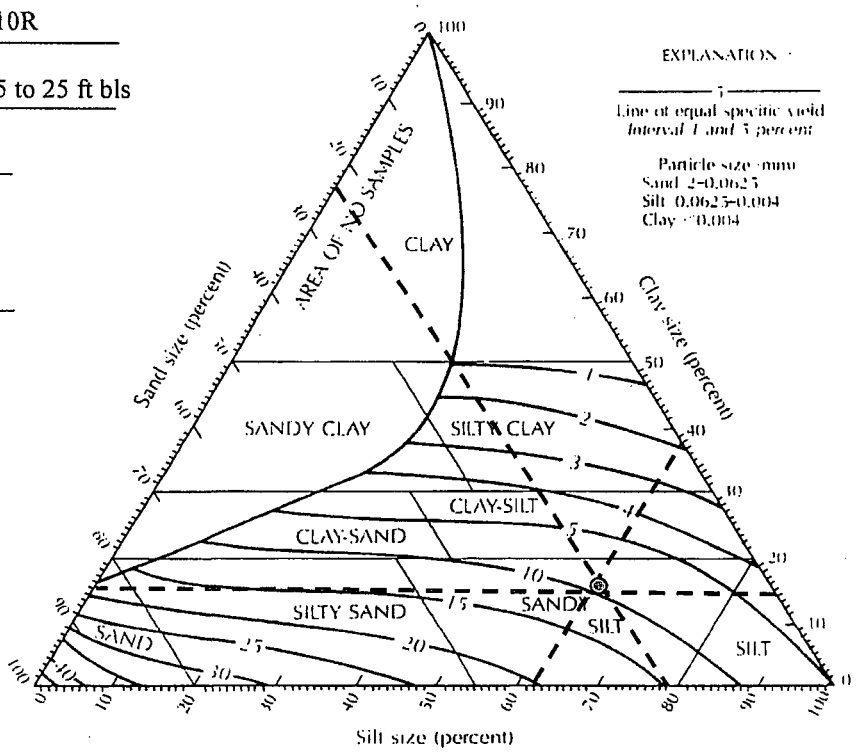
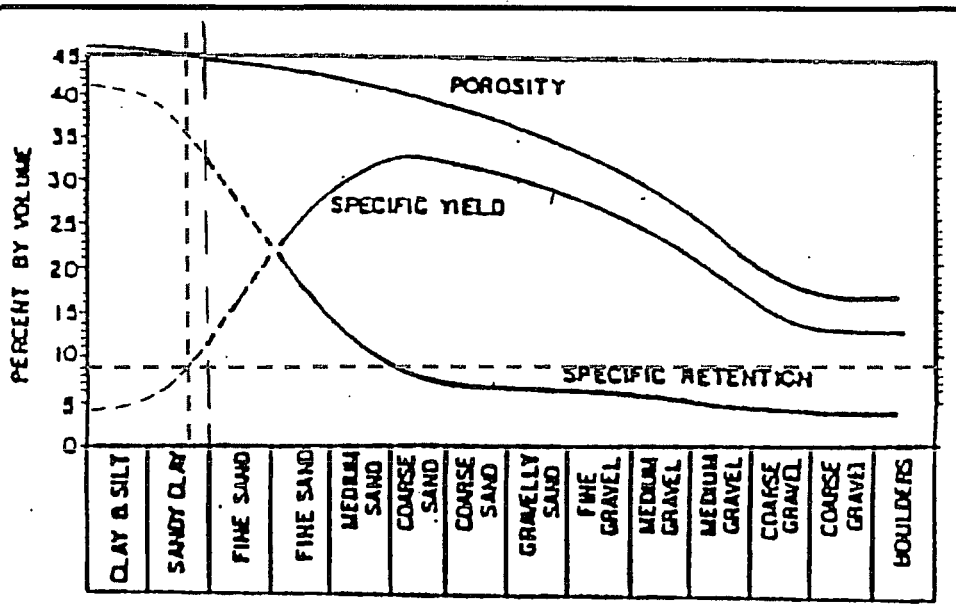


FIGURE 4.11 Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A. I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.



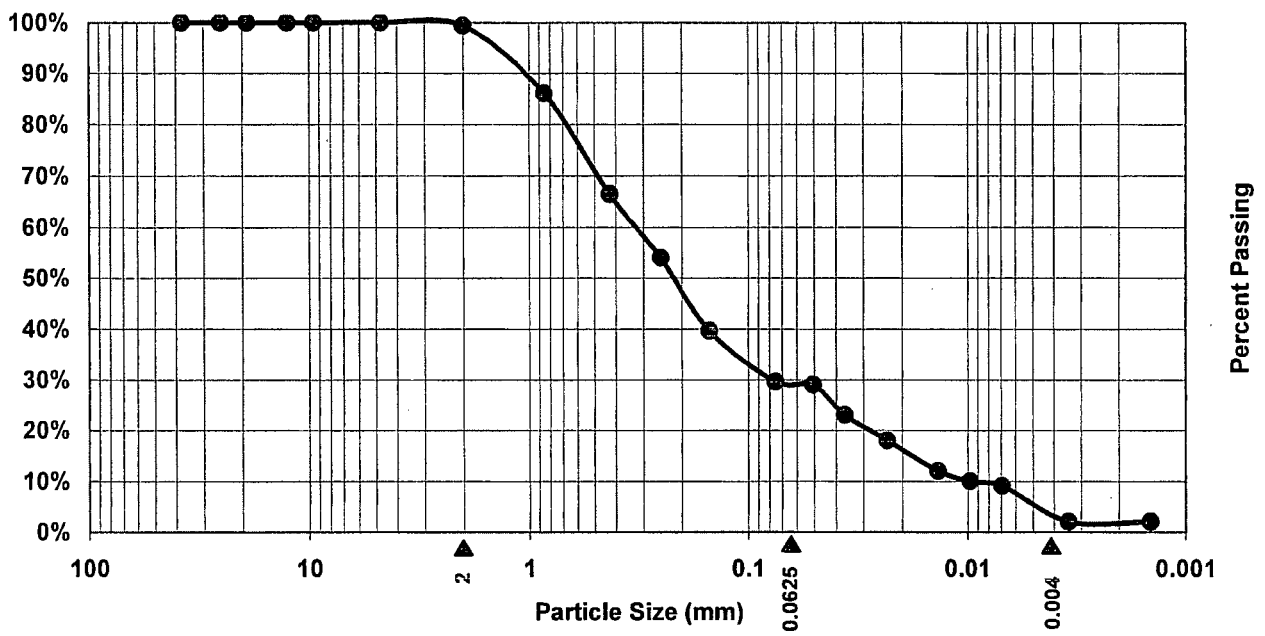
Estimated Porosity: 45%

Variation of Porosity, Specific Yield, and Specific Retention with Grain Size (after Bear, 1972)

PARTICLE SIZE ANALYSIS OF SOILS
FOR USE IN FETTER AND BEAR DIAGRAMS

Boring No.:	Sample No.:	Depth:
GM-10R	SS-6	36.5 to 38 ft bls

Sample Description:
M1: Tan and White, Silty, Medium to Fine Sand (SM)



	> 2 mm	2 mm - 0.0625 mm	0.0625 mm - 0.004 mm	<0.004 mm
From Graph:	% Gravel 0.6%	% Sand 70.0%	% Silt 26.2%	% Clay 3.2%
Adjusted for Calculations	**0%**	**70%**	**26%**	**3%**

Notes:
Grain size distribution taken from grain size with hydrometer data located in Appendix II.
Gravel, sand, silt and clay sizes based on Wentworth Scale.

S&ME Project:
Oconee Nuclear Station - GWPP

S&ME Project No.:
1264-07-234

S&ME

FETTER AND BEAR DIAGRAMS

S&ME PROJECT: Oconee Nuclear Station - GWPP
S&ME PROJECT NO.: 1264-07-234

Boring No. GM-10R

Boring Depth: 36.5 to 38 ft bls

% Sand: 70%

% Silt: 26%

% Clay: 3%

Estimated Specific Yield: 26%

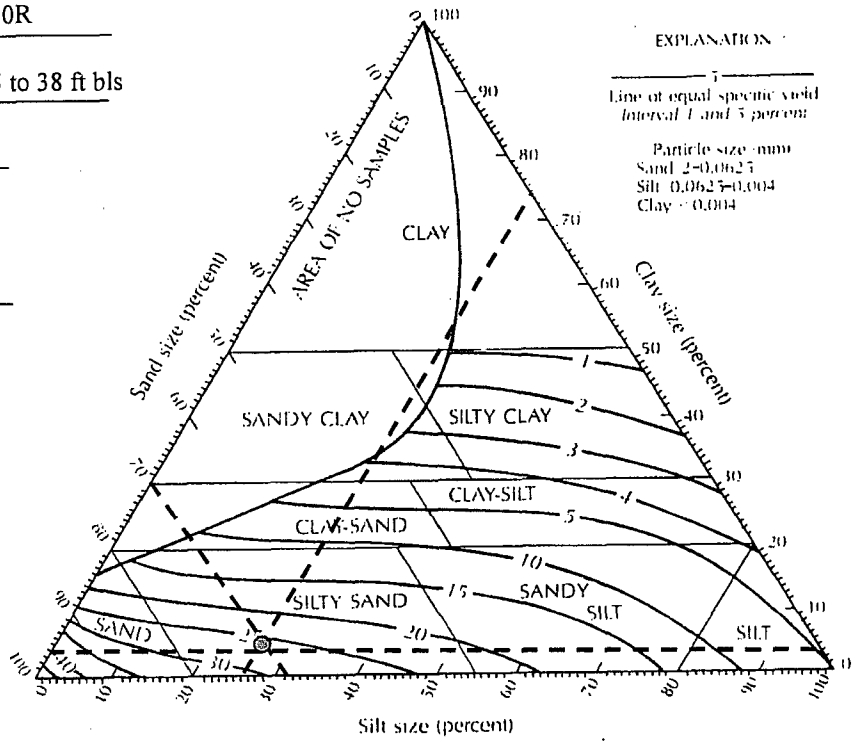
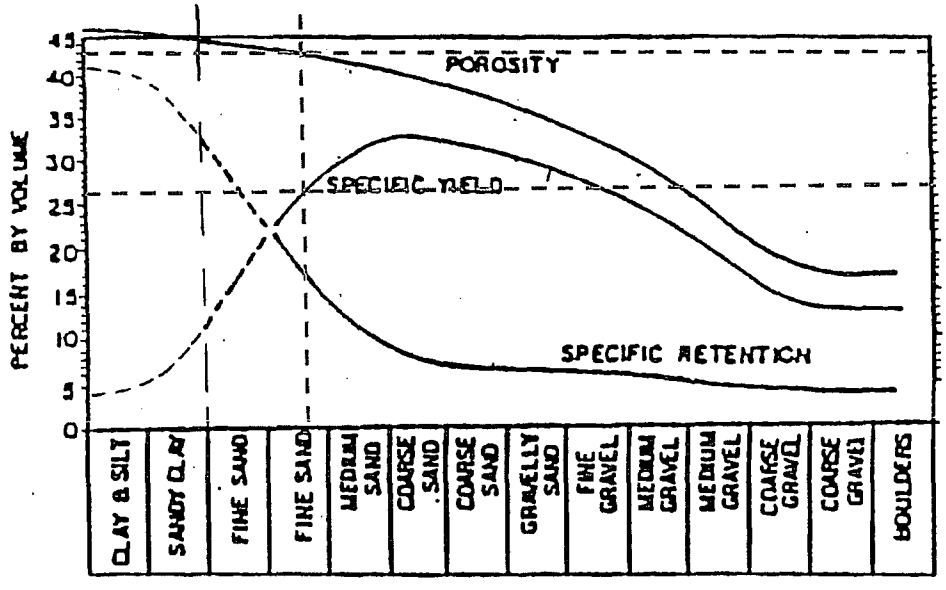


FIGURE 4.11 Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A. I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.



Estimated Porosity: 43%

Variation of Porosity, Specific Yield, and Specific Retention with Grain Size (after Bear, 1972)

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9751 Southern Pine Boulevard
Charlotte, North Carolina 28273
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Fax: 704-525-3953

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1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.
2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

Project: **Oconee Nuclear Station**			**Boring No. GM-11**
Location: **Seneca, SC**		Number: **1264-07-234**	Sheet No. 1 of 2
Boring Depth (ft): **40.0**	Elevation (ft): **720.4**	Driller: **Jay Little, SC Cert No. B1575**	Date Drilled: **9/25/07**
Logged By: **Scott Dacus**	Water Level: **Stabilized Water Level at 30.19 ft bls**		Drilling Method: **4¼" H.S.A.**

Elev. (Feet)	Depth (Feet)	Lith-ology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
720			**GRASS and TOPSOIL With GRAVEL**		
			FILL (F): Reddish-Brown, Clayey, **SILT**		
715	5		FILL (F): Light Brown, Micaceous, Medium to Fine Sandy, **SILT** With Roots		
710	10				
	15		FILL (F): Reddish-Brown, Micaceous, Medium to Fine Sandy, **SILT**		
705					
	20		FILL (F): Light Brown, Micaceous, Silty, Medium to Fine **SAND**		
700					
	25		FILL (F): Reddish-Brown, Silty, Medium to Fine **SAND** With Manganese Staining		
695					
	30		SOIL/SAPROLITE (M1): Light Brown and White, Silty, Medium to Fine **SAND**		
690					

BORING LOG WITH WELL RECOVERED ONS LOG.GPJ LAGWGN01.GDT 7/23/08

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9751 Southern Pine Boulevard
Charlotte, North Carolina 28273
Telephone: 704-523-4726
Fax: 704-525-3953

ENGINEERING • TESTING
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1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.
2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

Project: **Oconee Nuclear Station**			**Boring No. GM-11**
Location: **Seneca, SC**		Number: **1264-07-234**	Sheet No. 2 of 2
Boring Depth (ft): **40.0**	Elevation (ft): **720.4**	Driller: **Jay Little, SC Cert No. B1575**	Date Drilled: **9/25/07**
Logged By: **Scott Dacus**	Water Level: **Stabilized Water Level at 30.19 ft bls**		Drilling Method: **4¼" H.S.A.**

Elev. (Feet)	Depth (Feet)	Lith-ology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
685	35		SOIL/SAPROLITE (M1): Light Brown and White, Micaceous, Silty, Medium to Fine **SAND**. Layers of Brown, Very Micaceous, **SILT** at 40.42 ft and 40.48 ft bls		
	40		**Lithologic Description Obtained From GM-11R** **Boring Terminated at 40.00 ft bls**		

BORING LOG WITH WELL RECOVERED_ONS LOG.GPJ LAGWGN01.GDT 7/23/08

COMPLETION REPORT OF WELL No. GM-11

PROJECT: **Oconee Nuclear Station**
PROJECT NO: **1264-07-234**
PROJECT LOCATION: **Seneca, SC**

DRILLING CONTRACTOR: **S&ME, Inc.**
DRILLING METHOD: **4¼" H.S.A.**
DATE DRILLED: **9/25/07**

WATER LEVEL: **Stabilized Water Level at 30.19 ft bls**
LATITUDE: **34°47'35.017"**
LONGITUDE: **82°53'30.619"**
TOP OF CASING ELEVATION: **723.31**
DATUM: **MSL**
LOGGED BY: **Scott Dacus**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)
				0.00	GS	720.37
GRASS and TOPSOIL With GRAVEL		0				
FILL (F): Reddish-Brown, Clayey, **SILT**						
FILL (F): Light Brown, Micaceous, Medium to Fine Sandy, **SILT** With Roots		5				
		10				
FILL (F): Reddish-Brown, Micaceous, Medium to Fine Sandy, **SILT**		15				
FILL (F): Light Brown, Micaceous, Silty, Medium to Fine **SAND**		20		23.00		697.37
FILL (F): Reddish-Brown, Silty, Medium to Fine **SAND** With Manganese Staining		25		26.50		693.87
SOIL/SAPROLITE (M1): Light Brown and White, Silty, Medium to Fine **SAND**		30				

WELL CONSTRUCTION DETAILS

PROTECTIVE CASING
Diameter:
Type:
Interval:

RISER CASING
Diameter: **2"**
Type: **Sch. 40 PVC**
Interval: **0 to 28.5 ft bls**

GROUT
Type: **Neat Cement**
Interval: **0 to 23 ft bls**

SEAL
Type: **Bentonite**
Interval: **23 to 26.5 ft bls**

FILTERPACK
Type: **#1 Silica Sand**
Interval: **26.5 to 40 ft bls**

SCREEN
Diameter: **2"**
Type: **0.010 Slotted PVC**
Interval: **28.5 to 38.5 ft bls**

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL RECOVERED ONS LOG.GPJ S&ME.GDT 7/23/08

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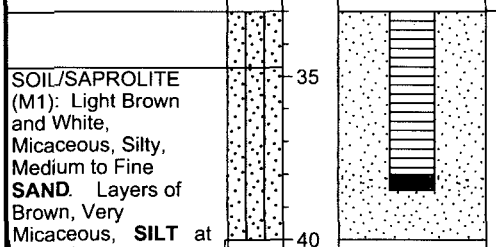
9751 Southern Pine Boulevard
Charlotte, North Carolina 28273

COMPLETION REPORT OF WELL No. GM-11

PROJECT: **Oconee Nuclear Station**
PROJECT NO: **1264-07-234**
PROJECT LOCATION: **Seneca, SC**

GROUND SURFACE ELEVATION:
LOGGED BY: **720.4**
CHECKED BY: **Scott Dacus**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)	WELL CONSTRUCTION DETAILS
							(See Page 1)
SOIL/SAPROLITE (M1): Light Brown and White, Micaceous, Silty, Medium to Fine **SAND**. Layers of Brown, Very Micaceous, **SILT** at 40.42 ft and 40.48 ft bls		35 40		38.00 38.50 40.00		682.37 681.87 680.37	



LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL RECOVERED_ONS.LOG.GPJ S&ME.GDT 7/23/08

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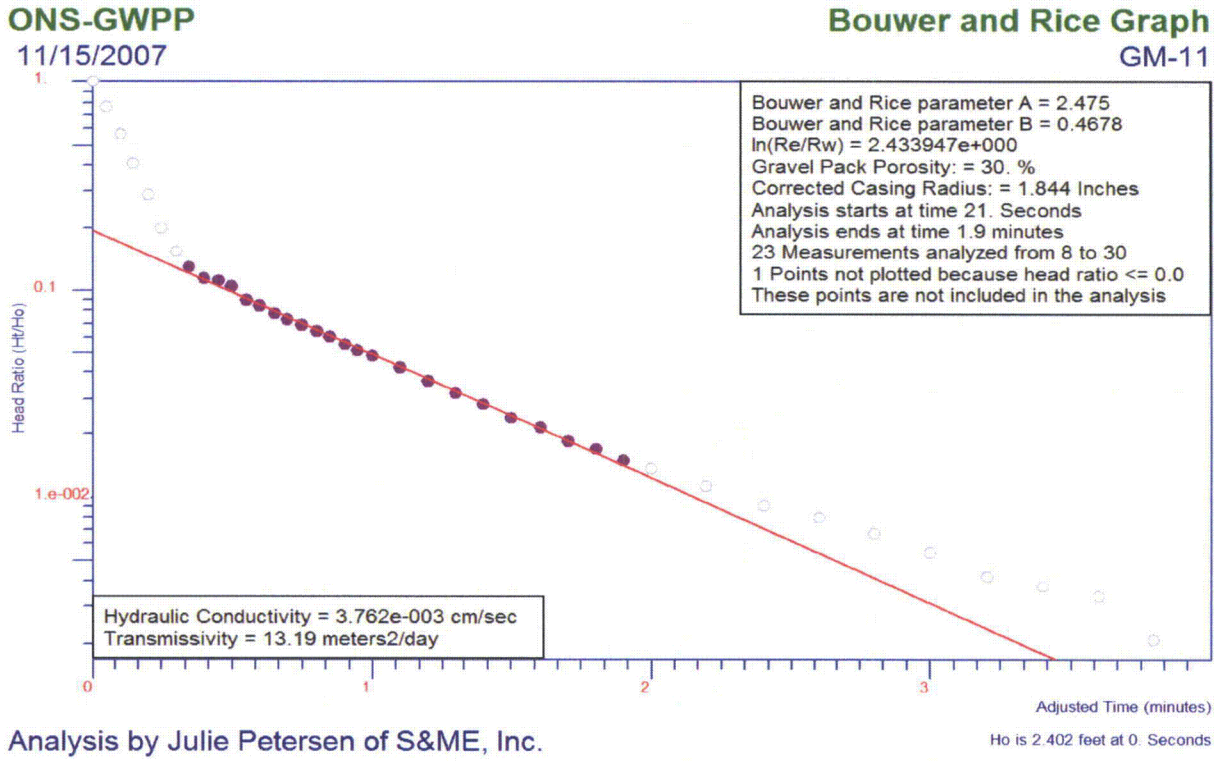
COMPLETION REPORT OF WELL No. GM-11

Calculation of Permeability By The Rising Head Method (Slug Test)

Site Name:	ONS-GWPP
Test Date:	11/15/2007
Well Label:	GM-11
Aquifer Thickness:	13.31 feet
Screen Length:	10. feet
Casing Radius:	1. Inches
Effective Radius:	3. Inches
Gravel Pack Porosity:	30.00%
Corrected Casing Radius:	1.844 Inches
Static Water Level:	30.19 feet
Water Table to Screen Bottom:	8.31 feet
Anisotropy Ratio:	1

Time Adjustment: 0. Seconds
Test starts with trial 0
There are 41 time and drawdown measurements
Maximum head is 2.402 feet
Minimum head is 0. feet

Calculation by Bouwer and Rice Graphical Method



PERMEABILITY

3.76×10^{-3} cm/sec

S&ME, Inc.
9751 Southern Pine Boulevard
Charlotte, North Carolina 28273
Telephone: 704-523-4726
Fax: 704-525-3953

ENGINEERING • TESTING
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1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.
2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

Project: **Oconee Nuclear Station**			**Boring No. GM-11R**
Location: **Seneca, SC**		Number: **1264-07-234**	Sheet No. 1 of 2
Boring Depth (ft): **70.2**	Elevation (ft): **720.5**	Driller: **Jay Little, SC Cert No. B1575**	Date Drilled: **9/20/07**
Logged By: **Scott Dacus**	Water Level: **Stabilized Water Level at 28.97 ft bls**		Drilling Method: **4¼" H.S.A.**

Elev. (Feet)	Depth (Feet)	Lith-ology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
720			**GRASS and TOPSOIL With GRAVEL**		
			FILL (F): Reddish-Brown, Clayey, **SILT**		
	5		FILL (F): Light Brown, Micaceous, Medium to Fine Sandy, **SILT** With Roots		6
715					
	10				5
710					
	15		FILL (F): Reddish-Brown, Micaceous, Medium to Fine Sandy, **SILT**		14
705					
	20		FILL (F): Light Brown, Micaceous, Silty, Medium to Fine **SAND**		6
700					
	25		FILL (F): Reddish-Brown, Silty, Medium to Fine **SAND** With Manganese Staining		14
695					
	30		SOIL/SAPROLITE (M1): Light Brown and White, Silty, Medium to Fine **SAND**	▼	13
690					
	35		SOIL/SAPROLITE (M1): Light Brown and White, Micaceous, Silty, Medium to Fine **SAND**. Layers of		15
685					

BORING LOG WITH WELL RECOVERED_ONS LOG.GPJ LAGWGN01.GDT 7/23/08

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Fax: 704-525-3953

ENGINEERING • TESTING
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1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.
2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

Project: **Oconee Nuclear Station**			**Boring No. GM-11R**
Location: **Seneca, SC**		Number: **1264-07-234**	Sheet No. 2 of 2
Boring Depth (ft): **70.2**	Elevation (ft): **720.5**	Driller: **Jay Little, SC Cert No. B1575**	Date Drilled: **9/20/07**
Logged By: **Scott Dacus**	Water Level: **Stabilized Water Level at 28.97 ft bls**		Drilling Method: **4¼" H.S.A.**

Elev. (Feet)	Depth (Feet)	Material Description
		Brown, Very Micaceous, **SILT** at 40.42 ft and 40.48 ft bls
680	40	
		SOIL/SAPROLITE (M1): White, Yellow, and Brown, Micaceous, Silty, Medium to Fine **SAND**
675	45	
		WEATHERED ROCK (M2): When Sampled Becomes, White, Yellow, and Brown, Micaceous, Silty, Medium to Fine **SAND**
670	50	**Auger Refusal at 50.60 ft bls**
		SOUND ROCK (D): Medium-Grained **GRANITIC GNEISS** With Intermittent Medium-Grained **BIOTITE HORNBLENDE GNEISS** Moderately Fractured, Low Angle and High Angle Joints With Moderate to No Staining
665	55	
660	60	
655	65	
	70	**Boring Terminated at 70.20 ft bls**

Well Construction

Penetration Resistance (Blows/Foot)
0 50 100
11
32
50/3

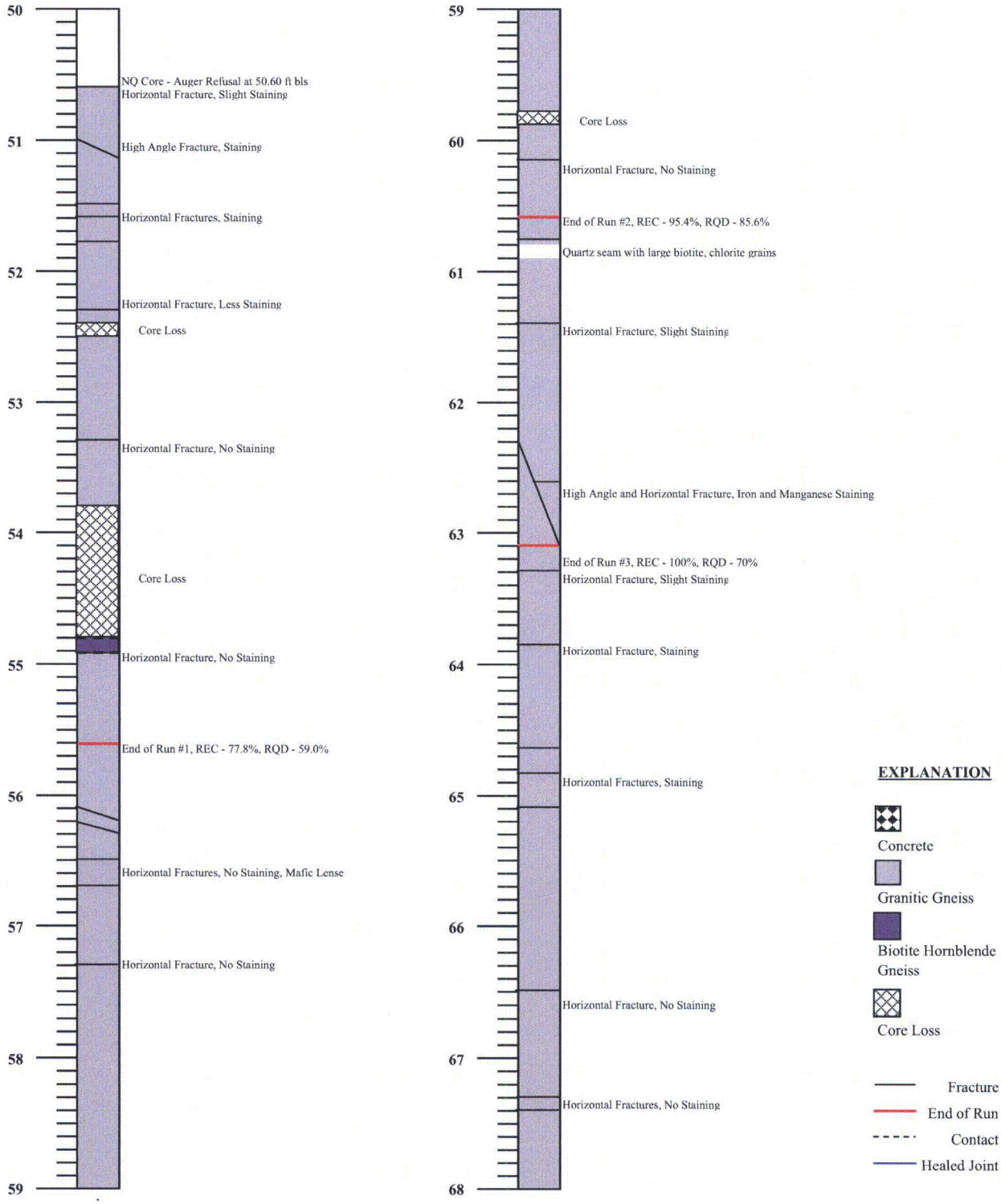
BORING LOG WITH WELL RECOVERED_ONS LOG.GPJ LAGWGN01.GDT 7/23/08

FIELD ROCK CORE LOG

Oconee Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-07-234

Core Location: GM-11R

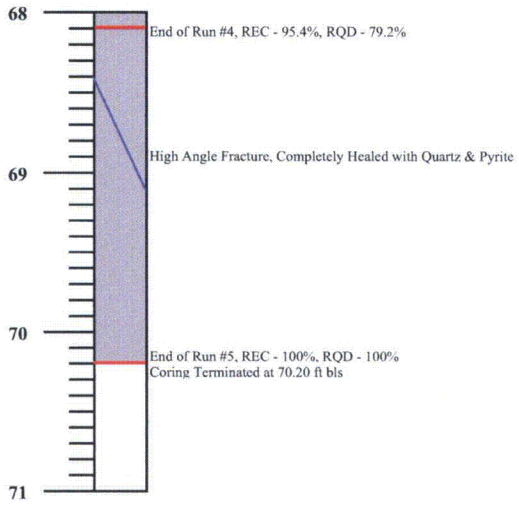


FIELD ROCK CORE LOG

Oconee Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-07-234

Core Location: GM-11R



EXPLANATION

Concrete

Granitic Gneiss

Biotite Hornblende Gneiss

Core Loss

Fracture

End of Run

Contact

Healed Joint

COMPLETION REPORT OF WELL No. GM-11R

PROJECT: **Oconee Nuclear Station**
PROJECT NO: **1264-07-234**
PROJECT LOCATION: **Seneca, SC**

DRILLING CONTRACTOR: **S&ME, Inc.**
DRILLING METHOD: **4¼" H.S.A.**
DATE DRILLED: **9/20/07**

WATER LEVEL: **Stabilized Water Level at 28.97 ft bls**
LATITUDE: **34°47'35.052"**
LONGITUDE: **82°53'30.574"**
TOP OF CASING ELEVATION: **723.48**
DATUM: **MSL**
LOGGED BY: **Scott Dacus**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)
GRASS and TOPSOIL With GRAVEL		0
FILL (F): Reddish-Brown, Clayey, **SILT**		
FILL (F): Light Brown, Micaceous, Medium to Fine Sandy, **SILT** With Roots		5
		10
FILL (F): Reddish-Brown, Micaceous, Medium to Fine Sandy, **SILT**		15
FILL (F): Light Brown, Micaceous, Silty, Medium to Fine **SAND**		20
		25
FILL (F): Reddish-Brown, Silty, Medium to Fine **SAND** With Manganese Staining		
SOIL/SAPROLITE (M1): Light Brown and White, Silty, Medium to Fine **SAND**		30
		35

WELL DETAILS

DEPTH (ft.)	LEGEND	ELEVATION (ft.)
0.00	GS	720.49

WELL CONSTRUCTION DETAILS

PROTECTIVE CASING
Diameter:
Type:
Interval:

RISER CASING
Diameter: **2"**
Type: **Sch. 40 PVC**
Interval: **0 to 61.5 ft bls**

GROUT
Type: **Neat Cement**
Interval: **0 to 58 ft bls**

SEAL
Type: **K-packer**
Interval: **60.8 to 61 ft bls**

FILTERPACK
Type:
Interval:

SCREEN
Diameter: **2"**
Type: **0.010 Slotted PVC**
Interval: **61.5 to 66.5 ft bls**

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL RECOVERED_ONS LOG.GPJ S&ME.GDT 7/23/08

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Charlotte, North Carolina 28273

COMPLETION REPORT OF WELL No. GM-11R

PROJECT: **Oconee Nuclear Station**
PROJECT NO: **1264-07-234**
PROJECT LOCATION: **Seneca, SC**

GROUND SURFACE ELEVATION: **720.5**
LOGGED BY: **Scott Dacus**
CHECKED BY:

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)
SOIL/SAPROLITE (M1): Light Brown and White, Micaceous, Silty, Medium to Fine **SAND**. Layers of Brown, Very Micaceous, **SILT** at 40.42 ft and 40.48 ft bls *(continued)*		40				
SOIL/SAPROLITE (M1): White, Yellow, and Brown, Micaceous, Silty, Medium to Fine **SAND**		45				
WEATHERED ROCK (M2): When Sampled Becomes, White, Yellow, and Brown, Micaceous, Silty, Medium to Fine **SAND** **Auger Refusal at 50.60 ft bls**		50				
SOUND ROCK (D): Medium-Grained **GRANITIC GNEISS** With Intermittent Medium-Grained **BIOTITE HORNBLENDE GNEISS**; Moderately Fractured, Low Angle and High Angle Joints With Moderate to No Staining		55		58.00		662.49
		60		60.80		659.69
				61.00		659.49
				61.50		658.99
		65		66.00		654.49
				66.50		653.99
				68.20		652.29
		70		70.20		650.29

WELL CONSTRUCTION DETAILS

(See Page 1)

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL RECOVERED_ONS LOG.GPJ S&ME.GDT 7/23/08

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COMPLETION REPORT OF WELL No. GM-11R

SPLIT SPOON SAMPLE PICTURES

Oconee Nuclear Station - Groundwater Protection Project

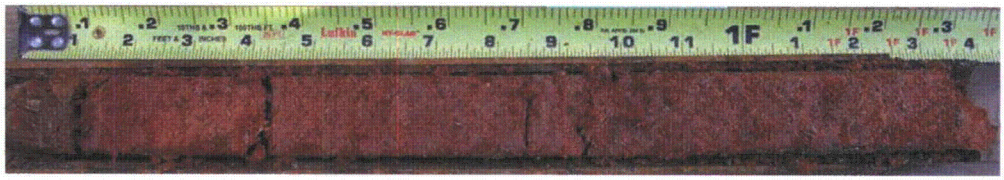
S&ME Project No: 1264-07-234

Boring Number: GM-11R

Sample No:	**1**
Depth (ft-bls):	**4 - 5.5**
Blow Count:	**3 * 3 * 3**

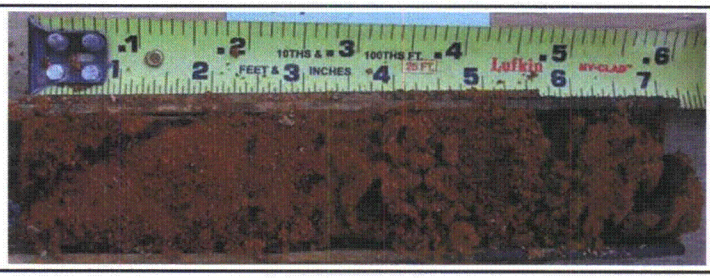
Sample No:	**2**
Depth (ft-bls):	**9 -10.5**
Blow Count:	**2 * 2 * 3**

Sample No:	**3**
Depth (ft-bls):	**14 - 15.5**
Blow Count:	**3 * 6 * 8**

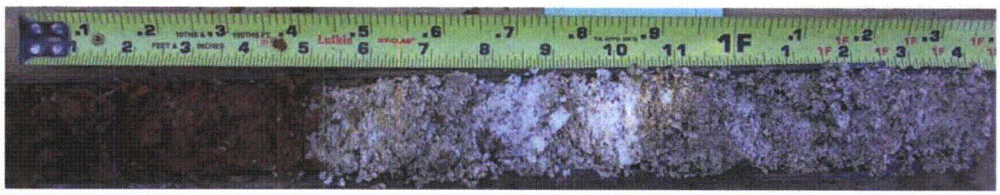


Sample No:	**4**
Depth (ft-bls):	**19 - 20.5**
Blow Count:	**4 * 3 * 3**

Sample No:	**5**
Depth (ft-bls):	**24 - 25.5**
Blow Count:	**5 * 6 * 8**



Sample No:	**6**
Depth (ft-bls):	**29 - 30.5**
Blow Count:	**4 * 5 * 8**

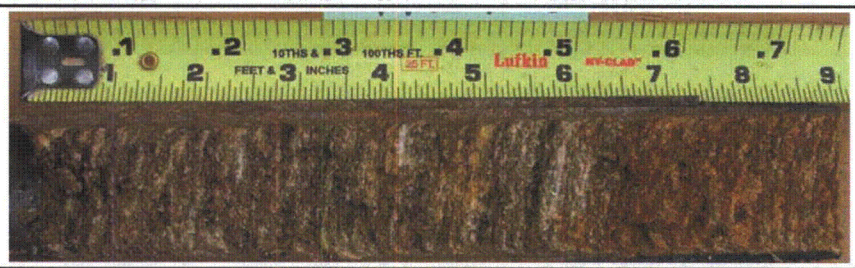


SPLIT SPOON SAMPLE PICTURES

Oconee Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-07-234

Boring Number: GM-11R

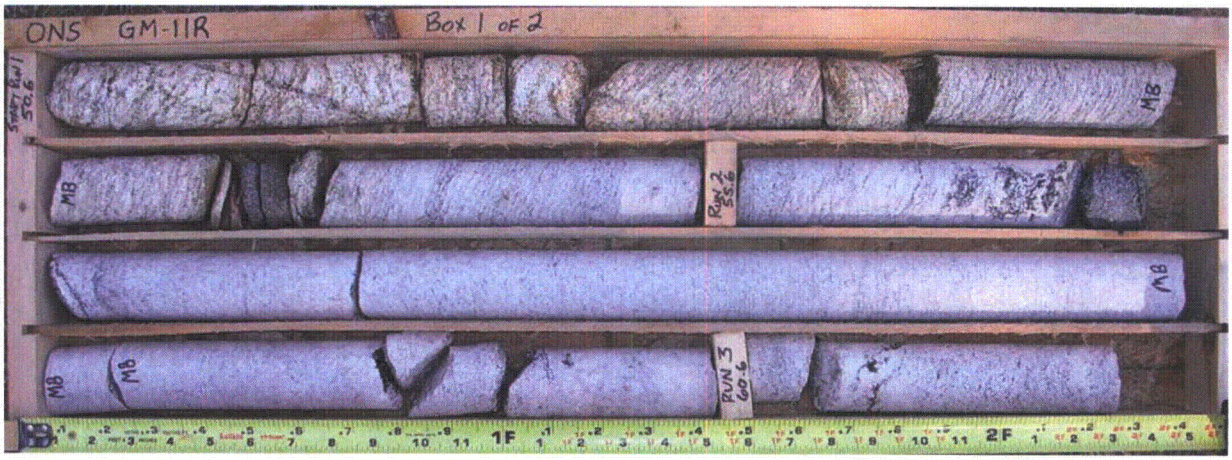
Sample No: 7 **Depth (ft-bls):** 34 - 35.5 **Blow Count:** 4 * 6 * 9	
Sample No: 8 **Depth (ft-bls):** 39 - 40.5 **Blow Count:** 6 * 5 * 6	
Sample No: 9 **Depth (ft-bls):** 44 - 45.5 **Blow Count:** 7 * 15 * 17	
Sample No: 10 **Depth (ft-bls):** 49 - 50.5 **Blow Count:** 20 * 39 * 50/3	

ROCK CORE PICTURES

Oconee Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-07-234

Core Location: GM-11R



CLASSIFICATION:

50.60' to 70.20': Medium-Grained Granitic Gneiss With Intermittent Biotite Hornblende Gneiss

CALCULATION OF PERMEABILITY BY THE FALLING HEAD METHOD (Open Hole in Uniform Material)

S&ME

Site Name:	ONS - GWPP	
Date:	9/21/2007	
Boring I.D.	GM-11R	
Test Interval:	50.6' to 55.6'	(Weathered/Sound Rock)
Total Depth of Hole:	55.6 ft	1695.12 cm
Length of Open Hole:	5 ft	152.44 cm
Transformation Ratio m=	1	
Performed by:	Scott Dacus	

Time (sec)	Head (cm)	Permeability (cm/sec)
0	615.03	
60	588.32	1.30E-04
120	578.90	4.73E-05
180	571.22	3.91E-05
240	563.84	3.81E-05
300	557.23	3.46E-05
360	551.01	3.29E-05
420	544.79	3.32E-05
480	541.19	1.94E-05
540	537.04	2.25E-05
600	531.92	2.81E-05
900	503.48	3.22E-05
1200	474.30	3.50E-05
1500	451.31	2.91E-05

Calculations

$$K_h = \frac{d^2 \cdot \ln\left(\frac{2mL}{D}\right)}{8 \cdot L \cdot (t_2 - t_1)} \cdot \ln\frac{H_1}{H_2}$$

for $\frac{mL}{D} > 4$

Where:

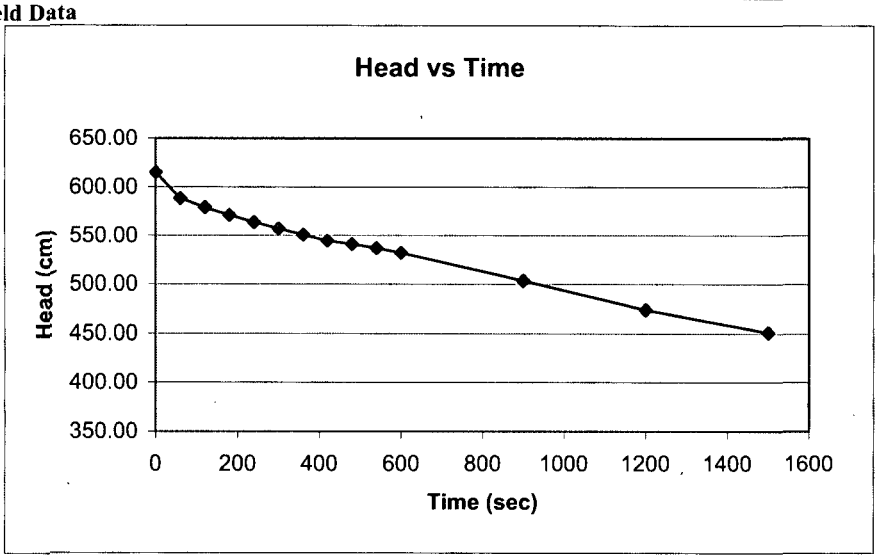
- K_h is the Horizontal Coefficient of Permeability (cm/sec)
- H_1 is the Piezometric Head for time; $t = t_1$ (cm)
- H_2 is the Piezometric Head for time; $t = t_2$ (cm)
- D is the Diameter of the Standpipe (cm)
- d is the diameter of the Open Length (cm),
- m is the Transformation Ratio, Where $m = \sqrt{K_h / K_v}$
  - K_h is the Horizontal Permeability
  - K_v is the Vertical Permeability
- L is the Open Length of Hole (cm)

Spreadsheet assumes 3" ID Pipe; NQ Hole, OD = 3"

MEAN PERMEABILITY (cm/sec)

4.01E-05

Graph of Field Data



CALCULATION OF PERMEABILITY BY THE FALLING HEAD METHOD (Open Hole in Uniform Material)

S&ME

Site Name:	ONS - GWPP	
Date:	9/20/2007	
Boring I.D.	GM-11R	
Test Interval:	35' to 38'	(Soil/Saprolite)
Total Depth of Hole:	38 ft	1158.54 cm
Length of Open Hole:	3 ft	91.46 cm
Transformation Ratio m=	1	
Performed by:	Scott Dacus	

Time (sec)	Head (cm)	Permeability (cm/sec)
0	490.46	
60	455.82	3.08E-04
120	427.35	2.71E-04
180	402.80	2.49E-04
240	381.13	2.33E-04
300	361.74	2.19E-04
360	344.15	2.10E-04
420	328.14	2.00E-04
480	313.57	1.91E-04
540	300.00	1.86E-04
600	287.41	1.80E-04
900	236.59	1.64E-04
1200	200.15	1.41E-04
1500	173.05	1.22E-04
1800	152.53	1.06E-04

Calculations

$$K_h = \frac{d^2 \cdot \ln\left(\frac{2mL}{D}\right)}{8 \cdot L \cdot (t_2 - t_1)} \cdot \ln\frac{H_1}{H_2}$$

for $\frac{mL}{D} > 4$

Where:

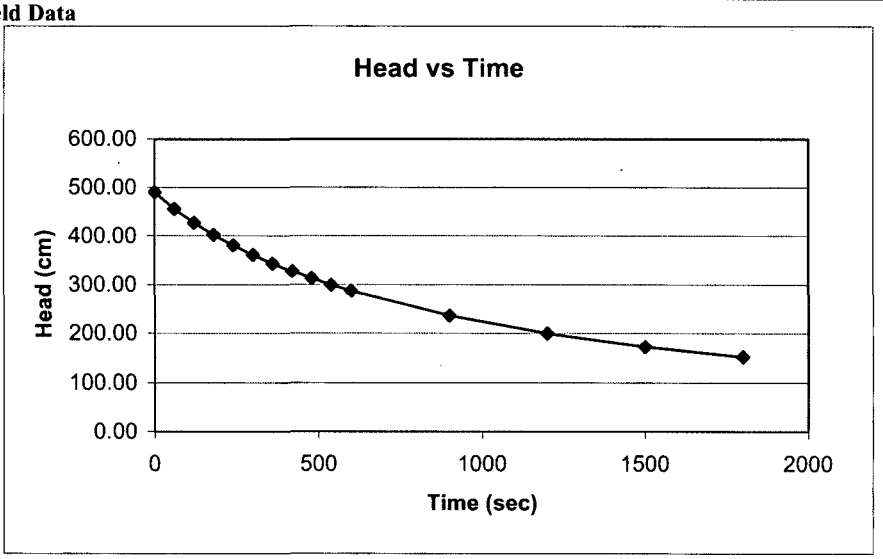
K_h	is the Horizontal Coefficient of Permeability (cm/sec)
H_1	is the Piezometric Head for time; $t = t_1$ (cm)
H_2	is the Piezometric Head for time; $t = t_2$ (cm)
D	is the Diameter of the Standpipe (cm)
d	is the diameter of the Open Length (cm),
m	is the Transformation Ratio, Where
	$m = \sqrt{K_h / K_v}$ K_h is the Horizontal Permeability; K_v is the Vertical Permeability
L	is the Open Length of Hole (cm)

Spreadsheet assumes 3" ID Pipe; NQ Hole, OD = 3"

MEAN PERMEABILITY (cm/sec)

1.99E-04

Graph of Field Data



CALCULATION OF PERMEABILITY BY THE FALLING HEAD METHOD (Open Hole in Uniform Material)

S&ME

Site Name:	ONS - GWPP	
Date:	9/21/2007	
Boring I.D.	GM-11R	
Test Interval:	50.6' to 60.6'	(Weathered/Sound Rock)
Total Depth of Hole:	60.6 ft	1847.56 cm
Length of Open Hole:	10 ft	304.88 cm
Transformation Ratio m=	1	
Performed by:	Scott Dacus	

Time (sec)	Head (cm)	Permeability (cm/sec)
0	680.82	
60	653.32	7.17E-05
120	641.83	3.09E-05
180	630.79	3.02E-05
240	620.18	2.95E-05
300	610.03	2.87E-05
360	600.18	2.83E-05
420	590.73	2.76E-05
480	581.52	2.73E-05
540	572.50	2.72E-05
600	563.84	2.65E-05
900	523.90	2.55E-05
1200	489.27	2.38E-05
1500	458.99	2.22E-05
1800	432.41	2.07E-05
2400	391.31	1.74E-05
3000	358.05	1.54E-05

Calculations

$$K_h = \frac{d^2 \cdot \ln\left(\frac{2mL}{D}\right)}{8 \cdot L \cdot (t_2 - t_1)} \cdot \ln\frac{H_1}{H_2}$$

for $\frac{mL}{D} > 4$

Where:

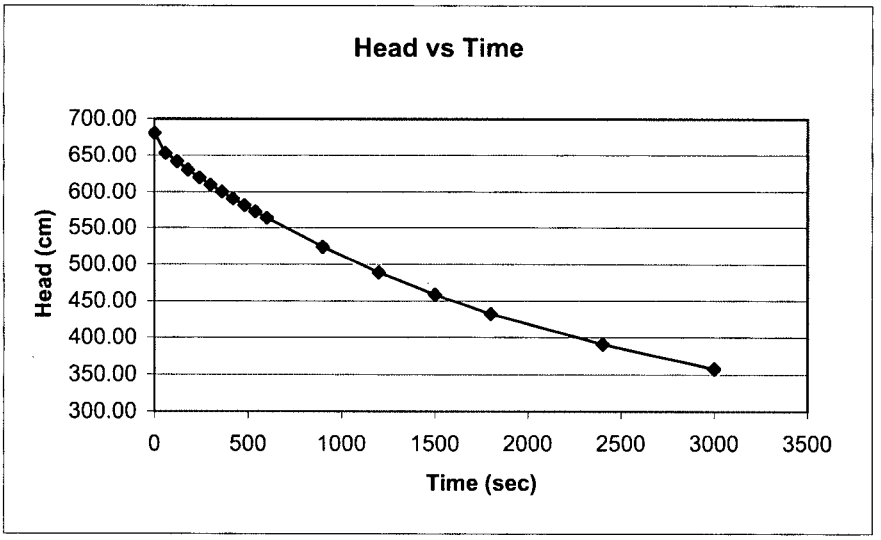
- K_h is the Horizontal Coefficient of Permeability (cm/sec)
- H_1 is the Piezometric Head for time; $t = t_1$ (cm)
- H_2 is the Piezometric Head for time; $t = t_2$ (cm)
- D is the Diameter of the Standpipe (cm)
- d is the diameter of the Open Length (cm),
- m is the Transformation Ratio, Where $m = \sqrt{K_h / K_v}$
  - K_h is the Horizontal Permeability
  - K_v is the Vertical Permeability
- L is the Open Length of Hole (cm)

Spreadsheet assumes 3" ID Pipe; NQ Hole, OD = 3"

MEAN PERMEABILITY (cm/sec)

2.83E-05

Graph of Field Data



BOREHOLE PERMEABILITY TEST USING PACKERS CALCULATIONS

PROJECT NAME AND NO.: ONS - GWPP
LOCATION: Seneca, SC
TEST DATE: 9/24/2007
TESTED BY: Adam Jennings/Scott Dacus
GROUND ELEV (ft MSL): 720.5

BOREHOLE NO.: GM-11R
TEST INTERVAL: 61.0 to 67.0 bgs
TEST INTERVAL: 659.5 to 653.5 EL

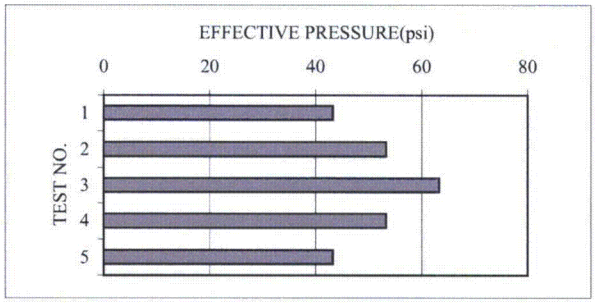
TEST METHOD: Double Packer Method using Multiple Pressure Tests
METHOD REFERENCE: Ground Water Manual, US Bureau of Reclamation, 1995, Chapter 10

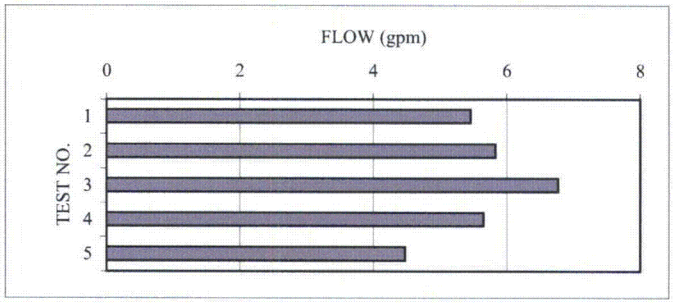
RESULTS OF PERMEABILITY CALCULATIONS
MULTIPLE STEP TEST

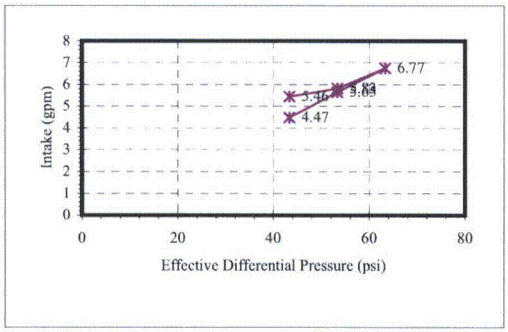
Step	Flow (Q) (gpm)	Pressure (psi) Gauge	Pressure (psi) Effective	Lugeons	Permeability (ft/sec)	Permeability (cm/sec)
1	5.46	30	43	38	1.35E-05	4.1E-04
2	5.83	40	53	33	1.2E-05	3.6E-04
3	6.77	50	63	32	1.1E-05	3.5E-04
4	5.65	40	53	32	1.1E-05	3.5E-04
5	4.47	30	43	31	1.1E-05	3.4E-04
			AVERAGE	33	1.2E-05	3.6E-04
			SELECTED VALUES			

Rock Description of Tested Interval:
Moderately Fractured Granitic Gneiss With Intermittent Biotite Hornblende Gneiss

TEST INTERPRETATION







PERMEABILITY CALCULATIONS FOR EACH STEP OF TEST

S&ME

CALCULATED PERMEABILITY FOR STEP 1

Gauge Pressure, **h2**:	30	psi	69.3	feet of water
Flow Rate, **Q**:	5.46	gpm	0.012	ft^3/sec
Head loss per TEN foot section of pipe:	0.1	psi		(per tables)
Head Loss, ***L*** :	0.7	psi	1.5	feet of water
Distance from pressure gauge to bottom of test section, h_1:	32.2	feet		
Value of h_1:	32.2	feet		
Effective Head, ***H*** where ***H = h1+h2-L*** :	99.9	feet	43.3	psi
Determine Saturation Zone:				
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H	62.2	feet		
X = (H/Tu)*100	160.8	%		
Tu/A	10.3			
Determine Conductivity Coefficient				
H/r	-		Value for Zone 1 analysis	
A/H	-		Value for Zone 1 analysis	
A/r	48		Value for Zone 2 and 3 analysis	
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1	
Cs for Zone 2 and 3 tests:	72		Cs for Zones 2 and 3	
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)	1.35E-05	ft/sec	4.12E-04	cm/sec
Is this step valid?				
If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow				
Calculate a, the total open area of the test section:			4.7	square feet
Is Q/a * (estimated porosity) > 10??			True, Test Valid	

CALCULATED PERMEABILITY FOR STEP 2

Gauge Pressure, **h2**:	40	psi	92.4	feet of water
Flow Rate, **Q**:	5.83	gpm	0.013	ft^3/sec
Head loss per TEN foot section of pipe:	0.1	psi		(per tables)
Head Loss, ***L*** :	0.7	psi	1.5	feet of water
Distance from pressure gauge to bottom of test section, h_1:	32.2	feet		
Value of h_1:	32.2	feet		
Effective Head, ***H*** where ***H = h1+h2-L*** :	123.0	feet	53.3	psi
Determine Saturation Zone:				
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H	85.3	feet		
X = (H/Tu)*100	144.3	%		
Tu/A	14.2			
Determine Conductivity Coefficient				
H/r	-		Value for Zone 1 analysis	
A/H	-		Value for Zone 1 analysis	
A/r	48		Value for Zone 2 and 3 analysis	
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1	
Cs for Zone 2 and 3 tests:	72		Cs for Zones 2 and 3	
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)	1.17E-05	ft/sec	3.58E-04	cm/sec
Is this step valid?				
If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow				
Calculate a, the total open area of the test section:			4.7	square feet
Is Q/a * (estimated porosity) > 10??			True, Test Valid	

CALCULATED PERMEABILITY FOR STEP 3

Gauge Pressure, **h2**:	50	psi	115.5	feet of water
Flow Rate, **Q**:	6.77	gpm	0.015	ft^3/sec
Head loss per TEN foot section of pipe:	0.1	psi		(per tables)
Head Loss, ***L*** :	0.7	psi	1.5	feet of water
Distance from pressure gauge to bottom of test section, h_1:	32.2	feet		
Value of h_1:	32.2	feet		
Effective Head, ***H*** where ***H = h1+h2-L*** :	146.1	feet	63.3	psi
Determine Saturation Zone:		-		
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H	108.3	feet		
X = (H/Tu)*100	134.9	%		
Tu/A	18.0			
Determine Conductivity Coefficient				
H/r	-		Value for Zone 1 analysis	
A/H	-		Value for Zone 1 analysis	
A/r	48		Value for Zone 2 and 3 analysis	
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1	
Cs for Zone 2 and 3 tests:	72		Cs for Zones 2 and 3	
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)	1.15E-05	ft/sec	3.50E-04	cm/sec
Is this step valid?				
If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow				
Calculate a, the total open area of the test section:			4.7	square feet
Is Q/a * (estimated porosity) > 10??			True, Test Valid	

CALCULATED PERMEABILITY FOR STEP 4

Gauge Pressure, **h2**:	40	psi	92.4	feet of water
Flow Rate, **Q**:	5.65	gpm	0.013	ft^3/sec
Head loss per TEN foot section of pipe:	0.1	psi		(per tables)
Head Loss, ***L*** :	0.7	psi	1.5	feet of water
Distance from pressure gauge to bottom of test section, h_1:	32.2	feet		
Value of h_1:	32.2	feet		
Effective Head, ***H*** where ***H = h1+h2-L*** :	123.0	feet	53.3	psi
Determine Saturation Zone:		-		
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H	85.3	feet		
X = (H/Tu)*100	144.3	%		
Tu/A	14.2			
Determine Conductivity Coefficient				
H/r	-		Value for Zone 1 analysis	
A/H	-		Value for Zone 1 analysis	
A/r	48		Value for Zone 2 and 3 analysis	
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1	
Cs for Zone 2 and 3 tests:	72		Cs for Zones 2 and 3	
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)	1.14E-05	ft/sec	3.47E-04	cm/sec
Is this step valid?				
If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow				
Calculate a, the total open area of the test section:			4.7	square feet
Is Q/a * (estimated porosity) > 10??			True, Test Valid	

CALCULATED PERMEABILITY FOR STEP 5

Gauge Pressure, **h2**:	30	psi	69.3	feet of water
Flow Rate, **Q**:	4.47	gpm	0.010	ft^3/sec
Head loss per TEN foot section of pipe:	0.1	psi		(per tables)
Head Loss, ***L*** :	0.7	psi	1.5	feet of water
Distance from pressure gauge to bottom of test section, h_1:	32.2	feet		
Value of h_1:	32.2	feet		
Effective Head, ***H*** where ***H = h1+h2-L*** :	99.9	feet	43.3	psi
Determine Saturation Zone:		-		
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H	62.2	feet		
X = (H/Tu)*100	160.8	%		
Tu/A	10.3			
Determine Conductivity Coefficient				
H/r	-		Value for Zone 1 analysis	
A/H	-		Value for Zone 1 analysis	
A/r	48		Value for Zone 2 and 3 analysis	
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1	
Cs for Zone 2 and 3 tests:	72		Cs for Zones 2 and 3	
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)	1.11E-05	ft/sec	3.37E-04	cm/sec

Is this step valid?

If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow

Calculate a, the total open area of the test section: 4.7 square feet

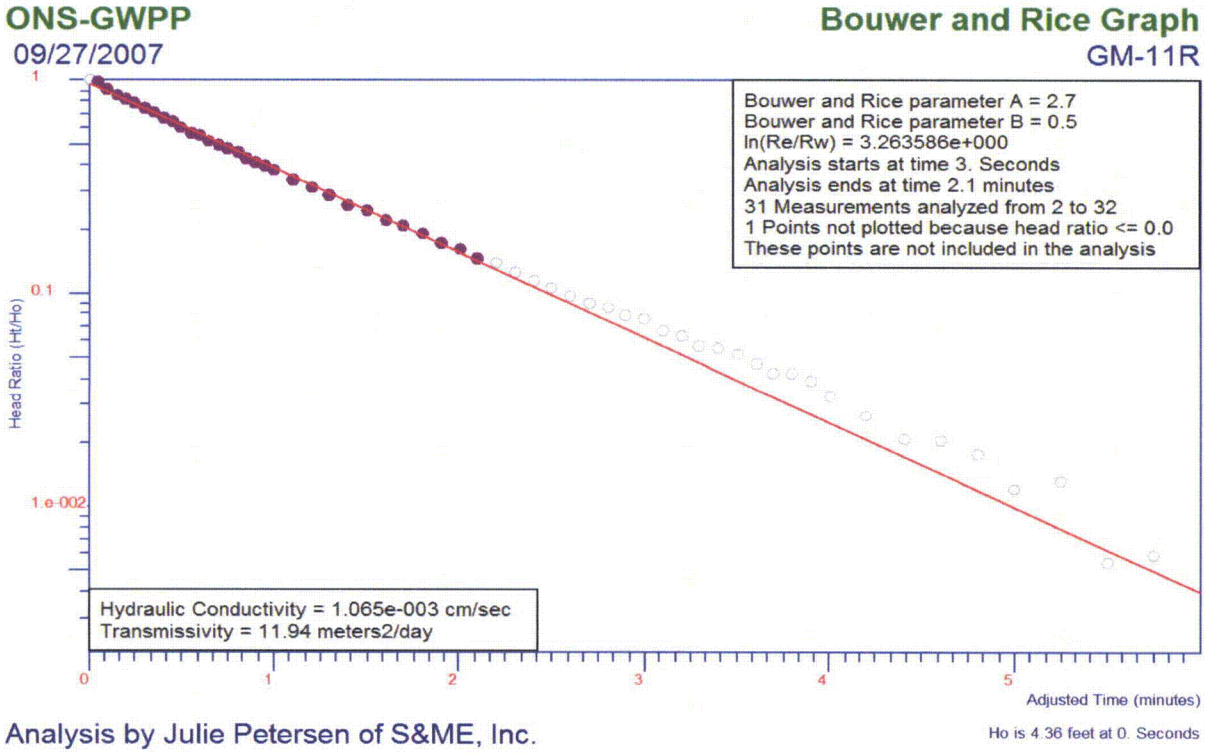
Is Q/a * (estimated porosity) > 10?? True, Test Valid

Calculation of Permeability By The Rising Head Method (Slug Test)

Site Name:	ONS-GWPP
Test Date:	9/27/2007
Well Label:	GM-11R
Aquifer Thickness:	42.56 feet
Screen Length:	5. feet
Casing Radius:	1. Inches
Effective Radius:	1.5 Inches
Static Water Level:	28.94 feet
Water Table to Screen Bottom:	37.56 feet
Anisotropy Ratio:	1
Time Adjustment:	0. Seconds

Test starts with trial 0
There are 60 time and drawdown measurements
Maximum head is 4.36 feet
Minimum head is 0. feet

Calculation by Bouwer and Rice Graphical Method



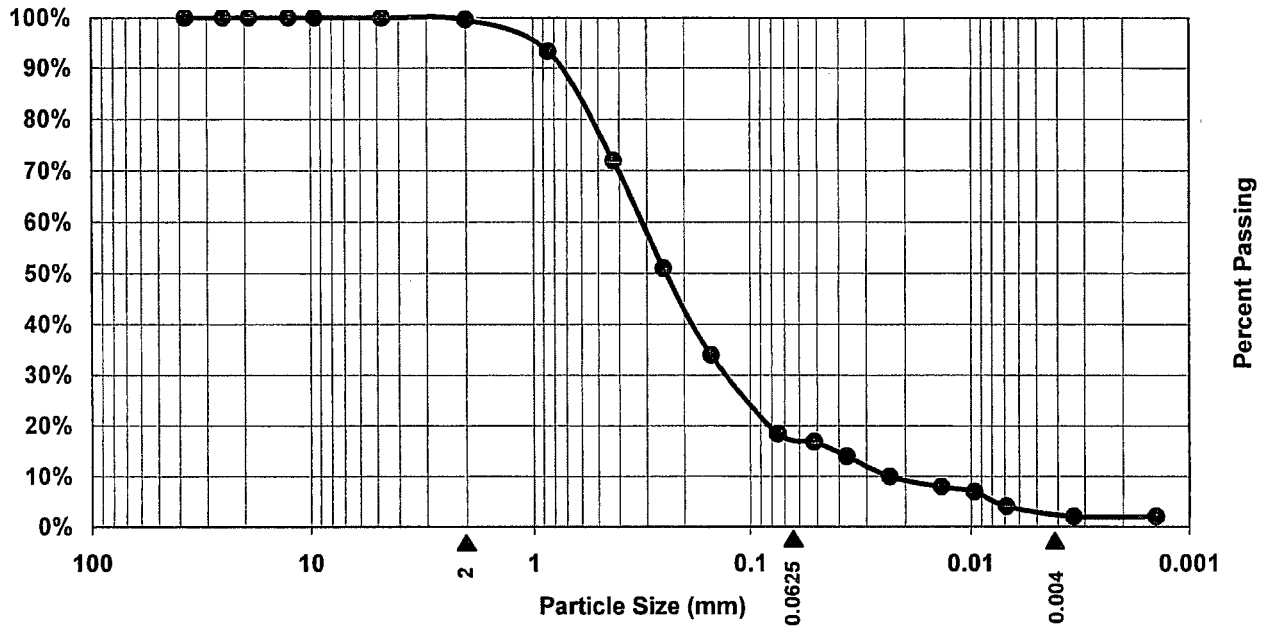
PERMEABILITY

1.07×10^{-3} cm/sec

PARTICLE SIZE ANALYSIS OF SOILS
FOR USE IN FETTER AND BEAR DIAGRAMS

Boring No.:	Sample No.:	Depth:
GM-11R	SS-10	49 to 50.5 ft bls

Sample Description:
M2: White, Yellow, and Brown, Micaceous, Silty, Medium to Fine Sand (SM)



	> 2 mm	2 mm - 0.0625 mm	0.0625 mm - 0.004 mm	<0.004 mm
From Graph:	% Gravel 0.4%	% Sand 81.9%	% Silt 15.4%	% Clay 2.4%
Adjusted for Calculations	**0%**	**82%**	**15%**	**2%**

Notes:
Grain size distribution taken from grain size with hydrometer data located in Appendix II.
Gravel, sand, silt and clay sizes based on Wentworth Scale.

S&ME Project:
Oconee Nuclear Station - GWPP

S&ME Project No.:
1264-07-234

S&ME

FETTER AND BEAR DIAGRAMS

S&ME PROJECT: Oconee Nuclear Station - GWPP
S&ME PROJECT NO.: 1264-07-234

Boring No. GM-11R

Boring Depth: 49 to 50.5 ft bls

% Sand: 82%

% Silt: 15%

% Clay: 2%

Estimated Specific Yield: 30%

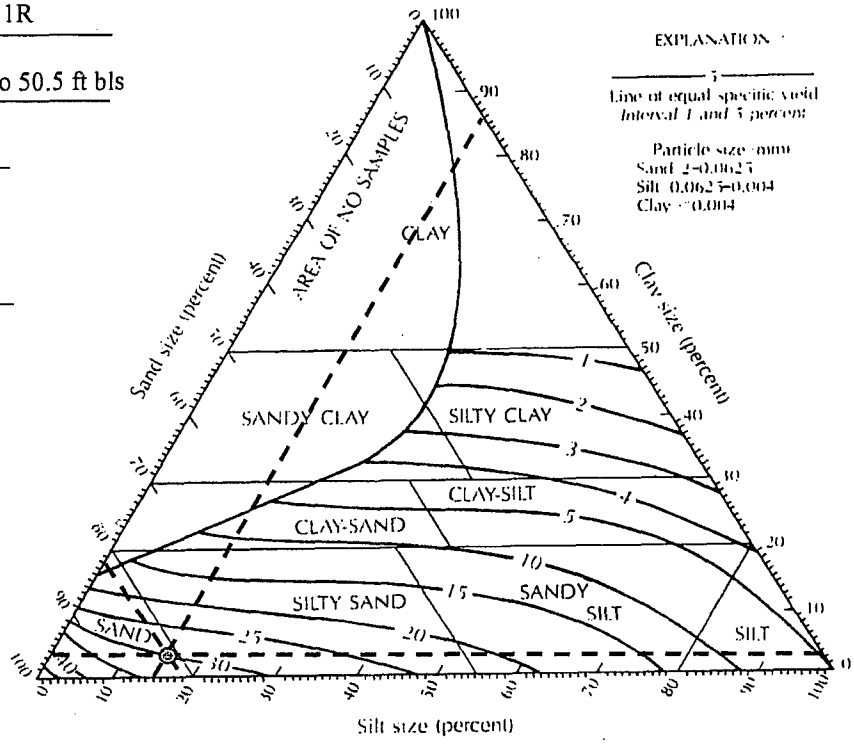
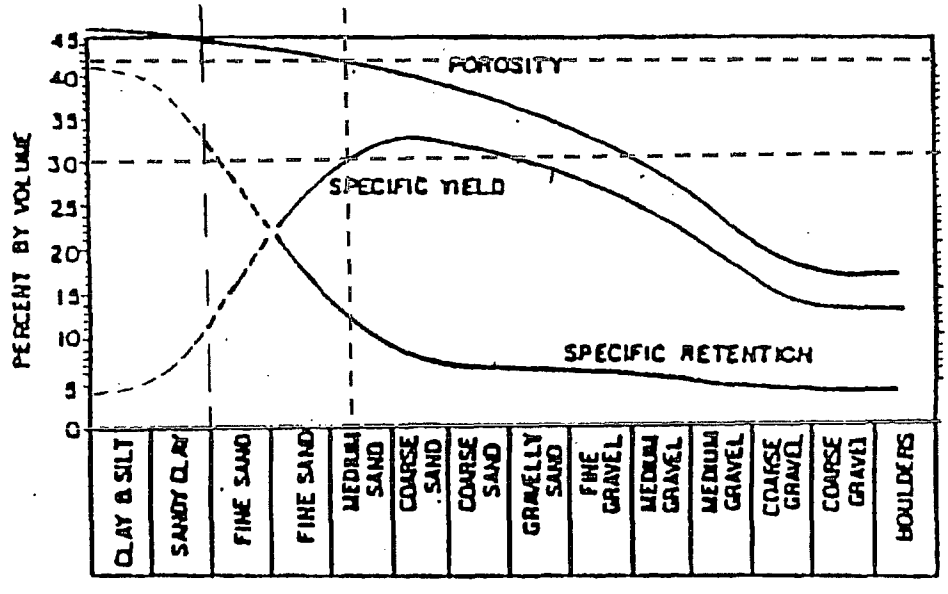


FIGURE 4.11 Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A. I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.



Estimated Porosity: 42%

Variation of Porosity, Specific Yield, and Specific Retention with Grain Size (after Bear, 1972)

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Charlotte, North Carolina 28273
Telephone: 704-523-4726
Fax: 704-525-3953

ENGINEERING • TESTING
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1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.
2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

Project: **Oconee Nuclear Station**			**Boring No. GM-12**
Location: **Seneca, SC**		Number: **1264-07-234**	Sheet No. 1 of 1
Boring Depth (ft): **23.0**	Elevation (ft): **695.1**	Driller: **Jay Little, SC Cert No. B1575**	Date Drilled: **9/26/07**
Logged By: **David Klemm**	Water Level: **Stabilized Water Level at 7.91 ft bls**		Drilling Method: **4¼" H.S.A.**

Elev. (Feet)	Depth (Feet)	Lith-ology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
690	5		FILL (F): Orange and Brown, Silty, Medium to Fine **SAND**		
			FILL (F): Gray, Silty, Coarse to Fine **SAND** With Quartz Gravel		
685	10		SOIL/SAPROLITE (M1): Brown, Silty, Fine **SAND** With Tan, Silty, Fine **SAND** From 10.10 ft to 10.40 ft bls, and White, Silty, Fine **SAND** at 13.70 ft bls and From 19.00 ft to 19.20 ft bls		
680	15				
675	20		SOIL/SAPROLITE (M1): Brown, Micaceous, Silty, Medium to Fine **SAND**		
			SOIL/SAPROLITE (M1): White, Silty, Medium to Fine **SAND** With Quartz Rock Fragments		
			Lithologic Descriptions Obtained From GM-12R Boring Terminated at 23.00 ft bls		

BORING LOG WITH WELL RECOVERED_ONS LOG.GPJ LAGWGN01.GDT 7/23/08

COMPLETION REPORT OF WELL No. GM-12

PROJECT: **Oconee Nuclear Station**
PROJECT NO: **1264-07-234**
PROJECT LOCATION: **Seneca, SC**

DRILLING CONTRACTOR: **S&ME, Inc.**
DRILLING METHOD: **4¼" H.S.A.**
DATE DRILLED: **9/26/07**

WATER LEVEL: **Stabilized Water Level at 7.91 ft bls**
LATITUDE: **34°47'30.943"**
LONGITUDE: **82°53'33.023"**
TOP OF CASING ELEVATION: **698.02**
DATUM: **MSL**
LOGGED BY: **David Klemm**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)
				0.00	GS	695.09
FILL (F): Orange and Brown, Silty, Medium to Fine **SAND**		0		2.00		693.09
				4.00		691.09
		5				
FILL (F): Gray, Silty, Coarse to Fine **SAND** With Quartz Gravel						
SOIL/SAPROLITE (M1): Brown, Silty, Fine **SAND** With Tan, Silty, Fine **SAND** From 10.10 ft to 10.40 ft bls, and White, Silty, Fine **SAND** at 13.70 ft bls and From 19.00 ft to 19.20 ft bls		10				
		15				
				19.50		675.59
SOIL/SAPROLITE (M1): Brown, Micaceous, Silty, Medium to Fine **SAND**		20		20.00		675.09
SOIL/SAPROLITE (M1): White, Silty, Medium to Fine **SAND** With Quartz Rock Fragments				23.00		672.09

WELL CONSTRUCTION DETAILS

PROTECTIVE CASING
Diameter:
Type:
Interval:

RISER CASING
Diameter: **2"**
Type: **Sch. 40 PVC**
Interval: **0 to 5 ft bls**

GROUT
Type: **Neat Cement**
Interval: **0 to 2 ft bls**

SEAL
Type: **Bentonite**
Interval: **2 to 4 ft bls**

FILTERPACK
Type: **#1 Silica Sand**
Interval: **4 to 20 ft bls**

SCREEN
Diameter: **2"**
Type: **0.010 Slotted PVC**
Interval: **5 to 20 ft bls**

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL RECOVERED_ONS.LOG.GPJ S&ME.GDT 7/23/08

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Charlotte, North Carolina 28273

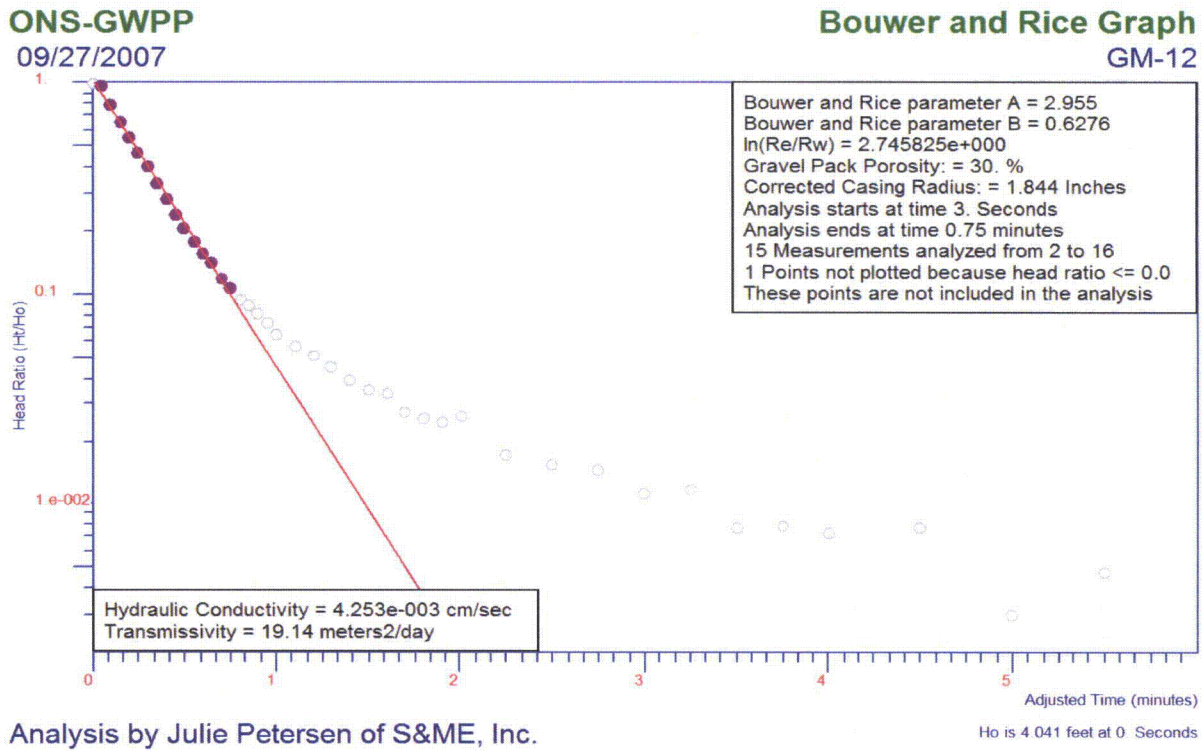
COMPLETION REPORT OF WELL No. GM-12

Calculation of Permeability By The Rising Head Method (Slug Test)

Site Name:	ONS-GWPP
Test Date:	9/27/2007
Well Label:	GM-12
Aquifer Thickness:	17.09 feet
Screen Length:	15. feet
Casing Radius:	1. Inches
Effective Radius:	3. Inches
Gravel Pack Porosity:	30.00%
Corrected Casing Radius:	1.844 Inches
Static Water Level:	7.91 feet
Water Table to Screen Bottom:	12.09 feet
Anisotropy Ratio:	1

Time Adjustment: 0. Seconds
Test starts with trial 0
There are 43 time and drawdown measurements
Maximum head is 4.041 feet
Minimum head is 0. feet

Calculation by Bouwer and Rice Graphical Method



PERMEABILITY

4.25×10^{-3} cm/sec

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Project: **Oconee Nuclear Station**			**Boring No. GM-12R**
Location: **Seneca, SC**		Number: **1264-07-234**	Sheet No. 1 of 2
Boring Depth (ft): **54.3**	Elevation (ft): **695.2**	Driller: **Jay Little, SC Cert No. B1575**	Date Drilled: **9/24/07**
Logged By: **David Klemm**	Water Level: **Stabilized Water Level at 7.49 ft bls**		Drilling Method: **4¼" H.S.A.**

Elev. (Feet)	Depth (Feet)	Lith-ology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
695			FILL (F): Orange and Brown, Silty, Medium to Fine **SAND**		
690	5		FILL (F): Gray, Silty, Coarse to Fine **SAND** With Quartz Gravel		15
685	10		SOIL/SAPROLITE (M1): Brown, Silty, Fine **SAND** With Tan, Silty, Fine **SAND** From 10.10 ft to 10.40 ft bls, and White, Silty, Fine **SAND** at 13.70 ft bls and From 19.00 ft to 19.20 ft bls		7
680	15				5
675	20		SOIL/SAPROLITE (M1): Brown, Micaceous, Silty, Medium to Fine **SAND**		12
			SOIL/SAPROLITE (M1): White, Silty, Medium to Fine **SAND** With Quartz Rock Fragments		
670	25		**Auger Refusal at 27.30 ft bls**		29
665	30		PARTIALLY WEATHERED/FRACTURED ROCK (WF): Medium-Grained **GRANITIC GNEISS** Intensely Weathered and Fractured, Low Angle Joints With No Staining		
			SOUND ROCK (D): Medium-Grained **GRANITIC GNEISS**; Unfractured		
			PARTIALLLY WEATHERED/FRACTURED ROCK (WF): Medium-Grained **GRANITIC GNEISS**		

BORING LOG WITH WELL RECOVERED_ONS LOG.GPJ LAGWGN01.GDT 7/23/08

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2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

Project: **Oconee Nuclear Station**			**Boring No. GM-12R**
Location: **Seneca, SC**		Number: **1264-07-234**	Sheet No. 2 of 2
Boring Depth (ft): **54.3**	Elevation (ft): **695.2**	Driller: **Jay Little, SC Cert No. B1575**	Date Drilled: **9/24/07**
Logged By: **David Klemm**	Water Level: **Stabilized Water Level at 7.49 ft bls**		Drilling Method: **4¼" H.S.A.**

Elev. (Feet)	Depth (Feet)	Lith-ology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
660			Intensely Weathered and Fractured, Low Angle Joints With No Staining		
			SOUND ROCK (D): Medium-Grained **GRANITIC GNEISS**; Unfractured		
			SOUND ROCK (D): Medium-Grained **GRANITIC GNEISS** With Intermittent Seams of Medium-Grained **BIOTITE HORNBLENDE GNEISS** Moderately Fractured, Low Angle Joints With No Staining		
655	40				
			SOUND ROCK (D): Medium-Grained **BIOTITE HORNBLENDE GNEISS** With Intermittent Medium-Grained **GRANITIC GNEISS** Moderately Fractured, Low Angle Joints With No Staining		
650	45				
			SOUND ROCK (D): Medium-Grained **GRANITIC GNEISS**; Moderately Fractured, Low Angle Joints With No Staining		
645	50				
			Boring Terminated at 54.30 ft bls		

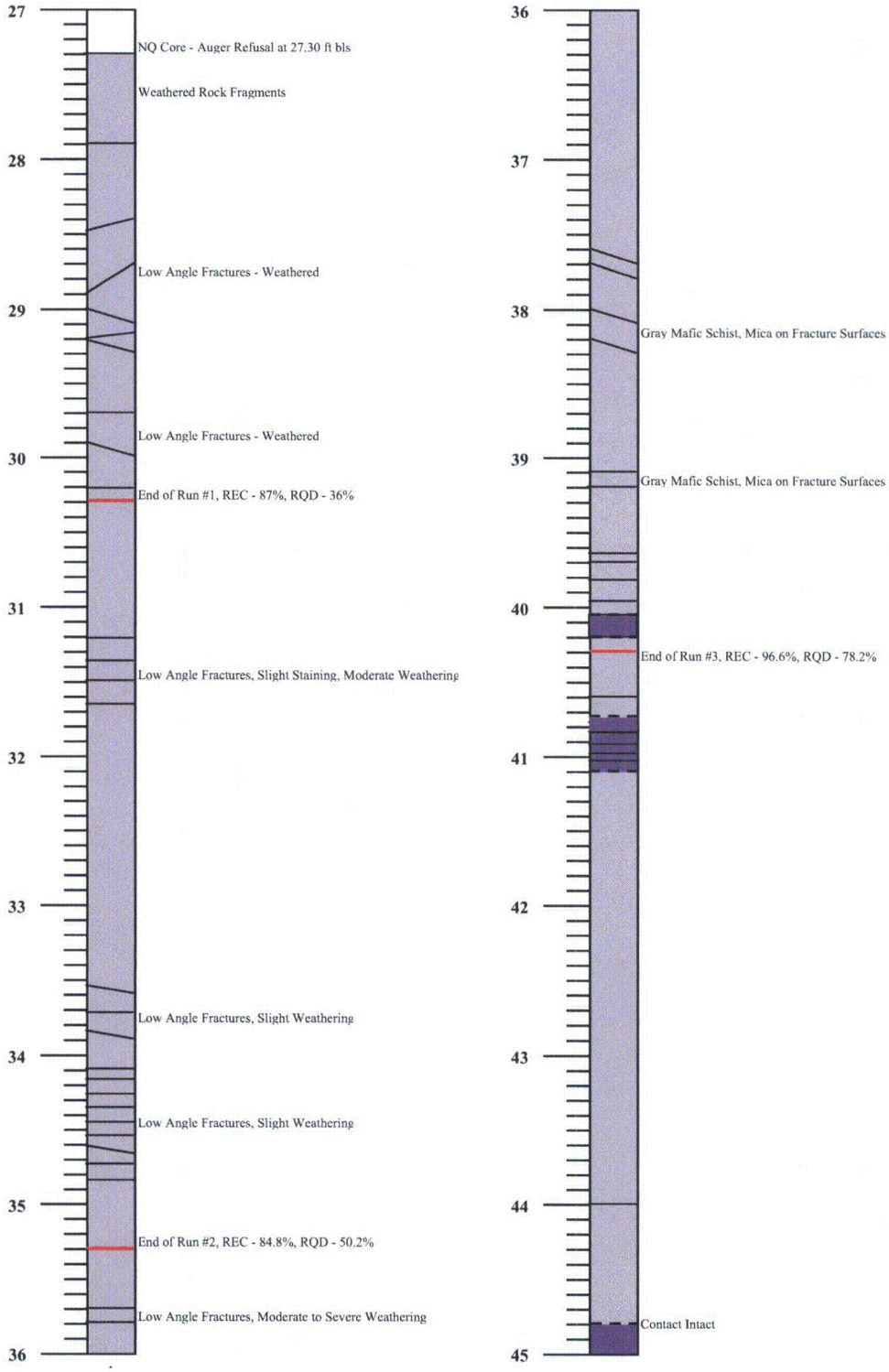
BORING LOG WITH WELL RECOVERED ONS LOG.GPJ LAGWGN01.GDT 7/23/08

FIELD ROCK CORE LOG

Oconee Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-07-234

Core Location: GM-12R



EXPLANATION

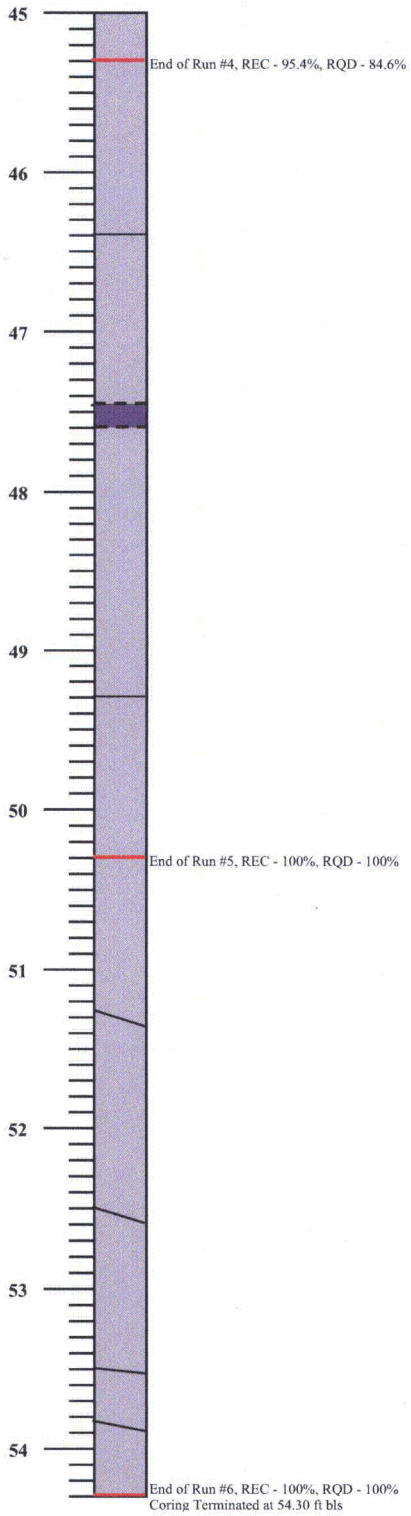
- Concrete
- Granitic Gneiss
- Biotite Hornblende Gneiss
- Core Loss
- Fracture
- End of Run
- Contact
- Healed Joint

FIELD ROCK CORE LOG

Oconee Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-07-234

Core Location: GM-12R



EXPLANATION

- Concrete
- Granitic Gneiss
- Biotite Hornblende Gneiss
- Core Loss
- Fracture
- End of Run
- Contact
- Healed Joint

COMPLETION REPORT OF WELL No. GM-12R

PROJECT: **Oconee Nuclear Station**
PROJECT NO: **1264-07-234**
PROJECT LOCATION: **Seneca, SC**

DRILLING CONTRACTOR: **S&ME, Inc.**
DRILLING METHOD: **4¼" H.S.A.**
DATE DRILLED: **9/24/07**

WATER LEVEL: **Stabilized Water Level at 7.49 ft bls**
LATITUDE: **34°47'30.895"**
LONGITUDE: **82°53'33.004"**
TOP OF CASING ELEVATION: **698.18**
DATUM: **MSL**
LOGGED BY: **David Klemm**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)
				0.00	GS	695.22
FILL (F): Orange and Brown, Silty, Medium to Fine **SAND**		0				
		5				
FILL (F): Gray, Silty, Coarse to Fine **SAND** With Quartz Gravel						
SOIL/SAPROLITE (M1): Brown, Silty, Fine **SAND** With Tan, Silty, Fine **SAND** From 10.10 ft to 10.40 ft bls, and White, Silty, Fine **SAND** at 13.70 ft bls and From 19.00 ft to 19.20 ft bls		10				
		15				
SOIL/SAPROLITE (M1): Brown, Micaceous, Silty, Medium to Fine **SAND**		20				
SOIL/SAPROLITE (M1): White, Silty, Medium to Fine **SAND** With Quartz Rock Fragments		25				
PARTIALLY WEATHERED/FRACTURED ROCK (WF): Medium-Grained **GRANITIC GNEISS** Intensely Weathered and Fractured, Low Angle Joints With No Staining		30				
SOUND ROCK (D):				35.00		660.22

WELL CONSTRUCTION DETAILS

PROTECTIVE CASING
Diameter:
Type:
Interval:

RISER CASING
Diameter: **2"**
Type: **Sch. 40 PVC**
Interval: **0 to 37 ft bls**

GROUT
Type: **Neat Cement**
Interval: **0 to 35 ft bls**

SEAL
Type: **K-packer**
Interval: **36.2 to 36.5 ft bls**

FILTERPACK
Type:
Interval:

SCREEN
Diameter: **2"**
Type: **0.010 Slotted PVC**
Interval: **37 to 42 ft bls**

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL RECOVERED_ONS LOG.GPJ S&ME.GDT 7/23/08

S&ME
ENGINEERING • TESTING
ENVIRONMENTAL SERVICES

9751 Southern Pine Boulevard
Charlotte, North Carolina 28273

COMPLETION REPORT OF WELL No. GM-12R

PROJECT: **Oconee Nuclear Station**
PROJECT NO: **1264-07-234**
PROJECT LOCATION: **Seneca, SC**

GROUND SURFACE ELEVATION:
LOGGED BY: **695.2**
CHECKED BY: **David Klemm**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)	WELL CONSTRUCTION DETAILS
							(See Page 1)
Medium-Grained **GRANITIC GNEISS** Unfractured		35		36.20		659.02	
				36.40		658.82	
PARTIALLLY WEATHERED/FRACTURED ROCK (WF): Medium-Grained **GRANITIC GNEISS** Intensely Weathered and Fractured, Low Angle Joints With No Staining		40		37.00		658.22	
				41.50		653.72	
				42.00		653.22	
SOUND ROCK (D): Medium-Grained **GRANITIC GNEISS** Unfractured *(continued)*		45		44.50		650.72	
SOUND ROCK (D): Medium-Grained **GRANITIC GNEISS** With Intermittent Seams of Medium-Grained **BIOTITE HORNBLENDE GNEISS**; Moderately Fractured, Low Angle Joints With No Staining		50		54.30		640.92	
SOUND ROCK (D): Medium-Grained **BIOTITE HORNBLENDE GNEISS** With Intermittent Medium-Grained **GRANITIC GNEISS** Moderately Fractured, Low Angle Joints With No Staining							
SOUND ROCK (D): Medium-Grained **GRANITIC GNEISS** Moderately Fractured, Low Angle Joints With No Staining							

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL RECOVERED_ONS LOG.GPJ S&ME.GDT 7/23/08

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9751 Southern Pine Boulevard
Charlotte, North Carolina 28273

COMPLETION REPORT OF WELL No. GM-12R

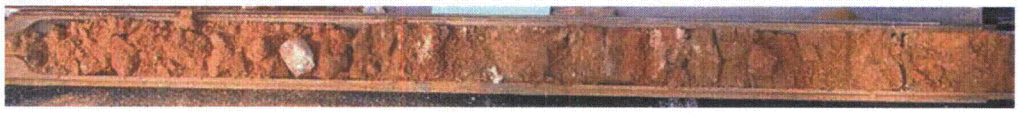
SPLIT SPOON SAMPLE PICTURES

Oconee Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-07-234

Boring Number: GM-12R

Sample No: 1
Depth (ft-bls): 13.4 - 14.9
Blow Count: 2 * 2 * 3

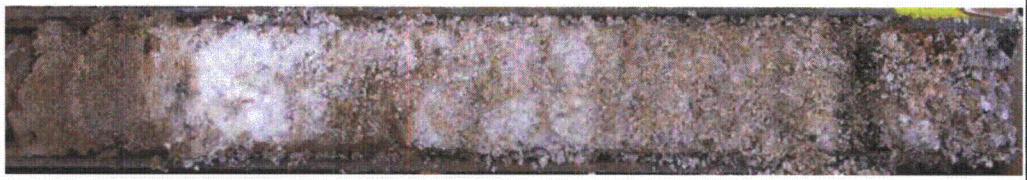


Sample No: 2
Depth (ft-bls): 8.4 - 9.9
Blow Count: 4 * 4 * 3

Sample No: 3
Depth (ft-bls): 13.4 - 14.9
Blow Count: 2 * 2 * 3

Sample No: 4
Depth (ft-bls): 18.4 - 19.9
Blow Count: 4 * 6 * 6

Sample No: 5
Depth (ft-bls): 23.4 - 24.9
Blow Count: 16 * 8 * 21



Sample No: 6
Depth (ft-bls): 27.3 - 27.4
Blow Count: 50/1

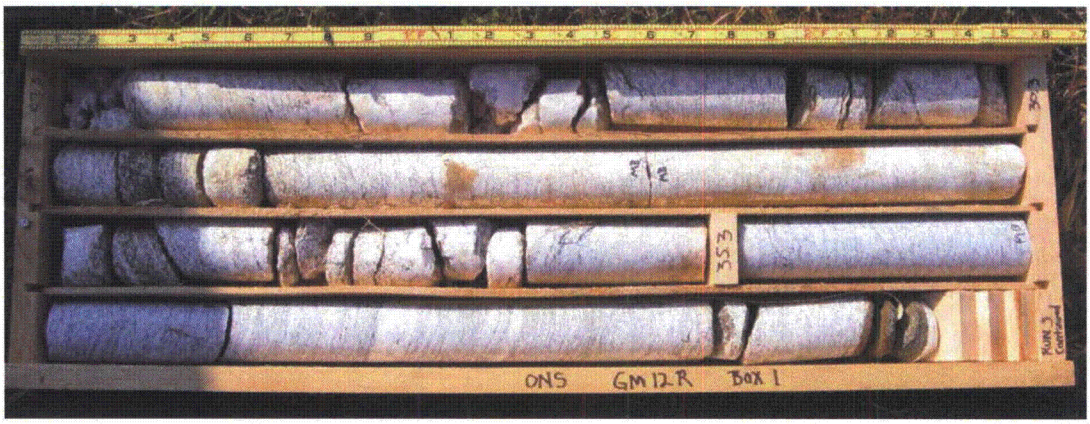
No Recovery

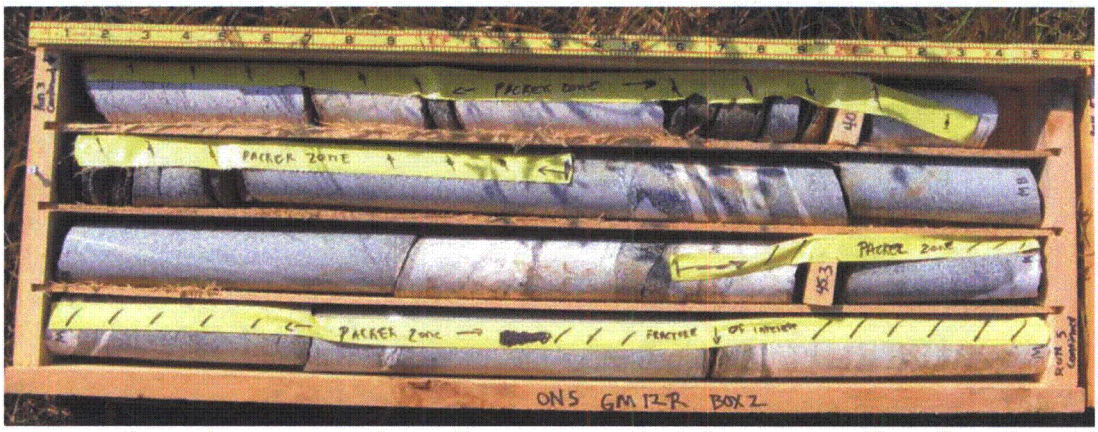
ROCK CORE PICTURES

Oconee Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-07-234

Core Location: GM-12R





CLASSIFICATION:

27.30' to 37.60': Medium-Grained Granitic Gneiss

37.60' to 47.60': Medium-Grained Granitic Gneiss With Intermittent Biotite Hornblende Gneiss

47.60' to 54.30': Medium-Grained Granitic Gneiss With Intermittent Biotite Hornblende Gneiss

CALCULATION OF PERMEABILITY BY THE FALLING HEAD METHOD (Open Hole in Uniform Material)

S&ME

Site Name:	ONS - GWPP	
Date:	9/20/2007	
Boring I.D.	GM-12R	
Test Interval:	27.3' to 30.3'	(Partially Weathered/Fractured Rock)
Total Depth of Hole:	30.3 ft	923.78 cm
Length of Open Hole:	3 ft	91.46 cm
Transformation Ratio m=	1	
Performed by:	David Klemm	

Time (sec)	Head (cm)	Permeability (cm/sec)
0	366.46	
3	349.70	3.94E-03
6	330.21	4.82E-03
9	316.46	3.58E-03
12	306.89	2.58E-03
15	300.24	1.84E-03
18	295.64	1.30E-03
21	292.53	8.89E-04
24	290.27	6.51E-04
27	288.63	4.78E-04
30	287.29	3.92E-04

Calculations

$$K_h = \frac{d^2 \cdot \ln\left(\frac{2mL}{D}\right)}{8 \cdot L \cdot (t_2 - t_1)} \cdot \ln\frac{H_1}{H_2}$$

for $\frac{mL}{D} > 4$

Where:

K_h	is the Horizontal Coefficient of Permeability (cm/sec)
H_1	is the Piezometric Head for time; $t = t_1$ (cm)
H_2	is the Piezometric Head for time; $t = t_2$ (cm)
D	is the Diameter of the Standpipe (cm)
d	is the diameter of the Open Length (cm),
m	is the Transformation Ratio, Where

$m = \sqrt{K_h / K_v}$ K_h is the Horizontal Permeability; K_v is the Vertical Permeability

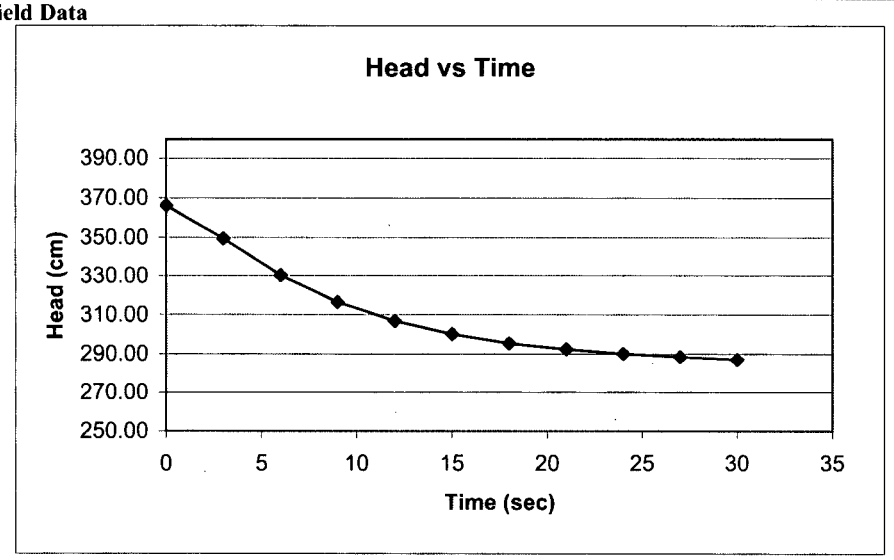
L	is the Open Length of Hole (cm)

Spreadsheet assumes 3" ID Pipe; NQ Hole, OD = 3"

MEAN PERMEABILITY (cm/sec)

2.05E-03

Graph of Field Data



CALCULATION OF PERMEABILITY BY THE FALLING HEAD METHOD (Open Hole in Uniform Material)

S&ME

Site Name:	ONS - GWPP	
Date:	9/20/2007	
Boring I.D.	GM-12R	
Test Interval:	15' to 18'	(Soil/Saprolite)
Total Depth of Hole:	18 ft	548.78 cm
Length of Open Hole:	3 ft	91.46 cm
Transformation Ratio m=	1	
Performed by:	David Klemm	

Time (sec)	Head (cm)	Permeability (cm/sec)
0	211.28	
60	178.48	7.09E-04
120	158.99	4.86E-04
180	145.67	3.68E-04
240	136.19	2.83E-04
300	129.24	2.20E-04
360	124.05	1.72E-04

Calculations

$$K_h = \frac{d^2 \cdot \ln\left(\frac{2mL}{D}\right)}{8 \cdot L \cdot (t_2 - t_1)} \cdot \ln\frac{H_1}{H_2}$$

for $\frac{mL}{D} > 4$

Where:

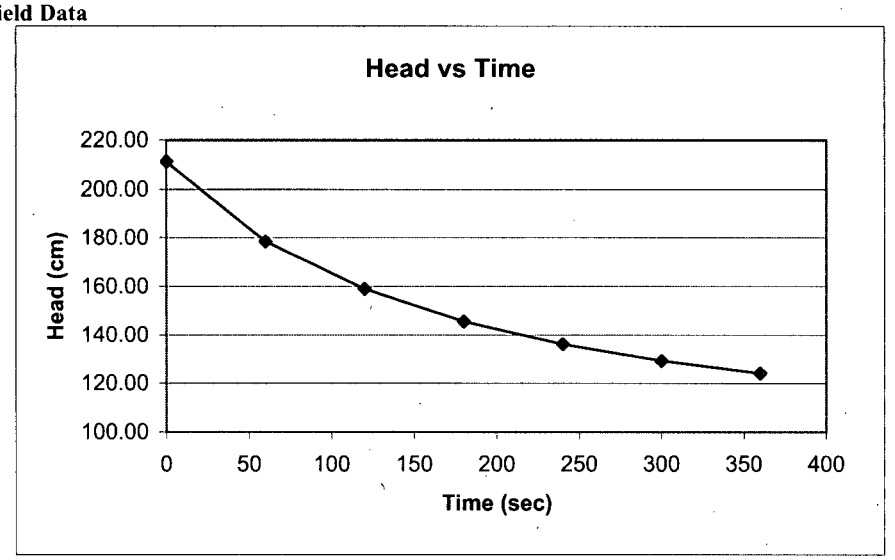
- K_h is the Horizontal Coefficient of Permeability (cm/sec)
- H_1 is the Piezometric Head for time; $t = t_1$ (cm)
- H_2 is the Piezometric Head for time; $t = t_2$ (cm)
- D is the Diameter of the Standpipe (cm)
- d is the diameter of the Open Length (cm),
- m is the Transformation Ratio, Where $m = \sqrt{K_h / K_v}$
  - K_h is the Horizontal Permeability
  - K_v is the Vertical Permeability
- L is the Open Length of Hole (cm)

Spreadsheet assumes 3" ID Pipe; NQ Hole, OD = 3"

MEAN PERMEABILITY (cm/sec)

3.73E-04

Graph of Field Data



CALCULATION OF PERMEABILITY BY THE FALLING HEAD METHOD
(Open Hole in Uniform Material)

S&ME

Site Name:	ONS - GWPP	
Date:	9/21/2007	
Boring I.D.	GM-12R	
Test Interval:	27.3' to 35.3'	(Partially Weathered/Fractured and Sound Rock))
Total Depth of Hole:	35.3 ft	1076.22 cm
Length of Open Hole:	8 ft	243.9 cm
Transformation Ratio m=	1	
Performed by:	David Klemm	

Time (sec)	Head (cm)	Permeability (cm/sec)
0	396.19	
3	391.59	4.82E-04
6	378.84	1.36E-03
9	375.18	4.00E-04
12	371.04	4.58E-04
15	367.99	3.40E-04
18	365.49	2.81E-04
21	363.38	2.38E-04
24	361.52	2.12E-04
27	359.94	1.81E-04
30	358.51	1.65E-04
45	353.35	1.19E-04

Calculations

$$K_h = \frac{d^2 \cdot \ln\left(\frac{2mL}{D}\right)}{8 \cdot L \cdot (t_2 - t_1)} \cdot \ln\frac{H_1}{H_2}$$

for $\frac{mL}{D} > 4$

Where:

K_h	is the Horizontal Coefficient of Permeability (cm/sec)
H_1	is the Piezometric Head for time; $t = t_1$ (cm)
H_2	is the Piezometric Head for time; $t = t_2$ (cm)
D	is the Diameter of the Standpipe (cm)
d	is the diameter of the Open Length (cm),
m	is the Transformation Ratio, Where

$m = \sqrt{K_h / K_v}$ K_h is the Horizontal Permeability; K_v is the Vertical Permeability

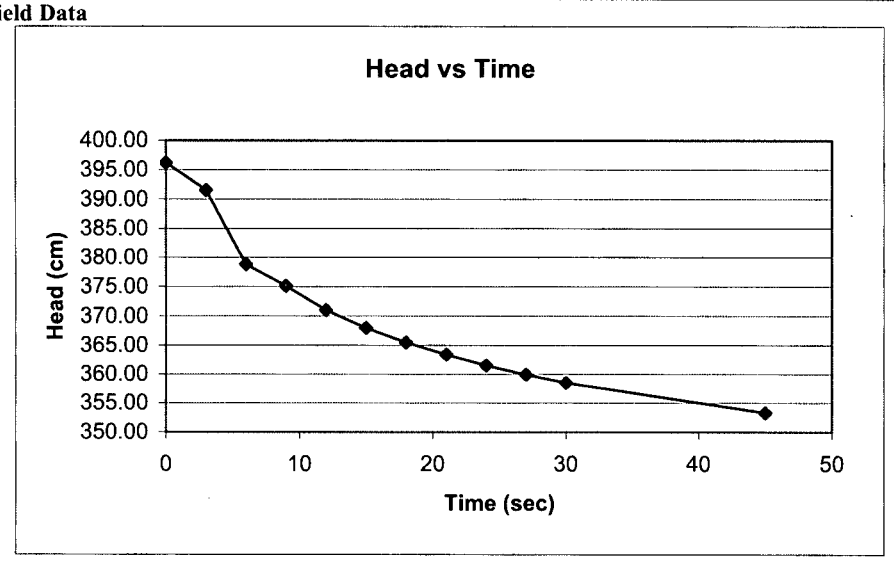
L	is the Open Length of Hole (cm)

Spreadsheet assumes 3" ID Pipe; NQ Hole, OD = 3"

MEAN PERMEABILITY (cm/sec)

3.86E-04

Graph of Field Data



BOREHOLE PERMEABILITY TEST USING PACKERS CALCULATIONS

PROJECT NAME AND NO.: ONS - GWPP
LOCATION: Seneca, SC
TEST DATE: 9/25/2007
TESTED BY: Jay Little/Julie Petersen
GROUND ELEV (ft MSL): 695.2

BOREHOLE NO.: GM-12R
TEST INTERVAL: 37.0 to 42.0 bgs
TEST INTERVAL: 658.2 to 653.2 EL

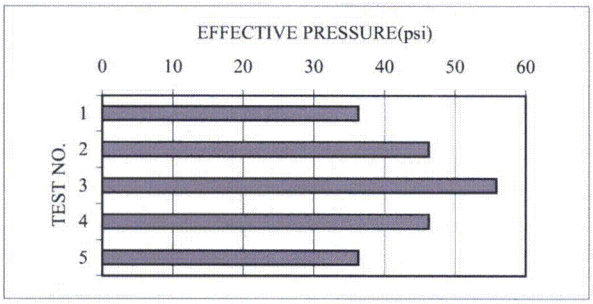
TEST METHOD: Double Packer Method using Multiple Pressure Tests
METHOD REFERENCE: Ground Water Manual, US Bureau of Reclamation, 1995, Chapter 10

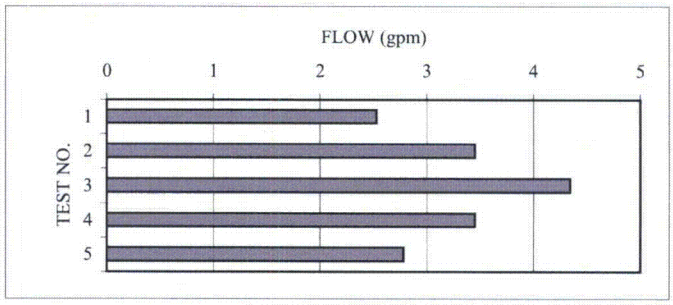
RESULTS OF PERMEABILITY CALCULATIONS
MULTIPLE STEP TEST

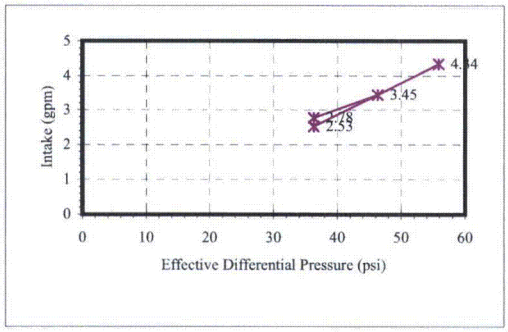
Step	Flow (Q) (gpm)	Pressure (psi) Gauge	Pressure (psi) Effective	Lugeons	Permeability (ft/sec)	Permeability (cm/sec)
1	2.53	30	36	25	8.41E-06	2.6E-04
2	3.45	40	46	27	9.0E-06	2.7E-04
3	4.34	50	56	28	9.4E-06	2.9E-04
4	3.45	40	46	27	9.0E-06	2.7E-04
5	2.78	30	36	28	9.2E-06	2.8E-04
			AVERAGE	27	9.0E-06	2.7E-04
			SELECTED VALUES			

Rock Description of Tested Interval:
Moderately Fractured Granitic Gneiss With Intermittent Biotite Hornblende Gneiss

TEST INTERPRETATION







PERMEABILITY CALCULATIONS FOR EACH STEP OF TEST

S&ME

CALCULATED PERMEABILITY FOR STEP 1

Gauge Pressure, **h2**:	30	psi	69.3	feet of water
Flow Rate, **Q**:	2.53	gpm	0.006	ft^3/sec
Head loss per TEN foot section of pipe:	0.0	psi		(per tables)
Head Loss, ***L*** :	0.0	psi	0.0	feet of water
Distance from pressure gauge to bottom of test section, h_1:	14.5	feet		
Value of h_1:	14.5	feet		
Effective Head, ***H*** where ***H = h1+h2-L*** :	83.8	feet	36.3	psi
Determine Saturation Zone:		-		
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H	52.8	feet		
X = (H/Tu)*100	158.7	%		
Tu/A	10.6			
Determine Conductivity Coefficient				
H/r	-		Value for Zone 1 analysis	
A/H	-		Value for Zone 1 analysis	
A/r	40		Value for Zone 2 and 3 analysis	
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1	
Cs for Zone 2 and 3 tests:	64		Cs for Zones 2 and 3	
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)	8.41E-06	ft/sec	2.56E-04	cm/sec
Is this step valid?				
If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow				
Calculate a, the total open area of the test section:			3.9	square feet
Is Q/a * (estimated porosity) > 10??			True, Test Valid	

CALCULATED PERMEABILITY FOR STEP 2

Gauge Pressure, **h2**:	40	psi	92.4	feet of water
Flow Rate, **Q**:	3.45	gpm	0.008	ft^3/sec
Head loss per TEN foot section of pipe:	0.0	psi		(per tables)
Head Loss, ***L*** :	0.0	psi	0.0	feet of water
Distance from pressure gauge to bottom of test section, h_1:	14.5	feet		
Value of h_1:	14.5	feet		
Effective Head, ***H*** where ***H = h1+h2-L*** :	106.9	feet	46.3	psi
Determine Saturation Zone:		-		
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H	75.9	feet		
X = (H/Tu)*100	140.8	%		
Tu/A	15.2			
Determine Conductivity Coefficient				
H/r	-		Value for Zone 1 analysis	
A/H	-		Value for Zone 1 analysis	
A/r	40		Value for Zone 2 and 3 analysis	
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1	
Cs for Zone 2 and 3 tests:	64		Cs for Zones 2 and 3	
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)	8.99E-06	ft/sec	2.74E-04	cm/sec
Is this step valid?				
If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow				
Calculate a, the total open area of the test section:			3.9	square feet
Is Q/a * (estimated porosity) > 10??			True, Test Valid	

CALCULATED PERMEABILITY FOR STEP 3

Gauge Pressure, **h2**:	50	psi	115.5	feet of water
Flow Rate, **Q**:	4.34	gpm	0.010	ft^3/sec
Head loss per TEN foot section of pipe:	0.1	psi		(per tables)
Head Loss, ***L*** :	0.4	psi	1.0	feet of water
Distance from pressure gauge to bottom of test section, $\mathbf{h_1}$:	14.5	feet		
Value of h_1:	14.5	feet		
Effective Head, ***H*** where ***H = h1+h2-L*** :	129.0	feet	55.9	psi
Determine Saturation Zone:		-		
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H	98.0	feet		
X = (H/Tu)*100	131.6	%		
Tu/A	19.6			
Determine Conductivity Coefficient				
H/r	-		Value for Zone 1 analysis	
A/H	-		Value for Zone 1 analysis	
A/r	40		Value for Zone 2 and 3 analysis	
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1	
Cs for Zone 2 and 3 tests:	64		Cs for Zones 2 and 3	
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)	9.37E-06	ft/sec	2.86E-04	cm/sec
Is this step valid?				
If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow				
Calculate a, the total open area of the test section:			3.9	square feet
Is Q/a * (estimated porosity) > 10??			True, Test Valid	

CALCULATED PERMEABILITY FOR STEP 4

Gauge Pressure, **h2**:	40	psi	92.4	feet of water
Flow Rate, **Q**:	3.45	gpm	0.008	ft^3/sec
Head loss per TEN foot section of pipe:	0.0	psi		(per tables)
Head Loss, ***L*** :	0.0	psi	0.0	feet of water
Distance from pressure gauge to bottom of test section, $\mathbf{h_1}$:	14.5	feet		
Value of h_1:	14.5	feet		
Effective Head, ***H*** where ***H = h1+h2-L*** :	106.9	feet	46.3	psi
Determine Saturation Zone:		-		
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H	75.9	feet		
X = (H/Tu)*100	140.8	%		
Tu/A	15.2			
Determine Conductivity Coefficient				
H/r	-		Value for Zone 1 analysis	
A/H	-		Value for Zone 1 analysis	
A/r	40		Value for Zone 2 and 3 analysis	
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1	
Cs for Zone 2 and 3 tests:	64		Cs for Zones 2 and 3	
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)	8.99E-06	ft/sec	2.74E-04	cm/sec
Is this step valid?				
If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow				
Calculate a, the total open area of the test section:			3.9	square feet
Is Q/a * (estimated porosity) > 10??			True, Test Valid	

CALCULATED PERMEABILITY FOR STEP 5

Gauge Pressure, **h2**:	30	psi	69.3	feet of water
Flow Rate, **Q**:	2.78	gpm	0.006	ft^3/sec
Head loss per TEN foot section of pipe:	0.0	psi		(per tables)
Head Loss, ***L*** :	0.0	psi	0.0	feet of water
Distance from pressure gauge to bottom of test section, h_1:	14.5	feet		
Value of h_1:	14.5	feet		
Effective Head, ***H*** where ***H = h1+h2-L*** :	83.8	feet	36.3	psi
Determine Saturation Zone:		-		
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H	52.8	feet		
X = (H/Tu)*100	158.7	%		
Tu/A	10.6			
Determine Conductivity Coefficient				
H/r	-		Value for Zone 1 analysis	
A/H	-		Value for Zone 1 analysis	
A/r	40		Value for Zone 2 and 3 analysis	
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1	
Cs for Zone 2 and 3 tests:	64		Cs for Zones 2 and 3	
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)	9.24E-06	ft/sec	2.82E-04	cm/sec

Is this step valid?

If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow

Calculate a, the total open area of the test section: 3.9 square feet

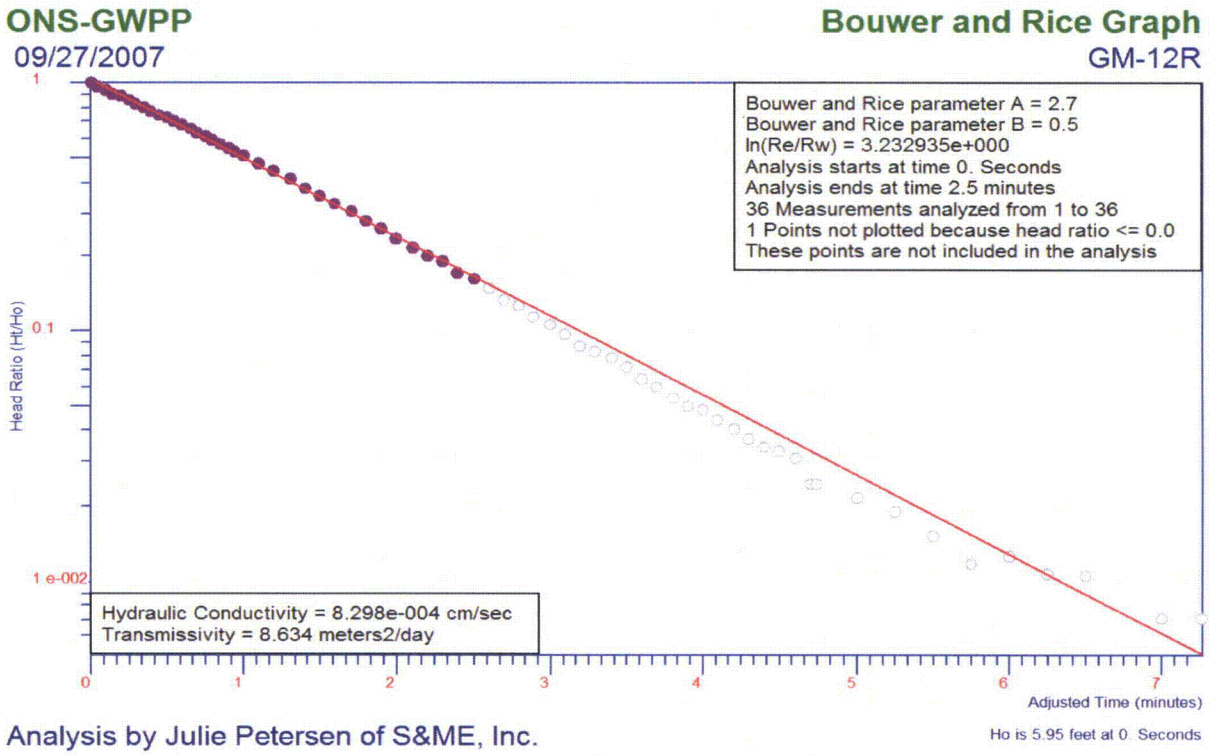
Is Q/a * (estimated porosity) > 10?? True, Test Valid

Calculation of Permeability By The Rising Head Method (Slug Test)

Site Name:	ONS-GWPP
Test Date:	9/27/2007
Well Label:	GM-12R
Aquifer Thickness:	39.51 feet
Screen Length:	5. feet
Casing Radius:	1. Inches
Effective Radius:	1.5 Inches
Static Water Level:	7.49 feet
Water Table to Screen Bottom:	34.51 feet
Anisotropy Ratio:	1

Time Adjustment: 0. Seconds
Test starts with trial 0
There are 69 time and drawdown measurements
Maximum head is 5.95 feet
Minimum head is -1.6e-002 feet

Calculation by Bouwer and Rice Graphical Method



PERMEABILITY

8.30×10^{-4} cm/sec

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ENGINEERING • TESTING
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1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.
2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

Project: **Oconee Nuclear Station**			**Boring No. GM-13**
Location: **Seneca, SC**		Number: **1264-07-234**	Sheet No. 1 of 2
Boring Depth (ft): **46.2**	Elevation (ft): **736.3**	Driller: **Jay Little, SC Cert No. B1575**	Date Drilled: **11/5/07**
Logged By: **Scott Dacus**	Water Level: **Stabilized Water Level at 37.16 ft bls**		Drilling Method: **4¼" H.S.A.**

Elev. (Feet)	Depth (Feet)	Lith-ology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
735			PRE-DUG HOLE FOR UTILITY CLEARANCE: **FILL**		
	5		FILL (F): Red and Brown, Micaceous, Silty, **CLAY**		
730					
	10				
725			FILL (F): Brown, Micaceous, Clayey, **SILT** With Rock Fragments		
	15				
720					
	20				
715			FILL (F): Gray and Brown, Micaceous, Silty, **CLAY** With Roots		
	25				
710			SOIL/SAPROLITE (M1): Orange, White, and Brown, Micaceous, Silty, **SAND**		
	30				
705			SOIL/SAPROLITE (M1): White, Tan, and Brown, Micaceous, Silty, **SAND**		

BORING LOG WITH WELL RECOVERED_ONS LOG.GPJ LAGWGN01.GDT 7/23/08

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Project: **Oconee Nuclear Station**				**Boring No. GM-13**
Location: **Seneca, SC**		Number: **1264-07-234**		Sheet No. 2 of 2
Boring Depth (ft): **46.2**	Elevation (ft): **736.3**	Driller: **Jay Little, SC Cert No. B1575**	Date Drilled: **11/5/07**	
Logged By: **Scott Dacus**	Water Level: **Stabilized Water Level at 37.16 ft bls**		Drilling Method: **4¼" H.S.A.**	

Elev. (Feet)	Depth (Feet)	Lith-ology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
700					
	40				
695					
	45				
			Lithologic Description Obtained From GM-13R **Roller Cone Refusal at 46.20 ft bls**		

BORING LOG WITH WELL RECOVERED_ONS LOG.GPJ LAGWGN01.GDT 7/23/08

COMPLETION REPORT OF WELL No. GM-13

PROJECT: **Oconee Nuclear Station**
PROJECT NO: **1264-07-234**
PROJECT LOCATION: **Seneca, SC**

DRILLING CONTRACTOR: **S&ME, Inc.**
DRILLING METHOD: **4¼" H.S.A.**
DATE DRILLED: **11/5/07**

WATER LEVEL: **Stabilized Water Level at 37.16 ft bls**
LATITUDE: **34°47'32.366"**
LONGITUDE: **82°53'36.494"**
TOP OF CASING ELEVATION: **739.10**
DATUM: **MSL**
LOGGED BY: **Scott Dacus**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)
				0.00	GS	736.25
PRE-DUG HOLE FOR UTILITY CLEARANCE: **FILL**		0				
FILL (F): Red and Brown, Micaceous, Silty, **CLAY**		5				
		10				
FILL (F): Brown, Micaceous, Clayey, **SILT** With Rock Fragments		15				
		20				
FILL (F): Gray and Brown, Micaceous, Silty, **CLAY** With Roots		25				
				26.80		709.45
SOIL/SAPROLITE (M1): Orange, White, and Brown, Micaceous, Silty, **SAND**		30		28.80		707.45

WELL CONSTRUCTION DETAILS

PROTECTIVE CASING
Diameter:
Type:
Interval:

RISER CASING
Diameter: **2"**
Type: **Sch. 40 PVC**
Interval: **0 to 30.8 ft bls**

GROUT
Type: **Neat Cement**
Interval: **0 to 26.8 ft bls**

SEAL
Type: **Bentonite**
Interval: **26.8 to 28.8 ft bls**

FILTERPACK
Type: **#1 Silica Sand**
Interval: **28.8 to 45.8 ft bls**

SCREEN
Diameter: **2"**
Type: **0.010 Slotted PVC**
Interval: **30.8 to 45.8 ft bls**

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL RECOVERED_ONS LOG.GPJ S&ME.GDT 7/23/08

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COMPLETION REPORT OF WELL No. GM-13

PROJECT: **Oconee Nuclear Station**
PROJECT NO: **1264-07-234**
PROJECT LOCATION: **Seneca, SC**

GROUND SURFACE ELEVATION:
LOGGED BY: **736.3**
CHECKED BY: **Scott Dacus**

STRATA			WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)	WELL CONSTRUCTION DETAILS
DESCRIPTION	SYMBOL	DEPTH (ft.)					
							(See Page 1)
SOIL/SAPROLITE (M1): White, Tan, and Brown, Micaceous, Silty, **SAND** *(continued)*		35 40 45		45.30 45.80 46.20		690.95 690.45 690.05	

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL RECOVERED ONS LOG.GPJ S&ME.GDT 7/23/08

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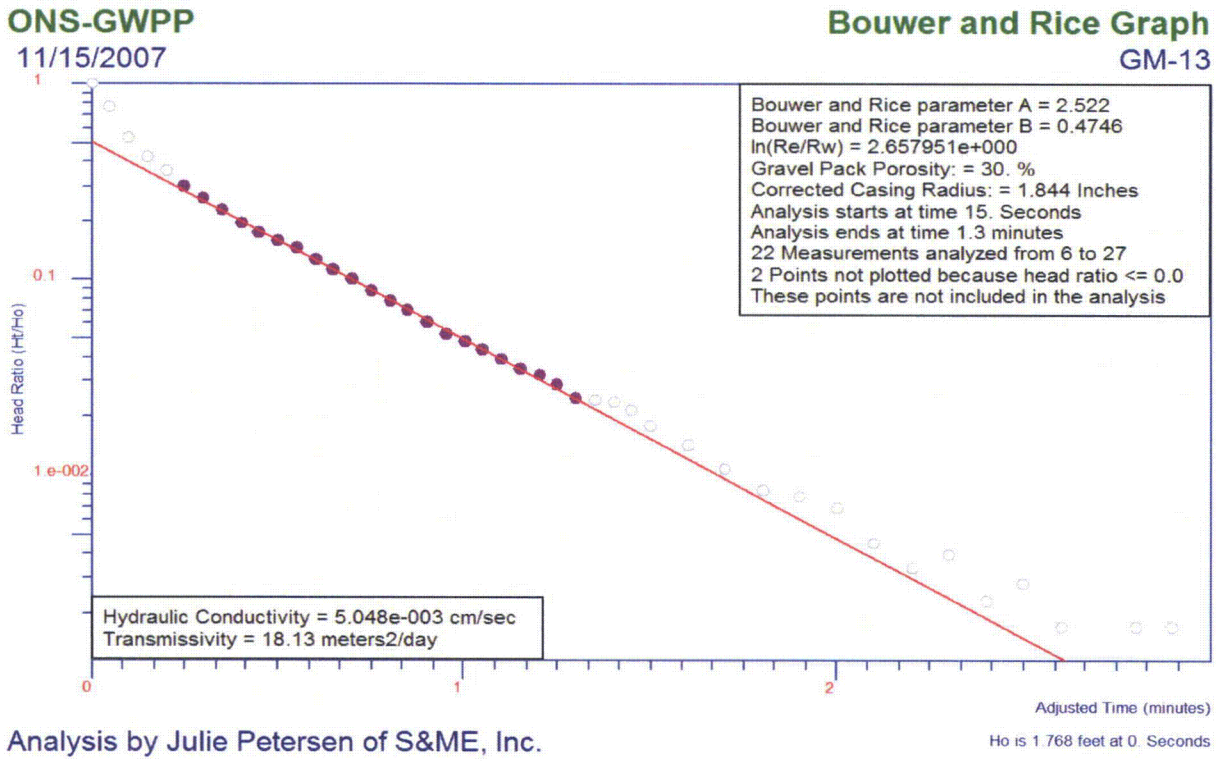
COMPLETION REPORT OF WELL No. GM-13

Calculation of Permeability By The Rising Head Method (Slug Test)

Site Name:	ONS-GWPP
Test Date:	11/15/2007
Well Label:	GM-13
Aquifer Thickness:	13.64 feet
Screen Length:	15. feet
Casing Radius:	1. Inches
Effective Radius:	3. Inches
Gravel Pack Porosity:	30.00%
Corrected Casing Radius:	1.844 Inches
Static Water Level:	37.16 feet
Water Table to Screen Bottom:	8.64 feet
Anisotropy Ratio:	1

Time Adjustment: 0. Seconds
Test starts with trial 0
There are 46 time and drawdown measurements
Maximum head is 1.768 feet
Minimum head is 0. feet

Calculation by Bouwer and Rice Graphical Method



PERMEABILITY

5.05×10^{-3} cm/sec

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Project: **Oconee Nuclear Station**			**Boring No. GM-13R**
Location: **Seneca, SC**		Number: **1264-07-234**	Sheet No. 1 of 2
Boring Depth (ft): **68.2**	Elevation (ft): **736.3**	Driller: **Jay Little, SC Cert No. B1575**	Date Drilled: **10/30/07**
Logged By: **Scott Dacus**	Water Level: **Stabilized Water Level at 33.56 ft bls**		Drilling Method: **4¼" H.S.A.**

Elev. (Feet)	Depth (Feet)	Lith-ology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
735			PRE-DUG HOLE FOR UTILITY CLEARANCE: **FILL**		
	5		FILL (F): Red and Brown, Micaceous, Silty, **CLAY**		10
730					
	10		FILL (F): Brown, Micaceous, Clayey, **SILT** With Rock Fragments		10
725					
	15				16
720					
	20				14
715			FILL (F): Gray and Brown, Micaceous, Silty, **CLAY** With Roots		
	25				20
710			SOIL/SAPROLITE (M1): Orange, White, and Brown, Micaceous, Silty, **SAND**		
	30				15
705			SOIL/SAPROLITE (M1): White, Tan, and Brown, Micaceous, Silty, **SAND**	▼	
	35				

BORING LOG WITH WELL RECOVERED_ONS LOG.GPJ LAGWGN01.GDT 7/23/08

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Project: **Oconee Nuclear Station**			**Boring No. GM-13R**
Location: **Seneca, SC**		Number: **1264-07-234**	Sheet No. 2 of 2
Boring Depth (ft): **68.2**	Elevation (ft): **736.3**	Driller: **Jay Little, SC Cert No. B1575**	Date Drilled: **10/30/07**
Logged By: **Scott Dacus**	Water Level: **Stabilized Water Level at 33.56 ft bls**		Drilling Method: **4¼" H.S.A.**

Elev. (Feet)	Depth (Feet)	Lith-ology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
700					
	40				18
695			SOUND ROCK (D): Medium-Grained **GRANITIC GNEISS**; Slightly Fractured Low Angle Joints With No Staining		
	45		**Roller Cone Refusal at 46.10 ft bls**		22
690					
	50				
685					
	55				
680			SOUND ROCK (D): Medium-Grained **GRANITIC GNEISS** With Intermittent Medium-Grained **BIOTITE HORNBLENDE GNEISS** Moderately Fractured, High Angle and Low Angle Joints With Moderate to No Staining		
	60				
675					
	65				
670			**Boring Terminated at 68.15 ft bls**		

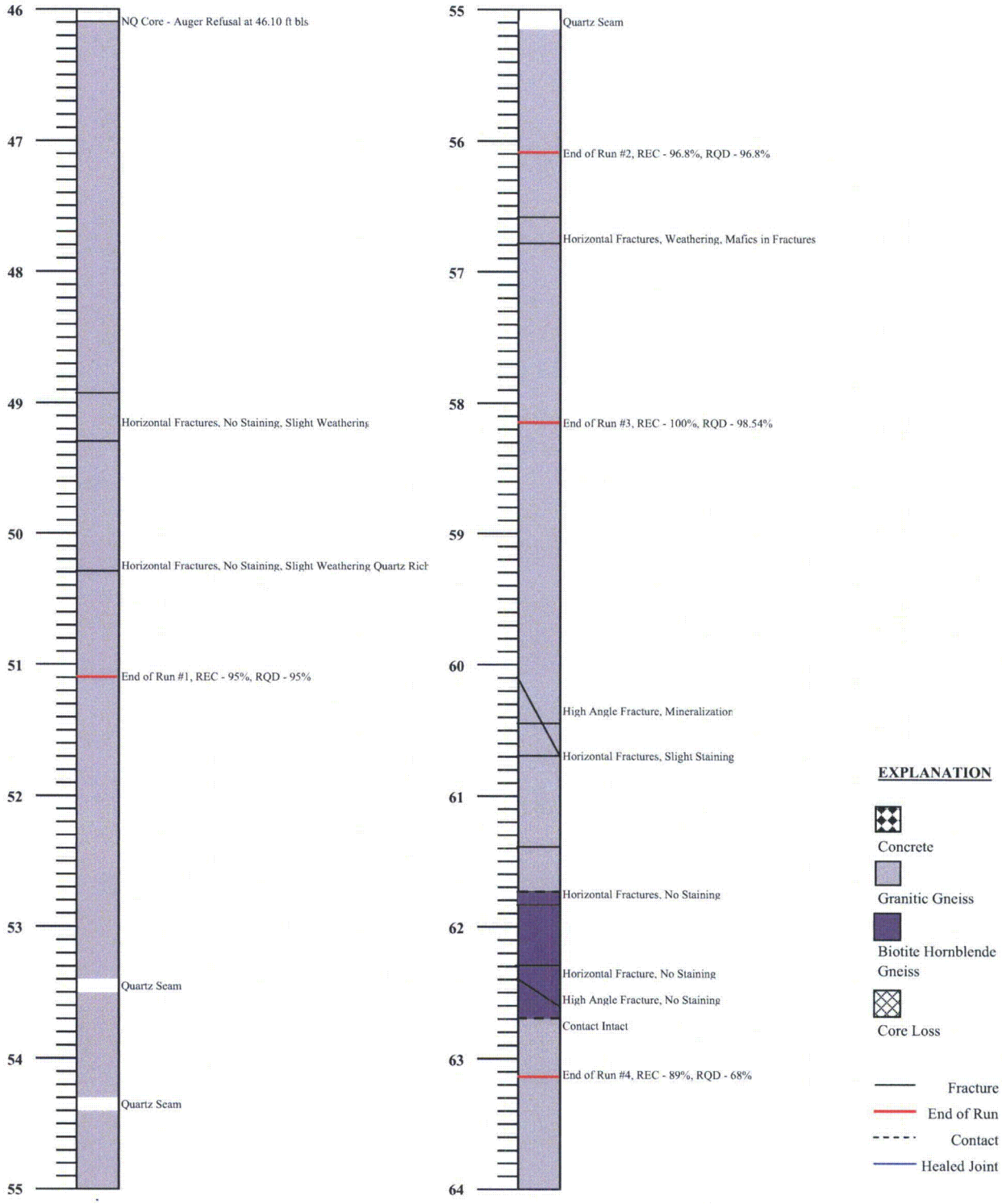
BORING LOG WITH WELL RECOVERED_ONS LOG.GPJ LAGWGN01.GDT 7/23/08

FIELD ROCK CORE LOG

Oconee Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-07-234

Core Location: GM-13R

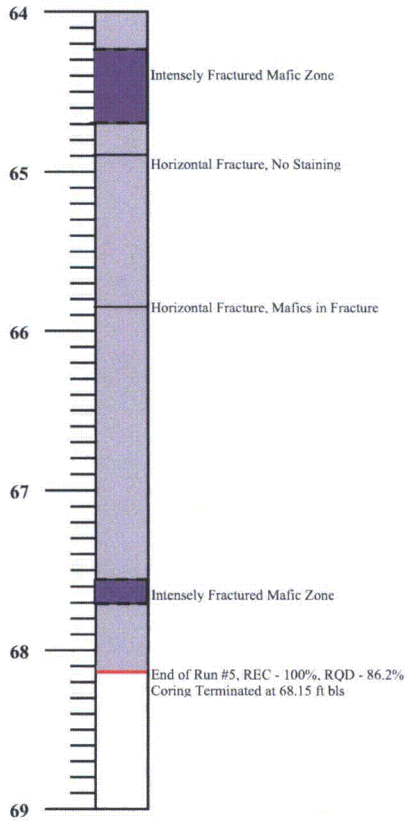


FIELD ROCK CORE LOG

Oconee Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-07-234

Core Location: GM-13R



EXPLANATION

Concrete

Granitic Gneiss

Biotite Hornblende Gneiss

Core Loss

Fracture

End of Run

Contact

Healed Joint

COMPLETION REPORT OF WELL No. GM-13R

PROJECT: **Oconee Nuclear Station**
PROJECT NO: **1264-07-234**
PROJECT LOCATION: **Seneca, SC**

DRILLING CONTRACTOR: **S&ME, Inc.**
DRILLING METHOD: **4¼" H.S.A.**
DATE DRILLED: **10/30/07**

WATER LEVEL: **Stabilized Water Level at 33.56 ft bls**
LATITUDE: **34°47'32.417"**
LONGITUDE: **82°53'36.511"**
TOP OF CASING ELEVATION: **739.18**
DATUM: **MSL**
LOGGED BY: **Scott Dacus**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)
PRE-DUG HOLE FOR UTILITY CLEARANCE: **FILL**		0
FILL (F): Red and Brown, Micaceous, Silty, **CLAY**		5
		10
FILL (F): Brown, Micaceous, Clayey, **SILT** With Rock Fragments		15
		20
FILL (F): Gray and Brown, Micaceous, Silty, **CLAY** With Roots		25
SOIL/SAPROLITE (M1): Orange, White, and Brown, Micaceous, Silty, **SAND**		30
SOIL/SAPROLITE (M1): White, Tan, and Brown, Micaceous, Silty, **SAND**		35

WELL DETAILS

DEPTH (ft.)	LEGEND	ELEVATION (ft.)
0.00	GS	736.33

WELL CONSTRUCTION DETAILS

PROTECTIVE CASING
Diameter:
Type:
Interval:

RISER CASING
Diameter: **2"**
Type: **Sch. 40 PVC**
Interval: **0 to 58.15 ft bls**

GROUT
Type: **Neat Cement**
Interval: **0 to 55 ft bls**

SEAL
Type: **K-packer**
Interval: **57.58 to 57.78 ft bls**

FILTERPACK
Type:
Interval:

SCREEN
Diameter: **2"**
Type: **0.010 Slotted PVC**
Interval: **58.15 to 68.15 ft bls**

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL RECOVERED_ONS LOG.GPJ S&ME.GDT 7/23/08

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COMPLETION REPORT OF WELL No. GM-13R

PROJECT: **Oconee Nuclear Station**
PROJECT NO: **1264-07-234**
PROJECT LOCATION: **Seneca, SC**

GROUND SURFACE ELEVATION:
LOGGED BY: **736.3**
CHECKED BY: **Scott Dacus**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)
SOIL/SAPROLITE (M1): White, Tan, and Brown, Micaceous, Silty, **SAND** *(continued)*		40				
SOUND ROCK (D): Medium-Grained **GRANITIC GNEISS** Slightly Fractured Low Angle Joints With No Staining		45 50 55		55.00		681.33
SOUND ROCK (D): Medium-Grained **GRANITIC GNEISS** With Intermittent Medium-Grained **BIOTITE HORNBLENDE GNEISS**; Moderately Fractured, High Angle and Low Angle Joints With Moderate to No Staining		60 65		57.58 57.78 58.15 67.65 68.15		678.75 678.55 678.18 668.68 668.18

WELL CONSTRUCTION DETAILS

(See Page 1)

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

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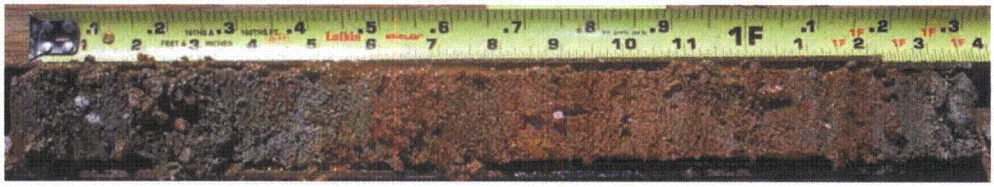
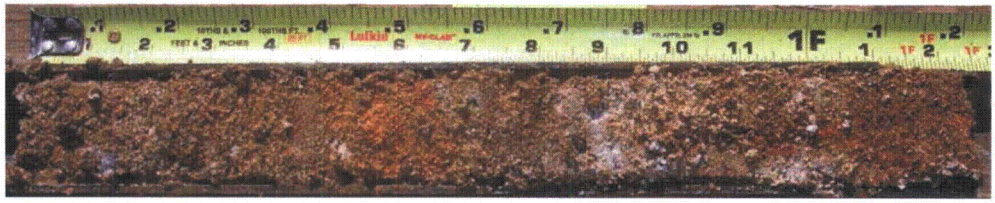
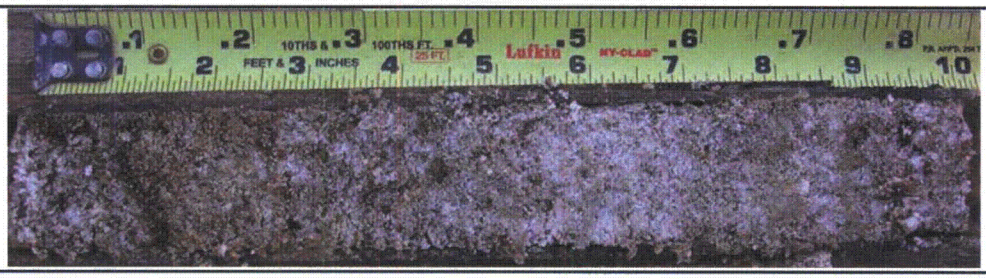
COMPLETION REPORT OF WELL No. GM-13R

SPLIT SPOON SAMPLE PICTURES

Oconee Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-07-234

Boring Number: GM-13R

Sample No:	**1**	
Depth (ft-bls):	**8.5 - 10**	
Blow Count:	**3 * 4 * 6**	
Sample No:	**2**	
Depth (ft-bls):	**13.5 - 15**	
Blow Count:	**4 * 4 * 6**	
Sample No:	**3**	
Depth (ft-bls):	**18.5 - 20**	
Blow Count:	**4 * 7 * 9**	
Sample No:	**4**	
Depth (ft-bls):	**23.5 - 25**	
Blow Count:	**4 * 6 * 8**	
Sample No:	**5**	
Depth (ft-bls):	**28.5 - 30**	
Blow Count:	**5 * 8 * 12**	
Sample No:	**6**	
Depth (ft-bls):	**33.5 - 35**	
Blow Count:	**7 * 9 * 6**	

SPLIT SPOON SAMPLE PICTURES

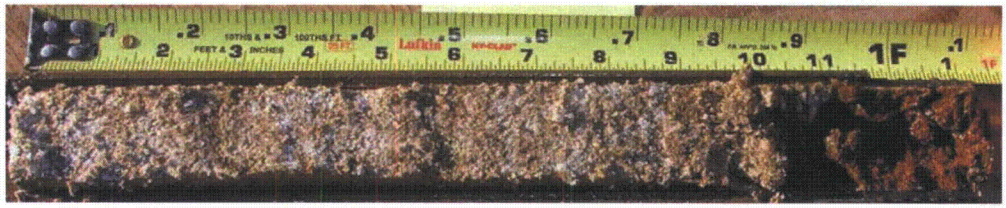
Oconee Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-07-234

Boring Number: GM-13R

Sample No:	**7**
Depth (ft-bls):	**38.5 - 40**
Blow Count:	**2 * 6 * 12**

Sample No:	**8**
Depth (ft-bls):	**43.5 - 45**
Blow Count:	**10 * 14 * 8**

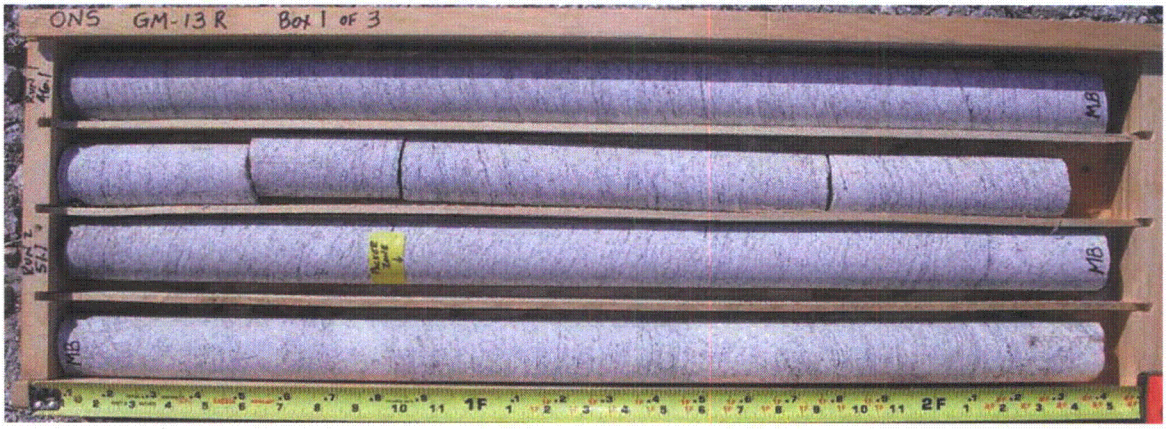


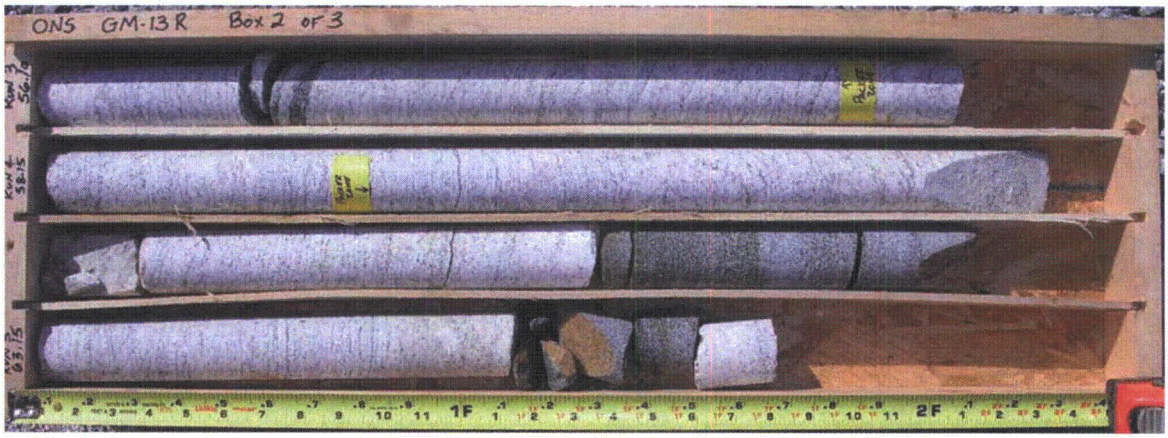
ROCK CORE PICTURES

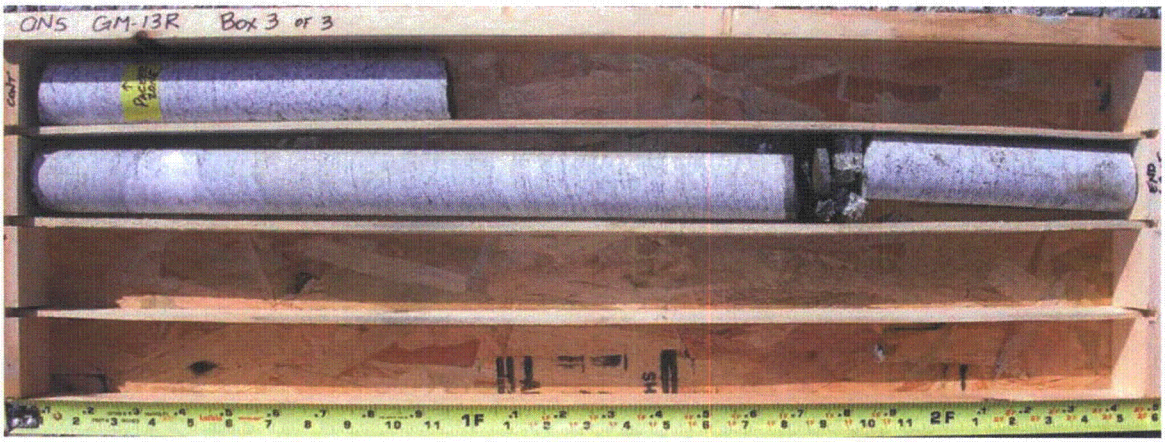
Oconee Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-07-234

Core Location: GM-13R







CLASSIFICATION:

46.10' to 56.60': Medium-Grained Granitic Gneiss

56.60' to 68.15': Medium-Grained Granitic Gneiss With Intermittent Biotite Hornblende Gneiss

CALCULATION OF PERMEABILITY BY THE FALLING HEAD METHOD
(Open Hole in Uniform Material)

S&ME

Site Name:	ONS - GWPP	
Date:	10/31/2007	
Boring I.D.	GM-13R	
Test Interval:	46.1' to 51.1'	(Sound Rock)
Total Depth of Hole:	51.1 ft	1557.93 cm
Length of Open Hole:	5 ft	152.44 cm
Transformation Ratio m=	1	
Performed by:	Scott Dacus	

Time (sec)	Head (cm)	Permeability (cm/sec)
0	685.46	
60	627.26	2.60E-04
120	609.97	8.18E-05
180	603.23	3.25E-05
240	597.13	2.97E-05
300	591.55	2.75E-05
360	586.16	2.68E-05
420	581.07	2.55E-05
480	576.25	2.44E-05
540	571.68	2.33E-05
600	567.41	2.19E-05
900	549.42	1.89E-05
1200	532.74	1.80E-05
1500	515.00	1.98E-05
1800	500.34	1.69E-05
2400	477.80	1.35E-05
3000	454.05	1.49E-05
3600	431.62	1.48E-05

Calculations

$$K_h = \frac{d^2 \cdot \ln\left(\frac{2mL}{D}\right)}{8 \cdot L \cdot (t_2 - t_1)} \cdot \ln\frac{H_1}{H_2}$$

for $\frac{mL}{D} > 4$

Where:

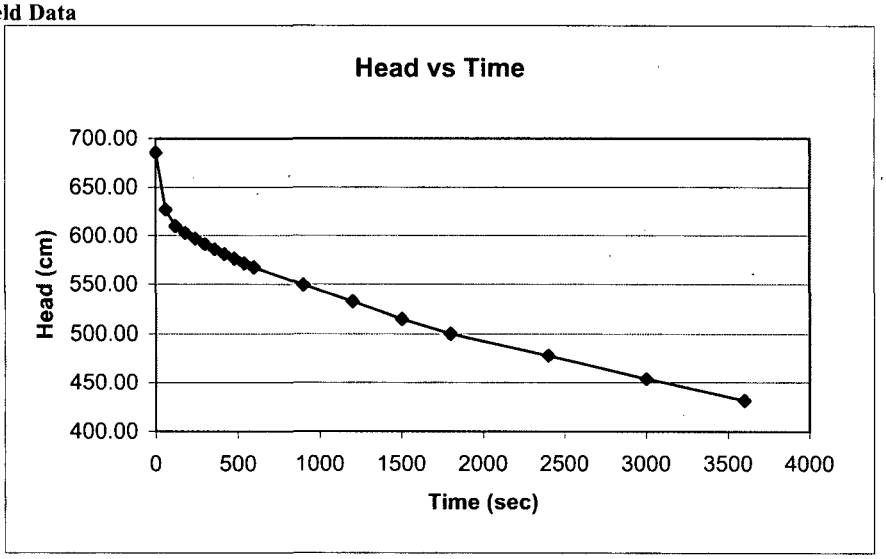
K_h	is the Horizontal Coefficient of Permeability (cm/sec)
H_1	is the Piezometric Head for time; $t = t_1$ (cm)
H_2	is the Piezometric Head for time; $t = t_2$ (cm)
D	is the Diameter of the Standpipe (cm)
d	is the diameter of the Open Length (cm),
m	is the Transformation Ratio, Where
	$m = \sqrt{K_h / K_v}$ K_h is the Horizontal Permeability; K_v is the Vertical Permeability
L	is the Open Length of Hole (cm)

Spreadsheet assumes 3" ID Pipe; NQ Hole, OD = 3"

MEAN PERMEABILITY (cm/sec)

3.94E-05

Graph of Field Data



CALCULATION OF PERMEABILITY BY THE FALLING HEAD METHOD (Open Hole in Uniform Material)

S&ME

Site Name:	ONS - GWPP	
Date:	11/5/2007	
Boring I.D.	GM-13R	
Test Interval:	43.5' to 46.2'	(Soil/Saprolite)
Total Depth of Hole:	46.2 ft	1408.54 cm
Length of Open Hole:	2.7 ft	82.32 cm
Transformation Ratio m=	1	
Performed by:	Scott Dacus	

Time (sec)	Head (cm)	Permeability (cm/sec)
0	632.07	
60	623.45	6.21E-05
120	617.96	3.99E-05
180	613.57	3.22E-05
240	610.00	2.63E-05
300	606.52	2.58E-05
360	603.08	2.57E-05
420	599.70	2.54E-05
480	596.43	2.46E-05
540	593.26	2.41E-05
600	590.12	2.40E-05
900	576.07	2.18E-05
1200	563.54	1.99E-05
1500	552.04	1.86E-05
1800	541.34	1.77E-05
2400	521.34	1.70E-05
3000	503.84	1.54E-05
3600	491.46	1.12E-05

Calculations

$$K_h = \frac{d^2 \cdot \ln\left(\frac{2mL}{D}\right)}{8 \cdot L \cdot (t_2 - t_1)} \cdot \ln\frac{H_1}{H_2}$$

for $\frac{mL}{D} > 4$

Where:

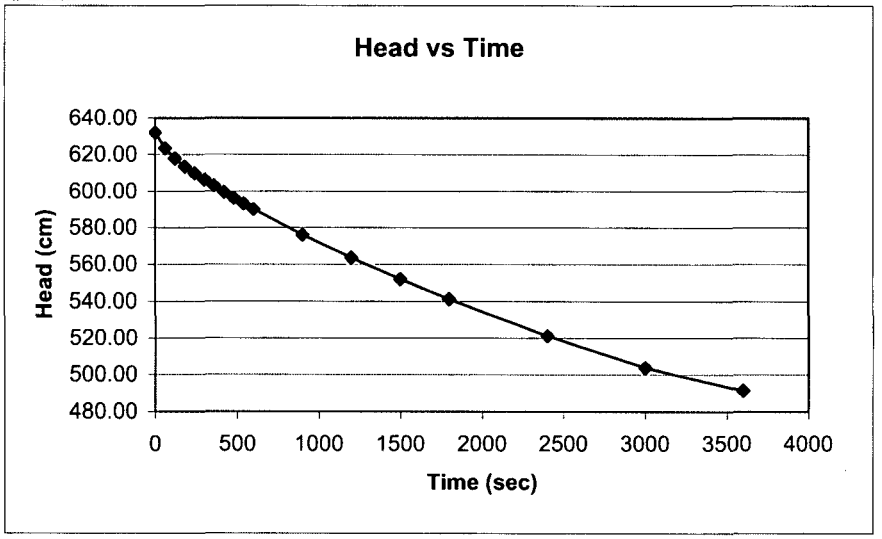
K_h	is the Horizontal Coefficient of Permeability (cm/sec)
H_1	is the Piezometric Head for time; $t = t_1$ (cm)
H_2	is the Piezometric Head for time; $t = t_2$ (cm)
D	is the Diameter of the Standpipe (cm)
d	is the diameter of the Open Length (cm),
m	is the Transformation Ratio, Where
	$m = \sqrt{K_h / K_v}$ K_h is the Horizontal Permeability; K_v is the Vertical Permeability
L	is the Open Length of Hole (cm)

Spreadsheet assumes 3" ID Pipe; NQ Hole, OD = 3"

MEAN PERMEABILITY (cm/sec)

2.54E-05

Graph of Field Data



CALCULATION OF PERMEABILITY BY THE FALLING HEAD METHOD (Open Hole in Uniform Material)

S&ME

Site Name:	ONS - GWPP	
Date:	10/31/2007	
Boring I.D.	GM-13R	
Test Interval:	46.1' to 56.1'	(Sound Rock)
Total Depth of Hole:	56.1 ft	1710.37 cm
Length of Open Hole:	10 ft	304.88 cm
Transformation Ratio m=	1	
Performed by:	Scott Dacus	

Time (sec)	Head (cm)	Permeability (cm/sec)
0	732.47	
60	679.33	1.31E-04
120	668.05	2.91E-05
180	660.43	2.00E-05
240	652.77	2.03E-05
300	645.79	1.87E-05
360	640.40	1.46E-05
420	636.31	1.11E-05
480	632.77	9.69E-06
540	629.15	1.00E-05
600	625.82	9.21E-06
900	607.29	1.05E-05
1200	586.49	1.21E-05
1500	569.09	1.05E-05
1800	556.83	7.57E-06
2400	530.79	8.33E-06
3000	501.49	9.87E-06
3600	475.61	9.21E-06

Calculations

$$K_h = \frac{d^2 \cdot \ln\left(\frac{2mL}{D}\right)}{8 \cdot L \cdot (t_2 - t_1)} \cdot \ln\frac{H_1}{H_2}$$

for $\frac{mL}{D} > 4$

Where:

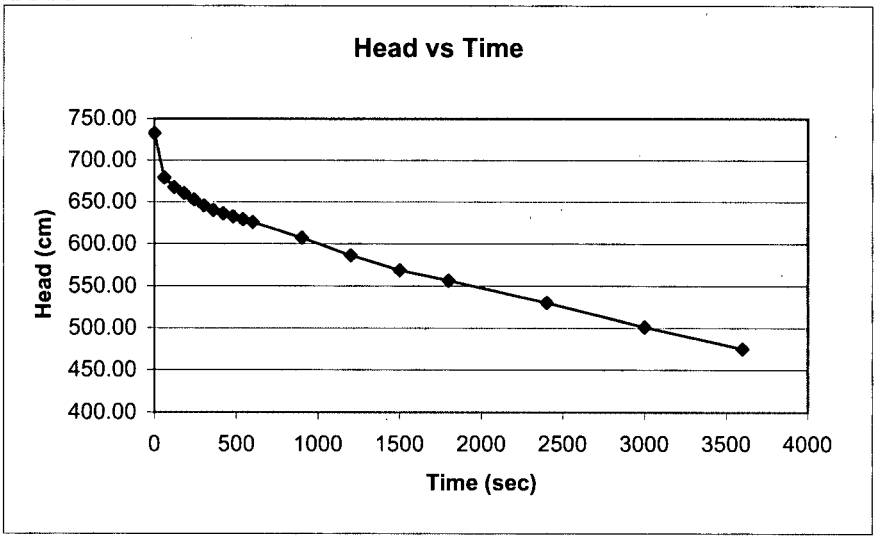
- K_h is the Horizontal Coefficient of Permeability (cm/sec)
- H_1 is the Piezometric Head for time; $t = t_1$ (cm)
- H_2 is the Piezometric Head for time; $t = t_2$ (cm)
- D is the Diameter of the Standpipe (cm)
- d is the diameter of the Open Length (cm),
- m is the Transformation Ratio, Where $m = \sqrt{K_h / K_v}$
  - K_h is the Horizontal Permeability
  - K_v is the Vertical Permeability
- L is the Open Length of Hole (cm)

Spreadsheet assumes 3" ID Pipe; NQ Hole, OD = 3"

MEAN PERMEABILITY (cm/sec)

2.01E-05

Graph of Field Data



BOREHOLE PERMEABILITY TEST USING PACKERS CALCULATIONS

PROJECT NAME AND NO.: ONS - GWPP
LOCATION: Seneca, SC
TEST DATE: 11/1/2007
TESTED BY: Adam Jennings/Scott Dacus
GROUND ELEV (ft MSL): 736.3

BOREHOLE NO.: GM-13R
TEST INTERVAL: 51.9 to 57.9 bgs
TEST INTERVAL: 684.4 to 678.4 EL

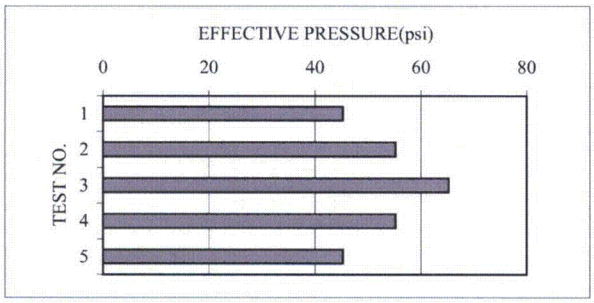
TEST METHOD: Double Packer Method using Multiple Pressure Tests
METHOD REFERENCE: Ground Water Manual, US Bureau of Reclamation, 1995, Chapter 10

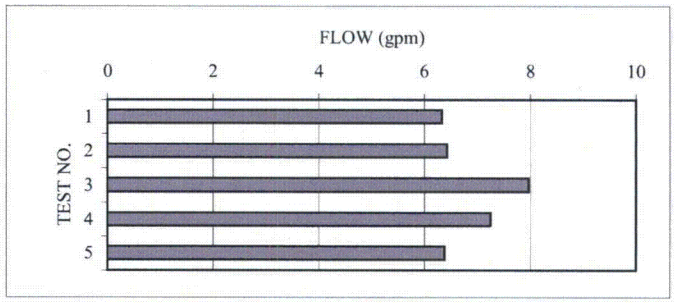
RESULTS OF PERMEABILITY CALCULATIONS
MULTIPLE STEP TEST

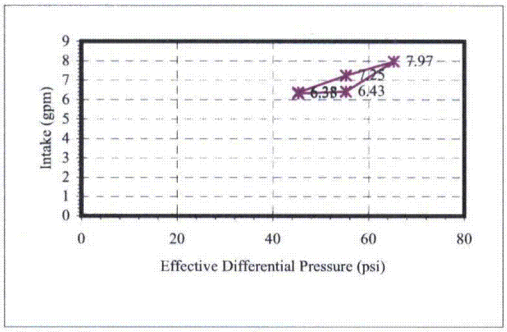
Step	Flow (Q) (gpm)	Pressure (psi) Gauge	Pressure (psi) Effective	Lugeons	Permeability (ft/sec)	Permeability (cm/sec)
1	6.33	30	45	42	1.50E-05	4.6E-04
2	6.43	40	55	35	1.2E-05	3.8E-04
3	7.97	50	65	37	1.3E-05	4.0E-04
4	7.25	40	55	39	1.4E-05	4.3E-04
5	6.38	30	45	42	1.5E-05	4.6E-04
			AVERAGE	39	1.4E-05	4.3E-04
			SELECTED VALUES			

Rock Description of Tested Interval:
Moderately Fractured Granitic Gneiss With Intermittent Biotite Hornblende Gneiss

TEST INTERPRETATION







PERMEABILITY CALCULATIONS FOR EACH STEP OF TEST

S&ME

CALCULATED PERMEABILITY FOR STEP 1

Gauge Pressure, **h2**:	30	psi	69.3	feet of water
Flow Rate, **Q**:	6.33	gpm	0.014	ft^3/sec
Head loss per TEN foot section of pipe:	0.1	psi		(per tables)
Head Loss, ***L*** :	0.6	psi	1.3	feet of water
Distance from pressure gauge to bottom of test section, h_1:	36.5	feet		
Value of h_1:	36.5	feet		
Effective Head, ***H*** where ***H = h1+h2-L*** :	104.4	feet	45.2	psi
Determine Saturation Zone:		-		
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H	80.4	feet		
X = (H/Tu)*100	130.0	%		
Tu/A	13.3			
Determine Conductivity Coefficient				
H/r	-		Value for Zone 1 analysis	
A/H	-		Value for Zone 1 analysis	
A/r	48		Value for Zone 2 and 3 analysis	
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1	
Cs for Zone 2 and 3 tests:	72		Cs for Zones 2 and 3	
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)	1.50E-05	ft/sec	4.57E-04	cm/sec
Is this step valid?				

If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow

Calculate a, the total open area of the test section: 4.7 square feet

Is Q/a * (estimated porosity) > 10?? True, Test Valid

CALCULATED PERMEABILITY FOR STEP 2

Gauge Pressure, **h2**:	40	psi	92.4	feet of water
Flow Rate, **Q**:	6.43	gpm	0.014	ft^3/sec
Head loss per TEN foot section of pipe:	0.1	psi		(per tables)
Head Loss, ***L*** :	0.6	psi	1.3	feet of water
Distance from pressure gauge to bottom of test section, h_1:	36.5	feet		
Value of h_1:	36.5	feet		
Effective Head, ***H*** where ***H = h1+h2-L*** :	127.5	feet	55.2	psi
Determine Saturation Zone:		-		
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H	103.5	feet		
X = (H/Tu)*100	123.3	%		
Tu/A	17.2			
Determine Conductivity Coefficient				
H/r	-		Value for Zone 1 analysis	
A/H	-		Value for Zone 1 analysis	
A/r	48		Value for Zone 2 and 3 analysis	
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1	
Cs for Zone 2 and 3 tests:	72		Cs for Zones 2 and 3	
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)	1.25E-05	ft/sec	3.80E-04	cm/sec
Is this step valid?				

If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow

Calculate a, the total open area of the test section: 4.7 square feet

Is Q/a * (estimated porosity) > 10?? True, Test Valid

CALCULATED PERMEABILITY FOR STEP 3

Gauge Pressure, **h2**:	50	psi	115.5	feet of water
Flow Rate, **Q**:	7.97	gpm	0.018	ft^3/sec
Head loss per TEN foot section of pipe:	0.1	psi		(per tables)
Head Loss, ***L*** :	0.6	psi	1.3	feet of water
Distance from pressure gauge to bottom of test section, $\mathbf{h_1}$:	36.5	feet		
Value of h_1:	36.5	feet		
Effective Head, ***H*** where ***H = h1+h2-L*** :	150.6	feet	65.2	psi
Determine Saturation Zone:		-		
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H	126.6	feet		
X = (H/Tu)*100	119.0	%		
Tu/A	21.0			
Determine Conductivity Coefficient				
H/r	-		Value for Zone 1 analysis	
A/H	-		Value for Zone 1 analysis	
A/r	48		Value for Zone 2 and 3 analysis	
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1	
Cs for Zone 2 and 3 tests:	72		Cs for Zones 2 and 3	
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)	1.31E-05	ft/sec	3.99E-04	cm/sec
Is this step valid?				
If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow				
Calculate a, the total open area of the test section:			4.7	square feet
Is Q/a * (estimated porosity) > 10??			True, Test Valid	

CALCULATED PERMEABILITY FOR STEP 4

Gauge Pressure, **h2**:	40	psi	92.4	feet of water
Flow Rate, **Q**:	7.25	gpm	0.016	ft^3/sec
Head loss per TEN foot section of pipe:	0.1	psi		(per tables)
Head Loss, ***L*** :	0.6	psi	1.3	feet of water
Distance from pressure gauge to bottom of test section, $\mathbf{h_1}$:	36.5	feet		
Value of h_1:	36.5	feet		
Effective Head, ***H*** where ***H = h1+h2-L*** :	127.5	feet	55.2	psi
Determine Saturation Zone:		-		
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H	103.5	feet		
X = (H/Tu)*100	123.3	%		
Tu/A	17.2			
Determine Conductivity Coefficient				
H/r	-		Value for Zone 1 analysis	
A/H	-		Value for Zone 1 analysis	
A/r	48		Value for Zone 2 and 3 analysis	
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1	
Cs for Zone 2 and 3 tests:	72		Cs for Zones 2 and 3	
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)	1.41E-05	ft/sec	4.29E-04	cm/sec
Is this step valid?				
If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow				
Calculate a, the total open area of the test section:			4.7	square feet
Is Q/a * (estimated porosity) > 10??			True, Test Valid	

CALCULATED PERMEABILITY FOR STEP 5

Gauge Pressure, **h2**:	30	psi	69.3	feet of water
Flow Rate, **Q**:	6.38	gpm	0.014	ft^3/sec
Head loss per TEN foot section of pipe:	0.1	psi		(per tables)
Head Loss, ***L*** :	0.6	psi	1.3	feet of water
Distance from pressure gauge to bottom of test section, h_1:	36.5	feet		
Value of h_1:	36.5	feet		
Effective Head, ***H*** where ***H = h1+h2-L*** :	104.4	feet	45.2	psi
Determine Saturation Zone:		-		
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H	80.4	feet		
X = (H/Tu)*100	130.0	%		
Tu/A	13.3			
Determine Conductivity Coefficient				
H/r	-		Value for Zone 1 analysis	
A/H	-		Value for Zone 1 analysis	
A/r	48		Value for Zone 2 and 3 analysis	
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1	
Cs for Zone 2 and 3 tests:	72		Cs for Zones 2 and 3	
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)	1.51E-05	ft/sec	4.61E-04	cm/sec

Is this step valid?

If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow

Calculate a, the total open area of the test section: 4.7 square feet

Is Q/a * (estimated porosity) > 10?? True, Test Valid

BOREHOLE PERMEABILITY TEST USING PACKERS CALCULATIONS

PROJECT NAME AND NO.: ONS - GWPP
LOCATION: Seneca, SC
TEST DATE: 11/1/2007
TESTED BY: Adam Jennings/Scott Dacus
GROUND ELEV (ft MSL): 736.3

BOREHOLE NO.: GM-13R
TEST INTERVAL: 58.9 to 64.9 bgs
TEST INTERVAL: 677.4 to 671.4 EL

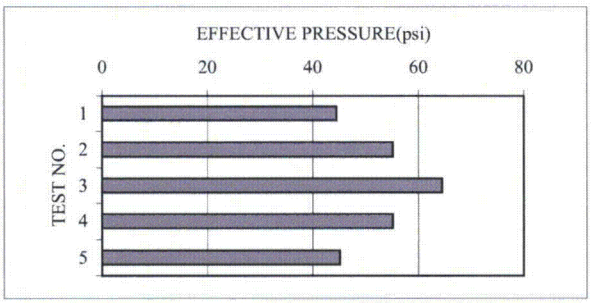
TEST METHOD: Double Packer Method using Multiple Pressure Tests
METHOD REFERENCE: Ground Water Manual, US Bureau of Reclamation, 1995, Chapter 10

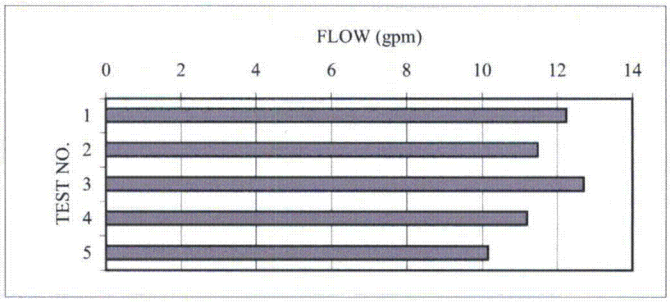
RESULTS OF PERMEABILITY CALCULATIONS
MULTIPLE STEP TEST

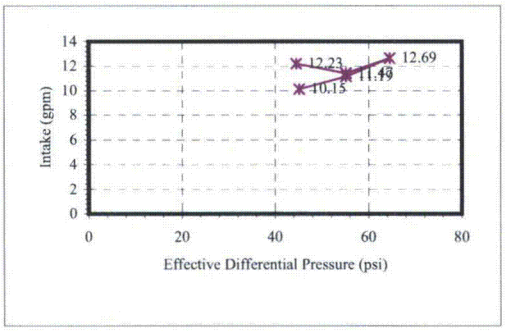
Step	Flow (Q) (gpm)	Pressure (psi) Gauge	Pressure (psi) Effective	Lugeons	Permeability (ft/sec)	Permeability (cm/sec)
1	12.23	30	45	82	2.95E-05	9.0E-04
2	11.47	40	55	62	2.2E-05	6.8E-04
3	12.69	50	65	59	2.1E-05	6.4E-04
4	11.19	40	55	61	2.2E-05	6.6E-04
5	10.15	30	45	67	2.4E-05	7.3E-04
			AVERAGE	66	2.4E-05	7.2E-04
			SELECTED VALUES			

Rock Description of Tested Interval:
Moderately Fractured Granitic Gneiss With Intermittent Biotite Hornblende Gneiss

TEST INTERPRETATION







PERMEABILITY CALCULATIONS FOR EACH STEP OF TEST

S&ME

CALCULATED PERMEABILITY FOR STEP 1

Gauge Pressure, **h2**:	30	psi	69.3	feet of water
Flow Rate, **Q**:	12.23	gpm	0.027	ft^3/sec
Head loss per TEN foot section of pipe:	0.2	psi		(per tables)
Head Loss, ***L*** :	1.3	psi	3.0	feet of water
Distance from pressure gauge to bottom of test section, h_1:	36.5	feet		
Value of h_1:	36.5	feet		
Effective Head, ***H*** where ***H = h1+h2-L*** :	102.8	feet	44.5	psi
Determine Saturation Zone:		-		
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H	71.7	feet		
X = (H/Tu)*100	143.3	%		
Tu/A	11.9			
Determine Conductivity Coefficient				
H/r	-		Value for Zone 1 analysis	
A/H	-		Value for Zone 1 analysis	
A/r	48		Value for Zone 2 and 3 analysis	
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1	
Cs for Zone 2 and 3 tests:	72		Cs for Zones 2 and 3	
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)	2.95E-05	ft/sec	8.98E-04	cm/sec

Is this step valid?

If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow

Calculate a, the total open area of the test section: 4.7 square feet

Is Q/a * (estimated porosity) > 10?? True, Test Valid

CALCULATED PERMEABILITY FOR STEP 2

Gauge Pressure, **h2**:	40	psi	92.4	feet of water
Flow Rate, **Q**:	11.47	gpm	0.026	ft^3/sec
Head loss per TEN foot section of pipe:	0.1	psi		(per tables)
Head Loss, ***L*** :	0.6	psi	1.5	feet of water
Distance from pressure gauge to bottom of test section, h_1:	36.5	feet		
Value of h_1:	36.5	feet		
Effective Head, ***H*** where ***H = h1+h2-L*** :	127.4	feet	55.2	psi
Determine Saturation Zone:		-		
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H	96.3	feet		
X = (H/Tu)*100	132.3	%		
Tu/A	16.0			
Determine Conductivity Coefficient				
H/r	-		Value for Zone 1 analysis	
A/H	-		Value for Zone 1 analysis	
A/r	48		Value for Zone 2 and 3 analysis	
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1	
Cs for Zone 2 and 3 tests:	72		Cs for Zones 2 and 3	
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)	2.23E-05	ft/sec	6.80E-04	cm/sec

Is this step valid?

If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow

Calculate a, the total open area of the test section: 4.7 square feet

Is Q/a * (estimated porosity) > 10?? True, Test Valid

CALCULATED PERMEABILITY FOR STEP 3

Gauge Pressure, **h2**:	50	psi	115.5	feet of water
Flow Rate, **Q**:	12.69	gpm	0.028	ft^3/sec
Head loss per TEN foot section of pipe:	0.2	psi		(per tables)
Head Loss, ***L*** :	1.3	psi	3.0	feet of water
Distance from pressure gauge to bottom of test section, $\mathbf{h_1}$:	36.5	feet		
Value of h_1:	36.5	feet		
Effective Head, ***H*** where ***H = h1+h2-L*** :	149.0	feet	64.5	psi
Determine Saturation Zone:		-		
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H	117.9	feet		
X = (H/Tu)*100	126.4	%		
Tu/A	19.6			
Determine Conductivity Coefficient				
H/r	-		Value for Zone 1 analysis	
A/H	-		Value for Zone 1 analysis	
A/r	48		Value for Zone 2 and 3 analysis	
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1	
Cs for Zone 2 and 3 tests:	72		Cs for Zones 2 and 3	
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)	2.11E-05	ft/sec	6.43E-04	cm/sec

Is this step valid?

If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow

Calculate a, the total open area of the test section: 4.7 square feet

Is Q/a * (estimated porosity) > 10?? True, Test Valid

CALCULATED PERMEABILITY FOR STEP 4

Gauge Pressure, **h2**:	40	psi	92.4	feet of water
Flow Rate, **Q**:	11.19	gpm	0.025	ft^3/sec
Head loss per TEN foot section of pipe:	0.1	psi		(per tables)
Head Loss, ***L*** :	0.6	psi	1.5	feet of water
Distance from pressure gauge to bottom of test section, $\mathbf{h_1}$:	36.5	feet		
Value of h_1:	36.5	feet		
Effective Head, ***H*** where ***H = h1+h2-L*** :	127.4	feet	55.2	psi
Determine Saturation Zone:		-		
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H	96.3	feet		
X = (H/Tu)*100	132.3	%		
Tu/A	16.0			
Determine Conductivity Coefficient				
H/r	-		Value for Zone 1 analysis	
A/H	-		Value for Zone 1 analysis	
A/r	48		Value for Zone 2 and 3 analysis	
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1	
Cs for Zone 2 and 3 tests:	72		Cs for Zones 2 and 3	
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)	2.17E-05	ft/sec	6.63E-04	cm/sec

Is this step valid?

If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow

Calculate a, the total open area of the test section: 4.7 square feet

Is Q/a * (estimated porosity) > 10?? True, Test Valid

CALCULATED PERMEABILITY FOR STEP 5

Gauge Pressure, **h2**:	30	psi	69.3	feet of water
Flow Rate, **Q**:	10.15	gpm	0.023	ft^3/sec
Head loss per TEN foot section of pipe:	0.1	psi		(per tables)
Head Loss, ***L*** :	0.6	psi	1.5	feet of water
Distance from pressure gauge to bottom of test section, h_1:	36.5	feet		
Value of h_1:	36.5	feet		
Effective Head, ***H*** where ***H = h1+h2-L*** :	104.3	feet	45.2	psi
Determine Saturation Zone:		-		
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H	73.2	feet		
X = (H/Tu)*100	142.4	%		
Tu/A	12.2			
Determine Conductivity Coefficient				
H/r	-		Value for Zone 1 analysis	
A/H	-		Value for Zone 1 analysis	
A/r	48		Value for Zone 2 and 3 analysis	
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1	
Cs for Zone 2 and 3 tests:	72		Cs for Zones 2 and 3	
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)	2.41E-05	ft/sec	7.34E-04	cm/sec

Is this step valid?

If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow

Calculate a, the total open area of the test section: 4.7 square feet

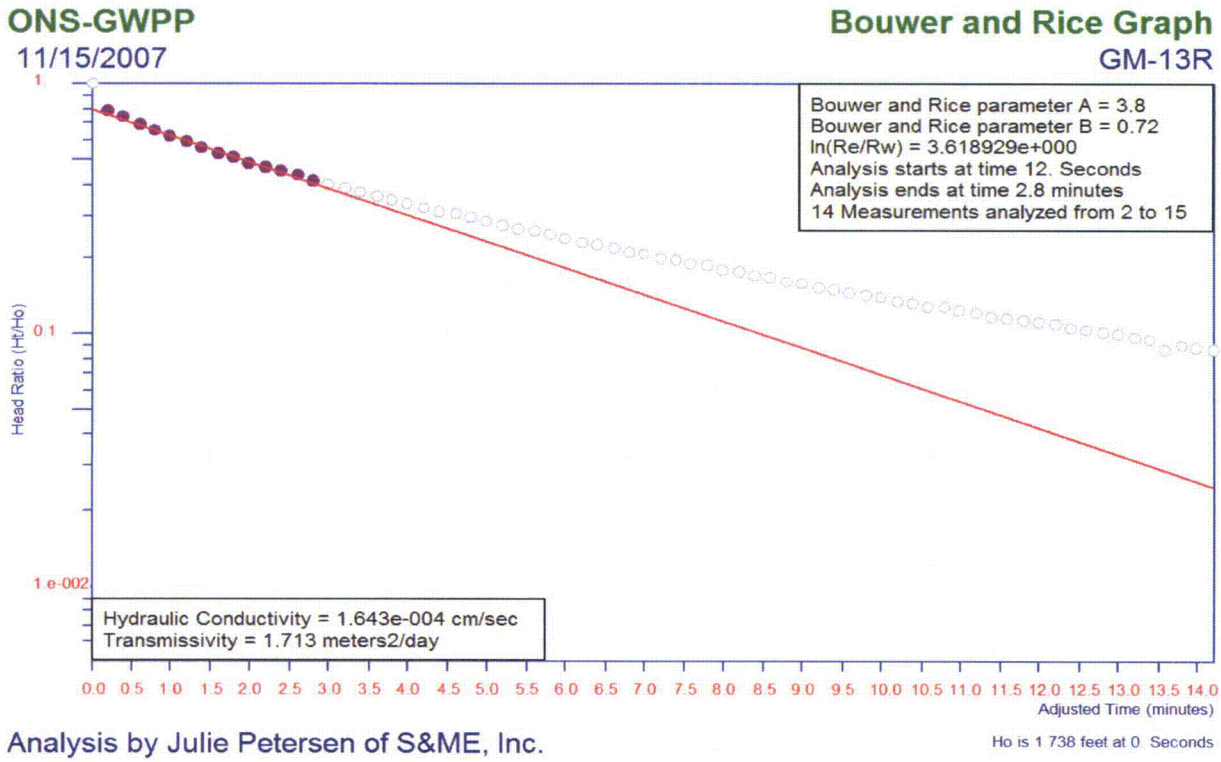
Is Q/a * (estimated porosity) > 10?? True, Test Valid

Calculation of Permeability By The Rising Head Method (Slug Test)

Site Name:	ONS-GWPP
Test Date:	11/15/2007
Well Label:	GM-13R
Aquifer Thickness:	39.59 feet
Screen Length:	10. feet
Casing Radius:	1. Inches
Effective Radius:	1.5 Inches
Static Water Level:	33.56 feet
Water Table to Screen Bottom:	34.59 feet
Anisotropy Ratio:	1

Time Adjustment: 0. Seconds
Test starts with trial 0
There are 72 time and drawdown measurements
Maximum head is 1.738 feet
Minimum head is 0. feet

Calculation by Bouwer and Rice Graphical Method



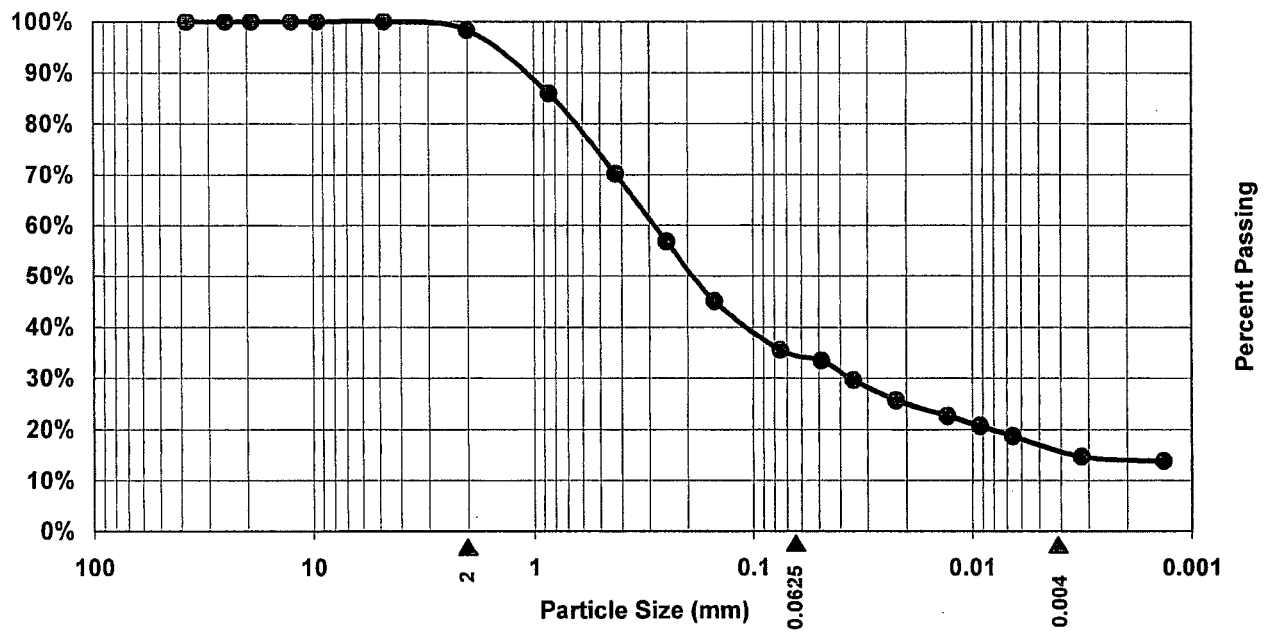
PERMEABILITY

1.64×10^{-4} cm/sec

PARTICLE SIZE ANALYSIS OF SOILS
FOR USE IN FETTER AND BEAR DIAGRAMS

Boring No.:	Sample No.:	Depth:
GM-13R	SS-1	8.5 to 10 ft bls

Sample Description:
F: Red and Brown, Micaceous, Clayey, Silty, Coarse to Fine Sand (SM)



	> 2 mm	2 mm - 0.0625 mm	0.0625 mm - 0.004 mm	<0.004 mm
From Graph:	% Gravel 1.7%	% Sand 63.6%	% Silt 19.1%	% Clay 15.6%
Adjusted for Calculations	**0%**	**65%**	**19%**	**16%**

Notes:
Grain size distribution taken from grain size with hydrometer data located in Appendix II.
Gravel, sand, silt and clay sizes based on Wentworth Scale.

S&ME Project:
Oconee Nuclear Station - GWPP

S&ME Project No.:
1264-07-234

S&ME

FETTER AND BEAR DIAGRAMS

S&ME PROJECT: Oconee Nuclear Station - GWPP
S&ME PROJECT NO.: 1264-07-234

Boring No. GM-13R

Boring Depth: 8.5 to 10 ft bls

% Sand: 65%

% Silt: 19%

% Clay: 16%

Estimated Specific Yield: 13%

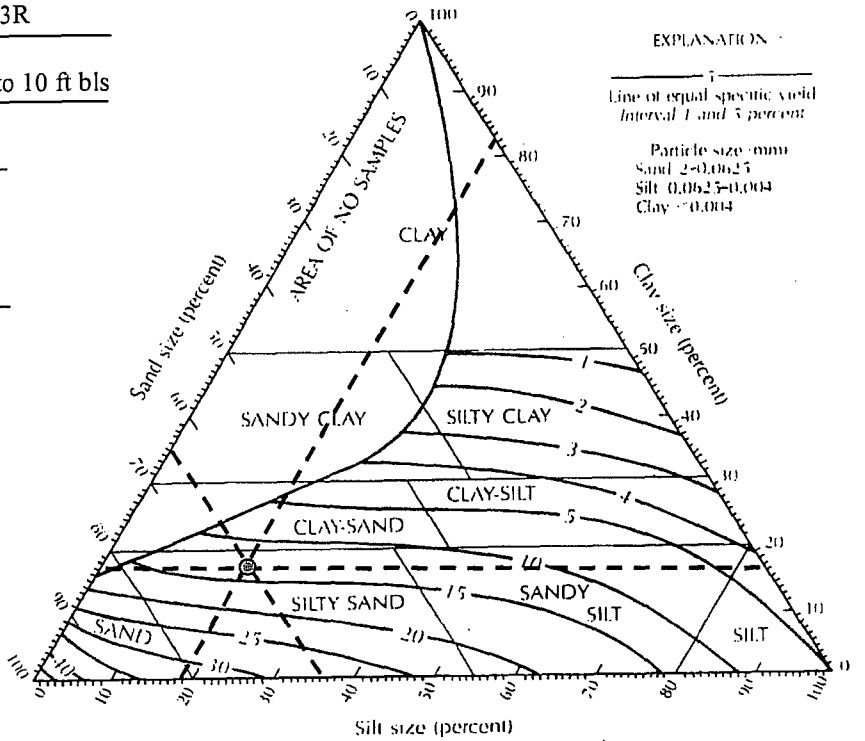
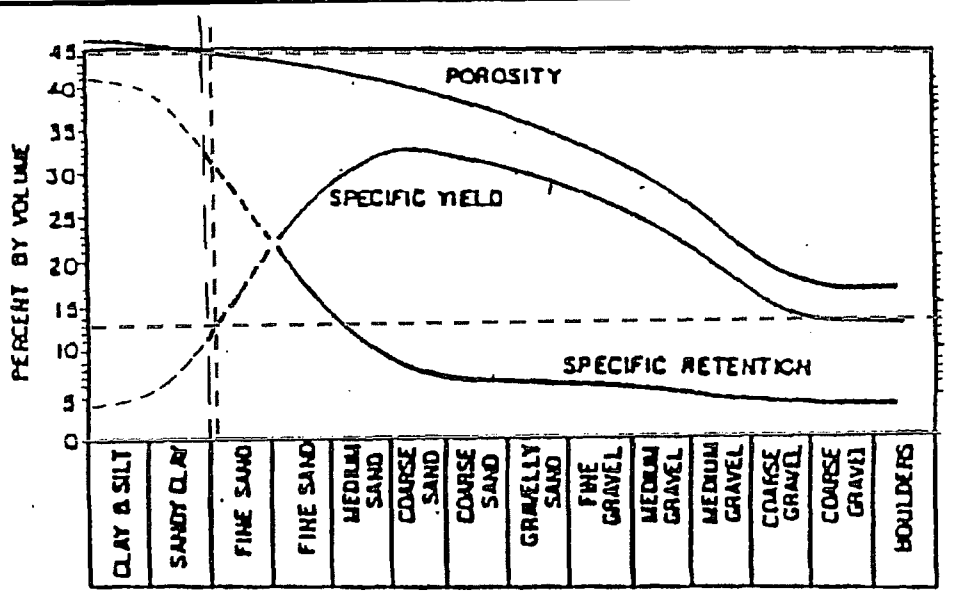


FIGURE 4.11 Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A. I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.



Estimated Porosity: 44.5%

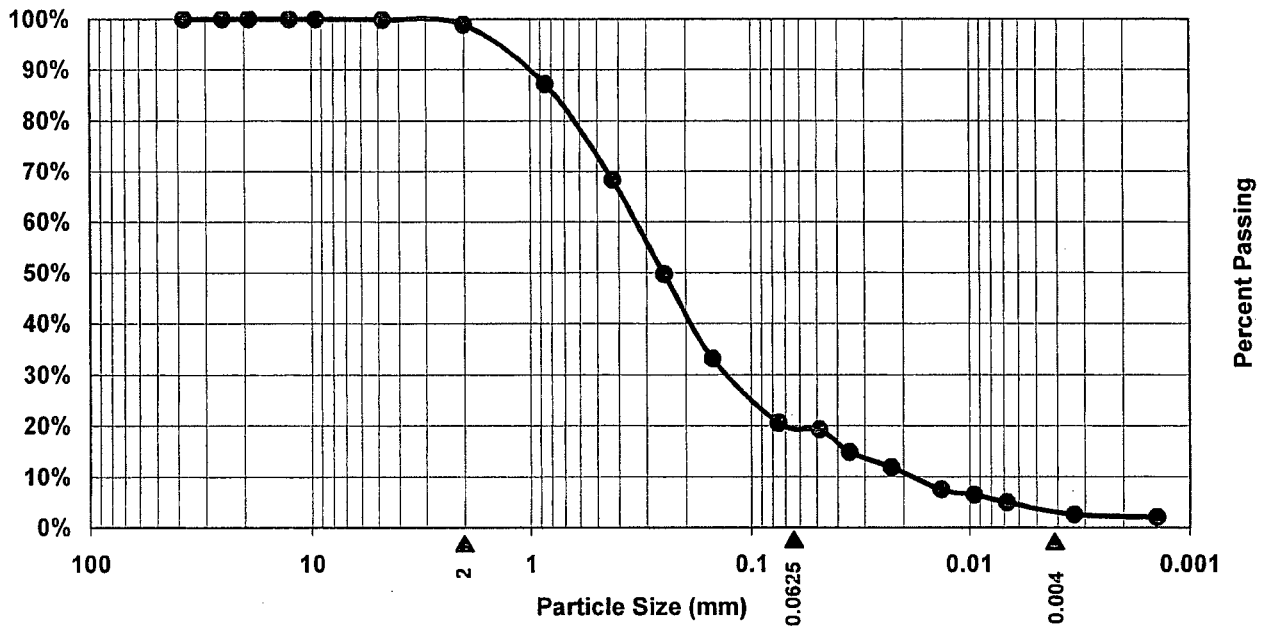
Variation of Porosity, Specific Yield, and Specific Retention with Grain Size (after Bear, 1972)

PARTICLE SIZE ANALYSIS OF SOILS
FOR USE IN FETTER AND BEAR DIAGRAMS

Boring No.:	Sample No.:	Depth:
GM-13R	SS-8	43.5 to 45 ft bls

Sample Description:

M1: White, Tan, and Brown, Micaceous, Silty, Medium to Fine Sand (SM)



	> 2 mm	2 mm - 0.0625 mm	0.0625 mm - 0.004 mm	<0.004 mm
From Graph:	% Gravel 1.1%	% Sand 78.9%	% Silt 17.1%	% Clay 3.0%
Adjusted for Calculations	**0%**	**80%**	**17%**	**3%**

Notes:

Grain size distribution taken from grain size with hydrometer data located in Appendix II.

Gravel, sand, silt and clay sizes based on Wentworth Scale.

S&ME Project:

Oconee Nuclear Station - GWPP

S&ME Project No.:

1264-07-234

S&ME

FETTER AND BEAR DIAGRAMS

S&ME PROJECT: Oconee Nuclear Station - GWPP
S&ME PROJECT NO.: 1264-07-234

Boring No. GM-13R

Boring Depth: 43.5 to 45 ft bls

% Sand: 80%

% Silt: 17%

% Clay: 3%

Estimated Specific Yield: 29%

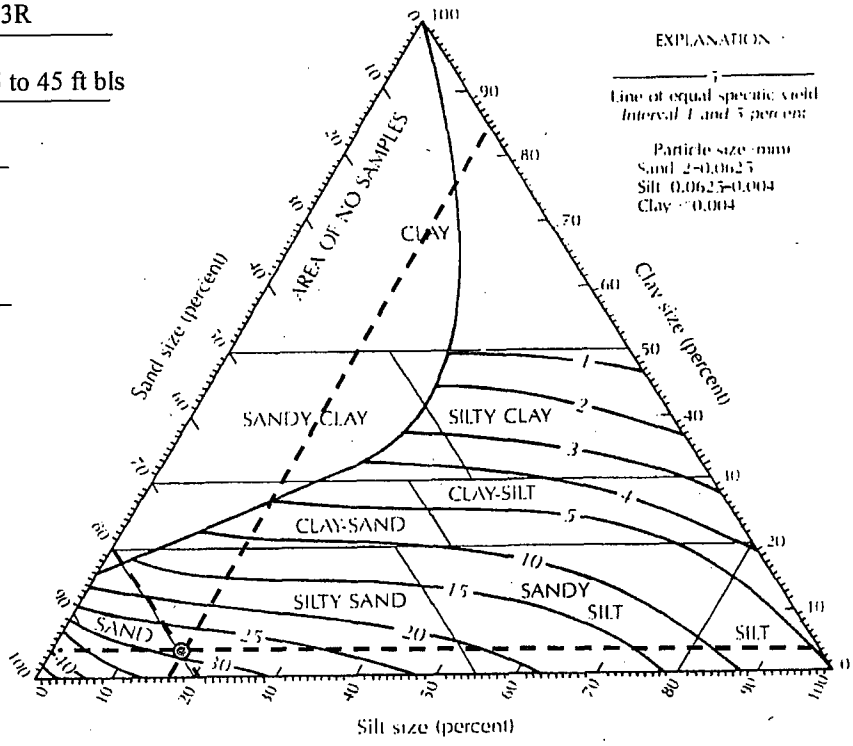
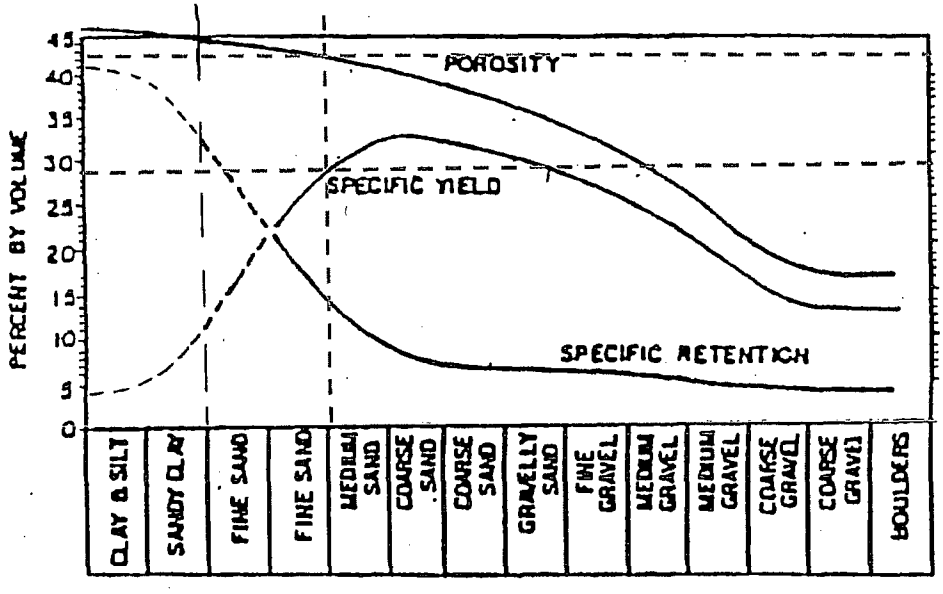


FIGURE 4.11 Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A. I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.



Estimated Porosity: 42.5%

Variation of Porosity, Specific Yield, and Specific Retention with Grain Size (after Bear, 1972)

S&ME, Inc.
9751 Southern Pine Boulevard
Charlotte, North Carolina 28273
Telephone: 704-523-4726
Fax: 704-525-3953

ENGINEERING • TESTING
ENVIRONMENTAL SERVICES

1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.
2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

Project: **Oconee Nuclear Station**			**Boring No. GM-14**
Location: **Seneca, SC**		Number: **1264-07-234**	Sheet No. 1 of 1
Boring Depth (ft): **29.0**	Elevation (ft): **719.6**	Driller: **Jay Little, SC Cert No. B1575**	Date Drilled: **11/13/07**
Logged By: **Scott Dacus**	Water Level: **Stabilized Water Level at 18.50 ft bls**		Drilling Method: **4¼" H.S.A.**

Elev. (Feet)	Depth (Feet)	Lith-ology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
			GRAVEL		
			FILL (F): Reddish-Brown, Silty, **CLAY**		
715	5				
710	10				
705	15		FILL (F): Brown, Micaceous, Silty, **SAND**		
700	20		FILL (F): Orange and Brown, Clayey, **SILT**		
695	25		SOIL/SAPROLITE (M1): Tan, White, and Brown, Micaceous, Silty, Medium to Fine **SAND**		
			SOIL/SAPROLITE (M1): Black, White, and Gray, Micaceous, Silty, Medium to Fine **SAND** With Rock Fragments		
			Lithologic Description Obtained From GM-14R		
			Boring Terminated at 29.00 ft bls		

BORING LOG WITH WELL RECOVERED_ONS LOG.GPJ LAGWGN01.GDT 7/23/08

COMPLETION REPORT OF WELL No. GM-14

PROJECT: **Oconee Nuclear Station**
PROJECT NO: **1264-07-234**
PROJECT LOCATION: **Seneca, SC**

DRILLING CONTRACTOR: **S&ME, Inc.**
DRILLING METHOD: **4¼" H.S.A.**
DATE DRILLED: **11/13/07**

WATER LEVEL: **Stabilized Water Level at 18.50 ft bls**
LATITUDE: **34°47'41.305"**
LONGITUDE: **82°53'30.305"**
TOP OF CASING ELEVATION: **722.62**
DATUM: **MSL**
LOGGED BY: **Scott Dacus**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)
				0.00	GS	719.56
GRAVEL FILL (F): Reddish-Brown, Silty, **CLAY**		0				
		5				
				9.43		710.13
		10		11.43		708.13
FILL (F): Brown, Micaceous, Silty, **SAND**		15				
FILL (F): Orange and Brown, Clayey, **SILT**		20				
SOIL/SAPROLITE (M1): Tan, White, and Brown, Micaceous, Silty, Medium to Fine **SAND**		25				
				27.93		691.63
SOIL/SAPROLITE (M1): Black, White, and Gray, Micaceous, Silty, Medium to Fine **SAND** With Rock Fragments				28.43		691.13
				29.00		690.56

WELL CONSTRUCTION DETAILS

PROTECTIVE CASING
Diameter:
Type:
Interval:

RISER CASING
Diameter: **2"**
Type: **Sch. 40 PVC**
Interval: **0 to 13.43 ft bls**

GROUT
Type: **Neat Cement**
Interval: **0 to 9.43 ft bls**

SEAL
Type: **Bentonite**
Interval: **9.43 to 11.43 ft bls**

FILTERPACK
Type: **#1 Silica Sand**
Interval: **11.43 to 28.43 ft bls**

SCREEN
Diameter: **2"**
Type: **0.010 Slotted PVC**
Interval: **13.43 to 28.43 ft bls**

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL RECOVERED_ONS LOG.GPJ S&ME.GDT 7/23/08

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9751 Southern Pine Boulevard
Charlotte, North Carolina 28273

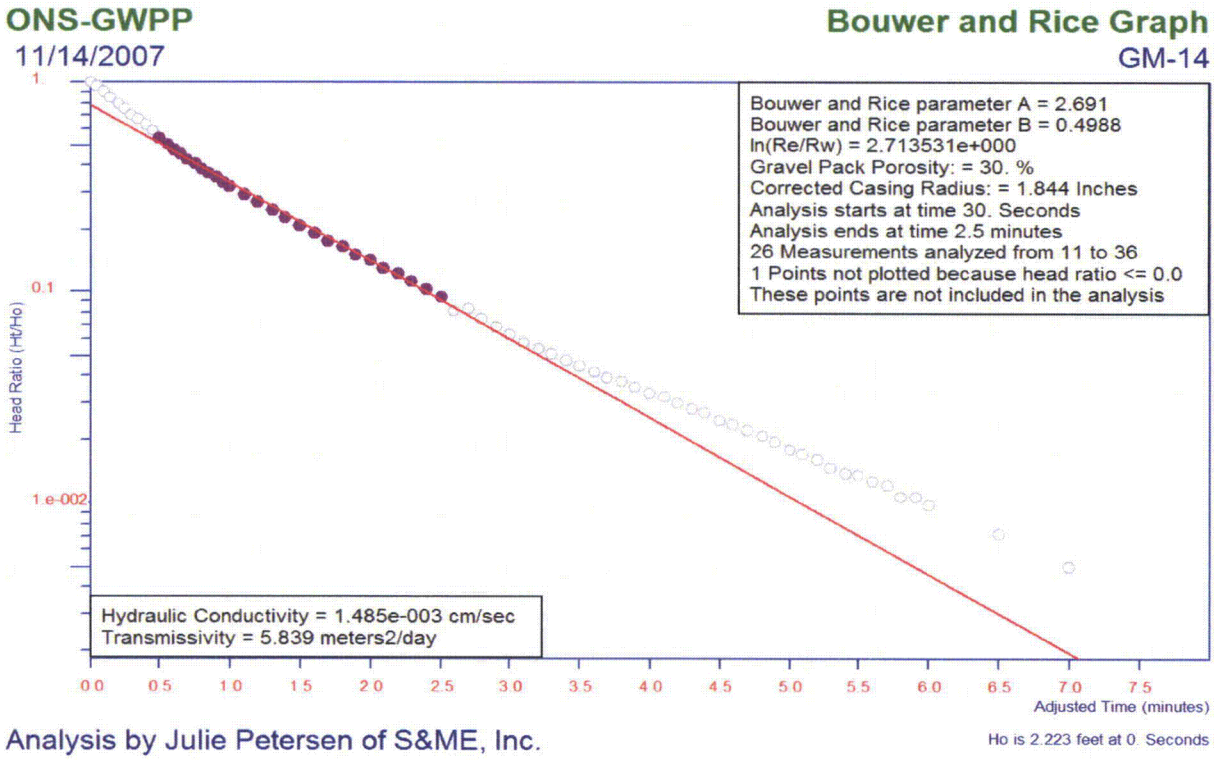
COMPLETION REPORT OF WELL No. GM-14

Calculation of Permeability By The Rising Head Method (Slug Test)

Site Name:	ONS-GWPP
Test Date:	11/14/2007
Well Label:	GM-14
Aquifer Thickness:	14.93 feet
Screen Length:	15. feet
Casing Radius:	1. Inches
Effective Radius:	3. Inches
Gravel Pack Porosity:	30.00%
Corrected Casing Radius:	1.844 Inches
Static Water Level:	18.5 feet
Water Table to Screen Bottom:	9.93 feet
Anisotropy Ratio:	1

Time Adjustment: 0. Seconds
Test starts with trial 0
There are 74 time and drawdown measurements
Maximum head is 2.223 feet
Minimum head is 0. feet

Calculation by Bouwer and Rice Graphical Method



PERMEABILITY

1.49×10^{-3} cm/sec

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Fax: 704-525-3953

ENGINEERING • TESTING
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1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.
2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

Project: **Oconee Nuclear Station**			**Boring No. GM-14R**
Location: **Seneca, SC**		Number: **1264-07-234**	Sheet No. 1 of 2
Boring Depth (ft): **68.0**	Elevation (ft): **719.6**	Driller: **Jay Little, SC Cert No. B1575**	Date Drilled: **11/7/07**
Logged By: **Scott Dacus**	Water Level: **Stabilized Water Level at 4.80 ft bls**		Drilling Method: **4¼" H.S.A.**

Elev. (Feet)	Depth (Feet)	Lith-ology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
			GRAVEL		
			FILL (F): Reddish-Brown, Silty, **CLAY**		
715	5				
					10
710	10				
					14
705	15		FILL (F): Brown, Micaceous, Silty, **SAND**		
					8
700	20		FILL (F): Orange and Brown, Clayey, **SILT**		
			SOIL/SAPROLITE (M1): Tan, White, and Brown, Micaceous, Silty, Medium to Fine **SAND**		13
695	25				
			SOIL/SAPROLITE (M1): Black, White, and Gray, Micaceous, Silty, Medium to Fine **SAND** With Rock Fragments		40
690	30				
			SOIL/SAPROLITE (M1): Tan, White, and Brown, Micaceous, Silty, Medium to Fine **SAND**		15
685					

BORING LOG WITH WELL RECOVERED_ONS LOG.GPJ LAGWGN01.GDT 7/23/08

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9751 Southern Pine Boulevard
Charlotte, North Carolina 28273
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Fax: 704-525-3953

ENGINEERING • TESTING
ENVIRONMENTAL SERVICES

1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.
2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

Project: **Oconee Nuclear Station**			**Boring No. GM-14R**
Location: **Seneca, SC**		Number: **1264-07-234**	Sheet No. 2 of 2
Boring Depth (ft): **68.0**	Elevation (ft): **719.6**	Driller: **Jay Little, SC Cert No. B1575**	Date Drilled: **11/7/07**
Logged By: **Scott Dacus**	Water Level: **Stabilized Water Level at 4.80 ft bls**		Drilling Method: **4¼" H.S.A.**

Elev. (Feet)	Depth (Feet)	Lith-ology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
680	40		WEATHERED ROCK (M2): When Sampled Becomes Tan, White, and Brown, Micaceous, Silty, Medium to Fine **SAND** **Roller Cone Refusal at 39.80 ft bls**		50/1 >>
			SOUND ROCK (D): Medium-Grained **BIOTITE HORNBLENDE GNEISS** Slightly Weathered, Moderately Fractured, Low Angle Joints With Moderate Staining		
675	45		WEATHERED ROCK (M2): When Sampled Becomes White and Brown, Micaceous, Silty, Medium to Fine **SAND**; (Core Loss)		
670	50		SOUND ROCK (D): Medium-Grained **GRANITIC GNEISS** With Intermittent Seams of **BIOTITE HORNBLENDE GNEISS** Moderately Fractured, Horizontal, Low Angle, and High Angle Joints With No Staining		
665	55				
660	60				
655	65		**Boring Terminated at 68.00 ft bls**		

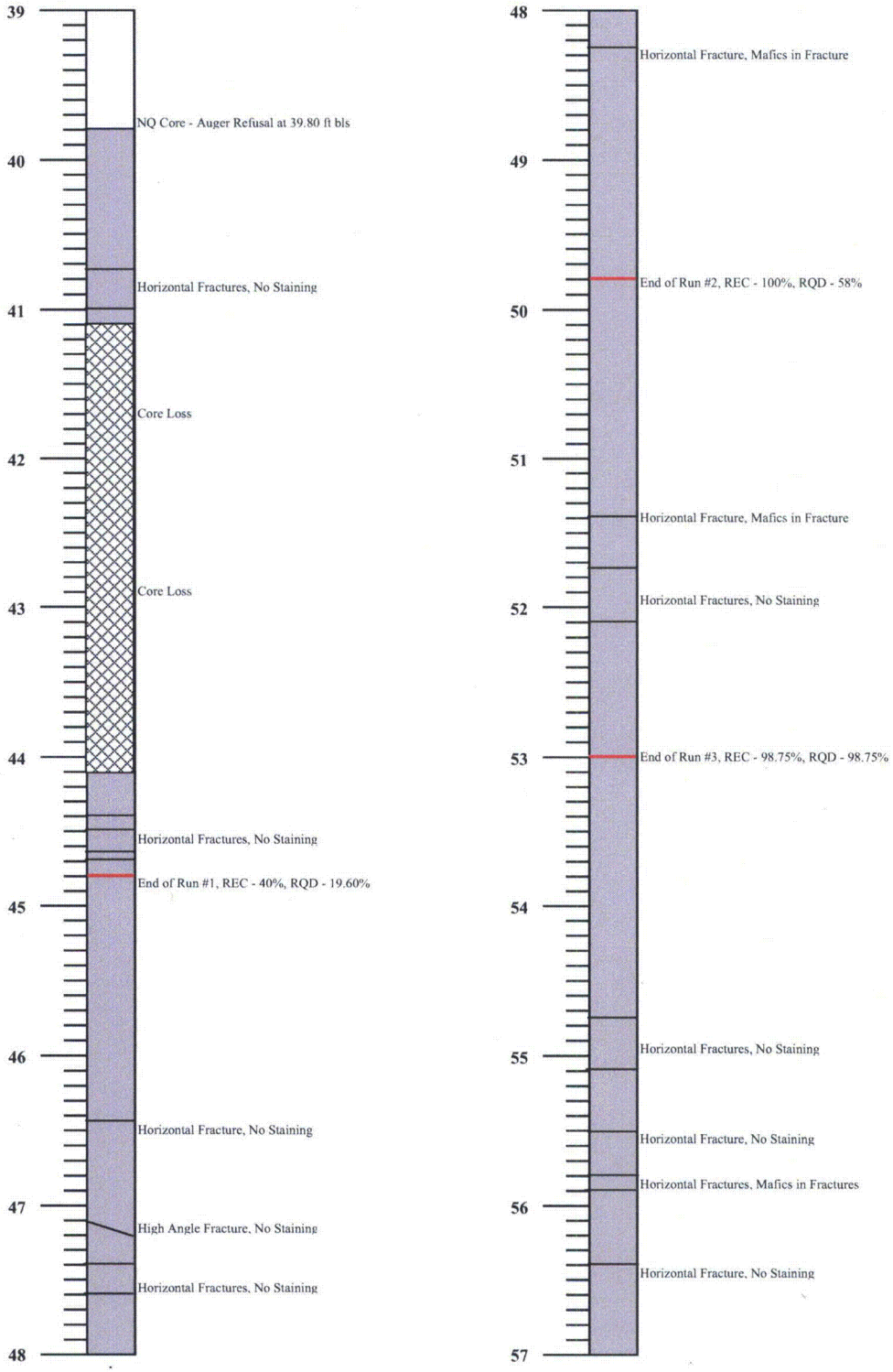
BORING LOG WITH WELL RECOVERED_ONS LOG.GPJ LAGWGN01.GDT 7/23/08

FIELD ROCK CORE LOG

Oconee Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-07-234

Core Location: GM-14R

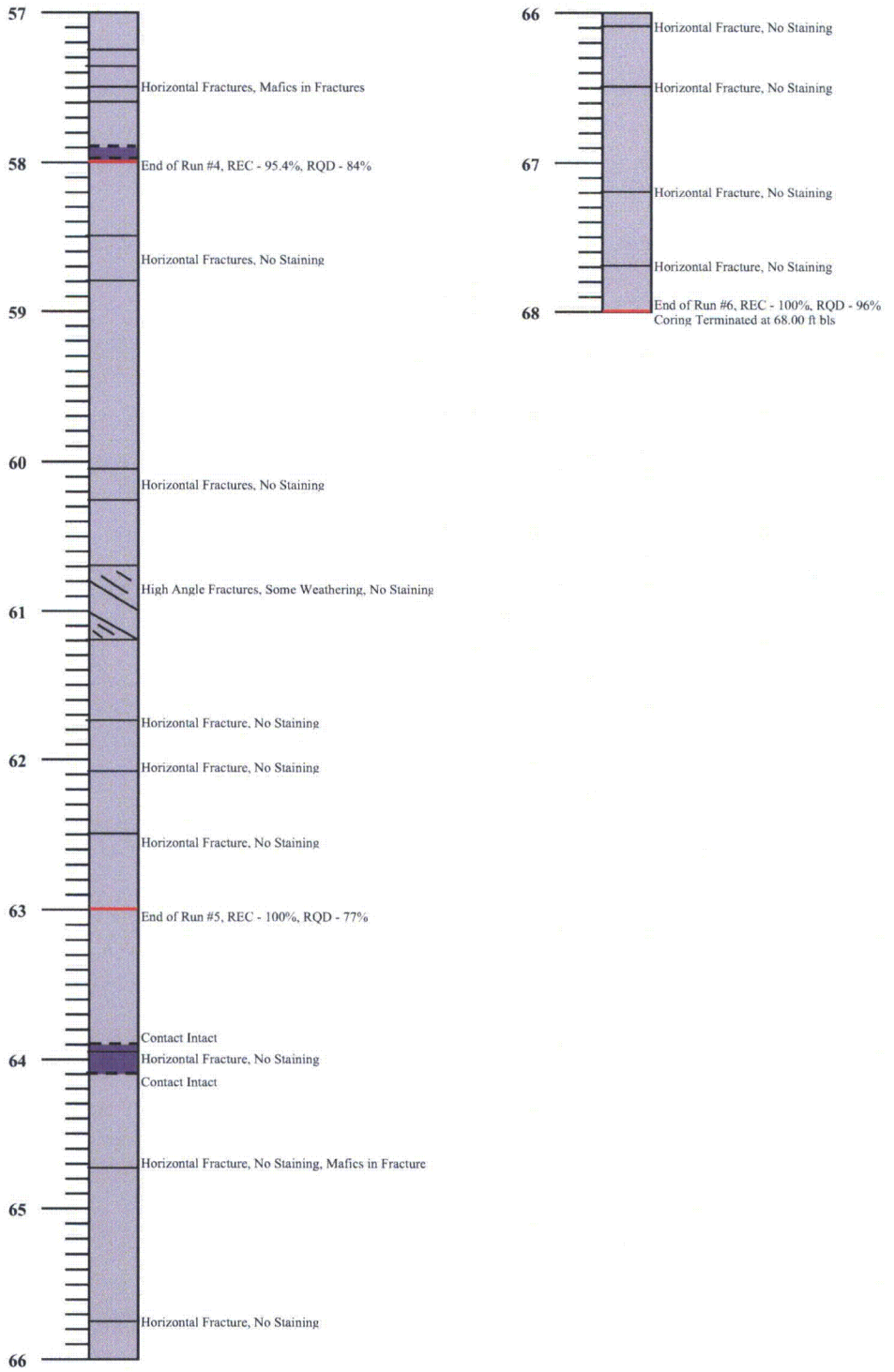


FIELD ROCK CORE LOG

Oconee Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-07-234

Core Location: GM-14R



COMPLETION REPORT OF WELL No. GM-14R

PROJECT: **Oconee Nuclear Station**
PROJECT NO: **1264-07-234**
PROJECT LOCATION: **Seneca, SC**

DRILLING CONTRACTOR: **S&ME, Inc.**
DRILLING METHOD: **4¼" H.S.A.**
DATE DRILLED: **11/7/07**

WATER LEVEL: **Stabilized Water Level at 4.80 ft bls**
LATITUDE: **34°47'41.293"**
LONGITUDE: **82°53'30.362"**
TOP OF CASING ELEVATION: **722.59**
DATUM: **MSL**
LOGGED BY: **Scott Dacus**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)
GRAVEL		0
FILL (F): Reddish-Brown, Silty, **CLAY**		
FILL (F): Brown, Micaceous, Silty, **SAND**		15
FILL (F): Orange and Brown, Clayey, **SILT**		20
SOIL/SAPROLITE (M1): Tan, White, and Brown, Micaceous, Silty, Medium to Fine **SAND**		25
SOIL/SAPROLITE (M1): Black, White, and Gray, Micaceous, Silty, Medium to Fine **SAND** With Rock Fragments		30

WELL DETAILS

DEPTH (ft.)	LEGEND	ELEVATION (ft.)
0.00	GS	719.63

WELL CONSTRUCTION DETAILS

PROTECTIVE CASING
Diameter:
Type:
Interval:

RISER CASING
Diameter: **2"**
Type: **Sch. 40 PVC**
Interval: **0 to 57.5 ft bls**

GROUT
Type: **Neat Cement**
Interval: **0 to 54 ft bls**

SEAL
Type: **K-packer**
Interval: **56.93 to 57.13 ft bls**

FILTERPACK
Type:
Interval:

SCREEN
Diameter: **2"**
Type: **0.010 Slotted PVC**
Interval: **57.5 to 67.5 ft bls**

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL RECOVERED ONS LOG.GPJ S&ME.GDT 7/23/08

S&ME
ENGINEERING • TESTING
ENVIRONMENTAL SERVICES

9751 Southern Pine Boulevard
Charlotte, North Carolina 28273

COMPLETION REPORT OF WELL No. GM-14R

PROJECT: **Oconee Nuclear Station**
PROJECT NO: **1264-07-234**
PROJECT LOCATION: **Seneca, SC**

GROUND SURFACE ELEVATION:
LOGGED BY: **719.6**
CHECKED BY: **Scott Dacus**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)
SOIL/SAPROLITE (M1): Tan, White, and Brown, Micaceous, Silty, Medium to Fine **SAND** *(continued)*		35				
WEATHERED ROCK (M2): When Sampled Becomes Tan, White, and Brown, Micaceous, Silty, Medium to Fine **SAND** **Roller Cone Refusal at 39.80 ft bls**		40				
SOUND ROCK (D): Medium-Grained **BIOTITE HORNBLENDE GNEISS**; Slightly Weathered, Moderately Fractured, Low Angle Joints With Moderate Staining		45				
WEATHERED ROCK (M2): When Sampled Becomes White and Brown, Micaceous, Silty, Medium to Fine **SAND**; (Core Loss)		50		54.00		665.63
SOUND ROCK (D): Medium-Grained **GRANITIC GNEISS** With Intermittent Seams of **BIOTITE HORNBLENDE GNEISS**; Moderately Fractured, Horizontal, Low Angle, and High Angle Joints With No Staining		55		56.93 57.13 57.50		662.70 662.50 662.13
		60				
		65		67.00 67.50 68.00		652.63 652.13 651.63

WELL CONSTRUCTION DETAILS

(See Page 1)

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL RECOVERED_ONS LOG.GPJ S&ME.GDT 7/23/08

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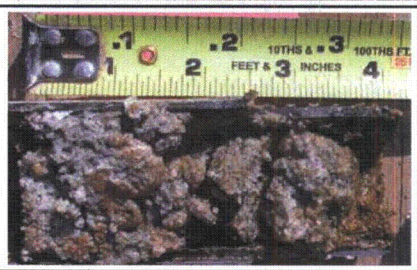
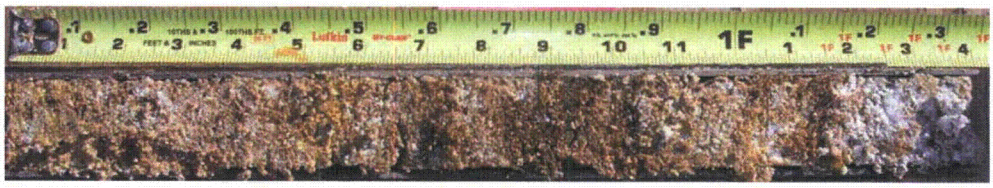
COMPLETION REPORT OF WELL No. GM-14R

SPLIT SPOON SAMPLE PICTURES

Oconee Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-07-234

Boring Number: GM-14R

Sample No: 1 **Depth (ft-bls):** 8.5 - 10 **Blow Count:** 4 * 4 * 6	
Sample No: 2 **Depth (ft-bls):** 13.5 - 15 **Blow Count:** 6 * 6 * 8	
Sample No: 3 **Depth (ft-bls):** 18.5 - 20 **Blow Count:** 3 * 2 * 1	
Sample No: 4 **Depth (ft-bls):** 23.5 - 25 **Blow Count:** 8 * 7 * 6	
Sample No: 5 **Depth (ft-bls):** 28.5 - 30 **Blow Count:** 10 * 26 * 14	
Sample No: 6 **Depth (ft-bls):** 33.5 - 35 **Blow Count:** 8 * 7 * 8	

SPLIT SPOON SAMPLE PICTURES

Oconee Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-07-234

Boring Number: GM-14R

Sample No:	**7**
Depth (ft-bls):	**38.5 - 40**
Blow Count:	**50/1**

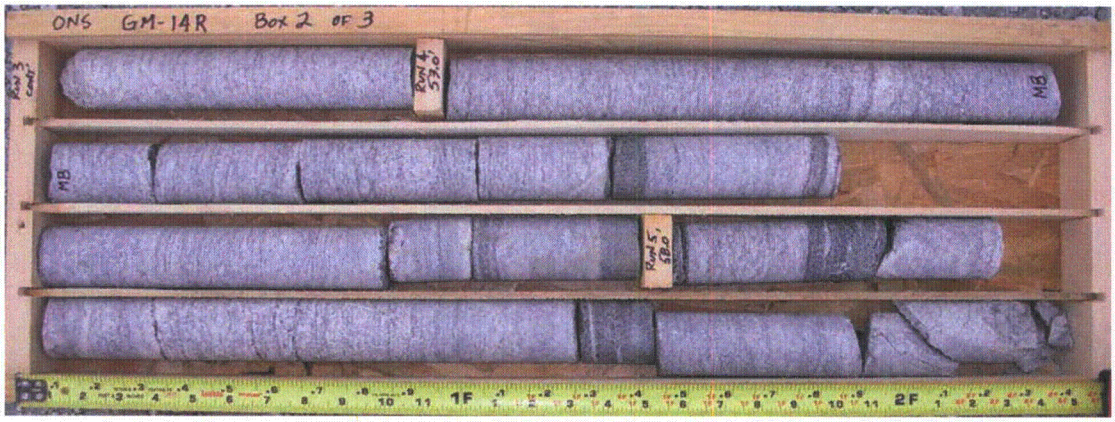
No Recovery

ROCK CORE PICTURES

Oconee Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-07-234

Core Location: GM-14R



CLASSIFICATION:

39.80' to 41.10': Medium-Grained Biotite Hornblende Gneiss

41.10' to 44.10': Soil

44.10' to 68.00': Medium-Grained Granitic Gneiss With Intermittent Biotite Hornblende Gneiss

CALCULATION OF PERMEABILITY BY THE FALLING HEAD METHOD (Open Hole in Uniform Material)

S&ME

Site Name:	ONS - GWPP	
Date:	11/8/2007	
Boring I.D.	GM-14R	
Test Interval:	39.8' to 44.8'	(Weathered/Sound Rock)
Total Depth of Hole:	44.8 ft	1365.85 cm
Length of Open Hole:	5 ft	152.44 cm
Transformation Ratio m=	1	
Performed by:	Scott Dacus	

Time (sec)	Head (cm)	Permeability (cm/sec)
0	579.02	
60	523.66	2.94E-04
120	515.09	4.83E-05
180	506.52	4.91E-05
240	498.60	4.62E-05
300	493.11	3.24E-05
360	488.75	2.60E-05
420	484.09	2.81E-05
480	480.18	2.37E-05
540	477.04	1.92E-05
600	473.38	2.25E-05
900	458.05	1.93E-05
1200	448.02	1.30E-05
1500	442.04	7.86E-06
1800	436.13	7.89E-06
2400	419.70	1.12E-05
3000	406.65	9.25E-06
3600	395.85	7.87E-06

Calculations

$$K_h = \frac{d^2 \cdot \ln\left(\frac{2mL}{D}\right)}{8 \cdot L \cdot (t_2 - t_1)} \cdot \ln\frac{H_1}{H_2}$$

for $\frac{mL}{D} > 4$

Where:

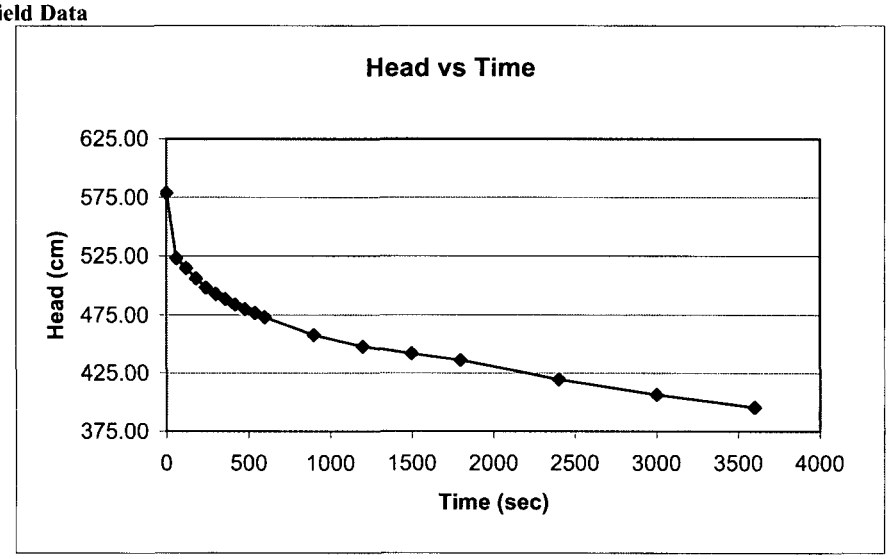
K_h	is the Horizontal Coefficient of Permeability (cm/sec)
H_1	is the Piezometric Head for time; $t = t_1$ (cm)
H_2	is the Piezometric Head for time; $t = t_2$ (cm)
D	is the Diameter of the Standpipe (cm)
d	is the diameter of the Open Length (cm),
m	is the Transformation Ratio, Where
	$m = \sqrt{K_h / K_v}$ K_h is the Horizontal Permeability; K_v is the Vertical Permeability
L	is the Open Length of Hole (cm)

Spreadsheet assumes 3" ID Pipe; NQ Hole, OD = 3"

MEAN PERMEABILITY (cm/sec)

3.92E-05

Graph of Field Data



CALCULATION OF PERMEABILITY BY THE FALLING HEAD METHOD
(Open Hole in Uniform Material)

S&ME

Site Name:	ONS - GWPP	
Date:	11/7/2007	
Boring I.D.	GM-14R	
Test Interval:	28.5' to 31.5'	(Soil/Saprolite)
Total Depth of Hole:	31.5 ft	960.37 cm
Length of Open Hole:	3 ft	91.46 cm
Transformation Ratio m=	1	
Performed by:	Scott Dacus	

Time (sec)	Head (cm)	Permeability (cm/sec)
0	416.86	
60	404.15	1.30E-04
120	394.09	1.06E-04
180	385.95	8.77E-05
240	378.96	7.67E-05
300	372.93	6.75E-05
360	367.47	6.20E-05
420	361.01	7.46E-05
480	356.25	5.57E-05
540	352.62	4.30E-05
600	348.08	5.45E-05
900	326.86	5.29E-05
1200	313.57	3.49E-05
1500	303.48	2.75E-05
1800	292.68	3.04E-05
2400	277.62	2.22E-05
3000	268.35	1.43E-05
3600	255.09	2.13E-05

Calculations

$$K_h = \frac{d^2 \cdot \ln\left(\frac{2mL}{D}\right)}{8 \cdot L \cdot (t_2 - t_1)} \cdot \ln\frac{H_1}{H_2}$$

for $\frac{mL}{D} > 4$

Where:

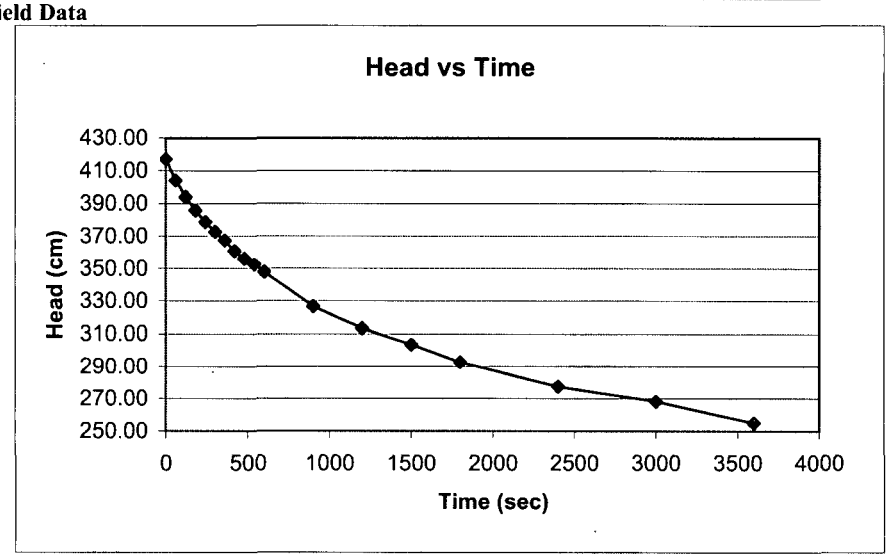
K_h	is the Horizontal Coefficient of Permeability (cm/sec)
H_1	is the Piezometric Head for time; $t = t_1$ (cm)
H_2	is the Piezometric Head for time; $t = t_2$ (cm)
D	is the Diameter of the Standpipe (cm)
d	is the diameter of the Open Length (cm),
m	is the Transformation Ratio, Where
	$m = \sqrt{K_h / K_v}$ K_h is the Horizontal Permeability; K_v is the Vertical Permeability
L	is the Open Length of Hole (cm)

Spreadsheet assumes 3" ID Pipe; NQ Hole, OD = 3"

MEAN PERMEABILITY (cm/sec)

5.66E-05

Graph of Field Data



CALCULATION OF PERMEABILITY BY THE FALLING HEAD METHOD (Open Hole in Uniform Material)

S&ME

Site Name:	ONS - GWPP	
Date:	11/8/2007	
Boring I.D.	GM-14R	
Test Interval:	39.8' to 49.8'	(Weathered/Sound Rock)
Total Depth of Hole:	49.8 ft	1518.29 cm
Length of Open Hole:	10 ft	304.88 cm
Transformation Ratio m=	1	
Performed by:	Scott Dacus	

Time (sec)	Head (cm)	Permeability (cm/sec)
0	634.39	
60	577.96	1.62E-04
120	573.23	1.43E-05
180	569.24	1.22E-05
240	565.73	1.07E-05
300	562.90	8.74E-06
360	560.55	7.27E-06
420	558.48	6.44E-06
480	556.40	6.47E-06
540	554.70	5.34E-06
600	552.84	5.84E-06
900	542.38	6.64E-06
1200	532.26	6.55E-06
1500	523.81	5.56E-06
1800	515.98	5.24E-06
2400	506.13	3.35E-06
3000	497.01	3.16E-06
3600	483.60	4.76E-06

Calculations

$$K_h = \frac{d^2 \cdot \ln\left(\frac{2mL}{D}\right)}{8 \cdot L \cdot (t_2 - t_1)} \cdot \ln\frac{H_1}{H_2}$$

for $\frac{mL}{D} > 4$

Where:

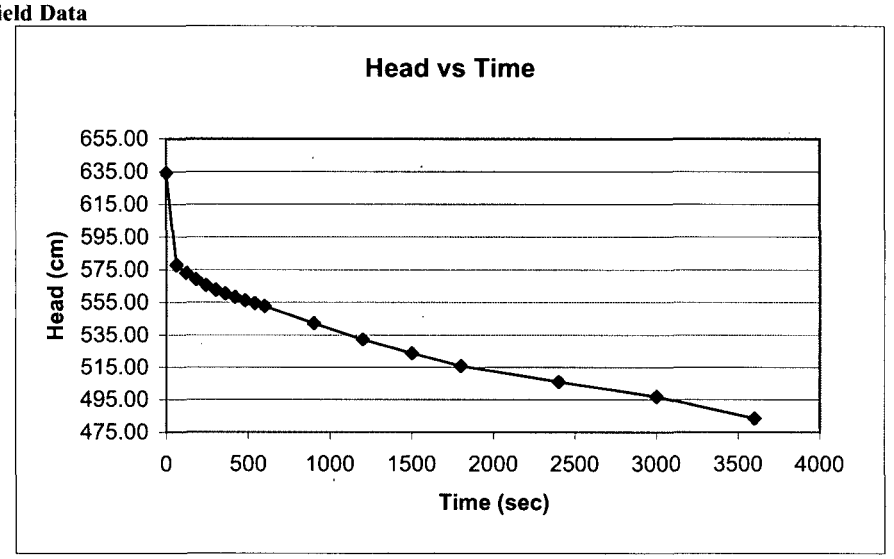
K_h	is the Horizontal Coefficient of Permeability (cm/sec)
H_1	is the Piezometric Head for time; $t = t_1$ (cm)
H_2	is the Piezometric Head for time; $t = t_2$ (cm)
D	is the Diameter of the Standpipe (cm)
d	is the diameter of the Open Length (cm),
m	is the Transformation Ratio, Where
	$m = \sqrt{K_h / K_v}$ K_h is the Horizontal Permeability; K_v is the Vertical Permeability
L	is the Open Length of Hole (cm)

Spreadsheet assumes 3" ID Pipe; NQ Hole, OD = 3"

MEAN PERMEABILITY (cm/sec)

1.61E-05

Graph of Field Data

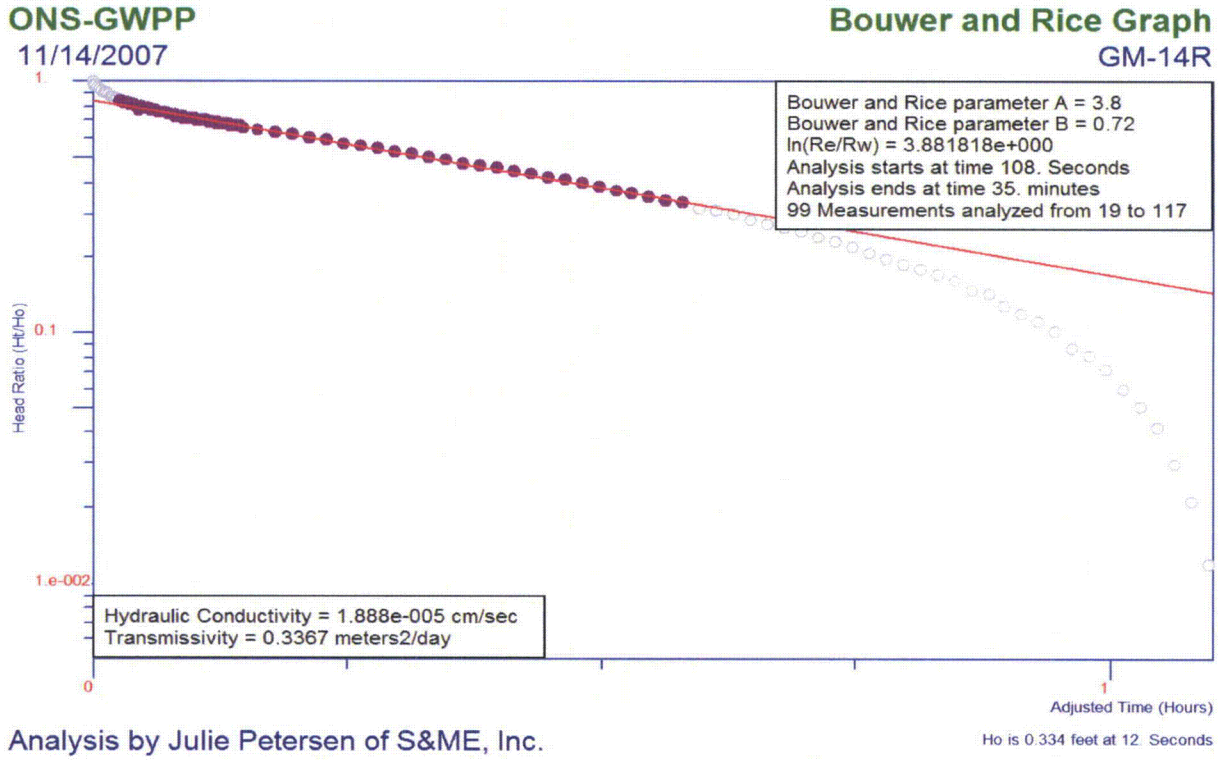


Calculation of Permeability By The Rising Head Method (Slug Test)

Site Name:	ONS-GWPP
Test Date:	11/14/2007
Well Label:	GM-14R
Aquifer Thickness:	67.7 feet
Screen Length:	10. feet
Casing Radius:	1. Inches
Effective Radius:	1.5 Inches
Static Water Level:	4.8 feet
Water Table to Screen Bottom:	62.7 feet
Anisotropy Ratio:	1

Time Adjustment: 12. Seconds
Test starts with trial 2
There are 148 time and drawdown measurements
Maximum head is 0.334 feet
Minimum head is 0. feet

Calculation by Bouwer and Rice Graphical Method



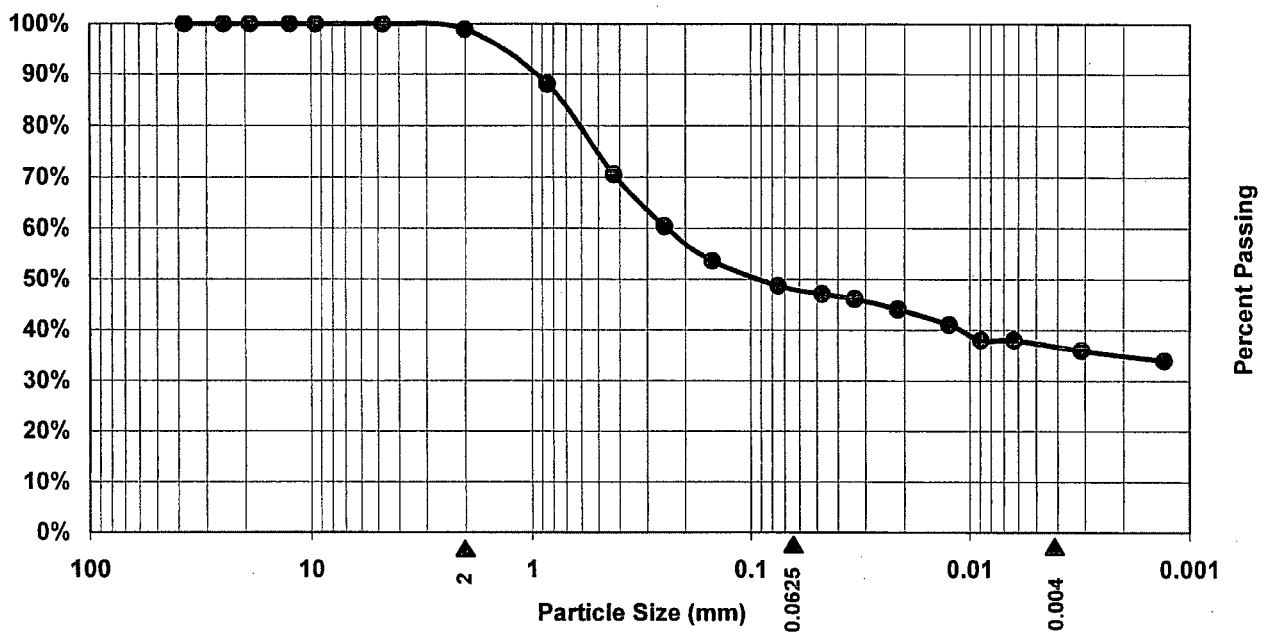
PERMEABILITY

1.89×10^{-5} cm/sec

PARTICLE SIZE ANALYSIS OF SOILS
FOR USE IN FETTER AND BEAR DIAGRAMS

Boring No.:	Sample No.:	Depth:
GM-14R	SS-1	8.5 to 10 ft bls

Sample Description:
F: Reddish-Brown, Silty, Clayey, Coarse to Fine Sand (SC)



	> 2 mm	2 mm - 0.0625 mm	0.0625 mm - 0.004 mm	<0.004 mm
From Graph:	% Gravel 1.1%	% Sand 50.9%	% Silt 11.5%	% Clay 36.6%
Adjusted for Calculations	**0%**	**51%**	**12%**	**37%**

Notes:
Grain size distribution taken from grain size with hydrometer data located in Appendix II.
Gravel, sand, silt and clay sizes based on Wentworth Scale.

S&ME Project:
Oconee Nuclear Station - GWPP

S&ME Project No.:
1264-07-234

S&ME

FETTER AND BEAR DIAGRAMS

S&ME PROJECT: Oconee Nuclear Station - GWPP
S&ME PROJECT NO.: 1264-07-234

S&ME

Boring No. GM-14R

Boring Depth: 8.5 to 10 ft bls

% Sand: 51%

% Silt: 12%

% Clay: 37%

Estimated Specific Yield: 3.5%*

* Estimated Value

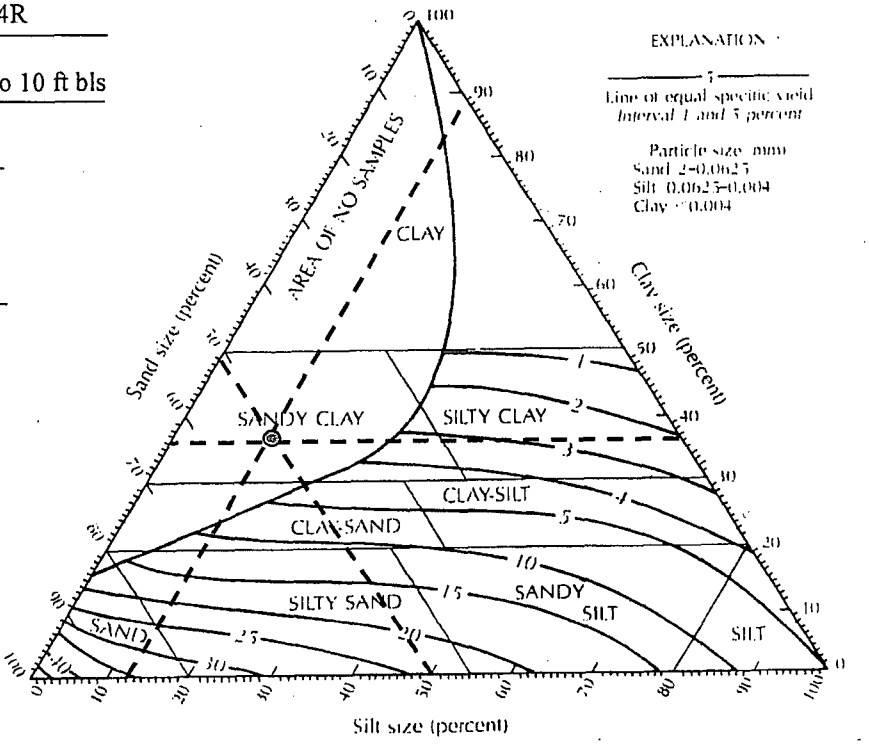
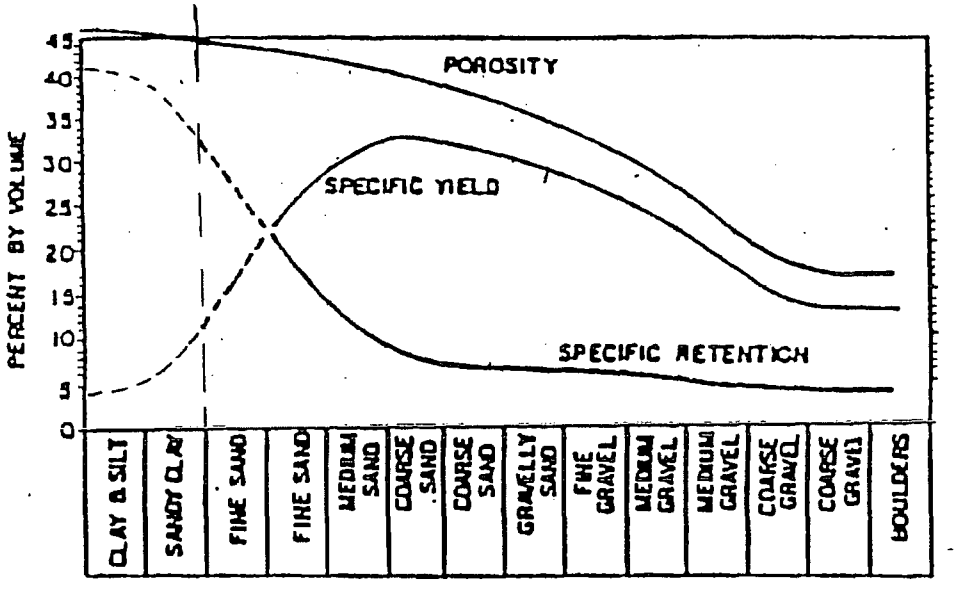


FIGURE 4.11 Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A. I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.



Estimated Porosity: 48%**

**Based on Table of Selected Values of Porosity, Specific Yield and Specific Retention, USGS Water Supply Paper 2220.

Variation of Porosity, Specific Yield, and Specific Retention with Grain Size (after Bear, 1972)