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Carmen Johnson
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BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL, ENVIRONMENTAL AND CONSTRUCTION MATERIALS CONSULTANTS

STATUS REPORT OF SITE HYDROGEOLOGIC CHARACTERIZATION

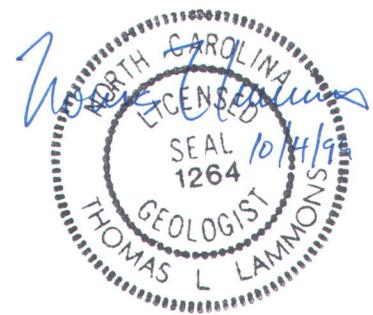
**JMN/CLEVELAND CONTAINER LANDFILL
CLEVELAND COUNTY, NORTH CAROLINA**

Prepared for:

**HODGES, HARBIN, NEWBERRY, & TRIBBLE, INC.
484 Mulberry Street, Suite 265
Macon, Georgia 31201**

Prepared By:

**BUNNELL-LAMMONS ENGINEERING, INC.
1200 Woodruff Road, Suite B-7
Greenville, South Carolina 29607**



October 4, 1999

BLE Project Number J99-1307-04



BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL, ENVIRONMENTAL AND CONSTRUCTION MATERIALS CONSULTANTS

October 4, 1999

Hodges, Harbin, Newberry, & Tribble, Inc.
484 Mulberry Street, Suite 265
Macon, Georgia 31201

Attention: Mr. William F. Hodges, P.E.

Subject: **Status Report of Site Hydrogeologic Characterization**
JMN/Cleveland Container Industrial Landfill
Cleveland County, North Carolina
BLE Project Number J99-1307-04

Gentlemen:

As authorized, Bunnell-Lammons Engineering, Inc. (BLE) is pleased to submit this status report of the hydrogeologic characterization study of the subject site near Shelby, North Carolina. The purpose of this report is to document the project completion to date, and make suggestions for further assessment during this interim stage.

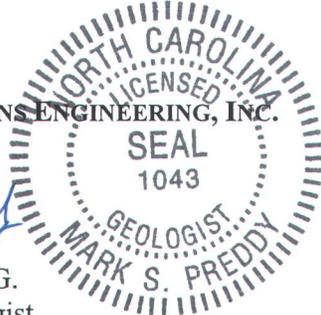
We appreciate the opportunity to serve as your hydrogeological consultant on this project and look forward to continue working with you at the proposed JMN/Cleveland Container Industrial Landfill. If you have any questions, please contact us at (864) 288-1265.

Sincerely,

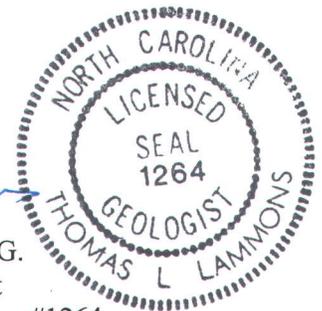
BUNNELL-LAMMONS ENGINEERING, INC.



Mark S. Preddy, P.G.
Senior Hydrogeologist
Registered, North Carolina #1043



Thomas L. Lammons, P.G.
Principal Hydrogeologist
Registered, North Carolina #1264



List of Attachments:

- Attachment A – Fracture Trace Analysis Results
- Attachment B – Residential Well Reconnaissance Map (2-Mile Radius)
- Attachment C – Private Water Supply Well Installation Records
- Attachment D – Map of Proposed Boring/Piezometer Locations

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PROJECT INFORMATION

The subject industrial waste landfill is located in Cleveland County, North Carolina near the town of Shelby. The site consists of about 110 acres, which includes an existing landfill, borrow areas, and a proposed Phase 2 expansion area (approximately 37 acres). It is our understanding that the existing landfill is unlined and has been receiving industrial waste since the 1970's. Since the facility continued to receive waste after January 1, 1998 and has plans for expansion (the Phase 2 area), the landfill must obtain a permit modification under applicable solid waste regulations 15A NCAC 13B.

The North Carolina Department of Environment and Natural Resources (NCDENR) has evaluated the compliance status of the facility with regards to solid waste management Rule 15A NCAC 13B .0503(2)(d)(ii). This rule pertains to the design of the landfill such that the ground-water standards under 15A NCAC 2L will not be exceeded in the uppermost aquifer at the compliance boundary.

Camp, Dresser, and McKee (CDM) prepared a *Landfill Design Plan*, dated December 1, 1997. The Division of Waste Management, Solid Waste Section (Section) reviewed the Plan and determined that the information submitted does not meet the requirements of Rule .0503(2)(d)(ii). As stated in a letter from Mr. James C. Coffey of the Section to Republic Services, Inc.:

“Specifically, the submitted ground water monitoring information does not demonstrate current compliance with the ground water standards in the upper most aquifer at the compliance boundary; the modeling information submitted does not provide adequate hydrogeologic characterization of the site to demonstrate future compliance with ground water standards in the upper most aquifer at the compliance boundary; and the information provided concerning previously disposed waste does not provide accurate physical and chemical characteristics of the leachate.”

BLE prepared a proposed scope of work to address the requirements of Rule .0503(2)(d)(ii) (*Work Plan for Site Hydrogeologic Characterization*, JMN/Cleveland Container Industrial Landfill, dated March 3, 1999, BLE Job Number J99-1307-02), herein referred to as the “Work Plan”. The Work Plan includes stages for the Section to be notified of project progress as tasks are completed.

This submittal includes the results of the fracture trace analysis and the residential well reconnaissance, and with this information, provides recommendations for drilling, piezometer installation, and hydraulic testing.

RESULTS OF FRACTURE TRACE ANALYSIS

Methodology

The fracture trace analysis consisted of evaluating exposed rock outcrops and topographic fracture traces and lineaments.

The orientation of bedrock fractures (open joints, open foliation, open bedding planes) were measured using a Brunton-style compass. The orientation information was collected from exposed rock and saprolite outcrops at the site as well as along nearby roads within about two miles of the

site. The field measurements were plotted on Schmidt lower hemisphere equal-area stereonet and Rose diagrams.

Topographic fracture traces and lineaments were evaluated using topographic maps. Regionally, pronounced depressions typically develop along zones of weakness in the bedrock where fractures induce preferential weathering. This preferential weathering along bedrock fractures is ultimately expressed topographically as linear valleys. The trend of fracture traces and lineaments greater than 1,000 feet in length within a 2-mile radius of the site were measured from USGS topographic maps and plotted on a Rose diagram.

Results

The field and map data are plotted as shown in Attachment A. A summary of the fracture trace analysis is provided below.

The trend of 126 topographic fracture traces and lineaments within two miles of the site were measured and plotted on a Rose diagram utilizing a 10° interval. Two primary fracture trace trends were observed: N31°-60°W and N11°-20°E. Additionally, three secondary trends were observed: N31°-50°E, N0°-30°W, and N61°-90°W.

The orientations and trends of 16 open joint surfaces and 18 bedrock foliation planes were measured in the field from rock and saprolite outcrops, then plotted on Schmidt equal area projections and Rose diagrams. The plots consist of one Schmidt net for plotting poles to the joints and foliation, one Rose diagram utilizing a 10° interval for joint trends, and one Rose diagram utilizing a 10° interval for foliation trends. One primary joint orientation was observed: N71°-90°W, dipping 70°-90°S; and two secondary trends were observed: N71°-N80°E, near vertical, and N41°-50°W, dipping 80°-90°NE. The metamorphic foliation orientation is N21°-40°W, dipping 32°NE-25°SW.

Our analysis of the local fracture trends, bedrock joint orientations, and foliation orientations indicate that the prevailing fracture trend is northwest. Additionally, a west-northwest trend is present as indicated from local fracture traces and joint trends. Other less prominent trends include north-northeast (primary fracture trace trend), and north-northwest (secondary fracture trace trend), and east-northeast (secondary joint trend).

RESIDENTIAL WELL RECONNAISSANCE

Methodology

The locations of private and public water supply wells within two miles of the site were identified in the field during our vehicular reconnaissance. The regional Division of Environmental Management office in Mooresville, North Carolina was visited to obtain private well installation records. Additionally, the extent of the public water system in the vicinity of the site was determined.

Results

The Cleveland County Regional Water System supplies most of the residences near the site with public water. The source of the public water is from the First Broad River.

The vehicular reconnaissance identified 516 habitable residences within two miles of the site which have, or most likely have, a private water supply well. Of these residences:

- 338 residences are on roads serviced by the public water system; and
- 178 residences are on roads not serviced by the public water system.

Attachment B shows the locations of the 516 residences identified in the field. Areas serviced by the Cleveland County Regional Water System are also shown.

Installation records at the Mooresville Regional Office were sparse, and only six private water well records were obtained for locations within two miles of the site. Attachment C includes copies of the well records and locations of the wells are indicated on the figure in Attachment B. These wells range in depth from 45 to 60 feet and are constructed with 24-inch diameter PVC.

The reconnaissance also identified a Superfund site about 7000 feet upgradient of the site. The site is known as the Kosa Plant (former Hearst-Celanese Plant), which is located along highway NC-198, north of the town of Earl. The nature of contamination at the site is chlorinated solvents and glycols in an on-site landfill.

RECOMMENDATIONS

As outlined in the Work Plan, the next phases of assessment include assessing vertical hydraulic gradients on the existing landfill property, and performing drilling and piezometer installation on the expansion area. Based on the information presented herein and the proposed tasks in the Work Plan, we propose to following assessment activities:

Existing Landfill Property

1. Install a piezometer in the bedrock aquifer, adjacent to existing well MW-7 (set to 28 feet in soil). The new well will be deeper than MW-7 and drilled using air-rotary drilling techniques to an estimated depth of 60 feet, or until a water producing fracture is encountered;
2. Install a piezometer in the bedrock aquifer, adjacent to existing well MW-4 (set to 14.5 feet in soil). The new well will be deeper than MW-4 and drilled using air-rotary drilling techniques to an estimated depth of 45 feet, or until a water producing fracture is encountered;
3. Measure the stabilized water levels to evaluate vertical hydraulic gradients and determine the configuration of the water table surface; and
4. Conduct drawdown/recovery tests in the deep piezometers to evaluate the hydrogeology of the bedrock aquifer unit.

Landfill Expansion Area

1. Perform soil test borings and, if necessary, rock coring at the four locations indicated on Attachment D;
2. Install piezometers in each of the four borings;



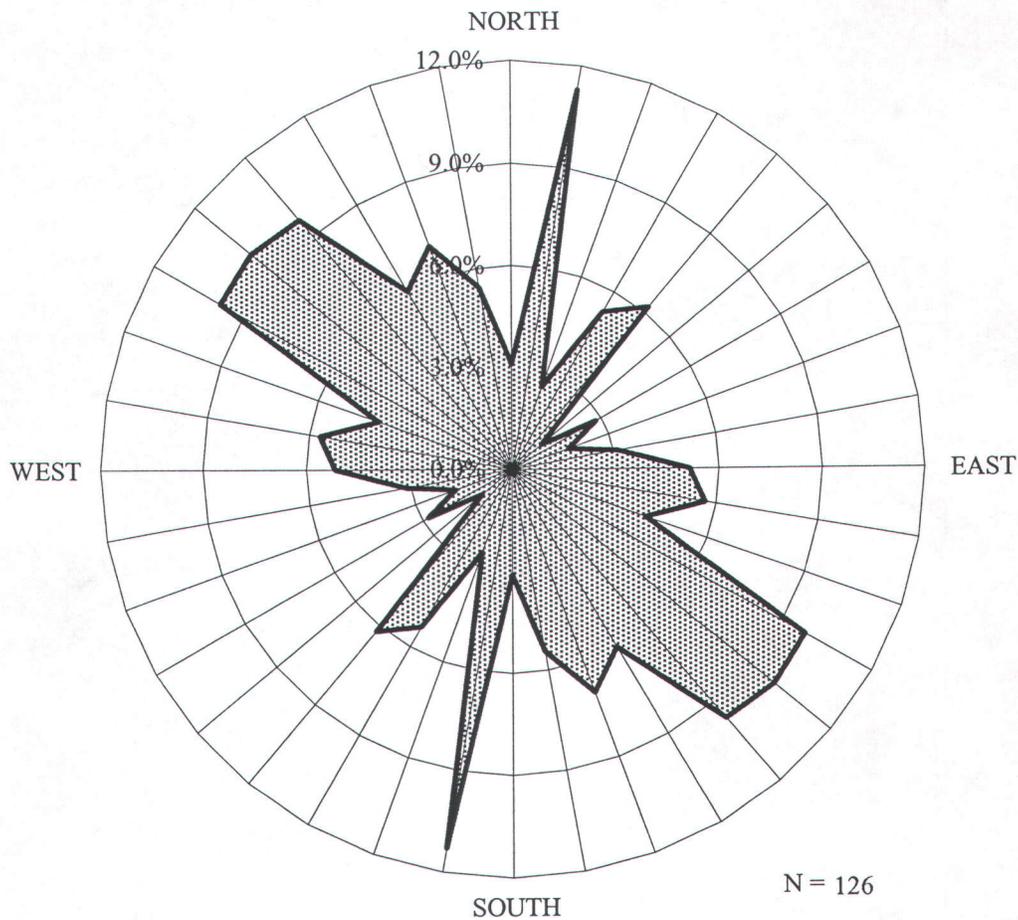
3. Install two additional piezometers at two of the four aforementioned drilling locations to assess vertical hydraulic gradients: one in an upgradient location and one in a downgradient location;
4. Measure the stabilized water levels to evaluate vertical hydraulic gradients and determine the configuration of the water table surface; and
5. Conduct hydraulic tests in three of the newly installed piezometers using either the slug test (soil piezometers) or drawdown/recovery test methods (bedrock piezometers).

Procedures for drilling, piezometer installation, and hydraulic testing are included in the Work Plan.

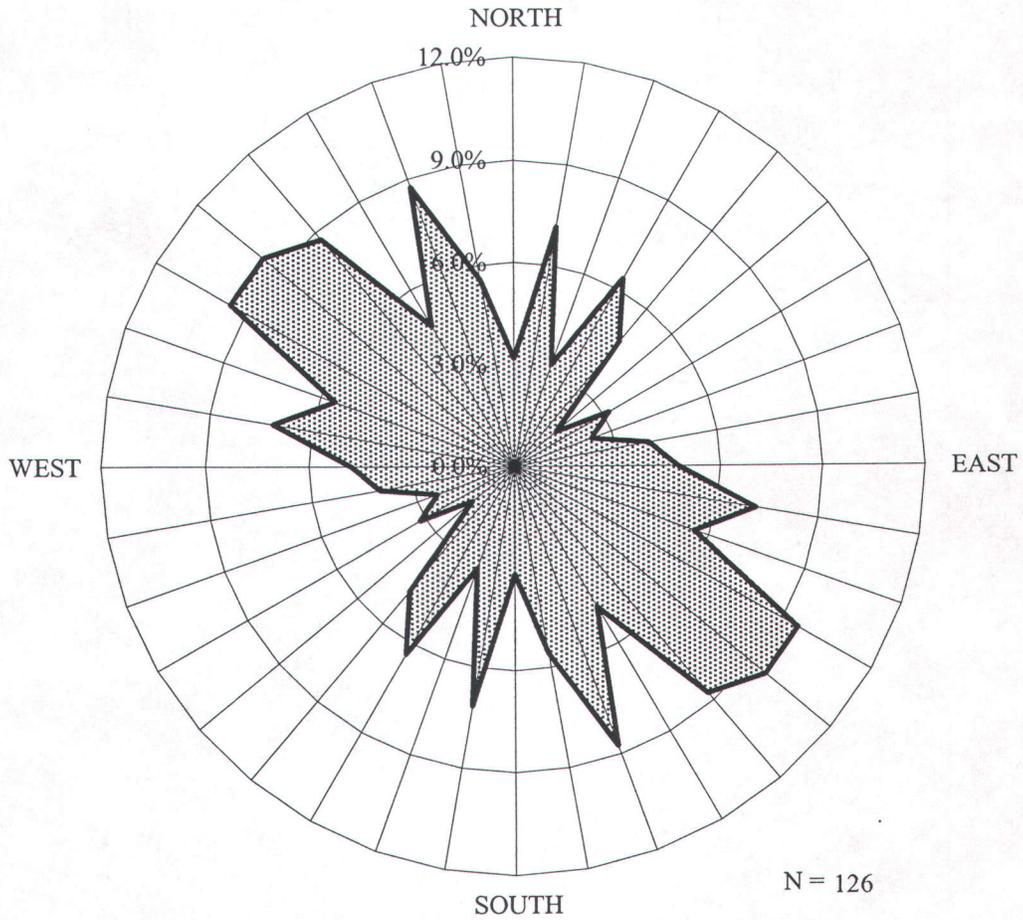
Attachment A

Fracture Trace Analysis Results

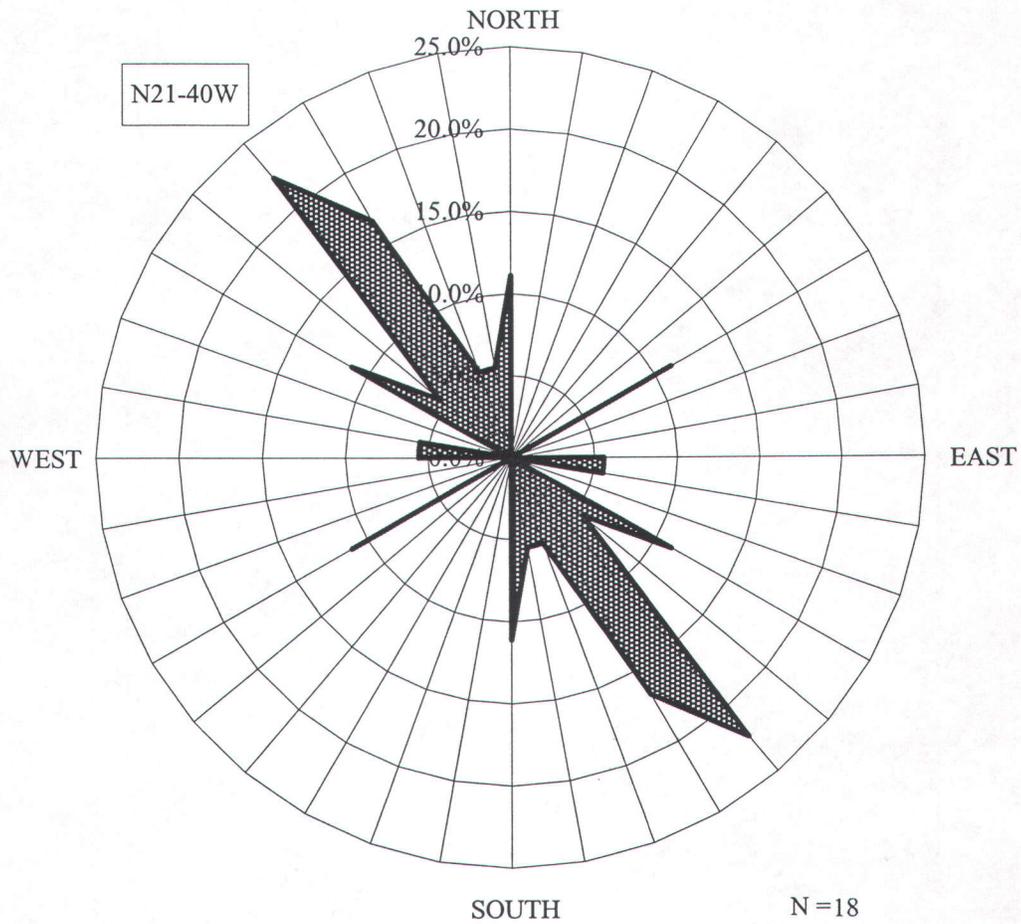
ROSE DIAGRAM OF FRACTURE TRACE AND LINEAMENT TRENDS
Percentage Expressed as Length of Fracture Traces/Lineaments
Data Collected within 2-Mile Radius of the JMN/Cleveland Container Landfill, Shelby, NC
BLE Job J99-1307-04



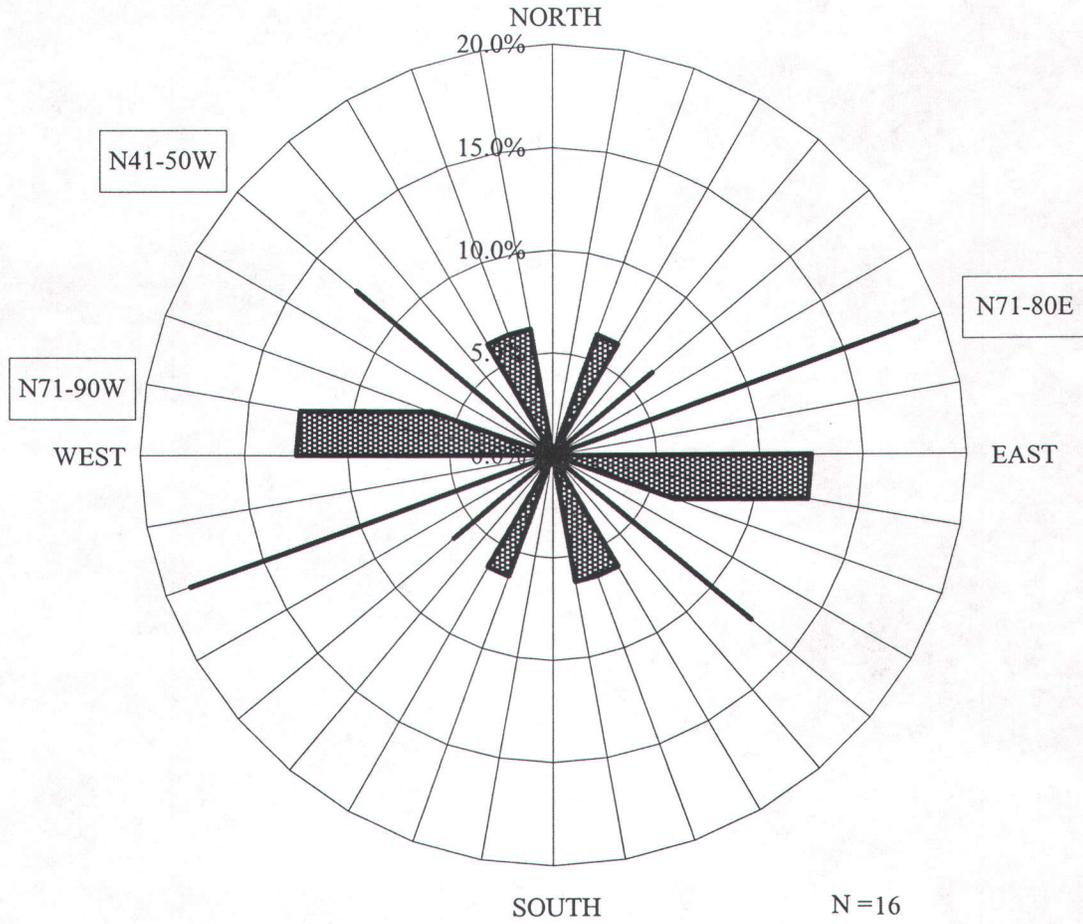
ROSE DIAGRAM OF FRACTURE TRACE AND LINEAMENT TRENDS
Percentage Expressed as Number of Fracture Traces/Lineaments
Data Collected within 2-Mile Radius of the JMN/Cleveland Container Landfill, Shelby, NC
BLE Job J99-1307-04



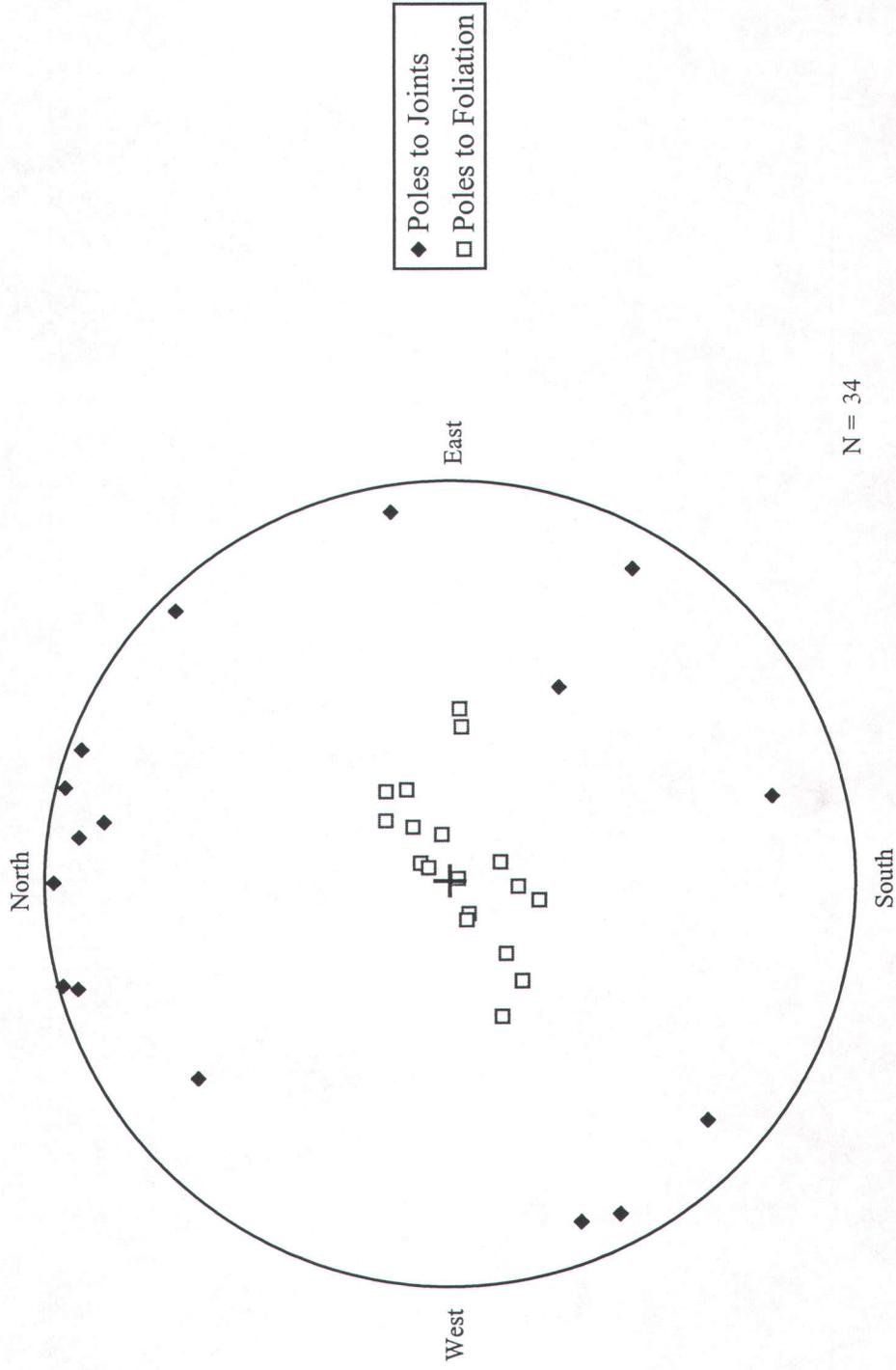
**Rose Diagram of Foliation Trends Measured at and near the
Cleveland Container Industrial Landfill, Shelby, NC
BLE Job Number J99-1307-04**



Rose Diagram of Joint Trends Measured at and near the
Cleveland Container Industrial Landfill, Shelby, NC
BLE Job Number J99-1307-04



PLOT OF POLES TO JOINTS & FOLIATION
Cleveland Container Industrial Landfill, Shelby, NC
BLE Job Number J99-1307-04



Attachment B

Residential Well Reconnaissance Map (2-Mile Radius)

Under Seperate cover

Attachment C

Private Water Supply Well Installation Records

R-1

NC DEHNR
DEM - GW SECTION
P.O. BOX 29535
RALEIGH, NC 27626-0535
(919) 733-3221

QUAD NO. _____ SER. NO. _____
LAT _____ LONG _____
BASIN CODE _____
HEADER ENT. _____ GW-1 ENT. _____

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR: PITTMAN WELL BORING

STATE WELL CONSTRUCTION
PERMIT NUMBER: _____

DRILLER REGISTRATION #: 946

1. WELL LOCATION: (SHOW SKETCH OF THE LOCATION BELOW)

NEAREST TOWN: EARL COUNTY: CLEV
HWY. #198

(ROAD, COMM., OR SUBDV. & LOT NO.)

DEPTH DRILLING LOG
FROM TO FORM. DESC.

2. OWNER WYLIE LEE

ADDRESS HWY. #198

EARL NC 28038

CITY OR TOWN STATE ZIP CODE

3. DATE DRILLED: 06-13-96 USE OF WELL: HOUSE

4. TOTAL DEPTH: 45'

5. CUTTINGS COLLECTED: YES NO XX

6. DOES WELL REPLACE EXISTING WELL? YES NO XX

7. STAT. WAT. LEVEL. BEL. TOP OF CASING 25'

(USE "+" IF ABOVE TOP)

8. TOP OF CASING IS 18" ABOVE LAND SURF.*

9. YIELD (GPM): 20' METHOD OF TEST STEEL TAPE

10. WATER ZONES (DEPTH): _____

11. CHLORINATION: TYPE CLOROX AMOUNT 1/2 GAL

12. CASING:

DEPTH		DIA	W. THICK.	MTL
FROM	TO	FT.	OR WT/FT.	CONC
0	45	24"		
FROM	TO	FT.		

LOCATION SKETCH

13. GROUT:

DEPTH		MATERIAL	METHOD
FROM	TO	FT.	
0	20	CEMENT	POURED
FROM	TO	FT.	

GO DOWN HWY. #198 FROM
EARL. HOUSE ON RT. JUST
BEFORE CROSSING BUFFALO
CREEK.

14.

DEPTH		DIA	SLOT SIZE	MTL
FROM	TO	FT.	IN.	IN.
FROM	TO	FT.	IN.	IN.
FROM	TO	FT.	IN.	IN.

NC DEPT. OF
ENVIRONMENT, HEALTH
& NATURAL RESOURCES

OCT 10 1996

15. SAND/GRAVEL PACK:

DEPTH		SIZE	MATERIAL
FROM	TO	FT.	
25	45	#6 M	STONE
FROM	TO	FT.	

DIVISION OF ENVIRONMENTAL MANAGEMENT
MOORESVILLE REGIONAL OFFICE

16. REMARKS: _____

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH
15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD
HAS BEEN PROVIDED TO THE WELL OWNER.

RECEIVED

OCT - 7 1996

Danmark Adhmer
SIGNATURE OF CONTRACTOR OR AGENT

9-16-96
DATE

NC DEHNR
DEM - GW SECTION
P.O. BOX 29535
RALEIGH, NC 27626-0535
(919) 733-3221

QUAD NO. _____ SER. NO. _____
LAT _____ LONG _____
BASIN CODE _____
HEADER ENT. _____ GW-1 ENT. _____

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR: PITTMAN WELL BORING

STATE WELL CONSTRUCTION
PERMIT NUMBER: _____

DRILLER REGISTRATION #: 946

1. WELL LOCATION: (SHOW SKETCH OF THE LOCATION BELOW)
NEAREST TOWN: GROVER COUNTY: CLEV

(ROAD, COMM., OR SUBDV. & LOT NO.)
2. OWNER DAVID ADAMS
ADDRESS 1237 LAVENDER RD.
GROVER NC 28073
CITY OR TOWN STATE ZIP CODE
3. DATE DRILLED: 05-27-96 USE OF WELL: HOUSE
4. TOTAL DEPTH: 60'
5. CUTTINGS COLLECTED: YES NO XX
6. DOES WELL REPLACE EXISTING WELL? YES NO XX
7. STAT. WAT. LEVEL. BEL. TOP OF CASING 40'
(USE "+" IF ABOVE TOP)
8. TOP OF CASING IS 18" ABOVE LAND SURF.*
9. YIELD (GPM): 20' METHOD OF TEST STEEL TAPE
10. WATER ZONES (DEPTH): _____
11. CHLORINATION: TYPE CLOROX AMOUNT 1/2 GAL
12. CASING:

DEPTH		DRILLING LOG
FROM	TO	
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

DEPTH		DIA		W. THICK.	
FROM	TO	FT.	24"	OR	WT/FT. MTL
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

13. GROUT:

DEPTH		MATERIAL		METHOD	
FROM	TO	FT.	CEMENT	POURED	
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

14.

DEPTH		DIA		SLOT SIZE		MTL	
FROM	TO	FT.	IN.	IN.	IN.	IN.	IN.
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____

15. SAND/GRAVEL PACK:

DEPTH		SIZE		MATERIAL	
FROM	TO	FT.	#6 M	STONE	
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

16. REMARKS: _____

=====

LOCATION SKETCH

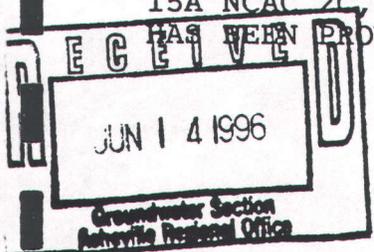
HWY. #226 S. FROM SHELBY.
1 MILE THIS SIDE OF GROVER
RT. ON LAVENDER RD. 1/4
MILE ON RT. (1237 ON
MAILBOX)

N.C. DEPT. OF
ENVIRONMENT, HEALTH,
& NATURAL RESOURCES

JUN 19 1996

DIVISION OF ENVIRONMENTAL MANAGEMENT
MORGESVILLE REGIONAL OFFICE

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH
15A NCAC 2C. WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD
HAS BEEN PROVIDED TO THE WELL OWNER.



Donna A. Pittman 6/11/96
SIGNATURE OF CONTRACTOR OR AGENT DATE

DRILLING CONTRACTOR Walter L. King REG. NO. 55 WELL CONSTRUCTION PERMIT NO. _____

1. WELL LOCATION: (Show sketch of the location below)

Nearest Town: _____ County: Chatham

(Road, Community or Subdivision and Lot No.) _____

Quadrangle No. R-74

2. OWNER: Ricky Jordan

DRILLING LOG

3. ADDRESS: P.O. Box 274 Earl, N.C.

4. TOPOGRAPHY: draw, valley, slope, hilltop, flat (circle one)

DEPTH FROM TO FORMATION DESCRIPTION

5. USE OF WELL: Home DATE: 9-15-78

6. DOES THIS WELL REPLACE AN EXISTING WELL? -

7. TOTAL DEPTH: 56 RIG TYPE OR METHOD: Barrel

8. FORMATION SAMPLES COLLECTED: YES NO

9. CASING: Depth Inside Dia. Wall thick. or weight/ft. type

From 0 to 56 ft 24" 1 1/2" Concrete

10. GROUT: Depth Material Method

From 0 to 26 ft Concrete and mife

11. SCREEN: Depth Dia. Type & Opening

From _____ to _____ ft

If additional space is needed, use back of form

LOCATION SKETCH (Show distance to numbered roads, or other map reference points)

12. GRAVEL: Depth Size Material

From 20 to 56 ft 3/4" crushed stone

13. WATER ZONES (depth): 26

14. STATIC WATER LEVEL: 26 ft ^{above} below top of casing

Casing is 1 ft. above land surface ELEV: _____

15. YIELD (gpm): _____ METHOD OF TESTING: _____

16. PUMPING WATER LEVEL: _____ ft.

after _____ hours at _____ gpm.

17. CHLORINATION: Type HTH Amount 1/2 cup

18. WATER QUALITY: _____ TEMPERATURE (°F) _____

19. PERMANENT PUMP: Date Installed _____

Type _____ Capacity _____ (gpm) HP _____

Make _____ Intake Depth _____

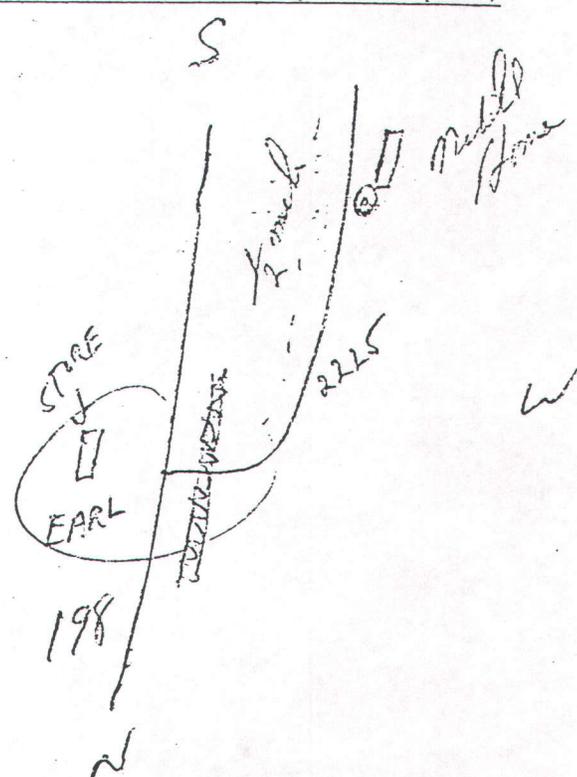
Airline Depth _____

20. HAS THE OWNER BEEN PROVIDED A COPY OF THIS RECORD AND INFORMED OF THE DEPARTMENTS REQUIREMENTS AND RECOMMENDATIONS? _____

21. REMARKS _____

I do hereby certify that this well was constructed in accordance with N.C. Well Construction Regulations and Standards and that this well record is true and exact.

James L. King 1-8-79
SIGNATURE OF CONTRACTOR OF AGENT DATE



CV2010

NORTH CAROLINA DEPARTMENT OF NATURAL RESOURCES & COMMUNITY DEVELOPMENT
WELL RECORD DIVISION OF ENVIRONMENTAL MANAGEMENT

P. O. Box 27687 - RALEIGH, N.C. 27611 919-733-2020

DRILLING CONTRACTOR Arnold's Well Drilling REG. NO. 65 WELL CONSTRUCTION PERMIT NO. _____

1. WELL LOCATION: (Show sketch of the location below)

Nearest Town: EASL County: Cleveland
EASL Wood Rd. Dead End. Quadrangle No. R74
(Road, Community or Subdivision and Lot No.)

2. OWNER: Eugene Foster

DRILLING LOG

3. ADDRESS: _____

DEPTH FROM TO FORMATION DESCRIPTION

4. TOPOGRAPHY: draw, valley, slope, hilltop, flat (circle one)

5. USE OF WELL: TRAILER DATE: 4-15-82

1- 45 CLAY

6. DOES THIS WELL REPLACE AN EXISTING WELL? No

7. TOTAL DEPTH: 45 RIG TYPE OR METHOD: 905 peck

8. FORMATION SAMPLES COLLECTED: YES NO

9. CASING: Depth Inside Wall thick. type
Dia. or weight/ft.

From 1 to 45ft 24 Cement

10. GROUT: Depth Material Method

From 1 to 20ft Sand & Cement

If additional space is needed, use back of form

11. SCREEN: Depth Dia. Type & Opening

From _____ to _____ ft _____

LOCATION SKETCH
(Show distance to numbered roads, or other map reference points)

12. GRAVEL: Depth Size Material

From _____ to _____ ft _____

13. WATER ZONES (depth): 24

14. STATIC WATER LEVEL: 24 ft above top of casing
Casing is 1 ft. above land surface ELEV: _____

15. YIELD (gpm): 2 METHOD OF TESTING: Bailing

16. PUMPING WATER LEVEL: _____ ft.
after _____ hours at _____ gpm.

17. CHLORINATION: Type H+H Amount _____

18. WATER QUALITY: Good TEMPERATURE (°F) _____

19. PERMANENT PUMP: Date Installed _____

Type _____ Capacity _____ (gpm) HP _____

Make _____ Intake Depth _____

Airline Depth _____

20. HAS THE OWNER BEEN PROVIDED A COPY OF THIS RECORD AND INFORMED OF THE DEPARTMENTS REQUIREMENTS AND RECOMMENDATIONS? YES

21. REMARKS _____

I do hereby certify that this well was constructed in accordance with N.C. Well Construction Regulations and Standards and that this well record is true and exact.

Arnold Philbeck 4-15-82
SIGNATURE OF CONTRACTOR OR AGENT DATE



Attachment D

Map of Proposed Boring/Piezometer Locations