Fac/Perm/Co ID #	Date	Doc ID#
BC	01/04/11	DIN

Westinghouse **IMPORTANT**

To Walt Strand

Date 6-11-91 Time 12:40

WHILE YOU WERE OUT

M

of G'boro 855-7547

Phone 919 ~~872-2660~~

AREA CODE NUMBER EXTENSION

RE: Alamance Co. (Rockingham Co.)

TELEPHONED		PLEASE CALL	
CALLED TO SEE YOU		WILL CALL AGAIN	
WANTS TO SEE YOU		URGENT	
RETURNED YOUR CALL			

Message Subs. Characterization

Routine Detection Monitoring

Signed

N.C. Dept. of Environment, Health, and Natural Resources

Printed on Recycled Paper

State of North Carolina
Department of Environment, Health, and Natural Resources
Division of Solid Waste Management
P.O. Box 27687 · Raleigh, North Carolina 27611-7687

James G. Martin, Governor
William W. Cobey, Jr., Secretary

William L. Meyer
Director

April 15, 1991

Mr. Robert C. Smith, County Manager
Alamance County
124 W. Elm Street
Graham, NC 27253

RE: Inter-Agency Task Force Comments for proposed site
Austin Quarter Site

Dear Mr. Smith:

In addition to the comments provided on 29Jun90 for four proposed sites, enclosed please find the Task Force comments for the Austin Quarter Site. The previous correspondence provided a complete explanation of the Task Force and its purpose.

With a few considerations, the comments for the Austin Quarter Site are favorable. Enclosed is a copy of DEM's Document, "Guidance For Evaluation Of Wastewater Disposal Alternatives". As noted in the comments, the County should fully evaluate the leachate management alternatives for the site selected. Referencing the Solid Waste Section's comments and the attached maps, if the County proceeds with investigations at this site it is advisable that they also consider purchasing the two areas delineated on the map as Area 1 and Area 2.

Should you have any questions concerning the comments, please contact the appropriate agency or this office at (919) 733-0692.

Sincerely,

James C Coffey

James C. Coffey, Acting Chief
Solid Waste Section

enclosures

cc: Gary Ahlberg
Jeff Rodgers
Julian Foscue
Margaret Foster - WSRO
Steve Reid

Meeting 6-7-91
S.W.S. - Gary Ahlberg, Bobby Luffy
Hazen + Sawyer - Bob DiFiore, Mike Hebert
Westinghouse - Walter Strand

State of North Carolina
Department of Environment, Health, and Natural Resources
Division of Environmental Health
P.O. Box 27687 • Raleigh, North Carolina 27611-7687

James G. Martin, Governor
William W. Cobey, Jr., Secretary

Richard K. Rowe
Director

April 12, 1991

SOLID WASTE SECTION
APR 12 1991

MEMORANDUM

TO: Gary W. Ahlberg
Task Force Coordinator
Solid Waste Section
Division of Solid Waste Management

FROM: W. E. Venrick, Chief W.E. Venrick
Public Water Supply Section

RE: Proposed Landfill
East of Saxapahaw
Alamance County

We have participated in the Inter-Agency Solid Waste Task Force site review of the referenced proposed landfill.

I have no objection to the proposed site as a location for a non-discharging landfill.

WEV:cf

cc: Mr. Richard K. Rowe

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT
HEALTH AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL MANAGEMENT

SOLID WASTE SECTION
MAR 28 1991

March 22, 1991

M E M O R A N D U M

TO: Gary Ahlberg
Solid Waste Section

THROUGH: Larry Coble
Regional Supervisor

M. Steven Mauney
Water Quality Supervisor

FROM: Eric Galamb
Water Quality Environmental Tech. IV

SUBJECT: Site Section
Alamance County Landfill
Austin Quarter Road
Alamance County

The site visit was held on March 21, 1991. This site was found to have very little surface waters that could be impacted.

In one of the streams, Plecoptera or stoneflies was observed. Trichoptera or caddisflies was also observed in the same stream. These species are indicators of good water quality.

Cyprinidae (minnow-like) were observed in the major stream near boring #5. This stream may be a nursery area off of the Haw River.

The site is not located in a protected area of a watershed.

The Corps of Engineers should be contacted to assess the wetlands on the site.

Leachate disposal needs to be addressed.

Should you have any questions, please contact me at (919) 761-2351.

cc: Steve Tedder
Central Files
WSRO

State of North Carolina
Department of Environment, Health, and Natural Resources
Winston-Salem Regional Office

James G. Martin, Governor
William W. Cobey, Jr., Secretary

Margaret Plemmons Foster
Regional Manager

SOLID WASTE SECTION
APR 05 1991

DIVISION OF ENVIRONMENTAL MANAGEMENT
GROUNDWATER SECTION

April 3, 1991

MEMORANDUM

TO: Gary Ahlberg
Task Force Coordinator
Solid Waste Section

THROUGH: Larry K. Lucas
Hydrogeological Regional Supervisor, WSRO

FROM: Steve Weiss
Hydrogeologist I, WSRO

SUBJECT: Comments On Proposed Alamance County Landfill; Preliminary Site Investigation Report, And Task Force Visit

Structurally, there does not appear to be faults or significant structure in the area to act as cross-cutting conduits. From literature search the study does not note the mafic dikes prevalent elsewhere in the Piedmont. Nonetheless some future borings should be extended into bedrock to characterize possible faulting and fracturing.

Preliminary drilling indicates the presence of low to moderate permeability soils underlying the site in the unsaturated zone. Sandy clayey silt is the uppermost soil in the southern area of primary development. Sandy clayey soils are also deeply developed on Little Mountain, too steep for cell development, but readily available for liner and cover material.

In general, soils appear to be of suitable permeability and sufficient thickness for cell development. In any case the actual range of hydraulic conductivities will be defined along with other aquifer characteristics in the next stage of investigation. More wells will need to be placed on the useable portion of the northwest section, to characterize that area.

Depth to bedrock runs from 9 to 47 feet and should not prove to be a limitation.

Groundwater occurrence is defined only in terms of estimated water table. The water table on the broad hilltop divide to the south is stated to be at least ten feet and generally 20 to 40 feet. The northwest area has a more even water table of 33 to 37 feet-adequate to maintain the required four feet above seasonal high water table.

Springs do not appear to be too numerous for construction design nor do there appear to be indications of perched water tables. One anomalous small pond was probably constructed.

Monitoring well placement and depth will require careful planning even if engineering concerns are met. Daily cover and runoff maintenance, proposed liner and collection system may limit leakage over the proposed 25 year life of the site. Site development, however, will concentrate on hill tops in what is an area of groundwater recharge. Leachate from possible failure will descend steeply across potentiometric lines before ascending to the Haw River or intermediate drainages. Monitor wells therefore will have to project to deep saprolite and bedrock to intercept indications of contaminant spread.

The second planning concern is the doubling in monitor wells necessary to monitor parts of the site. While the broad area to the south may be effectively monitored around its perimeter, the long ridges in the northwest area may require monitor wells on both sides of the ridge to be comprehensive.

There does not appear to be a threat to the area domestic water supply wells through potential groundwater contamination. The site is in a sparsely populated area with no domestic wells downgradient. However, any water wells within 1500' should be sampled periodically.

LKL/CSW/ahl

State of North Carolina
Department of Environment, Health, and Natural Resources
Division of Solid Waste Management
P.O. Box 27687 · Raleigh, North Carolina 27611-7687

James G. Martin, Governor
William W. Cobey, Jr., Secretary

William L. Meyer
Director

April 4, 1991

MEMORANDUM

TO: James C. Coffey

FROM: GW Gary W. Ahlberg

RE: Inter-Agency Task Force for Alamance County
Austin Quarter Site

In addition to the site assessments provided last year (29June90 cover), on 21Mar91 the Task Force met to evaluate the above referenced site. The following is a preliminary assessment of the site's characteristics, based on surficial observations, topographic maps, applicable regulations, and a preliminary subsurface investigation report prepared by Westinghouse.

The 370 acre site is part of a larger tract, situated east of the Haw River and north of Cane Creek. The proposed site is located in southeastern Alamance County near Saxapahaw, NC and is accessed via Austin Quarter Road. The site is relatively well isolated from populated areas. The surrounding properties are primarily farmland. The site is thickly vegetated with pines and brush, with older hardwoods delineating the creek lines. It is evident that this land was cleared no less than 10-15 years ago. The dense vegetation limited the assessment to areas of the site which could be accessed via the existing trails.

Topographically, the site is dominated by three features: the Haw River is approximately 1000 feet west of the proposed property line; originating off-site to the east, an unnamed tributary to the Haw River divides the site into two (2) sections, which are referred to as the North and South sections; and Little Mountain (elevation 652 ft. MSL) dominates the eastern area of the South section. The site is further characterized as the North and South sections.

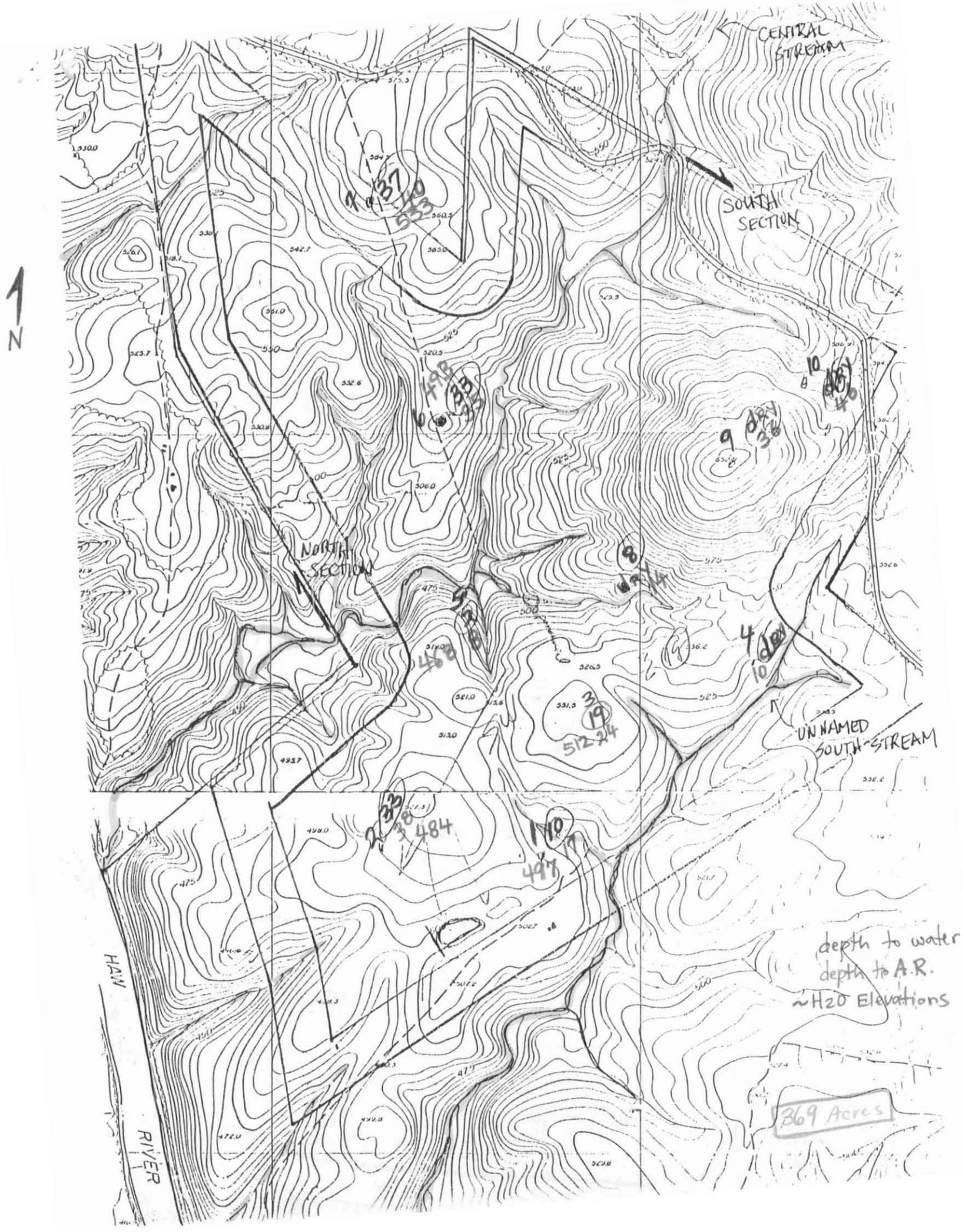
The South section represents approximately 60 percent of the site. Generally, relief is east to west (approximately 200 feet), from Little Mountain towards the river. Another unnamed stream originates on-site, south of Little Mountain, and cuts across the southeastern area and leaves the proposed site, eventually meeting the river. Average slopes range from 15 % in the east to more gradual slopes

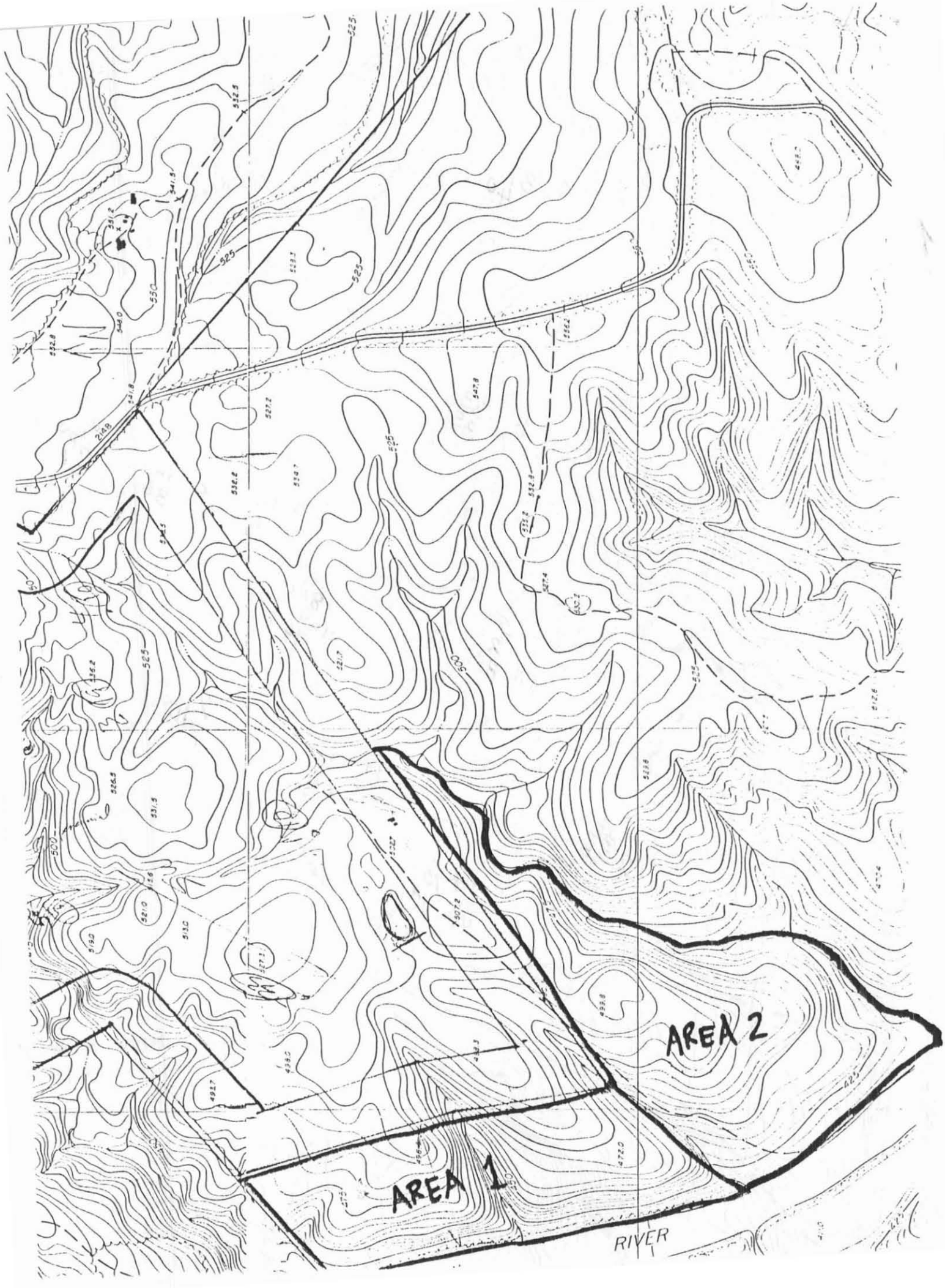
(3 %) in the center and west. Depth to ground water appears favorable. The Haw River provides an adjacent groundwater discharge area, with no wells currently present between it and the proposed waste boundary. This is a favorable characteristic, however, the lack of control (i.e. ownership) for the area between the proposed property line and the river presents some concern. Likewise, a similar situation could exist with the southern property line and the unnamed stream which originates on-site and flows southwest to the Haw. These areas are delineated on the enclosed map.

The North section is divided by three streams, with two of the streams flowing to the south where they join the central stream. On-site relief is oriented north to south, towards the central stream. However, local relief is oriented east-to-west towards the adjacent property and the Haw River. According to local landowners, the adjacent property is farmland and no homes or wells are presently located on-site. For this section of the site, the apparent lack of control between the proposed waste boundary and the groundwater discharge area is not favorable. Depth to ground water is favorable. Accordingly, actual groundwater characteristics must be adequately defined in a site plan application.

Overall, the proposed site is large enough to incorporate a 300 foot buffer from the proposed disposal boundary to all property lines. The central stream shall be adequately buffered (minimum 50 ft.) and potentially impacted wetlands shall be delineated and managed according to ACOE and DEM-WQ requirements. Conceptually, the proposed disposal boundary should focus on the South section; ground water characteristics appear more favorable in this section. Any airports within 5 miles shall be identified. Current landfill design technology requires the use of liner and leachate collection systems to contain and remove leachate. The alternatives available for managing leachate should be completely analyzed to determine technical and economic feasiblity.

cc: Jeff Rodgers
Julian Foscue
Bobby Lutfy


N
CENTRAL STREAM
SOUTH SECTION
NORTH SECTION
UNNAMED SOUTH STREAM
HAW RIVER
depth to water
depth to A.R.
~H2O Elevations
369 Acres


AREA 1
AREA 2
RIVER

(ii) Potential or existing sources of ground-water and surface water pollution;
(iii) Water intakes;
(iv) Airport and runways; and
(v) Subdivisions.

(c) A geological and hydrological study of the site which provides:
(i) Soil borings for which the numbers and depths have been confirmed by the Division and lab testing of selected soil samples that provide:
(A) standard penetration - resistance;
(B) particle size analysis;
(C) soil classification - USCS;
(D) geologic considerations (slopes, solution features, etc.);
(E) undisturbed representative geologic samples of the unconfined or confined or semiconfined hydrological units within a depth of 50 feet that provide the following information for each major lithologic units:
(I) saturated hydraulic conductivity (or by in-situ);
(II) volume percent water; and
(III) porosity;
(F) remolded sample of cover soils that provide:
(I) saturated hydraulic conductivity,
(II) total porosity,
(III) atterberg limits;
(G) stratagraphic cross-sections identifying hydrogeological units including lithology;
(H) tabulation of water table elevations at time of boring, 24 hours, and seven days (The number of cased borings to provide this information shall be confirmed by the Division.); and
(I) boring logs;
(ii) A boundary plat locating soil borings with accurate horizontal and vertical control which are tied to a permanent onsite bench mark;
(iii) A potentiometric map of the surfical aquifer based on stabilized water table elevations; and
(iv) A report summarizing the geological and hydrological evaluation.

(d) A conceptual design plan presenting special engineering features or considerations which must be included or maintained in site construction, operation, maintenance and closure.

(e) Local government approvals:
(i) If the site is located within an incorporated city or town, or within the extra-territorial jurisdiction of an incorporated city or town, the approval of the governing board of the city or town shall be required. Otherwise, the approval of the Board of Commissioners of the county in which the site is located shall be required. Approval may be in the form of either a resolution or a vote on a motion. A copy of the resolution, or the minutes of the meeting where the vote was taken, shall be forwarded to the Division.
(ii) A letter from the unit of government having zoning jurisdiction over the site which states that the proposal meets all of the requirements of the local zoning ordinance, or that the site is not zoned.

(f) A discussion of compliance with siting standards in Rule .0503(1) of this Subchapter.

(g) A report indicating the following:
(i) population and area to be served;
(ii) type, quantity and source of waste;
(iii) the equipment that will be used for operating the site;
(iv) a proposed groundwater monitoring plan including well location and schematics showing proposed screened interval, depth and construction; and
(v) a more detailed geologic report may be required depending on specifics of the site. This report may be based on physical evidence, initially, or due to information obtained from the site plan application.

(h) Any other information pertinent to the suitability of the proposed site.

(2) The following information shall be is required for reviewing a construction plan application for a proposed sanitary landfill:

(a) A map showing existing features to include:
(i) existing topography of the site on a scale of at least 1 inch equals 200 feet with five foot contours;
(ii) bench marks;

Westinghouse Environmental
and Geotechnical Services, Inc.

PRELIMINARY GEOLOGIC AND HYDROGEOLOGIC SITE CHARACTERIZATION

PROPOSED ALAMANCE COUNTY LANDFILL SOUTHEAST ALAMANCE COUNTY

WESTINGHOUSE JOB #1381-90-013

369 acres

Meeting 6-7-91

Westinghouse Environmental
and Geotechnical Services, Inc.

135-C Montlieu Avenue
P.O. Box 18169
Greensboro, North Carolina 27419
(919) 855-7547
Fax (919) 855-8017

February 8, 1991

Hazen and Sawyer, Consultants
4000 Westchase Blvd., Suite 550
Raleigh, North Carolina 27612

Attention: Mr. Robert DiFiore

Reference: Preliminary Geologic and Hydrogeologic Site Characterization
Proposed Alamance County Landfill
Southeast Alamance County
Westinghouse Project No. 1381-90-013

Dear Mr. DiFiore:

Attached please find the results of our preliminary site characterization. We hope that it is responsive to your needs. If you have any questions regarding this information, please contact us.

Very truly yours,

Westinghouse Environmental
and Geotechnical Services, Inc.

Jim Buschur
Geologist

Walter Strand III, P.E.
Project Manager

JB/WSIII/AB/lpn

Enclosure(s)

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- B. Test Boring Results
- C. Engineering Data

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II. Groundwater Elevations

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I. Soil Capabilities

II. Test Boring Records

I. INTRODUCTION

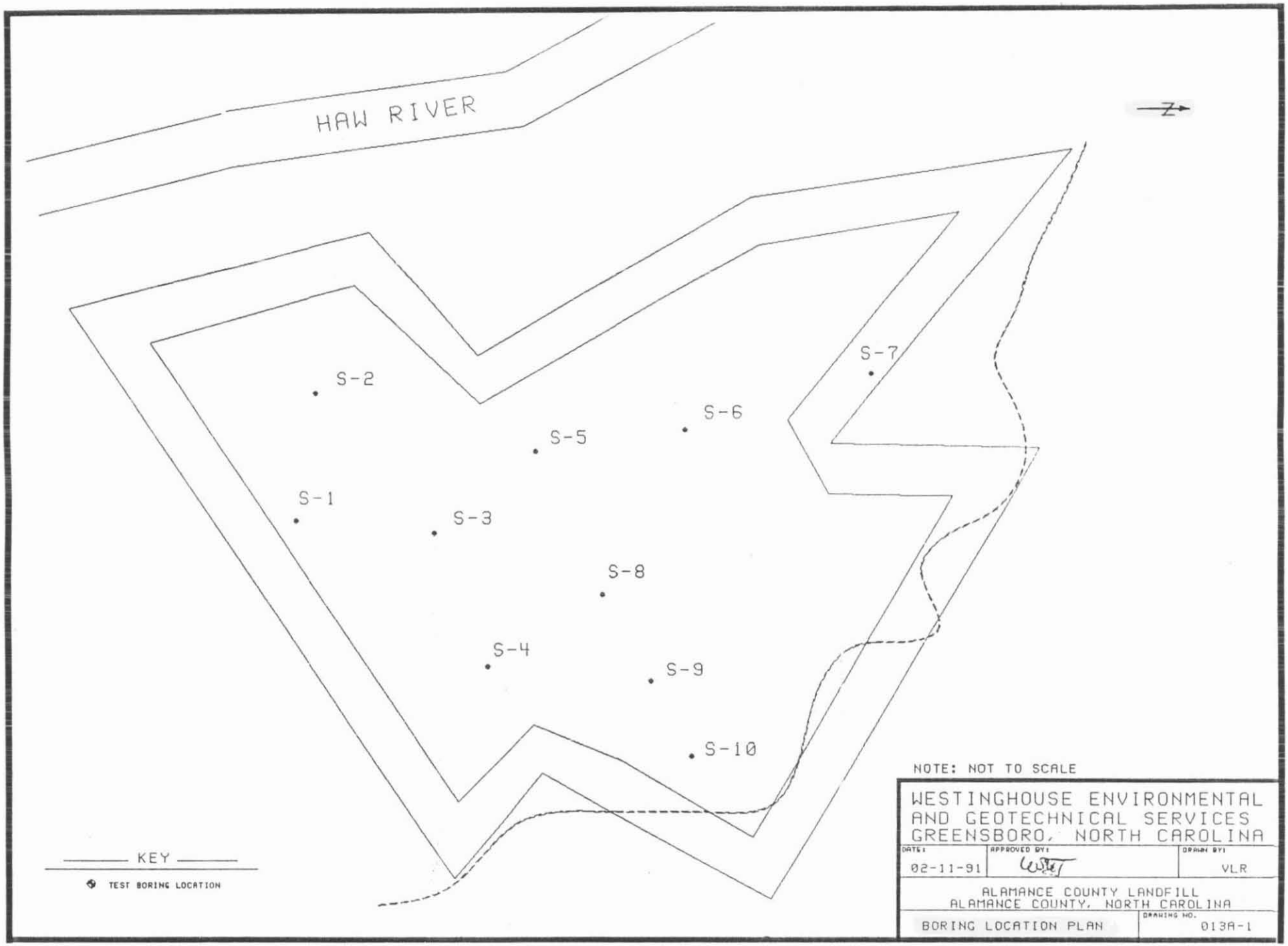
A limited test boring program was completed as part of site evaluation procedures for construction of a new Alamance County landfill. The purpose of drilling was to obtain data on 1) soil depth, 2) soil type, 3) soil characteristics, 4) rock depth, and 5) groundwater occurrence. The information was evaluated with respect to criteria for landfill site applications, consistent with current North Carolina Solid Waste Regulation 10 NCAC 10G, Section .0500, Disposal Sites.

The property contains a total of 369 acres. The site is located about two miles southeast of Saxapahaw, in terrain adjacent to the Haw River. Highway access is via Austin Quarter Road. Hilltops are overgrown with dense growths of volunteer pine covering most of the areas. However, hillsides, drains and creek valleys contain woods of mixed hardwood and pine.

The central and northern part of the area is dominated by Little Mountain at an elevation of 652 feet. Average slopes in the vicinity of the structure are 14%. The southern third of the property contains relatively flat hilltops. Slopes in this area average approximately 3%. Drainage is directed towards the Haw River. There are no named streams within the area of investigation.

II. EXPLORATION PROCEDURES

Ten soil test borings were advanced between January 29, 1991 and February 1, 1991, at the approximate locations shown on Drawing 013-1. Information was obtained on soil depth, type, and characteristics. additionally, each hole was fitted with slotted pvc pipe to determine groundwater occurrence. Borings were located in the field by Westinghouse personnel using topographic maps and



NOTE: NOT TO SCALE

WESTINGHOUSE ENVIRONMENTAL AND GEOTECHNICAL SERVICES
GREENSBORO, NORTH CAROLINA

DATE:	APPROVED BY:	DRAWN BY:
02-11-91		VLR

ALAMANCE COUNTY LANDFILL
ALAMANCE COUNTY, NORTH CAROLINA

BORING LOCATION PLAN

DRAWING NO. 013A-1

aerial photograph provided by Hazen and Sawyer Consultants. Borings were completed using a four wheel drive truck mounted rig and an all-terrain vehicle (ATV). Each rig was equipped with 6 1/4 inch O.D. hollow stem augers. All borings were advanced to auger refusal. Standard penetration tests were conducted at selected intervals at each hole in accordance with ASTM D-1586-67 to provide an index for estimating soil strength and relative density. In conjunction with penetration testing, split-spoon soil samples were recovered for classification and laboratory testing. Three samples were obtained in the upper 10 feet and at 5 feet intervals thereafter. Samples were visually classified and noted on the Test Boring Records.

Groundwater occurrences was measured through two-inch slotted pvc standpipes which were placed in each borehole. Measurements were obtained on February 5, 1991. The results are discussed below in section V.

III. PHYSIOGRAPHY AND HYDROLOGY

The site is located in the Carolina Slate Litho-Tectonic Belt, which consists of a northeast trending belt of rocks crossing the central part of the state. It varies in width from 25 to 70 miles and is bounded to the west by igneous and medium to high-rank metamorphic rocks of the Charlotte Belt and to the east by Triassic sediments located in a half graben. Rocks in the slate belt consist of rhyolitic to basaltic volcanic flows and tuffs interbedded with sediments. They have been metamorphosed and intruded by igneous rocks ranging in composition from granite to gabbro. Some of the intrusives have been metamorphosed but others are apparently unaltered.

The area of investigation is located in the southeast corner of Alamance County nearly adjacent to the Haw River. The topography

is generally intricately dissected by numerous narrow bottomed drains and swales. The dominant feature is Little Mountain, occupying the eastern quarter of the property. Slopes are generally steep in the vicinity of Little Mountain. However, two hilltop areas located in the northwestern and southern parts of the property contain relatively flat or gently sloping land. These areas are penetrated by steep sided, narrow drains. Relief ranges between 652 feet on Little Mountain to 450 feet where the major drainage-way leaves the property. Drainage is to the southwest via an unnamed tributary to the Haw River.[1]

652
450
202 ft.

Published geologic information [1-2] indicate the site to be underlain by felsic to intermediate metavolcanic rock. The rocks consist of dacitic to rhyolitic flows and tuffs., light gray to greenish gray, interbedded with mafic to intermediate metavolcanic rock, meta-argillite, and metamudstone. The intermediate rocks consist of medium to dark grayish green andesitic tuffs and flows with minor felsic and mafic metavolcanic rock. Mafic dikes which commonly occur in the slate belt were not noted upon reference to published information.[3]

Depth to the water table would vary depending on topography, climate and properties of water bearing material (regolith and fractured bedrock). Topography probably has the greatest influence on the depth to the water table in a specific area. On upland flats and broad interstream divides, such as occur at the site, the water table generally ranges from a few feet to a few tens of feet beneath the surface.[4] Narrow ridges and steep slopes would cause groundwater to occur a greater depths.

Site specific information on depth to groundwater is contained in Section V.

IV. SITE SUBSURFACE CONDITIONS

A. Soil Conservation Service (SCS) Data

The soil survey of Alamance County shows five soil series and associated phases to occur on the site. Excerpts of each mapped soil unit are contained below. A Table listing selected SCS soil characteristics useful for planning development of the site is included in Appendix I.

Georgeville Series

Georgeville soils occur in approximately equal proportions with Herndon soils and together cover over 60% of the site. Four phases of the Georgeville series occupy the site. They are distinguished from each other primarily by slope which range from 2% to 15%. The Georgeville series consists of reddish brown or yellowish brown, well-drained, strongly acid soils on uplands. They developed from weathering of gray to light gray, fine grained volcanic rocks consisting of rhyolites, quartz schists, and impure quartzites.

Herndon Series

Herndon soils occur in three phases, primarily distinguished by slope which range between 6% and 15%. The Herndon series consists of light brownish-gray, very acid, well-drained soils on uplands. They developed from weathering of volcanic rocks consisting of rhyolite and quartzite schists. Herndon silt loams in wooded areas have a surface layer of dark brown silt loam. The subsoil is mottled yellowish red and brownish yellow firm silty clay or clay.

One small area of the property is classified as Herndon silty clay loam, severely eroded with 6% to 10% slopes. All surface soil and

one-fourth of the subsoil has washed away. The high clay content results in very low permeability.

Tirzah Series

Two phases of the Tirzah soils occur on the property. They are Tirzah silty clay loam severely eroded sloping phase (6% to 10 % slopes) and the strongly sloping phase (10% to 15% slopes). Tirzah soils are dark reddish brown or brown, and moderately acid occurring on smooth or hilly uplands. They were derived from dark gray or dark green basic volcanic rocks.

Local Alluvial Land

Poorly drained alluvial land occurs along small streams or in drainageways between hills that slope gently toward the main flood plain. It is somewhat poorly to poorly drained and strongly acid.

Moderately Gullied Land

Two types of moderately gullied land occur on the property, differing only in the parent material components. Cecil and Appling soils were formed on felsic crystalline rock. Lloyd soil materials were formed on mixed felsic and mafic crystalline rocks. Moderately gullied land consisting of Georgeville and Herndon soils was formed from parent material of volcanic origin and contain more silt.

B. Test Boring Results

Ten test borings were completed at the approximate locations shown on Drawing 013-1. Most boreholes were advanced on topographically high positions such as hilltops and broad drainage divides. One hole was located in a creek valley, two were placed on the slope

leading towards Little Mountain and one on top of Little Mountain. Field spotting of borings was accomplished using aerial photo maps supplied by Hazen and Sawyer, Consulting Engineers. Elevations shown on test boring records are based on a contour interval of 5 feet.

Test boring records are contained in Appendix II. A generalized profile of each boring was constructed to illustrate soil characteristics. The information is presented on Drawing 013-2.

Residuum

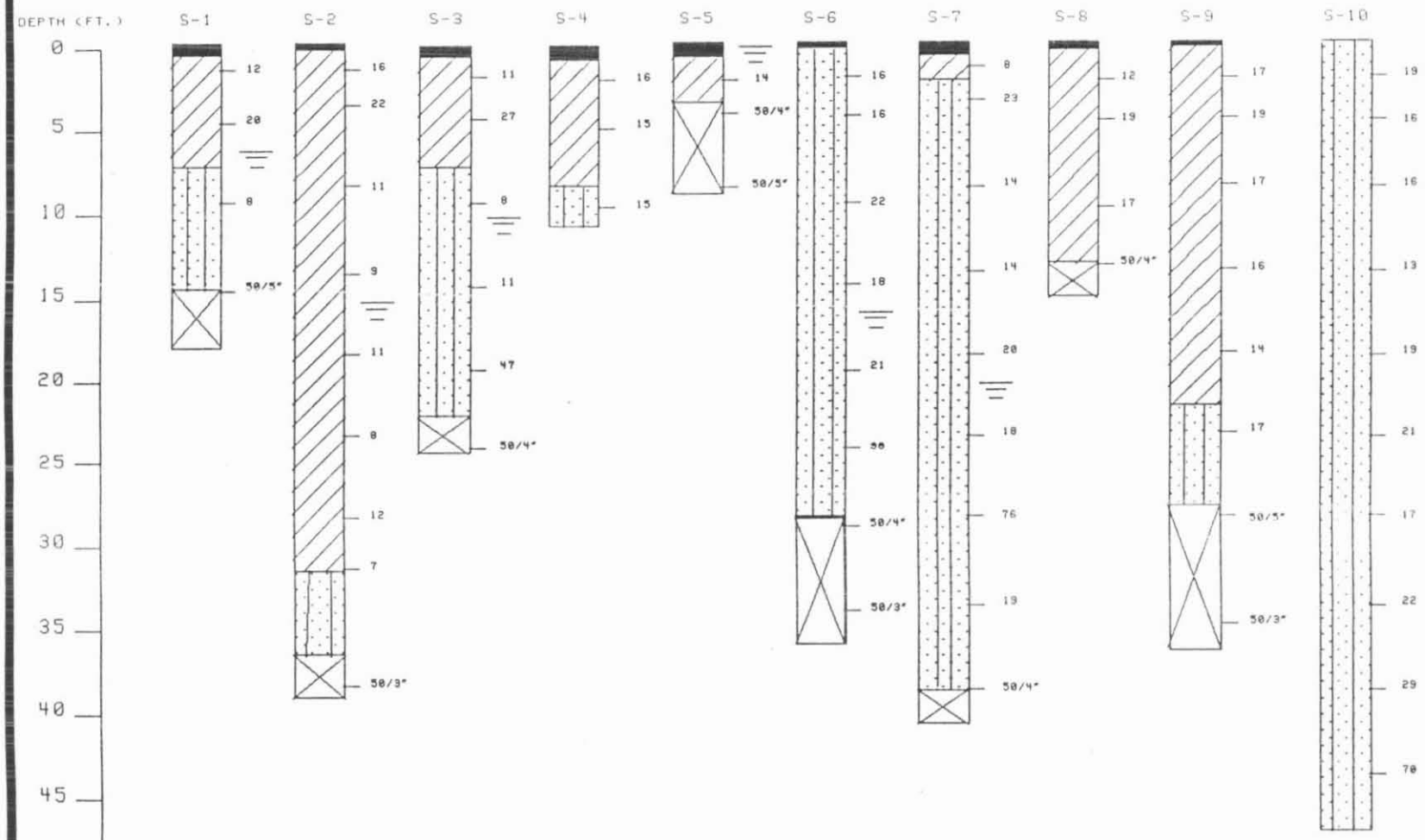
Aside from thin topsoil layers, all soils were classified as residuum. It was characterized by sandy clayey silts at seven locations as the upper-most soil. These soils ranged in thickness from 1.5 feet to 31.5 feet. Below this the residuum contained a coarser component, consisting of sandy silt to silty sand. This ranged in thickness from 2 feet to 40.5 feet. At three locations, the sandy silts and sands were the only residual soils present. Penetration resistances ranged between 8 and 76 blows per foot.

Partially Weathered Rock

All borings encountered partially weathered rock (PWR) except S-4, and S-10. Depths to partially weathered rock ranged between 3.5 feet and 40.5 feet. Drilling continued through the PWR until auger refusal occurred.

Auger Refusal

All borings were advanced to auger refusal. Refusal material is defined as any material that cannot be penetrated by the soil drilling equipment used on the drilling project. Depths of refusal



KEY

- TOPSOIL
- SANDY CLAYEY SILT
- SANDY SILT TO SILTY SAND
- PWR
- 24 HOUR GROUNDWATER READING

WESTINGHOUSE ENVIRONMENTAL AND GEOTECHNICAL SERVICES
GREENSBORO, NORTH CAROLINA

DATE:	APPROVED BY:	DRAWN BY:
02-11-91		VLR

ALAMANCE COUNTY LANDFILL
ALAMANCE COUNTY, NORTH CAROLINA

SUBSURFACE PROFILE

DRAWING NO. 013A-2

ranged from 8.6 feet to 46.6 feet.

C. ENGINEERING DATA

Drilling information established the presence of fine grained, readily excavated material extending 3.5 to 40.5 feet. Table I contains estimated physical properties of the most common soils occurring on-site. The data was obtained from the soil survey of Alamance County.[5]

V. GROUNDWATER CHARACTERIZATION

Each bore hole was fitted with a slotted two-inch pvc standpipe and used to determine groundwater occurrence. A summary of measurements taken on February 5, 1991, is contained in Table II.

A cluster of dry holes occurred on and in the vicinity of Little Mountain. Boreholes S-4, S-8, S-9, and S-10 contained no water, probably because of insufficient depth of these borings to intercept the groundwater table. Reference to Table I indicates a groundwater elevation at location S-3 to be 512 feet. The bottom elevations of boreholes at locations S-4, S-8, and S-9 were 526 feet, 546 feet and 616 feet respectively. Although it is apparent that the boreholes were not deep enough to intercept the groundwater table in these areas, based on groundwater elevation data, the surface of the water table is expected to generally conform to surface topography. Water is nearest the surface in drains and stream valleys and deeper on hillsides and hilltops. The greatest number of water-containing standpipes are located on hilltops (S-2, S-3, S-6, and S-7). One borehole (S-5) is in a valley at the confluence of four drainages. Depth to water at S-5 is two feet.

Additional boreholes with penetration into the refusal material would be needed to define the groundwater elevation across the site. The intricately dissected topography prevents extrapolation of groundwater data across drains and creek valleys. Limited conclusions can be drawn however, based on the February 5, 1991, water measurements.

Locations S-2, S-3, and S-4 are on relatively broad hilltop drainage divides in the southeast section of the property. Groundwater is at least 10 feet below the surface at all points on the hilltop. And at some locations between 19 and 33 feet below the hilltops.

In the northwestern part of the property, similar hilltop conditions were investigated with borholes S-6 and S-7. Variability in depth to water (33 feet and 37 feet) was much less than in the southeast area. Due to surface elevation differences, the elevation of the groundwater table ranges between 473 feet and 533 feet.

The area dominated by Little Mountain was evaluated with boreholes S-8, S-9, and S-10. The boreholes met with auger refusal before encountering the groundwater table. The lowest elevation was achieved at locations S-10, at 536 feet. Based on groundwater elevations at S-3 and S-6, boreholes may have to advance to around elevation 500 feet before reaching the groundwater table.

VI. SUMMARY

Ten soil test borings were advanced on the property identified on Drawing 013-01. Data was obtained on soil type, penetration resistance, partially weathered rock, and groundwater. Each borehole was fitted with a slotted, two-inch pvc standpipe in an effort to obtain groundwater levels.

All soils at the site were classified as residuum, consisting of generally fine grained sandy clayey silts, sandy silts, and silty sands. Residuum thickness ranged between 3.5 feet to 40.5 feet. Depth to partially weathered rock ranged between 3.5 feet to 40.5 feet. Auger refusal ranged between 8.6 feet to 46.6 feet. Penetration resistances ranged between 8 and 76 blows per foot.

Suitable soil for low permeability liner components would appear to be present at most boring locations. Published information indicate such soils belong the Georgeville and Herndon soil series. Additional drilling, sampling and testing should be conducted to define the extent and characteristics of these potential liner soils.

Depth to groundwater varies with topographic position. It is less than a few feet in creek bottoms. Beneath hills the depth ranged from 10 feet to in excess of 37 feet. Several boreholes were dry, which indicated bottom hole elevations were higher than the top of the groundwater table. Precise determination of groundwater elevations would require installation of properly constructed monitoring wells.

CONCLUSIONS

1. Initial drilling results indicate suitably deep residual soils available to provide material for cell liners as well as daily, interim, and final cover. Further sampling and testing should be completed to determine soil suitability as composite liner component material.

2. Depth to rock on hilltops is generally sufficient to not preclude excavation of landfill cells.

3. Depth to groundwater below hilltops and hillsides appears to be adequate to maintain the required four foot distance above the seasonal high water table. Confirmation of this will require installation of properly constructed monitoring wells. The wells will also be used to obtain additional data required for the site application under NCAC T10: 10G .0504.

REFERENCES

1. Brown, Phillip M., 1985. Geologic Map of North Carolina. North Carolina Department of Natural Resources and Community Development.

2. Carpenter, Albert P. III, 1982. Geologic Map of Region 6 G North Carolina Department of Natural Resources and Community Development, Geological Survey Section.

3. Burt, E.R., Carpenter, P.A.III, 1978. Diabase Dikes of the Eastern Piedmont of North Carolina. North Carolina Department of Natural Resources and Community Development, Geologic Survey, Section. Information Circular 23.

4. Daniel, Charles C., 1983. Groundwater Supply Potential and Procedures for Well Site Selection. Upper Cape Fear River Basin. North Carolina Department of Natural Resources and Community Development.

5. Castor, Dwight L., 1960. Soil Survey of Alamance county, North Carolina. U.S. Department of Agriculture, Soil Conservation Service.

TABLE I

ESTIMATED ENGINEERING/PHYSICAL PROPERTIES

Soil Series	Unified Depth (in) Classification		Grain Size % Passing #4 Sieve	Grain Size % Passing #20 Sieve	Liquid Limit	Plasticity Index
Georgeville	0-6	ML	89	66	1-4" - 33	1-4" - 7
	6-36	MH	100	94	18-30" - 71	18-30" - 34
	86-72	MH	100	93	39-46" - 70	39-46" - 33
Herndon	0-6	ML	95	81	Data Not Available	Data Not Available
	6-36	MH	98	85		
	36-72	MH	100	67		
Tirzah	0-8	ML	81	70	0-3" - 49	0-3" - 13
	8-48	MH	100	96	13-28" - 81	13-28" - 40
	48-96	ML	100	90	44"+ - 49	44"+ - 14

TABLE II

GROUNDWATER ELEVATIONS
(Measured on 2/ 5/91)

Location	Approximate Surface Elev. (ft)	Depth to Water (ft)	Depth to Bottom of Hole (ft)	Elev. of Bottom of Hole (ft)	Approximate Elevation of Groundwater (ft)
S-1	507	10	17	490	497
S-2	517	33	38	479	484
S-3	531	19	24	507	512
S-4	536	Dry	10	526	Dry
S-5	470	2	8	462	468
S-6	526	33	35	491	493
S-7	570	37	40	530	533
S-8	560	Dry	14	546	Dry
S-9	652	Dry	36	616	Dry
S-10	582	Dry	46	536	Dry

SELECTED SOIL CHARACTERISTICS

Soil Series	Depth to Bedrock (ft)	Depth to Seasonal High Water Table (ft)	Range in Slope (%)	Suitability for Shallow Excavations	Permeability of Subsoil	Shrink Swell Potential
Georgeville	4-10	8+	2-25	Moderate to Severe C,S	Moderate	Low to Moderate
Herndon	4-8	8+	2-25	Moderate C,S	Slow to Moderate	Low to Moderate
Tirzah	4-20	8+	2-15	Data Not Available	Moderate	Low to Moderate
Local Alluival Land	8-20	0-5	0-5	Data Not Available	Variable	Low
Moderately Gullied Land	3-20	8+	6-25	Data Not Available	Moderate	Low

Source: For Georgeville and Herndon soils, soil survey of Alamance County and Supplement to Geologic Maps of Region G References 5 and 2.
For Tirzah, Alluvial, and Gullied land, soil survey of Alamance County

Explanation of Symbols and Terms
for Shallow Excavation, Permeability,
and Shrink Swell Potential

Moderate: Soil properties and site features are unfavorable for the specified use, but the limitations can be overcome or minimized by special planning and design

Severe*: One or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in construction effort, special design, or intensive maintenance is required
C: Too Clayey
S: Slope

* Severe restrictions for excavation in Georgeville and Herndon soils may not apply for the intended use as landfill liner or cover. Commonly used construction equipment should be adequate to excavate these soils.

PERMEABILITY

Permeability relates only to movement of water downward through undisturbed materials. These values should be expressed in terms of inches per hour.

The following classes are used to rate the soil permeability:

Permeability Class	Grouping for Report
Very Slow	Less than 0.06
Slow	0.06 to 0.2
Moderately slow	0.2 to 0.6
Moderate	0.6 to 2.0
Moderately Rapid	2.0 to 6.0
Rapid	6.0 to 20
Very Rapid	Over 20

SHRINK-SWELL POTENTIAL

Shrink-swell behavior is that quality of the soil that determines its volume change with respect to moisture content. Building foundations, roads, and other structures may be severely damaged by the shrinking and swelling of soils. The volume change of soils is influenced by the amount of moisture change and the amount and kind of clay present in the soil.

The methods used in determining the shrink-swell potential of soils are (1) the Coefficient of Linear extensibility (COLE) used by soil scientists; (2) the Shrinkage Index used by soil engineers; and (3) the Potential Volume Change (PVC) used by the Federal Housing Administration.

Three Classes are used to help interpret for shrink-swell behavior-low, moderate, and high. In rare instances, a rating of very high may be justified.

SHRINK-SWELL POTENTIAL

	LOW	MODERATE	HIGH
CODE	.03	.03 TO .06	.06
SHRINKAGE INDEX	15	15 TO 30	30
PVC	2	2 TO 4	4

Good, Fair and Poor - These terms are parallel to slight, moderate and severe definitions.

TEST BORING RECORD

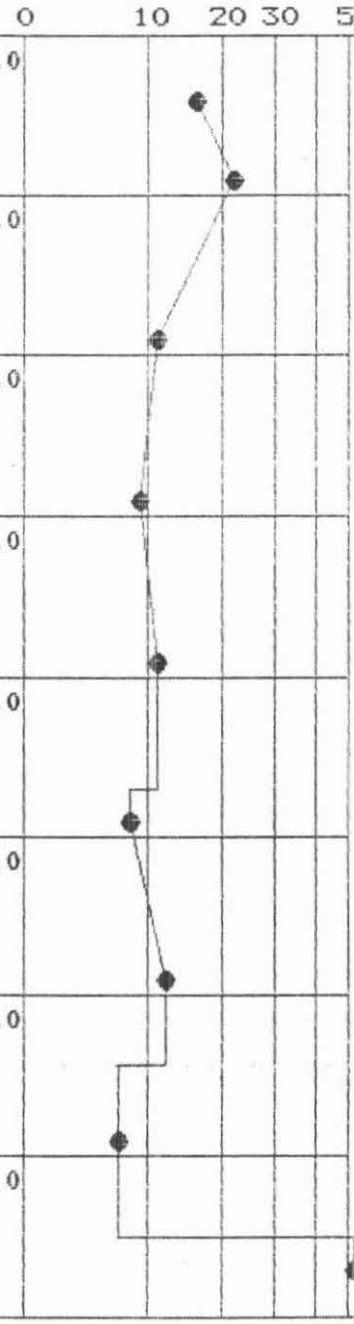
DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	PENETRATION (BLOWS/FT.) 0 10 20 30 50	BLOWS PER SIX IN.	REC. (IN.)
0.0	Topsoil	507.0			
0.7	Stiff to Very Stiff, Red-Brown, Fine Sandy Clayey Silt- Residual			2-5-7	0
				7-9-11	0
		502.0			
7.3	Firm, Tan-Brown, Fine Sandy Silt				
9.6	PWR Sampled as Tan-Gray, Medium to Fine Sandy Silt			3-3-5	0
		497.0			
				13-32-50/5.0"	0
		492.0			
17.6	Auger Refusal 2" PVC Standpipe Installed				
		487.0			

REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER 1381-90-013A
BORING NUMBER S-1
DATE 01/29/91

TEST BORING RECORD

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	BLOWS PER SIX IN.	REC. (IN.)
0.0	Very Stiff to Stiff, Tan-Brown, Fine Sandy Slightly Clayey Silt- Residual	517.0	3-7-9	0
			7-9-13	0
		512.0	4-4-7	0
		507.0	4-4-5	0
		502.0	4-5-6	0
		497.0	3-4-4	0
23.5	Firm to Stiff, Tan-Brown, Fine Sandy Slightly Clayey Silt	492.0	3-5-7	0
		487.0		
32.2	Firm, Yellow-Black, Fine Sandy Silt		5-3-4	0
		482.0		
37.5	PWR Sampled as Green, Medium to Fine Sandy Silt		50/3.0"	0
38.9				



Auger Refusal
2" PVC Standpipe Installed

REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER 1381-90-013A
BORING NUMBER S-2
DATE 01/29/91

TEST BORING RECORD

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	PENETRATION (BLOWS/FT.) 0 10 20 30 50	BLOWS PER SIX IN.	REC. (IN.)
0.0	Topsoil	581.0			
0.7	Stiff to Very Stiff, Red-Brown, Fine to Medium Slightly Clayey Sandy Silt-Residual			3-5-6	0
				8-13-14	0
		576.0			
7.4	Firm to Stiff, Orange-Brown, Fine Sandy Silt			4-4-4	0
		571.0			
				4-5-6	0
		566.0			
17.9	Dense, Greenish-Tan, Fine Silty Sand			12-21-26	0
		561.0			
22.3	PWR Sampled as Light Green, Medium to Fine Slightly Silty Sand			38-50/4.0"	0
24.2	Auger Refusal 2" PVC Standpipe Installed	556.0			

REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER 1381-90-013A
BORING NUMBER S-3
DATE 01/30/91

TEST BORING RECORD

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	PENETRATION (BLOWS/FT.) 0 10 20 30 50	BLOWS PER SIX IN.	REC. (IN.)
0.0	Topsoil	536.0			
0.1	Very Stiff to Stiff, Red-Brown, Orange-Brown, Medium to Fine Clayey Sandy Silt- Residual			3-7-9	0
				6-7-8	0
		531.0			
8.5	Stiff, Tan-Green, Medium to Fine Sandy Silt			9-9-6	0
10.7	Initial Auger Refusal at 7.0 Feet Offset 10' - Auger Refusal at 10.7 Feet 2" PVC Standpipe Installed	526.0			DRY
		521.0			

REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER 1381-90-013A
BORING NUMBER S-4
DATE 01/29/91

TEST BORING RECORD

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	PENETRATION (BLOWS/FT.) 0 10 20 30 50	BLOWS PER SIX IN.	REC. (IN.)
0.0	Topsoil	470.0			
0.8	Stiff, Tan, Fine Sandy Slightly Clayey Silt- Residual			3-5-9	0
2.7	PWR Sampled as Light Green, Fine to Medium Sandy Silt			50/4.0"	0
		465.0			
8.5	PWR Sampled as Light Green, Fine to Medium Sandy Silt			50/4.0"	0
8.6	Initial Auger Refusal at 3.8 Feet Offset 10 Feet, Auger Refusal at 8.6 Feet 2" PVC Standpipe Installed	460.0			

REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER 1381-90-013A
BORING NUMBER S-5
DATE 01/30/91

TEST BORING RECORD

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	PENETRATION (BLOWS/FT.) 0 10 20 30 50	BLOWS PER SIX IN.	REC. (IN.)
0.0	Topsoil	526.0			
0.3	Very Stiff to Hard, Red-Brown, Tan-Green, Fine Sandy Silt- Residual			4-7-9	0
				6-7-9	0
		521.0			
				8-10-12	0
		516.0			
				6-8-10	0
		511.0			
				6-9-12	0
		506.0			
				9-17-21	0
		501.0			
				50/4.0"	0
28.5	PWR Sampled as Light Green, Fine Sandy Silt				
		496.0			
				50/3.0"	0
35.6	Auger Refusal 2" PVC Standpipe Installed	491.0			

REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER 1381-90-013A
BORING NUMBER S-6
DATE 01/31/91

TEST BORING RECORD

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	PENETRATION (BLOWS/FT.) 0 10 20 30 50	BLOWS PER SIX IN.	REC. (IN.)
0.0	Topsoil	570.0			
0.8	Stiff, Red-Brown, Fine to Medium Clayey Sandy Silt- Residual			4-4-8	0
2.8	Very Firm, Tan-White, Fine Silty Sand	565.0		9-10-13	0
8.5	Stiff, Red-Brown, Medium to Fine Sandy Silt	560.0		5-6-8	0
		555.0		5-6-8	0
17.9	Firm, Tan-White, Medium to Fine Silty Sand			11-11-9	0
19.7	Very Stiff, Tan-Black, Fine Sandy Silt	550.0		8-8-10	0
		545.0			
27.6	Very Dense, Tan, Medium to Fine Silty Sand			13-28-48	0
		540.0			
33.5	Firm, Light Brown, Medium to Fine Silty Sand			8-9-10	0
		535.0			▼
38.5	PWR Sampled as Tan-Brown, Silty Sand			50/4.0"	0

REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER 1381-90-013A
BORING NUMBER S-7
DATE 01/31/91

TEST BORING RECORD

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	PENETRATION (BLOWS/FT.) 0 10 20 30 50	BLOWS PER SIX IN.	REC. (IN.)
40.4	Initial Auger Refusal at 12.4 Feet Offset 10', Auger Refusal at 40.4 Feet 2" PVC Standpipe Installed	530.0			
		525.0			

REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER 1381-90-013A
BORING NUMBER S-7
DATE 01/31/91

TEST BORING RECORD

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	PENETRATION (BLOWS/FT.) 0 10 20 30 50	BLOWS PER SIX IN.	REC. (IN.)
0.0	Topsoil	560.0			
0.4	Stiff to Very Stiff, Red-Brown, Medium to Fine Sandy Slighlty Clayey Silt With Rock Fragments- Residual			3-5-7	0
				24-9-10	0
		555.0			
				6-6-11	0
		550.0			
12.9	PWR Sampled as Light Brown, Fine Sandy Silt			50/4.0"	0
14.8	Initial Auger Refusal at 13.9 Feet Offest 10 Feet, Auger Refusal at 14.8 Feet	545.0			

DRY

REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER 1381-90-013A
BORING NUMBER S-8
DATE 01/30/91

TEST BORING RECORD

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	PENETRATION (BLOWS/FT.) 0 10 20 30 50	BLOWS PER SIX IN.	REC. (IN.)
0.0					
0.2	Topsoil	652.0			
	Very Stiff to Stiff, Red-Brown, Fine Sandy Slightly Clayey Silt- Residual			5-7-10	0
				8-9-10	0
		647.0			
				7-8-9	0
		642.0			
				5-7-9	0
		637.0			
				6-7-7	0
		632.0			
21.7	Very Stiff, Brown to Black Fine Sandy Silt				
				5-7-10	0
		627.0			
27.8	PWR Sampled as Light Brown Fine Sandy Silt			50/5.0"	0
		622.0			
				50/3.0"	0
36.0	Auger Refusal 2" PVC Standpipe Installed	617.0			

DRY

REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER 1381-90-013A
BORING NUMBER S-9
DATE 02/01/91

TEST BORING RECORD

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	PENETRATION (BLOWS/FT.) 0 10 20 30 50	BLOWS PER SIX IN.	REC. (IN.)
0.0	Very Stiff to Stiff, Red-Brown, Fine Sandy Silt- Residual	582.0		6-9-10	0
				7-8-8	0
		577.0		6-7-9	0
		572.0		6-6-7	0
		567.0		16-9-10	0
19.1	Very Stiff, Brown-Black, Very Fine Sandy Silt	562.0		7-9-12	0
		557.0		6-7-10	0
		552.0		7-9-13	0
		547.0		11-13-16	0

REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER 1381-90-013A
BORING NUMBER S-10
DATE 01/31/91

TEST BORING RECORD

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	PENETRATION (BLOWS/FT.) 0 10 20 30 50	BLOWS PER SIX IN.	REC. (IN.)
		542.0			
43.5	Hard, Tan, Very Fine Sandy Silt			21-28-42	0
		537.0			DRY
46.6	Auger Refusal				
		532.0			

REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER 1381-90-013A
BORING NUMBER S-10
DATE 01/31/91