GEOTECHNICAL INVESTIGATION REPORT
SOUTHEAST BEAVERCREEK TRUNK SEWER
NORTH OF INDIAN RIPPLE ROAD
GREENE COUNTY, OHIO

ATC/ATEC FILE NUMBER: 00157.0006

PREPARED FOR: Greene County Sanitary Eng. Dept.
Attention: Mr. Jeffrey A. Hissong, P.E
667 Dayton-Xenia Road
Xenia, Ohio 45385-2665

PREPARED BY: ATC/ATEC Associates, Inc.
2027 Springboro West
Dayton, Ohio 45439

October 2, 1997

ATC ASSOCIATES INC.

October 2, 1997

Greene County Sanitary Engineering. Department
Attention: Mr. Jeffrey A. Hissong, P.E
667 Dayton-Xenia Road
Xenia, Ohio 45385-2665

RE: Geotechnical Investigation Report
Southeast Beavercreek Trunk Sewer
North of Indian Ripple Road
Greene County, Ohio
ATC/ATEC File Number: 00157.0006

Gentlemen:

In compliance with your recent request, we have completed a subsurface investigation and evaluation for the above referenced project. It is our pleasure to transmit herewith two (2) copies of our written report of the result of this investigation. This work was performed in accordance with our written proposal dated June 23, 1997 and was authorized by the issuance of the Greene County Sanitary Engineering Department Purchase Order No. 42601, dated July 29, 1997.

If you should have any questions regarding this site or our report, please feel free to call us at your convenience. It has been a pleasure working with you on this project.

Very Truly Yours,

ATC ASSOCIATES, INC.
d.b.a. ATEC Associates, Inc.

Mohammed Obaidul Haque, EIT
Staff Engineer I

James P. Kapsho, P.E.
Principal Engineer

STATE OF OHIO ★ JAMES P. KAPSHO #E-55109 REGISTERED PROFESSIONAL ENGINEER

MOH/moh

cc: Mr. Brent Detwiler - R. D. Zande Associates

ENVIRONMENTAL, GEOTECHNICAL AND MATERIALS PROFESSIONALS
2027 Springboro West • Dayton, OH 45439 • (513) 297-6600 • FAX (513) 297-6605

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GEOTECHNICAL INVESTIGATION REPORT

SOUTHEAST BEAVERCREEK TRUNK SEWER
NOTH OF INDIAN RIPPLE ROAD
GREENE COUNTY, OHIO

ATEC FILE NUMBER: 00157.0006

1.0 INTRODUCTION

This report presents the results of a geotechnical investigation and soils evaluation for the proposed Southeast Beavercreek Trunk Line, which will be constructed just from the north side of Indian Ripple Road and along the existing creek to serve the future residential development in Beavercreek, Ohio. This work was performed in accordance with our written proposal dated June 23, 1997 and was authorized by the issuance of the Greene County Sanitary Engineering Department Purchase Order No. 42601, dated July 29, 1997.

The purpose of this investigation was to determine the types of subsoils present at the proposed site and to make comments and recommendations relative to the design and construction of the sanitary sewer line. Also selected pertinent comments and recommendations regarding earthwork is also provided.

The scope of this investigation included a review of available geologic and soils data for the project area, a subsurface investigation consisting of nine (9) standard soil test borings located as shown on the attached Boring Location Plan in the Appendix and an engineering analysis and evaluation of the subsurface conditions encountered at this site.

3.0 GENERAL SUBSURFACE CONDITIONS

Nine (9) widely spaced soil borings were requested by the client. Due to the presence of dense woods and associated accessibility problems, two (2) soil borings were offset from their original locations. SB-1 was offset approximately 90 feet to the southeast and boring SB-6 was offset approximately 70 feet to the west from their respective original locations. All the borings for this investigation was drilled, using standard rotary drill equipment. The soil samples were returned to our soil mechanics laboratory in Dayton, Ohio, for the required analysis, testing and evaluation.

It should be noted that stratification lines shown on the soil boring logs represent approximate transitions between material types. In-situ strata changes could occur gradually or at slightly different levels. Also, it should be noted that the borings depict conditions at particular locations and times indicated. Some conditions, particularly groundwater levels, could change with time.

The subsurface soil profile and groundwater conditions are described in detail on the boring logs located in the Appendix to this report, but in general terms consist of the following:

3.1 Soil Profile

3.1.1 Borings SB-1, SB-7 and SB-9

Approximately 0.9 to 1.0± foot of topsoil was disclosed by the borings on the surface of this site. This material is a dark clayey silt containing considerable organic matter as a result of the heavy vegetative cover. It is not uncommon for such topsoil deposits to extend to deeper depths in areas where brush and timber are prevalent.

Black silty to sandy clay was encountered in borings SB-5 and SB-6 to a depth of 5 to 6 feet below the existing ground. The N-values were 2 to 4 bpf indicating a very soft to soft soil consistency.

Below the topsoil, dark brown with trace gray/brownish gray sandy clay was encountered at the boring locations SB-3 and SB-8 to a depth of 7.0 and 4.8± feet respectively below the existing grade. Standard Penetration Test (N) values were generally in the range of 7 to 11 bpf, indicating a medium stiff to stiff soil consistency.

Below the topsoil in boring SB-4 and below the above described soils at the other boring locations, silts (ML)/sandy silts (ML)/sandy clay (CL)/sand and gravel (SP-GP) layers or interbedded strata of those were encountered. Some of the borings were terminated in the gray sandy clay soil, some of the borings were terminated in the gray clayey silt or sandy silt and the others were terminated in the sand and gravel deposit. The N-values were generally in the range of teens to twenties indicating a very stiff/medium dense soil.

3.2 Groundwater Conditions

Observations concerning groundwater were made during and at completion of the drilling operations. The following table summarizes the levels at which groundwater was measured at each boring locations.

Table I

Boring No.	Apr. Boring Elevation	Noted on Drilling Rods	At completion	Invert Elevation at the Boring Location
B-1	789	-	-	780
B-2	791	2.5±	3.0±	783
B-3	806	7.0±	6.8±	785
B-4	807	13.0±	-	792
B-5	810	8.5±	-	797
B-6	810	2.5±	4.0±	799
B-7	816	2.0±	-	807
B-8	826	8.0±	-	817
B-9	789	-	-	781

During the time of our field investigations very shallow water was noticed at the creek bed. It is our belief that the groundwater table within the boring locations will vary depending on the fluctuation of the surface water elevation of the existing creek.

We wish to point out that seasonal influences can sometimes cause a substantial rise or fall in groundwater levels. The actual level of hydrostatic water, or the presence of a perched water table, if any, should be anticipated to fluctuate depending on variations in precipitation, surface runoff, infiltration, site topography and drainage. Fluctuations in groundwater can only be determined through observations made in cased holes, the construction of which was beyond the scope of this investigation.

4.0 GEOTECHNICAL CONCLUSIONS AND RECOMMENDATIONS

Based upon our analysis of the soil conditions and the preliminary design details supplied for this project by the client as previously outlined, the following conclusions and recommendations were reached for this proposed project. If the project characteristics are changed from those assumed herein, our recommendations should be reviewed to see whether any modifications are needed.

4.1 Pipe Support

The sanitary sewer line supporting conditions encountered at this site during our investigation can be generally considered satisfactory. The invert elevation and the subsurface material encountered at specific boring locations are tabulated below:

Table II

Boring No.	Invert Elevation	Material Encountered at the Invert Elevation
SB-1	780	Shale and Limestone
SB-2	783	Sand & Gravel, with interbedded Silty/Sandy clay
SB-3	785	Gray Sandy Clay, with little gravel
SB-4	792	Gray Silty Clay, with trace sand & gravel
SB-5	797	Gray Sandy Clay, with little gravel
SB-6	799	Gray Sandy Clay, with little gravel
SB-7	807	Shale and Limestone
SB-8	817	Gray Sandy Clay, with little gravel
SB-9	781	Gray Sandy Clay/gray Silty Clay & Limestone

The results of the borings indicate that the very stiff cohesive soil consisting of silty to sandy clay or medium dense sand and gravel or shale and limestone bedrock should provide adequate support for the proposed sewer line pipes.

Soft and wet sandy clay soil was encountered in boring SB-9 at the invert elevation, which is possibly due to the trapped/perched groundwater. In the areas of soft soil encountered the excavation should be continued until firm natural soil is encountered. The undercut could then be backfilled with a lean concrete and the pipe can be supported on the lean concrete fill at the desired elevation.

4.2 Construction Considerations

It is anticipated that there will be minimal difficulty experienced in excavating the silty to sandy clay cohesive soil, cohesionless sand and gravel and overburden soils at this site with conventional equipment and methods. Excavation above the bedrock should be achievable with conventional earth moving equipment.

Excavations in the weathered and unweathered shale and limestone will prove to be more difficult, although it should be rippable with the proper equipment. Narrow excavations or excavations in confined areas may require the use of hydraulic or pneumatic actuated impact spades or pointed breaker bars. Unless specified otherwise, all permanent cut slopes shall be no steeper than 3 horizontal to 1 vertical. All temporary excavations for the installation of sewer line pipe should be properly laid back or braced in accordance with Occupational Safety and Health Administration (OSHA) requirements. It is our opinion that the silty to sandy clay cohesive soils encountered above and below the water table can be classified as OSHA Type "B" and type "C" soil respectively, and the sand and gravel cohesionless soils can be classified as OSHA Type "C" soil. It may be possible to "lay back" the cohesive and granular soils in certain areas of the site where there is sufficient room to work. It is our recommendation that any backfill placed be compacted to at least 100 percent of the Standard Proctor (ASTM-D698) maximum dry density, with appropriate measures taken to avoid damage to the new sewer pipe by the compaction equipment.

Our boring information indicates that the groundwater table at this site will be about 3 to 6 feet below the existing ground surface. Furthermore, given the probable presence of sand seam and sand layers within the cohesive soil matrix (and therefore high permeable) subsoils at the site, it should be assumed that the groundwater table could rise substantially during high water and flood events of the existing creek. **Groundwater will cause construction difficulties for this project for the excavation of the proposed sewer line due to the high groundwater table.** It may be possible to "lay back" the cohesive and granular soils in certain areas of the site where there is more room, if the soils can be dewatered. In order to dewater the site a well point system may need to be installed. The design of the well point system (if used) is considered a contractor's means and methods of construction, and should be the contractor's responsibility.

4.3 Inspection

It is recommended that a representative of ATEC Associates, Inc. be present during the excavation and backfilling for the proposed Sanitary Sewer line to verify that the actual field conditions are similar to the results of the test borings, and to monitor the compaction of the backfill. Otherwise, we assume no responsibility for construction compliance with the design concepts, specifications, or our recommendations.

5.0 FIELD AND LABORATORY INVESTIGATIONS

5.1 Scope

Field investigations to determine the general engineering characteristics of the foundation materials for this project included the performance of soil test borings located approximately as shown on the enclosed Boring Location Plan, and the performance of standard penetration tests on the in-situ soils. The apparent groundwater level at each boring location was also determined. Elevations referred to herein were interpolated from a site plan provided by the client.

The types of foundation materials encountered in the test borings have been visually classified by ATEC engineering staff, and are described in detail on the boring logs. The results of the field penetration tests, strength tests and water level observations are present on the boring logs in numerical form. Representative samples of the soils encountered in the field were placed in sample jars and are now stored in our laboratory for further analysis, if desired. Unless we are notified to the contrary, all samples will be disposed of 30 days from the date of this report.

5.2 Field Investigations

The soil borings were performed with an ATV-mounted drilling rig equipped with a rotary head. Conventional hollow-stem augers were used to advance the holes. Representative samples of the in-situ soils were obtained employing split-barrel sampling procedures in accordance with ASTM Procedures D-1586.

6.0 LIMITATIONS OF STUDY

Differing Conditions

Our recommendations for this project were developed utilizing soils information obtained from the test borings that were made at the proposed site. At this time we would like to point out that soil test borings only depict the soil conditions at the specific locations and time at which they were made. The soil conditions at other locations on the site may differ from those occurring at the boring locations. If deviations from the noted subsurface conditions are encountered during construction, they should be brought to the attention of the soils engineer.

Changes in Plans

The conclusions and recommendations herein have been based upon the available soil information and the preliminary design details furnished by a representative of the owner of the proposed project and/or as assumed herein. Any revision in the plans for the proposed construction from those anticipated in this report should be brought to the attention of the soils engineer to determine whether any changes in the foundation or earthwork recommendations are necessary.

Recommendations vs. Final Design

This report and the recommendations included within are not to be considered a final design, but rather as a basis for the final design to be completed by others (architect, civil or structural engineer, etc.). It is the client's responsibility to insure that the recommendations of the geotechnical engineer are properly integrated into the design, and that the geotechnical engineer is provided the opportunity for design input and comment after the submittal of this report, as needed. We recommend that this firm be retained to review the final construction documents to confirm that the proposed project design sufficiently considers our geotechnical recommendations. We also suggest that our firm be represented at pre-bid and/or pre-construction meetings regarding this project to offer any needed clarification of the geotechnical information to all involved.

Construction Issues

Although general constructability issues have been considered in this report, the means, methods, techniques, sequences and operations of construction, safety precautions, and all items incidental thereto and consequences of, are the responsibility of parties to the project other than ATEC. This office should be contacted if additional guidance is needed in these matters.

Report Interpretation

This company is not responsible for the conclusions, opinions, or recommendations made by others based upon the data included herein. It is the client's responsibility to seek any guidance and clarifications from the geotechnical engineer needed for proper interpretation of this report.

Environmental Considerations

The scope of our services does not include any environmental assessment or investigation for the presence or absence of hazardous or toxic materials in the soil, groundwater, or surface water within or beyond the site studied. Any statements in this report or on the test boring logs regarding odors, staining of soils, or other unusual conditions observed are strictly for the information of our client. Unless complete environmental information regarding the site is already available, an environmental assessment is recommended prior to the development of this site.

Standard of Care

Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. This statement is made in lieu of all other warranties either express or implied.

APPENDIX

Boring Location Plan (SEE DETAILED DRAWINGS)

Logs of Borings (9)

Unified Soil Classification

Field Classification of System for Soil Exploration

Important Information About Your Report

ATEC Associates, Inc.
2027 Springboro West
Dayton, Ohio 45439
(937) 297-6600

RECORD OF SUBSURFACE EXPLORATION

CLIENT: Greene County Sanitary Engineering Department
ARCHITECT ENGINEER:
PROJECT NAME: Southeast Beavercreek Trunk Sewer
PROJECT LOCATION: North of Indian Ripple Rd., Beavercreek, Ohio

BORING #: SB-1
JOB #: 00157.0006
DRAWN BY: M.O.H.
APPROVED BY: M.O.H.

DRILLING and SAMPLING INFORMATION

Date Started: 9/5/97
Date Completed: 9/5/97
Drill Foreman: D. Fisher
Inspector:
Boring Method: H.S.A.

Hammer Wt.: 140 lbs.
Hammer Drop: 30 in.
Spoon Sampler OD: 2 in.
Rock Core Dia.: in.
Shelby Tube OD: in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 789.0	Stratum Depth	Depth Scale	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Ground Water	Standard Penetration Test, N - blows/foot	Qu-tsf Unconfined Compressive Strength	PP-tsf Pocket Penetrometer	Moisture Content %	Liquid Limit (LL)	Plastic Limit (PL)	Remarks
Topsoil	0.9												
Brown to olive brown and gray SILTY CLAY and limestone fragments (CL to CH) [residual soil] Moist, very stiff to hard			1	SS			15+50/0.5						Invert Elev. 780.
		5	2	SS			2+11+50/0.4						
Extremely weathered LIMESTONE	8.0		3	SS			50/0.1						
Gray with trace brown extremely weathered SHALE and LIMESTONE	10.0	10											
Boring discontinued due to auger refusal at 11.5 feet depth. Boring caved in at 7.0 feet depth. No groundwater encountered at completion.	11.5												

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Groundwater
At Completion ______ ft.
After ______ hours ______ ft.
Water on Rods ______ ft.
+ At Survey ______ ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casing
HP - Hydraulic Push

ATEC Associates, Inc.
2027 Springboro West
Dayton, Ohio 45439
(937) 297-6600

RECORD OF SUBSURFACE EXPLORATION

CLIENT: Greene County Sanitary Engineering Department
ARCHITECT ENGINEER:
PROJECT NAME: Southeast Beavercreek Trunk Sewer
PROJECT LOCATION: North of Indian Ripple Rd., Beavercreek, Ohio

BORING #: SB-2
JOB #: 00157.0006
DRAWN BY: M.O.H.
APPROVED BY: M.O.H.

DRILLING and SAMPLING INFORMATION

Date Started: 9/5/97
Date Completed: 9/5/97
Drill Foreman: D. Fisher
Inspector:
Boring Method: H.S.A.

Hammer Wt.: 140 lbs.
Hammer Drop: 30 in.
Spoon Sampler OD: 2 in.
Rock Core Dia.: in.
Shelby Tube OD: in.

TEST DATA

SOIL CLASSIFICATION — SURFACE ELEVATION ~791	Stratum Depth	Depth Scale	Sample No.	Sample Type	Ground Water	Standard Penetration Test, N - blows/foot	Qu-tsf Unconfined Compressive Strength	PP-tsf Pocket Penetrometer	Moisture Content %	Liquid Limit (LL)	Plastic Limit (PL)	Remarks
Topsoil	0.9											
Brown SAND and GRAVEL, with little silt and clay (SP) Wet, medium dense					● ▽							
			1	SS		21						Invert Elev. 783.
		5										
—interbedded layers of thin SILTY to SANDY CLAY at different depths—			2	SS		25						
			3	SS		24						
		10										
			4	SS		38						
Gray SANDY CLAY, with little gravel (CL) [glacial till] Wet, hard	11.5 12.0											

Boring discontinued at 12.0 feet depth.
Boring caved in at 5.0 feet depth.

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Groundwater
▽ At Completion 3.0 ft.
▼ After ____ hours ____ ft.
● Water on Rods 2.5 ft.
+ At Survey ____ ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casing
HP - Hydraulic Push

ATEC Associates, Inc.
2027 Springboro West
Dayton, Ohio 45439
(937) 297-6600

RECORD OF SUBSURFACE EXPLORATION

CLIENT: Greene County Sanitary Engineering Department
ARCHITECT ENGINEER:
PROJECT NAME: Southeast Beavercreek Trunk Sewer
PROJECT LOCATION: North of Indian Ripple Rd., Beavercreek, Ohio

BORING #: SB-3
JOB #: 00157.0006
DRAWN BY: M.O.H.
APPROVED BY: M.O.H.

DRILLING and SAMPLING INFORMATION

Date Started: 9/5/97
Date Completed: 9/5/97
Drill Foreman: D. Fisher
Inspector:
Boring Method: H.S.A.

Hammer Wt.: 140 lbs.
Hammer Drop: 30 in.
Spoon Sampler OD: 2 in.
Rock Core Dia.: in.
Shelby Tube OD: in.

TEST DATA

SOIL CLASSIFICATION — SURFACE ELEVATION ~806

Soil Classification	Stratum Depth	Sample No.	Sample Type	Ground Water	Standard Penetration Test, N - blows/foot	Qu-tsf Unconfined Compressive Strength	PP-tsf Pocket Penetrometer	Moisture Content %	Liquid Limit (LL)	Plastic Limit (PL)	Remarks
Topsoil	1.0										
Dark brown with trace gray SANDY CLAY, with little gravel (CL) Very moist, medium stiff		1	SS		7						Invert Elev. 785.
Brown with trace gray SILTY SAND (SM) Wet, very loose	7.0			▽ ●							
		2	SS		5						
Gray CLAYEY SAND and gravel (SC) Wet, medium dense	12.0	3	SS		15						
		4	SS		20						
Gray SANDY CLAY and little gravel (CL) [glacial till] Wet to very moist, very stiff	18.0	5	SS		23						
		6	SS		26						
----sand and gravel seam at different depths----		7	SS		31						

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Groundwater
▽ At Completion 6.8 ft.
▼ After ____ hours ____ ft.
● Water on Rods 7.0 ft.
+ At Survey ____ ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casing
HP - Hydraulic Push

ATEC Associates, Inc.
2027 Springboro West
Dayton, Ohio 45439
(937) 297-6600

RECORD OF SUBSURFACE EXPLORATION

CLIENT	Greene County Sanitary Engineering Department	BORING #	SB-3
ARCHITECT ENGINEER		JOB #	00157.0006
PROJECT NAME	Southeast Beavercreek Trunk Sewer	DRAWN BY	M.O.H.
PROJECT LOCATION	North of Indian Ripple Rd., Beavercreek, Ohio	APPROVED BY	M.O.H.

DRILLING and SAMPLING INFORMATION

Date Started	9/5/97	Hammer Wt.	140 lbs.
Date Completed	9/5/97	Hammer Drop	30 in.
Drill Foreman	D. Fisher	Spoon Sampler OD	2 in.
Inspector		Rock Core Dia.	in.
Boring Method	H.S.A.	Shelby Tube OD	in.

TEST DATA

SOIL CLASSIFICATION	Stratum Depth	Depth Scale	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Ground Water	Standard Penetration Test, N - blows/foot	Qu-tsf Unconfined Compressive Strength	PP-tsf Pocket Penetrometer	Moisture Content %	Liquid Limit (LL)	Plastic Limit (PL)	Remarks
			8	SS			18						
			9	SS			19						
Boring discontinued at 30.0 feet depth. Boring caved in at 7.0 feet depth.	30.0	30											

Sample Type
- SS - Driven Split Spoon
- ST - Pressed Shelby Tube
- CA - Continuous Flight Auger
- RC - Rock Core
- CU - Cuttings
- CT - Continuous Tube

Groundwater
- ▽ At Completion 6.8 ft.
- ▼ After ____ hours ____ ft.
- ● Water on Rods 7.0 ft.
- + At Survey ____ ft.

Boring Method
- HSA - Hollow Stem Augers
- CFA - Continuous Flight Augers
- DC - Driving Casing
- HP - Hydraulic Push

ATEC Associates, Inc.
2027 Springboro West
Dayton, Ohio 45439
(937) 297-6600

RECORD OF SUBSURFACE EXPLORATION

CLIENT: Greene County Sanitary Engineering Department
ARCHITECT ENGINEER:
PROJECT NAME: Southeast Beavercreek Trunk Sewer
PROJECT LOCATION: North of Indian Ripple Rd., Beavercreek, Ohio

BORING #: SB-4
JOB #: 00157.0006
DRAWN BY: M.O.H.
APPROVED BY: M.O.H.

DRILLING and SAMPLING INFORMATION

Date Started: 9/5/97
Date Completed: 9/5/97
Drill Foreman: D. Fisher
Inspector:
Boring Method: H.S.A.

Hammer Wt.: 140 lbs.
Hammer Drop: 30 in.
Spoon Sampler OD: 2 in.
Rock Core Dia.: in.
Shelby Tube OD: in.

TEST DATA

SOIL CLASSIFICATION — SURFACE ELEVATION ~807

Soil Classification	Stratum Depth	Sample No.	Sample Type	Ground Water	Standard Penetration Test, N - blows/foot	Qu-tsf Unconfined Compressive Strength	PP-tsf Pocket Penetrometer	Moisture Content %	Liquid Limit (LL)	Plastic Limit (PL)	Remarks
Topsoil	0.9										
Brown with trace gray SANDY SILT, with little gravel (ML) Very moist, stiff	4.5	1	SS		15						Invert Elev. 792.
Brown SILTY CLAY, with little sand and gravel (CL) [glacial till] Moist, stiff	7.0										
Brown SILTY SANDY CLAY, with little gravel (CL) [glacial till] Moist, very stiff		2	SS		28						
—sand seam at different depths—		3	SS		22						
	13.5			●							
Gray SILTY SANDY CLAY, with trace sand and gravel (CL) [glacial till] Moist, very stiff	15.5	4	SS		18						
Gray SILTY CLAY to CLAYEY SILT, with varved layer (CL to ML) Moist, very stiff	17.0	5	SS		19						

Boring discontinued at 17.0 feet depth.
Boring caved in at 6.0 feet depth.

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Groundwater
At Completion ______ ft.
After ______ hours ______ ft.
● Water on Rods 13.0 ft.
+ At Survey ______ ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casing
HP - Hydraulic Push

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2027 Springboro West
Dayton, Ohio 45439
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RECORD OF SUBSURFACE EXPLORATION

CLIENT: Greene County Sanitary Engineering Department
ARCHITECT ENGINEER:
PROJECT NAME: Southeast Beavercreek Trunk Sewer
PROJECT LOCATION: North of Indian Ripple Rd., Beavercreek, Ohio

BORING #: SB-5
JOB #: 00157.0006
DRAWN BY: M.O.H.
APPROVED BY: M.O.H.

DRILLING and SAMPLING INFORMATION

Date Started	9/5/97	Hammer Wt.	140 lbs.
Date Completed	9/5/97	Hammer Drop	30 in.
Drill Foreman	D. Fisher	Spoon Sampler OD	2 in.
Inspector		Rock Core Dia.	in.
Boring Method	H.S.A.	Shelby Tube OD	in.

TEST DATA

SOIL CLASSIFICATION (SURFACE ELEVATION ~810)	Stratum Depth	Depth Scale	Sample No.	Sample Type	Sampler Graphics / Recovery Graphics	Ground Water	Standard Penetration Test, N - blows/foot	Qu-tsf Unconfined Compressive Strength	PP-tsf Pocket Penetrometer	Moisture Content %	Liquid Limit (LL)	Plastic Limit (PL)	Remarks
Topsoil	1.0												
Black SANDY CLAY, with trace gravel and hair roots (CL) Very moist, soft			1	SS			4						Invert Elev. 797.
Gray SANDY CLAY, with little gravel (CL) [glacial till] Very moist, very stiff	5.0	5											
			2	SS		●	16						
----gray wet sand layer at about 9.8 feet depth---- ----sand seam at different depths----		10	3	SS			17						
			4	SS			16						
Gray SANDY SILT (ML) wet, very stiff	15.0	15	5	SS			18						
Boring discontinued at 17.0 feet depth. Boring caved in at 7.5 feet depth.	17.0												

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Groundwater
At Completion ______ ft.
After ______ hours ______ ft.
● Water on Rods 8.5 ft.
+ At Survey ______ ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casing
HP - Hydraulic Push

ATEC Associates, Inc.

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Dayton, Ohio 45439
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RECORD OF SUBSURFACE EXPLORATION

CLIENT: Greene County Sanitary Engineering Department
ARCHITECT ENGINEER:
PROJECT NAME: Southeast Beavercreek Trunk Sewer
PROJECT LOCATION: North of Indian Ripple Rd., Beavercreek, Ohio

BORING #: SB-6
JOB #: 00157.0006
DRAWN BY: M.O.H.
APPROVED BY: M.O.H.

DRILLING and SAMPLING INFORMATION

Date Started	9/4/97	Hammer Wt.	140 lbs.
Date Completed	9/4/97	Hammer Drop	30 in.
Drill Foreman	D. Fisher	Spoon Sampler OD	2 in.
Inspector		Rock Core Dia.	in.
Boring Method	H.S.A.	Shelby Tube OD	in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION ~810	Stratum Depth	Depth Scale	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Ground Water	Standard Penetration Test, N - blows/foot	Qu-tsf Unconfined Compressive Strength	PP-tsf Pocket Penetrometer	Moisture Content %	Liquid Limit (LL)	Plastic Limit (PL)	Remarks
Topsoil	0.9												
Black SILTY to SANDY CLAY, with trace to little gravel and organics (CL) Wet, very soft						●							
—organic odor in sample—			1	SS		∇	2						Invert Elev. 799.
	6.0	5											
Gray SANDY CLAY, with little gravel (CL) [glacial till] Very moist to wet, very stiff			2	SS			26						
—sample #5 is very sandy and wet— —sand seam in sample 5—		10	3	SS			37						
			4	SS			38						
Gray SANDY SILT (ML) wet, very stiff	15.0 16.0	15	5	SS			23						

Boring discontinued at 16.0 feet depth.
Boring caved in at 12.0 feet depth.

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Groundwater
∇ At Completion 4.0 ft.
▼ After ____ hours ____ ft.
● Water on Rods 2.5 ft.
+ At Survey ____ ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casing
HP - Hydraulic Push

ATEC Associates, Inc.
2027 Springboro West
Dayton, Ohio 45439
(937) 297-6600

RECORD OF SUBSURFACE EXPLORATION

CLIENT: Greene County Sanitary Engineering Department
ARCHITECT ENGINEER:
PROJECT NAME: Southeast Beavercreek Trunk Sewer
PROJECT LOCATION: North of Indian Ripple Rd., Beavercreek, Ohio

BORING #: SB-7
JOB #: 00157.0006
DRAWN BY: M.O.H.
APPROVED BY: M.O.H.

DRILLING and SAMPLING INFORMATION

Date Started	9/4/97	Hammer Wt.	140 lbs.
Date Completed	9/4/97	Hammer Drop	30 in.
Drill Foreman	D. Fisher	Spoon Sampler OD	2 in.
Inspector		Rock Core Dia.	in.
Boring Method	H.S.A.	Shelby Tube OD	in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION ~816	Stratum Depth	Depth Scale	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Ground Water	Standard Penetration Test, N - blows/foot	Qu-tsf Unconfined Compressive Strength	PP-tsf Pocket Penetrometer	Moisture Content %	Liquid Limit (LL)	Plastic Limit (PL)	Remarks
Topsoil	0.9												
Olive brown and gray SILTY CLAY and limestone fragments (CL to CH) [residual soil] Moist, hard						●							
			1	SS			38						Invert Elev. 807.
Gray extremely weathered SHALE and LIMESTONE fragments	4.8	5											
			2	SS			50/0.5						
	9.5		3	SS			50/0.1						
Boring discontinued due to auger refusal at 9.5 feet depth. Boring caved in at 5.0 feet depth.													

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Groundwater
At Completion ____ ft.
After ____ hours ____ ft.
● Water on Rods 2.0 ft.
+ At Survey ____ ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casing
HP - Hydraulic Push

ATEC Associates, Inc.
2027 Springboro West
Dayton, Ohio 45439
(937) 297-6600

RECORD OF SUBSURFACE EXPLORATION

CLIENT: Greene County Sanitary Engineering Department
ARCHITECT ENGINEER:
PROJECT NAME: Southeast Beavercreek Trunk Sewer
PROJECT LOCATION: North of Indian Ripple Rd., Beavercreek, Ohio

BORING #: SB-8
JOB #: 00157.0006
DRAWN BY: M.O.H.
APPROVED BY: M.O.H.

DRILLING and SAMPLING INFORMATION

Date Started: 9/4/97
Date Completed: 9/4/97
Drill Foreman: D. Fisher
Inspector:
Boring Method: H.S.A.

Hammer Wt.: 140 lbs.
Hammer Drop: 30 in.
Spoon Sampler OD: 2 in.
Rock Core Dia.: in.
Shelby Tube OD: in.

TEST DATA

SURFACE ELEVATION ~826

SOIL CLASSIFICATION	Stratum Depth	Depth Scale	Sample No.	Sample Type	Ground Water	Standard Penetration Test, N - blows/foot	Qu-tsf Unconfined Compressive Strength	PP-tsf Pocket Penetrometer	Moisture Content %	Liquid Limit (LL)	Plastic Limit (PL)	Remarks
Topsoil	1.5											
Brownish gray SANDY CLAY, with little gravel (CL) [glacial till] Very moist, stiff	4.8		1	SS		11						Invert Elev. 817.
Gray SANDY CLAY, with little gravel (CL) [glacial till] Moist to very moist, very stiff		5										
			2	SS	●	22						
			3	SS		24						
		10	4	SS		29						
	11.8											
Brown and gray SAND and GRAVEL (SP) Wet, medium dense	12.1											

Boring discontinued at 12.0 feet depth.
Boring caved in at 9.0 feet depth.

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Groundwater
At Completion ______ ft.
After ______ hours ______ ft.
● Water on Rods 8.0 ft.
+ At Survey ______ ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casing
HP - Hydraulic Push

ATEC Associates, Inc.
2027 Springboro West
Dayton, Ohio 45439
(937) 297-6600

RECORD OF SUBSURFACE EXPLORATION

CLIENT: Greene County Sanitary Engineering Department
ARCHITECT ENGINEER:
PROJECT NAME: Southeast Beavercreek Trunk Sewer
PROJECT LOCATION: North of Indian Ripple Rd., Beavercreek, Ohio

BORING #: SB-9
JOB #: 00157.0006
DRAWN BY: M.O.H.
APPROVED BY: M.O.H.

DRILLING and SAMPLING INFORMATION

Date Started	9/5/97	Hammer Wt.	140 lbs.
Date Completed	9/5/97	Hammer Drop	30 in.
Drill Foreman	D. Fisher	Spoon Sampler OD	2 in.
Inspector		Rock Core Dia.	in.
Boring Method	H.S.A.	Shelby Tube OD	in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION ~789	Stratum Depth	Depth Scale	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Ground Water	Standard Penetration Test, N - blows/foot	Qu-tsf Unconfined Compressive Strength	PP-tsf Pocket Penetrometer	Moisture Content %	Liquid Limit (LL)	Plastic Limit (PL)	Remarks
Topsoil													
Brown with trace gray SILTY CLAY, with trace sand (CL) Moist, stiff			1	SS			13						Invert Elev. 781.
		5											
Brown SANDY CLAY, with little gravel (CL) [glacial till] Wet, soft			2	SS			5						
Olive brown and gray SILTY CLAY and limestone fragments (CL to CH) [residual soil] Moist, hard		10	3	SS			10+50/0.1						
Boring discontinued at 11.5 feet depth. Boring caved in at 6.0 feet depth. No groundwater encountered at completion.													

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Groundwater
At Completion ______ ft.
After ______ hours ______ ft.
Water on Rods ______ ft.
At Survey ______ ft.

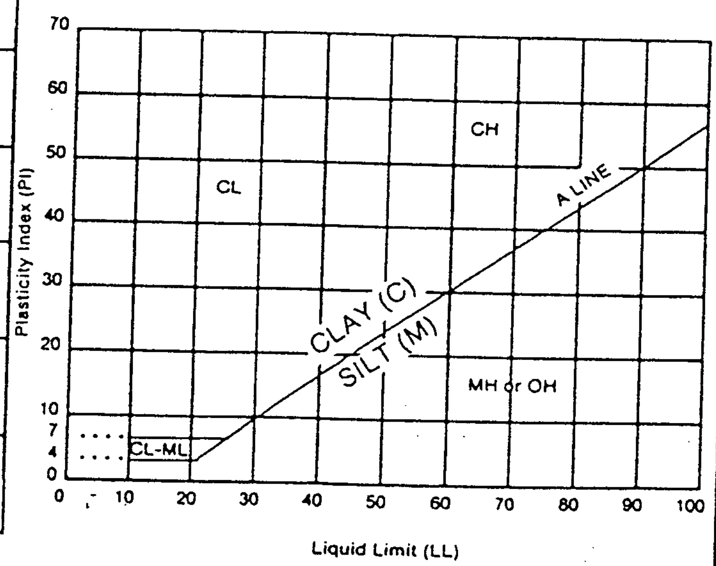
Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casing
HP - Hydraulic Push

Unified Soil Classification System

Major Divisions			Group Symbol	Typical Names	Laboratory Classifications Criteria	
COARSE GRAINED SOILS (More than half of material is larger than No 200 sieve)	Gravels (More than half of coarse fraction is larger than No. 4 sieve)	Clean gravels	GW	Well graded gravels, gravel-sand mixtures, little or no fines.	$C_u = \frac{D_{60}}{D_{10}} > 4$. 1 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} < 3$	
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines	Not meeting all gradation requirements for GW	
		Gravels with fines	GM	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of duel symbols
			GC	Clayey gravels, gravel-sand-clay mixtures	Atterberg limits above "A" line with P.I. greater than 7	
	Sands (More than half of coarse fraction is smaller than No 4 sieve)	Clean sands	SW	Well graded sands, gravelly sands, little or no fines	$C_u = \frac{D_{60}}{D_{10}} > 6$: 1 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} < 3$	
			SP	Poorly graded sands, gravelly sands, little or no fines	Not meeting all gradation requirements for SW	
		Sands with fines	SM	Silty sands, sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in hatched zone with P.I. between 4 and 7 are borderline cases requiring the use of dual symbols
			SC	Clayey sands, sand-clay mixtures	Atterberg limits above "A" line with P.I. greater than 7	
FINE GRAINED SOILS (More than half of material is smaller than No. 200 sieve)	Silts and Clays (LL less than 50)		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity		
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays		
			OL	Organic silts and organic silty clays of low plasticity		
	Silts and Clays (LL greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts		
			CH	Inorganic clays of high plasticity, fat clays		
			OH	Organic clays of medium to high plasticity, organic silts		
	Highly Organic Soil		Pt	Peat or other highly organic soils		

Determine percentages of sand and gravel from grain size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse grained soils are classified as follow:
Less than 5% . . . . GW, GP, SW, SP
More than 12% . . . . GM, GC, SM, SC
5 to 12% . . . . Borderline cases requiring dual symbols

1. Plot intersection of PI and LL as determined from Atterberg Limits tests.
2. Points plotted above A line indicate clay soils, those below the A line indicate silt.



Plasticity Chart

ATEC Associates, Inc.
OF OHIO

Unified Soil Classification System
ASTM Designation D - 2487

FIELD CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

NON COHESIVE SOILS
(Silt, Sand, Gravel and Combinations)

Density

Very Loose	- 5 blows/ft. or less
Loose	- 6 to 10 blows/ft.
Medium Dense	-11 to 30 blows/ft.
Dense	-31 to 50 blows/ft.
Very Dense	-51 blows/ft. or more

Relative Proportions

Descriptive Term	Percent
Trace	1 -10
Little	11-20
Some	21-35
And	36-50

Particle Size Identification

Boulders	-8 inch diameter or more	
Cobbles	-3 to 8 inch diameter	
Gravel	-Coarse	-1 to 3 inch
	Medium	-½ to 1 inch
	Fine	-¼ to ½ inch
Sand	-Coarse	2.00mm to ¼ inch (dia. of pencil lead)
	Medium	0.42 to 2.00mm (dia. of broom straw)
	Fine	0.074 to 0.42mm (Dia. of human hair)
Silt		0.074 to 0.002mm (Cannot see particles)

COHESIVE SOILS
(Clay, Silt and Combinations)

Consistency

Very Soft	- 3 blows/ft. or less
Soft	- 4 to 5 blows/ft.
Medium Stiff	- 6 to 10 blows/ft.
Stiff	-11 to 15 blows/ft.
Very Stiff	-16 to 30 blows/ft.
Hard	-31 blows/ft. or more

Plasticity

Degree of Plasticity	Plasticity Index
None to slight	0- 4
Slight	5- 7
Medium	8-22
High to Very High	over 22

Classification on logs are made by visual inspection of samples.

Standard Penetration Test—Driving a 2.0" O.D., 1-⅜" I.D., sampler a distance of 1.0 foot into undisturbed soil with a 140 pound hammer free falling a distance of 30.0 inches. It is customary for ATEC to drive the spoon 6.0 inches to seat into undisturbed soil, then perform the test. The number of hammer blows for seating the spoon and making the test are recorded for each 6.0 inches of penetration (Example—6/8/9). The standard penetration test result can be obtained by adding the last two figures (i.e. 8 + 9 = 17 blows/ft.). (ASTM D-1586-67)

Strata Changes — In the Column "Soil Descriptions" on the drill log the horizontal lines represent strata changes. A solid line (__________) represents an actually observed change a dashed line (— — — —) represents an estimated change.

Ground Water observations were made at the times indicated. Porosity of soil strata, weather conditions, site topography, etc., may cause changes in the water levels indicated on the logs.

ATEC Associates, Inc.

Consulting Geotechnical & Materials Engineers about the potential for hazardous materials existing at the site. The equipment, techniques, and personnel used to perform a geoenvironmental exploration differ substantially from those applied in geotechnical engineering. Contamination can create major risks. If you have no information about the potential for your site being contaminated, you are advised to speak with your geotechnical consultant for information relating to geoenvironmental issues.

A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a geotechnical engineering report. To help avoid misinterpretations, retain your geotechnical engineer to work with other project design professionals who are affected by the geotechnical report. Have your geotechnical engineer explain report implications to design professionals affected by them, and then review those design professionals' plans and specifications to see how they have incorporated geotechnical factors. Although certain other design professionals may be familiar with geotechnical concerns, none knows as much about them as a competent geotechnical engineer.

BORING LOGS SHOULD NOT BE SEPARATED FROM THE REPORT

Geotechnical engineers develop final boring logs based upon their interpretation of the field logs (assembled by site personnel) and laboratory evaluation of field samples. Geotechnical engineers customarily include only final boring logs in their reports. Final boring logs should not under any circumstances be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process. Although photographic reproduction eliminates this problem, it does nothing to minimize the possibility of contractors misinterpreting the logs during bid preparation. When this occurs, delays, disputes, and unanticipated costs are the all-too-frequent result.

To minimize the likelihood of boring log misinterpretation, give contractors ready access to the complete geotechnical engineering report prepared or authorized for their use. (If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared and that developing construction cost estimates was not one of the specific purposes for which it was prepared. In other words, while a contractor may gain important knowledge from a report prepared for another party, the contractor would be well-advised to discuss the report with your geotechnical engineer and to perform the additional or alternative work that the contractor believes may be needed to obtain the data specifically appropriate for construction cost estimating purposes.) Some clients believe that it is unwise or unnecessary to give contractors access to their geotechnical engineering reports because they hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems. It also helps reduce the adversarial attitudes that can aggravate problems to disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY

Because geotechnical engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against geotechnical engineers. To help prevent this problem, geotechnical engineers have developed a number of clauses for use in their contracts, reports, and other documents. Responsibility clauses are not exculpatory clauses designed to transfer geotechnical engineers' liabilities to other parties. Instead, they are definitive clauses that identify where geotechnical engineers' responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your geotechnical engineering report. Read them closely. Your geotechnical engineer will be pleased to give full and frank answers to any questions.

RELY ON THE GEOTECHNICAL ENGINEER FOR ADDITIONAL ASSISTANCE

Most ASFE-member consulting geotechnical engineering firms are familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a construction project, from design through construction. Speak with your geotechnical engineer not only about geotechnical issues, but others as well, to learn about approaches that may be of genuine benefit. You may also wish to obtain certain ASFE publications. Contact a member of ASFE of ASFE for a complimentary directory of ASFE publications.

ASFE THE ASSOCIATION OF ENGINEERING FIRMS PRACTICING IN THE GEOSCIENCES
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