



Tech Brief

GIS Applications in Geotechnical Engineering

Need a solution?
Think Jersey DOT

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HERE'S THE PROBLEM

The New Jersey Department of Transportation's Bureau of Geotechnical Engineering currently maintains a large database of boring location plans and corresponding test boring logs. These plans and logs are in hard copy format and are stored in boxes, file cabinets, and plan drawers. Locating specific boring location plans and test boring logs can be a very time consuming process that also relies on the memory of the personnel that are responsible for maintaining the database. This report presents the results of a successful pilot study to investigate the development of a Geographic Information System (GIS) to better manage and disseminate soils information, as developed from test boring results



THESE ARE OBJECTIVES OF THE STUDY...

- To present the results of a pilot study for a statewide test boring management system and engineering soil series system for the New Jersey Department of Transportation (NJDOT).
- To use Geotechnical Geographic Information System (GEOGIS) in a pilot study to assess the feasibility and effort that will be necessary for full implementation of the system.

AND, HERE'S WHAT WE DID...

The Rutgers Soil Series is used both within, and outside, the NJDOT to assist in designing roadways and performing preliminary assessments of soil conditions at a bridge or structure. Since the original soil series maps were developed in the 1950's, the base maps used then are not representative of the transportation system as it is today. As such, it is sometimes very difficult to locate a roadway or bridge project using the soil series maps alone. In addition, once the soil

	Horizon A	Horizon B	Horizon C
Depth in	0-12	28-32	over 40
Depth at	80-100	80-100	90-100
Percent A	10-50	20-90	10-40
CL %	-	-	-
LL %	41-55	41-55	41-55
PI %	10-20	10-20	10-20
Max. Organic mat.	-	11-21%	0-10%
Organic Matter, %	-	1-14	1-21%
HRF Class	A-2,4,6-4	A-2,4,6-4	A-2,4,6-4
Group Index	0-6	0-6	0-2

type(s) has been identified, the user must go to a soil series book to obtain engineering information regarding the soil type. By placing the scanned soil series maps on the NJDOT base map and digitizing the areas of the soil types, the pilot study presented herein has resulted in an GIS system that makes it easier to obtain information regarding soil types at a specific project location

It is estimated by the Bureau of Geotechnical Engineering that there are approximately 70,000 boring log sheets currently maintained by NJDOT, as well as approximately 4,000 soil boring location plan sheets. The Rutgers soil series consists of almost 100 soil maps and corresponding tables of engineering soil properties.

The pilot GEOGIS system basically consisted of two modules. One module allowed users to obtain electronic boring location plans and boring logs from NJDOT's projects. The other module allowed users to obtain electronic information from the engineering soil survey series developed by Rutgers University (hereafter referred to as the Rutgers soils series). The GEOGIS system was developed using the computer software GeoMedia.

For the purpose of this pilot study, a representative sample of boring information from the NJDOT's library of geotechnical boring information was selected. The NJDOT Bureau of Geotechnical Engineering selected a total of 14 projects located throughout the state. Each project contains a boring location plan(s) and corresponding boring logs. A list of type and number of boring location plans and number of borings and boring sheets for each project is included in table 1. In total, there are 32 boring location plans and 267 test boring logs (382 boring log sheets).

This pilot study used the Rutgers Soil Series maps and soil information from Morris County, New Jersey.

Implementation of the Soil Boring Management System consisted of:

1. Identifying the boring location plans and boring logs that go with a specific boring contract;
2. Scanning hard copies of the boring location plans and boring logs;
3. Placing the boring location plans at the proper location on the NJDOT base map;
4. Linking the boring logs to their corresponding boring location plans, and;
5. Inputting key attribute data (values placed in the database that are linked to a graphical image) that is included in the boring location plans and boring logs.

After the boring location plan(s) for a specific boring contract were scanned, the boring location plans were located on a statewide base map. The attribute data associated with a boring contract, which consists of a set of boring location plans, are as follows:

- Site Identification Number
- Route Number
- County
- Municipality
- Local Project Name

The site identification number is a unique identification number that is sequentially numbered.

The attribute data associated with a test boring location are as follows:

- Local Test Boring Identifier
- Source of Data (In house / Contractor)
- Soil Boring Reference Identifier
- Section
- Station
- Offset
- Reference Line
- Ground Elevation
- Contractor
- Date Started
- Final Depth
- Coordinate Validity
- Northing Coordinate
- Easting Coordinate
- Route
- Local Project Name
- County
- Municipality
- Region
- Agreement Number

The Soil Boring Reference Identifier (SBRI) is a unique number for a given test boring that is sequentially numbered. The coordinate validity will be used to describe the accuracy with which the test boring was located.

CONCLUSION...

The results of this pilot study indicate that development of a GIS system to better manage the NJDOT's soil boring system can be implemented. Once developed, this GIS system will allow for the rapid dissemination of information to NJDOT personnel, as well as outside consultants. In addition, the development of a GIS system will eliminate the need for maintaining the current system of paper originals and copies of the boring location plans and test boring logs, which are susceptible to loss. Development of the GIS system will result in digital images that are less susceptible to loss.

The results of the pilot study also indicate that overlaying the Rutgers Soil Series maps over the NJDOT base map will assist designers in identifying the soil types that may be encountered at a bridge site or along a roadway.

Location Plans should be submitted by contractors in a nonproprietary image format such as .DXF. It is envisioned that future soil boring information will be collected by a Web based input and retrieval system. Html programs can be developed to create capture screens for the boring log data that would then be filled in by in-house forces or outside consultants.

It is also envisioned that read only access to stored data would be made available over NJDOT's website. Ongoing maintenance must also be addressed once a GeoGIS is implemented.

WHAT IS THE NEXT STEP?

There are several ways that future test boring information can be incorporated into the soil boring management portion of the GEOGIS. The use of a commercial program for logging the borings and transferring the information to a database is not recommended because it would mean that in-house forces, as well as all consultants would need to purchase and use this program. In addition, these programs are typically developed to handle many different boring log formats. Since the NJDOT boring log format is standardized, the use of the multiple formats of a commercial program are not needed and will make implementation more difficult. The program will be developed such that the necessary information is entered via specific fields. This information would be stored in a database that is then retrieved to create the boring log in the proper format.

The procedure for incorporating future soil boring information would be similar to that described previously for converting the current paper archives. It is also envisioned that New Jersey State Plane coordinates would be required for the boring location plans and the boring logs so that they can be easily located on the base map. The boring location plan(s) would be developed and delivered in a digital format and then located on the base map. The corresponding test boring logs would then be linked to the boring location plans.

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<p>A final report is available online at http://www.state.nj.us/transportation/research/research.html</p> <p>If you would like a copy of the full report, please FAX the NJDOT, Bureau of Research, Technology Transfer Group at (609) 530-3722 or send an e-mail to Research.Bureau@dot.state.nj.us and ask for:</p> <p>Report Title: GIS Applications in Geotechnical Engineering NJDOT Research Report No: FHWA-NJ-2002-006</p>	