



STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

ROY COOPER
GOVERNOR

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SECRETARY

DATE: August 1, 2024

TO: Geotechnical Engineering Unit Personnel and Consultants

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SUBJECT: GEU CADD and Subsurface Modeling Update

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The Geotechnical Engineering Unit (GEU) provides the following update regarding our progress implementing Bentley applications in our geotechnical workflows. Adjustments to our workflows and deliverables will be necessary over the next several years as Bentley continues to develop and expand the capabilities of their geotechnical software suite and alternative applications are developed and evaluated. The deliverables required for each project should be discussed during scoping and should align with the complexity and criticality of the information being conveyed for design and construction.

NCDOT is using the Bentley OpenX applications for modeling and design of projects. The GEU continues to move forward with implementation of the OpenX platform, specifically:

1. OpenRoads Designer (ORD)
 - Roadway Subsurface Investigation Inventory
 - Pavement and Subgrade Investigation Inventory
 - Structure Subsurface Investigation Inventory
 - Roadway Recommendation Graphics
 - Geotechnical Design Plan Sheets
 - Roadway special details (2G sheets)
 - Retaining wall envelopes and typical details (W sheets)
2. OpenGround development for replacement of gINT

ORD INVENTORY REPORTS

The GEU has documented methods for displaying borings from gINT on plan, profile, and cross sections using gINT Civil Tools and the placement of annotations (N-Values, water tables, and material descriptions) utilizing Element Templates, Place Label and Civil Labeler. Investigation levels and cells are in the latest workspace for ORD 10.10, 10.12 and 2023 available for use in ProjectWise (or [here](#) as a zip file). You may see projects being developed in any of these versions of ORD. **DO NOT UPGRADE** files to the current version of ORD unless directed by the Project Manager. **DO NOT REVERT** files back to earlier versions of Bentley applications. The GEU encourages the use of the [ProjectWise](#) platform.

All subsurface investigation inventory reports shall contain the GEU title sheet, the GEU legend sheet, plan sheets, bore/core logs, and laboratory test results. Rock core photographs shall be included when applicable. Methods for creating cross sections and profiles for structure reports are available. However, profile and cross section creation for bridge bents should be reserved for large, length or width, structures and to depict complex inferred geology for the benefit of design and construction. Subsurface investigation reports for retaining and sound walls should include a profile depicting the borings along the wall alignment when more than two borings are performed for a wall. A Geotech pen table is under development for use in plotting all GEU ORD sheets.

ORD ROADWAY RECOMMENDATIONS REPORTS

Roadway recommendations can be drawn on cross section drawing models and the cross-sectional area measured to estimate quantities. A formal roadway recommendations report may not be required for simple projects with little grade change, but supporting documentation for contract quantity estimates should always be provided with the Roadway Recommendations text report. Project reporting should be discussed during scoping.

ORD GEOTECHNICAL DESIGN CELL LIBRARY AND CONTRACT PLAN SHEETS

The GEU is in the process of updating the geotechnical design cell library for 2024 Standard Specifications for Roads and Structures. At this time, the 2018 geotechnical design cell library should be used and cells modified on an as-needed basis for the 2024 specifications. The updated design cell library and sheet borders will be delivered with the workspace when available. Plan sheets for roadway or structures plan sets will be created by placing appropriate border and detail / notes cell and printing to ANSI D size PDF. A Geotech pen table is under development for use in plotting all GEU ORD sheets.

ORD GEOENVIRONMENTAL

GeoEnvironmental work products should use the latest investigation cell library and workspace. The latest workspace for each version of ORD includes updated levels and line styles to complete GeoEnvironmental .dgn deliverables.

ORD CHALLENGES

The following ORD challenges have been identified:

- Annotation of N-Values, water table, etc. is labor intensive (i.e., each entry must be annotated individually). This is expected to improve with the implementation of Civil Elements for geotechnical objects such as borings, etc. once the OpenGround workflow for ORD is released.
- Additional functionality and/or other software are needed to allow defining subsurface strata and making quantity estimate calculations possible from the 3D model.
- The method for creating cross-sections with projected borings is laborious and only intended for use when bridge bent stratigraphy visualization is critical to design. Roadway reports will continue to show cross-sections cut at boring locations rather than the 50 feet intervals shown in roadway plans.

IMPLEMENTATION OF ORD

The GEU will now be requesting inventory reports prepared using ORD for projects designed in ORD or converted from legacy Bentley applications to ORD. These projects will require a subsurface investigation inventory as outlined above. Roadway recommendations requirements should be discussed on a per project basis during scoping.

The GEU has created the following training modules to support users in developing the requested geotechnical, geoenvironmental and geopavement deliverables:

- Module 1 - Creating New Files in ProjectWise, creating 3D Default Model
- Module 2 - Connecting to gINT database, importing boreholes in 2D and 3D
- Module 3 - Creating Plan Sheets
- Module 4 - Creating Cross-section Sheets
- Module 5 - Creating Profile Sheets
- Module 6 – Geotech Bridge Cross-section

Modules are available at [OpenRoads Designer and OpenGround Information](#) on the GEU's Connect site. A flashcard has been developed which is at the same link for configuring ORD to work on projects that are not on ProjectWise.

OPENGROUND

A configuration pack has been created for NCDOT with the preferred content for borehole logging. This configuration pack is currently being tested. OpenGround workflow for ORD is anticipated in a major release later this fall.

Actual timing for OpenGround implementation is dependent on Bentley software releases and on completion of tools to import boring data into ORD. For now, gINT should continue to be used.

During this interim period, contact Christina Bruinsma at cmbruinsma@ncdot.gov, Kevin Miller at kbmiller@ncdot.gov, or Jaime Love at jilove2@ncdot.gov with any questions. Suggestions and feedback are always welcome.