G.H.E. CAD Standards

Geotechnical CAD Manual
Geotechnical Data

December 2019

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Delivery and Operations Division, Engineering and Technical Services Branch

Hydraulic Engineering and Environmental Services Section, MS#6

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Geotechnical Data Section 3

Section 3-1 Overview

Geotechnical Data sheets are required for the contract plans of projects involving earthworks or subsurface materials. To determine existing subsurface conditions, skilled interpretation of the exploration data is performed. The resulting geotechnical design parameters are provided to contractors and ODOT design and construction staff. Delivering this information to our contractors in a clear and concise manner provides them with the understanding they need to bid on the project.

Subsurface information is used for the design of structure(s) or features(s), for example: bridge and retaining structures, or cuts, fills and embankments. Plan sheets must clearly show the subsurface information found at the boring locations on the project. This chapter provides the methods and procedures for uniformity and clarity in the presentation of subsurface information that ensures contractors and ODOT personnel receive the information needed to perform geotechnical-related construction project work.

Section 3-2 Development

Geotechnical Data sheets are produced for contract plans through collaboration between the project geotechnical engineer, the engineering geologist, and the drafting resource. The engineer and geologist are responsible for developing the subsurface data, based on the exploration results, to be shown on the Geotechnical Data sheets for the contract plans.

The project drafter is responsible for developing the plan sheets showing the subsurface conditions in a format consistent with the current CAD and drafting standards provided in the ODOT MicroStation workspace, this manual, and the Contract Plans Manual (CPM).

Tasks and Workflows

ODOT's MicroStation workspace contains a Subsurface Data work flow for the development of Geotechnical Data sheets.

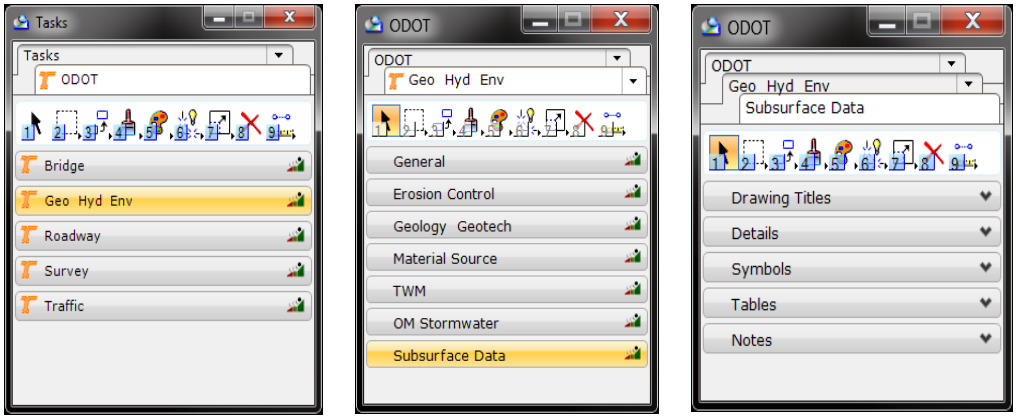


Figure 3–1 MicroStation Geotechnical Data sheets

This chapter will further describe the specific tasks, tools and other standards; such as text styles, sheet layout, cells, etc., used to create a Geotechnical Data sheet.

Standard Text

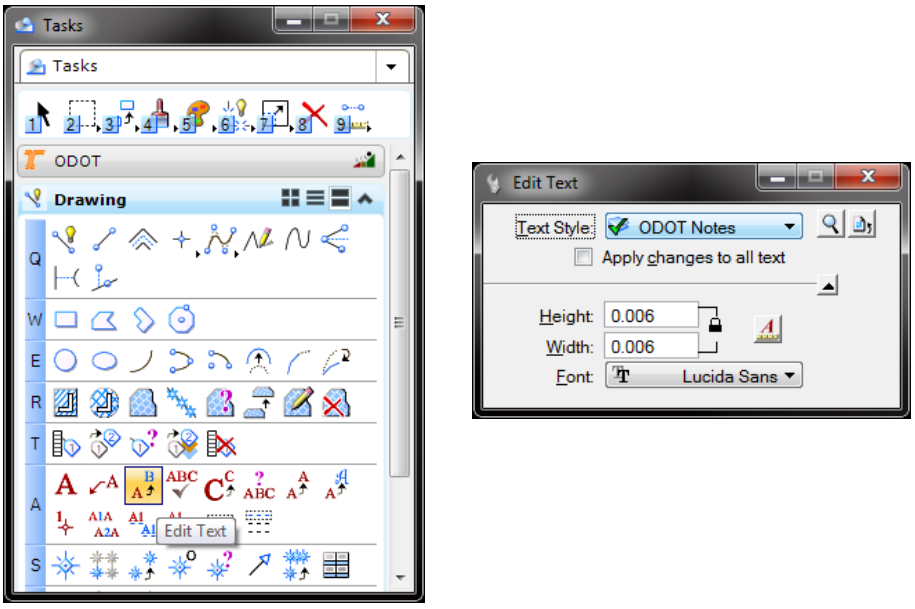


Figure 3–2 MicroStation Geotechnical Text Styles

The standard text styles are available in the text tools located in the Drawing tab of the main Tasks dialog within the MicroStation workspace, and also within the task workflows.

Three standard ODOT text styles are used on Geotechnical Data sheets:

- ODOT Notes
- ODOT Subtitles
- ODOT Titles

Text styles can be set in the text attributes tools, or users can take advantage of the workflow tasks where styles are set automatically.

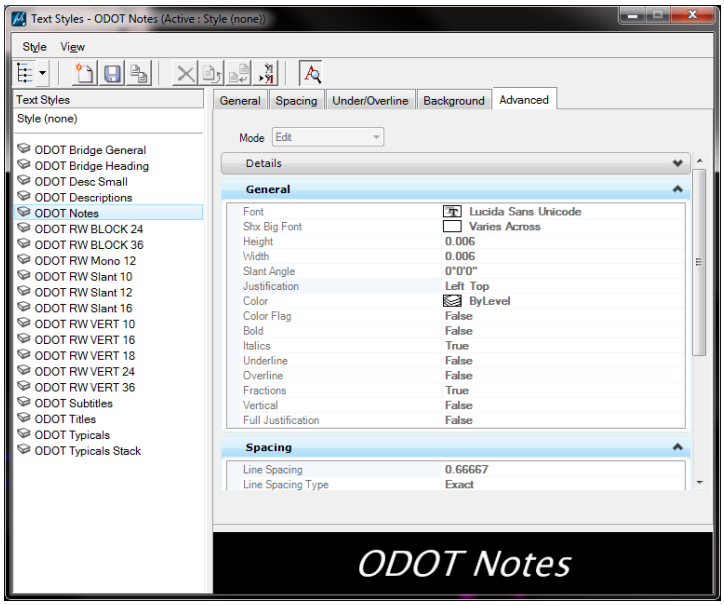
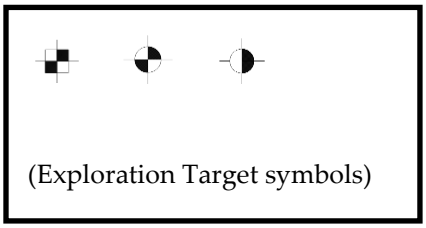


Figure 3–3 MicroStation Geotechnical Workflow Tasks

Cell Library

The cell library for the Geology/Geotechnical disciplines is named **Geo.cel**. Many of the elements necessary to complete a Geotechnical Data sheet are located in this cell library. The cell library is accessed by the Geology Geotech tasks and workflow tabs for the needed tools. Tools used on Geotechnical Data sheets are located in the Subsurface Data task tab and include elements such as; a profile grid, Unit Descriptions, a Core Table, Standard Notes, etc.



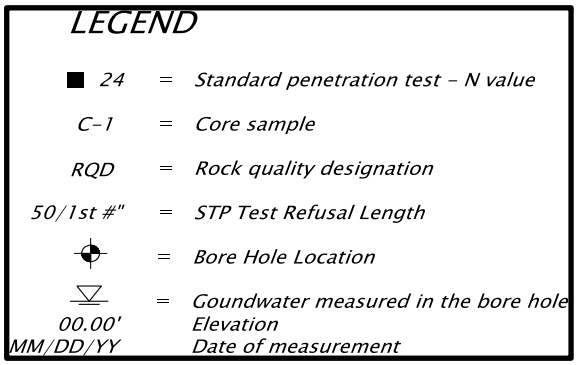


Figure 3–4 Cell Library Legend

Seed and Cache

Seed and Cache files are provided in the ODOT MicroStation workspace. See Chapter 2 for more information on seed and cache files, plus a link to access the ODOT workspace.

The seed file for Geotechnical Data sheets is **seed_GTsub.dgn**. Notes, a legend, unit descriptions, core tables and a profile grid are included in the seed file. The seed file is a template drawing for the development of a Geotechnical Data sheet.

File Name and Sheet Name

File Name

ODOT uses a set list of CAD file names, based on an approved file naming convention developed for use within ODOT's new data management system called ProjectWise.

The project drafter must coordinate with the other disciplines involved in the project to determine individual structures/features where Geotechnical Data sheets are required. Each discipline has a specific file name assigned to Geotechnical Data sheets for their structures/features. Project drafters are responsible for naming individual files according to discipline specific standards found in the ProjectWise naming tool.

The approved file naming for Geotechnical Data sheets is located in the ProjectWise Document Name List and in the ProjectWise File Naming Tool.

Sheet Name (Title)

Geotechnical Data sheets are titled as "GEOTECHNICAL DATA". A seed file, named ***seed_titleblock.dgn,*** is available in the workspace. The titleblock seed file is a reference file similar to the previously used .nam file. Seed_titleblock.dgn contains models for sheet names by discipline. Sheet names are located within models and on separate levels, so the correct sheet name can remain turned on while all others are turned off.

Refer to the CPM Chapter 3 – Plan Sheet Title Block

Drawing Sequence and Sheet Numbering

Drawing Sequence

Place Geotechnical Data sheets with the corresponding structure or feature they are developed for. This allows those involved with construction to easily find the subsurface information specific to each feature and eliminates the burden of looking elsewhere in the plan set to locate the drawings.

Place the Geotechnical Data sheets after the design plan sheets and before the profile sheets for the structures or features they are intended. When the plan and profile are shown on one sheet, the Geotechnical Data sheet immediately follows that sheet.

Geotechnical Data sheets developed for cuts, fills, and embankments are placed after the corresponding Plan and Profile sheet. Roadway typically utilizes cuts and fills most often and placing the data sheets after the profile sheets aids construction crews during that phase of construction.

Avoid duplication and overlap of information on individual Geotechnical Data sheets, or on multiple sheets within one discipline.

Note: Duplication of information among multiple disciplines may be necessary, at times, in order to provide all the information available for multiple structures/features. For example: Two bore holes in close proximity to each other used for two separate structures/features, such as a

retaining wall and a Signal Pole, will appear the same on the Geotechnical Data sheets for the Retaining Wall as they will on the Geotechnical Data sheets for the Signal Pole. This gives the contractors and subcontractors access to the data for their portion of the project.

Index Sheet

When Geotechnical Data sheets are produced for numerous structures/features an Index sheet depicting the locations covered by the data sheets should be produced. Index sheets aid in locating the appropriate information for larger projects with multiple structures/features. The Index sheet appears in the 'G' series section of the project plans set.

Refer to the CPM Chapter 2 – Plan Sheet Numbering and Seed Files

Title the index sheet "*Exploration Location Index"*. Clearly label references to the locations of the Geotechnical Data sheets throughout the project plan set. Each Geotechnical Data sheet within the plan set refers to the Exploration Locations Index when used.

Sheet Numbering

Geotechnical Data sheets that are placed with the plan sheets for a structure or feature will take on the sheet numbering series of that structure or feature. For example, if the Geotechnical Data sheet is intended for a feature in the C04 series of the plans it might be numbered C04D and the feature profile is then numbered C04E. If the Geotechnical Data sheet is intended for a retaining wall in the G series it might be numbered GB02. Refer to the CPM for correct sheet numbers.

The exceptions are the "Exploration Location Index" sheet for the project and the "Geotechnical Data" sheets that do not apply to any specific structure or feature. Place these more general sheets in the Geology\Geotechnical, or 'G' series, portion of the contract plans. The "Exploration Location Index" is the first sheet to appear in the 'G' series and is numbered as GA##, as shown in Table 2-1 of the CPM

Plan and Profile Sheet

The content of a Geotechnical Data plan sheet is based on the final bore logs produced by the Project Geologist. The project Geologist is responsible for making sure the unit descriptions for the plan sheet match the corresponding descriptions on the final logs. Exploration data on the individual borings is provided to the project drafter with location information for the plan and placement requirements for the profile.

The MicroStation workspace provides all the essential CAD elements needed to develop plan sheets according to current CAD standards. Example plan sheets are provided at the end of this chapter.

Layout

Arrange Geotechnical Data sheets to clearly depict subsurface conditions. At minimum, display a plan and profile showing subsurface information that underlie the subject structure/feature with the profile along the centerline. The centerline may be the roadway centerline, or the structure centerline. Additional profiles offset from centerline may be included as determined by the geologist to accurately convey the information.

Sections or Cross-sections may be used in place of a Profile, or to supplement the profile for wide features where complex geology exists. Sections may also be drawn at skewed angles to the centerline where needed to best display subsurface conditions, or to show a specific element such as the principal axis of a landslide.

Plan sets may begin with a plan view sheet, followed by a profile sheet(s) or section(s). Any additional details needed to aid in the understanding of the underlying geologic conditions are placed on additional sheets. All sheets displaying the bore logs must include unit descriptions, legend and general notes. Rock core tables are typically placed below the profile and in line with the corresponding bore log. A core table cell is included in the cell library/tasks and workflows.

Plan View

Provide a footprint, or general layout, of all existing and proposed structures and features in the plan view of a Geotechnical Data sheet. Locate and label all existing and proposed bent and abutment locations for bridges. Features should be scaled for easy viewing. See figure 3.2.4.1 Plan View.

Alignment stationing should be labeled sufficient to orient the reader and to provide reference points/stations to the important elements of the structure/feature being constructed. Follow the CPM requirements for displaying stationing from left to right on the sheet. Show the project highway centerline alignment when structure alignments are used.

The location of all explorations must be shown, whether borings, test pits, cone penetrometer tests, seismic lines or other subsurface explorations. Identify each location with the correct symbology and label. Each label should include the exploration number, the name of the alignment, and the station and offset with right (Rt) or left (Lt) offset indicated.

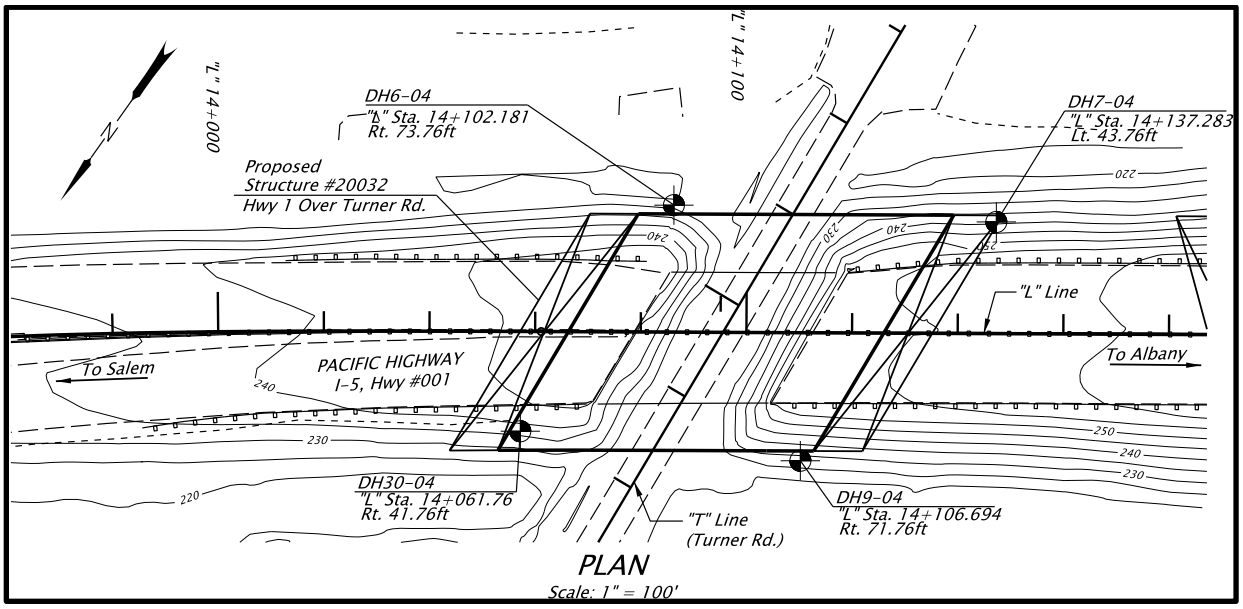


Figure 3–5 Plan View of Bridge showing features and structures with respect to bore holes.

For projects without alignments, provide the coordinates of the explorations. (If cone penetrometer, pressure meter, vane shear, packer or other in-situ testing is performed include a note stating the results of these tests are available in the Geotechnical Data Report).

Where bodies of water lie within the plan view of the structure or feature, clearly show the boundaries and include direction of flow arrows. Label the name of each body of water. If the waterway is unnamed, label as "unnamed stream", "unnamed creek", etc. Intermittent waterways should be shown with appropriate symbology and labeled (i.e. ditch).

Gray-shading the contour lines allow feature linework and symbology to stand out, enhancing the readability of the plan. Contours must be labeled with the correct elevation at an appropriate interval. The contour interval should be stated somewhere on the plan sheet.

Features or lines that do not serve a clear purpose with respect to conveying information about the site conditions should be omitted. (See section 3.3 Check List for items to remain on).

Profile View

The profile view shows the engineering geology interpretation of the subsurface conditions along an alignment. The Geologic subsurface data is depicted by graphic columns or "stick logs" that represent each exploration at the station and elevation at which they occur along the alignment. Graphic columns consist of separate sections that represent the subsurface materials by patterned symbology. Unit descriptions are used to describe the materials represented by the patterns, and shown in a legend format located along the far right edge of the sheet. See figure 3.2.4.2 Profile View for an example of stick logs.

Profiles are shown along the alignment(s) used for construction as described in the preceding LAYOUT section. When the plan and profile appear on the same sheet, each graphic column (stick log) should be aligned with the corresponding exploration symbol on the plan view,

immediately above the profile. Profiles are displayed on standard station and elevation grids. Label stations on the x-axis and elevations on the y-axis of the grid. Elevations should be labeled on both the left and right sides of the grid. Grid lines may be subdued to avoid conflict with graphic columns showing geologic interpretations or the various graphic column labels. Profiles should be labeled as PROFILE 'LINE NAME'". For example 'PROFILE "SB1" LINE'.

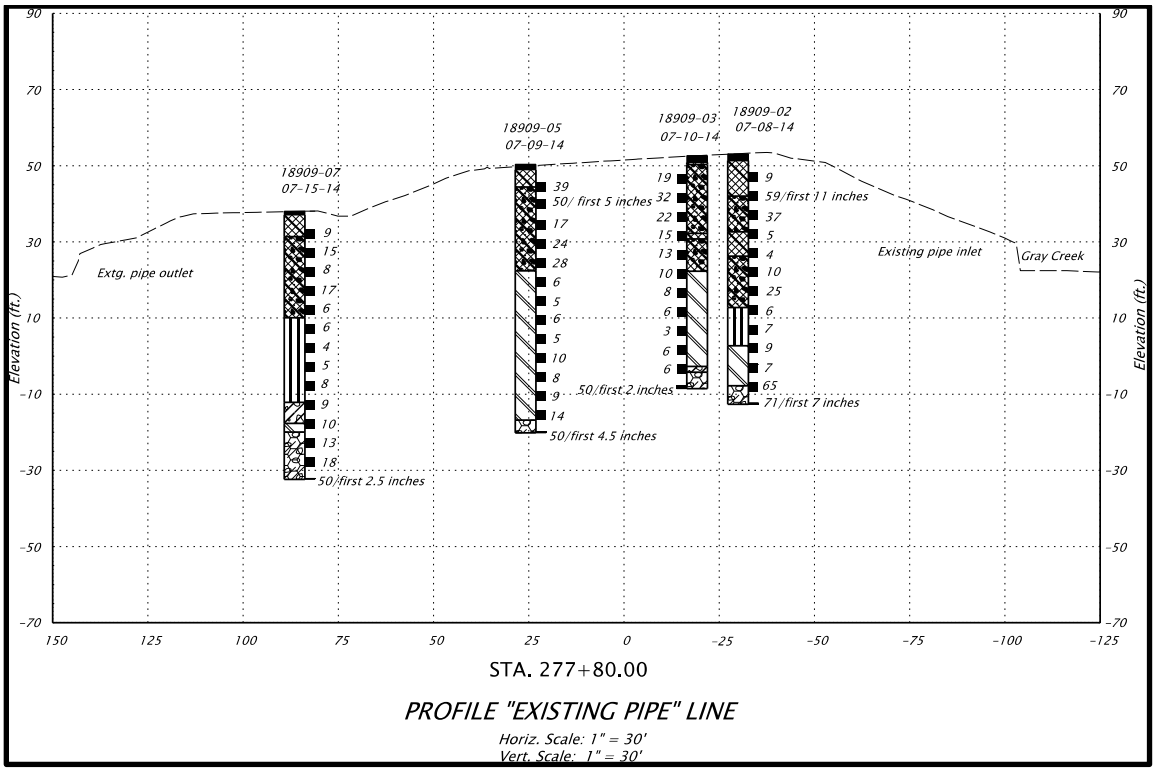


Figure 3–6 Profile View of stick logs brought into MicroStation from gINT, scaled and placed in a standard profile.

Numerous explorations shown on one single profile can obscure data or lead to a cluttered appearance. Several options can be used to alleviate this situation:

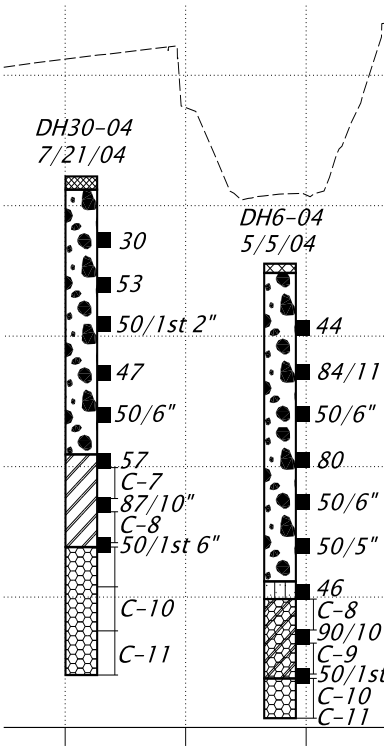
- Expand the horizontal scale of the drawing
- Relocate the exploration and descriptive text to a different point on the drawing with an arrow connecting it to its true location
- Use supplemental sections, profiles, or cross-sections.

Sheets produced for supplemental profiles will be identical in format to the standard Geotechnical Data Sheet.

Elevation View

Some project features, such as landslides or retaining walls, do not require an alignment. In these cases the profile view can be labeled as 'ELEVATION'. The grid and subsurface information is shown exactly the same on an elevation view as it is on a profile view.

Graphic Columns (Stick Logs)



- Graphic columns are labeled at the top with the exploration number, offset (optional), and the date the boring was completed.
- Samples and in-situ test results are shown with their designated symbols at the depth they were taken, or performed, along the right side of the graphic column.
- SPT intervals are to be labeled by their N-Value.
- Sample intervals are denoted by the vertical length of the symbol.
- Continuous sampling methods such as rock coring are shown by dimensions labeled with the core run.
- Groundwater is typically shown on the left side of the graphic column, with the standard groundwater symbol placed at the depth of the highest and lowest groundwater levels measured. Groundwater symbols should be labeled with the elevation and date the sample was taken.

Figure 3–7 Graphic Columns

See the drawings at the end of the chapter for full graphic column examples.

Unit Descriptions

Unit descriptions and their corresponding symbols are displayed in a legend-style format. The Project Geologist compiles and provides the descriptions for the geologic units. Only the geologic unit descriptions shown on that sheet are displayed. Orient the unit descriptions in a manner to allow space for a legend of symbols, notes, and core tables. Unit descriptions, legends and notes generally appear along the far right edge of the plan sheet.

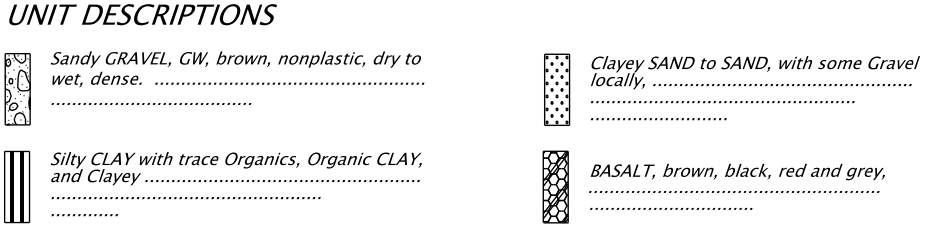


Figure 3–8 Unit Descriptions

Specific information may be conveyed on a Data Sheet from other project data sources. For example, a note on a boulder-bearing Engineering Geologic unit that did not encounter boulders in borings on that sheet, but were found elsewhere in the same unit.

Rock Core Tables

10352-02

Core	% Rec.	Hardness	R.Q.D.
C1	16	R1	
C2	100	R1	100%
C3	100	R1	89%

Figure 3-9 Rock Core Table

Rock Core Tables are used to show specific rock core data for each boring that encountered hard rock. Each graphic column with rock coring should have a corresponding table that includes the core run, percent recovery, hardness, and Rock Quality Designation (RQD). Rock core tables are ideally shown below the profile where the corresponding graphic column occurs. When space is limited, use judgement to place tables so they clearly show the information and can easily connect to the corresponding stick log.

Legend and Notes

GENERAL NOTES:

1. Elevations are based on North American Vertical Datum (1988).
2. Geotechnical data shown on this drawing are a consolidation of information and/or revision in terminology from the drill logs. More detailed subsurface data is available on the drill logs in the geotechnical report, which is available from the Engineer.
3. 2' Contour Interval

LEGEND

■ 24	=	Standard penetration test - N value
C-1	=	Core sample
RQD	=	Rock quality designation
50/1st #"	=	STP Test Refusal Length
⊕	=	Bore Hole Location
▽	=	Goundwater measured in the bore hole
00.00'	=	Elevation
MM/DD/YY	=	Date of measurement

Figure 3-10 Legend and Notes

The workspace contains a legend of commonly used symbols and their descriptions. When placing the legend, only include the items found on that sheet.

A set of standard notes are included in the workspace to provide further project information. Notes may be edited to address project specifics and can be added to, or deleted from, at the discretion of the project Geologist. Notes clearly convey project specific information.

Detail sheet

Sections and Cross-Sections

Sections and cross-sections help with the analysis of complex subsurface conditions. Sections are required for all landslides and cuts/embankments that require subsurface exploration. Cross-sections should be considered for wide or skewed structures, structures founded on spread footings, and where variable-lengths of deep foundations result from high local relief or geologic structure.

Plan views may be shown on section and cross-section sheets where needed. Sections and cross-sections may be shown on plan and profile sheets when space allows.

When section sheets are used, the section line should be shown on the Plan View of the primary geotechnical data sheet and labeled with the appropriate section arrow and designation.

Sections and cross-sections should include the existing ground line along the section and the graphic columns showing the subsurface conditions as described in the preceding PROFILE VIEW section. Sections should also be drawn on a grid with the elevations labeled on the left and right side of the grid and the horizontal offset from centerline labeled on the bottom of the grid. Grid lines may be faded back to avoid conflict with graphic columns showing geologic interpretations or the various graphic column labels.

Cross-sections developed perpendicular to the centerline alignment may be labeled as "SECTION 'Station' ". Sections developed at any angle other than perpendicular should be labeled as "SECTION 'alphabetic letter – alphabetic letter' "(i.e. A-A).

Section 3-3 Check List

The drafting check list below contains all items to be included on Geotechnical Data sheets. (Depending on the project, some items may not apply).

- ☐ Border, title block, sheet title, sheet number
- ☐ Title block information complete
- ☐ Professional of record stamp
- ☐ "V" number or project status stamp
- ☐ Index sheet (if needed)
- ☐ Plan view
- ☐ Profile/section view(s)
- ☐ North arrow
- ☐ Scales noted
- ☐ Existing roadway
- ☐ Existing structures (e.g. bridge, culvert, wall, sign bridge, etc.)
- ☐ Existing utilities
- ☐ Existing contours
- ☐ Contours labeled
- ☐ Bore hole locations with labels (including station and offset)
- ☐ Proposed roadway with alignment and stationing
- ☐ Proposed structures
- ☐ Proposed utilities
- ☐ Proposed contours
- ☐ All structures labeled with assigned structure numbers
- ☐ Waterway(s) labeled and flow direction shown
- ☐ Right-of-way lines
- ☐ Temporary construction easements
- ☐ Construction limits
- ☐ Graphic columns and labels
- ☐ Groundwater marks
- ☐ SPT marks
- ☐ Cross section(s)
- ☐ Detail(s)
- ☐ Legends, notes, unit descriptions and core tables

Section 3-4 Example Drawing(s)

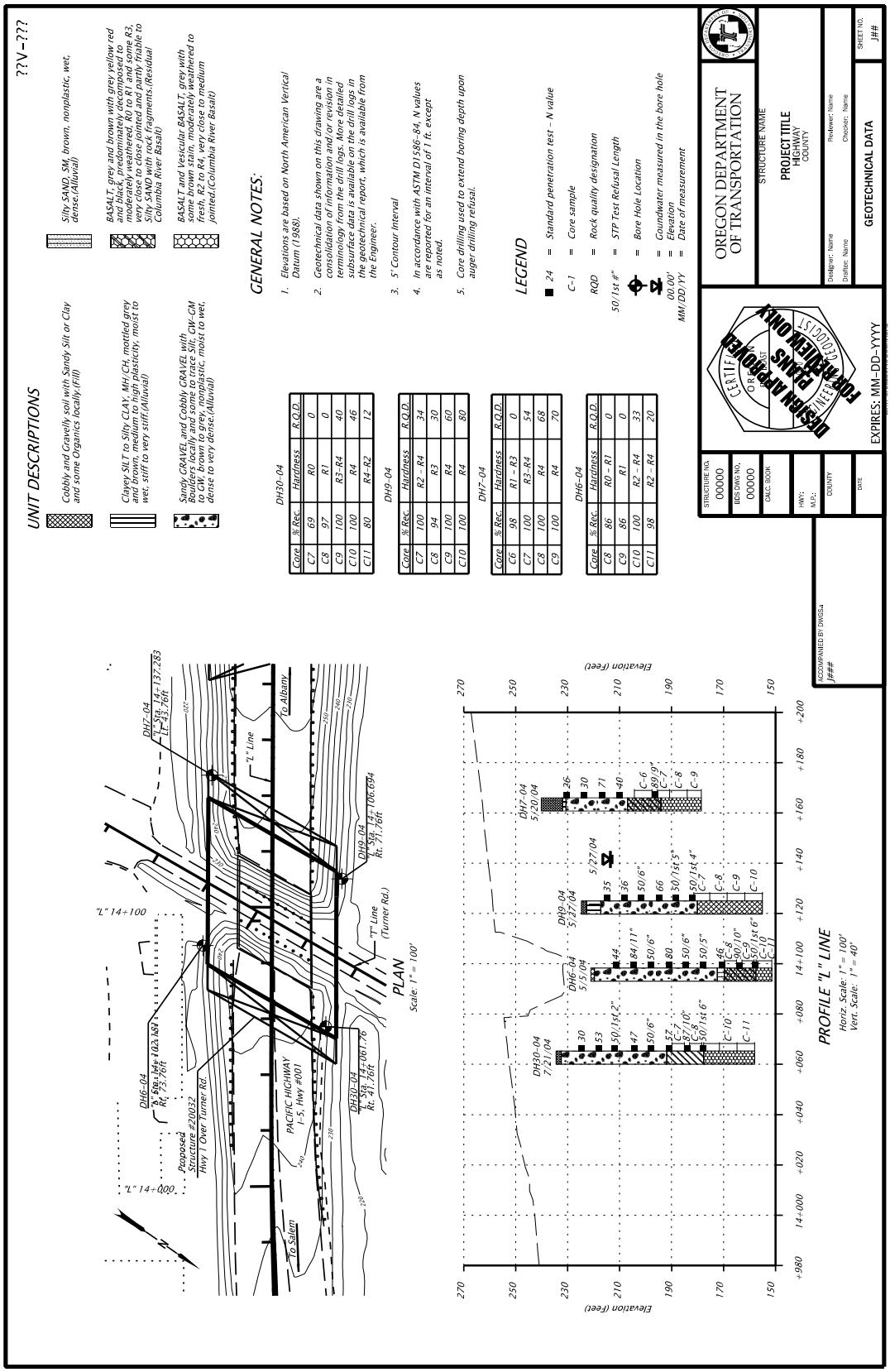
The following Geotechnical Data example drawings demonstrate typical sheet layouts with regard to the placement of project exploration data and the key CAD components.

These drawings are provided as a guide for developing final Contract Plans and not all project scenarios are covered. Drawings have been taken from miscellaneous ODOT projects, reviewed for accuracy and readability, and updated to meet current design and drafting standards. Due to these changes, all project information has been removed from each drawing rendering them usable only as examples of the required CAD and drafting standards.

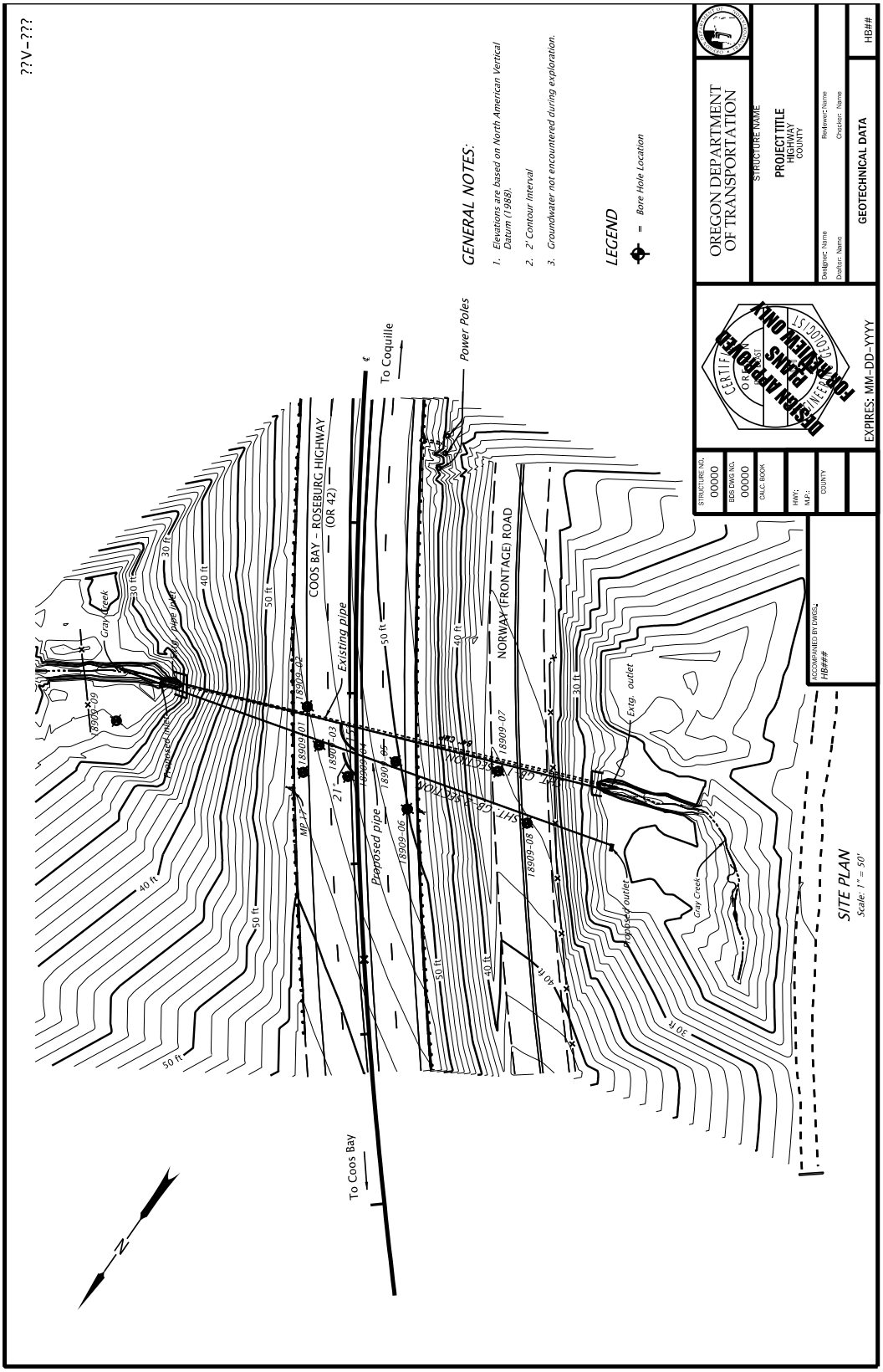
Refer to the MicroStation workspace for the most recent CAD standards components available.

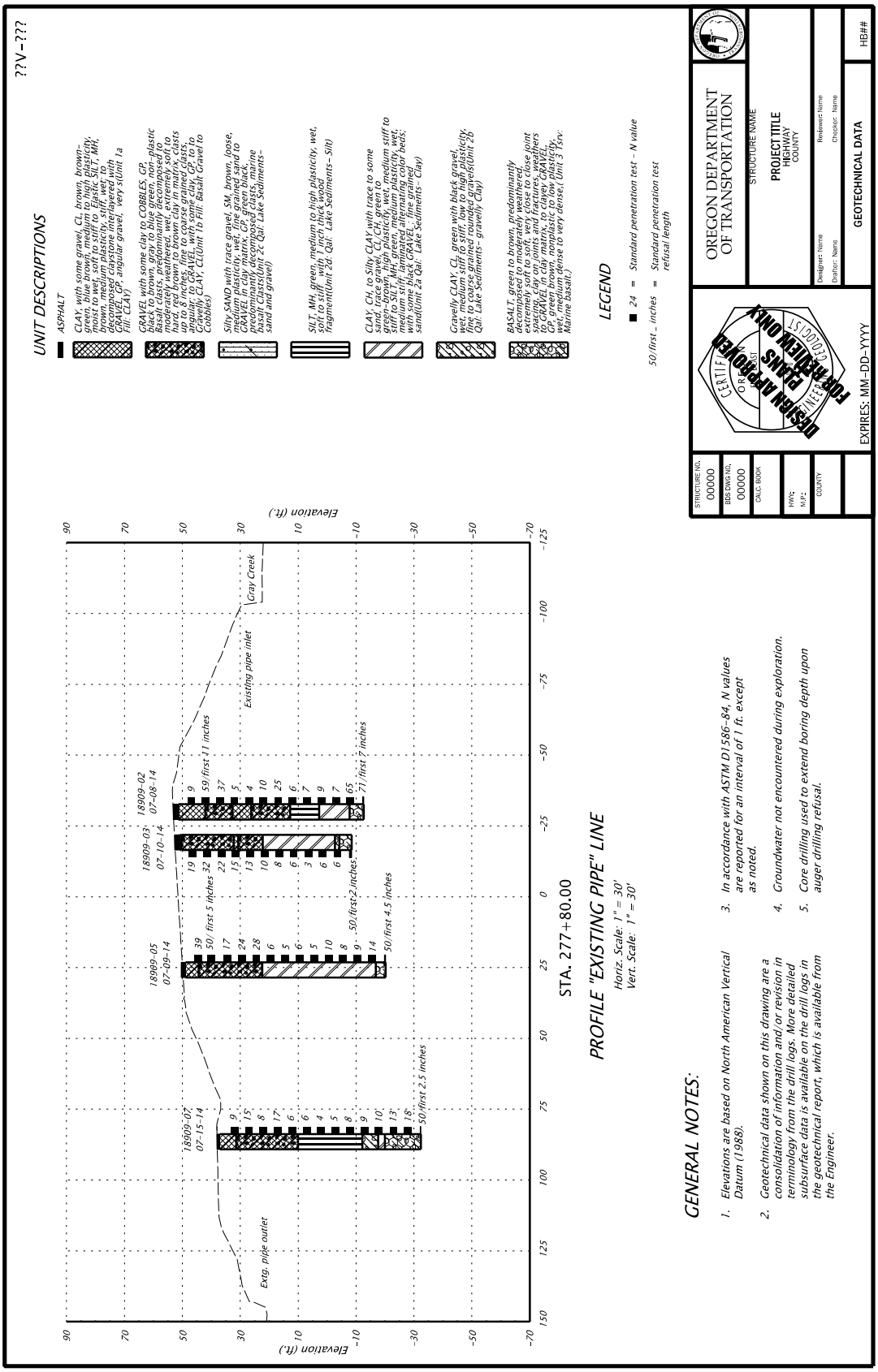
GHE discipline specific program leads and the GHE drafting program lead are available to help resolve any standards issues not covered by this or other manuals. Contact information on Geo-Environmental website.

Example Bridge Geotechnical Data Sheet

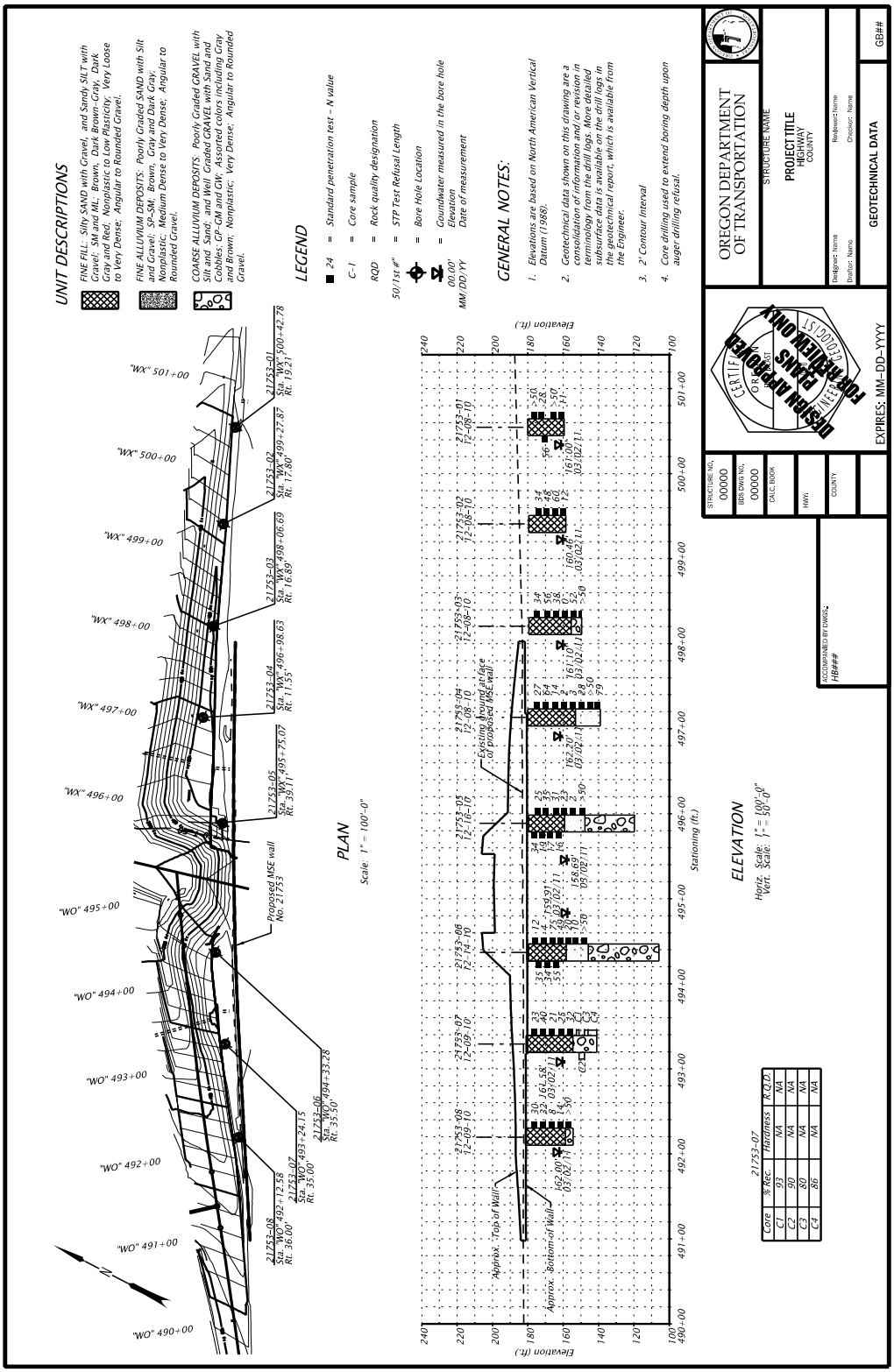


Example Culvert Geotechnical Data Sheets (2 sheet plan set)




??V-???
UNIT DESCRIPTIONS
ASPHALT
CLAY, with some gravel, CL, brown, brown-green, blue brown, medium to high plasticity; stiff to very stiff, moist to wet; SILT, MH, brown, medium plasticity, stiff, wet, to decomposed claystone interlayered with CLAY, CP, angular gravel, very stiff (Unit 1a Fill: CLAY)
GRAVEL with some clay to COBBLES, GP, black to brown, gray to blue green, non-plastic basalt clasts, predominantly decomposed to moderately weathered, wet, extremely soft to very stiff, clayey matrix, to moderately hard clasts up to 8 inches, fine to coarse grained clasts, angular, to GRAVEL, with some clay, GP, to Cobbles) CLAY, CL(Unit 1b Fill: basalt Gravel to
Silty SAND with trace gravel, SM, brown, loose, medium plasticity, wet, fine grained sand to medium grained sand, trace fine grained basalt clasts, predominantly decomposed clasts, marine sand and gravel)
SILT, MH, green, medium to high plasticity, wet, soft to stiff with 1 inch thick wood fragment(Unit 2d: Qal: Lake Sediments- Silt)
CLAY, CH, to Silty CLAY with trace to some sand, trace gravel, CL, CH, green to green-brown, high plasticity, wet, medium stiff to stiff to SILT, MH, green, medium plasticity, wet, with some black GRAVEL, fine grained sand(Unit 2a Qal: Lake Sediments- Clay)
Gravelly CLAY, CL, green with black gravel, wet, medium stiff to stiff, low to high plasticity, with some black GRAVEL, fine grained sand(Unit 2b Qal: Lake Sediments- gravelly Clay)
BASALT, green to brown, predominantly decomposed to moderately weathered, extremely soft to very hard, close to close joint spacing, clay on joints and fractures, weathers to GRAVEL in clay matrix, to clayey GRAVEL, CP, dense to very dense, wet, low to high plasticity, wet, (medium dense to very dense(Unit 3 Tsrv: Marine basalt.)
LEGEND
24 = Standard penetration test - N value
50/first _ inches = Standard penetration test refusal length
Elevation (ft.)
Exist. pipe outlet
Existing pipe inlet
Gray Creek
18909-07 07-15-14
18909-05 07-09-14
18909-03 07-10-14
18909-02 07-08-14
50/ first 5 inches
50/first 2.5 inches
50/first 4.5 inches
50/first 2 inches
59/first 11 inches
71/ first 7 inches
STA. 277+80.00
PROFILE "EXISTING PIPE" LINE
Horiz. Scale: 1" = 30'
Vert. Scale: 1" = 30'
GENERAL NOTES:
1. Elevations are based on North American Vertical Datum (1988).
2. Geotechnical data shown on this drawing are a consolidation of information and/or revision in terminology from the drill logs. More detailed subsurface data is available on the drill logs in the geotechnical report, which is available from the Engineer.
3. In accordance with ASTM D1586-84, N values are reported for an interval of 1 ft. except as noted.
4. Groundwater not encountered during exploration.
5. Core drilling used to extend boring depth upon auger drilling refusal.
OREGON DEPARTMENT OF TRANSPORTATION
STRUCTURE NAME
PROJECT TITLE
HIGHWAY
COUNTY
GEOTECHNICAL DATA
HB##
STRUCTURE NO.: 00000
BDE DWG NO.: 00000
CALC. BOOK
HWY:
MP:
COUNTY
EXPIRES: MM-DD-YYYY
DESIGN APPROVED FOR REVIEW ONLY
Designer: Name
Reviewer: Name
Drafter: Name
Checker: Name

Example Wall Geotechnical Data Sheet



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Hydraulic Engineering and Environmental Services Section, MS#6

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