M E M O

TO: CADD Users

FROM: CADD Committee; Ron Henke (chairperson), Jon Collado, Diane Gunsch,
             Nancy Horner, Diane Laub, DeLane Meier, Brian Raschke and Joyce Schmidt
             (secretary)

DATE: July 26, 2007

SUBJECT: CADD Standards Implementation

The North Dakota Department of Transportation (NDDOT) wants to stress the importance of
following the CADD Standards. These standards increase the readability and consistency of
design plans. When the format is consistent, readers can find information quicker and a standard
level of professionalism is met and maintained.

CADD Standards are also needed for automation. CADD Standards allow applications such as
MicroStation and GEOPAK to work together. CADD tools and settings can be adjusted for one
particular way of drawing and designing. These tools can be set up once and used on multiple
projects. In order to make the most of these tools, the CADD Standards need to be used. The
NDDOT is expecting full implementation of the standards. **The CADD Standards must be
followed.**

If you are having difficulties applying the CADD Standards to a particular task, please contact
the CADD Specialist or a CADD Standards Representative.

20/jdc

CADD Standards

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CADD Standards

Support

1.1   Manuals and Tutorials
Nov 2017

Internet Resources

This manual, **CADD Standards** manual, is available on the Internet: www.dot.nd.gov/manuals/design/caddmanual/caddmanual.pdf. Users should review this web site for all future revisions.

The **Procedures for Calculating Final Earthwork Quantities** manual is available on the Internet: www.dot.nd.gov/manuals/design/caddmanual/nddot-procedures-for-calculating-final-earthwork-quantities.pdf.

The OpenRoads Fundamentals (NDDOT version) is a guide for using station, offset and elevation with civil geometry and corridor modeling. www.dot.nd.gov/manuals/design/caddmanual/OpenRoads%20Fundamentals%20for%20Reviewers.pdf

The "How to Check Supplemental Design Data" guide provide recommendations for reviewing model information that is provided to contractors. www.dot.nd.gov/manuals/design/caddmanual/How%20to%20check%20Supplemental%20Design%20Data.pdf

NDDOT Server Network Resources

Axiom manuals are located under their respective folders under M:\APPS\Production\Design\AxiomV8.

A variety of "How To" reference videos and guides are available under S:\SUPPORT\How_To.

Chapter 21 –Surveys and Photogrammetry, CADD Editing, is available at S:\SUPPORT\Teams\Survey\NonMicroStationData\DraftingStandards\Level_1\CH21 CADD Editing Standards.pdf

CADD Standards

1.2   The CADD Specialist and Support Contacts
Jan 2019

The CADD Specialist (Jon Collado, 328-4439) provides technical engineering related support for CADD programs. His other duties include:

>   Researching and maintaining CADD technologies
>   Providing application specific training
>   Coordinating engineering related standards development and implementation

The CADD Specialist is the primary contact for technical engineering related CADD support questions. Support from co-workers is also important. Here is a list of other users who may be able to help you:

Survey:
Troy Zornjak

Alignments:
Monte Deis, Jeff Rensch

Earthwork:
Monte Deis, Jeff Rensch

Corridor Modeling:
Darell Arne

MicroStation:
Travis Cork, Kris Altepeter, Chad Frisinger

Information Technology:
Nicholas Hanson

Adobe Acrobat:
Travis Cork, Garrett Hartl

GuideSign:
Travis Cork

CADD Standards

1.3   Standards Committee

Jan 2019

Members: Jon Collado (chairperson), Brian Raschke, Troy Zornjak, Travis Cork and Monte Deis

The Standards committee is responsible for developing, maintaining, documenting and providing training for the NDDOT CADD standards. The standards committee is not responsible for enforcing the standards. If a user has a problem or cannot use one of the standards, they should contact the CADD support specialist.

CADD Standards

Project Administration

2.1   Project Directories
Jan 2019

The sharing of information is a vital part of the success of a NDDOT project. Thus, when a new project begins, a centralized directory structure is needed. Since it is important that data is shared but not corrupted by unauthorized users, the Department has established a standard procedure for directory creation and file naming.

Users should contact the "Help Desk" within the Information Technology Division if they need to set up a new project directory. Users should contact the "Help Desk" by email (-grp-dot Help Desk). The email request should include the project number. The Help Desk will setup the standard root directories on the central CADD server. NDDOT project numbers consist of a funding code, district, highway, agreement number, and mile point. A typical number may be: NH-8-013(031)389. The directory created for this project would be as follows: r:\project\80013389.031.

Each directory has the appropriate security access set by division. Thus, Bridge staff is only allowed write access to the Bridge subdirectory. Other directories will be "read only" for Bridge staff. The directory under the r:\project\80013389.031 directory would consist of the following subdirectories:

As-built	(Assigned District or Construction Division)
Bridge	(Bridge Division)
Consultant	(Hired Consultant Firm)
Design	(Roadway Design Sections)
District	(Any of the 8 District offices)
ePlans	(Electronic Plans)
ETS	(Environmental and Transportation Services)
Material	(Materials & Research Division)
Resources	(common resources such as old plans)
ROW	(Right of Way Section)
Survey	(Surveys and Photogrammetry Section)
Traffic	(Traffic Section)
Utilities	(Technical Support Section, Utility Coordination Plans)

Computer Services has optimized levels of security so that project related folders, up to and including the above root directories, cannot be deleted or edited. However, any folder can be created by an individual user, past that level. Obviously, users need to follow certain conventions of folder and file naming in order to effectively communicate with others.

CADD Standards

Under each of these root directories, there are unique folders that describe the specialized operations of these users. For example, the users in Surveys and Photogrammetry would use the following directory when they are working on electronic field book data: r:\project\80013389.031\survey\EFB.

The following are recommended subdirectories:

As-built
- Sheets

Bridge
- (Subdirectories for each structure, name based on structure number)

Consultant
- As-built
- Bridge
- Design
- Material
- ROW
- Survey
- Supplemental Design Data
- Traffic

Design
- Base (dgn)
- DCE/PCE (Environmental)
- Photos
- Sheets
- Supplemental Design Data

District
- Sheets

Material

ROW
- Sheets

Survey
- Compilation
- Consultant
- EFB
- Photos_Scans

Traffic
- Sheets
- Photos

Utilities

ePlans
- Addendum
- Asbuilt
- Final
- Plan_Rev
- Preliminary
- PS_E

CADD Standards

The ePlan directory is used for managing Adobe PDF files. Under the ePlan directory, subfolders are used to organize pdf files created at particular phases of project development.

Project Development Phase	Directory Name
Preliminary Project Reviews Conducted before the PS&E	Preliminary
Comprehensive Review of Plans Specifications Estimates done approximately one month before the plan completion deadline.	PS_E
Original version of plans first posted on the internet	Final
After final plan completion and before the bid opening	Addendum
After the bid opening, often used with change orders	Plan_Rev

The Consultant directory is not automatically created. If consultants are involved on a project, The Technical Support person should contact the help desk to have the consultant folder added. Technical Support will have write access to all subfolders. Surveys and Photogrammetry will a write access to the "consultant\survey" subfolder.

Occasionally, some projects are not associated with a project number. The project may not be adjacent to a highway such as a wetland mitigation project. Miscellaneous projects that don't have standard project numbers should be stored in a subdirectory under R:\project\misc\. A brief project description could be used as the project subdirectory name. The sub directory structure will be set up the same as a normal project. Users should call the help desk to get a base subdirectory created.

Right of Way plots that are not associated with a highway project are stored in the "R:\project\PLATS_misc\" directory.

CADD Standards

Consultants

Consultants shall set up and use a directory structure similar to the Central Office.
1. Create a project folder using the NDDOT Standard directory structure. Consultants can revise the server or drive designation as they need (example: x:\NDDOT\project\80013389.031). Everything after the project number (example: 80013389.031) must be setup the same as the NDDOT standard project directory.
2. Work in this directory.
3. When a project is complete copy the files to a CD or DVD.
4. If an entire project has been completed for the NDDOT (including design details), the files should be sent to your respective Technical Support Contact within the Design Division.
5. If only the survey work is to be done by a consultant, the files should be sent to Surveys and Photogrammetry Section Leader.
6. Dependent on steps 4 and 5, the Technical Support Contact or the Survey and Photogrammetry Section Leader will import the project information to the r:\ drive and re-path reference files with Axiom Reference Manager.

All users, especially District and Consultant users, need to use the "Save Relative Path" options when referencing files. The "Save Relative Path" option will help keep the reference path integrity when the files are moved from one drive to another.

CADD Standards

2.2   File Naming Conventions

Sept 2015

MicroStation drawing names have been standardized for easy, quick and consistent identification and they have been standardized to ease the preparation of plan plot sets. Standard names also apply to non-drawing files that are used in a plan plot set. This section applies to names of original files. For names of the pdf plan sets, see *Section 2.9*

Standard drawing names can be made up from 4 parts; prefix, plot number, suffix and suffix modifier. The following drawing name is in accordance with the standards:

004SW_002_SCOPE.dgn

In this example the "prefix" is **004SW**, the "plot number" is **002**, and the "suffix" is **SCOPE**. Note the underscore characters are standard name dividers. They are used after the prefix, plot number and between the suffix and suffix modifier. The example standard name doesn't use a "suffix modifier".

The "prefix" is used to divide and organize plot sets into sections. The prefix is required for all drawings that are going to be directly incorporated into a plot set for plan production. These plots are used to directly print a sheet in the plans. The prefix should not be used for a referenced drawing that is indirectly included in the plans. For example, topog information include in the plans is indirectly included in the plans because it is a referenced drawing. The topog drawing should not have a prefix. The topog drawing would just be named TOPOG.dgn.

Appendix A lists the current standard drawing names. Check the appendix to find the correct naming convention when creating a new file.

The NDDOT also has a custom macro that can be used to create a new drawing with a standard name. This macro creates a new drawing as you look up the standard name. The Macro is activated through the main NDDOT pull down menu in MicroStation. It is named "New File".

The macro accommodates suffix modifiers and the page number within section. User will be prompted for this information through a dialog box.

The new file will be created in the present drawing directory. This macro doesn't provide options to create drawings in other directories.
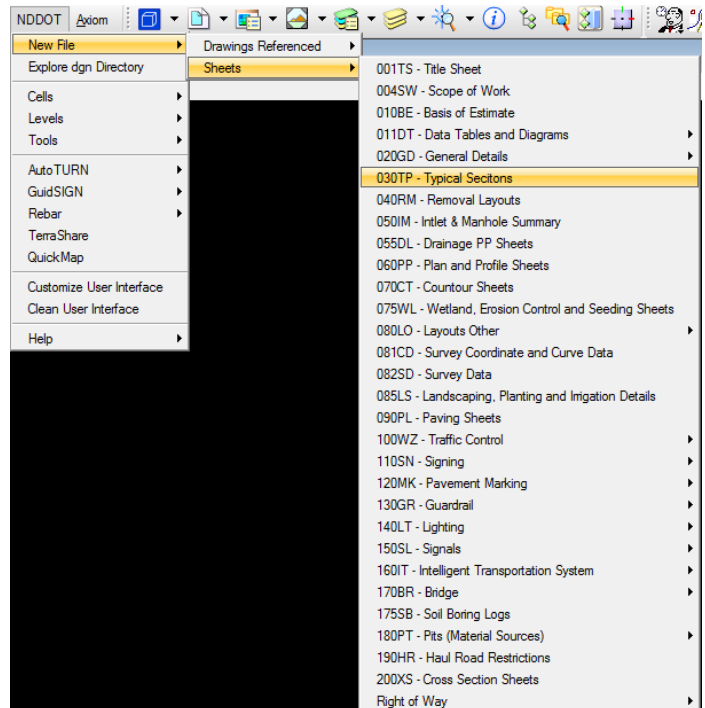
CADD Standards

Some other features of this macro include a safeguard to prevent creating a drawing that already exists (overwriting a file). Different seed files are used based on the type of drawing selected.

One limitation to this macro is metadata. This macro actually uses a file copy and open command in the background. The file metadata is not rest with a copy command. Some properties such as author, logged edit time and number of revisions will not be reset. These properties don't affect file performance and metadata is presently not a CADD Standard.

Please contact the CADD Specialist (see *Section 1.2*) if you need a file name that doesn't fit the existing naming standards.

The table on the following page lists standard sheet name prefixes.

CADD Standards

Section Number	Section Description	Sheet Name Prefix
001	Title Sheet	001TS
002	Table of Contents	002TB
004	Scope of Work	004SW
006	Notes	006NT
008	Quantities	008QS
010	Basis of Estimate	010BE
011	Data Tables (Concrete Pavement Repair Locations, Coring Data, Salvaged Base Summary, Earthwork Summary, Mass Diagram, etc)	011DT
020	General Details, Super Elevation Tables and Layouts	020GD
030	Typical Sections	030TP
040	Removals	040RM
050	Inlet & Manhole Summary, Culvert Hydraulic Data	050IM
051	Allowable Pipe List (Pipe Policy)	051AP
055	Drainage Layouts (Separate Plan and Profile Sheets for Drainage Items, Use When PP Sheets too Crowded)	055DL
060	Plan & Profile	060PP
070	Contours	070CT
075	Wetlands, Mitigation and Environmental	075WL
076	Temporary Sediment and Erosion Control	076TE
077	Permanent Sediment and Erosion Control	077PE
080	Layouts (Fencing and Miscellaneous Layouts)	080LO
081	Survey Coordinate and Curve Data	081CD
082	Survey Data Layouts	082SD
085	Landscaping	085LS
090	Paving Layouts	090PL
100	Work Zone Traffic Control	100WZ
110	Signing	110SN
120	Marking	120MK
130	Guardrail	130GR
140	Lighting	140LT
150	Signals	150SL
160	ITS	160IT
170	Bridges & Box Culverts	170BR
175	Soil Boring Logs	175SB
180	Pit Plats and Borrow Areas	180PT
190	Haul Road Restrictions	190HR
199	Tied Plans Not Contractually Requiring NDDOT CADD Standards	199TI
200	Cross Sections	200XS

Note, If Signing and Marking are on the same layout sheet use section 110-Signing

CADD Standards

Information that is included in sections 040 Removals, 055 Drainage Layouts, 080 Layouts, 085 Landscaping, and or 090 Paving Layouts can be included in section 060 Plan and Profile instead of segregating information in their respective drawings. If the plan and profiles don't have enough space to clearly communicate details, additional sections, such as 040, 055, 080, 085 and 90 should be used.

The "plot number" is used to organize drawings within a section (prefix) of the plans. When plot numbers are used, they should start out at 001 for each section and increment up through the end of the section. Plot numbers are used to organize sheets within a section. They are not intended to be the sole tool to organize all the sheets within a plan plot set.

For example plan and profile sheets could be organized so that mainline plan and profile sheets are before side street plan and profile sheets. A project may have 7 mainline plan and profile sheets and 4 side street plan and profile sheets. The mainline sheets could be numbered 001 through 007 and each specific side street sheet could be organized by the next plot number. The sheet that directly precedes the mainline plan and profile sheet would be numbered 008, the next sheet would be numbered 009 and so on. Note: the plot number should be named with three characters for sorting purposes. Zeros should be used as place holders for plot numbers less than 100. The text "2" is after the text "002". The text "2" is also after the text "003".

Leading zeros should not be used in the sheet title block for section and page number.

Plot numbers are not needed for drawings that are not directly used for plan plot sets. They are optional for drawings that are directly used for a plan plot set if the full drawing name is sufficient to sort the names in the correct order. Example: a drawing that is the only drawing within the section would not need a plot number. A plan plot sets may not need a "plot number" for the "Scope of Work" sheet if it is the only sheet in the section. There are no other sheets within the "Scope of Work" section to organize.

The "suffix" part of the name is used to identify a sheet within a section by content. For example there are many different types of Data and Table sheets. Several are in section 011. However users need a suffix to distinguish by name the Coring Data Sheets from the Earthwork Summary Layout sheets. For drawings that are not directly included in a plan plot set (a referenced drawing), the suffix part of the name is the same as the name of the drawing. Example the drawing named TOPOG.dgn has a suffix that is the entire name.

Suffix modifiers may be added after the suffix to give additional distinction to a standard drawing name. Suffix modifiers are usually optional. They are only mandatory for as-builts, addenda and change orders (see sections 7.1 and 7.4). If used, they should be based on the information in the drawing. Users are to use their discretion when creating a suffix modifier. Example, construction sign layout sheets may have suffix modifiers to indicate the phase and location. The following drawing name is an acceptable standard name: 100WZ_012_CS_Phase1EighthSt.dgn. The suffix is CS and the suffix modifier is Phase1EighthSt. Suffix modifiers can be used with any drawing name.

2.3   AAREADME File and Directory Cleaning

July 2007

The AAREADME file should be an ASCI text file that helps users find data within a project folder. Each folder within a project directory should have an AAREADME file in it. This file is simply a text file that describes the folder contents.

All AAREADME files should contain:
1. Directory being described
2. Project Number(s)
3. PCN Number
4. Brief Project Description
5. Drawings that do not use the standard naming convention should be listed in the AAREADME file. This list should also be submitted to a CADD Standards representative in order to correct any deficiency with the Standard Naming Convention.
6. List files that should not be archived. List or group files to be deleted after plan completion, like conceptual drawings.
7. If a project was abandoned or shelved, a history of what was designed should be detailed.

AAREADME files for the Survey folder should also contain:
8. County Name
9. File Index
    a. File Name
    b. Progress
    c. Description
10. Journal (in paragraph format)

It might include a dated description of how the data was collected, where it came from, or what needs to be done in the future. Each entry should be dated and the author should attach their name to the information in case someone has questions.

AAREADME files for Design, Traffic and District folders used for design work should also contain:

11. Name of designers who worked on the files within the directory
12. Multiple gpk explanation (If multiple GPK files were used within one directory explain why.)
13. Provide a key for correlating alignments (chains and profiles) This key should describe what chains were used with what profiles
14. Explanation of Sub (children) directories.

CADD Standards

Example for a Survey Folder

R:\project\70002091.065\SURVEY\EFB>

NH-7-002(065)091

PCN 14794

Reconstruction, Palermo Section, Stanley, east 10 miles

Mountrail County

2dBdy.dgn
       Complete   EFB data and user information
Aareadme.txt
       Complete   this document
bdy91001.ind
       Complete   GPK input file for Hwy2
Efb-Top2
       TEMP DEL   Work file additional Topo data
Efb-Top3
       TEMP DEL   Work file additional Topo data
Efb-Bdy.dgn
       In Progress   EFB Bndry data; EFB data from January 2nd needs to be added.
Efb-Top.dgn
       Complete   EFB Topog data; includes side road extension at station 154+65 Left.
Job001.gpk
       N/A   Contains current alignment. EFB data from January 2nd will need to be added.

18 March '04 [J. Doe]..… Tammy Doe e-mailed in five (5) .dat files, and an excel file with the observation of the station information. These data files are the GPS observations of the control points for the above said project. I sent these .dat files into the NGS OPUS processing center and received back the OPUS derived coordinates. The dat files and opus results (*.doc) documents can be found under ….

25 March '04 [E-mail from ABC engineering]
Good Morning John,

We have completed the first segment, project number PCN14794. There are several things to note. I changed the point numbers of the targets we discussed last week. Point numbers 312 and 313 had already been used for … Tioga and heads east next week. Thanks for all your help.

Tim Smith, ABC Engineering
(701)555-1234

CADD Standards

Example for the Design, Traffic or District folders used for design

R:\project\30002269.065\D_URBAN

CMU-3-002(065)269

PCN 12345

Hwy 2 through the City of Devils Lake – Reconstruction

Files that should not be archived
 All of the files in the "design\temp" folder should be deleted after final plans have been submitted.

Designers
John Doe
Mary Jane

GPK – 001 was used by Design in the Central Office. GPK -002 was used by a consultant for the tied city project (9th Street)

ALIGNMENTS KEY

HORIZ	EXIST-V	PROP-V	ROADWAY
BASE01			N-S SECTION LINE (NEW STA - S TO N)
BASE64			N-S SECTION LINE (OLD STA - N TO S)
PROP01	EXSR01	VER01	WEST SR 34TH AVE END PROJECT 119+00
PROP02	EXML02	VER02	WEST MAINLINE ROADWAY
PROP03	EXML03	VER03	EAST MAINLINE ROADWAY
PROP04	EXSR04	VER04	EAST SR 36TH AVE TO 32ND AVE
PROP05	EXSR05	VER05	EAST SR 32ND AVE TO END PROJECT 119+00

Sub (children) directories
 The "sheet" directory was used for plan cut sheets. The "details" directory was used for plan details.

CADD Standards

Directory Cleaning

CADD Files should be cleaned (organized and purged) regularly during project development. Some CADD files should also be purged after the following milestones:

1. Final Plans Have Been Submitted
2. Final Construction Records Have Been Completed (including as-built drawings)
3. Three Years After Project Completion – Final Construction Records Have Been Completed.

Preliminary files that were only used for conceptual planning, like environmental documents, should be kept through the design phase. The main environmental document should be stored on FileNet. However, most conceptual planning documents on the r: drive should be purged after the **Final Plans Have Been Submitted** for construction.

Microsoft Word and other word processing documents should also be purged after the **Final Plans Have Been Submitted** for construction. Only documents that directly support the plans, like plan notes, should be archived in the project directory. Other documents such as correspondence and reports should be in FileNet. These documents should not be archived with the project directory.

The only conceptual drawings that should be kept after the final plans have been submitted are drawings that were displayed at a public meeting. Drawings displayed at public meetings should be kept until **Three Years After Project Completion** and then discarded. Drawings displayed at public meetings should be grouped in a project sub directory for easy identification and protection (example r:\project\30002269.080\DESIGN\Public Hearing\). Remember that drawings displayed at public meetings should not be edited after the meeting. You must keep an unedited version of the drawings (including reference files). All files stored in a directory named like "Public Meeting", "Public Input", "Public Hearing" or "Public Information" will be deleted three years after the project is completed.

After the **Final Plans Have Been Submitted**, the only files that should be in the design folder are files that directly support the final plans. Temporary files and files detailing alternates that were not advanced should be deleted after the final plans have been submitted. Alternates or options advanced as part of the plans (bidding options like a steel bridge vs. a concrete bridge) should be archived.

Consultants submitting final plans should clean the project directory before the electronic files for final plan submittal are packaged and delivered to the NDDOT.

CADD Standards

After the construction records have been completed (at the time the project is moved near-line) some supporting project files may be deleted from the project by the Information Technology Division. The following list of files that will be deleted at this time.

*.x, *.rx	GEOPAK Criteria Files
*.inp	Input files used mostly for GEOPAK
*.jou	GEOPAK journals
*.bak	Backup files
Projdbs Directory	GEOPAK Project Manager directory
*.ind	User input files used for GEOPAK
.lis,.btb *.rtb	Files used for blue top books – slope stakes
*.ond	User cogo output files used for GEOPAK
*.log	Log files
*.cel	Project cell libraries

CADD Standards

2.4   Standards Directory

Jan 2017

Here is a summary of the "NDDOT Standards Directory". Files stored in this directory are used to configure many of the operations performed in MicroStation, and GEOPAK. More extensive descriptions of their functions are contained in the *Section 2.5*.

Description	Directory
Bentley View Setting Files	S:\STANDARD\ **BENTLEYVIEW**
Axiom Support Files	S:\STANDARD\ V8I \ **AXIOM**
Geographic Coordinate Systems	S:\STANDARD\ V8I\ **BENTLEY_MAP**
Cell Libraries	S:\STANDARD\ V8I\ **CELL**
Configuration Files	S:\STANDARD\ V8I \ **CFG**
Spell checker Dictionaries, Border Sheet Tags, and Scale definition	S:\STANDARD\ V8I \ **DATA**
OpenRoads Data	S:\STANDARD\ V8I \DATA\ **Civil**
DGN Libraries	S:\STANDARD\ V8I \ **DGNLIB**
Set Up Configuration, Preference Files	S:\STANDARD\ V8I \ **INSTALL**
Interface Files	S:\STANDARD\ V8I \ **INTERFACE**
MDL Applications	S:\STANDARD\ V8I \ **MDLAPPS**
MicroStation Macros	S:\STANDARD\ V8I \ **MACROS**
Central Office Plot Divers	S:\STANDARD\ V8I \ **PLOTDRV**
Seed Files	S:\STANDARD\ V8I \ **SEED**
line styles, fonts, color table	S:\STANDARD\ V8I \ **SYMB**
Visual Basic	S:\STANDARD\ V8I \ **VBA**
GEOPAK Criteria Files	S:\STANDARD\ V8I \GEOPAK\ **CRITERIA**
GEOPAK D&C Manager	S:\STANDARD\ V8I \GEOPAK\ **DCMAN**
GEOPAK Sheet Files	S:\STANDARD\ V8I \GEOPAK\ **SHEETS**
GEOPAK Super Elevation Files	S:\STANDARD\ V8I \GEOPAK\ **SUPERELEVATION**
GEOPAK Survey Support Files	S:\STANDARD\ V8I \GEOPAK\ **SURVEY**

2.5 Configuration Settings, Preference Settings, and User Interface
Jan 2019

Having the correct settings is required to use the NDDOT standards properly. Details of some of these settings will be discussed shortly. But for many users, the following summary will suffice.

For most NDDOT users, the standard configuration, preference and setting files should be correctly set up by support staff. Most of the CADD standard files are linked to the s:\ drive. Typically if one standard setting is set up correctly, they all will be correctly set.

Most users can typically tell if their computer is set up correctly by doing the following:
1. Open MicroStation
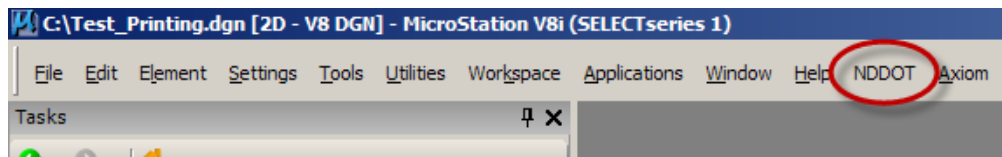
2. The main menu should have a "NDDOT" pull down menu. If you can see this, everything is probably installed correctly.

Default Directories

Most user workspace files have been moved to "**C:\NDDOT_CADD\s_drive\Support\users**". A subdirectory named after your user name should have been created under this directory. In this explanation "jcollado" is used. But, everyone will have their own unique name. CADD standards have been created to help you leverage this directory without having to adjust configuration files.

The directory "c:\NDDOT_CADD\" has been structured the way it is for a couple reasons:
1. Modified local CADD files are grouped together for easer management. This standard workspace area helps automate many user processes.
2. Files are grouped for easier portability. MicroStation-Geopak, NDDOT CADD Standards and project information can be used locally, such as on a laptop –that is disconnected from the network. See NDDOT CADD Standards for "Taking Electronic Drawings into the Field".
3. Files are grouped the way they are to copy some of Bentley's default paths.
4. Files are grouped the way they are to enable networked workspaces. A very small group of users keep workspace settings under "s:\Support\Users\". Guidance for these users is not discussed in this reference.

Your default user name and interface should be setup for you. These settings should be named after your user ID.

CADD Standards
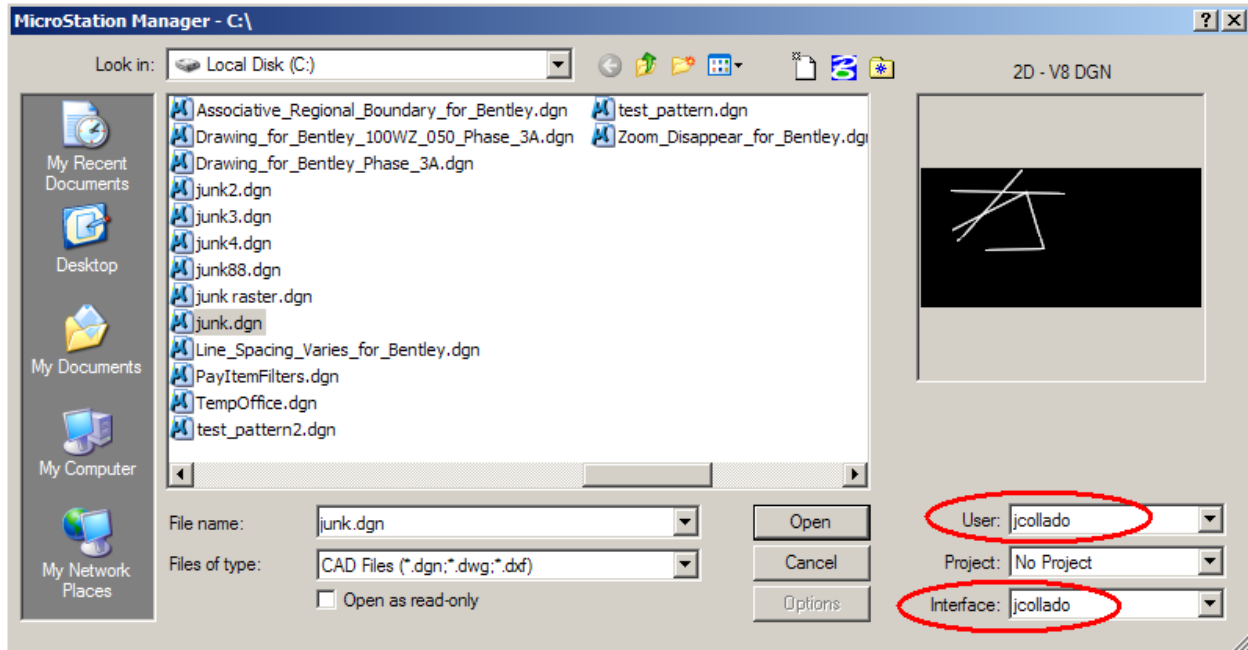
Note, when you log on to your computer (log on to windows) use lower case. The text case isn't important for Windows but it is important for MicroStation (example, "jcollado" is not the same as "Jcollado").

User Configuration Files

Your user configuration file is named after your user id and is stored in the "user" sub directory (example, C:\NDDOT_CADD\s_drive\Support\users\jcollado\V8i\Users\jcollado.ucf). Note, a user may have more than one set of user configurations. Example, a user may have another configuration file for the "Image Viewer" Application (C:\NDDOT_CADD\s_drive\Support\users\jcollado\ V8i\Users\iv.ucf).

CADD Standards

Cells

If you put personal cell libraries in the cell directory (example, C:\NDDOT_CADD\s_drive\Support\ users\jcollado\ V8i\cell), they will automatically be added to your cell list. You should not have to search for your personal cell libraries.
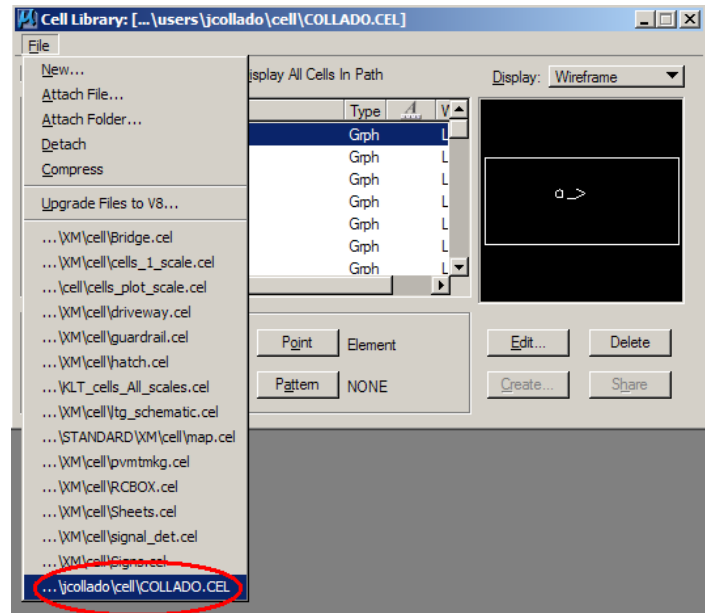
Interfaces (Menus and Tools)

If you create a dgnlib for custom menus and tools for personal use, it should be stored in your interface directory for MicroStation under the appropriate user subdirectory (example, C:\NDDOT_CADD\s_drive\Support\users\jcollado\V8i\Interfaces\MicroStation\jcollado\ jcollado.dgnlib). Changes will be appended to the Standards Interface.

Function Keys

If you create custom function keys, you should save your changes to the Fkey subdirectory and name the file after your user ID (Example, C:\NDDOT_CADD\s_drive\Support\users\jcollado\ V8i\Interfaces\Fkeys\jcollado.mnu) This file must be named using your user ID in order for it to be attached without editing configuration files.

Accudraw Shortcut Keys

If you edit Accudraw shortcut keys, you should save your changes to the Fkey subdirectory and name the file after your user ID and the appended "_shortcut.txt" (Example, C:\NDDOT_CADD\s_drive\Support\users\jcollado\V8i\Interfaces\Fkeys\jcollado_shortcut.txt). This file must be named using your user ID and the appended "_shortcut.txt" in order for it to be attached without editing configuration files.

WMS Server List

If you want to edit and use your own WMS Server List, copy the following: S:\STANDARD\V8i\data\WmsServerList.xml, and pasted it in your user\data directory (Example, C:\NDDOT_CADD\s_drive\Support\users\jcollado\v8i\data\jcollado_WmsServerList.xml). This file must be named using your user ID and the appended "_WmsServerList.xml" in order for it to be attached without editing configuration files.

CADD Standards

Macros

MicroStation Basic

If you create personal Macros, you should save them to the Macro Folder (example, C:\NDDOT_CADD\s_drive\Support\users\jcollado\V8i\macros\jdc_test.bas). If the macros are stored in this directory, you will not have to browse for them.

VBA

If you create personal VBA, you should save them to the VBA Folder (example, C:\NDDOT_CADD\s_drive\Support\users\jcollado\V8i\macros\jdc_test.mvba). This is the first place MicroStation will look for your macros.

Projects (MicroStation Shortcuts)

Does browsing the R drive for your project annoy you? Do you want to see shortcuts for only your projects? If yes, using a project configuration file may be the answer for you. Simple project configuration files can be copied from S:\STANDARD\PCF\Test. Find the one for your respective project and copy it to your projects subdirectory (example, C:\NDDOT_CADD\s_drive\Support\users\jcollado\V8i\Projects\80010932.027.pcf). If you have a pcf file in this directory, your respective team list will be replaced with your personal list in the MicroStation Manager dialog box. Setting the "Project" in this dialog box will automatically point to your project subdirectory.
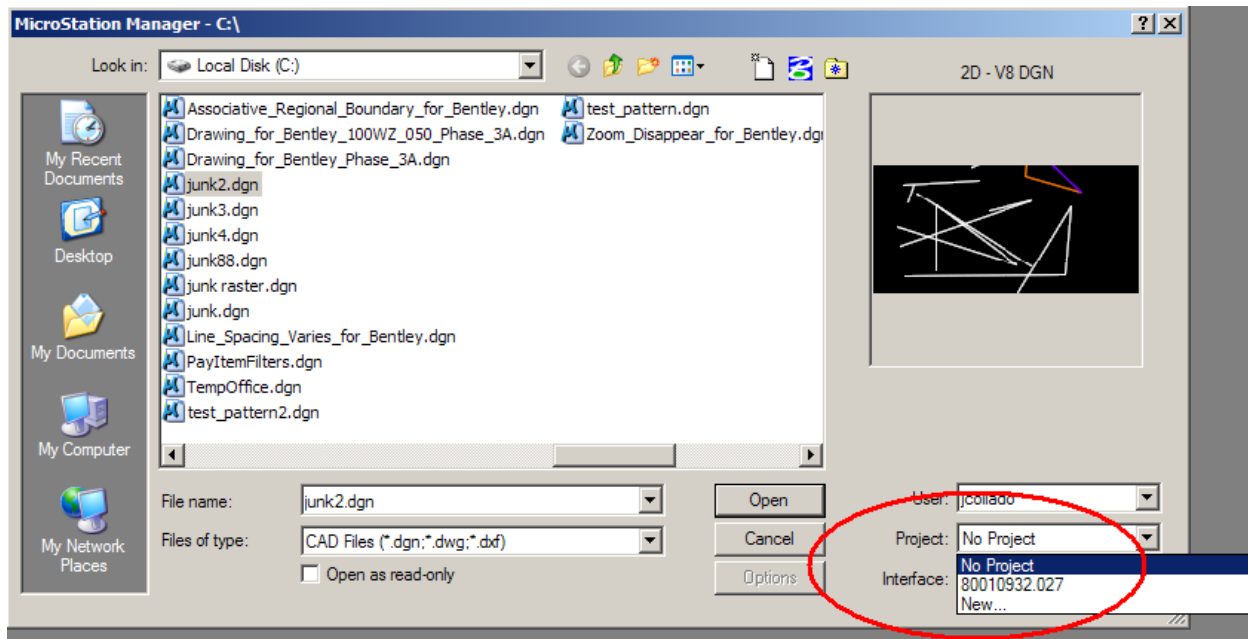
If a project configuration file (pcf) has not been set up for your project – file is not in S:\STANDARD\PCF\Test, contact the CADD support specialist.

CADD Standards

Site Configuration Files

Most users don't need to understand how Site Configuration files work. This section is primarily for Consultants and other users that have to set up their own site – office.

The typical installation of Bentley software is used. The application is installed at the default location usually "C:\Program Files (x86)\Bentley\".

The NDDOT uses site configuration files to point to most of the CADD Standard resource files. These files can be opened and reviewed with a simple text editor application such as notepad. During a typical NDDOT computer setup, the configuration settings are redirected to use a different series of configuration files.

The file
"C:\Program Files (x86)\Bentley\MicroStation V8i (SELECT series)\MicroStation\ config\appl\aaNDDOT_Pointer_1.cfg"
points to the configuration file
"C:\NDDOT_CADD\s_drive\Support\NDDOT_Pointer_2.cfg"
which then points to the configuration file
"S:\STANDARD\V8i\include.cfg"
which intern points to the configuration files under the directory
S:\STANDARD\V8i\cfg.
The second pointer (NDDOT_Pointer_2.cfg) has been added to allow non administrators on Windows 7 the ability to disable the NDDOT CADD Standards.
There are 2 subdirectories under **S:\STANDARD\V8i\cfg.** The **"appl"** directory contains application configuration settings modified for NDDOT work. The **"user_and_groups"** directory contains configuration settings to address NDDOT work groups.

No CADD standards are stored in user configuration files. The NDDOT sets up an empty user configuration files named after the users log on name.

Batch files were created to automate the creation of the standard user workspace. These files are located at **"S:\Standard\V8i\Install\"**

The NDDOT uses a standard interface. For NDDOT users the interface file is accessed directly from the following location;
       S:\STANDARD\V8i\Interface\Interface_Date-Version.dgnlib

Appendix S provides a recommendation for NDDOT CADD Standards Installation for Consultants.

CADD Standards

Preferences
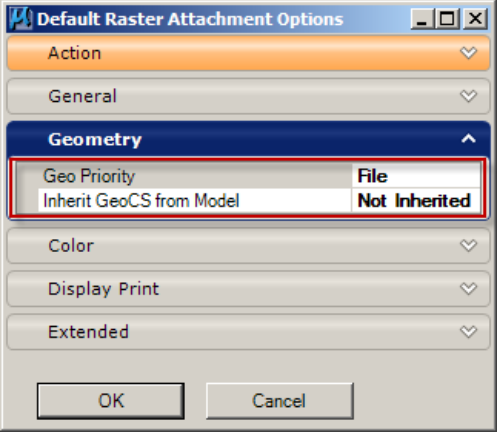
Your user preference files are named after your user id and is stored in the "pref" subdirectory. Most users will have 2 preference files. One for working without Geopak SS4 and one for working with Geopak SS4.
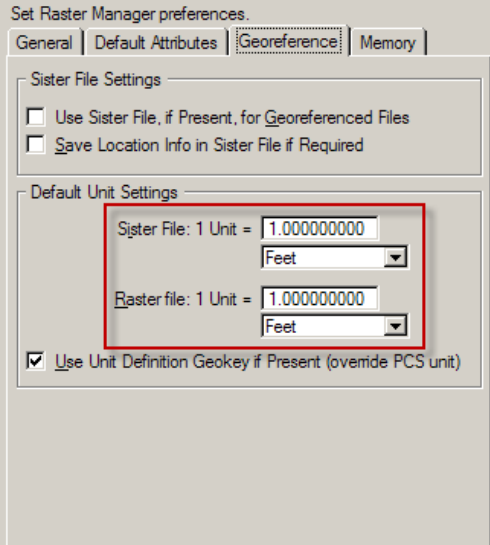
Example,
C:\NDDOT_CADD\s_drive\Support\users\jcollado\V8i\V8i_Home\prefs\jcollado.upf
C:\NDDOT_CADD\s_drive\Support\users\jcollado\v8i\V8i_Home_GeopakSS4\prefs\jcollado.upf

The following table lists some preference settings that are not set with the original MicroStation Installation. These settings are recommended for the general user. Most of the preferences are stored in the user preference file (upf). Make the following changes in your user preferences by selecting "workspace > preferences".

Preference Name	Description	Setting
Input>Allow ESC key to stop current command	When the ESC key is selected, the current command is stopped and the default command is started.	enabled
Raster Manager > Default Raster Attributes	Use Active Level	disabled
	Default level that rasters are attached to	Level = Raster Group 1
Raster Manager > Default Raster Attributes	Set Geographic Coordinate System from Raster	

CADD Standards

Raster Manager > Georeference (tab) > (as shown)	These are some settings needed for working with raster images created by the Photogrammetry Section	Set Raster Manager preferences. General | Default Attributes | Georeference | Memory Sister File Settings ☐ Use Sister File, if Present, for Georeferenced Files ☐ Save Location Info in Sister File if Required Default Unit Settings Sister File: 1 Unit = 1.000000000 Feet Raster file: 1 Unit = 1.000000000 Feet ☑ Use Unit Definition Geokey if Present (override PCS unit)
Reference > Set Default Attachment Preferences > Display Raster References	When references are attached, they can also automatically attach the rasters that are attached to the reference.	Disable
Task Navigation > Icon Size	Makes dialog smaller, recommend for verbose task navigation	Small (16 x 16)
View Options >	Element Highlight color Selection Set Color	Yellow Yellow

CADD Standards

Some preferences are stored in the preference file (upf) but are not changed through "workspace > preferences". The following table lists some NDDOT preference settings that are different than the MicroStation default settings, but not edited in the preference dialog box.

Preference Name	Description	Setting
File > Compress > Options	Allow deletion of unused – empty parts of the dgn file	All settings enabled
Settings>Snaps>AccuSnap>Enable For Fence Create	Allows AccuSnap while placing a fence.	enable
Within the Place text command - "Apply changes to all text"	Allows multiple formats within one text element	disabled
Within MicroStation Print Dialog Box – "Settings>Preferences> Allow Paper Size Editing	This setting is needed to create custom plot sizes from roll plotters	enable
Within "Change Attributes" tool	Defaults	Use Active Attributes: On Level: On Color: On Style: On Weight: On
Project Explorer Settings >Browsers	Display additional Project Explorer tabs	Survey: True Civil Standards: True Civil Model: True

CADD Standards

NDDOT Main Menu
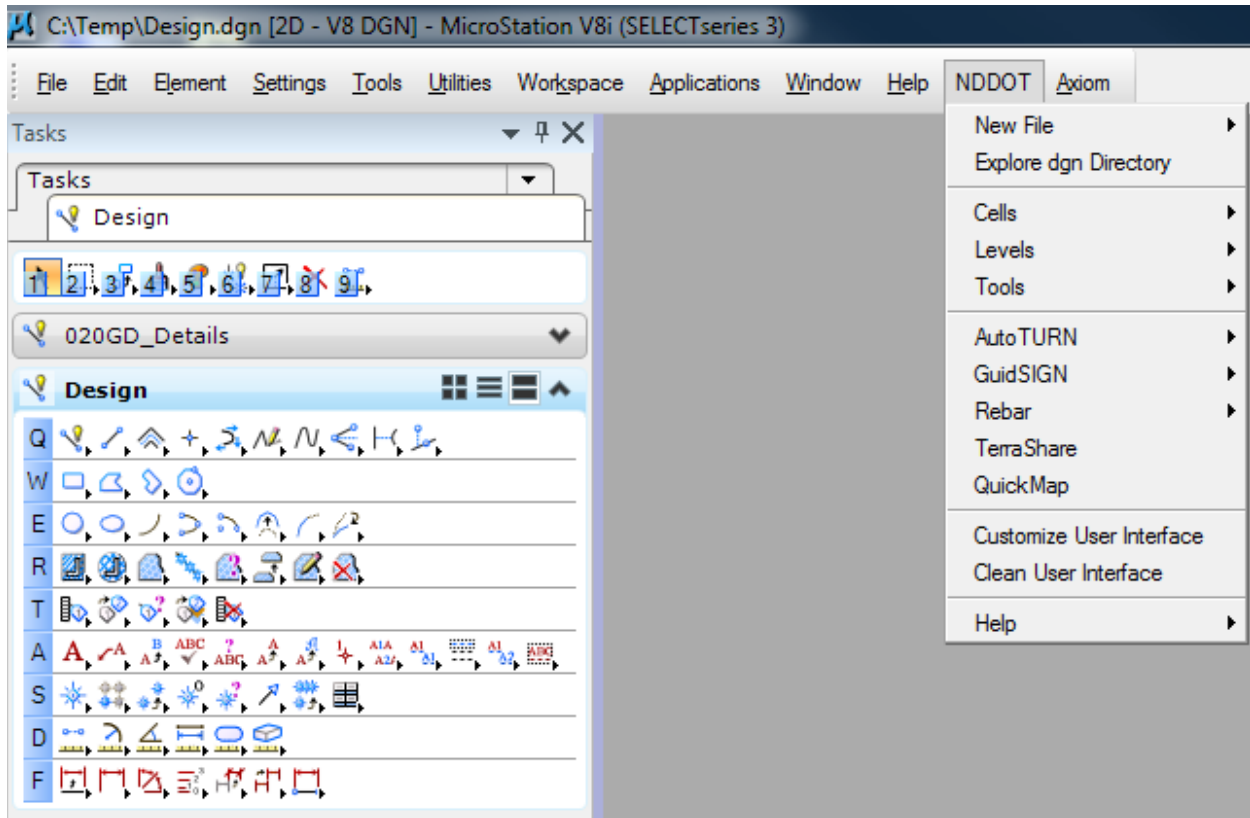
NDDOT changes to the MicroStation menu can be found in one pull down called NDDOT.

New File

This tool creates a new drawing file as you look up the standard name.

Explore DGN Directory

This tool is used to quickly open your drawing directory with Windows Explorer. It's a quick way to get to resource files related to your drawing.

Cells

Cell shortcuts are quick ways of opening common standards cell libraries.

Attach Levels

These tools will attach additional level libraries.

CADD Standards

Tools (NDDOT)

Additional tools adopted or created by the NDDOT can be quickly accessed from this pull out.

Area Tool

This is an advanced measuring and labeling tool. Not loaded with MicroStation by Default.

Attach Mosaics

This tool is only available to NDDOT staff. This tool gives you spatial hints to what aerial photos are available and help you quickly reference (attach) them to your drawing.

Coordinate Conversions

Caution is recommended with these tools. Don't use these tools unless you have received the applicable training.

DD Cell NDDOT

This is a quick way of loading ddcell mdl and launching the NDDOT tool box for dimension driven cells.

Draw Cells Along Chain

This is a great tool to place cells along a roadway alignment, such as placing delineators for work zone traffic control. Some GEOPAK knowledge is required.

Glossary

This tool can be used to look up NDDOT abbreviations and send them to your clip board and MicroStation Text editor – Word Processor dialog.

Index NDDOT Standard Files

This tool compares the active CADD standards to an Index of posted CADD standards. See *section 2.12*.

ITL File Copy

This tool checks to see if you have the NDDOT.itl file in your working directory. If this file is not in your working directory, it is copied there.

Level Symbology NDDOT

This tool is used for some typical level symbology overrides.

Pan Chain

This tool is used to pan (move and rotate) a MicroStation view based on a Geopak Alignment.
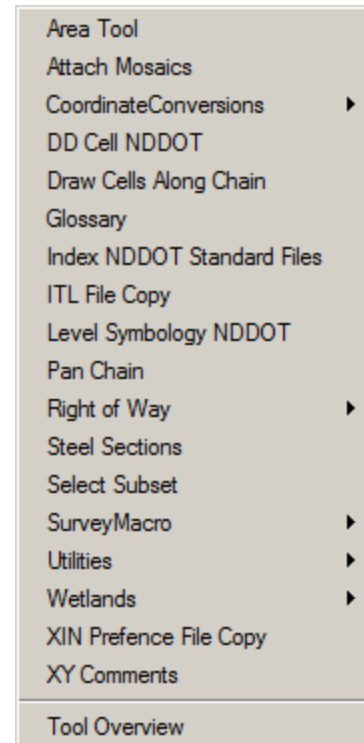
CADD Standards

Right of Way

This tool compares the level color weight and style of elements. If the symbology matches Right of Way features then the Civil Feature properties are assigned to the elements.

Steel Sections

This tool places a steel section shapes.

Select Subset

This tool can refine selection sets by filtering line lengths and angles. It is great for refining Geopak Cross Section Symbology.

Utility Cell Report

This tool runs a special report that is read by NDDOT Geopak utility criteria.

Utility Notes

This tool helps with labeling utility conflict sheets.

Set Utility features

This tool compares the level color weight and style of elements. If the symbology matches Utility features then the Civil Feature properties are assigned to the elements.

Utility (Rotate Point Symbol)

This is a Geopak Survey Tool. It is provided in this menu for easier access. It is used in the "utility cell as lines" workflow.

Wetlands (Shape to line with gap)

Linear features can't be shapes or closed line strings. This tool edits MicroStation shapes into a line string with a gap so that it can be turned into a wetland feature.

Set Wetland features

This tool compares the level color weight and style of elements. If the symbology matches Wetland features then the Civil Feature properties are assigned to the elements.

XIN Preference File Copy

This tool checks to see if you have the NDDOT_XS_and_Earth.xin file in your working directory. If this file is not in your working directory, it is copied there.

XY Comments

This macro records and relates comments to a specified xy coordinate in MicroStation. Macro centers view on coordinate as comments are reviewed. Macro includes author and priority tags for filtering purposes.

CADD Standards

Other Applications

Short cuts have been created to quickly turn on and off CADD related Applications such as AutoTurn, GuidSign, Terrashare and QuickMap. Note these applications will not work if they are not installed on your computer.

Customize User Interface

Opens user's dgnlib as assigned by the NDDOT standards and opens the customize dialog box.

Clean User Interface

Sometimes users accidently copy level definitions, dimension styles or text styles into their user dgnlib. These definitions can override current NDDOT CADD standards. This tool can purge these definitions and styles.

Help

This pull out contains shortcuts to common help references.

2.6   Metric Support
October 2005

Presently the NDDOT is not using metric measurements for plan preparation work. At this time, NDDOT doesn't have standards created specifically for metric use. However, many of the English Standards could easily be adjusted for metric use. If you need to use metric settings for NDDOT work, contact CADD Support (see *Section 1.2*).

2.7   CADD Standard Revisions (When to Use Old Standards).
Oct 2008

CADD Standards often change while users are in the middle of a project. Productivity may be increased by switching to the new standard. However, continuing to use the previous standards may be more convenient.   The previous or old CADD Standards can be used if all of the following occur:

1.   The active project is presently incorporating the previous CADD standard.
2.   Productivity, project uniformity, and/or plan readability are diminished by switching to the new standard.
3.   The previous or old CADD standard is not considered a primary standard. Certain CADD Standards revisions must be implemented immediately. The following is a list of primary standards in which the most current version must be used:
   a.   Title sheet changes.
   b.   Standards needed to implement NDDOT software changes (example: GEOPAK V8.11)

When a new project is started the most current version of the CADD standards are to be used.

Example: The file naming standard for alignment drawings changed January 10, 2001. Alignment drawings were previously named align.dgn, but now they are named ds_align.dgn.   If an active project already contained an alignment drawing named align.dgn, and this file was referenced in several other drawings, changing the name of the alignment drawing to ds_align.dgn may take several minutes to fully implement. In this case the user may elect to keep the old file name through the completion of the project.

CADD Standards

2.8   Taking Electronic Drawings into the Field
Oct 2008

This section discusses using CADD in the field. Field computers are not typically connected to the network (CADD Servers). Several important resource files are stored on the network and if computers cannot find these resources they will not operate correctly. Some reference and raster files use a specific (full) path. These reference and raster files may not be properly attached when they are moved off the network ("R" drive). The following procedure discusses a method of copying and mapping resource files to a computer that is not networked or will not be networked when CADD tools and files are needed.

This procedure involves:
1.   Copying the resource files to "C" drive. These files must be stored in a specific location.
2.   Copying the needed project drawings and files to "C" drive. These files must be stored in a specific location.
3.   Learning to use the appropriate icon - shortcut. This shortcut maps the resource files and project files in a manner that is similar to the way the files are mapped on the network. The shortcut creates a local "S" and "R" drive.
4.   Updating resource files and project files as needed (as they change).

Note this procedure does not cover installing MicroStation and GEOPAK or checking out licenses. A Work Management System request is required for installing MicroStation and GEOPAK.

Step 1 can be accomplished by running a batch file or manually. Running the batch file is the preferred method. However, the computer must temporarily be connected to the network ("S" drive). After the computer is connected to the network, double click on the batch file **S:\STANDARD\V8I\Install\CopyStandardsLocal.bat.** This file will copy the needed files locally (on the computer's hard drive) to the directory "C:\NDDOT_CADD\s_drive\STANDARD".

Step 2 involves copying the project files needed for field work. CADD project files are stored on the "R" drive. Files should be copied from "R:\project*.*" to "C:\NDDOT_CADD\r_drive\project*.*". Similar - relative paths should be used when files are copied. Example: if the file R:\project\10083088.059\Design\Design.dgn is going to be taken into the field, it should be copied to C:\NDDOT_CADD\r_drive\project\10083088.059\Design\Design.dgn.

CADD Standards

Step 3 uses a customized desktop icon to temporarily create "S" and or "R" drives on your computer and start MicroStation. Caution, local "S" and or "R" drives cannot be created if networked "S" and or "R" drives are already connected. Make sure your computer is disconnected from the network before proceeding with step 3. The icon - batch file runs a "Command Prompt" script, typically in a black dialog box. A new path "S:\" will be created. The files in C:\ NDDOT_CADD\s_drive and S:\ will be the exact same files. They will just have different paths. The local "R" drive will have a similar relation to C:\ NDDOT_CADD\r_drive.

Step 3 is to remember to update the standard resource files on "C" drive as needed. This should be done at least seasonally. To do this, just repeat step 1. Project files should also be updated on the "R" drive as required. The "R" drive is the official location to save project CADD files.

2.9   Final Plan Delivery

Jan 2019

The "Final Plan Delivery" includes several products such as production drawings, resource files, supplemental design data, pdf plan sets and printed paper drawings. Some requirements are provided in this section. Additional requirements are also listed in the "Scope of Work for Consultants Performing Preliminary Highway Surveys" and in other areas of the Design Manual.

1.   Production Drawings – These files are typically MicroStation Drawings (dgn). Production Drawings are required on projects under a direct contract with the NDDOT.

2.   Resource Files - These files are not directly used in the plans but are used to design projects or can be used to help build a project. Examples of functional files include: Alignments files (gpk, xml), point files (asc, csv), and surface models (tin, xml) and other modeling files (itl, xin). Several types of Functional Resource Files can be imported directly into survey equipment.

3.   Supplemental Design Data – These files include a subset of production drawings and resource files. This subset of files excludes data that isn't directly applicable to construction. Supplemental design data has an emphasis on Automated Machine Guidance workflows.

4.   PDF Plan Sets – PDF's (portable document format) are required on all projects.

5.   Printed Paper Drawings - This document is the original PE stamped and sealed document. Printed plan sheets are not required on digital signature pilot projects.

The "Final Plan Delivery" shall not include copies of the correspondence documents and preliminary reports. If the NDDOT Technical Support Contact person requests additional copies of the correspondence documents and preliminary reports, this information should be sent in separately.

CADD Standards

Production Drawings

Production drawings shall follow the NDDOT CADD Standards. They shall be developed with MicroStation V8i.

Conceptual production (dgn) drawings should be delivered when the project is being developed by a consultant that is only responsible for developing the environmental document. If the same consultant is responsible for developing the final plans, most conceptual production (dgn) drawings should not be submitted. Drawings that are displayed for the public (environmental documents, public input meetings and hearings) are exceptions to this rule. Keep records of drawings that were displayed for the public according to the Design Manual (see II.03.02.04 Public Involvement Report).

Production drawings shall only include files required for the development of the final plans. All of the conceptual drawings are seldom desired (see above paragraph). The Production files shall only include the essential (CADD Standard) files. Temporary, junk, alternative drawings not used in the final plans, backups, and other interim drawings shall not be submitted. The goal is to make it easy to review the project files and avoid the transmittal and storage of unnecessary files.

Drawing display setting (levels, reference files, view attributes and other rendering settings) shall be set and saved as they were used to create the final printed plans. The goal is to make it easy to review and print files. The reviewer should not have to figure out what reference files need to be turned on and what display settings need to be used.

Consultants should use the directory structure discussed in *section 2.1* and they should use the "Save Relative Path" when referencing drawings. The goal is to make project files portable. Broken reference paths are CADD standards violations (see *section 3.12* of the NDDOT CADD Standards Manual).

Production drawings should be set to read only before the plans are signed and stamped as required by the Board of Professional Engineers and Land Surveyors. The goal is to use the file modify date to flag and eliminate changes to the plans after they have been signed.

Resource File

Resource Files and Supplemental Design Data are required on projects under a direct contract with the NDDOT and that require substantial earthwork. Projects that don't involve earthwork (grading) will not require resource files to be delivered with the plans.

If earth work is calculated from cross sections, the earthwork shapes shall be drawn into the cross sections. The final earthwork shapes shall be kept so that they can be compared with earthwork reports.

CADD Standards

Supplemental Design Data

Supplemental Design Data is provided to the contractor in order to help them prepare a bid and construct the project. Supplemental Design Data includes AMG (Automated Machine Guidance) data such as surface files.

Since supplemental design data includes a subset of production drawings and resource files, the applicable files should be copied into a "Supplemental Design Data" folder under either the Design project folder or Consultant project folder.

Supplemental Design Data includes the following;

1. Supplemental Design Data Notification
2. Surface Files
3. Alignment Information
4. AMG AAreadme file for contractor
5. Earthwork_End_Area Volumes Spread Sheet
6. Drawings

The following is an example list of file to provide as supplemental design data.

Supplemental Design Data.pdf   Control.dgn
Exst.tin   Design.dgn
Exst.xml   DS_Align.dgn
T.tin   Profile.dgn
T.xml   RW_Bndry.dgn
B1.tin   Terrain.dgn
B1.xml   Terrain_Exst.dgn
DG.tin   Topog.dgn
DG.xml   200XS.dgn
job001.gpk   RDM.dgn
Alignment.xml
AAReadMe.docx
Earthwork_End_Area Volumes.xml
Earthwork_End_Area Volumes.html
Earthwork_End_Area Volumes.xslx

Supplemental Design Data Notification

See the following:
http://www.dot.nd.gov/manuals/design/caddmanual/SDD/Posting%20Supplemental%20Design%20Data.pdf

Consultant staff only need to create the notification pdf. Technical support staff will post the actual documents.

CADD Standards

Surface Files

Surface files are provided to the contractor as MicroStation terrain elements, xml files and Geopak tin files.

Alignment Information

Alignment Information is provided to the contractor as MicroStation civil geometry element, an xml file and a Geopak gpk file. Information on creating an alignment xml file is in *section 4.3 Cogo*.

AMG AAreadme file for Contractor.

An informational text file shall be provided to the contractor. An Alignment Index (informational key – general description) shall be included. The aareadme file should also describe general limitations with the model (examples; driveways were not modeled, the terrain near bridge XYZ was not modeled, approaches were modeled without the appropriate in-slopes – use plan information to build approaches, etc). Include the following phrase.

> "This aareadme file does not list all limitations with the model. It is only provided as a place to start your review. The contractor is responsible for reviewing model information and determining if and where it may be applicable."

Drawings Provided to Contractor

The following drawings should be provided to the contractor if available. These drawings do not need to be created if they are not needed for plan preparation.
1. Control
2. Design
3. DS_Align
4. Profile
5. RW_Bndry
6. Terrain
7. Terrain_Exst
8. Topog
9. 200XS_*
10. RDM

CADD Standards

PDF Plan Sets

The paper size format for the pdf must match requirements for paper delivery (example, plan sheet intended to be printed on 11x17 inch paper should be formatted to be printed on 11x17 inch paper). PDF's should be created at 600 dpi. Supplemental images - Rasters may be printed at a lower resolution.

The overall electronic files size of the PDF plans is a concern. The plans must be easy to download.

1. The plans shall be divided and published in separate volumes.
   a. Every separate volume shall be less than 100 MB. The individual sections, as defined by section numbers, shall not be split between volumes. The volumes may be spilt where the section numbers change. Designers shall use their discretion when deciding where the splits occur.
   b. Cross Sections are always published as a separate volume(s).
   c. The separate volume requirements only apply to the Final Plans that are posted on the NDDOT web site for bidding purposes. Separate volumes are not required for other phases of project development, color or the PE version (used only for printing as sealing by a Profession Engineer or Surveyor).
2. The PDF shall be optimized with Adobe Professional. The "PDF Optimizer" tool usually reduces the file sizes. The following is an overview of the Optimizer Settings.

The "PDF Optimizer" tool is found in the Adobe Acrobat Pro menu under "Save As Other> Optimized PDF". Optimizing a file can take several minutes. Copy the pdf to a local drive before using the "PDF Optimizer" tool in order to improve performance.

CADD Standards

The standard-default "Images" settings should be used.

In the Fonts category, "Do not unembed any font". **Fonts must be embedded within the PDF.**

Transparency settings have not been incorporated into the CADD Standards. Optimization settings for "Transparency" aren't enabled.
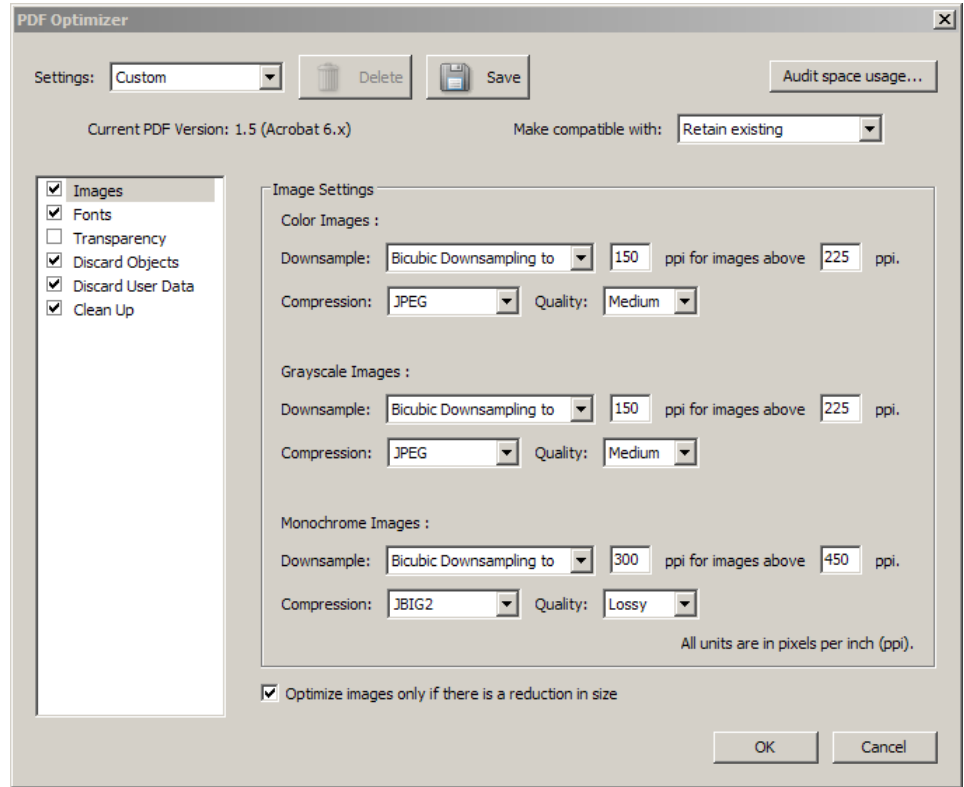
Discard Object Settings are as shown.

CADD Standards

Discard User Data Settings are as shown.

PDF Optimizer

Settings: Custom | Delete | Save | Audit space usage...

Current PDF Version: 1.5 (Acrobat 6.x)   Make compatible with: Retain existing

- ☑ Images
- ☑ Fonts
- ☐ Transparency
- ☑ Discard Objects
- ☑ Discard User Data
- ☑ Clean Up

Discard user related information
- ☑ Discard all comments, forms and multimedia
- ☑ Discard document information and metadata
- ☑ Discard all object data
- ☑ Discard file attachments
- ☐ Discard external cross references
- ☐ Discard private data of other applications
- ☐ Discard hidden layer content and flatten visible layers
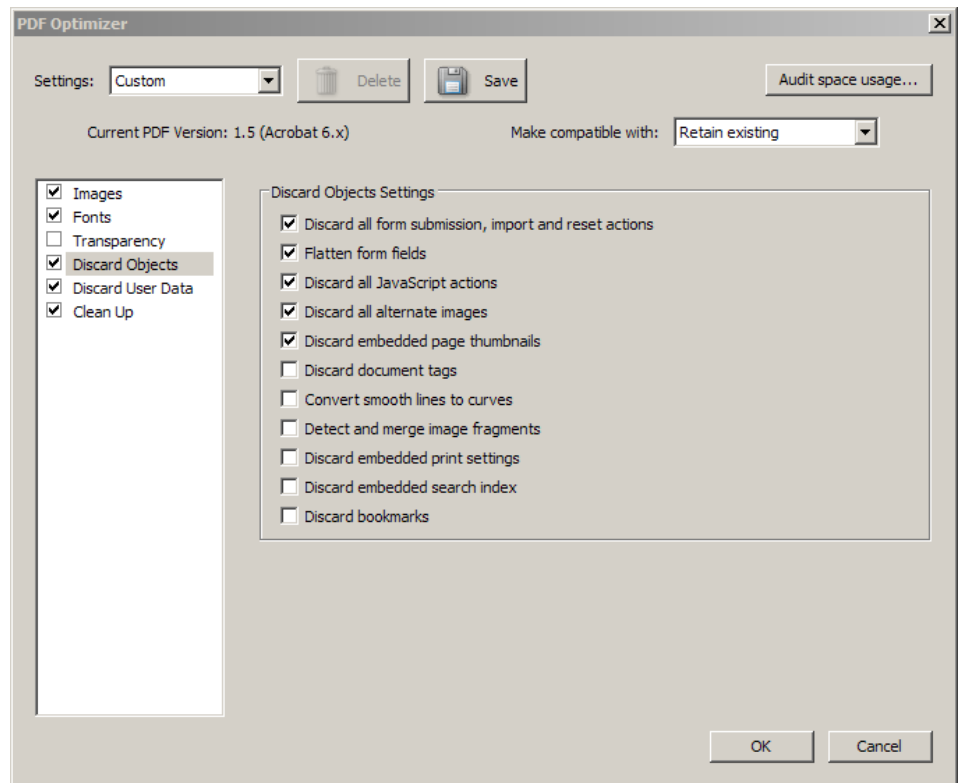
OK | Cancel

The standard-default "Clean Up" settings should be used.

PDF Optimizer

Settings: Custom | Delete | Save | Audit space usage...

Current PDF Version: 1.5 (Acrobat 6.x)   Make compatible with: Retain existing

- ☑ Images
- ☑ Fonts
- ☐ Transparency
- ☑ Discard Objects
- ☑ Discard User Data
- ☑ Clean Up

Clean Up Settings
Object compression options: Compress entire file
- ☑ Use Flate to encode streams that are not encoded
- ☑ In streams that use LZW encoding, use Flate instead
- ☑ Discard invalid bookmarks
- ☑ Discard invalid links
- ☐ Discard unreferenced named destinations
- ☑ Optimize page content
- ☑ Optimize the PDF for fast web view

OK | Cancel

CADD Standards

The pdf plan set files must be named according to a standard naming convention. PDF files should be named by combining, in the order shown, the following information:

1.   "Project Number"
    a.   If the plan set includes multiple project numbers (multiple project numbers shown on title sheet) the project numbers should be included in the name separated by a space character, ampersand, and another space character (example: "SS-3-001(015)128 & SS-3-020(071)044 Final Plans 1of3 ED.pdf"). The space characters are needed for the proper word wrapping when the document gets posted on the web.
    b.   If naming the pdf using multiple project numbers will create a very long name (over 100 characters long), then only the first project number listed on the title sheet should be used follow by the phrase "and Other Projects" (example: "STM-SU-1-988(024)036 and Other Projects Final Plans 1of2 ED.pdf").

2.   Project phase such as
    a.   "Preliminary"
    b.   "PS&E"
    c.   "Final Plans"
    d.   "Addendum1", "Addendum2", … etc
    e.   "Plan-Rev1", "Plan-Rev2', … etc
    f.   "Asbuilt"

3.   The specific volume number and total number of volumes shall be included in the file names (example "1of3"). Every volume shall be counted, including cross sections and standard drawings. The volume suffix is only required for final plans used for bidding purposes. The use of separate volumes is optional for other phases of project development.

4.   If the project requires cross sections, they must be included as a segregated file. A separate file must be used even if there is only one cross section sheet. The file name for cross sections shall include the abbreviation "XSEC".

5.   "Color" if the plan set is in color. All other sets will be assumed "black and white".

6.   "ED" (for electronic distribution) or "PE" (for Profession Engineer signing and stamping) or "DS" (for Digital Signature).

CADD Standards

The following is a list of example names.

IM-2-094(070)275 Preliminary	IM-2-094(070)275 Preliminary XSEC
IM-2-094(070)275 Preliminary Color	IM-2-094(070)275 Preliminary XSEC Color
IM-2-094(070)275 PS&E	IM-2-094(070)275 PS&E XSEC
IM-2-094(070)275 PS&E Color	IM-2-094(070)275 PS&E XSEC Color
IM-2-094(070)275 Final Plans #of# ED	IM-2-094(070)275 Final Plans #of# XSEC
IM-2-094(070)275 Final Plans #of# DS	IM-2-094(070)275 Final Plans XSEC Color
IM-2-094(070)275 Final Plans PE	IM-2-094(070)275 Addendum1 XSEC
IM-2-094(070)275 Final Plans Color ED	IM-2-094(070)275 Plan-Rev1 XSEC
IM-2-094(070)275 Addendum1 ED	IM-2-094(070)275 Plan-Rev2 XSEC
IM-2-094(070)275 Addendum1 DS	IM-2-094(070)275 Asbuilt XSEC
IM-2-094(070)275 Addendum1 PE	IM-2-094(070)275 Asbuilt XSEC Color
IM-2-094(070)275 Plan-Rev1 ED	
IM-2-094(070)275 Plan-Rev1 DS	
IM-2-094(070)275 Plan-Rev1 PE	
IM-2-094(070)275 Plan-Rev2 ED	
IM-2-094(070)275 Plan-Rev2 DS	
IM-2-094(070)275 Plan-Rev2 PE	
IM-2-094(070)275 Asbuilt	

(Replace # with actual numbers, example 1of3)

At this time, color final plans are not posted on the internet for bidding purposes. They may be used by field personnel as an added convenience. A Black and white version of the PDF Final Plans and Addendums shall be used for the internet.

After the final plans have been completed, the pdf plan set for preliminary review should be deleted. The pdf plan set used for PS&E review should be kept until the project is constructed (assumed 3 years after bid opening). Versions of PDF plans created for PE stamping should be purged after the paper set of plans has been officially approved and stamped.

Electronic Distribution Statements or Digital Signatures must be used as noted in the North Dakota Administrative Code, Title 28, "28-02.1-08-03.9". PDF plan sets without the electronic Distribution Statement or Digital Signatures will not be accepted for final plans, addendums and plan revisions.

Optically scanning the original paper plan set in order to create a pdf plan set is discouraged because the image quality is degraded and an electronic distribution statement is needed.

CADD Standards

2.10   Plan Submittal and Distribution

May 2017

Refer to the Design Manual for information on Plan Submittal and Distribution;

Plan Review Distribution List
http://www.dot.nd.gov/manuals/design/designmanual/Plan%20Review%20Distribution%20List.pdf

I-08.03 Final Plan Submittal
http://www.dot.nd.gov/manuals/design/designmanual/Chapter%201.pdf#page=108

I-09 Plan Revisions and Change Orders
http://www.dot.nd.gov/manuals/design/designmanual/Chapter%201.pdf#page=118

I-11 Cost Estimates, Bid Items and Incidental Work
http://www.dot.nd.gov/manuals/design/designmanual/Chapter%201.pdf#page=126

CADD Standards

2.11   Current Software

Sept 2020

The NDDOT is presently using the following versions of software;

        AutoTurn 10.1
        Axiom Toolkit
        Axiom Title Block Administrator 8.13i
        Bentley View 08.11.09.829
        GuideSign 7.0
        GEOPAK 8.11.09.903 or 8.11.09.918
        MicroStation 8.11.09.832 or 8.11.09.919

CADD Standards

2.12 Current Resource Files
Sept 2020

The current CADD Standard Index File is dated "**9/29/20 2:24:26 PM**". This index is used with a macro to review your current version of NDDOT CADD Standards. From the MicroStation menu, see "NDDOT > Tools > Index NDDOT Standard Files". The index file (nddotUpdateIndex.csv) is a comma separated value file that can also be manually reviewed with a text editor or Excel.

The following tables show the update dates for CADD Standard Resource Files. **The file name shown in blue is a hyperlink.**

Description	File Name (Linked to Recourse)	Updated	Posted
Cell Libraries	Cells.exe	8-20	9-20
Dictionaries, Annotation Scale Definitions, Tag Library, Geographic Coordinate Systems, Line Styles, Fonts and Colors, Seed Files	Data.exe	12-19	9-20
DGN Libraries	dgnlib.exe	6-20	9-20
Macros, MDL	Macros.exe	3-13	9-13
Plotting	Plotting.exe	5-18	1-19
OpenRoads Report Browser	ReportBrowser.exe	3-19	3-19
VBA	VBA.exe	9-20	9-20
Workspace Configuration and Setup Files	ConfigurationFiles.exe	3-19	3-19
Geopak Files - Design and Computation Manager, Borehole Tools, Sheet Library, Super Elevation, Survey Manager and Legal Library	GeopakStandards.exe	10-18	1-19

Other CADD Files

Description	File Name (Linked to Recourse)	Updated	Posted
GuideSIGN	GuideSIGN.exe	1-19	1-19

CADD Standards

2.13   Software License Agreements

Sept 2010

Most of the time, common sense and a little respect will keep you on the right legal track with software license agreements. The NDDOT Information Technology Division will also promote the legal use of software. So if they tell you not to do something, don't do it. ITD completes most of the License Agreements for NDDOT employees, but all employees need to live up to them. At the end of this section are links to software agreements if you need to get into the details.

There are some agreement rules that might not be widely known.   These CADD Standards will highlight a few rules that might deserve more of your attention.

1. The NDDOT has an axiom License for only the Central Office. Employees at Materials and Research, District Offices and Field Offices shouldn't use Axiom products. Central Office employees shouldn't use Axiom products on files located on district servers. ITD will add and remove software as applicable, but sometimes there is a little delay during employee transfers and rotational assignments. Just because you can use Axiom doesn't mean it's OK.

2. Google Map imagery from the "Free Addition" shall not be used for any documents that are used outside of the department. Don't use a Google Map in a concept report or public meeting. The "Professional" version of Google Earth is required for sharing information externally.
    If your using Google Map imagery for an internal purpose. Don't remove the Google water marks. You are using copyrighted material.
    Note, the NDDOT has an Arc Internet Mapping Service that is available to all employees. Imagery from this tool is often better than Google imagery. See section 7.2.

Axiom (accessible on NDDOT Central Office Network)
S:\STANDARD\V8i\Axiom\Axiom End User Software License Agreement.pdf

Google Earth
www.google.com/accounts/TOS

MicroStation (Typical location, if installed on your computer)
C:\Program Files (x86)\Bentley\MicroStation V8i (SELECTseries)\MicroStation\Eula.pdf

GEOPAK (Typical location, if installed on your computer)
C:\Program Files (x86)\Bentley\GEOPAK\V8.11\eula.pdf

CADD Standards

2.14 Bentley License Key Use for Production and Evaluation
Jan 2019

This section of the manual is not applicable to consultants. This section provides guidelines for the use of the Bentley Evaluation license key and the Bentley Production license key while using the products in the Bentley software suite.

NDDOT has separate Bentley license keys for production work and for evaluation of new software products that are not fully implemented (examples include OpenBridge Modeler, ContextCapture, and Concept Station).

The Bentley evaluation license key should be used when working with software products that are not fully implemented in the NDDOT environment. Examples of these software products include OpenBridge Modeler, Context Capture, and Concept Station.

The Bentley production license key should be used when working with Bentley software products that are fully implemented in the NDDOT environment. Examples of these software products include MicroStation V8i (SELECTseries 4), GEOPAK V8i(SELECTseries 4), and gINT.

This documentation will be using MicroStation V8i as a demonstration of where to find the license tool and how to make the change to the key. The license keys can be obtained from Jon Collado.

To find the license tool, where the change to the key will be made, navigate to:

C:\Program Files (x86)\Bentley\MicroStation V8i (SELECTseries)\MicroStation\licensetool.exe

You can make a shortcut to this application by right-clicking the application and selecting Create Shortcut. The shortcut can be moved to any location on your system for easy access to the tool.

Before using the license tool, make sure all Bentley software products are closed. This tool will make the license key change to all Bentley products installed on your system.
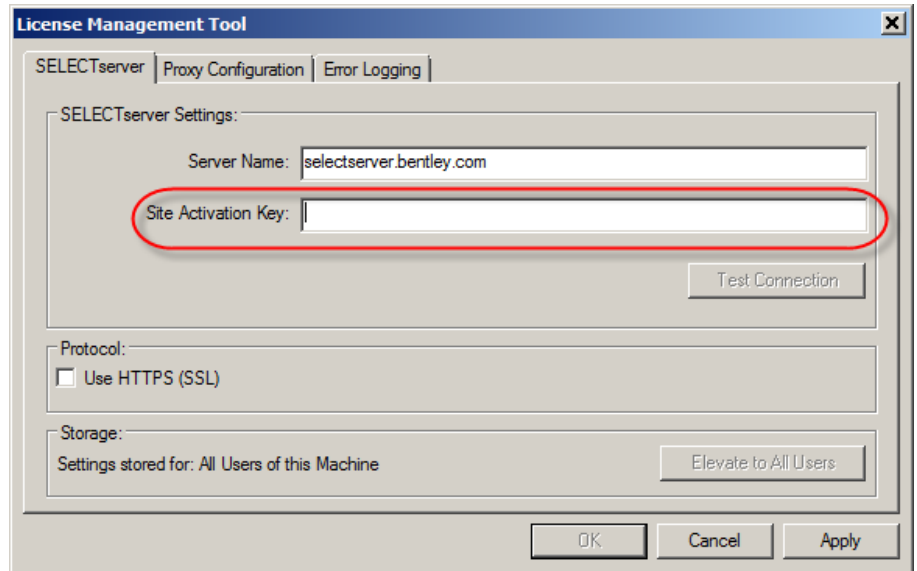
CADD Standards

Open the Bentley License Management Tool. Select to "Tools > Options".
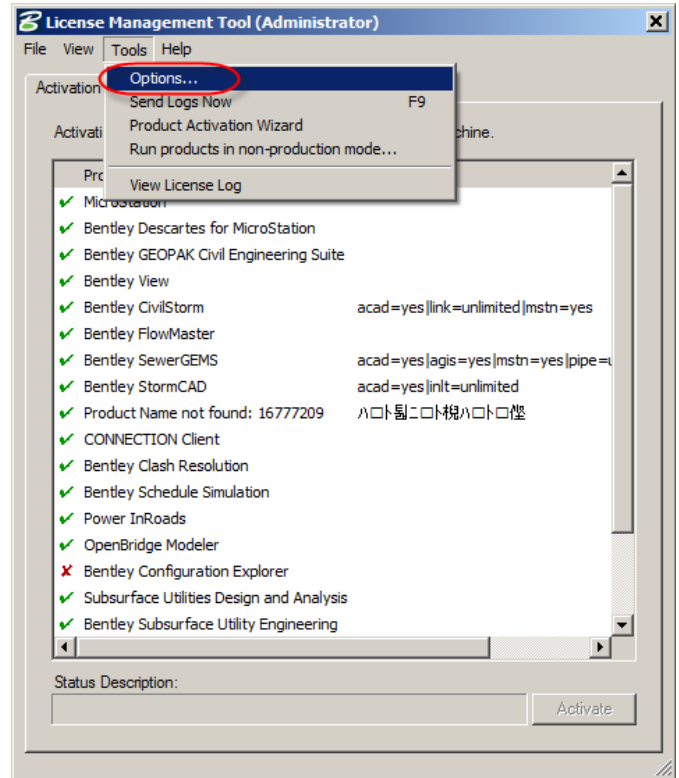
Paste the license key (evaluation or production) that you would like to use in the Site Activation Key text box. Click Test Connection to verify that the new key works. Then Click Apply and exit the License Management Tool.

The desire software can now be opened.

Note: The license Management Tool can typically be accessible from within the individual software applications. However these instruction open the license management tool outside of the software application so that specific combinations or license keys and application use are not used even for short periods.

CADD Standards

MicroStation

3.1 Seed Files
Dec 2010

Seed files are used to set a number of DGN file parameters. When a new DGN is going to be created, the operator needs to select the correct seed file. The seed file is actually a DGN file itself. Presently the NDDOT is using 3 different seed files;
1. NDDOT_seed.dgn
2. NDDOT_seed_Ft&In.dgn
3. NDDOT_seed_3D.dgn

The following are some of the features adjusted in the NDDOT seed file (NDDOTseed.dgn).

	NDDOT_seed.dgn	NDDOT_seed_Ft&In.dgn	NDDOT_seed_3D.dgn
Default Font	NDDOT (true type)	NDDOT (true type)	NDDOT (true type)
Default Drawing Scale	1" = 200'	1" = 5"	1" = 200'
Design File > Color	Selection Set: Yellow Highlight Color: Yellow	Selection Set: Yellow Highlight Color: Yellow	Selection Set: Yellow Highlight Color: Yellow
Design File > Working Unit Format	MU	MU:SU	MU
Design File > Working Units > Linear Units > Custom > Master Unit Definition	Unit = Feet Label = '	Unit = Feet Label = '	Unit = Feet Label = '
Design File > Working Units > Linear Units > Custom > Sub Unit Definition	Define Custom Unit: toggled on 1000 th = 12 inches	Unit = Inches Label = "	Define Custom Unit: toggled on 1000 th = 12 inches
Design File > Working Units > Advanced Settings > Edit >Resolution	304800 per Foot Solids 0.62137 miles	304800 per Foot Solids 0.62137 miles	304800 per Foot Solids 0.62137 miles
Design File > Working Units > Angels > Format	DD MM SS	DD MM SS	DD MM SS
Levels - Embedded	Tag DipText Sht Text Sht Stamp Text Sht Lines	Tag DipText Sht Text Sht Stamp Text Sht Lines	Tag DipText Sht Text Sht Stamp Text Sht Lines
View Attributes	ACS Triad: Off Clip Volume: Off Fill: On Grid: Off	ACS Triad: Off Clip Volume: Off Fill: On Grid: Off	ACS Triad: Off Clip Volume: Off Fill: Off Grid: Off
"Place Note" tool	Start at "Terminator"	Start at "Terminator"	Start at "Terminator"
"Scaling" tool	Scale Dimension Values: Off Scale Annotations: On	Scale Dimension Values: Off Scale Annotations: On	Scale Dimension Values: Off Scale Annotations: On
Model Properties > Line Style Scale	Annotation Scale	Annotation Scale	Annotation Scale

CADD Standards

3.2   Global Origins and Coordinate Systems

Sept 2010

The present NDDOT CADD standard seed files have a different Global Origin than the previous CADD standard seed files. The new Global Origin is at: $x = y = z(3d) = 0$

The global origin in a MicroStation design file will not need to be changed if referencing is done with the "Coincident –World" option. This option has been set as the default in the NDDOT Standards and will automatically be selected for most users.

If this option is not used and the active file has a different global origin than the reference file, the data may appear to reference into the active file correctly, but the coordinate values of the referenced data may change!

To check the existing global origin of a file, key 'GO=?' into the key-in box. The value will appear in the bottom right-hand corner of the screen. **Do not key in any other GO commands - except 'GO=?', the coordinate values of existing points in the design file could change!**

When creating a new plan view drawing, assumed drawing coordinates should be avoided.   Plan view drawing elements should be drawn as close to real ground coordinates as survey data allows. Using real ground coordinates will help with the exchange and comparison of data with other sources (example; wetland delineations can be compared to all plan view drawings if real ground coordinates are used, GIS data can easily be imported into MicroStation).

If real ground coordinate survey information is not readily available for projects such as ones that use 90-1 surveys, spatially correct base maps should be used to get reasonably close to real ground coordinates. MicroStation base maps can be referenced from the directory **R:\project\BaseMaps**. Each county has its own base map because each county has a slightly different projection. Highway centerlines, Mile Points, and Section lines are some of the drawing features that can be used to tie plan information to real ground coordinates. The base maps are exported into MicroStation with a high degree of accuracy, but the accuracy of the GIS data varies considerably. Users should be conscience of the degree of accuracy when comparing information. Just because information is very close doesn't always mean it is acceptable.

CADD Standards

3.3   MicroStation Templates, Tools and Task Navigation

July 2014

The CADD standards use the term "Task Navigation" to describe the way templates, tools and tasks are used together to manage commands and symbology.

MicroStation "Templates" are the primary way the NDDOT manages element symbology. Tools are the primary way MicroStation commands are issued. Tools often reference the symbology in a template. Tools also offer some additional control of symbology that might not be available in the template. Tasks are used to manage the way tools are delivered – displayed.

A good understanding of Task Navigation will simplify the placement of most drawing elements. This tool is used to change several settings at one time and select a specific tool. Example; the level, color, line weight and style, text height and width and justification could all be switched and the place text tool could all be activated with one click of a button.

There are numerous Task groups. Some are delivered with MicroStation and GEOPAK. Many other groups have been created by the CADD standards. Several Task groups are organized to draw specific elements in a specific drawing or group of drawings. These task groups promote drawing with the correct standard in the correct drawing. For example, existing power poles are found in the Topog task group and they should be drawn in the file named Topog.dgn. Several task groups are intended for only one particular type of drawing. Some task groups are intended for a group of drawings. *Appendix A* explains which task groups are used with which drawings.

The standard NDDOT interface hides some task groups based on the active drawing name. The standard interface makes it easier to pick the appropriate task group while promoting the use of standard drawing names by limiting the available task groups. For example; to display the Topog task group, the active drawing typically needs to have a name starting out with the word "Topog". If you were in a drawing named "Design.dgn" you would not typically be able to see the Topog task group. The hiding of task groups uses a function called "**Named Expressions**".

Task groups can be organized in a directory structure with parent child relationships. For example the Topog task group is found under the Photo task. The Photo task is the parent task and the Topog task is the child task. The following list shows how the standard task group parent child relationships.

CADD Standards

Bridge Work Flow
    Section 170

Design
    001TS Title
    004SW Scope
    011DT Data Tables
    020GD Details
    030TP Typical
    100WZ_ConSign
    AutoTurn
    Consign
    Countour
    Cut Sheets Design
    Design
    DS Align
    DS Util
    DTM
    Environmental
    Fencing
    Paving
    Profile
    Removal
    P_Erosion_C
    T_Erosion_C
    Shape
    Wetland Impacts
    Xsec

Materials
    Materials
    180PT_PitPlat

Photo
    081CD_Survey
    Control
    RW Bndry
    Topog
    DTM

Planning
    Planning

Section 100
    ConSign
    CSDtl
    DTmpLtDe
    LTmpLt
    DIntDe
    Lint
Section 110
    DOHDet
    DSignDet
    LOH
    LRemSign
    LSign
Section 120
    LPvmt
    DPvmtDet
Section 130
    LGdrl
    LJBar
    GdrlDe
    DBarrier
Section 140
    DHMDet
    DLitDe
    DLitOH
    DULDet
    LHM
    LLight
    LLitOH
    LUL
Section 150
    DFlsh
    DIntDe
    DSigDet
    DATRDet
    LFlsh
    LInt
    LRemSgl
    LScop
    LSgnl
    LATR
Section 160
    DITSDet
    LITS

Traffic Work Flow

CADD Standards

NDDOT symbology (templates) rely heavily on Annotation scale (Drawing Scale) settings. In order to use the standards correctly, the drawing scale must be set. Guidelines have been set up for placing cells, custom line styles, text, patterns, etc. to insure uniformity in all prints. Most of these settings are automated in Task Navigation. For example, one user is creating a border sheet set to plot at 1"=40' and another user is creating a border sheet set to plot at 1"=200'. If both sheets were plotted and compared, the text in the title block should be the same size even though they were plotted using different scales. By using Task Navigation, a user can place cells, custom line styles, text, patterns, etc. quickly and easily, because the individual element scale factor are adjusted by the drawing scale. See the next section on "Annotation Scale".

CADD Standards

3.4.1 Levels

Sept 2010

Many levels are named with the noun first and then the adjectives, example "Pole Wood Cell Exst". Abbreviations are often used. The "Exst" (Existing) adjective is used at the end of level names when applicable. Level names without the "Exst" adjective are intended to indicate an undefined or proposed state of presence.

Levels have been set up for specific pay items. The names and descriptions for these levels are based on the pay item spec-code number and description, example "722-3690 INLET SPECIAL 42IN"

Level descriptions are similar to level names except the "Exst" adjective, when used, is first and the element type is not used, example "Exst Pole Wood".

Level numbers have been set up as an identification number. The digits in the number represent attributes of the items on that level. Most standard levels are numbered from 1,000,000,000 to 4,294,967,294. The numbering system is as follows: "A,BCC,CDD,DDE"

A – 1 digit – Type of element
  1= Points, Lines, Curves, and shapes 2=Cells, 3=Text and Dimensions, 4=Patterns
B – 1 digit – Presence
  0=Undefined, 1=Existing, 2=Proposed
C – 3 digits – Closest NDDOT Specification Number
  Some CADD specific specifications have been added.
D - 4 digits – Subsection or NDDOT Code.
  When used as subsection it helps ensure uniqueness.
E – 1 digit – Pay Item Use
  0=No, 1=Yes

Notes
- The maximum level number in V8 is $2^{32}-2$= 4,294,967,294.
- Component names are usually based on the level names except that the element type is not used in the component name.
- Special levels have been set up for raster attachments.

Level Name	Level Number
"Raster Group 1"	101
"Raster Group 2"	102
"Raster Group 3"	103

  Rasters should be attached to the level named "Raster Group 1". The levels "Raster Group 2" and "Raster Group 3" can also be used if you desire to stratify rasters by level.

CADD Standards

3.4.2 "ByLevel" Settings

July 2013

The standard Levels have been set up for "ByLevel" use. However, the linestyle scales have to be manually set by the user and only a few components of the "Tasks - Element Templates" and the D&C Manager use "ByLevel" settings. Presently, "ByLevel" settings are only recommended when they are used by the standard "Tasks - Element Templates" or "D&C Manager" files.

3.4.3 Level Libraries

Sept 2010

The level information is stored in drawing libraries (dgnlib) files. They are located in the directory "S:\Standard\V8i \dgnlib\Levels\". Most levels are automatically attached with the NDDOT standards. Presently the NDDOT has only one supplemental level library that can be used for additional pay item levels.

CADD Standards

3.5   Line Styles
Sept 2010

Users are strongly encouraged to use Task Navigation and Annotation Scale to set the appropriate line style settings (see *Section 3.3*). A user could individually set the Level, Color, Weight, Style and Style Scale for each element. However, this is not recommended because changing each setting individually/manually takes more effort and time and has a higher potential for user errors.

Many line styles use both a line style scale factor and Annotation scale. One of the common line style scale factors is 1/240 = 0.004167. This factor is based on how the original line styles were created. The displayed line style uses the product of line style scale and Annotation Scale. Task Navigation – Templates automates the line style scale factor.

There are a few line styles that are not plotted with a "Scale Factor". These line styles typically represent the true physical size of a feature such as guardrails, curbs, curb and gutter and dowel joints. These features are always drawn at the same scale and will be plotted on paper proportional to the plotting scale. These line styles are digitized by turning off the scale factor toggle and ignoring the Annotation Scale. Again, Task Navigation – Templates automates the line style scale factor. The line styles that are drawn to a physical size are highlighted with an asterisk in *Appendix B*.

Certain line styles are directional, in that their pattern component is not symmetrical. An example would be the 'Exst Wetland Delineated' custom line style. The small filaments that represent vegetation and grasses should point in toward the water side of the wetland. Consequently, the line needs to be digitized in the direction that will produce this effect (counter-clockwise on a closed shape.) Check *Appendix B* for directional information.

Tech Tip: To easily change the direction of a line style, do the following:
On the menu bar under Tools –> Tool Boxes –> Check the Curves tool box

                    –> Click OK
Click on the Change Element Direction icon.
Identify the Element needing new direction
Direction of element changed!

CADD Standards

3.6   Cells

July 2013

NDDOT cell libraries are located at "S:\STANDARD\V8I\cell\". The following is a list of the active NDDOT cell libraries:

Bridge.cel	Bridge items
Bridge_RCBox.cel	Reinforce concrete box items
Cells 1 scale.cel	General cells placed at 1 scale
Cells plot Scale.cel	General cells placed at plot scale
CSP_end_sections.cel	Corrugated steel pipe end sections
drainage_structures.cel	Drainage structures
Driveway.cel	Dimension driven driveway cells
Guardrail.cel	Guardrail items
Hatch.cel	Patterning items
Ltg schematic.cel	Lighting schematic items
Manholes.cel	Manholes
Pipe.cel	Pipe End View
pipe_bends.cel	Pipe Bends
Pvmtmkg.cel	Pavement marking
RCP_end_sections.cel	Reinforce concrete pipe end sections
Sheets.cel	Sheet borders (see *Appendix H*)
Signal_Det.cell	Signal Detail Items
Signals.cel	Signal items
Signs.cel	Signing items

For a comprehensive listing of the available cells (see *Appendix C*).

Some cells in the Signs.cel library contain "Data Fields". By using data fields there is no need to drop the cell to edit the text in the cell. These cells can be easily identified by looking for the letters DF at the beginning of the cell's description. For example, the description for the cell named R1 2U, is DF SPEED LIMIT. To use these cells, place the cells and simply select the "Fill in Single Enter-Data Field" tool and click on the data field that needs to be changed.

Then type in the text and press "ENTER". The data field will fill in with the text that was just entered. Data fields will appear as "   " within the cells. To ensure that these lines do not show up when the drawing is plotted, access the "View Attributes" through "Settings" and make sure the "Data Fields" box does <u>not</u> have an X in it.

CADD Standards

3.7.1 Annotation and Fonts

May 2016

All features on plan sheets should be annotated whenever possible. To ensure the final plans have a consistent and clear readability, operators must follow the standard guidelines for upper and lowercase letters, font type, annotation size, underlining and bolding, use of levels and abbreviations.

Lowercase annotation is used for all annotation except for:
- Capitalization at the beginning of a description (e.g. Bridge begins 1200+65.0)
- Abbreviations for separate words (e.g., the abbreviation for power pole is PP, for cable guardrail is C Gdrl, for corrugated metal pipe is CMP).
- Pay Item Headings and Descriptions

The most common text font used for NDDOT plans is "NDDOT" (true type font). Some standard annotation is placed with font "engineer" or true type font "Dot Matrix".   The use of the "engineer" and "DotMatrix" fonts are for unique situations as programmed into the Templates, "D&C Manager" or other NDDOT standard tools. Engineer font is used with some documentation created by GEOPAK in order to avoid formatting problems such as spacing and special characters. "DotMatrix" font is used with particular labels used on ROW plats. The only fonts to be used on NDDOT plans and related drawings are fonts "NDDOT", "engineer", and "DotMatrix".

Annotation should be underlined when it is in a title that is outside of a title block, or when it is a Pay Item. Slanted or italicized text will not be used on plan sheets.

Pay Items Pay Items that are itemized on sheets should use the following format.
1.   Include heading labels in capital letters on each sheet at the beginning of a pay item list. The headings are; SPEC, CODE, BID ITEM, QTY, and UNIT.
2.   Include Spec and Code Numbers. A hyphen should not be used between the sec and code. Always use 7 digits for the spec and code (example: 123 0001).
3.   Include Pay Item Name In All Capital Letters.
4.   Underline the Spec and Code and Pay Item Name. The underline should extend through the quantity and unit columns.
5.   The itemized quantity information should be indented from the spec and code. The itemized quantity information should be left aligned with the bid item name.
6.   Include measurement units with the quantities.
7.   Use the font size specified by the MicroStation task group for the applicable sheet.
8.   Individual sheet subtotals should not be used.

Designers should use their discretion for pay item location descriptions. Station and offset information doesn't have to be used for all quantities.

CADD Standards

This formatting is not required for pay item used in tables such as the "Traffic Control Device List" and earthwork summary tables.

The following is an example of Pay Item formatting.

SPEC	CODE	BID ITEM	QTY	UNIT
867	5309	GARBAGE CAN		
		Sta 6+00 83' Rt	1	Ea
		Sta 7+00 97' Lt	1	Ea
328	1722	EXTENSION CORD		
		Sta 6+00 83' Rt to 7+00 97' Lt	145	LF
		Sta 7+00 97' Lt to 8+00 97' Lt	100	LF

Additional characters have been added to the font tables to enable the placement of such characters as fractions, Greek symbols and mathematical symbols. *Appendix L* lists the available characters. To draw a special character into a MicroStation drawing, open the "Place Text" box and enter back slash (\) followed by the special character number designation (from 0-255). The special character will be visualized on the screen and it can be placed by left mouse clicking.

A special character was added to the NDDOT true type font library in March, 2014. This character looks like a question mark with a box around it. This character is located after the square root symbol. The character is in keystroke \208 which is not normally programmed on most keyboards.

This character is used to describe some surveyed items that "Indicate a feature that has an unknown characteristic, potentially based on: lack of description, location accuracy or purpose." This special character will simplify CADD labeling.

True type fonts are not resources that are directly installed on the network. Users will need to have the fonts installed or updated on their computer every time there is a font update.

Standards have been set for the size (height and width) of annotation. Task Navigation – Templates have been programmed with the standard sizes and should be used for the placement of most annotation. The typical annotation heights used on NDDOT plans range from 0.05 to 0.17 inches when plotted to paper.

Plan Note sheets should use a 0.12" text height - (12) Arial font. The summary of "Estimated Quantities" should use a 0.09" text height - (9) Arial font.

CADD Standards

3.7.2 Abbreviations

Sept 2013

When so many features are annotated in a set of plans, space is at a premium. To generate more available space, operators should use abbreviations as often as possible. We have established a comprehensive list of abbreviations that are commonly used by the DOT. These abbreviation lists can be found in *Appendices E and F*.

The NDDOT also has a glossary tool (macro). This is used to look up NDDOT abbreviations and send them to your clip board and MicroStation Text editor – Word Processor dialog.   This macro can be accessed from the main pull down menu NDDOT>Tools>Glossary. It is also accessible with short cut key combination "Ctrl + F10" if the NDDOT function key menus are used.

Abbreviations are placed without any punctuation (e.g., CI is 23.9' lt of hyd at elev 1800.6').

CADD Standards

3.8   Dimensioning

Sept 2010

Commonly used dimension settings are grouped and stored in dimension styles. Dimension styles are available to the designer through the "Dimension and Text Styles" dgn library file. A complete list of styles and their settings can be found in Appendix P.

There are several settings within the standard dimension styles that can be modified. The following is an overview of these settings.

Tool Settings

Alignment: Determines the axis along which the dimension is aligned (View, Drawing, True, or Arbitrary

Location: Controls the location of dimension text (Automatic, Semi-Auto, or Manual.)

Dim Offset: Sets a standard offset for the placement of a dimension.

Style Settings

Fit Options

Text/Terminator: Selects the minimum fit dependent on the text, terminator or combination (Text Moves First, Terminator Moves First, Smallest Moves, Both Move, Text Inside, Term. Outside, Term Inside, or Term. Reversed.)

Angle Format

Units: Sets the units of measurement for angular dimensions (Length or Angle.)

Display: Sets the display format for angular dimension text (D.DDDD, DD^MM', DD^MM'SS", C.CCCC, or Radians.)

Accuracy: Sets the number of decimal places to display for angular dimensions.

Text Format

Orientation: Sets the orientation of dimension text relative to the dimension line (Aligned or Horizontal.)

Location: Sets the location of the text relative to the dimension line (Inline, Above, Outside, or Top Left.)

CADD Standards

3.9   Patterning and Hatching

Jan 2017

Patterning and hatching is used for drawings that require material definitions, such as concrete, rock and excavations. A list of patterns is shown in *Appendix G*.

Users are encouraged to use "Tasks" for patterning and hatching because several of the settings are automated.   If "Tasks" are not used, settings such as scale, row spacing, column spacing and angle will have to be manually calculated and entered.

The standard patterns are stored in the cell library S:\Standard\V8I\Cell\Hatch.cel. To establish the correct values for the "Pattern Area" box, multiply the values given in *Appendix G* (for scale, row spacing and column spacing) by the final plot scale. For example, if the final plot scale is 1" = 200', and the pattern cell is "Lignite Coal," the scale will be 0.5 x 200 = 100. Row spacing will be 0.15 x 200 = 30. Column spacing will be 0.15 x 200 = 30. And the angle remains at 45 degrees. Remember if "Tasks" is used, these settings are automated.

MicroStation SS4 has the ability to use annotation scale. MicroStation SS2 doesn't have this capability. The current CADD standards use a macro to read the current drawing scale to adjust hatching and patterning, but they do not use annotation scale directly. Do not use annotation scale for hatching and patterning. The annotation scale toggle button should be off for hatching and patterning.

If an operator is working in a file with a lot of hatching or patterning, they should probably toggle off "Patterns" under "Settings," "View Attributes." This will help with refresh speed. If they toggle on "Associative Pattern" in the "Pattern Area" box, the operator will be able to manipulate the closed shape and still have the pattern fill the altered shape.
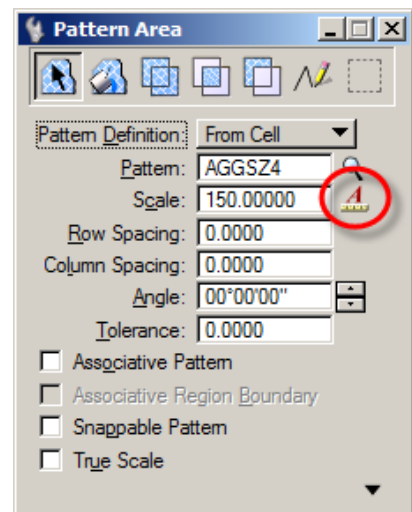
CADD Standards

3.10   Print Drivers

Sept 2010

NDDOT customized print drivers have been setup for printing. These print drivers files have the extension "pltcfg". These files work together with the Windows system print drivers. These files adjust many configurations for NDDOT work. *Appendix M* is a catalog of the printers and drivers set up for the NDDOT. The following is an overview of some of the adjusted print configurations.

Printers
The drivers in the "…\plotdrv\Manually_Pick_Printer" folder don't force a certain printer. You need to select a printer during the printing process or your default windows printer will be used. The drivers in the "... plotdrv\Printer_Specific" folder automatically select a designated printer.

Forms and Sheet Sizes
Some printer drivers work more efficiently with designated form names and sheet sizes. These have been adjusted accordingly.

Pen Tables
Several pen tables have been set up to control the way some drawing elements are printed such as sheet stamps, tags, border comments and general color control.

Print Styles
Print Styles can control most of the same settings found in plot drivers. One key feature of print styles is automatically coordinating the print area with the sheet cell boundary.

Color Settings
Print drivers control what is printed in color, black and white, and gray scale.

Points Size
Most NDDOT print drivers don't display points in output.

CADD Standards

Weights

The table on the right is a line weight guide. It is provided ... as a cross reference for evaluating your printer output. These widths have been used to develop the CADD standards.

MicroStation Line Weight	Millimeter
0	0.0423
1	0.1270
2	0.2540
3	0.3810
4	0.5080
5	0.6350
6	0.7620
7	0.8890
8	1.0160
9	1.1430
10	1.2700
11	1.3970
12	1.5240
13	1.6510
14	1.7780
15	1.9050

Line Caps and Joins

The "NDDOT print drivers" print lines with the following attributes:

Endcap = Butt
This setting keeps the spaces in linestyles constant as the weights are increased
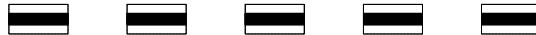
Linejoin = Round
This setting rounds the corners of joined lines
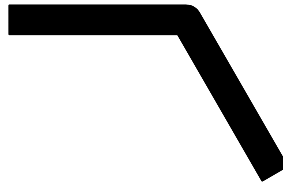
CADD Standards

3.11   Print Organizer

Sept 2010

Print organizer is a utility for plotting one or more design files at a time. A single print organizer job can print drawings from multiple directories. This section only discusses the NDDOT standards set up for print organizer. The following is a quick guide.

1.   Use the NDDOT standard sheet cells.
   a.   The NDDOT standards for print organizer use a plot boundary defined by a particular shape. These shapes are included in all of our sheet cells. The shape is the outer box with attributes; level = Sht Lines, color = 102, Weight = 1, Style = 1.
   b.   Do not use the "Use Shared Cells" option when placing sheets. Printing will not work correctly if this option is used.
   c.   Borders in reference files will not be found.

2.   Invoke print organizer under MicroStation file commands.

3.   Check the current assigned printer in the lower right of the screen. If it is correct, skip to step 5, if not, follow step 4.
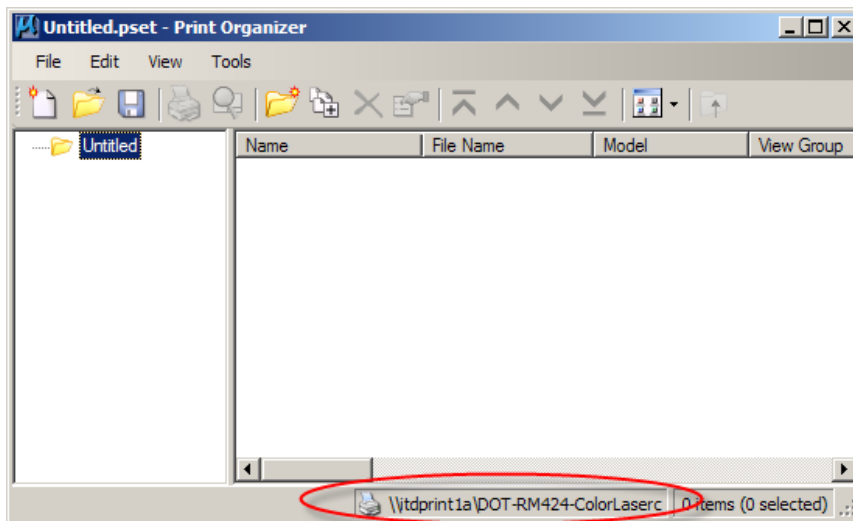
4.   Under the File command, select Printer Setup. In the new window, choose printer from the drop down box. Click OK.

   a.   If the file you intend to print contains multiple sheets within on drawing, such as a cross-section file, changing printers later in the process will be more complicated.

CADD Standards

5.   Select files to batch plot under the print organizer "add files to set" icon. Click the Add button to browse for files. Select desired files and click Done. You may click the Add button again to browse for files in other directories. When all files have been selected, browse for the print style name that matches your printer and desired output format. Click OK.

     a.   Print style must match the chosen printer or output errors may occur. The drawings will print to the printer indicated in the lower right, see #3. If the print style does not match the printer; paper size or color output may be incorrect; ex. a color drawing may print in grayscale.

     b.   If the file you intend to print contains multiple sheets within one drawing, changing print styles later in the process will be more complicated.

6.   If this is for the final set of plans, add any Standard Drawings that you may need. The Standard Drawings can be found at R:\SUPPORT\DESSTD. Add these files the same way you would add any other MicroStation files.

7.   Sort the files into the correct order by clicking on the File Name in the left-hand column. The up and down arrow icons in the tool bar will now be active. The same options are available under the Edit command.

8.   Click "File>Save As" on the menu bar and save the print set into a working directory, in case you need to make any changes later. The print sets should be saved in the corresponding ePlan folder under the project directory. For example, you are in Bridge and are working on PS&E plans. First you would navigate to the PS&E folder under the ePlan directory. Next create a new Bridge folder by clicking on the Create New Folder button. Double click on the newly created Bridge folder. Type "Bridge PSE01" in the File name field and click the Save button.

9.   Review the paper size for each document. Paper size should default to 11 x 17. If adjustments are needed; double click the individual paper size you want to edit or highlight all entries that need correction to change them at the same time. Double clicking directly on a paper size will allow you to change all highlighted entries.

     a.   Check the print area size (X Size and Y Size) as well. It can be adjusted in the same manner. For 11 x 17 sheets, the X Size should be 16.

     b.   When a print style is applied, one sheet will be printed for each sheet cell found in your files. Print preview will show if this is working. If your drawing does not have a sheet cell, it will default to saved view.

CADD Standards

10. Selecting the print command will give you a pop-up box.

    a. There is a box that allows a choice of "send to printer", "create print file", and "create Windows metafile". For paper copies, the "send to printer" option should show. For PDF or electronic files, this box should be grayed out.

    b. There is also a box that allows a choice of "single print job" or "separate print jobs" when a PDF or electronic file is to be created. "Single print job" should be selected to create a single file that contains all the pages. This box will be grayed out for paper copies.

    c. Review the Destination box for desired location and name for PDF or electronic files.

    d. Click OK when ready to print.

11. Changing Printer or Print Style

    a. If NONE your drawings contain multiple sheets, you may change either of these items at any time. Printer may be changed from Printer Setup under the File command. Print Style can be changed by using "apply print style" under the Tools icon. Be sure to match printer and print style. If you do this step to change printer or print style for a file that contains multiple sheets, you will receive a single sheet printed multiple times.

    b. If any your files contain multiple sheets and you must change the printer or print style, follow these steps:

       i. Delete only the files with multiple sheets

      ii. To change the printer, follow step #4 above.

     iii. To change the print style:

         1. If you have other files still existing, select the Tools icon and "apply print style" to apply your new selection, otherwise skip to step B.

         2. Re-add the deleted files following step #5 above, being sure to use the correct, new print style.

      iv. Follow steps #6 - 10 as necessary.

CADD Standards

3.12 Referencing Drawings and Attaching Rasters
May 2016

Reference Paths

All users, especially District and Consultant users, need to use the "Save Relative Path" options when referencing files. The "Save Relative Path" option will help keep the reference path integrity when the files are moved from one drive to another.   The "Save Relative Path" option requires that the original directory structure is similar to the final directory structure. Reference paths must be the same through a common parent directory (higher level directory). See *section 2.1* of this manual.

Referencing by "Primary Search Paths" or by "Configuration Variables" is not the preferred method to reference drawings and attach rasters. Sometimes rasters are referenced from drawings in multiple directories. If this type of raster attachment is necessary, a project configuration variable file can be used. This project configuration file must be submitted with the project files. Consultants must discuss their use of "Primary Search Paths" and "Configuration Variables" for referencing with their assigned "Technical Support Contact".

Broken reference paths are CADD Standard violations even if the references are not important. Unimportant-Temporary-Junk references and raster attachments should be deleted when final plans are completed. Consultants and District users should do this before the electronic files are submitted.

Reference Transparency

Reference Transparency settings for the following sections and reference files are an option to be used at the designer's discretion. In sections 40, 55, 60, and 80 the reference files Topog.dgn and RW_Bndry.dgn can be referenced with a transparency setting of 50%. These optional setting can help clarify dense urban drawing. Using transparency will lighten up some reference files, allowing other files to have more of an emphases.

Note, The NDDOT is using transparency as interpreted by Adobe which doesn't require the rasterized option. In order to print with transparency with only MicroStation, the rasterized option needs to be used.

CADD Standards

Live Nesting

"Pointer Files" are used in an optional work flows. They are not required for plan production, but are encouraged because they can simplify revisions in drawings that use nested referencing. The following is an overview of "Live Nesting" referencing and "Pointer Files".

A nested reference file is a reference file that is referenced by way of at least one other reference file. If file "A" is referenced by file "B", and then file "C" references file "B" with a nested depth of 1, then file "A" would be a nested reference file when viewed in file "C".

"Pointer Files" are drawings that should have nothing drawn directly in them. They consist of only references to other files. These files are used to manage reference files for sheet drawings in the plans. Each section of the plans could have its own pointer file ("Pointer_" and Section Number); Pointer_040.dgn, Pointer_055.dgn, Pointer_060.dgn, Pointer_070.dgn, Pointer_075.dgn, Pointer_076.dgn, Pointer_077.dgn, Pointer_080.dgn, Pointer_082.dgn, Pointer_090.dgn, Pointer_100.dgn, Pointer_110.dgn, Pointer_120.dgn, Pointer_130.dgn, Pointer_140.dgn.

The Pointer file controls which reference files and level will be displayed in your sheet drawings. The Pointer file can be used to turn on and off levels in multiple drawings.   They can also be used to attach or detach reference files in multiple drawings. The Pointer file makes it easier to consistently adjust what is displayed in your plan sheet drawings. Multiple sheet drawings can reference the Pointer files and reference adjustments including level display can be made in one place.

Level display settings can be changed for the active file, a reference file and a nested reference file. MicroStation has "Display Overrides" for "nested" reference files.   The "Display Overrides" are not applicable to regular reference files. This is an important difference between reference files and nested reference files. Whenever you reference a "Pointer" file, "Live Nesting" should be set, Display Overrides should be set to "Never" and the Nesting Depth is usually set to "1".
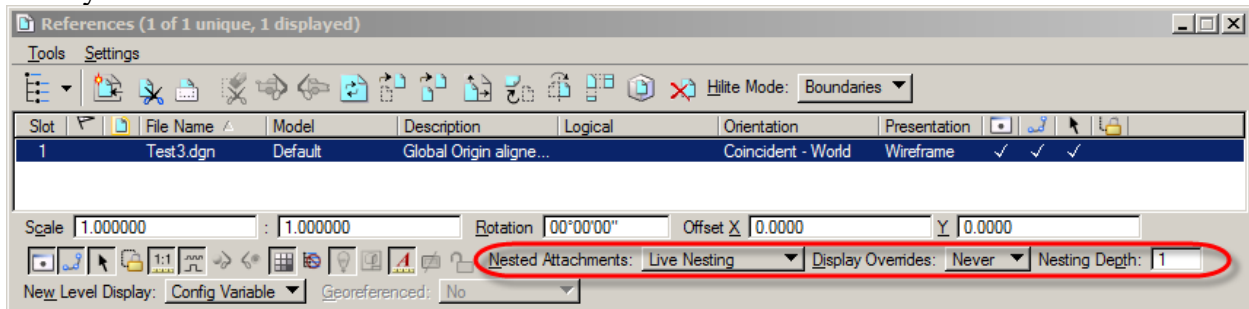
When you reference files into the Pointer file, Live Nesting is not typically used because the Pointer file is usually referenced by others with nesting depth of 1. If the Pointer file is referenced with a Nesting Depth of 2 or more then the Live Nesting and Display Override options within the Pointer file are also important. The Nesting Option outcomes become more complicated as the Nesting Depth increases.

3.13   Printing Rasters (Pictures)

Oct 2008

Embedding pictures within a MicroStation drawing is discouraged. Don't cut and paste pictures
into MicroStation. Pictures should be attached to drawings using Raster Manager. Pictures
attached with raster manager are easier to adjust then embedded pictures.

Printing color pictures in grayscale is easier to do with raster manager than with embedded
pictures. Color Pictures should be printed as grayscale when creating black and white plan sets.

The raster settings for printing with just MicroStation can be found in the "Print" dialog box
under "Settings>Raster Options.
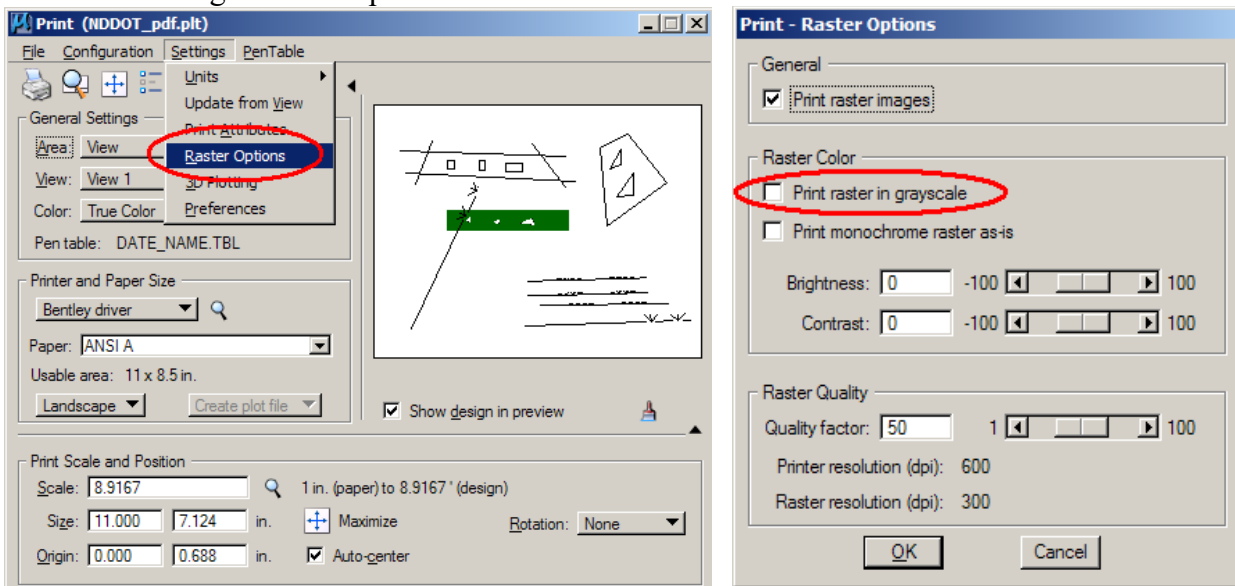
CADD Standards

3.14 Annotation Scale

Jan 2017

The NDDOT CADD standards use annotation scale. Annotation scale (for placement) should be on for most elements. Hatching and Patterning is the exception. Annotation scale for hatching and patterning should be off. Annotation scale affects more than just annotation. Annotation scale affects the scale for line styles, cells, text, dimensions, hatching and patterning.   The CADD standards presently use annotation scale indirectly, through a macro (VBA), to adjust hatching and patterning.

Annotation Scale is part of the Drawing Scale. The Drawing scale also contains the working units settings and Annotation Scale Lock toggle. The Annotation Scale can be selected from the main MicroStation menu under "Settings>Drawing Scale".
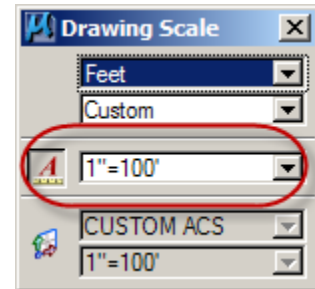
MicroStation drawing elements that directly use annotation scale will automatically change scale when the Annotation scale is changed. One drawing model can use only one Annotation scale at a time. Example, you can't correctly draw two different scaled typical sections in one drawing. The annotation scale for one of the typical sections will be off.

There are a lot of settings related to annotations scale. Most of these settings are AUTOMATED in the standard NDDOT tools.

Annotation Scale for Line Styles
- This is a model property. V8i Standards use "Annotation Scale for Line Styles".
- The V8i standard resource file (dotlst.rsc) uses a property named "physical" to indicate which line styles should not be adjusted by annotation scale such as "24 inch RCP".
- Custom Line Style scale factor is used in V8i.
    - Annotation Scale and line style scale factors are different properties.
    - Line styles that should not be scaled will use a factor of 1.
    - Line styles that should be scaled, dependent on annotation scale, will use a factor of 0.0041666 (1/240).
    - Line Style Scale Factor is it used in conjunction with annotation scale. What you see is the product of the two different factors (annotation scale x line style scale).
    - Task Navigation tools will automatically adjust the line style scale factors as needed.

Annotation Scale for Cells
- Annotation Scale for Cells consists of two properties; model and placement ("Annotation Purpose" and "Is Annotation").
- Both of these properties need to be on if the cell is to be directly adjusted by annotation scale.

CADD Standards

- The cell property "Annotation Purpose" (model) is set by CADD standards. User will not adjust this setting.
- The cell property "Is Annotation" (placement) can be toggle on or off during placement. Users could change is setting but typically shouldn't. NDDOT standard task navigation automates this setting.

Annotation Scale for Text (Text Styles)

Text Styles are used in V8i to help implement annotation scale for text. The actual paper scale values are used for text height and width. You are probably familiar with the values in units of inch. The actual values will be in master units – feet. The style "text 0.07" will display a text height and width of 0.0058 feet. For this standard the text height and width shown in the tool settings will not change. But the actual drawing text height and width will be a product of the text style values x the annotation scale. At an annotation scale of 1" = 40', the actual drawing height, not the value shown in the tool settings, will be 2.8 Feet (0.07 x 40 = 2.8 ≈ 2.784 = 0.0058 x 12 x 40).

Annotation Scale for Dimension Styles

V8i Dimension settings are dependent on text height values. The NDDOT Dimension Styles have been set up using text styles.

Annotation Scale for Hatching and Patterning

Hatching and Patterning do not directly use annotation scale. The NDDOT standard tools read the annotation scale that is presently active and it adjust the Hatching and Patterning settings according to this scale. However subsequent changes to the annotation scale will not change the hatching and patterning settings. If the annotation scale is changed after hatching or patterning is placed, this hatching – patterning will have to manually be edited to the correct scale or replaced.

Annotation Scale and Referencing

In the references dialog box the "Use Active Annotation Scale" toggle can make the reference file use the active model's annotation scale.
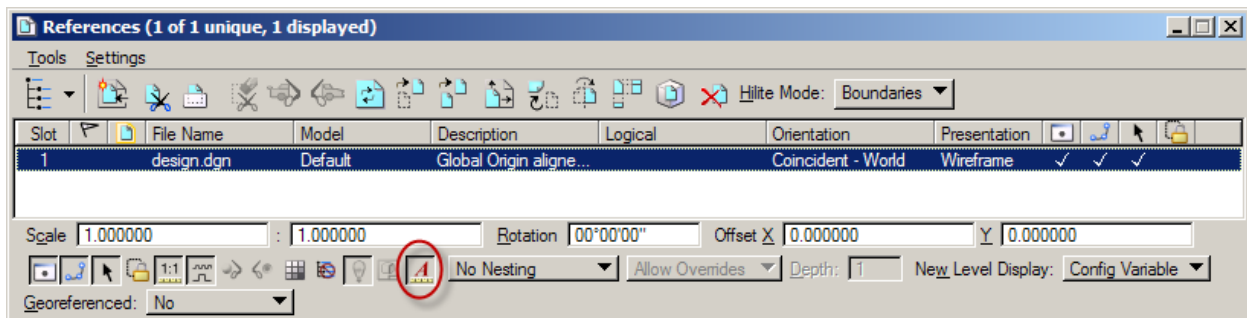
CADD Standards

3.15   Priorities and Masking Elements

Jan 2017

MicroStation shape elements with an opaque color matching the back ground color (number 255) are being used as masking elements within many sheet cells. These masking items are being used to hide referenced elements that might overlap a title block. These elements are being used with MicroStation "priority" attributes. Reference elements with a lower priority are covered up and hidden by the masking element.

There are a few things to remember when using these masking elements. First, masking elements are on their own level (Mask Lv Priority 100). The level can be turn off if you don't want to use the masking elements.

Second, the "Fill" view attribute must be turned on.
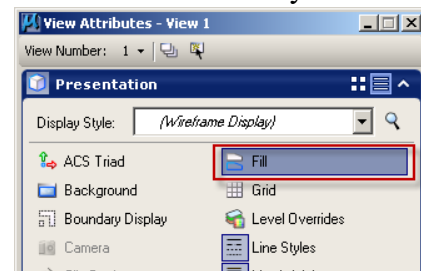
Third, the reference update sequence may need to be changed if a 3D drawing is referenced. This step isn't needed if all references are 2D. Note, most "Topog" drawings are 3D.

If a 3D drawing is referenced, all of the cut sheets – sheet drawings will need to be edited. With the sheet drawing active, open the reference dialog box and select "Settings > Update Sequence".   Move the active sheet drawing to the end of the update sequence list. Be sure to save settings after the update.
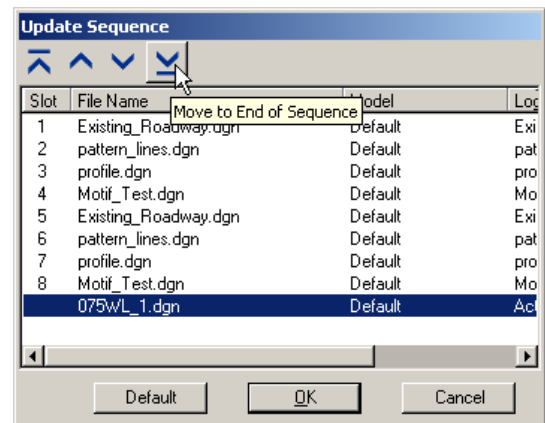
If a drawing with opaque shapes are being referenced, they should be first in the update sequence. Next should be any 3D drawings, then regular 2D references, and lastly the active sheet drawing. This adjustment is typically need for sheets in sections 075 through 077.

Fourth, if the sheets are being created from a drawing that used an older level priority definition for sheet lines, this level priority definition will need to be updated. Do this before cutting sheets if possible. If done after, all cut sheets will need to be edited.

CADD Standards

Within Level Manager, select the "sht Lines" level. Then select the "update levels from library" button. Level definitions not matching the present CADD Standard definition will be marked with the modified attribute as shown.
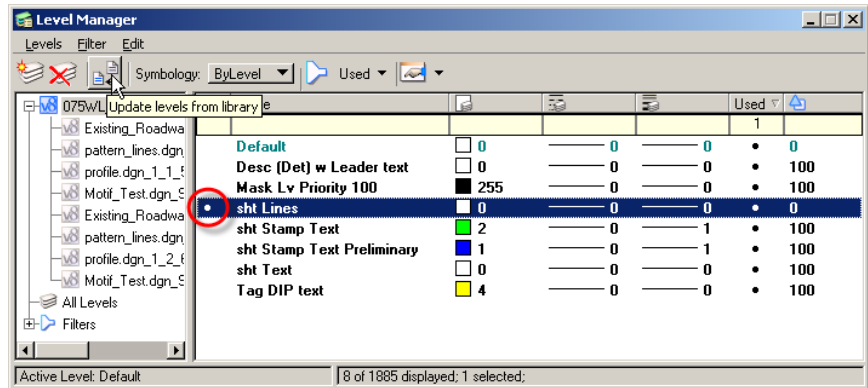
Most users will not need to change priority setting. The following is a summary of NDDOT standard priority attributes. Display priority is determined by a combination of element, level and reference priorities. Reference priorities are a 1000 times that of level priorities and level priorities are a 1000 times that of element priorities.

Display priority = (1,000,000 x reference priority) + (1000 x level priority) + element priority.

Most CADD standards don't use reference and element priorities. Most CADD standards have a level priority of 100 (display priority 100,000) or less. Many sheet cells have display priorities greater than 100,000. The following are some of the sheet display priorities. Bigger display priorities display on top of smaller display priorities.

Items	Level Priority	Element Priority	Display Priority
Masking Element	100	10	100,010
Sheet Lines	100	20	100,020
Sheet Text	100	30	100,030

CADD Standards

3.16   Geographic Coordinate Systems (GCS)

May 2017

The NDDOT has assigned a special coordinate system to each county. Most NDDOT projects use one of these county coordinate systems. Three libraries of coordinate systems are included in the CADD Standards;

NDDOT_County_Coordinates.dty
NddotCountyNAD83-CORS96.dty
NddotCountyNAD83-2011.dty

The library NDDOT_County_Coordinates.dty is no longer used. This is an older library that was used with MicroStation SS2. This is kept with the standards incase work needs to be done with older software. This library is not attached by default.

The other 2 libraries are not compatible with MicroStation SS2 and lower versions.

By assigning a GCS to each drawing you enable additional capabilities. MicroStation and Bentley Map can use these GCS to project and re-project data from differ geographic coordinate systems. This data includes Bentley data and many other formats such as pictures and ESRI formats.

The GCS's are not set with the default NDDOT seed files. They need to be set up on an individual drawing basis. Set the coordinate system by going to Tools>Geographic>Select Geographic Coordinate System. This will bring up the "Geographic Coordinate System Dialog. Select the second button "From Library".
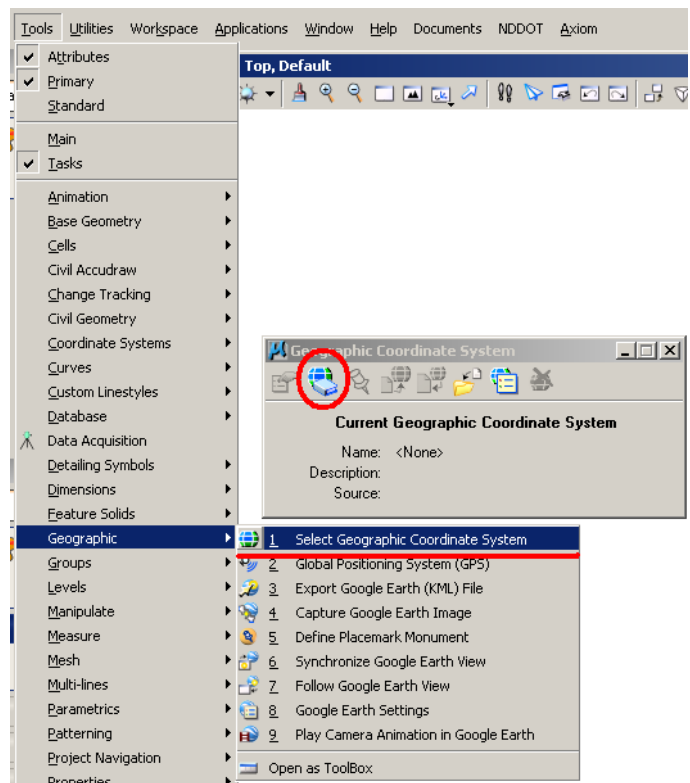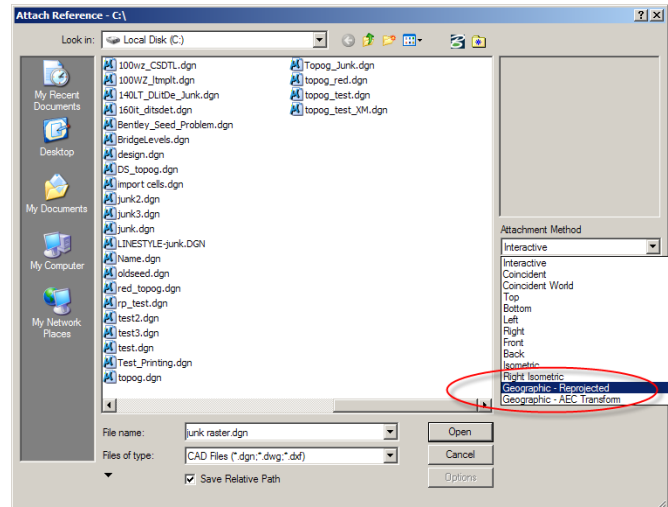
CADD Standards

Select the Coordinate system to apply to the DGN file from the available selections. Most Projects within the DOT will use one of the NDDOT county systems. After selecting the appropriate Coordinate System, click OK.
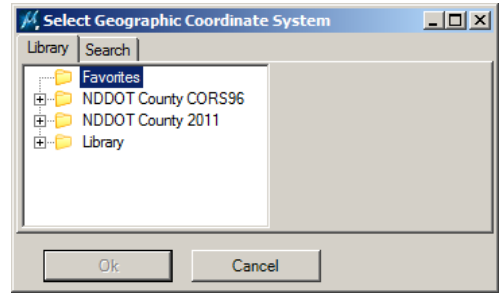
Typically the Survey or Photogrammetry section will determine what coordinate system to use. Review their AAreadme file to determine which coordinate system to use. Their files can also be reviewed in order to determine the applicable coordinate system. The CORS96 GCS's will not have a year listed in the name. The 2011 GCS's will show the year in the name.
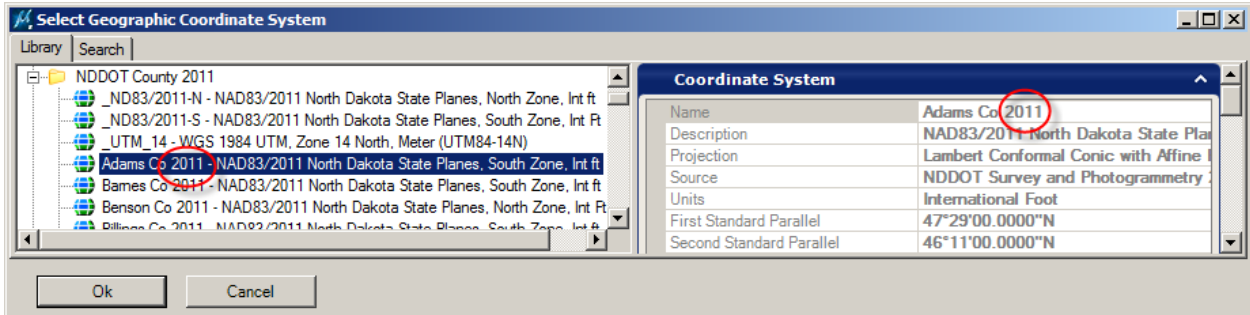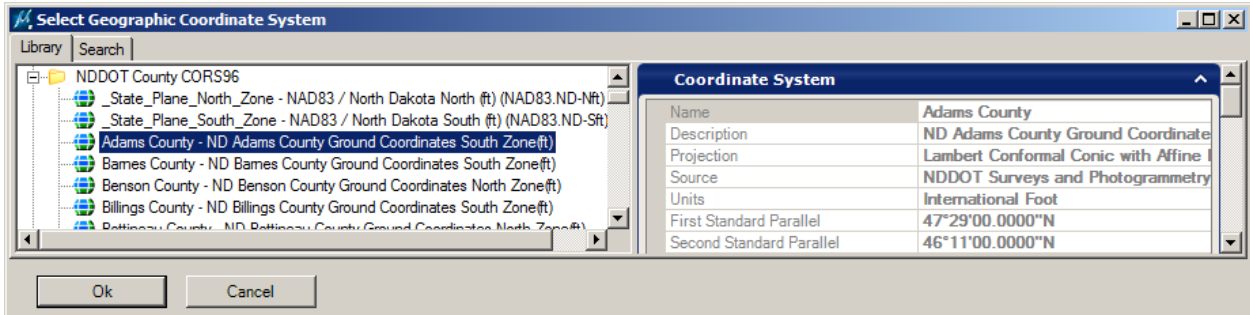
Hint: When working with different GCS's, look for and use the option "Geographic – Reprojected" when using tools such as referencing.

CADD Standards

GEOPAK

4.1 GEOPAK User Preference

Jan 2019

The following is a brief discussion on the "working directory" and "job directory" as set in the GEOPAK Users Preferences. The "working directory" is the location of the directory in which the working and support files are located. This directory can be set three different ways.

1. GEOPAK User Preference - Empty Default Method.

    Many GEOPAK functions work properly without setting the "working directory" preference. If this preference is empty, GEOPAK will default to the directory of the first opened drawing. One disadvantage of this method is it can not be used when using GEOPAK to clip sheets that reference drawings in different directories; the working directory must be set to the directory that contains the clipped sheets. See Method 2.

2. GEOPAK User Preference - Defined Location Method.

    This method is straight forward. Manually set the working directory to the appropriate location. This location is usually the directory in which your .gpk file resides.

3. Project Manager is no longer recommended.

The GEOPAK user - Cogo preference "job directory" is similar to the "working directory" preference. The "job directory" preference is used for Cogo files and if not set it will default to your working directory. Most users can leave this preference empty because they keep their Cogo files and drawings in the same directory. If the job directory is set, it also must be reset when switching between projects.

Notes:
- The "project name" field is optional.
- The initials "nd" (North Dakota) should be used for the "operator code" field.
- The "subject" field is optional.

CADD Standards

4.2   GEOPAK Database (GPK file)

October 2005

The gpk file is the main project related GEOPAK file. It is usually stored in the working directory. Individual projects may have multiple .gpk files. Multiple .gpk files are often created and copied to protect the integrity of work. Users should be conscious of all .gpk files used on a project. Users are often required to copy other .gpk files and use the copied .gpk file as a starting point.

When users are first involved in a project they should closely examine what information is presently available in existing .gpk files before creating .gpk files of their own. Users are encouraged to copy .gpk information, in order to save time.

CADD Standards

4.3   Cogo (Coordinate Geometry)
July 2007

Cogo is an acronym for Coordinate Geometry. GEOPAK's Cogo is an application that allows the operator to define alignments and other elements within a data base (gpk file). This data base is the backbone of a GEOPAK project.

Elements stored in GEOPAK should follow the numbering convention shown below. The GEOPAK POINT NUMBERING SYSTEM should be followed even if multiple *.gpk files are created for a single project.

GEOPAK NUMBERING SYSTEM			
Numbers	**Information at the Point**		**Typical User**
1-100	Existing	Alignment	Survey - Photo
100-5999	Existing	Primary\Other Control	Survey - Photo
100-5999	Existing	Earth	Survey - Photo
100-5999	Existing	Public Land Survey System (Section Data)	Survey - Photo
100-5999	Existing	Photo Panels	Survey - Photo
100-5999	Existing	Topog	Survey - Photo
100-5999	Existing	Utility	Survey - Photo
6000-7999		Property Lines and Right of Way	ROW
8000-8999	Proposed	Alignment - Office Location	Design
9000-9999	Proposed	Topog Info (curb returns, sidewalk control points, etc)	Design
10000-10999	Proposed	Utilities-Drainage	Design
11000-11999		Bridge	Bridge
12000-13999		Testing and Sample Locations	Materials and Research
14000-14999		Construction - Change Order - As-builts	District
15000-19999		Reserved for CADD Standards Development	
20000-30000	Existing	Survey Data Overflow	Survey - Photo

Curve names should include a prefix "C" and use the same number as the PI point number. Example; the name for curve with a PI at point number 11, should be "C11". Spirals should also be named in a similar fashion with an additional suffix. The entry spiral should have a suffix "A" and the exit spiral should have a suffix "B". Example: a SCS with its combination PI at point number 11 would be made up of a spiral named C11A, a curve named C11, and spiral named C11B.

CADD Standards

Alignments

Alignments stored in GEOPAK should follow the naming convention shown below. All alignments require a standard prefix.

Standard GEOPAK Alignment Prefixes			
Type of Alignment	Alignment Prefix		
	Horizontal	**Existing Vertical**	**Proposed Vertical**
Survey Center Line	SCL	EXS	PRS
Existing Alignment – Alignment previously Defined in another set of plans – older plans	EX	EXE	PRE
Proposed Alignment – New Alignment Defined	PR	EXP	PRP

The prefix is based on the type of chain – alignment being stored. The rest of the name (body of the name) should be based on the street-roadway name and/or location. The body of the name should consistently be used in the horizontal alignment, existing vertical alignment, and proposed vertical alignment.

The following is a list of example Names:

| Example Names for Alignments			
Type of Alignment	Alignment Name		
	Horizontal	**Existing Vertical**	**Proposed Vertical**
Survey Center Line for US Highway 85	SCL85	EXS85	PRS85
Existing Alignment for US Highway 85	EX85	EXE85	PRE85
Proposed Alignment for US Highway 85	PR85	EXP85	PRP85
Existing Alignment for the North West Loop Ramp for 10th Street	EX10NWL	EXE10NWL	EXP10NWL
Proposed Alignment for the North West Loop Ramp for 10th Street	PR10NWL	EXP10NWL	PRP10NWL
Existing Alignment for Interstate 94 Westbound	EX94WB	EXE94WB	PRE94WB
Proposed Alignment for Interstate 94 Westbound	PR94WB	EXP94WB	PRP94WB

CADD Standards

Note, some of the alignments/profiles in the above examples might not be applicable or typical. You probably would not need to design a profile for EXP10NWL if you were going to have a profile for PRP10NWL. The combinations of example names were listed to show the naming pattern.

Cogo input files, journals, and output files have not been standardized, but users are strongly encouraged to develop and save these files in a manner which can easily be reviewed.

Parcels

A parcel is stored in GEOPAK using points, curves, spiral curves, or chains that were previously stored. Points can be stored from electronic field book data, graphical data from intersecting lines or traverse courses drawn into MicroStation. An owner's name and address can be stored with each parcel by invoking Coordinate Geometry and by keying in "Own Parcel" followed by the parcel name and the owner's name and address.
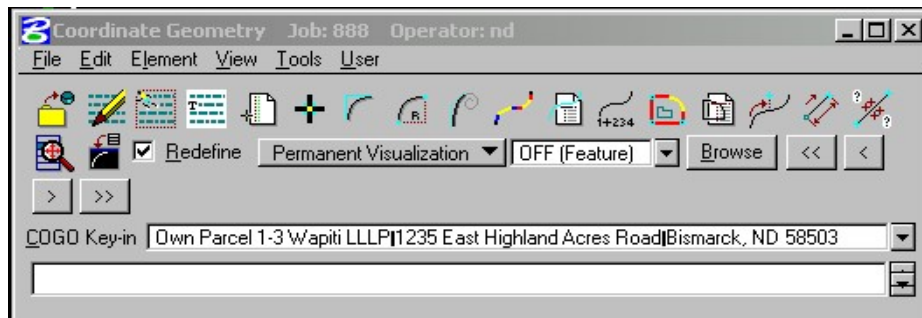
The Design and Computation Manager can read the information of the parcels and prints it into a dgn file along with the parcel boundary.

Exporting Alignment Information to an XML file

Civil geometry elements need to be exported to a gpk file in order to export them to an xml file. This is the procedure for creating an alignment XML file.
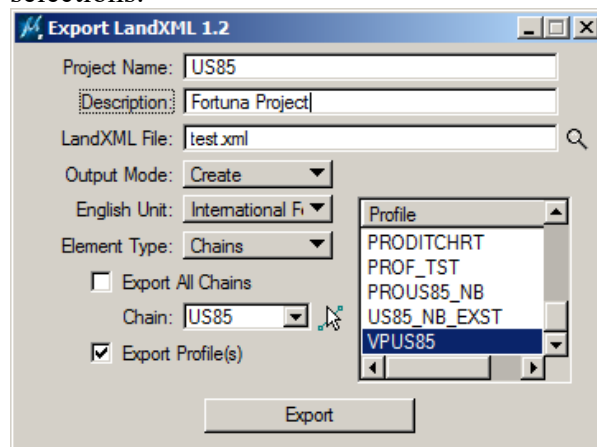
1.   Open Geopak Coordinate Geometry

CADD Standards

2.   Select File > Export > LandXML 1.2 Geometry
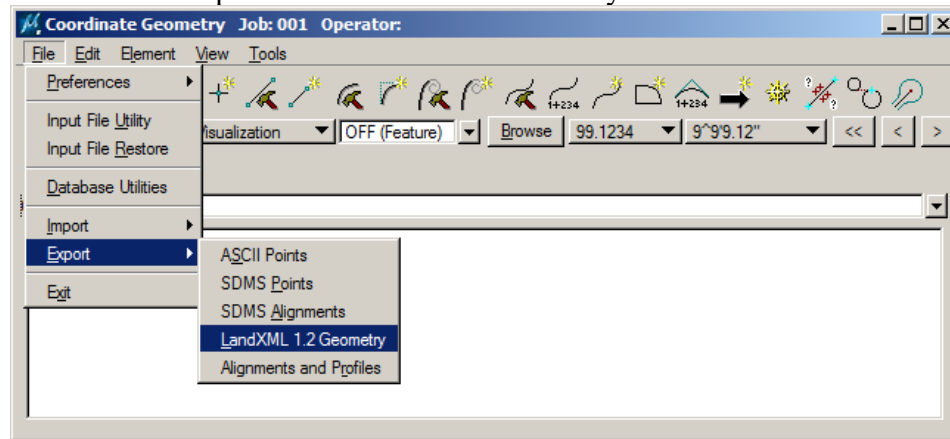
3.   The Export LandXML 1.2 dialog should open. Make the appropriate dialog selections.

      a.   Most of the settings are intuitive. However there is one setting that is not commonly understood. **The English Unit must be set to "International Foot".** The NDDOT always uses "International Feet".

      b.   Project Name and Description fields can be provided as desired. These fields are optional.

      c.   The Output Mode > Create or Append lets your create a file from scratch or append an existing file.

      d.   The Element Type options let you pick the type of cogo element to export; points or chains.

4.   Select Export and the xml file should be written to your working directory.

CADD Standards

4.4   Design and Computation Manager

October 2008

GEOPAK's Design and Computation Manager (D&C Manager) is used to draw features into a MicroStation design file using preset attributes and a designated GPK file. The D&C Manager is similar to the MicroStation Settings Manager, in that it can be used to draw a feature into a drawing and it will set the attributes of that specific feature to the current NDDOT Drafting Standards.

There are 2 standard Design and Computation Manager databases; NDDOT.ddb and NDDOT PayItems.ddb. The default database for the D&C Manager should be NDDOT.ddb. If it isn't your default, see *Section 2.5* of this manual. The following outlines describe the general hierarchies of the database.

1.   NDDOT.ddb
   a.   Drafting Standards
      i.   Alignments
         1.   Horizontal
         2.   Profiles
      ii.   Cross Sections and Typicals Sections
      iii.   Pavement Details
      iv.   Right of Way and Easements
   b.   Applications - 3 Port Criteria – Special GEOPAK programs-scripts

2.   NDDOT PayItems.ddb - Features that can be used in calculations of costs
   a.   SECTION - Section Number Divisions by hundreds
      i.   SPEC – Specification Number
         1.   UNIT – Pay Unit Measurement

The DC Manager has several advantages over the MicroStation Settings Manager; The DC Manager draws Cogo features quickly, performs many quantity calculations and has advanced highlighting capabilities. The disadvantage is that the DC Manager does not contain all the standard features.

Note the scale factors in the DC Manager "Design Settings" needs to be adjusted for some cells and custom line styles to be drawn correctly. The line style scale factor is equal to the plot scale / 20.

Note, hatching and patterning symbology used in D&C Manager pay items don't automatically adjust for scale. Settings such as hatch spacing will need to be adjusted manually.
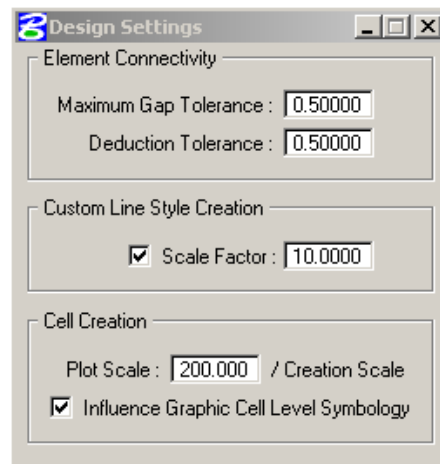
CADD Standards

The majority of the NDDOT pay items are in the D&C Manager (over 4000 items included). Some pay items units are difficult to visualize in a drawing like "Lump Sum" and "Hours". These types of pay items are not included in the D&C manager. Most of the pay items don't have unique symbology.
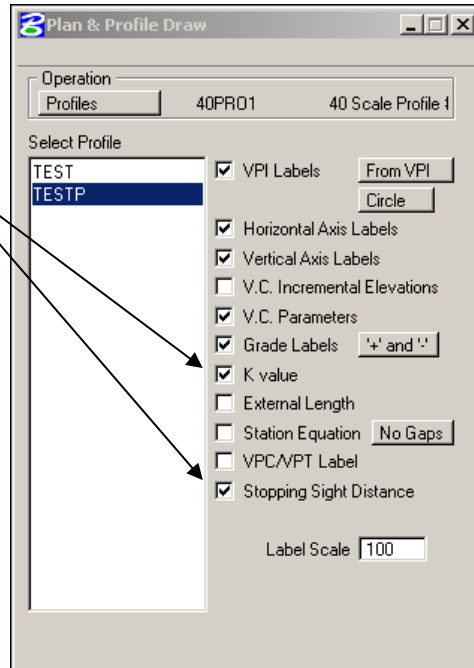
Notes for Drawing Profiles

The NDDOT D&C Manager's Profiles were created with specific exaggerations (ratios of the horizontal scale to the vertical scale). If you don't use these scales your curve table data may need to be manually adjusted.

Horizontal Scale	Vertical Scale	Exaggeration	Strip Grades
40	5	8	20'
60	10	6	20'
80	10	8	50'
100	10	10	50'
200	20	10	100'

The vertical curve tables have been set up to display the VPI station, elevation, stopping sight distance (SSD), k, and Length. Most of this information will display by default. However, user will need to manually turn on SSD and K. See the diagram below.

Turn on these settings

Don't forget to set the correct "label scale" based on the final drawing scale. Examples; 40 scale profiles can only be draw when the label scale is set to 40, and 200 scale profiles can only be draw when the label scale is set to 200.

Notes for Drawing Horizontal Alignments

The horizontal alignment items have been setup for specific label scales. "Small – 80 scale and less" D&C manager alignments can be used for 40, 60 and 80 scale drawings. "Large – 100 scale and greater" D&C manager alignments can be used 100, 200 and 400 scale drawings.

4.5 Digital Terrain Model (DTM)

Jan 2019

The Triangulated Irregular Network (TIN) files are used for storing surface information. Some of the information that they contain is similar to the information stored in MicroStation terrain elements. TINs are normally created in GEOPAK, using the "Applications", "GEOPAK Road", "DTM tools" box. From here a user extracts graphical information from a dgn file.

The type of graphical data extracted determines the name of the TIN file. The primary sources for graphical data are: Field Surveys, Aerial Stereo Compilation and Aerial Automatic Elevation data. The title "DTM" refers to data collected using field survey and aerial stereo compilation methods. TIN file naming conventions will be the same as the Terrain Models in chapter 5.5

ISAE surface data

Photogrammetry uses a suite of ImageStation programs created and distributed by Intergraph. ImageStation Automatic Elevations (ISAE) is a program designed to use stereo aerial image pairs to automatically create a grid of points in a variety of configurations. The grid size can be constant or variable. The default grid size is based on the Height Above Ground (HAG). Generally speaking a low level flight at 1500' HAG will have a default grid size of 4'.

ISAE generates elevation points from the stereo imagery. The program does not necessarily differentiate between a gravel pile and a house. The program will create elevation points on top of both features. This is also true for large trees and thick vegetation.

ISAE DTM surface data

ISAE_DTM files contain a hybrid of manually digitized stereo compilation data and ISAE surface points. There are many variations of this hybrid data but generally it is used to extend the limited coverage of the stereo compilation data with quickly generated ISAE data. A few examples of these ISAE_DTM files are:
- DTM data from R\W line to R\W line and a 500' ISAE surface outside the R\W
- DTM data covering only the road surfaces with ISAE data for everything else out to the R\W.
- Typical DTM data for the entire project corridor with a 1000' ISAE surface at the beginning of the project.

The ISAE data included in the ISAE_DTM files can have different levels of editing completed. Some of the edits to the ISAE data that may be completed are:
- Limiting the extents of the included ISAE data (generally completed to conserve space)
- Removal of major anomalies (trees, buildings, trucks, etc.)
- Removal of minor anomalies (brush, vegetation, random object, processing ambiguities, etc.)

The user should consult the AAreadme file for the project (or the project editor) to determine the level of editing completed for the ISAE portion of the data in the ISAE_DTM files.

CADD Standards

4.6   Survey Manager Database (SMD)

Dec 2010

The SMD file is used in the translation of data from survey data collectors to MicroStation Design files using GEOPAK Survey.

To begin the translation of data, the operator invokes the "Preferences" from Applications>GEOPAK SURVEY>Project>Preferences. Within the Preferences dialog box navigate to the Visualization tab. The SMD Feature File path should be set to s:\STANDARD\V8I\GEOPAK\SURVEY\NDDOT.SMD. The "Apply Feature Best Match" toggle should be turned on and the "Plot Scale" should be set to "1" for all projects. The scale of graphical data will be determined by the Annotation Scale set in the DGN.

Once the data is visualized the key-in "ANNOTATATIONSCALE ADD" must be issued for the graphic to assume the scale set for the DGN.

The .SMD files are protected files and cannot be edited. If any operators have a need for additional items to be added into the .SMD they should contact a support person.
The feature codes, used by field personnel to enter data into their data collectors, are listed in *Appendix I*.

Linking Codes

The linking codes need to be set in the Preferences dialog box. They can be found under the Dataset tab in the Linking Codes item. They should be set as follows:

Begin Line:	=	+
End Line:	=	-
Close Figure:	=	!
Beg/End Curve:	=	/
PC Curve:	=	XPC
PT Curve:	=	XPT
Curve Fit:	=	XCF
PCC Curve:	=	XCC
Continuation:	=	XCN
Left Right:	=	XLR
Front Back:	=	XFB
Up Down:	=	XUD
Duplicate Prefix:	=	XDU
Comment Char:	=	*

The linking codes that are prefixed with an "X" are not intended to be used, however they do need to be set to eliminate conflicts with the EFB codes. Note: The Continuation linking code may be grayed out. You will have to set the definition of this code once you create a dataset in the XYZ to Coordinates dialog box.

CADD Standards

4.7   Plan Sheet Library

Jan 2017

The GEOPAK Plan and Profile sheet layout tool is used to automate the creation of plan and profile sheets. In this process, many new drawings are created that can contain a number of referenced drawings. These newly created drawings are formatted to present information in traditional, manageable sized sheets.

The table below lists the sheet layouts that are presently available. If additional types of layouts are needed, please contact a Standards Committee Representative.

SHEET NAME	CELL NAME
Double Plan Sheet 1	Plan-Plan1
Double Plan Sheet 2	Plan-Plan2
Plan and Profile Sheets1	PP10
Plan and Profile Sheets2	PP10S60
Plan and Profile Sheets3	PP10S80
Plan and Profile Sheets4	PP12
PLAN A (Margins; Lt.=0 Rt.=0.0 Top=0.5 Bottom=1.5)	PLAN
PLAN B (Margins; Lt.=0 Rt.=0.0 Top=0.5 Bottom=2.5)	PLAN
PLAN C (Margins; Lt.=0 Rt.=4.5 Top=0.0 Bottom=0.0)	PLAN
PLAN D (Margins; Lt.=0 Rt.=4.5 Top=0.0 Bottom=1.5)	PLAN
PLAN E (Margins; Lt.=0 Rt.=4.5 Top=0.0 Bottom=2.5)	PLAN
PLAN F (Margins; Lt.=0 Rt.=4.5 Top=0.5 Bottom=2.5)	PLAN
PLAN T (Margins; Lt.=1 Rt.=1.0 Top=0.5 Bottom=1.5)	PLAN
PLAN MAX (No Margins)	PLAN
ROWPLAT	RWPLAT

All the different sheet layouts, such as cross section sheets, right of way plats and plan and profile sheets, are designed to be placed as cells. Some sheet cells can be plotted at different scales, others are designed to be plotted at only one scale.

Sheet cell origins are located in the lower left corner, at the intersection of the bottom and left borders. A list of available sheets is included in *Appendix H*.

Most sheets laid out with the NDDOT standards are designed with an overlap. The total overlap is the sum of the beginning and ending overlap. Two different sheet compositions are used within the CADD Standard Plan Sheet Library. The CADD Standards only use 2 out of the 4 "sheet composition" methods.

CADD Standards

For Plan and Profiles Sheets, you should use the sheet composition method of **"By Station Range: Inside Out"**. For all other sheets, you should use the sheet composition method of **"By BeginStation\Overlap"**.

"By Station Range: Inside Out" Example:
A user wants to layout plan and profile sheets at a horizontal scale of 100. The user would select "Plan & Profile Sheets1" from the "NDDOTSheet.psl" and set the scale to 100. The primary coverage (Station Range) is set to 1000 ft. However, this does not include the overlap. The actual plan drawing area will be noted in the Sheet Composition dialog box, in this case, 1100' x 512.5' (see dialog box shown). The primary horizontal coverage is 1000' and the actual coverage is 1100'. In this case the horizontal clip is actually an additional clip outward of 50' on both sides (50+1000+50=1100). Users are expected to realize from these numbers that the overlap is 100' (1100'-1000'=100'). This overlap is split equally between the beginning overlap and ending overlap, in this case 50' and 50' respectively. See diagram below. The user must start the sheet layout process at an even station if they want their sheets to line up with the grid lines.
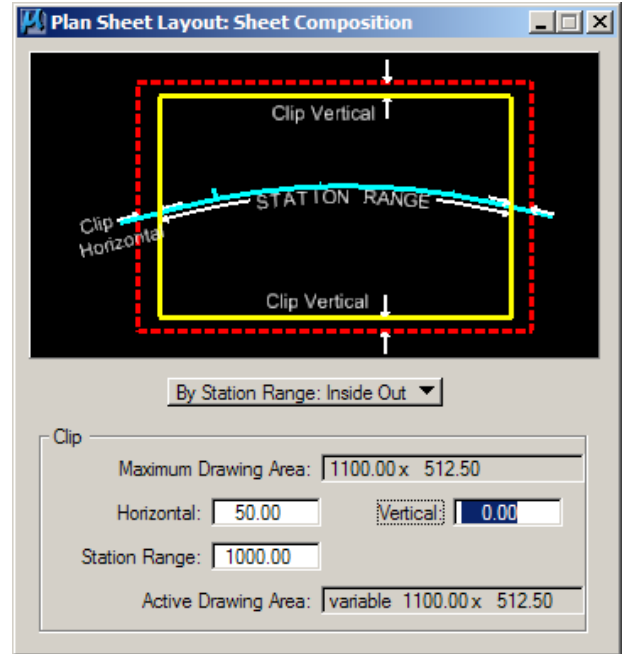
The following table summarizes composition settings for plan and profile sheets. These sheets use the **"By Station Range: Inside Out"** method.

| Scale	Clip Horizontal	Clip Vertical	Drawing shown
40	20	0	400
60	30	0	600
80	40	0	800
100	50	0	1000
200	100	0	2000

CADD Standards

"By BeginStation\Overlap" Example:
A user wants to layout plan sheets at a horizontal scale of 100 with 1000 feet of coverage, starting at station 10+00. In this case, the user would select Plan C from the plan sheet library. Note that Plan C settings will provide no margins between the clip area and the sheet border cell for the top, bottom and left edges. However, a 4.5 inch margin will be provided between the clip area and the sheet border for the right edge. This 4.5 inch margin area is often used for quantities.

As discussed earlier, most of the sheets are designed for an overlap. In this example, the actual length of plan view is 1050' long. The actual plan drawing area will be noted in the "Active Drawing Area" (1050.00 x 1000.00). Users are expected to realize from this number that there is 50' overlap. The primary horizontal coverage is 1000' (1050' actual coverage – 50' overlap = 1000' primary coverage).

The overlap is split equally between the beginning overlap and ending overlap, in this case 25' on the left and 25' on the right. The user must start the sheet layout process, half the total overlap distance, before the desired station. In this case, the starting station would be 9+75.
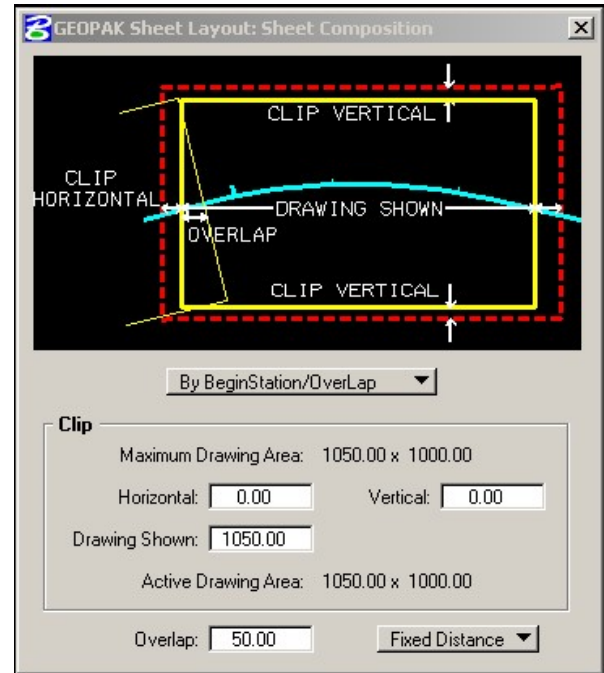
Additional Notes

Adjustments for Priorities and Masking Elements may be needed. See section 3.15.

Make sure to set the drawing scale to the desired sheet scale before cutting sheets.

When using a Double Plan sheet, the length of the "Drawing Shown" in the Sheet Composition is only for the top view (port). The actual coverage on the sheet is greater (+ 11 x plotting scale) than what is listed in this dialog because there are to views.

The "Double Plan Sheet 2" (Plan-Plan2) and "Plan and Profile Sheets4" (PP12) sheets are not intended to be used in situations where quantities need to be summarized on the sheets.

When sheets are clipped, you are given an option to "Rotate Reference" or "Rotate View". Users should always "Rotate View". If you "Rotate Reference", your coordinate system will not be aligned with your drawing and the profile elevation axis within plan and profile sheets will not be aligned.

CADD Standards

The use of a "Motif" files provide several benefits. Motif files can provide a consistent template of reference files including level display. The Motif file can control what is referenced and what is displayed. If you are using motif files and creating similar cut sheets several times during plan preparation, you don't have to be concerned with what files are referenced to your main drawings, what is displayed and when settings are changed. These settings are independently controlled by the motif file. The motif file can also eliminate unnecessary references. Example, in a plan and profile sheet, references of design.dgn are seldom needed in the profile and tabular data views. Separate motif files, using different sets of reference files, can be used for each view.

"Motif Files" are often used with "Pointer Files" in order to simplify future referencing adjustments. See previous section 3.12 for "Pointer File". The Motif File should reference the Pointer file with "Live Nesting" and the Display Override set to "Never".

Having cross sections referenced to drawings used to clip plan or plan and profile sheets may slow down the sheet creation process. Detach unnecessary reference files before clipping sheets.

4.8 Legal Description Editor (Right of Way Plats)

Oct 2008

The "Legal Description Editor" is a GEOPAK tool used to create right of way legal descriptions. The Legal Description Library (NDDOT.ldb) is customized to conform to the standard NDDOT legal description format (Chapter 20 Right Of Way Plats; Procedures For Creating Right Of Way Plats). The general statements that are common to all descriptions are stored in the GEOPAK library. The Editor receives information unique to certain parcels from the GPK file, key-in, or lists provided in dialog boxes. Legal descriptions and parcel data are typed one time and stored in GEOPAK.

The Legal Description Editor can be used once the parcel is stored. Points, curves, and parcels must be stored in GEOPAK before using the Legal Description Editor. The Legal Description Editor is found in GEOPAK Road or GEOPAK Site under "\Geometry\Legal Description". When selected, a dialog box with a menu will appear. The menu bar allows the user to choose a File, Edit the current file, Insert items into a legal description, select the desired Library, define Global Settings, or obtain a closure report on the parcel description.

Go into Library to select the NDDOT.ldb library and hit OK. Select "Insert" on the menu bar then select "Text Phrase" from the pull down menu and the dialog box shown below appears.
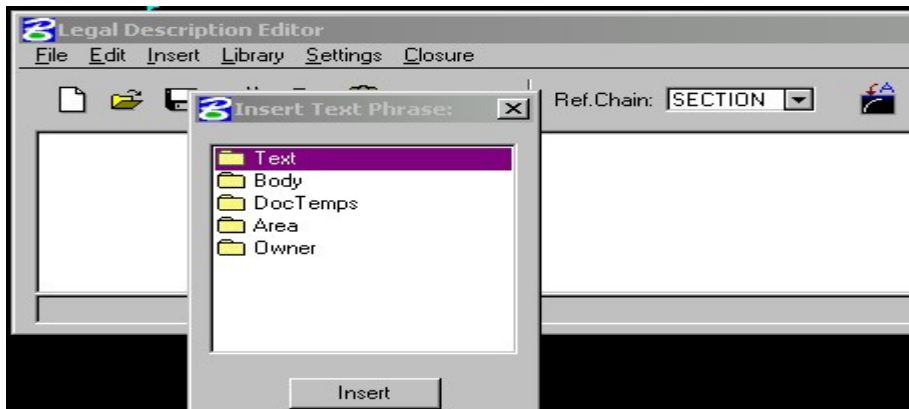
CADD Standards

Text Folder

Following are steps and explanations concerning the items in the text folder. Select "Insert", then "Text Phrase" folder. A dialog box appears with a list of Text Phrases to insert. Double click on "Text". This folder contains phrases for parts of the description dealing with text statements only.
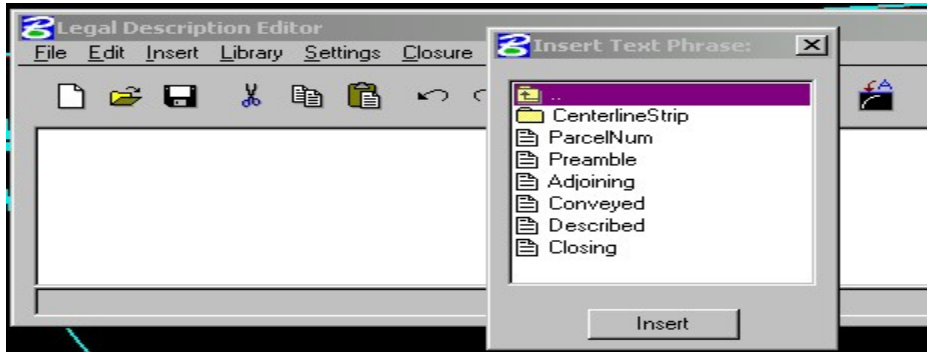
Parcel Number

The first item required to create the NDDOT legal description, is the parcel number. In the text folder, select "ParcelNum" and hit the "Insert" button on the bottom of the dialog box. The "library editor" will automatically print the phrase "Parcel Number," centered over the description on the first line. A dialog box then appears. At the top of the box is a statement identifying the information needed to complete the first line of the description. In this case, it is the parcel number. Place the cursor in the top window and type in the name of the parcel or open the pull down. Keyed in information is stored in the temporary memory, while creating a legal description. This information will appear in the pull down. Choose information from the pull down, hit the "Add" button, and then hit OK. This will automatically add the parcel number to the text editor.

Preamble or Caption

The next required entry is the "Preamble or Caption," from the Text Phrase dialog box, select "Preamble" and hit insert. The "library editor" will automatically print "A portion of" and a dialog box appears with "Aliquot part" on the top of the box. This is asking the user to type in the part of the section or subdivision that the parcel is located in. The library editor will fill in the general statements in a description and for any data unique to a description, a dialog box will appear to key-in or select data from a list.

CADD Standards

Centerline Strip folder

The centerline description of a strip of land that is parallel or referenced to a survey centerline follows the preamble. Below are explanations concerning the items in the "CenterlineStrip" folder, which is found in "Insert\Text Phrase\CenterlineStrip".
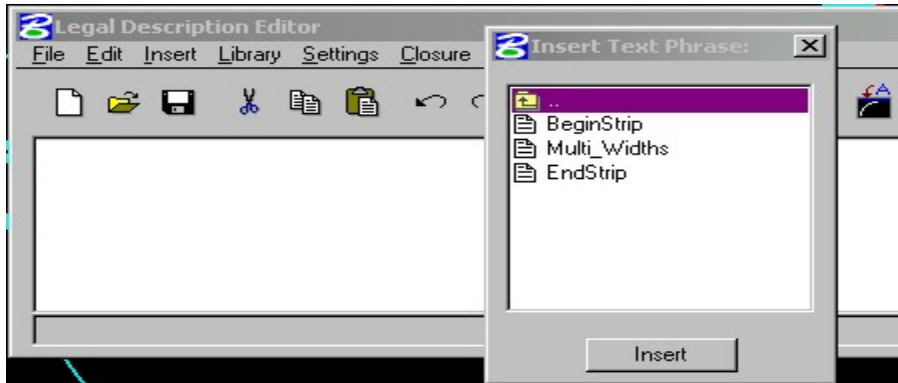

BeginStrip

The editor prints "A strip of land" automatically, and then a dialog box appears for input of the strip width in feet. The next dialog box has a list of cardinal directions (northerly, westerly, easterly…) to describe which lines of the parcel are parallel.

Multi Widths

The editor prints "And a strip of land" automatically, and then a dialog box appears for input of the strip width. The next dialog box has a list of cardinal directions to describe which lines of the parcel are parallel.

EndStrip

A dialog box appears with a list of cardinal directions to select the description of the line on the strip that is being described. Another dialog box is available with a list to select strip or strips (if multiple widths strip). The next dialog box contains a key-in to input the offset distance from the centerline, to the closest described line. The last dialog box has a list with cardinal directions to indicate the direction the closest line lies from the survey centerline. The Library Editor will then automatically complete the caption for the centerline description.

Closing

This statement is required at the end of the legal description. Select "Closing" then hit "Insert", the editor will type in "The legal description was prepared by". A dialog box will appear and on the top bar are the words "Insert name" this refers to the name of the person writing the legal description.
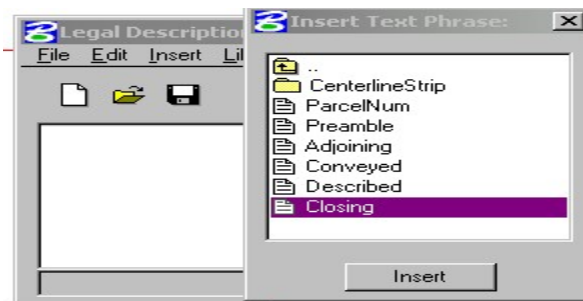
CADD Standards

Body Folder

Following are steps and explanations concerning the items in the Center Line folder. This is obtained by clicking on the "Line\Curve\Spiral Phrase" from the Insert pull down, a dialog box with a variety of choices pops up for these items. The first selection is outlined by a box with the heading "Insert By". Following is a list of the choices and explanations of the choices:
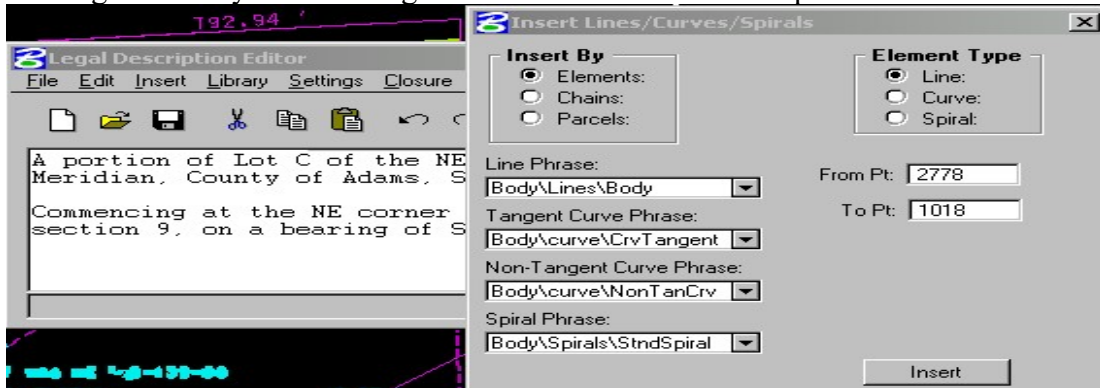
Elements

To create the "body of the description" based on existing "Elements," select,

> **Line**: The user may enter points that were stored in the GPK file to identify a line; for example enter a stored point number in the "From Pt:" field and the end point of the course in the "To Pt:" field.

> **Curve or Spiral**: the user may choose from a list of previously stored curves or spirals in the GPK file.

Chains

The user may choose from a list of stored chains in the GPK file from the pull down.

CADD Standards

Parcels

A pull down is available for the Parcels stored in the GPK file. The window to the lower right of the dialog box has a list of the parcel courses. The library will show each course as a "point-to-point chain" or a "point-to-curve" chain. If the points, chains, and/or curves of the parcel are not in a clockwise direction, check the box under the window to invert the courses. It will invert the parcel features but not the curves themselves. Select the parcel from the pull down in the upper right corner, highlight a course, and select the desired "Line Phrase:" statement. Hit "Insert" and the library editor will read the selected course from the GPK file in GEOPAK to print the correct data into the description.
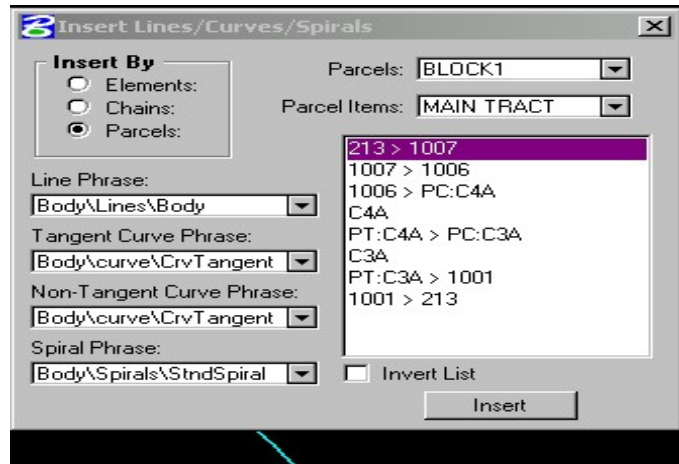
Under the "Insert By" box are Line Phrase, Tangent Curve Phrase, Non-Tangent Curve Phrase, or Spiral Phrase pull down choices. <u>Explanations for "Phrase" statements follow</u>:

Line Phrases

This pull down contains different statements or line styles, which are listed below with an example. The bearings and distances are read from the data stored in GEOPAK:

Body\Lines\Body
"Commencing at the SE corner of section 26, thence northerly along the east line of section 26, on a bearing of N 01 deg. 11 min. 24 sec. E and a distance of 424.46 feet."
This should be the first line used in the body. "Insert By" "Elements" or "Chains" can be used and the first point should be a Section Corner, Quarter Corner, or some known point.

Body\Lines\ToPOBLine
"Thence on a bearing of N 90 deg. 00 min. 00 sec. W and a distance of 422.01 feet to the point of beginning."

Body\Lines\StdLine
"Thence N 90 deg. 00 min. 00 sec. W a distance of 422.01 feet."

Body\Lines\BegCrv Line
"Thence N 90 deg. 00 min. 00 sec. W a distance of 422.01 feet"
This sentence is the same as "Body\Lines\StdLine" but does not have a period at the end; the purpose is to lead into a curve statement. The editor reads the line data for the course before the curve in this part of the statement. The remainder of the statement will require data from a previously stored curve. If the curve is non-tangent, data for the direction of the radius (Body\Lines\ToNonTanCrv) on the curve is required. Insert this before the curve data.

CADD Standards

Body\Lines\ToNonTanCrv
"to a point on a non-tangent curve concave (right), northwesterly, the radius point of which bears N 90 deg. 00 min. 00 sec. W."
The statement for the non-tangent curve is in three different line statements. Insert the "Body\Line\BegCrv Line" statement first, this statement reads the non-tangent course data before the curve. Next insert the "Body\Line\ToNonTanCrv" (the present statement), the data required for this will read the direction of the radius. A data point must be stored at the curve center or radius point, then go back to the "Insert By" box and click on "Elements:" Enter the point number of the PC on the parcel in the "From pt" field and the point number of the curve center in the "To pt" field. From here click on the "Parcels" in the "Insert By" box and continue with the curve data in the parcel. The explanation for the third part of the statement, "Body\curve\NonTanCrv," is in the curve section.

Body\Lines\ComAtForStrip
"Commencing at the NE corner of section 33, thence westerly along the north line of section 33, which is also the survey centerline of ND 6, on a bearing of N 90 deg. 00 min. 00 sec. W and a distance of 422.01 feet to the beginning of a 37 foot strip."
This statement begins the body of a centerline description for a strip of land parallel with the centerline of a highway. The first dialog box contains a list to select the corner of the section or quarter section where the description begins. The next dialog box is a key-in for the section number. Then a dialog box with a list to select the direction traveled. The fourth dialog box contains a list to select the side of the section traveled on. The next dialog box is a key-in for the section number. Another is a key-in for highway name. The last is a key-in for the width of the strip.

Body\Lines\CL Multi Widths
"This point is also the beginning of a 37 foot strip."
This statement describes a change in widths of a continuous strip.

Body\Lines\End of Strip
"Thence N 90 deg. 00 min. 00 sec. W a distance of 422.01 feet to the end of the 37 foot strip."

Body\Lines\Alongline
"Thence on a bearing of N 90 deg. 00 min. 00 sec. W along <u>section line</u> a distance of 422.01 feet."
A dialog box appears with a request to "Insert Reference Line" (a section line, Senior property line, Riparian boundary, or right-of-way line) that the course is to proceed along.

CADD Standards

Curve Phrases

Body\curve\CrvTangent
"to the beginning of a tangent curve, concave (right) northwesterly having a radius of 899.50 feet. Thence northeasterly along said curve 113.23 feet through a central angle of 07 deg. 12 min. 45 sec. to the end of the curve."
Insert the "Body\Line\BegCrv Line" before this statement. A dialog box that contains a list to select the direction of the concavity of the curve will appear. Next a dialog box with a list to select the direction of travel along the curve will appear. The library editor reads the arc distance and delta angle of the curve data stored in GEOPAK.

Body\curve\NonTanCrv
"a distance of 1095.07 feet. Thence northwesterly along said curve 1990.55 feet through a central angle of 104 deg. 08 min. 57 sec."
Insert the "Body\Lines\BegCrv" Line (reads the data from the non-tangent course, before the curve) and "Body\Lines\ToNonTanCrv" (reads the data concerning the bearing of the radius) before this curve statement.
The complete statement for the non-tangent curve should read as follows:
"Thence N 90 deg. 00 min. 00 sec. W a distance of 422.01 feet to a point on a non-tangent curve concave (right), northerly, the radius point of which bears N 90 deg. 00 min. 00 sec. W. a distance of 1095.07 feet. Thence northwesterly along said curve 1990.55 feet through a central angle of 104 deg. 08 min. 57 sec."

Area Phrase

Select Insert\ Area Phrase.
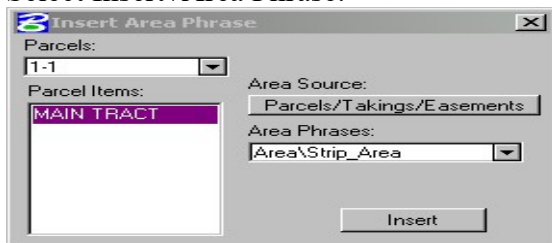
A dialog box appears with a pull down list of all the parcels stored in GEOPAK. A pull down is also available for the "Area Source:" this is the fractional areas of a parcel. The parcels must be stored previously with fractional parts. The next pull down on the same dialog box is "Area Phrases:" The choices in here are "Area\Strip Area" and "Area\Parcel". The editor will end this application with "End of description." on a separate line.

Area\Strip Area
The Editor will print out "Said strip is shown on the plat as parcel." a dialog box will appear to type in the parcel name, hit OK and the Editor reads the GEOPAK area data for this particular parcel and finishes the area portion of the description.

CADD Standards

Area\Parcel
This selection will print out the phrase "Said parcel" rather than "Said strip".

Temp Easement

This statement is used if the parcel is temporary construction easement.
"It is a condition of this easement that it shall not be filed for record and that all rights conveyed to the state of North Dakota and North Dakota Department of Transportation by this instrument shall terminate upon completion of construction of said project, or in five years from the date of conveyance, whichever comes first."

Closing Phrase

This statement is required at the end of the legal description. Select "Closing" then hit "Insert", the editor will type in "The legal description was prepared by". A dialog box will appear and on the top bar are the words "Insert name" this refers to the name of the person writing the legal description.

Select "Insert\Text Phrase\Text\Closing" the Editor will print out the following statement automatically, "The legal description was prepared by". At this point a dialog box appears to key-in the name of the person creating the legal description. Hit OK, the Editor will complete the closing portion of the legal description.

Parcel Owner's Name Phrase

To create a list of owners' names and addresses on a project select "Parcel Owner's Name Phrase" folder, found in the "Insert" pull down. A dialog box appears, the phrase at the top of the box says "Insert Owner's Name Phrase". A pull down is available to select a parcel. The owner's name and address, of the selected parcel, will in the window under "Owner's Names". Hit insert and the phrase "Parcel No." is printed, then a dialog box appears, with a key-in, to insert the parcel number. After hitting the "OK" button, the Name and address of the owner will print out.

CADD Standards

4.9   Survey Alignment Data Sheets

Feb 2009

Survey Alignment Data Sheets (081LO ### SDL.dgn) are plan sheets used to communicate alignment data and points for topographical features such as curb radii and Manholes.   In this process, electronic text files are created that can be imported into survey equipment and corresponding paper documents are created. Surveyors should not have to key in this information. This process involves:

1.   Storing the alignments and points into cogo.
2.   Drawing and labeling the alignments and points.
3.   Creating and placing a coordinate table.
4.   Exporting the alignments and points.

This section of the manual will give an overview of the process and highlight a few steps. This section will not provide comprehensive instructions. For additional comprehensive instructions for tasks such as storing an alignment see the GEOPAK help files.

1.   Storing the alignments and points into cogo.
   a.   Be careful not to redefine important points. If "Redefinition of Elements" is on, you will be able to rewrite existing points. If it is off, you will only be able to create new points. Within Coordinate Geometry, use Navigator to find point ranges not used. Alignments created by design should use points within the range 8000-8999. Design topographical points should stay within the range 9000-9999. See *Section 4.2.2*.

   b.   Temporary Cogo Visualization is recommended. Use the D&C Manager for the final symbology displayed in the plans.

   c.   Design topographical points should be stored with the cell "ADP". You can leave the cell scale blank. You can set the scale later when it is drawn by the D&C Manager. If the "Auto Increment" option is turned on, the "Point Name" will be incremented after a point is stored into cogo.

   d.   A system of point ranges should be developed for each cut sheet. Try to create points in a logical sequence and leave extra numbers between point ranges in case revisions or additions are needed.   Example: sheet 1 uses points 9000-9043, sheet 2 uses points 9100-9153, sheet 3 uses points 9200-9241, the point range 9044-9099 is not used unless revisions to sheet 1 are required and the point range 9154-9199 is not used unless revisions to sheet 2 are required.

2.   Drawing and labeling the alignments and points

CADD Standards

a. Alignment Data Points (used for design topographical features) should be drawn in DS Align.dgn and referenced into the 080LO ### SDL.dgn sheets.

b. Alignment Data Points are drawn from the Horizontal Alignment items in the NDDOT Standard D&C Manager (S:\STANDARD\V8I\GEOPAK\DCMAN\NDDOT.ddb). There are 8 alignment symbologies. Each alignment can be used for a different point level and point annotation level.
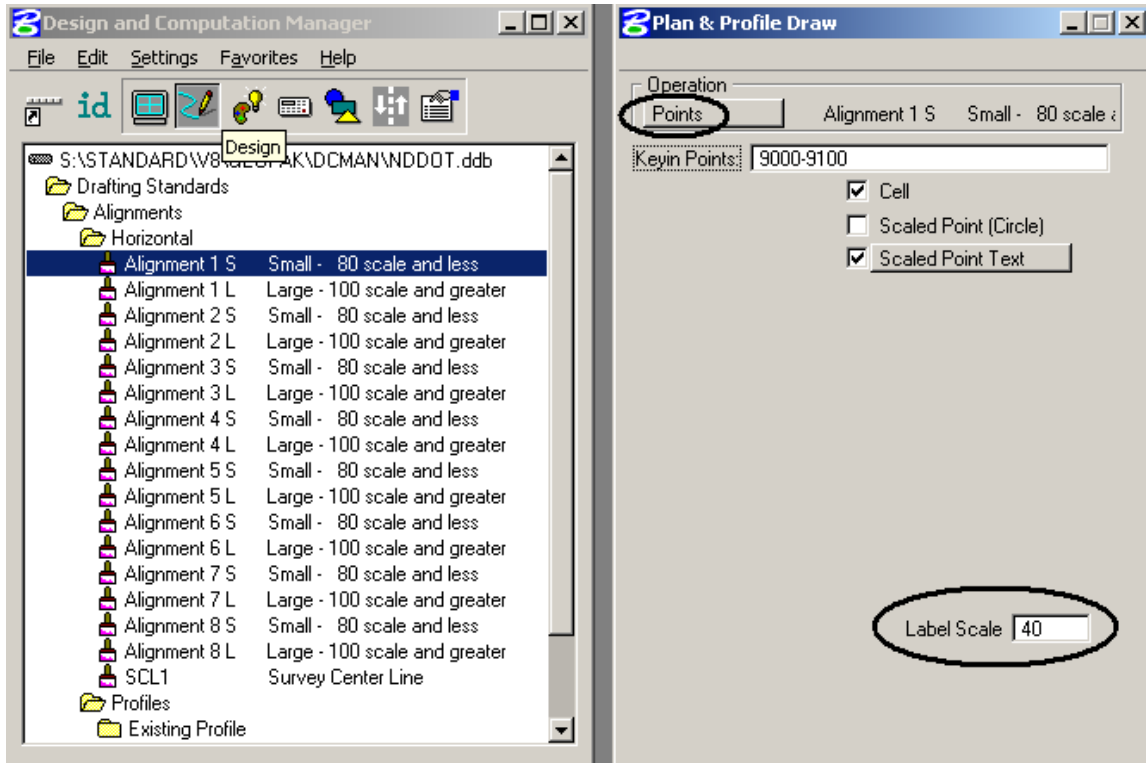
c. Set the "Label Scale" before you type in the point range that you want to draw. The options to draw "Cell" and "Scale Point Text" should be on by default.

3. Creating and Placing a Coordinate Table
    a. There are two main ways of Creating and Placing a Coordinate Table

        i. Cogo and a text editor can be used to create the Coordinate Table

        ii. Cogo and the "Place Coordinate Table" tool can be used to create the Coordinate Table. This is the recommended method.

CADD Standards

b.　　To create a Coordinate Table using Cogo and a text editor:

　　i.　　Open Cogo. From Cogo's main pull down menu select "Element>Chain>Layout offsets".

　　ii.　　Select the "Baseline" for the stationing and offsets

　　iii.　　Set the option to "Point"

　　iv.　　Provide a "Point List"

　　v.　　Turn off the "Elevation" option if elevations are not stored with points. Turn off "Near Point" if projections are not needed.
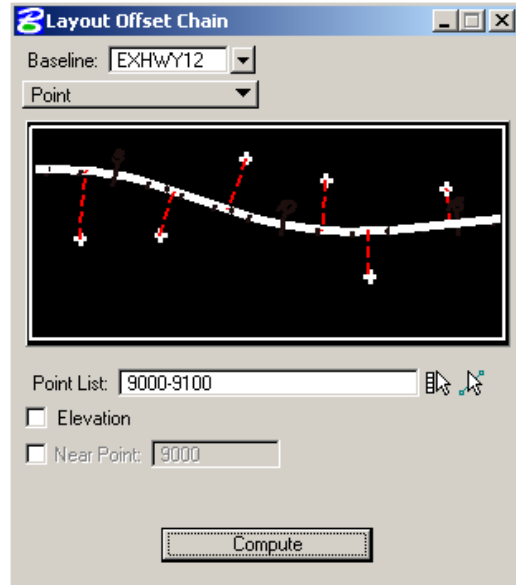
　　vi.　　Select the Compute button. Cogo will calculate coordinate information.

　　vii.　　Create a cogo output file by selecting "File>File Utility" from cogo's pull down menu. Set the option to "Output" and provide an "Output File" name. Note the GPK number will be appended to the name and the extension will be ".ond" if ND was used as the operator code. Example if "yyy" was specified as the "Output file" and the GPK number was 001 then the output file would be named "yyy001.ond".

　　viii.　　Use a text editor to edit and copy the desired information.

　　ix.　　Coordinate Data can be placed into sheet drawings using the "Cut Sheets Design.stg", "Annotations" group and the "Note (07)" component. Using the MicroStation "Place Text" tool, right click in the "Text Editor" text entry area. A popup menu should appear. Select "Paste".
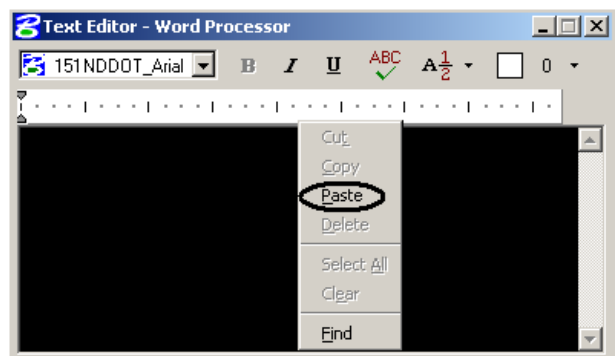

　　x.　　Format and clean up text as needed and place it into the drawing.

CADD Standards

c. To create a Coordinate Table using Cogo and the "Place Coordinate Table" tool.

  i. Activate Cogo and Select your GPK – Job Number.

  ii. The "Place Coordinate Table" tool is in GEOPAK Survey. Select "Plans Preparations>Place Coordinate Table" to load the "Place Coordinate Table" tool. A survey project does not need to be set up.
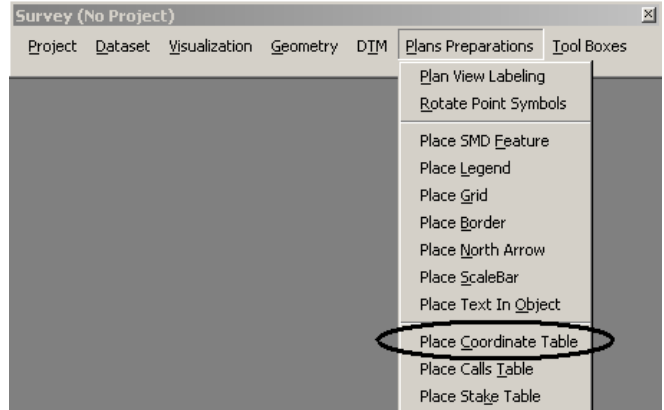
  iii. The "Place Coordinate Table" should open. Load the NDDOT CADD Standard symbology settings by selecting "Settings>Open" from the "Place Coordinate Table" dialog box.
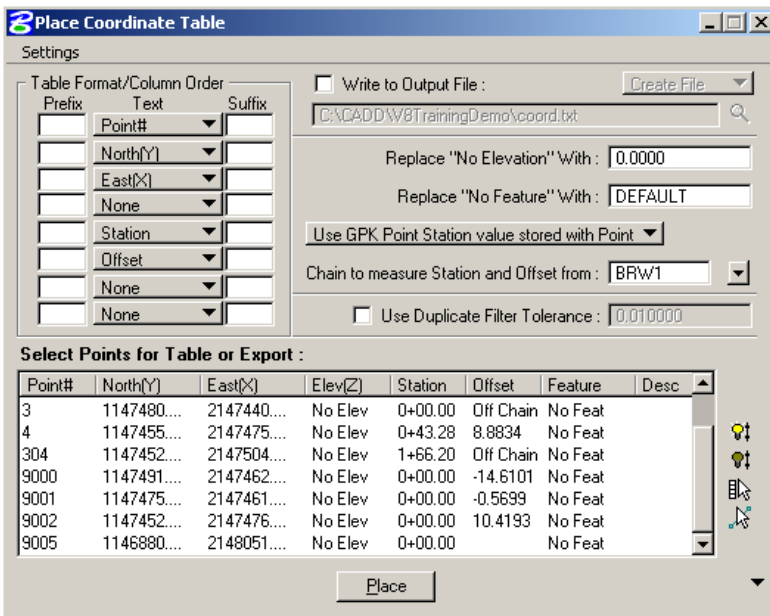
The settings files are located at C:\Program Files\Bentley\GEOPAK\bin\. Pick the appropriate settings file.

  "nddot040.set" is for 40 scale
  "nddot060.set" is for 60 scale
  "nddot080.set" is for 80 scale
  "nddot100.set" is for 100 scale
  "nddot200.set" is for 200 scale

These settings files can be copied from S:\STANDARD\V8I\GEOPAK\bin

Note: the settings files don't always set the appropriate levels for the coordinate table. This is a know bug with GEOPAK. The levels may have to be corrected manually. The text is intended to be place on level "sht Text 2" and the table lines should be on level "sht Lines 2"

CADD Standards

1. The default table is set up for the fields; Point Number, Northing, Easting, Station, and Offset. If additional fields such as Elevation are needed, use the "Table Format/Colum Order" area of the dialog box to enable additional fields.

2. Set Stationing option to "Compute Station value from Ref. Chain".
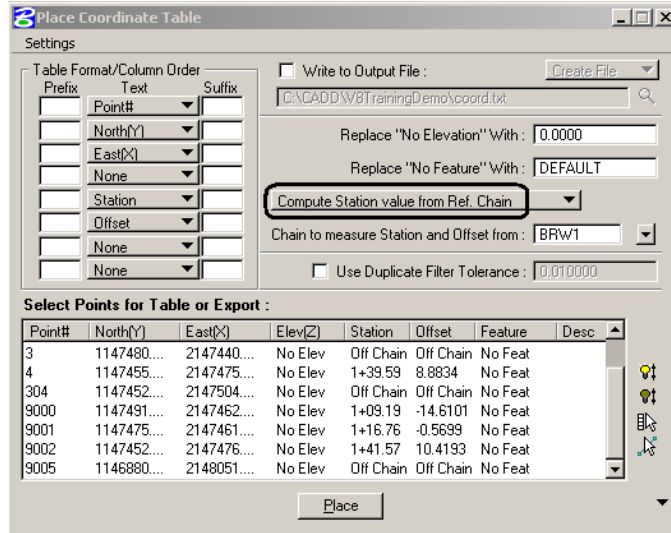
3. Select the desired points.

4. Select the "Place" button and place a data point to define the upper left corner of the table.

4. Exporting the alignments and points

   a. Giving field personnel electronic output files of points and alignments is NOT the correct method of exporting design data into the field. GEOPAK output files (*.ond) can not be directly imported into survey equipments. GEOPAK Points and Alignments should be exported to files that can be directly imported by survey equipment. Points are exported to ASCI files (*.asc). Alignments and Profiles are exported to "Trimble DC" files (*.dc).

   b. To export points from GEOPAK

      i. Open cogo for the applicable gpk – job.

      ii. From the Cogo dialog box, select "File>Export>ASCII Points"

CADD Standards

iii. The "Export GPK Points to ASCII Coordinate File" dialog box should open. Clear all prefixes from the "Output Format". A comma (,) should be used as a suffix for all fields except the last one. Example, if elevation is your last field, it should not have a suffix.
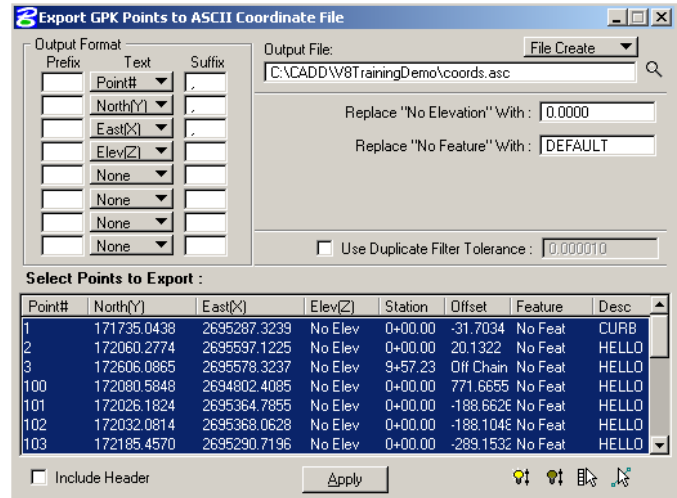
iv. Point#, North(Y), East(X) and Elev (Z) are the main fields imported into survey equipment. The Station and Offset Fields are not usually used in files to be imported into survey equipment. Station and Offset Fields are used in coordinate tables that printed in the plans.

v. The "Include Header" option should be turned off.

vi. Select the points to export to the survey file and select the "Apply button" to create the file.

vii. The survey ASCII file can be reviewed with a text editor to insure it was created correctly.

c. To export alignments and profiles from GEOPAK:

i. Open cogo for the applicable gpk – job.

ii. From the Cogo dialog box, select "File>Export>Alignments and Profiles".

iii. The "Export Alignments and Profiles" dialog box should open.
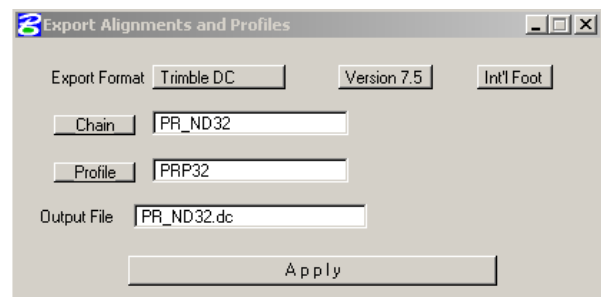
iv. Set the "Export Format" to Trimble DC. Set the Version to 7.5. Set the Foot to international ("Int'l Foot"). Do not use "US Foot".

v. Select the appropriate Chain and Profile. You will have to create a

separate "dc" file for each alignment.

vi.   The "Output File" should have a "dc" extension. It will be written to your working directory. Select the "Apply" button to create the file.

vii.   The "dc" file could be viewed with a text editor. However the format is complex and it will probably not be practical to review without additional Trimble software.

CADD Standards

OpenRoads

5.1   OpenRoads Survey
May 2017

At this time OpenRoads Survey for SS4 is not mandated. Users are encouraged to use the OpenRoads version, but the older Geopak Survey workflows and deliverables will be allowed.

There are a few things to note when importing survey data with open roads.

The decimal settings for elevation text using the SMD-XML file (NDDOT_Survey.xml) are controlled by the Design File Settings (Settings > Design File > Working Units). Most survey labels are to the hundredth of a foot. The accuracy of the Design File should be changed before importing survey data that typically displays elevation information such as culverts. After the survey data has been imported, the Design File Settings for Accuracy can be changed without changing the labels.
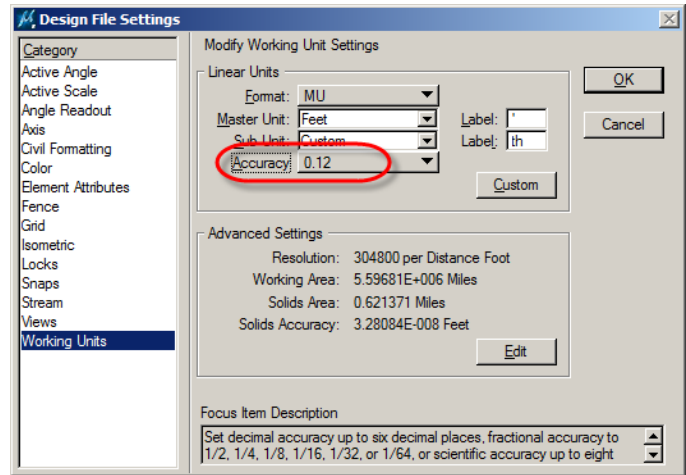
The NDDOT OpenRoads settings for importing survey data is supplemented with macros that can expedite CADD editing. These macros add additional labels. Many of these labels will need additional editing and all will need to have their locations manually adjusted. The following are some examples.

The feature "FNW" will include the label "Wood" if the macro is active.

The feature "GM" will include the label "OWNER?". The CADD editor is expected edit this label with the gas main owners name.

The feature "24RCPF" with a survey comment of "gf" will include the label
            24" x ' RCP (good) – RCFES (fair)
The CADD editor is expected to manually edit the length and add the station and offset to the alignment.
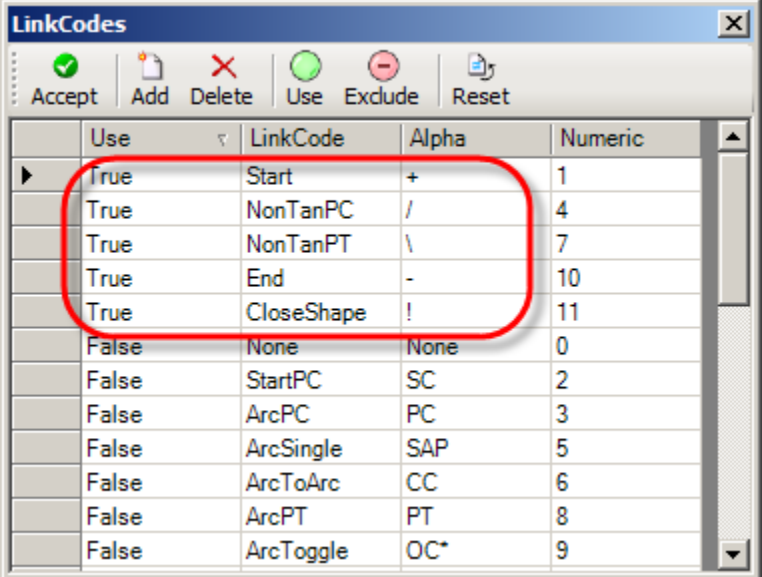   24" x 64' RCP (good) – RCFES (fair)

Using the macros during import will take longer for the computer. If the macros are off (unloaded) the import will still work but the additional labels will not be included. Tools to load and unload the survey macros have been added to the NDDOT standard menu (NDDOT > Tools > Survey Macro > On or Off). The survey macros are off by default.

CADD Standards

OpenRoads uses slightly different linking codes than Geopak. The link codes for begin and end curve are different.

The link code / (forward slash) is for "Non Tangential Point of Curvature" (begin curve).

The link code \ (back slash) is for "Non Tangential Point of Tangency" (end curve).

CADD Standards

5.2　OpenRoads Feature Definitions
March 2019

The NDDOT Feature Definitions for OpenRoads are stored in multiple dgnlibs (libraries). The organization of feature definitions across different files may not be intuitive because there are links to the old system of features used in the Geopak Design and Computation Manager Database and the Survey Manager Database. There are also new feature definitions created solely for OpenRoads.   People familiar with the older feature systems may find this structure useful. New users might not appreciate this organization. Another organization system can be used to access Feature Definitions.

The NDDOT element templates, tools and tasks system has been updated to account for features. Several NDDOT drawing elements are directly related to NDDOT feature definitions. Accessing the NDDOT tasks system for a drawing element will also set a feature definition if applicable. If there is no applicable feature, the feature definition will not change. To use the feature definition, you must switch to a civilized tool after you pick the regular (old – uncivilized) tool.

For example, if you pick "Aggr A" from the NDDOT tasks, The Feature Definition Toggle Bar should open and also switch to "Aggr A".   You could ignore the feature definition and continue to draw a non featurized element or you could switch to a civilized tool such as in Horizontal Geometry and draw with the feature definition. Feature definition are only recognized with civilized (OpenRoads) tools.

If you're not using civil features and don't want the Feature Definition Toggle Bar opening, choose the Main Menu item "NDDOT > Feature with Tasks > Off".

Note, some task don't automate feature definitions.   Example, the feature definitions for elements such as terrains will need to be manually set at the time of creation.

5.3　Civil Geometry
Jan 2017

The design file drawing scale must match one of common Design Computation Manager Scales in order to work. Example, the feature definition for "Alignment 1 L" will only auto annotate at drawing scales 100, 200, 300, 400, 500 and 1000. The feature definition for "Alignment 1 S" will only auto annotate at drawing scales 40,60 and 80.

Profiles that use civil geometry must be in the same drawing as the horizontal alignment. Civil geometry profiles can be drawn in other drawings such as "DS_Align.dgn" but the horizontal alignments should not be drawn in the "Profile.dgn". This means only non-civil geometry profiles should be drawn in the "Profile.dgn".

5.4   Terrains

March 2019

Preliminary Survey Terrains

The existing ground surface may be represented by different types of terrains. Standard drawing, terrain and feature definition names have been assigned to communicate the differences between these terrains.

Separate drawings are required for each terrain.   The DTM drawings should not include any terrains.   These drawings should only include the information used to create the terrains.   The actual terrains should be stored in separate drawings by themselves.

1. Drawing Name 2. Terrain Name 3. Feature Definitions	Description
1. Terrain_Exst 2. Exst 3. Terrain Boundary Exst	Continuous Along Primary Road Alignment - Used to create continuous existing profile for primary design road.
1. Terrain_Exst_Alt 2. Exst_Alt 3. Terrain Boundary Alt Exst	Discontinuous Along Primary Road Alignment - May include underpasses, overpasses or exclude primary alignment structures. Used for alternate profiles and earthwork calculations.
1. Terrain_Exst_No_Voids 2. Exst_No_Voids 3. Terrain Boundary No Voids Exst	Similar to "Exst" terrain except voids are modeled as break lines and obscured data may be considered
1. Terrain_Exst_Alt_No_Voids 2. Exst_Alt_No_Voids 3. Terrain Boundary Alt No Voids Exst	Similar to "Exst_Alt" terrain except voids are modeled as break lines and obscured data may be considered
1. Terrain_Exst_Drape 2. Exst_Drape 3. Terrain Boundary Drape Exst	Extended terrain coverage is obtained with less regard to accuracy. Used to drape features along surface, Voids modeled as break lines, Supplemental data is used to increase extent of terrain, Do not use for earthwork calculations

The Terrain_Exst drawing is required for all earthwork projects. The requirements for the other terrain drawings are dependent on project complexity.

The "Terrain_Exst" and "Terrain_Exst Alt" drawings are the only drawings that meet the NDDOT survey accuracy requirements.

CADD Standards

The "Terrain_Exst_No_Voids" and "Terrain_Exst_Alt_No_Voids" may use obscured data under certain circumstances. Additional project documentation and direct coordination with the NDDOT Survey Section is required when incorporated obscured data. Examples of obscured data may include data such as photogrammetric elevations obtained in dense vegetation. Designers should compare the Exst to Exst_No_Voids and the Exst_Alt to Exst_Alt_No_Voids terrains. Designers are responsible for understanding the limitations and complications with using obscured data.

The "Exst Drape" terrain should not be used for earthwork calculations. The "Exst Drape" terrain includes information from automated elevation software that has not been refined. The "Exst Drape" terrain may contain surface data on top of features like buildings, cars and vegetation. In order to stress accuracy concerns with "Exst Drape" terrains, the DTM information used for the Exst_Drape terrain and the actual Terrain_Exst_Drape drawing shall be segregated into its own "Drape" folder under the "Survey" folder.

Intermediate Design Terrains

SS4 project will require an additional terrain compared to SS2 projects. OpenRoads Earthwork doesn't handle varied thickness and types of unsuitable grading materials. In SS4 the unsuitable grading materials like topsoil and pavement removal should be calculated from plan view. A suitable grading terrain needs to be created for actual earthwork calculations.

The suitable grading terrain can be created by offsetting selected elements used to create the existing ground terrain. The suitable grading terrain is usually an estimate of where the suitable grading surface begins and is based on old typical sections or old cross sections or both. The following is a recommended procedure to create a suitable grading terrain.

1. Locate the drawing used to create the existing ground terrain. This drawing usually contains only elements used for the terrain creation.

2. Use the "Copy/Move Fence Contents to File" command to create a new drawing named DTM_Suitable_Grading. Use the copy option. This command will do two important things. You will get a separate file to make changes independent of existing ground, and SS4 features used for existing ground creation will be dropped down to regular (non featurized) elements.

3. In the newly created drawing, delete all elements that were not used for the exiting terrain. The remaining elements will be vertically offset to represent the suitable grading terrain. Typically there is only a handful of different offset values.

4. Color code the drawing to simplify and track the offsets. Many of the elements should be offset the thickness of topsoil. Change all of these elements to one color. Use a different color to represent each depth of pavement removal. Remember this drawing is being used for earthwork so if the elements are outside of the limits of construction, don't get too concerned about a perfect suitable grading representation in these areas.

5. Once the entire drawing is color coded, use the select by color commands to move the element down the desired amount (adjust elevations as needed).

6. Use the offset elements to create the suitable grading terrain. Store the terrain in a separate drawing named "Terrain_Suitable_Grading" and name the terrain "Suitable_Grading".

7. It is good practice to keep DTM_Suitable_Grading drawing. The suitable grading terrain may require addition edits in the future. Access to the elements that were used to create the terrain may simplify future edits.

Design Terrains

Terrains for proposed surfaces shall be created for most earthwork projects. Three surfaces are usually provided for AMG: Dirt Grade (DG), top of Base (B1), and the top surface (T).

Exterior Triangles that don't accurately represent surfaces should be removed. At a minimum, a reasonable triangle side length should be used in order to remove the majority of bogus exterior triangles. Additional break lines may be required to prevent gaps in surfaces. These gaps typically occur at the corridor beginning, corridor ending and at intersections. A terrain boundary feature may also be used to eliminate all bogus exterior triangles.

Terrain anomalies within the primary roadway pavement and under it (base and dirt grade) should be eliminated or thoroughly documented in both the drawing and the AAreadme file for contractors. A perfect terrain representation of the proposed design is desirable but may be time and cost prohibitive to create. Minor anomalies within the inslope, backslope and with intersections should be avoid but can be tolerated.

CADD Standards

Creating XML Files from Terrains

Contractors might not have software that can work with MicroStation terrain elements. The terrain elements should also be saved as XML files for a broader range of compatible software formats.

1. Select the "Export to File" tool from the Terrain Model sub task.

2. Select the terrain in MicroStation.

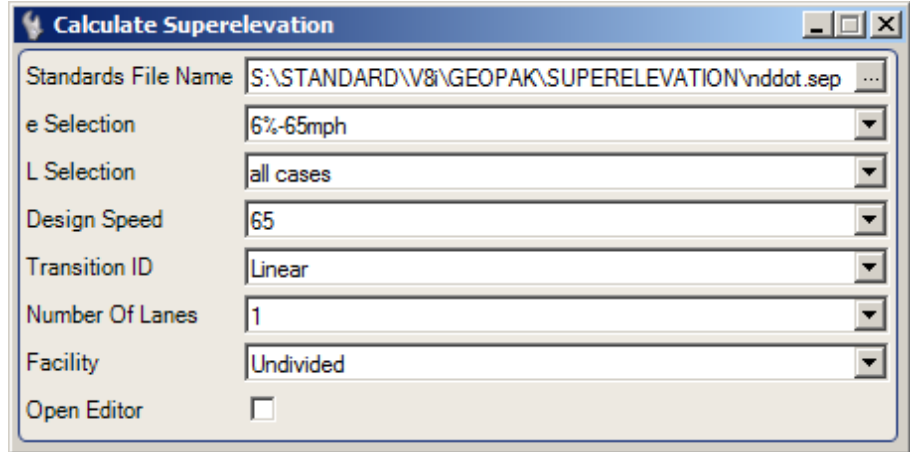3. Set the Export Options. Typically the Triangles are exported without the terrain Features.
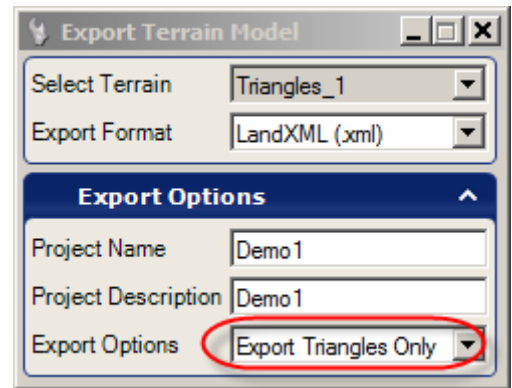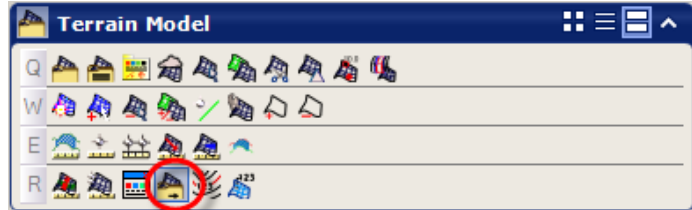
CADD Standards

5.5   Super Elevation

Jan 2019

OpenRoads super elevation should use the same preference file as used for Geopak SS2. When prompted for a Standards File Name, pick the nddot.sep file.

Display Superelevation in Plan

The "Display Super elevation in Plan" tool settings are taken from the active settings.   The line spacing is used to offset the text from the top and bottom of the super elevation lines. This doesn't work well with NDDOT Standards because annotation scale for text height determines line spacing. The "Display Superelevation in Plan" tool also applies annotation scale.   Annotation scale is being applied twice for the offsets.   The offsets move exponentially instead of linearly.

A temporary solution to this problem is to temporarily set the Line Spacing to 0 within the text style. Example pick and set text style "Text 0.05" then temporary set lines spacing to 0.

CADD Standards

The NDDOT uses a table based on table 3-9 of "A Policy on Geometric Design of Highways and Streets" (Green Book), 2018 to calculate super elevation. The 6% e max table is used for most highway designs. Intermediate values for every tenth of a percent have been interpolated into this table.

Super elevation runoff and tangent runout are based on a "relative gradient". The NDDOT uses relative gradient values that are flatter than the 2018 Green Book (second to last paragraph of page 3-62). The table on the right shows desired relative gradients used by the NDDOT.

The Maximum Relative Gradients shown in the table are from the 2011 Green Book (table 3-15). The NDDOT Relative Gradient is 83.3% of the "Maximum Relative Gradient". The NDDOT relative gradient results in runoff and runout lengths that are 120 % of the minimum lengths (120 % = 1 / 83.3%).

These values are the same values used prior to the 2018 Green book.

Design Speed	Maximum Relative Gradient (%)	NDDOT Relative Gradient (%)	Equivalent Relative Slope
15	0.78	0.650	1:153.85
20	0.74	0.617	1:162.07
25	0.70	0.583	1:171.53
30	0.66	0.550	1:181.82
35	0.62	0.517	1:193.42
40	0.58	0.483	1:207.04
45	0.54	0.450	1:222.22
50	0.50	0.417	1:239.81
55	0.47	0.392	1:255.10
60	0.45	0.375	1:266.67
65	0.43	0.358	1:279.33
70	0.40	0.333	1:300.30
75	0.38	0.317	1:315.46
80	0.35	0.292	1:342.47

For non-spiral curve combinations, 1/3 of the runoff is placed on the curve and 2/3 of the runoff is placed on the tangent. For spiral curve combinations, all of the super elevation runoff is usually placed on the spiral. Often, the super elevation runoff used in spiral curve combinations is changed to match the spiral length. Tangent runout should be directly proportional to runoff. On very long spirals, the tangent runout can be placed on the spiral if the maximum relative gradient is not exceeded.

Super Elevation Settings

Default super elevation preferences have been set up for NDDOT users (NDDOT.sep).

The NDDOT uses "Adjustment Factors" for increasing the runoff and runout length when multiple lanes are rotated (as shown on table 3-15 of "A Policy on Geometric Design of Highways and Streets", 2018). These adjustment factors are enabled in the sep file. Previous NDDOT versions of the sep had these factors disable.

Note. If designers need to edit the super elevation preference file (NDDOT.sep), it should be copied, renamed and stored in the project directory.

CADD Standards

<u>Simple Curve Example</u>

Given

PI	= 1409+95.59
PC	= 1403+11.54
PT	= 1416+73.20
Delta	= 13d 37m 0s left
R	= 5729.58
V	= 75 mph

Solution

e = 3.8 % interpolated from 6 % max table
(Preferences are set to use "Radius Interpolation" as "Conservative Entry")
(5560' = 3.8 %, 5745' = 3.7 %, 5729.58' => 3.8 %)

NDDOT Relative Gradient (from table) = 0.317 %

Runoff on high side (Geopak) = e * width of traffic lane / relative gradient
Runoff on high side = 3.8 % * 12' / 0.317 % = 143.84' => 144'
(Preferences have been set to round runoff to the even foot.)

Runoff on low side is proportional to runoff on high side.
Runoff on low side = (e - normal crown) / e * Runoff on high side
Runoff on low side = (3.8 -2.1) / 3.8 * 144.0' = 64.42'

Runout is proportional to runoff on high side.
Runout = normal crown / e * Runoff on high side
Runout = 2.1 % /3.8 % * 144.0' = 79.58'

Begin e on right side (high side) = PC – 2/3 * Runoff – Runout = sta 1401+35.96
Begin full e = PC + 1/3 * Runoff = sta 1403+59.54
End full e = PT - 1/3 * Runoff = sta 1416+25.20
End e on right side (high side) = PT + 2/3 * Runoff + Runout = sta 1418+48.78

Begin e on left side (low side) = Begin full e - (Runoff on low side) = sta 1402+95.12
End e on left side (low side) = End full e + (Runoff on low side) = sta 1416+89.62

CADD Standards

5.6 Corridor Modeling
Jan 2019

On OpenRoads (Corridor Modeling) projects the files located in the following directory should be copied to your project working directory.

"S:\STANDARD\V8i\data\Civil\SS4 Files To Copy To Working Directory"

Corridor models shall be save in the rdm_*.dgn (roadway design model) drawing. Multiple "rdm_" files are recommended for large project in order to simply corridor processing. Descriptive suffixes for these files are strongly encouraged.

Corridor feature reference graphics can be drawn in a drawing named rdpg_*.dgn (roadway design plan graphics).

Template Library
The NDDOT template library contains the following main folders"
   1. Components (No End Conditions)
   2. End Conditions
   3. Linear Templates
   4. Surface Templates
   5. Example Templates
   6. Project Specific
   7. Training

Copy the templates to be used for your template drops into the "Project Specific" folder. Project templates are typically customized. This folder will help manage edits.

The right side of the road is used as the default for individual roadway components and templates.

Use the underscore (_) to delineate affixes. Hyphens (-) can be used to tie phrases together, but spaces are also acceptable.

Parametric Constraints (Template Variables)
Parametric Constraints such as Inslope1_R will have to be manually edited to Inslope1_L if mirrored.

Default variables values should be used in the library. This makes editing and building templates easier. See *Appendix R*

CADD Standards

Parametric constraints are rounded to the accuracy set in the Geopak user preferences. Four decimal places are used in the template library for consistency purposes (example, 4" = 0.3333', 4" is not equal to 0.33')

Widths on the right side are typically positive values. Widths on the left side are typically negative values.

Parametric Variables are case sensitive. Parametric Variables should be title case.

Point Names

Standard point names aid with point styles, template transitions, point controls, labeling and alternate surfaces. The Names also provide a partial description. The names have up to 5 parts. The standard point name is the combinations of the parts:

1. Layer Description
2. Horizontal Description
3. Repetitive Affix (count)
4. Parent Component Name (Optional-use to avoid duplicate names)
5. Right or Left Side Affix

There are 3 common layer descriptions:
    T (Top - Finished Grade),
    B1 (Top of Base 1),
    DG (Dirt Grade)

Some points don't belong to a surface. These points still have a layer description.
    DNC (Do Not Construct – This is a marking point)
    Alt (points that represent physical points but don't represent a surface),
    Find (This point is usually part of an end condition looking for a feature)

The "Horizontal Location" describes common horizontal markers. If one of the following points doesn't adequately describe a point this part of the name is optional and the Repetitive Affix (count) is used.
    CL (Center Line)
    EOL (Edge of Lane)
    Shldr (Shoulder)
    EOSP (Edge of Slough Pavement)
    EOSB (Edge of Slough Base)
    Gutter
    FOC (Face of Curb)
    BOC (Back of Curb)
    Tie (Tie Between Finished and Existing Grade)
    Bnch-Front (Bench Front)
    Bnch-Back (Bench Back)
    Ditch

CADD Standards

The number –repetitive affix or count part of the name is used to keep the name unique. If the name would be unique without the count part of the name, this part of the name is unnecessary and should be omitted. Points are typically number away from center line (bigger number used when it is further from center line).

Repetitive affixes that are automatically assigned, should be renumbered (example: xx_L, xx1_L, xx2_L should be renumbered xx_1_L, xx_2_L, xx_3_L).

The component part of the name is used for points in different end conditions within the same template. Again, if the name would be unique without the component part of the name, this part of the name is unnecessary and should be omitted.

The last part of the name is the right or left affix. This affix can be automatically included in the name by the Roadway Designer tools. It is often used to keep the point names unique when a component is mirrored.

Super Elevation and In-slope Relationships

Super elevation and inslope rates are project variables that indirectly affect dirt grade widths. Consistent relationships between these slope rates help facilitate template transitions and the comparison of alternates.   The development of the NDDOT template library uses the following philosophies:

1. The top edge of dirt grade offsets will be variable through a supper elevated curve. These offsets will be controlled by slope rates.
2. The edge of the roadway dirt grade will be determined by projecting a point from the top edge of pavement (top of sluff) to the bottom of base line at the in-slope rate for both concrete and asphalt templates. Topsoil will be projected up for both asphalt and concrete templates.
3. The templates will address safety edges and traversable stuffs.
4. Topsoil extensions that are parallel to the roadway pavement are desirable. Topsoil should tie to the top of asphalt slough pavement.

CADD Standards

Corridor Modeling Requirements

1. Corridor modeling break lines (feature styles) are required deliverables. These break lines are drawn with the corridor within the RDM file. Some break lines are optional other are required. Some of the break lines don't need to be created. Points used to calculate and mark points such as a minimum dich depth where it isn't used as a break point, can be omitted from the terrain. Other break lines should be included even if it doesn't represent a break point. The following are required break lines and shall be included in the terrains:

    - EOP – Edge of pavement for all surfaces (T, B1, DG)
    - SHLDR - Shoulder for all surfaces (T, B1, DG)
    - EOL – Edge of lanes for all surfaces (T, B1, DG)
    - B1-EOSP – Edge of sluff for pavement

2. The following intersections must be modeled in areas to be constructed.
    a. Highway to Highway Intersections
    b. Principal Arterials
    c. Minor Arterials
    d. Collectors (includes County Major Collectors)

    Note, modeling lower classification intersections may be desirable but is not required

    See County Classification Maps
    http://www.dot.nd.gov/business/maps-portal.htm#countyfunctionalclass
    See Urban Classification Maps
    http://www.dot.nd.gov/business/maps-portal.htm#urbanfunctionalclassandsystem

3. If multiple models are used with one construction project, they should have coincident adjoining edges if they connect. Avoid overlapping model areas. Example, two roads intersect. One of the models includes the intersection the other model should stop at the beginning of the intersection modeling.

4. Models for work zone traffic control such as median cross overs, ramp connections and temporary bypasses are required if cross sections for these same areas are required.

CADD Standards

5.   If a proposed surface has gaps in it, then the model should also reflect these gaps, Example a widening project has shoulders added to both sides of the road but the center is unchanged. The proposed surfaces should not cross over unaffected areas. The follow are ways to create the applicable gaps.

      a. Rename the points and alternate surfaces to simplify the creation of a separate base surface. Example the base surface on the left side of the road could use "B1" points, alternate surfaces and graphical filters. The base surface on the right side of the road could use "B2" points, alternate surfaces and graphical filters.

      b. Separate corridors could be used to segregate the left and right side of road. Surface that need to be merged could be done as a separate step.

      c. Terrains can manually be created from the applicable proposed break lines and boundaries.

6.   Break line and boundary prefixes must match the related surface. Example, a "B1" break line must belong to a "B1" terrain, the "B1" break line shouldn't be used in a "B2" terrain even if the terrain is correct. Rename template points to avoid mismatched prefixes. Matching prefixes are required for the standard graphical filters for terrains. Matching prefixes also simplifies model review.

CADD Standards

5.7 Template Drop Interval and Design Stages
Jan 2019

The maximum template drop interval for NDDOT projects is 25'. However this drop interval may not provide enough detail for some corridor references such as intersections and approaches. Shorter distances are recommended for better accuracy.

Short corridor references also require a shorter template drop interval. All components must start with a template and end with a template. Components reflected with just one template will not be drawn correctly when cut into cross sections.   Example; if there is only one template (drop) for a driveway, it may appear in the dynamic cross section but it won't appear in the cross section for sheets.

Processing requirements (time) increases as the template drop interval is shortened.   Designers need to balance the requirements for accuracy with the time needed to process a corridor. A 5' template drop may seem like an easy way to promote accuracy, but it isn't usually feasible.

Consider the cross section sheet interval when selecting a template drop interval. If there isn't a template drop where there is a cross section for sheets, the sheet information will be interpolated. Example, an end condition tie point will be interpolated (close but not actually tying). If the template drop started at an even station with a 10' interval and the sheet interval started at an even station with a 25' interval, then the sheet sections at +25 and +75 would be interpolated. The interpolated section might be acceptable for a sliver grading inslope, but an interpolated section may be problematic for a bridge tie point. In this example adding a key station for the bridge tie point would be a simple solution.

The corridor sections (actual template drops) are determined from a combination of settings including;
- Template Drop (Distance)
- Key Stations
- Template Drop Interval Multiplier
- Critical Sections

Two of these settings can be quickly changed for an entire corridor by changing the "Corridor Design Stage"; Template Drop Interval Multiplier and Critical Sections.

The "Conceptual" corridor design stage has the template drop interval multiplier of 2. This increased distance simplifies the corridor and process faster, but may overlook some necessary detail. This is the only NDDOT standard corridor design stage with a template drop interval multiplier other than 1.

The NDDOT standard corridor design stages include critical sections in varying degrees. Design stage that use more critical sections settings general have a shorter template interval.

CADD Standards

Corridor Design Stage	Horizontal Cardinal Points	Vertical Cardinal Points	External Control Points	Densify Horizontal Curves	Densify Vertical Curves
1 - Conceptual	no	no	no	no	no
2 - Design – No Critical Sections	no	no	no	no	no
3 - Design – Control Points	no	no	yes	no	no
4 - Deign – Critical Sections	yes	yes	yes	yes	yes
5 - Bottom Mesh	yes	yes	yes	yes	yes
6 - Top Mesh	yes	yes	yes	yes	yes
7 - Top and Bottom Meshes	yes	yes	yes	yes	yes

When "Densify Horizontal Curves" is used, the NDDOT standards use a maximum chord height of 0.05'. The following are example curves and template spacing that accommodate this chord height.

Degree of Curve	Template Drop Interval
1	45'
2	30'
5	20'
10	15'
20	10'

When "Densify Vertical Curves" is used, the NDDOT standards use a maximum chord height of 0.05'. The following are example curves and template spacing that accommodate this chord height.

Rate of Vertical Curve, K	Template Drop Interval
300	100
100	60
50	40
25	30

Most rural main line alignments meet a 0.05' chord tolerance by using a 25' template drop interval.

Projects that use an existing profile might have VPI's (vertical points of inflection) that are very close together. The profile may cause numerous corridor sections if the "Vertical Cardinal Points" or "Densify Vertical Curves" critical sections are used with the design stages. Consider avoiding or manually overriding these options if your corridor uses an existing profile. Example, use the design stage "3 – Design – Control Points".

CADD Standards

5.8   Cross Sections

Jan 2017

As discussed in *section 5.6*, the xin file should be copied to the project working directory. This file may need to be edited for cross section settings. The OpenRoad xin file includes options for the stacked (old working cross section file format) but this is not the desired format. OpenRoads Cross Section Sheet models should be used.

If your preferences options aren't showing the options shown to the right then the standard xin file may not be in the correct directory or your xin file may be empty.   The OpenRoads application will create an empty xin file if cross section tools are accessed. This empty xin may need to be replaced by the standard xin and microstation may need to be restarted inorder to access the NDDOT standards for cross sections.
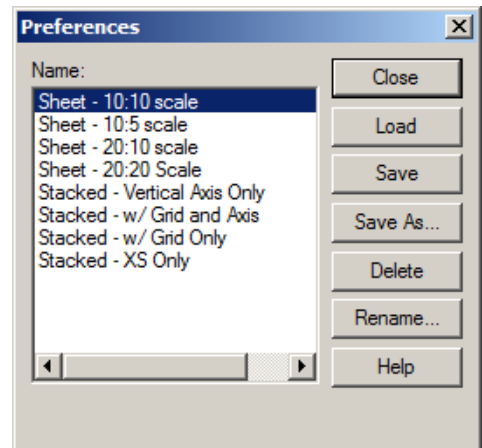
Do not manually draw on the cross section sheets. Realize that when modifications are needed, the typical workflow entails recreating the sheet model from scratch. This includes cross section annotation.

Cross Sections Interval

The following are recommend minimums cross section sheet intervals. These intervals are not the same as Template Drop intervals. Neither are these standards a construction field staking standard.

Recommended Minimums

- Rural projects should use an interval of 100' and 50' within super elevated curves and spirals.
- Urban (curb and gutter) projects should use an interval of 25'.
- Extra cross sections should be added for all centerline pipe.
- Extra cross sections should be added at all super elevation key stations such as; end normal crown, begin super, begin full super, end full super, end super, and begin normal crown.
- Extra cross sections should be added for wetland areas. The interval of cross sections through a wetland should be between 10' and 50'. If the wetland cross section is generally uniform in shape such as a linear ditch wetland, a long interval can be used. If the wetland doesn't have a uniform linear shape a shorter interval should be used to show changes in in-slope, width and depth. If there is onsite wetland mitigation or a wetland is to be moved, the cross sections need to show enough detail and use a short enough interval to properly construct the wetlands. Designers should also consider providing additional drawings in the plans if these changed wetlands have an irregular shape.

CADD Standards

Other additional "Optional" cross sections have been considered in the CADD standards. The recommended minimum intervals are close together and address these "Optional" cross sections to a degree. Additional sections can be used at the designer's discretion. These additional – optional sections may include:

Optional (extra cross sections)
- Intersections, approaches and driveways
- Inlets, ADA ramps, building entrances
- Horizontal roadway breaks such as begin taper, end taper, begin lane, end lane, PC's, PT's, curve returns and others.
- Vertical curve breaks such as PVC's and PVT's.

OpenRoads Features Represented as Cells in Cross Sections

OpenRoads cross sections show information from a 3D model. Some of the 3D information is drawn as linear elements. Most linear elements when cut into cross sections show up as a point. Standards have been setup to replace this point symbolization with a cell in the cross section view. These cells usually have a label and are much more identifiable. Additional work may be required to display some features in cross sections.

Additional drawing versions are usually required for OpenRoads Cross Sections. The most common drawings needed include; RW_Bndry.dgn, Togog.dgn, Wetland_Impacts.dgn and DS_Util.dgn. The suffix "Features" is recommend as part of the drawing name suffix (RW_Bndry_Features.dgn, Togog_Features.dgn, Wetland_Impacts_Features.dgn and DS_Util_Features.dgn).

These drawing versions contain civil features element that can be referenced into the cross sections. The civil features have Plan (2D), 3D, Profile and Cross Section components.

The Default 3d view of these drawings should have a default drawing scale that is same as the cross section file. If this scale is not set correctly, the scale of the cells drawn in the cross sections will be incorrect.

Some CADD workflows like the ones in Right of Way and Environmental aren't inherently incorporated into OpenRoads. Additional processing is required.

The following workflow will describe creating RW_Bndry_Features.dgn. This workflow assumes a regular – non featurized RW_Bndry drawing is available.

1. Create a new drawing named RW_Bndry_Features from a 2D seed drawing. It is usually easier to let the civil geometry tools create the 3D model from the 2D model.

2. Reference and copy in only the MicroStation elements that you want to change to OpenRoads features and display into cross sections. For Example you may want to only copy the RW and Easement lines. You probably don't need elements like text and dimensions.
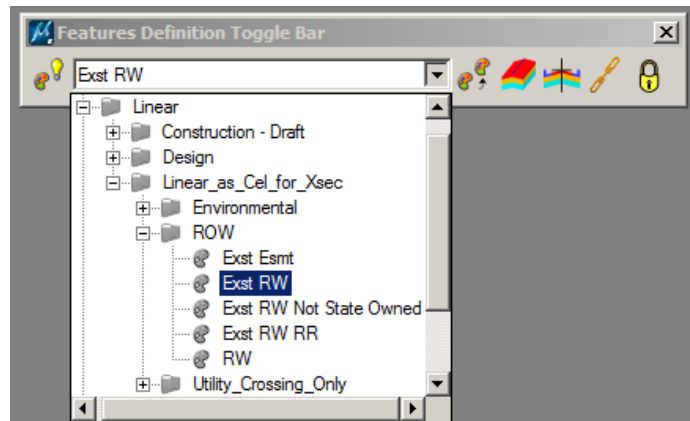
CADD Standards

3. Most RW and easement lines are drawn as MicroStation lines or lines string elements. These element types will work in this conversion process. However MicroStation elements like shapes will not. Most wetlands are originally drawn as shapes. The shape surface will display in the cross section view instead of the desired cross section feature. **MicroStation shape elements will need to be dropped down to simple lines and line strings for this conversion process.**

4. Reference in the existing ground terrain. If available, use a terrain that covers the same areas as the elements that you are converting to features. If you don't have coverage or if a void is overlapped, features may be missed in your cross sections. Reference in the 2D model version of the terrain and then make this terrain your active terrain model. A Default-3D model should have automatically been created by setting your active terrain.

   Most features should be draped to the existing ground terrain. If they are not draped, they will be at elevation 0 which will be hard to view in a cross section. The next steps will create feature and drape them to the surface.

5. Select all drawing elements that you want to convert to a specific type of feature. Each feature type will be processed separately, one at a time. Example, New RW will be processed separately from Existing RW lines.

6. Select the appropriate Feature Definition. NDDOT Tasks can be used to access feature definitions. Also note that many needed feature definitions are under the "Linear_as_Cel_for_Xsec" folder.
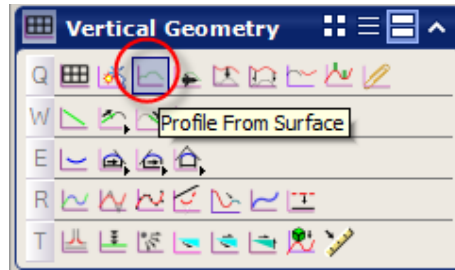

7. Set the feature definition.
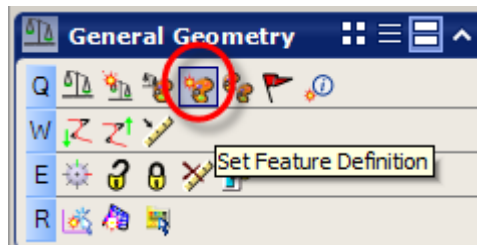
CADD Standards

8. Use the "Profile from Surface" tool to create both a profile element and 3D Linear Element. **Note the "Quick Profile from Surface" tool doesn't create the needed 3D Linear Element.**

9. Switch to the Default-3D model. You should see the 3D Linear elements.

10. Set the drawing scale of the Default-3D model to match the drawing scale of your proposed cross sections and save drawing settings. The scale of the cross section feature cells will be based on this drawing scale setting.

11. This drawing is now ready to be referenced to your cross section model. Reference the 2D model into the parent 2D file and 3D models should automatically attach.

12. When either Dynamic or Sheet Model cross sections are viewed, the features should appear with the NDDOT CADD standards as a feature cell (example, Existing R/W).
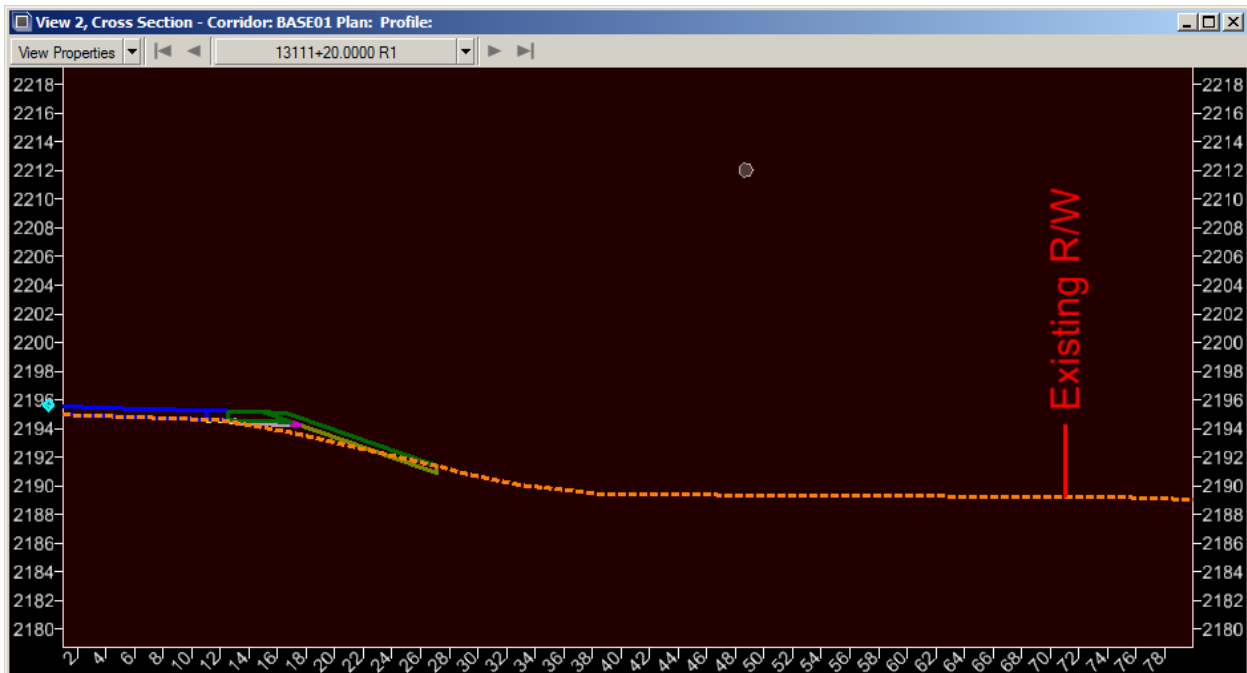
Note, step 7 should include vertical offsets for several existing utilities.
- If underground elevations for water and sanitary sewer lines are not available, a -7.5 foot offset should be used for these features.
- If underground elevations for electrical, communication, gas and other petroleum products is not available, a -3.0 foot offset should be used.

CADD Standards

Utilities, such as storm sewer, may have valid underground elevations. These elements can be reference directly to the default-3D model and set as a feature.

3D solids can also be reference directly into the model and cut into cross sections. These 3D solids don't need to be featurized. Note, some surfaces don't cut into cross sections. Solids, terrains and meshes work better.

The SS4 version of the drawing DS_Util.dgn should contain a 3D representation of drainage pipe and structures. (See also Appendix Q – Drawing Production Guidance – DS_Util)

CADD Standards

5.9   Cross Section Annotation

Jan 2017

Cross sections sheets should be labeled. Several preferences have been set up for labeling. These options are also delivered in the NDDOT_XS_and_Earth.xin file. See section 5.6.

The NDDOT standard "Annotate Cross Section > Preferences" should include the following as shown to the right.

The following are included in the xin for development purposes only;
- Frame – Design Elevations
- Frame – Design Offset
- Object – Feature Name
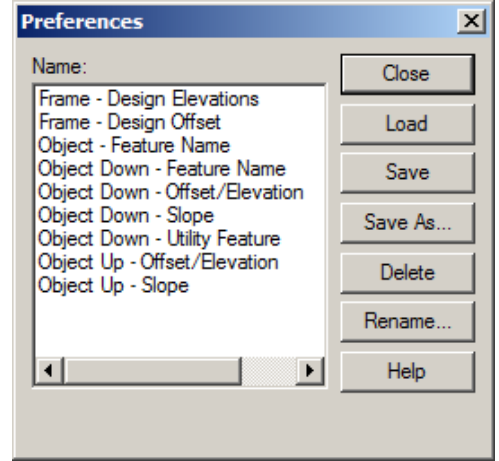
Label important break points. The "Object Down" prefix is intended to be used for dirt grade points. The "Object Up" prefix is intended to be used only for surface (top) points. Top of base points are not typically labeled because sheet space is limited. End users may need to deduce base point elevations from the top of pavement elevation, dirt grade elevations and typical sections.

Remember

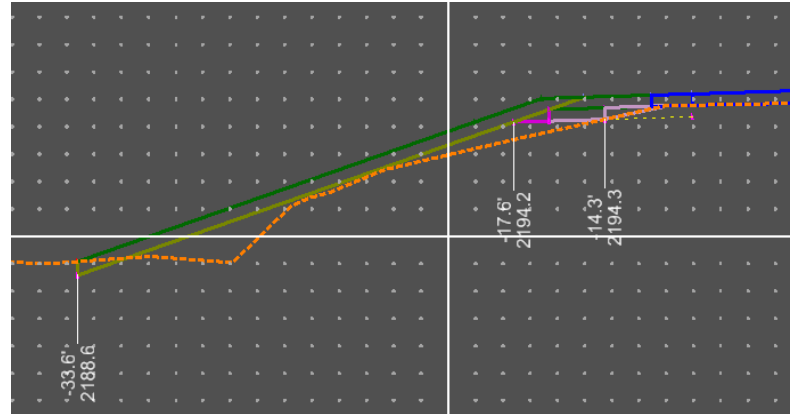- Points (offset/Elevation) should be selected by **Features** Annotate.
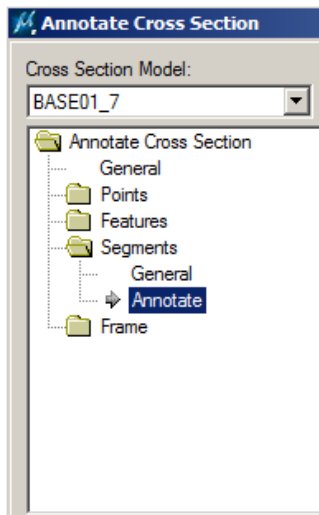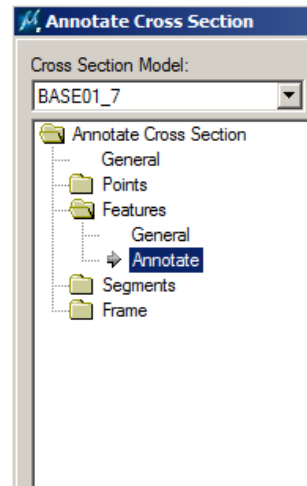
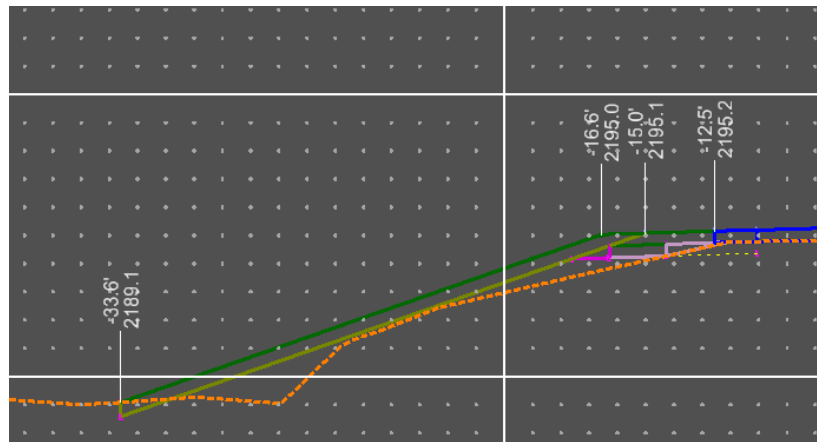- Slopes should be selected by **Segment** > Annotate.

CADD Standards

The main annotations used are
- Object Down – Offset/Elevation
- Object Up – Offset/Elevation
- Object Up – Slope

The "Object Down – Offset/Elevation" labels should be used for all important dirt grade points.

The "Object Up – Offset/Elevation" labels should be used for all important top surface points.

The "Object Up – Slope" labels should be used for all important slopes. Note that sometimes it is easier to label groups of continuous segments in separate processes in order to avoid labeling undesired segments. For example the segment from the top of curb to the flow line is seldom labeled because is very steep and short.
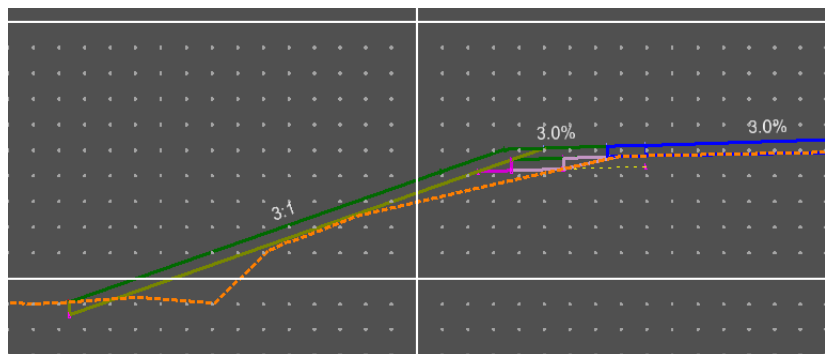
CADD Standards

5.10 Earthwork

March 2019

Multiple earthwork preferences have been set up in the NDDOT CADD Standards. These preferences are stored in the NDDOT_XS_and_Earth.xin file. See section 5.6. The only differences in the preferences are for different Mass Diagram Scales.

Use the total length of the project, not the individual range of sections, when selecting the earthwork preferences. Typically the drawing scale for cross sections is either 20 or 10 scale. The Mass diagram is intended to be copied into another model with a different drawing scale. The selected preference shown to the right was intended for a 2000 scale Mass Diagram (2000 Mass).
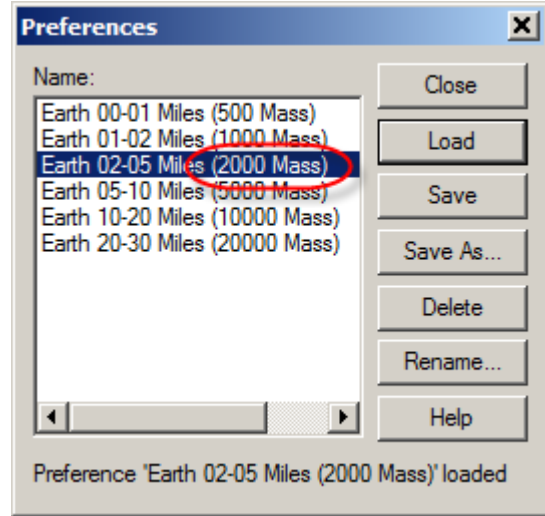
Modest adjustments to the Mass Diagram Drawing scale can easily be made. If too big of an adjustment is made, the text in the axes will overlap or be sparsely labeled. There is more guidance on mass diagrams at the end of this section.

Earthwork should be calculated from the suitable grading terrain. See section 5.4.   The "Unsuitable Materials by Station" option is not recommended.

OpenRoads Cross Sections should have quantity summaries for each section; cut area, fill area, cut volume, fill volume and mass ordinate. The NDDOT standards have these preferences turned on. These labels are automated with the earthwork calculations.

Earthwork shapes must be saved with the cross sections. The earthwork shapes can be used to check earthwork calculations. Earthwork shapes are on a separate level and should be turned off for plan production.
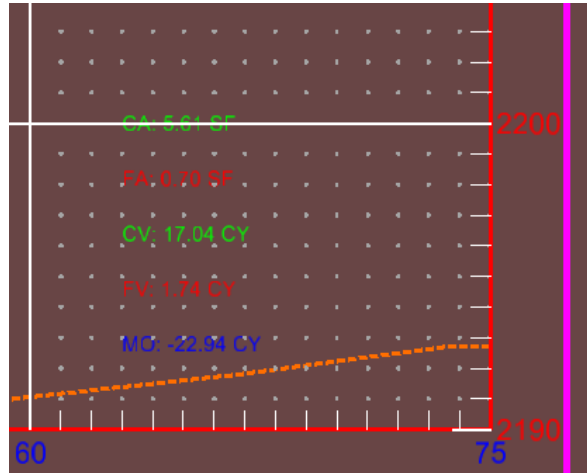
Earthwork Tables

Earthwork tables shall be created for all projects that calculate volumes by average end area. The earthwork table that shows end area volumes by station is no longer included in the plans. However the earthwork "summary" table is still included in the plans.

The earthwork table that show volumes by station are stored in an excel spreadsheet that shall be made available as supplemental design data.

CADD Standards

Embankment above Subgrade

Cross sections that use a closed shape component to account for embankment are sections that have "Embankment above Subgrade". This material is usually handled twice. It is placed after the subgrade has been established. The embankment above subgrade volume is included in a "roadway designer components" report. The "roadway designer components" report is separate from the Bentley default "end area volume" report.

The OpenRoads earthwork tool has options to "Include" component quantities in the mass ordinate. Embankment above subgrade usually uses the "grnd" feature and is usually included in the mass ordinate. The other component quantities are usually excluded from the mass ordinate.
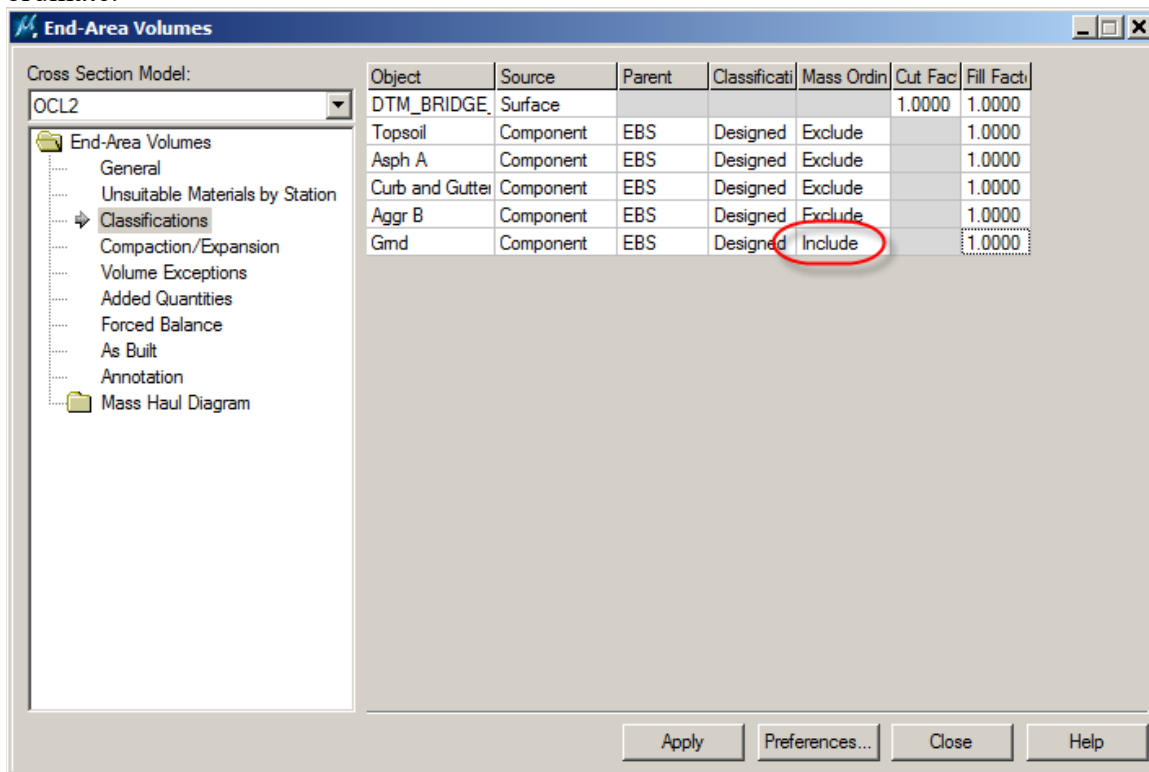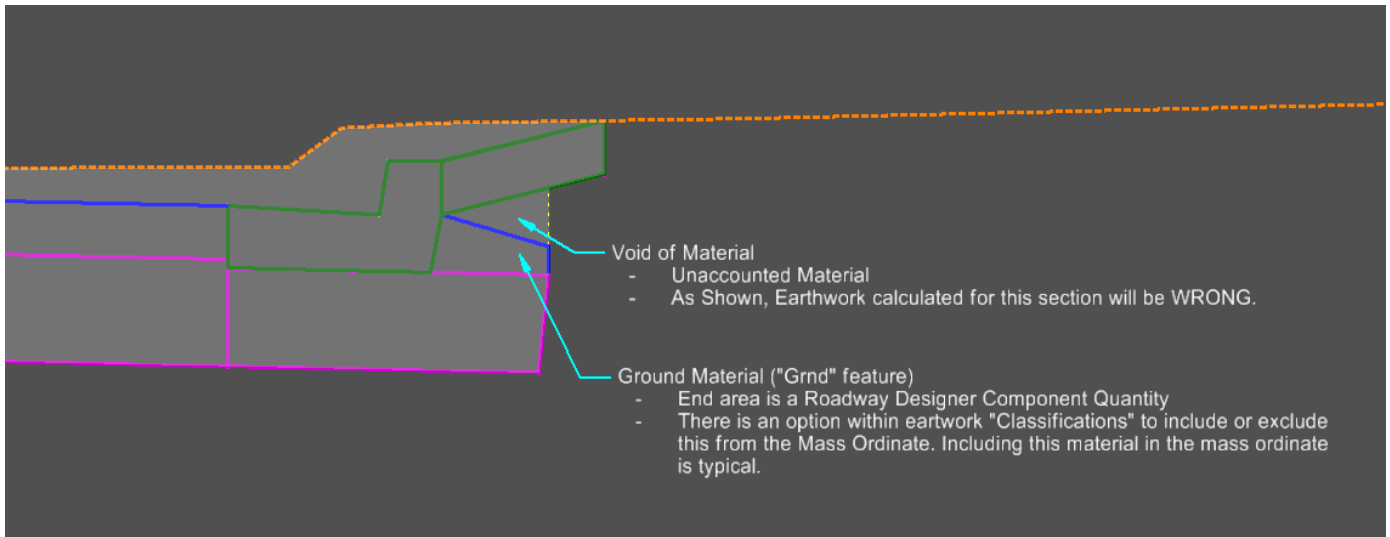

The "Include" mass ordinate option does NOT change the default excavation and embankment end areas and volumes. The adjusted mass ordinate will be labeled correctly on the cross sections. However the automated end areas and volumes shown on the cross sections will not include the embankment above subgrade. The volumes shown on the cross sections will not add up to the mass ordinate on projects that have embankment above subgrade. Projects that have embankment above subgrade may require an adjusted end area volume report where normal embankment and embankment above subgrade are added together.

All projects that have embankment above subgrade shall include a note with the summary of earthwork that explains special handling requirements such as double handing or separate construction operations. State that the cross sections end area and volumes labeled in the cross sections do NOT include the embankment above subgrade. Indicate whether the mass ordinate includes or excludes embankment above subgrade. Including embankment above

subgrade usually simplifies the mass diagram. State that this work is paid as --- and there is no other compensation.

With OpenRoads earthwork, it is possible to unintentionally design voids between Roadway Designer Components. A void can be created when material needs to be removed for constructability and it isn't replaced by another material.

Void of Material
- Unaccounted Material
- As Shown, Earthwork calculated for this section will be WRONG.

Ground Material ("Grnd" feature)
- End area is a Roadway Designer Component Quantity
- There is an option within eartwork "Classifications" to include or exclude this from the Mass Ordinate. Including this material in the mass ordinate is typical.

CADD Standards

Earthwork Reports

Categorizing an earthwork project as complex, intermediate, or simple may help explain different workflows for calculating earthwork.

Complex Earthwork

OpenRoads may not be able to process earthwork (create xml report) or create a mass haul diagram on complex projects with numerous sections (Service Request 7000713478, Defect 795118). The tools work on smaller projects and there are work arounds for large projects. Defining "What is a complex project?" is difficult. This is probably determined by a combination of corridor complexity, number of sections and computer processing power. This is more of a matter of "try it and if it doesn't work, it might not be your fault."

If you cannot process an entire project, then the workaround is to process it in parts and then merge the information together. If multiple earthwork reports are used, make sure to start the next earthwork report on the same station that the last report ended on. Use the "Added Quantities" option to carry the mass ordinate from previous earthwork report to the next earthwork report.
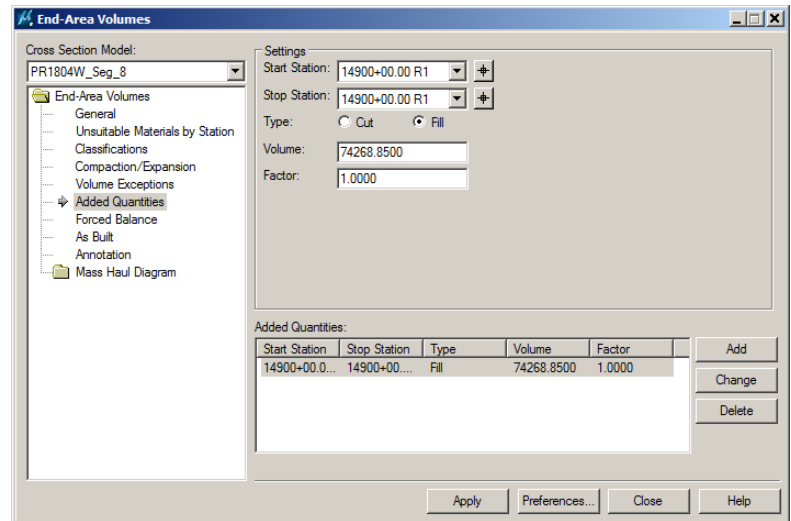
Intermediate Earthwork

On long projects, using just one corridor for the entire project might not be practical from a computer processing view point. Processing is usually simplified by breaking the project into multiple smaller corridors. Multiple corridors are also involved in complex earthwork projects, the difference with an intermediate earthwork project is that a continuous earthwork report and mass diagram can be complete in one step. The corridor models are created in separate drawings. Then they are referenced together in another drawing (200XS_*.dgn). Earthwork for the entire project is calculated from this drawing that references all the models. When calculating earthwork from one or multiple referenced corridor models, the alignment and active terrain will also need to be referenced.

Simple Earthwork

Simple Earthwork involves only one corridor and the earthwork and mass diagram can be calculated in one step

CADD Standards

The NDDOT has a custom earthwork report (EndAreaVolume-NDDOT.xsl). The default earthwork reports are under the "Evaluation" Folder. The NDDOT reports are in the "NDDOT" folder near the bottom of the list.

The main fields for the EndAreaVolume-NDDOT.xsl report are;
- Station
- Exc (Excavation End Area)
- Emb (Embankment End Area)
- Emb Above Subgr (Embankment Above Subgrade Area)
- Exc (Excavation Volume)
- Emb (Embankment Volume)
- Emb Factor (Embankment Factor)
- Adj Emb (Adjusted Embankment Volume)
- Emb Above Subgr (Embankment Above Subgrade Volume)
- Emb Above Subgr Factor (Embankment Above Subgrade Factor)
- Adj Emb Above Subgr (Adjusted Embankment Above Subgrade Volume)
- Added Exc (Added Excavation Volume)
- Added Emb (Added Embankment Volume)
- Added Emb Factor (Added Embankment Factor)
- Adj Added Emb (Adjusted Added Embankment Volume)
- Mass Ordinate
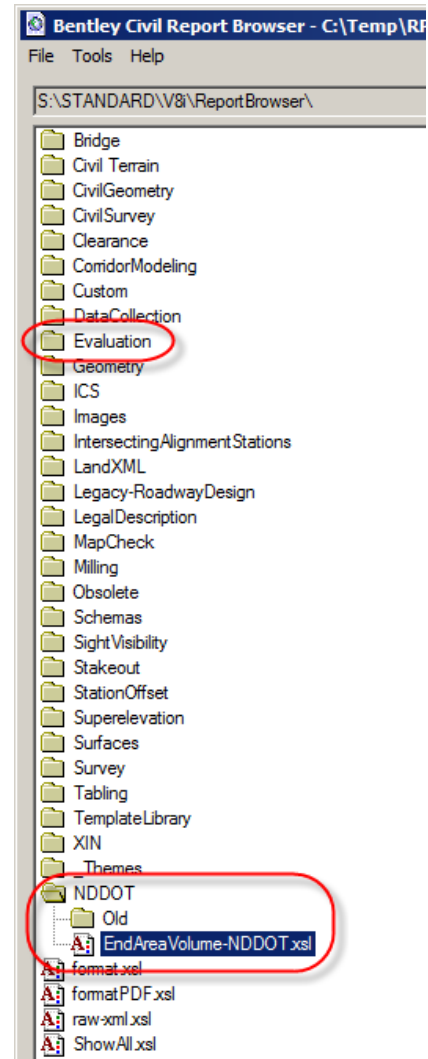
The NDDOT custom report "EndAreaVolume-NDDOT.xsl" does something important that the default reports don't do. The custom report has extra columns for embankment that is from a corridor template shape component. Embankment used as a roadway designer component quantity doesn't show in the Bentley reports for end areas with volumes. It is shown in the Roadway Designer Component Quantities report.

The NDDOT earthwork report "EndAreaVolume-Plus-NDDOT.xsl" is similar to the "EndAreaVolume-NDDOT.xsl" report. The "Plus" version includes common roadway components such as aggregate, asphalt, base and topsoil. The "Plus" report version is intended for design comparisons only. The "Plus" version should not be distributed with the supplemental design data.

Roadway component quantities usually don't address all quantities needed for the project. This report excludes quantities from civil cells and other manual calculations. In order to avoid confusion and misunderstandings, only the "EndAreaVolume-NDDOT" report (without added roadway components) should be distributed with the supplemental design data.

CADD Standards

Processing Earthwork for Multiple Corridors

The custom NDDOT earthwork reports don't work correctly for multiple corridors or civil cells. Consider an interstate gore area where the interstate roadway and ramp are separate corridors. Both of these corridors may be shown on one cross section and the simple excavation and embankment will be calculated correctly but the roadway components may not be correctly summarized. This problem includes embankment above sub grade.

The most common solution to this problem is to only process earthwork for one corridor at a time. In the interstate gore example above, the interstate mainline and ramp would need to be cut into separate cross sections and two separate earthwork calculations would be used.

The second solution is to avoid using the same roadway components on multiple corridors. The problem with the custom NDDOT earthwork reports is that for each station it only looks for roadway components once. If both the interstate mainline and the ramp use "Conc A", the report will only list one of the quantities. A potential way to avoid this problem would be to use "Conc A" for one corridor and "Conc B" on the other.

Saving earthwork reports

Earthwork Reports should be saved in both the xml and html formats. Within the "Bentley Civil Report Browser" dialog box, select File > Save As. Then change the "Save as type" option to xml File. The final posted report should be named "**Earthwork_End_Area_Volumes*.xml**" A file name suffix can be used to describe multiple reports. Repeat this workflow a second time while using the "Save as type" option of html and name of "**Earthwork_End_Area_Volumes*.html**"

A third version of the report should be created in Excel. Open Microsoft Excel. Then browse to the applicable Earthwork_End_Area_Volumes*.html file and open it. The html file should automatically be parsed based on the html table format. Within Excel, use the "Save As" commands and the "Save as Type: Excel Workbook (*.xlsx)" option to create the Excel report. The third report should be named "**Earthwork_End_Area_Volumes*.xlsx**". All three file versions (xml, html and xlsx) should have similar names. You may want to adjust formatting in the excel version for clarity (grid line, headings, spacing, etc).

Added Excavation or Added Embankment Software Bug

If added excavation or added embankment is added on the first station in the cross section earthwork run, then total added excavation or total added embankment may not be correct. The first station quantities are probably incorrectly excluded from the totals (Service Request 7000860701, Defect 984665). The totals should manually be corrected within the Excel reports.

CADD Standards

Mass Diagram

A mass diagram shall be included in the plans for most rural grading, sliver grading and widening projects. A mass diagram is not needed if any of the following conditions apply:

- Urban projects - The earthwork hauling on urban project is largely controlled by project phasing and traffic control.
- Projects that are shorter than ½ mile, require no excavation, use only one borrow source and have a single balance in the mass diagram - These short projects may include independent turn lane projects, intersection improvements and small grade raises.

Calculate and document the "average haul for project" on all required mass diagrams.

If multiple earthwork reports are used to make a comprehensive mass diagram, make sure the same scales (same earthwork preferences) are used so that the individual mass diagrams can be copied into one drawing. The comprehensive mass diagram will need to be manually combined by the use of referencing and basic MicroStation editing commands.

Note that the standard preferences for the mass diagram all use a scaled down vertical scale of 0.1. The distance from the Zero Mass Ordinate Axis will be 10 time the distance in the drawing.
The flooded areas used for haul calculations need to be corrected by multiplying the volume by 10. When recalculating volumes with excel, remember to calculate the actual length across station equations.
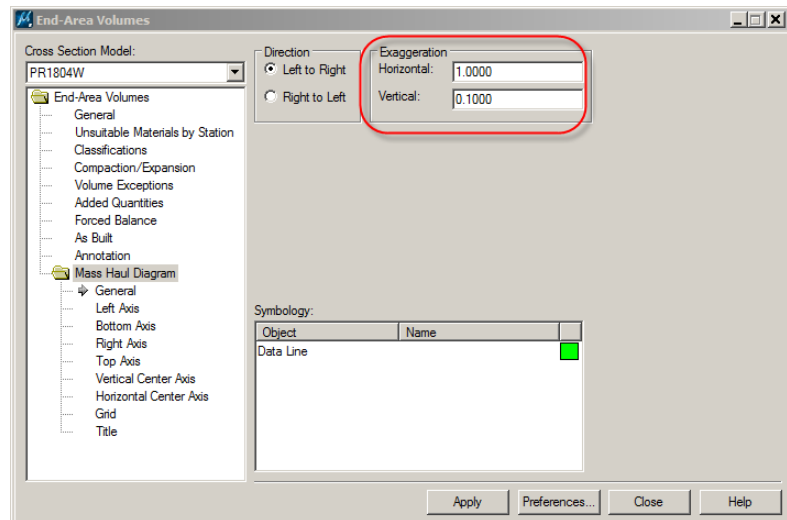
Mass Diagram from Microsoft Excell Spread Sheet –Alternate Processing Method

An Excell spreadsheet can be used to calculate mass ordinates and Geopak profile tools can be used to draw a mass diagram. This Alternate Processing Method has a few advantantages over the Openroads mass diagram tools.

- Quantities can be added at stations where there isn't a cross section. OpenRoad quantities can only be added where there is a cross section.
- Embankment, embankment above subgrade, and quantities from other earthwork reports can be tracked on one spreadsheet.
- Mass Ordinates do not need to be carried from one report to the next.
- The old Geopak Profile tools can be used to label critical mass ordinates needed in the calculation for average haul for the project.

The entire process for drawing a mass diagram from a spreadsheet will not be covered in this document. Only a few key points will be discussed.

CADD Standards

Recalculating volumes in Excel will require converting station values to numbers. Example, convert the text string "14983+00.00 R1" to a number using the formula.

    =VALUE(SUBSTITUTE(LEFT(A1,LEN(A1)-3),"+",""))

A1 is the excel cell for the station as text. The blue part of the formula trims off the right 3 characters " R1", removing the region information. The red part of the formula removes the "+" character. The purple part of the formula change the text to a number.

Showing a number value in the stationing format may be desired. Use custom excel formatting to show numbers as stationing (Examples; ##+#0, ##+#0.00)

A series of text strings will needed to be copied into Geopak Cogo to draw a mass diagram. The following is an example "VPI 10 S 120+00 E 6140.0". A Excel formula can be used to build each string.

    =CONCATENATE("VPI ",A2," S ",A3," E ",ROUND(A4,2))

A2 is an increment. You will have to create this as a new column such as 1,2,3,4,5…
A3 is the station as number or text.
A4 is the Elevation or Mass Ordinate.

Cogo VPI commands can be used to store a mass diagram as a profile. The mass ordinate can be used for the Y axis Instead of elevation. Then the DC manager can be used to draw the mass diagram. The following is an example of the Cogo Input format.

    S Pro Mass1
    VPI 10 S 120+00 E 6140.0
    VPI 11 S 130+00 E 6140.5
    End Pro
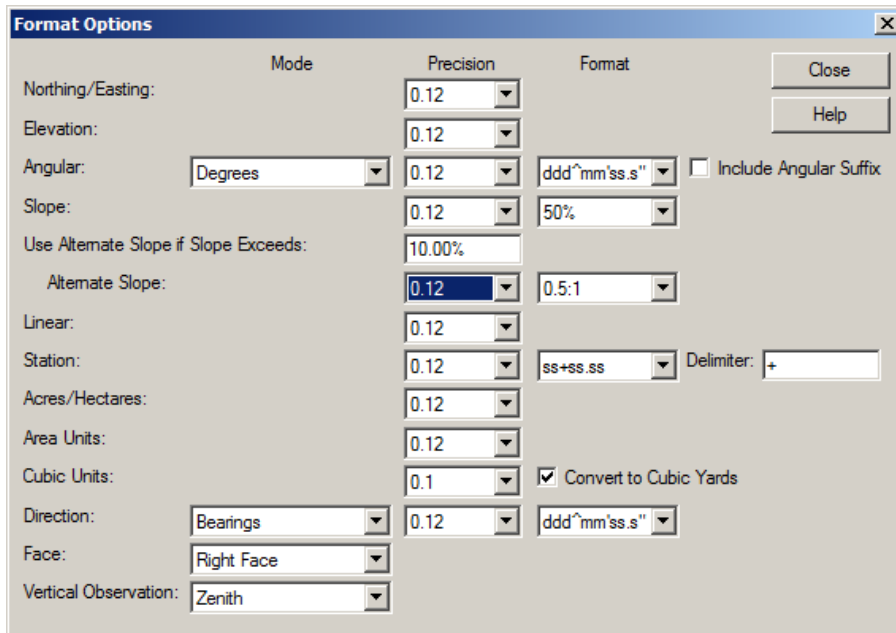
CADD Standards

5.11   Bentley Civil Report Browser

Sept 2017

Bentley Civil Report Browser is used to generate many different types of OpenRoads Reports. This includes alignment and earthwork reports. Users may need to adjust measurement format setting for these reports. This can be done within the Bentley Civil Report Browser by selecting "Tools > Format Options".
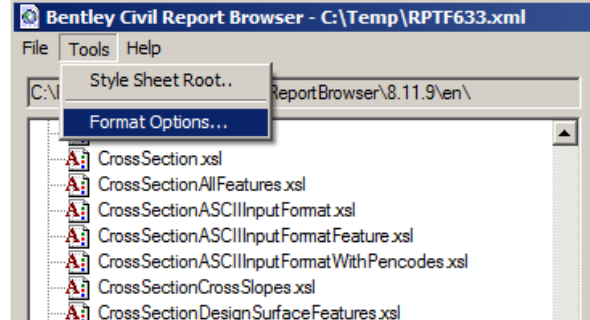
The settings shown are some common formats for the NDDOT.

Presently the only custom reports for the NDDOT pertains to Earthwork Quantities. Users may need to cut data from the default Bentley reports and reformat data for other plan production tables.

CADD Standards

Axiom

6.1   Axiom Title Block Manager
Jan 2019 (minor edits)

The Axiom Title Block Manager (TBM) tool is used to edit (manage) MicroStation title blocks and tags. This tool allows multiple title blocks and tags from multiple drawings to be edited from one spreadsheet.

    1.   General Title Block Manager Setup

         a.   Only the Central Office has access to this tool. The tool "Title Block Administrator" should be available within MicroStation under the Axiom pull down menu.

         b.   TBM will work with a blank Microsoft Excel spreadsheet. Users can save a blank spread sheet to their project directory before they start TMB or this can be created while running TBM (see step 2c). Using a preformatted spreadsheet is not recommended.

         c.   Don't Drop your Sheet Cells. Your Tags and Title Blocks will have to be recreated. Dropping cells should be avoided, because it takes time and can be complicated.

         d.   This section doesn't discuss TBM in detail. For more information on TBM see Axiom's User Guides;
m:\apps\production\design\axiomV8\tbadmin\tbadminv8.pdf

    2.   Update Title Block Manager Excel Spreadsheet from Selected Drawings

         a.   In Title Block Administrator's main dialog box, Select Action: "Update database from selected design files."

         b.   Click the <Select> button to the right of the "Design Files:" field. The dialog that opens allows you to select a batch of files for processing. Select the files that you want to manage. You need "write access" to these files and they should all use standard sheet cells. After selecting the files that you want to manage, click <OK> to return to the Title Block Administrator main dialog.

         c.   Select your database (Excel Spreadsheet). This could be an empty spread sheet that you created before you started TBM or you can have TBM create one for you now by typing in a path and file name. Remember Excel files have an xls extension. Also note that spreadsheet can't be open while you run TBM.

         d.   Select a name and location for your report file. Example (c:\temp\TBM.rep). This file only documents what you have done.

CADD Standards

e.   This step is optional. If you want to work with just one type of tag set within one spread sheet, the specific tag set or sets can be specified in the TBM settings. Example, if you only want to edit just DIP tags in one spread sheet, you would select "Settings>Change Settings" from the TBM pull down menu. Then you would type "bordercell" in the "Tag sets to process" field. Note, the character "*" can be used in the "Tag sets to process" field. The "*" character means it will process all tags within the drawing.

f.   CAUTION, if you process multiple tag sets at one time, your spread sheet may imply false tag relationships. Example, you may need to process a cell with the tag sets named "bordercell" and "titleblock". The tag named "bridge" is part of the tag set named "bordercell". However your spread sheet will contain a cell for the tag named "bridge" in the tag set named "titleblock". This is a false relationship. Nothing will happen if you fill it in because it doesn't exist within your drawing. These false fields are not important if you remember that they are not used. You must be aware of which tags belong to which tag set.

g.   Click the Start button to begin the update. At the end of processing, you will see summary totals. Click <OK>.

h.   Now you can select <Display Report> to see a summary of what was done.

i.   Open the Excel by pressing the <Edit Database> button to see what was added.

3.   Update Selected Drawings from Title Block Manager Spreadsheet

a.   If you just completed step 2, your file list is still there as <Edited File List>. If not, use the <Edit List> dialog to select your files.

b.   Open database by clicking on the <Edit Database> button. You will see all of your design files represented one row per tag set. Note most sheet cells have multiple tag sets.

c.   Edit the data fields as needed. The data fields have been grouped by tag sets. You may have to sort on the tag set name in order to edit groups of data fields. Note, page and section numbers should not use preceding zeros – place holding zeros in the title blocks.

d.   Save and close the spreadsheet.

e.   In MicroStation - Axiom, change the "Action:" to <Update selected design files from Database>. Make sure that your TBM spreadsheet is selected and you have specified a report file.

f.   Now click <Start> to begin the update. At the end, you will see summary totals.

g.   Click <OK> to those totals.

h.   Open the MicroStation files to see your changes.

## 6.2   Axiom FileRename and FileResequence (Custom Macros)
Oct 2008

The FileRename macro will add the section number and sequence (page) number to the front of your file name. You can only do one section at a time and the files must be sequential, but the files do not have to be MicroStation files. You can use this macro for all types of files.

In order to use the FileRaname and FileResequence macros, a list of files names that you want to rename must be stored in an ASCII file with a "lis" extension. Axiom "Title Block Administrator" can be used to create this list.

### Creating an ASCII list File

1.   Open a MicroStation drawing file that is **not** going to be added to the list.

2.   Click on "Axiom > Title Block Administrator" on the menu bar.

3.   Click on the "Select" button.

4.   Click the "Browse for files and add to list" button. Select the file that you want to be first in the sequence. Multiple files can be selected by holding down the control key while the files are selected. The order that files are selected is important because this influences the order drawings will be renamed. Select "Open" to add the files to the list.

5.   When your list is complete, click the save button or select "File > Save File List" on the menu bar.

6.   A "Save File List" dialog box should open. The "Save as type option" needs to be set to "Plain Text List Files (*.lst).

7.   Type in a name for the file and save the file in your project directory.

8.   Click OK to close the "Choose Files to Process" dialog box.

9.   Close the Title Block Administrator dialog box.
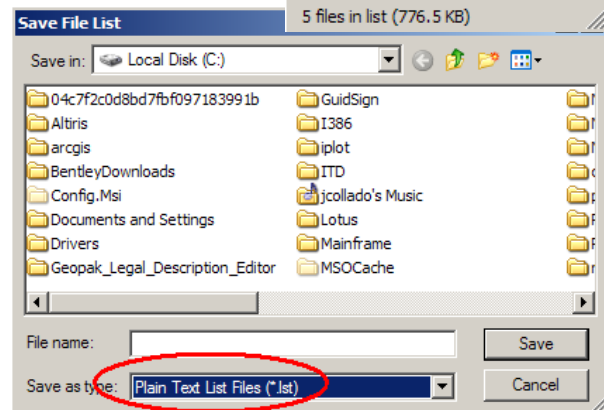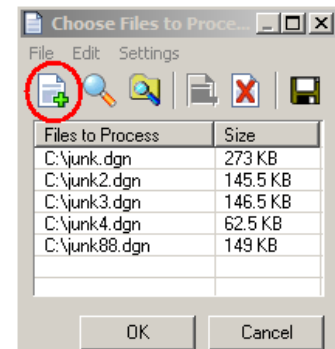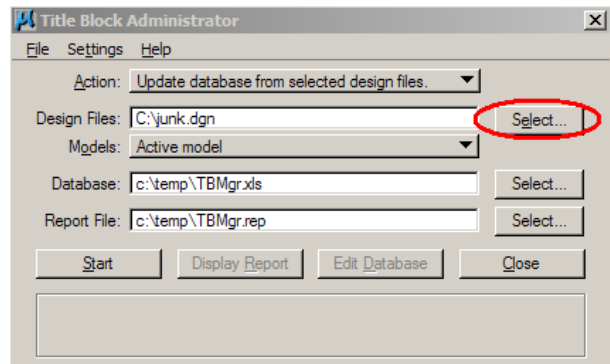
CADD Standards

Running the FileRename Macro

1. An ASCII list file is needed before running this macro (See creating and ASCII list file). The files in the list should not be open because the macro will not be able to rename them while they are open.

2. Click "Utilities > Macro > MicroStation Basic" on the menu bar.

3. In the Macros dialog box scroll down to the FileRename macro. Click the Run button.

4. Choose the section number from the list and click OK.

5. Enter the starting sequence (page) number and click OK.

6. Locate the ASCII list file you previously saved (Creating an ASCII list file, step 7).

7. Click the OK button on the Information dialog box to finish the process.
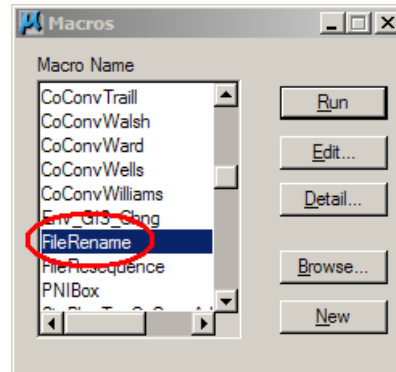
If you have to add a file in the middle of a section, you can quickly renumber the files following the inserted file by using the FileResequence macro. The FileResequence macro will change the sequence (page) number of existing files. You can only do one section at a time and the files must be sequential, but the files do not have to be MicroStation files. You can use this macro for all types of files.

Running the FileResequence Macro

1. An ASCII list file is needed before running this macro (See creating and ASCII list file). You will only have to add the files that come after the file you added. The files in the list should not be open because the macro will not be able to rename them while they are open.

2. Click "Utilities > Macro > MicroStation Basic" on the menu bar.

3. In the Macros dialog box scroll down to the FileResequence macro.

4. Click the Run button.

5. Enter the sequence (page) number that comes after the file you inserted and click OK.

6. Locate the ASCII list file and click OK.

7. Click the OK button on the Information dialog box to finish the process.

CADD Standards

Other Standards and Procedures

7.1   As-built Plans   (Record Drawings)
May 2016

The "Construction Records Manual" (*Section 7*) discusses what is to be included in As Built Plans. As-Builts can be hand drawn or created electronically. The following instructions for creating as-built drawings are recommendations. This section of the CADD Standards Manual elaborates on "how and where" to specifically include this information in the CADD files.

All as built information that is different than the information from Design will be kept in the As-built Folder located in the project directory (see *Section 2.1*). As-built plans will be assembled in the same manner that the Design Plans were assembled. If design details were documented in one drawing then referenced in cut sheets, then the as-built details should be documented in one drawing then referenced in cut sheets.

Example: A driveway was not built at the location shown in the design plans. Originally the driveway information was specifically drawn in the file
R:\project\80046083.017\DESIGN\design.dgn
then referenced into
R:\project\80046083.017\DESIGN\Sheets\pp geelan1.dgn.
The person creating the as-built drawings should create new drawings named "design AB.dgn" and "pp geelan1AB.dgn". Note that the file name uses a suffix modifier "AB".   *Section 2.2* discusses file naming requirements. As-built drawings are the only drawings where a suffix modifier is mandatory. All as-built drawings are to be named with a suffix modifier "AB".

The as-built changes should only be made to the new files within the as-built folder. Include only the features that have changed from the original design. The as-built driveway would be drawn within R:\project\80046083.017**Asbuilt**\design AB.dgn and then referenced and clipped into R:\project\80046083.017**Asbuilt**\Sheets\pp geelan1AB.dgn. The pp geelan1AB.dgn should reference the original drawing pp geelan1.dgn. Remember to use a reference nest depth of "1" in order to reference the original sheet and all of its references.

Most as-built drawings reference the original design drawings. Referencing is usually preferred over copying because changes can be quickly identified and it is less redundant. However there are exceptions to referencing for as-builts.

Some as-built files need to be copied from the original design file and then edited in order work with GEOPAK. The GPK file and Cross Section files should be copied from the original design folder.

As-built drawings with extensive changes are another exception to referencing. Drawings that have many revisions can be copied an edited for simplicity. For example a detailed drawing of a Lift station may have many revisions. This drawing could be copied from the design folder into the as-built folder. Then the revisions could be made to the typical drawing without referencing.

CADD Standards

Remember to rename these copied drawings with the as-built "AB" suffix modifier. The element symbology for as-built drawings should be the same as the symbology used for the design plans. Unique element symbology is desired in as-builts for the same reasons it is desirable in design plans. We want to be able to quickly identify features both in as-built and design plans. However all as-built drawings need to use "level symbology". Traditional as-builts are black and white with the exception of the as-built information. As-built information should appear blue. When creating as-built drawings the 'level symbology" for all design drawings should be set to color "0" (black and White) and the "level symbology" for all as-built drawings should be set to color "1" (blue). This symbology should produce a black, white and blue set of plans.

Creating as-built's from drawings that were created with Pointer files requires additional adjustments. See previous section 3.12 for a discussion on Live Nesting and Pointer files. If a Pointer file is used in the original plan sheet, the as-built sheet should be created by referencing the as-designed sheet with a nesting level of 2.

As-built plans shall be assembled in the same manner that the Design Plans are assembled except that the words "As-Built", shall be placed directly under the project number in the upper right title block.

CADD Standards

7.2   Design Division's Quick Maps

Jan 2019

This tool can be used to create maps for "Design Plan Title Sheets" and reports. The Design Division's Quick Maps are accessed through the web; http://gis.dot.nd.gov/external/ge_html/?viewer=ext_quickmap

If you just want a simple county map, don't use this service. County maps as pdf's can be retrieved from www.dot.nd.gov/road-map/county-base/index.htm .

CADD Standards

7.3   Tags, Professional Stamping and Signing
Sept 2010

Most Consultants and NDDOT Districts don't have Axiom Title block Manager. However, these people still need to use the same sheet library (sheets.cel) and still have to address the professional engineer stamping requirements. The following notes discuss how these users can operate.

1.   The sheets library has been modified. Most of the title blocks for the sheet cells have been filled with "tags". Tags are special MicroStation elements that look like "text" elements.
    a.   These tags have been added so that the sheet cells can be used with Axiom Title Block Manager. However, you don't need TBM to edit these tags. The tags can be edited with just the MicroStation "Edit Tags" tool.
    b.   Title block tags can be deleted without dropping the cell. So if you don't want to use them, they can be deleted and you could fill out the title blocks with normal text. However, the Standard Committee recommends using the "Edit Tags" tool. The preformatted tags are setup with the standard symbology.

2.   Several of the standard sheets have a title block for a profession engineer's or registered surveyor's stamp. A special note is included in these title blocks. The note must be included when the drawing is transmitted electronically. Do not fill in the PE stamp tags until the plan sheet has been sealed by a PE. By filling in this information, you are stating the sheet has been sealed. In order to avoid having to maintain multiple versions of a drawing (preliminary, one for stamping and one for electronic distribution), special print drivers and pen tables are being used to control when the PE note is printed and when it is not printed. The following pen tables are used;
    a.   Preliminary.tbl
    b.   PE_Stamping.tbl
    c.   Electronic_Distribution.tbl

3.   The title sheet has several signature lines. When the design plans are electronically distributed or archived, these signature lines need to be electronically filled out. The signatory name should be spelled out followed by characters "/s/". These lines should only be filled out after the plans have been signed. The text used for the signature line should be on the level named "Sht Stamp Text" so that it is displayed through the pen tables in a manner similar to the standard "Electronic Distribution Statements".
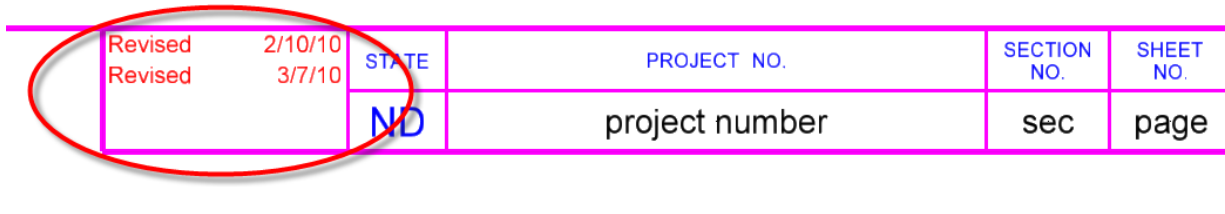
CADD Standards

7.4   Addenda and Change Orders

Jan 2019

Plan revisions before the Bid Opening are referred to as Addenda. Plan Revisions after the Bid Opening are referred to as Change Orders.

All plan sheets cells have an area (revision block) reserved for addenda and change order information. This revision block is part of the upper left title block.

Addendum and Change Order plan sheets shall include the words "Revised" or "Sheet Added", as applicable, and the date in this revision block. If the sheet was previously revised as an addendum or change order, keep the original revised note and add another one (example: Revised 2-10-10, Revised 3-07-10). If the project is moved to a later bid opening or if the project is rebid, the revision block should be reset to "null" entries (blank fields) and the sheet should be included in the plans as a normal sheet.

This revision block contains a MicroStation tag set Named "Revision_Box". This block contains enough tags for 4 revisions. There are tags to describe the type of change ("Revision" or "Sheet Added") and tags for the dates. The Revision_Box tag set can be edited with Axiom Title Block Manager or the standard MicroStation "Edit Tag" tool. The default tag values are empty. You cannot see the tags when the sheet cell is first placed, but they are still part of the cell.

If an addendum or change order added or voided a plan sheet, the plan sheet containing the table of contents must also be revised as part of the change. The table of contents does not need to be revised if the revised sheets are already listed.

If sheets need to be added in the middle of a section, alphabetical suffixes should be added to the sheet number (example: section 80 sheet 10A, section 80 sheet 10B, section 80 sheet 10C …). Alphabetical suffixes should only be used for sheets added with an addendum or a change order. These suffixes should not be used in the original plans. The original plans should always be renumbered if sheets are added.

A separate pdf shall be created for each Addendum or Change Order. The original posted PDF file shall never be edited. The separate pdf shall only include the sheets that have been revised. There are different procedures for creating and processing addendums or change orders with digital signatures. Designers working on digital signature pilot projects with addendums or change orders should contact James Rath or Jon Collado for these procedures.

CADD Standards

When the plans are signed, all of the files should be set to read only. The read only setting shall not be turned off.

All plan revisions (addenda and change orders) shall never be made in the original files. The original files shall never be edited after they have been signed and sealed. If changes are needed, copies of the files should be made.

All plan revision information shall be kept in separate folders located in the designers corresponding project directory (see *Section 2.1*). A separate folder shall be used for each addenda and change order that is issued. A new folder named "Addendum (followed by a letter) shall be added for each addendum that is issued (Ex. "Addendum A"). Likewise, a new change order folder (followed by a letter) shall be added for each change order that is issued (Ex. ChangeOrder A.) When the next revision is added, the folder should end with the next letter in the alphabet. When starting a revision, check the other designer's folders for previous revisions. If someone is already working on a revision, check to see if your sheets can be added to it.

Examples: R:\project\80046083.017\DESIGN\Addendum_A
R:\project\80046083.017\DESIGN\Addendum_B
R:\project\80046083.017\DESIGN\Addendum_C
R:\project\80046083.017\DESIGN\ChangeOrder_A
R:\project\80046083.017\BRIDGE\ChangeOrder_ A
R:\project\80046083.017\BRIDGE\ChangeOrder_B
R:\project\80046083.017\TRAFFIC\ChangeOrder_A

The original files should not be modified for addenda and change orders. If changes need to be made to a file, the file should be copied into the respective addenda or change order folder and a suffix modifier shall be added to the end of the filename. Addenda shall use the modifier "AD" followed by the group letter. Change Orders shall use the modifier "CO" followed by the group letter (example: 060PP_004_PP_AD-A or 060PP_004_PP_CO-A). If sheets were added, the sheet number suffix should be used in the file name (example: 060PP_004**A**_PP_AD-A).

If design details were documented in one drawing then referenced in cut sheets, then the revised details should be documented in one drawing then referenced in cut sheets.

Example: A driveway should not be built at the location shown in the original design plans. Originally the driveway information was specifically drawn in the file R:\project\80046083.017\DESIGN\design.dgn then referenced into R:\project\80046083.017\DESIGN\Sheets\060PP_006_pp_geelan1.dgn. The person creating the change order drawings should create new drawings named "design_CO-A.dgn and 060PP_006_pp_geelan1_CO-A.dgn. Note that the file name uses a suffix modifier "CO-#," where # is the change order group letter.

The change order modifications should only be made to the new files within the Change Order folders. Include only the features that have changed from the

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original design.dgn file to the design CO A.dgn. The change order driveway would be drawn within **R:\project\80046083.017\DESIGN\ChangeOrder_A\design_CO-A.dgn** and then referenced and clipped into **R:\project\80046083.017\DESIGN\ChangeOrder_A\Sheets\060PP_006_pp_ geelan1-CO-A.dgn**.

When changes are made to a drawing that is referenced into other drawings, all parties involved in making the original plans shall be notified of the changes and the location of the new revised drawing.

Most revised drawings reference the original design drawings. Referencing is usually preferred over copying because changes can be quickly identified and it is less redundant. However, there are exceptions to referencing for addenda and change orders.

OpenRoads civil geometry, features and corridors may use reference paths that are difficult to reestablish. Some of these reference are more than a graphic reference. They may include a civil (OpenRoads) reference such as the references used for corridor modeling. If the file involved with the plan revision includes civil (OpenRoads) references then the original file should be backed up and then the original file can be edited. The backed up files should use a suffix modifier similar to the one discussed for plan revisions, but they should include the phrase "Pre" (examples: RDM_Pre-AD-A, RDM_Pre-CO-A). The backed up file should be placed in the Addendum or Change order folder.

Drawings that do not have reference files attached or drawings with extensive changes can be copied directly into the Change Order folder and do not need to be referenced back into the new change order drawing. All of the changes can then be made in the change order drawing. For example, a detailed drawing of a Lift station may have many revisions. This drawing could be copied from the design folder into the Change Order folder.

Remember to rename these copied drawings with the addenda "AD-#" or change order "CO-#" suffix modifier.

The element symbology for these revised drawings should be the same as the symbology used for the design plans.

Update the supplement design data such as AMG files to match the applicable plan revisions. Consultants should resubmit changed supplemental design data with the addenda or change order.

Refer to the Design Manual, Section 1-9, Plan Revisions and Change Orders, for additional administrative requirements.

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7.5   Incorporating Microsoft Word and Excel Documents in PDF Plan Sets
Oct 2008

Plan sets contain some sheets that are created from Microsoft Word and Excel. These sheets include the Table of Contents, Notes, and Traffic Control Devices List.

1.   There are templates available for these sheets on the Plan Preparation Guide website at http://www.ugpti.org/dotsc/prepguide/index.php. These are special sheets that have macros built into them for printing.
2.   Put the page numbers in the upper right-hand corner.
3.   When printing these sheets, do not use the File => Print option from the menu bar. Instead use the following method to print the sheets:
     b.   The Table of Contents and Notes sheets have dialog boxes that launch when you first open the files. If you accidentally closed the dialog boxes, they can be opened by closing and then reopening the file.
     c.   The Traffic Control Devices List has a Print Plan Sheet button located at the top of the Input sheet.

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7.6   Rasters and Geographic Coordinate Systems

Dec 2010

This section discusses how to assign GCS's to rasters in order to enable the re-projection capabilities. Most of the aerial photos – rasters that are created by the Surveys and Photogrammetry Section are created using one of the following projection systems.

- State Plane North Zone – NAD83/ North Dakota North (Feet)
- State Plane South Zone – NAD83/ North Dakota South (Feet)

These rasters will reference into drawings that use the county ground GCS's at a location that may be close to the appropriate location, but not at the correct location. These rasters need to be re-projected. Users need to tell MicroStation which GCS was used in each raster and MicroStation will re-project the raster in the correct location.

First, the data in the drawing must match a defined coordinate system. Most of the drawings that are delivered by the Surveys and Photogrammetry Sections or other drawings that use Surveys and Photogrammetry's drawings as a direct reference have a matching defined coordinate system.

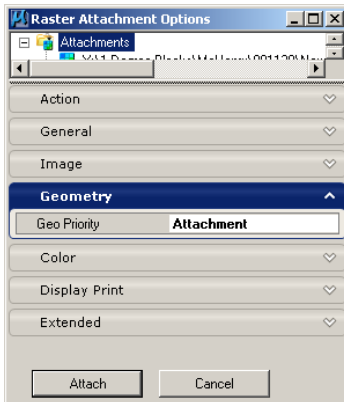Second, your user preferences for Raster Manager – Georeference must be set up correctly. See *Section 2.5*.

Thirdly, the appropriate GCS needs to be assigned to your drawing. See *Section 5.1*.

Now the rasters can be attached and GCS assigned.

Use Raster Manager to Attach the desired image(s). Make sure that "Place Interactively" is toggled OFF. Click Open
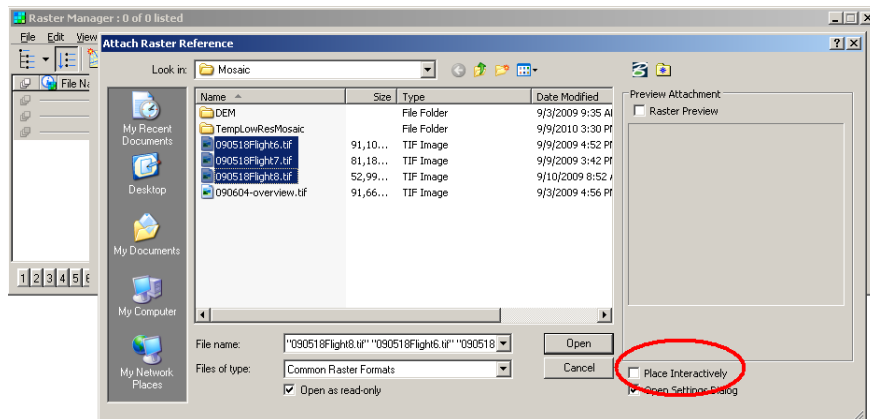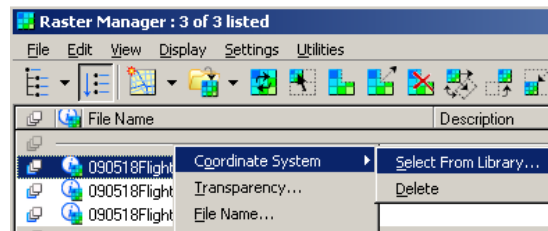
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The Raster Attachment Options Dialog will open. On the Geometry ribbon make sure that the Geo Priority is set to Attachment.
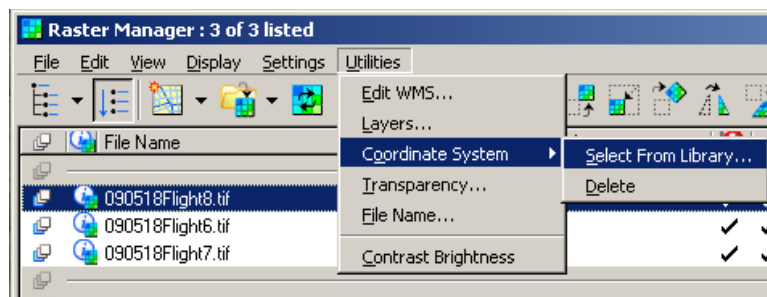
The final step is to set the coordinate system for the Raster Image. You can access the selection Dialog in one of several ways.

1. Select a single raster in the Raster Manger Dialog Box. Right Click on the selected Raster and select Coordinate System>Select From Library.

OR

2. Select a single raster in the Raster Manger Dialog Box. In the Raster Manger Dialog box access the Utilities Menu and select Coordinate System>Select From Library.

OR

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3. This final option will allow you to set the coordinate system for one or many images at the same time. Double Click on One of the images in the Raster manager which will bring up the Element Information Dialog Box. If desired, Select all of the images in the Raster Manager Dialog box that you wish to set to a single coordinate system. All of the selected images should be shown in the Element Information Dialog box. To set the Coordinate system you will need to access the Geometry section of the Element Information Dialog box. Expand the Geocoding item under the Geometry section by click the Plus sign next to if necessary to access the Name field. Click the in the Name Settings field, which may be set to <None> at this point and click the Drop down arrow to access the Coordinate System operations buttons. Click the "Select Geographic Coordinate System From Library" button.
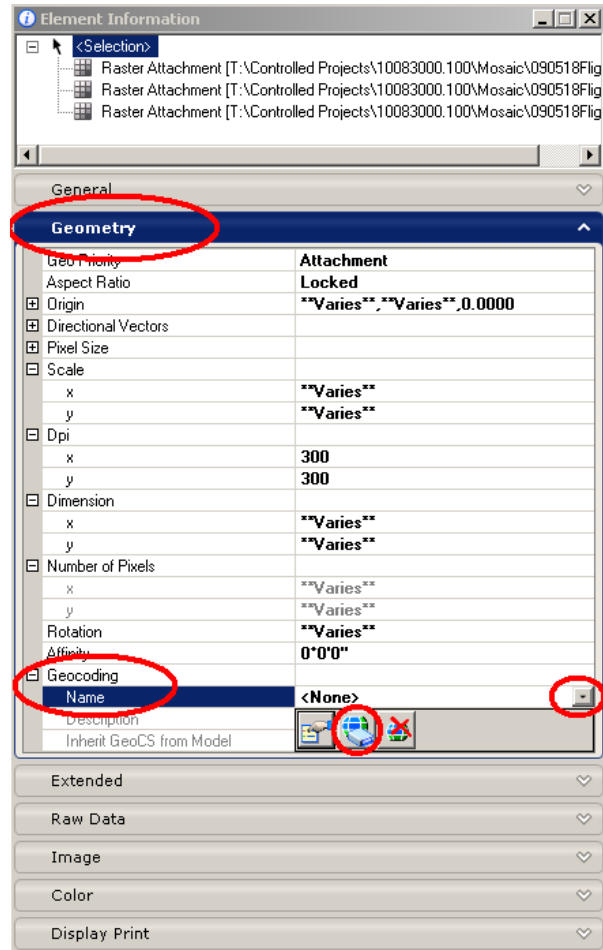
Each of the 3 options listed above will bring up the Select Geographic Coordinate System Dialog. Select the Coordinate system appropriate for the Raster(s) selected. In most cases this will be one of the 2 North Dakota State Plane systems, either North or South. These GCS have been copied to the NDDOT_County_Coordinates Folder for easier access.
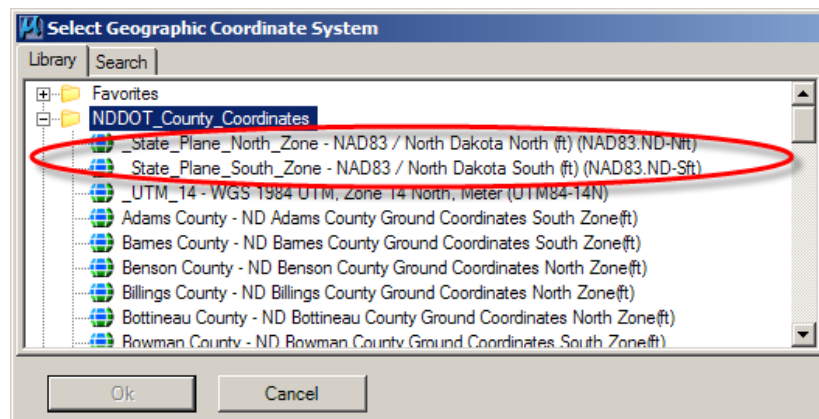
Click OK

The Raster Images will be re-projected from the coordinate system you selected for them into the Coordinate System selected for the DGN file.
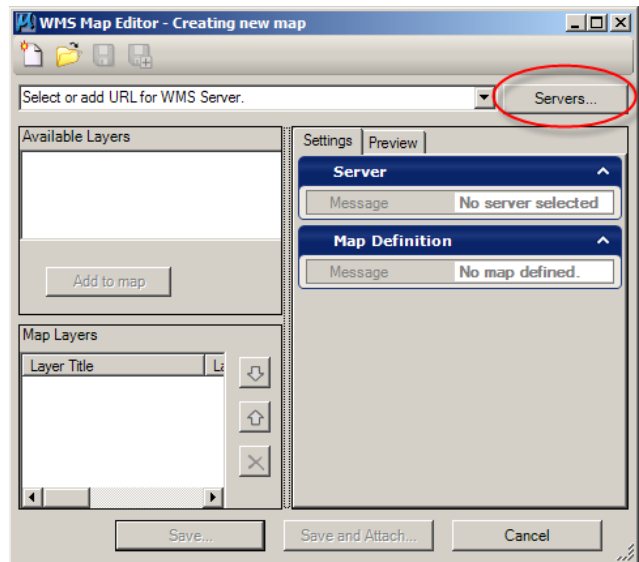
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7.7   Web Map Services (WMS) and Raster Manager
July 2015

A Web Map Service can be used with MicroStation Raster Manager to reference existing data. Two different data source are discussed in this section; OnRamp and NAIP imagery. These data sources are used by many NDDOT ArcMap users. Now this data can be accessed directly from MicroStation.

The following are instructions to reference a WMS.

1.   Attach a Geographic Coordinate System to your drawing. See the previous *section 5.1* (GCS).

2.   Open Raster Manager and select File>New>WMS from the Raster Manager Dialog. The WMS Map Editor dialog box should open.

3.   Click on the "Servers" button. The Servers Manager dialog box should open. Several URL address should be shown in the left panel. Two of these addresses should be marked with a star as favorites by default.
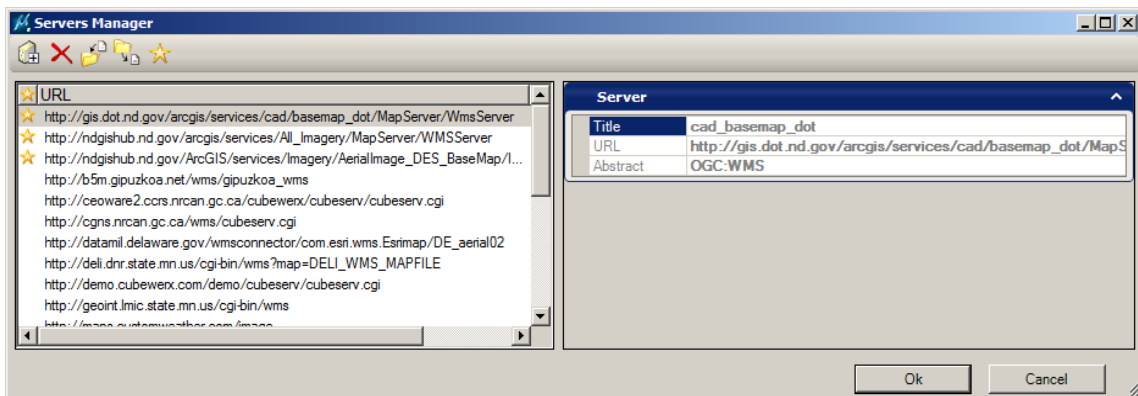
OnRamp data from the NDDOT GIS server
http://gis.dot.nd.gov/arcgis/services/cad/basemap_dot/MapServer/WmsServer

NAIP imagery
http://ndgishub.nd.gov/arcgis/services/All_Imagery/MapServer/WMSServer
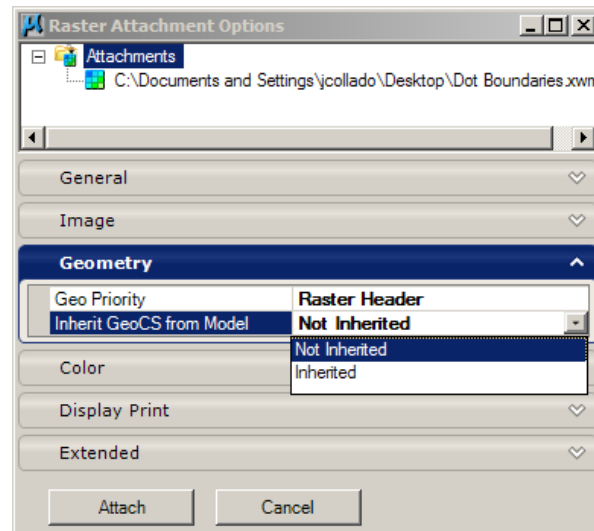
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4.   Select one of these addresses and click the Ok button. The Servers Manager dialog box will close and the address will be entered into the WMS Map Editor dialog box. Near the upper left corner of this dialog box there will be a panel that shows a layer tree.

5.   Select a desired layer (branch). Then select the "Add to map" button. The Layer will be added to the Map Layers panel in the lower left. This step can be repeated to add additional layers from the same server.
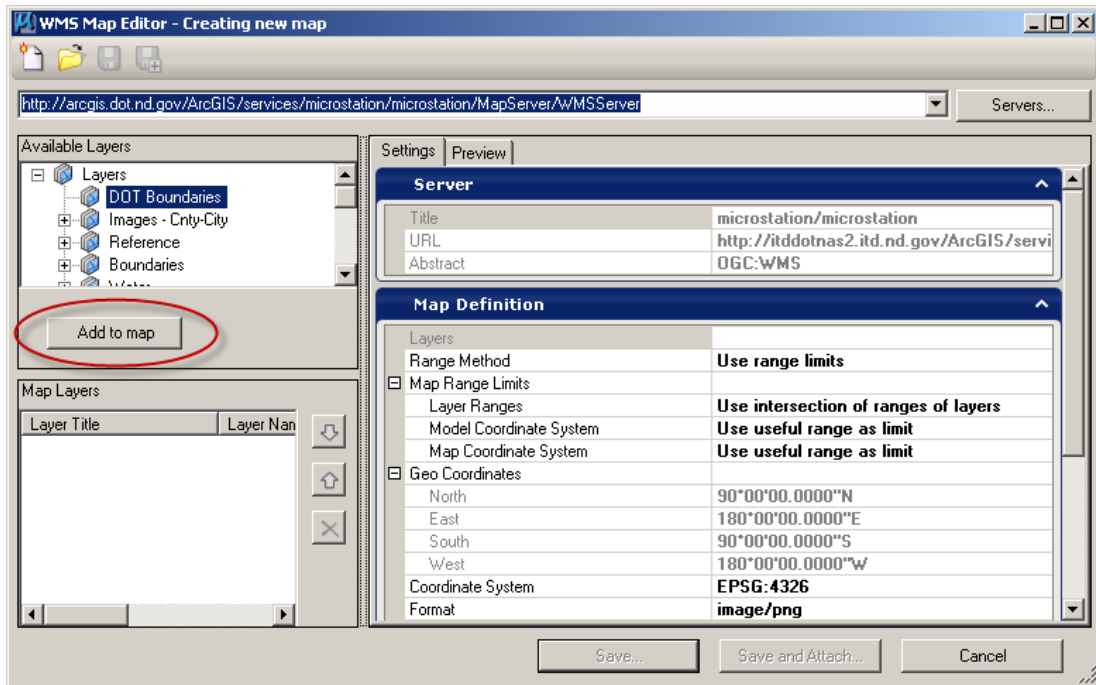
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6.   Select the "Save and Attach" button near the lower right. You will be prompted to name and save a file (.xwms) that contains the WMS linking information. After you have saved the .xwms file, the Raster Attachment Options dialog box will open.

7.   Expand the Geometry panel within the Raster Attachment Options dialog. Within this panel set the property "Inherit GeoCS from Model" to "Not Inherited". Then Click the Attach button.

Note re-projected rasters can't presently be clipped in MicroStation.

Miscellaneous Help

8.1   Using MicroStation Files in Microsoft Word
Nov 2011

There are several ways to export a MicroStation drawing to a format that can be imported into Microsoft Word. The following is a list of some of the common methods.

1.   Windows Cut and Paste
2.   Print Screen
3.   MicroStation Image Capture Tool
4.   Print Drawing to an Image file
    a.   Encapsulated Postscript (.eps)
    b.   Tagged Image Format (.tif)
    c.   Joint Photographic Expert Group (.jpg)
    d.   Microsoft Document Imaging
    e.   Clear Water

Window Cut and Paste is one of the easiest way to bring a drawing into Word. However, the image quality is poor. Linestyles appear altered. Sometimes text is not exported. Images imported using this method are not typically good enough for reports. This procedure is not documented in this manual.

Print screen is another easy way to bring a drawing into Word. This method usually requires considerable cropping once imported into Word. The background color usually needs to be changed to white. Image quality is OK. This procedure is not documented in this manual.

The MicroStation Image Capture tool can be used to export images to a wide variety of image file formats. This tool allows for cropping during the export process. The background color usually needs to be changed to white. Image quality is OK. This tool can be found in the main MicroStation pull down menu "Utilities>Image>Capture".   No further documentation on this procedure is given in this manual.

Using MicroStation printing tools to export a drawing to an image file is typically the best method to use for most NDDOT reports in the Word document format. Good image quality can usually be maintained. There are numerous variations with this process. The active background color used during the export process is less of a concern.

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Printing a Drawing to an Image File

There are several variations of this process. This manual will discuss how to export an "postscript" (.eps) file from MicroStation.   This format is recommended for word documents because file sizes are small and image integrity is good.

The same techniques used to print a drawing to paper, using MicroStation print tools, are used to print a drawing to an image file. The main difference is that different plot drivers are used. Several plot drivers have been modified for NDDOT use. They are located at: S:\STANDARD\V8I\plotdrv. From the MicroStation "Print" dialog box, select "File>Select Bentley Driver".   The "Select Bentley Driver File" dialog box should open. In order to create an eps file select S:\STANDARD\V8I \plotdrv\Manually_Pick_Printer\NDDOT-pscript.plt. When you print the drawing, you will be prompted for an eps file name and a location to save the file.

Once the image file (*.eps) has been created, it can be imported into Microsoft Word. In Word, select "Insert>Picture>From File". Then select the eps file.

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8.2   Bentley View
Oct 2008

If you don't have MicroStation and you just want to view and print CADD drawings, this might be the tool for you. This tool is relatively easy to use and it is free. People like district engineers and administrative assistants could use this tool to view and print MicroStation drawings.

Exporting drawings to PDF takes little time. However, some reviews benefit from eliminating even the smallest step. If all reviewers have CADD viewers, drawing preparation effort is minimized. Bentley View does not "push" the information to the end user as much as PDF, but it is more flexible in terms of not needing to process drawings into another format. Bentley View reads directly from raw CADD - dgn files.

Some people don't have MicroStation installed on their computer. It is not practical for them to become proficient nor is it cost efficient to install a full version of MicroStation on their computer. But occasionally they may need to review a drawing, (example a drawing was sent to them by email). If this person had Bentley View, they would not have to ask the sender to convert the drawing to another format or ask someone with MicroStation to help them view the drawing. They could view and or print the drawing themselves.

This tool is free and is relatively easy to use. Addition help using Bentley View can be found in its own help files.

NDDOT personnel should submit a work order request through the Work Management System if they want Bentley View loaded on their computer.

Note, privileges to certain servers for certain uses may need to be adjusted. Some people may benefit if they had access to the CADD Server.

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8.3   Roadway Inventory Management System (RIMS)

Mar 2011

The Roadway Inventory Management System (RIMS) tool can export information to a PDF. This manual does not intend to explain how to use RIMS. This manual only highlights some of the options while print to a PDF.

RIMS files exported to PDF are named after your RIMS User ID, Year, Month, day and Time (example, JONCOL1.080917085600.PDF). RIMS documents exported to PDF are created in the directory: **O:\000 Reports.**

Print Sequence Numbers are used to control the print format. Some print formats don't work with some reports. Data may be clipped from the print or hard to read. The table below can be used to help select the correct print format.

RIMS Printer ID	Print Sequence Number	Characters per Inch (CPI)	Lines per Inch (LPI)	Orientation	Size	Typical Use
PDF	1	12	6	Portrait	8.5x11	
PDF	2	12	8	Portrait	8.5x11	
PDF	3			Landscape	11x8.5	
PDF	4	18		Landscape	11x8.5	
PDF	5	18	10	Portrait	8.5x11	Most Milestone Reports
PDF	6	18	10	Landscape	11x17	Quantity Sheets with Border
PDF	7	18	10	Landscape	11x17	Quantity Sheets without Border
PDF	8		8.5	Portrait	8.5x11	Milestone Reports with less margins

Additional Notes
- PDF's of the Quantity sheets and other should be stored in the project Directory.
- Please review, print, or store this report, then delete it from the site in order to keep this folder manageable. The folder will be purged each month.