STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION

2012 CAD/D PROCEDURES AND REQUIREMENTS

EFFECTIVE: APRIL 12, 2012

PART I – GENERAL INTRODUCTION

DISCLAIMER

The procedures described in this document are for reference only. This information is provided on an "as is" basis. The material contained is provided without warranty or liability of any kind to the New Hampshire Department of Transportation (NHDOT).

Updating this manual is intended to be a continuous process. As technology evolves, policies change, and process improvements are discovered, this document will be updated to reflect those changes.

As with any documentation, improvements can and should be made. Any additions, suggestions or comments for improvement are encouraged. This documentation is not meant to be a complete instructional document. The intent is to provide guidelines that, if followed, will result in better quality and consistency for electronic plans and documents.

This manual, in its entirety, may be freely copied and distributed for the purpose of providing a consistent guide to the computer aided design & drafting (CAD/D) requirements of the New Hampshire Department of Transportation. Copies of this manual along with CAD/D resource files (style libraries, naming conventions, etc.) can be downloaded at **http://nh.gov/dot/cadd/cadd.html**.

Any recommendations for improvements to this documentation are welcome. Any errors found should be brought to the attention of the CAD/D Staff so corrections can be made. For additional information or detailed explanations of the standards described within this document, contact:

CAD/D Support and Development
New Hampshire Department of Transportation
PO Box 483
Concord, NH 03302-0483

E-mail: cadd@dot.state.nh.us
Tel: 603-271-2171

ABOUT THE COVER

This year's cover shows the double-decker bridge in Suncook completed in 2007. On top is a photo of the completed structure taken by Jerry Zoller on November 30, 2007. Below it is a rendering of the proposal developed during the design phase by Lysa Bennet Crouch of the CAD/D Section.

REVISION SUMMARY

APRIL 2012

Part I– General Introduction

- New software versions.

Part II– General CAD/D Information

- The project directory structure was modified to separate MX data from contract plan drawing data.

Part III– MicroStation

- Updates to cell file listing.
- Seed file information now includes geographic coordinate system being used.
- Information about the NHDOT pen table has been updated.

Part V – Procedures

- The process for creating cut sheets has been modified along with the sheet naming convention.

Part VI – Other Project Data

- Notes on QA_Input and other GDM programs have been replaced by descriptions of task menus.

Appendix

- Changes to MicroStation drawing names in Appendix A.
- Linestyle charts have been updated in Appendix C.
- Appendix D (MX model names) has been updated to reflect current practices.
- MX String label lists have been updated.

JULY 2009

Part III– MicroStation

- New cell files added. These are identified within the text.

Part V – Procedures

- New section to remove descriptions of specific procedures from sections describing software programs.
- Information about Legacy Alignments has been added.
- An additional option has been added to the process for creating cut sheets.

Appendix

- MX String label lists have been removed –see the CAD/D website for current information.

APRIL 2007

Part II – General CAD/D Information

- New section

Part III– MicroStation

- The BrD directory for Bridge Design files has been renamed to BRC.
- Details of changes to the nh_engineering font.
- Addition of Bridge Design cross-hatching details.

Part IV– MX

- The ERW8 style set has been renamed to ERL.
- Documentation of MX add-ins has been added.

Part VI – Engineering Consultant Requirements

- The Right-of-Way process has been revised.

Appendix

- Appendix A has been expanded to include additional drawing information.
- Appendix C shows updates to the nh_engineering font.
- Appendix J has been updated to reflect changes to the MX add-in for adding cross-section detail symbols.

APRIL 2006

General

- The CAD/D website address has been changed to: http://nh.gov/dot/cadd/
- The email address has been changed to cadd@dot.state.nh.us

Part III– MicroStation

- Use of NHDOT-defined MicroStation line styles is required.
- The text style and linestyle sections have been expanded and clarified.
- The lists of drawing names have been expanded and clarified.

Part IV– MX

- Aerial survey data has been merged into the EXD style set.

Part VI – Engineering Consultant Requirements

- LandXML is now the preferred method of exchanging design data between MX and other design software.
- A process for exchanging right-of-way data has been added.
- File submission requirements for projects designed with InRoads have been updated.

Appendix

- Appendix A has been expanded to include additional drawing information.

- Appendix H has been modified to encourage the use of LandXML when transferring design data between MX and other design software.

APRIL 2005

General

- No significant changes.

Part III– MicroStation

- Added NHDOT website location of engineering detail drawings.
- Update to directory structure for projects containing multiple bridges.
- Added text style information for Bridge Design projects.

Part IV – MX

- Style set & feature set listing reformatted to include additional information.

Appendix

- Changes to MicroStation drawing names in Appendix A.
- Linestyle charts have been updated in Appendix C.
- Special characters included in the nh_engineering font (font 180) are listed.
- Appendix D (MX model names) has been updated to reflect current practices.
- MX String label lists have been updated.
- A new section – Appendix J – has been added to document MX Cross Section Sets.

APRIL 2004

General

- No significant changes.

Part III– MicroStation

- References to MicroStation/J features have been modified to reflect the upgrade to MicroStation v8.
- References to Settings Manager have been removed.
- Corrected errors in custom linestyle scaling charts.
- New cell files added. These are identified within the text.

Part IV– MX

- Style sets have been updated for MX 2.6/MicroStation v8.

Appendix

- References to MX version 2.5 have been modified to reflect the upgrade to MX 2.6
- Modifications have been made to the MicroStation drawing name list. Specific changes are identified in the drawing list.
- Some MX string labels have been added or modified. These are identified within the string label tables.

APRIL 2002

General

Consultant deliverable specifications relocated from various parts of the document and combined as *PART VII - ENGINEERING CONSULTANT DELIVERABLE REQUIREMENTS*

Part III– MicroStation

- The process for creating cut sheets has been modified along with the sheet naming convention.
- The project directory structure was modified to include subdirectories for front sheets and profiles. The bridge directory now includes additional subdirectories.
- Changes to cell file listing – titles.cel was renamed to stamps.cel, borders.cel, br_borders.cel, stnoffset.cel, and turnrad.cel have been added.
- Information about the NHDOT pen table has been included.
- BatchPlot information has been added.

Part IV– MX

- Additional style sets have been listed.

Part V – Other Project Data

- Information about the quality assurance/quality control software has been included.

Part VI – Engineering Consultant Requirements

- New section.
- NHDOT will only accept plan drawings that were developed in MicroStation for projects that were initiated after April 18, 2002.
- MicroStation plot file returnable changed from HPGL to PDF format.

Appendix

- Modifications have been made to the MicroStation drawing name list. Specific changes are identified in the drawing list.
- Information about MicroStation level colors, styles, and cell names have been removed to avoid potential conflicts with documentation on the CAD/D website.
- Some MX string labels have been added or modified. These are identified with the string label tables.

INTRODUCTION

This document contains the New Hampshire Department of Transportation's (NHDOT) specifications for electronic (computer) data as it relates to engineering design projects. It explains the minimum requirements that must be met for all Computer Aided Design & Drafting (CAD/D) data produced by and for the New Hampshire Department of Transportation. This is to ensure that CAD/D files can be used by the entire project team throughout all phases of project development. While the requirements contained herein provide a basis for uniform CAD/D practice for NHDOT projects, precise rules that would apply to all possible situations that may arise are not possible to describe. Situations may exist where these standards will not apply. If variances from the "CAD/D PROCEDURES AND REQUIREMENTS" are necessary for a project, they must be approved in writing by the NHDOT Project Manager and documented in the Project Journal File as defined herein. The creation of MicroStation drawings and/or levels for features that are not described in this document shall be documented in the Project Journal File. The creation of MX models that are not described in this document shall be documented in the Project Journal File.

As a minimum, NHDOT Design staff and engineering consultants are expected to adhere to the standards that were in force at the time the contract was initiated. Although not required, following the latest standard is recommended whenever feasible.

In addition to the traditional hardcopy delivery items, NHDOT requires supplementary electronic data delivery items. This data shall be submitted in the formats specified by this document. In general, design data and Digital Terrain Model (DTM) data is to be provided in the MX model file, LandXML, or 3-D DXF file formats, and graphical data is to be provided in MicroStation's .DGN drawing format. Organizations wishing to perform professional engineering services for NHDOT are required to deliver electronic data as specified by this document. This specification also requires organizations to accept and utilize pertinent electronic input data as provided by NHDOT.

These electronic delivery items **DO NOT** replace any **hardcopy** delivery items.

This document is published as an update to the "CAD/D PROCEDURES AND REQUIREMENTS" document dated July 2009 and supersedes all CAD/D standards previously published.

Trademarks

CURRENT NHDOT SOFTWARE VERSIONS

NHDOT desires to stay current with state of the art trends in the market, however, budget constraints, statewide implementation, impact on users, and providing support for the new features must be considered prior to any change.

As NHDOT makes a change that results in modifying electronic procedures, the "CAD/D PROCEDURES AND REQUIREMENTS" will be updated where necessary to reflect the change. A list of the modifications will be found in the revision summary. **As a rule, until documentation is modified, deviation from the current dated requirements must be approved by the Project Manager.**

MAJOR SOFTWARE AND CURRENT PRODUCTION VERSIONS

1. MicroStation V8i (SELECTseries 2) (version 08.11.07.443)
2. MX V8i (SELECTseries 2) (version 08.11.07.536)
3. Microsoft Office 2000 products with Excel 2002

FUTURE UPGRADES

Bentley released MicroStation SELECTseries 3 as this document was being prepared and a SELECTSeries 3 version of MX is forthcoming. The Department will be testing those updates when time and availability permit.

PART II – GENERAL CAD/D INFORMATION

DOCUMENTATION

Documentation of NHDOT CAD/D practices and procedures can be found on the Internet at **http://nh.gov/dot/cadd/**. Summaries of selected procedures will be found in *PART V – PROCEDURES* beginning on page 31.

SURVEY DATUM

For NHDOT projects, the vertical datum is based on NGVD29 and the coordinate system is NAD83/86.

PROJECT JOURNAL FILES

PROJECT JOURNAL GUIDELINES

A Project Journal will be produced for each project. On consultant-designed projects, a copy of the journal file will be delivered with each electronic project plan submission. The purpose for this journal is to aid downstream customers of the CAD/D data so they may utilize existing CAD/D work in their processes. The format of the journal will be an electronic file, either in text format or a format supported by Microsoft Word 2000. As a minimum, the journal will contain the following information:

- A listing (Index) of the project files, including brief descriptions of each file and where the file is located.
- Documentation about the CAD/D software used, special CAD/D decisions made, exceptions to standards that were made, problems encountered and work around, or other important issues that arose during the course of the CAD/D work. For example, if a custom line style needed to be created, the justification, resource file, and files where that line style was used would be documented in the Journal. Other documentation would include the design software used (including version number), particular software settings, and other information that would help a downstream user of the data understand how it was created.

Important data that should also be contained in the Journal include:

- All information necessary for the regeneration or use of those files by subsequent customers of the CAD/D data
- Document the design data, controlling alignment and profile names and geometry input/output files, relevant survey information, cross sections and the methodology used to obtain the final geometric controls in the CAD/D product.

NHDOT has not established a specific format for the Journal file. The sample file shown on the following pages should be used a guideline for the type of information to be included and format that is expected.

The project journal must be kept up to date as the CAD/D design work progresses and be delivered with the project on the preferred media for archival purposes.

SAMPLE CAD/D PROJECT JOURNAL

CAD/D PROJECT JOURNAL

(12345_project_index.doc)
4/13/00

PROJECT JOURNAL

This file contains information about the project 12345 and the corresponding electronic files contained in the **project directory**. This file should be kept up to date and archived with the project's electronic files. When filling in the required information, please delete the instructions and examples in order to maintain a concise record.

PROJECT DESCRIPTION

State Project Number: 12345
Federal Aid Number: N/A
County: Merrimack
Project Manager: Project Manager
Project Designer: Project Designer
Project Directory: N:\CADD\pbt\town\12345\cadd\prj

SCOPE OF WORK

The scope of work for project 12345 goes here. Include as much detail as necessary to define the work done for the project.

PROJECT FILES

List any files that do not fit into the standard naming convention. Include a brief description of the data contained in each one.

MICROSTATION FILE INFORMATION

Seed File Used for this Project: nhseedft.dgn, nhseedf2.dgn, nhseedm.dgn, nhseedm2.dgn (select one, delete the rest)

Non-Standard Drawings

List any drawings that are not on the standard naming convention list with a brief description of each one's contents.

Plot Information

List information about batch print specifications, pen tables, or other features used to generate the print files.

MX FILE INFORMATION
(or information for other design programs used)

MX Topo input file: topo.inp

Preliminary Design Engineer: Your Name

Final Design Team Leader: Team Leader

MX Design Input File Names	Description
pdesign-mc0m.inp	The file that creates the alignment MC0M and design strings up to and including the interface stage.
psectmc0m.inp	Creates the old ground and proposed cross-sections for alignment MC0M

MX Design Output File Names	Description
Topo.prn	Output from Topo.inp – Reports assigned string labels and errors. Contains X, Y, Z coordinates of the survey points.
Triangles.prn	Output from Triangles.inp – Reports crossing strings, minimum and maximum elevations and plan area.
Sprofiles.prn	Output from Sprofiles.inp – Reports x,y,z coordinates of each survey alignment.

Ssections.prn	Output from Ssections.inp – Reports string assignments as well as point and offset information for each survey alignment.

TEXT FILES

Include information about output files, genio files, or other ASCII files provided with the project drawings.

NON-STANDARD MODEL NAMES

Include information about any models that do not conform to standard naming conventions. These could be models developed as study alternatives or other special uses.

SPECIAL INFORMATION/COMMENTS

Include any information about special considerations or problems discovered during the design process.

MAIN LINE – "Main Street (NH 25)"

Survey (Plan Prep)
Master Alignment Model: SALIGN
Master Alignment Name: . MC1S
Triangle Model:..... Triangles
Triangle String:..... TX00
Cross Section Model:..... SSECTMC1S

Preliminary Design
Master Alignment Name: . MC1M
Master Alignment Model: PALIGN
Design Model:..... PDESIGN MC1M
Proposed Triangle Model:
Proposed Triangle String: .
Cross Section Model:..... PDESIGN MC1M SECTIONS

Final Design
Master Alignment Name: .
Master Alignment Model:
Design Model:.....
Proposed Triangle Model:
Proposed Triangle String: .
Cross Section Model:.....

SIDE ROAD – "Pleasant Street"

Survey (Plan Prep)
Master Alignment Model: SALIGN
Master Alignment Name: . MC2S
Triangle String:..... TX00
Cross Section Model:..... SSECTMC2S

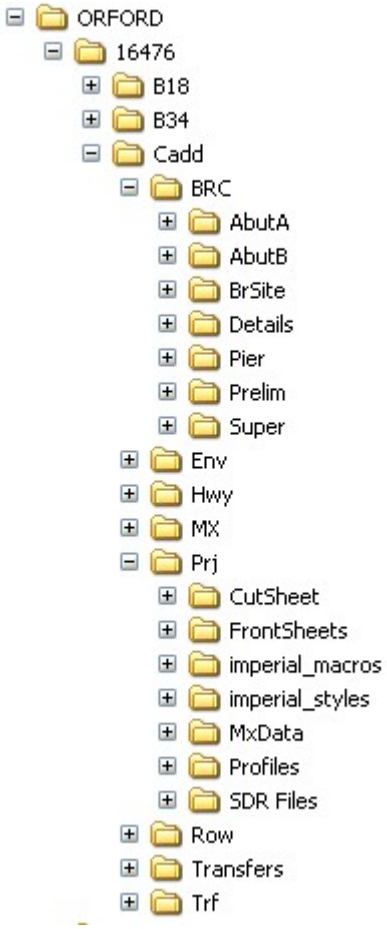
Preliminary Design
Master Alignment Name: . MC2A
Master Alignment Model: PALIGN
Design Model:..... PDESIGN MC2A
Proposed Triangle Model:
Proposed Triangle String: .
Cross Section Model:..... PDESIGN MC2A SECTIONS

Final Design
Master Alignment Name: .
Master Alignment Model:
Design Model:.....
Proposed Triangle Model:
Proposed Triangle String: .
Cross Section Model:.....

Cross-Section Settings File (CSU)	**Description**
mc1m.csu	Cross sections for Main St. including drives and skewed sections.
mc1m_all.csu	Cross-sections for Main St. cut at every point on the alignment for drainage study.
mc2a.csu	Cross sections for Pleasant St. including drives and skewed sections.

DIRECTORY STRUCTURE

The standard directory structure being used for CAD/D projects within NHDOT is shown below: Directory and file names will only contain alphanumeric characters and underscores ("_"). No spaces will be included in names.



CAD/D files are stored in directories under the *Cadd* folder.
Files that are used with MicroStation or by multiple bureaus are stored in the *Prj* folder.
Files that are used with MX v8i are stored in the *MX* folder.
The following folders will contain files that are only pertinent to that particular bureau:

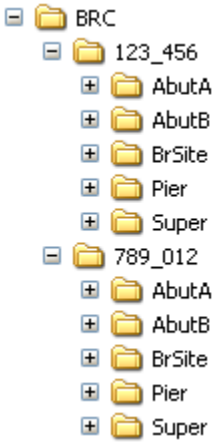
BRC – Bridge Design
Env – Environment
Hwy – Highway Design
Row – Right of Way
Trf – Traffic

The BRC folder contains the following subdirectories:

AbutA - Detail plans depicting Abutment A footing, masonry, and reinforcing.
AbutB - Detail plans depicting Abutment B footing, masonry, and reinforcing.
BrSite - General Plan, Site Plan, notes, and boring logs.
Details - Miscellaneous details, for example Bridge and Approach Rail.
Pier - Detail plans depicting Pier footing, masonry, and reinforcing.
Prelim - Preliminary Plans. After preliminary plans are accepted, pdf files of the Genplan & Siteplan drawings are created. Other drawings are copied into this directory and renamed.
Super - Superstructure details.

The *CutSheet* folder under *Prj* is where Highway Design's final contract plan DGN files will be stored. Front sheets are stored in the *FrontSheet* folder under *Prj*. Bridge Design contract plan files are stored in the various Bridge directories.

The *imperial_macros, imperial_styles* and the *MxData* folders under *MX* are created by MX. The *imperial_macros* and *imperial_styles* store project specific macros and style sets. *MXData* is used to store miscellaneous MX files.



If there are multiple bridges on a project, the BRC directory structure is typically modified so that drawings for each bridge are kept separate. The subdirectories under BRC can be named for the feature being crossed or in cases where the same feature is crossed multiple times, the bridge number as shown here.

PART III – MICROSTATION

MICROSTATION WORKSPACE

Through a collaborative effort, the NHDOT has made available a spreadsheet (nhdotdownloads.xls) to clarify how to best and most easily utilize the files provided for download on the DOT's website. The spreadsheet and associated readme files found in nhdot-msv8i-workspace.zip should provide the information necessary to duplicate the intent of the MicroStation workspace used at NHDOT. This will aid the consultant in producing plans that meet the expectations laid out in the Department's "CAD/D PROCEDURES AND REQUIREMENTS" document with minimal interference to a site's established workspace.

FILE NAMING

An attempt shall be made to have MicroStation files named using only an eight character file name with a .DGN extension. However, it is understood that this will not always be possible or preferable. Drawing names will only contain alphanumeric characters, "-", and "_". No spaces or other special characters shall be used. See Appendix A - MicroStation Drawing Names beginning on page 45 for more details.

LEVEL ASSIGNMENTS AND SYMBOLOGY

The files mentioned in this section are available on the CAD/D website or can be requested through the Project Manager. The website address is listed in the *DOCUMENTATION* section on page 9.

Level library files contain level names and color/weight/style information for MicroStation .DGNs. For Highway Design there are level library files available for most detail drawings. These files have the same 3-character name as the drawing with a .csv extension. For example, the level naming file for drawing *12345exd.dgn* will be *exd.csv*.

There are two *.CSV files to be utilized when creating .DGNs for the Bureau of Bridge Design. The first file is called *brc.csv*, and stands for BRidge Cut-sheet. It contains the names required to accurately place graphical elements on a cut sheet (also referred to as a detail sheet). The second file, called *brd.csv*, contains the names required to place graphical elements in a .DGN at project coordinates. Many of the names in *brd.csv* are required in order to convert elements to MX from MicroStation.

Level standards for front sheets is fsh.csv, and for all other cut sheets is the *bxx.csv*. Filters for displaying borders are included in *BorderFilters.dgnlib*.

Standard plan drawings are maintained by the CAD/D Section and were revised and approved on 7/29/2010. They are available on the NHDOT website (www.nh.gov/dot → Doing Business with DOT → Engineers/Consultants → Standard Plans for Road Construction). Symbol sheets can also be found on the NHDOT website (www.nh.gov/dot → Doing Business with DOT → Engineers/Consultants → Detail Sheets – Highway Design)

Line weights, styles and text heights shall conform to the NHDOT level mapping located on the NHDOT CAD/D website. Use of NHDOT-defined MicroStation line styles is required. The consultant, with the approval of the Project Manager, may create symbols that are not covered in the NHDOT Design Manual or contained in NHDOT cell libraries that are needed to complete project plans. Resource files containing any linestyles and/or symbols created by the consultant for use on the project drawings will be provided to NHDOT.

MicroStation symbols, including standard borders, are contained in NHDOT's standard cell libraries and are available in MicroStation .CEL file format. A standard color table, line style resource files with NHDOT line styles and font library with NHDOT fonts for use with MicroStation are available for download.

REFERENCE FILE ATTACHMENTS

A reference file is a MicroStation drawing or other CAD/D file attached as a background to an active design file, thus allowing several design groups to share the same information without the need to copy the file(s). MicroStation and MX v8i can attach a reference file by one of three different ways:

1. Name only – the path to the referenced file is resolved by the MicroStation configuration variable MS_RFDIR.
2. Relative path – the reference file name and its location relative to the master file.
3. URL address – the file is attached in the form of a URL address using relative paths.

In order for a project to be delivered to NHDOT in an electronic format that will allow future use of the files for printing purposes without modification to the files, the reference files must be attached in a way that will allow MicroStation or MX v8i to resolve the reference file attachment paths regardless of the drive or parent directory of the project. Option 1 above is the preferred method for NHDOT projects, since it allows the files to be moved from drive to drive without losing the reference file attachments. However, this option requires the MicroStation configuration variable, MS_RFDIR, be set for all NHDOT projects.

SEED FILES

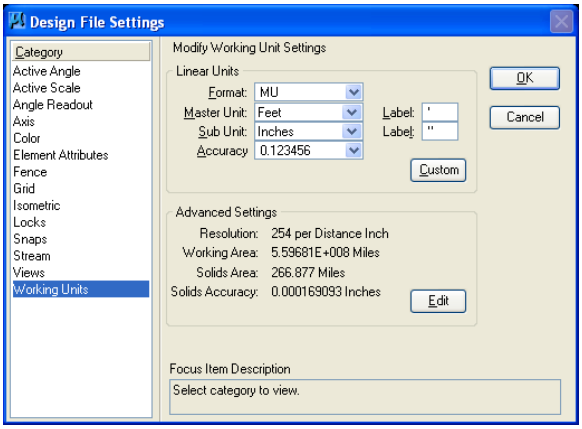
MicroStation uses "seed" files to create all design files. These seed files are templates in which standard parameters are set according to what is needed to begin drafting for a specific type of work in accordance with NHDOT standards. Seed files allow the user to begin work in a standard format and maintain uniformity. The seed file defines the working units for the file, global origin, coordinate system, view attributes, default color table, text settings, coordinate readout and several other important parameters. NHDOT supplies seed files for both 2-D and 3-D drawings.

By default, NHDOT design teams are working with 2-D MicroStation drawings. If a consultant prefers to use 3-D MicroStation drawings, this should be mentioned prior to obtaining survey or design data from the Department.

Two of the most important settings in the seed file are the working units and global origin. Working units are expressed as master units and fractional sub-units. The number of positional units per sub-unit is called the working resolution. The working resolution determines the precision to which elements are drawn. The format for the working units in MicroStation is defined as MU:SU (master units, sub-units).

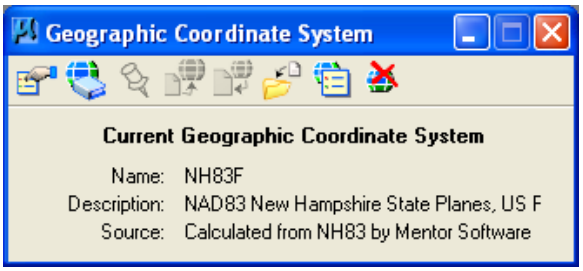
IMPERIAL 2D SEED FILE (NHSEEDF2.DGN)

Working Units:
Master Units = ft
Sub-Units = inches
Global Origin: X= 500
Y= 500
Resolution 254/inch



IMPERIAL 3D SEED FILE (NHSEEDFT.DGN)

Working Units:
Master Units = ft
Sub-Units = inches
Global Origin: X= 500
Y= 500
Z= 10,000
Resolution 254/inch



The global origin has been set at 500, 500, 10000 using the NAD83 New Hampshire State Plane coordinate system. Using these coordinates, the seed files can be used for both drawings based at State Plane Coordinates and drawings, such as cross-sections, profiles, typicals and special details, using a local coordinate base. The 10,000 unit offset allows MX data with null elevations to be transferred properly.

To reset the global origin for a drawing file, enter the key-in GO=-500,-500,-10000 and use the right mouse button to issue a "reset" command.

FONTS

MicroStation font resource files are binary files created from font cells, TrueType, Postscript, or AutoCAD SHX fonts. MicroStation will read multiple font resource files according to the paths set by the MS_SYMBRSC configuration variable in the selected workspace. However, within MicroStation they are compiled into a list of all the fonts from all the resource files that were found. If one file contains a font with the same number assigned as another font resource file, the user will see the last one located.

The NHDOT font resource files are called *nh-custom-font.rsc* & *nhttfont.rsc*. Any fonts within the NHDOT resource files that are no longer in use will be maintained for backward compatibility purposes. The fonts contained within the NHDOT resource files are described below. Font numbers below 170 are reserved for standard MicroStation fonts.

NH-CUSTOM-FONT.RSC

Font	Description
180	nh_engineering (Engineering w/bridge and drafting symbols) Non-alphanumeric characters contained within this font are pictured in *APPENDIX C - NHDOT CUSTOM LINESTYLES & FONT* on page 51.

The following information is only included for historical reference. Project drawings should use the Windows true-type fonts instead of the MicroStation fonts listed below.

NHTTFONT.RSC

Font	Description
170	True Type font Arial
171	True Type font Arial Bold
173	True Type font Courier
174	True Type font Courier Bold
176	True Type font Times New Roman
177	True Type font Times New Roman Bold
182	True Type font Comic Sans
183	True Type font Comic Sans Bold

TEXT HEIGHT AND SPACING

Standard text heights and fonts have been defined to ensure uniformity and legibility on all CAD/D drawings. The correct text height is shown on the level mapping table and is dependent on the plot scale. Note that the text height listed represents both the text height and width. Since, the most important issue with text is that it should be legible, font and text height may vary if absolutely necessary. Text line spacing varies between half of the text height and the text height depending on the use.

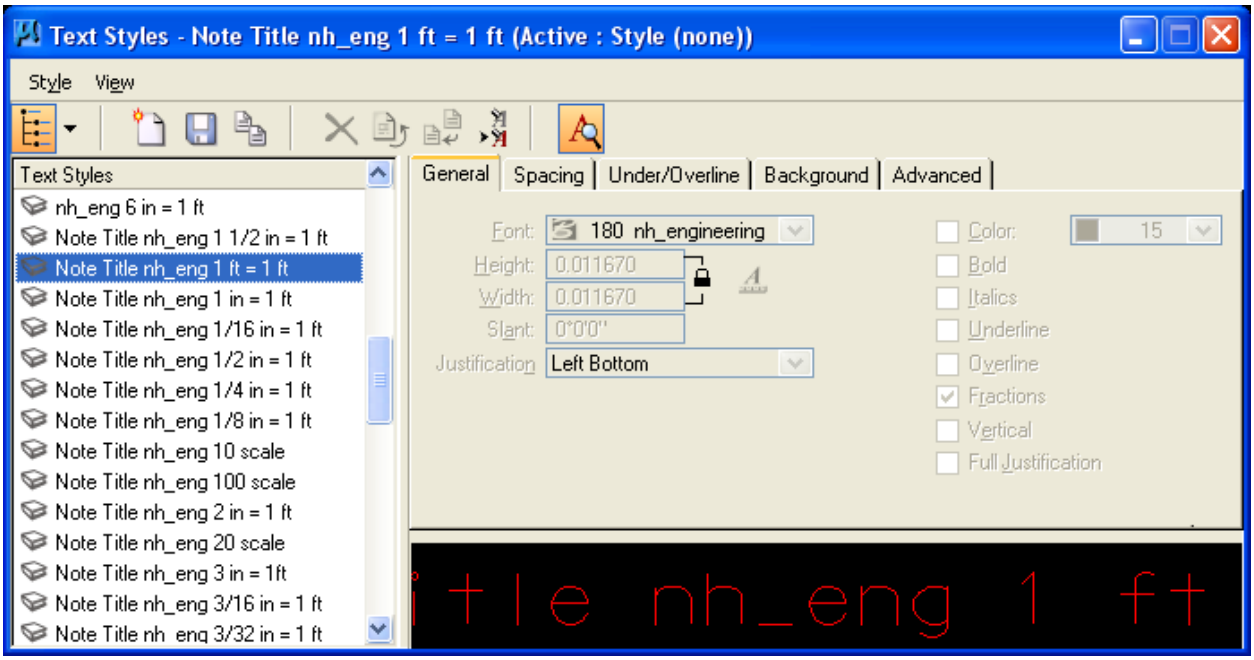
TEXT STYLES

For bridge drawings, text styles are available at various engineering and architectural scales. The styles are located within nhdotTextandDimStyleLibraryFT.dgnlib (Imperial).

These dgnlib's should be defined by the MS_DGNLIBLIST variable. The style names include the intended purpose of the text and the scale of the drawings they will be used on.

nh_eng	Used for note and detail text
Title nh_eng	Used for detail title text
Note Title nh_eng	Used for a smaller or sub-title text

Dimension and text style libraries used by Bridge Design are available on the NHDOT CAD/D website.



LINE STYLES

Line style is part of the symbology of graphical elements in MicroStation. An element can be set to the standard MicroStation line styles (numbered 0 - 7) or to a custom line style defined in a custom line style resource file. Custom line styles are user definable resource files for the display of different patterns, for example, a tree line, fence line, guardrail, etc. When an element is drawn in MicroStation with a custom line style, the definition of the line style is not contained within the design file. The resource file from which it was selected must be packaged with the design file and it must be found by MicroStation's configuration in order to properly display the line. Therefore, users are strongly discouraged from creating their own custom line styles. Use the NHDOT supplied custom line style resources whenever practical. Graphical depictions of NHDOT MicroStation linestyles are shown in *APPENDIX C - NHDOT CUSTOM LINESTYLES & FONT* on page 51.

NHDOT CUSTOM LINE STYLE RESOURCE FILES

Standard NHDOT Custom line style files
line-ft.rsc
pipe-ft.rsc

As mentioned above, custom line styles are user definable in MicroStation. NHDOT linestyles are created at two different scales (1:1 and 1”=50’) depending on the intended use. These settings are included in the task menus. The task menus are described in more detail in *DRAWING QUALITY ASSURANCE / QUALITY CONTROL* on page 35.

Caution must be exercised as the definition for the line style is maintained in a resource file and a design file only contains links to custom line style resource files. If a new (non-standard) custom linestyle is developed by a user, those resource files must be delivered with the project. Users shall not modify the NHDOT delivered standard custom line style files.

TRUE SIZE LINESTYLES

Linestyles that are defined to be a specific size (such as pipe and railroad styles) should always be drawn at a scale of 1. Styles in this group include:

BmGrDbl
BmGrLt
BmGrRt
CblGrLt
CblGrRt
CblGrMed
CurbLt
CurbRt
DrainPipe
JerseyBarrier
PCurbLt
PCurbRt
Pavemark
PipeE#
PipeP#
Railroad
SheetPile
TrafBarls
UnderDrain
XPipE#
XPipP#

SCALED LINESTYLES

Linestyles for plan drawings have been created for use on a 1”=50' scale Imperial drawing. This includes most of the linestyles available. When these linestyles are used on 1"=20' Imperial drawings, they should be scaled by 0.4. Charts showing scale values for other drawing scales are shown below.

CUSTOM LINESTYLE SCALING CHARTS

Imperial

Scale for plotting	Ratio	Custom linestyle scale setting
1”=1”	1:1	0.0016
6”=1'	1:2	0.003
3”=1'	1:4	0.006
2”=1'	1:6	0.01
11/2” = 1'	1:8	0.013
1” = 1'	1:12	0.02
3/4” = 1'	1:16	0.026
1/2” = 1'	1:24	0.04
3/8” = 1'	1:32	0.053
1/4” = 1'	1:48	0.08
1" = 5'	1:60	0.1
3/16” = 1'	1:64	0.1066
1/8” = 1'	1:96	0.16
1” = 10'	1:120	0.2
3/32” = 1'	1:128	0.2135
1/16” = 1'	1:192	0.32
1” = 20'	1:240	0.4
1” = 30'	1:360	0.6
1” = 50'	1:600	1
1” = 100'	1:1200	2

LINESTYLES CREATED AT 1:1

The *line-ft.rsc* file also contains custom line styles created at a scale of 1:1. In order for these lines to be properly proportioned, the user must enter the scale associated with the plot size of the drawing in the Line Styles dialog box for custom line styles before placing the line. The line styles for which this rule applies include:

ArBegOpn	BreakBr	LeaderBr
ArBegSld	BreakDimBr	LedgeBr
ArEndOpn	DimBr	RocklineBr
ArEndSld	GroundBr	
ArrowBr	ITS-Prop	

There are multiple ways to alter the scale of linestyles on a drawing. To set the scale, select *Element* → *Line Style* → *Custom*. Select the linestyle, check the "*Scale factor*" box and enter the desired scale. Click on the graphic representation of the linestyle to implement the change. An alternative way is to issue the key-in *dwg celtscale #* where the # is replaced with the desired scale. Future lines will be drawn at the new scale. To alter the scale of linestyles that have already been drawn, select all the elements to be changed. Issue the *Change Linestyle Scale #* key-in replacing the # with the desired scale.

COLOR TABLE

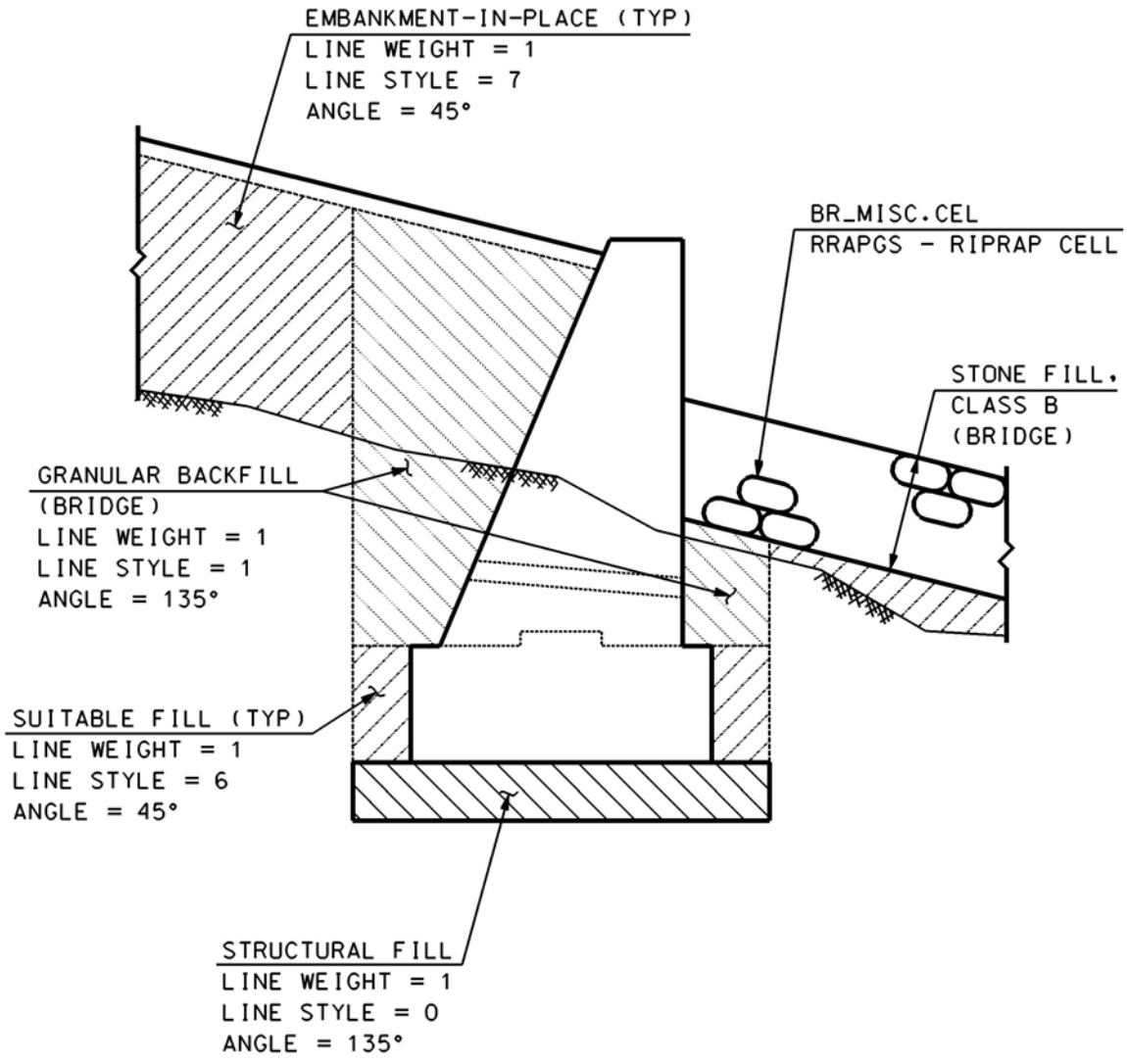
A standard color table is necessary to provide visual consistency thus allowing users to easily identify elements in shared files and for consistency in color plotting. NHDOT has its own default color table called nh-color.tbl. The table defines 256 colors from which an active color can be selected and applied to an element. NHDOT's black and white plotters are configured to print all colors except 10-14 in black. Colors 10-14 will plot in the shades of gray displayed in MicroStation.

CROSS HATCHING

Cross-hatching used by Bridge Design is shown on the next page.

	Hatch spacing	
Architect	in	ft
1/16" = 1'-0"	24	2.00
3/32" = 1'-0"	16	1.33
1/8" = 1'-0"	12	1.00
3/16" = 1'-0"	8	0.67
1/4" = 1'-0"	6	0.50
3/8" = 1'-0"	4	0.33
1/2" = 1'-0"	3	0.25
3/4" = 1'-0"	2	0.17
1" = 1'-0"	1.5	0.13
1.5" = 1'-0"	1	0.08
2" = 1'-0"	0.75	0.06
3" = 1'-0"	0.5	0.04
6" = 1'-0"	0.25	0.02
12" = 1'-0"	0.125	0.01

Highway	in	ft
1" = 100'	150	12.50
1" = 50'	75	6.25
1" = 30'	45	3.75
1" = 20'	30	2.50
1" = 10'	15	1.25



BRIDGE DESIGN
TYPICAL HATCHING

SCALE: $^{3}/_{8}$" = 1'-0"

CELL FILES

The following graphic cell files have been created for use on NHDOT projects. Items shown in *italics* have been added since the previous edition.

alignment.cel	*symbols for alignment transfers and ms tasks*
borders.cel	cut sheet borders (including front sheets, ROW summary, property layout and xsection borders and their text cells)
br_Borders.cel	miscellaneous bridge borders
br_bore.cel	boring sheet symbols
br_Misc.cel	rip-rap, slope lines, waterstops, sheet piles, section A-A, North arrow, shear connector, & RR section
br_pile.cel	HP sections and Pile Key
br_precast.cel	New England Bulb Tees (precast concrete beams)
br_Rail.cel	2 bar, 3 bar aluminum and T2,3,4 steel bridge and approach rails
br_Railmisc.cel	existing/superseded, temporary, and Texas 101 bridge and approach rails
br_weld.cel	weld symbols
drainage.cel	proposed drainage detail cells
environ.cel	environmental detail cells
exist-in.cel	existing topography cells
geotech.cel	*geotechnical cells*
grdrail.cel	proposed guardrail detail cells
legends.cel	hearing plan legends
logos.cel	NHDOT and other logos
notes.cel	project begin/end notes
pavemark.cel	proposed pavement marking detail cells
profile.cel	cells for profile drawings
row.cel	proposed right-of-way detail cells
signals.cel	proposed signalization detail cells
signs.cel	proposed sign detail cells
stamps.cel	miscellaneous roll/plan sheet cells
StnOffset.cel	Station–Offset macro cells
turnrad.cel	Imperial turning radii templates
utility.cel	proposed utility detail cells
xsect.cel	cross-section detail cells

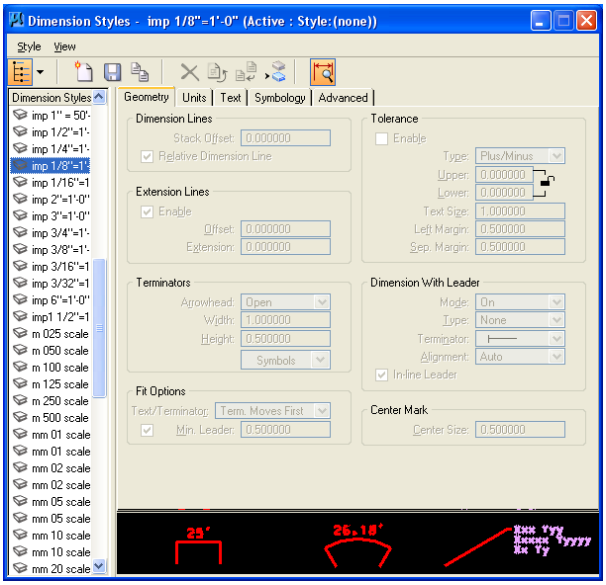
The following pattern cell file has been created for use on NHDOT projects.

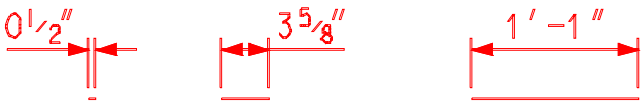
nhpatern.cel	hearing plan removal patterns

Cells from Bentley's archpa.cel may also be used.

DIMENSIONING

Dimensions should appear as shown in the Highway Design Manual with the following exception: The dimensions for Bridge detail drawings shall be placed to have the appearance of those that follow:



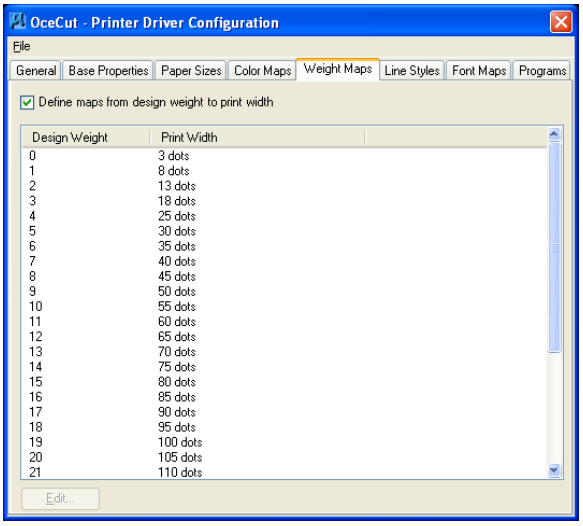


The use of Dimension Styles is strongly encouraged for the placement of all dimensions on structural design drawings, since, at a minimum, it will select the proper text height. It is understood that in order to achieve the dimension appearances shown above, the Dimension Style defaults will, at times, need to be overridden.

Dimension style names reflect the scale.

Dimension and text style libraries are available on the NHDOT CAD/D web site.

PLOTTING



The plotter configuration file (file extension .PLTCFG) is used to set default plotter settings. Black and white plot configuration files have been modified to force all pen colors to black except pens 10-14 which are defined as various shades of gray in the NHDOT color table. Line weights for full size plotters are as indicated in the graphic.

Plotter driver files should be edited for plotter specific adjustments only. Changes intended to affect all plots should be made in the pen tables.

BATCH PRINT/PRINT ORGANIZER

To plot cut sheets, a rectangular element drawn on level Border and in color 84, style 0, weight 0 has been placed at the outer edge of NHDOT border cells. Batch Print looks for these elements when plotting cut sheets. When developing CAD/D drawings, elements of this color, style and weight should be avoided unless an element defining a batch print limit is being created. A print style BorderLevelandColor was created for Print Organizer to use this same element.

PEN TABLES

A pen table is used to alter the way a drawing is sent to the plotter. It can be used to control the levels that are plotted, control the order in which they are plotted, make text substitutions, or run macros at plot time. NHDOT uses a pen table called nhdot-pen.tbl to make a number of text substitutions in plan borders and front sheets. The variables that are substituted are typically defined in the project control file (pcf). Currently defined substitutions include:

Drawing text	Text substitution	Description
$PROJCLASS$	$(PROJCLASS)	Project class
$STNO$	$(STNO)	State project number
$SCALE$	$(NH_SCALE)	Project scale
$FEDNO$	$(FEDNO)	Federal project number
$NHPROJ$	$(NHPROJ)	"N.H. PROJECT NO. 12345"
$ROUTENO$	$(ROUTENO)	Route number or road name
$CSHTOT$	$(CSHTOT)	Total number of construction plan sheets
$LSHTOT$	$(LSHTOT)	
$MRSHTOT$	$(MRSHTOT)	Total number of Materials & Research plan sheets
$RSHTOT$	$(RSHTOT)	Total number of right-of-way plan sheets
$SSHTOT$	$(SSHTOT)	Total number of shoreland plan sheets
$WSHTOT$	$(WSHTOT)	Total number of wetland plan sheets
BT	$(BT)	Total number of bridge sheets
PBT	$(PBT)	Total number of preliminary bridge sheets
$BRNO$	$(BRNO)	Bridge inventory number
$BRDESCR$	$(BRDESCR)	Bridge description (road over feature crossed)
$BRFILNO$	$(BRFILNO)	Bridge file number
$BRDIR$	$(lastdirpiece(_DGNFILE))	Bridge directory
$TIME$	_TIME_	Current time
$FILE$	_FILE_	DGN file name
$USER$	$(_USTN_USERNAME)	User name
$DATE$	_DATE_	Current date
$FILENAME$	$(basename(_DGNFILE))	DGN file name without directory path
$ROWTOWN$	$(ROWTOWN)	"TOWN OF ---------"
$COUNTY$	$(COUNTY)	County name
$TOWN$	$(TOWN)	Project Name (Town)
$MODELNAME$	_MODELNAME_	Model name
$REVNUM$	$(REVNUM)	Right-of-Way plan revision number
$REVDATE$	$(REVDATE)	Right-of-Way plan revision date
$PROJNAMENUM$	$(PROJNAMENUM)	identifier for Project Explorer to find V:/ project

PART IV – MX

FILE NAMING

MX files should be named in such a way that someone unfamiliar with the project can figure out what the file is for. MX projects are typically given names beginning with the town name followed by the state project number. For example: *Concord 12345.mmd*. Other file types are listed in the table below.

Type	Extension	Description
Input	.INP	Used to store line mode commands to create or modify MX strings
Output	.PRN	Used to store the results of an input file or interactive commands
Draw	.DRW	An input file that is used to create a display using a drawing macro or major option DRAW and/or ENHANCE commands
Journal	.JOU	A journal file stores commands issued during an MX session so they can be rerun at a later time

MODEL NAMING

Suggested MX model names are listed in *APPENDIX D – MX MODEL NAMING CONVENTION*, on page 55. Any variations from this convention shall be noted in the project journal file.

STRING LABELING

MX data is contained in strings and the strings are contained in models. Each string has a unique four-character label. Typically the first two characters of the string label are used to identify the type of string. NHDOT's string labeling convention can be found in the MX section of the CAD/D website at the address listed in the *DOCUMENTATION* section on page 9.

STYLE SETS

A style set is a collection of styles which is used to draw a complete model or a selected part of it. Beginning with MX v8i, style set references to MX macro symbols and macro lines have been replaced with MicroStation cell and linestyle references. NHDOT style and features sets are stored on the network in MX's Public folder so they are accessible to all users. This eliminates the need to upgrade each workstation when changes are made.

FEATURE SETS

Feature sets are a means of grouping strings and identifying them with a description. They are used throughout MX to make it easier to select strings for subsequent operations. The strings belonging to a feature set are specified using a partial string name, and are drawn with a style set (usually having the same name as the feature set). For design detail, NHDOT uses a modified version of *mxroad.fns* to conform to MX design wizards. When transferring detail between MX and MicroStation, be aware that MicroStation elements are drawn based on the model's default style set. This should be the same style set that was used to draw the MX DPW/DPF.

NHDOT Developed Style sets for MX drawings

Style Sets	Feature Sets	Description
brd8.pss	brd8.fns	Used to transfer proposed bridge structure strings between MX and MicroStation.
catchment.pss	catchment.fns	Used to transfer drainage catchment models.
ctr8.pss	ctr8.fns	Used to draw and transfer contours.
env8.pss	env8.fns	Used to draw and transfer environmental features.
erl.pss	erl.fns	Used to draw and transfer existing Right-of-Way detail.
exd.pss	exd.fns	Used to draw existing and aerial survey detail in MX 2.6 that will become MicroStation v8i detail drawings. This style set is used to create the project's EXD and AIR dgn files.
mxroad.pss	mxroad.fns	Used for MX design options. Used to draw alignments. Alignments to be transferred to MicroStation are drawn with the *NHAlign* add-in. See the CAD/D website for more details.
ply8.pss	ply8.fns	Used to draw and transfer proposed roadway detail.
prw8.pss	prw8.fns	Used to transfer proposed Right-of-Way strings between MX and MicroStation.
pvm8.pss	pvm8.fns	Used to draw proposed pavement design.
trav.pss	trav.fns	Used to draw survey traverses.
xsu.pss	xsu.fns	To be set as the model default for cross section models. Cross sections to be transferred to MicroStation are drawn with the XS-MS macro.

DRAWING MACROS

In addition to the style and feature sets mentioned above, MX users can also draw detail and sections with drawing macros. A number of these macros have been developed and are available for download from the NHDOT website.

CROSS-SECTION SETTINGS FILES

Cross sections and profiles can be generated in a number of different ways. Using the cross-section wizard within MX allows the user to save parameters defining the cross-section set. These saved settings files have a .CSU extension and are stored in the project directory. The settings file will define the type of sections cut (based on the cross-section feature set used), models selected, and information about any special stations or skewed sections. By default, the cross-section wizard uses the information in the cross section model's default style set to determine the different types of cross-sections. String labels for cross sections are listed in *APPENDIX F – CROSS SECTION SET LABELS* on page 63. For NHDOT projects, the default cross-section style set and feature set are listed in the table on the previous page.

MACRO SYMBOLS & LINES

Symbols for use with versions of MX software before v8i, including standard line patterning symbols, are available in the MX .MMS and .MML file formats. These MX symbols and lines are being phased out in favor of MicroStation cells and lines in the MX v8i style sets. This data is available on the NHDOT website or can be requested through the Project Manager.

ADD-INS

MX Add-Ins are applications such as Visual Basic programs that can interact with MX. NHDOT has developed a number of these programs to simplify some operations. These programs are available on the CAD/D website.

CONREPO	Used to generate an output file of string points from a specified model. This report is commonly used to provide 3 dimensional string information to non-MX consultants.
Data Import	For importing GPS data or other delimited/formatted text files into MX.
NHAlign-v8i	Used to create an alignment drawing that can be transferred to MicroStation. Improved to handle spiral curves.
NHAliReport	Used to create a formatted report of an MX alignment. This report can also be used to plot curve data on a MicroStation alignment.
NHDraper	Used to add elevations to one or more strings in a model
NHProfile	Used to draw existing and proposed profiles that can be transferred to MicroStation.
PointScan	Used to create a report of project features referenced by station and offset.
RenameM	Used to rename Master Alignment strings It eliminates the need to address it's Sub-reference, the Geometry string, and it's Sub-reference.
XSDetail	Used to create section sets representing detail symbols plotted on cross-sections. For best results, cross-sections created with this program should be drawn with the XS-MS drawing macro.

PART V – PROCEDURES

INTRODUCTION

This section offers summaries of some NHDOT CAD/D procedures. It is not intended to provide an in-depth discussion of any particular topic. For more details, refer to the CAD/D website.

EXCHANGING RIGHT-OF-WAY DATA

Right-of-way data is routinely updated during the project's lifetime. This information is typically maintained by the NHDOT Bureau of Right-Of-Way for both in-house and Consultant-designed projects. Knowing that DOT staff and Consultants both need to work on the existing right-of-way drawings, a process has been developed to ensure that this data is kept current and accurate.

The existing right-of-way information will be divided between two drawings. One contains the line work (ERL) and the other will have the text information (ERT). It is intended that the Department will maintain the master ERL drawing (abstracting) and send the consultant a copy when updates have been made.

The Bureau of Right-Of-Way will continue to utilize Design History and that record will be maintained throughout the life of the project. This is in line with how business was conducted when the process included the ROW Abstracting mylar. The Bureau of Right-Of-Way will continue business as usual with the ability to make changes at any time during the design process with the understanding that the NHDOT Consultant Reviewer will be notified when changes have been made.

The process shall be:

- ERT and ERL drawings are created by the Bureau of Right-Of-Way and Design History is turned on. Under normal circumstances, only the NHDOT Bureau of Right-Of-Way should be making changes to the ERL drawing.
- The Consultant receives a copy of the ERT drawing. At their discretion, the Consultant is free to adjust text position or make other cosmetic changes to improve appearance of the drawings.
    - Updates to parcel ownerships made by the NHDOT abstractors are revised on the ERT drawing and a copy of the updated ERT drawing is sent to the Consultant. The Consultant will be responsible for updating their copy of the ERT drawing. Design History can be used to highlight changes and text revisions made to the ERT drawing by NHDOT staff.
- The Consultant also receives a copy of the ERL drawing which is referenced into other drawings (Not copied or merged).
    - Updates to property lines, ROW lines, easement lines etc. are made to the ERL.dgn by NHDOT Bureau of Right-Of-Way staff and a copy is sent to the Consultant. The revised ERL.dgn supercedes all previous versions.
    - Updates to the ERL.dgn can be reviewed using the Design History to identify changes and impacts to the property line and ROW line locations

- Right-of-way data is submitted in both paper and DGN format to NHDOT Bureau of Right of Way for review and approval prior to the production of recordable mylars.

LEGACY ALIGNMENTS

Prior to the implementation of a CAD/D system in the 1980's, it was customary to show alignments of former projects on plan drawings as a reference between the old and new projects. Computer-aided design, electronic survey equipment and advancement in GPS technology eliminated the need to reference former alignments when creating new ones. As a result, former project data was no longer shown on the plan drawings.

The Bureau of Right-of-Way has expressed a need to reference this historical information to facilitate the locating of right-of-way boundaries that were laid out during these former projects. To assist this process, future projects are to include information about these "legacy" alignments. Whenever possible, this information should also be added to current projects.

The process includes:

- Researching former projects to identify those within the limits of the current project. On consultant projects, the Bureau of Right-of-Way will do the research.
- Obtaining alignment information from the as-built plans.
- Drafting that information onto the alignment drawing of the current project.

ROLL PLANS

Project "roll-plan" file names are composed of three parts; the NHDOT state project number (first five characters), drawing type (last three characters), and the .DGN file extension.

A further explanation of standard naming conventions and drawing type designators used by NHDOT is contained in *APPENDIX A - MICROSTATION DRAWING NAMES* beginning on page 45.

CUT SHEETS

The Highway Design group at NHDOT presently uses a method for preparing cut sheets where a single drawing is created for an entire set of drawings (general plans, drainage plans, etc.) with each sheet stored in a different model within the drawing file.

The drawing file names will be the project number followed by the type of drawing such as 12345genplans.dgn for the general plans of project #12345. Within this file there will be models for each individual sheet using the naming convention outlined in the following table. For example, the model for the first general plan sheet will be called GEN01.

For more details of the processes for developing cut sheets, see the documentation on the CAD/D website.

Realizing that there are a number of different ways to accomplish this same task, variations to the method described above may be acceptable with prior approval of NHDOT. Consultants wishing to use an alternative method should contact the CAD/D Development Staff. Any deviations from these formats shall be noted in the Project Journal File. A listing of drawing type designators used by NHDOT is contained in *APPENDIX A - MICROSTATION DRAWING NAMES* beginning on page 45.

CROSS-SECTION DRAWINGS

NHDOT has decided to store MicroStation cross-sections in one or more files each containing a number of cross-sections. This method is compatible with MX and allows for a smaller number of DGN files to be created for the project. The sections are plotted using a batch print option that prints all instances of an element contained within the border cell.

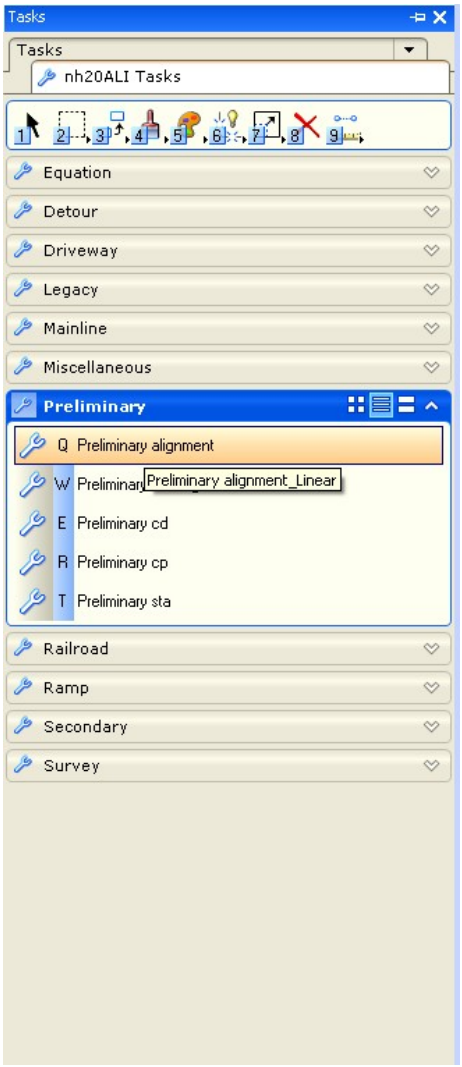
Realizing that there are a number of different ways to accomplish this same task, variations to the method described above may be acceptable with prior approval. Consultants wishing to use an alternative method should contact the CAD/D development staff.

BRIDGE DETAIL SHEETS

A single detail sheet frequently requires the placement of several details of various scales. To accomplish this, all details shall be drawn at a scale of 1:1 while using the NHDOT standard working units defined within the NHDOT seed files. The detail sheet shall be composed by applying scale factors to the self-referenced attachments of the detail drawing. The border of the detail sheet shall be a cell placed on the drawing at a scale of 1. Detail drawings shall not be created by either increasing the scale of the border or by temporarily adjusting the working units of the file, in any way.

PART VI – OTHER PROJECT DATA

DRAWING QUALITY ASSURANCE / QUALITY CONTROL



To aid the consultant and in-house staff in developing a set of contract plans that conform to the requirements contained in this document, NHDOT has developed a series of task menus for working on MicroStation drawings. Using the task menus provided will ensure that elements on the drawings are created according to the established MicroStation standards. At this time, use of the task menus is optional although their use is strongly encouraged.

The task menu system is composed of a collection of dgnlib files. The dgnlib files contain the element templates, tools, and tasks for the particular drawing name. Separate task menus have been created for each of the standard drawing names at both 50-scale and 20-scale. Metric files will be created when necessary. The task menu for 20-scale alignment drawings is shown here. The menu includes sections for the various types of alignments, each containing commands to set the level/color/style for drafting the particular feature.

For NHDOT operators, a macro checks the dgn name and project scale when a drawing is opened to determine the appropriate task list to load. If the dgn name is non-standard the NH50bxx Tasks are loaded assuming the dgn is a cut sheet type of drawing.

PART VII - ENGINEERING CONSULTANT DELIVERABLE REQUIREMENTS

OVERVIEW

The purpose of this section is to establish the minimum acceptable criteria for electronic CAD/D deliverables. Obtaining drawings and ground models in a common format will reduce the amount of time spent becoming familiar with the designs if they are transferred from one designer to another and allows for their reuse in the future.

FILE FORMAT AND DELIVERY

REQUIREMENTS FOR SUBMITTING ELECTRONIC DATA TO NHDOT

All electronic data furnished to the NHDOT shall use the appropriate naming scheme and format for the type of data to be transmitted. It is very important to clearly communicate what is being transmitted and to describe the format of the transmitted files.

A letter is to be attached to **all submissions** stating briefly:

1. File content
2. File Format (zipped, MicroStation, MX, etc. and the utility used)
3. MX and/or MicroStation version
4. Number of CDs, DVDs, etc.
5. Files must be in the proper format before transmitting to NHDOT. **No translating of information by NHDOT personnel shall be required.**
6. If files are zipped or backed up, a brief explanation of the recommended procedure to extract the files should be included.
7. Versions of software must be current to or fully compatible with that of the NHDOT.
8. Each disk submitted shall be labeled and dated with a minimum of the State Project # and date. If a series of CDs/DVDs are transmitted, the disk label shall also include the disk number and the total CDs/DVDs of that set, (ex: 1 of 10). Other subsequent CDs/DVDs shall be labeled so as to uniquely identify each group or set and shall include the sequence number followed by the total number in the group (ex: 2 of 10, 3 of 10, etc.)
9. NHDOT reserves the right to reject any file transmitted that does not conform to these requirements.

DATA SUBMISSION

In addition to hard copy drawings specified by the contract, the consultant shall submit electronic drawing files in MicroStation .DGN file format. Electronic files shall be delivered on one of the following in order of preference:

1) DVD
2) CD-ROM
3) Placed on DOT FTP site[1]
4) Flash drive

The final submission shall include all files necessary to reproduce the cut sheet drawings as well as copies of the original "roll-plan" drawings used to generate the cut sheets. Documentation of procedures and project history shall be maintained in a Project Journal File. An in-depth description of the Project Journal File is in *PART II – GENERAL CAD/D INFORMATION* beginning on page 9. The Project Journal File will be provided with the submission. Any drawings not included in the NHDOT standard drawing list will be identified and will include a description of levels used on each drawing.

Detailed descriptions of the data to be provided by NHDOT to the consultant and expected deliverables at various stages of the project's development are included in the next section, *NHDOT DESIGN PROCESS* on page 40.

If MicroStation tables for linestyles, multilines, level tables, symbology tables, database, special fonts, or any special user defined feature is used, that information must be provided and shall become property of NHDOT. Similarly, any MX macro, symbol, linestyle, style set, or feature set developed by the consultant that is necessary to properly display the project data shall become property of NHDOT. Any MX input file developed to generate, enhance, or alter the project's design that the consultant feels would be beneficial to future designers of the project should also be provided. A name and description of each file must also be provided. NHDOT will not distribute these items to any other individual, consultant or State Transportation Department without prior permission of the developer.

INTERMEDIATE SUBMISSIONS

The consultant shall be prepared to submit sample cut sheet, profile, typical or detail, and/or cross-section sheets for review of conformity to the NHDOT CAD/D specifications at various stages of the project's development. As a minimum, the final design consultant should be prepared to submit electronic project drawings at the Preliminary Plans, Specifications & Estimate (PPS&E) and PS&E stages of the project. Depending on the project, NHDOT may request electronic submissions at a more or less frequent interval.

Since numerous groups work together during the project's design, it is important that everyone uses the same data. Therefore, when changes are made that would affect the design, updated drawings shall be provided to the NHDOT Consultant Reviewer. These, in turn, will be distributed to all affected parties.

[1] The NHDOT ftp site is located at ftp://nhftp.admin.state.nh.us/. Contact your Consultant Reviewer for username and password information.

DEVIATION FROM FORMAT

Any file to be submitted that deviates from the above-mentioned format must have prior NHDOT approval. The approval must be in writing with the name of the individual from NHDOT who permitted the varying format.

MICROSTATION ONLY DELIVERABLE

For projects that were initiated after April 18, 2002, NHDOT will only accept plan drawings that were developed in MicroStation's DGN format. Translations from AutoCAD or any other CAD/D software will no longer be allowed on those projects. Projects initiated before that date will continue to follow the requirements in place at the time the project was initiated. Engineering consultants may, at their discretion, choose to follow a subsequent release of these requirements.

MICROSTATION PLOT FILES (FINAL DESIGN CONSULTANTS ONLY)

In addition to MicroStation format drawings, plot files of project cut sheets in PDF format will be required at the completion of the project. Plot files should be named with the convention for plan sheets outlined Appendix A - MicroStation Drawing Names beginning on page 45 using a .PDF file extension. The purpose of this requirement is to provide a viewable and reproducible copy of the drawing as it existed at the end of the consultant contract.

FILE CONVERSION

This information only applies to projects initiated prior to April 18, 2002.

Translation tables, conversion tables, or special software programs have not been created or standardized for exchanging information between common file formats such as DXF, DWG, ICES, IGES, or software such as AutoCAD, ARCVIEW, ARCINFO, GDS, etc.

MicroStation provides methods for exchanging select file types but data is often modified during the process. The Consultant is solely responsible for any translation and verification required to convert non-MicroStation graphics files to the current NHDOT MicroStation design file format. All translated design files shall conform to the standards adopted by NHDOT for electronic plans and the specifications required in this document. Those files shall be converted to MicroStation and thoroughly reviewed prior to transmitting to NHDOT.

NHDOT DESIGN PROCESS

This section is intended to describe the data that is to be provided when a project moves from one design phase to the next. There are two major transition points where Highway Design CAD/D data needs to be transferred: the turnover from the Plan Preparation Section to Preliminary Design and the one from Preliminary Design to Final Design. The Bridge Design section is responsible for developing the preliminary and/or final plans and, as a result, Bridge Design falls within both the Preliminary and Final Design sections defined below.

PLAN PREPARATION

The Plan Preparation section is responsible for taking project survey and preparing the digital terrain model (DTM) and base drawings that will be used during the design process. They should also be the ones to initiate the Project Journal File described in *PART II – GENERAL CAD/D INFORMATION* beginning on page 9.

By default, NHDOT design teams are working with 2-D drawings. If a consultant prefers to use 3-D drawings, this must be mentioned prior to obtaining survey or design data from the Department.

Electronic data to be provided by Plan Preparation to:

NHDOT Preliminary Design Section and consultants using MX software:

1. Copy of the MX modelfile
2. Copy of the topo input file (TOPO.INP) containing survey data and Plan Preparation modifications/enhancements.
3. Copy of annotated MicroStation .DGN files developed for the project.
4. Copy of the Project Journal File containing all pertinent information about the project.

Consultants without MX software:

1. 3D DXF files of existing detail and triangulation generated from the MX modelfile
2. Copy of annotated MicroStation .DGN files developed for the project.
3. Copy of the Project Journal File containing all pertinent information about the project.

PRELIMINARY DESIGN

The Preliminary Design section is responsible for taking the data provided by the Plan Preparation section and designing the project up to the Public Hearing stage. This includes gathering all data necessary to prepare designs to be presented at the Public Officials Meeting, Public Informational Meetings, and Public Hearing.

Electronic deliverables expected at the completion of the Preliminary Design process:

NHDOT Preliminary Design Staff and Consultants using MX software:

1. Copy of the MX modelfile
2. Copy of any input files available to recreate the submitted design
3. Copy of MicroStation .DGN files developed for the project
4. Copy of the Project Journal File containing all pertinent information about the project.
5. Copies of any MicroStation cell files and linestyle resource files used on the project that are not included in the NHDOT standards.

Consultants without MX software:

1. 3D DXF files of existing detail and triangulation generated from the design software
2. Copy of project horizontal and vertical alignments and associated design features in LandXML formats. Descriptions of file transfer formats can be found in *APPENDIX D – MX DATA TRANSFER FORMATS* beginning on page 57
3. Copy of MicroStation .DGN files developed for the project
4. Copy of the Project Journal File containing all pertinent information about the project.
5. Copies of any MicroStation cell files and linestyle resource files used on the project that are not included in the NHDOT standards.

Electronic data to be provided by NHDOT Preliminary Design section to:

NHDOT Final Design Section and consultants using MX software:

1. Copy of the MX modelfile
2. Copy of the topo input file (TOPO.INP) containing survey data and Plan Preparation modifications/enhancements
3. Copy of MicroStation .DGN files developed for the project
4. Copy of the Project Journal File containing all pertinent information about the project.
5. Copy of the Project Public Hearing Plan in PDF format

Consultants without MX software:

1. Copy of project horizontal and vertical alignments and associated design features in LandXML formats. Descriptions of file transfer formats can be found in *APPENDIX D – MX DATA TRANSFER FORMATS* beginning on page 57
2. 3D DXF files of existing detail and triangulation generated from the MX modelfile

3. Copy of MicroStation .DGN files developed for the project
4. Copy of the Project Journal File containing all pertinent information about the project.
5. Copy of the Project Public Hearing Plan in PDF format

FINAL DESIGN

The Final Design section is responsible for taking the data provided by the Preliminary Design Section or Preliminary Design Consultant and designing the project up to the Contract Plans stage. This includes refining the project design as approved at the Public Hearing, preparing a project estimate, bid documents, and obtaining necessary construction permits.

Electronic deliverables expected at the project's completion:

All Consultants and NHDOT Final Design Staff

1. Copy of MicroStation .DGN files developed for the project
2. Copy of the Project Journal File containing all pertinent information about the project.
3. COGO and coordinate reports of each alignment similar in format to the ones shown in *APPENDIX E – CONSTRUCTION REPORTS* on page 61
4. Station and offset listing of proposed bounds
5. Plot files in PDF format of each contract plan sheet

Consultants using MX software:

1. Copy of the MX modelfile
2. Copy of any input files available to recreate the submitted design
3. Copies of any MicroStation cell files and linestyle resource files used on the project that are not included in the NHDOT standards.

Consultants without MX software:

1. 3D DXF files of existing detail and triangulation generated from the design software
2. Copy of project horizontal and vertical alignments and associated design features in LandXML formats. Descriptions of file transfer formats can be found in *APPENDIX D – MX DATA TRANSFER FORMATS* beginning on page 57
3. If the project was designed with InRoads/SelectCAD, include files mentioned below
4. Copies of any MicroStation cell files and linestyle resource files used on the project that are not included in the NHDOT standards.

PROJECTS DESIGNED USING INROADS

If a project is designed with InRoads the following files should be delivered as part of the electronic deliverable:

Surface data: (*.dtm): These files will contain existing and proposed surface information. This information will include but is not limited to the surface triangulation. Other information that will potentially be found in the dtm include planemetric features like: breaklines

representing existing and proposed objects, feature lines for entities like R.O.W. or easements, as well as random point information that can depict features like catch basins, mailboxes, or other single point features.

Alignment data (alg): This will contain all coordinate geometry and alignment information for the project alignments.

Roadway designer files (*.ird): The roadway designer file will include the templates (Typical sections) in addition to the roadway model definition, this is the "recipe" to build your design. Items in this file include: superelevation, links to the alignments used in the design, as well as the limits of design.

Survey data (*.fwd or other formats): If the survey for the project was completed by people outside the department all data used to create the existing conditions plans should be provided. If the survey was done in InRoads Survey the .fwd files that were imported into InRoads Survey should be provided. If the survey was done with a different software the data brought into InRoads should be provided in it's original format.

Style Sheets (*.xsl): InRoads report style sheets used for reports included in the design should also be delivered with the project.

InRoads Preferences (*.xin): This file will contain the settings used to control the display of information as well as the default values displayed in InRoads dialogs for generating the design graphics.

Storm & Sanitary files (*.sdb): The design information entered into InRoads Storm & Sanitary should also be included for the Department's use. This will include location, sizes and structure types for the drainage design.

Quantity Manager files (*.mdb): This file is the database containing the automatically generated quantities from InRoads for the project.

SPECIALIZED DEVELOPMENT BY DESIGN CONSULTANTS

Any specialized programs, macros, utilities, symbology, etc., developed by the consultant that are necessary to properly display drawings submitted to NHDOT shall be included with other project deliverables.

Submission of copies of other specialized programs, macros, utilities, symbology, etc. developed to improve MicroStation and MX drafting and design processes is encouraged. It is understood that NHDOT accepts these items without any guarantee of usefulness or expectations of support by the developer. In addition, NHDOT will not distribute these items to any other individual, consultant or State Transportation Department without prior permission of the developer.

NHDOT RESOURCES AVAILABLE FOR CONSULTANTS

To assist in the production of the required CAD/D files, NHDOT has provided MX and MicroStation support files available from the Department's web site. The website address is listed in the *DOCUMENTATION* section on page 9. Many of the files that are available are described in the *LEVEL ASSIGNMENTS AND SYMBOLOGY* section on page 15.

PART VIII - APPENDIX

APPENDIX A - MICROSTATION DRAWING NAMES

MicroStation drawing names will begin with the NHDOT state project number followed by the drawing type. The tables below show the text that will follow the project number along with a description of the drawing.

For example: 12345ALI.DGN would contain alignment data for project 12345.

BRIDGE DESIGN DETAIL DRAWINGS

For projects that contain multiple bridges the six digit bridge inventory number shall be used after the names below. For example: 12345A-Abut123_456.DGN will contain the abutment A masonry for the 12345 project for bridge number 123/456.

	AbutA
A-Abut	Abutment A Masonry
A-Rebar	Abutment A Reinforcement
A-Wings	Abutment A Wings
A-ReWings	Abutment A Wings Reinforcement
A-Foot	Footing A Masonry
A-ReFoot	Footing A Reinforcement
	AbutB
B-Abut	Abutment B Masonry
B-Rebar	Abutment B Reinforcement
B-Wings	Abutment B Wings
B-ReWings	Abutment B Wings Reinforcment
B-Foot	Footing B Masonry
B-ReFoot	Footing B Reinforcement
	Pier
Pier1	Pier 1 Masonry
Re-Pier1	Pier 1 Reinforcement
Pier2	Pier 2 Masonry
Re-Pier2	Pier 2 Reinforcement
	Box
BX-Deck	Box Deck
BX-ReDeck	Box Deck Reinforcement
BX-Foot	Box Footing
BX-ReFoot	Box Footing Reinforcement
BX-Wings	Box Wings Masonry
BX-ReWings	Box Wings Reinforcement
BX-Walls	Box Walls
BX-ReWalls	Box Walls Reinforcement
BX-Detls	Box Details

	Frame
FR-Detls	Frame Details
FR-Foot	Frame Footing
FR-ReFoot	Frame Footing Reinforcement
FR-ALeg	Frame Leg A
FR-ReALeg	Frame Leg A Reinforcement
FR-BLeg	Frame Leg B
FR-ReBLeg	Frame Leg B Reinforcement
FR-Deck	Frame Deck
FR-ReDeck	Frame Deck Reinforcement
FR-Wings	Frame Wings
FR-ReWings	Frame Wings Reinforcement
	PrelimPlans
Pre-Gen	Preliminary Genplan
Pre-Site	Preliminary Site Plan
	BrSite
Genplan	Genplan
Siteplan	Siteplan
Borings	Boring Logs
Bor-Req	Boring Request
Devl-View	Developed Views
BrNotes	Bridge Notes
BrDetour	Bridge Detour
	Super
DeckDetls	Deck Details
DeckBars	Deck Reinforcing
DeckSect	Deck Section
Girder	Girder Layout and Details
FramePlan	Framing Plan
SSDetls	Super Structure Details
Shoes	Bridge Shoes
Joints	Fixed Joints and Expansion Joints

HIGHWAY DESIGN CONTRACT PLAN DRAWINGS

Drawing (DGN) Name	Content	Prefix for Model Names *
12345crbplans	Curbing	CRB
12345drnplans	Drainage	DRN
12345detplans	Detour	DET
12345eroplans	Erosion	ERO
12345genplans	General	GEN
12345geoplans	Geotechnical	GEO
12345lndplans	Landscaping	LND
12345pvtplans	Pavement Marking	PVT
12345plplans	Property Layout	PL
12345rowplans	Right-of-Way	ROW
12345shrplans	Shoreland	SHR
12345sgnplans	Signing	SGN
12345sigplans	Signalization	SIG
12345trfplans	Traffic Control	TRF
12345wetplans	Wetland	WET

* model name followed by # or ## indicating a sequential number

OTHER HIGHWAY DESIGN CONTRACT PLAN DRAWINGS

For example: 12345FSC.DGN would be the construction plan front sheet for project 12345.

FSC	Front Sheet-Construction	RS#	Row Summary Sheet
FSR	Front Sheets-ROW	SG#	Signalization
FSW	Front Sheet-Wetland	SM#	Summary Sheet
FSS	Front Sheet-Shoreland	ST#	Sign Text Layout
P##	Profiles	TY#	Typical

HIGHWAY DESIGN PLAN DRAWINGS

(Names in *italics* have been added since the previous version of this document)
When attaching these drawings as reference files, it is recommended that the three character drawing name be used as the logical name.

Drawing Name	Content	Level Library (CSV)	Additional Details
AIR	Aerial Survey Data	EXD	All ground data obtained from aerial surveys.
ALI	Alignment	ALI	Existing and proposed roadway alignments & survey traverses
BOR	Borings	BOR	Geotechnical boring locations
BRD	Bridge Information	BRD	The BRD dgn contains abutments, wings, deck, approach slab, rail and stone layout in the bridge area at project coordinates.

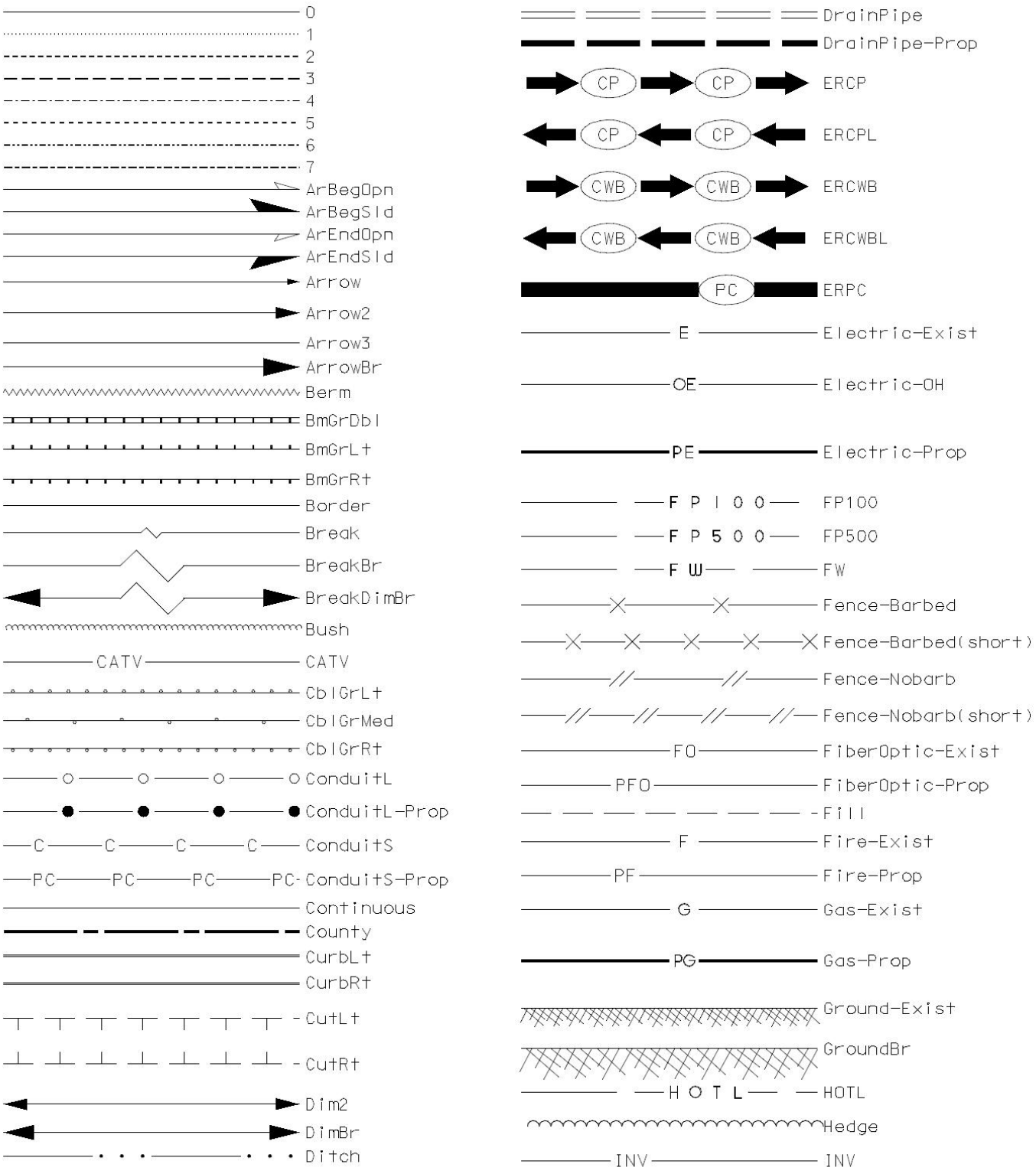
Drawing Name	Content	Level Library (CSV)	Additional Details
CLR	Color Plan	HER	Color fill patterns typically used for project meetings and presentations. This is not the same as the HER drawing developed for the Public Hearing which has a clearly defined format and color legend.
CTR	Existing Contours	CTR	
DET	Detour	DET	Detours, Diversions and Traffic control items
EDD	Existing Digitized Detail	EXD & TXT	Detail created by tracing old plans or aerial photos
EDU	Existing Digitized Utilities	EXD & TXT	Information received from utility companies that was added to the drawing by DOT or Consultant staff.
ENV	Environment	ENV	Wetland or flood zone delineations, identifications of historic properties, and other environmental concerns
ERL	Existing Right-of-Way Lines	ERL	Right-of-Way lines, property lines, civil boundaries
ERT	Existing Right-of-Way Text	ERT	Property owner names, tax map & lot information, other associated notes.
EXD	Existing Detail	EXD	Data obtained by ground survey.
EXF	Field Check Data	EXD & TXT	Ground data and text picked up during field checks
EXL	Excel data		Contains links to Excel data, generally used for summary sheets.
HER	Hearing Plan	HER	
HHO	Informational Handout	HER	The Informational Handout is prepared for the Public Hearing.
LLC	Large Location Map		LLC is typically used at meetings on larger projects. It shows the project location in relation to the surrounding area.
LND	Landscaping	LND	
LOC	Project Location Map	LOC	The LOC drawing shows the project's location in relation to the surrounding area. It is one of the drawings used in development of the Front Sheet.
MTH	Match Lines	MTH	Part of the cut sheet process. This drawing contains outlines representing the areas to be displayed on each sheet.
PCN	Proposed Contours	CTR	
PDR	Proposed Drainage	PDR	
PGR	Proposed Guardrail	PGR	
PLY	Proposed Layout	PLY	
PNT	Proposed Notes	PNT	
PRO_MC##	Profile	PRO	Profile drawings will be named with "PRO_" followed by the four character alignment label for projects designed in MX. Projects not using MX will need some other method of identification.
PRW	Proposed Right-of-Way	PRW	
PSG	Proposed Signalization	PSG	
PSN	Proposed Signing	PSN	
PUT	Proposed Utilities	PUT	
PVM	Pavement Markings	PVM	

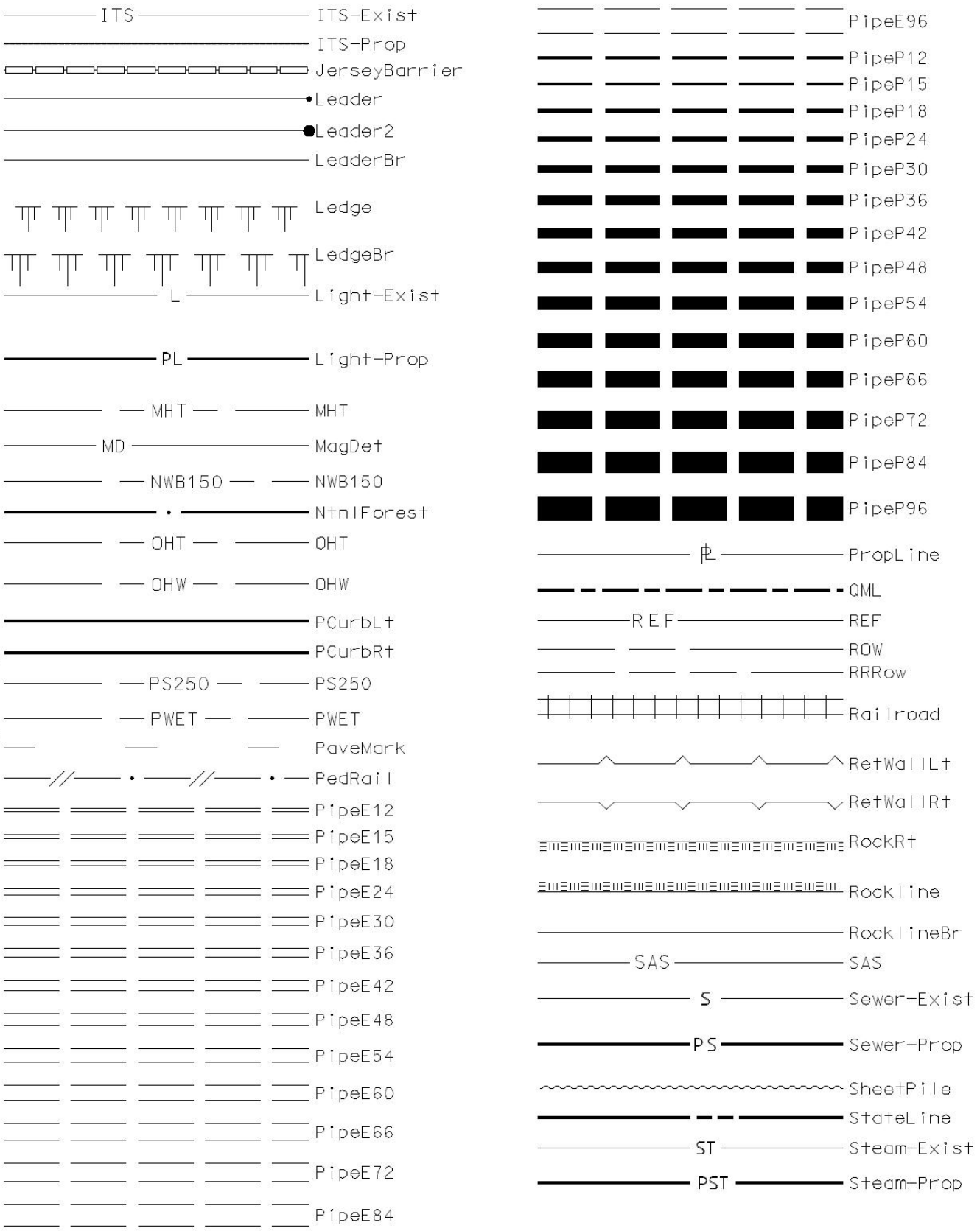
Drawing Name	Content	Level Library (CSV)	Additional Details
PWT	Proposed Wetlands	PWT	Includes shoreland and erosion control items.
PXB	Pictures – Bridge Design		The PX series of drawings are used for storing raster photographs. There are separate drawings for each design bureau to indicate who added the images.
PXBM	Pictures – Bridge Maintenance		
PXE	Pictures – Environmental		
PXH	Pictures – Highway Design		
PXM	Pictures – Materials & Research		
PXR	Pictures – Right-of-Way		
PXT	Pictures – Traffic		
SSD	Superceded Details		The SSD drawing can store details that have been changed and are no longer valid, but want to be kept in case they are needed in the future.
TXT	Existing Text	TXT	Text from survey books annotated by plan prep.
XS_MC##	Cross-section	XSU	Cross-section drawings will be named with "XS_" followed by the four character alignment label for projects designed in MX. Projects not using MX will need some other method of identification.
XSU	Section Details	XSU	

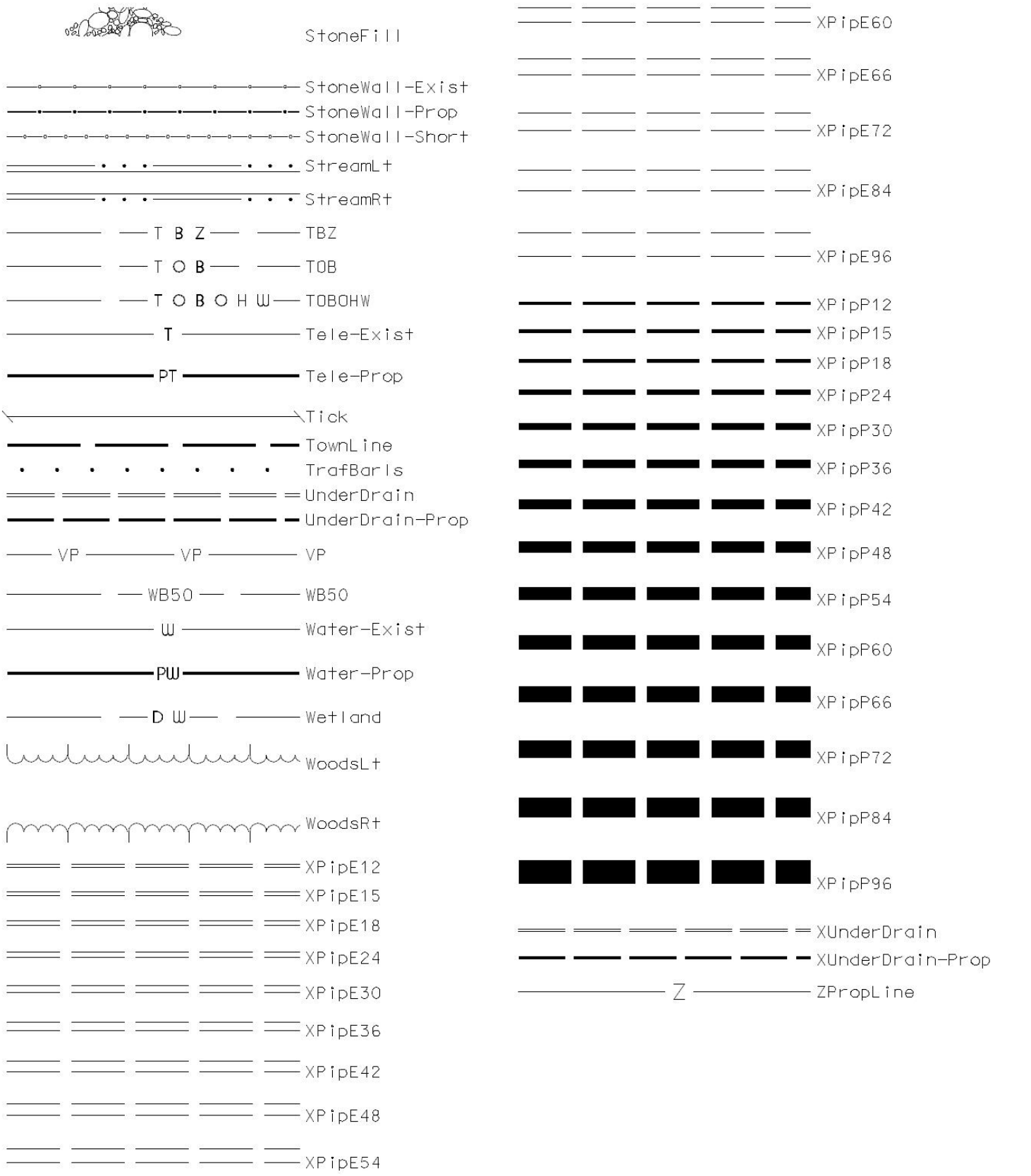
APPENDIX B - LEVEL MAPPING CONVENTION

Note: MicroStation level information was included in previous editions of this document. To reduce the potential for errors and conflicting data, this information has been removed. The latest mapping convention can be found on the NHDOT web-site at the address listed in the *DISCLAIMER* section of this document. Previous versions of the level mapping will be maintained on the website.

APPENDIX C - NHDOT CUSTOM LINESTYLES & FONT




ITS
ITS-Exist
ITS-Prop
JerseyBarrier
Leader
Leader2
LeaderBr
Ledge
LedgeBr
L
Light-Exist
PL
Light-Prop
MHT
MHT
MD
MagDet
NWB150
NWB150
NtnlForest
OHT
OHT
OHW
OHW
PCurbLt
PCurbRt
PS250
PS250
PWET
PWET
PaveMark
PedRail
PipeE12
PipeE15
PipeE18
PipeE24
PipeE30
PipeE36
PipeE42
PipeE48
PipeE54
PipeE60
PipeE66
PipeE72
PipeE84
PipeE96
PipeP12
PipeP15
PipeP18
PipeP24
PipeP30
PipeP36
PipeP42
PipeP48
PipeP54
PipeP60
PipeP66
PipeP72
PipeP84
PipeP96
PropLine
QML
REF
REF
ROW
RRRow
Railroad
RetWallLt
RetWallRt
RockRt
Rockline
RocklineBr
SAS
SAS
S
Sewer-Exist
PS
Sewer-Prop
SheetPile
StateLine
ST
Steam-Exist
PST
Steam-Prop


StoneFill
StoneWall-Exist
StoneWall-Prop
StoneWall-Short
StreamLt
StreamRt
TBZ
TOB
TOBOHW
Tele-Exist
Tele-Prop
Tick
TownLine
TrafBarls
UnderDrain
UnderDrain-Prop
VP
WB50
Water-Exist
Water-Prop
Wetland
WoodsLt
WoodsRt
XPipE12
XPipE15
XPipE18
XPipE24
XPipE30
XPipE36
XPipE42
XPipE48
XPipE54
XPipE60
XPipE66
XPipE72
XPipE84
XPipE96
XPipP12
XPipP15
XPipP18
XPipP24
XPipP30
XPipP36
XPipP42
XPipP48
XPipP54
XPipP60
XPipP66
XPipP72
XPipP84
XPipP96
XUnderDrain
XUnderDrain-Prop
ZPropLine

nh_engineering (Font 180) Special Characters

035 = #
036 = $
037 = %
038 = &
039 = ′
040 = (
041 =)
042 = ∗
043 = +
044 = ,
045 = −
046 = .
047 = /
048 = 0
049 = 1
050 = 2
051 = 3
052 = 4
053 = 5
054 = 6
055 = 7
056 = 8
057 = 9
058 = :
059 = ;
060 =
061 = =
062 = ₡
063 = ?
064 = @
065 = A
066 = B
067 = C
068 = D
069 = E
070 = F
071 = G
072 = H
073 = I
074 = J
075 = K
076 = L
077 = M
078 = N
079 = O
080 = P
081 = Q

082 = R
083 = S
084 = T
085 = U
086 = V
087 = W
088 = X
089 = Y
090 = Z
091 = [
092 = ≤
093 =]
094 = °
095 = _
096 = ∠
097 = a
098 = b
099 = c
100 = d
101 = e
102 = f
103 = g
104 = h
105 = i
106 = j
107 = k
108 = l
109 = m
110 = n
111 = o
112 = p
113 = q
114 = r
115 = s
116 = t
117 = u
118 = v
119 = w
120 = x
121 = y
122 = z
123 = {
124 = ≥
125 = }
126 = ~
127 = <
128 = >

129 = 1/2
130 = 1/4
131 = 3/4
132 = 1/8
133 = 3/8
134 = 5/8
135 = 7/8
136 = 1/16
137 = 3/16
138 = 5/16
139 = 7/16
140 = 9/16
141 = 11/16
142 = 13/16
143 = 15/16
144 = 1/32
145 = 3/32
146 = 5/32
147 = 7/32
148 = 9/32
149 = 11/32
150 = 13/32
151 = 15/32
152 = 17/32
153 = 19/32
154 = 21/32
155 = 23/32
156 = 25/32
157 = 27/32
158 = 29/32
159 = 31/32
160 = 1/64
161 = 3/64
162 = 5/64
163 = 7/64
164 = 9/64
165 = 11/64
166 = 13/64
167 = 15/64
168 = 17/64
169 = 19/64
170 = 21/64
171 = 23/64
172 = 25/64
173 = 27/64
174 = 29/64
175 = 31/64

176 = 33/64
177 = 35/64
178 = 37/64
179 = 39/64
180 = 41/64
181 = 43/64
182 = 45/64
183 = 47/64
184 = 49/64
185 = 51/64
186 = 53/64
187 = 55/64
188 = 57/64
189 = 59/64
190 = 61/64
191 = 63/64
192 = ₵
193 = ₽
194 = ₱
195 = ₥
196 = ₲₥
197 = ₿
198 = ₲
199 = △
200 = ±
201 =
202 = ⊾
203 = ⌝
204 = ⌞
205 = ⌟
206 = ⌡
207 = ⌞
208 = ⌡
209 = ∠
210 = ⌟
211 = ⌞
212 = ⌜
213 = ⌝
214 = ⌟
215 =
216 = ⊂
217 = ⊃
218 = ¬
219 = ⌐
220 = ¬
221 = ⌐
222 = ⌒

223 = ∩
224 = ∪
225 = ⊓
226 = ⊔
227 =
228 =
229 = ⊔
230 = ⊔
231 = ⊓
232 = ⊓
233 = ⊓
234 = ⌐
235 = ⌐
236 = ⍁
237 = ⍁
238 = ⍥
239 =
240 = ⍁
241 = ⊐
242 = ⊐
243 = ⊐
244 = ⌟
245 = ∗
246 = Q_{10}
247 = Q_{25}
248 = Q_{50}
249 = Q_{100}
250 = ⊖
251 = ‰
252 = ²
253 = ³
254 =
255 = ⁊

Character 245 is used in dimensions where a character appearing as an ∗ is needed. The normal ∗ will show the dimension value.

APPENDIX D – MX MODEL NAMING CONVENTION

Note: These are the most commonly encountered models on a project. When creating additional models, use names that easily and accurately reflect the information contained in the model.

(Names in *italics* are changed or have been added since the previous version of this document)

PLAN PREPARATION MODELS

(Models appear in approx. order of creation)

RAxxxxx Model containing a field surveyed traverse string PSSA. Traverses may be received as separate dump files (eg. RAxxxxx.SDR, RBxxxxx.SDR, etc. - where xxxxx is the project number). Individual traverses are typically combined to create a single traverse in this model. The Survey Section is responsible for closing/adjusting traverses.

TOPO Model containing existing project detail/topo strings as recorded in the field by survey data collectors. This model is created by editing then merging individual topo dump files (eg.TAxxxxx.SDR, TBxxxxx.SDR, etc. - xxxxx is the project number).

AERIAL DETAIL Model containing existing aerial survey detail obtained from an outside agency.

BOUNDARY A model containing one or more boundary strings (BDRY, BY01, etc.) Boundary strings may be used in merging models or controlling creation and trimming of the triangle string (although PBRK strings have generally superceded boundary string needs in triangulation).

TRIANGLES Model containing the triangulation string (TRIA) created by using select topo detail string information. Triangulation interpolates points on and between strings, creating a surface from which elevations can be extracted at any location.

CONTOURS Model containing the existing ground contour strings (0 [zero] = major, D = minor) created by surfacing (contouring) the TRIANGLES model.

PPALIGN Model containing reference master alignments (MCxS) created using center of road shots (CO) to establish tangents and adding approximate curves (to nearest 15'). Reference alignments are used to cut profiles and cross sections which assist in verifying the accuracy of the TOPO & CONTOURS models via a field check. Existing ground elevations are attached to the master strings by sectioning them over the TRIANGLES model. Strings in this model must be refined (drive points added, etc.) if they are to be used for design purposes.

PPSECT MCxS Model containing existing ground cross sections cut referencing the master string MCxS in SALIGN. Existing ground sections are cut over the TRIANGLES model at each point along the master string and assigned string labels beginning with 'E'. Separate section models are maintained for each unique master string.

NOTE: THESE MODELS ARE RECORD FILES! NO MODIFICATIONS ARE TO BE MADE WITHOUT THE PRIOR APPROVAL OF PLAN PREP.

PRELIMINARY DESIGN MODELS

LEGACY Model for storing Legacy Alignments. Legacy alignments are used by the Bureaus of Highway Design, Maintenance and Right-of-Way to determine where the existing roadway and structures are located, to better define our ROW assets.

PALIGN Model for storing all master (MC) and geometry (GC) strings with proposed elevations, as well as the corresponding Existing Ground 'OC' strings. During early stages of a project, a large number of alignments may be created. Side road alignments are sometimes stored in a model named after the road.

Note: Master 'MC' and the associated existing ground 'OC' strings must reside in the same model to be drawn up or plotted together on a profile.

PDESIGN MCxx This model contains the master string 'MCxx' with proposed elevations (copied from PALIGN), and the associated template (created with DESIGN options) and Earthworks (INTERFACe options) strings. Separate design models are maintained for each master string.

PDRIVES Model for storing all driveway alignments.

PCONTOURS Model to contain the proposed preliminary design contours.

PSECT MCxx Model containing all cross sections for master string MCxx. Section Sets are listed in Cross Section Set Labels. Separate cross section models are maintained for each master string.

For the most accurate results, existing cross sections 'E' should be cut over the TRIANGLES model.

SIGHT LINES MCxx Model intended to store sight lines and visibility envelope strings resulting from Visibility Analysis. Separate sight line models are maintained for each master string.

NOTE: THESE MODELS ARE INTENDED FOR PRELIMINARY USE ONLY AND ARE TECHNICALLY CONSIDERED 'RECORD' FILES. NO MODIFICATIONS ARE TO BE MADE WITHOUT THE APPROVAL OF THE PRELIMINARY DESIGN ENGINEER.

FINAL DESIGN MODELS

When a project is turned over, the preliminary design engineer shall provide the team with a list of the models and pertinent strings in each. The final team will copy the pertinent strings into the appropriate Final Design models. Final work should not be done on Preliminary Design models.

FALIGN
FDESIGN MCxx
FSECT MCxx

Model descriptions are identical to Preliminary Design models with the exception that they are for Final Design use.

FTRIANGLES Model containing the final triangulation string (TRIP) based on the proposed design template and interface strings contained in the FDESIGN MCxx model. A PBRK or boundary string may be created to prevent contours from being generated outside the limits of the interface (slope) lines. These string(s) would be stored in the appropriate FDESIGN MCxx model.

FCONTOURS Model to contain the final contours generated by surfacing the FTRIANGLES model.

NOTE: THESE ARE THE MOST COMMONLY ENCOUNTERED MODELS ON A PROJECT. WHEN CREATING ADDITIONAL MODELS, USE NAMES THAT EASILY AND ACCURATELY REFLECT THE INFORMATION CONTAINED IN THE MODEL.

OTHER MODELS

MICROSTATION ALIGNMENT A temporary model used to store alignments transferred from MicroStation to MX.

XS DETAIL MCxx Survey detail points as feature strings to be used for developing cross-sections.

APPENDIX D – MX DATA TRANSFER FORMATS

LANDXML

The use of LandXML is encouraged for transferring design data. LandXML was established to exchange design data utilizing a non-proprietary data standard. LandXML is the easiest avenue for transferring alignments between design softwares, including (but not limited to) MX, InRoads, and Geopak.

Survey data and surface triangulations may also be transferred via LandXML. However at this time, there are still limitations when transferring large models (surfaces). Therefore, it is strongly recommended to translate only essential data.

Importing LandXML data to MX and exporting MX data to LandXML are documented on the department's web site. Also, learn more about LandXML at www.LandXML.org.

Traditional formats used for importing alignment data to MX are also described below.

HALGN

HALGN should only be used for transferring alignment data between two groups who both use MX. LandXML should be used to transfer alignment data between different design software. HALGN is an ASCII format that can be used to define a horizontal alignment in MX using straight and circular elements.

A maximum of 500 elements may be processed.

Single element alignments may be defined.

SAMPLE HALGN INPUT DATA

```
MOSS
EDIT,PALIGN
004,3=MC4A
004,3=GC4A
999
HALGN,PALIGN,PALIGN
300,LB=MC4A,SC=10000.000,CF=10000.000,CE=25.000,TL=0.100
301,1,SX,X1=1074148.120202,Y1=386094.810662,X2=1074100.198409,Y2=386000.78602
6
301,2,LE,RA=150.000000
301,3,SX,X1=1074100.198409,Y1=386000.786026,X2=1074173.873438,Y2=385776.46549
7
301,4,RE,RA=150.000000
301,5,SX,X1=1074173.873438,Y1=385776.465497,X2=1074187.614075,Y2=385623.90322
2
301,6,LE,RA=150.000000
301,7,SX,X1=1074187.614075,Y1=385623.903222,X2=1074439.853660,Y2=384526.11973
9
```

```
301,8,RE,RA=675.000000
301,9,SX,X1=1074439.853660,Y1=384526.119739,X2=1074076.050658,Y2=384210.19930
7
999
FINISH
```

DESCRIPTION OF HALGN FORMAT

MOSS .....MX files begin with this line to clear any previous errors

EDIT,PALIGN.....Tells MX to EDIT the model called PALIGN. For simplicity always use this model name in files generated from other design packages.

004,3=MC4M.....The 004 option tells MX to delete the string labeled MC4M if it currently exists. MX alignments are named with 4 character labels beginning with "MC". The third character is selected by the user and can be any alpha-numeric character. However, the selected character cannot be used for more than one alignment. See the Design string labeling convention on the CAD/D website for the appropriate fourth character.

004,3=GC4M.....Delete the corresponding Geometry String. Use the label above changing the initial character to "G"

999.....Tells MX to end the EDIT command

HALGN,PALIGN,PALIGN.....Begin the HALGN option. Include the model name twice.

300,LB=MC4M,SC=10000.000,CF=10000.000,CE=25.000,TL=0.100
Initiate the alignment.
LB = Alignment label
SC & CF are start station. These numbers should match
CE = Station interval. Typically 25 for Imperial projects, 10 for metric
TL is a curve tolerance, use 0.1

301,1,SX,X1=1074148.120202,Y1=386094.810662,X2=1074100.198409,Y2=386000.78602
6
Tangent and curve sections are defined using option 301. The first field after the 301 record is a sequence number beginning at 1. The following code tells the type of element; SX = Tangent, LE = Left-hand curve, RE = Right-hand curve.
X1, Y1 are coordinates at the beginning of the tangent section
X2, Y2 are coordinates at the end of the tangent section

301,2,LE,RA=150.000000.....This line creates a left-hand curve between the tangent in the line above and the one below with a radius of 150.

301,3,SX,X1=1074100.198409,Y1=386000.786026,X2=1074173.873438,Y2=385776.46549
7

301,4,RE,RA=150.000000

301,5,SX,X1=1074173.873438,Y1=385776.465497,X2=1074187.614075,Y2=385623.90322
2

301,6,LE,RA=150.000000

301,7,SX,X1=1074187.614075,Y1=385623.903222,X2=1074439.853660,Y2=384526.11973
9

301,8,RE,RA=675.000000

301,9,SX,X1=1074439.853660,Y1=384526.119739,X2=1074076.050658,Y2=384210.19930
7

999

FINISH.....Indicates the end of input data

VERAT

VERAT should only be used for transferring alignment data between two groups who both use MX. LandXML should be used to transfer alignment data between different design software. VERAT is an ASCII format that can be used to define the vertical components of a previously created MX alignment.

SAMPLE VERAT INPUT DATA

```
MOSS
VERAT,PALIGN,PALIGN
MC4M,10000.000000,10145.714000,7=9
10000.000000,328.220000
10003.600000,328.097000,0.010000
10004.800000,328.037000,0.010000
10010.800000,327.867000,0.010000
10041.000000,327.500000,40.000000
10095.000000,327.875477,30.000000
10118.624000,329.271000,0.010000
10135.902000,330.756000,0.010000
10145.714000,331.789000
999
FINISH
```

DESCRIPTION OF VERAT FORMAT

MOSS	MX files begin with this line to clear any previous errors
VERAT,PALIGN,PALIGN	Begin the VERAT option. Include the model name twice.
MC4M,10000.000000,10145.714000,7=9	Begin the profile definition in the format: String label,start station,end station,7=number of profile points defined
10000.000000,328.220000	Start data – Beginning station,elevation
10003.600000,328.097000,0.010000	Vertical PI point – Station 100+03.6, elevation 328.097, 0.01 curve length The 0.01 curve length is used to indicate a grade break. In this case the alignment is crossing another roadway at an intersection. Station 100+03.6 is the point where the alignment crosses the edge of travelled way on the intersecting road.
10004.800000,328.037000,0.010000	
10010.800000,327.867000,0.010000	
10041.000000,327.500000,40.000000	this line shows a vertical curve with a length of 40 at VPI station 100+41, elevation 327.5
10095.000000,327.870000,30.000000	
10118.624000,329.271000,0.010000	
10135.902000,330.756000,0.010000	
10145.714000,331.789000	End of profile station and elevation.
999	Tells MX to end the VERAT command
FINISH	Indicates the end of input data

APPENDIX E – CONSTRUCTION REPORTS

SAMPLE ALIGNMENT REPORT (COGO STYLE)

```
                        Description of ALIGNMENT  M101
                        ------------------------------

*ELEMENT    1 TANGENT
  PBT    156+00.00          N  500908.132    E   98347.355

          DISTANCE    12.662     DIRECTION     S 49 06 45 E

  PC     156+12.66          N  500899.844    E   98356.927

*ELEMENT    2 CURVE  LEFT
  PC     156+12.66          N  500899.844    E   98356.927

    PI   158+45.26          N  500747.591    E   98532.771

          RADIUS=     1909.860      DEGREE=      03 00 00
          LENGTH=      462.917      DELTA=       13 53 15
          TANGENT=     232.598      L CHORD=      461.784
          EXTERNAL=     14.112      L CH BRG=  S 56 03 22.5 E
          MID ORD=      14.008

  PT     160+75.58          N  500641.993    E   98740.017

*ELEMENT    3 TANGENT
  PT     160+75.58          N  500641.993    E   98740.017

          DISTANCE  1993.548     DIRECTION     S 63 00 00 E

  PC     180+69.13          N  499736.941    E  100516.282


*ELEMENT    4 CURVE RIGHT
  PC     180+69.13          N  499736.941    E  100516.282

    PI   182+16.20          N  499670.171    E  100647.325

          RADIUS=     2864.789      DEGREE=      02 00 00
          LENGTH=      293.889      DELTA=       05 52 40
          TANGENT=     147.073      L CHORD=      293.760
          EXTERNAL=      3.773      L CH BRG=    S 60 03 40 E
          MID ORD=       3.768

  PT     183+63.02          N  499590.333    E  100770.842


*ELEMENT    5 TANGENT
  PT     183+63.02          N  499590.333    E  100770.842

          DISTANCE  1550.624     DIRECTION     S 57 07 20 E

  PAT    199+13.64          N  498748.578    E  102073.104
```

SAMPLE ALIGNMENT REPORT (COORDINATES)

Point	North	East	Elevation	Station
1	500004.15	99991.85	636.90	70100.00
2	500008.48	99994.35	637.00	70105.00
3	500010.22	99995.36	637.04	70107.01
4	500012.81	99996.85	636.99	70110.00
5	500017.14	99999.35	636.89	70115.00
6	500021.47	100001.85	636.79	70120.00
7	500025.80	100004.35	636.69	70125.00
8	500026.69	100004.86	636.67	70126.02
9	500030.13	100006.85	636.51	70130.00
10	500034.46	100009.35	636.32	70135.00
11	500038.79	100011.85	636.13	70140.00
12	500043.12	100014.35	635.95	70145.00
13	500047.45	100016.85	635.78	70150.00
14	500051.78	100019.35	635.62	70155.00
15	500052.40	100019.71	635.60	70155.72
16	500056.11	100021.85	635.47	70160.00
17	500060.45	100024.34	635.33	70165.00
18	500064.79	100026.83	635.20	70170.00
19	500069.13	100029.31	635.08	70175.00
20	500073.47	100031.79	634.97	70180.00
21	500077.82	100034.26	634.87	70185.00
22	500082.17	100036.72	634.77	70190.00
23	500086.52	100039.18	634.69	70195.00
24	500090.88	100041.63	634.61	70200.00
25	500095.24	100044.08	634.55	70205.00
26	500099.60	100046.52	634.49	70210.00
27	500103.97	100048.95	634.44	70215.00
28	500108.34	100051.38	634.41	70220.00
29	500112.71	100053.81	634.38	70225.00
30	500117.09	100056.23	634.36	70230.00
31	500121.47	100058.64	634.35	70235.00
32	500125.85	100061.04	634.35	70240.00
33	500130.24	100063.45	634.36	70245.00
34	500134.63	100065.84	634.37	70250.00
35	500139.02	100068.23	634.40	70255.00
36	500143.42	100070.61	634.44	70260.00
37	500147.81	100072.99	634.48	70265.00
38	500152.21	100075.36	634.54	70270.00
39	500156.62	100077.73	634.60	70275.00
40	500161.03	100080.09	634.66	70280.00
41	500165.44	100082.45	634.72	70285.00
42	500169.85	100084.80	634.78	70290.00
43	500174.27	100087.14	634.84	70295.00
44	500178.69	100089.48	634.90	70300.00
45	500183.11	100091.81	634.96	70305.00
46	500187.54	100094.13	635.02	70310.00
47	500191.97	100096.45	635.08	70315.00
48	500196.40	100098.77	635.14	70320.00
49	500200.83	100101.08	635.20	70325.00
50	500205.27	100103.38	635.26	70330.00
51	500209.71	100105.68	635.32	70335.00

APPENDIX F – CROSS SECTION SET LABELS

(Items in *italics* have been added since the previous version of this document)

Section Set	Feature Name	MX Label
0,1	*available*	
2	Environment lines	VB, VH, VO, VT, VZ, WD
3	Right-of-way lines	BC, BN, BP, BR, BS, BT
4,5, 6, 7	*available*	
8,9	Building sills	BD
A,B	*available*	
C	Other	Determined by user
D	Design	Design model
E	Existing Ground	Triangulation
F	Subgrade	
G, H, I, N, O, P, Q, S, T, U. V	*available*	
J	*Misc Section J*	
K	*Misc Section K*	
L	*Misc Section L*	
M	*Misc Section M*	
R	Drainage Pipes	*XC * see table below*
W	Detail Features	* see table below
X	Old Ground Elevations	OC
Y	General	
Z	Temporary	Used by MX wizards

CROSS-SECTION DETAIL FEATURE STRINGS

MX Label	Feature Name
X0, X1	Coniferous & Deciduous Trees
X2	Environment lines
X3	Right-of-way lines
X4, X5	Joint Pole
X6, X7	Hydrant
X8, X9	Building sills
XA, XB	Guy Pole
XC, XD	*Drainage Pipes*
XE	*Drainage Structure Sumps*
XG, XH	Light Pole
XI, XJ	Joint Pole with Light
XK, XL	Power Pole with Light

XM, XN	Pole
XO, XP	Power Pole
XQ, XR	Telephone Pole
XS	Catch Basin
XT	Drop Inlet
XU	Drainage Manhole
XV	Utility Manholes