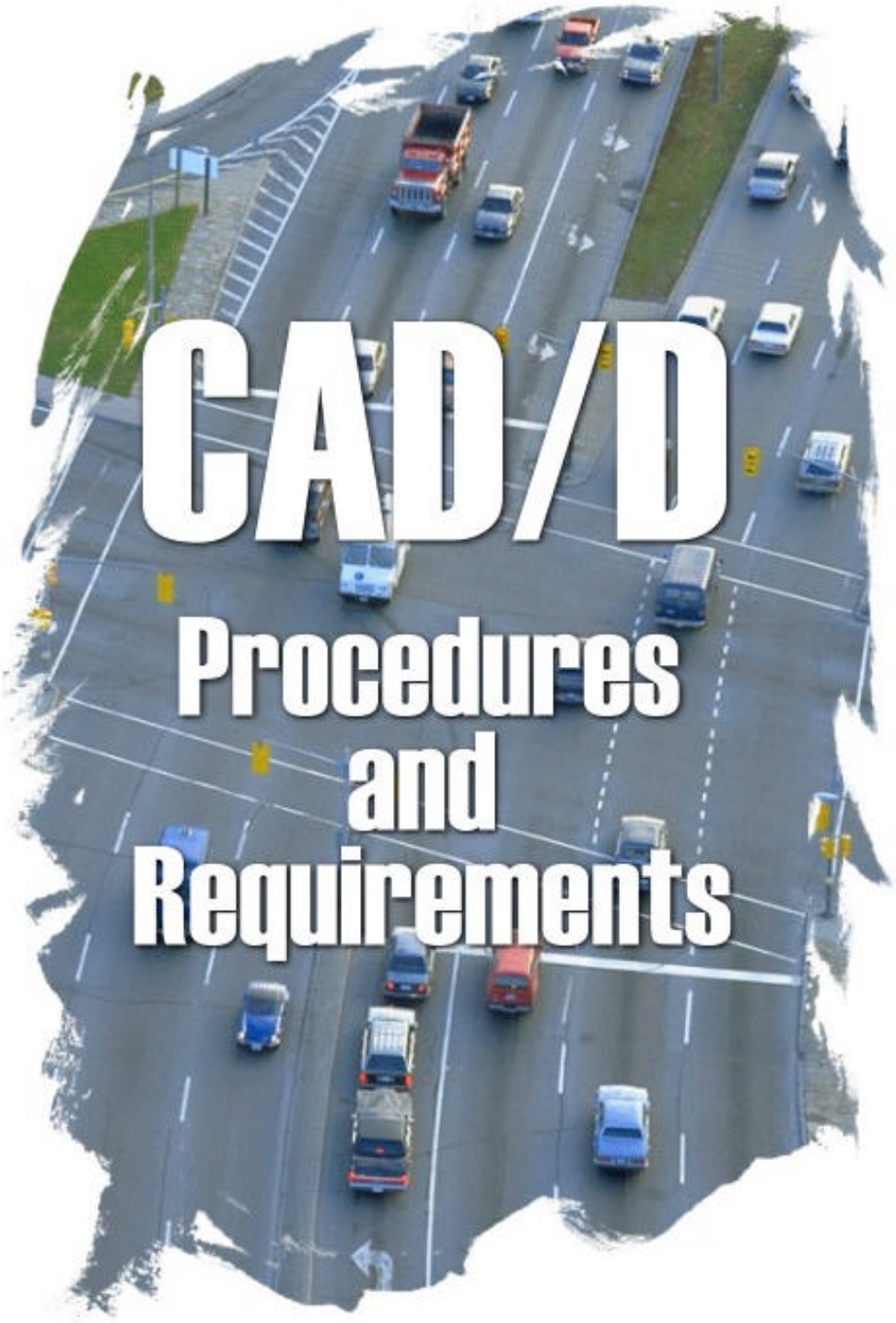
New Hampshire
Department of Transportation



CAD/D
Procedures and Requirements

April 2002

PART I – GENERAL INTRODUCTION

DISCLAIMER

The procedures described in this document are for reference only. The material contained is provided without warranty or liability of any kind to the New Hampshire Department of Transportation. Every effort has been made to make the documentation as complete and accurate as possible without errors.

This information is provided on an "as is" basis. Updates to these procedures and requirement will be made as needed due to any errors found in the documentation, new programs, change in software, software enhancements, or as policy and management dictate.

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.

Current versions of software specific files (style libraries, fonts, naming conventions, etc.) can be found on the NHDOT CAD/D website at http://www.state.nh.us/dot/its/cadd/cadd.html

Any recommendation for improvement to this documentation is welcomed. Any errors found should be brought to the attention of NHDOT so corrections can be made. Any additional information or detailed explanation needed should be documented and mailed to:

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New Hampshire Department of Transportation
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REVISION SUMMARY

APRIL 2002

General

Consultant deliverable specifications relocated from various parts of the document and combined as Part V – Engineering Consultant Requirements

Part II – 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 III – MX

- Additional style sets have been listed.

Part IV – Other Project Data

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

Part V – 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 is the New Hampshire Department of Transportation's (NHDOT) specifications for required electronic (computer) data as it relates to engineering design project deliverables. In addition to the traditional hardcopy delivery items, NHDOT will require supplementary electronic data delivery items. This data will be 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 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.

The requirements in this document represent the minimum requirements that must be met for the development of NHDOT Computer Aided Design & Drafting (CAD/D) projects. 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 NHDOT 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.

Engineering projects are expected to adhere to the standards that were in force at the time the contract was initiated. Consultants may voluntarily choose to follow a later revision.

This document is published as a complete revision to the "CAD/D PRODUCTION GUIDELINES" document dated April 2001.

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, no deviation from the current dated requirements should be considered.**

MAJOR SOFTWARE AND CURRENT PRODUCTION VERSIONS

1. MicroStation J version 07.01.04.16
2. MX version 2.5ae
3. Microsoft Office 2000 products

PART II – MICROSTATION

FILE NAMING

An attempt shall be made to have electronic 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. Only alpha or numeric characters with no spaces or special characters shall be used.

CUT SHEETS

Project sheet file names are composed of four parts; the NHDOT state project number (first five fields), drawing type, sheet number (usually the last two fields), and the file extension. The five digit key number of the project is assigned by NHDOT. The letter(s) following the project number indicate the type of cut sheet drawing. The sheet number is a sequential listing of the type of cut sheet for the project. (Ex. 12345R01 : "12345" - project number, "R" – ROW, "01" – ROW Cut Sheet 1.) The extension is always ".DGN". Modifications to this format will 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 33.

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 project manager to arrange a meeting with the CAD/D development staff.

ROLL PLANS

Project "roll-plan" file names are composed of three parts; the NHDOT state project number (first five fields), drawing type (last three fields), 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 33.

LEVEL ASSIGNMENTS AND SYMBOLOGY

When selecting level schemes for MicroStation, a limit of 63 levels for each design file is a current software limitation. The release of v8 enables unlimited levels in one file. When NHDOT upgrades to v8, level schemes may be modified to take advantage of the additional levels. At that time, NHDOT may make a revision to the CAD/D Procedures and Requirements allowing additional levels per file to be used. Until the revision, levels 1-63 shall be used.

Elements used to construct CAD/D drawings shall be placed on the appropriate design file levels as assigned in *APPENDIX B - LEVEL MAPPING CONVENTION* beginning on page 35. Standard plan sheet symbols

are illustrated in volume 2 of the NHDOT Design Manual on the Standard Symbol drawing. Line weights, styles and text height shall conform to the sample drawings shown in volume 2 of the NHDOT Design Manual. Use of NHDOT-defined MicroStation line styles is preferred. The consultant, with the approval of the Project Engineer, 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.

Actual symbols for use with MicroStation software, including standard borders, are contained in NHDOT's standard cell libraries and are available in MicroStation .CEL file format. A standard color table, standard metric & Imperial line style resource files with NHDOT line styles and font library with NHDOT fonts for use with MicroStation are available. This data is available on the NHDOT website or can be requested through the Project Manager. The website address is listed in the Disclaimer section at the beginning of this document.

Level naming files contain names and group definitions for MicroStation .DGNs. For Highway Design use there are level naming files available for most detail drawings. These files have the same 3-character name as the drawing with an .LVL extension. For example, the level naming file for drawing *12345ex3.dgn* will be *ex3.lvl*.

There are two .LVL files to be utilized when creating .DGNs for the Bureau of Bridge Design. The first file is called *brc.lvl*, 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.lvl*, contains the names required to place graphical elements in a .DGN at project coordinates. Many of the names in *brd.lvl* are required in order to transfer elements to MX For MicroStation. If information is not going to be passed from MicroStation into MX, several of the layers will remain vacant.

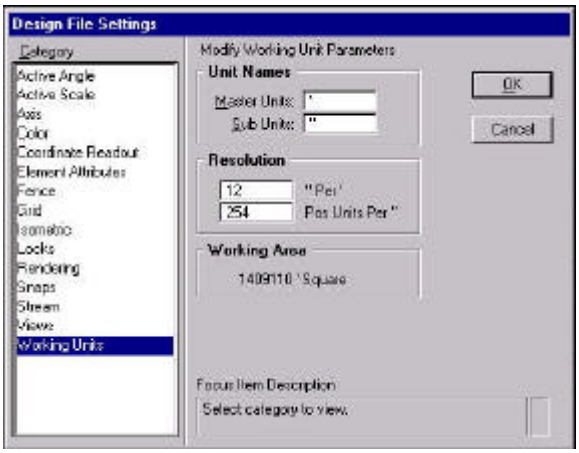
Level naming for front sheets, right-of-way summaries, and property layout sheets is contained in borders.lvl. All the level files mentioned are available on the CAD/D website or can be requested through the Project Manager. The website address is listed in the Disclaimer section at the beginning of this document.

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. The seed file defines the working units for the file, global origin, view attributes, default color table, text settings, coordinate readout and several other important parameters. NHDOT supplies seed files for both metric and Imperial drawings. Seed files allow the user to begin work in a standard format and maintain uniformity.

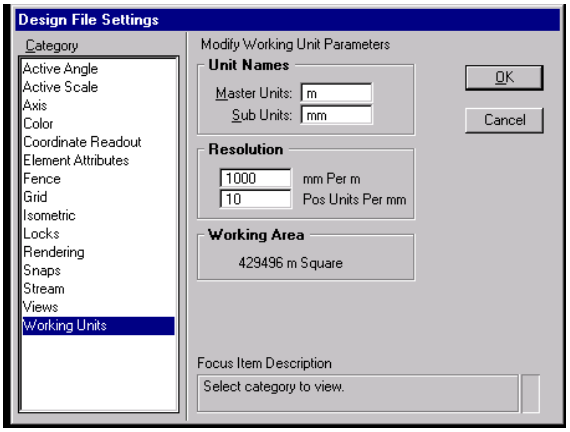
Two of the most important settings in the seed file are the working units and global origin. Working units are expressed as master units and fractional sub-units. The number of positional units per sub-unit is called the working resolution. The working resolution determines the precision to which elements are drawn and the size of the design plane. The design cannot exceed the working area. Because the size of the design plane is dependent on the precision as established by the working units defined in a file, the working units must allow the required precision without limiting the coordinate range of the design plane. The format for the working units in MicroStation is defined as MU:SU:PU (master units, sub-units, positional units). The NHDOT seed file working units are defined below:

IMPERIAL 3D SEED FILE (NHSEEDFT.DGN)



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

METRIC 3D SEED FILE (NHSEEDM.DGN)



Working Units:
Master Units = m
Sub-Units = mm
Positional Units = 10/mm
Global Origin: X= 500
Y= 500
Z= 10,000

The global origin has been set at 500,500, 10000 for both metric and Imperial files. 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 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.

REFERENCE FILE ATTACHMENTS

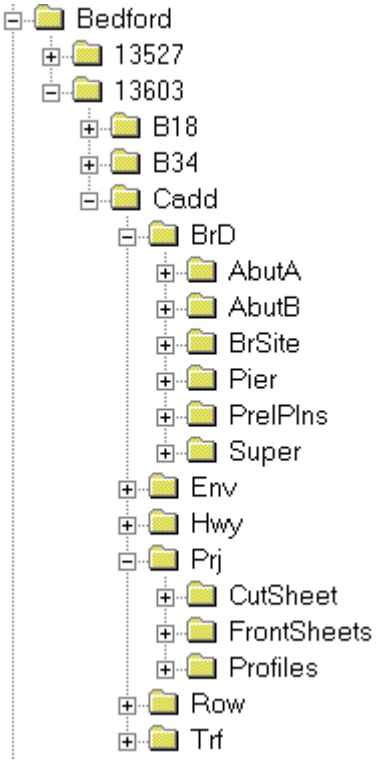
A reference file is a MicroStation design file or a raster image attached as a background file to an active design file, thus allowing several design groups to share the same information without the need to copy the file(s). MicroStation can attach a reference file by one of three different ways:

1. Name only – the path to the referenced file is resolved by the MicroStation configuration variable MS_RFDIR.
2. Full path – the reference file name and directory path is saved within 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 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.

DIRECTORY STRUCTURE

The standard directory structure being used for CAD/D projects within NHDOT is shown below:



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

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

The BrD 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, and boring logs.
Pier - Detail plans depicting Pier footing, masonry, and reinforcing.
PrelPlns - Preliminary Plans. After preliminary plans are accepted, any reference files in these .dgns should be merged and the .dgns should be made read-only.
Super - Superstructure plans.

The *CutSheet* folder under *Prj* is where final contract plan DGN files will be stored. Front sheets are stored in the *FrontSheet* folder under *Prj*.

MXData is used to store miscellaneous MX files. The *macros* and *styles* folders (*imperial_macros* and *imperial_styles* on Imperial projects) under *Prj* are created by MX to store project specific macros and style sets.

TEXT STYLES

MicroStation font resource files are binary files created from font cells, TrueType, Postscript, or AutoCAD shape 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. A font resource file can contain 256 fonts.

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.

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

NH-CUSTOM-FONT.RSC

Font	Description
180	Nh_engineering (engineering w/bridge and drafting symbols)

TEXT SIZE AND SPACING

Standard text sizes and fonts have been defined to ensure uniformity and legibility on all CAD/D drawings. The correct text size is dependent on the plot scale. Since, the most important issue with text is that it should be legible, font and text size may vary as necessary. Text line spacing should be, on average, the same as the text height. The following table of text sizes for plans at a given scale is to be use as a guideline for the existing, new, and maximum text size:

STANDARD TEXT SIZES

Imperial Text

Imperial Scale	1"=1"	1/4"=1'	1"=20'	1"=50'	1"=100'
Existing	0.007	0.320	1.600	4.000	8.000
New	0.008	0.400	2.000	5.000	10.000
Maximum	0.012	0.560	2.800	7.000	14.000

Metric (SI) Text

Metric Scale	1:1	1:100	1:250	1:400	1:500	1:1000
Existing	0.002	0.200	0.500	0.800	1.000	2.000
New	0.0025	0.250	0.625	1.000	1.250	2.500
Maximum	0.0035	0.350	0.875	1.400	1.750	3.500

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 on page 36.

NHDOT CUSTOM LINE STYLE RESOURCE FILES

Standard NHDOT Custom line style files	
Imperial	Metric
line-ft.rsc	line-m.rsc
pipe-ft.rsc	pipe-m.rsc

As mentioned above, custom line styles are user definable in MicroStation. Styles for plan drawings have been created for use on a 1:500 scale (1”=50') drawing. Linestyles that are not defined to be a specific width (such as pipe and railroad styles) need to be scaled to display properly on other scale plan drawings. Linestyles used on 1:250-scale metric drawings should be scaled by 0.5 and those used on 1"=20' Imperial drawings should be scaled by 0.4. These settings will be included in the settings manager and GDM rules files. The GDM programs are described in more detail on page 25.

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.

CUSTOM LINESTYLE SCALING CHARTS

Metric

Scale for plotting	Custom linestyle scale setting
1:1	500
1:2	250
1:5	100
1:10	50
1:20	25
1:25	20
1:50	10
1:100	5
1:250	2
1:500	1

Imperial

Scale for plotting	Ratio	Custom linestyle scale setting
1”=1”	1:1	600
6”=1'	1:2	300
3”=1'	1:4	150
2”=1'	1:6	100
11/2”=1'	1:8	75
1”=1'	1:12	50
3/4”=1'	1:16	37.5
1/2”=1'	1:24	25
3/8”=1'	1:32	18.75
1/4”=1'	1:48	12.5
3/16”=1'	1:64	9.375
1/8”=1'	1:96	6.25
1”=10'	1:120	5
3/32”=1'	1:128	4.6875
1/16”=1'	1:192	3.125
1”=20'	1:240	2.5
1”=50'	1:600	1

The following list of custom linestyles do not require scaling. The lines are created with a true size assigned.

BmGrDbl
BmGrLt
BmGrRt
CblGrLt
CblGrRt
CurbLt
CurbRt
PCurbLt
PCurbRt
Pavemark
PipeE#
PipeP#
Railroad
TrafBarls
XPipeE#
XPipeP#

The names are the same for both metric and Imperial except the numbers on the pipe linestyles.

NOTES

The *line-ft.rsc* and *line-m.rsc* files contain custom line styles called ARROW-BR. This line should be used to connect the note text to the graphic. In order for the arrowhead of the ARROW-BR line to be properly proportioned, the user must enter the proper scale in the Line Styles dialog box for custom line styles before placing the line.

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. The table defines 256 colors from which an active color can be selected and applied to an element.

CELL FILES

The following graphic cell files have been created for use on NHDOT projects.

border.cel	cut sheet borders (including front sheets, ROW summary, property layout and xsection borders and their text cells)
br_2bral.cel	2 bar aluminum bridge rail and approach rail details
br_3bral.cel	3 bar aluminum bridge rail and approach rail details
br_bgr.cel	beam guardrail and end section details
br_borders	miscellaneous bridge borders
br_bore.cel	boring sheet symbols
br_brush.cel	2 bar aluminum approach rail with brush curb
br_curb.cel	granite bridge curb, type A & B bituminous curb, & Jersey barrier
br_exrai.cel	existing rail details
br_misc.cel	borders, state seal, state outline, rip-rap, slope lines, waterstops, sheet piles
br_pile.cel	HP sections and Pile Key
br_precast	New England Bulb Tees (precast concrete beams)
br_scree.cel	protective screening
br_t2pl2.cel	t2 rail, approach rail, and safety fence details
br_t4pl2.cel	t4 rail and approach rail details
br_weld.cel	weld symbols
drainage.cel	proposed drainage detail cells
environ.cel	environmental detail cells
exist-in.cel	existing topography cells
grdrail.cel	proposed guardrail detail cells
pavemark.cel	proposed pavement marking detail cells
row.cel	proposed right-of-way detail cells
signals.cel	proposed signalization detail cells
signs.cel	proposed sign detail cells
	miscellaneous roll/plan sheet cells
stnoffset.cel	Station–Offset macro cells
~~titles.cel~~	~~miscellaneous plan sheet 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

SETTINGS MANAGER

NHDOT is in the process of replacing the settings manager files with rules files to be used with the GDM Software products. The settings manager files are no longer being updated but will be maintained until GDM products are fully implemented. At this time, this section is being maintained for historical reference and will be eliminated in future editions of this document. The GDM programs are described in more detail on page 25.

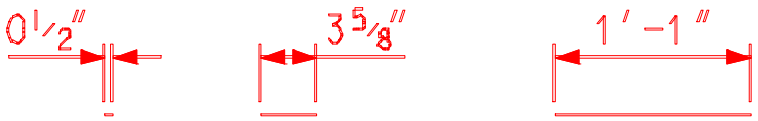
Copies of the settings manager files are available to consultants on the NHDOT website. Four files are available.

File	Use
nhdot500.stg	500-scale metric
nhdot250.stg	250-scale metric
nhdot50.stg	50-scale Imperial
nhdot20.stg	20-scale Imperial

Several of the groups in Setting's Manager are prefixed with "BRD", "Bridge", or "BRD & Bridge". Components labeled "BRD" are for use in the .DGN containing the bridge at project coordinates. Components labeled "Bridge" are for use in the detail sheets. Components labeled "BRD & Bridge" are for use in all Bridge Design drawings. It should be noted that components in the group labeled "Bridge – Exist, Substr, Rebar" are to be used on detail sheets for placing graphics representing all existing objects (e.g. an existing abutment or girder), proposed substructure, and proposed rebar.

DIMENSIONING

The dimensions for bridge detail drawings shall be placed to have the appearance of those which follow:



The use of Settings Manager is strongly encouraged for the placement of all dimensions, since, at a minimum, it will select the proper text size. It is understood that in order to achieve the dimension appearances shown above, the Settings Manager defaults will, at times, need to be overridden. The Dimension Settings, as set by Settings Manager, that will most frequently require adjustment are as follows:

Placement	- Location	Default = Semi-Auto
Terminators	- Orientation of Terminators	Default = Automatic
Terminators	– Geometry – Minimum Leader	Default = 2

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. For each cross-section drawing a second drawing file is created to contain additional detail such as drainage, notes, and border cells. The sections are plotted using a batch plot option that plots 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 project manager to arrange a meeting with the CAD/D development staff.

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.

PLOTTING

The plotter driver file (file extension .PLT) is used to set default plotter settings. Style records used within NHDOT .PLT files are taken directly from the Bentley supplied *hpgl2.plt* file. Black and white plot drivers 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. The following lines have been added to black and white plot drivers:

```
;plot colors 1-9,15-254 black
pen(1)=(1-9,15-254)/rgb(0,0,0)
```

The following lines replaced the lines in the Bentley supplied black and white plot drivers:

```
; units for weight stroke are multiples of .025 mm
weight_strokes=(3,8,13,18,25,30,35,40,45,50,55,60,65,70,75,80,85,90,95,100,10
5,110,115,120,125,130,135,140,145,150,155,160)
```

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
$RSHTOT$	$(RSHTOT)	Total number of right-of-way plan sheets
$WSHTOT$	$(WSHTOT)	Total number of wetlands sheets
$CSHTOT$	$(CSHTOT)	Total number of construction plan sheets
BT	$(BT)	Total number of bridge sheets
$BRNO$	$(BRNO)	Bridge inventory number
$BRDESCR$	$(BRDESCR)	Bridge description
$BRFILNO$	$(BRFILNO)	Bridge file number
$BRDIR$	$(lastdirpiece(_DGNFILE))	
$TIME$	_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

BATCHPLOT

To plot cut sheets, a rectangular element drawn in color 84 has been placed at the outer edge of NHDOT border cells. BatchPlot looks for these elements for plotting cut sheets. When developing CAD/D drawings, color 84 should be avoided unless an element defining a batchplot limit is being created.

PART III – 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 rerun at a later time

MODEL NAMING

Suggested MX model names are listed in Appendix C, on page 41. 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 will continue to use the existing survey detail string labeling convention that was implemented with MOSS (the VMS version of MX). The existing detail string labeling convention is shown in Appendices D & E on pages 45 (topical listing) and 51 (alphabetical listing).

STYLE SETS

A style set is a collection of styles which is used to draw a complete model or a selected part of it in plan view.

NHDOT DEVELOPED STYLE SETS FOR MX DRAWINGS

ali.pss	Used to draw alignment detail.
topo.pss	Used to draw existing survey detail.
ply.pss	Used to draw proposed roadway designs.
salign.pss	Used to draw survey alignment detail
trav.pss	Used to draw survey traverse points

STYLE SETS USED TO CREATE MICROSTATION DRAWINGS

ali.pss	Used to draw alignment detail.
ex1.pss, ex2.pss, ex3.pss, exu.pss	Used to create the four existing detail DPW's that will become MicroStation base detail drawings.
ply.pss	Used to draw proposed roadway designs.
ctr.pss	Used to draw contour models.

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 plan drawings, NHDOT uses a single feature set, *nhdot.fns*, that is a combination of the individual feature sets available for each MX style set. For design detail, NHDOT uses a modified version of mxroad.fns to conform to MX design wizards.

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.

MACRO SYMBOLS & LINES

Symbols for use with MX software, including standard line patterning symbols, are available in the MX .MMS and .MML file formats. Since line and symbol size is defined in the MX style sets, the same line and symbol definitions are used for both metric and Imperial projects. This data is available on the NHDOT website or can be requested through the Project Manager.

PART IV – OTHER PROJECT DATA

PROJECT JOURNAL FILES

PROJECT JOURNAL GUIDELINES

A Project Journal will be produced and 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 files delivered, 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 such as the design software used, particular software settings, and other information that would help a downstream user of the data understand where and how the data was created should be documented.

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.

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.

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.

EXAMPLE OF CAD/D PROJECT JOURNAL

CAD/D PROJECT JOURNAL

(nhdotproject_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: M:\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 drawing files that to not fit into the standard naming convention. Include a brief description of the data contained in each one.

MICROSTATION FILE INFORMATION

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 plot specifications, pen tables, or other features used to generate the plot 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

TEXT FILES

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

SPECIAL INFORMATION/COMMENTS

This job was designed with MX version 2.4a. We had problems getting some cross-sections working, so we estimated the earthwork in that area (123+00 to 125+00). When job was completed, there was a design change that affected cross sections. Earthwork was minimal so we did not recalculate earthwork in the area of 195+00 to 202+00.

Cross Section Info (Main Line)

Existing Cross Sections
Master Alignment Model: PALIGN
Master Alignment Name: . MC1M
Description: ..... Main St. (NH 100)
Triangle String:..... TRIA
Cross Section Model: ..... PDESIGN MC1M SECTIONS
Cross Section Label: ..... E

Proposed Cross Sections
Design Model: ..... PDESIGN MC1M
Master Alignment Name: . MC1M
Description: ..... Main St. (NH 100)
Triangule String:..... TRIA

Cross Section Model: ..... PDESIGN MC1M SECTIONS
Cross Section Label: ..... D

Cross Section Info (Side Road)

Description: ..... Main St. (NH 100)
Master Alignment Model: PDESIGN MC1M
Master Alignment Name: . MC1M
Cross Section Model: ..... PDESIGN MC1M SECTIONS

Existing Cross Sections
Triangle Model: ..... TRIANGLES
Triangle String: ..... TRIA
Cross Section Label: ..... E

Proposed Cross Sections
Cross Section Label: ..... D
Mask File: 1.msk

Additional Section Sets
Cross Section Label: X
Description: ..... Existing ground feature labels

Cross Section Label: ..... A
Description: ..... Sections of Side Road cut from Main St. alignment

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 purchased QA/QC software that works with MicroStation drawings. These utilities, provided by GDM Software of Calgary, Alberta, will work from a set of "rule" files based on the established MicroStation standards. It is the intent of NHDOT to distribute a read-only version of this software, at no cost, to consultants with active NHDOT projects to be used to check the drawings before they are submitted. The software can also be used in the creation of the drawings. At this time use of the drafting tools are optional although their use is strongly encouraged.

The QA/QC software contains a number of components. They include:

QA_INPUT

As an upgrade and replacement for Settings Manager, QA_Input provides a "cascaded" or hierarchical flyout menu derived from the CAD/D drawing standard. Starting from the Rules pull-down menu, a feature is selected from the categories and sub-categories provided. QA_Input will set the correct level, weight, color, style, font, text size, active cell, etc. and activate the relevant placement command.

QUIKCHEK

QuikChek checks the active design file to ensure all elements have used valid drawing parameters. Errors are identified and corrected by category or by individual occurrence, at the user's option. Corrections are specified by selecting entries from the drawing standard, using the same interface described above in QA_Input. QuikChek will also suggest possible corrections from the closest matches to the drawing standards.

SPOT_FIX

Spot_Fix is a general-purpose proofreading tool. Spot_Fix will gray the display of an entire file, and then highlight items matching the rule(s) selected from the cascaded menu. The user can concentrate on one aspect of a file at a time, and spot anomalies with a quick visual examination. MicroStation commands or the tools provided in Spot_Fix can be used to correct the problem.

PART V – ENGINEERING CONSULTANT 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 or MicroStation version (SE, J, etc.)
4. Number of diskettes, zip disks, 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 disks are transmitted, the disk label shall also include the disk number and the total disks of that set, (ex: 1 of 10). Other subsequent disks 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:

a) CD-ROM
b) Zip Drive Cassette

c) 3½" floppy disk

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. A 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.

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 IV – OTHER PROJECT DATA* beginning on page 21.

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.

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 and 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.

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

NHDOT will only accept plan drawings that were developed in MicroStation for projects that were initiated after April 18, 2002. 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 guidelines in place at the time the project was initiated. Engineering consultants may, at their discretion, choose to follow a later copy of these guidelines.

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 on page 5 using a .PDF file extension. The consultant has the option to include all drawings in a single PDF file or create separate files, whichever is more convenient. 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.

The consultant shall be prepared to submit a sample cut sheet, profile, typical or detail, and/or cross-section sheet 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.

UNSUPPORTED AUTOCAD FEATURES

The following AutoCAD 2000 objects were not supported in MicroStation J at the time this was written:

- RText
- Arc Aligned Text
- Wipeout
- Layouts other than the active one

Other AutoCAD features that were previously known to improperly translate to MicroStation:

- Paper Space.
- MTEXT.
- Symbol Fonts

Suggestions to improve translations:

- Use Romans or Simplex Text
- If you have to rotate the View to place text or to view a sheet that has been rotated, use DVIEW and the TWIST command.
- If possible, use Standard AutoCAD Color

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.

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 IV – OTHER PROJECT DATA* beginning on page 21.

Electronic data to be provided by Plan Preparation to:

Preliminary Design 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

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

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 from consultants at the completion of the Preliminary Design process:

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 macro symbols and macro line definitions used on the project that are not included in the NHDOT standards
4. Copy of MicroStation .DGN files developed for the project
5. Copy of the Project Journal File

Consultants without MX software:

1. 3D DXF files generated from the design software used
2. Copy of project horizontal and vertical alignments in MX HALGN and VERAT formats. Examples of HALGN and VERAT data can be found on pages 57 and 59
3. Copy of MicroStation .DGN files developed for the project
4. Copy of the Project Journal File

Electronic data to be provided by Preliminary Design to:

Final Design 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

Consultants without MX software:

1. 3D DXF files generated from the MX modelfile
2. Copy of MicroStation .DGN files developed for the project
3. Copy of the Project Journal File

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 from a Final Design consultant at the project's completion:

All Consultants

1. Copy of MicroStation .DGN files developed for the project
2. Copy of the Project Journal File
3. COGO and coordinate reports of each alignment similar in format to the ones shown beginning 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 macro symbols and macro line definitions used on the project that are not included in the NHDOT standards

Consultants without MX software:

1. 3D DXF files generated from the design software used
2. Copy of project horizontal and vertical alignments in MX HALGN and VERAT formats. Examples of HALGN and VERAT data can be found on pages 57 and 59
3. If the project was designed with InRoads/SelectCAD, include files mentioned below

PROJECTS DESIGNED USING INROADS/SELECTCAD

If a project is designed with InRoads/SelectCAD the following files should be delivered with other project data:

Surface Files (*.dtm): These files contain the existing and proposed ground information. In Version 7.x of InRoads they contain just the "triangulation". In the newest version of InRoads (SelectCAD) these files store the "triangulation" and other data. They will contain element types, i.e. edge of pavement, wetlands, buildings, and random shots.

Alignment Files (*.alg): These files contain the Horizontal, Vertical, and Superelevation information for a project.

Template Library (*.tml): These files contain the templates, Material Tables, Cut/Fill Tables, and Decision Tables used to create the proposed design. Decision Tables work basically the same as an interface macro. Templates are similar to MX templates.

Roadway Library (*.rwl): These files tell InRoads how to apply the templates and decision tables.

Preference Files (*.prf or *.ini): In Version 7.x of InRoads these files control the display of design information in InRoads; how InRoads draws profiles, sections, alignments, and design data. If SelectCAD is used then *civil.ini* and *wysiwyg.ini* preferences should be provided. These two files control how all information is displayed in SelectCAD (These files are very similar to the .prf files).

Custom Cross Section files (*.xsc): These files contain a list of stations and offsets for InRoads to display sections. They will contain constant intervals, special stations, and skewed sections.

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 site address is listed in **Part I – General Introduction.**

PART VI - APPENDIX

APPENDIX A - MICROSTATION DRAWING NAMES

MicroStation drawing names will begin with the NHDOT state project number. The tables below show 3 character codes that will follow the project number.

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

BRIDGE DESIGN DRAWINGS

AAM	Abutment A Masonry
AAR	Abutment A Reinforcement
ABM	Abutment B Masonry
ABR	Abutment B Reinforcement
AW1	Abutment A Wings 1
AW2	Abutment A Wings 2
BDT	Box Details
BOR	Borings
BRD	Proposed Bridge
BRQ	Boring Request
BW1	Abutment B Wings 1
BW2	Abutment B Wings 2
BXD	Box Deck
BXF	Box Footing
BXM	Box Wings Masonry
BXR	Box Wing Reinforcing
BXW	Box Walls
DEV	Developed Views
DRE	Deck Reinforcing
DXS	Deck Section
FAM	Footing A Masonry
FAR	Footing A Reinforcement
FBM	Footing B Masonry
FBR	Footing B Reinforcement
FDD	Frame Deck Details
FFA	Frame Footing A
FFB	Frame Footing B
FLA	Frame Leg A
FLB	Frame Leg B
FRA	Framing Plan
FRD	Frame Deck
FWA	Frame Wings A
FWB	Frame Wings B
GLD	Girder Layout and Details
GNP	Genplan
P1M	Pier 1 Masonry
P1R	Pier 1 Reinforcement
P2M	Pier 2 Masonry
P2R	Pier 2 Reinforcement
PCD	Precast Deck
PGP	Preliminary Genplan
PSP	Preliminary Site Plan
STP	Siteplan

HIGHWAY DESIGN DRAWINGS

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

ALI	Alignment
CLR	*Final Design Color*
CTR	Existing Contours
DET	*Detour*
EDU	*Existing Digitized Utilities*
ENV	Environment
EX1	Existing roadway features
EX2	Existing manmade features
EX3	Misc. existing details
EXF	Field check data
EXU	Existing utilities
HER	Hearing plan
HHO	*Informational Handout*
LND	*Landscaping*
MTH	*Match Lines*
PDR	*Proposed Drainage*
PGR	Proposed guard-rail
PLY	Proposed layout
PNT	Proposed notes
~~PPM~~	~~Proposed pavement markings~~
PRO_MCxx	Profile
PSG	Proposed signalization
PSN	Proposed signing
PUT	Proposed utilities
PVM	Pavement Markings
PWT	Proposed Wetlands
ROW	Right-of-Way
~~Sxx~~	~~Cut Sheet~~
TXT	*Existing Text*
XS_MCxx	Cross-section
XSU	*Section Details*

CUT SHEET DRAWING TYPES

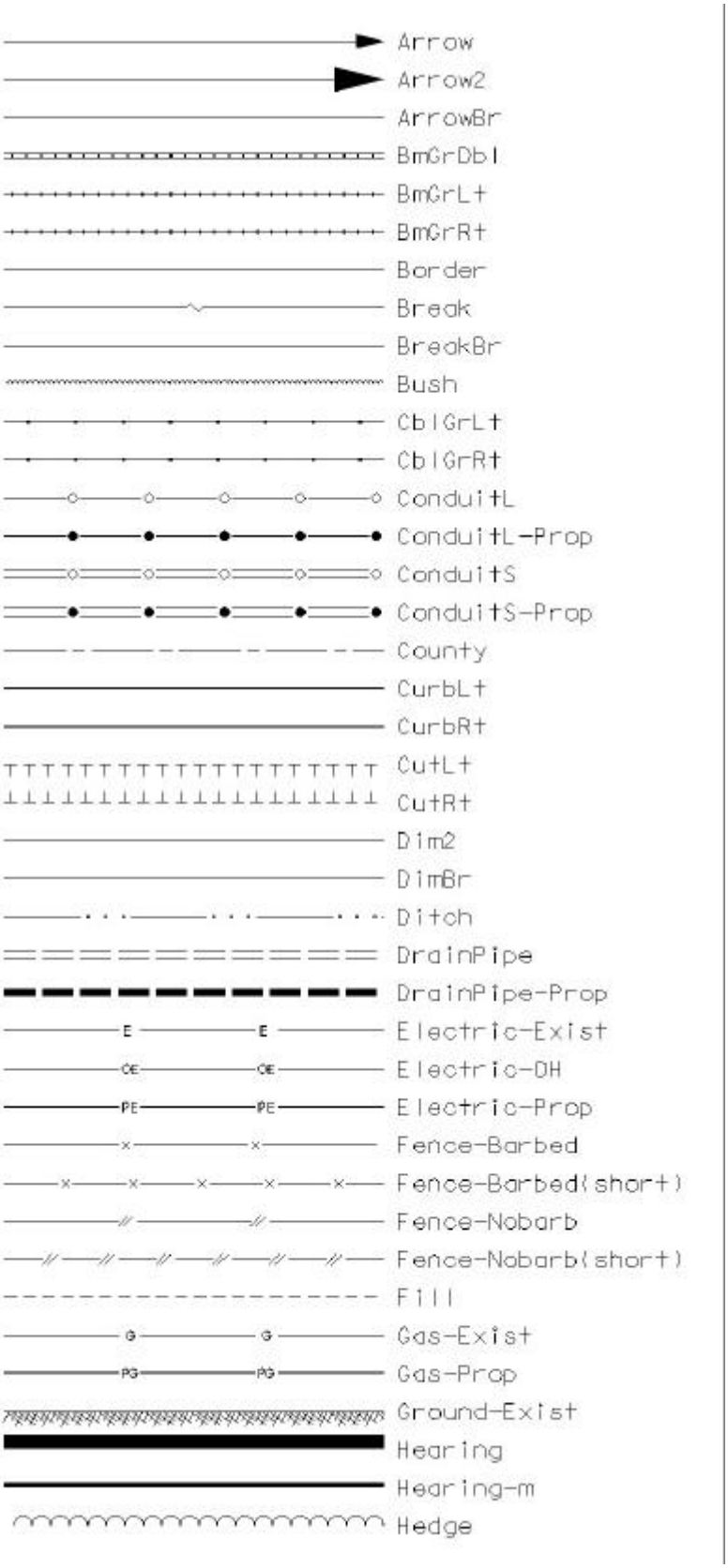
(This section was added since the previous version of this document)

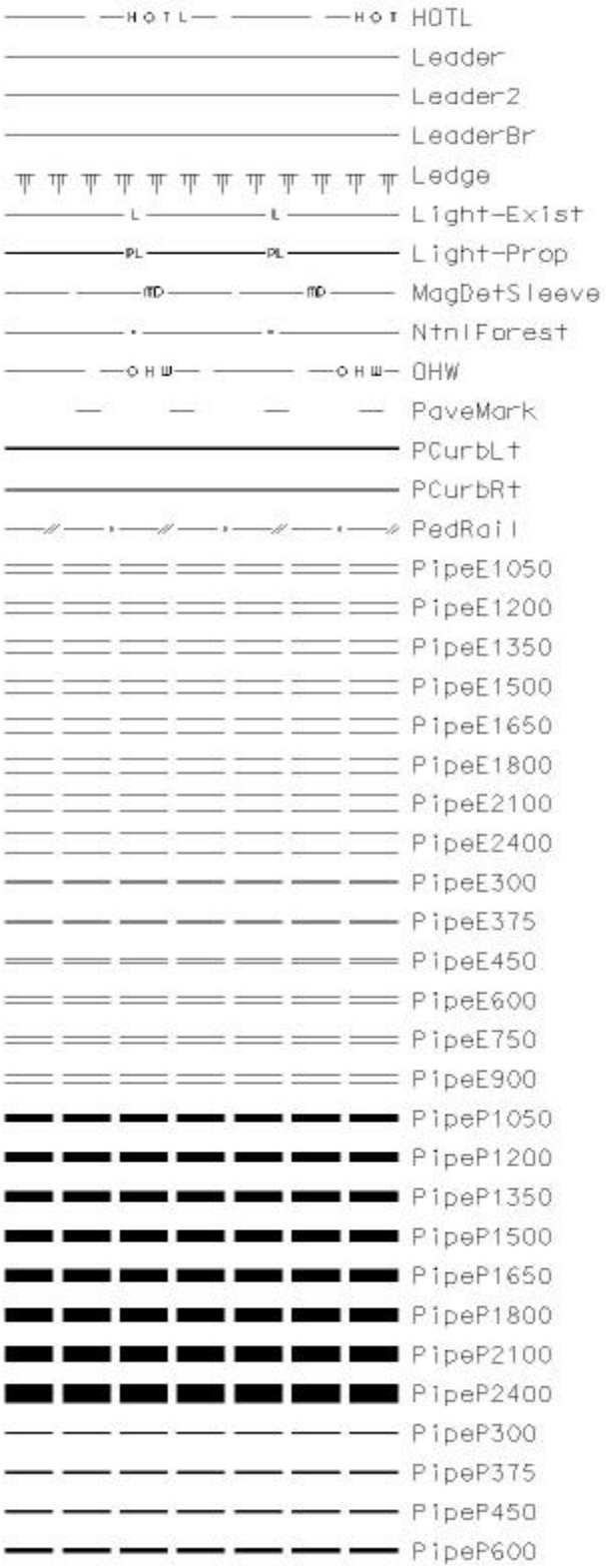
Bxx	*Base Sheets*	*FSW*	*Front Sheet-Wetlands*	*SGx*	*Signalization*
Cxx	*Curbing & Pavement Layout*	*Gxx*	*General Plans*	*SMx*	*Summary Sheet*
		Mxx	*Pavement Marking*	*STx*	*Sign Text Layout*
Dxx	*Drainage*	*Pxx*	*Profiles*	*Txx*	*Traffic Control Plans*
Exx	*Detour*	*PLx*	*Property Layout*		
FSC	*Front Sheet-Construction*	*Rxx*	*Right-of-Way*	*TYx*	*Typicals*
		RSx	*Row Summary Sheet*	*Wxx*	*Wetland*
FSR	*Front Sheets-ROW*	*Sxx*	*Signing*		

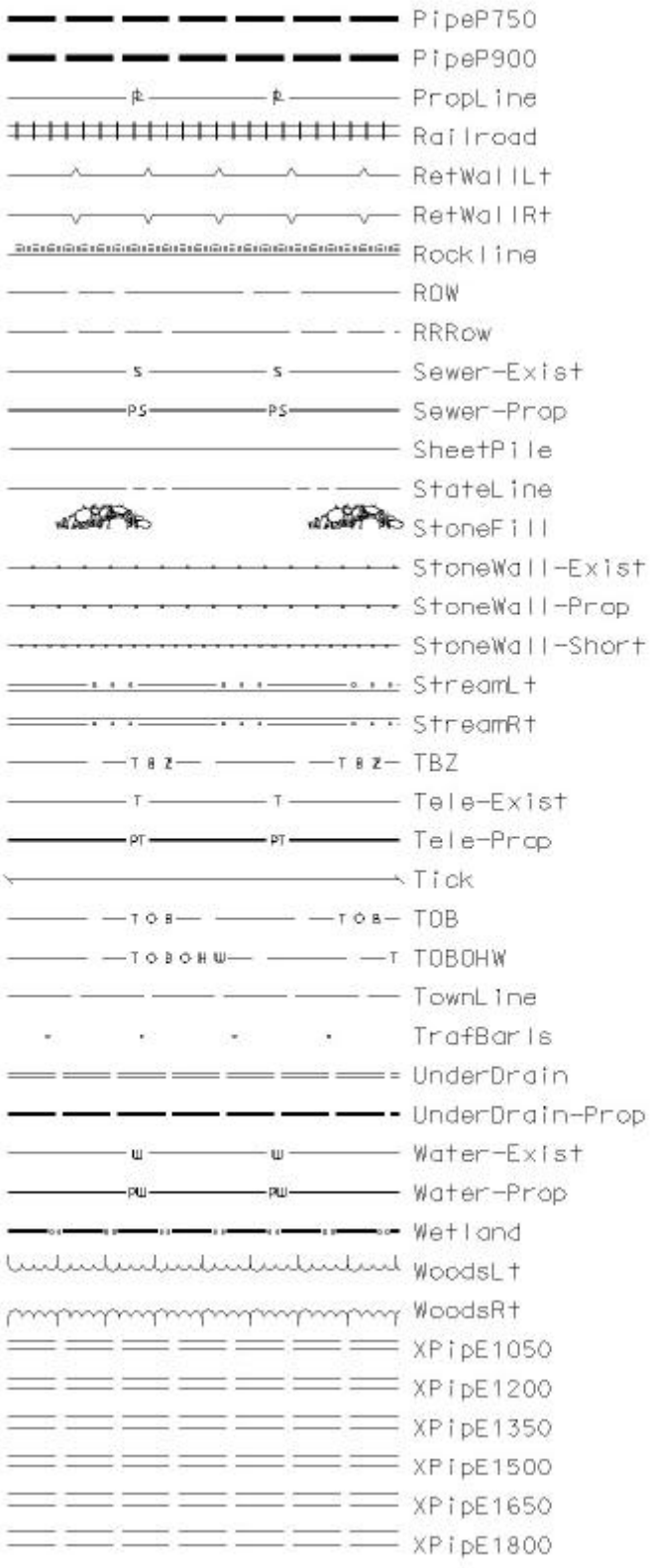
APPENDIX B - LEVEL MAPPING CONVENTION

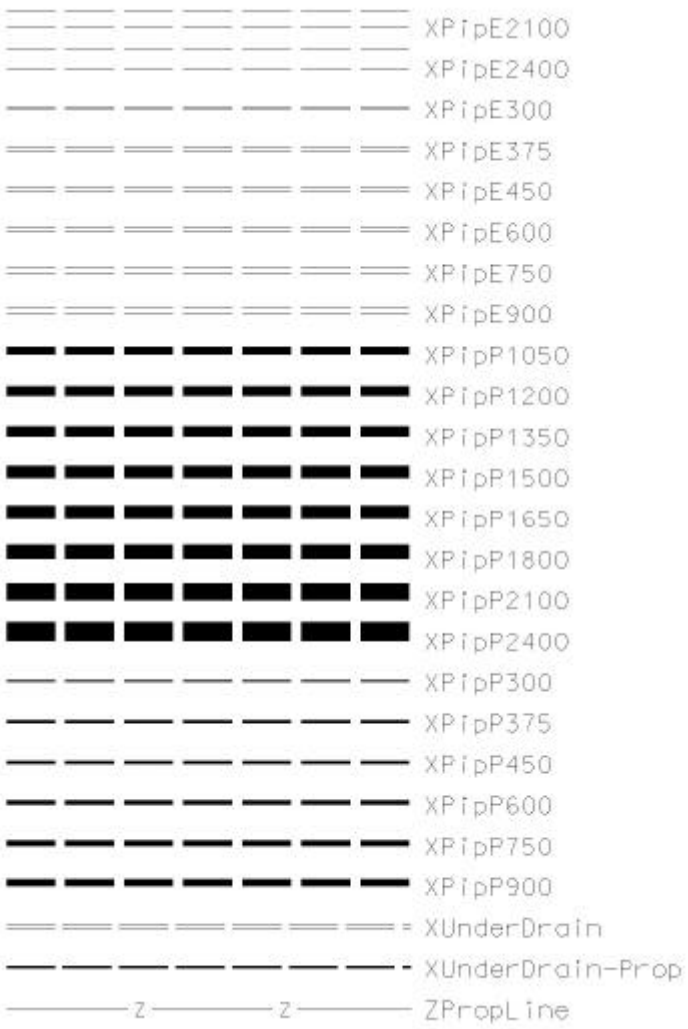
Note: MicroStation level information was included in the previous edition of this document titled "CAD/D Production Guidelines". To reduce the potential for errors and conflicting data, this information has been removed. The latest mapping convention can be found on the NHDOT web-site at the address listed at the beginning of this document.. Previous versions of the level mapping will be maintained on the website

APPENDIX C - NHDOT CUSTOM LINESTYLES




HOTL
Leader
Leader2
LeaderBr
Ledge
Light-Exist
Light-Prop
MagDetSleeve
NtnlForest
OHW
PaveMark
PCurbLt
PCurbRt
PedRail
PipeE1050
PipeE1200
PipeE1350
PipeE1500
PipeE1650
PipeE1800
PipeE2100
PipeE2400
PipeE300
PipeE375
PipeE450
PipeE600
PipeE750
PipeE900
PipeP1050
PipeP1200
PipeP1350
PipeP1500
PipeP1650
PipeP1800
PipeP2100
PipeP2400
PipeP300
PipeP375
PipeP450
PipeP600


PipeP750
PipeP900
PropLine
Railroad
RetWallLt
RetWallRt
Rockline
ROW
RRRow
Sewer-Exist
Sewer-Prop
SheetPile
StateLine
StoneFill
StoneWall-Exist
StoneWall-Prop
StoneWall-Short
StreamLt
StreamRt
TBZ
Tele-Exist
Tele-Prop
Tick
TOB
TOBOHW
TownLine
TrafBarls
UnderDrain
UnderDrain-Prop
Water-Exist
Water-Prop
Wetland
WoodsLt
WoodsRt
XPipE1050
XPipE1200
XPipE1350
XPipE1500
XPipE1650
XPipE1800


XPipE2100
XPipE2400
XPipE300
XPipE375
XPipE450
XPipE600
XPipE750
XPipE900
XPipP1050
XPipP1200
XPipP1350
XPipP1500
XPipP1650
XPipP1800
XPipP2100
XPipP2400
XPipP300
XPipP375
XPipP450
XPipP600
XPipP750
XPipP900
XUnderDrain
XUnderDrain-Prop
Z
Z
ZPropLine

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.

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 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 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 interrelates 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.

SALIGN Model containing reference master alignments (MCxx) 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.

SSECT MCxx Model containing existing ground cross sections cut referencing the master string MCxx 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'.

Additional cross sections may be cut across select topo detail for annotation purposes (EP, TW, etc.). These are assigned a string label of 'D'. 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 THE PLAN PREPARATION SECTION.

PRELIMINARY DESIGN MODELS

OG PROFILES Model storing the master strings 'MCxx' (with existing ground **or** elevations), existing ground strings 'LCxx' and original geometry

OG PALIGN strings 'GCxx'. This model is used for back up purposes. Note that drive points need to be inserted on the master string if it has not already been done. Master strings are sectioned (177 over the TRIANGLES model or 171 over a CONTOURS & DETAIL model - only if no Triangles model exists) to attach existing ground elevations, then 'L' strings created (by specifying 'Lxxx' in the 3rd field). Once these steps are complete, the 'M', 'L', and 'G' strings are copied into the PALIGN model where proposed elevations will be attached.

PALIGN Model for storing all master strings 'MCxx' with proposed elevations, geometry 'GCxx' strings containing updated vertical information and existing ground elevation strings 'OGxx'. New elevations are attached to the master strings using the VERAT option. The vertical portion of the geometry string must be updated as well. This is accomplished by specifying a second model when using the VERAT option.

Note: Master 'MC' and associated ground 'OG' strings must reside in the same model to be drawn up or plotted together.

PDESIGN MCxP This model contains the master string 'MCxP' with proposed elevations (copied from PALIGN), and the associated template and interface strings (created with DESIGN and INTERFACe options). Separate design models are maintained for each master string to minimize masking requirements when cutting cross sections.

PSECT MAxP Model containing existing, proposed, bottom of box, detail and subgrade cross sections for master string MCxP. Sections are to be labeled based on the following conventions: 'B' bottom of box, 'E' existing, 'F' proposed, 'D' detail (used for the purpose of annotating cross sections) and 'V' subgrade generated using the VOLSECT UPM. Separate cross section models are maintained for each master string. Related cross section strings must reside in a common model to allow overdraws.

For the most accurate results, existing cross sections 'E' should be cut over the TRIANGLES model. Older projects may not contain a TRIANGLES model. In this case, users need to create a model called CONTOURS & DETAIL containing the combined information of the two independent models - this will yield acceptable but less accurate results than sectioning over a TRIANGLES model.

Proposed sections 'F' are cut using the template, interface and proposed master string(s) stored in the PDESIGN MCxx model, while detail sections 'D' are cut over the TOPO model. Bottom of box sections are given a 'B' label. Subgrade sections 'V' are generated using the VOLSECT UPM and can be used to calculate preliminary cut and fill volumes.

SIGHT LINES Model intended to store sight lines for various alternates.

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 moss models and pertinent strings in each. The final team will copy the pertinent strings into the appropriate Final Design models where work will progress. Final work should not be done in Preliminary Design models.

If the number of models becomes excessive, the Team should consider utilizing the MX ARCHIVE option. This enables removal of infrequently used models from the active MODEL.FIL and placement into an ARCHOLD.FIL. Use the LIST or RETRIEVE options to view or retrieve model information.

OG FALIGN
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.

APPENDIX E – MX DETAIL STRING LABELING CONVENTION (TOPICAL)

GENERAL USE:	
Bench mark	PBMK
Boring	PBOR
Drill hole	PDHL
Level string	L
Spot elevations	PELV
Survey traverse string	PSSA
Point labels within survey traverse string (PSSA)	
Traverse PI S	
Survey fly station P	
BOUNDARIES:	
County line	BC
Iron pin or pipe	PIPN
National forest line	BN
Project marker	PRJM
Proposed construction easement	CE
Proposed drainage easement	DE
Property line	BP
Right-of-way bound	PCON
Right-of-way, controlled access	BRC
Right-of-way, limited access	BRL
Right-of-way line	BRW
State line	BSL
State line marker	PSLM
Town line	BT
Town line marker	PTLM
ROADWAY FEATURES:	
Center of road	CO
Edge of traveled way	TW
Edge of pavement	EP
Lane markings	LM
Driveway	DR
Trail	TL
Curb - Left	CL

Curb - Right	CR
Curb - Top	TC
Beam guard rail - Left	BL
Beam guard rail - Right	BR
Cable guard rail - Left	GL
Cable guard rail - Right	GR
Double face beam guard rail	DF
Jersey barrier	JB
Ditch line	DL
Bottom of slope	BS
Top of slope	TS
BRIDGE FEATURES:	
Bridge deck	BG
Bridge abutment - Top	TB
Bridge abutment - Bottom	BB
Expansion joint	EJB
Exposed bridge footing - Top	TF
Exposed bridge footing - Bottom	BF
Obscured area of bridge (aerial surveys)	OB
Top of bridge pier	TP
Wing wall - Top	WT
Wing wall - Bottom	WB
Rip-rap	RP
Spot elevations	PEBV
Miscellaneous detail features - point string	PMBF
RAILROAD FEATURES:	
Railroad	RR
Railroad sign	PRSN
Railroad signal	PRSL
Railroad switchstand	PRSW
STRUCTURES:	
Building (outline of building on photogrammetry or sill shots for ground survey)	BD(Default,Off)
Concrete Pad (gas station island; etc.)	CP
Ground at/near building	BE
Foundation/Ruin	FD
Steps	SP
Sidewalk	SK
Fence - Barbed wire	FB
Fence - Other	FO
Retaining wall - Left ---^---^---	RL*
Retaining wall - Right ---v---v---	RW*

Retaining wall - Top	TR
UTILITIES:	
Catch basin top	PCBD
Catch basin/Drop inlet sump	PSUM
Dam	DM
Dam - bottom	DB
Drainage pipe (Survey: use IGL for dir. shots)	DP
Drop inlet top	PDID
Fire hydrant	PHYD
Fuel tank	PFTK*
Gas pump (point)	PGAS*
Gas pumps (linear)	GP
Gas shutoff	PGSO
Gate	GA
Guy pole or stub	PGUY
Guy wire anchors	PANC
Headwall, culvert end - Bottom	BH
Headwall - Top	TH
Joint power and telephone pole	PJNT
Light on joint pole	PLTJ
Light on power pole	PLTP
Light pole	PLIT
Manhole - Drainage	PMHD
Manhole - Electric	PMHE
Manhole - Gas	PMHG
Manhole - Sewer	PMHS
Manhole - Telephone	PMHT
Manhole - Water	PMHW
Pole	PPOL
Power pole	PPWR
Sluiceway	SU
Storage tanks	SG
Storage tank fill cap	PSTT
Public telephone	PBTH
Telephone/telegraph pole	PTEL
Transmission line/Aerial electric lines	AE
Transmission line tower	PPTR
Utility junction box	PJCT
Underdrain	UD
Underground Electric	UE
Underground Gas	UG
Underground Sewer	US
Underground Telephone	UT
Underground Water	UW
Water gate	PWGT
Water shutoff	PWSO

SIGNING/SIGNALS:	
Controller cabinet	PCCT
Handhole	PHHL
Loop detector	SD*
Magnetic detector sleeve	DS
Mast arm pole	PMAP
Pullbox	PPBX
Sign – Single post	PSGN
Sign - Double post	PSND
Sign - Billboard or other large sign (string feature)	SN
Signal conduit	SC
Street light conduit	LC
Traffic signal without mast arm	PSGL
OTHER GROUND FEATURES:	
Athletic Field	AF
Berm	BM
Boulder	PBDR
Bush	PBUS
Cemetery	CM
Delineated wetland	WD
Ground light/yard light	PGLT
Fire tower	PFTR
Flag pole	PFPL
Gravestone	PGRV
Hedge	HE
High water mark	HW
Intermittent or small stream	ST
Lamp post/private light pole	PLPT
Lawn features (flower beds; etc.)	OR*
Leachfield	LF
Mail box	PMBX
Miscellaneous detail features - Point string	PMDF
Miscellaneous detail features - Feature string	FM
Monuments/statues or other related items	PMON
Obscured area (aerial surveys)	OA
Pool	QP
Post - all types	PPST
Ramp - Boat; etc.	RM
Ridge line	RD
Rock outcrop	RO
Satellite dish	PDAT
Septic Tank	PSTK
Shore line - Left	SL
Shore line - Right	SR
Stockpile/lumber pile	QS
Stone wall	SW

Stream or river flow arrow (AERIAL SURVEYS ONLY) FA	
Stump	PSTP
Swamp/marsh or wet area	WA
Swamp symbol	PSWP
Tree - Coniferous	PTCS
Tree - Deciduous	PTDS
Vent pipe - Outlet	PVNT
Waterfall	WF
Well	PWEL
Woods line or brush line - Left	WL
Woods line or brush line - Right	WR
CONTOURS:	
Index contour	C*
Intermediate contour	Z*
PIT SURVEYS:	
(Survey use only)	
Bottom of slope	BS
Level string	L
Limit of pit	LP
Limit of work	LW
Old ground	OG
Stockpile	SO
Top of slope	TS
Waste	WS
TEXT STRINGS:	
(Not for survey use)	
Building name	*BD
Cemetery name	*CM
County name	*CT
Dam name	*DM
General name	*GN
Miscellaneous name	*MS
Ocean name	*OC
Pipeline name	*PI
Pole numbers	*PL
Pool text	*PO
Road names	*RD
Railroad name	*RR

River name	*RV
Spot elevations	*E
State name	*ST
Town name	*TW

* Added or modified since previous version

APPENDIX F – MX DETAIL STRING LABELING CONVENTION (ALPHABETICAL)

*BD	Building name
*CM	Cemetery name
*CT	County name
*DM	Dam name
*E	Spot elevations
*GN	General name
*MS	Miscellaneous name
*OC	Ocean name
*PI	Pipeline name
*PL	Pole numbers
*PO	Pool text
*RD	Road names
*RR	Railroad name
*RV	River name
*ST	State name
*TW	Town name
AE	Transmission line/Aerial electric lines
AF	Athletic Field
BB	Bridge abutment - Bottom
BC	County line
BD	Building (outline of building on photogrammetry or sill shots for ground survey)
BE	Ground at/near building
BF	Exposed bridge footing - Bottom
BG	Bridge deck
BH	Headwall, culvert end - Bottom
BL	Beam guard rail - Left
BM	Berm
BN	National forest line
BP	Property line
BR	Beam guard rail - Right
BRC	Right-of-way, controlled access
BRL	Right-of-way, limited access
BRW	Right-of-way line
BS	Bottom of slope
BSL	State line
BT	Town line
C	Index contour
CE	Proposed construction easement
CL	Curb - Left
CM	Cemetery
CO	Center of road
CP	Concrete Pad (gas station island; etc.)
CR	Curb - Right
DB	Dam - bottom
DE	Proposed drainage easement
DF	Double face beam guard rail
DL	Ditch line

DM	Dam
DP	Drainage pipe (Survey: use IGL for dir. shots)
DR	Driveway
DS	Magnetic detector sleeve
EJB	Expansion joint
EP	Edge of pavement
FA	Stream or river flow arrow (AERIAL SURVEYS ONLY)
FB	Fence - Barbed wire
FD	Foundation/Ruin
FM	Miscellaneous detail features - Feature string
FO	Fence - Other
GA	Gate
GL	Cable guard rail - Left
GP	Gas pumps
GR	Cable guard rail - Right
HE	Hedge
HW	High water mark
JB	Jersey barrier
L	Level string
LC	Street light conduit
LF	Leachfield
LM	Lane markings
LP	Limit of pit
LW	Limit of work
OA	Obscured area (aerial surveys)
OB	Obscured area of bridge (aerial surveys)
OG	Old ground
OR*	Lawn features (flower beds; etc.)
PANC	Guy wire anchors
PBDR	Boulder
PBMK	Bench mark
PBND	Bound
PBOR	Boring
PBTH	Public telephone
PBUS	Bush
PCBD	Catch basin top
PCCT	Controller cabinet
PCON	Right-of-way bound
PDAT	Satellite dish
PDHL	Drill hole
PDID	Drop inlet top
PEBV	Spot elevations (bridge)
PELV	Spot elevations
PFPL	Flag pole
PFTK*	Fuel tank
PFTR	Fire tower
PGAS*	Gas pump
PGLT	Ground light/yard light
PGRV	Gravestone
PGSO	Gas shutoff
PGUY	Guy pole or stub
PHHL	Handhole
PHYD	Fire hydrant

PIPN	Iron pin or pipe
PJCT	Utility junction box
PJNT	Joint power and telephone pole
PLIT	Light pole
PLPT	Lamp post/private light pole
PLTJ	Light on joint pole
PLTP	Light on power pole
PMAP	Mast arm pole
PMBF	Miscellaneous detail features - point string
PMBX	Mail box
PMDF	Miscellaneous detail features - Point string
PMHD	Manhole - Drainage
PMHE	Manhole - Electric
PMHG	Manhole - Gas
PMHS	Manhole - Sewer
PMHT	Manhole - Telephone
PMHW	Manhole - Water
PMON	Monuments/statues or other related items
PPBX	Pullbox
PPOL	Pole
PPST	Post - all types
PPTR	Transmission line tower
PPWR	Power pole
PRJM	Project marker
PRSL	Railroad signal
PRSN	Railroad sign
PRSW	Railroad switchstand
PSGL	Traffic signal without mast arm
PSGN	Sign - Single post
PSLM	State line marker
PSND	Sign - Double post
PSSA	Survey traverse string
PSTK	Septic Tank
PSTP	Stump
PSTT	Storage tank fill cap
PSUM	Catch basin/Drop inlet sump
PSWP	Swamp symbol
PTCS	Tree - Coniferous
PTDS	Tree - Deciduous
PTEL	Telephone/telegraph pole
PTLM	Town line marker
PVNT	Vent pipe - Outlet
PWEL	Well
PWGT	Water gate
PWSO	Water shutoff
QP	Pool
QS	Stockpile/lumber pile
RD	Ridge line
RM	Ramp - Boat; etc.
RO	Rock outcrop
RP	Rip-rap
RR	Railroad
RL*	Retaining wall - Left ---^---^---

RW*	Retaining wall - Right ---v---v---
SC	Signal conduit
SG	Storage tanks
SK	Sidewalk
SL	Shore line - Left
SD*	Loop detector
SN	Sign - Billboard or other large sign (string feature)
SO	Stockpile
SP	Steps
SR	Shore line - Right
ST	Intermittent or small stream
SU	Sluiceway
SW	Stone wall
TB	Bridge abutment - Top
TC	Curb - Top
TF	Exposed bridge footing - Top
TH	Headwall - Top
TL	Trail
TP	Top of bridge pier
TR	Retaining wall - Top
TS	Top of slope
TW	Edge of traveled way
UD	Underdrain
UE	Underground Electric
UG	Underground Gas
US	Underground Sewer
UT	Underground Telephone
UW	Underground Water
WA	Swamp/marsh or wet area
WB	Wing wall - Bottom
WD	Delineated wetland
WF	Waterfall
WL	Woods line or brush line - Left
WR	Woods line or brush line - Right
WS	Waste
WT	Wing wall - Top
Z*	Intermediate contour

* Added or modified since previous version

APPENDIX G – MX DESIGN STRING LABELING CONVENTION

Mainline alignment ..... MC-M
Side Road alignment ..... MC-A
Detour alignment ..... MC-B
Driveway alignment ..... MC-D
Preliminary alignment ..... MC-P
Ramp alignment ..... MC-R
Survey alignment ..... MC-S
Railroad alignment ..... MC-T
Road Center Line (Geometry) ..... GC
Road Center Line (Proposed Elevations) LC
Road Center Line (Old Ground Elevations) ..... OC
Roadway (Edge) ..... CE
Formerly TW
Roadway (Hard Strip) ..... CS
Boundary between travel lane and median
Roadway (Hinge) ..... CH
Used for line separating travel lane from widened section
Roadway (Curb Return) ..... CR

Shoulders (Edge)
Formerly EP ..... ES
Shoulders (Shoulder rollover) ..... ER
Shoulders (Top of Curb) ..... ET
Shoulders (Back of Curb) ..... EB
Shoulders (Front of Sidewalk) ..... EW
Shoulders (Back of Sidewalk) ..... EX
Shoulders (Level Datum) ..... EH
Top of slope, 0.3m (1') from ES string
This is the string to be used as the datum string for INTERFAC macros

Earthworks (Cut left) IL
Formerly ICL
Earthworks (Cut right) ..... IR
Formerly ICR
Earthworks (Fill) ..... IF
Earthworks (Front of Ditch) ..... ID
Earthworks (Back of Ditch) ..... IE
Earthworks (Cut Berm) ..... IB
Earthworks (Fill Berm) ..... IS
Earthworks (Widened area for 2:1 slopes) ..... IY
Earthworks (Top of Slope) ..... IZ
Earthworks (Rounding) ..... R

Traffic Island () ..... TI
Traffic Island () ..... TJ
Traffic Island (Flowline) ..... TF
Traffic Island (Top of Curb) ..... TT
Traffic Island (Back of Curb) ..... TB

Curb Return (M String) ..... MR

APPENDIX H – MX ALIGNMENT DATA FORMATS (HALGN & VERAT)

HALGN

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=0.500
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
```

Description of HALGN Format

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

`EDIT,PALIGN` ..... Tell 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 page 55 for the appropriate fourth character.

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

```
999 ..... Tell 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=0.500
                                  Initiate the alignment.
                                  LB = Alignment label
                                  SC & CF are start station.  These numbers should match
                                  CE = Station interval.  Typically 10 for metric projects, 25 for Imperial
                                  TL is a curve tolerance, use 0.5
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=385 623.90322
                                  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
```

VERAT

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
```

Description of VERAT Format

MOSS	MX files begin with this line to clear any previous errors
VERAT,PALIGN,PALIGN	Begin the HALGN 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	Tell MX to end the VERAT command

APPENDIX I – 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
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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