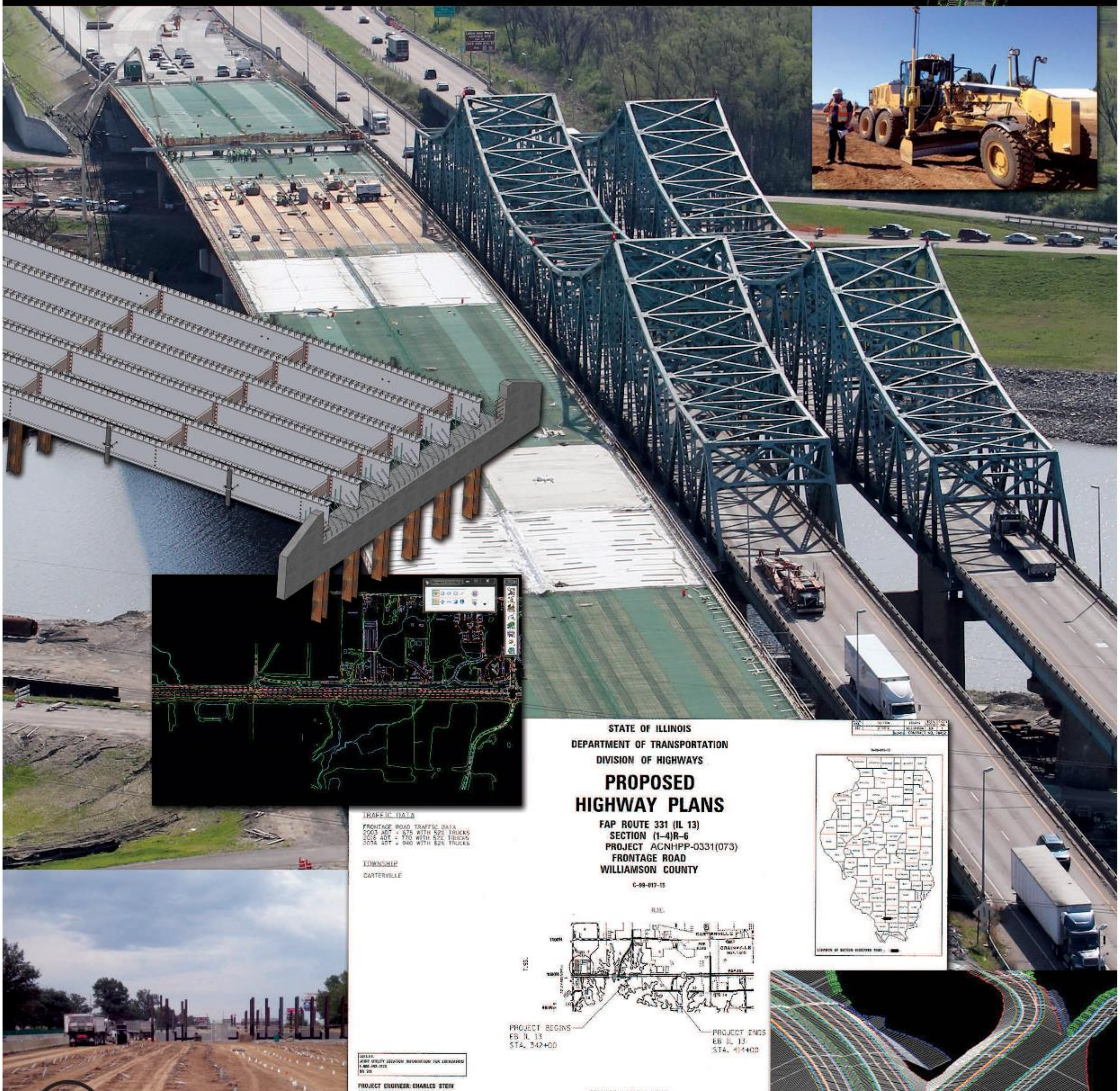
State of Illinois
Illinois Department of Transportation

Computer Aided Design, Drafting, Modeling and Deliverables Manual



Computer Aided Design, Drafting, Modeling and Deliverables Manual

Prepared by:

The Illinois Department of Transportation

Office of Highways Project Implementation

Bureau of Bridges and Structures

Bureau of Design and Environment

Springfield, Illinois

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Document Control and Revision History

The Illinois Department of Transportation *Computer Aided Design, Drafting, Modeling and Deliverables Manual* is owned by the Illinois Department of Transportation Bureau of Design and Environment. The manual is reviewed during use and updated by the Bureau of Design and Environment, as necessary.

This manual (April 2017 version, including all subsequent revisions) is a substantial revision and consolidation of previous versions of the *CADD Roadway Drafting Reference Guide*, *CADD Structures Drafting Reference Guide*, and the *CADD Roadway and Structures Project Deliverables Policy*. The manual will be updated by the Department on an as needed basis.

Electronic copies of this policy can be downloaded at the websites below. Interim changes are communicated through the IDOT CADD Support subscription service; see Section 5-3.

http://www.idot.illinois.gov/doing-business/procurements/engineering-architectural-professional-services/Consultants-Resources/

Archived versions of this manual are available for examination at the IDOT Policy and Research Library, 2300 S. Dirksen Parkway, Room 320, Springfield, IL.

This manual is not distributed in hard copy format. Users of this manual who choose to print a copy are responsible for ensuring use of the most current version.

The latest revisions are indicated in the left margin by the bold double line as seen in next paragraphs.

May 2017:

New web links above on this page and in Section 5.

May 2018:

Miscellaneous minor revisions based on feedback of original release.

Web links added to the Table of Contents and throughout the Manual.

Section 2- Corrected incorrect Section references and re-named “Tables” to “Figures” where necessary.

Section 2-3.01 – Added language requiring communication of design collaboration decisions as part of the initial survey request in order to guide survey density.

Section 2-5.02(e) – Removed strip filename for survey ground shots. Improved descriptions for other survey strip filenames.

Section 3- Corrected incorrect Section references where necessary.

Section 3-6.03- Updated reference to the Department’s new standardized Survey Point Code Descriptions, now located in Appendix I.

Table 3-9.A- Updated Bridge Dimension Styles.

Section 3-16.02- Updated reference to the Department’s new standard Survey Settings, now located in Appendix J.

Section 4-4.02 – Added standard structures sheet to the list of plan sheets with cross-reference to IDOT’s Bridge Manual.

Section 5-1: Updated District and Central Office Contact information as needed.

Section 5-6 – Removed file transfer options other than ProjectWise. All submittals from consultants shall use ProjectWise for submittal.

Appendix B – Added new level Topo_Point SPC Cell for placement of survey point cells which use the SPC cell, which appears as a dot of heavy weight.

Appendix D – Added roadway text styles for bold and italic. Font named Franklin Gothic replaced with Swiss Bold Condensed.

Appendix E – Additional feature definitions for civil cells added.

Appendix I - Added this appendix listing Survey Feature Definitions.

Appendix J - Added this appendix listing Survey Project Settings.

July 2021:

General- Miscellaneous minor text and formatting, misspelling and punctuation corrections.

Section 1 – Reorganized sub-sections and added new information regarding 3D modeling.

Section 2-1 – Added info to General Information.

Section 2-1.01(a) – Added Project Content file guidance for LiDAR projects.

Section 2-3.01(b) – deleted mesh surfaces and LiDAR raw data to be expanded and added into new sub-section on LiDAR deliverables and additional LiDAR guidance in Appendix K.

Sections 2-3-01(b).1 thru 2-3-01(b).4 - Added LiDAR deliverables sub-sections.

Section 2-3.02 – Added note for Phase I.

Section 2-3.02(d) – Added language to 2D DGN section on delivery.

Section 2-3.02(g) – Updated what information is to be submitted electronically to BDE.

Section 2-4.01 (c) – Added discussion on model creation due to maintenance of traffic.

Section 3-1 – Included listing of currently available point cloud software for internal staff use.

Table 2-5.B – Added names for survey point clouds and meshes.

Table 3-11.B – Updated structure cell library names.

Table 3-14.A – Updated civil cell library names.

Section 3-16.01(c) – Added recommendation that corridors should be no larger than 10 MB in size.

Section 3-20 – Added where to find current list of IDOT Visual Basic applications (VBAs).

Section 4-3.04(e) - Renamed bridge.cel to CADD-Elements.cel.

Section 4-8 – References to Axiom Office importer removed.

Section 4-8.01- References to Axiom Office importer removed.

Section 4-9 - Renamed bridge.cel to CADD-Elements.cel.

Section 5-1 - Updated District and Central Office Contact information as needed.

Section 5-2 – Updated menus to match website and added new links.

Appendix B – Added and modified several levels to match level library.

Appendix C – Added Table C.2.

Appendix E – 11 feature definitions added.

Appendix H – Removed/reserved.

Appendix I – Added codes 698 and 704.

Appendix K – Added this Appendix for LDAR Specs and best Practices.

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APPENDICES

SECTION 1 INTRODUCTION

This Computer Aided Design, Drafting, Modeling and Deliverables policy manual has been established by the Illinois Department of Transportation (IDOT) to promote the development of highway improvement projects in a consistent and efficient manner.

This manual consolidates and supersedes all previous versions of the:

IDOT CADD Roadway and Structures Deliverables Policy,

IDOT CADD Roadway Drafting Reference Guide, and

IDOT CADD Structures Drafting Reference Guide.

The policies within this manual provide MicroStation, GEOPAK, OpenRoads, and other design and modeling information that shall be used for:

1. The preparation of roadway plans for the Illinois Department of Transportation,
2. The preparation of structure plans for the Illinois Department of Transportation,
3. The preparation of three-dimensional (3D) models used for measurements and Automated Machine Guidance (AMG) in construction projects of the Illinois Department of Transportation, and
4. The preparation of deliverable files to various units within the Illinois Department of Transportation at various stages in the project lifecycle.

This policy manual is established to ensure that, for any given project, IDOT will receive Computer Aided Design and Drafting (CADD) drawings and 3D models that are in a standard and consistent format. This manual defines requirements for providing acceptable deliverables throughout the phases of the project in a uniform format.

The goal of the Department is to take advantage of technology and develop a process for 3D electronic plan development and submission. In order for that to happen, there must be a level of consistency for drafting, modeling, and managing files between all involved entities. The end product must be a deliverable that the Department and its consultants and contractors can use and is compatible with all other associated processes the Department manages.

The Department requires CADD highway project data in Strip Map format. Contract Sheet Files shall be created using references of the Strip Map Files to the Sheet Files; see Section 1-2 for definitions. This policy manual contains the requirements that must be met in order to provide an acceptable deliverable.

Adherence to this policy manual is a term of all IDOT consultant contracts involving CADD, unless specified otherwise by the District Project Manager.

1-1 PURPOSE

This manual represents a significant update to IDOT's CADD policy and standards. It incorporates updated information based on advances in technology and it addresses many changes in the way modern roadway and bridge projects are being designed and constructed. Additionally, this document merges into one manual what was previously three different manuals covering roadway requirements, structure requirements, and deliverables requirements.

Specifically, the requirements in this manual are intended to address the current ongoing shift from printed design documents towards growing demand for 3D models and the Department's transition to a workflow where 3D models are an integral component during every stage of the project's life cycle- including tasks from survey, planning, design, geotechnical investigation, utility coordination, and land acquisition activities within program development; conflict mitigation, Automated Machine Guidance (AMG), and as-built plan retention during construction; and field maintenance, inventory, and asset management activities during facility operation. Creating these models efficiently and consistently is a primary motivator in the development of this manual.

This manual is not a training guide for performing design functions or building 3D models. A reader of this manual who lacks training in the use of the various software referenced herein may not fully comprehend every nuance of the details of requirements. Therefore, it is strongly recommended that some portion of every internal and external project team be fully versed in the technical capabilities of the software referenced in this manual.

This manual is not a training guide in the use of the IDOT workspace which enables the production of models and plans generated by the design software. While this manual includes significant discussion of various parts of the workspace, the discussion herein shall not be construed as complete instruction in the use of the workspace. For more information regarding the Department's current CADD workspace, including downloads, sample plans, and an ever-expanding CADD and GIS how-to video library, see Section 5-2 of this manual, or contact the Technology Policy & Support Manager in the Bureau of Design and Environment.

1-2 MANUAL OVERVIEW

Sections of this manual are defined as follows:

Section 1 - Introduction.

Section 2 - Deliverables Policy is applicable whenever data is exchanged. It covers requirements for exchanging data between IDOT units, IDOT consultants, and IDOT contractors at various phases of the project life. A detailed list of electronic deliverables is included. This section also describes requirements for file naming, folder structure, and reference file structure.

Section 3 - Design Time Workspace is applicable to workflows during design time and describes CADD and Modeling Standards for IDOT roadway and structures projects. It provides quick reference to the standards that are in place, as well as the relevant tools and workflow steps that utilize them.

Section 4 - Plans Production Workspace describes requirements for preparation of contract plan documents for both electronic and hard copy form, including information such as annotation and sheeting requirements, as well as quantities reporting requirements.

Section 5 - Internet and Contact Information provides miscellaneous business information of interest to IDOT employees, consultants and contractors. It also includes a link to a set of example construction plans in proper IDOT format.

Appendices – provides a variety of lists of information which are too large to fit in the body of the text. This section also includes answers to Frequently Asked Questions and additional information on Light Detection and Ranging (LiDAR) entitled, *LiDAR Data Collection and Processing Overview.*

1-3 DEFINITIONS

The following are descriptions of various terminologies, as used in this manual:

3D Model: A digital representation of any three-dimensional object. A 3D model may consist of any of the following 3D element types: lines, meshes, terrain models, and/or solids. For the Department's purposes, a 3D model is a digital representation of a specific project, or components of a project, in various 3D file formats; see Section 2-4.

4D Model: The dimension of time is added to a 3D model. A 4D model combines the 3D model with a project schedule, including construction phasing and Maintenance of Traffic (MOT) issues, to create a simulation of all proposed construction activities on a project. Although the development of 4D models is not currently discussed in this manual, this is an area which is established in the construction industry and for which it is expected that future versions of this manual will address.

5D Model: The dimensions of both cost and time are added to a 3D model. A 5D model combines the 3D model with both a 4D project schedule and a 5D estimate of cost over time, which can help forecast or predict the flow of finance for a project from initialization through completion. Although the development of 5D models is not currently discussed in this manual, this is an area which is being quickly established in the construction industry and for which it is expected that future versions of this manual will address.

Automated Machine Guidance (AMG): The process of enabling construction machinery with geospatial positioning system (GPS) equipment and providing a 3D model of the construction surfaces in order to provide the operator of the equipment with visual and automation tools to optimize the construction process. The tools available include visual feedback of the virtual model in relation to the construction equipment position and automatic positioning of the equipment cutting attachments.

Contractor: A company or individual contracted by IDOT to perform construction activities on an IDOT project.

Consultant: A company or individual contracted by IDOT to perform engineering services.

Designer: Any IDOT or Consultant technician or engineer working on survey, planning, modeling, or design aspects of a project. For specific responsibilities of the Designer; see *Bureau of Design and Environment Manual* Section 63-1.01.

Design Surveys: The survey function performed for mapping and modeling of existing features for use of developing proposed roadways or structures design(s).

Phase I: The time during a project's life when planning and study activities are performed. Major activities during Phase I include design survey and geometric studies. It should be noted that the use of computer methods, especially 3D design workflows, enable the designer to shift many activities forward from Phase II to Phase I. For example, the workflow to produce corridor designs also produces geometric layouts of the pavement and lane edge lines. Because of this, it is reasonable to expect that more complete 3D models will exist in Phase I even though these are not required deliverables in Phase I.

Phase II: The time during a project's life when contract plans are developed. Major activities during Phase II are roadway design, structures design, and right-of-way acquisition.

Phase III: The construction phase of a roadway or structures project, including letting activities.

Phase IV: The post-construction phase of a project which includes various activities related to maintenance, operations, and asset management.

Project Content File: An electronic document which lists and describes the files used to build a complete project dataset. The dataset usually consists of various DGN CADD files along with the GEOPAK ancillary files used to perform engineering and modeling calculations. This file will also describe the contents of each file, especially the location of alignments and profiles and the components which compose 3D models. The Project Content File may be in spreadsheet form or a text document.

Project Engineer: The IDOT Engineer in the district Design Section who oversees the work of one or more Designers and is directly responsible for the project's development.

Project Manager: The IDOT district representative who is directly responsible for the project's management and coordination. This is often the main liaison between the Project Engineer or Consultant and other units within the Department.

Sheet File: Sheet Files are made up by referencing various Strip Map Files onto a defined border. Whereas Strip Map Files are long and narrow along the entire project length, Sheet Files are broken by match lines so that a given sheet covers only a short station interval along the length of the project.

Strip Map File: DGN files used for various design or surveying purpose used in the development of a roadway project. These files are prepared in long strips which following the roadway alignments and are generally not segmented at sheet match lines. For example, the topography strip map will generally contain all the topography for the entire project's length and a defined width. Likewise, the rights of way and property line information will be contained in a single long strip. For very long projects, it may be desired to divide the length of the project into two or more strip maps per type. Strip Map Files shall be developed using the Illinois state plane coordinate systems with appropriate geographic coordinate system assigned to the DGN files.

Subsurface Utility Engineering (S.U.E.): The specialization of engineering and surveying concerned with the location and depiction of existing underground utility assets using a variety of direct measure and remote sensing technologies.

IDOT Organizational Units: The following are descriptions of the various organizational units within the Department, as used in this manual. It is noted that the specific arrangement of these units may vary by district. The Designer will coordinate with the Project Manager to ascertain the specific embodiment of these functions for each project:

Construction Unit: Those persons or groups charged with the execution and management of construction activities, including but not limited to staking, earth moving, paving, and installation of drainage structures, as well as the administrative tasks associated with these activities.

Design Survey Unit: Those persons or groups charged with developing the topographic maps and terrain models of the exiting conditions of a proposed project.

Drainage (Hydraulic) Design Unit: Those persons or groups charged with the design of and review of the drainage aspects associated with a project. In some districts the design function is performed by the Roadway Design Unit with review being performed by the Drainage Unit.

Environmental Studies Unit: Those persons or groups which perform the environmental investigations required for a project. As a part of this process, this unit will define the required design adjustments or mitigations resulting from any environmental findings and manage the permitting process for the project.

Geometrics Design Unit: Those persons or groups which provide the geometric details for a project and any associated studies. A typical example of this unit's work is the development of the required geometries (horizontal and vertical alignments, radii, storage lengths, etc.) of intersection or interchange layouts.

Land Acquisition Unit: Those persons or groups which define the existing property and right of way boundaries and manage the process of acquiring additional rights of way when needed.

Lighting Design Unit: Those persons or groups which provide the design and layout of the roadway lighting needed on a project.

Roadway Design Unit: Those persons or groups assigned the tasks of developing contract plans as well as the 2D and 3D models of the designed features. In some districts this unit will also perform the design functions related to drainage.

Signal Design Unit: Those persons or groups which provide the design and layout of the traffic signal equipment needed on a project.

Structures Design Unit: Those persons or groups which provide the design and layout of the bridges, box culverts, retaining walls, and sign structures on a project.

Utilities Unit: Those persons or groups which coordinate with utility owners to provide information for development of maps of existing utilities and to manage any required utility relocations.

Throughout this manual, the following prescriptive language is intended:

- If the word "shall" is used, the described action or policy is a requirement to be followed by all internal and consultant designers.
- If the word "should" is used, the described action or policy is a recommended best practice. The Designer is strongly encouraged to use the described action or policy, but substitutes will be accepted if the intent of the requirement is achieved.
- If the word "may" is used, the described action or policy has been found to produce a satisfactory result. An action described as "may" will sometimes appear in this manual to accompany a "should" declaration. In this case, either described action is considered equally valid.

1-4 BENEFITS OF CADD STANDARDS

With the increased use of 3D models during all stages of IDOT projects, along with the normal increase in complexity of projects, it becomes increasingly important to maintain and follow a CADD and modeling standard so that projects can progress efficiently through each phase of the project life. Efficiency is realized when all participants of an IDOT project, both internal and external, can expect that all projects will follow a consistent policy format for CADD and 3D modeling across all districts. This consistency also builds a foundation for future modeling needs and asset management activities which may develop with further advancements in technology.

When creating printed plan sets, it was usually enough to follow basic symbology guidelines. Blunders in implementation of a CADD standard with paper as its final product could tolerate some failure in following the prescribed standards since there was still a failsafe check of the printed plan set.

With the increased complexity of 3D modeling, however, a stricter adherence to CADD standards is necessary. CADD elements have become much more than simple graphics on the computer screen. Today, those elements contain large amounts of “intelligent” information that dictate not only the appearance of the elements, but also how each is used to create the final 3D model. In such a design and modeling paradigm, it is important that consumers of the data be able to efficiently review and retrace the survey and design data and be able to construct workflows to parse the data for construction workflows in a predictable manner.

The standards documented herein, when used consistently, result in CADD files and models which will produce both the printed plan documents as well as properly constructed 3D models. When properly applied, these standards will result in:

- An efficient single standard used throughout IDOT, its consultants, and contractors,
- Reduced design and quantity errors,
- Properly constructed 3D models required to feed Automated Machine Guidance (AMG) for more efficiency in construction,
- Simplified Quality Assurance /Quality Control (QA/QC) processes,
- A streamlined construction bid process using 3D models,
- Data integrity preserved throughout the entire life cycle of projects, and
- Compliance with the Federal Highway Administration (FHWA) and industry’s best practices.

1-5 BENEFITS OF 3D MODELS

Many contractors have been utilizing automated machine guidance for many years. In order to generate the necessary data, traditional 2D plans are converted by the contractor into 3D files required to operate the automated machinery. While it started as a tool to increase construction productivity, contractors learned that it also had the additional benefits of providing more accurate bids and identifying errors and omissions in the engineering documents.

Technological advancements in roadway and structure surveying, design, and construction processes are driving the transportation industry toward the development of 3D models by agency personnel during the planning and design phases, and the utilization of these geospatial models by both agency field personnel and the contractor using global positioning system (GPS) survey equipment and automated machine guidance (AMG), respectively, during construction activities.

Beyond automated machine guidance, 3D models are an enabling technology for a variety of activities including conflict detection, improved QA/QC, and stakeholder review. As a result, many Departments of Transportation, including IDOT, have set goals for developing 3D models for road and structures designs. Incorporating 3D models into the design process provides the following additional benefits to that of the list shown in Section 1-4:

- Enables cost savings during construction by utilizing Automated Machine Guidance,
- Improves construction documents, which provides more detailed information to the construction team,
- Increases efficiency when conducting construction measurement tasks,
- Details visualization for stakeholder buy-in on projects,
- Enhances identification and resolution of conflicts, issues, design errors, and omissions prior to construction,
- Offers intuitive subsurface visualization, thereby reducing utility conflicts and delays,
- Optimizes material usage and increased bid quantity accuracy,
- Increases productivity during the design and bidding phases, by relaying the information in a more efficient manner, and
- Allows for efficient incorporation of detailed as-built information into the asset management system.

The primary goal of a Department generated 3D model is to fully convey the design intent of the specific project, especially in areas traditionally not well-defined in 2D plans and cross sections.

The primary customers for the 3D model are the designer (to define and validate the design), the contractor (to construct the proposed surface), and the Department’s field personnel (to pay the contractor for field quantities and verify plan adherence).

1-6 CONCEPT STATEMENT

It is the desire of the Illinois Department of Transportation to implement 3D Engineered Modeling from project conception and initiation through maintenance and operations. At a high level, this concept of “cradle to grave” model-based electronic design data involves the following key steps:

1. Collection and development of geospatially located survey data for development of an accurate existing model.
2. Utilization of the survey model in design, with design software capable of 3D model output.
3. Output of critical electronic deliverables for use in bidding and letting the project.
4. Utilization of the electronic deliverables in constructing the project in an automated fashion (i.e., automated machine guidance, stakeless paving, etc.).
5. Field collection of as-constructed and inspection measurements using modern surveying tools, relative to the model.
6. Archiving of the electronic model for future use, including asset preservation and management.

This manual will reflect the Department's move to 3D modeled design and will be updated as technology and need evolve.

1-7 STANDARDS DOWNLOADS AND SUBSCRIPTIONS

The files, configuration, and other standard files which are needed to satisfy the requirements of this policy manual are available under the support sections of the web links shown in Section 5-2. The current CADD software versions used by IDOT are also shown on these pages along with additional resources. On these web pages, the Designer can also subscribe to be notified of both updates to this manual and IDOT's CADD workspace, view sample roadways and structures plans, and access an ever-expanding CADD and GIS how-to video library.

SECTION 2 DELIVERABLES POLICY

2-1 GENERAL INFORMATION ABOUT DELIVERABLES

This section defines the requirements for delivery of electronic files, the workflows for submittal of electronic files, including electronic versions of sheets, and the file and folder structure to be used on IDOT projects.

For requirements related to design and modeling, see Section 3 of this manual.

For requirements related to plans production, see Section 4 of this manual.

For files, configuration, and other information needed to satisfy the requirements of this policy manual, see Section 5-2.

For additional information regarding survey types and accuracy, see the *IDOT Survey Manual*.

For additional information regarding LiDAR (Light Detection and Ranging), see Appendix K of this manual entitled, *LiDAR Data Collection and Processing Overview.*

At each stage in the lifecycle of a project is a need to exchange data between various groups involved in the project development and to pass data forward for the next stage in the process. The intent of this chapter is to define required data formats for exchanging data and to outline the workflows for each type of exchange.

2-1.01(a) Project Content File

A Project Content File shall be transmitted every time an exchange of data occurs. The Project Content File shall list every file submitted and shall contain a description of:

1. The content of every file, including sheet number, area, and stationing, if applicable.
2. For files which contain 3D models, a description of the levels on which the 3D model information (surfaces, terrain models, and 3D line strings) are located:
   - A. See Section 2-3.03 for information on 3D deliverables and Appendix B for proper level assignments.
   - B. For each corridor, the Project Content File shall list:
     - a. The name of the corridor,
     - b. The levels on which the corridor surfaces and 3D line strings are located, and
     - c. The template library and names of the templates used.
   - C. For structures models, the Project Content File shall list the files which form the 3D structure model and a general description of the contents of each file.

D. For LiDAR models, the Project Content file shall list the file names containing each point cloud tile and the location of each tile in the overall tile grid.

The information included in this Project Content File shall be required for every data exchange even when the exchange occurs between units, sections, bureaus, offices, or districts within IDOT, or its project development consultants, and even when there is no physical exchange of files, such as when the data is stored on shared servers.

The Project Content File shall also include a list of all centerlines, baseline, and associated proposed profiles of all roadways, ditches, or tops of retaining walls and bottoms of retaining walls contained in the DGN files and/or GPK files. This list shall include the names of these alignments and a short description.

Acceptable formats for the Project Content File are:

- Text file
- Microsoft Excel
- Microsoft Word

Methods for submittal of electronic files are defined in Section 5-6.

2-1.01(b) Frequency of Submittals

The Project Manager may request a copy of the electronic project files at any reasonable time or at various designated review stages of the project. The frequency of submittals for plan review should be established at the beginning of the project.

2-2 COORDINATION

After review of this and other relevant manuals and coordination with internal staff, the IDOT Project Manager shall determine at the beginning of the project:

1. How files are to be delivered at each phase of the project life cycle and the procedures to be followed,
2. The types and limits of survey,
3. The anticipated needs of data exchange based on the following:
    1. Project type/scope,
    2. Project complexity,
    3. Whether design will be completed in-house, by a consultant(s), or a hybrid of both.
4. Whether roadway 3D models will be required, and for which portions of the project 3D roadway models will be developed,

5. Whether bridge 3D models will be required, and for which portions of the project 3D bridge models will be developed. Note the decision of whether to produce 3D bridge models will be determined upon coordination with the IDOT Bureau of Bridges and Structures,
6. Maximum length of any corridor in a DGN file to optimize for performance and files size (See Section 3-16.01(c).

For projects with consultant involvement, this communication should be included in the scope of services meeting.

2-3 DATA EXCHANGE AT VARIOUS LIFECYCLE STAGES

During each phase of the project life there is a need to exchange data for both review and for downstream activities within the project life. It is important to note that this section attempts to describe all potential data exchanges during the life of any given project. Not every data exchange described here will be part of every project. As such, the remaining portions of this section should be seen as a statement of need for the most complex of projects. For a given project, there may be additional required transfer of data which is not defined in this manual. Key individuals involved in the hand-off of project development data, including the CADD Manager, Surveyor, and Designer should discuss data exchange needs with the Project Manager.

It is important to note that for many of the data exchange items in this section, the deliverables describe a 3D CADD file as desired or preferred, but allow for a 2D, or paper, alternative. In these sections, the designer is encouraged to discuss the best option with the Project Manager. See *Bureau of Design and Environment Manual* Section 63-1.03a for a description of the criteria which is used to determine whether a 3D model will be required for a particular project.

The following extreme examples are offered for guidance:

- Example 1 - A project which is a major relocation of alignment with significant amounts of earthwork:
  a) This project is ideally suited for full 3D modeling of the roadway corridors.
  b) If there are many existing utilities along the project route, then there may be great benefit in also modeling the utilities. However, the Utilities Unit for the project may not be ready to accept or produce such models and may request 2D CADD or paper deliverables instead.
  c) Similarly, for other deliverables at each stage of this project, while a 3D deliverable may be ideal, the particular staff assigned to the project may not yet be adequately equipped to benefit from a 3D model.
- Example 2 – 3P and SMART projects are, by their nature, less benefited by production of 3D models. For these projects, the deliverables may typically be more oriented to 2D deliverables at most phases of the project life.

The CADD Standards in Section 3 and Section 4 are developed to satisfy both 2D and 3D deliverables.

The following sections describe which files may be required for exchange during the project life and the workflow to exchange and/or produce those files. The naming of work units throughout this Section has been generalized and may include in-house and/or consultant personnel. For projects involving consultants, the appropriate project submittal to the Department is generally at key project milestones to the District CADD Manager or Project Manager, as determined during the scope of services meeting.

It should be noted that the use of computer methods, especially 3D design workflows, enable the designer to shift many activities forward from Phase II to Phase I. For example, the workflow to produce corridor designs also produces geometric layouts of the pavement and lane edge lines. Because of this, it is reasonable to expect that more complete 3D models will exist in Phase I even though these are not required deliverables in Phase I.

Phase I (Studies)

1. Roadway Design deliverables for Surveys
2. Data exchange between Design Surveys and Roadway Design and/or Structures
3. Data exchange between Roadway Design and Structures
4. Geometrics Design deliverables to Roadway Design
5. Geometrics Design deliverables for preliminary Signal Design
6. Deliverables from Environmental Studies

Phase II (Plan Design)

1. Data exchange between Roadway Design and Land Acquisition
2. Data exchange between Roadway Design and Utilities
3. Data exchange between Roadway Design and Drainage (Hydraulics) Design
4. Data exchange between Roadway Design and Structures
5. Geotechnical design deliverables to Roadway Design
6. Materials design deliverables to Roadway Design
7. Operations design deliverables (traffic signals, signing, striping, traffic control plans, and/or detour route plans) to Roadway Design
8. Deliverables from Roadway/Structures Design to Bureau of Design and Environment

Phase III (Construction)

1. Deliverables from Roadway Design to Construction
2. Deliverables from Construction to Design

Phase IV (Maintenance and Operations)

1. As-Built Models – As of this writing, Phase 4 is recognized ONLY as a future desire to collect as-built information for use in various asset management workflows. However,

the documentation of collecting and delivering as-built information is NOT defined in this manual and is reserved for future study.

The *Bureau of Design and Environment Manual* Section 63-1.02 contains additional information about the various plans development activities in the various phases.

2-3.01 Phase I Deliverables

2-3.01(a) Deliverables from Roadway Design to Surveys

For general survey needs, the Project Manager shall submit a survey request to the district Surveys Unit early in Phase I, which defines the type of survey needed and general limits of the project. Additional pickup survey requests may become necessary throughout Phase I and Phase II and shall be initiated by the Project Manager.

The survey request shall include the decisions made during project coordination discussions, as described in Section 2-2, including whether the design shall be done in 2D or 3D and whether any 3D design shall be matching existing pavement cross-slopes or reprofiling/correcting cross slopes. In general, 3D models require denser survey data collection than 2D designs and matching of cross-slopes requires denser survey data than when correcting cross-slopes.

If requested by the Surveys Unit, any existing electronic files which contain information in the project area shall be transmitted to the Surveys Unit along with the request. This information may consist of DGN files, terrain models, geometric layouts, alignments, pictures (.jpg files), point cloud data, or miscellaneous other information.

2-3.01(b) Deliverables from Design Surveys to Roadway Design and/or Structures Design

When delivering survey information, the package of deliverables will consist of all those DGN files which contain the final processed survey map information and terrain model information.

The following description of deliverables from Surveys to Roadway Design is only for the purpose of advancing the project development and design. There are additional deliverables requirements for the surveyor for purposes of review by the Surveys Unit. See *Appendix B, Electronic Survey Data Requirements*, of the *IDOT Survey Manual* for these additional requirements. A link to the *Survey Manual* is shown in Section 5-2.

At the completion of Design Surveys activities, or at intervals as defined by the Project Manager, the following information shall be provided to the Roadway and/or Structures Designer:

1. A full description of the geographic coordinate system which is used for the survey and any project specific adjustment factors (such as elevation factor or combined scale/elevation factor) that have been applied to develop a local coordinate system for the project.

2. One or more Strip Map Files which contain:
   A. Alignment DGN files and any accompanying GPK file,
   B. The final topographic maps,
   C. Any property or right of way information located in the survey process, and
   D. All surveyed features and property information.

   Note the following:

   a. Topographic information should be contained in 3D DGN files, as this will maximize the potential use of these files for creation of terrain models.
   b. Property and right-of-way information should be contained in 2D DGN files which facilitates more efficient land area computations.
   c. Existing utilities and drainage systems should be contained in 3D DGN files consisting of the following:

      i. 3D line strings showing the position of existing underground utility lines, cross-drain pipes, and storm sewer pipes. The position of this line string is presumed to be the top of conduit for non-gravity systems and invert (flow line) of gravity systems, unless otherwise designated.
      ii. 3D points marking the top (rim) elevation of any node structures such as manholes, catch basins, valves, meters, and such.
      iii. 3D points marking the extreme bottom elevation of node structures where feasible and practical to collect.

3. One or more existing terrain models, with the following expectations:
   A. It is expected that there will usually be a terrain model of the existing ground surface which covers the entire project.
   B. There may also be additional terrain models used to depict auxiliary surfaces such as bridge decks.
   C. There may be additional terrain models for subsurface layers of earth, such as rock layers, cave, or mines.

These terrain models shall be delivered in one of the following formats:

- Preferred:
  An OpenRoads terrain model format. OpenRoads terrain models are DGN elements instead of external files and will directly integrate with OpenRoads design workflows.

- Acceptable:
  A GEOPAK TIN format terrain model file. A TIN file is GEOPAK's older format file. It is a binary file format which is external to the DGN file. With this file as the deliverable, the Roadway Designer can import the TIN file to an OpenRoads format terrain model very easily.

2-3-01(b)1 – Survey Deliverables When LiDAR is Used

LiDAR (Light Detection and Ranging) technology uses laser scanners to collect a cloud of surveyed points on a project. These point clouds are made up of hundreds of thousands, or even millions, of points. The collection of these points is non-discriminatory; anything within the visual field of the scanner is collected. Because of these data characteristics, survey data collected using LiDAR technology requires special handling by the surveyor and specialized discussion of required deliverables.

Sub-sections 2-3-01(b).1-4 of this manual describe only the required deliverables when LiDAR technology is used on IDOT projects. For required field procedures and accuracy standards when performing field collection of LiDAR data, see the following sections of the *IDOT Survey Manual*:

Chapter 4- Contains information on required accuracy standards.

Chapter 6 – Contains information regarding collection, control requirements and accuracy standards for airborne and mobile collected LiDAR data.

Chapter 8 – Contains similar information for terrestrial based scanners.

For additional information regarding LiDAR, see Appendix K of this manual entitled, *LiDAR Data Collection and Processing Overview.*

All LiDAR data, including survey control, shall be verified by the Department both at the time of collection and before proposed use. Please contact the Surveys, Mapping and Modeling Section of the Bureau of Design and Environment and the appropriate district Survey Chief to discuss coordinate systems, accuracy, and survey control standards for a particular project before data collection. If work is completed by a consultant and found in error, it shall be corrected by the consultant to the satisfaction of the Department at the consultant's expense.

It should be understood that the survey deliverables described in preceding sections are not changed in any substantial way, even if LiDAR is used. The surveyor is still required to deliver terrain model(s), topographic maps, alignments and property/right-of-way information. There may be additional DGN files containing this information, as described below. Additionally, the LiDAR point cloud data itself shall be made available to both Roadway and Structures Design Units.

2-3-01(b)2 - Accuracy and Coordinate Systems of LiDAR Data

All deliverables of LiDAR data, or data which is derived from LiDAR, from Surveys to Design shall have the same absolute accuracy and exist in the same coordinate system as the remainder of the project's survey data.

Any LiDAR data which is consumed from statewide, county-wide or public sources shall be transformed to match the coordinate system and accuracy of the project as a whole.

These accuracy and coordinate system requirements shall apply regardless if the source of LiDAR data is collected by fixed wing aircraft, helicopter, Unmanned Aerial Systems (UAS, drone), or mobile or terrestrial scanners.

2-3-01(b)3 - LiDAR Point Cloud Deliverables

The “raw data” product created by LiDAR scanning is called a point cloud. The form and function of these point clouds are identical whether the field collection is performed by terrestrial, mobile, UAS, or aircraft mounted scanners. The volume of information collected creates very large computer files and subsequent demands for processing speed from the computer.

These very large datasets are to be expected, but certain measures can be taken to minimize down-stream impacts to design processes. These measures include:

1. Data Tiling – Breaking the project into multiple adjacent point clouds.
2. Noise removal – Removing points from the cloud which are not relevant to the project. For example, passing cars are often seen in the point cloud.
3. Point filtering – Using filtering algorithms to reduce the total number of points in the point clouds while retaining the overall accuracy of derived terrain models.
4. Point classification – Assigning a classification to some or all points which allows toggling the visibility of points in a similar fashion as a level is used in a CADD file.

Additionally, the surveyor shall extract information from the point cloud which allows the designer to completely ignore the point cloud itself, if desired. The extracted deliverables are discussed in the next section.

However, the point cloud is the official raw data source and as such, its delivery shall be standardized throughout the department. Please deliver all point clouds using the following guidelines:

Data Tiling

The entirety of a point cloud for a project can easily require total file size of more than 50 GB. Such enormous file sizes cannot be managed as a single file. Therefore, the delivered point clouds shall be tiled (segmented into multiple individual files). Each of the several files shall be small enough that the file can be opened, viewed, and edited without overly taxing the computer system.

The activities in which the point clouds will be used are point cloud editing, as described in this section, and viewing activities by the designer and other down-stream consumers. In order to accommodate these activities and the potential for hardware limitations of down-stream users, it is recommended individual point cloud files should not exceed 2 GB in size. Typical tile sizes generally should not exceed 1000 feet in length measured along the project main centerline.

Noise in the Point Cloud

Laser scanning captures points on all surfaces within the distance, surface reflectivity, and/or angle of incidence limits for the system. Points on surfaces such as pedestrians and passing vehicles, or false points caused by the distortion of the laser signal return are considered noise and must be removed.

Point Filtering

As part of the post processing effort of the point cloud, the surveyor should consider applying elevation filters to reduce the total number of points in the cloud. Most modern post processing software provide filtering capabilities in which the surveyor inputs desired final vertical accuracy parameters and the software applies algorithms to adjacent points such that points which fit within the defined envelopes are removed. Often, total numbers of points can be drastically reduced. While the surveyor may wish to retain the unfiltered cloud for archive, a filtered point cloud can somewhat reduce some downstream issues when handling the large files.

Point Classification

Since the LiDAR data is managed as a cloud of millions of points, it is necessary to enable the cloud with additional capability so that the different types of points can more easily be distinguished. In a single cloud there will exist points which represent the surface of pavement, curbs, grass areas, trees, signs, walls, and any number of other things which are within the field of view. Viewing all these types of points at once can be difficult. By assigning a classification to every point in the point cloud, classifications can be toggled on or off similar to how a level is toggled on or off in a CADD file.

Table 2-3.A shows the standard point cloud classifications as defined by the American Society for Photogrammetry and Remote Sensing (ASPRS) update July 9th 2019

While it is beneficial to classify all points within a point cloud, the effort in doing so can be very laborious. For this reason, the only required classifications that shall be typically used for IDOT Roadway and Structures projects are Ground, Building, Road Surface and Bridge Deck. All points representing these surfaces shall generally be classified. All other points may typically remain unclassified. However, discuss with the requestor of the data all classification requirements prior to collection of the data to ensure specific project needs are met.

Table 2-3.A - ASPRS Standard Point Cloud Classifications (1 of 2)	
Classification value	Meaning
0	Never classified
1	Unclassified
2	Ground (For IDOT, this includes all points which are not road surface which help constitute the existing ground terrain model)
3	Low Vegetation
4	Medium Vegetation
5	High Vegetation

Table 2-3.A - ASPRS Standard Point Cloud Classifications (1 of 2)	
Classification value	Meaning
6	Building
7	Low Point (noise)
8	Reserved
9	Water
10	Rail
11	Road Surface (For IDOT projects this includes all paved or unpaved road surfaces, including curbs and sidewalks.)
12	Reserved
13	Wire - Guard (Shield)
14	Wire - Conductor (Phase)
15	Transmission Tower
16	Wire-Structure Connector (for example Insulator)
17	Bridge Deck (For IDOT projects, this also includes bridge abutments, beams, piers and other substructure.)
18	High Noise
19	Overhead Structures
20	Ignored Ground
21	Snow
22	Temporal Exclusion
23-63	Reserved
64	Retaining Walls. (Classification value 64 is listed as “user definable by ASPRS.)
65-255	User Definable

Other Point Cloud Attributes

As collected in the field, each point within the point cloud can also be collected with the following attributes:

Intensity – Brightly lit objects within view of the scanner will return a signal of greater intensity than dull objects. This intensity value shall be collected, preserved, and delivered as part of the point cloud.

Color – Modern scanners can also collect photography through the same lens as the laser signal is collected. This photography is used to determine the true-life color of the measured point. These color values (Red, Green, Blue) provide very high value to down-stream consumers of the point cloud because the point cloud will appear more like a photograph rather than a cloud of points. Interpreting the point cloud is thus greatly simplified.

However, collecting the R, G, B values can increase time in the field and resulting file sizes are larger. Also, in some projects, such as when collecting data only along an interstate, the color value will not provide much enhancement for the consumer of the point cloud data. Because of this, the surveyor shall balance the value of the collected color values against the increased file size and the greater time exposed to traffic collecting the data when determining whether or not to collect color values in the point cloud. Discuss with the requestor of the data all attribute requirements prior to collection of the data to ensure specific project needs are met.

Format of Delivered Point Clouds

Point clouds shall be delivered in one of the following formats. Regardless of format delivered, all the above requirements for the data apply:

1. LAS file format is an industry standard format for point clouds and can be created and read by all point cloud processing and viewing software. It is recommended that binary LAS be used since it results in a smaller file size than ASCII LAS. LAS format is 1.2 for PowerGEOPAK SS10 and 1.4 for OpenRoads Designer.

2. E57 file format is a newer format which includes the capability to include images along with the point cloud. Use of E57 is not currently recommended since not all products can yet read this format. If and when used, each separate setup should be individually provided in order to view the complete data in the appropriate software.

3. One or more MicroStation DGN files with the point cloud(s) attached.

   A. The process of attaching the point clouds will create Bentley POD format files which shall also be delivered.
   B. The DGN files shall be named in accordance with Section 2-5-02(e).

4. DOT is a file format specific to TopoDOT software which takes all the LAS files for a project and converts them into a single DOT file, which allows for increased processing speed within TopoDOT. This file type is not mandatory for use within TopoDOT but is recommended.

2-3-01(b)4 LiDAR Derived Deliverables

Point clouds cannot be used directly for design or mapping workflows. To support traditional workflows for design, various information shall be extracted from the point cloud. The outcome of such extraction results in a group of deliverables which are derived from the point cloud, but in every other respect will match data which is created from more traditional survey processes.

For example, terrain models and topographic features can be extracted from the point cloud data. These derived features shall be delivered in the same formats and file naming conventions as the conventional field survey.

Additionally, other feature types can also be extracted because of the extreme data density of the point cloud. These additional feature types include mesh features, which are useful for tunnels and vertical faces, and solid features, which can be useful for bridge and wall structures.

The following information shall be extracted from the point cloud and delivered to Design, except when the Design Unit has specified a point cloud only delivery or a smaller subset of these deliverables:

1. Existing ground terrain model – A terrain model which represents the existing surface of the ground. This terrain model will consist of the points in the point cloud which are classified as ground, road surface or wall. This terrain model will usually be merged with terrain models produced from traditional survey information. On some projects, the terrain model from a point cloud will not provide any additional useful information and need not be produced.
2. Linear Features – Linear features shall be extracted from the point cloud corresponding to all usual topographic features, pavement striping, low wires and break lines. These features shall be assigned appropriate feature definitions as shown in Appendix E or I. These features shall be stored in a DGN file with appropriate strip file naming, as shown in Section 2-5-02(e). The linear features extracted from point clouds may be in a separate file from the features collected by traditional survey methods.
3. Point features – Point features shall be extracted from the point cloud for identifiable topographic features such as hydrants, poles, inlets, manholes, signs, etc. The surveyor may find that the effort to extract these point features is greater than the effort of collecting them in the field using traditional survey methods. This can happen because there will almost always be a necessary survey effort in the field to collect utilities, drainage and other similar information which is not evident in the point cloud. It may often be the case that it is easier to collect everything in the field survey pass rather than extracting from the point cloud. In any case, it is the intent that the end result of traditional survey combined with point cloud processing produces a final map with all relevant point features displayed in the topographic strip map file(s).
4. Solids – As directed by the Project Manager or requested by the Bridge Unit, solid objects shall be extracted from the point clouds representing the bridge deck slab, abutments, piers and retaining walls. These solids shall be stored in DGN files with strip file names as defined in Section 2-5-02(e).
5. Mesh Surfaces – Mesh surface objects shall be extracted from the point clouds and stored in DGN files with strip file names as defined in Section 2-5-02(e). The mesh elements shall be assigned an appropriate feature definition from the lists shown in Appendix

E or I. These mesh surfaces can be used by Design in similar fashion as terrain models, such as for targeting of cut/fill slopes. Mesh surfaces shall be extracted from the point cloud for:

A. The inside surface of tunnels.
B. Vertical or over-hanging existing cut slopes or cliffs.

2-3.01(c) Deliverables between Roadway Design and Structures Design

The Roadway Design team shall make available to the Structures Design team the following:

1. Existing ground terrain model, if one has been developed, in OpenRoads terrain model format.
2. Proposed terrain model, if one has been developed, in OpenRoads terrain model format, showing the existing ground merged with the proposed finish grade surface of the roadway design:
   - Optionally, as requested by the Structures Design Unit, these terrain models may be provided in GEOPAK TIN format.
3. A full package of DGN files showing the proposed roadway design including all lines, grades and 3D models associated with the proposed design.
4. Any DGN files which contain models of existing and proposed underground utilities and drainage features. Each utility feature is properly designated for Quality Level according to Chapter 11 of the *IDOT Survey Manual*; see Section 5-2 for link to the *Survey Manual*.

Since the profile grade line mutually affects the roadway design and structures design, there will often be multiple exchanges between these units until a final profile grade line is determined. The Roadway Designer should anticipate multiple iterations of submittal of the above files followed by receipt of a revised grade line from the Structures Design Unit.

2-3.01(d) Deliverables between Geometric Design and Roadway Design

In the districts, the Geometric Design Unit performs very specific design function for geometric layout of intersections and interchanges in Phase I. When required on a project, the Geometric Design Unit's involvement is typically the initial design work completed on a project, and therefore it is preferred that these geometric designs be conducted using OpenRoads geometry commands and make use of feature definitions from the IDOT workspace. Doing so maximizes efficiency as a project progresses because the Roadway Designer can immediately make use of the intelligence which has gone into the prior work. It also minimizes the possibility of design errors caused by misinterpretation of the data or annotations. It is recognized however, that in the short term when staff are learning to use OpenRoads that the benefit of using OpenRoads may be outweighed by the cost of training.

When the Geometric Design Unit performs design functions, the Roadway Design Unit shall make available the information provided from Design Surveys as described in Section 2-3.01(b).

At the conclusion of Geometric Design, the following alternatives for submittals of geometric designs are provided:

1. 2D DGN file – For projects with the Geometric Design Unit's involvement, there is always a DGN file which shows the geometric design. This DGN file will be in Strip Map form. This DGN file will contain either:

    A. The OpenRoads geometry elements which properly utilize the workspace feature definitions, or
    B. A graphic reflection of the contents of the GEOPAK GPK file.

    Note the DGN file shall follow the level and symbology standards of the roadway design workspace whether using OpenRoads or traditional GEOPAK tools. The DGN file shall contain sufficient annotation to eliminate ambiguity in the specifics of the geometry.

2. GPK file – If using traditional GEOPAK tools, the GPK file will contain all geometric elements of the geometric design.

3. IDS Sheet files – When an intersection design study (IDS) is performed, the IDS sheet files in DGN format shall be provided.

2-3.01(e) Deliverables for Signal Design

The Roadway Design Unit or Geometrics Unit shall make available to the Signal Design Unit:

- DGN files containing all geometric layouts, and
- All other DGN files which are referenced to the 2D layouts including any terrain models or proposed models.

At the conclusion of the preliminary traffic signal design, the following shall be provided to Roadway Design:

- DGN files containing the positions of signals and accompanying equipment, and
- DGN files containing any preliminary signal design plans sheets.

2-3.01(f) Deliverables from Environmental Studies

During the course of developing environmental studies, there may be various CADD and/or GIS files produced as a part of the reports, and which show the spatial extents of the various environmental features. All such CADD and GIS files shall be provided to the Project Manager along with submittal of the report.

2-3.02 Phase II Deliverables*

2-3.02(a) Deliverables between Roadway Design and Land Acquisition (Plats and Plans)

The Roadway Designer shall make available the following files for purposes of conducting the processes of land acquisition.

1. 2D DGN file(s) containing centerline and all geometric layouts, limits of construction, location of proposed right-of-way, permanent easements, or temporary construction easements necessary for construction of the project,
2. 2D DGN file(s) containing any preliminary existing property boundaries and rights of way which may have been extracted from records information during Phase I of the project development, and
3. Any 3D DGN models which have been built for existing or proposed features.

As needed during project development, the Land Acquisition Unit shall make available to the Roadway Designer the following:

1. One or more 2D DGN files containing final existing property lines and existing right of way lines, and
2. One or more 2D DGN files containing the final proposed rights of way and right of way plans for the project.

The DGN files above will contain all annotations as shown in the example plans (see Section 5-4). The data created by the Land Acquisition Unit shall be produced in accordance with the *IDOT Land Acquisition Manual* and Section 3 of this manual, including the proper use of CADD Standards and OpenRoads feature definitions.

*Note some of the information in this sub-section may be requested in Phase I due to time constraints and to help eliminate project delays and extra costs in Phase II.

2-3.02(b) Deliverables between Roadway Design and Utilities Unit

The Roadway Designer shall provide the following minimum information to the Utilities Unit for purposes of performing utility coordination activities:

- Preferred:
  - 2D DGN model showing horizontal locations of existing utilities as determined during survey operations in Phase I, along with all additional DGN files which are referenced,

  - 2D DGN model showing vertical locations (profiles) of existing utilities as determined during survey operations in Phase I, along with all additional DGN files which are referenced.

- Acceptable:
  - Hard copy equivalents of these described DGN files.

Additionally, the following should be made available when they exist. Note if these files are desired by the Utilities Unit, request should be made early in the project life to provide adequate time to prepare these models:

1. 3D DGN file(s) showing 3D models of existing utilities as determined during survey operations in Phase I, along with all additional DGN files which are referenced,
2. Existing ground terrain model in OpenRoads terrain model format,
3. Proposed terrain model, in OpenRoads terrain model format, showing the existing ground merged with the proposed finish grade surface of the new design:
   - Optionally, as requested by the Utilities Unit, these terrain models may be provided in GEOPAK TIN format, and
4. A full package of DGN files showing the proposed roadway and structures design including all lines, grades, and 3D models associated with the proposed design.

For all the above files, proper feature definitions, level, and symbology from the IDOT workspace shall be used.

All existing utilities shall be marked with an indicator of the reliability and certainty of the true position of the utility asset according to Chapter 11 of the *IDOT Survey Manual*, which can be downloaded from the link in Section 5-2 of this manual.

At the conclusion of utilities coordination work, or at intervals as required, the Utilities Unit shall provide to Roadway Design any of the following which are available:

1. 3D DGN files of proposed utility relocations,
2. 2D DGN files showing horizontal alignment of proposed utility relocations,
3. 2D DGN files showing vertical alignments of proposed utility relocations,
4. PDF files provided by utility owners showing supposed positions of existing utilities or corrections to positions of utilities previously shown in roadway or survey data, and
5. SHP files – GIS data format containing utility assets.

2-3.02(c) Deliverables from Roadway Design to Hydraulics Unit

As required by the Hydraulics Unit, the following information shall be provided to the Hydraulics Unit for review or design purposes:

1. Existing ground terrain model in OpenRoads terrain model format,
2. Proposed terrain model, in OpenRoads terrain model format, showing the existing ground merged with the proposed finish grade surface of the new design:
   - Optionally, as requested by the Hydraulics Unit, these terrain models may be provided in GEOPAK TIN format,
3. A full package of DGN files showing the proposed roadway and structures design including all lines, grades, and 3D models associated with the proposed design,
4. Stream cross-sections, profiles and similar data as requested by the Hydraulics Unit,
5. When the storm drainage design is performed by a designer which is not a part of the Hydraulics Unit (such as a consultant designed project), a Hydraulic Report as defined in the *IDOT Drainage Manual* shall be included in the submittal; see Section 5-5 of this manual for link to the *Drainage Manual*, and
6. In District 1, additional Hydraulic Report information will be required as defined in the *Manual of Procedures of the Metropolitan Water Reclamation District of Greater Chicago*; see Section 5-5 of this manual for link.

If any design function is performed by the Hydraulics Unit, such as ditch geometry (horizontal or vertical) design or hydraulic analysis, the Hydraulics Unit shall deliver back to the Roadway Design Unit:

- Preferred:
  - DGN files showing the horizontal and vertical alignments,
  - DGN files showing ditch typical sections, and
  - DGN files showing any drainage structures or piping layouts, along with any generated 3D models.
- Acceptable:
  - The above noted information in paper or PDF form containing sufficient information to reproduce the alignments and sections and produce 3D models.

2-3.02(d) Deliverables from Structures Design to Roadway Design

At the conclusion of the structures design, or at reasonable intervals as requested, the Structures Design team shall make available the following to Roadway Design team:

1. 3D DGN models or 3D PDF's of all structures, if any have been prepared, which may be contained in multiple files, and
2. 2D DGN sheet models or PDF's of all structures that allow incorporation of the structures' sheets to the contract plans. These sheets are generally only provided to the district at the pre-final stage. Final structure plan sheets and/or models are delivered directly from the Central Bureau of Bridges and Structures to the Central of Bureau Design and Environment; see Section 2-3.02(g).

Structures models shall not be delivered to the contractor unless those models are prepared under the control of the Structures Designer of record.

It is common practice for the Roadway Designer to prepare generically derived models of bridge structures when the Structures Designer was preparing only 2D plans. For example, the Roadway Designer can produce a basic model of a bridge deck by extruding a simple roadway corridor. These models have value for non-construction activities such as public hearings. However, these generic models shall not be included in the package of models provided to the contractor.

2-3.02(e) Deliverables between Geotechnical Design and Roadway or Structures Design

The Roadway Designer shall make available the following to the Geotechnical Designer or Geotechnical Unit:

1. DGN files of all geometric layouts,
2. DGN files showing proposed 3D models:
   - A. Terrain Model, in OpenRoads format, of the proposed roadway finish grade,
   - B. Terrain Model, in OpenRoads format, of the existing ground surface, and
   - C. OpenRoads component meshes for all corridors showing roadway finish grade and subgrade surfaces.
3. When requested by the Geotechnical Unit, the above 3D models will be supplied in legacy GEOPAK TIN format.

At the conclusion of the geotechnical investigation and design process, Geotechnical Design shall provide to Roadway Design the following:

4. A Roadway Geotechnical Report in electronic or hard copy format prepared according to Chapter 7 of the *IDOT Geotechnical Manual*. See Section 5-5 for link to the *IDOT Geotechnical Manual*,
5. For the portions of the Roadway Geotechnical Report which are spatial in nature (such as profiles, cross-sections, and designations of special soils considerations) it is encouraged to deliver these items in DGN files which accompany the report, and
6. It is encouraged that the boring plan and soil profile be delivered in DGN format to accompany the report.

It is desired that as the various districts and consultants become more proficient in 3D modeling workflows that the following items will be delivered. Although these are not currently required, it is highly encouraged that workflows and practices be developed to provide these deliverables and that such workflows will be shared across all districts for inclusion in a future revision of this manual:

- A 3D DGN file containing an OpenRoads terrain model which depicts the top surface of subsurface soils and rock strata, and
- A 3D DGN file which contains 3D depictions of the soil borings.

2-3.02(f) Deliverables between Operations Design and Roadway Design

The Roadway Designer shall make available the following to the designer or reviewer of traffic signals, striping, signing, and lighting:

- Preferred:
  - DGN files of all geometric layouts and their associated 3D models, and
  - DGN files showing geometry and associated models for traffic control and detour plans.
- Acceptable:
  - Hard copy equivalents of these described DGN files.

At the conclusion of the design process for traffic signals, striping, and signing, the following shall be provided to Roadway Design:

1. 2D DGN files containing the positions of signals, signs, and striping,
2. SignCAD files of all proposed highway signs,
3. If available, 3D models of the signals and signs features, and
4. 2D DGN files containing the finished sheets for signals, signs, lighting, striping, traffic control and detour route plans.

In District 1, lighting design is handled by the district Operations Unit. In all other districts, lighting design is managed by the Bureau of Design and Environment, Electrical and Mechanical Unit.

2-3.02(g) Deliverables from Roadway/Structures Design to Central Bureau of Design and Environment

At the end of the roadway and/or structures design phase, the plans and/or models for the project shall be submitted electronically to the Project Manager or CADD Manager in the appropriate district. The Project Manager (or CADD Manager, depending on district) then submits the following electronically to the Bureau of Design and Environment (BDE), after district personnel have completed their review:

For all in-house 2D plan sets, electronically provide:

1. Final sheet files of all contract plan sheets in PDF format; see Section 2-4.02.
2. Summary of Quantities Spreadsheet in PDF format; see Section 4-8.

For all consultant developed 2D plan sets, electronically provide:

1. Final sheet files of all contract plan sheets in PDF and DGN format; see Section 2-4.02.
2. Summary of Quantities Spreadsheet in PDF format; see Section 4-8.

For all 3D modeled plans, in addition to items 1-2 above, electronically provide:

3. Existing ground terrain model, if one has been developed, in PowerGEOPAK SS10 OpenRoads tools terrain model format.
4. Proposed terrain model, if one has been developed, in PowerGEOPAK SS10 OpenRoads tools terrain model format.
   - Optionally, these terrain models may be provided in GEOPAK TIN or LandXML format.
5. Separate LandXML or IFC files for each roadway alignment and its associated profile.
6. A full package of DGN files showing the proposed roadway design, including all lines, grades and 3D models associated with the proposed design.
7. Any DGN files which contain models of existing and proposed underground utilities and drainage features. Each utility feature is properly designated for Quality Level according to Chapter 11 of the *IDOT Survey Manual*; see Section 5-2 for link to the *Survey Manual*.

The Bureau of Bridges and Structures shall submit the PDF sheet files for structures designed in-house directly to the Bureau of Design and Environment.

In addition to the electronic submission of PDF sheet files, scanned PDF copies of any sheets containing original signatures shall also be submitted electronically to the Bureau of Design and Environment. PDF sheets that commonly include signatures are the plan cover sheet, the plan general note sheet, the storm water pollution prevention plan sheet, and any structure general plan and elevation sheets.

The files and/or models mentioned above are used in the bid letting process.

2-3.03 Phase III Deliverables

2-3.03(a) Deliverables from Roadway Design to District Construction

The PDF sheet files contained within the contract are the controlling contract drawings. However, the following final design CADD files shall be made available to facilitate construction:

1. For designs developed in 2D:
   A. A project content file identifying, by name, all alignments and profiles such that Construction personnel can easily locate the correct file name and level name where the alignments exist; see Section 2-1,

B. Final DGN sheet files – see Section 2-4.02 and Section 4 for more information,

C. A full package of final DGN files showing the proposed roadway and structures design including all lines and grades associated with the proposed design,

D. A GEOPAK geometry (GPK) file which contains all horizontal and profile geometry, and

E. Separate LandXML or IFC files for each roadway alignment and its associated profile. For projects where only alignments exist without profiles, all alignments can be combined into a single LandXML file.

2. For designs developed in 3D:

A. A project content file identifying all alignments, profiles, surfaces, components, and linear features. These are listed by name and the file location and level are clearly described such that Construction personnel can easily locate the correct information; see Section 2-1,

B. Final DGN sheet files – see Section 2-4.02 and Section 4 for more information,

C. A GEOPAK geometry (GPK) file which contains all horizontal and profile geometry,

D. Separate LandXML or IFC files for each roadway alignment and its associated profile, and

E. A full package of DGN files showing the proposed roadway and structures design, including all lines, grades, and any 3D models associated with the proposed design; see Section 2-4.01(c) for a more complete description of the following:

a. All geometry elements,
b. Terrain Model of the proposed roadway subgrade,
c. Terrain Model of the proposed roadway finish grade,
d. Terrain Model of the existing ground surface,
e. OpenRoads component meshes for all corridors showing roadway finish grade and subgrade surfaces,
f. 3D linear features for all corridors representing the roadway finish grade and subgrade, and
g. Terrain models or mesh surfaces of structure excavation surfaces.

These final design CADD files should be stored in ProjectWise at a location that is readily available and easily identified by the Department's construction staff; see Section 2-5 for information on preferred folder structure.

Designers shall anticipate that these CADD files will be used by the Department's inspection staff to facilitate contract administration activities in accordance with developing 3D CADD and e-construction processes. Designers shall also anticipate that these CADD files will be used by contractors to facilitate their construction activities, including, but not limited to, automated machine guidance. Thus, it is of the utmost importance that the final design CADD files and models are in complete agreement with the contract PDF sheets. It is further emphasized that the contractor and the Department's construction inspection staff must check and confirm that the CADD files are in agreement with the contract PDF sheets.

The PDF sheet files contained within the contract are the controlling contract drawings. If any discrepancy exists between the CADD files and the PDF contract drawings, the PDF contract drawings shall take precedence and be verified by the Department's staff for accuracy.

2-3.03(b) CADD Deliverables from District Construction to District Design

At the completion of all contract work, the Department's construction staff shall store all electronic CADD files developed or revised during construction (and any marked-up as-built PDF files) in ProjectWise, in an "as-built folder", at a location that is readily available and easily identified by the Department's operations and program development staff for future use.

2-4 FILES AND FORMATS USED FOR DATA EXCHANGE

As described above, during various stages of the project life cycle, one or more of the following file types and formats will be delivered from one unit to another unit. Data is exchanged at various times among staff of any of the following groups: Design Surveys, Roadway Design, Structures, Land Acquisition, Utilities, Geometrics, Hydraulics, Geotechnical, Operations, Construction, the Bureau of Design & Environment, consultants, and contractors. In the future, collection and delivery of as-built models is also expected.

The following sections provide some additional description about the form of the above described files.

2-4.01 MicroStation DGN Files

MicroStation DGN files constitute the bulk of data exchange for most workflows. OpenRoads Survey and Roadway Design processes store all information into the DGN file so that the packaging of additional external files is reduced as compared to historic workflows.

All project plans shall be developed and delivered in MicroStation DGN format. See Section 5-2 for links to IDOT web pages which define current required versions of roadway and structures design software.

Design File extensions shall be DGN only. Other extensions will not be accepted. Project design (.dgn) files will vary as to whether the contents of the files are 2D in nature or 3D in nature. Any specific requirements of 2D or 3D are described in the various deliverables above, but the following is generally expected:

1. The 3D DGN models needed for roadway design are automatically generated by OpenRoads software and require no separate 3D DGN files to be created. These

OpenRoads DGN files will contain both 2D and 3D DGN models within a single DGN file. This is normal and expected.

2. Terrain models produced using OpenRoads tools will usually be contained in 3D DGN files, but if started in 2D files, OpenRoads will create and manage 3D models as needed.
3. Survey data, whether produced using OpenRoads Survey tools or the older GEOPAK Survey tools, will be delivered in 3D DGN files, except for property and right of way information which will be contained in 2D DGN files.
4. Structures 3D models will be contained in 3D DGN files.
5. Sheet files will be delivered as 2D DGN files. Multiple sheet models may exist in a single DGN file.
6. Geometric elements such as alignments, property lines, rights of way and roadway geometry will be contained in 2D DGN files. As noted above, these 2D elements will often exist alongside the 3D models which are managed by OpenRoads.

In all cases, file names and reference file structure shall conform to the requirements of Section 2-5.

The placement of all elements and text within a design file shall conform to IDOT CADD Standards as defined in Section 3 and Section 4 and as described in example plans available for download using the link shown in Section 5-2.

2-4.01(a) I-Model Files

For some deliverables, or as requested, the use of i-model files may be appropriate. I-models are a specialized form of the DGN file which is read-only in nature and serves a specific purpose for the published design data complete with attributes for a specific purpose. When used, i-model files will contain the same information as described in Section 2-4.01. However, in the process of creating the i-model file, the information exported from MicroStation may be filtered to isolate certain aspects of the model or the contents of multiple MicroStation files may be combined into a single i-model file.

2-4.01(b) Integrated Civil Model (ICM) Files

Integrated Civil Model files, commonly referred to as ICM, are a specialized form of i-model files which are specifically designed for transferring 3D civil model information to Construction. When used, ICM files will contain the same information, as described in Section 2-4.01. However, in the process of creating the ICM file, the information exported from MicroStation may be filtered to isolate certain aspects of the model or the contents of multiple MicroStation files may be combined into a single i-model file.

There are no required deliverables of ICM files in this version of this manual. However, upon request, and when the delivery of ICM is in the benefit of the project, as determined by the Project Manager, ICM may be a useful deliverable during Phase III.

2-4.01(c) Automated Machine Guidance Required Model Elements

As described in Section 2-3.03(a) above, the contents of the 3D models which will be used for automated machine guidance must contain all the 3D model elements created for the project, including:

1. Terrain Model of the proposed roadway subgrade,
2. Terrain Model of the proposed roadway finish grade,
3. OpenRoads component meshes for all corridors showing roadway finish grade and subgrade surfaces,
4. 3D linear features for all corridors representing the roadway finish grade and subgrade, and
5. Terrain models or mesh surfaces of structure excavation surfaces.

When maintenance of traffic (MOT) or other phased construction sequences generate an interim design need for a model (e.g., when a later phase depends on an earlier phase to determine slopes), then:

- Road models must be created for the interim phases.
- These interim construction phases must be delivered to Construction just as if they were a final construction model.

Terrain Model of the Proposed Subgrade:

The designer shall produce and include a terrain model as part of the Phase III deliverables to Construction, which depicts the subgrade surface of the project. As viewed in cross-section this surface will depict the surface marked in red as seen in Figure 2-4.A. The file format for delivery shall be as described at beginning of Section 2-4.01.

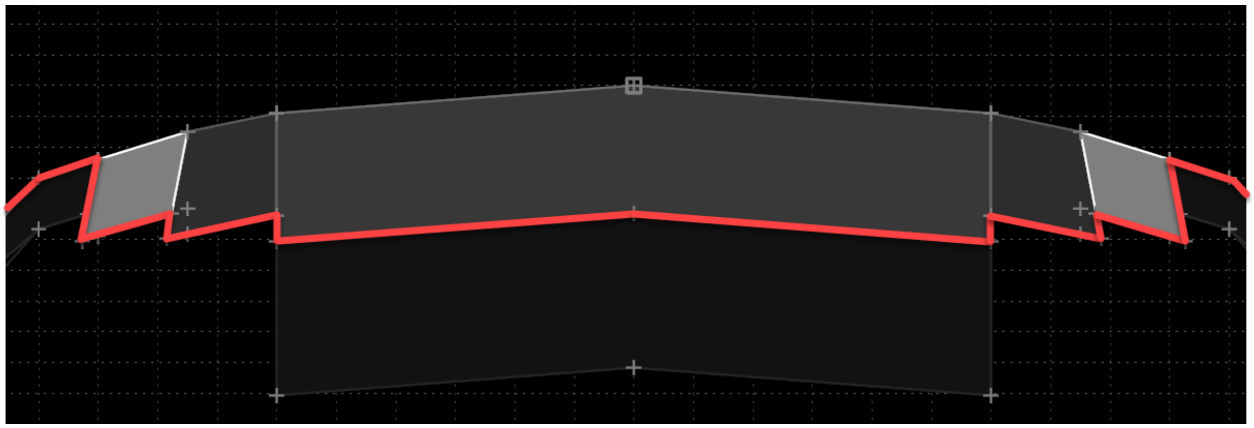


Figure 2-4.A – Subgrade Terrain Model Surface

Terrain Model of the Proposed Finish Grade:

The designer shall produce and include a terrain model as part of the Phase III deliverables to Construction, which depicts the finished grade surface of the project. As viewed in cross-section, this surface will depict the surface marked in red as seen in Figure 2-4.B. The file format for delivery shall be as described at the beginning of Section 2-4.01.

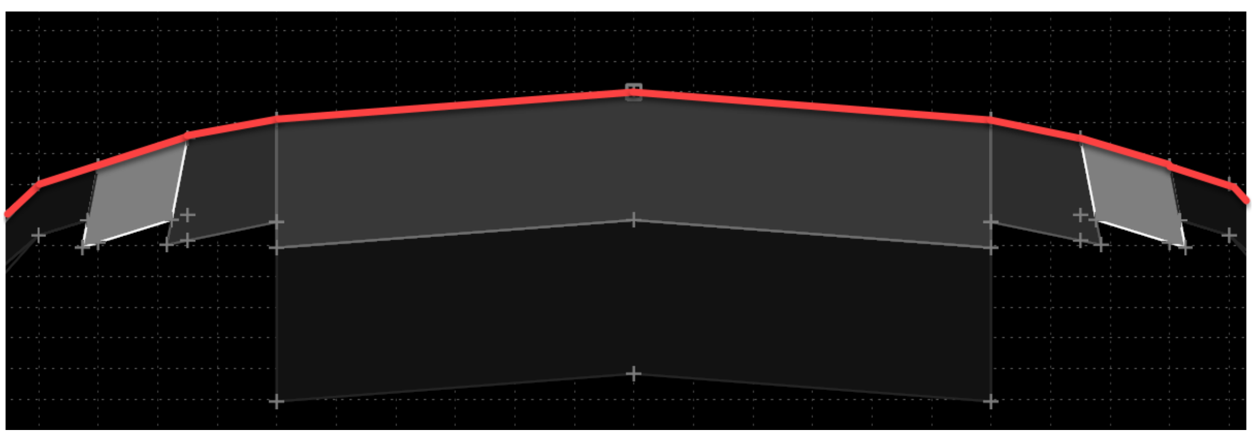


Figure 2-4.B – Finished Grade Terrain Model Surface

OpenRoads Component Meshes:

The designer shall produce and include the roadway components in the Phase III deliverables to Construction, which depict the various roadway paving components including pavement layers, curbs, sidewalks, and other volume quantifiable items. Figure 2-4.C and Figure 2-4.D show examples of these components as viewed in cross-section and in 3D. The file format for delivery shall be as described at the beginning of Section 2-4.01. These meshes will normally be included in the same file(s) as the 3D linear features described below.

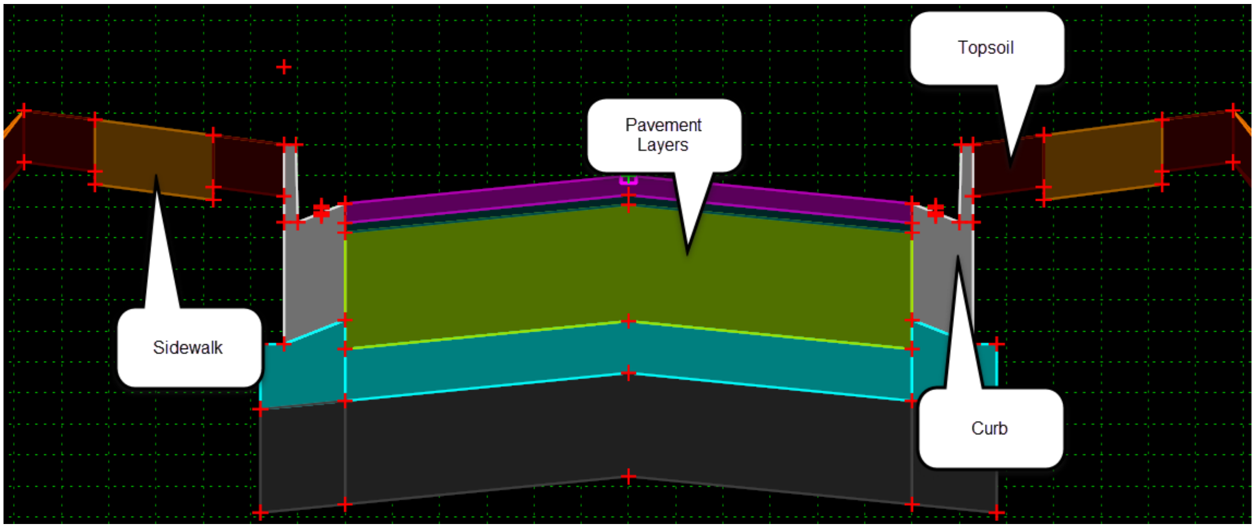


Figure 2-4.C – Roadway Components in Cross-section

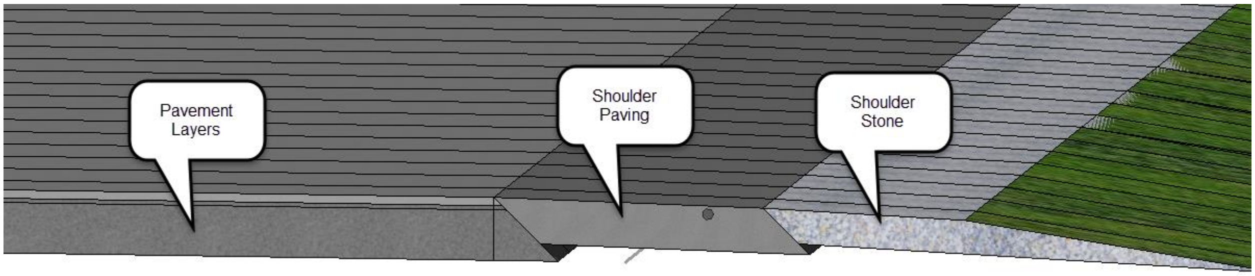


Figure 2-4.D – Roadway Components in 3D

OpenRoads 3D Linear Features:

The designer shall produce 3D linear features (line strings) which depict the top edges of the various components and include them in the Phase III deliverables to Construction. These line strings are often a more efficient means of loading the 3D model to automated machine guidance equipment because their smaller size (compared to a terrain model) is more compatible with the limited storage space. Figure 2-4.E shows the corresponding cross-section points which generate the 3D line strings. Figure 2-4.F shows an example of the line strings in a 3D model with the line weight enhanced for clarity. The file format for delivery shall be as described at the beginning of Section 2-4.01. These line strings will normally be included in the same file(s) as the component mesh features described above.

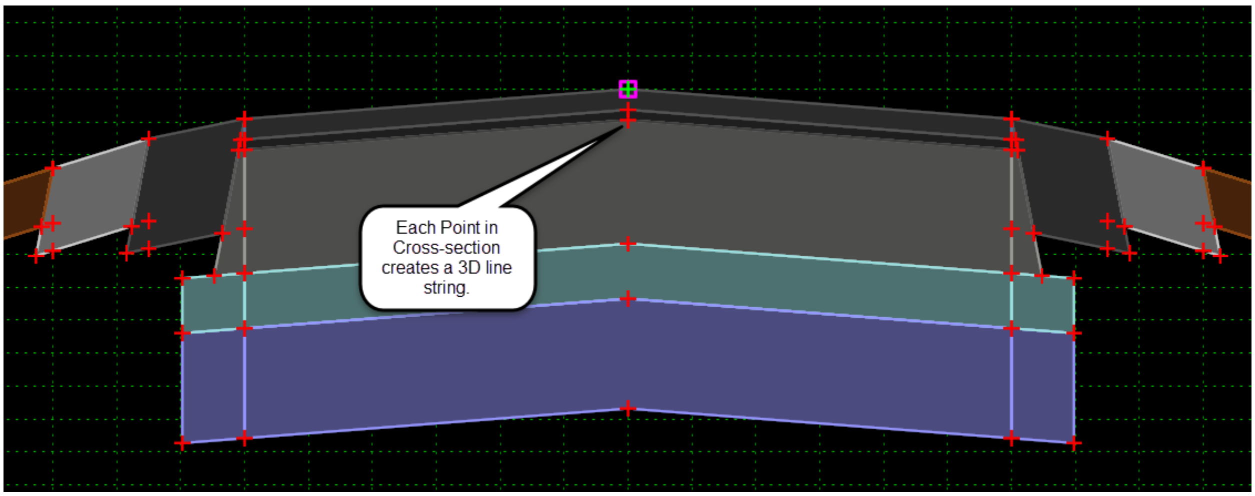


Figure 2-4.E – Points in Cross-section Generate 3D Line Strings

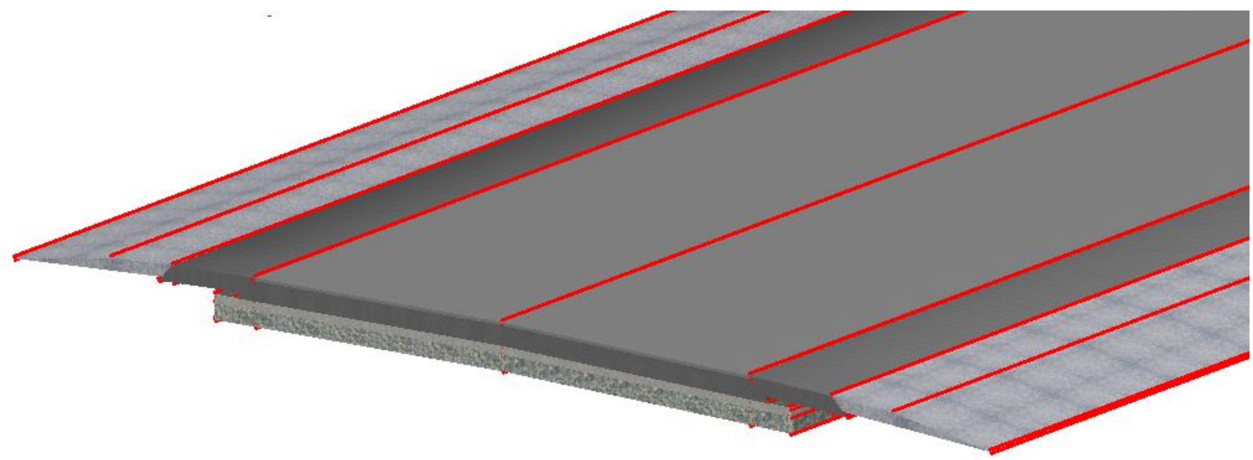


Figure 2-4.F – Example of 3D Line Strings in Model

Structures Excavation Surfaces:

For all structures on the project, there shall also be delivered terrain models, mesh components and 3D line strings for the excavation required at any footings, bridge piers, bridge abutments and retaining walls. It is noted that many retaining wall excavation surfaces will be naturally included as a part of the roadway deliverables described above. The preparation of these structures' excavation surfaces shall be prepared by the appropriate Roadway or Structures Designer. Figure 2-4.G shows an example of an excavation surface required for a bridge pier.

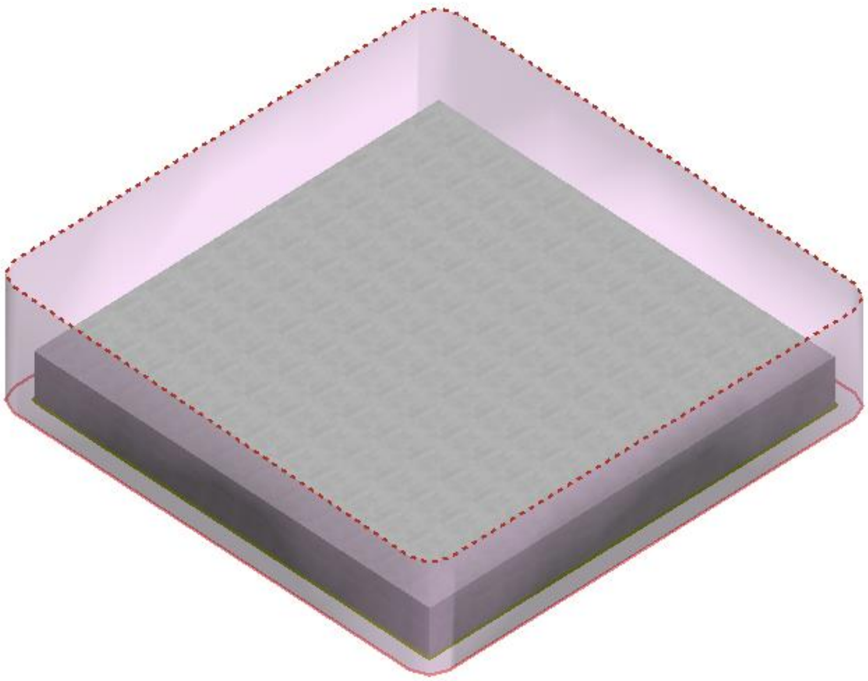


Figure 2-4.G – Example of Structure Excavation Surface Terrain Model for a Footing

2-4.02 Sheet Files

In most cases, when a DGN deliverable is required, the DGN package will also include all sheet DGN files and cross-section sheet DGN files which have been produced. All DGN sheet files, including cross sections, shall be submitted on standard sheet border format of the appropriate type as defined in the IDOT workspace cell libraries for roadway or structure plans.

Sheet files submitted shall have the associated references attached and appropriately documented in the sheet file and noted in the Project Content File, as defined in Section 2-1 above.

In addition to DGN format sheet files, sheets shall also be delivered as 11" x 17" PDF files at various stages of the project life cycle, including the plan review stage, submission of final contract plan sheets to the Bureau of Design and Environment for placement on a letting, and other stages as requested by the Project Manager. Sheet PDF files shall be delivered in two forms:

- An individual PDF for each sheet shall be created, and
- One or more multi-page PDF files containing all contract plan sheets shall be submitted. Multi-page PDF files shall not exceed 100 sheets per file.

See Sections 2-5.04 and 2-5.04(b) for details on file naming of these PDF sheet files.

PDF sheet files shall conform to the following submittal requirements:

1. Sheets in the PDF files shall be exactly 11” x 17” in size.
2. The PDF files should be grayscale. Coordinate with the Project Manager if monochrome or color PDF files are indicated for a specific project,
3. The PDF files should NOT have layers. Coordinate with the Project Manager if the needs of a specific project would benefit from use of layers in the PDF file,
4. Sheets in the PDF files shall be created with landscape orientation, except for narrow cross-sections, which may be portrait orientation, and
5. Signed sheets shall be submitted both as a PDF and as a paper document. The signed paper sheets shall be 11” x 17” in size.

Print styles, plot configuration files, and pen tables are included with the IDOT CADD configuration and detailed in Section 4-7. These files may be used to assist in the creation of PDF files that meet the above requirements.

2-4.03 Legacy Terrain Model File Formats

In some cases, the recipient of exchanged data is not equipped to receive terrain model data in the newer GEOPAK 3D form and may require legacy terrain model formats. For example, some Units of the Department may take somewhat longer to adapt their workflows and may request a legacy format to be produced for the terrain model. Another example might be a contractor who requests an older format during the transition to newer workflows. Any existing or proposed terrain model created in OpenRoads can be exported to one of the following formats:

1. GEOPAK TIN file
2. LandXML
3. It is also possible to display the triangles and contours into a DGN format as plain graphics which could be used by the recipient to build new terrain models in their specific software.

The use of these legacy formats is not ideal and should only be used as a last resort. However, during the transitional period towards modern 3D design processes some segments of the IDOT project workflow may require these formats.

To produce these legacy terrain model formats from OpenRoads, select the OpenRoads terrain model and on the context toolbox use the export tool as shown in Figure 2-4.H.

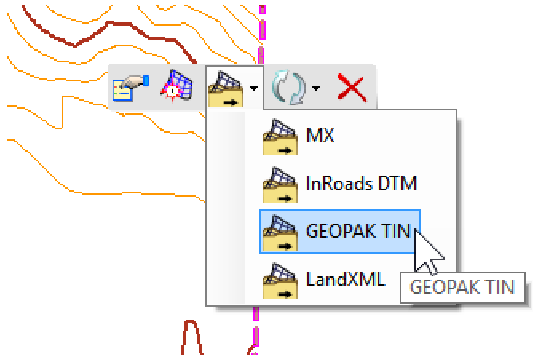


Figure 2-4.H – Create a Legacy Format Terrain Model

2-4.04 Legacy Geometry File Formats

In some cases, the recipient of exchanged data is not equipped to receive geometry data in full 3D form and will require legacy file formats for the project geometry. When the need arises for exchanging geometry data, any existing or proposed geometry created in OpenRoads can be exported to one of the following formats:

- GEOPAK GPK file
- LandXML

The use of the legacy GEOPAK GPK format is not ideal and should only be used as a last resort when the recipient of the data exchange can accept no other form. However, during the transitional period between current practices and the implementation of modern 3D design processes, some segments of the IDOT project workflow, particularly when transferring data internally, may require this format.

The feature definitions in the IDOT workspace have been configured such that most geometry which is needed in the GPK format is automatically exported. To manually export to GPK, use the Export to Native OpenRoads command as shown in Figure 2-4.I.

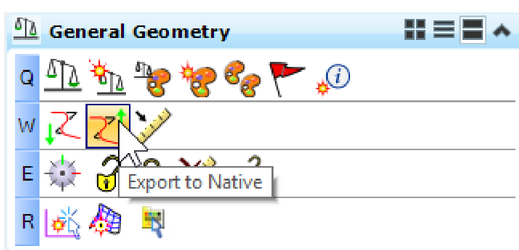


Figure 2-4.I – Export Geometry Command

The LandXML format may continue as a “fail-safe” deliverable for construction activities for an extended time period. For example, see Section 2-3.03(a), where LandXML is listed as a required deliverable for alignments and profiles. A LandXML file for any geometry can be produced by selecting the geometry in the DGN file and then opening an alignment report from the Tasks menu.

2-5 FILE NAMING AND REFERENCE FILE STRUCTURE

See also: *Bureau of Design and Environment Manual* Section 63-2.04.

For consistency and efficiency of review and data exchange, there is a required naming convention for all files which are exchanged during the project lifecycle.

Combined folder path and file name length shall not exceed 200 characters. Do not use spaces or special characters in file or folder names, other than dashes and underscores. A project shall not contain duplicate file names.

The contract may require several project submittals for review, therefore, folder or file renaming during the project life shall not be allowed. For each required submittal, the Department will overwrite or update the current project copy located on the Department’s project server to allow for quick response to any project questions.

All files used for CADD and design shall be named according to the file naming conventions described in Section 2-5.02.

A recommended reference file method is detailed in Section 2-5.03 below.

All files used for contract plan sheets shall be named according to the file naming conventions shown in Section 2-5.04.

2-5.01 Design File Folder Structure

The following is a recommended folder structure for project files:

Table 2-5.A - Project Folder Structure (1 of 2)	
Project Folder Name	Folder Content
CAD_Sheets	DGN sheet files used for contract. Includes structures sheets when consultant designs the structure. Includes cross-section sheets.
Construction	Files prepared for Construction for use in staking, inspection, or automated machine guidance. These may include various XML files terrain models, and other files prepared exclusively for construction.

Table 2-5.A - Project Folder Structure (2 of 2)	
Project Folder Name	Folder Content
Design	DGN strip map files containing design information such as corridors, profiles, etc. Project Template Library (ITL) Ancillary DGN files which are part of the roadway design process such as cross-sections produced only for computing phased quantities. If the roadway design includes multiple alternatives, subfolders may be used.
Reports	Various design reports.
Documents	Supporting documentation such as the Project Content File and/or other required documents or spreadsheets. In some districts these documents are stored outside of ProjectWise. However, submittals from external should follow this structure.
Electrical	Lighting and other electrical design strip map files.
Environment	Environmental and wetlands strip map files.
Exhibits	Exhibits prepared for stakeholder engagement.
Geometrics	DGN files prepared by Geometrics Design Unit.
GEOPAK Project Manager	GEOPAK files, including the geometry file (GPK) and various input and output files.
Geotechnical	Geotechnical strip map files.
Hydraulics	Drainage design and layout strip map files.
LandAcq	Right of way and property strip map files.
PDFs	PDF files of contract plan sheets. In some districts these documents are stored outside of ProjectWise. However, submittals from external should follow this structure.
Structures	Structures 3D Models and 2D DGN files.
Studies	Planning strip map files and sheets.
Surveys	Existing survey data and associated DGN files for the project.
Traffic	Pavement marking and signals strip map files.
Utilities	Utilities strip map files.

2-5.02 File Naming Convention for Design Files

The names of DGN files used for roadway design shall be of the form D$12345-*type*.dgn where:

$ = District number

12345 = Contract number

type = the strip map type as shown in Section 2-5.02(e), Table 2-5.B.

For example, D605555-alignSurvey.dgn is used for the DGN file which contains horizontal alignment as defined by the Surveys Unit for project 05555 in District 6.

Recognizing that using this naming convention may not cover all circumstances, if unique file names are required or for large projects that may have a large number of design sections, the file naming may be modified to accommodate the situation. Any revised naming convention shall be requested of and approved by the Project Manager.

2-5.02(a) Naming for Structures Design Files

The DGN file names used for creating 3D models of structures has not been defined in this manual. The file names used for this purpose shall follow a logical structure whereby the various files can be easily identified as to which files contain the various substructure, superstructure, rebar, etc.

Structures 2D file names follow the naming conventions for sheet files as defined in Sections 2-5.04(d) and 2-5.04(e).

2-5.02(b) Naming for Files Used on Alternative Designs

For alternate designs an alpha character shall be added to the end of the file name (A=first alternate, B=second alternate, etc.). For example, two alternates for a design plan would be named:

- Alternate A - D$12345-DesignA.dgn
- Alternate B - D$12345-DesignB.dgn

2-5.02(c) Naming for Multiple Files of Same Type

If there is a continued sequence of files for a large project, or a project contains multiple sections to which multiple files are required for each section, a numeric character shall be added to the end of the file name. For example, two files that contain the design plan for two adjacent segments of a given project would be:

- Segment 1 - D$12345-Design1.dgn
- Segment 2 - D$12345-Design2.dgn

Another valid reason for segmenting a project is to allow multiple designers to simultaneously work on the same project and for the same file types.

2-5.02(d) Naming of Multiple Alternates of Same Type

It is possible that a need may arise for naming of files when alternate designs are also sufficiently complex to merit breaking into multiple segments. In this case, the naming conventions for alternatives and segments shall be combined. For example:

1. Alternate A, Segment 1 – D$12345-DesignA1.dgn
2. Alternate A, Segment 2 – D$12345-DesignA2.dgn
3. Alternate B, Segment 1 – D$12345-DesignB1.dgn
4. Alternate B, Segment 2 – D$12345-DesignB2.dgn

2-5.02(e) Naming of Roadway Strip Map DGN Files

Table 2-5.B defines the naming structure that shall be used for strip map files covering the roadway portions of a project. The contents of various strip map files may be combined upon approval by the Project Manager. When combined a filename which appropriately reflects the combined contents shall be used.

Sections 2-5.02(b) thru 2-5.02(d) apply when there are multiple alternates for the project or there is a need to segment the project into sections.

Table 2-5.B - Strip File Naming Requirements (1 of 4)	
Strip File Name	Description
Structures DGN files	See Section 2-5.02(a).
D$12345-alignSurvey.dgn	Alignments produced by Surveys Unit
D$12345-alignDesign.dgn	Alignments produced or modified by the Design Unit. It is acceptable to have multiple design alignment files. Some designers prefer one file per alignment. Add name of roadway or other identifier as part of file name.
D$12345-alignMaster.dgn	Master alignment file which contains no data and serves only as a container for efficient referencing; see Section 2-5.03(a).

Table 2-5.B - Strip File Naming Requirements (2 of 4)	
Strip File Name	Description
D$12345-topoSurvey.dgn	Existing topographic conditions produced by the Surveys Unit. This file also includes the terrain model which results from the calculations of the survey data. In many cases, this terrain model will be the only terrain model and the file "D$12345TerrainExist" below will be empty.
D$12345-topoDesign.dgn	Topographic conditions augmented by the Design Unit
D$12345-survey.dgn	Survey data owned by Surveys Unit. The survey data contained in this file can be exported to D$12345topoSurvey.dgn to protect survey raw data or shared directly with Design.
D$12345-survey point cloud.dgn	Used for attaching point cloud files. Apply suffixes as appropriate when multiple files are required.
D$12345-survey extracted meshes and solids.dgn	Used for storage of solid objects and mesh elements which are extracted from point clouds.
D$12345-CADD.dgn	CADD Unit proposed compiled data file
D$12345-Planning.dgn	Phase 1 Study work file
D$12345-Environ.dgn	Environmental study work file
D$12345-Cor.dgn	OpenRoads Corridor Model files. There will be multiple corridor files. It is recommended that each DGN file contain only a single corridor and that for longer alignments that the length of corridor in a single DGN be limited to less than 2 miles. Add name of roadway or other identifier as part of the file name.
D$12345-CorMaster.dgn	Master corridor file which contains no data and serves only as a container for efficient referencing; see Section 2-5.03(b).
D$12345-Super.dgn	Superelevation objects for OpenRoads corridors.
D$12345-Design.dgn	Phase 2 Design Plans work file. Includes proposed corridor geometry to accommodate widening and similar. It is acceptable to have multiple design files. Some designers prefer one file per alignment. Add name of roadway or other identifier as part of file name.
D$12345-Geom.dgn	Geometrics IDS work file
D$12345-Hyd.dgn	Hydraulics Unit work file
D$12345-prof.dgn	Phase 2 Profiles work file. Since OpenRoads stores design profiles in the same file as the alignment, this file will only be used for legacy workflows or for profile plans production.

Table 2-5.B - Strip File Naming Requirements (3 of 4)	
Strip File Name	Description
D$12345-drain.dgn	Drainage work file. It is acceptable to have multiple drainage work files. Some designers prefer one drainage network file. Add suffix to file name as needed.
D$12345-ROW.dgn	Land Acquisition work file
D$12345-Soil.dgn	Geotechnical Soils work file
D$12345-TS.dgn	Traffic Signal work file
D$12345-signs.dgn	Roadway Signing work file
D$12345-light.dgn	Roadway Lighting work file
D$12345-lndscp.dgn	Landscaping work file
D$12345-eros.dgn	Erosion Control work file
D$12345-staging.dgn	Traffic Staging and Traffic Control work file
D$12345-wetland.dgn	Wetlands work file
D$12345-pmk.dgn	Pavement Marking work files
D$12345-TerrainExist.dgn	Existing terrain models. It is acceptable to have multiple existing terrain files, especially to limit file sizes. Add suffix to file name as needed. As noted above, if the existing terrain model is fully described by the terrain model automatically generated from survey data, this file will be empty. This file will contain terrain models which originate from sources external to processing of the survey raw data, for example downloaded data from USGS, and the result of merging the survey generated terrain with these external sources.
D$12345-TerrainProp.dgn	Proposed terrain models. It is acceptable to have multiple proposed terrain files, especially to limit file sizes. Add suffix to file name as needed.
D$12345-util.dgn	Utility company survey
D$12345-SUE.dgn	Sub-surface Utility Engineering
D$12345-xscTSG_ml.dgn	Cross sections after initial run of the TSG-Mainline
D$12345-xsc_ml.dgn	Completed cross section cells-Mainline
D$12345-xscTSG_sr.dgn	Cross sections after initial run of the TSG-Side Roads
D$12345-xsc_sr.dgn	Completed cross section cells-Side Roads
D$12345-layout.dgn	Layout file for GEOPAK plan and profile sheet composition
D$12345-geolines.dgn	GEOPAK work file

Table 2-5.B - Strip File Naming Requirements (4 of 4)	
Strip File Name	Description
D$12345-quantityfile.dgn	GEOPAK quantity shape file

2-5.03 Reference File Method for Design Files

The following diagrams show one suggested option for referencing various files together which will facilitate adherence to the standards in this manual and maximize the efficiency of the OpenRoads software workflow.

It must be noted that this section covers only the most common needs of a roadway corridor project. It is not the intent here to define how and where every file of every type will be referenced. Instead, these reference file diagrams describe the general intent for most projects and most file types.

Beyond the recommendations described herein, the designer is instructed to attach files as reference wherever needed so that for any given work file type the necessary information is attached.

This section does not define a reference file methodology for structures files. When constructing 3D structures models, the designer is advised to use a logical method of referencing files together.

When needing to reference the structure design files to the roadway design, the Roadway Designer is advised to use a logical method of referencing the necessary structures DGN files into the roadway files so that appropriate information is shown in the roadway design.

2-5.03(a) Alignment DGN Files References

Using the Alignment Master file as shown in Figure 2-5.A:

- Attach all other alignment files as references with nest depth of zero (none).
- Attach TopoSurvey, TopoDesign, and TerrainExist with nest depth of zero (none).

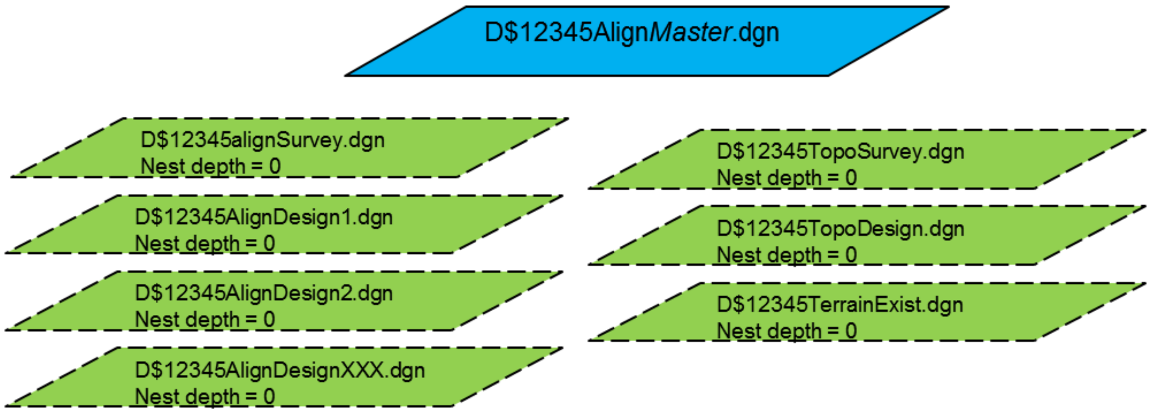


Figure 2-5.A – Alignment Master Reference Structure

Then for every individual alignment file for the various roadways:

- Attach alignment master with a nest depth of 1.

The intent of this recommended structure is to allow attachment of all reference files which contain information pertinent to developing centerlines or may impact the centerline design decisions. Thus, for any specific project there may be additional references from other working groups. For example, for some projects you may need to also reference the wetlands file or other files if they impact the alignment development process.

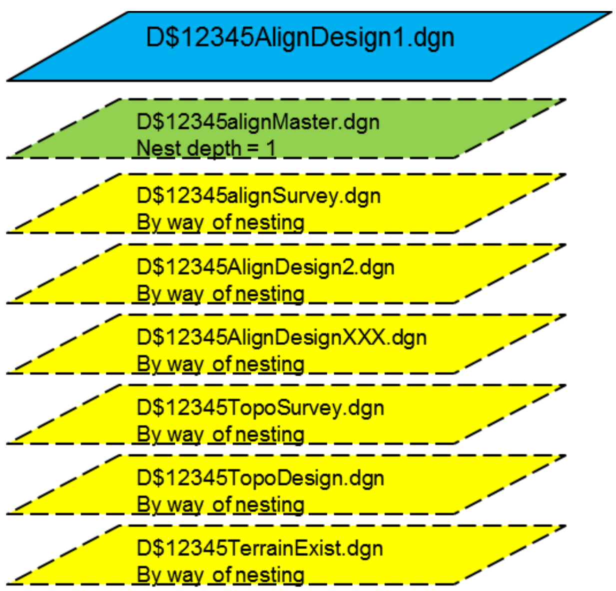


Figure 2-5.B – Reference Structure for Individual Alignment Files

2-5.03(b) Corridor DGN Files References

Using the Corridor Master file as shown in Figure 2-5.C, attach all other corridor files as references with a nest depth of zero (none).

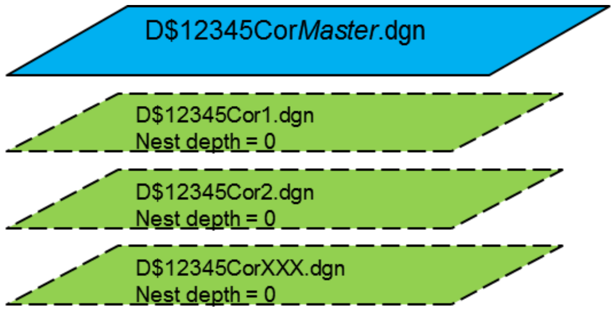


Figure 2-5.C – Reference Structure for Corridor Master

Then for each individual corridor file:

- Attach the Corridor Master with nest depth of 1.
- Attach the Alignment Master with nest depth of 1.

The intent of this recommended structure is to allow attachment of all reference files which contain information pertinent to developing corridor models. Thus, for any specific project there may be additional references from other working groups. If other strip files are needed, add as references with nest depth of zero (none).

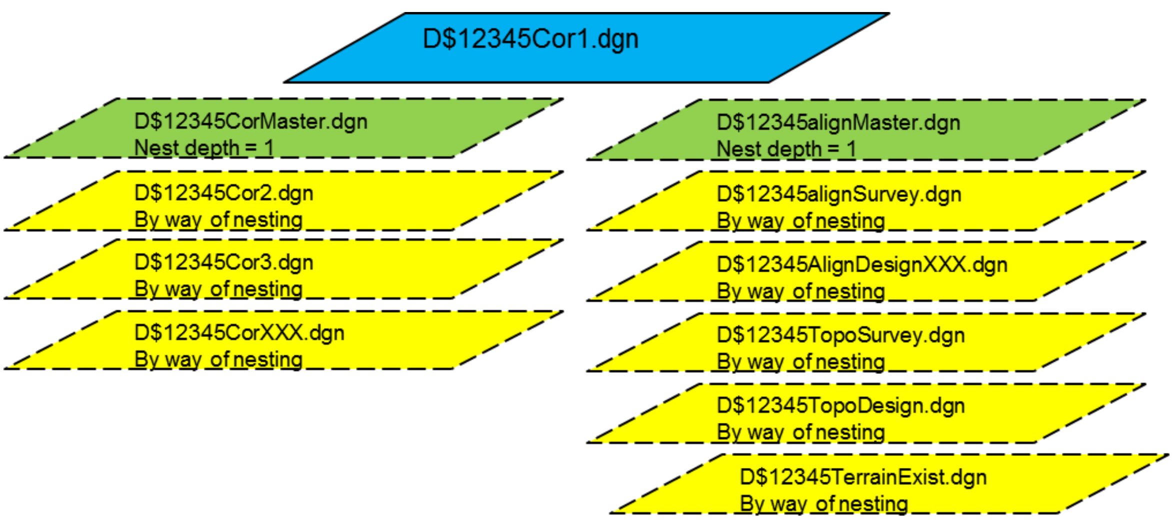


Figure 2-5.D – Reference File Structure for Individual Corridors

2-5.03(c) Other Working Files

The reference structure shown in Figure 2-5.D is also used for:

- Any of the other strip map types listed in Figure 2-5.B.
- DGN files used to set up cross-section sheet files.

Thus, for any particular strip map working file:

- Attach the Corridor Master with nest depth of 1.
- Attach the Alignment Master with nest depth of 1.

And for any of the D$12345xsc___.dgn files:

- Attach the Corridor Master with nest depth of 1.
- Attach the Alignment Master with nest depth of 1.

The resultant reference structure would then be the same, in form, as Figure 2-5.D.

2-5.04 Naming Convention of PDF Sheet Files

Final contract plan sheets shall be submitted to the Project Coordination & Implementation Section of the Bureau of Design & Environment in PDF format. The submittal shall include PDF files for each individual sheet and one or more multi-page PDF sheet files containing not more than 100 sheets each.

2-5.04(a) Naming for Individual Sheet Files

The naming convention for the individual sheet PDF files shall be:

Format: Contract Number-plan sheet number.pdf

Example:72111-001.pdf.

If a, b, or c sheets are needed, use the following naming convention:

Table 2-5.C - Naming for a,b,c Sheets	
Plan sheet	File name
50a	72111-050a
50b	72111-050b
50c	72111-050c

2-5.04(b) Naming for Multi-Page PDF Sheet Files

The multi-page PDF files shall not contain more than 100 sheets each.

If the entire contract plan set can be contained in a single PDF file of 100 sheets or less, then the naming convention for the multi-page PDF's shall be as follows:

Format: PLcontract#.pdf

Example: PL72111.pdf

If the entire contract plan set contains more than 100 sheets, break the group files at logical points by sheet content. Use the Index of Sheets to help determine break points. When submitting multiple multi-page PDF files, the naming convention shall be:

Format: PLcontract#-beginSheetNo-endSheetNo.pdf

Example: PL72111-001-100.pdf; PL72111-101-180; PL72111-181-222.pdf

2-5.04(c) Naming of Contract Sheet Files

Table 2-5.D defines the naming system that shall be used for DGN sheet files of the roadway plans. Sections 2-5.02(b) thru 2-5.02(d) apply to this list.

Structures sheet file naming is described in Sections 2-5.04(d) and 2-5.04(e).

Table 2-5.D - Sheet File Naming Requirements (1 of 2)	
Sheet Name	Description
D$12345-sht-cover.dgn	Cover sheet
D$12345-sht-gennote.dgn	Index of sheets, general notes sheets
D$12345-sht-SOQ.dgn	Summary of quantities
D$12345-sht-typical.dgn	Typical sections
D$12345-sht-schedule.dgn	Schedule of quantities sheets
D$12345-sht-ATB.dgn	Alignment, ties, and benchmarks sheets
D$12345-sht-plnprf.dgn	Design plan & profile sheets
D$12345-sht-plan.dgn	Design plan sheets
D$12345-sht-profile.dgn	Design profile sheets
D$12345-sht-elev.dgn	Elevation details sheets
D$12345-sht-staging.dgn	Staging and traffic control plan sheets
D$12345-sht-eros.dgn	Erosion and sediment control sheets
D$12345-sht-drain.dgn	Drainage sheets

Table 2-5.D - Sheet File Naming Requirements (2 of 2)	
Sheet Name	Description
D$12345-sht-rowplan.dgn	R.O.W. plan sheets
D$12345-sht-parcel.dgn	R.O.W. plat sheets
D$12345-sht-intersec.dgn	Intersection details sheets
D$12345-sht-pvtjoint.dgn	Design pavement joint details
D$12345-sht-pmk.dgn	Pavement marking plan sheets
D$12345-sht-lndscp.dgn	Landscaping sheets
D$12345-sht-ts.dgn	Traffic signal plan sheets
D$12345-sht-light.dgn	Roadway lighting sheets
D$12345-sht-sign.dgn	Signing plan sheets
D$12345-sht-wetland.dgn	Wetlands details sheets
D$12345-sht-removal.dgn	Design removal sheets
D$12345-sht-details.dgn	Detail drawings sheets
D$12345-sht-soil.dgn	Soil report plan sheets
D$12345-sht-blog.dgn	Boring Log Sheets
D$12345-sht-xssht.dgn	Cross section sheets
D$12345-sht-misc.dgn	Miscellaneous designs (non-highway work)
D$12345-sht-bcr.dgn	Bridge condition report
D$12345-sht-ids.dgn	Geometrics IDS sheets
D$12345-sht-rpt.dgn	Project report sheets

2-5.04(d) Structures Sheet File Naming Multiple Models

When creating structures sheets in a single DGN file with multiple models, the primary design file name shall be as follows:

Format: Structure Number-Contract Number.dgn.

Example: 0100272-90758.dgn

The Individual model names shall be as follows:

Format: Structure Number-Contract Number-Sheet Number.

Example: 0100272-90758-001

The model description fields shall be representative of what is in each model.

The individual structure planning model name(s) shall be as follows:

Format: Structure Number-Contract Number-TSL-Sheet Number.

Example: 0100272-90758-TSL-001

Figure 3-3.A shows some examples of multiple models in a single DGN file.

2-5.04(e) Structures Sheet File Naming Individual DGN

When creating structures sheets in individual DGN files, each planning and design file shall be named in the following format:

Structure Number-Contract Number-Sheet Number-Brief description of sheet.dgn.

Example: 0100272-90758-001-GPE.dgn

2-5.05 Reference File Method for Sheet Files

When referencing the various strip files into the sheet layout file(s), it is recommended to follow the same referencing structure as outlined for corridors in Section 2-5.03(b) and then add any additional needed references with nest depth of zero (none).

SECTION 3 DESIGN TIME WORKSPACE

This section defines requirements for producing strip maps and models using CADD and the related portions of the IDOT workspace environment used during design time.

For requirements related to plans production, see Section 4 of this manual.

For requirements related to submittal of electronic files, including electronic versions of plan sheets, see Section 2 of this manual.

For requirements related to file and folder structure and naming, see Section 2 of this manual.

3-1 CADD SOFTWARE PACKAGE

For roadway and structures design, IDOT has selected a variety of software for department-wide computer-aided drafting and design.

- Bentley's MicroStation is used as the basis of all computer aided drafting activities. The DGN format is the native format for the CADD files produced by MicroStation. MicroStation can also be used to develop 3D models of structures.
- Bentley's GEOPAK software installs as an integral part of MicroStation and is used to generate roadway contract plans:
  - OpenRoads is an advanced toolset and is part of GEOPAK. These tools are used to develop the roadway 3D models.
- A variety of MicroStation compatible software is used for analytical aspects of structures design. Regardless of the analytical software used, the plans and 3D structures models (if required) are delivered in MicroStation DGN format.

All CADD files and 3D models developed by or for the Department shall be developed using versions of these software products as adopted by the Department; see *Bureau of Design and Environment Manual* Section 63-2.03.

The IDOT workspace and this manual have been developed specifically for these CADD software products. Using the workspace settings described below allows the following benefits:

1. All project participants are able to work on the same set of plans without interfering with other's design work,
2. The resulting CADD and engineering files will follow a common and consistent form,
3. The resulting 2D models can continue to be used for production of plans and other processes,
4. The resulting 3D models can consistently and reliably be used for automated machine guidance and other 3D enabled processes, and
5. Calculation of the quantities and other business information can be completed more efficiently.

For LiDAR workflows, point cloud software including Bentley Descartes, Bentley Pointools, Open Roads Designer, Trimble Business Center Scanning module, Trimble RealWorks, Leica Cyclone, and TopoDOT/TopoCloud are available for internal staff use. See Section 2-3 for discussion on file types included as part of LiDAR deliverables. Also see Appendix K entitled, *LiDAR Data Collection and Processing Overview* for more information on LiDAR.

3-2 LOADING THE CADD WORKSPACE CONFIGURATION

The Bureau of Design and Environment has created a CADD environment for OpenRoads which defines the configuration and the files necessary for the preparation of roadway and structure plans.

IDOT users can ensure that they are using this environment by launching Power GEOPAK from ProjectWise. If working outside of ProjectWise, use the desktop shortcut that was created with the Power GEOPAK installation, then browse to open the file. Double-clicking a file from Windows Explorer to open is discouraged as this may open Power GEOPAK with an incorrect workspace.

For external users, the workspace environment is available for download at the links shown in Section 5-2 under the Support tab as a single download entitled "IDOTCADD_SS10.exe". A project configuration file (PCF) is included in the download which can be used to streamline the use of the workspace for external users. Figure 3-2.A below shows the use of the PCF file in an external environment. Refer to the "ReadMeNow.pdf" file and the "IDOTCADD_Directories.pdf" file contained within the downloaded file.

Before starting a new project, verify that the latest configuration files are installed. This can be accomplished via a comparison of installed files to those currently available from the IDOT CADD Support web page.

The best way to stay informed about the latest IDOT configuration is to be an active participant in the IDOT CADD Support Subscription Service. Subscribers are notified through e-mail whenever changes are made to the contents of the CADD Support websites or this manual. See Section 5-3 for instructions to subscribe to the various notification services.

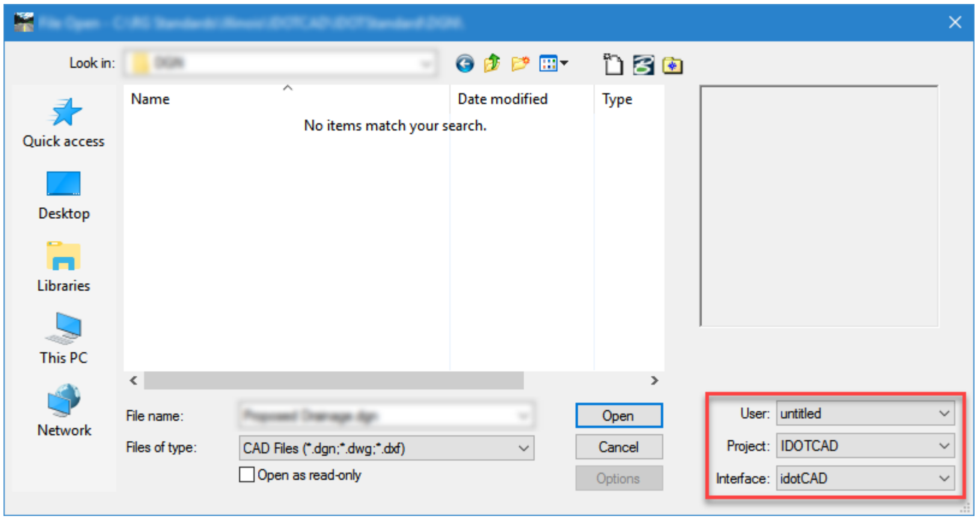


Figure 3-2.A - Selection of IDOT Workspace

3-3 SEED FILES

The IDOT CADD environment includes multiple seed files and defines the default seed file which is used unless overridden. A seed file contains most of the settings which are needed to define the geographic extents of a project designed for IDOT.

3-3.01 Road Seed Files

The seed files required for the preparation of roadway plans are shown in Table 3-3.A.

Table 3-3.A - Roadway Seed Files	
Seed File Name	Description
IDOTeng.dgn	Imperial Units 2D seed file. No coordinate system assigned.
IDOTeng3D.dgn	Imperial Units 3D seed file. No coordinate system assigned.
IDOTseed_dgnlib	Used ONLY for creating new DGN Libraries (dgnlib).

It is usually most efficient to start roadway design files with a 2D seed file with the appropriate coordinate system assigned. See Section 3-3.06 for more information on coordinate systems, especially when a ground to grid adjustment factor is applied.

It is usually most efficient to start survey files and terrain models files using a 3D seed file with the appropriate coordinate system assigned.

The file naming requirements for design files and models are discussed in Section 2-5 of this manual.

3-3.02 Structures Seed Files

The seed files available for the preparation of structure plans and models are shown in Table 3-3.B.

Table 3-3.B - Structures Seed Files	
Seed File Name	Description
ebridge_Models.dgn	Contains design and planning models in which ANSI D-sized borders have been placed. Additional models intended for sheets and full scale details may be added or removed as required. Use this seed file when a single design file is to be employed for an entire project; see Figure 3-3.A
ebridge_Individual.dgn	Contains a single design model with a design border inserted. Use this seed file when individual design files are utilized for each sheet in a project; see Figure 3-3.B
ebridge_in-house.dgn	Used solely for jobs to be completed internally by IDOT similar to “ebridge_models.dgn” seed file but contains IDOT borders which slightly differ from those to be used by consultants.
ebridge-3D.dgn	Used for generating the 3D models of structures. Similar to the Roadway seed file defined in Section 3-3.01, it is appropriate for use on 3D bridge models which need to be geographically aligned with the roadway models.

For the structures seed files which contain sheet borders, the borders are placed with the lower left hand corner of the inner border (working area) at xy = 0,0.

The file naming requirements for design files and models are discussed in Section 2-5 of this manual.

Model names and descriptions are easily changed by slowly double-clicking on a model name in the models dialog or else they may be changed in the ***Edit Model Properties*** dialog.

For more information concerning the borders used in these seed files; see Section 4-5.02.

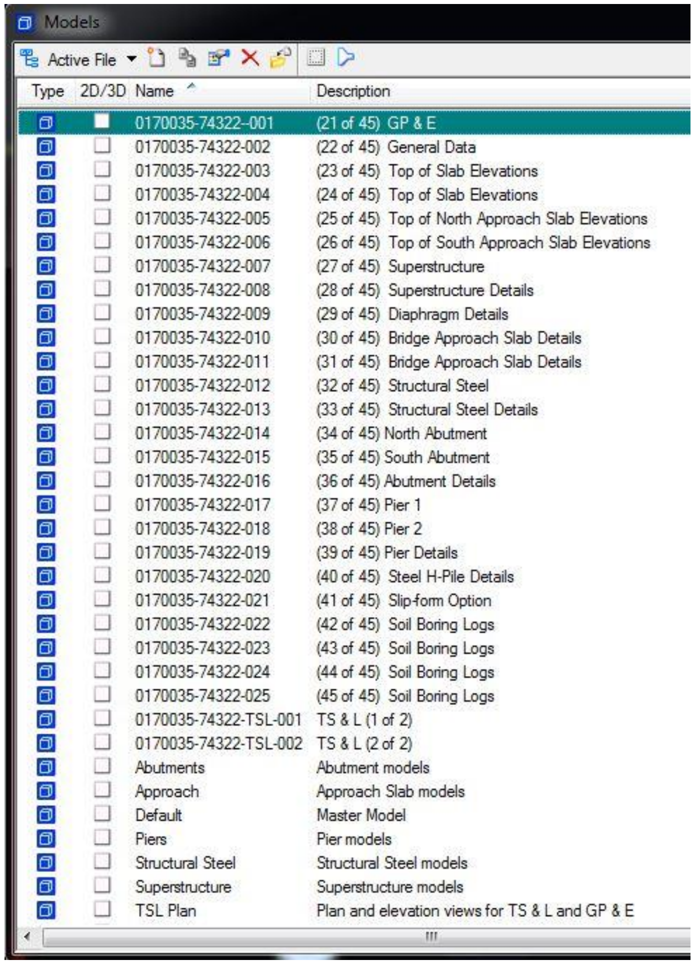


Figure 3-3.A - Structures DGN Model Examples

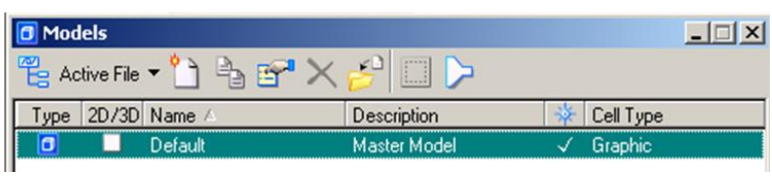


Figure 3-3.B - Structures Seed with no Models

HARD COPIES UNCONTROLLED

3-3.03 Models in Seed Files

The seed files contain models as appropriate for starting new DGN files for a roadway or structures project. Multiple drawings (models) can exist (and usually will) within a single DGN file. Each model can be thought of as its own design space, complete with its own settings and configuration.

There are three types of models available: Design, Drawing, and Sheet. Design and Sheet models can be two- or three-dimensional, while the drawing models are limited to two dimensions, IDOT only uses and accepts two-dimensional models for plan sheets.

The roadway design elements will be contained in a mix of 2D and 3D models which are managed by the OpenRoads software. It is highly recommended that the majority of design graphics, including OpenRoads geometry, corridors, and other elements be created within two-dimensional models. GEOPAK automatically creates three-dimensional models for use with the OpenRoads three-dimensional model.

Survey information and terrain models are normally developed in 3D models.

Structures design elements will be a mix of 2D and 3D models. The Bureau of Bridges and Structures uses the model concept by creating each sheet of a set of design plans in its own design model. Use of the model concept in the preparation of structure plans is not mandatory and it is acceptable to have individual DGN files for each sheet. A sample project has been placed on the Bureau of Bridges and Structures CADD Downloads and Guidelines section on the Department's website to illustrate both methods. The sample is available using the links shown in Section 5-4.

New models can be added to the active DGN file by selecting the ***File > Models*** pull-down menu or by selecting the ***Models*** icon from the ***Primary Tools*** toolbar. When creating a new model, it is important that the correct seed file is selected so that the model's settings will be correct; see Figure 3-3.C. The Geographic Coordinate System (GCS) must be set correctly for each model; see Section 3-3.06. Standard details, such as Structures Base Sheets, do not have a GCS assigned.

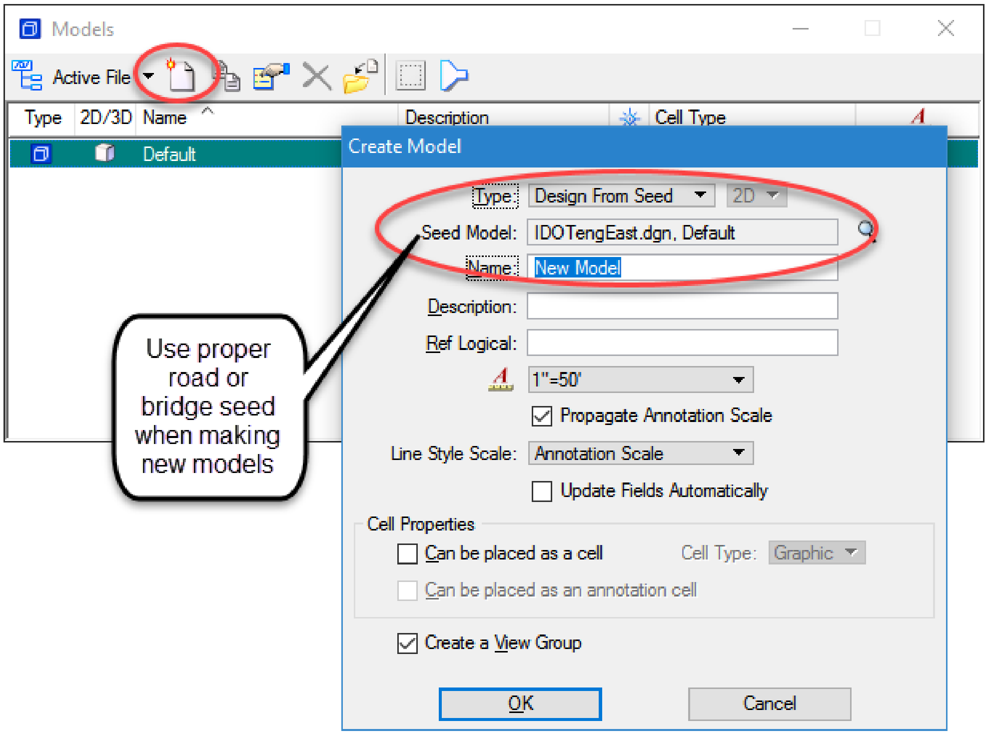


Figure 3-3.C – Use of Seed File When Making Models

3-3.04 Global Origin in Seed Files

Along with the working units, the global origin setting of the design file affects the accuracy of the design. The Department sets the global origin to x = 0, y = 0 and z = 0 in all of the IDOT seed files.

In previous versions of MicroStation and previous versions of the workspace, there was a required shift in the global origin so that the Illinois state plane coordinate system would fit within the limited design plane of MicroStation Version 7. MicroStation Version 8 eliminated this required shift and with the advent of OpenRoads technology the shift became a hindrance to efficient design modeling. Thus, the offset was removed, and the global origin is defined as the center of the design cube as noted above.

When the need arises to reference files from older IDOT projects, which may contain a shifted global origin, into newer DGN files, without a shift, the designer will need to accommodate the difference by either referencing the files with global origins aligned or by moving the reference to known coordinates.

3-3.05 Working Units

The seed files delivered in the IDOT workspace define appropriate working units of Survey Feet as the master units and Survey Inches as the sub-units within the IDOT seed files. The working units are defined in all IDOT seed files and are extremely important in long distance design file measurements. The resolution is defined as 1000 units per Survey Foot, which provides for the ability to measure and design to an accuracy of 0.001 Survey Feet. It is important to note the Solids Area is defined as 1 mile. This setting is important for the accurate generation of 3D solids and should not be changed.

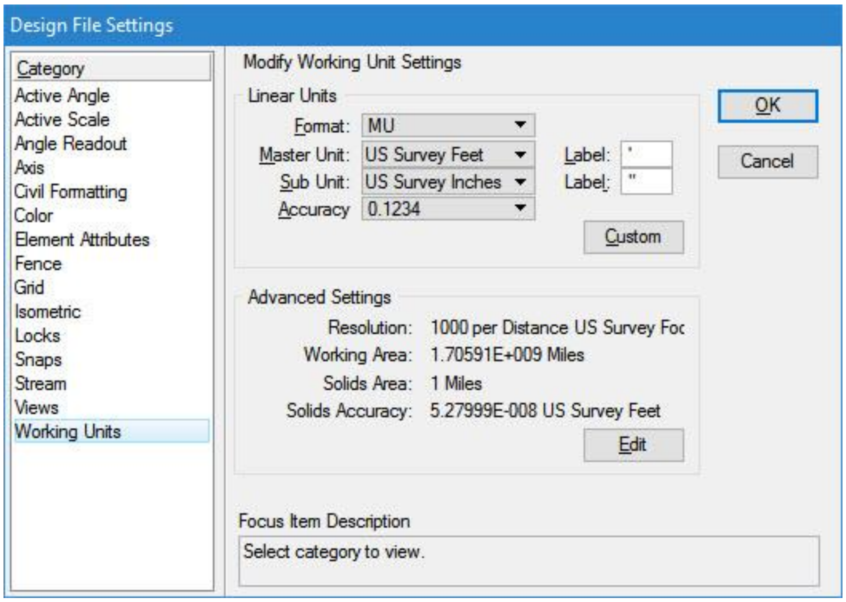


Figure 3-3.D - Seed File Working Units

The image shown above displays the settings in the roadway seed file. The settings in the structures seed files are identical with only one exception. The format defined for the structures file is set to MU:SU rather than MU as seen here for roadways. This has no effect on the design models whatsoever and only affects how units are presented to the user in various commands. The result of these settings in the roadway and structures seed files is that the Structures Designer will see distances presented in the form "feet: inches" which is most convenient for them and the Roadway Designer will see distances presented in the form of decimal feet. However, in both cases the storage units are U.S. Survey Feet.

3-3.06 Geographic Coordinate Systems

Assigning a coordinate system to every DGN file facilitates the easy exchange of information to external systems such as Google Earth and simplifies the referencing of files which exist in disparate coordinate systems.

The correct coordinate system and any additional transformation parameters used for the project are part of the delivery from Design Surveys to Roadway/Structures Design. Contact the Surveys Unit for details on the geographic coordinate system, if needed.

To assign the geographic coordinate system to any DGN file, select *Tools > Geographic > Select Geographic Coordinate System.*

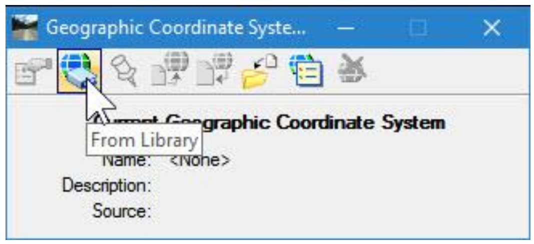


Figure 3-3.E - Geographic Coordinate System Tools

Click the button to select from Library.

Then on the library list, choose the geographic coordinate system as described by the Survey deliverables. The complete file path to locate these is: *Projected Systems > North America > United States of America > Illinois*

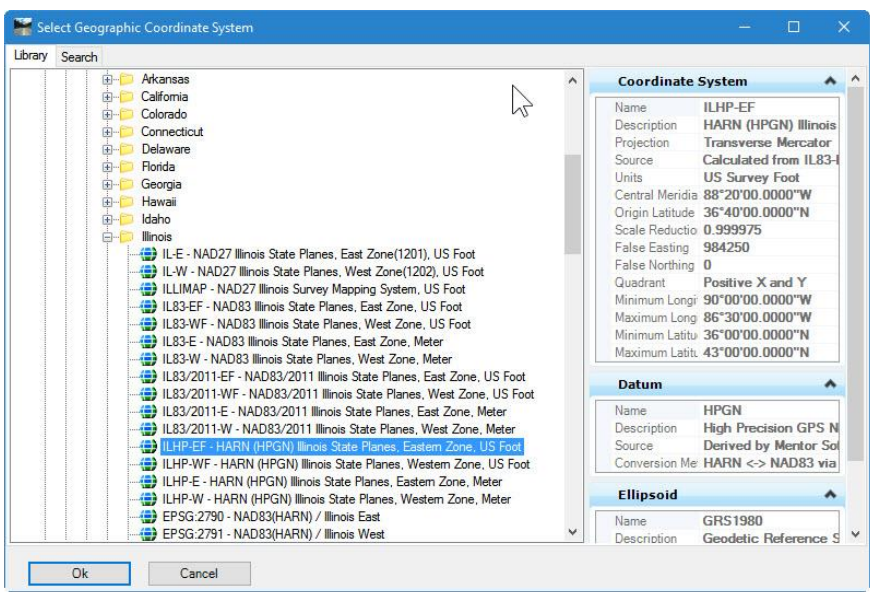


Figure 3-3.F - Selection of Geographic Coordinate System

For some projects, there may be an additional modifier applied to the coordinate system to account for elevation and scale factor. If the project uses this adjustment parameter then on the GCS dialog, click on the Details button. This is where the combined elevation and scale factor provided by the Design Surveys Unit can be entered. The Surveys Unit will advise whether an adjustment factor is used.

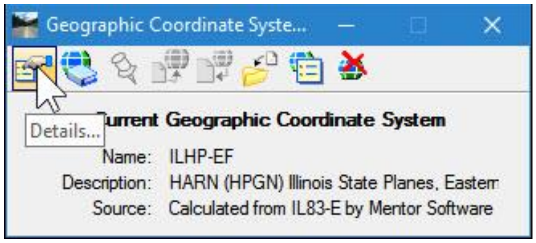


Figure 3-3.G - Geographic Coordinate Systems Details Tool

Change the transform type to Helmert Transform, and enter the combined factor assigned for the project as the Helmert A parameter.

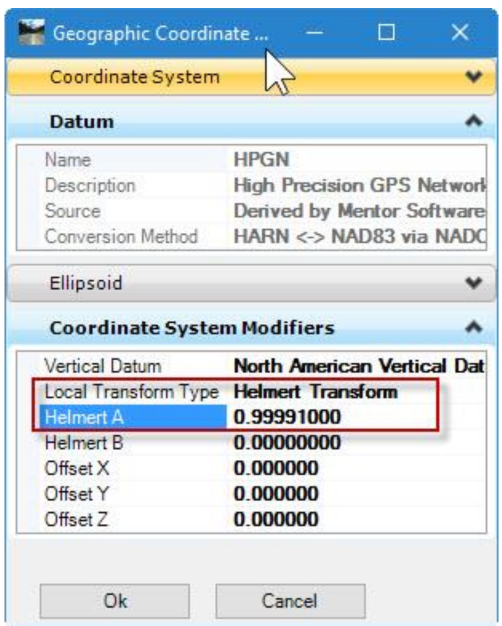


Figure 3-3.H - Ground to Grid Adjustment Factor

When attaching references where coordinate systems have been properly assigned, use the attachment method of Geographic-Reprojected. When this is done, the reference file is transformed on the fly so that alignment of the two coordinates systems is automatic. The “Geographic” attachment methods are only shown when both the active and the reference file have been configured with a coordinate system.

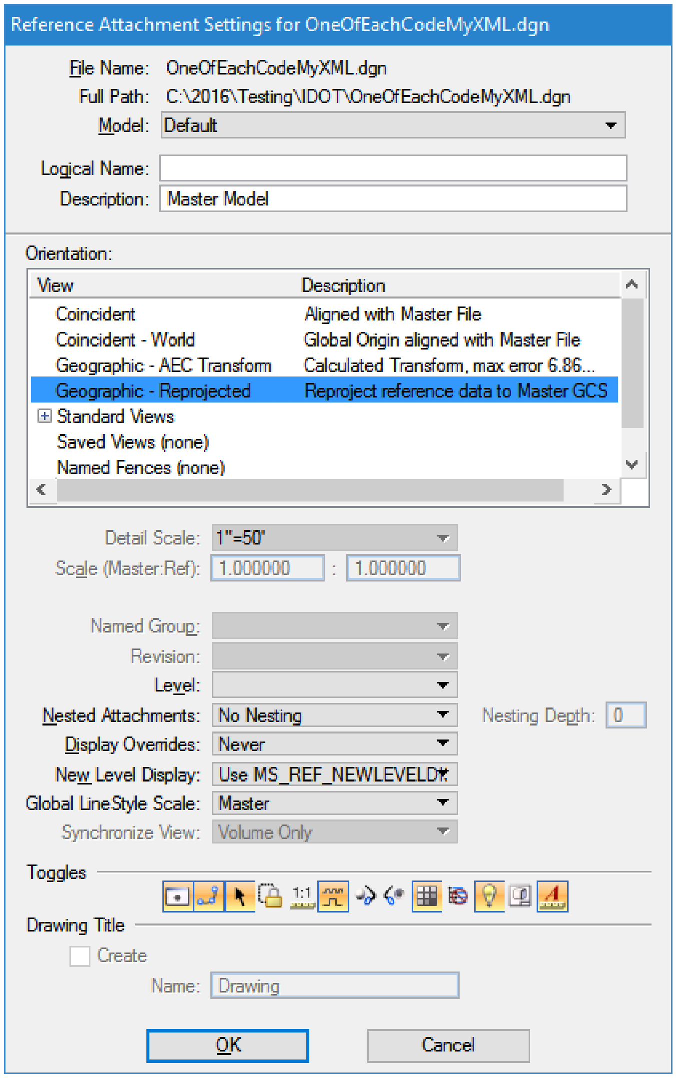


Figure 3-3.I – MicroStation Attachment Methods

For some projects, there may be DGN files which you need to reference but for which the coordinate system is not defined. In these cases, you can either add the coordinate system definitions or use the traditional Coincident or Coincident World attachment methods.

3-3.07 Hydraulic Seed File

The IDOT CADD Workspace defines settings for hydraulic computations using the OpenRoads Subsurface Utility Design and Analysis tools in file named:

Drainage_Feature_Definitions.dgnlib

This file contains the feature definitions for storm and sanitary sewers (See Sections 3-6.04 and Appendix F) as well as the hydraulic properties needed for performing hydraulic design. This file is referenced in the workspace by the following configuration variables:

- SUDA_SEED_FILE = $(IDOT_STANDARD)/dgnlib/Drainage_Feature_Definitions.dgnlib
- SUDA_SEED_MODEL = Default

These variables provide the instructions for OpenRoads for seeding the hydraulic properties needed for drainage design. Whenever a SUDA command is launched in a DGN file which lacks a hydraulic model the hydraulic contents of the hydraulic seed are copied to the active DGN. No user interaction is required for selecting the hydraulic seed file nor does the user need to make a conscious decision of when to create the hydraulic model. It is created automatically as needed. The creation of a hydraulic model in the active DGN is preceded by this warning message.

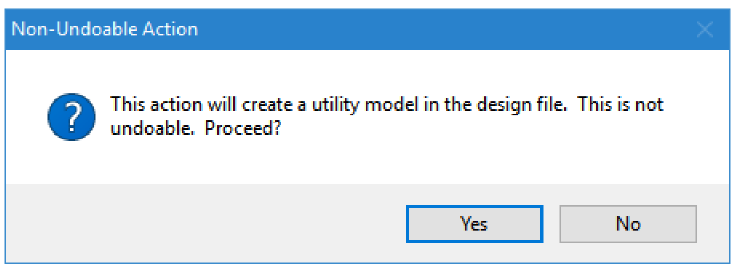


Figure 3-3.J – Message Notifying of Utility Model Creation

Included in the hydraulic seed file and copied to new hydraulic models are:

1. Storm definitions for the Illinois regions – Time-depth and IDF curves are configured for zones 1 through 10 and for return periods between 2 years and 100 years.

2. Hydraulic design constraints – these define minimums and maximums for slopes, velocities and other design constraints.

3. Hydraulic definitions for grates, curb inlets and manholes, including the various special inlets as defined per district.

4. Runoff factors for various land use as defined in the Department's Drainage Manual.

5. Calculation Options for analysis and design of storm sewer network including culverts.

6. Preconfigured Design Scenarios covering each storm return period for each storm zone.

In current versions of GEOPAK, there is a defect which does not properly recognize the units of U.S. Survey Feet in the hydraulic model. Although the hydraulic seed contains the proper definitions, any new hydraulic models are improperly defined as international feet. This error can be seen by opening the Project Defaults command.

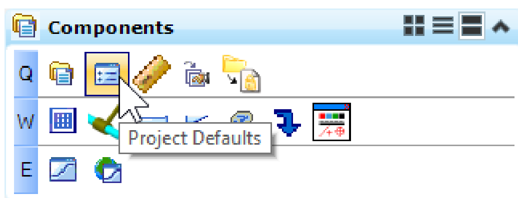


Figure 3-3.K – Subsurface Utilities Project Defaults

On the Units tab, click Load to open an XML file included in the workspace.

…\IDOTCAD\Standard\Data\IDOT SUDA Units.xml

This will correct the units to U.S. Survey Feet.

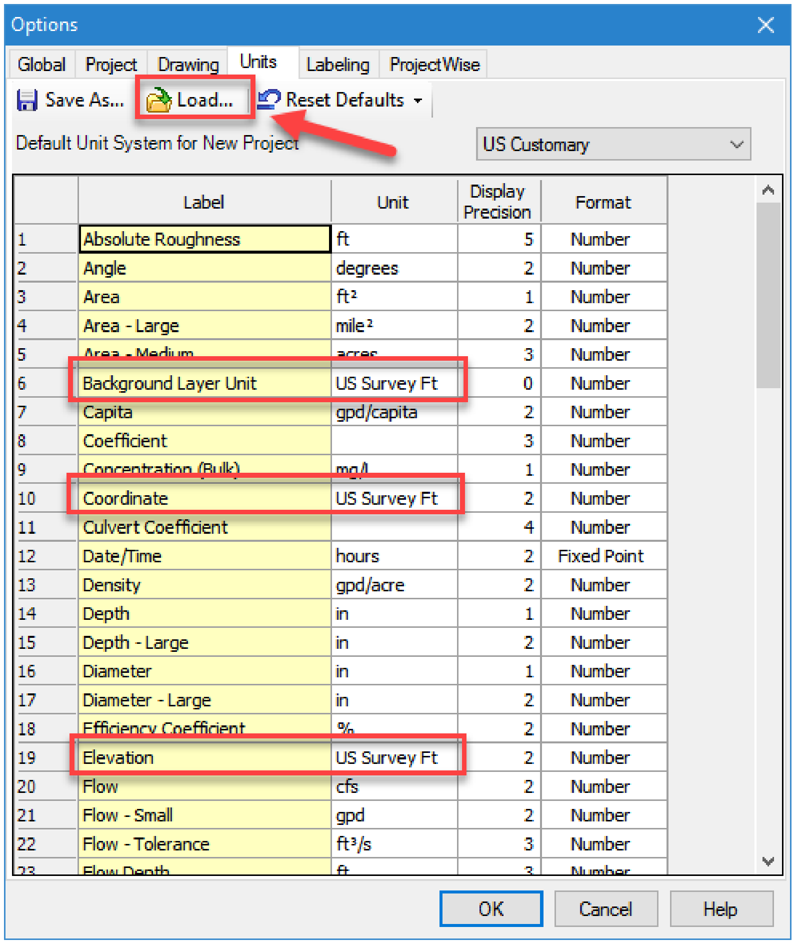


Figure 3-3.L – Subsurface Utilities Units Settings

3-4 LEVEL STRUCTURE

The IDOT CADD workspace defines levels and level filters which form the foundation of the plans production and modeling workspace. These are defined within the IDOT DGN Library file named *IDOT_Levels_ElementTemplates_Features.dgnlib*. This file contains level definitions for each Department discipline, including bridge, roadway, mapping, aerial survey, etc. All level symbology definitions are preset within this DGN Library and the defined attributes include the name, color, line style and weight for each level.

Before placing elements into a design file, first select the desired level or the appropriate OpenRoads Feature Definition; see Section 3-6 for information on feature definitions. This ensures that elements are created on the correct level and that the associated symbology will be automatically set correctly. Note that the ***Attributes*** toolbar buttons for color, line style and weight should all be set to ***By Level*** in order for the level symbology settings to be applied.

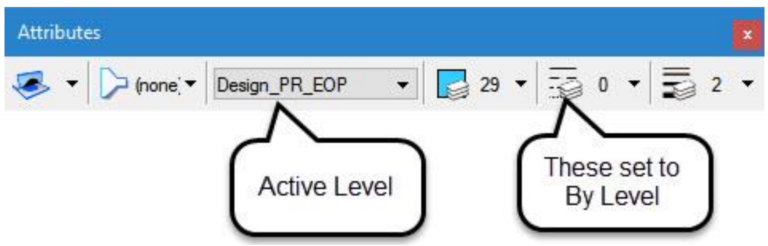


Figure 3-4.A - Element Attributes Toolbox

Level Filters have been set up to make it easier to locate a particular discipline's group of levels. The ***Active Level Filter*** dialog, located on the ***Attributes*** toolbar, allows users to select the set of levels viewed within the ***Level Manager*** or ***Level Display*** dialogs.

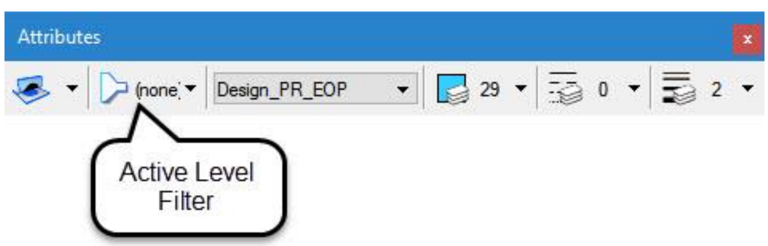


Figure 3-4.B - Active Level Filter

Appendix B lists required levels and level filters for both Roadway and Structures projects. This list also shows the colors used for each level.

3-5 COLOR TABLE

The IDOT workspace contains standard color definitions for use in roadway and structure plans preparation. The standard colors are defined in the file named *IDOTcolor.tbl*. The color table can be reviewed by clicking in the menu, *Settings > Color Table* which presents the colors as seen in Figure 3-5.A and Appendix G.

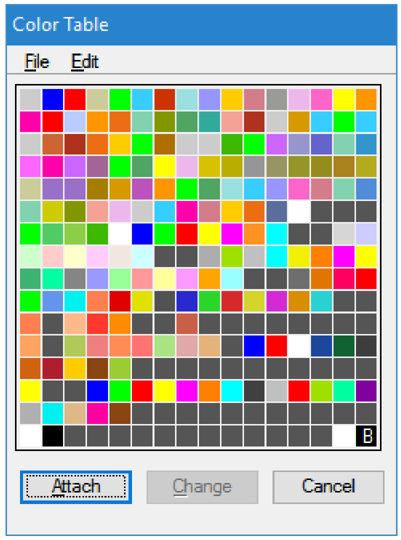


Figure 3-5.A – IDOT Color Table

Each DGN file can have its own color table assigned and once assigned the DGN colors are separate and distinct from the color table. To reload the color table in a DGN file which may have been changed or out of date, click on *File > Open* in the color table settings shown in Figure 3-2.A.

See Appendix G for the red-green-blue color definitions in the default color table.

3-6 FEATURE DEFINITIONS

The IDOT CADD environment defines OpenRoads feature definitions for roadway, utilities and drainage plans, and model production. The feature definitions work in combination with the level structure as an aid to defining the nature of the plans and modeling features. It is important to understand the definitions of "Feature" and "Feature Definition" as used in the OpenRoads tools.

Feature – a plan or modeling element in the CADD file which represents a real-world entity. Examples of features are centerline, curb, slope hinge line, break line, manhole and culvert, as well as many more.

Feature Definition – a definition for an entire class of real world features including:

- What the feature is, including business or engineering intelligence.
- How the feature is represented in CADD in plan, profile, 3D, and cross-section context.

A complete list of feature definitions, as defined for the IDOT workspace, is shown in Appendix E and F.

The IDOT workspace contains the feature definition libraries shown in Table 3-6.A:

Table 3-6.A – IDOT Feature Definition Libraries

Library Name	Description
IDOT_Levels_ElementTemplates_Features.dgnlib	Contains feature definitions used for Design Surveys and Roadway Design.
Drainage_Feature_Definitions.dgnlib	Contains feature definitions used for drainage modeling/design, including culverts and sanitary sewer feature definitions.
Utility_Feature_Definitions.dgnlib	Contains feature definitions used for modeling of utilities other than drainage or sanitary sewer.

Feature Definitions are created and managed in the Project Explorer. Right click on a feature definition in the project explorer to open its properties.

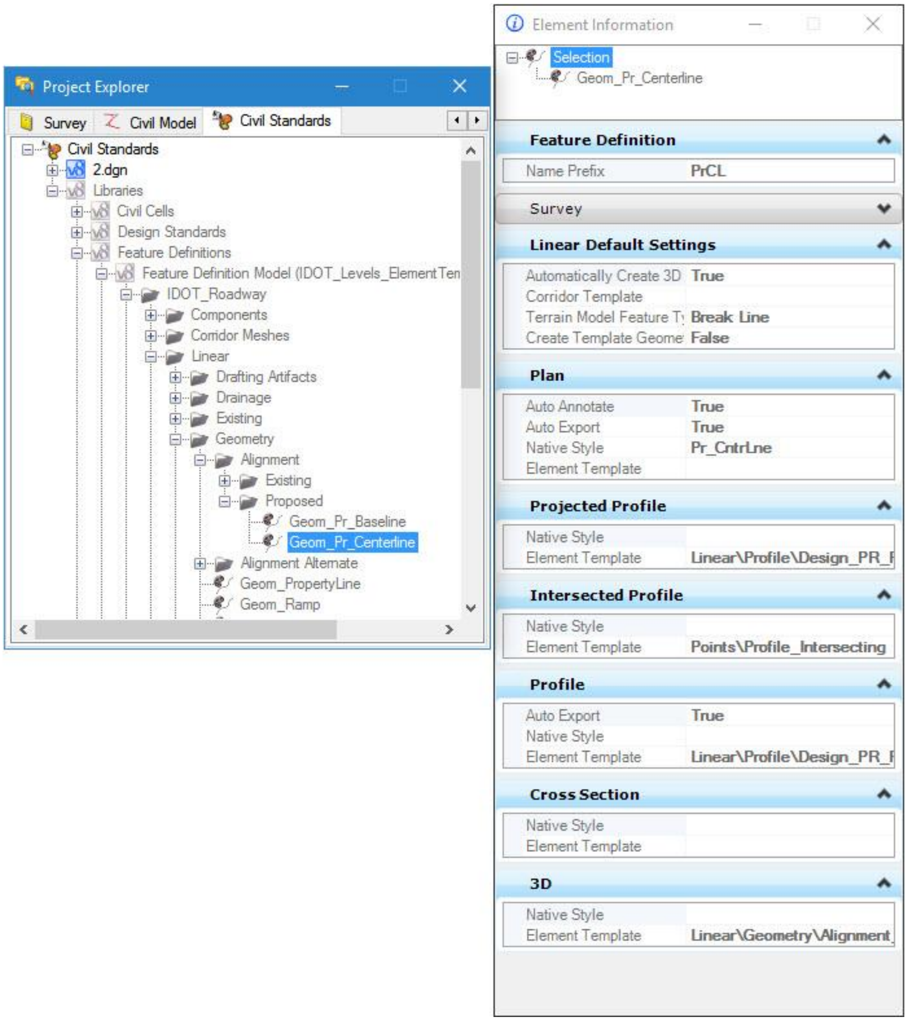


Figure 3-6.A - Feature Definitions Library

Feature Definitions are selected for use in the commands or using the Feature Definition Toggle Bar.

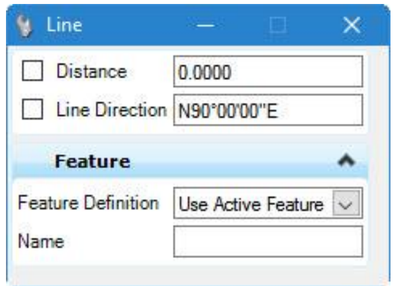


Figure 3-6.B - Choosing Active Feature Definitions

Figure 3-6.C - Feature Definition Toggle Bar

3-6.01 Element Templates

MicroStation Element Templates are used in a feature definition to control graphical symbology. These element templates typically define required level, color, line style and line weight for the presentation of a feature in the context of plan, profile, 3D, and cross-section. For point geometry, the element template may also define a cell for display of the point. For 3D context, the element template may also define a material for rendering the 3D view. These templates are defined in the feature definition library.

Figure 3-6.A above shows an example of element template assignments in the properties of a feature definition. Figure 3-6.D shows an example of a typical element template used for display of a point in plan view context.

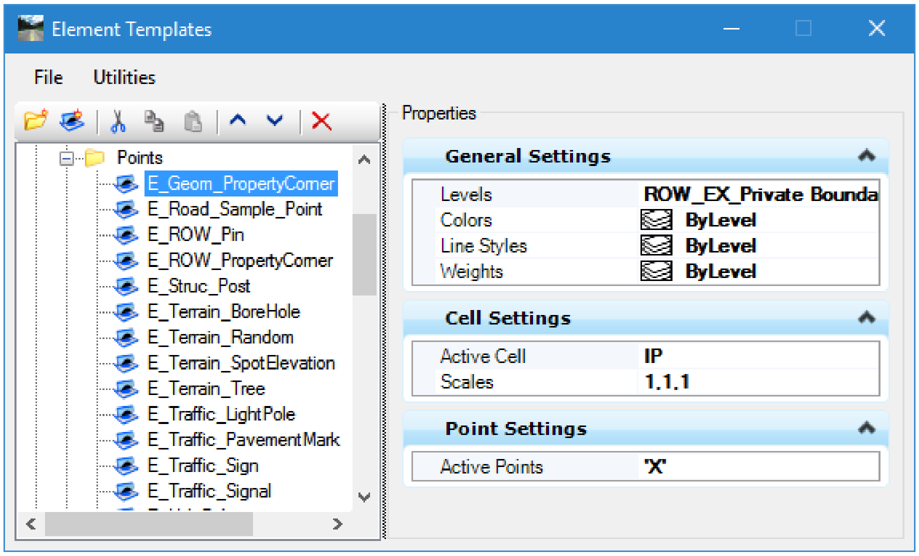


Figure 3-6.D – Example of an Element Template

3-6.02 Geometry Feature Definitions

The most common type of feature definition is a geometry type. An example of this is shown in Figure 3-6.A. Geometry feature definition types may be configured to apply to point geometry, linear geometry, or terrain models. They are used for:

1. Laying out all sorts of geometry such as centerlines, edge of pavement, right of way, sidewalks, etc.,
2. Used in conjunction with roadway corridor and template design,
3. Used for points and break lines which form terrain models,
4. Used for survey points and survey lines, although this is a special case described below, and
5. Used to define the nature and display characteristics of terrain models.

3-6.02(a) Design and Computation Manager File

In Figure 3-6.A, notice that in the *Properties* > *Plan* panel, the plan view symbology is defined by "Native Style." This native style links to an entry in GEOPAK Design and Computation Manager (D&C Manager). The D&C Manager is a legacy tool that plays a reduced role since the introduction of OpenRoads technology but is still required for some operations. Historically, it was used to draw coordinate geometry and other elements into the MicroStation design file using preset display attributes. The drawing of the geometry is now handled for most feature definition types by MicroStation element templates, but some tools and operations still require the use of the D&C Manager and its database settings file.

Primarily on IDOT projects, the D&C Manager is used to perform annotation for alignments and profiles.

- The feature definitions for alignments are configured to place the annotations automatically, but the annotations can be performed after export of the alignments to GPK, if preferred.
- The profile annotations are performed after export to GPK using the historic workflows.

The default database for the D&C Manager is defined in the workspace: *IdotRoad.ddb*. The individual DDB items may be linked to OpenRoads feature definitions to provide annotation and automate the export to GPK process. Appendix E indicates the feature definitions for which the link to DDB is configured.

Recommended Workflows:

For creating alignment annotations, it is recommended to use the automated method. To use this method, there must be an active GPK file. The designer is prompted to select the GPK when it is needed. By using the proper feature definition for the alignment, the annotations are then automatically created.

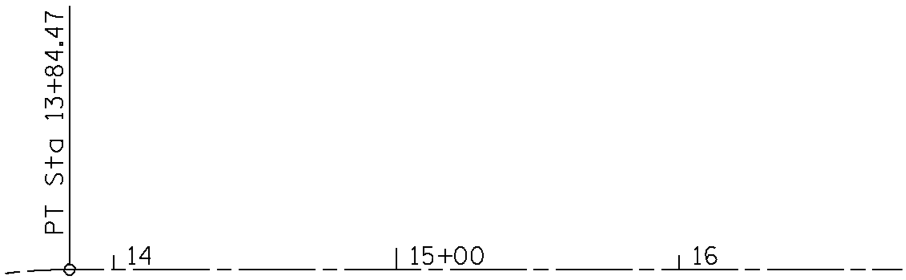


Figure 3-6.E – Sample of Automated Centerline Annotation

For annotation of profiles, the alignments and profiles are first exported. This occurs automatically for centerline feature definitions. Manual export is available from the tasks list. After geometry is exported, use the Design and Computation Manager tool in legacy GEOPAK with the appropriate item in the DDB file.

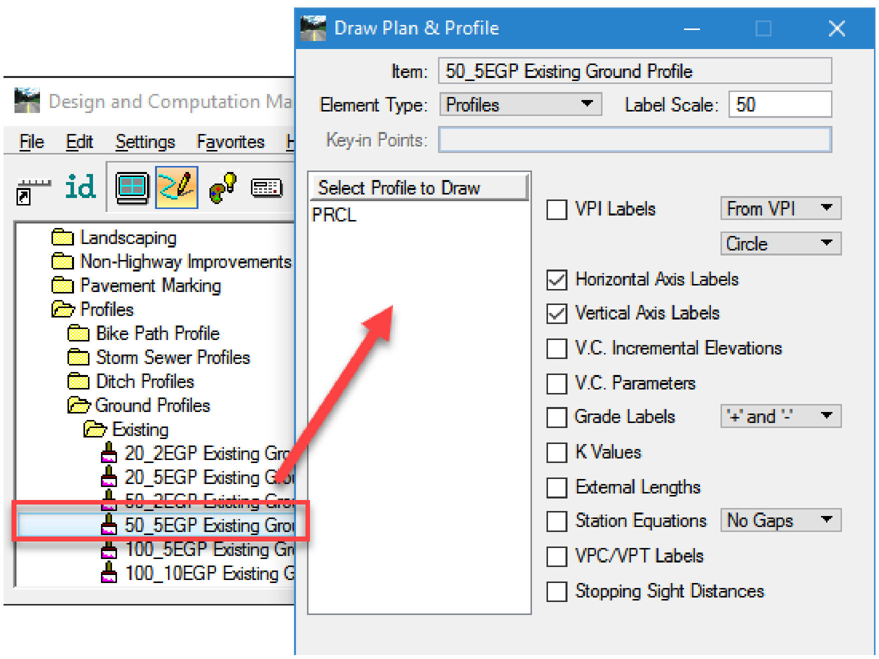


Figure 3-6.F – Annotation of Profile Using DDB Item

It is possible to use the D&C Manager with the Place Influence switch. The Place Influence switch was used in legacy workflows as an aid to control symbology of graphical elements which were created with ordinary MicroStation drafting commands. By selecting an item in the D&C Manager, then clicking on *Place Influence*, as shown below, the active symbology can be controlled.

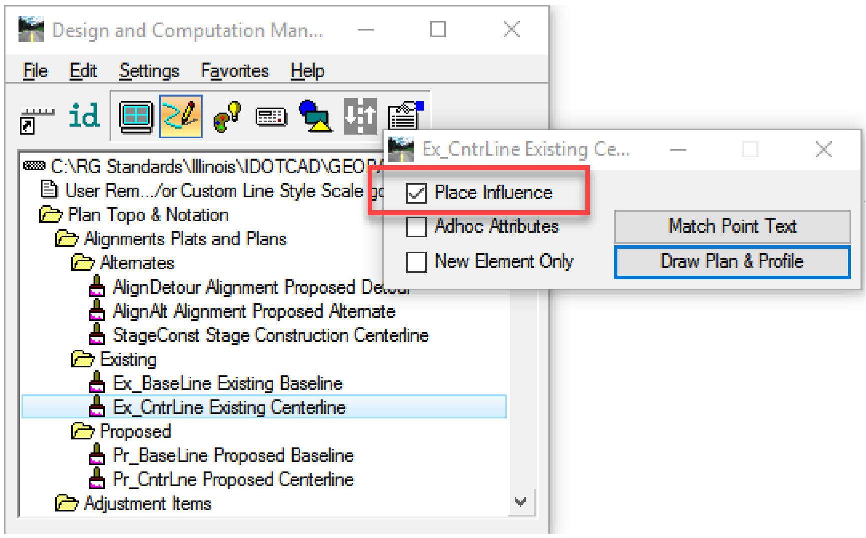


Figure 3-6.G – D&C Manager Place Influence

However, there are some important differences from previous versions of the workspace that the designer needs to be aware of which result from the change in the use of annotation scale. In order to achieve the proper scale of line styles and cells which are created when using the Place Influence switch, the D&C Manager settings for scale must be correct. In the D&C Manager menu click on *Settings > Design* and then:

- Always set line style scale to 1.0 with DGN annotation lock turned on, and
- Set the cell creation scale to the appropriate ratio shown in Section 3-10.

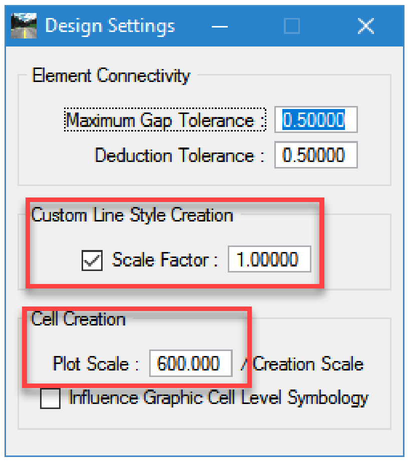


Figure 3-6.H – D&C Manager Scale Settings

The D&C Manager also includes some special applications which continue to be useful for some types of projects. The designer will take note that these items will only function on geometry which has been created in or exported to the GPK file. It should be further noted that in future versions of GEOPAK, these items will cease to function and will be removed from the workspace.

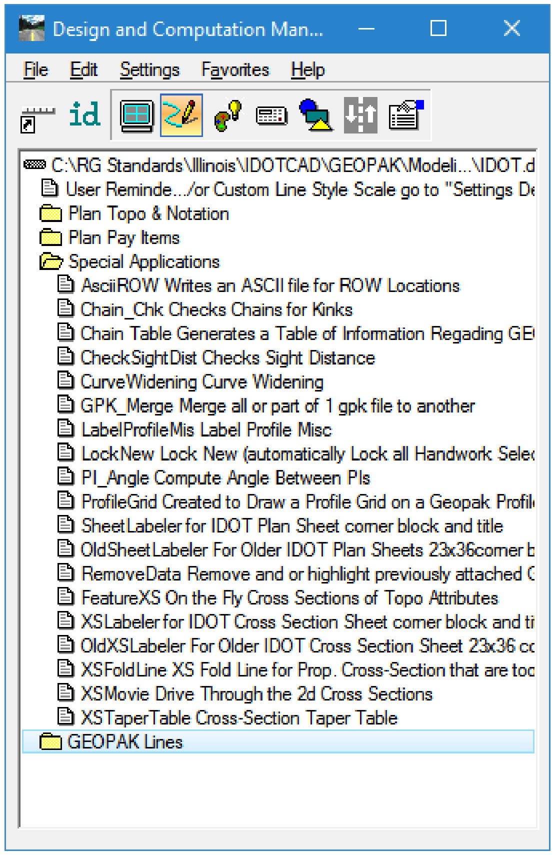


Figure 3-6.I – Design and Computation Manager

For guidance on the use of these special applications, see historic versions of this manual or IDOT training materials.

3-6.02(b) GEOPAK Database (GPK)

In Figure 3-6.A, the feature definition for centerline is marked to Auto Export and Auto Annotate in the properties. The export in question here is OpenRoads' export to GEOPAK's legacy geometry database file (GPK).

The GPK file contains project geometry that has either been created using legacy GEOPAK tools or exported from OpenRoads geometry features. And while its role has been diminished with the introduction of OpenRoads technology, it remains necessary for plans production annotation tasks.

For use with the legacy GEOPAK coordinate geometry tools, the IDOT workspace is configured with an SMD file which will produce graphical results consistent in look and feel to the OpenRoads feature definitions. When using the legacy coordinate geometry tools, it is important to define the GEOPAK user preferences with a modern definition for scale.

To check or change the scale, go to the *GEOPAK menu > Road > User Preferences*.

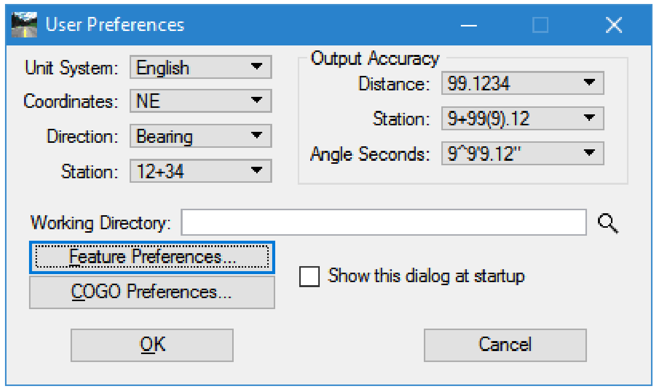


Figure 3-6.J – Legacy GEOPAK User Preferences

Then click on *Feature Preferences*. Set the scale to proper ratio as defined in Section 3-10.

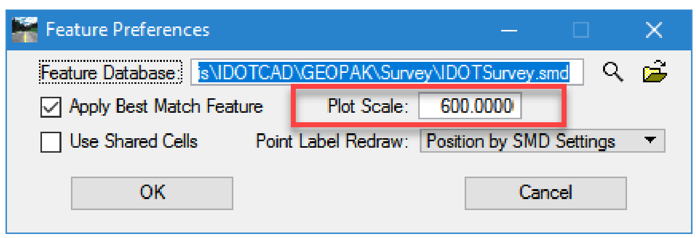


Figure 3-6.K – Legacy Scale set to Ratio

3-6.03 Survey Feature Definitions

The point codes used to generate surveyed features shall be as defined in Appendix I. Additional details are shown in a spreadsheet delivered in the workspace named IDOTSurvey.xlsx. The workspace has been configured to utilize these point codes by way of *IdotSurvey.smd*. For use with OpenRoads Survey, this file is converted to XML format and also delivered in the workspace as *IdotSurvey.xml*. The survey feature definitions configured in the workspace reflect this XML file and the Point codes in use by the Surveys Unit.

Survey Feature Definitions are a special case of Geometry Feature definitions. They are used for processing of field survey data. Rather than an optional link to the D&C Manager file, Survey Feature Definitions require a link to a native style located in the legacy XML file noted above.

The properties of a Survey Feature Definition look more or less the same as a Geometry Feature Definition, except for the link to the native style. In the following image, the Survey panel of the properties is configured to make the selected feature definition as a survey type and includes a link to the appropriate XML item.

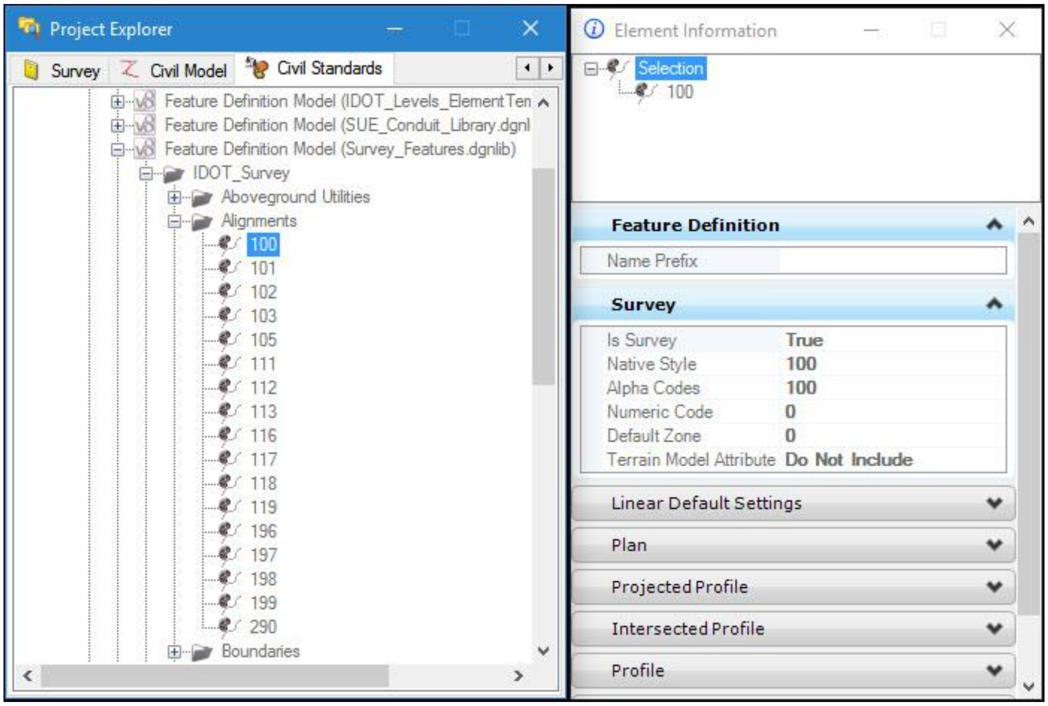


Figure 3-6.L - Survey Feature Definitions

The Survey XML file then works with the feature definition during the processing of data from survey data collectors to MicroStation Design files using OpenRoads Survey.

It is important that when processing survey data using the OpenRoads feature definitions that the proper scale be defined, and annotation scale lock turned on (see Section 3-10) before processing the data. This ensures that the point cells are properly sized. With scale lock turned off the cells will be placed at an absolute scale of 1.0 and will not resize with changes in the scale.

As noted above, OpenRoads Survey feature definitions are created by linking to individual items in an XML file exported from the GEOPAK SMD file. However, the requirements of OpenRoads feature definitions forced some changes in the exported XML such as would cause errors in visualization when used with the legacy coordinate geometry and survey tools. Specifically, in order to take advantage of the use of annotation scale in OpenRoads Survey, the Apply Creation Scale setting in SMD had to be turned off. By disabling this setting, OpenRoads can allow MicroStation Annotation Scale setting to determine the final size of the cells and allows the cells to resize if scale ever changes.

However, disabling this setting changes the behavior if the SMD is used with legacy GEOPAK coordinate geometry and survey tools. Therefore, the SMD file configured in the workspace is somewhat different than the XML file used by OpenRoads. However, this difference is mostly invisible to the designer as long as the proper scales are defined for GEOPAK Survey. When using GEOPAK Survey, in the survey preferences, set the plot scale to the appropriate ratio as defined in Section 3-10.

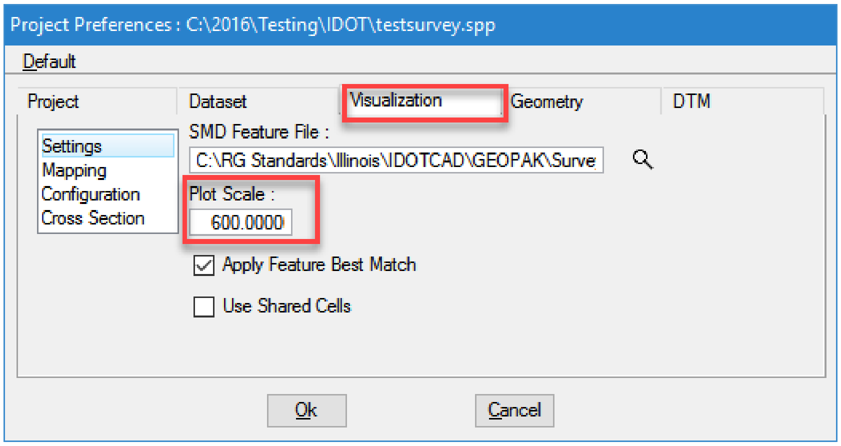


Figure 3-6.M – Legacy GEOPAK Survey Plot Scale

3-6.04 Utility and Drainage Feature Definitions

Feature Definitions used with GEOPAK Subsurface Utilities tools are similar to geometry feature definitions but with properties which apply additional intelligence to the created features.

In the following image, note that the top level of the feature definition includes additional settings that define the type of utility. And, for storm water or waste water types, there is a panel for hydraulic properties which enable hydraulic analysis.

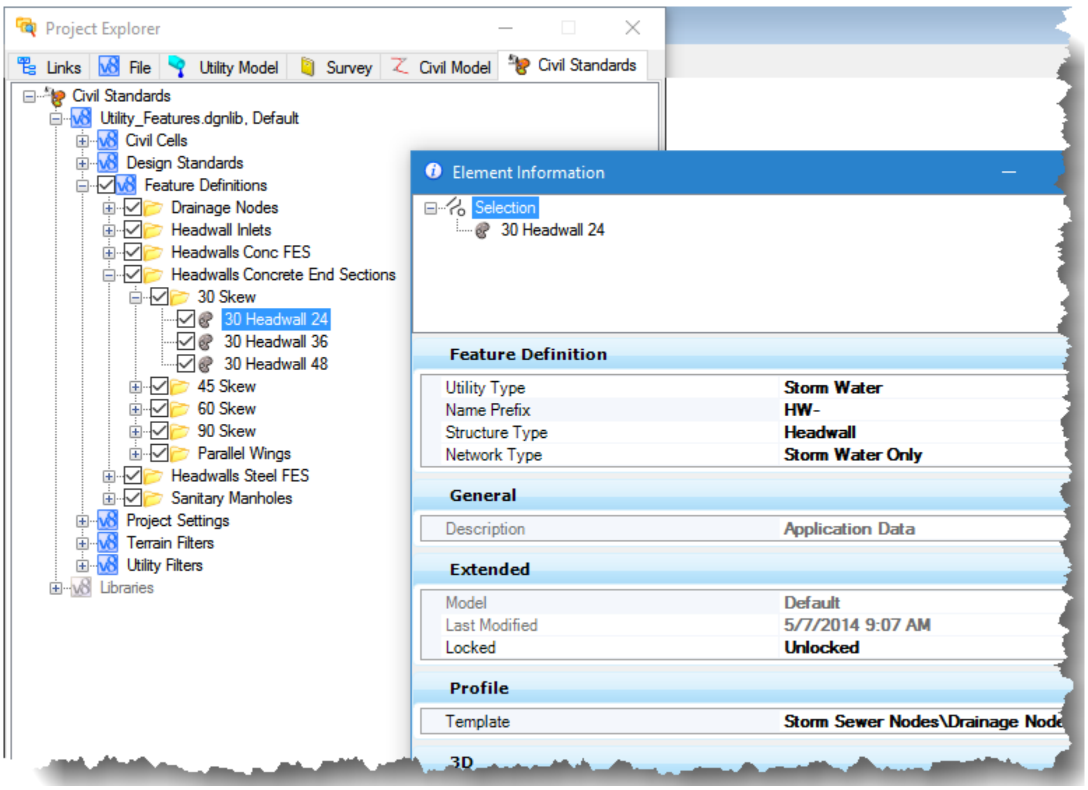


Figure 3-6.N - Utility Feature Definitions

When using the subsurface utility feature definitions from the IDOT workspace, annotation scale is normally not a factor. This is because, for most utility features, the structures are not scaled but are drawn true to actual real world sizes. For example, catch basins are shown in plan and 3D at actual size rather than a simple symbol. Doing this is important for proper construction of the 3D models. The designer does not have to do anything to scale settings. The proper scales are embedded in the feature definitions.

3-7 MATERIALS DEFINITIONS

The IDOT workspace defines materials for visualization in a file *named IDOT Materials.dgnlib*. These materials are integrated with the feature definitions and element templates so that rendering of the 3D models is automatic.

3-8 FONTS AND TEXT STYLES

The IDOT CADD environment defines the fonts to be used on IDOT projects. Non-true type fonts are configured in a file named *fontlib.rsc* and contains all the traditional fonts used for IDOT roadway and structure plans. Effective with this manual, IDOT is beginning the transition from the traditional fonts stored in *.rsc* files and implementing true type fonts. While the two font types may coexist for a period of time, the various styles defined in the workspace will increasingly make use of true type fonts.

A full listing of preferred text styles for various annotation needs is defined in Appendix D.

The various fonts are consumed in text styles which are used throughout the OpenRoads configuration. The text styles are defined to take advantage of annotation scales as defined in Section 3-10.

When placing text, selecting a text style will automatically adjust the text settings. When text styles are used, it is not necessary to manually change font, text height, text width, line spacing or other properties independently. It is only necessary to identify the drawing scale and turn on the Annotation Scale lock when placing a text element. Information on how to do this is discussed in Section 3-10.

An additional benefit to using text styles is the ability to modify the style in the DGN Library (dgnlib) file where it is defined and then make global changes to a design file using the “dgnlib update” command. This allows efficient changes to Department font styles by implementing changes in the DGNLIB files which then promulgate through the Department.

Various text styles have been configured in the workspace for use in the preparation of roadway and structure plans. These text styles are configured as appropriate in many different tools used for design. Appendix D lists all available text styles. This, in conjunction with the example plans, (see Section 5-4) should be used in identifying what text styles shall be used throughout the plans.

The text styles defined in Appendix D are configured to use a font developed by the Florida Department of Transportation. The roadway text styles use font “FDOT Vert” which is a vertical sans serif font preferred for use on roadway plans. The bridge text styles use a font named “FDOT” which is a slanted sans serif font preferred for structures plans. The only difference in the two fonts is the slant.

These fonts include the usual special characters needed for roadway and structure plans. There are two ways to embed these special characters in annotations:

- Use keyed in shortcuts.
- Use the symbols tool in the Place Text command.

When using keyed in shortcuts, type a backslash followed by the character code into the body of the text editor as shown in Figure 3-8.A. For example, type “\161” for a centerline symbol. A full list of character codes is shown in Table 3-8.A.

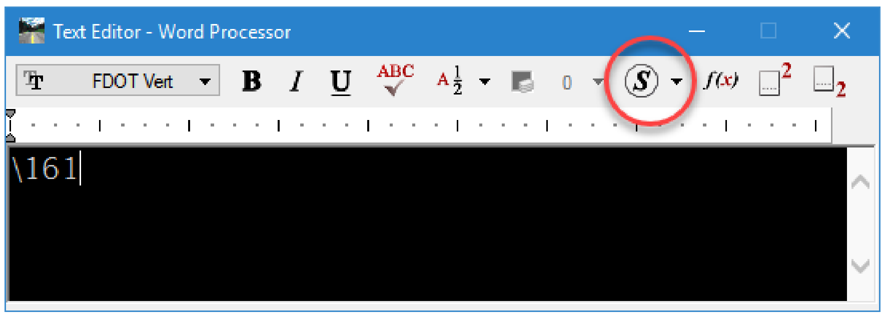


Figure 3-8.A – Typing Character Codes into Text

Table 3-8.A – Special Character Codes	
Symbol	Code Key In
℄	\161
⅊	\162
BL	\163
FL	\165
Δ	\172
°	\176
±	\177
^{2}	\178
^{3}	\179
¼	\188
½	\189
¾	\190
≤	\8804
≥	\8805

To use the symbol selector, click on the symbols tool in the text editor (circled in Figure 3-8.A.) and double click the desired symbol from the list box as shown in Figure 3-8.B. Note: The symbol selector may not function as expected unless the true type font is installed into Windows. Using the MicroStation configuration variable to load true type fonts does not enable the proper mechanisms upon which MicroStation relies for producing the symbol table.

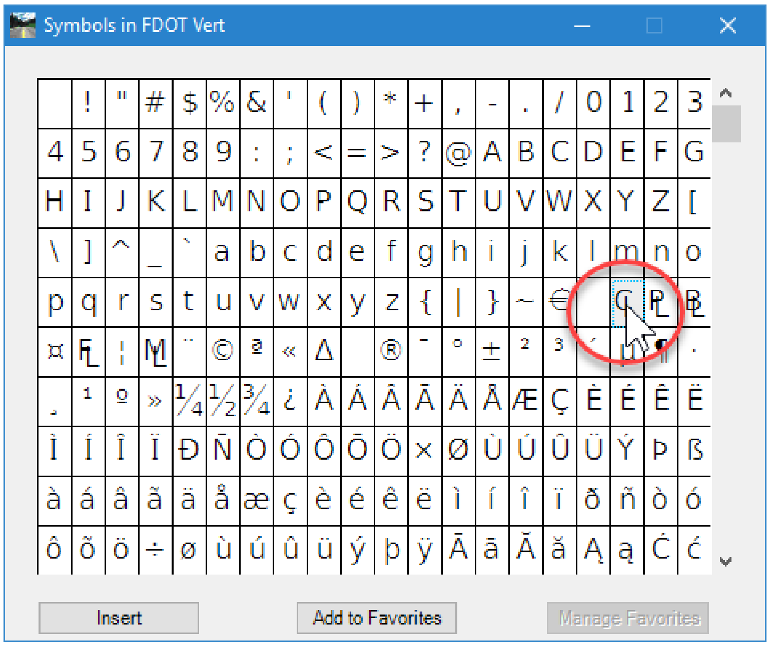


Figure 3-8.B – Symbols List Box

Text style settings generally should not be overridden. Two exceptions are the justification and the underline. Changing other settings defeats the purpose of using text styles. Additionally, if text styles have been modified and the ***dgnlib update*** key-in command is run, the changes will be reset to the default values of the associated text styles.

3-9 DIMENSION STYLES

The IDOT CADD environment also defines dimension styles. Dimension styles simplify placement of dimensions and promotes uniformity. Similar to text styles, dimension style settings are pre-defined inside a DGN library. The fonts as defined in Section 3-8 are utilized in these dimension styles and annotation scale, as defined in Section 3-10, applies to these dimension styles. When placing dimensions, set the drawing scale as appropriate and turn on annotation scale lock. Then, the sizes of text and dimensions will be appropriate for scale.

Table 3-9.A shows the dimension styles which are configured in the workspace:

Table 3-9.A - Dimension Styles

Dimension Style Name	Use
Bridge 1:001	Structures Dimensions
Roadway 120	Roadway Dimensions
Roadway 140	
Roadway 175	
Roadway 200	

The numeric portion of these dimension styles is intended to convey a similarity to, but not an exact match to, historic Leroy text sizes.

Note that the use of dimension styles is not required. If desired, dimension settings may be set manually when placing dimensions into the drawing.

3-10 ANNOTATION SCALES

As part of the development of this manual and implementation of 3D modeling workflows, the use of annotation scale for roadway design has been changed to be consistent with the expectations of modern versions of MicroStation and structures design use of annotation scale. The modern interpretations of scale account for the differing units of scale used in the United States. For example, a typical scale for projects in the U.S. is 1in. = 50ft. Historically, engineers and software have ignored the difference in units and treated the scale as a simple multiplier. But a rigorous usage of scale requires the recognition that the mixed units actually results in a ratio which is 12 times larger resulting in an actual ratio which is 1:600 (or 1 inch = 600 inches).

The changes related to annotation scale are mostly invisible to the designer except when opening older projects which were created with previous versions of this workspace. For handling of older project files; see Section 3-10.03. The impacts on legacy tools are described in the various sections dealing with those tools throughout this manual.

The IDOT CADD environment defines the scales shown in Table 3-10.A which are used for development of roadway and structure plans and models:

Table 3-10.A - Annotation Scales				
Roadway Scales			Structures Scales	
Scale	Ratio		Scale	Ratio
1” = 500’	1:6000		1/32” = 1’-0”	1:384
1” = 200’	1:2400		1/16” = 1’-0”	1:192
1” = 100’	1:1200		1/8” = 1’-0”	1:96
1” = 60’	1:720		3/16” = 1’-0”	1:64
1” = 50’	1:600		1/4” = 1’-0”	1:48
1” = 40’	1:480		3/8” = 1’-0”	1:32
1” = 30’	1:360		1/2” = 1’-0”	1:24
1” = 25’	1:300		3/4” = 1’-0”	1:16
1” = 20’	1:240		1” = 1’-0”	1:12
1” = 10’	1:120		1½” = 1’-0”	1:8
1” = 5’	1:60		3” = 1’-0”	1:4
1” = 2.5’	1:30		6” = 1’-0”	1:2
1” = 2’	1:24			

These scale factors are pre-defined within the scales definition file (scales.def) in the IDOT CADD configuration. The ratios shown above are utilized automatically. The designer does not need to make any calculations for sizes since the various cell, text and dimensions libraries have been constructed to accommodate these scale definitions. See the various other sections of this manual (text styles dimension styles, cell library, etc.) for specifics related to annotation scale in the context of using those particular libraries.

These annotation scales are used for multiple purposes, including automation of cell sizing for point features and automated text sizing when using text styles and dimension styles. Prior to using text or dimension styles within a design file, the annotation scale for the DGN model is set and the Annotation scale toggle is turned on.

To set the annotation scale, use ***Settings > Drawing Scale*****.** From within that dialog, the desired scale can be set, and the annotation scale toggle can be turned on. These settings may also be set in the Model Properties dialog.

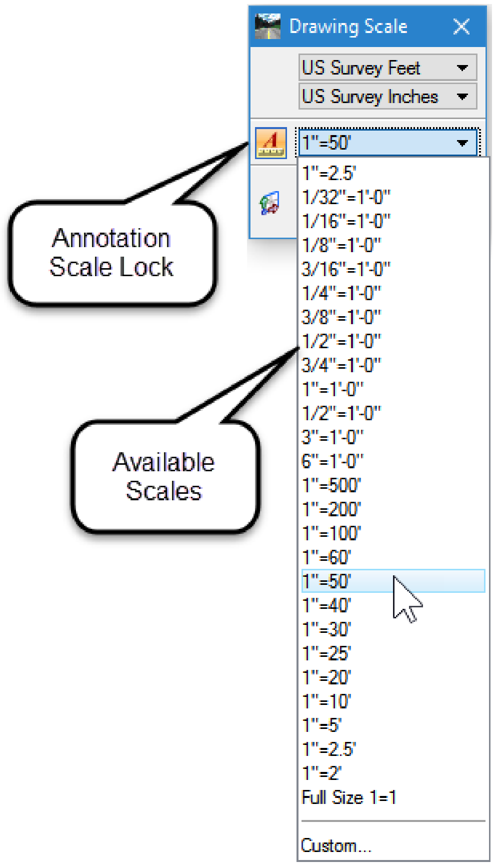


Figure 3-10.A - Drawing Scale Settings

3-10.01 Drawing Scales used in Roadway Plans

The following presents the recommended drawing scales that should be used when developing a set of plans:

1. Cover Sheet. For the layout map, use 1 in. = 1 mile. Layout maps for urban areas may use a larger scale for better clarity.
2. Typical Sections. The scale for the typical section figures is generally at the designer's discretion. The scale may vary from typical section to typical section. The vertical scale should be exaggerated to adequately show the pavement cross section.
3. Plan and Profile Sheets. Plan and profile sheets can be either shown on separate sheets or together on one sheet. The following scales are typically used on plan and profile sheets:
   - A. Layout Maps. For those plans where it is determined that a layout map is required, use 1 in. = 200 ft scale.
   - B. Plan View (Rural). For most projects, use a scale of 1 in. = 50 ft. However, for simple resurfacing projects, 1 in. = 100 ft or 1 in = 200 ft may be used.
   - C. Plan View (Urban). Depending upon the complexity of the location and work to be accomplished, a scale of 1 in. = 20 ft is normally used.
   - D. Profile View (Horizontal). The horizontal profile scale is the same scale as the plan view.
   - E. Profile View (Vertical). The vertical profile scale is a multiple of the profile horizontal scale to provide a vertical exaggeration factor of 10:1 or 5:1 depending on the complexity of the project. For example, a horizontal scale of 1 in. = 50 ft will have a 1 in. = 5 ft vertical scale.
   - F. Other scales, as necessary, may be used to provide better clarity or more practical layouts. Include a graphic bar scale on all plan sheets drawn to scale.
4. Detail Sheets. Detail sheets will vary according to the element shown. For special intersection or approach drawings, a plan view scale of 1 in. = 20 ft is generally used.
5. Cross Sections. The horizontal cross section scale will typically be prepared using 1 in. = 5 ft or 1 in. = 10 ft scale. A larger scale may be used where a greater cross section width or height is required. The vertical scale should be a 2:1 proportion of the horizontal scale. For example, a horizontal scale of 1 in. = 10 ft will have a 1 in = 5 ft vertical scale.

3-10.02 Drawing Scales Used in Structure Plans

It is advantageous to create structures drawings to scale and to use the geographic coordinate systems established by the Surveys Unit for the following reasons:

1. Visualization of blunders and errors are more evident when drawn to scale,
2. Referencing structures drawings to roadway drawings is more efficient when structures drawings are to scale and utilize the project coordinate system, and
3. The relationship between the structures 3D models and 2D details is simpler to manage when the drawings are to scale.

See Section 3-10 for a list of common architectural and engineering scales that may be used for bridge plans and models. The following is preferred usage of scale when producing structure plans:

1. Create structures drawings at full scale in a DGN file or model which is separate from the border.
2. Place sheet borders at scale of 1.0 into a separate DGN file or model.
3. From within the DGN file or model containing the border, the full-scale drawings are referenced in at 1 / X scale factor, where X is the ratio as defined in Section 3-10.
4. Text and dimensions can be placed either in the DGN file (or model) containing the border or in the DGN file (or model) with the structures drawing:
    - Employment of the annotation scale feature is necessary if the text and dimensions are placed in the design file (or model) containing the full-scale drawing. See Section 3-10 for information concerning the annotation scale and see Section 3-8 for information on use of text styles.

3-10.03 Scale Usage with Projects Started with Previous Workspace

In the original GEOPAK V8i Select Series 4 IDOT workspace, the roadway scales were defined differently as noted elsewhere in this manual. This workspace existed in all Select Series 4 workspaces published prior to April 2017. Any DGN files which were created with this previous workspace will exhibit line styles and cell size which are too large by a factor of 12, when opening the file in the latest workspace.

These are easily corrected however by the following:

1. Use the *Adjust DGN File Scale* command from the IDOTMenu which opens the dialog shown in Figure 3-10.B.

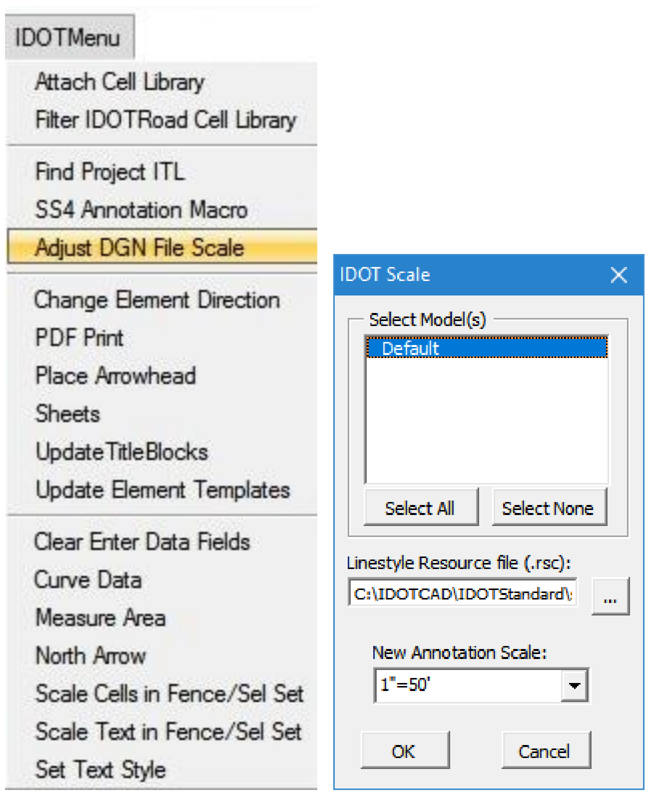


Figure 3-10.B – Macro for Adjusting DGN File Scale Definition

2. At the top of the dialog, select the model(s) which needs to be adjusted for the change in scales definition.

3. In the center of the dialog, select the file IDOT Linestyles from Level Library.rsc. This file contains the custom linestyles which exist in the new workspace DGN library files, but in a form, which can be imported.

4. At the bottom of the dialog, the initial entry will show a scale as defined in the old workspace, such as *1:50*. Change this to the new scale for the file which will be of the form *1" = 50'*

5. Click OK.

If the batch process is unavailable or fails, then the following is the workflow which is executed by the automated batch file. Use the following steps in all DGN files for the affected project.

When these older files are opened the drawing scale which show as Custom XX (Settings > Drawing Scale). Custom 50 is the most common but you may also see Custom 20, Custom 40, and so on.

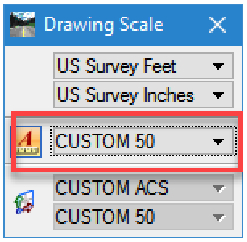


Figure 3-10.C - Older Projects will show Custom XX as scale.

The drawing scale needs to be changed to 1" = 50' (or 1" = 40' or so on)

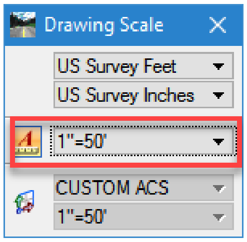


Figure 3-10.D – Change scale to 1" = XX

Upon changing the drawing scale, custom lines styles and cells will appear 12 times too large.

To correct the line styles, open the custom line style editor. (Element > Line Styles > Edit) and in the editor menu click File > Import > MicroStation Resource File.

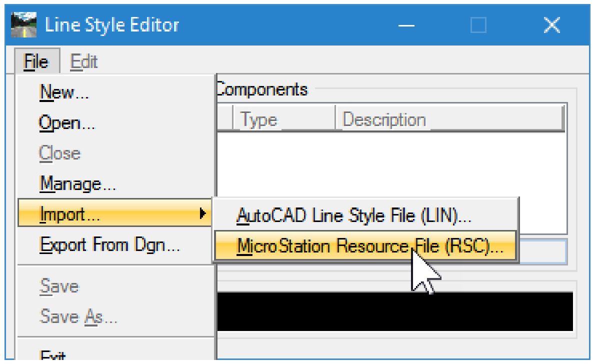


Figure 3-10.E – Import Line Styles from Library

Select the file located in the workspace at \IDOTCAD\IDOTStandard\Data\ IDOT Linestyles from Level Library.rsc.

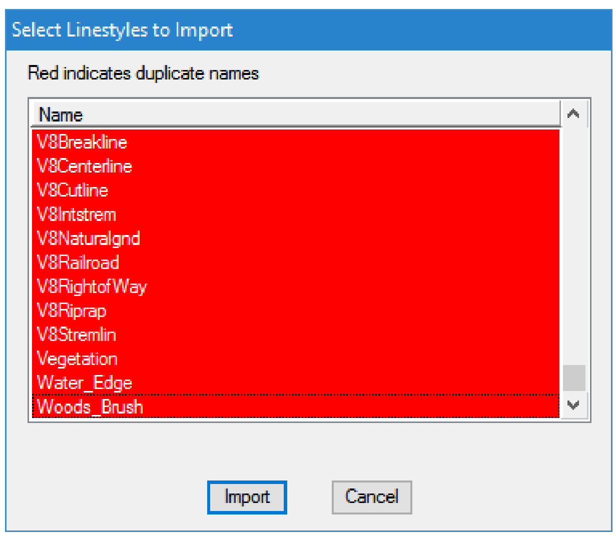


Figure 3-10.F – Importing Line Styles

Select all the line styles in the list and click Import. This will adjust all the line styles.

To correct the cell sizes, select all cells using the Selector tool as shown in Figure 3-10.G.

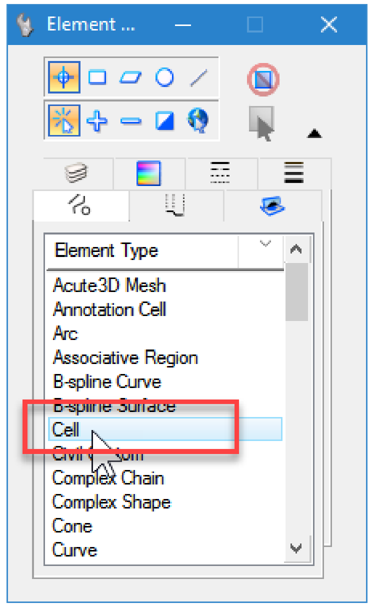


Figure 3-10.G – Select all Cells

Then, use the Replace Cells command (Tools > Cells > Replace Cells) with method set to Update and mode set to Global as shown in Figure 3-10.H.

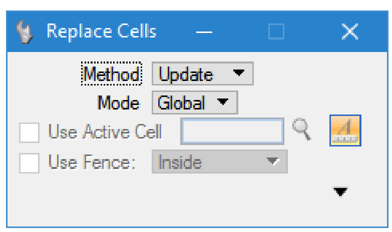


Figure 3-10.H – Replace Cells

For DGN files which contain survey data, update the line styles and cells simultaneously with the redraw survey command found in the Tasks.

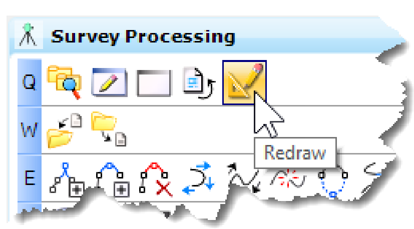


Figure 3-10.I – Redraw Survey

3-11 CELL LIBRARIES

Cell libraries are standard DGN files with *.cel* filename extension. Cell libraries utilize the design model concept with each cell definition occupying its own model. The cell libraries are used in a variety of drafting tools as well as consumed by feature definitions.

The cell libraries in the workspace have been adjusted for size to accommodate scale changes as described in Section 3-10.

Also, for each cell library delivered in the IDOT workspace, there is a corresponding PDF file delivered in the workspace as documentation accessible from Project Explorer.

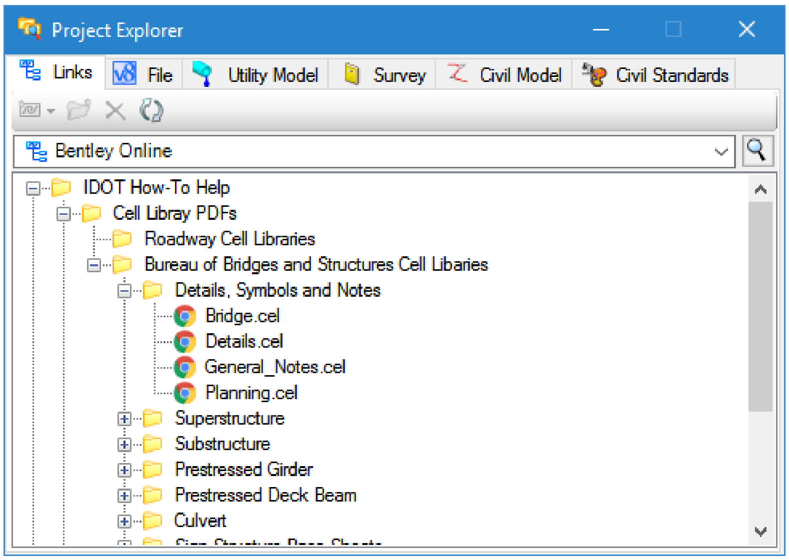


Figure 3-11.A – Lists of Cells in Project Explorer

3-11.01 Roadway Cell Libraries

The cell libraries configured in the IDOT workspace for use in the preparation of roadway plans are shown in Table 3-11.A.

Table 3-11.A – Roadway Cell Libraries	
Roadway Cell Library Name	Description
IDOTroad.cel	Contains all the cells used for roadway design workflows and tools.
IDOT_Utility.cel	Used with the OpenRoads Subsurface Utility tools. Contains the cells used for 3-D modeling of drainage and utility nodes.
IDOT_3D-Modeling.cel	Contains cells used to make rights of way (and related lines) in the dynamic cross-sections view.

3-11.02 Structures Cell Libraries

The Bureau of Bridges and Structures has several cell libraries available to aid in the preparation of structure plans. These cell libraries are loaded with the IDOT workspace. The cell libraries are described in PDF files which are accessible from Project Explorer as shown in Figure 3-11.A. The cells are generally described as: standard details which can be inserted to a set of structure plans with modifications to the details as needed for the specific design.

The structures cells are created with the expectation that they are placed at a scale of 1.0 and then adding the appropriate structures sheet border also at a scale of 1.0.

See Section 4-5.02 for information on use of base sheets.

The following is a list of the structures cell libraries and their contents.

Table 3-11.B – Structures Cell Libraries (1 of 4)	
Structures Cell Library Name	Description
Details, Symbols and Notes	
CADD-Elements.cel	Patterns, symbols, and full size bridge objects
Details-Design.cel	Bridge design details (not included with base sheets)
Notes-General.cel	General notes for placement on General Plans & Elevation or general data sheet
Details-Planning.cel	Planning details for Type Size & Location and General Plans & Elevation

Table 3-11.B – Structures Cell Libraries (2 of 4)	
Structures Cell Library Name	Description
BASE BRIDGE SHEETS Superstructure Libraries	
Approach Slabs-Bridge Cast in Place.cel	Bridge Approach Slab Detail Sheets
Approach Slabs-Bridge Precast.cel	Precast Bridge Approach Slab Sheets
Approach Spans-Vaulted Abutments.cel	Vaulted Abutment Approach Span Detail Sheets
Base Sheets-General.cel	General Detail Sheets
Beams-Plate Girder.cel	Plate Girder Detail Sheets
Railings.cel	Railing Detail Sheets
Bearings-Steel Beams.cel	Type I, II and II Elastomeric Bearing Detail Sheets
Diaphragms-Expansion Abutment Steel Beams.cel	Diaphragm Detail Sheets
Diaphragms-Integral Abutment Steel Beams.cel	Diaphragm Detail Sheets
Superstructure-Expansion Steel Beams.cel	Superstructure Plan and Cross Section Sheets; Superstructure Detail Sheets
Superstructure-Integral Steel Beams.cel	Superstructure Plan and Cross Section Sheets; Superstructure Detail Sheets
BASE BRIDGE SHEETS Substructure Libraries	
Abutments-Deck Beams.cel	Deck Beam Abutment Base Sheets
Abutments-Intergral.cel	Integral Abutment Base Sheets
Piers.cel	Pier Base Sheets
Piles.cel	Pile Detail Base Sheets
Abutments-Stub.cel	Pile Stub Abutment and Details Base Sheets
Abutments-Vaulted.cel	Vaulted Abutment and Details Base Sheets
BASE BRIDGE SHEETS Prestressed Girder Cell Libraries	
Beams-Prestressed Girders.cel	Prestressed Girder Detail Sheets
Bearings-Prestressed-Bearings Beams.cel	Bearing Detail Sheets
Diaphragms-Expansion Abutment Prestressed Beams.cel	Diaphragm Detail Sheets

Table 3-11.B – Structures Cell Libraries (3 of 4)	
Structures Cell Library Name	Description
BASE BRIDGE SHEETS Prestressed Girder Cell Libraries (cont'd)	
Diaphragms-Expansion Pier Prestressed Beams.cel	Diaphragm Detail Sheets
Diaphragms-Fixed Pier Prestressed Beams.cel	Diaphragm Detail Sheets
Diaphragms-Integral Abutment Prestressed Beams.cel	Diaphragm Detail Sheets
Superstructure-Expansion Prestressed Beams.cel	Superstructure Plan and Cross Section Sheets; Superstructure Detail Sheets
Superstructure-Integral Ptrestressed Beams.cel	Superstructure Plan and Cross Section Sheets; Superstructure Detail Sheets
BRIDGE BASE SHEETS Prestressed Deck Beam Cell Libraries	
Beams-Prestressed deck beams.cel	PPC Deck Beam and Detail Sheets
Superstructure-Prestressed Deck Beams.cel	Superstructure Plan and Cross Section Sheets; Superstructure Detail Sheets
Culvert Base Sheets	
Culvert Details.cel	Culvert Details
Culvert End Section Details.cel	General Plan and Elevation Sheets; Culvert End Section Detail Sheets; Pipe Grate Schedule for Culvert End Section Sheet
Single Box Culvert-Horizontal Cantilever Wingwalls.cel	Culvert Detail Sheets
Single Box Culvert-L Type Wingwalls.cel	Culvert Detail Sheets
Single Box Culvert-Sheet Pile Wingwalls.cel	Culvert Detail Sheets
Single Box Culvert-Soldier Pile Wingwalls.cel	Culvert Detail Sheets
Single Box Culvert-T Type Wingwalls.cel	Culvert Detail Sheets
Sign Structure Base Sheets	
alum_butterfly_sign.cel	Aluminum butterfly sign structure sheets
alum_cantilever_sign.cel	Aluminum cantilever sign structure sheets
alum_simple_span_sign.cel	Aluminum simple span sign structure sheets
breakaway_tubular_steel_sign.cel	Breakaway tubular steel signpost sheets
breakaway_wf_steel_sign.cel	Breakaway wide flange steel signpost sheets

Table 3-11.B – Structures Cell Libraries (4 of 4)	
Structures Cell Library Name	Description
Sign Structure Base Sheets (cont'd)	
bridge_mounted_sign.cel	Bridge mounted sign structure sheets
monotube_sign.cel	Monotube sign structure sheets
steel_cantilever_sign.cel	Steel cantilever sign structure sheets
steel_simple_span_sign.cel	Steel simple span sign structure sheets
steel_trichord_sign.cel	Steel trichord sign structure sheets

3-12 TEMPLATE LIBRARY

Standard roadway templates for use in IDOT roadway design are stored in the workspace in a file named IDOT.itl. The default path to this file is:

\IDOTCAD\GEOPAK\Modeling\Template_Library

When a new project is started, this library is copied to the project directory so that any local changes to templates can be made without introducing changes to the master library. Inside the Department's ProjectWise environment, this file is copied automatically, otherwise the designer should copy the file manually.

After the template library is copied to the local project folder then the IDOT menu provides an easy method for defining the path to the local copy. From the IDOT menu, click on "Find Project ITL".

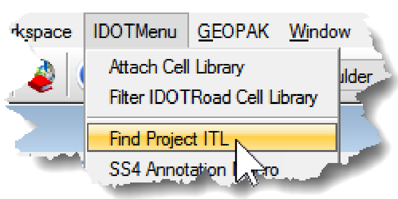


Figure 3-12.A – Find Project ITL Utility Command

There is no user feedback from this command, but it will search your computer starting at the folder of the active DGN to find the IDOT.itl file and load it as the active library.

Once the ITL file is in place, the designer can review the library by clicking the Create Template command.

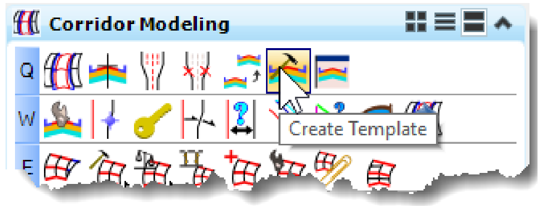


Figure 3-12.B – Create Template Command

This command allows review and edit of templates in the library and creation of new templates. Some items of note:

- There is an empty folder at the top of the template library which describes the date when the standard library was last edited. No information should be stored in this folder. It is for informational purposes only.
- The Project Templates folder should be used to store the templates used on the project. The project templates can be placed here by copy from the other folder structure or by using the Template Organizer to copy templates from the DGN project files into the template library file.

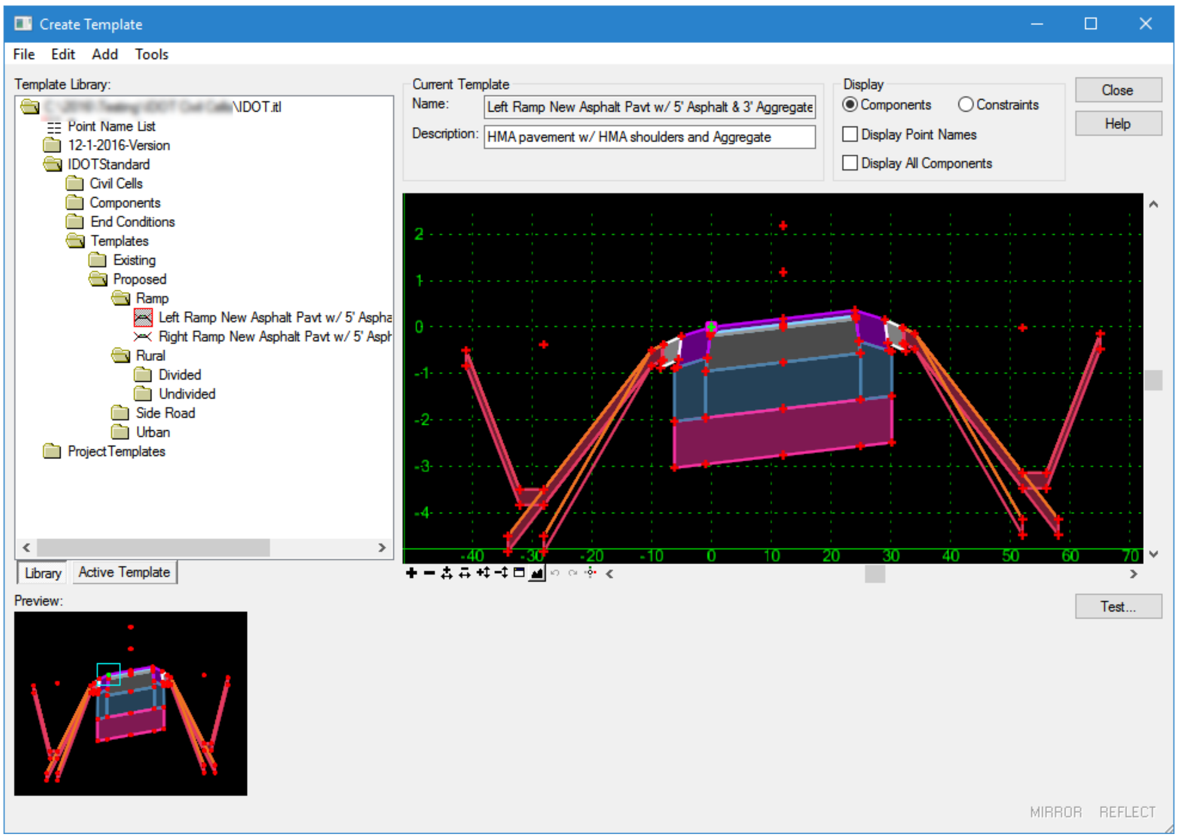


Figure 3-12.C – Template Library

3-13 SUPERELEVATION TABLES (SEP)

IDOT uses the AASHTO Method 5 radius tables to calculate the superelevation rate (e) and length of superelevation runoff (L). The *Superelevation Tables* that IDOT uses can be found in the \IDOTCAD\GEOPAK\Superelevation folder in file named IDOT_2011_English.sep file. When used with the GEOPAK / OpenRoads tools, this file defines various options for the superelevation method, superelevation runoff length, tangent runout length, adjustment factors, distributions, rotation, compound curves, and short curves.

These files are configured in the IDOT workspace and are integrated with the OpenRoads corridor superelevation tools.

For more information regarding superelevation design, see the *IDOT Bureau of Design and Environment Manual* or the *IDOT Bureau of Local Roads and Streets Manual*.

3-14 CIVIL CELLS

Civil Cells are an OpenRoads concept that allows creation and reuse of complex geometry layouts, such as various intersection configurations, median crossover configurations, and freeway entrance and exit ramp terminals. Using the OpenRoads tools, the complex layout is designed, including centerlines, geometry and surfaces, then stored in a DGN Library (dgnlib) file. Thereafter, the complex layout can be reused in future projects where the geometric needs are similar.

Civil Cells should not be confused with MicroStation Cells. Civil cells are groups of OpenRoads geometric elements while MicroStation cells are groups of graphical elements only. While similar in concept, the usage of and tools used for these complex elements is very different.

The following civil cells have been created and delivered in the IDOT workspace. Additional details for the usage of these civil cells is delivered in the workspace as documentation accessible from Project Explorer.

Table 3-14.A - Civil Cell Library (1 of 4)		
DGN Library	Civil Cell Name	Description
Box Culverts	Box Culvert	Creates a simplified representation of a box culvert.
Bridges	Bridge Embankment	Creates embankment slopes at bridge abutments.
Curb-Ramps	Perpendicular-PavedArea	Creates a simple mid-block ADA ramp.
Entrances.dgnlib	Field Entrance	Simple Flared FE
	Residential Entrance	Simple Flared PE

Table 3-14.A - Civil Cell Library (2 of 4)		
DGN Library	Civil Cell Name	Description
Interchange-Ramps	IR-Entrance-2d	Interchange entrance ramp – 2D geometry only.
	IR-Entrance-3d	Interchange entrance ramp – full 3D design.
	IR-Exit-2d	Interchange exit ramp – 2D geometry only.
	IR-Exit-3d	Interchange exit ramp – full 3D design.
Median-Openings	MedianOpening Semi OpenShld	Simple radius on the median nose radii with open shoulders and with turn lanes.
	MedianOpening Semi C&G	Simple radius on median nose with curb and gutter shoulders and with turn lanes.
	MedianOpening Semi C&G 1 Turn-Up Station	Simple radius on median nose with curb and gutter shoulders and with turn lane on ahead station side only.
	MedianOpening Semi C&G 1 Turn-Down Station	Simple radius on median nose with curb and gutter shoulders and with turn lane on back station side only.
	MedianOpening Bullet OpenShld	Complex curve on the median nose with open shoulders and with turn lanes.
	MedianOpening Bullet OpenShld 1 Turn Up Station	Complex curve on the median nose with open shoulders and with turn lane on ahead station side only.
	MedianOpening Bullet OpenShld 1 Turn Down Station	Complex curve on the median nose with open shoulders and with turn lane on back station side only.
	MedianOpening Bullet CG	Complex curve on median nose with curb and gutter shoulders and with turn lanes.
	Base-Semi-OS1	Simple Radius on median nose with open shoulder
	Base-Semi-CG	Simple radius on median nose with curb and gutter
Roundabouts.dgnlib	Splitter_Median	Median Island.

Table 3-14.A - Civil Cell Library (3 of 4)		
DGN Library	Civil Cell Name	Description
	Approach (High Speed)	Horizontal geometry only. Roundabout high speed approach.
	Splitter_Island	Island Only
	Bypass Lane	Full 3D design. Bypass lane to the outside of Roundabout
	Approach (Deflection LT)	Roundabout approach deflected to the left.
	Approach (High Speed_MedianOnly	Full 3D design. Roundabout high speed median only.
	Rotary (Placed on Alignments)	Roundabout circle model placed on two alignments.
	Roatary (Placed on Alignments)	Roundabout circle placed using two alignments.
	Rotary (Placed on Circular Ref)	Roundabout circle placed on defined geometry of the inside edge of pavement, 3D.
T-Intersections.dgnlib	T-CG	Simple T intersection with C&G.
	T-CG-Short	Simple T intersection with curb and gutter. Minimal required approach length.
	T-CG-Islands-Small	Simple T intersection with C&G and small channelizing islands.
	T-CG-Island-Small-R	Simple T intersection with curb and gutter and channelizing island for right turn from mainline only.
	T-CG-Island-Small-L	Simple T intersection with C&G and small channelizing island for right turn out of the side road only.
	T-CG-Islands-Intermediate	Simple T intersection with curb and gutter and intermediate sized channelizing islands.
	T-CG-Island-Single	Simple T intersection with curb and gutter and single channelizing island for right-in, right-out only.
	T-CG-Median	Simple T intersection with curb and gutter, center left turn out of intersection and median on side road.

Table 3-14.A - Civil Cell Library (4 of 4)		
DGN Library	Civil Cell Name	Description
	T-CG-Median-Island-Small	Simple T intersection with curb and gutter, center left turn out of intersection, median on side road and channelizing islands.
	T-CG-Median-Island-Small-R	Simple T intersection with curb and gutter, center left turn out of intersection, median on side road and channelizing island for right turn from mainline only.
	T-CG-Median-Island-Small-L	Simple T intersection with curb and gutter, center left turn out of intersection, median on side road and channelizing island for right turn out of side road only.
	T-Openshld	Simple T intersection with open shoulders.
	T-Openshld-Short	Simple T intersection minimum length with open shoulders. Optional turn lanes. Simple curves on curb returns.
	T-OpenShld-Islands-Small	Simple T intersection with open shoulders and small channelizing islands.
	T-OpenShld-Island-Small-R	Simple T intersection with open shoulders and channelizing island for right turn from mainline only.
	T-OpenShld-Island-Small-L	Simple T intersection with open shoulders and small channelizing island for right turn from side road only.
	T-Overlay-Variable-C&G	Simple T intersection with curb and gutter and sidewalks. Optional turn lanes. Two centered curves on curb returns. Applies 1.5 in. overlay and variable leveling course to side road. Constructs widening full depth.
	T-Open Simple	Simple T intersection with curved Radius

3-15 DESIGN STANDARDS

The OpenRoads geometry commands are able to monitor design standards, such as minimum radius, which are driven by design speed. The IDOT workspace delivers the following preconfigured design standards in folder \IDOTCAD\GEOPAK\Design Standards. For use in the legacy GEOPAK profiling tools, there is also delivered the K Values table for vertical alignment design.

Table 3-15.A – Design Standards	
Design Standard Library Name	Description
AASHTO Design Standards 2011_IDOT.DGNLib	Horizontal and vertical design standards for use with OpenRoads geometry commands.
IDOT_KValues_2001.kvl	Vertical design standards for use with legacy GEOPAK VPI profile command.

Design Standards are selected and assigned to alignments using the Design Standards Toolbar.

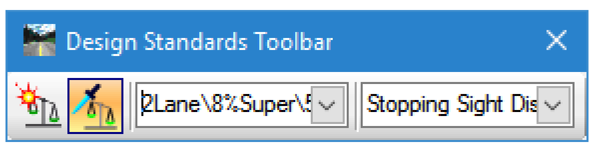


Figure 3-15.A – Design Standards Toolbar

3-16 PROJECT SETTINGS

OpenRoads controls the processing of survey and corridors by way of project settings which are stored in DGNLIB files. These settings entries are automatically copied to the active design file upon usage so that the design becomes completely portable.

3-16.01 Corridor Settings

3-16.01(a) Corridor Modeling Tolerances

The following variables are defined in the IDOT workspace and define the tolerances used by OpenRoads modeling tools. These tolerances control the algorithms in OpenRoads corridor tools by driving the density of the model when design stages are configured to automatically densify the model.

- Civil_Default_Linear_Stroking = 10.0
- Civil_Default_Profile_Stroking = 0.05
- Civil_Default _Curve_Stroking = 0.05

Units for the values defined by these variables are master units of the active DGN file.

3-16.01(b) Corridor Density

The 3D models delivered from Roadway Design to the contractor shall have sufficient density such that no portion of the designed surfaces exceed the following acceptable levels of accuracy:

- Horizontal and vertical accuracy at all points in the model shall match the true location to a tolerance of ±0.05 feet.

This tolerance applies to the portions of the model between OpenRoads template drop locations. At the locations of the template drops, the accuracy is expected to be exact, but in the areas between drops the chorded offset between the model and true location shall not exceed the tolerance defined above.

This accuracy level can generally be obtained by utilizing the IDOT workspace files in accordance with the practices defined in Section 3-16.01. However, the designer is instructed to define the model appropriately based on project specific requirements. The designer shall configure OpenRoads corridor template drops with the following maximum intervals. These recommended intervals are intended to provide sufficient accuracy in the model when delivered to construction.

Table 3-16.A - 3D Model Density Requirements	
Geometry Type	Maximum Template Drop Interval
Rural Section	
Tangents	20 feet
Curves (Horizontal and Vertical)	10 feet
Intersections	5 feet
Urban Section	
Tangents	10 feet
Curves (Horizontal and Vertical)	5 feet
Intersections	2 feet

Then when delivering the models for construction define the OpenRoads corridor design stage for all corridors and linear templates with the following:

1. Include key stations at all sag locations.
2. Ensure that template drop Interval multiplier is set to 1.
3. Ensure that the design stage is set to include horizontal and vertical cardinal points.
4. Ensure that the design stage is set to include external control points.
5. Ensure that the design stage is set to densify horizontal and vertical curves.

3-16.01(c) Length of Corridors

In order to maximize performance and stability of the design files, the designer should limit the length of any corridor stored in a single DGN file to less than 2 miles and or no more than 10 MB.

3-16.01(d) Workspace Corridor Design Stages

The IDOT workspace defines multiple design stages which are used to control the design time density and appearance of corridors models. The Project Engineer or consultant may adjust the details of these default design stages to satisfy the needs of a specific project and the requirements of Sections 3-16.01(a) and 3-16.01(b).

The following are defined in Corridor Design Stage settings:

1. Template Drop Interval Multiplier – allows models to be rendered in lower resolution during design time and higher resolution for final model production. For example, the designer can define the template drop interval to 10ft. A template drop multiplier of 5 would then render the model with 50ft intervals which will speed the design time rendering.
2. Include critical sections - allows further densification of the final model production by including the following as additional template drop locations:
   A. Horizontal Cardinal Points – the beginning and ending of horizontal curves and spirals.
   B. Vertical Cardinal Points – the beginning and ending of vertical curves.
   C. External Control Points – the start and end of point controls.
3. Densify Horizontal (Vertical) Curves – Additional template drops are added so that the chord offset distance along horizontal and vertical curves does not exceed the tolerance defined by configuration variables in Section 3-16.01(a).
4. Display Settings – controls how the manipulation handles for corridor and template drop objects are displayed.
5. Output settings – controls whether meshes, components, linear templates or all three are displayed in the model.

The IDOT workspace defines the corridor settings in Project_Settings.dgnlib. These settings provide progressively higher model resolution and control display of model feature types as described in the name:

Table 3-16.B – Corridor Design Stages (1 of 2)	
Design Stage Name	Description
0 – Functional	Low resolution display of corridor components for better performance. Template drop multiplier = 10 Critical Sections – all off 3D Output – Linear Features and Components
1 – Preliminary	Medium-Low resolution display of corridor components for better performance. Template drop multiplier = 5 Critical Sections – densify vertical off 3D Output – Linear Features and Components
2 – Design	Medium-High resolution display of corridor components for better performance. Template drop multiplier = 2 Critical Sections – densify vertical off 3D Output – Linear Features and Components
3 – Final	High resolution display (no template drop multiplier) of corridor components. Template drop multiplier = 1 Critical Sections – all on 3D Output – Linear Features and Components
4 – Final with Meshes	High resolution display of corridor components, top mesh and bottom mesh. Template drop multiplier = 1 Critical Sections – all on 3D Output – Linear Features, Components, Top Mesh, Bottom Mesh
5 – Final Top Mesh	High resolution display of corridor top mesh. Template drop multiplier = 1 Critical Sections – all on 3D Output – Linear Features and Top Mesh
6 – Final Bottom Mesh	High resolution display of corridor bottom mesh. Template drop multiplier = 1 Critical Sections – all on 3D Output – Linear Features and Bottom Mesh

Table 3-16.B – Corridor Design Stages (2 of 2)	
Design Stage Name	Description
7 – Final Linear Features	High resolution display of corridor linear features. Template drop multiplier = 1 Critical Sections – all on 3D Output – Linear Features
8 – Final Components	High resolution display of corridor components. Template drop multiplier = 1 Critical Sections – all on 3D Output – Linear Features and Components

Linear templates are a special case of a corridor and as such the Linear Template Design stages settings are similar. The resolution of a linear template is controlled by the defining geometry and so the settings for template drop multiplier and whether to include critical sections are not present. The IDOT workspace defines the Linear Template Design stage settings in Project_Settings.dgnlib and the following are defined:

Table 3-16.C – Linear Template Design Stages	
Design Stage Name	Description
1 – Design	Medium-High resolution display of linear template components for better performance. 3D Output – Linear Features and Components
2 – Final with Meshes	High resolution display of linear template components, top mesh and bottom mesh. 3D Output – Linear Features, Components, Top Mesh, Bottom Mesh
3 – Final Top Mesh	High resolution display of linear template top mesh. 3D Output – Linear Features and Top Mesh
4 – Final Bottom Mesh	High resolution display of linear template bottom mesh. 3D Output – Linear Features and Bottom Mesh
5 – Final Linear Features	High resolution display of linear template linear features. 3D Output – Linear Features
6 – Final Components	High resolution display of linear template components. 3D Output – Linear Features and Components

The Corridor settings delivered in the IDOT workspace are intended to properly set the corridor density as required in Section 3-16.01(a). However, the requirements of any specific project may require adjustments to the settings at the project level. Project level adjustments can be made by editing the design stage in the project DGN file after the corridor is created. Open Project Explorer and then find the project settings which were copied into the active DGN. Then adjust the properties for the desired projects settings.

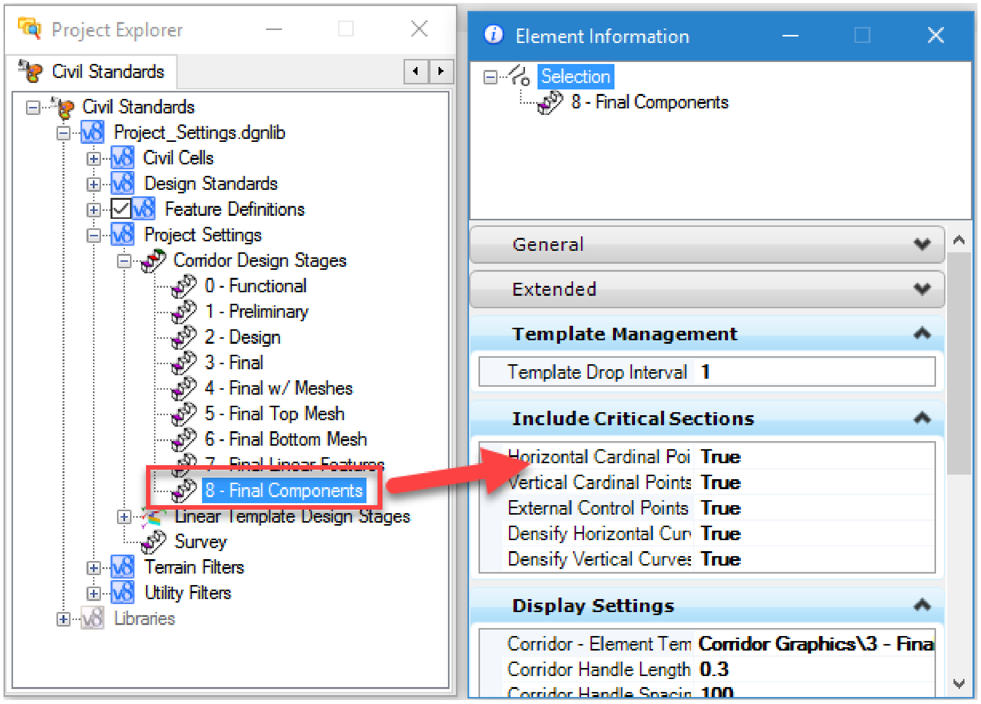


Figure 3-16.A – Corridor Settings Properties

3-16.02 Survey Settings

The methods used for processing of survey data are defined in survey settings. These settings control such things as processing methods, linking codes and whether to automatically create terrain models. The survey settings are stored in Survey_Settings.dgnlib and loaded with the workspace.

Appendix J lists the standard survey settings used in all Districts.

3-17 TERRAIN FILTERS

The OpenRoads Terrain Model tools contain functionality that can automate the building of terrain models from graphical data when the data is available in a predictable form. Standard filters have been configured in the workspace in file GraphicalFilters.dgnlib.

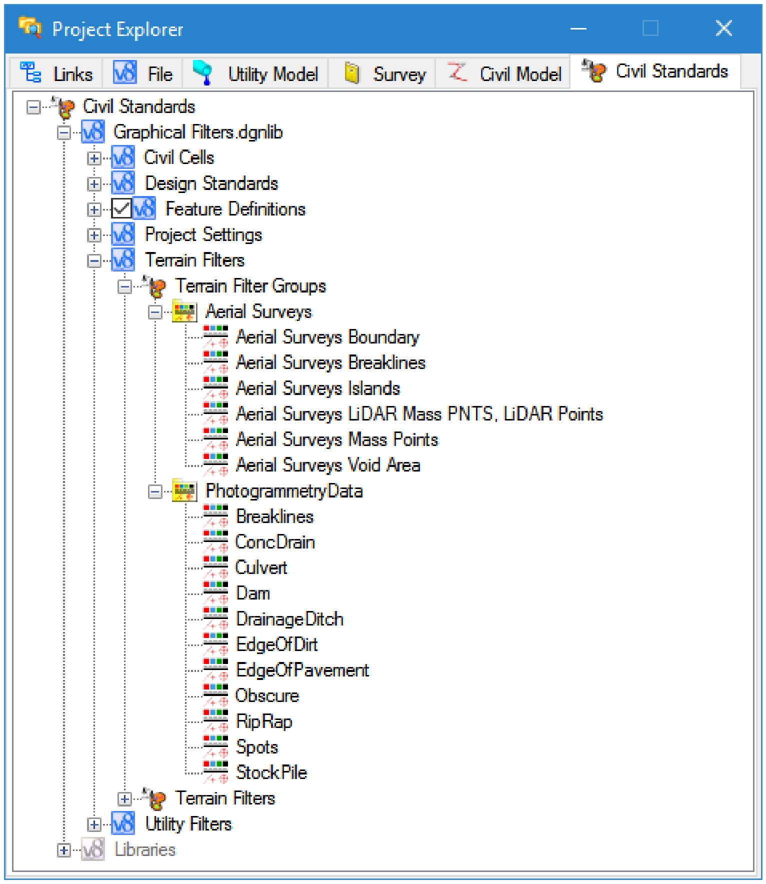


Figure 3-17.A – Terrain Model Filters

The two supplied filters are used to create terrain models from standard data supplied by the Aerial Surveys and Photogrammetry Units.

3-18 UTILITY FILTERS

The OpenRoads Subsurface Utility tools contain functionality that can automate the building of utility models from graphical data when the data is available in a predictable and standard form. At this time, the IDOT workspace includes a minimum set of preconfigured utility filters for building models from survey data processed using the workspace. These utility filters are stored in the libraries used by Subsurface Utilities Design and Analysis: Drainage_Feature_Definitions.dgnlib and Utility Feature Defintions.dgnlib

Table 3-18.A – Utility Filters	
Filter Name	Description
CATV Cable	Filters for linear features on level Utilities_EX_Underground CableTV.
Electric Cable	Filters for linear features on level Utilities_EX_Underground Electric.
Fiber Optic Cable	Filters for linear features on level Utilities_EX_Underground Fiber Optic.
Gas Lines	Filters for linear features on level Utilities_EX_Underground Gasline.
Gas Valve	Filters for node features with survey code 344.
Light Pole	Filters for node features with survey code 252, 262, 266, or 267.
Power Pole	Filters for node features with survey code 253, 254, or 255.
Telephone Cable	Filters for linear features on level Utilities_EX_Underground Telephone.
Water Hydrant	Filters for node features with survey code 349.
Water Lines	Filters for linear features on level Utilities_EX_Underground Water.
Water Meter	Filters for node features with survey code 331.
Water Valve	Filters for node features with survey code 343.
Sanitary Sewer	Filters for linear features on level Utilities_EX_Underground Sanitary Sewer.
Storm Sewer	Filters for linear features on level Drainage_EX_Storm Sewer.

Additionally, there are a variety of Utility Filter Groups defined for extracting many utilities at once into 3D models.

The Project Engineer or consultant is encouraged to develop additional filters as needed for project needs while the preconfigured list is expanded.

3-19 PROJECT EXPLORER LINKSETS

Link sets have a variety of uses, including the ability to provide help and guidance by way of configuring web links to training materials. The IDOT workspace delivers link sets in file Project_Explorer_Linksets.dgnlib. By way of this, the user of the workspace can access training information through Project Explorer.

Open Project Explorer (File > Project Explorer). Select the Links tab and then select Bentley Online from the dropdown list. A variety of information videos and training topics are available.

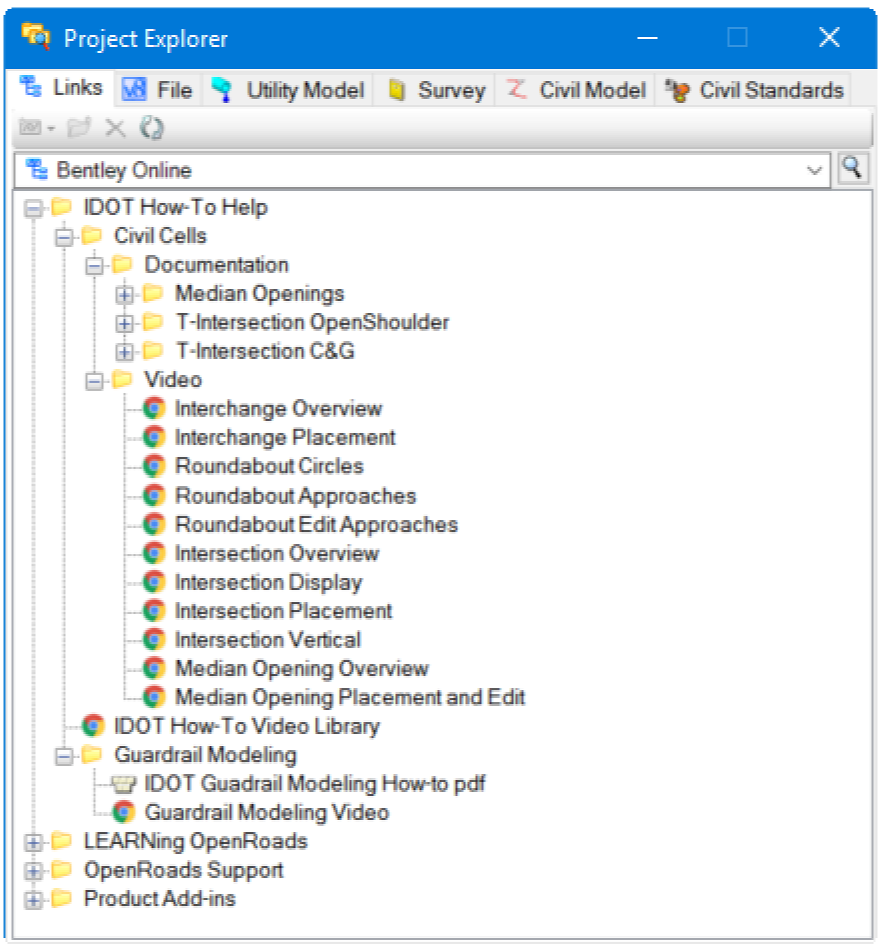


Figure 3-19.A – Linksets

3-20 CUSTOM MENU ITEMS IN THE WORKSPACE

Some tasks for plans production can be somewhat streamlined by utilizing the custom applications which are configured in the IDOT workspace. These custom tools are available in the top menu.

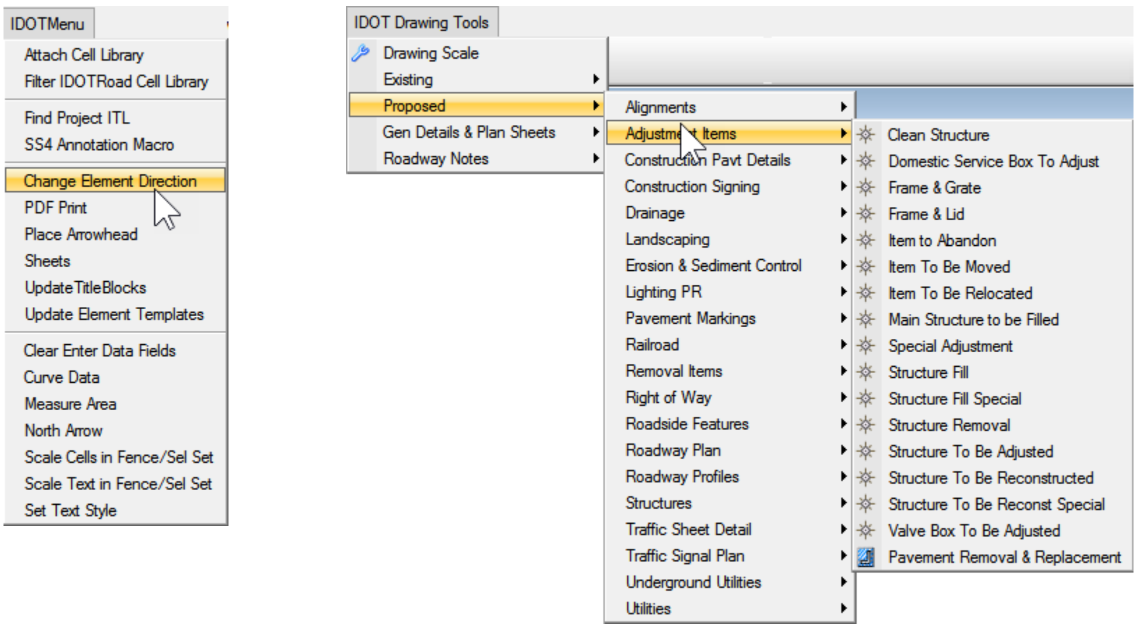


Figure 3-20.A – Custom Workspace Menus

All the functions shown in these custom menus can also be performed with other methods. However, for simpler projects without the need for 3D models, these customized tools may prove valuable to the designer. Navigate to \IDOTCAD\IDOTStandard\VBA in your IDOT CADD workspace folder to view a current list of VBA applications available for use.

SECTION 4 PLANS PRODUCTION WORKSPACE

4-1 PLANS PRODUCTION

This section defines requirements of content for the roadway and structures contract plan sheets and the related portions of the IDOT workspace.

For requirements related to design and modeling, see Section 3 of this manual.

For requirements related to submittal of electronic files including electronic versions of plan sheets, see Section 2 of this manual.

For requirements for file and folder structure of the electronic files, see Section 2 of this manual.

4-2 EXAMPLE PLANS

Example plans have been prepared to guide the designer in the requirements for plan sheet production and are posted for download. They are to be used as an aid in the preparation of roadway and structures construction plans in proper IDOT format. For each possible sheet type, there is a page containing general comments pertaining to it, followed by an example of how that particular sheet type should appear.

Sample plans for roadways and structures can be downloaded using the links in Section 5-4.

4-3 ROADWAY ANNOTATION

In order to accomplish some portions of the below requirements, some OpenRoads data must be exported to legacy GEOPAK formatted files. The following is a list of OpenRoads information that will be exported:

1. Geometry – the following geometry will need to be exported to GEOPAK GPK file:
   - A. All road centerlines and baselines:
     - Proposed profiles corresponding to these centerlines.
     - Existing ground profiles for roadway centerlines.
   - B. Baselines for retaining walls and noise walls:
     - Proposed ground profiles for top and bottom of wall.
     - Existing ground profile along the wall baseline.
   - C. Baselines for ditches and channels:
     - Proposed profile.
     - Existing ground profile.
   - D. If requested by Land Acquisition, any proposed right of way lines and property lines created in OpenRoads.

2. Drainage nodes and links created in the OpenRoads Subsurface Utilities toolset can be exported to GEOPAK Drainage to allow use of the Drainage Labeler tool.
3. Existing and proposed OpenRoads terrain models may need to be exported to GEOPAK TIN files.

All final alignment and profile elements within the GEOPAK database file shall be listed in the Project Content File according to Section 2-1.01(a).

4-3.01 Roadway Plan and Profile Sheet Labeling

The IDOT workspace defines the files and settings needed to utilize the GEOPAK plan view labeler tool and profile labeling tool. The files containing the settings are:

IDOTCAD\GEOPAK\Labelers\IDOT-Plan.lsf

These files contain preconfigured settings for labeling of plan and profile view annotations as defined in the example plans.

The plan view labeler tool is found in the GEOPAK menu at GEOPAK > Road > Plan Preparation > Plan View Labeler.

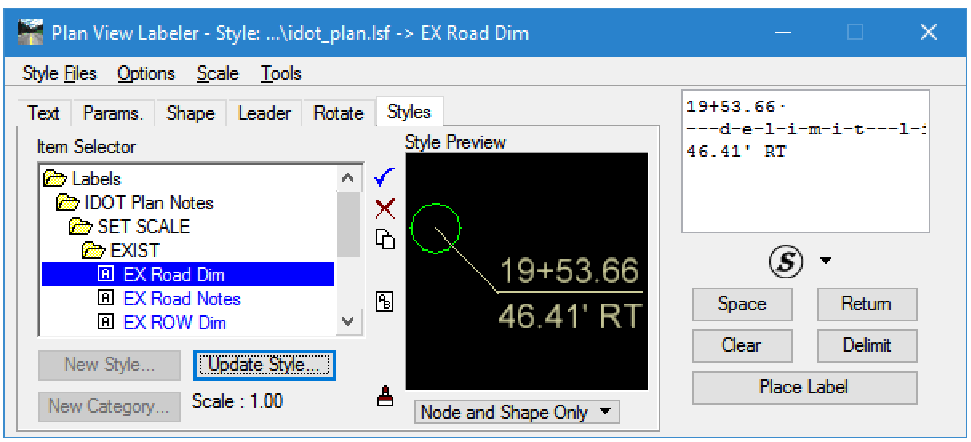


Figure 4-3.A – Plan Labeler

The profile view labeler is found in the GEOPAK menu at GEOPAK > Road > Plan Preparation > Profile Labeler.

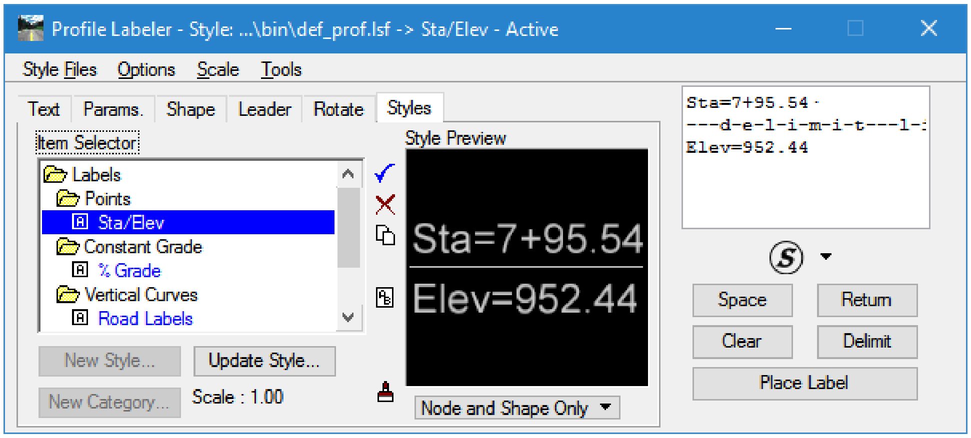


Figure 4-3.B – Profile Labeler

In most instances, these labeling tools can be used on plain MicroStation and OpenRoads graphical elements without export to GPK.

The labeler tools define their own scale and do not use the MicroStation drawing scale. Click Scale in the labeler menu to define the scale to be used in the labels being placed. When using the plan or profile labelers, the historic use of scale is used rather than the modern usage of scale as discussed in Section 3-10. For example, the historic value of 50 will be entered for 1" = 50' plan sheets.

4-3.02 Cross Section Labeling

The preferred workflow for producing cross-sections and cross-section sheets is to develop OpenRoads 3D models and then use the OpenRoads create cross-sections process. Labeling of OpenRoads cross-sections is accomplished as a part of this process which is described more fully in Section 4-5.01(d).

See example plans (Section 5-4) for required labels on cross-section sheets.

When using the legacy GEOPAK cross-section workflow, labeling can be accomplished using the following legacy files.

- GEOPAK cross-section labeler uses the cross-section graphics and a GEOPAK cross-section cell to place a variety of graphics. The settings file is named IDOT_xs.lsf. When using the cross-section labeler, the historic use of scale is used rather than the modern usage of scale as discussed in Section 3-10. For example, the historic value of 10 will be entered for 1" = 10' cross-section sheets.

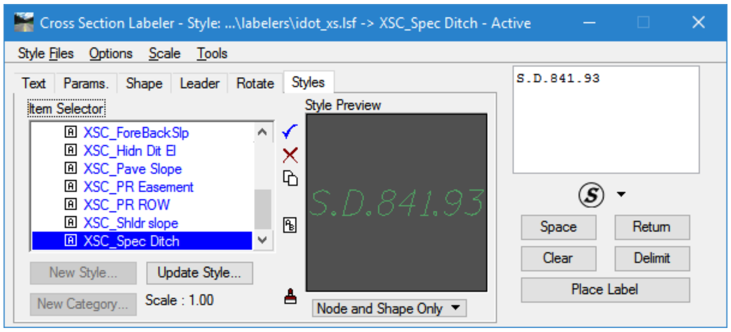


Figure 4-3.C – Legacy Cross-Section Labeler

- GEOPAK design criteria and 3PC files can be used for labeling. The GEOPAK v8i, SELECTseries 10 criteria files are delivered in the SS4/SS10 workspace. The designer is directed to IDOT's SELECTseries 10 documentation for more information.

It is also possible to use a hybrid workflow whereby the designer builds a model using OpenRoads but when producing cross-section sheets would instead produce "stacked" cross-sections with a legacy GEOPAK cross-section cell. Thus, the designer may take advantage of the OpenRoads modeling capabilities while leaving the legacy labeling and sheeting workflows intact; see Section 4-5.01(e).

4-3.03 Legal Descriptions

4-3.03(a) GEOPAK Legal Description Editor

The Legal Description Editor is a GEOPAK tool that may be used to create Right of Way legal descriptions utilizing GEOPAK coordinate geometry, and predefined styles. The default IDOT Legal Description Library is IDOTCAD\Geofiles\Legal\IDOTLegalEnglish.ldb.

To use the legal description editor, the geometry for rights of way and property lines must be created in, or exported to, a legacy GPK file. These lines are then built into parcel elements in the GPK file. The parcel elements will then report implicit information such as area and can be further defined to contain and report owner names, taking areas and other necessary information for producing metes and bounds descriptions.

The Legal Description Editor can be used once the parcel is stored. The general statements that are common to all descriptions are stored in the GEOPAK library. Using the information stored in the parcel element and the stored common phrases, the Editor can produce legal descriptions.

For further information on the use of the Legal Description Editor, the designer is directed to IDOT's SELECTseries 10 documentation for more information.

4-3.03(b) OpenRoads Parcel Report

Parcels are created in OpenRoads geometry by creating a “closed” complex geometric element. Naturally, since there may be some error in the underlying deed information the closure may not be perfect. Such OpenRoads geometry is not identical in function to the legacy GEOPAK parcel element type. The OpenRoads geometry does not have the ability to accumulate taking areas (sub parcels) and the other properties which are unique to the legacy parcel element type. As a result, taking areas will be created as separate geometry elements.

Once the parcel geometry is created, a legal report or map check report can be produced from the OpenRoads tasks menu. The report styles can be customized by editing the underlying style sheets, but the designer will likely need to copy the report information into other software for final document preparation.

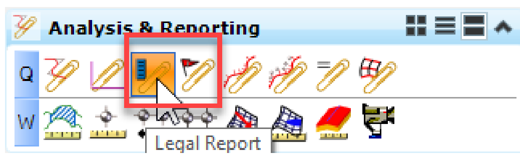
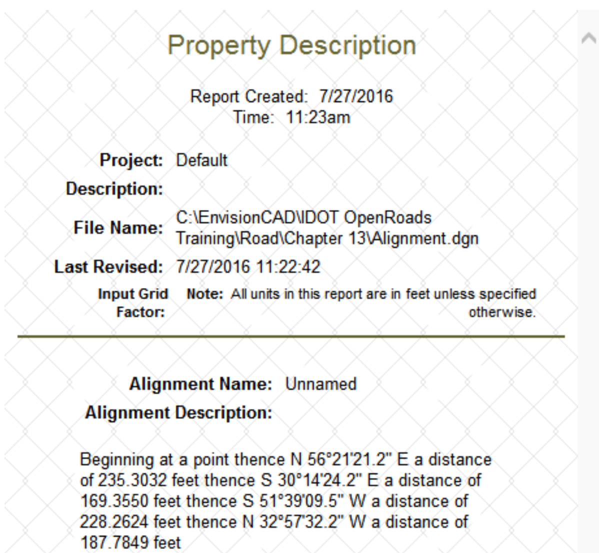


Figure 4-3.D – OpenRoads Parcel Report Tools



Property Description

Report Created: 7/27/2016
Time: 11:23am

Project: Default
Description:
File Name: C:\EnvisionCAD\IDOT OpenRoads Training\Road\Chapter 13\Alignment.dgn
Last Revised: 7/27/2016 11:22:42
Input Grid Factor:
Note: All units in this report are in feet unless specified otherwise.

Alignment Name: Unnamed
Alignment Description:

Beginning at a point thence N 56°21'21.2" E a distance of 235.3032 feet thence S 30°14'24.2" E a distance of 169.3550 feet thence S 51°39'09.5" W a distance of 228.2624 feet thence N 32°57'32.2" W a distance of 187.7849 feet

Figure 4-3.E – Sample Legal Report

Map Check Report

Report Created: 7/27/2016
Time: 11:23am

Project: Default
Description:
File Name: C:\EnvisionCAD\IDOT OpenRoads Training\Road\Chapter 13\Alignment.dgn
Last Revised: 7/27/2016 11:23:15
Input Grid Factor: **Note:** All units in this report are in feet unless specified otherwise.

Alignment Name: Unnamed
Alignment Description:

Type	Point Name/ Direction	Northing/ Length	Easting	Elevation
POB		1144083.627	2462985.974	0.00
	N 56°21'21.1924" E	235.3032		
PI		1144213.992	2463181.863	0.00
	S 30°14'24.2161" E	169.3550		
PI		1144067.683	2463267.154	0.00
	S 51°39'09.5108" W	228.2624		
PI		1143926.063	2463088.136	0.00
	N 32°57'32.1609" W	187.7849		
POE		1144083.625	2462985.974	0.00

Northing Error:	-0.0013 ft
Easting Error:	0.0000 ft
Closing Direction:	N 0°00'00.0" E
Closing Distance:	0.0013 ft
Closed Area:	0 sq ft 0 ac
Perimeter:	820.7055 ft
Precision:	1994904.9787

Figure 4-3.F – Sample Map Check Report

4-3.04 Annotation Guides

The text styles discussed in the MicroStation Configuration Information (Section 3-8) should be used in the preparation of roadway and structure plans to provide uniformity in appearance.

Annotations placed for roadway or structure plans shall be placed according to the following: If the active angle when placing text is between 90 degrees and 105 degrees, the text shall be placed such that it can be read from the right of the sheet. If the angle is greater than 105 degrees, the text shall be placed such that it can be read from the left or bottom as shown in Figure 4-3.G.

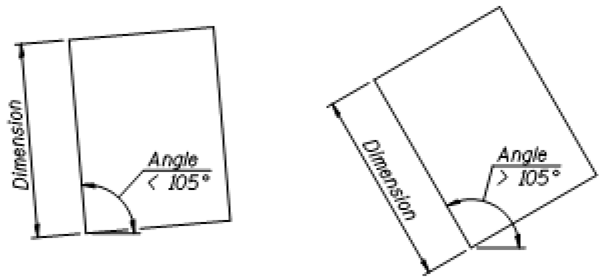


Figure 4-3.G - Annotation Rotation

Use only the symbols available in the cell libraries shown in Section 3-11 when preparing a set of plans.

IDOT uses U.S. Customary stationing interval of 100 ft. Stationing is shown to two decimal places, for example, 1 + 00.00.

All dimensions shall be in U.S. Customary units. Do not use dual units.

All survey information (for example, offsets and elevations) shall be shown in feet and decimals of a foot. For items that will be constructed (for example box culvert dimensions and pavement thickness), use feet, inches, and fractions of an inch.

Where all or most of the units are shown in one set of dimensions (for example feet or inches), a footnote can be added to the sheet stating this fact. For example, “ALL DIMENSIONS ARE IN INCHES (IN) EXCEPT AS NOTED”. Removing the inch or foot symbol from the plans improves the sheet clarity.

Provide a space between the number and symbol (for example, 12 ft).

Use a comma for numbers greater than three digits (for example, 12,000 ft²).

Cross-slopes, superelevation slopes, and vertical grades shall be shown in percent format to the second decimal place, for example 6.00%.

Side slopes shall be shown as ratio format V:H. For example, “1:2 indicates a ratio of 1 vertical per every 2 feet of horizontal offset.

Angles shall be expressed in degrees, minutes, and seconds, for example 55°12’14”. Directions shall be expressed as a bearing, for example N 55°12’14” W.

A north arrow shall be shown on every sheet and on every inset of a sheet where the inset is rotated differently than the master sheet.

A graphic scale shall be placed on all sheets which are drawn to scale.

Number all sheets sequentially, with the sheet numbers in the lower right-hand corner, except the cover sheet, which is numbered in the upper right-hand corner. Do not number *IDOT Highway Standards*.

Sheets that are added after the sheet numbers have been placed on the plans should be numbered A, B, C, etc., and noted in the index. The additional sheets are not included in the total number of sheets.

4-3.04(a) Text Guides for Structure Plans

The following is information regarding how text should be placed in structure plans ONLY:

1. Words that are abbreviated are not capitalized or put in parentheses. Examples are "typ.", "min." and "max."

2. When using asterisks for a reference note, place the asterisk as a separate text entity to the left of the note as follows: "*Tightly fasten the #8 bars together with No. 9 wire ties."

3. When placing a note under a title of a section which applies to that section, do not use "Note:". Only use "Note:" for a block of notes that are grouped or listed together in one location on a sheet.

4. The words "wingwall," "streambed," and "headwall" should always be shown as single words.

5. The plus-or-minus symbol ("±") shall be placed before approximate dimensions unless showing a specific tolerance. A specific tolerance should be shown in parentheses following the dimension.

6. Avoid use of the note "Work this sheet with sheet…" Use of a note such as this can become cumbersome and usually provides little benefit.

7. Do not call out the route number within a job unless it is the centerline of a divided highway. Call out the centerline of roadway (and Profile Gradeline (PG), if applicable).

8. Notes that are a part of any of the base sheets should generally remain on the base sheet. For example, the note "A distance of half the length of the wingwall but not less than six feet of the barrel shall be poured monolithically with the wingwalls" is occasionally moved or reworded on the General Plan and Elevation. This note should not be moved or reworded unless a unique situation requires it.

9. All notes should be left justified. An exception is when a multi-line callout is placed between arrows of a dimension. In this case, it can either be left or center justified. If it is left justified, try to make each line of text approximately the same length.

10. The Bill of Material for individual elements, such as superstructure, abutment, pier, etc., should contain only the items that are listed in BBS base sheets. Showing all pay items for each of the structure elements on these sheets is unnecessary. All pay items are shown on the total bill of material.

11. For appearance, the reinforcement bars should be listed in the bill of material with a blank line between the bar groupings, e.g., show a blank line between b bars and d bars.

12. When referencing sheets, do not write “see sheet #3 of #15”, instead use “see sheet 3 of 15.”

13. Generally, span numbers do not need to be called out. An exception to this could be a large structure with many spans.

14. When calling out the centerline of a pier, do not call it out as centerline bearing pier _. There are instances when the centerline bearing and centerline pier are not the same. It is preferable to either use two separate labels or to write “Centerline bearing and centerline pier.”

15. Callouts for reinforcement bar spacing, steel plates, and bearing plates may be shown in inches. However, plan view dimensions for reinforcement bars and bearing plate details shall be shown in feet and inches.

16. Concrete dimensions shall be shown in feet and inches. If a concrete dimension is less than 1’-0”, it shall be shown in inches.

4-3.04(b) Capitalization

Roadway plans shall use all caps for text.

For structure plans, capitalize the first letter of the first word of a note or sentence as well as proper names. There are two basic exceptions. One is contractual parties such as ENGINEER and CONTRACTOR, which should be capitalized. The other basic exception is pay items. The first letter of each word of the pay item should be capitalized except for words such as “of,” “and,” “for,” or “in.”

4-3.04(c) Abbreviations

Abbreviations should be avoided whenever possible. The word should be completely spelled out whenever possible. Periods do not need to be placed within acronyms of proper names such as AASHTO.

The IDOT Highway Standard 000001-08 (“Standard Symbols, Abbreviations, and Patterns”) presents common abbreviations that are used where it is necessary to abbreviate words. The standard drawings are available for download at the link shown in Section 5-2 of this manual.

Table 4-3.A contains a basic list of acceptable abbreviations that may be used on structures plans.

Spell out any words which are not listed in these two sources.

Table 4-3.A – Abbreviations for Structure Plans			
Abbreviation	Full Text	Abbreviation	Full Text
abut.	abutment	B.F.	back face
℔	baseline	brg.	bearing
℄	centerline	cl.	clearance
const.	construction	ø	diameter
E.F.	each face	elev.	elevation
exist.	existing	FL	flowline
F.F.	front face	I.F.	inside face
jt.	joint	long.	longitudinal
max.	maximum	min.	minimum
no.	number	O.F.	outside face
PJF	preformed joint filler	PJS	preformed joint sealer
PG	profile grade	prop.	proposed
req'd.	required	rte.	route
sect.	section	spa.	spaces
spec.	specification	sta.	station
std.	standard	struct.	structure
typ.	typical		

4-3.04(d) Dimensioning Used in Structure Plans

The Bureau of Bridges and Structures currently places dimensions manually using line terminators. Dimension styles shown in Section 3-9 have been created and may be used instead of, or in addition to, manually placed dimensions.

Whether manually placing dimensions or employing the dimension style, the proper arrowhead (B00021 from the cell library "bridge.cel") should be used.

Guidelines for the placement of dimensions or callouts are as follows:

1. Dimension stack spacing should be 1/2", although 3/8" is acceptable if there are space constraints. The extension lines should extend 1/16" beyond the dimension line; see detail "A" in Figure 4-3.H below.
2. Dimension lines should not be broken unless passing through another dimension or text; see detail "B" in Figure 4-3.H below.
3. Generally, do not break or mask object lines for dimension lines unless there is interference with an arrowhead or text; see detail "C" in Figure 4-3.H below.
4. It is acceptable to show reinforcement dimensions with double arrows or by pointing to the first and last bar. Consistency with a chosen style is important.
5. If there is no skew on a structure, there is no need to dimension a 90° angle throughout the job. This angle should only be shown on the Type, Sizing and Location and General Plan and Elevation.
6. Avoid causing callouts to pass through lines of dimensions; see Figure 4-3.I below.

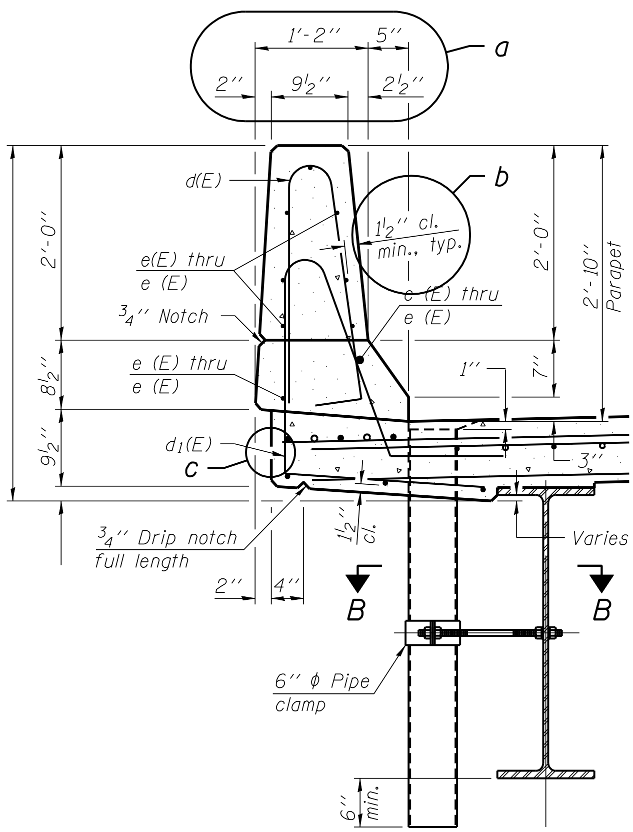


Figure 4-3.H - Dimensioning Example

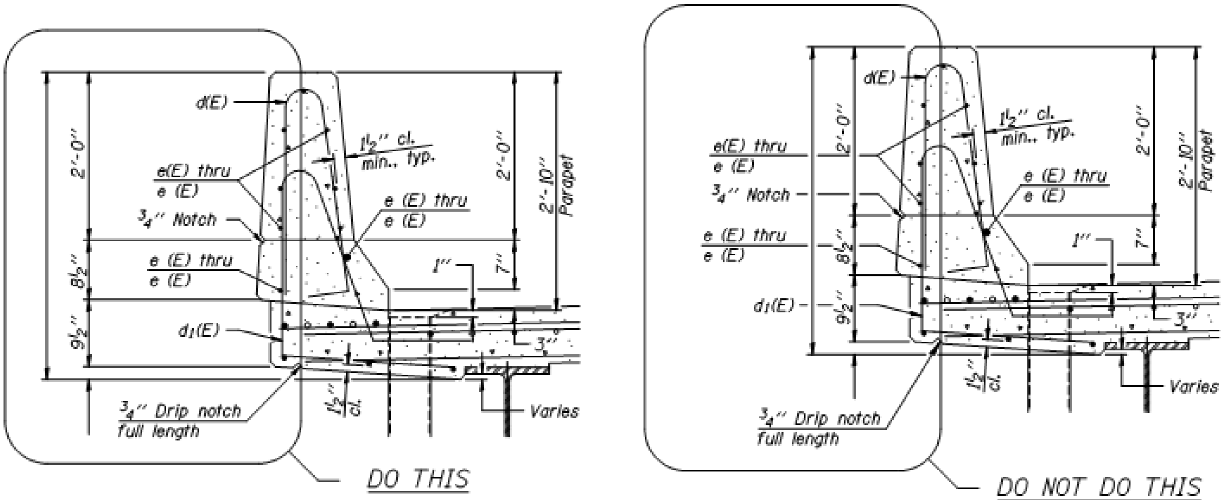


Figure 4-3.I - Proper Dimension Placement

4-3.04(e) Patterning Used in Structure Plans

Several different area patterns exist in “CADD_Elements.cel[CT1]” for general use on section cuts.

Table 4-3.B – Structures Pattern Cells	
Pattern Cell Name	**Description**
B00010	Aluminum Hatch Pattern
B00011	Concrete Hatch Pattern
B00012	Porous Material Hatch Pattern
B00013	Regular Hatch Pattern
B00014	Riprap Hatch Pattern
B00015	Sand Hatch Pattern
B00016	Steel Hatch Pattern
B00017	Wood Hatch Pattern

Placement of patterns shall be as follows:

- Whenever a section is cut through any material, the surfaces touched by the cutting plane shall be patterned using the proper pattern (stipple or hatching).
- End views shall not be patterned as if they are sections.

4-4 SHEET ORGANIZATION AND CONTENT

Sheets should be prepared as simply as practical. The use of duplicated data and cross references should be avoided.

See *Bureau of Design and Environment Manual* Section 63-4 for a detailed discussion of the required contents of each sheet type and Section 63-6 for a checklist of sheet contents.

4-4.01 Sheet Sizes

The following sheet sizes are generally used during project development:

1. 34 in. x 22 in. (D). This sheet size is considered a full-size sheet. It should be used for design layouts on most projects. A border around the sheet should be provided with a 2 in. left-binding margin, 0.5 in. right margin, and 1 in. top and bottom margins. This provides a working area of 31.5 in. x 20 in.

2. 11 in. x 17 in. (B). For Department purposes, this sheet size is considered a half-size sheet.

3. 8.5 in. x 11 in. (A). This sheet size is generally only used on projects that do not require a significant amount of detail, such as, simple resurfacing projects. These types of projects typically contain only a plan view. This sheet should show centerline, culverts, entrances, side roads, utilities, and existing right-of-way. If a project contains significant other amounts of information, use one of the larger sheet sizes.

For the preliminary and pre-final design stages, and for the final plans, print all sheets on white paper. See Section 2-3.03 for required final deliverables.

4-4.02 Sheet Organization

To provide consistency from project to project, the plan sheets should be assembled in the recommended sequence below. The designer should note that not all plans will have all sheets and that several sheets can be combined. See *Bureau of Design and Environment Manual* Section 63-4 for a detailed discussion of the required contents of each roadway sheet type and Section 63-6 for a checklist of roadway sheet contents. See *Bureau of Bridges and Structures Bridge Manual* Section 3.1 for details and contents of structures sheets.

1. Cover Sheet;
2. Index of Sheets, Listing of applicable Highway Standards, General Notes, Commitments;
3. Summary of Quantities;
4. Typical Sections;
5. Schedules of Quantities;
6. Alignment, Ties, and Benchmarks;
7. Plan and Profile Sheets;
8. Suggested Stages of Construction and Traffic Control;
9. Erosion and Sediment Control Details;
10. Drainage and Utilities Sheets;
11. Right-of-Way Sheets;
12. Intersection Details;
13. Pavement Marking Details;
14. Landscaping Details;
15. Traffic Signal Details;
16. Lighting Details;
17. Structural Sheets in the following order:
    - A. General Plan and Elevation (GP&E)
    - B. General Data (except for simple structures)
    - C. Footing Layout (if required)
    - D. Stage Construction Details (if required)
    - E. Temporary Barrier or Temporary Railing Details (if required)
    - F. Top of Slab Elevations
    - G. Top of Approach Slab Elevations
    - H. Superstructure (Plan and Cross Section)
    - I. Superstructure Details
    - J. Diaphragm Details (for bridges with integral or semi-integral abutments)
    - K. Bridge Approach Slab Details
    - L. Bridge Railing Details
    - M. Expansion Joint Details
    - N. Drainage Scuppers
    - O. Girder and Framing Details (Steel or Concrete)
    - P. Bearing Details
    - Q. Abutment Details
    - R. Pier Details
    - S. Foundation Details (includes piles)

T. Bar Splicer Assembly Details
U. Cantilever Forming Brackets
V. Soil Boring Logs

18. Wetland Details;
19. Culvert Details;
20. District Details;
21. Cross Sections; and
22. Highway Standards.

4-4.03 Sheet Titles

4-4.03(a) Roadway Sheet Titles

The designer shall include the following information on every sheet, except for the IDOT Highway Standards included in the back of the plans:

1. Sheet Index Block. Title blocks are provided in the lower right corner (upper right for cover sheet) of sheet cells in the IDOT roadway cell library and contains the following information:

   A. project route number(s);
   B. section number(s);
   C. county the project is located in;
   D. total number of sheets for the project, including the cover sheet and excluding the highway standards sheets;
   E. sheet number;
   F. stationing shown on the sheet, if applicable
   G. contract number

2. Project Numbers. Project numbers will be determined and placed on the plans by the Central Office.

3. For consultant design projects, provide the consultant's company name, professional engineer's signature, date of their license expiration, and their professional stamp in the lower right-hand corner of the sheet to the left of the State approval box.

4-4.03(b) Structure Sheet Titles

Both the planning Type Size & Location (TS & L) sheet(s) and the design General Plans & Elevation (GP & E) must show the sheet name, crossing, route, section, county, station, and structure number. The title is to be placed as shown in Figure 4-4.A using the text style “Br1:001scale200.”

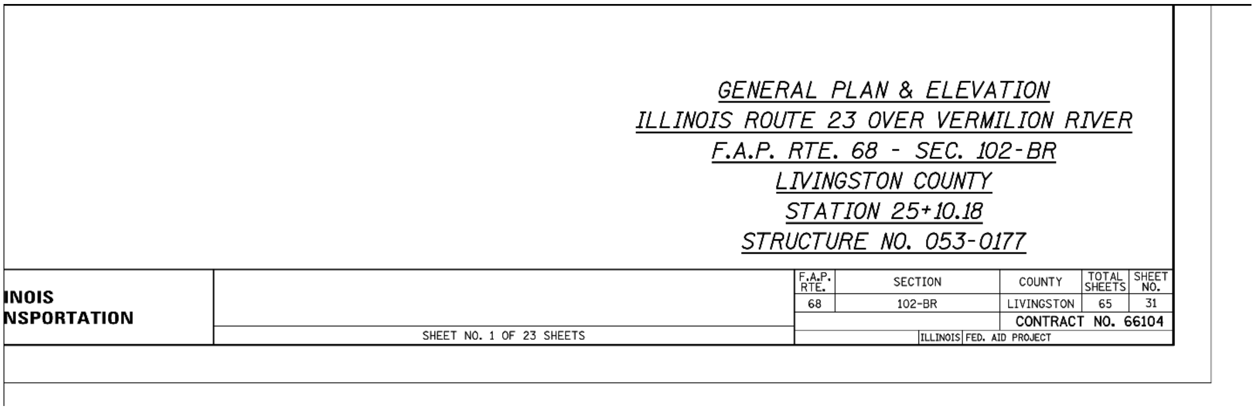


Figure 4-4.A - Structures Sheet Titles

For all other sheets of the structures design plans, only the sheet name and structure number are shown within the title block. Data fields exist within the borders for this information. They are to appear as shown here using the data fields.

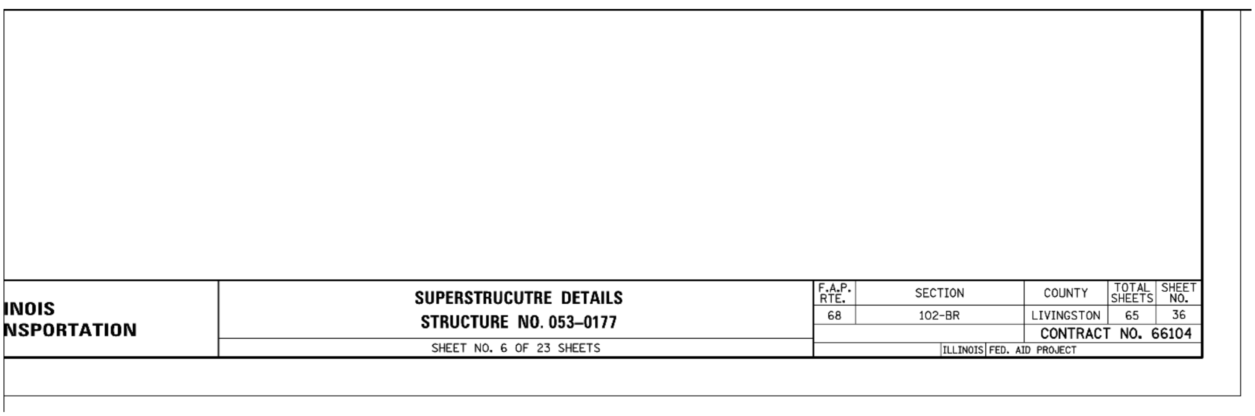


Figure 4-4.B - Structures Sheet Titles

The titles for individual details within a set of plans are to be placed using the text style "Br1:001scale200". By using this text style, the justification, spacing, text size, and underlining will appear correctly.

Consultant names and/or logos shall be included in the lower left block of structure borders as shown in Figure 4-4.C. The "File name =" text may be removed if desired.

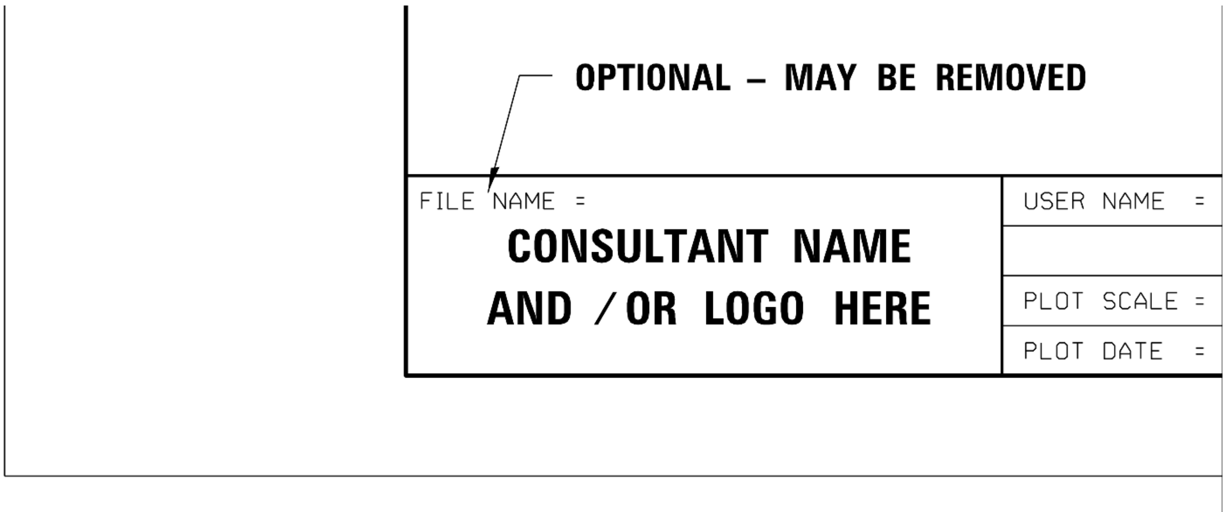


Figure 4-4.C - Placement of Consultant Name

4-5 SHEET LAYOUT

The borders used for roadway plans are different than the borders for structure plans. One must not be substituted for the other. The differences include: different levels, differences in signature/name block, differences in title block, and scale is not shown for structures sheets.

The sheet borders included in the Department's cell and seed libraries have been designed to facilitate the use of batch printing. The cells include a shape construction element that is on the outermost perimeter of the border to be used for the creation of ANSI B and D-sized prints. This element exists on the level "Sheets_Printer Plotting Border" for roadway sheet border and level "Bridge_Sheet Design Print" for structures border. It is important to note that this outer shape (22" x 34") is intended to be the edge of the paper or image. This shape is not to be visible in the final prints or images.

4-5.01 Roadway Sheets

4-5.01(a) Roadway Plan-Profile Sheet Layout

The IDOT workspace defines the files and settings needed to lay out roadway sheets using the GEOPAK Plan and Profile Sheet Layout tool. To use this tool, the roadway centerlines and proposed profiles must be exported from OpenRoads to the legacy GEOPAK GPK file.

The Plan Sheet Layout tool provides an automated method for generating IDOT standard roadway plan and profile sheets. Each view of plan, profile and tabular data is referenced into the sheet design file to compile the plan and profile sheets. Sheet libraries have been configured for use with IDOT's standard plan and profile sheet cells. The IDOT Plan Sheet library is in the following directory: \IDOTCAD\GEOPAK\Sheets\Plan.

Table 4-5.A - Roadway Sheet Layout Libraries

Configured Settings	Description
IdotPlanSheets.psl	Standard 22" x 34" sheets <u>without</u> match lines
IdotPlanSheetsML.psl	Standard 22" x 34" sheets <u>with</u> match lines

If a sheet library other than the default is needed, use ***File>Attach*** to attach the desired library.

Once the sheet library is attached, various sheet types are available in the drop down list.

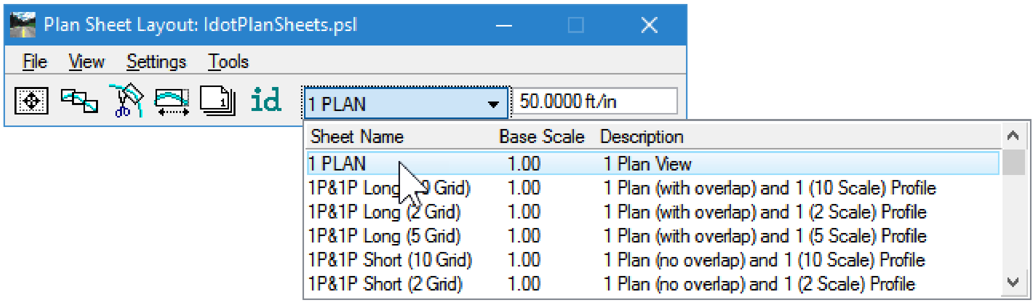


Figure 4-5.A - Plan Sheet Layout Tool

The plan and profile sheet layout tool requires the use of legacy interpretation of scale. Thus, when setting the scale in the dialog, you **do not** use the ratio from Section 3-10. Instead you will use the historical simple multiplier. For example, enter 50 instead of 600.

Within the configured libraries, the following types of sheet sets can be laid out. The sheet libraries with "ML" in the name are identical except a match line is drawn on the sheets.

Table 4-5.B - Sheet Styles (1 of 3)	
Sheet Name in the Drop Down	Description
1 Plan	Creates one plan view per sheet
1P&1P Long (10 Grid)	Creates one plan (with overlap) and one (10 Scale) profile
1P&1P Long (2 Grid)	Creates one plan (with overlap) and one (2 Scale) profile
1P&1P Long (5 Grid)	Creates one plan (with overlap) and one (5 Scale) profile
1P&1P Short (10 Grid)	Creates one plan (no overlap) and one (10 Scale) profile
1P&1P Short (2 Grid)	Creates one plan (no overlap) and one (2 Scale) profile
1P&1P Short (5 Grid)	Creates one plan (no overlap) and one (2 Scale) profile
1P&1P U Long (10 Grid)	Creates one plan (with overlap) and one (10 Scale) profile (urban sheet)

Table 4-5.B - Sheet Styles (2 of 3)	
Sheet Name in the Drop Down	Description
1P&1P U Long (2 Grid)	Creates one plan (with overlap) and one (2 Scale) profile (urban sheet)
1P&1P U Long (5 Grid)	Creates one plan (with overlap) and one (5 Scale) profile (urban sheet)
1P&1P U Short (10 Grid)	Creates one plan (no overlap) and one (10 Scale) profile (urban sheet)
1P&1P U Short (2 Grid)	Creates one plan (no overlap) and one (2 Scale) profile (urban sheet)
1P&1P U Short (5 Grid)	Creates one plan (no overlap) and one (2 Scale) profile (urban sheet)
1P&2P Long (10 Grid)	Creates one plan (with overlap) and two (10 Scale) profile
1P&2P Long (2 Grid)	Creates one plan (with overlap) and two (2 Scale) profile
1P&2P Long (5 Grid)	Creates one plan (with overlap) and two (5 Scale) profile
1P&2P Short (10 Grid)	Creates one plan (no overlap) and two (10 Scale) profile
1P&2P Short (2 Grid)	Creates one plan (no overlap) and two (2 Scale) profile
1P&2P Short (5 Grid)	Creates one plan (no overlap) and two (2 Scale) profile
2 Plan	Creates two plan sections per sheet
2 Plan Staging	Creates two plan sections per sheet for staging
2 Profile	Creates two profile sections per sheet
2 Profile Staging	Creates two profile sections per sheet for staging
2P&2P Long (10 Grid)	Creates two plan (with overlap) and two (10 Scale) profile
2P&2P Long (2 Grid)	Creates two plan (with overlap) and two (2 Scale) profile
2P&2P Long (5 Grid)	Creates two plan (with overlap) and two (5 Scale) profile
2P&2P Short (10 Grid)	Creates two plan (no overlap) and two (10 Scale) profile

Table 4-5.B - Sheet Styles (3 of 3)	
Sheet Name in the Drop Down	Description
2P&2P Short (2 Grid)	Creates two plan (no overlap) and two (2 Scale) profile
2P&2P Short (5 Grid)	Creates two plan (no overlap) and two (2 Scale) profile
3 Profile	Creates three profile sections per sheet
Full Profile (10 Grid)	Creates full profile sheets with elevation labels at 10' interval
Full Profile (2 Grid)	Creates full profile sheets with elevation labels at 2' interval
Full Profile (5 Grid)	Creates full profile sheets with elevation labels at 5' interval

4-5.01(b) Roadway Sheet Borders

The plan sheets layout tool automatically places the appropriate sheet borders from the cell library. Several sheet borders exist within the primary roadway cell library, *IDOTroad.cel*.

As noted in Section 3-10, annotation scale has been changed in the version of workspace released in conjunction with this manual. The changes made have limited impact on the function of the GEOPAK plan and profile sheet generation tools. However, it should be noted that to accommodate this legacy tool, the sheet border cells are NOT marked as annotation cells. The size of the cells is also such as to be consistent with the legacy expectation of using simple multiplier rather than a mathematical ratio as described in Section 3-10. The designer need not be concerned with these minutiae since the appropriate scales and cell sizes have been accommodated in the workspace.

Table 4-5.C - Roadway Sheet Cells	
Cell Name	Border Description
SHT_1 PLAN 2 PROFILE	Single plan, double profile
SHT_2 PLAN 2 PROFILE	Double plan, double profile
SHT_COVER	Cover sheet
SHT_DOUBLE Plan	Double plan
SHT_DOUBLE Profile	Double profile
SHT_FULL Profile	Profile only
SHT_IDS A	Intersection Design Study sheet
SHT_IDS AWSC	Intersection Design Study sheet for all way stop controlled intersections
SHT_IDS B	Intersection Design Study sheet
SHT_IDS R	Intersection Design Study sheet for roundabout intersection
SHT_IDS S	Intersection Design Study sheet for signalized intersection
SHT_IDS TWSC	Intersection Design Study sheet for two way stop controlled intersection
SHT_PLAN	Plan only
SHT_PLNPROF	Single plan single profile
SHT_PLNPROF Urban	Urban single plan, single profile
SHT_ROW EASEMENT Plat	Easement Plat sheet
SHT_ROW Plans	Right of Way plans
SHT_ROW Plat	Right of Way plat
SHT_TRIPLE Profile	Triple profile
SHT_XS_H GRID	Cross sections (landscape) with grid
SHT_XS_H NO GRID	Cross sections (landscape) without grid
SHT_XS_V GRID	Cross sections (portrait) with grid
SHT_XS_V NO GRID	Cross sections (portrait) without grid

4-5.01(c) Roadway Cross Section Sheet Layout

There are two workflows for developing cross-section sheets, and both are configured in the workspace.

- Preferred:
  When roadway models are developed using OpenRoads tools and 3D models, the sheets are created using the OpenRoads Create Cross-Section command described below.

- Accepted:
  The legacy GEOPAK Cross-Section Sheet Layout command can be used when the roadway model is created with OpenRoads or legacy design tools.

When creating cross-sections, under no circumstance shall existing features or proposed features extend beyond the limits of the GEOPAK cross section cell or sheet. Match lines are permitted where necessary to match two adjoining alignments; however, they may not be placed where they dissect a superelevation shape.

When using legacy GEOPAK cross-section workflows with a cross-section cell:

- When additional cross-section cells are placed for sheet separation, the original cell must be left intact.
- Cross section cells shall extend a minimum of 10 feet beyond the ground line. Earthwork shapes utilizing color stratification shall be included for all cross-section files.

4-5.01(d) OpenRoads Create Cross-Sections

When the roadway is modeled using the OpenRoads commands, then the cross-section sheets can be created using the Create Cross-section command. The IDOT workspace has been configured with a variety of settings for different scales and sheet orientation.

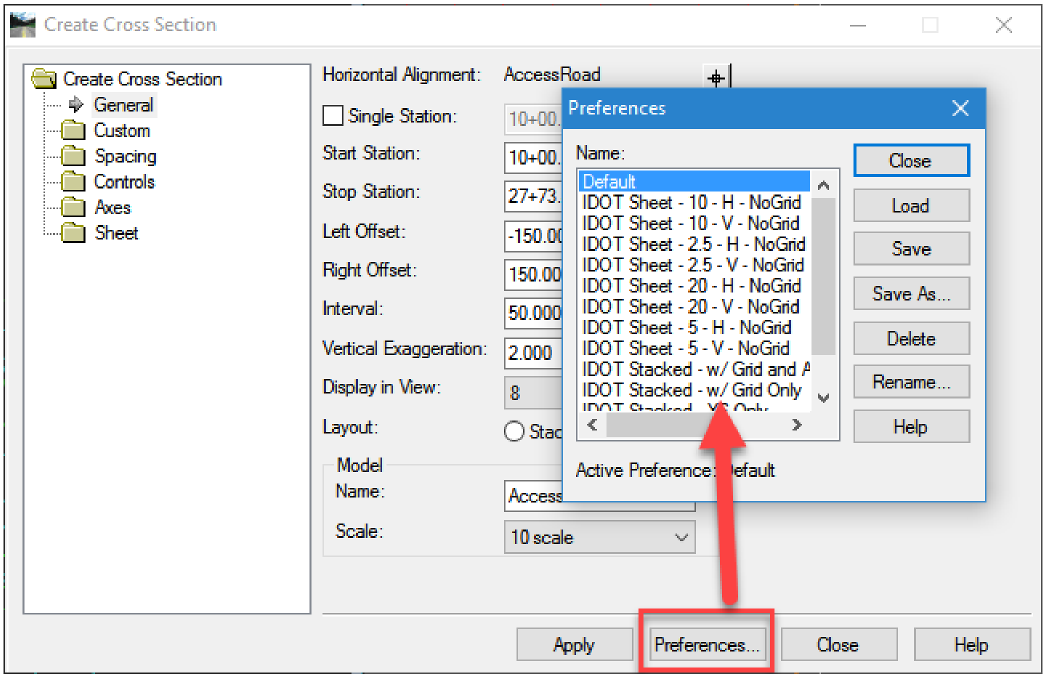


Figure 4-5.B - OpenRoads Create Cross-section Command

When the command opens, the desired settings are selected by clicking on the Preference button as shown above. The preferences titled “IDOT Sheet…” create sheet borders ready for plotting in a separate drawing model. The OpenRoads tools for cross-section annotations and end area volumes can then be used on the created sheets.

Descriptions for the various preferences as well as the example sheets which result from each preference are included as a link from Project Explorer.

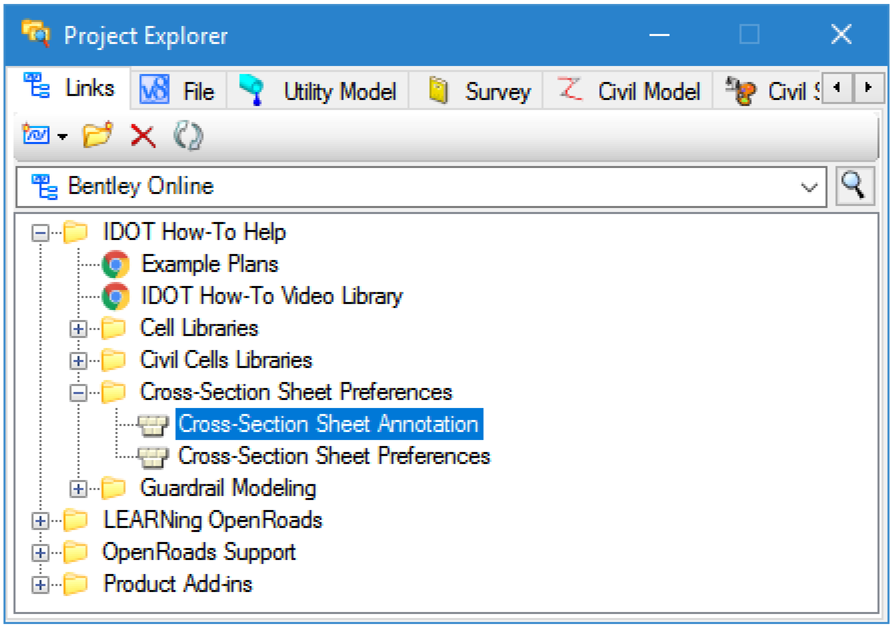


Figure 4-5.C – Documentation of Cross-Section Preferences

4-5.01(e) Legacy GEOPAK Create Cross-Section Sheets

If it is desired to use the legacy cross-section sheet tool to make sheets of the cross-sections produced by OpenRoads, run the Create cross-section command as described in Section 4-5.01(d) above and use one of the preferences settings title “IDOT Stacked…” Once the stacked cross-sections are created in a model, the legacy cross-section sheet composition tool can then be used.

The IDOT workspace defines requirements and settings for the legacy cross-section sheet layout tool in a file named *IdotXsecSheets.xssl*.

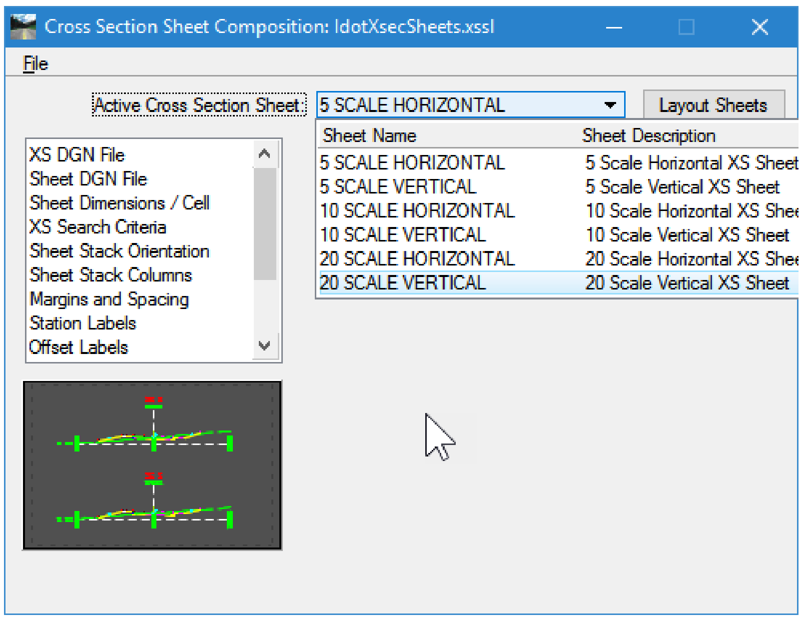


Figure 4-5.D - GEOPAK Cross-Section Sheet Composition Tool

In the configured XSSL library files are a variety of settings to produce sheets at various scale and orientation.

Table 4-5.D – Legacy Cross-Section Sheet Composition Settings	
Preference Name	Description
5 Scale Horizontal	Landscape Orientation, 1” = 5’ scale
5 Scale Vertical	Portrait Orientation, 1” = 5’ scale
10 Scale Horizontal	Landscape Orientation, 1” = 10’ scale
10 Scale Vertical	Portrait Orientation, 1” = 10’ scale
20 Scale Horizontal	Landscape Orientation, 1” = 20’ scale
20 Scale Vertical	Portrait Orientation, 1” = 20’ scale

4-5.01(f) Cross Section Files

Whether using OpenRoads or legacy GEOPAK cross-section workflow, each alignment must have its own set of cross sections, including R.O.W. lines and centerline identification, except for a multiple configuration (divided highway) which shall be on the same set of sections. When producing cross-sections according to Section 4-5.01(d), the designer should place cross sections for each alignment in separate files. If using the legacy workflow (Section 4-5.01(e)), place the stacked cross-sections in separate files or models, and the stacked cross-sections in separate files from the sheets.

The proper symbology settings for cross-section elements are defined in the IDOT workspace feature definitions. The designer shall insure proper usage of feature definitions and specified element symbology throughout the design process.

Using the legacy cross-section workflow is discouraged and designers should plan to migrate to the OpenRoads tools in a reasonable time frame. However, for those projects where the legacy workflow is needed, a viable GEOPAK cross section cell (i.e., recognizable by the cross section labeling window) must be present on each cross section at the correct location. This cell is created by the OpenRoads cross-section tool when using the preferences titled “IDOT Stacked…”

If OpenRoads is not used to develop the stacked cross-section, the designer shall ensure that a viable cross-section cell is in place. In legacy workflows, this cell is created by the GEOPAK cross-section commands and design criteria.

With the cross-section cell in place, the legacy IDOT criteria for labeling and design can be used. The element symbology of all cross-section elements in the legacy workflow shall be dictated by the IDOT criteria via the use of the Typical Section Generator, or if standard criteria are not used, the element attributes shall conform to those listed in the *variables.x* file provided with the IDOTCAD download. Under no circumstances will the top and bottom layer of any cross-section feature have identical symbology, including pavement features. Separate layers shall be provided for each aggregate layer. In place feature such as topsoil, pavement and shoulders shall be included on the cross sections.

4-5.01(g) Legacy Cross-Sections with Multiple Alignment Setup

When using legacy cross-section workflows, it is necessary that the existing ground lines and shapes must be color coordinated to facilitate the processing of proposed cross sections. When multiple alignments are utilized, a cross section match line or shear line must be supplied in addition to the actual cross section pattern line file. Unless otherwise specified by the Department, the GEOPAK default settings shall be used as described in the GEOPAK documentation.

4-5.01(h) Staged Construction Cross-Sections

When staged earthwork or cross sections are required, a separate construction phase cross section file shall be provided for each project stage where earthwork is to be computed.

In OpenRoads, this is facilitated by building interim terrain models which represent the top surface of each phase and then computing[CT2] the next phase using the interim terrain model as the base (active terrain).

For legacy GEOPAK workflow, similar interim surfaces must be established and drawn into new cross-section sets where the previous phase surface serves as “existing ground” for the next phase.

4-5.02 Structures Sheets and Borders

When using the base sheets in the structures cell library, there may be required changes or additions before being included with a set of design plans. When a base sheet’s original content is changed, the base sheet name and date shall be removed. This signals to the reviewers that modifications were made to the base sheet. If information is added to a base sheet (such as adding dimension values), then the base sheet name and date shall remain. When base sheets contain details that do not apply to a project (such as the pile base sheets), the details that are not applicable shall not be crossed out.

4-5.02(a) Structures Borders

The following sheet borders have been created in the IDOT workspace for structure plans.

Table 4-5.E - Structures Sheet Cells	
Cell Name	Description
B00040	IDOT use only. Standard sheet border
B00041	IDOT use only. Planning sheet border
B00042	IDOT use only. Repairs sheet border
B00043	Consultant use only. Standard sheet border

These cells have been placed in the model(s) of the seed files described in Section 3-3.02

4-6 DRAINAGE ANNOTATION AND PROFILES

The GEOPAK Drainage toolset is replaced in OpenRoads by the Subsurface Utility Design and Analysis (SUDA) toolset. However, this new toolset is presently incomplete from a plans production perspective. The new toolset provides the following annotation tools which have been configured in the IDOT workspace:

1. Element Symbology tool can place annotation labels on plan sheets for pipes and drainage nodes, and
2. Flex Table tool can place tables of pipe and node properties.

The new toolset has limited capability for profile plans production and no ability to project drainage profiles onto a roadway profile. For these tasks, the drainage designer will need to export the drainage design from SUDA to GEOPAK Drainage, after which the following tools can be used in the legacy GEOPAK Drainage toolset:

1. Drainage plan view labeling.
2. Drainage profile projected to roadway profile after which the profile sheet production workflows in Section 4-5.01(a) can be used for sheeting.
3. Drainage profile labeling.

The feature definition library used in SUDA has been developed in a manner consistent with the historic GEOPAK Drainage library so that the export process is straightforward when the following workflow is used:

1. Export the drainage project from SUDA to GEOPAK. During this process a GEOPAK drainage library (dlb) is also exported but this will be ignored.

2. In GEOPAK drainage, open the exported project.
3. In the GEOPAK Drainage project preferences open the standard drainage preference file (.dpf) which will also load the historic drainage library (.dlb).
4. In the preferences, define original and design surface (TIN files) which have been exported from OpenRoads terrain models.
5. In the GEOPAK Drainage > Component menu, update all nodes and links to draw them into a blank DGN file.
6. Since profiles are not exported from SUDA, create new profiles such as are needed to project onto the various road profiles.
7. Finalize plan and profile labeling using the GEOPAK Drainage Labeler tool.

Notes:

- The designer is cautioned that the use of GEOPAK Drainage in previous versions of GEOPAK was uneven within the Department. Many districts did not use GEOPAK Drainage at all. Because of this fact, the exported SUDA information should be carefully inspected to ensure that the assigned GEOPAK Drainage library item was correctly assigned in export.
- The exported GEOPAK Drainage project should be used ONLY for plan and profile annotation and for placing profiles onto road profile sheets. While hydraulic calculations in the exported project are possible, the SUDA calculations are more modern and support the latest theories and research into hydraulic design. The older methods in GEOPAK Drainage will result in some small hydraulic differences.

4-7 PRINTING

The IDOT workspace delivers the printing tables shown in Table 4-7.A as an aid to developing printing workflows for internal and consultant designers. The files delivered in the workspace are specific to the printing hardware used by the Department. However, the settings within the workspace files are useful to guide development of additional files for the designer’s hardware.

4-7.01 Plotter Configuration Files (pltcfg)

The following configuration files are provided in the IDOT workspace. These will need review and potential editing to match your specific printer/plotter setup:

Table 4-7.A - Plotter Configurations	
Configuration File	Description
PRINTER.pltcfg	Used when plotting to a laser or inkjet device.
pdfNOLAYERSbw.pltcfg	Used when plotting to a PDF file.

These plotter configurations define the following line thicknesses for plot output that shall be used on full-size (ANSI D) prints. The line weights for quarter-size (ANSI B) plans shall be set to one-half of these values.

Table 4-7.B - Plotted Line Thickness			
Line Weight	Thickness (in.)	Thickness (mm)	Pen Size
0	0.010	0.25	000
1	0.014	0.35	0
2	0.020	0.500	1
3	0.024	0.600	2
4	0.031	0.800	3
5	0.047	1.200	4

The plotter configurations also define the following line strokes that shall be used on full-size (ANSI D) prints for defining MicroStation's built-in line codes. The line strokes for quarter-size (ANSI B) plans shall be set to one-half of these values.

Table 4-7.C - Internal Line Code Plotting Dimensions						
Line Code	Line (in.)	Space (in.)	Line (in.)	Space (in.)	Line (in.)	Space (in.)
1	0.015	0.0394				
2	0.0788	0.0788				
3	0.1574	0.0788				
4	0.1574	0.0788	0.0236	0.0788		
5	0.0552	0.0522				
6	0.1574	0.0522	0.0394	0.0552	0.0394	0.0552
7	0.1574	0.0552	0.0552	0.0552		

4-7.02 Pen Table (tbl)

The delivered pen table, $(IDOT)\IdotStandard\Tables\Pen\PLOTLABEL.TBL, performs a number of symbology adjustments at plot time. Element processing is performed in the following order:

Table 4-7.D - Pen Tables

Element Section	Action
No_Constructions	Turns off display of Construction Class elements.
Grid	Sets border grid lines to color 161.
White_Out	Sets all closed shapes using color 250 to solid fill, priority 50. Used in conjunction with Hide_Sheet_on_White_Out.
Shading10	Sets all closed shapes using color 110 to solid fill, 10% black.
Shading20	Sets all closed shapes using color 120 to solid fill, 20% black.
Shading30	Sets all closed shapes using color 130 to solid fill, 30% black.
Shading40	Sets all closed shapes using color 140 to solid fill, 40% black.
Shading50	Sets all closed shapes using color 150 to solid fill, 50% black.
Shading60	Sets all closed shapes using color 161 to solid fill, 60% black.
Shading70	Sets all closed shapes using color 170 to solid fill, 70% black.
NoFillSigns	Sets all closed shapes using color 188 to no fill.
Hide_Sheet_on_White_Out	Set all elements except those using colors 19 and 35 to priority 100. Used in conjunction with White_Out.

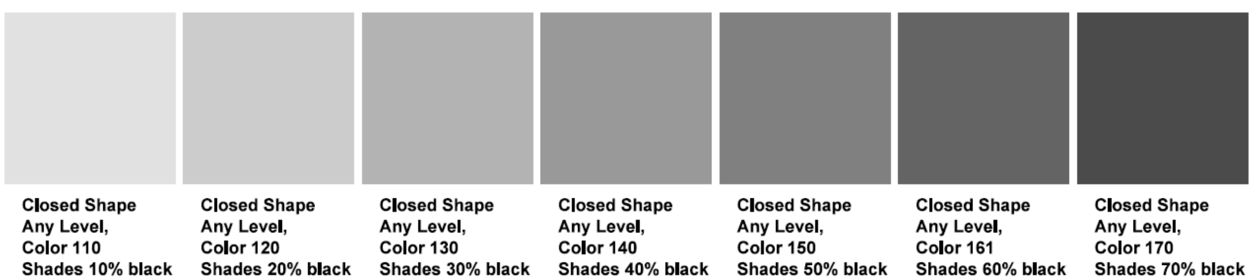


Figure 4-7.A – Shading Levels from Pen Table

The pen table also makes the following text substitutions:

Table 4-7.E - Pen Table Text Substitutions	
Actual Text	Replacement
DGN-SPEC	_FILE_
DATE-TIME	_DATE_
$DATE$	_DATE_
$FILEL$	_FILEL_
$SCALE$	_SCALE_
$USER$	$(USERNAME)
$TIME$	_TIME_
USER	$(_USTN_USERINTNAME)
$FILES$	_FILES_
$MODELNAME$	_MODELNAME_

4-7.03 Print Styles

The following standard print styles are defined in the delivered Print Organizer DGN Library, PrintOrganizer.dgnlib:

Table 4-7.F - Print Organizer Styles	
Print Style	Description
Standard 11"x17" Laser	Uses the *printer.pltcfg* printer driver but defines no paper sizes. This file should be copied and modified to reflect each organization's printers and paper sizes. If only one type of laser printer is used then only one print style will be required. If more than one type of printer is used then a print style will be needed for each one, since each type of printer uses different paper names, i.e. "Ledger," "Tabloid," "11x17", etc. Attaches PLOTLABEL.TBL pen table.
Standard 11"x17" PDF	Uses the *pdfNOLAYERSbw.pltcfg*. This is the standard printer driver for creating PDFs for letting submittals to D&E. Attaches the PLOTLABEL.TBL pen table.
Standard Find Print Shape	Set up to search for print area shapes on level Sheets_Printer Plotting Border.

These Standard print styles are provided as a starting point for companies and organizations to use when setting up print styles for their own use. No changes should be made to the PrintOrganizer.dgnlib. Modifications can be made to a copy of this file by following the procedure below.

To create modified Print Styles:

1. Copy and rename the delivered Print Organizer.dgnlib to a new filename, for example: *Company* Print Organizer.dgnlib.
2. Open the new DGN Library in MicroStation. To do so, make sure the Files of Type selector in the MicroStation Manager dialog is set to display DGN Library Files (*.dgnlib).
3. Open the Print Organizer by selecting (File > Print Organizer) from the pull-down menu.
4. In the Print Organizer dialog, select (Tools > Define Print Styles…) from the pull-down menu.
5. Rename each of the delivered print styles by replacing “Standard” with “Company.” Note that if more than one laser print style is needed, make multiple copies and name them accordingly, for example: *Company 11x17 Lexmark*, *Company 11x17 HP*, etc.
6. On the Main tab, select the correct paper size that corresponds to an 11” x 17” print the printer.
7. On the Main tab, select the desired pen table for the printer.
8. On the Printer tab, assign the desired plot configuration file (plt or pltcfg) to each print style.
9. Once all settings have been made for a printer, click the Disk icon in the Print Styles dialog to save the changes. Repeat the configuration for each of the 11x17 printers. Note that the Print Area (located on the Fence tab) should not be defined for any print styles except those based on the Standard Find Print Shape print style.
10. Create other Print Styles for additional printers by copying a completed Company print style (other than Find Print Shape) as a starting point. Then make changes necessary for each printer’s driver, paper, etc.

4-8 QUANTITIES

Project quantities shall be delivered to Project Development and Implementation Unit in a standard spreadsheet form as defined by the Bureau of Design and Environment. The spreadsheet is updated as needed for every letting. The designer shall download the correct version of the spreadsheet from the Roadway CADD Guidelines website link shown in Section 5-2.

This spreadsheet contains macros which may be disabled by your spreadsheet software applications. Enable the macros according the instructions of your spreadsheet application.

This spreadsheet contains all coded pay items. The macros take the selected items and generate Summary of Quantities table(s), including the grid(s), in the file while removing the unselected coded pay items. The resulting tables can be linked into MicroStation using the copy/paste method.

4-8.01 Coded Pay Item Resources in Spreadsheet

Detailed instructions for use of the spreadsheet are shown on the first tab of the spreadsheet and are briefly described here:

1. In the "Header" tab of spreadsheet, define the proper Construction and Safety Codes. Add Structure Numbers to "Pay Item Description" tab as needed.
2. In "Pay Item Descriptions" tab, include pay items as needed by double clicking in the "Include" column for appropriate code numbers.
3. After selecting pay items, click on "Create SOQ" in the "Pay Items Description" tab. This copies the selected pay items into the "Items and Quantities" tab and the "Summary of Quantities" tab.
4. Click on "Add Item(s)" button in "Pay Item Description" tab to auto sum column E in "Items and Quantities" tab.
5. Add quantities into "Items and Quantities" tab.
6. Click "Format" button in "Pay Item Description" tab, which formats the quantity sheet layout.
7. The finished table of quantities is then placed onto a DGN sheet by selecting the appropriate cells in the spreadsheet and copying/pasting the cells into the DGN sheet file using the following process:
   - A. Select the cells for the table in Excel.
   - B. In PowerGEOPAK, use the menu item (Edit > Paste Special).
   - C. In the Paste Special method selection box select the "Linked Microsoft Excel Worksheet" method.
   - D. In the Paste Special dialog use the "By Corners" option and place the table into the sheet.

When placed into the DGN sheet file the table shall be created as vector graphics and shall not be created as a raster image.

Repeat these steps for each table generated in the spreadsheet. Include the spreadsheet with the submittal to the Bureau of Design and Environment's Project Coordination and Implementation Section.

4-8.02 Earthwork

Earthwork shall be processed to a tolerance of ±0.01 cubic yards. All input and report files shall be included along with quantities tables. The results of the report files must be consistent with the graphic cross sections. Add volumes are permitted for unique circumstances on the project, such as driveway gravel quantities, but shall not be used in lieu of graphic elements for consistent trends in the sections (pavement or topsoil removal). A comment line shall be added to specify the justification for the adjustment, or a spreadsheet file shall be included to reflect the graphical end areas on the cross sections.

4-8.03 Summary of Quantity Sheet Requirements

The minimum requirements for all Summary of Quantities sheets:

1. A grid must be used such as that generated by the spreadsheet described in Section 4-8.01, or the cell, “SUMMARY_OF_QUANTITIES” located in the roadway cell library. (Columns of the table cell may be added, removed, or modified, as required).
2. Coded pay item numbers, descriptions, units, and quantities must use the text style “Rdwy_SOQ140” or its equivalent.
3. Coded pay items must be double-spaced (i.e., a blank line before the first pay item and after the last pay item as well as between each row of coded pay items).
4. The full description (not the abbreviated description) of the pay items must be used in the Summary of Quantities.

Reference the Summary of Quantities in the example plans for the desired appearance. Link for download of example plans is shown in Section 5-4.

4-9 ADDENDUMS

See also: *Bureau of Design and Environment Manual* Section 63-1.03(b).

If revisions or changes to the contract plans are required after plans have been posted for bidding, but prior to the letting, an “Addendum” may be required.

Approval for all addendums shall be coordinated with the Project Manager, who will solicit all required review and approval authorities within IDOT.

If an addendum is approved, all required deliverables that are affected by the addendum, including 3D models, shall be resubmitted to the Project Implementation Unit. See Section 2-3.03 for required deliverables. The Project Content File shall also be amended to include a description of the changes which have occurred in each file.

For structures sheets, any element or detail that is changed shall be denoted on the sheets by placing a shape around the affected area using the attributes set by the level “Bridge_Addendum”. Attached to this shape shall be a triangle that can be inscribed within a ¼” radius circle and a number indicating the addendum number. This callout shall be on the level “Bridge_Dimensions and Text”. In the revision block of the sheet, the symbol with the revision number shall follow “Revised,” along with the date of the revision and the initials of the person making the revision. If an entire sheet is added or revised, do not place a shape around the perimeter of the sheet. Place an additional addendum symbol near the revision block with the text “Added sheet” or “Entire sheet revised” following the symbol. Cells are available in the cell library “CADD-Elements.cel” to simplify symbol placement. The addendum cells are B00032 and B00033.

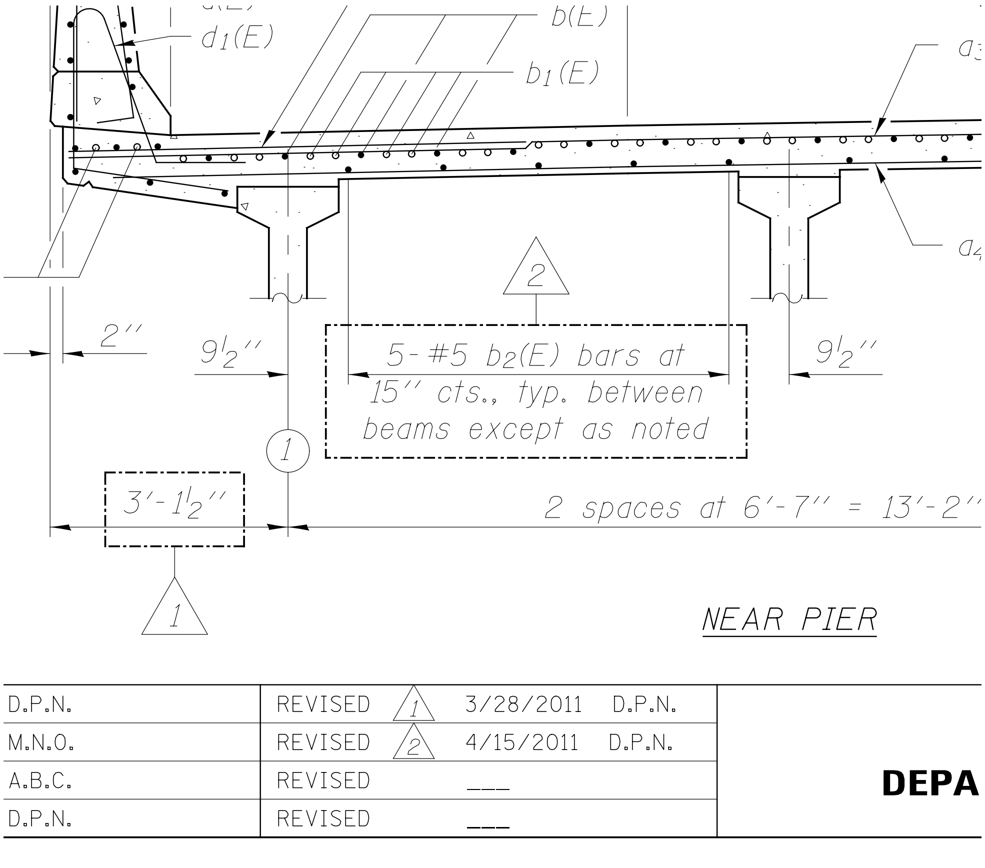


Figure 4-9.A - Addendum Notation

4-10 CONSTRUCTION CHANGES

See also: *Bureau of Design and Environment Manual* Section 63-1.03(b).

If revisions or changes to the contract plans are required after letting, a *construction change* to the contract plans is required to be prepared and distributed.

Approval for all construction changes shall be coordinated with the Project Manager, who will solicit all required review and approval authorities within IDOT.

If a *construction change* is approved, all required deliverables that are affected by the addendum, including 3D models, shall be resubmitted to the Project Implementation Unit. See Section 2-3.03 for required deliverables. Coordinate all required deliverable files with the Project Manager. The Project Content File shall also be amended to include a description of the changes which have occurred in each file.

If a *construction change* is required for a bridge project, any element or detail that is changed shall be denoted by placing a shape using the attributes set by the level "Bridge_Construction Change." Attached to this shape shall be a ¼" square and a number indicating the construction change number. This callout shall be on the level “Bridge_Dimensions and Text.” In the revision block of the sheet, the symbol with the construction change number shall follow “Revised,” along with the date of the revision and the initials of the person making the revision. If an entire sheet is added or revised, do not place a shape around the perimeter of the sheet. Place an additional construction change symbol near the revision block with the text “Added sheet” or “Entire sheet revised” following the symbol. Cells are available in the cell library *CADD-Elements.cel* to simplify symbol placement. The construction change cells are B00034 and B00035.

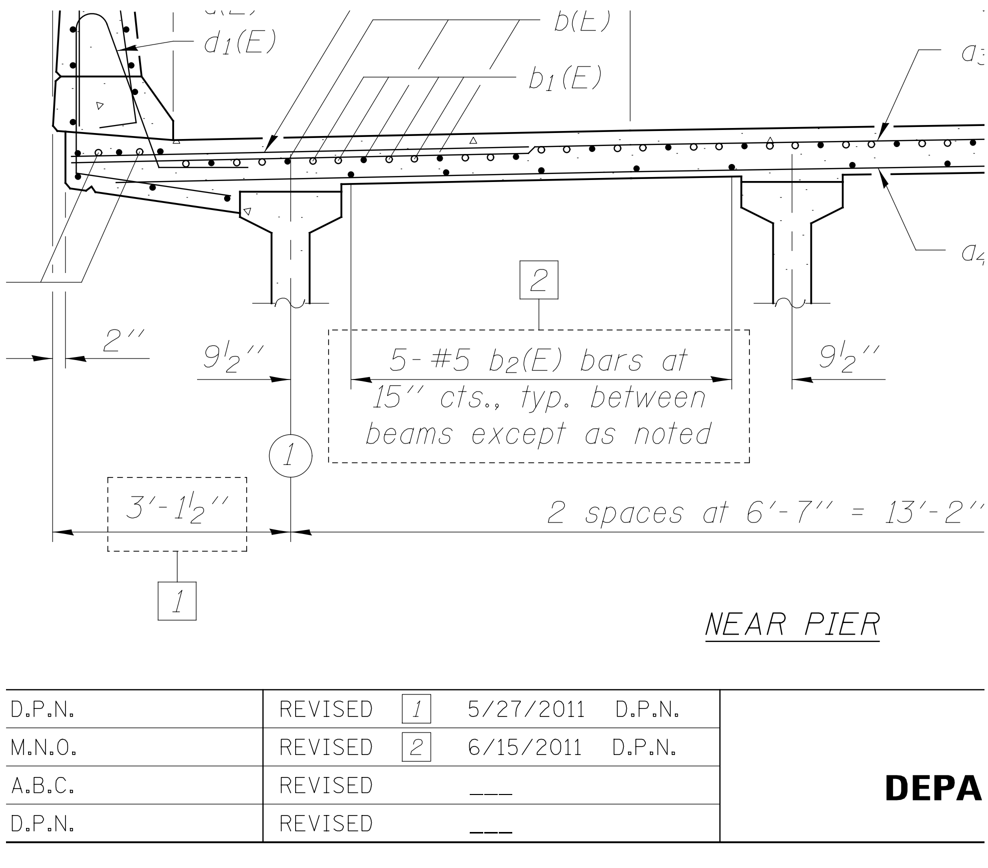
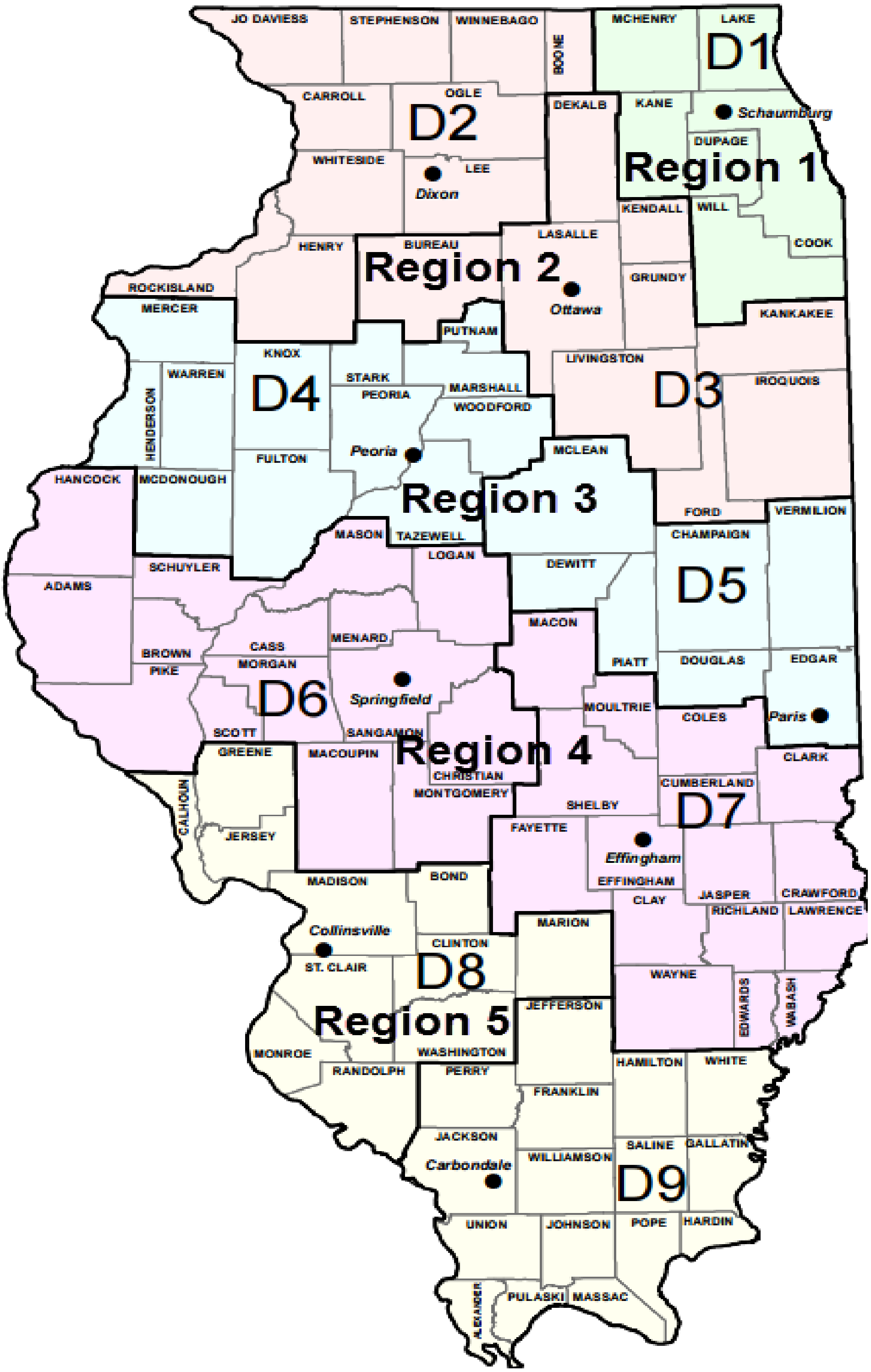


Figure 4-10.A - Construction Change Notation

SECTION 5 INTERNET AND CONTACT INFORMATION

5-1 CONTACT INFORMATION



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5-2 WEB PAGES

Electronic copies of this policy and the workspace files documented herein can be downloaded at the website below:

http://www.idot.illinois.gov/doing-business/procurements/engineering-architectural-professional-services/Consultants-Resources/

At top of page are downloads of Standard Specifications, Supplemental Specifications and Special Provisions.

Click on “Highway” tab in middle of page to navigate to or download:

1. Manuals and Guides
    - A. Bureau of Design and Environment policy manual.
    - B. CREATE Program Manuals
    - C. District Specific Standard Details
    - D. Illinois Construction Scheduling Expert System
    - E. Highway Standard Details
    - F. Survey Manual
    - G. Information related to Transitional Approaches to Channelized Islands

2. Materials
    A. Approved Labs
    B. Pay Item/Material Conversion Report
    C. Qualified Product List
3. Letting Specific Items
    A. BDE Special Provisions
    B. Coded Pay Items List
4. Environmental
    A. Environment Protection Practices
    B. Environmental Survey Forms
    C. Roadside Maintenance web page
5. Phase I and Phase II Work Forms
6. Approved Pavement Life Cycle Cost Analyses

Click on “Bridge and Structures” tab in middle of page to navigate to or download:

1. Bridge Manual
2. Guide Bridge Special Provisions (GBSP)
3. Specific Scope of Services Documents
4. Prequalified Structural Systems
5. Subscribe to Bridge Support and National Bridge Inventory notification subscription services
6. Bridges and Structures Contact Directory

Click on the “CADD” tab in middle of page to navigate to or download:

1. This Manual
2. Roadway Example Plans
3. A sample Bridge Model
4. A sample Structures DGN file
5. Fonts described in this manual can be downloaded for installation to Microsoft Windows environment.
6. Under the “Support” heading:
    A. Bridge cell library PDF files
    B. CADD & GIS Video Library
    C. Workspace files for the ORD Connect environment
    D. Workspace files for the SS4/ SS10 environment
        - IDOT CADD training materials
    E. Summary of Quantities spreadsheet download
    F. ProjectWise Web Client
7. Subscribe for *CADD Manual* and CADD workspace change notifications

5-3 SUBSCRIPTION SERVICES

Interim changes to various policies are communicated through various subscription services. Signing up for these services is strongly encouraged. Notifications are sent via e-mail whenever changes are made to items on the Consultant Resources web page shown in Section 5-2.

IDOT CADD Support subscription service – click on the "Stay Connected" heading under "CADD" on the page shown in Section 5-2.

Bureau of Design and Environment – Subscribe to policy changes by clicking on the "Highway" tab on the web page shown in Section 5-2.

Standard Drawings – Subscribe to policy changes by clicking on the "Highway" tab on the web page shown in Section 5-2.

Structures – Subscribe to the Structures notification service by clicking on the "Bridges and Structures" tab on the web page shown in Section 5-2.

5-4 EXAMPLE PLANS

Example roadway plans and example structures plans can be downloaded by clicking on the "CADD" tab on the web page shown in Section 5-2.

5-5 ADDITIONAL RESOURCES

An ever-expanding CADD and GIS how-to video library is available for both internal and external users on the IDOT YouTube Channel. Please see:

https://www.youtube.com/user/IllinoisDOT

For information related to Design Surveys requirement, the IDOT *Survey Manual* is available on the "CADD" tab on the web page shown in Section 5-2.

For District 1, hydraulic requirements are defined in the Manual of Procedures of the Metropolitan Water Reclamation District of Greater Chicago and can be downloaded at the following:

https://www.mwrd.org/irj/go/km/docs/documents/MWRD/internet/Departments/Engineering/docs/ManofProced.pdf

The Drainage Manual for use in Districts 2-9 can be downloaded at the following:

http://www.idot.illinois.gov/Assets/uploads/files/Doing-Business/Manuals-Guides-&-Handbooks/Highways/Bridges/Hydraulics/IDOT%20DRAINAGE%20MANUAL.pdf

The *Bureau of Design & Environment Manual* can be located at:

https://idot.illinois.gov/doing-business/procurements/engineering-architectural-professional-services/Consultants-Resources/index

The IDOT Geotechnical Manual can be located at:

http://www.idot.illinois.gov/Assets/uploads/files/Doing-Business/Manuals-Guides-&-Handbooks/Highways/Materials/Geotechnical%20Manual.pdf

Also, various Visual Basic Applications (VBAs) have been written by the Illinois Department of Transportation to support additional CADD functions. Navigate to \IDOTCAD\IDOTStandard\VBA in your IDOT CADD workspace folder to view a current list of VBA applications available for use.

5-6 FILE TRANSFER

Deliverables shall be submitted by using the IDOT ProjectWise Server located at:

https://planroom.dot.illinois.gov/

Files shall be posted to the project's specified ProjectWise location, and files placed in the appropriate folder structure.

To request a ProjectWise login for access to the ProjectWise Server click on the following link:

http://apps.dot.illinois.gov/consultantreg/

SECTION 6 APPENDICES

APPENDIX A – FREQUENTLY ASKED QUESTIONS

1. What other manuals and policies govern CADD work for IDOT?

CADD related reference manuals for roadway drafting include:

IDOT Survey Manual

IDOT Bureau of Design and Environment Manual

IDOT Land Acquisition Manual

2. How can I assure that my design file meets IDOT's requirements and standards?

Several things are involved: first, it is imperative to download and use the latest IDOT CADD environment and subscribe to the IDOT CADD Support Subscription Services to be notified of all updates; make sure that the file adheres to the policies, standards, and guidelines described in applicable Department manuals and policy memoranda; verify that the drafting follows the conventions described in this manual; use IDOT supplied seed files when creating new drafting files; run MicroStation Standards Checker to assure compliance with IDOT CADD standards; and refer to the *MicroStation Standards checker.doc* file for instructions.

3. What tools and electronic files are available from IDOT to assist with electronic drafting for IDOT?

IDOT provides access to a number of CADD related files through the official IDOT website. These files include electronic versions of all IDOT standard symbols and Design Libraries, seed files for MicroStation, and various GEOPAK related files. A searchable CADD and GIS Video Library has also been created to assist users with various CADD and GIS related tasks.

4. Where can I find the official IDOT website?

IDOT's home page is located at http://www.idot.illinois.gov. Links to this manual, IDOT's CADD workspace, and the CADD and GIS video library are shown in Section 5-2 of this manual.

5. What if I have other questions about using CADD for IDOT projects and can't find the appropriate answers in the policies or manuals?

Contact the Project Manager in the appropriate district office. He or she can refer technical CADD questions to the appropriate district CADD Manager.

6. What happens if I submit CADD files that do not meet IDOT standards?

As described in Section 2, for any given project there is considerable variation on the required deliverables for any given project. The Designer is encouraged to discuss all submittals with the Project Manager and/or district CADD Manager to ensure compliance with this manual. By consulting this manual, using the current IDOT CADD Workspace, and coordinating submittals with the IDOT Project Manager for the specific project being developed, the instances of incompatible files is greatly diminished.

7. Can we submit CADD drawings with all work for a portion of the highway on a single sheet?

No. IDOT standards require that a project be drafted in one continuous strip, not on individual sheets. Notes and Dimensions shall also be included on the strip plan or in sheet files if approved by the Project Manager.

8. How does IDOT complete final drafting using reference files?

Final drafting is done in the file containing the strip plan or strip profile. This allows updates to be done in one location. These files are referenced to the sheet files. With the increase in the number of references that MicroStation allows, project drafting can be accomplished with multiple strip files referenced to sheet files; for example, generate a survey topography file, an alignment file, proposed roadway, existing and proposed Right of Way, along with existing and proposed roadway and drainage profiles that could be referenced to sheet files. This method requires a complete and accurate Project Content File to describe all file content; see Section 2-1.01(a).

9. Do Aerial Survey files come referenced in grid or ground distance format?

Aerial Survey mapping files are referenced using grid distance format. Check with the district Survey Unit prior to beginning a project to confirm coordinate systems and any transformations; see Section 3-3.06.

10. Do I need to use IDOT supplied seed files for CADD drafting?

Yes, you must use these files. IDOT provides seed files through the website so that working units are consistent between every file. Department seed files are available within the IDOT CADD workspace configuration which may be downloaded from the IDOT CADD Support page; see Section 3-3.

11. Do files have to use the IDOT file naming conventions?

Yes. see Section 2-5.

12. Should I use 2D or 3D design files?

Use 2D design files for roadway plans, profiles, cross sections, and detail drawings. Use 3D design files for digital terrain models (DTM) and Survey; see Section 2-3.

13. Why are 3D design files not used for roadway plans, profiles, cross sections, and detail drawings?

Since these elements are 2D representations, it makes sense to place them in a 2D file. The OpenRoads software manages the 3D models. Also, custom line styles in 3D files do not always display correctly.

14. What cell libraries should I use for drafting roadway plans?

See Section 3-11.

15. What are IDOT's electronic survey data deliverables?

Various files will be required at various stages during the project life cycle; see Section 2.

16. What manuals and policies govern electronic surveying for IDOT?

Survey policies are defined in the *IDOT Survey Manual*; see Section 5-2 of this manual for a link to the *Survey Manual.*

APPENDIX B – LEVEL LIBRARY

Table Appendix B.1 - Level Library

Level Name	Description	Color	Line Style (See Section 6-3)	Weight
3D_Reference		0	0	0
Aerial Survey_Boundary	Aerial Surveys break line boundary limits	14	2	0
Aerial Survey_Break lines	Aerial Surveys centerlines, x-section lines, break lines, and shear diagrams	14	0	0
Aerial Survey_Control Points	Aerial Surveys horizontal and vertical control points and principal points	30	0	0
Aerial Survey_Index Contours	Aerial Surveys major ground contours with elevation notation	26	0	3
Aerial Survey_Intermediate Contours	Aerial Surveys minor ground contours	19	0	0
Aerial Survey_Legend	Aerial Surveys legend and scales	31	0	0
Aerial Survey_LIDAR Boundary	Aerial Surveys LIDAR boundary	1	2	2
Aerial Survey_LIDAR Mass PNTS	Aerial Surveys LIDAR terrain mass points	74	0	0
Aerial Survey_LIDAR TIN	Aerial Surveys LIDAR extracted terrain boundary shape	73	0	0
Aerial Survey_Mass Points	Aerial Surveys DTM mass points	71	0	0
Aerial Survey_Spot Elevations	Aerial Surveys ground spot elevation points	32	0	0
Aerial Survey_State Plane Grid	Aerial Surveys state plane grid	33	0	2

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Aerial Survey_TIN	Aerial Surveys terrain triangles and boundary shape	41	0	0
Aerial Survey_Void Area	Aerial Surveys omitted ground shot data and terrain voided areas	2	2	2
Alignment_EX_20 Baseline	20 scale existing baseline stationing and symbols	2	0	0
Alignment_EX_20 Centerline	20 scale existing centerline survey line stationing and roadway name	2	Centerline	0
Alignment_EX_20 Notation	20 scale existing curve data, notes, ties benchmarks, points of curvature (PC), points of tangency (PT), stationing and station equations	20	0	0
Alignment_EX_50 Baseline	50 scale existing baseline stationing and symbols	2	0	0
Alignment_EX_50 Centerline	50 scale existing centerline survey line stationing and roadway name	2	Centerline	0
Alignment_EX_50 Notation	50 scale existing curve data, notes, ties benchmarks, points of curvature (PC), points of tangency (PT), stationing and station equations	20	0	0

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Alignment_EX_100 Baseline	100 scale existing baseline stationing and symbols	2	0	0
Alignment_EX_100 Centerline	100 scale existing centerline survey line stationing and roadway name	2	Centerline	0
Alignment_EX_100 Notation	100 scale existing curve data, notes, ties benchmarks, points of curvature (PC), points of tangency (PT), stationing and station equations	20	0	0
Alignment_EX_200 Baseline	200 scale existing baseline stationing and symbols	2	0	0
Alignment_EX_200 Centerline	200 scale centerline survey line stationing and roadway name	2	Centerline	0
Alignment_EX_200 Notation	200 scale existing curve data, notes, ties benchmarks, points of curvature (PC), points of tangency (PT), stationing and station equations	20	0	0
Alignment_EX_500 Baseline	500 scale existing baseline stationing and symbols	2	0	0
Alignment_EX_500 Centerline	500 scale existing centerline survey line stationing and roadway name	2	Centerline	0

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Alignment_EX_500 Notation	500 scale existing curve data, notes, ties benchmarks, points of curvature (PC), points of tangency (PT), stationing and station equations	20	0	0
Alignment_EX_Baseline	Existing Baseline Features	2	0	0
Alignment_EX_Baseline Small Tic Sta		2	0	2
Alignment_EX_Centerline	Existing Centerline Features	2	Centerline	0
Alignment_EX_Centerline Small Tic Sta		2	0	0
Alignment_PR_20 Baseline	20 scale proposed baseline stationing and symbols	42	0	2
Alignment_PR_20 Centerline	20 scale proposed centerline stationing and symbols	42	Centerline	2
Alignment_PR_20 Scale Notation	Proposed 20 scale curve data, notes, ties benchmarks, points of curvature (PC), points of tangency (PT), stationing and station equations	24	0	1
Alignment_PR_50 Baseline	50 scale proposed baseline stationing and symbols	42	0	2
Alignment_PR_50 Baseline Bot		42	0	2

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Alignment_PR_50 Centerline	50 scale proposed centerline stationing and symbols	42	Centerline	2
Alignment_PR_50 Centerline Bot		42	Centerline	2
Alignment_PR_50 Scale Notation	Proposed 50 scale curve data, notes, ties benchmarks, points of curvature (PC), points of tangency (PT), stationing and station equations	24	0	1
Alignment_PR_100 Baseline	100 scale proposed baseline stationing and symbols	42	0	2
Alignment_PR_100 Centerline	100 scale proposed centerline stationing and symbols	42	Centerline	2
Alignment_PR_100 Scale Notation	Proposed 100 scale curve data, notes, ties benchmarks, points of curvature (PC), points of tangency (PT), stationing and station equations	24	0	1
Alignment_PR_200 Baseline	200 scale proposed baseline stationing and symbols	42	0	2
Alignment_PR_200 Centerline	200 scale proposed centerline stationing and symbols	42	Centerline	2

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Alignment_PR_200 Scale Notation	Proposed 200 scale curve data, notes, ties benchmarks, points of curvature (PC), points of tangency (PT), stationing and station equations	24	0	1
Alignment_PR_500 Baseline	500 scale proposed baseline stationing and symbols	42	0	2
Alignment_PR_500 Centerline	500 scale proposed centerline stationing and symbols	42	Centerline	2
Alignment_PR_500 Scale Notation	Proposed 500 scale curve data, notes, ties benchmarks, points of curvature (PC), points of tangency (PT), stationing and station equations	24	0	1
Alignment_PR_Alternate	Phase 1 alternate alignment for centerline of construction	17	Centerline	2
Alignment_PR_Alternate Small Tic Sta		17	0	2
Alignment_PR_Baseline	Proposed Baseline Features	42	0	2
Alignment_PR_Baseline Small Tic Sta		42	0	2
Alignment_PR_Centerline	Proposed Centerline Features	42	Centerline	2
Alignment_PR_Centerline Small Tic Sta		42	0	2

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Alignment_PR_Detour	Proposed centerline of construction for detour or runaround	45	Centerline	2
Alignment_PR_Detour Notation	Proposed detour curve data, notes, ties benchmarks, points of curvature (PC), points of tangency (PT), stationing and station equations	24	0	1
Alignment_PR_Detour Small Tic Sta		45	0	2
Bridge_Addendum	Level used for addendums which display an addition or update to the Design	11	4	4
Bridge_Breakline	Break line (shift position if unable to see pattern)	9	V8Breakline	0
Bridge_Centerline	Centerline (shift position if unable to see pattern)	9	V8Centerline	0
Bridge_Construction Change	Level used for construction changes	7	2	1
Bridge_Construction Line	Level used for construction element in GEOPAK Rebar	20	0	0
Bridge_Cut or Match Line	Cut or match line (shift position if unable to see pattern)	9	V8Cutline	2
Bridge_Design Concrete Hidden	Hidden concrete object line for design plans	6	3	4
Bridge_Design Concrete Object	Concrete object line for design plans	5	0	4
Bridge_Design Existing	Existing object line for design plans	4	1	1

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Bridge_Design Reinforcement	Reinforcement object line for design plans	8	0	2
Bridge_Design Reinforcement Bending	Reinforcement bar bending diagram object line for design plans	12	0	4
Bridge_Design Reinforcement Existing	Existing reinforcement object line for design plans	11	2	1
Bridge_Design Reinforcement Hidden	Hidden reinforcement object line for design plans	10	3	2
Bridge_Design Steel Hidden	Hidden steel object line for design plans	3	3	2
Bridge_Design Steel Object	Steel object line for design plans	2	0	2
Bridge_Dimensions and Text	General text and dimensions	1	0	0
Bridge_Markups	Level for revision notation for designers	15	0	3
Bridge_Miscellaneous	Level where symbology may vary	14	0	0
Bridge_Pattern	Patterning	9	0	0
Bridge_Riprap	Riprap	9	V8Riprap	0
Bridge_Sheet Border	Border level	35	0	0
Bridge_Sheet Design Print	Design level for shape that can be used with batch plot	36	0	0
Bridge_Sheet TSandL Print	Planning level for shape that can be used with batch plot	38	0	0

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Bridge_Table Border	Heavy line for use with tables	1	0	3
Bridge_Table Lines	Thin line for use with tables	9	0	0
Bridge_Title	Title level	1	0	3
Bridge_TSandL Concrete Hidden	Hidden concrete object line for General Plans & Elevation and Type Size & Location	6	2	2
Bridge_TSandL Concrete Object	Concrete object line for General Plans & Elevation and Type Size & Location	5	0	2
Bridge_TSandL Existing	Existing object line for General Plans & Elevation and Type Size & Location	4	1	0
Bridge_TSandL Intermittent Stream	Intermittent stream object line for General Plans & Elevation and Type Size & Location	9	V8Intstrem	1
Bridge_TSandL Natural Ground	Natural ground object line for General Plans & Elevation and Type Size & Location	9	V8Naturalgnd	1
Bridge_TSandL Railroad	Railroad track line for General Plans & Elevation and Type Size & Location	9	0	1
Bridge_TSandL Reinforcement	Reinforcement object line for General Plans & Elevation and Type Size & Location	8	0	1

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Bridge_TSandL Reinforcement Existing	Existing reinforcement object line for General Plans & Elevation and Type Size & Location	11	2	0
Bridge_TSandL Reinforcement Hidden	Hidden reinforcement object line for General Plans & Elevation and Type Size & Location	10	3	1
Bridge_TSandL Right of Way	Right of Way line for General Plans & Elevation and Type Size & Location	7	V8RightofWay	1
Bridge_TSandL Steel Hidden	Hidden steel object line for General Plans & Elevation and Type Size & Location	3	2	1
Bridge_TSandL Steel Object	Steel object line for General Plans & Elevation and Type Size & Location	2	0	1
Bridge_TSandL Streamline	Stream object line for General Plans & Elevation and Type Size & Location	9	V8Stremlin	1
Construction_PR_AsBuilt	Proposed changes to contract during construction	2	0	3
Construction_Signing	Signs	49	0	2
Construction_Signing_Names	Sign Names	192	0	1
Corridor_Design	Corridor Object Graphics – Design Stage	14	0	3

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Corridor_Draft_DNC	Corridor and Template graphics which are not plotted	91	0	0
Corridor_Draft_GoreMainIdeal	Preliminary-Civil-Corridor Graphics-Preliminary	2	0	1
Corridor_Draft_GoreMax	Final-Civil-Corridor Graphics-Final	3	0	1
Corridor_Draft_GoreMin	Design-Civil-Corridor Graphics	52	0	1
Corridor_Draft_GoreRampIdeal	Existing flow arrows	15	0	0
Corridor_Draft_Model_Misc	Miscellaneous construction elements for corridors.	57	0	0
Corridor_Draft_NoPLOT	Miscellaneous construction elements for corridors.	20	0	0
Corridor_Draft_Setup	Setups	36	0	1
Corridor_Draft_Thematics	Thematics	22	0	1
Corridor_Final	Corridor Object Graphics – Final Stage	4	0	3
Corridor_Functional	Corridor Object Graphics – Functional Stage	13	0	3
Corridor_Prelim	Corridor Object Graphics – Preliminary Stage	2	0	3
Corridor_Range_Design	Template Drop Object Graphics – Design Stage	92	2	1
Corridor_Range_Final	Template Drop Object Graphics – Final Stage	92	2	1

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Corridor_Range_Functional	Template Drop Object Graphics – Functional Stage	92	2	1
Corridor_Range_Prelim	Template Drop Object Graphics – Preliminary Stage	92	2	1
Corridor_Superelevation	Superelevation objects display	1	0	2
Corridor_TemplateDrop_Design	Single Template Drop Object Graphics – Design Stage	0	2	1
Corridor_TemplateDrop_Final	Single Template Drop Object Graphics – Final Stage	0	2	1
Corridor_TemplateDrop_Functional	Single Template Drop Object Graphics – Functional Stage	0	2	1
Corridor_TemplateDrop_Prelim	Single Template Drop Object Graphics – Preliminary Stage	0	2	1
Corridor_Transition_Design	Transition Object Graphics-Design Stage	100	0	2
Corridor_Transition_Final	Transition Objects Graphics-Final Stage	100	0	2
Corridor_Transition_Functional	Transition Object Graphics-Preliminary Stage	100	0	2
Corridor_Transition_Prelim	Transition Object Graphics-Preliminary Stage	100	0	2

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Default	Used by some Microstation and GEOPAK commands when no other level is specified	0	0	0
Design_CC_Constr_1	Scratch Level Used for Civil Cells	14	1	1
Design_CC_Constr_2	Scratch Level Used for Civil Cells	107	1	1
Design_CC_Constr_3	Scratch Level Used for Civil Cells	16	1	1
Design_CC_Constr_4	Scratch Level Used for Civil Cells	14	3	1
Design_CC_Constr_5	Scratch Level Used for Civil Cells	107	4	1
Design_CC_Constr_6	Scratch Level Used for Civil Cells	16	4	1
Design_CC_Constr_7	Scratch Level Used for Civil Cells	14	4	1
Design_CC_Constr_8	Scratch Level Used for Civil Cells	107	4	1
Design_CC_Constr_9	Scratch Level Used for Civil Cells	16	4	1
Design_CC_Intersection	Scratch Level Used for Civil Cells	2	0	4
Design_CC_Intersection_LR	Scratch Level Used for Civil Cells	2	0	4
Design_CC_XOVER	Scratch Level Used for Civil Cells	2	0	4
Design_EX_Bike Path Notes	Existing bike path notes	36	0	0
Design_EX_Bike Path Profile	Existing bike path profile grade line	25	3	2

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Design_EX_Roadway Dimensions	Existing plan roadway dimensions	3	0	0
Design_EX_Roadway Notes	Existing topography labels and profile labels	16	0	0
Design_EX_Roadway Profile	Existing roadway pavement or centerline of survey profile grade line	3	3	2
Design_PR_Aggregate Bot	Proposed edge of pavement line	54	0	2
Design_PR_Aggregate Shoulder	Proposed aggregate shoulder line	180	Shoulder_Aggregate	1
Design_PR_Aggregate Shoulder Bot	Proposed aggregate shoulder line	180	Shoulder_Aggregate	1
Design_PR_Asphalt Shoulder	Proposed hot mix asphalt shoulder line	179	0	1
Design_PR_Asphalt Shoulder Bot	Proposed hot mix asphalt shoulder line	179	0	1
Design_PR_Attenuator	Proposed impact attenuator installation	46	0	1
Design_PR_Back of Gutter or Curb line	Proposed back edge line of gutter or curb	46	0	1
Design_PR_Back of Gutter or Curb line Bot	Proposed back edge line of gutter or curb	46	0	1
Design_PR_Barrier	Proposed barrier	32	0	2
Design_PR_Base Bot	Proposed edge of pavement line	45	0	2
Design_PR_Bike Path	Proposed bike path edge line	82	0	1
Design_PR_Bike Path Bot	Proposed bike path edge line	82	0	1

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Design_PR_Bike Path Notes	Proposed bike path notes	46	0	1
Design_PR_Bike Path Profile	Proposed bike path profile grade line	47	0	4
Design_PR_Binder Bot	Proposed edge of pavement line	7	0	2
Design_PR_Bituminous Shoulder	Proposed bituminous shoulder line	179	0	1
Design_PR_Bituminous Shoulder Bot	Proposed bituminous shoulder line	179	0	1
Design_PR_Cable Barrier	Proposed cable barrier	181	Cable_Barrier_Proposed	1
Design_PR_Civil Cell Placement Reference	Scratch Level Used for Civil Cells	223	0	2
Design_PR_Concrete Barrier	Proposed concrete barrier	181	Concrete_Barrier	1
Design_PR_Concrete Barrier Bot	Proposed concrete barrier	181	Concrete_Barrier	1
Design_PR_Edge of Curb line	Proposed Edge of Curb	20	0	2
Design_PR_Edge of Curb line Bot	Proposed Edge of Curb at Flowline	20	0	2
Design_PR_Entrance	Proposed edges for driveways, CE, PE, and FE	176	0	1
Design_PR_Entrance Bot	Proposed edges for driveways, CE, PE, and FE	176	0	1
Design_PR_Entrance Subgrade	Proposed edges for driveways, CE, PE, and FE	56	0	1
Design_PR_Entrance Subgrade Bot	Proposed edges for driveways, CE, PE, and FE	60	0	1

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Design_PR_EOP	Proposed edge of pavement line	29	0	2
Design_PR_EOP Bot	Proposed edge of pavement line	29	0	2
Design_PR_EOP Intersection	Proposed edge of pavement line where mainline joins side roads.	29	0	2
Design_PR_Face of Curb line	Proposed face of curb line	46	0	0
Design_PR_Face of Curb line Bot	Proposed face of curb line	46	0	0
Design_PR_Guardrail	Proposed SPBGR	46	Guardrail_Proposed	1
Design_PR_Gutter FL	Proposed face of curb line	46	0	0
Design_PR_Gutter FL Bot	Proposed face of curb line	46	0	0
Design_PR_HMA Bot	Proposed edge of pavement line	6	0	2
Design_PR_Mainline Shapes	Proposed mainline pavement slope shapes for cross sections	1	0	1
Design_PR_Median	Proposed median island and corrugated median	178	0	1
Design_PR_Median Bot	Proposed median island and corrugated median	178	0	1
Design_PR_MultiUse Path	Proposed multiple usage path edge line	98	0	1
Design_PR_MultiUse Path Bot	Proposed multiple usage path edge line	98	0	1
Design_PR_Pavement	Proposed pavement	32	0	3

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Design_PR_Pavement Patches	Proposed pavement removal and replacement locations from patching survey	53	0	1
Design_PR_PCC Bot	Proposed edge of pavement line	13	0	1
Design_PR_PCC Shoulder	Proposed Portland Cement Concrete shoulder line	182	0	1
Design_PR_PCC Shoulder Bot	Proposed Portland Cement Concrete shoulder line	182	0	1
Design_PR_PMK 2Way Left Turn Lane	Proposed pavement marking two way left turn lane yellow line	9	PMK_TurnLane	0
Design_PR_PMK CL Markers 40	Proposed pavement marking 2 lane - 2 way yellow centerline with marker 40' o.c.	9	PMK_CenterLine_Marker_40	0
Design_PR_PMK CL Markers 80	Proposed pavement marking 2 lane - 2 way yellow centerline with marker 80' o.c.	9	PMK_CenterLine_Marker_80	0
Design_PR_PMK CL Multilane	Proposed pavement marking multilane undivided yellow centerline	9	PMK_CenterLine_MultiLane	0
Design_PR_PMK Dotted Line	Proposed pavement marking dotted line	92	PMK_Dotted	2
Design_PR_PMK Double Centerline	Proposed pavement marking double stripe centerline	9	PMK_CenterLine_Double	2

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Design_PR_PMK Labels	Proposed pavement marking notation	9	0	1
Design_PR_PMK LaneLine Dbl Markers	Proposed pavement marking multilane divided white lane line with double markers 80' o.c.	92	PMK_LaneLine_Marker_Dbl	0
Design_PR_PMK LaneLine Marker 40	Proposed pavement marking multilane divided white lane line with marker 40' o.c.	92	PMK_LaneLine_Marker_40	0
Design_PR_PMK LaneLine Marker 80	Proposed pavement marking multilane divided white lane line with marker 80' o.c.	92	PMK_LaneLine_Marker_80	0
Design_PR_PMK Skip Dash White	Proposed pavement marking skip dash white line	92	PMK_SkipDash_White	0
Design_PR_PMK Skip Dash Yellow	Proposed pavement marking skip dash yellow line	9	PMK_SkipDash_Yellow	0
Design_PR_PMK Solid Line	Proposed pavement marking solid	9	0	2
Design_PR_PMK Stop line	Proposed pavement marking stop line	92	PMK_StopLine_Proposed	2
Design_PR_PMK Symbols	Proposed pavement marking symbols	92	0	2
Design_PR_PMK Temporary	Proposed temporary pavement marking symbology	9	0	2

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Design_PR_Private Pavement Marking	Proposed private pavement marking symbology	9	0	2
Design_PR_Profile_Intersecting	Proposed Profile Intersection marks	5	0	15
Design_PR_Railroad Items	Proposed railroad elements	48	0	2
Design_PR_Railroad Track	Proposed railroad track	48	Railroad	2
Design_PR_Reflective Markers	Proposed raised reflective pavement markers	9	0	1
Design_PR_Roadway Dimensions	Proposed station offset dimensions for roadway	43	0	1
Design_PR_Roadway Items	Proposed traffic sign and other miscellaneous objects within ROW	46	0	2
Design_PR_Roadway Notes	Proposed roadway plan and profile notes, labels, and object identification	55	0	1
Design_PR_Roadway Profile	Proposed roadway profile grade line	43	0	3
Design_PR_Sideroad Shapes	Proposed side road pavement slope shapes for cross sections	2	0	1
Design_PR_Sidewalk	Proposed sidewalk edge line	47	0	1
Design_PR_Sidewalk Bot	Proposed sidewalk edge line	47	0	1
Design_PR_Stabilized Shoulder	Proposed stabilized shoulder line for guard rail terminals	179	0	1

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Design_PR_Subbase	Proposed edge of pavement line	11	0	2
Design_PR_Subbase Bot	Proposed edge of pavement line	93	0	2
Design_Roadway Profile Cell	GEOPAK cell placed to define profile area based on chain line location	2	1	0
Drainage_Area	Drainage areas used for hydraulic calculations and drainage map	52	0	2
Drainage_EX_Aggregate Ditch	Existing aggregate ditch line	37	Ditch_Aggregate	0
Drainage_EX_Channel or Stream	Existing channel or stream line	5	6	1
Drainage_EX_Ditch Bottom	Existing ditch flow line	23	4	2
Drainage_EX_Ditch Top	Existing Top of Ditch	36	0	0
Drainage_EX_Divide Area	Drainage divide area	2	Drainage_Divide	3
Drainage_EX_Drainage Boundary	Boundary line of an existing drainage area	2	Drainage_Boundry	1
Drainage_EX_Floodplain Boundary	Boundary line of an existing floodplain area	5	Drainage_Floodplain	1
Drainage_EX_Floodway Boundary	Boundary line of an existing floodway area	5	Drainage_Floodway	1
Drainage_EX_Hydraulic Study	Existing Phase 1 study information provided by Hydraulics Unit	0	0	0
Drainage_EX_Land Use	Land use area information for GEOPAK drainage only provided by Hydraulics Unit	0	0	0

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Drainage_EX_Paved Ditch	Existing paved ditch line	37	Ditch_Paved	0
Drainage_EX_Pipe Culvert	Existing pipe culvert	37	5	0
Drainage_EX_Pipe Underdrain	Existing pipe underdrain line	57	Pipe_Underdrain_Existing	0
Drainage_EX_Plan and Profile Notes	Existing notes labels and object identification of drainage structures	22	0	0
Drainage_EX_Profile Leftside	Existing roadway drainage profile on left side of pavement - default	37	6	2
Drainage_EX_Profile Rightside	Existing roadway drainage profile on right side of pavement - optional	36	2	2
Drainage_EX_Storm Sewer	Existing storm sewer line	57	Sewer_Storm_Existing	0
Drainage_HYD_LOB_Reach_Length	Hydraulics left overbank reach length for HEC-RAS input data	5	0	0
Drainage_HYD_LT_Bank Sta	Hydraulics left bank station for HEC-RAS input data	2	0	0
Drainage_HYD_ROB_Reach_Length	Hydraulics right overbank reach length for HEC-RAS input data	5	0	0
Drainage_HYD_RT_Bank Sta	Hydraulics right bank station for HEC-RAS input data	2	0	0

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Drainage_PR	Proposed drainage elements (pipe culvert end section, manhole, catch basin, inlet, etc.)	52	0	0
Drainage_PR_Adjustment Items	Drainage structure adjustment label notations	53	0	0
Drainage_PR_Aggregate Ditch	Proposed aggregate ditch line	52	Ditch_Aggregate	1
Drainage_PR_Channel or Stream	Proposed channel or stream line	1	6	2
Drainage_PR_Drainage Boundary	Boundary line for a proposed drainage area	2	Drainage_Boundry	3
Drainage_PR_Floodplain Boundary	Boundary line of a proposed floodplain area	52	Drainage_Floodplain	3
Drainage_PR_Floodway Boundary	Boundary line of a proposed floodway area	52	Drainage_Floodway	3
Drainage_PR_Grading and Shaping Ditch	Proposed perimeter of grading area of existing ditch improvement	52	6	2
Drainage_PR_Hydraulic Study	Proposed Phase 1 study information provided by Hydraulic Units	52	0	1
Drainage_PR_Paved Ditch	Proposed paved ditch line	52	Ditch_Paved	1
Drainage_PR_Pipe Culvert	Proposed pipe culvert line	52	0	2
Drainage_PR_Pipe Underdrain	Proposed pipe underdrain line	58	Pipe_Underdrain_Proposed	2
Drainage_PR_Plan and Profile Notes	Proposed notes, labels, and object identification of drainage structures	51	0	1

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Drainage_PR_Profile Leftside	Proposed roadway drainage profile on left side of pavement - default	52	6	4
Drainage_PR_Profile Rightside	Proposed roadway drainage profile on right side of pavement - optional	51	ROW_Existing	4
Drainage_PR_Storm Sewer	Proposed storm sewer line	58	Sewer_Storm_Proposed	2
Drainage_PR_Temporary Items	Temporary drainage elements (ditches, pipe culverts, manholes, inlets, etc.)	37	0	0
Drainage_PR_Trench	Proposed Drainage Pipe Trenches	23	0	2
Drainage_Survey Request	Hydraulic survey request showing area of floodplain cross sections orientation and special notation	31	0	2
Environmental_Archaeological Sites	Existing locations designated as historical importance (graves, structures, etc.)	45	0	3
Environmental_Endangered Species	Existing locations designated for endangered flora and fauna	4	0	3
Environmental_Hazardous Waste	Existing locations containing hazardous waste material	6	0	3

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Environmental_Index Contours	Proposed approximate index major ground contours with elevation notation	26	3	2
Environmental_Intermediate Contours	Proposed approximate intermediate minor ground contours	26	3	0
Environmental_Wetlands	Proposed wetland areas	5	0	2
Erosion Control_Clearing and Grading	Clearing and grading limits of erosion and sediment control areas	21	Erosion_Clearing	1
Erosion Control_Dike	Proposed dike for erosion and sediment control areas	21	Erosion_Dike	1
Erosion Control_Fence	Proposed fence placed in erosion and sediment control areas	21	Erosion_Fence	1
Erosion Control_Notes	Notation for Erosion and Sediment Control Plans	21	0	1
Erosion Control_Perimeter Barrier	Proposed silt filter fence to be removed or decompose during construction project	21	Erosion_Perimeter_Barrier	1
Erosion Control_Permanent Items	Proposed erosion control elements to remain after construction phase	52	0	0
Erosion Control_Temporary Fence	Proposed continuous barrier placed adjacent to construction areas	21	Erosion_Fence_Temporary	1

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Erosion Control_Temporary Items	Proposed elements to be removed or decompose during construction phase	21	0	0
Grade_EX_Berm	Existing berm	34	0	0
Grade_PR_Bench	Proposed benching	98	0	2
Grade_PR_Berm	Proposed berm	34	0	2
Grade_PR_ClearZone	Proposed Clear Zone	69	0	2
Grade_PR_Cut	Proposed cut	18	0	2
Grade_PR_Cut Volume	Proposed Cut Volume	2	0	2
Grade_PR_Daylight	Proposed toe of slope	18	6	2
Grade_PR_Ditch	Proposed ditch	18	4	2
Grade_PR_Fill	Proposed fill	18	0	2
Grade_PR_Fill Volume	Proposed Fill Volume	1	0	2
Grade_PR_Finished	Finished grade	47	0	2
Grade_PR_Fixed_Tie	Proposed Fixed Tie Lines	6	0	2
Grade_PR_Hinge	Proposed roadway model hinge lines	36	0	2
Grade_PR_Levee	Proposed berm	46	0	2
Grade_PR_Misc	Miscellaneous Proposed features	11	0	2
Grade_PR_Pond	Proposed detention pond	17	0	2
Grade_PR_Rock_Surface	Proposed rock surface	22	0	2
Grade_PR_RockLine	Proposed rock surface line work	22	0	2

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Grade_PR_Subgrade	Proposed subgrade	192	0	2
Grade_PR_Veg_Grass	Proposed vegetation for road models	50	0	2
Grade_PR_Veg_Seeding	Proposed seeding	11	0	2
Grade_PR_Veg_Verge	Proposed vegetation verge lines	50	0	2
GSBWFILL	Black and white level objects for GuidSign	0	0	0
GSCOLORFILL	Color level objects for GuidSign	0	0	0
GSDIMS	Dimensions level for GuidSign	0	0	0
GSOUTLINE	Outline level objects for GuidSign software	0	0	0
GSSHT	GuidSign supplied sheets and report level	0	0	0
HS_Border	Highway Standards sheet border	3	0	2
HS_Breakline	Highway Standards breakline	9	V8Breakline	0
HS_Centerline	Highway Standards centerline	9	V8BDECenterline	0
HS_Concrete Hidden	Highway Standards hidden concrete edge line	6	3	4
HS_Concrete Object	Highway Standards concrete edge line	5	0	4
HS_Dimensions and Text	Highway Standards dimensions and notation	30	0	1
HS_Electrical Cable	Highway Standards electrical cable line	30	0	1

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
HS_Electrical Cable Hidden	Highway Standards electrical cable hidden line	24	3	1
HS_Electrical Conduit	Highway Standards electrical conduit line	66	0	2
HS_Electrical Conduit Hidden	Highway Standards electrical conduit hidden line	75	3	2
HS_Electrical Devices	Highway Standards electrical device line	109	0	2
HS_Electrical Devices Hidden	Highway Standards electrical device hidden line	133	3	2
HS_Electrical Enclosure	Highway Standards electrical enclosure line	163	0	3
HS_Electrical Enclosure Hidden	Highway Standards electrical enclosure hidden line	160	3	3
HS_Existing	Highway Standards existing item line	4	1	1
HS_Miscellaneous	Highway Standards miscellaneous items	14	0	0
HS_Pattern and Hatching	Highway Standards area patterns and hatching areas	9	0	0
HS_Pavement Hidden	Highway Standards pavement hidden line for details	23	3	4
HS_Pavement Hidden PlanProf	Highway Standards pavement hidden line for plan or profile	55	3	2

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
HS_Pavement Object	Highway Standards pavement object line for details	17	0	4
HS_Pavement Object PlanProf	Highway Standards pavement object line for plan or profile	49	0	2
HS_Pipe	Highway Standards existing item line	181	0	2
HS_Pipe Hidden	Highway Standards existing item line	176	3	2
HS_PMK_Skip Dash	Highway Standards pavement marking skip dash line	100	PMK_SkipDash_Yellow	0
HS_Reinforcement	Highway Standards rebar	8	0	2
HS_Reinforcement Bending	Highway Standards rebar bending diagram	12	0	4
HS_Reinforcement Existing	Highway Standards existing rebar	11	2	1
HS_Reinforcement Hidden	Highway Standards hidden rebar	10	3	2
HS_Shading	Highway Standards miscellaneous shading areas	120	0	0
HS_Signatures	Highway Standards drawing approval signatures	0	0	0
HS_Steel Hidden	Highway Standards hidden steel edge line	3	3	2
HS_Steel Object	Highway Standards steel edge line	2	0	2

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
HS_Table Border	Highway Standards table border	30	0	3
HS_Table Lines	Highway Standards table gridlines	9	0	0
HS_Title	Highway Standards detail title text	30	0	3
HS_Traffic Signal	Highway Standards traffic signal line	153	0	3
HS_Traffic Signal Hidden	Highway Standards traffic signal hidden line	181	3	3
IDS_2or3 Centered Curve Radial Lines	Radial lines between control points on 2 or 3 centered curves	43	2	0
IDS_Intersection Sight Distance	Vehicle sight distance lines for intersections	17	7	2
IDS_Notes	Intersection Design Study detail sheet notation	15	0	0
IDS_Pavement Elevations	Intersection pavement surface elevation text placed at defined intervals	0	0	0
IDS_Pavement Joint Keyed	Intersection longitudinal pavement joint keyed with tie bars	49	Pavement_Joint_Keyed	2
IDS_Pavement Joint Keyed without Bars	Intersection longitudinal pavement joint keyed without tie bars	49	Pavement_Joint_Keyed_WO_Bars	2
IDS_Pavement Joint Sawed	Intersection longitudinal pavement joint sawed with tie bars	49	Pavement_Joint_Sawed	2

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
IDS_Stopping Sight Distance	Vehicle sight distance lines for stopping conditions	36	0	1
IDS_Turning Control Radii	Left turn vehicle movement control line dimension	9	1	0
IDS_Vehicle Left Turn Path	Vehicle path area for left turning movement	62	0	0
IDS_Vehicle Right Turn Path	Vehicle path area for right turning movement	63	0	0
IDS_Vehicle Templates	Vehicle size diagrams	2	0	0
Landscaping_Contour Mounding Line	Proposed mounding of ground contour	23	2	2
Landscaping_Elements	Proposed roadside development plan features	23	0	0
Landscaping_Fences	Proposed fence	23	Fence	2
Landscaping_Mowline	Proposed edge of area defined for mowing of Right of Way	23	Mowline	2
Landscaping_Shrubs	Proposed edge of planting area defined for shrubs	23	Shrubs	2
Landscaping_Trees	Existing and proposed tree symbols for landscaping plans	23	0	0
NOTE: Levels named “Level 1-63” are used only when migrating Microstation Version 7 files to Microstation V8i and shall not be used in new projects.				

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Level 1	V7 Reference clip boundary cells to frame sheet data	1	0	0
Level 2	V7 EX alignments stationing and roadway name	2	0	0
Level 3	V7 EX roadway profile elevations and notes or plan roadway dimensions	3	0	0
Level 4	V7 EX vegetation features and notation	4	0	0
Level 5	V7 EX water features and notation	5	0	0
Level 6	V7 EX Right of Way elements and notation	6	0	0
Level 7	V7 EX pavement marking lines, letters & symbols, and raised pavement markers	7	0	0
Level 8	V7 EX Non-highway improvement items for outside right of way and notation	8	0	0
Level 9	V7 PR pavement marking lines, letters & symbols, and raised pavement markers	9	0	0
Level 10	V7 EX political boundaries or government property lines	10	0	0

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Level 11	V7 EX traffic signal items and detail sheet data	11	0	0
Level 12	V7 EX private boundaries items for private property limits	12	0	0
Level 13	V7 PR traffic signal items and detail sheet data	13	0	0
Level 14	V7 EX utility company above ground items	14	0	0
Level 15	V7 EX highway lighting elements	15	0	0
Level 16	V7 EX topography notes for existing features and objects	16	0	0
Level 17	V7 PR highway lighting elements	17	0	0
Level 18	V7 EX utility notes for existing utility company objects	18	0	0
Level 19	V7 EX traffic systems elements and soil boring plan and profile details	19	0	0
Level 20	V7 EX alignment notation	20	0	0
Level 21	V7 PR traffic systems elements and temporary erosion control items	21	0	0
Level 22	V7 EX drainage notation for existing drainage items	22	0	0
Level 23	V7 PR landscaping detail elements for roadside development plans	23	0	0

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Level 24	V7 PR alignment notation	24	0	0
Level 25	V7 EX roadside features (entrances, sidewalks, parking lots, etc.)	25	0	0
Level 26	V7 EX contours existing ground and proposed construction limits line	26	0	0
Level 27	V7 EX edge of pavement for dedicated roadways (streets, roads, alleys, etc.)	27	0	0
Level 28	V7 EX roadway plan elements (gutters, curbs, guardrail, shoulders, etc.)	28	0	0
Level 29	V7 PR edge of pavement for dedicated roadways (streets, roads, alleys, etc.)	29	0	0
Level 30	V7 aerial survey horizontal and vertical control points	30	0	0
Level 31	V7 aerial survey data sheet legend	31	0	0
Level 32	V7 aerial survey spot elevations and DTM mass points	32	0	0
Level 33	V7 aerial survey state plane grid	33	0	0
Level 34	V7 aerial survey map limit borders or EX Right of Way dimensions	34	0	0

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Level 35	V7 general details and plan format sheet cells	35	0	0
Level 36	V7 aerial survey cross section points and triangles or PR Right of Way dimensions	36	0	0
Level 37	V7 EX drainage items for plan and profile data	37	0	0
Level 38	V7 EX railroad elements (track, signal, crossing gates, etc.)	38	0	0
Level 39	V7 EX structures (bridges, box culverts and retaining walls)	39	0	0
Level 40	V7 PR Right of Way elements and notation	40	0	0
Level 41	V7 north and east coordinates notation	41	0	0
Level 42	V7 PR alignments stationing and roadway name	42	0	0
Level 43	V7 PR roadway profile elevations and notes or plan roadway dimensions	43	0	0
Level 44	V7 PR utility company above ground items	44	0	0
Level 45	V7 PR utility notes for proposed utility company objects	45	0	0

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Level 46	V7 PR roadway plan elements (gutters, curbs, guardrail, shoulders, etc.)	46	0	0
Level 47	V7 PR roadside features (entrances, sidewalks, parking lots, etc.)	47	0	0
Level 48	V7 PR railroad elements (track, signal, crossing gates, etc.)	48	0	0
Level 49	V7 PR stage construction signs and detail drawings	49	0	0
Level 50	V7 PR structures (bridges, box culverts or retaining walls)	50	0	0
Level 51	V7 PR drainage notations for proposed drainage items	51	0	0
Level 52	V7 PR drainage plan/profile elements and erosion and sediment control elements	52	0	0
Level 53	V7 PR adjustment item notations for drainage and/or utility company elements	53	0	0
Level 54	V7 PR removal item indicator elements	54	0	0
Level 55	V7 PR roadway plan notation for proposed roadway elements	55	0	0

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Level 56	V7 aerial survey centerlines, x-section lines, break lines and shear diagrams	56	0	0
Level 57	V7 EX underground drainage & utilities (pipe lines, cable, drains, sewer, etc.)	57	0	0
Level 58	V7 PR underground drainage & utilities (pipe lines, cable, drains, sewer, etc.)	58	0	0
Level 59	V7 temporary easement elements and notation.	59	0	0
Level 60	V7 aerial surveys omitted ground shot data and DTM voided areas	60	0	0
Level 61	V7 unassigned optional level for user to place various elements	61	0	0
Level 62	V7 unassigned optional level for user to place various elements	62	0	0
Level 63	V7 unassigned optional level for user to place various elements	63	0	0
Lighting_EX_Above Ground Items	Existing highway lighting symbols	15	0	0
Lighting_EX_Aerial Cable	Existing highway lighting overhead electrical cable	15	Cable_Aerial	0

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Lighting_EX_Buried Cable	Existing highway lighting buried electrical cable	15	Underground_Lighting	0
Lighting_EX_Cable in Duct	Existing highway lighting cable in duct without ground	15	Cable_in_Duct	0
Lighting_EX_Conduit	Existing highway lighting conduit with ground	15	Cable_Conduit	0
Lighting_EX_Foundation	Existing highway lighting foundations	15	0	0
Lighting_EX_Notes	Existing highway lighting notes	15	0	0
Lighting_PR_Above Ground Items	Proposed highway lighting symbols	17	0	0
Lighting_PR_Aerial Cable	Proposed highway lighting overhead electrical cable	17	Cable_Aerial	2
Lighting_PR_Buried Cable	Proposed highway lighting buried electrical cable	17	Underground_Lighting	2
Lighting_PR_Cable in Duct	Proposed highway lighting cable in duct without ground	17	Cable_in_Duct	2
Lighting_PR_Conduit	Proposed highway lighting conduit with ground	17	Cable_Conduit	2
Lighting_PR_Foundation	Proposed highway lighting foundations	17	0	0
Lighting_PR_Notes	Proposed highway lighting notes	17	0	1
Lighting_PR_Temporary Items	Temporary highway lighting symbols	17	0	0
Mapping_Airport and Name		13	0	0
Mapping_Airport Runway		211	0	2

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Mapping_Area Map Construction Line Box		216	0	2
Mapping_Block Out		100	0	0
Mapping_Border Details		217	0	0
Mapping_Border Frame		215	0	5
Mapping_Border Grid		0	0	0
Mapping_Border Legend		211	0	0
Mapping_Border Title		216	0	0
Mapping_Canal and Name		211	0	0
Mapping_Cemetery Boundary		212	1	2
Mapping_Cemetery Fill		212	5	0
Mapping_Cemetery Symbol		212	0	0
Mapping_Cemetery Text		69	0	0
Mapping_City and Village Name		215	0	0
Mapping_City and Village Symbol		215	0	0
Mapping_Clip Boundary		211	3	0
Mapping_Corporate Adj City and Village Text		55	0	0
Mapping_Corporate Adjacent City Fill		240	0	3
Mapping_Corporate Boundary		221	0	0
Mapping_Corporate Fill		110	0	0
Mapping_County Line		211	0	1

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Mapping_County Line Text		211	0	0
Mapping_Corporate Feature Label		225	0	1
Mapping_Corporate Features		225	0	0
Mapping_Dam and Name		13	0	0
Mapping_Drainage Ditch		211	0	0
Mapping_Drainage Ditch Text		211	0	0
Mapping_FC Collector		215	0	0
Mapping_FC FreewayExpressway		228	0	0
Mapping_FC Interstate		211	0	0
Mapping_FC Legend		216	0	0
Mapping_FC Minor Arterials		212	0	0
Mapping_FC Other Principal Arterials		213	0	0
Mapping_FC Shield Text		55	0	0
Mapping_FC Text		55	0	0
Mapping_FC Tile		155	0	0
Mapping_FC Urban Boundary Line		216	0	0
Mapping_FC Urban Boundary Line GIS		215	0	1
Mapping_FC Urban Boundary Line Ref Base Map		217	0	1
Mapping_Ferry		211	0	0
Mapping_Ferry Text		13	0	0

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Mapping_Index County Line		211	0	2
Mapping_Index Hatch Line		150	0	1
Mapping_Index Township Line		211	0	1
Mapping_Indian Boundary Line		216	0	2
Mapping_Indian Boundary Line Text		216	0	2
Mapping_Inset or Enlargement Circles		0	0	0
Mapping_Lake Fill		217	0	0
Mapping_Lake Shore LIne		211	0	1
Mapping_Lake Text		211	0	1
Mapping_Lat-Long Cell		222	0	5
Mapping_Lat-Long Grid		222	0	0
Mapping_leader Arrow		213	0	0
Mapping_Match Line		220	0	1
Mapping_Park and Golf Course Text		69	0	0
Mapping_Park Boundary		212	1	2
Mapping_Park Fill		214	5	0
Mapping_Park Military Reservation Boundary		216	1	2
Mapping_Park Military Reservation Fill		216	1	2
Mapping_Park Military Reservation Text		69	0	0

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Mapping_Park National Forest Boundary		0	0	0
Mapping_Park National Forest Fill		214	5	0
Mapping_Park National Forest Text		69	0	0
Mapping_Park Stae Park Boundary		212	1	2
Mapping_Park Stae Park Fill		214	0	0
Mapping_Park Stae Park Text		69	0	0
Mapping_Principal Meridian and Base Line Text		55	0	0
Mapping_Railroad		62	0	0
Mapping_Railroad Text		62	0	0
Mapping_Range Township Numbers		55	0	0
Mapping_River Direction of Flow		217	0	0
Mapping_River Fill Construction Line		216	0	0
Mapping_River Pattern		217	0	0
Mapping_River Shore Line		211	0	1
Mapping_River Text		211	0	0
Mapping_Road Identification Text		217	0	0
Mapping_Route Destination Arrow		213	0	0
Mapping_Route Destination Text		213	0	0
Mapping_Rural Reference Text		211	0	1
Mapping_School		214	0	0
Mapping_School Text		214	0	0

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Mapping_Section Line		214	0	0
Mapping_Section Line Marker		214	0	0
Mapping_Shield County Highway		55	0	0
Mapping_Shield FAS		55	0	0
Mapping_Shield Illinois		55	0	0
Mapping_Shield Interstate		55	0	0
Mapping_Shield US		55	0	0
Mapping_State Line		213	0	1
Mapping_State Line Text		213	0	0
Mapping_State Plane Coordinate Cell		215	0	0
Mapping_State Plane Coordinate Construction Grid		216	0	0
Mapping_State Plane Coordinate Tick		215	0	0
Mapping_Stream Continuous		211	0	1
Mapping_Stream Intermittent		217	0	0
Mapping_Stream Text		217	0	0
Mapping_Structure		216	0	1
Mapping_Survey Township Line		216	0	2
Mapping_T-0 Soil		217	0	0
Mapping_T-1 City Street		213	0	3
Mapping_T-1 City Street Text		222	0	2

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Mapping_T-1 County Street Text		222	0	2
Mapping_T-2 Gravel or Stone		213	0	0
Mapping_T-5 High Type Bituminous		215	0	0
Mapping_T-5 High Type Bituminous Divided		215	0	0
Mapping_T-5 HT Interstate		215	0	0
Mapping_T-5 HT Interstate Div Frontage		215	0	0
Mapping_T-5 Low Type Bituminous		226	0	0
Mapping_T-5 Low Type Bituminous Divided		226	0	0
Mapping_T-7 Access Control		211	0	0
Mapping_T-7 Concrete		211	0	0
Mapping_T-7 Divided		211	0	0
Mapping_T-7 Frontage Road		211	0	1
Mapping_T-7 Frontage Road Ramps		211	0	1
Mapping_T-7 Interstate Frontage Tollway		211	0	0
Mapping_T-7 Interstate Tollway with Name		211	0	0
Mapping_T-7 Interstate with Access Control		211	0	0
Mapping_T-7 Interstate with Frontage		211	0	0
Mapping_T-7 One Way		211	0	0
Mapping_T-7 Road with Frontage		211	0	0

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Mapping_TM Legend		0	0	0
Mapping_TM pop over 20000 – A 5000 and over		213	0	0
Mapping_TM pop over 20000 – B 2500 to 4999		215	0	0
Mapping_TM pop over 20000 – C 1000 to 2499		212	0	0
Mapping_TM pop over 20000 – D 5000 and over		213	0	0
Mapping_TM pop over 20000 – E 2500 to 4999		215	0	0
Mapping_TM pop over 20000 – F 1000 to 2499		212	0	0
Mapping_TM pop over 20000 – G 400 to 999		214	0	0
Mapping_TM Shields		55	0	0
Mapping_TM Text		55	0	0
Mapping_TM Title		155	0	0
Mapping_Township Line		227	0	1
Mapping_Township Line Text		227	0	0
Mapping_UnderConstruction		228	0	0
Mapping_Vicinity Map Block Out		0	0	0
North Arrow		0	0	0
RASTER	Level for raster image attachments	216	0	3

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Removal_Asphalt	All asphalt items to be removal (pavement surface, shoulder, curb, etc.)	54	0	0
Removal_Bituminous	All bituminous items to be removal (pavement surface, shoulder, curb, etc.)	54	0	0
Removal_Building	Buildings to be removed	54	0	0
Removal_Concrete	All concrete items to be removed (pavement, shoulder, curb and gutter, etc.)	54	0	0
Removal_Entrance	CE PE and driveway pavement to be removed	54	0	0
Removal_Hazardous Material	Areas containing hazardous waste material to be removed	54	0	1
Removal_Items	General items marked to be removed	54	0	0
Removal_Linear Items	Linear items marked with removal tic noting item to be removed	54	Removal_Items	2
Removal_Sidewalk	Sidewalk to be removed	54	0	0
Removal_Tree	Trees to be removed	54	0	1
ROW_EX ROW Line	Existing Right of Way line	6	ROW_Existing	1
ROW_EX ROW Markers	Existing Right of Way marker symbol	6	0	0

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
ROW_EX_Access Control	Existing access control line	6	ROW_AccessControl_Existing	1
ROW_EX_Access Control and ROW	Existing Right of Way with access control line	6	ROW_AccessControl_ROW_Existing	1
ROW_EX_Access Control and ROW with Fence	Existing Right of Way with access control line and fence	6	ROW_AccessControl_ROW_Fence_Existing	1
ROW_EX_Building Setback Line	Private property building construction edge lines	12	2	0
ROW_EX_Coordinate Data	Northing and easting coordinate notation for plats and plans	41	0	0
ROW_EX_County or Township Lines	County or township lines	10	Section	0
ROW_EX_Dimensions	Existing Right of Way dimensions	34	0	0
ROW_EX_Easement	Existing Right of Way easement line	6	Easement	0
ROW_EX_Notes	Existing Right of Way notes, labels, and object identification	6	0	0
ROW_EX_Private Boundary Items	Private property symbols and owner names	12	0	0
ROW_EX_Property Dashed Lines	Private property dashed lines	12	Property	0
ROW_EX_Property Solid Lot Lines	Private property solid lot lines	12	0	0
ROW_EX_Quarter Quarter Section Lines	Lines defining the quarter of a quarter section for plat work	12	Quarter_Quarter_Section_Existing	0
ROW_EX_Quarter Section Lines	Lines defining a quarter section for plat work	12	Quarter_Section_Existing	0

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
ROW_EX_Section Items	Section corner symbols and other section-related items	12	0	0
ROW_EX_Section Lines	Section or grant lines	12	Section	0
ROW_EX_Section Notes	Section notes, labels	6	0	0
ROW_EX_State Line	State line	10	4	3
ROW_PR ROW Line	Proposed Right of Way lines	40	ROW_Proposed	3
ROW_PR ROW Markers	Proposed Right of Way markers	40	0	0
ROW_PR_Access Control	Proposed access control line	40	ROW_AccessControl_Proposed	2
ROW_PR_Access Control and ROW	Proposed Right of Way with access control line	40	ROW_AccessControl_ROW_Proposed	3
ROW_PR_Access Control and ROW with Fence	Proposed Right of Way with access control line and fence	40	ROW_AccessControl_ROW_Fence_Proposed	3
ROW_PR_Dimensions	Proposed Right of Way station offset dimensions	36	0	1
ROW_PR_Easement Notes	Proposed permanent easement notes and dimensions	40	0	1
ROW_PR_Excess Property Limits	Proposed excess property line, notes, and labels	6	ROW_ExcessPropertyLimits	2
ROW_PR_Limits of Construction Line	Project area limit of construction or proposed earth slope line	26	5	2
ROW_PR_Notes	Proposed Right of Way notes, labels, and object identification	40	0	1

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
ROW_PR_Permanent Easement	Permanent easement line	40	Easement	2
ROW_PR_Temporary Easement	Temporary easement line	59	Easement_Temporary	2
ROW_PR_Temporary Easement Notes	Temporary easement notes and dimensions	59	0	1
Sheets_100 Reference Boundary	Defined shapes for 100 scale sheet references	1	0	1
Sheets_20 Reference Boundary	Defined shapes for 20 scale sheet references	1	0	1
Sheets_200 Reference Boundary	Defined shapes for 200 scale sheet references	1	0	1
Sheets_50 Reference Boundary	Defined shapes for 50 scale sheet references	1	0	1
Sheets_General Details	IDOT sheets and north arrows	35	0	0
Sheets_Matchline	Line used to define same location on separate drawings	35	0	2
Sheets_Minor Grid	IDOT sheet minor cross grid on profile and cross section sheet cells	35	0	0
Sheets_Plotter Plotting Border	Plotter sheet clipping boundaries for batch plots	0	0	1
Sheets_Printer Plotting Border	Printer sheet clipping boundaries for batch plots	0	0	0
Signals_EX_Above Ground	Existing traffic signal equipment items	11	0	0
Signals_EX_Detector Loop	Existing detector loop line	11	1	0
Signals_EX_Foundations	Existing traffic signal post and mast arm foundations	11	0	0

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Signals_EX_Interconnect	Existing traffic signal interconnect conduit, pull points, handholes, and foundations	11	0	0
Signals_EX_Notes	Existing traffic signal notes, labels, and object identification	11	0	0
Signals_EX_Underground Cable	Existing traffic signal cable	11	Underground_Cable	0
Signals_EX_Underground Conduit	Existing traffic signal conduit	11	Underground_Conduit	0
Signals_PR_Above Ground	Proposed traffic signal equipment symbols	13	0	1
Signals_PR_Detector Loop	Proposed detector loop line	13	0	2
Signals_PR_Foundations	Proposed traffic signal post and mast arm foundations	13	0	2
Signals_PR_Interconnect	Proposed traffic signal interconnect conduit, pull points, handholes, and foundations	13	0	2
Signals_PR_Notes	Proposed traffic signal notes labels and object identification	13	0	1
Signals_PR_Temporary	Temporary traffic signal equipment items	11	0	0
Signals_PR_Underground Cable	Proposed traffic signal cable	13	Underground_Cable	2
Signals_PR_Underground Conduit	Proposed traffic signal conduit	13	Underground_Conduit	2

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Soils_Boring Logs	Soil boring log data (symbology may vary)	19	0	0
Soils_Plan and Profile	Soil borings plan locations and profile data	19	0	0
Stage_1 Construction Centerline	Construction stage alignment for a stage detour or runaround	41	Centerline	2
Stage_1 Construction Drainage	Construction stage drainage items (ditches, pipe culverts, manholes, inlets, etc.)	41	0	2
Stage_1 Construction Edge Drums	Barricade drums and temporary pavement marking edge line	41	Construction_Drums	1
Stage_1 Construction Entrances	Construction stage edge of driveways and entrances	41	0	1
Stage_1 Construction EOP	Construction stage edge of pavement line	41	0	2
Stage_1 Construction Erosion Control	Construction stage erosion control items to be placed during a construction stage	41	0	0
Stage_1 Construction Notes	Construction stage notes, labels, and object identification	41	0	1
Stage_1 Construction Pavement Shapes	Detour runaround or crossover pavement cross section shapes	4	0	1

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Stage_1 Construction Sheet Piling	Construction stage temporary sheet piling line item to be placed during a construction stage	41	Sheet_Piling	1
Stage_1 Construction Shoulders	Construction stage bituminous or aggregate shoulder line	41	0	1
Stage_1 Construction Sidewalk	Construction stage sidewalk	41	0	2
Stage_1 Construction Slope Limits	Construction stage area limits of construction or edge of earth slope line	41	0	2
Stage_1 Construction Traffic Control	Signs, cones, drums, barricades. and temporary pavement marking	41	0	0
Stage_2 Construction Centerline	Construction stage alignment for a stage detour or runaround	34	Centerline	2
Stage_2 Construction Drainage	Construction stage drainage items (ditches, pipe culverts, manholes, inlets, etc.)	34	0	2
Stage_2 Construction Edge Drums	Barricade drums and temporary pavement marking edge line	34	Construction_Drums	1
Stage_2 Construction Entrances	Construction stage edge of driveways and entrances	34	0	1
Stage_2 Construction EOP	Construction stage edge of pavement line	34	0	2

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Stage_2 Construction Erosion Control	Construction stage erosion control items to be placed during a construction stage	34	0	0
Stage_2 Construction Notes	Construction stage notes, labels, and object identification	34	0	1
Stage_2 Construction Pavement Shapes	Detour runaround or crossover pavement cross section shapes	5	0	1
Stage_2 Construction Sheet Piling	Construction stage temporary sheet piling line item to be placed during a construction stage	34	Sheet_Piling	1
Stage_2 Construction Shoulders	Construction stage bituminous or aggregate shoulder line	34	0	1
Stage_2 Construction Sidewalk	Construction stage sidewalk	34	0	2
Stage_2 Construction Slope Limits	Construction stage area limits of construction or edge of earth slope line	34	0	2
Stage_2 Construction Traffic Control	Signs, cones, drums, barricades, and temporary pavement marking	34	0	0
Stage_3 Construction Centerline	Construction stage alignment for a stage detour or runaround	31	Centerline	2

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Stage_3 Construction Drainage	Construction stage drainage items (ditches, pipe culverts, manholes, inlets, etc.)	31	0	2
Stage_3 Construction Edge Drums	Barricade drums and temporary pavement marking edge line	31	Construction_Drums	1
Stage_3 Construction Entrances	Construction stage edge of driveways and entrances	31	0	1
Stage_3 Construction EOP	Construction stage edge of pavement line	31	0	2
Stage_3 Construction Erosion Control	Construction stage erosion control items to be placed during a construction stage	31	0	0
Stage_3 Construction Notes	Construction stage notes, labels, and object identification	31	0	1
Stage_3 Construction Pavement Shapes	Detour runaround or crossover pavement cross section shapes	6	0	1
Stage_3 Construction Sheet Piling	Construction stage temporary sheet piling line item to be placed during a construction stage	31	Sheet_Piling	1
Stage_3 Construction Shoulders	Construction stage bituminous or aggregate shoulder line	31	0	1
Stage_3 Construction Sidewalk	Construction stage sidewalk	31	0	2

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Stage_3 Construction Slope Limits	Construction stage area limits of construction or edge of earth slope line	31	0	2
Stage_3 Construction Traffic Control	Signs, cones, drums, barricades, and temporary pavement marking	31	0	0
Stage_4 Construction Centerline	Construction stage alignment for a stage detour or runaround	36	Centerline	2
Stage_4 Construction Drainage	Construction stage drainage items (ditches, pipe culverts, manholes, inlets, etc.)	36	0	2
Stage_4 Construction Edge Drums	Barricade drums and temporary pavement marking edge line	36	Construction_Drums	1
Stage_4 Construction Entrances	Construction stage edge of driveways and entrances	36	0	1
Stage_4 Construction EOP	Construction stage edge of pavement line	36	0	2
Stage_4 Construction Erosion Control	Construction stage erosion control items to be placed during a construction stage	36	0	0
Stage_4 Construction Notes	Construction stage notes, labels, and object identification	36	0	1
Stage_4 Construction Pavement Shapes	Detour runaround or crossover pavement cross section shapes	7	0	1

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Stage_4 Construction Sheet Piling	Construction stage temporary sheet piling line item to be placed during a construction stage	36	Sheet_Piling	1
Stage_4 Construction Shoulders	Construction stage bituminous or aggregate shoulder line	36	0	1
Stage_4 Construction Sidewalk	Construction stage sidewalk	36	0	2
Stage_4 Construction Slope Limits	Construction stage area limits of construction or edge of earth slope line	36	0	2
Stage_4 Construction Traffic Control	Signs, cones, drums, barricades, and temporary pavement marking	36	0	0
Stage_Construction Centerline	Construction stage alignment for a stage detour or runaround	49	Centerline	2
Stage_Construction Centerline small Tic Sta		49	02	
Stage_Construction Drainage	Construction stage drainage items (ditches, pipe culverts, manholes, inlets, etc.)	49	0	2
Stage_Construction Edge Drums	Barricade drums and temporary pavement marking edge line	49	Construction_Drums	1
Stage_Construction Entrances	Construction stage edge of driveways and entrances	49	0	1
Stage_Construction EOP	Construction stage edge of pavement line	49	0	2

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Stage_Construction Erosion Control	Construction stage erosion control items to be placed during a construction stage	49	0	0
Stage_Construction Notes	Construction stage notes, labels, and object identification	49	0	1
Stage_Construction Pavement Shapes	Detour runaround or crossover pavement cross section shapes	3	0	1
Stage_Construction Sheet Piling	Construction stage temporary sheet piling line item to be placed during a construction stage	49	Sheet_Piling	1
Stage_Construction Shoulders	Construction stage bituminous or aggregate shoulder line	49	0	1
Stage_Construction Sidewalk	Construction stage sidewalk	49	0	2
Stage_Construction Slope Limits	Construction stage area limits of construction or edge of earth slope line	49	0	2
Stage_Construction Traffic Control	Signs, cones, drums, barricades, and temporary pavement marking	49	0	0
Structures_EX_Dam	Existing dam	51	0	0
Structures_EX_Dock	Existing dock	34	0	0
Structures_EX_Foundation	Existing foundations	64	0	0
Structures_EX_Misc	Existing miscellaneous survey features	68	0	0

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Structures_EX_PavedArea	Existing paved areas	64	0	0
Structures_EX_Post	Existing posts	54	0	0
Structures_EX_Tunnel	Existing tunnel	41	3	1
Structures_PR_Box Culvert	Proposed box culvert line	184	0	2
Structures_PR_Box Culvert Headwall	Proposed box culvert headwall line	50	0	2
Structures_PR_Br_Abutment	Proposed bridge abutment	35	0	2
Structures_PR_Br_Beam	Proposed Steel bridge beams	51	0	2
Structures_PR_Br_Bearing	Proposed bridge bearings	37	0	2
Structures_PR_Br_Cap	Proposed bridge caps	62	0	2
Structures_PR_Br_Column	Bridge column	48	0	2
Structures_PR_Br_Concrete_Misc	Proposed misc concrete bridge items	48	0	1
Structures_PR_Br_Crash_Barrier	Proposed bridge crash barrier	52	6	2
Structures_PR_Br_Cross_Frames	Proposed cross framing	51	0	2
Structures_PR_Br_Deck	Proposed bridge deck	75	0	2
Structures_PR_Br_Diaphragms	Proposed bridge diaphragms	39	0	1
Structures_PR_Br_Drilled_Shaft	Proposed drilled shaft	5	2	1
Structures_PR_Br_Footing	Proposed bridge footing	14	0	2
Structures_PR_Br_Misc_Rebar	Miscellaneous rebar	35	3	1
Structures_PR_Br_Pier	Proposed bridge piers	3	0	2

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Structures_PR_Br_Pile	Proposed bridge pilings	30	4	2
Structures_PR_Br_Railing	Proposed bridge railings	36	0	2
Structures_PR_Br_Slope	Proposed bridge Slopes	77	0	2
Structures_PR_Br_Steel_Misc	Proposed miscellaneous steel	35	0	1
Structures_PR_Br_Struts	Proposed bridge struts	69	7	1
Structures_PR_Bridge	Proposed bridge line	50	0	2
Structures_PR_Bridge Bot	Proposed bridge line	50	0	2
Structures_PR_Bridge Pier	Proposed bridge pier line	50	3	2
Structures_PR_Misc	Proposed miscellaneous	20	0	2
Structures_PR_Rebar	Proposed bridge column rebar	35	3	1
Structures_PR_Retaining Wall	Proposed retaining wall line	183	0	2
Structures_PR_Retaining Wall Bot	Proposed retaining wall line	183	0	2
Structures_PR_Sign	Proposed signs	20	0	2
Structures_PR_Wall	Proposed walls	20	0	2
Terrain_CC_Surface	Used for civil cell surfaces	55	0	2
Terrain_CC_Surface_Const	Used for temporary surfaces used in civil cells	55	1	2
Terrain_EX	Existing terrain ground	10	3	2
Terrain_EX_Aerial	Existing terrain aerial LIDAR	74	0	0
Terrain_EX_Bank	Existing terrain top of bank	1	0	0

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Terrain_EX_BoreHole	Existing terrain soil borings	19	0	0
Terrain_EX_Breakline	Existing terrain survey break lines	56	0	1
Terrain_EX_Contour_Imported	Existing terrain imported contours	80	3	0
Terrain_EX_Contour_Label	Existing terrain contour labels	26	0	1
Terrain_EX_Contour_Major	Existing terrain major contours	26	0	3
Terrain_EX_Contour_Minor	Existing terrain minor contours	19	0	0
Terrain_EX_DitchBottom	Existing Terrain Ditch Break lines	37	6	1
Terrain_EX_DitchBottomWidth	Existing Terrain Ditch Break lines	49	0	1
Terrain_EX_DitchTop	Existing Terrain Ditch Break lines	49	4	1
Terrain_EX_Exterior	Existing terrain exterior boundary	10	3	2
Terrain_EX_Fence	Existing Terrain Fence Break lines	38	0	0
Terrain_EX_Flowline_Natural	Existing terrain natural flow line	5	0	1
Terrain_EX_Groundwater	Existing terrain ground water	5	0	0
Terrain_EX_Hole	Existing terrain hole	11	2	2
Terrain_EX_Interior	Existing terrain interior boundary	20	0	2
Terrain_EX_Island	Existing terrain island	25	2	2

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Terrain_EX_Points_High	Existing terrain high points	49	0	4
Terrain_EX_Points_Low	Existing terrain low points	38	0	4
Terrain_EX_Random	Existing Terrain Random Ground Points	23	0	0
Terrain_EX_Ridgeline	Existing Terrain Ridge Lines	66	0	0
Terrain_EX_Rock	Existing terrain rock line	184	3	2
Terrain_EX_Slope	Existing Terrain Slope Arrows	35	0	0
Terrain_EX_SpotElevation	Existing terrain spot elevations	32	0	0
Terrain_EX_Tree	Existing terrain trees	4	0	0
Terrain_EX_TreeLine	Existing terrain tree line	4	Woods_Brush	0
Terrain_EX_Triangle	Existing terrain triangles	4	0	0
Terrain_EX_Vegetation	Existing terrain vegetation	4	Vegetation	0
Terrain_EX_Void	Existing terrain void	2	2	2
Terrain_EX_Water_Natural	Existing terrain natural water	5	6	0
Terrain_PR_Breakline	Proposed DTM break lines	54	0	1
Terrain_PR_Contour_Imported	Proposed DTM imported contours	80	0	2
Terrain_PR_Contour_Major	Proposed DTM major contours	36	0	2
Terrain_PR_Contour_Minor	Proposed DTM minor contours	29	0	1
Terrain_PR_Design	Proposed DTM ground	55	0	2

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Terrain_PR_Exterior	Proposed DTM exterior boundary	42	0	2
Terrain_PR_Hole	Proposed DTM hole	13	2	2
Terrain_PR_Interior	Proposed DTM interior boundary	24	0	2
Terrain_PR_Island	Proposed DTM island	47	2	2
Terrain_PR_Points_Inferred	Proposed DTM inferred points	22	0	4
Terrain_PR_Points_Random	Proposed DTM random points	67	0	4
Terrain_PR_Triangle	Proposed DTM triangles	64	0	0
Terrain_PR_Void	Proposed DTM void	42	2	2
Topo_Advertising Sign	Existing advertising signs	8	0	0
Topo_Attenuator	Existing impact attenuator installation	28	3	0
Topo_Base of Levee	Existing edge of levee	8	Levee_Base	0
Topo_Bike Path	Existing edge of bike path	97	3	0
Topo_Breaklines	Existing edge of surfaces drawn to define triangles for the DTM	56	0	0
Topo_Bridge Piers	Existing bridge pier line	39	3	0
Topo_Bridge Structures	Existing bridges	39	0	0
Topo_Building	Existing perimeter of buildings	8	0	0
Topo_Cable Barrier	Existing cable barrier	164	Cable_Barrier_Existing	0
Topo_Concrete Barrier	Existing concrete barrier	164	Concrete_Barrier	0

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Topo_Contour Index	Existing major ground contours with elevation notation	26	0	0
Topo_Contour Intermediate	Existing minor ground contours	3	0	0
Topo_Control Points	Survey control points for back sight, fore sight, radius and traverse shots	2	0	0
Topo_Culvert Headwall	Existing culvert headwalls	167	0	0
Topo_Culverts	Existing culvert barrel line	37	5	0
Topo_Curb and Gutter	Existing concrete gutter and curb and gutter	28	3	0
Topo_Ditch Line	Existing ditch line	37	6	0
Topo_Drainage Items	Existing drainage plan and profile symbols (pipe culverts, manholes, inlets, etc.)	37	0	0
Topo_Drainage Labels	Existing drainage item notation for plan symbols (pipe culverts, manholes, inlets, etc.)	22	0	0
Topo_Entrances	Existing commercial and private parking lots, driveways, or entrances	160	3	0
Topo_EOP	Existing edge of pavement	27	3	0
Topo_Fence	Existing fence line	8	Fence	0
Topo_Field Comments	Survey shot comments by field survey personnel	63	0	0

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Topo_Guardrail	Existing SPBGR guardrail post	28	Guardrail_Existing	0
Topo_Landscape Items	Existing landscaping timbers, pavers, concrete edging, mulch areas, etc.	8	3	0
Topo_Levee Lg_scale	Existing levee for 200 scale location mapping	8	Levee_LargeScale	0
Topo_Mailbox	Existing mailbox	8	0	0
Topo_Medians	Existing concrete median	162	3	0
Topo_Miscellaneous	Survey shot of miscellaneous surveyed items	1	0	0
Topo_MultiUse Path	Existing edge of multiple usage path	99	3	0
Topo_Noise Wall or Levee	Existing noise wall and levee	8	Levee	0
Topo_NonHighway Improvements	Existing private property slabs and other miscellaneous surface items	8	3	0
Topo_Orchard or Nursery Line	Existing outline of an orchard or nursery	4	4	2
Topo_Paved Ditch	Existing paved ditch line	37	0	1
Topo_Pay Telephone	Existing pay telephone symbol	8	0	0
Topo_PMK Dotted Line	Existing pavement marking dotted lines	7	PMK_Dotted_Existing	0

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Topo_PMK Double Centerline	Existing pavement marking double center lines	7	PMK_CenterLine_Double_Existing	0
Topo_PMK Skip Dash Line	Existing pavement marking skip-dash lines	7	PMK_SkipDash_Dot	0
Topo_PMK Solid Line	Existing pavement marking solid stripe lines	7	1	0
Topo_PMK Stop Line	Existing pavement marking stop lines	7	PMK_StopLine_Existing	0
Topo_PMK Symbols	Existing pavement marking symbols	7	1	0
Topo_Point Descriptions	Survey shot descriptions	62	0	0
Topo_Point Elevations	Survey shot with spot elevation text	61	0	0
Topo_Point Ground Shots	Survey shot at location on the earth surface	32	0	0
Topo_Point Numbers	Survey shot point numbers	60	0	0
Topo_Point SPC Cell	Survey point generic cells; i.e those survey points which have only a dot for the point indicator	26	0	7
Topo_Railroad	Existing railroad signals, cabinets, overpasses, and grade crossings	38	0	0
Topo_Railroad Abandon Lg_scale	Existing railroad abandon track for 200 scale location mapping	38	Railroad_Abandoned_LargeScale	0
Topo_Railroad Abandon Track	Existing railroad abandon track	38	Railroad_Abandoned	0

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Topo_Railroad Active Lg_scale	Existing railroad track for 200 scale location mapping	38	Railroad_LargeScale	0
Topo_Railroad Active Track	Existing railroad track	38	RailroadTrack	0
Topo_Railroad Notes	Existing railroad notes	38	0	0
Topo_Retaining Wall	Existing retaining wall	39	3	0
Topo_Riprap	Existing riprap areas	37	0	1
Topo_Roadway Notes	Existing topography labels for surveyed items	16	0	0
Topo_Shoulder	Existing edge of shoulder	163	3	0
Topo_Sidewalk	Existing edge of sidewalk	25	3	0
Topo_Stream	Existing streams	5	6	0
Topo_Survey Marker	Existing permanent survey marker	12	0	1
Topo_Swamp or Marsh Outline	Existing edge of swamp or marsh	5	3	0
Topo_Traffic Sign	Existing traffic roadway signs	28	0	0
Topo_Utilities	Existing above ground utility items	14	0	0
Topo_Utilities Labels	Existing above ground utility item notation	18	0	0
Topo_Vegetation	Existing tree, bush or shrub, stump symbol and associated vegetation text	4	0	0
Topo_Vegetation Line	Existing edge of areas of planted vegetation	4	Vegetation	0

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Topo_Vegetation Sizes	Existing tree diameter dimensions	4	0	0
Topo_Water Edge	Existing lakes, rivers, ponds, and other bodies of water edge line	5	Water_Edge	0
Topo_Water Features	Existing labels for lakes, rivers, streams, and symbols for disappearing ditches and marshes	5	0	0
Topo_Wetlands	Existing wetland defined areas	5	0	0
Topo_Woods and Brush	Existing areas of woods and brush outline	4	Woods_Brush	0
Utilities_AB_Notes	Abandoned utility company item notes, labels, and object identification	18	0	0
Utilities_AB_Underground CableTV	Abandoned underground TV cable	20	Underground_CableTV_AB	0
Utilities_AB_Underground Electric	Abandoned underground electric cable	2	Underground_Electric_AB	0
Utilities_AB_Underground Fiber Optic	Abandoned underground fiber optic communication cable	20	Underground_FiberOptic_AB	0
Utilities_AB_Underground Gasline	Abandoned underground gas pipe line	14	Underground_Gasline_AB	0
Utilities_AB_Underground Oil	Abandoned underground oil pipe line	49	Underground_Oil_AB	0
Utilities_AB_Underground Sanitary Sewer	Abandoned underground sewer main or service line	57	Underground_Sanitary_Sewer	0

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Utilities_AB_Underground Telephone	Abandoned underground telephone line	20	Underground_Telephone	0
Utilities_AB_Underground Water	Abandoned underground water main or service line	31	Underground_Water_AB	0
Utilities_Clashes	Proposed utilities	103	0	2
Utilities_EX_Aerial Lines	Existing aerial power lines crossing over pavement within Right of Way	14	Cable_Aerial	0
Utilities_EX_Generic	Existing utility company item notes, labels, and object identification	18	0	2
Utilities_EX_Notes	Existing utility company item notes, labels, and object identification	18	0	0
Utilities_EX_Sanitary Structures	Existing underground sewer main or service line	57	0	2
Utilities_EX_Underground CableTV	Existing underground TV cable	20	Underground_CableTV	0
Utilities_EX_Underground Combined Sewer	Existing combined storm and sanitary sewer line	57	Underground_Combined_Sewer_AB	0
Utilities_EX_Underground Electric	Existing underground electric cable	2	Underground_Electric	0
Utilities_EX_Underground Fiber Optic	Existing underground fiber optic communication cable	20	Underground_FiberOptic	0
Utilities_EX_Underground Gasline	Existing underground gas pipe line	14	Underground_Gasline	0
Utilities_EX_Underground Oil	Existing underground oil pipe line	49	Underground_Oil	0

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Utilities_EX_Underground Sanitary Sewer	Existing underground sewer main or service line	57	Underground_Sanitary_Sewer	0
Utilities_EX_Underground Telephone	Existing underground telephone line	20	Underground_Telephone	0
Utilities_EX_Underground Thermal	Existing underground geothermal line	2	0	2
Utilities_EX_Underground Water	Existing underground water main or service line	31	Underground_Water	0
Utilities_PR_Above Ground Items	Proposed utility items	44	0	2
Utilities_PR_Adjustment Items	Utility structure adjustment label notations	53	0	0
Utilities_PR_Aerial Lines	Proposed aerial power lines crossing over pavement within Right of Way	44	Cable_Aerial	2
Utilities_PR_Generic	Proposed utility company item notes, labels, and object identification	45	0	2
Utilities_PR_Misc	Proposed utilities	68	0	2
Utilities_PR_Notes	Proposed utility company item notes, labels, and object identification	45	0	1
Utilities_PR_Sanitary Structures	Proposed underground sewer main or service line	58	0	2
Utilities_PR_Underground CableTV	Proposed underground TV cable	20	Underground_CableTV	2
Utilities_PR_Underground Electric	Proposed underground electric cable	2	Underground_Electric	2

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
Utilities_PR_Underground Fiber Optic	Proposed underground fiber optic communication cable	20	Underground_FiberOptic	2
Utilities_PR_Underground Gasline	Proposed underground gas pipe line	14	Underground_Gasline	2
Utilities_PR_Underground Oil	Proposed underground oil pipe line	49	Underground_Oil	2
Utilities_PR_Underground Sanitary Sewer	Proposed underground sewer main or service line	58	Underground_Sanitary_Sewer	2
Utilities_PR_Underground Telephone	Proposed underground telephone line	20	Underground_Telephone	2
Utilities_PR_Underground Thermal	Proposed underground telephone line	2	0	2
Utilities_PR_Underground Water	Proposed underground water main or service line	31	Underground_Water	2
XS_Cross Section Cell	GEOPAK cell placed to define individual cross section from pattern line location	2	0	2
XS_Delimeter-Existing ROW	Lines which mark the existing right of way on cross-sections	6	3	2
XS_Delimeter-Proposed ROW	Lines which mark the proposed right of way on cross-sections	5	4	2
XS_Pattern Lines_Culverts	Pattern lines placed for cross road culverts	0	0	2
XS_Pattern Lines_Diagonals	Pattern lines placed at side road returns to address ROW concerns	0	0	2

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
XS_Pattern Lines_Entrances	Pattern lines placed at or along entrance alignments	0	0	2
XS_Pattern Lines_Flood Plain	Pattern lines placed for drainage in flood plain areas	0	0	2
XS_Pattern Lines_Mainline	Pattern lines placed along existing mainline alignment	0	0	2
XS_Pattern Lines_Mainline Horizontal Control	Pattern lines placed along mainline horizontal control alignment	0	0	2
XS_Pattern Lines_Mainline Vertical Control	Pattern lines placed along mainline vertical control	0	0	2
XS_Pattern Lines_Median	Pattern lines placed along divided highway for median work	0	0	2
XS_Pattern Lines_Ramp A	Pattern lines placed along interchange ramp A alignment	0	0	2
XS_Pattern Lines_Ramp B	Pattern lines placed along interchange ramp B alignment	0	0	2
XS_Pattern Lines_Ramp C	Pattern lines placed along interchange ramp C alignment	0	0	2
XS_Pattern Lines_Ramp D	Pattern lines placed along interchange ramp D alignment	0	0	2
XS_Pattern Lines_Sideroads	Pattern lines placed at or along sideroad alignments	0	0	2

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
XS_Pattern Lines_Staging	Pattern lines placed on stage construction alignments for detours or runarounds	0	0	2
XSC_Agg Base Course	Cross section criteria aggregate base course symbology	54	0	2
XSC_Agg Shoulder	Cross section criteria aggregate shoulder symbology	16	0	2
XSC_Agg Shoulder Subgrade	Cross section criteria aggregate shoulder subgrade symbology	17	0	2
XSC_Asphalt Base Course	Cross section criteria asphalt base course symbology	6	0	2
XSC_Asphalt Binder Course	Cross section criteria asphalt binder course symbology	5	0	2
XSC_Asphalt Milling	Cross-section areas to e milled	0	0	2
XSC_Asphalt Surface Course	Cross section criteria asphalt surface course symbology	4	0	1
XSC_Bottom of Surface	Cross section criteria bottom of surface symbology	52	0	1
XSC_Bottom of Widening	Cross section criteria bottom of widening symbology	53	0	2

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
XSC_CL Elevation Text	Cross section criteria CL elevation text symbology	21	0	1
XSC_Clear Zone	Cross section criteria clear zone symbology	19	0	3
XSC_Concrete Barrier Median	Cross section criteria concrete barrier median symbology	36	0	2
XSC_Curb Subgrade	Cross section criteria curb subgrade symbology	33	0	2
XSC_Curb Surface	Cross section criteria curb surface symbology	32	0	2
XSC_Ditch	Cross section criteria paved ditch symbology	39	0	3
XSC_Ditch Elevation Text	Cross section criteria ditch elevation text symbology	44	0	1
XSC_Ditch Slope Text	Cross section criteria ditch slope text symbology	20	0	1
XSC_Earth Shoulder	Cross section criteria earth shoulder symbology	18	0	3
XSC_Earth Shoulder Subgrade	Cross section criteria subgrade for earth shoulders symbology	19	0	3
XSC_Earthwork Shapes	Cross section criteria earthwork shapes	1	0	1
XSC_Elevation Text	Cross section criteria elevation text symbology	24	0	1
XSC_Entrance Subgrade	Cross section criteria entrance subgrade symbology	29	0	2
XSC_Exist Ground	Cross section criteria existing ground line	10	3	2

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
XSC_Exist Pavement	Cross section criteria exist pavement symbology	2	3	1
XSC_Exist Shoulder	Cross section criteria exist shoulder symbology	3	3	1
XSC_Exist Underground Utility	Cross section criteria existing underground utility symbology	57	0	1
XSC_Existing ROW XS Line	Cross section criteria existing ROW XS line	6	3	2
XSC_Existing ROW XS Text	Cross section criteria existing ROW XS text	6	0	1
XSC_General Message Text	Cross section criteria general message text symbology	5	0	2
XSC_GoreLimits		107	0	1
XSC_Guard Rail	Cross section criteria guard rail symbology	39	0	1
XSC_Guardrail_Post_Block	Guardrail post blocks in cross-section and 3D models	68	0	2
XSC_Guardrail_Post_Only	Guardrail posts in cross-section and 3D models	39	0	2
XSC_Hatching	Cross section criteria hatching symbology	51	0	0
XSC_Hidden Ditch Line	Cross section criteria hidden ditch line symbology	25	2	1
XSC_Hidden Ditch Text	Cross section criteria hidden ditch text symbology	25	0	0

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
XSC_HMA Subbase1	Cross section criteria PCC subbase1 symbology	56	0	1
XSC_HMA Subbase2	Cross section criteria PCC subbase2 symbology	11	0	1
XSC_Limits of Construction	Cross section criteria limits of construction symbology	26	5	1
XSC_LOC offset text	Cross section criteria LOC offset text symbology	27	0	1
XSC_Marked Point Text	Cross section criteria marked point text symbology	5	0	2
XSC_Material1		46	0	1
XSC_Material2		127	0	1
XSC_Paved Shoulder	Cross section criteria paved shoulder symbology	14	0	2
XSC_Paved Shoulder Base	Cross section criteria subdrain pipe symbology	16	0	2
XSC_Paved Shoulder Subgrade	Cross section criteria paved shoulder subgrade symbology	15	0	2
XSC_Pavement Surface	Cross section criteria pavement surface symbology	1	0	3
XSC_PCC Pavement	Cross section criteria PCC pavement symbology	9	0	2
XSC_PCC Subbase1	Cross section criteria PCC subbase1 symbology	56	0	1
XSC_PCC Subbase2	Cross section criteria PCC subbase2 symbology	11	0	1

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
XSC_PCC Subbase3	Cross section criteria PCC subbase3 symbology	12	0	1
XSC_PCC Subbase4	Cross section criteria PCC subbase4 symbology	13	0	1
XSC_Plan View Ditch	Cross section criteria plan view ditch symbology	52	5	0
XSC_Profile Grade Report Text	Cross section criteria profile grade report text	5	0	2
XSC_Proposed Base Line	Cross section criteria proposed base line symbology	42	0	2
XSC_Proposed Bike Path	Cross section criteria proposed bike path symbology	82	0	2
XSC_Proposed Bike Path Subbase	Cross section criteria proposed bike path subbase	86	0	2
XSC_Proposed Bike Path Subgrade	Cross section criteria proposed bike path subgrade	83	0	2
XSC_Proposed Bridge Structure	Cross section criteria proposed structure symbology	50	0	2
XSC_Proposed Culvert	Cross section criteria proposed culvert symbology	52	0	2

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
XSC_Proposed Drainage	Cross section criteria proposed drainage items (storm sewers, manholes, inlets, riprap, etc.) related symbology	52	0	2
XSC_Proposed Easement XS Line	Cross section criteria proposed easement XS line	59	6	3
XSC_Proposed Easement XS Text	Cross section criteria proposed easement XS text	59	0	3
XSC_Proposed Finish Grade	Cross section criteria finished earth grade line symbology	22	0	3
XSC_Proposed Finish Grade Bot	Cross section criteria finished earth grade line symbology	22	0	3
XSC_Proposed Finish Grade Rock	Cross section criteria finished rock grade line symbology	184	0	3
XSC_Proposed ROW XS Line	Cross section criteria proposed ROW XS line	40	6	3
XSC_Proposed ROW XS Text	Cross section criteria proposed ROW XS text	40	0	3
XSC_Proposed Sawcut	Cross section criteria proposed sawcut symbology	54	0	1
XSC_Proposed Sawcut Bot	Cross section criteria proposed sawcut symbology	54	0	1

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
XSC_Proposed Swale	Cross section criteria proposed swale	52	6	1
XSC_Proposed Underground Utility	Cross section criteria proposed underground utility symbology	58	0	2
XSC_Retaining Wall	Cross section criteria retaining wall symbology	41	0	2
XSC_Shoulder Slope Text	Cross section criteria shoulder slope text symbology	20	0	1
XSC_Side Road Tie Down	Cross section criteria side road tie down symbology	30	0	2
XSC_Sidewalk	Cross section criteria sidewalk symbology	37	0	2
XSC_Sidewalk Subgrade	Cross section criteria sidewalk bottom surface symbology	38	0	2
XSC_Slope Text	Cross section criteria slope text symbology	45	0	1
XSC_Special Ditch Label	Cross section criteria special ditch label symbology	23	0	2
XSC_Subbase1	Cross section criteria subbase1 symbology	7	0	1
XSC_Subbase2	Cross section criteria subbase2 symbology	8	0	1
XSC_Subdrain Envelope	Cross section criteria subdrain envelope symbology	52	0	2
XSC_Subdrain Pipe	Cross section criteria subdrain pipe symbology	22	0	3

Table Appendix B.1 - Level Library				
Level Name	Description	Color	Line Style (See Section 6-3)	Weight
XSC_Subgrade	Proposed subgrade	38	0	2
XSC_Topsoil	Cross section criteria topsoil symbology	31	3	1
XSC_Unsuitable Material	Material which is to be removed and backfilled	6	0	2
XSC_Urban Median Subgrade	Cross section criteria urban median subgrade symbology	35	0	2
XSC_Urban Median Surface	Cross section criteria urban median surface symbology	34	0	2
XSC_Volume		5	0	1
XSC_Volume_Annotation	Volume labels on cross-sections.	55	0	2
XSC_Warning Text	Cross section criteria warning text symbology	4	0	2

Table Appendix B.2 - Level Filters	
Filter Name	Description of Levels Isolated by the Filter
0 Current File	Shows all levels in the current file.
0 Rogue	Shows levels which do not adhere to IDOT standards.
0 Used	Levels which are in use in the active DGN.
63original ↳ Existing 63 ↳ Proposed63	The version 7 levels named Level 1 through Level 63
AerialSurveys ↳ Culture ↳ DrainageAS ↳ Roads	Levels used by Aerial Surveys ↳ Subset of aerial surveys – non-roadway features ↳ Subset of Aerial Surveys – drainage features ↳ Subset of Aerial Surveys – roadway features
Alignment ↳ Detour ↳ ExistingAl ↳ ProposedAL	All levels used for alignments ↳ Subset of alignments – detour only ↳ Subset of alignments – existing alignments only ↳ Subset of alignments – proposed alignments only
Bridge	Levels used for bridges only
Centerlines - All ↳ Existing Roads ↳ Preliminaary ↳ Proposed	All levels used for centerlines ↳ Subset of centerlines – existing centerlines only ↳ Subset of centerlines – preliminary centerlines only ↳ Subset of centerlines – proposed centerlines only
Construction - All	All levels with the word construction in it
Corridor	Level used for the corridor objects, template drop objects and corridor transition objects.
Design	All levels which contained proposed roadway and bridge features as well as corridor objects
Design - All	All Design Levels
Design - GPK Visualizations for Row	All levels related to Parcels
Design and Survey	Same as design only added Aerial Survey levels

Table Appendix B.2 - Level Filters	
Filter Name	Description of Levels Isolated by the Filter
Drainage ↳ ExistingDr ↳ ProposedDr	Drainage levels ↳ Existing drainage levels ↳ Proposed drainage levels
DTM Graphics	Levels used for Terrain Model
Environmental	Levels used for depiction of environmental features
ErosionControl	Levels used for designing erosion control features
Functional - All	Levels for Alignment, Stage and Corridor
Grade	Levels used for grading and cross-sections
HwyStandard	Levels used for standard highway details
Hydraulics - Plan	Levels used for drainage
Hydraulics - Profile	Levels used for drainage
IDS	Levels used for intersection design studies
Landscaping	Levels used for landscaping layout
Lighting ↳ ExistingLi ↳ ProposedLi	Levels used for lighting layout ↳ Existing lighting features only ↳ Proposed lighting features only
Mapping	Levels used for GIS Mapping
Notation	Levels used for annotation including alignments, bridge dimensions, rights of way, property and various others.
PlotControls ↳ Alignments ↳ AlignmentsEX ↳ AlignmentPR ↳ DrainageEX ↳ DrainagePC ↳ DrainagePR ↳ DrainageProfile ↳ DrainageProfileLT ↳ DRainageProfileRT	The plot control level filters are a superset of filters defined elsewhere in this table and include additional levels such that a standard plotted sheet is viewed. For example, the Alignments filter shown under PlotControls is similar to the Alignment filter above but also includes levels for sheets, topo and right of way which would appear on a typical sheet.

Table Appendix B.2 - Level Filters	
Filter Name	Description of Levels Isolated by the Filter
↳ ErosionControlPC ↳ GeneralPlan ↳ GeneralPlanEx ↳ GeneralPlanPR ↳ GroundProfile ↳ HighwayLighting ↳ HighwayLightingEX ↳ HighwayLightingPR ↳ IDS-PC ↳ LandscapingPC ↳ PavementMarking ↳ PlatofHighway ↳ SoilBorings ↳ TOPO ↳ TrafficSignalsEX ↳ TrafficSignalsPR ↳ TrafficSignalsTemp ↳ UtilitiesPC	
Removal	Levels used to designate features to be removed or demolished.
Roadway	Levels (existing and proposed) which affect roadway design.
ROW ↳ ExistingROW ↳ ProposedROW	Levels used for right of way layout ↳ Existing right of way only ↳ Proposed right of way only
Sheets Drainage Maps Erosion Control Existing Contours Pavement Marking Present Layout	Levels used for various sheet borders and boundaries.

Table Appendix B.2 - Level Filters	
Filter Name	Description of Levels Isolated by the Filter
Present Layout no ROW Profiles Profiles with V7 Levels Property Map Property Maps Proposed Contours Proposed Layout ROW Details Traffic Control Utilities	
Signalization - Existing	Existing Signalization Levels
Signalization - Proposed	Proposed Signalization Levels
Site	Levels used for archaeological site designation
Soils	Levels used for soils investigations and depictions.
StageConstruction	Levels used to depict all stage construction activities such as stated traffic control, erosion control and roadway features.
Structures	Levels used to depict existing and proposed bridge, wall, and other structures.
SubgradeSurface	Levels used to depict the subgrade model and cross-sections
Survey All All but Points All with Point Elevations All with Point Locations All with Point Numbers Drainage DTM Non-Transportation Points	Various configurations of Aerial Survey Levels

Table Appendix B.2 - Level Filters	
Filter Name	Description of Levels Isolated by the Filter
Profile Property Transportation Utilities	
Terrain	All levels used for depiction of terrain models
ToBeDeleted	
Topography	Levels used for depiction of existing topographic features
TrafficSignal ↳ ExistingTS ↳ ProposedTS	Levels used to depict traffic signal features ↳ Existing traffic signals ↳ Proposed traffic signals
Utilities ↳ AboveGroundEX ↳ AboveGroundPR ↳ UndergroundEX ↳ UndergroundPR	Includes all utility levels ↳ Above ground existing utilities only ↳ Above ground proposed utilities only ↳ Underground existing utilities only ↳ Underground proposed utilities only
Utilities - All	Includes all utility levels
Utilities – Plan w/o Points	Includes all utility levels
XSCriteria	Levels used to depict cross-sections generated from model
XSPlanView ↳ XSDitchandLOC ↳ XSPatternLines ↳ XSPavementShapes	Levels used for plan view features related to cross-sections ↳ Levels used to designate special ditch locations and limits of construction ↳ Levels used for showing the location of pattern lines ↳ Levels used to designate shapes used for pavement superelevation and stage construction.

APPENDIX C – LINE STYLES

The workspace contains a variety of numbered line styles. These are included in the workspace ONLY for convenience when opening projects created in GEOPAK V8i Select Series 2 and earlier. These line styles are not defined for use with annotation scale as defined in this manual. The numbered line styles SHALL NOT be used for projects created in the workspace described in this manual.

Table Appendix C.1 – IDOT Custom Line Styles

Line Style Name	Image
Cable Aerial	
Cable Barrier Existing	
Cable Barrier Proposed	
Cable Conduit	
Cable in Duct	
Centerline	
Concrete Barrier	
Concrete Barrier Temporary	
Construction Drums	
Ditch Aggregate	
Ditch Paved	
Drainage Boundary	
Drainage Divide	
Drainage Floodplain	
Drainage Floodway	
Easement	
Easement Temporary	

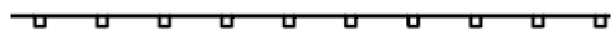
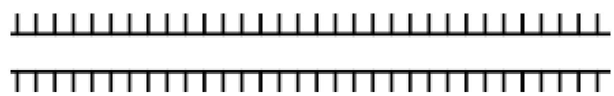
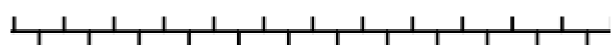
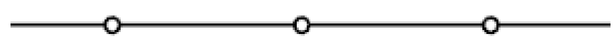
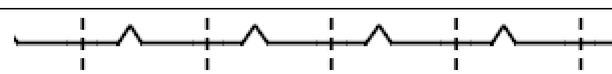
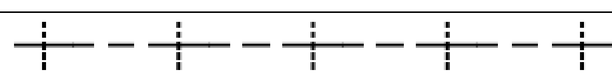
Table Appendix C.1 – IDOT Custom Line Styles	
Line Style Name	Image
Erosion Clearing	
Erosion Control Fence	
Erosion Perimeter Barrier	
Erosion Dike	
Erosion Fence Temporary	
Fence	
Guardrail Existing	
Guardrail Existing Rt	
Guardrail Proposed	
Guardrail Proposed Rt	
Levee	
Levee base	
Levee Large Scale	
Line (4”) 3/9	
Line (4”) 6/3	
Mowline	
Pavement Joint Keyed	
Pavement Joint Keyed WO Bars	
Pavement Joint Sawed	
Pipe Underdrain Existing	
Pipe Underdrain Proposed	

Table Appendix C.1 – IDOT Custom Line Styles	
Line Style Name	Image
PMK Amber1 Marker 40	
PMK Amber1 Marker 80	
PMK Amber2 Marker 40	
PMK Amber2 Marker 80	
PMK Centerline Double	
PMK Centerline Double Existing	
PMK Centerline Marker 40	
PMK Centerline Marker 80	
PMK Centerline Multilane	
PMK Crystal Marker 40	
PMK Crystal Marker 80	
PMK Dotted	
PMK Dotted Existing	
PMK LaneLine Marker 40	
PMK LaneLine Marker 80	
PMK LaneLine Marker Dbl	
PMK SkipDash Dot	
PMK SkipDash Solid	
PMK SkipDash Taper Ex	
PMK SkipDash Taper Pr	
PMK SkipDash Turnlane Ex	
PMK SkipDash Turnlane Pr	

Table Appendix C.1 – IDOT Custom Line Styles	
Line Style Name	Image
PMK Skip Dash White	
PMK Skip Dash Yellow	
PMK StopLine Proposed	
PMK StopLine Existing	
PMK TurnLane	
Property	
Quarter Quarter Section Existing	
Quarter Section Existing	
Railroad Abandoned LargeScale	
Railroad Abandoned	
Railroad LargeScale	
Railroad Track	
Removal Items	
Ret Wall Ex	
ROW AccessControl Existing	
ROW AccessControl ROW Existing	
ROW AccessControl ROW Fence	
ROW AccessControl Proposed	
ROW AccessControl ROW Proposed	
ROW AccessControl ROW Fence Proposed	
ROW ExcessPropertyLimits	
ROW Existing	

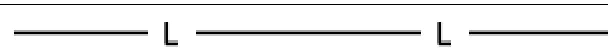
Table Appendix C.1 – IDOT Custom Line Styles	
Line Style Name	Image
ROW Proposed	
Section	
Sheet Piling	
Shoulder Aggregate	
Shrubs	
Storm Sewer Existing	
Storm Sewer Proposed	
Underground Cable	
Underground CableTV	
Underground CableTV AB	
Underground Combined Sewer AB	
Underground Conduit	
Underground Electric	
Underground Electric AB	
Underground FiberOptic	
Underground FiberOptic AB	
Underground Gasline	
Underground Gasline AB	
Underground Lighting	
Underground Oil	
Underground Oil AB	

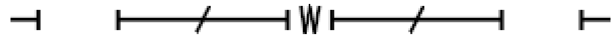
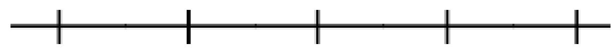
Table Appendix C.1 – IDOT Custom Line Styles	
Line Style Name	Image
Underground Sanitary Sewer	
Underground Telephone	
Underground Water	
Underground Water AB	
V8BDEBreakline	
V8BDECenterline	
V8Breakline	
V8Centerline	
V8CutLine	
V8IntStream	
V8Naturalgnd	
V8Railroad	
V8RightofWay	
V8RipRap	
V8Stremlin	
Vegetation	
Water Edge	
Woods Brush	

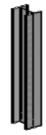
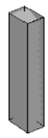
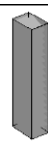
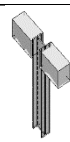
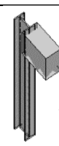
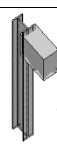
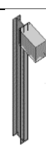
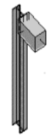
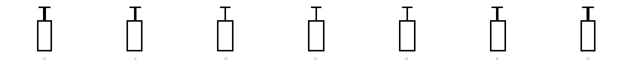
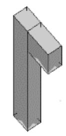
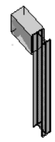
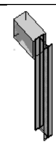
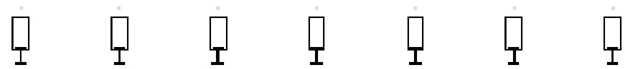
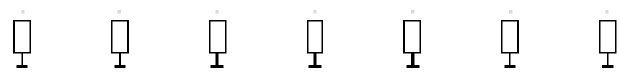
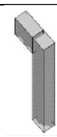
Table Appendix C.2 – IDOT Custom 3D Line Styles		
Line Style Name	3D image	Linear image
3D CRG LT - Steel Post - 1 Strand		
3D CRG LT - Steel Post - 4 Strand		
3D CRG LT - Wood Post - 1 Strand		
3D CRG RT - Steel Post - 1 Strand		
3D CRG RT - Steel Post - 4 Strand		
3D CRG RT - Wood Post - 1 Strand		
3D Guardrail - Steel Post 6 - Type D		
3D Guardrail LT - Steel Post 6 - Type A		
3D Guardrail LT - Steel Post 6 - Type B		
3D Guardrail LT - Steel Post 9 - Type A		

Table Appendix C.2 – IDOT Custom 3D Line Styles		
Line Style Name	3D image	Linear image
3D Guardrail LT - Steel Post 9 - Type B		
3D Guardrail LT - Wood Post 6 - Type A		
3D Guardrail RT - Steel Post 6 - Type A		
3D Guardrail RT - Steel Post 6 - Type B		
3D Guardrail RT - Steel Post 9 - Type A		
3D Guardrail RT - Steel Post 9 - Type B		
3D Guardrail RT - Wood Post 6 - Type A		

APPENDIX D – TEXT STYLES

Civil, Roadway and Structures text sizes shown in this table are the raw size without scale factor. When used with annotation scale lock turned on, the final size is the product of the size shown here multiplied by scale. For example, a label using text style Civil Existing using an annotation scale of 1" = 50' would result in a final text size of 6.0 feet (or 0.12 inches when plotted on paper).

Table Appendix D.1 - Roadway Text Styles

Text Style	Font	Height (ft.)	Width (ft.)	Line Spacing (%)	Justification	Description
Civil Existing	FDOT Vert	0.01	0.01	50	Left Center	Used for labeling of existing features.
Civil Major Contour	FDOT Vert	0.015	0.015	50	Center Center	Used in Element Templates assigned to feature definitions for labeling of contours.
Civil Major Contour 200	FDOT Vert	0.0333	0.0333	50	Center Center	Used in Element Templates assigned to feature definitions for labeling of contours.
Civil Minor Contour	FDOT Vert	0.01	0.01	50	Center Center	Used in Element Templates assigned to feature definitions for labeling of contours.
Civil Minor Contour 200	FDOT Vert	0.0333	0.0333	50	Center Center	Used in Element Templates assigned to feature definitions for labeling of contours.
Civil Proposed	FDOT Vert	0.01	0.01	50	Left Center	Used for labeling of proposed design features.
Civil Terrain Points	FDOT Vert	0.002	0.002	50	Center Center	Used in Element Templates assigned to feature definitions for labeling of terrain model vertices.

Table Appendix D.1 - Roadway Text Styles						
Text Style	Font	Height (ft.)	Width (ft.)	Line Spacing (%)	Justification	Description
Civil Title	Malgun Gothic	0.210	0.210	50	Left Center	Used for Title Sheet.
Extra Small CenterCenter	FDOT Vert	.0001	.0001	50	Center Center	Used only in element templates which are linked to a feature definition. In these feature definitions, a small X is placed using this font to mark a spot for later annotation on the cross-section. This style is not used for normal plans production activities.
Rdwy_exhibit100	FDOT Vert	0.0083	0.0083	80	Left Center	Used for annotation of exhibits. Final plot size equal to 0.100 in.
Rdwy_exhibit120	FDOT Vert	0.01	0.01	80	Left Center	Used for annotation of exhibits. Final plot size equal to 0.120 in.
Rdwy_exhibit140	FDOT Vert	0.0117	0.0117	80	Left Center	Used for annotation of exhibits. Final plot size equal to 0.140 in.
Rdwy_exhibit175	FDOT Vert	0.0146	0.0146	80	Left Center	Used for annotation of exhibits. Final plot size equal to 0.175 in.
Rdwy_schedule100	FDOT Vert Mono	0.0083	0.0083	80	Left Center	Mono-spaced font used for summary of quantity tables. Final plot size equal to 0.100 in.
Rdwy_schedule120	FDOT Vert Mono	0.01	0.01	80	Left Center	Mono-spaced font used for summary of quantity tables. Final plot size equal to 0.120 in.

Table Appendix D.1 - Roadway Text Styles						
Text Style	Font	Height (ft.)	Width (ft.)	Line Spacing (%)	Justification	Description
Rdwy_schedule140	FDOT Vert Mono	0.0117	0.0117	80	Left Center	Mono-spaced font used for summary of quantity tables. Final plot size equal to 0.140 in.
Rdwy_schedule175	FDOT Vert Mono	0.0146	0.0146	80	Left Center	Mono-spaced font used for summary of quantity tables. Final plot size equal to 0.175 in.
Rdwy_SOQ140	FDOT Vert Mono	0.0117	0.0117	80	Left Center	Mono-spaced font with a background used for summary of quantity tables. Final plot size equal to 0.140 in.
Rdwy_text100	FDOT Vert	0.0083	0.0083	80	Left Center	Used for annotation of roadway plans. Final plot size equal to 0.100 in.
Rdwy_text100Italics	FDOT Vert	0.0083	0.0083	80	Left Center	Italics style used for annotation of roadway plans. Final plot size equal to 0.100 in.
Rdwy_text100Bold	FDOT Vert Bold	0.0083	0.0083	80	Left Center	Bold face style used for annotation of roadway plans. Final plot size equal to 0.100 in.
Rdwy_text120	FDOT Vert	0.01	0.01	80	Left Center	Used for annotation of roadway plans. Final plot size equal to 0.120 in.

Table Appendix D.1 - Roadway Text Styles

Text Style	Font	Height (ft.)	Width (ft.)	Line Spacing (%)	Justification	Description
Rdwy_text120Italics	FDOT Vert	0.01	0.01	80	Left Center	Italics style used for annotation of roadway plans. Final plot size equal to 0.120 in.
Rdwy_text120Bold	FDOT Vert Bold	0.01	0.01	80	Left Center	Bold face style used for annotation of roadway plans. Final plot size equal to 0.120 in.
Rdwy_text140	FDOT Vert	0.0117	0.0117	80	Left Center	Used for annotation of roadway plans. Final plot size equal to 0.140 in.
Rdwy_text140Italics	FDOT Vert	0.0117	0.0117	80	Left Center	Italics Style used for annotation of roadway plans. Final plot size equal to 0.140 in.
Rdwy_text140Bold	FDOT Vert Bold	0.0117	0.0117	80	Left Center	Bold face style used for annotation of roadway plans. Final plot size equal to 0.140 in.
Rdwy_text175	FDOT Vert	0.0146	0.0146	80	Left Center	Used for annotation of roadway plans. Final plot size equal to 0.175 in.
Rdwy_text175Italics	FDOT Vert	0.0146	0.0146	80	Left Center	Italics style used for annotation of roadway plans. Final plot size equal to 0.175 in.
Rdwy_text175Bold	FDOT Vert Bold	0.0146	0.0146	80	Left Center	Bold face style used for annotation of roadway plans. Final plot size equal to 0.175 in.

Table Appendix D.1 - Roadway Text Styles						
Text Style	Font	Height (ft.)	Width (ft.)	Line Spacing (%)	Justification	Description
Rdwy_title200	Swiss Bold Condensed	0.20	0.20	80	Left Center	Used for annotation of title sheets. Final plot size equal to 0.200 in.
Rdwy_title240	Swiss Bold Condensed	0.24	0.24	80	Left Center	Used for annotation of title sheets. Final plot size equal to 0.240 in.
Rdwy_title350	Swiss Bold Condensed	0.35	0.35	80	Left Center	Used for annotation of title sheets. Final plot size equal to 0.350 in.
Rdwy_title500	Swiss Bold Condensed	0.50	0.50	80	Left Center	Used for annotation of title sheets. Final plot size equal to 0.500 in.
Rdwy_xsect120	FDOT	0.01	0.01	80	Left Center	Used for annotation of cross-section sheets. Final plot size equal to 0.120 in.
Rdwy_xsect140	FDOT	0.0117	0.0117	80	Left Center	Used for annotation of cross-section sheets. Final plot size equal to 0.140 in.
Rdwy_xsect175	FDOT	0.0146	0.0146	80	Left Center	Used for annotation of cross-section sheets. Final plot size equal to 0.175 in.
Rdwy_xsect200	FDOT	0.0167	0.0167	80	Left Center	Used for annotation of cross-section sheets. Final plot size equal to 0.200 in.
Title Block	FDOT Vert	0.0083	0.0083	80	Left Top	Used for annotation of title block on title sheet. Final plot size equal to 0.100 in.

Table Appendix D.2 - Structures Text Styles						
Text Style	Font	Height (ft)	Width (ft)	Line Spacing (%)	Justification	Description
Br1:001scale100	FDOT	0.0083	0.0083	80	Left Center	Used for annotation of bridge design sheets. Final plot size equal to 0.100 in.
Br1:001scale140	FDOT	0.0117	0.0117	71	Left Center	Used for annotation of bridge design sheets. Final plot size equal to 0.140 in.
Br1:001scale200	FDOT	0.0167	0.0167	100	Center Center	Used for annotation of bridge design sheets. Final plot size equal to 0.200 in.
Br1:001scale_boring	FDOT Vert	0.0075	0.0075	100	Left Center	Used for annotation of bridge boring sheets.

APPENDIX E – GEOMETRY AND SURFACE FEATURE DEFINTIONS

The following list of feature definitions shall be used for geometry and terrain models.

Table Appendix E.1 – Geometry and Surface Feature Definitions

Category	Feature Definition Name (* Auto Export to GPK) (** Auto Export and Annotate)	Descriptions?
Components\Drafting Artifacts	Draft_DNC	Used in roadway template components for features which are not presented in final model.
	Draft_XS_Material1	
	Draft_XS_Material2	
	Draft_XS_Sections	
	Draft_XS_Volume	
Components\Drainage	Channel_Concrete	Used in roadway templates for physical modeling of channels.
	Channel_RipRap	
Components\Existing	E_Road_Median	Used in roadway templates for modeling of existing features.
	E_Road_Pavement	
	E_Road_Topsoil	
	E_Struc_PavedArea	
	E_Terrain_Rock	
	E_Unsuitable_Material	
Components\Grading	Grade_ClearZone	Used in roadway templates for modeling of features related to end conditions.
	Grade_Cut	
	Grade_Cut Volume	

Table Appendix E.1 – Geometry and Surface Feature Definitions		
Category	Feature Definition Name (* Auto Export to GPK) (** Auto Export and Annotate)	Descriptions?
	Grade_Ditch	
	Grade_Fill	
	Grade_Fill Volume	
	Grade_Rock_Surface	
	Grade_Veg_Grass	
Components\Roadway	ExCurbGutter	Used in the backbone of roadway templates to depict Existing curb and gutter features
	ExGround	
	ExGuardRail	Existing Guardrail
	ExGuardRail_Block_Only	
	ExGuardRail_Post	
	ExGuardRail_Post_Only	
	ExHatching	
	ExPavement	Existing pavement surface
	ExROW	
	ExShoulder	Existing shoulder surface
	ExSidewalk	Existing sidewalk
	Overlay_Binder	Proposed overlay binder course
	Overlay_Leveling	Proposed overlay leveling course

Table Appendix E.1 – Geometry and Surface Feature Definitions		
Category	Feature Definition Name (* Auto Export to GPK) (** Auto Export and Annotate)	Descriptions?
	Overlay_Milling	Proposed overlay milling course
	PrAGGBaseCourse	Proposed base aggregate
	PrAGGSubbase1	Proposed sub-base aggregate
	PrAGGSubbase2	Proposed sub-base aggregate
	PrBridgeStructure	Proposed Bridges
	PrClearZone	Used to mark clear zone from the roadway template
	PrConcreteBarrier	Proposed concrete barrier wall
	PrCurbGutterA12	Proposed C&G type A12
	PrCurbGutterAB	Proposed C&G type AB
	PrCurbGutterB	Proposed C&G type B
	PrCurbGutterD	Proposed C&G type D
	PrCurbGutterM	Proposed C&G type M
	PrCurbGutterSurface	Concrete Curb and Gutter Depressed Surface; Conc Curb and Gutter M Surf
	PrDitch	Side slope in a ditch cut section; Special Ditch Backslope, Bottom
	PrDitchSurface	The top surface of ditch lining (soil, paved or stone)
	PrFinishGrade	Top Finished Surface
	PrFinishGradeRock	The finished surface of rock cuts

Table Appendix E.1 – Geometry and Surface Feature Definitions		
Category	Feature Definition Name (* Auto Export to GPK) (** Auto Export and Annotate)	Descriptions?
	PrGuardRail	Proposed guardrail in template
	PrHiddenDitch	
	PrHMABaseCourse	Proposed hot mix base
	PrHMABinderCourse	Proposed binder
	PrHMASubbase1	Proposed hot mix sub-base
	PrHMASubbase2	Proposed hot mix sub-base
	PrHMASurfaceCourse	Slope Correction Asphalt Surface; HMA Surface Course; Bottom of HMA surface course; HMA Surface Course Wedge; Crossover HMA
	PrPavedDitch	Paved Ditch
	PrPavedMedian	Bottom of urban median subgrade
	PrPavedMedianSurface	The proposed top surface of medians
	PrPavementSurface	The proposed top/finish pavement surface
	PrPavement	The proposed edges of top/finish pavement
	PrPCCSubbase1	Proposed concrete sub-base
	PrPCCSubbase2	Proposed concrete sub-base
	PrPCCSubbase3	Proposed concrete sub-base
	PrPCCSubbase4	Proposed concrete sub-base
	PrRaisedMedian	The edges of proposed raised medians.
	PrRetainingWall	Proposed Retaining Walls

Table Appendix E.1 – Geometry and Surface Feature Definitions		
Category	Feature Definition Name (* Auto Export to GPK) (** Auto Export and Annotate)	Descriptions?
	PrRevMat	
	PrRuralEntrance	The edges of proposed entrances
	PrRuralEntranceSubgrade	The subgrade surface of proposed entrances
	PrRuralEntranceSurface	The finish grade of proposed entrances
	PrShoulderAgg	Proposed aggregate under shoulder
	PrShoulderAggSubgrade	Proposed aggregate under shoulder
	PrShoulderEarthSurface	Proposed Shoulder with topsoil
	PrShoulderHMA	Proposed hot mix shoulder
	PrShoulderMedianAgg	Proposed Median Aggregate
	PrShoulderMedianPaved	Proposed median pavement
	PrShoulderPCC	Proposed concrete shoulder
	PrShoulderSurface	Proposed shoulder surface
	PrSidewalk	Proposed sidewalk
	PrSidewalkSurface	Surface of proposed sidewalk
	PrTopsoil	Proposed topsoil
	PrUrbanEntrance	The edges of proposed entrances
	PrUrbanEntranceSubgrade	The subgrade surface of proposed entrances
	PrUrbanEntranceSurface	The finish grade of proposed entrances
	PrWideningBottom	

Table Appendix E.1 – Geometry and Surface Feature Definitions		
Category	Feature Definition Name (* Auto Export to GPK) (** Auto Export and Annotate)	Descriptions?
	PrXover	
	Road_Curb	
	Road_Driveway	Edges of proposed driveways
	Road_Guardrail	Proposed guardrail
	Road_Guardrail_Block_Only	Guardrail blockout
	Road_Guardrail_Post	
	Road_Guardrail_Post_Only	Guardrail post
	Road_Median	
	Road_Pave_Aggregate	
	Road_Pave_Aggregate_B	
	Road_Pave_Asphalt	Asphalt Surface Pavement
	Road_Pave_Concrete	
	Road_Pave_Shoulder	
	Road_Pave_Subbase	
	Road_Pave_Subgrade	
	Road_PavedMedian	
	Road_Pavement	
	Road_Proposed_Subgrade	
	Road_Shoulder_Asphalt	

Table Appendix E.1 – Geometry and Surface Feature Definitions		
Category	Feature Definition Name (* Auto Export to GPK) (** Auto Export and Annotate)	Descriptions?
	Road_Shoulder_Concrete	Bottom of PCC shoulder
	Road_Shoulder_Earth	
	Road_Sidewalk	
Components\Structural	Bridge Abutment	Used in roadway templates for modeling of non-bridge structures
	Struc_Building	
	Struc_Parking	
	Struc_Wall	
	Struc_Wall_Footing	
	Struc_Wall_Type1	
	Struc_Wall_Type2	
	Struc_Wall_Type3	
	Struc_Wall_Type4	
	Struc_Wall_Type5	
Corridor Meshes	Bottom Mesh	Used in roadway templates for modeling of corridor surfaces. Bottom is subgrade surface; top is finish grade surface.
	Top Mesh	
Linear\Drafting Artifacts	Draft_DNC	Used in roadway templates for assignment to template points which are not part of final 3D model and does not create 2D geometry.

Table Appendix E.1 – Geometry and Surface Feature Definitions		
Category	Feature Definition Name (* Auto Export to GPK) (** Auto Export and Annotate)	Descriptions?
	Draft_DNC w/2d	Used in roadway templates for assignment to template points which are not part of final 3D model but 2D geometry is created.
Linear\Drainage\Existing	DrainaExAggregateDitch	Used for existing drainage linear features
	DrainExChannelorStream	
	DrainEXDivideArea	
	DrainEXDrainageBoundary	
	DrainEXFloodplainBoundary	
	DrainEXFloodwayBoundary	
	DrainEXHydraulicStudy	
	DrainEXLandUse	
	DrainEXPavedDitch	
	DrainEXPipeCulvert	
	DrainEXPipeUnderdrain	
	DrainEXProfileLeftside	
	DrainEXProfileRightside	
	DrainEXStormSewer	
Linear\Drainage\Proposed	DrainPR	Used for proposed drainage linear features
	DrainPRAdjustmentItems	
	DrainPRChannelorStream	

Table Appendix E.1 – Geometry and Surface Feature Definitions		
Category	Feature Definition Name (* Auto Export to GPK) (** Auto Export and Annotate)	Descriptions?
	DrainPRDrainageBoundary	
	DrainPRFloodplainBoundary	
	DrainPRFloodwayBoundary	
	DrainPRGradeShapeDitch	
	DrainPRHydraulicStudy	
	DrainPRPipeCulvert	
	DrainPRPipeUnderdrain	
	DrainPRProfileLeftside	
	DrainPRProfileRightside	
	DrainPRStormSewer	
Linear\Drainage	Paved Channel	
	Trap Channel	
	UtilTrenchOSHATyAMax8	
	UtilTrenchOSHATyAMax12	
	V Channel	
Linear\Existing	E_Terrain_Contour_Major	Existing Contour Lines
	E_Terrain_Contour_Minor	
Linear\Geometry\Alignment\Existing	Geom_Ex_Baseline **	Existing baseline. Links to DDB item Ex_Baseline.
	Geom_Ex_Centerline **	Existing centerline. Links to DDB item Ex_CntrLine.

Table Appendix E.1 – Geometry and Surface Feature Definitions		
Category	Feature Definition Name (* Auto Export to GPK) (** Auto Export and Annotate)	Descriptions?
Linear\Geometry\Alignment\Proposed	Geom_Pr_Baseline **	Proposed baseline. Links to DDB item PR_Baseline.
	Geom_Pr_Centerline **	Proposed centerline. Links to DDB item PR_CenterLine.
Linear\Alignment\Alignment Alternate\Proposed\Alternate	Geom_Pr_Alternate **	Proposed alternate alignment. Links to DDB item AlignAlt.
Linear\Alignment\Alignment Alternate\Proposed\Detour	Geom_Pr_Detour **	Proposed detour alignment. Links to DDB item Align_Detour.
Linear\Alignment\Alignment Alternate\Proposed\Stage Construction	Geom_Pr_Stage **	Proposed stage construct alignment. Links to DDB item StageConst.
Linear\Geometry	Geom_PropertyLine	Property Lines
	Geom_Ramp *	
	Geom_Scratch	
	Geom_Traverse	
	Geom_Vertical	
	Matchline	
Linear\Grading	Grade_Bench	Used in roadway templates to create linear features from templates
	Grade_Berm	
	Grade_ClearZoneLine	
	Grade_CutLine	
	Grade_Daylight	

Table Appendix E.1 – Geometry and Surface Feature Definitions		
Category	Feature Definition Name (* Auto Export to GPK) (** Auto Export and Annotate)	Descriptions?
	Grade_Ditch_Backslope	
	Grade_Ditch_Foreslope	
	Grade_DitchBottom	
	Grade_DitchBottom_Outside	
	Grade_DitchLine	
	Grade_DitchTop_Line	
	Grade_FillLine	
	Grade_Fixed_Tie	
	Grade_Hinge	
	Grade_Levee	
	Grade_RockLine	
Linear\Pavement Marking	PM_Pr 2Way Lt Turn Ln	Linear feature definitions for striping
	PM_Pr CL Markers 40	
	PM_Pr CL Markers 80	
	PM_Pr CL Multilane	
	PM_Pr Dotted Line	
	PM_Pr Double Centerline	
	PM_Pr Labels	
	PM_Pr LaneLine Dbl Mrk	

Table Appendix E.1 – Geometry and Surface Feature Definitions		
Category	Feature Definition Name (* Auto Export to GPK) (** Auto Export and Annotate)	Descriptions?
	PM_Pr LaneLine Marker 40	
	PM_Pr LaneLine Marker 80	
	PM_Pr Private PM	
	PM_Pr Skip-Dash White	
	PM_Pr Skip-Dash Yellow	
	PM_Pr Solid Line	
	PM_Pr Solid Line White	
	PM_Pr Stop Line	
	PM_Pr Symbols	
	PM_Pr Temporary	
Linear\Profile\Bike Path Profile\Existing	Prof_Ex_Bike Path	
Linear\Profile\Bike Path Profile\Proposed	Prof_Pr_Bike Path	
Linear\Profile\Ditch Profile\Existing\Left Ditch Profile	Prof_Ex_SpDitch_L	
Linear\Profile\Ditch Profile\Existing\Right Ditch Profile	Prof_Ex_SpDitch_R	
Linear\Profile\Ditch Profile\Proposed\Left Ditch Profile	Prof_Pr_SpDitch_L	

Table Appendix E.1 – Geometry and Surface Feature Definitions		
Category	Feature Definition Name (* Auto Export to GPK) (** Auto Export and Annotate)	Descriptions?
Linear\Profile\Ditch Profile\Proposed\Right Ditch Profile	Prof_Pr_SpDitch_R	
Linear\Profile\Ground Profile\Existing	Prof_Ex_Ground	
Linear\Profile\Ground Profile\Proposed	Prof_Pr_Ground	
Linear\Profile\Storm Sewer Profile\Existing\Left Storm Sewer Profile	Prof_Ex_StSewer_L	
Linear\Profile\Storm Sewer Profile\Existing\Right Storm Sewer Profile	Prof_Ex_StSewer_R	
Linear\Profile\Storm Sewer Profile\Proposed\Left Storm Sewer Profile	Prof_Pr_StSewer_L	
Linear\Profile\Storm Sewer Profile\Proposed\Right Storm Sewer Profile	Prof_Pr_StSewer_R	
Linear\Right of Way	Road_Ex ROW AC Line	Linear features for right of way
	Road_Ex ROW AC&ROW Line	
	Road_Ex ROW AC&ROW&Fence Line	
	Road_Ex ROW Easemt Line	

Table Appendix E.1 – Geometry and Surface Feature Definitions		
Category	Feature Definition Name (* Auto Export to GPK) (** Auto Export and Annotate)	Descriptions?
	Road_Ex ROW Line	
	Road_Pr ROW AC Line	
	Road_Pr ROW AC&ROW Line	
	Road_Pr ROW AC&ROW&Fence Line	
	Road_Pr ROW Excess Prp Line	
	Road_Pr ROW Line	
	Road_Pr ROW Perm Easemt	
	Road_Pr ROW Temp Easemt	
Linear\Roadway	Design_CC_Constr_1	Used for Civil cells as construction elements
	Design_CC_Constr_2	
	Design_CC_Constr_3	
	Design_CC_Constr_4	
	Design_CC_Constr_5	
	Design_CC_Constr_6	
	Design_CC_Constr_7	
	Design_CC_Constr_8	
	Design_CC_Constr_9	
	Design_CC_Intersection	

Table Appendix E.1 – Geometry and Surface Feature Definitions		
Category	Feature Definition Name (* Auto Export to GPK) (** Auto Export and Annotate)	Descriptions?
	Design_CC_IntersectionLR	
	Design_CC_XOVER	
	Road_Ex Alignment BL	Linear features related to road geometry
	Road_Ex Alignment BL Bot	
	Road_Ex Alignment CL	
	Road_Ex Alignment CL Bot	
	Road_Ex Curb & Gutter PCC	
	Road_Ex Curb & Gutter PCC Bot	
	Road_Ex Curb Back	
	Road_Ex Curb Back Bot	
	Road_Ex Curb Edge	
	Road_Ex Curb Edge Bot	
	Road_Ex Curb Face	
	Road_Ex Curb Face Bot	
	Road_Ex Curb FL	
	Road_Ex Curb FL Bot	
	Road_Ex Ditch Paved	
	Road_Ex Entrance	

Table Appendix E.1 – Geometry and Surface Feature Definitions		
Category	Feature Definition Name (* Auto Export to GPK) (** Auto Export and Annotate)	Descriptions?
	Road_Ex Entrance Bot	
	Road_Ex Ditch Paved Bot	
	Road_Ex Guardrail Line	
	Road_Ex Guardrail Post	
	Road_Ex Guardrail PostOnly	
	Road_Ex Guardrail SPB	
	Road_Ex Gutter TA	
	Road_Ex Gutter TA Bot	
	Road_Ex Gutter TA Mod	
	Road_Ex Gutter TA Mod Bot	
	Road_Ex Gutter TB	
	Road_Ex Gutter TB Bot	
	Road_Ex Path Bike	
	Road_Ex Path Bike Bot	
	Road_Ex Path MUse	
	Road_Ex Path MUse Bot	
	Road_Ex Pavt	
	Road_Ex Pavt Bot	
	Road_Ex Shoulder	

Table Appendix E.1 – Geometry and Surface Feature Definitions		
Category	Feature Definition Name (* Auto Export to GPK) (** Auto Export and Annotate)	Descriptions?
	Road_Ex Shoulder AGG	
	Road_Ex Shoulder AGG Bot	
	Road_Ex Shoulder Bot	
	Road_Ex Shoulder HMA	
	Road_Ex Shoulder HMA Bot	
	Road_Ex Shoulder PCC	
	Road_Ex Shoulder PCC Bot	
	Road_Ex Sidewalk_Back	
	Road_Ex Sidewalk_Back Bot	
	Road_Ex Sidewalk_Front	
	Road_Ex Sidewalk_Front Bot	
	Road_Pr Alignment BL	
	Road_Pr Alignment BL Bot	
	Road_Pr Alignment CL	
	Road_Pr Alignment CL Bot	
	Road_Pr Barrier Cable	
	Road_Pr Barrier Concrete	
	Road_Pr Barrier Concrete Bot	
	Road_Pr Barrier Line	

Table Appendix E.1 – Geometry and Surface Feature Definitions		
Category	Feature Definition Name (* Auto Export to GPK) (** Auto Export and Annotate)	Descriptions?
	Road_Pr Box Culvert Hdwl	
	Road_Pr Bridge	
	Road_Pr Bridge Bot	
	Road_Pr Bridge Pier	
	Road_Pr CL	
	Road_Pr Clear Zone	
	Road_Pr Curb Back	
	Road_Pr Curb Back Bot	
	Road_Pr Curb Edge	
	Road_Pr Curb Edge Bot	
	Road_Pr Curb Face	
	Road_Pr Curb FL	
	Road_Pr Curb FL Bot	
	Road_Pr Ditch Agg	
	Road_Pr Ditch Paved	
	Road_Pr Ditch Paved Bot	
	Road_Pr Ditch Swale	
	Road_Pr Entrance	
	Road_Pr Entrance Bot	

Table Appendix E.1 – Geometry and Surface Feature Definitions		
Category	Feature Definition Name (* Auto Export to GPK) (** Auto Export and Annotate)	Descriptions?
	Road_Pr Entrance Commercial	
	Road_Pr Entrance Field	
	Road_Pr Entrance MailBox	
	Road_Pr Entrance Private	
	Road_Pr Entrance Subgrade	
	Road_Pr Entrance Subgrade Bot	
	Road_Pr Entrance_Back	
	Road_Pr Entrance_Back Bot	
	Road_Pr Entrance_Front	
	Road_Pr Entrance_Front Bot	
	Road_Pr EOL	
	Road_Pr EOL Bot	
	Road_Pr EOP	
	Road_Pr EOP Bot	
	Road_Pr EOP Intersection	
	Road_Pr EOP_Inside	
	Road_Pr EOP_Inside Bot	
	Road_Pr EOP_Outside	

Table Appendix E.1 – Geometry and Surface Feature Definitions		
Category	Feature Definition Name (* Auto Export to GPK) (** Auto Export and Annotate)	Descriptions?
	Road_Pr EOP_Outside Bot	
	Road_Pr Finish Grade	
	Road_Pr Finish Grade Bot	
	Road_Pr Finish Grade Rock	
	Road_Pr Glarescreen	
	Road_Pr Grade Break	
	Road_Pr Guardrail Anchor	
	Road_Pr Guardrail Line	
	Road_Pr Guardrail Post	
	Road_Pr Guardrail PostOnly	
	Road_Pr Guardrail SPB	
	Road_Pr Gutter TA Back	
	Road_Pr Gutter TA Back Bot	
	Road_Pr Gutter TA FL	
	Road_Pr Gutter TA FL Bot	
	Road_Pr Gutter TAMod Back	
	Road_Pr Gutter TAMod Back Bot	
	Road_Pr Gutter TAMod FL	

Table Appendix E.1 – Geometry and Surface Feature Definitions		
Category	Feature Definition Name (* Auto Export to GPK) (** Auto Export and Annotate)	Descriptions?
	Road_Pr Gutter TAMod FL Bot	
	Road_Pr Gutter TB Back	
	Road_Pr Gutter TB Back Bot	
	Road_Pr Gutter TB FL	
	Road_Pr Gutter TB FL Bot	
	Road_Pr Hinge	
	Road_Pr Limit of Construction	
	Road_Pr Median PCC	
	Road_Pr Median PCC Bot	
	Road_Pr Null Point	
	Road_Pr Path HMA Bike	
	Road_Pr Path HMA Bike Bot	
	Road_Pr Path HMA MUse	
	Road_Pr Path HMA MUse Bot	
	Road_Pr Pavt AGG Subbase1	
	Road_Pr Pavt AGG Subbase1 Bot	
	Road_Pr Pavt AGG Subbase2	

Table Appendix E.1 – Geometry and Surface Feature Definitions		
Category	Feature Definition Name (* Auto Export to GPK) (** Auto Export and Annotate)	Descriptions?
	Road_Pr Pavt AGG Subbase2 Bot	
	Road_Pr Pavt Agg Surf Cse	
	Road_Pr Pavt Agg Surf Cse Bot	
	Road_Pr Pavt Base	
	Road_Pr Pavt Base Bot	
	Road_Pr Pavt Binder	
	Road_Pr Pavt Binder Bot	
	Road_Pr Pavt HMA	
	Road_Pr Pavt HMA Base	
	Road_Pr Pavt HMA Base Bot	
	Road_Pr Pavt HMA Binder	
	Road_Pr Pavt HMA Binder Bot	
	Road_Pr Pavt HMA Bot	
	Road_Pr Pavt HMA Subbase1	
	Road_Pr Pavt HMA Subbase1 Bot	
	Road_Pr Pavt HMA Subbase2	
	Road_Pr Pavt HMA Subbase2 Bot	

Table Appendix E.1 – Geometry and Surface Feature Definitions		
Category	Feature Definition Name (* Auto Export to GPK) (** Auto Export and Annotate)	Descriptions?
	Road_Pr Pavt PCC	
	Road_Pr Pavt PCC Bot	
	Road_Pr Pavt PCC Subbase1	
	Road_Pr Pavt PCC Subbase1 Bot	
	Road_Pr Pavt PCC Subbase2	
	Road_Pr Pavt PCC Subbase2 Bot	
	Road_Pr Pavt PCC Subbase3	
	Road_Pr Pavt PCC Subbase3 Bot	
	Road_Pr Pavt PCC Subbase4	
	Road_Pr Pavt PCC Subbase4 Bot	
	Road_Pr Retaining Wall	
	Road_Pr Retaining Wall Bot	
	Road_Pr Saw Cut Line	
	Road_Pr Saw Cut Line Bot	
	Road_Pr Shoulder Agg	
	Road_Pr Shoulder Agg Bot	

Table Appendix E.1 – Geometry and Surface Feature Definitions		
Category	Feature Definition Name (* Auto Export to GPK) (** Auto Export and Annotate)	Descriptions?
	Road_Pr Shoulder Agg Med	
	Road_Pr Shoulder Agg Med Bot	
	Road_Pr Shoulder AggTA	
	Road_Pr Shoulder AggTA Bot	
	Road_Pr Shoulder AggTB	
	Road_Pr Shoulder AggTB Bot	
	Road_Pr Shoulder Earth	
	Road_Pr Shoulder Earth Bot	
	Road_Pr Shoulder HMA	
	Road_Pr Shoulder HMA Bot	
	Road_Pr Shoulder HMA Med	
	Road_Pr Shoulder HMA Med Bot	
	Road_Pr Shoulder Inside	
	Road_Pr Shoulder Inside Bot	
	Road_Pr Shoulder Outside	
	Road_Pr Shoulder Outside Bot	
	Road_Pr Shoulder PCC	
	Road_Pr Shoulder PCC Bot	

Table Appendix E.1 – Geometry and Surface Feature Definitions		
Category	Feature Definition Name (* Auto Export to GPK) (** Auto Export and Annotate)	Descriptions?
	Road_Pr Shoulder PCC Med	
	Road_Pr Shoulder PCC Med Bot	
	Road_Pr Side Road	
	Road_Pr Sidewalk	
	Road_Pr Sidewalk Bot	
	Road_Pr Sidewalk PCC Ins	
	Road_Pr Sidewalk PCC Ins Bot	
	Road_Pr Sidewalk PCC Out	
	Road_Pr Sidewalk PCC Out Bot	
	Road_Pr Sidewalk Subgrade	
	Road_Pr Sidewalk_Back	
	Road_Pr Sidewalk_Back Bot	
	Road_Pr Sidewalk_Front	
	Road_Pr Sidewalk_Front Bot	
	Road_Pr Subgrade	
	Road_Pr Topsoil	
	Road_Pr Widening HMA	
	Road_Pr Widening HMA Bot	

Table Appendix E.1 – Geometry and Surface Feature Definitions		
Category	Feature Definition Name (* Auto Export to GPK) (** Auto Export and Annotate)	Descriptions?
	Road_Pr Widening PCC	
	Road_Pr Widening PCC Bot	
	Subgrade	
Linear\Safety & Structures\Cable Road Guard	Pr_CRG Left Steel 1 Strand	Linear feature definitions used for cable road guard geometry
	Pr_CRG Left Steel 4 Strand	
	Pr_CRG Left Wood 1 Strand	
	Pr_CRG Right Steel 1 Strand	
	Pr_CRG Right Steel 4 Strand	
	Pr_CRG Right Wood 1 Strand	
Linear\Safety & Structures\Guardrail\Existing	Ex_Guardrail Left type A	Linear feature definitions used for existing guardrail geometry
	Ex_Guardrail Right type A	
Linear\Safety & Structures\Guardrail\Proposed\6' Post	Pr_Guardrail Left Steel 6 Ft Type A	Linear feature definitions used for proposed guardrail geometry
	Pr_Guardrail Left Steel 6 Ft Type B	
	Pr_Guardrail Right Steel 6 Ft Type A	

Table Appendix E.1 – Geometry and Surface Feature Definitions		
Category	Feature Definition Name (* Auto Export to GPK) (** Auto Export and Annotate)	Descriptions?
	Pr_Guardrail Right Steel 6 Ft Type B	
	Pr_Guardrail Type D	
Linear\Safety & Structures\Guardrail\Proposed\9' Post	Pr_Guardrail Left Steel 9 Ft Type A	Linear feature definitions used for proposed guardrail geometry
	Pr_Guardrail Left Steel 9 Ft Type B	
	Pr_Guardrail Right Steel 9 Ft Type A	
	Pr_Guardrail Right Steel 9 Ft Type B	
Linear\Safety & Structures\Guardrail\Proposed\Wood Post	Pr_Guardrail Left Wood 6 Ft Type A	Linear feature definitions used for proposed guardrail geometry
	Pr_Guardrail Right Wood 6 Ft Type A	
Linear\Structural	Structures_Pr_Box Culv	
	Structures_Pr_Box Culv Hd	
	Structures_Pr_Bridge	
	Structures_Pr_Bridge Pier	
	Structures_Pr_Ret Wall	

Table Appendix E.1 – Geometry and Surface Feature Definitions		
Category	Feature Definition Name (* Auto Export to GPK) (** Auto Export and Annotate)	Descriptions?
	Structures_WallBottom	
	Structures_WallHoriz	
	Structures_WallPerch	
	Structures_WallTop	
Linear\Terrain Feature	Terrain_Breakline	Linear features used in terrain models
	Terrain_Exterior	
	Terrain_Interior	
Points	Geom_Control	
	Geom_Key	
	Geom_PI	
	Geom_PropertyCorner	
	Iron Pin Found	
	Iron Pin Set	
	Lt Turn Arrow	
	Misc Point	
	Property Corner	
	ROW Monument	
	Rt Turn Arrow	
	Util_Pole	

Table Appendix E.1 – Geometry and Surface Feature Definitions		
Category	Feature Definition Name (* Auto Export to GPK) (** Auto Export and Annotate)	Descriptions?
Preliminary Planning\HMA Pavement\Divided	Divided Rural New HMA Pavt & Bit Shldrs	
	Divided Urban New HMA Pavt & B-6.24 w/ S/W	
Preliminary Planning\HMA Pavement\undivided	Undivided Rural New HMA Pavt & Bit Shldrs	
	Undivided Urban New HMA Pavt & B-6.24 w/ S/W	
Preliminary Planning\PCC Pavement\Divided	Divided Rural New PCC Pavt & Bit Shldrs	
	Divided Rural New PCC Pavt & PCC Shldrs	
	Divided Urban New PCC Pavt & B-6.24 w/ S/W	
Preliminary Planning\PCC Pavement\Undivided	Undivided Rural New PCC Pavt & Bit Shldrs	
	Undivided Rural New PCC Pavt & PCC Shldrs	
	Undivided Urban New PCC Pavt & B-6.24 w/ S/W	
IDOT Terrain Display	Design_Boundary	Used for terrain models Sets initial and default display to boundary for design terrain models.

Table Appendix E.1 – Geometry and Surface Feature Definitions		
Category	Feature Definition Name (* Auto Export to GPK) (** Auto Export and Annotate)	Descriptions?
	Design_Contours	Sets initial and default display to contours for design terrain models.
	Design_Contours and Triangles	Sets initial and default display to contours and triangles for design terrain models.
	Design_Thematic_Height	Sets initial and default display to thematic height for design terrain models.
	Design_Thematic_Slope	Sets initial and default display to thematic slope for design terrain models.
	Design_Triangles	Sets initial and default display to boundary for design terrain models.
	Existing_Boundary	Sets initial and default display to boundary for existing terrain models.
	Existing_Contours	Sets initial and default display to contours for existing terrain models.
	Existing_Contours and Triangles	Sets initial and default display to contours and triangles for existing terrain models.
	Existing_Contours and Triangles 200	Optimized for 200 scale map. Sets initial and default display to contours and triangles for existing terrain models.
	Existing_Survey	
	Existing_Thematic_Height	Sets initial and default display to thematic height for existing terrain models.
	Existing_Thematic_Slope	Sets initial and default display to thematic slope for existing terrain models.

Table Appendix E.1 – Geometry and Surface Feature Definitions		
Category	Feature Definition Name (* Auto Export to GPK) (** Auto Export and Annotate)	Descriptions?
	Existing_Triangles	Sets initial and default display to triangles for existing terrain models.
	Proposed_Building_Pad	Used for terrain models which represent graded pads for a proposed site design.
	Proposed_Grassy_Area	Used for terrain models used to represent grassed areas for a proposed site design.
	Rock_Existing_Boundary	Used for terrain models which represent the top of rock. Sets initial and default display to boundary.
	Rock_Existing_Contours	Used for terrain models which represent the top of rock. Sets initial and default display to contours.
	Rock_Existing_Triangles	Used for terrain models which represent the top of rock. Sets initial and default display to triangles.
	Temporary_Construction	Used for terrain models used for temporary surfaces which help define other surfaces in a site design workflow.
	Terrain_CC_Surface	Used for temporary surfaces in civil cells.
	Terrain_CC_Surface_Const	Used for temporary surfaces in civil cells.

APPENDIX F - UTILITY FEATURE DEFINTIONS

The following list of feature definitions shall be used for utilities and drainage models.

Table Appendix F.1 - Utility Feature Definitions

Category	Feature Definition Name	Descriptions
Catchments\Composite Areas	City Business Area	Land use for drainage run-off calculations
	City Dense Residential	
	Parks-Golf Course-Etc	
	Rural Districts	
	Suburban Residential	
Catchments\Earth Surfaces	Clay Bare	Land use for drainage run-off calculations
	Clay Dense Veg	
	Clay Light Veg	
	Gravel Bare	
	Gravel Dense Veg	
	Gravel Light Veg	
	Loam Bare	
	Loam Dense Veg	
	Loam Light Veg	
	Sand Bare	
	Sand Bare	
	Sand Dense Veg	

Table Appendix F.1 - Utility Feature Definitions		
Category	Feature Definition Name	Descriptions
	Sand Light Veg	
Catchments\Lawns	Lawns Heavy Soil 2%-7%	Land use for drainage run-off calculations
	Lawns Heavy Soil Flat 2%	
	Lawns Heavy Soil Steep 7%	
	Lawns Sandy 2%-7%	
	Lawns Sandy Flat 2%	
	Lawns Sandy Steep 7%	
Catchments\Pavement	Asphalt	Land use for drainage run-off calculations
	Concrete	
	Gravel	
	Roof	
Channels	Trap Channel Concrete	Trapezoidal shaped channels for drainage design – concrete lined
	Trap Channel Grass	Trapezoidal shaped channels for drainage design – grass lined
	V Channel Concrete	V shaped channels for drainage design – concrete lined
	V Channel Grass	V shaped channels for drainage design – grass lined
Conduits\Communications	CATV	Community Access Television Cable not in duct
	Comm Box Duct	Any communication lines or cables contained in a box shaped duct.
	Comm Circular Duct	Any communication lines or cables contained in a circular shaped duct.
	Fiber Optic Cable	Fiber Optic Cable not contained in a duct

Table Appendix F.1 - Utility Feature Definitions		
Category	Feature Definition Name	Descriptions
	Telephone	Telephone cable not contained in a duct
Conduits\Electrical	Electrical Box Duct	Electrical Duct - box shaped
	Electrical Cable	Direct Buried Electrical Table
	Electrical Duct	Electrical Duct - circular shaped
	Overhead Cable	Electrical Overhead cable
Conduits\Gas Lines	Gas Line	Gas Line of unknown material
	Gas Line Ductile Iron	Gas Lines of material ductile iron
	Gas Line HDPE	Gas Lines of material high density polyethylene
Conduits\Sanitary Sewer	Sanitary Sewer	Sanitary sewer pipe of unknown material
	Force Main Sewer Solid Wall PVC	Force main sewers of material poly-vinyl chloride
	Sanitary Sewer	Sanitary Sewers of unknown material
	Sanitary Sewer A2000 PVC	Sanitary Sewers of material poly-vinyl chloride
	Sanitary Sewer Circular RCP	Sanitary Sewers of material reinforced concrete
Conduits\Drainage\Box Culverts	Pre-Cast Concrete Box Culverts < 2	Box Culverts of material reinforced concrete with fill heights less than 2 feet.
	Pre-Cast Concrete Box Culverts > 2	Box Culverts of material reinforced concrete with fill heights greater than 2 feet.
Conduits\Drainage\Pipe Culvert\Existing	Ex-Pipe Culvert Arch CMP	Existing metal storm pipe, arch shape
	Ex-Pipe Culvert Arch RCP	Existing reinforced concrete storm pipe, arch shape

Table Appendix F.1 - Utility Feature Definitions		
Category	Feature Definition Name	Descriptions
	Ex-Pipe Culvert Circular CMP	Existing metal storm pipe. Circular shape
	Ex-Pipe Culvert Circular RCP	Existing reinforced concrete storm pipe. Circular shape
	Ex-Pipe Culvert HorzElliptical CMP	Existing metal storm pipe. Elliptical in the horizontal plane
	Ex-Pipe Culvert HorzElliptical RCP	Existing reinforced concrete storm pipe. Elliptical in the horizontal plane
Conduits\Drainage\Pipe Culvert\Proposed	Pr-Pipe Culvert Arch CMP	Existing metal storm pipe, arch shape
	Pr-Pipe Culvert Arch RCP	Existing reinforced concrete storm pipe, arch shape
	Pr-Pipe Culvert Circular CMP	Existing metal storm pipe. Circular shape
	Pr-Pipe Culvert Circular RCP	Existing reinforced concrete storm pipe. Circular shape
	Pr-Pipe Culvert HorzElliptical CMP	Existing metal storm pipe. Elliptical in the horizontal plane
	Pr-Pipe Culvert HorzElliptical RCP	Existing reinforced concrete storm pipe. Elliptical in the horizontal plane
Conduits\Drainage\Storm Sewer\Existing	Ex-Storm Sewer Arch RCP	Existing reinforced concrete storm pipe, arch shape
	Ex-Storm Sewer Circular RCP	Existing reinforced concrete storm pipe. Circular shape

Table Appendix F.1 - Utility Feature Definitions		
Category	Feature Definition Name	Descriptions
	Ex-Storm Sewer HorzElliptical RCP	Existing reinforced concrete storm pipe. Elliptical in the horizontal plane
Conduits\Drainage\Storm Sewer\Proposed	Pr-Storm Sewer Arch RCP	Existing reinforced concrete storm pipe, arch shape
	Pr-Storm Sewer Circular RCP	Existing reinforced concrete storm pipe. Circular shape
	Pr- Storm Sewer HorzElliptical RCP	Existing reinforced concrete storm pipe. Elliptical in the horizontal plane
Conduits\Water Lines	Water Line	Water Lines of unknown material
	Water Line C900	Gas Lines of material C900 plastic
	Water Line Ductile Iron	Gas Lines of material ductile iron
	Water Line HDPE	Gas Lines of material high density polyethylene
	Water Line Solid Wall PVC	Gas Lines of material poly-vinyl chloride
Conflict Nodes	Borepit Needed	Marks a detected conflict where additional subsurface exploration is required.
	New Conflict	Marks a newly found conflict location.
Gas Nodes	Gas Valve	Gas Valves – all types
Water Nodes	Fire Hydrant	Fire Hydrants
	Water Valve	Water Valves – all types
Drainage Nodes\D1 Specials		
Drainage Nodes\D2 Specials		

Table Appendix F.1 - Utility Feature Definitions		
Category	Feature Definition Name	Descriptions
Drainage Nodes\D3 Specials		
Drainage Nodes\D4 Specials		
Drainage Nodes\D5 Specials		
Drainage Nodes\D6 Specials		
Drainage Nodes\D7 Specials		
Drainage Nodes\D8 Specials		
Drainage Nodes\D9 Specials		
Drainage Nodes	Catch Basin A4	
	Catch Basin A5	
	Catch Basin B	
	Catch Basin C	
	Catch Basin D3	

Table Appendix F.1 - Utility Feature Definitions		
Category	Feature Definition Name	Descriptions
	Catch Basin D4	
	Drain Struct Type 1 High Side	
	Drain Struct Type 1 Low Side	
	Drain Struct Type 1 Single	
	Drain Struct Type 2 High Side	
	Drain Struct Type 2 Low Side	
	Drain Struct Type 2 Single	
	Drain Struct Type 3 High Side	
	Drain Struct Type 3 Low Side	
	Drain Struct Type 3 Single	
	Drain Struct Type 4 High Side	
	Drain Struct Type 4 Low Side	
	Drain Struct Type 4 Single	
	Drain Struct Type 5 High Side	

Table Appendix F.1 - Utility Feature Definitions		
Category	Feature Definition Name	Descriptions
	Drain Struct Type 5 Low Side	
	Drain Struct Type 5 Single	
	Drain Struct Type 6 High Side	
	Drain Struct Type 6 Low Side	
	Drain Struct Type 6 Single	
	Flush Median Inlet	
	Inlet Special	
	ManholeSS4	
	ManholeSS5	
	ManholeSS6	
	ManholeSS7	
	ManholeSS8	
Gutters (Note: These gutters used for hydraulic definitions only. Physical models are produced by the roadway design and modeling process.)	Gutter Type A	Type A gutter shape.
	Gutter Type B 6"	Type B gutter shape with 6-inch-wide gutter pan.

Table Appendix F.1 - Utility Feature Definitions		
Category	Feature Definition Name	Descriptions
	Gutter Type B 12"	Type B gutter shape with 12-inch-wide gutter pan.
	Gutter Type B 18"	Type B gutter shape with 18-inch-wide gutter pan.
	Gutter Type B 24"	Type B gutter shape with 24-inch-wide gutter pan.
	Gutter Use Node Definition	Hydraulic gutter definition for bypass assignment only. Gutter shape is derived from the connecting nodes.
Headwall Inlets	Headwall Inlet 24A	
	Headwall Inlet 24B	
	Headwall Inlet 24C	
	Headwall Inlet 24D	
	Headwall Inlet 24E	
	Headwall Inlet 24F	
	Headwall Inlet 24G	
	Headwall Inlet 36A	
	Headwall Inlet 48A	
Headwalls Box Culvert\Fill < 2ft\3 ft Width	3’x2’ Box-1:2 Slope; 1:3 Slope; 1:4 Slope; 1:6 Slope	Headwalls for 3’x2’ Box Culvert with Fill Height less than 2 ft. at specified slopes.
	3’x3’ Box-1:2 Slope; 1:3 Slope; 1:4 Slope; 1:6 Slope	Headwalls for 3’x3’ Box Culvert with Fill Height less than 2 ft. at specified slopes.
Headwalls Box Culvert\Fill < 2ft\4 ft Width	4’x2’ Box-1:2 Slope; 1:3 Slope; 1:4 Slope; 1:6 Slope	Headwalls for 4’x2’ Box Culvert with Fill Height less than 2 ft. at specified slopes.
	4’x3’ Box-1:2 Slope; 1:3 Slope; 1:4 Slope; 1:6 Slope	Headwalls for 4’x3’ Box Culvert with Fill Height less than 2 ft. at specified slopes.

Table Appendix F.1 - Utility Feature Definitions		
Category	Feature Definition Name	Descriptions
	4’x4’ Box-1:2 Slope; 1:3 Slope; 1:4 Slope; 1:6 Slope	Headwalls for 4’x4’ Box Culvert with Fill Height less than 2 ft. at specified slopes.
Headwalls Box Culvert\Fill < 2ft\5 ft Width	5’x2’ Box-1:2 Slope; 1:3 Slope; 1:4 Slope; 1:6 Slope	Headwalls for 5’x2’ Box Culvert with Fill Height less than 2 ft. at specified slopes.
	5’x3’ Box-1:2 Slope; 1:3 Slope; 1:4 Slope; 1:6 Slope	Headwalls for 5’x3’ Box Culvert with Fill Height less than 2 ft. at specified slopes.
	5’x4’ Box-1:2 Slope; 1:3 Slope; 1:4 Slope; 1:6 Slope	Headwalls for 5’x4’ Box Culvert with Fill Height less than 2 ft. at specified slopes.
	5’x5’ Box-1:2 Slope; 1:3 Slope; 1:4 Slope; 1:6 Slope	Headwalls for 5’x5’ Box Culvert with Fill Height less than 2 ft. at specified slopes.
Headwalls Box Culvert\Fill > 2ft\3 ft Width	3’x2’ Box-1:2 Slope; 1:3 Slope; 1:4 Slope; 1:6 Slope	Headwalls for 3’x2’ Box Culvert with Fill Height greater than 2 ft. at specified slopes.
	3’x3’ Box-1:2 Slope; 1:3 Slope; 1:4 Slope; 1:6 Slope	Headwalls for 3’x3’ Box Culvert with Fill Height greater than 2 ft. at specified slopes.
Headwalls Box Culvert\Fill > 2ft\4 ft Width	4’x2’ Box-1:2 Slope; 1:3 Slope; 1:4 Slope; 1:6 Slope	Headwalls for 4’x2’ Box Culvert with Fill Height greater than 2 ft. at specified slopes.
	4’x3’ Box-1:2 Slope; 1:3 Slope; 1:4 Slope; 1:6 Slope	Headwalls for 4’x3’ Box Culvert with Fill Height greater than 2 ft. at specified slopes.
	4’x4’ Box-1:2 Slope; 1:3 Slope; 1:4 Slope; 1:6 Slope	Headwalls for 4’x4’ Box Culvert with Fill Height greater than 2 ft. at specified slopes.
Headwalls Box Culvert\Fill > 2ft\5 ft Width	5’x2’ Box-1:2 Slope; 1:3 Slope; 1:4 Slope; 1:6 Slope	Headwalls for 5’x2’ Box Culvert with Fill Height greater than 2 ft. at specified slopes.
	5’x3’ Box-1:2 Slope; 1:3 Slope; 1:4 Slope; 1:6 Slope	Headwalls for 5’x3’ Box Culvert with Fill Height less than 2 ft. at specified slopes.

Table Appendix F.1 - Utility Feature Definitions		
Category	Feature Definition Name	Descriptions
	5’x4’ Box-1:2 Slope; 1:3 Slope; 1:4 Slope; 1:6 Slope	Headwalls for 5’x4’ Box Culvert with Fill Height less than 2 ft. at specified slopes.
	5’x5’ Box-1:2 Slope; 1:3 Slope; 1:4 Slope; 1:6 Slope	Headwalls for 5’x5’ Box Culvert with Fill Height less than 2 ft. at specified slopes.
Headwalls Conc FES\Arch	FES 18 Arch	Flared End sections which attach to arch shaped pipes.
	FES 24 Arch	
	FES 30 Arch	
	FES 36 Arch	
	FES 42 Arch	
	FES 48 Arch	
	FES 54 Arch	
	FES 60 Arch	
	FES 72 Arch	
Headwalls Conc FES\Elliptical	FES 18 Elliptical	Flared end sections which attach to elliptical shaped pipes.
	FES 24 Elliptical	
	FES 27 Elliptical	
	FES 30 Elliptical	
	FES 36 Elliptical	
	FES 42 Elliptical	
	FES 48 Elliptical	
	FES 54 Elliptical	

Table Appendix F.1 - Utility Feature Definitions		
Category	Feature Definition Name	Descriptions
	FES 60 Elliptical	
Headwalls Conc FES\Round	FES 12 Round	Flared end sections which attach to round pipe.
	FES 15 Round	
	FES 18 Round	
	FES 21 Round	
	FES 24 Round	
	FES 27 Round	
	FES 30 Round	
	FES 33 Round	
	FES 36 Round	
	FES 42 Round	
	FES 48 Round	
	FES 54 Round	
	FES 60 Round	
	FES 66 Round	
	FES 72 Round	
	FES 78 Round	
	FES 84 Round	
Headwalls Concrete End Sections\30 Skew	30 Headwall 24	Concrete headwalls attached to respective pipe diameters at 30° skew.

Table Appendix F.1 - Utility Feature Definitions		
Category	Feature Definition Name	Descriptions
	30 Headwall 36	
	30 Headwall 48	
Headwalls Concrete End Sections\45 Skew	45 Headwall 24	Concrete headwalls attached to respective pipe diameters at 45° skew.
	45 Headwall 36	
	45 Headwall 48	
Headwalls Concrete End Sections\60 Skew	60 Headwall 24	Concrete headwalls attached to respective pipe diameters at 60° skew.
	60 Headwall 36	
	60 Headwall 48	
Headwalls Concrete End Sections\90 Skew	90 Headwall 24	Concrete headwalls attached to respective pipe diameters at 90° skew.
	90 Headwall 36	
	90 Headwall 48	
Headwalls Concrete End Sections\Parallel Wings\Elliptical\1:2 Slope	Parallel Headwall 15in Eqv - 1:2 Slope	Concrete headwalls elliptical pipe with parallel wingwalls on 1:2 slope.
	Parallel Headwall 18in Eqv - 1:2 Slope	
	Parallel Headwall 21in Eqv - 1:2 Slope	

Table Appendix F.1 - Utility Feature Definitions		
Category	Feature Definition Name	Descriptions
	Parallel Headwall 24in Eqv - 1:2 Slope	
	Parallel Headwall 27in Eqv - 1:2 Slope	
	Parallel Headwall 30in Eqv - 1:2 Slope	
	Parallel Headwall 36in Eqv - 1:2 Slope	
	Parallel Headwall 42in Eqv - 1:2 Slope	
	Parallel Headwall 48in Eqv - 1:2 Slope	
	Parallel Headwall 54in Eqv - 1:2 Slope	
	Parallel Headwall 60in Eqv - 1:2 Slope	
	Parallel Headwall 66in Eqv - 1:2 Slope	
	Parallel Headwall 72in Eqv - 1:2 Slope	

Table Appendix F.1 - Utility Feature Definitions		
Category	Feature Definition Name	Descriptions
Headwalls Concrete End Sections\Parallel Wings\Elliptical\1:3 Slope	Parallel Headwall 15in Eqv - 1:3 Slope	Concrete headwalls elliptical pipe with parallel wingwalls on 1:3 slope.
	Parallel Headwall 18in Eqv - 1:3 Slope	
	Parallel Headwall 21in Eqv - 1:3 Slope	
	Parallel Headwall 24in Eqv - 1:3 Slope	
	Parallel Headwall 27in Eqv - 1:3 Slope	
	Parallel Headwall 30in Eqv - 1:3 Slope	
	Parallel Headwall 36in Eqv - 1:3 Slope	
	Parallel Headwall 42in Eqv - 1:3 Slope	
	Parallel Headwall 48in Eqv - 1:3 Slope	
	Parallel Headwall 54in Eqv - 1:3 Slope	
	Parallel Headwall 60in Eqv - 1:3 Slope	

Table Appendix F.1 - Utility Feature Definitions		
Category	Feature Definition Name	Descriptions
	Parallel Headwall 66in Eqv - 1:3 Slope	
	Parallel Headwall 72in Eqv - 1:3 Slope	
Headwalls Concrete End Sections\Parallel Wings\Elliptical\1:4 Slope	Parallel Headwall 15in Eqv - 1:4 Slope	Concrete headwalls elliptical pipe with parallel wingwalls on 1:4 slope.
	Parallel Headwall 18in Eqv - 1:4 Slope	
	Parallel Headwall 21in Eqv - 1:4 Slope	
	Parallel Headwall 24in Eqv - 1:4 Slope	
	Parallel Headwall 27in Eqv - 1:4 Slope	
	Parallel Headwall 30in Eqv - 1:4 Slope	
	Parallel Headwall 36in Eqv - 1:4 Slope	
	Parallel Headwall 42in Eqv - 1:4 Slope	
	Parallel Headwall 48in Eqv - 1:4 Slope	

Table Appendix F.1 - Utility Feature Definitions		
Category	Feature Definition Name	Descriptions
	Parallel Headwall 54in Eqv - 1:4 Slope	
	Parallel Headwall 60in Eqv – 1:4 Slope	
	Parallel Headwall 66in Eqv - 1:4 Slope	
	Parallel Headwall 72in Eqv - 1:4 Slope	
Headwalls Concrete End Sections\Parallel Wings\Elliptical\1:6 Slope	Parallel Headwall 15in Eqv - 1:6 Slope	Concrete headwalls on elliptical pipe with parallel wingswalls on 1:6 slope.
	Parallel Headwall 18in Eqv - 1:6 Slope	
	Parallel Headwall 21in Eqv - 1:6 Slope	
	Parallel Headwall 24in Eqv - 1:6 Slope	
	Parallel Headwall 27in Eqv - 1:6 Slope	
	Parallel Headwall 30in Eqv - 1:6 Slope	
	Parallel Headwall 36in Eqv - 1:6 Slope	

Table Appendix F.1 - Utility Feature Definitions		
Category	Feature Definition Name	Descriptions
	Parallel Headwall 42in Eqv - 1:6 Slope	
	Parallel Headwall 48in Eqv - 1:6 Slope	
	Parallel Headwall 54in Eqv - 1:6 Slope	
	Parallel Headwall 60in Eqv - 1:6 Slope	
	Parallel Headwall 66in Eqv - 1:6 Slope	
	Parallel Headwall 72in Eqv - 1:6 Slope	
Headwalls Concrete End Sections\Parallel Wings\Round\1:2 Slope	Parallel Headwall 15 - 1:2 Slope	Concrete headwalls on round pipe with parallel wingswalls on 1:2 slope.
	Parallel Headwall 18 - 1:2 Slope	
	Parallel Headwall 21 - 1:2 Slope	
	Parallel Headwall 24 - 1:2 Slope	
	Parallel Headwall 27 - 1:2 Slope	

Table Appendix F.1 - Utility Feature Definitions		
Category	Feature Definition Name	Descriptions
	Parallel Headwall 30 - 1:2 Slope	
	Parallel Headwall 36 - 1:2 Slope	
	Parallel Headwall 42 - 1:2 Slope	
	Parallel Headwall 48 - 1:2 Slope	
	Parallel Headwall 54 - 1:2 Slope	
	Parallel Headwall 60 - 1:2 Slope	
	Parallel Headwall 66 - 1:2 Slope	
	Parallel Headwall 72 - 1:2 Slope	
Headwalls Concrete End Sections\Parallel Wings\Round\1:3 Slope	Parallel Headwall 15 - 1:3 Slope	Concrete headwalls on round pipe with parallel wingswalls on 1:3 slope.
	Parallel Headwall 18 - 1:3 Slope	
	Parallel Headwall 21 - 1:3 Slope	

Table Appendix F.1 - Utility Feature Definitions		
Category	Feature Definition Name	Descriptions
	Parallel Headwall 24 - 1:3 Slope	
	Parallel Headwall 27 - 1:3 Slope	
	Parallel Headwall 30 - 1:3 Slope	
	Parallel Headwall 36 - 1:3 Slope	
	Parallel Headwall 42 - 1:3 Slope	
	Parallel Headwall 48 - 1:3 Slope	
	Parallel Headwall 54 - 1:3 Slope	
	Parallel Headwall 60 - 1:3 Slope	
	Parallel Headwall 66 - 1:3 Slope	
	Parallel Headwall 72 - 1:3 Slope	
Headwalls Concrete End Sections\Parallel Wings\Round\1:4 Slope	Parallel Headwall 15 - 1:4 Slope	Concrete headwalls on round pipe with parallel wingswalls on 1:4 slope.

Table Appendix F.1 - Utility Feature Definitions		
Category	Feature Definition Name	Descriptions
	Parallel Headwall 18 - 1:4 Slope	
	Parallel Headwall 21 - 1:4 Slope	
	Parallel Headwall 24 - 1:4 Slope	
	Parallel Headwall 27 - 1:4 Slope	
	Parallel Headwall 30 - 1:4 Slope	
	Parallel Headwall 36 - 1:4 Slope	
	Parallel Headwall 42 - 1:4 Slope	
	Parallel Headwall 48 - 1:4 Slope	
	Parallel Headwall 54 - 1:4 Slope	
	Parallel Headwall 60 – 1:4 Slope	
	Parallel Headwall 66 - 1:4 Slope	

Table Appendix F.1 - Utility Feature Definitions		
Category	Feature Definition Name	Descriptions
	Parallel Headwall 72 - 1:4 Slope	
Headwalls Concrete End Sections\Parallel Wings\Round\1:6 Slope	Parallel Headwall 15 - 1:6 Slope	Concrete headwalls on round pipe with parallel wingswalls on 1:6 slope.
	Parallel Headwall 18 - 1:6 Slope	
	Parallel Headwall 21 - 1:6 Slope	
	Parallel Headwall 24 - 1:6 Slope	
	Parallel Headwall 27 - 1:6 Slope	
	Parallel Headwall 30 - 1:6 Slope	
	Parallel Headwall 36in Eqv - 1:6 Slope	
	Parallel Headwall 42 - 1:6 Slope	
	Parallel Headwall 48 - 1:6 Slope	
	Parallel Headwall 54 - 1:6 Slope	

Table Appendix F.1 - Utility Feature Definitions		
Category	Feature Definition Name	Descriptions
	Parallel Headwall 60 - 1:6 Slope	
	Parallel Headwall 66 - 1:6 Slope	
	Parallel Headwall 72 - 1:6 Slope	
Headwalls Steel FES \ Arch	FES 15 Arch Metal	Steel flared end sections attached to arch shaped pipe.
	FES 18 Arch Metal	
	FES 21 Arch Metal	
	FES 24 Arch Metal	
	FES 30 Arch Metal	
	FES 36 Arch Metal	
	FES 42 Arch Metal	
	FES 48 Arch Metal	
	FES 54 Arch Metal	
	FES 60 Arch Metal	
	FES 66 Arch Metal	
Headwalls Steel FES \ Elliptical		
Headwalls Steel FES \ Round	FES 15 Round Metal	Steel flared end sections attached to round shaped pipe.
	FES 18 Round Metal	

Table Appendix F.1 - Utility Feature Definitions		
Category	Feature Definition Name	Descriptions
	FES 21 Round Metal	
	FES 24 Round Metal	
	FES 30 Round Metal	
	FES 36 Round Metal	
	FES 42 Round Metal	
	FES 48 Round Metal	
	FES 54 Round Metal	
	FES 60 Round Metal	
	FES 66 Round Metal	
Lights and Poles	Electric Service Pole Ex	A generic service pole model.
	Light Control Center Ex	A generic lighting control center model.
	Light Standard Four Arm Ex	A generic light pole with 4 lamps.
	Light Standard High Mast Ex	A generic high mast light pole.
	Light Standard Single Arm Ex	A generic light pole with 1 lamp.
	Light Standard Two Arm Ex	A generic light pole with 2 lamps.
Water Nodes	Fire Hydrant	A generic fire hydrant model.
	Water Meter Ex	A generic water meter model.

Table Appendix F.1 - Utility Feature Definitions		
Category	Feature Definition Name	Descriptions
	Water Valve	A generic water valve model used for any size pipe.
Sanitary Manholes	Sanitary Manhole	4 feet diameter manhole for sanitary sewer networks.

APPENDIX G – COLOR TABLE

Table Appendix G.1 – Color Table

Color	Red Value	Green Value	Blue Value
0	204	204	204
1	0	0	255
2	255	0	0
3	204	204	154
4	0	255	0
5	55	205	254
6	204	51	0
7	155	224	224
8	150	150	255
9	255	204	0
10	210	124	140
11	154	154	150
12	236	184	236
13	254	101	200
14	255	255	0
15	255	150	0
16	254	1	170
17	255	0	0
18	186	204	255
19	255	150	0
20	235	110	20
21	130	210	175
22	130	150	0
23	80	164	100
24	50	170	155
25	244	161	150
26	175	50	30
27	204	204	204
28	214	154	0
29	55	205	254
30	0	255	0
31	55	205	254
32	204	204	204
33	205	100	50
34	175	50	30
35	235	110	20
36	255	204	0
37	0	255	0
38	174	110	0
39	204	204	204
40	204	204	204
41	60	185	0
42	0	255	0
43	205	101	255
44	150	150	205
45	100	100	205
46	130	210	175
47	50	150	205
48	254	101	255
49	254	31	170
50	205	101	255
51	164	101	150
52	0	255	0
53	80	164	100
54	255	255	0
55	236	184	236
56	215	194	0
57	185	174	0
58	150	150	150
59	150	150	100
60	150	150	40
61	150	140	30
62	170	130	30
63	180	170	30
64	204	204	154
65	154	111	200
66	154	111	200
67	165	125	0
68	214	154	0
69	186	84	186
70	255	150	0
71	0	255	0
72	80	164	100
73	155	224	224
74	55	205	254

Table Appendix G.1 – Color Table			
Color	Red Value	Green Value	Blue Value
75	150	150	255
76	254	101	200
77	210	124	140
78	130	210	175
79	80	140	215
80	130	210	175
81	204	204	0
82	130	150	0
83	244	161	150
84	236	184	236
85	204	204	204
86	55	205	254
87	254	31	170
88	210	124	140
89	255	204	0
90	235	110	20
91	90	110	155
92	254	254	254
93	85	85	85
94	85	85	85
95	85	85	85
96	0	255	0
97	80	204	100
98	140	206	70
99	60	185	0
100	255	255	255
101	0	0	255
102	0	255	0
103	255	0	0
104	255	255	0
105	255	0	255
106	254	146	34
107	0	255	255
108	85	85	85
109	85	85	85
110	214	214	214
111	204	204	255
112	204	255	204

Table Appendix G.1 – Color Table			
Color	Red Value	Green Value	Blue Value
113	255	204	204
114	255	255	204
115	255	204	255
116	240	232	224
117	204	255	255
118	85	85	85
119	85	85	85
120	173	173	173
121	160	224	0
122	192	192	192
123	0	255	255
124	240	240	0
125	255	127	0
126	255	0	255
127	255	255	0
128	60	179	113
129	0	254	160
130	133	133	133
131	153	153	255
132	153	255	153
133	255	153	153
134	255	255	153
135	255	153	255
136	255	165	0
137	153	255	255
138	85	85	85
139	85	85	85
140	110	110	110
141	225	117	0
142	254	0	96
143	255	0	0
144	0	255	0
145	100	149	237
146	0	240	240
147	255	127	80
148	225	0	0
149	225	225	0
150	82	82	82

Table Appendix G.1 – Color Table			
Color	Red Value	Green Value	Blue Value
151	41	41	207
152	43	214	43
153	214	42	42
154	212	212	42
155	212	42	212
156	217	141	0
157	42	209	209
158	85	85	85
159	85	85	85
160	255	127	80
161	85	85	85
162	255	184	135
163	255	57	47
164	255	140	0
165	85	85	85
166	85	85	85
167	201	95	71
168	85	85	85
169	85	85	85
170	85	85	85
171	85	85	85
172	85	85	85
173	85	85	85
174	85	85	85
175	85	85	85
176	255	164	96
177	85	85	85
178	177	201	89
179	240	128	128
180	255	140	85
181	255	115	115
182	170	227	132
183	224	168	168
184	227	179	123
185	85	85	85
186	0	0	255
187	255	0	0
188	255	255	255

Table Appendix G.1 – Color Table			
Color	Red Value	Green Value	Blue Value
189	28	71	156
190	17	97	51
191	61	61	61
192	209	99	246
193	175	30	45
194	255	204	0
195	139	69	19
196	154	205	50
197	85	85	85
198	85	85	85
199	85	85	85
200	85	85	85
201	85	85	85
202	85	85	85
203	85	85	85
204	85	85	85
205	85	85	85
206	85	85	85
207	85	85	85
208	255	255	0
209	85	85	85
210	85	85	85
211	0	0	255
212	0	255	0
213	255	0	0
214	255	255	0
215	255	0	255
216	255	127	0
217	0	255	255
218	64	64	64
219	192	192	192
220	255	0	0
221	160	224	0
222	0	254	160
223	128	0	160
224	176	176	176
225	0	240	240
226	222	184	135

Table Appendix G.1 – Color Table			
Color	Red Value	Green Value	Blue Value
227	254	0	160
228	139	69	19
229	85	85	85
230	85	85	85
231	85	85	85
232	85	85	85
233	85	85	85
234	85	85	85
235	85	85	85
236	85	85	85
237	85	85	85
238	85	85	85
239	85	85	85
240	255	255	255
241	0	0	0
242	85	85	85
243	85	85	85
244	85	85	85
245	85	85	85
246	85	85	85
247	85	85	85
248	85	85	85
249	85	85	85
250	85	85	85
251	85	85	85
252	85	85	85
253	85	85	85
254	255	255	255
255	0	0	0

Appendix H – RESERVED

APPENDIX I – SURVEY FEATURE DEFINTIONS

The following are feature definitions that shall be used for field data collections for Survey:

Code	Description	Level	Cell	Linestyle	DTM	Category
100	Backsight Station	Topo_Control Points	SURVEY_SPC	-	DNI	Alignments
101	Foresight Station	Topo_Control Points	SURVEY_SPC	-	DNI	Alignments
102	Closing Azimuth	Topo_Control Points	SURVEY_SPC	-	DNI	Alignments
103	Traverse Station	Topo_Control Points	AS_HORIZ_CTRL_STA	-	DNI	Alignments
104	Elevation Control	Design_EX_Roadway Profile	AS_VERT_CONTROL STA	-	DNI	Profiles
105	Survey Point	Topo_Control Points	SURVEY_SPC	-	DNI	Alignments
106	Vertical Curve Data	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Profiles
107	Horizontal Curve Data	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Cross Sections
108	Vertical Control Station	Design_EX_Roadway Profile	AS_VERT_CONTROL STA	-	DNI	Profiles
109	Horizontal Control Station	Design_EX_Roadway Profile	AS_HORIZ_CTRL_STA	-	DNI	Profiles
110	Remote Point	Design_EX_Roadway Profile	AS_HORIZ_CTRL_STA	-	DNI	Profiles
111	Calculated Point	Topo_Control Points	BOUND_SURVEY MARKER	-	DNI	Alignments
112	GPS Control Point	Topo_Control Points	AS_HORIZ_CTRL_STA	-	DNI	Alignments

Code	Description	Level	Cell	Linestyle	DTM	Category
113	Vertical Check	Topo_Control Points	SURVEY_SPC	-	DNI	Alignments
114	Set Turning Point	Topo_Point SPC Cell	SURVEY_SPC	-	Spot	Profiles
116	Shiner	Topo_Control Points	SURVEY_SPC	-	DNI	Alignments
117	Bench Tie	Topo_Control Points	SURVEY_SPC	-	DNI	Alignments
118	NGS Monument	Topo_Control Points	AS_HORIZ_CTRL_STA	-	DNI	Alignments
119	District Network Monument	Topo_Control Points	AS_HORIZ_CTRL_STA	-	DNI	Alignments
124	Read Turning Point	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Profiles
134	Check Elevation Control	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Profiles
135	Check Horizontal Control	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Profiles
196	Photo Control Horizontal	Aerial Survey_Control Points	AS_HORIZ_CTRL_STA	-	DNI	Alignments
197	Photo Control Vertical	Aerial Survey_Control Points	AS_VERT_PICTURE TIE	-	DNI	Alignments
198	Photo Control Horizontal & Vertical	Aerial Survey_Control Points	AS_HORIZ_PIC_TIE	-	DNI	Alignments
199	Photo Control Q.P.	Aerial Survey_Control Points	AS_VERT_CONTROL STA	-	DNI	Alignments
200	Section Corner	ROW_EX_Section Lines	BOUND_SECTION CORNER	-	DNI	Boundaries
201	Quarter Corner	ROW_EX_Section Lines	BOUND_SE QUARTER	-	DNI	Boundaries
202	1/16th Corner	ROW_EX_Section Lines	BOUND_SEC CORNER BOT	-	DNI	Boundaries
203	Meander Corner	ROW_EX_Section Lines	BOUND_SURVEY MARKER	-	DNI	Boundaries
204	Witness Corner	ROW_EX_Section Lines	BOUND_SURVEY MARKER	-	DNI	Boundaries
205	Reference Corner	ROW_EX_Section Lines	BOUND_SURVEY MARKER	-	DNI	Boundaries
206	Property Corner	ROW_EX_Private Boundary Items	BOUND_SURVEY MARKER	-	DNI	Boundaries
207	Lot Corner	ROW_EX_Private Boundary Items	BOUND_SURVEY MARKER	-	DNI	Boundaries

Code	Description	Level	Cell	Linestyle	DTM	Category
208	Block Corner	ROW_EX_Private Boundary Items	BOUND_SURVEY MARKER	-	DNI	Boundaries
209	Plat Corner	ROW_EX_Private Boundary Items	BOUND_SURVEY MARKER	-	DNI	Boundaries
210	Parcel Corner	ROW_EX_Private Boundary Items	BOUND_SURVEY MARKER	-	DNI	Boundaries
211	R.O.W. Corner	ROW_EX ROW Markers	BOUND_SURVEY MARKER	-	DNI	Boundaries
212	Project Marker	Topo_Survey Marker	ROW_EX MARKER	-	DNI	Boundaries
213	R.O.W. Marker	ROW_EX ROW Markers	ROW_EX MARKER	-	DNI	Boundaries
214	Drainage Marker	Topo_Drainage Items	ROW_EX MARKER	-	Spot	Drainage
215	Chiseled Square	Design_EX_Roadway Profile	BOUND_CHISELED SQUARE FOUND	-	DNI	Profiles
216	Existing Easement	ROW_EX_Easement	BOUND_SURVEY MARKER	BL (Easement)	DNI	Boundaries
217	Proposed Permanent Easement	ROW_PR_Permanent Easement	BOUND_SURVEY MARKER	BL (Easement)	DNI	Boundaries
218	Proposed Temporary Easement	ROW_PR_Temporary Easement	BOUND_SURVEY MARKER	BL (Easement_ Temporary)	DNI	Boundaries
219	Barricade	Topo_Point SPC Cell	SURVEY_SPC	-	Spot	Shldrs.,Medians, C & G
220	Traffic Signal	Topo_Utilities	UTIL_EX TRAF SIGNAL	-	Spot	Traffic Signals
221	Traffic Signal Foundation	Signals_EX_ Foundations	TS_EX SIGNAL POST	-	DNI	Traffic Signals
222	Traffic Signal Cantilever	Signals_EX_Above Ground	TS_EX COMB MAST ARM	-	DNI	Traffic Signals
223	Traffic Signal Controller	Signals_EX_Above Ground	UTIL_EX TRAFFIC SIGNAL CONTROLLER BOX	BL (0)	Spot	Traffic Signals
224	Detector Loop	Topo_Point SPC Cell	SURVEY_SPC	BL (1)	Spot	Traffic Signals
225	Combination Mast Arm	Signals_EX_Above Ground	TS_EX COMB MAST ARM	-	DNI	Traffic Signals

Code	Description	Level	Cell	Linestyle	DTM	Category
226	No Passing Paint Stripe	Topo_Point SPC Cell	SURVEY_SPC	PMK_CenterLine_Double_Existing	Spot	Pavement Features
227	For traffic and emergency vehicle cameras	Signals_EX_Detector Loop	TS_EX VIDEO DET SYSTEM	-	Spot	Traffic Signals
228	Flashing Signal	Signals_EX_Above Ground	TS_EX SIGNAL HEAD	-	Spot	Traffic Signals
229	Gutter Flow, Left	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	DTM Line Codes
230	Gutter Flow, Right	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	DTM Line Codes
231	Top of Curb, Left	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	DTM Line Codes
232	Top of Curb, Right	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	DTM Line Codes
233	Back of Curb, Left	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	DTM Line Codes
234	Back of Curb, Right	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	DTM Line Codes
235	Sidewalk, Near Left	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	DTM Line Codes
236	Sidewalk, Near Right	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	DTM Line Codes
237	Sidewalk, Far Left	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	DTM Line Codes
238	Sidewalk, Far Right	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	DTM Line Codes
239	Early warning pad on ADA ramp	Topo_Point SPC Cell	SURVEY_SPC	0	Break	DTM Line Codes
240	Sidewalk St. Near Rt	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	DTM Line Codes
241	Sidewalk St. Near Lt	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	DTM Line Codes
242	Sidewalk St. Far Rt.	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	DTM Line Codes
243	Sidewalk St. Far Lt	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	DTM Line Codes
245	Back Curb & Edge of Sidewalk Left	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	DTM Line Codes
246	Back Curb & Edge of Sidewalk Right	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	DTM Line Codes
247	Bike Path, Left	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	DTM Line Codes
248	Bike Path, Right	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	DTM Line Codes
249	Pole	Topo_Utilities	TS_EX SIGNAL POST	-	Spot	Aboveground Utilities
250	Pole Foundation	Topo_NonHighway Improvements	TS_EX SIGNAL POST	-	DNI	Buildings,Fences & Mailboxes

Code	Description	Level	Cell	Linestyle	DTM	Category
251	Pole - Guy	Topo_Utilities	AS_GUY_POLE	-	Spot	Aboveground Utilities
252	Pole - Light	Topo_Utilities	UTIL_EX LIGHT POLE	-	Spot	Aboveground Utilities
253	Pole - Power	Topo_Utilities	UTIL_EX PP	-	Spot	Aboveground Utilities
254	Pole - Power-W/Light	Topo_Utilities	UTIL_EX_PP LIGHT	-	Spot	Aboveground Utilities
255	Pole - Power-W/Trans.	Topo_Utilities	UTIL_EX PP TRAN	-	Spot	Aboveground Utilities
256	Pole - Sign	Topo_Utilities	NONHWY_AD SIGN	-	Spot	Aboveground Utilities
257	Pole - Telegraph	Topo_Utilities	UTIL_EX TEL POLE	-	Spot	Aboveground Utilities
258	Pole - Telephone	Topo_Utilities	UTIL_EX TEL POLE	-	Spot	Aboveground Utilities
259	Pole - Telephone.& Telegraph	Topo_Utilities	UTIL_EX TEL POLE	-	Spot	Aboveground Utilities
260	Pole - Television	Topo_Utilities	UTIL_EX TEL POLE	-	Spot	Aboveground Utilities
261	Pole - Meter	Topo_Utilities	AS_UTIL_POINT	-	Spot	Aboveground Utilities
262	Pole - Street Light	Topo_Utilities	UTIL_EX LIGHT POLE	-	Spot	Aboveground Utilities
263	Traffic Detector Loop Small	Topo_Utilities	TS_EX DET LOOP SMALL		Spo	Aboveground Utilities
264	Traffic Detector Loop Large	Topo_Utilities	TS_EX DET LOOP LARGE		Spo	Aboveground Utilities
265	Guy Wire	Topo_Utilities	UTIL_EX ANCHOR	-	DNI	Aboveground Utilities
266	Vapor Light	Topo_Utilities	UTIL_EX LIGHT POLE	-	Spot	Aboveground Utilities
267	Street Light	Topo_Utilities	UTIL_EX LIGHT POLE	-	Spot	Aboveground Utilities
268	Street Light Cantilever	Topo_Utilities	LGT_EX_COMB_MAST ARM	-	Spot	Aboveground Utilities

Code	Description	Level	Cell	Linestyle	DTM	Category
269	Street Light Control Box	Topo_Utilities	LGT_EX CONTROLLER	-	Spot	Aboveground Utilities
270	Transmission Tower	Topo_Utilities	AS_UTIL_TRANS TOWER	-	Spot	Aboveground Utilities
272	Anchor (Deadman)	Topo_Utilities	UTIL_EX ANCHOR	-	Spot	Aboveground Utilities
274	Handhole	Topo_Utilities	UTIL_EX HANDHOLE	BL (0)	Break	Aboveground Utilities
275	Double Handhole	Topo_Utilities	UTIL_EX DBLHH	BL (0)	Break	Aboveground Utilities
276	Heavy Duty Handhole	Topo_Utilities	UTIL_EX HDUTY HH	BL (0)	Break	Aboveground Utilities
278	Crosswalk Signal	Signals_EX_Above Ground	TSD_EX PED WALK SYMBOL	-	Spot	Traffic Signals
279	Crosswalk	Topo_Point SPC Cell	SURVEY_SPC	BL (1)	Spot	DTM Line Codes
280	Junction Box	Topo_Utilities	UTIL_EX JUNCTION BOX	BL (0)	Spot	Aboveground Utilities
281	Above Grd Splice Box	Topo_Utilities	UTIL_EX SPLICE BOX	-	Spot	Aboveground Utilities
282	Splice Box - Electrical	Topo_Utilities	UTIL_EX SPLICE BOX	-	Spot	Aboveground Utilities
283	Splice Box - Telephone	Topo_Utilities	UTIL_EX TEL SPLICEBOX	-	Spot	Aboveground Utilities
284	Splice Box - Cable TV	Topo_Utilities	UTIL_EX SPLICE BOX	-	Spot	Aboveground Utilities
285	Cable - Power	Topo_Point SPC Cell	SURVEY_SPC	BL (Underground_ Electric)	DNI	Underground Utilities
286	Cable - Telephone	Topo_Point SPC Cell	SURVEY_SPC	BL (Underground_ Telephone)	DNI	Underground Utilities
287	Cable - Telegraph	Topo_Point SPC Cell	SURVEY_SPC	BL (Underground_ Telephone)	DNI	Underground Utilities

Code	Description	Level	Cell	Linestyle	DTM	Category
288	Cable - Television	Topo_Point SPC Cell	SURVEY_SPC	BL (Underground_ CableTV)	DNI	Underground Utilities
289	Fiber Optic Cable	Topo_Point SPC Cell	SURVEY_SPC	BL (Underground_ FiberOptic)	DNI	Underground Utilities
290	Radius Point	Topo_Control Points	SURVEY_SPC	-	DNI	Alignments
291	Sidewalk	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Sidewalks & Driveways
292	Sidewalk Edge	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Sidewalks & Driveways
293	Sidewalk Center	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Sidewalks & Driveways
294	Wall	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Buildings,Fence s & Mailboxes
295	Wall - Noise	Topo_Point SPC Cell	SURVEY_SPC	BL (Levee)	Break	Buildings,Fence s & Mailboxes
296	Wall - Retaining	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Buildings,Fence s & Mailboxes
297	Miscellaneous Concrete Slab	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Buildings,Fence s & Mailboxes
298	Telephone Booth	Topo_Utilities	NONHWY_PAY TEL	-	Spot	Aboveground Utilities
299	Physical Ties	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Cross Sections
300	Culvert - Pipe	Topo_Point SPC Cell	SURVEY_SPC	BL (5)	Spot	Drainage
301	Culvert - Pipe Arch	Topo_Point SPC Cell	SURVEY_SPC	BL (5)	Spot	Drainage
302	Culvert - Pipe Elliptical	Topo_Point SPC Cell	SURVEY_SPC	BL (5)	Spot	Drainage
303	Culvert - Box	Topo_Point SPC Cell	SURVEY_SPC	BL (5)	Spot	Drainage
304	Tile	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Spot	Drainage
305	Drop Box	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Drainage
306	Catch Basin	Topo_Drainage Items	DRAIN_EX CATCH BASIN	BL (0)	Break	Drainage
307	Catch Basin Grate	Topo_Drainage Items	DRAIN_EX CATCH BASIN	-	Spot	Drainage
308	Drop Inlet	Topo_Drainage Items	DRAIN_EX INLET	BL (0)	Break	Drainage
309	End Section Flared	Topo_Drainage Items	DRAIN_EX END SECTION	BL (0)	Break	Drainage

Code	Description	Level	Cell	Linestyle	DTM	Category
310	End Section Flared with Grate	Topo_Drainage Items	DRAIN_EX END SECTION GRATE	BL (0)	Break	Drainage
311	Headwall	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Drainage
312	Flap Gate	Topo_Drainage Items	AS_CULTURE_PNT	-	DNI	Drainage
313	Miscellaneous Flowline Elevation	Topo_Drainage Items	DRAIN_EX FLOW LINE	-	Spot	Drainage
314	Flood Plain Section	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	DNI	Drainage
315	Grass Waterway	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Drainage
316	Winnebago Inlet	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Drainage
317	Ditch Check	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Drainage
318	Landscape Edge	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	DTM Line Codes
319	Buffalo Box - Gas	Topo_Utilities	UTIL_EX BBOX GAS	-	Spot	Aboveground Utilities
320	Buffalo Box - Water	Topo_Utilities	UTIL_EX BBOX WATER	-	Spot	Aboveground Utilities
321	Curb Cock - Gas	Topo_Utilities	UTIL_EX BBOX GAS	-	Spot	Aboveground Utilities
322	Curb Cock - Water	Topo_Utilities	UTIL_EX BBOX WATER	-	Spot	Aboveground Utilities
323	Hydrant	Topo_Utilities	UTIL_EX FIRE HYD	-	Spot	Aboveground Utilities
324	Hydrant - Water	Topo_Utilities	UTIL_EX WATER HYD	-	Spot	Aboveground Utilities
325	Lift Station	Topo_Point SPC Cell	SURVEY_SPC	-	Spot	Drainage
326	Lift Station - Sanitary	Topo_Point SPC Cell	SURVEY_SPC	-	Spot	Drainage
327	Lift Station - Storm	Topo_Point SPC Cell	SURVEY_SPC	-	Spot	Drainage
328	Meter	Topo_Utilities	UTIL_EX BBOX	-	Spot	Aboveground Utilities
329	Meter - Gas	Topo_Utilities	UTIL_EX BBOX GM	-	Spot	Aboveground Utilities
330	Meter - Electric	Topo_Utilities	UTIL_EX BBOX EM	-	Spot	Aboveground Utilities
331	Meter - Water	Topo_Utilities	UTIL_EX BBOX WM	-	Spot	Aboveground Utilities

Code	Description	Level	Cell	Linestyle	DTM	Category
332	Meter - Petroleum	Topo_Utilities	UTIL_EX BBOX PM	-	Spot	Aboveground Utilities
333	Pipe	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Aboveground Utilities
334	Regulator	Topo_Utilities	UTIL_EX BBOX	-	Spot	Aboveground Utilities
335	Regulator - Gas	Topo_Utilities	UTIL_EX BBOX	-	Spot	Aboveground Utilities
336	Sewer	Topo_Point SPC Cell	SURVEY_SPC	-	Spot	Drainage
337	Sewer - Sanitary	Topo_Point SPC Cell	SURVEY_SPC	-	Spot	Drainage
338	Sewer - Storm	Topo_Point SPC Cell	SURVEY_SPC	-	Spot	Drainage
339	Standard Inlet	Topo_Point SPC Cell	SURVEY_SPC	-	Spot	Drainage
340	Tee	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Aboveground Utilities
341	Valve	Topo_Utilities	UTIL_EX BBOX	-	Spot	Aboveground Utilities
342	Valve Box	Topo_Utilities	UTIL_EX BBOX	-	Spot	Aboveground Utilities
343	Valve - Water	Topo_Utilities	UTIL_EX BBOX WV	-	Spot	Aboveground Utilities
344	Valve - Gas	Topo_Utilities	UTIL_EX BBOX GV	-	Spot	Aboveground Utilities
345	Vault	Topo_Utilities	UTIL_EX MANHOLE	-	Spot	Aboveground Utilities
346	Vault - Valve	Topo_Utilities	UTIL_EX MANHOLE	-	Spot	Aboveground Utilities
347	Vault - Meter	Topo_Utilities	UTIL_EX MANHOLE	-	Spot	Aboveground Utilities
348	Line Crossing	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Aboveground Utilities
349	Fire Hydrant	Topo_Utilities	UTIL_EX FIRE HYD	-	Spot	Aboveground Utilities
350	Warning Sign	Topo_Utilities	NONHWY_AD SIGN	-	Spot	Aboveground Utilities
351	Manhole	Topo_Drainage Items	DRAIN_EX MANHOLE	-	Spot	Drainage

Code	Description	Level	Cell	Linestyle	DTM	Category
352	Manhole Lid	Topo_Drainage Items	DRAIN_EX MANHOLE	-	Spot	Drainage
353	Manhole Grate	Topo_Drainage Items	DRAIN_EX MANHOLE	-	Spot	Drainage
354	Vent Pipe	Topo_NonHighway Improvements	DRAIN_EX FIELD VENT PIPE	-	Spot	Aboveground Utilities
355	High Water Elevation	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Water Features
356	Invert	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Drainage
357	Crosswalk Button	Topo_PMK Solid Line	TS_EX PED PUSH BUTTON	PMK_StopLine_ Existing	Spot	DTM Line Codes
359	Paved Ditch	Topo_Point SPC Cell	SURVEY_SPC	BL (Ditch_Paved)	Break	Drainage
360	Paved Ditch - Flat	Topo_Point SPC Cell	SURVEY_SPC	BL (Ditch_Paved)	Break	Drainage
361	Paved Ditch - Round	Topo_Point SPC Cell	SURVEY_SPC	BL (Ditch_Paved)	Break	Drainage
362	Paved Ditch - "V"	Topo_Point SPC Cell	SURVEY_SPC	0	Break	Drainage
363	Ditch	Topo_Point SPC Cell	SURVEY_SPC	BL (6)	Break	Drainage
364	Stream	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Water Features
365	River	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Water Features
366	Pond	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Water Features
367	Lake	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Water Features
368	Retention Basin	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Water Features
369	Levee Top	Topo_Point SPC Cell	SURVEY_SPC	BL (Levee)	Break	Drainage
370	Levee Toe	Topo_Point SPC Cell	SURVEY_SPC	Levee_Base	Break	Drainage
371	Dam Crest	Topo_Point SPC Cell	SURVEY_SPC	0	Break	Drainage
372	Spillway	Topo_Point SPC Cell	SURVEY_SPC	1	Break	Drainage
373	Apron	Topo_Point SPC Cell	SURVEY_SPC	1	Break	Drainage
374	Apron Top	Topo_Point SPC Cell	SURVEY_SPC	1	Break	Drainage
375	Apron Base	Topo_Point SPC Cell	SURVEY_SPC	1	Break	Drainage
376	Runway	Topo_Point SPC Cell	SURVEY_SPC	0	Break	Drainage
377	Well	Topo_NonHighway Improvements	DRAIN_EX CATCH BASIN	-	Spot	Drainage
378	Cistern	Topo_Point SPC Cell	SURVEY_SPC	-	Spot	Drainage
379	Wetland	Topo_Wetlands	WATER_MARSH	BL (0)	Break	Water Features

Code	Description	Level	Cell	Linestyle	DTM	Category
380	Gravel Wetland	Topo_Point SPC Cell	SURVEY_SPC	2	Break	Water Features
381	Underdrain Outlet left	Drainage_EX_Pipe Underdrain	AS_PAVT PIPE DRAIN	BL (Pipe_Underdrain_Existing)	Break	Drainage
382	Underdrain Outlet right	Drainage_EX_Pipe Underdrain	AS_PAVT PIPE DRAIN	BL (Pipe_Underdrain_Existing)	Break	Drainage
383	Cleanout	Utilities_EX_ Underground Sanitary Sewer	UTIL_EX CLEANOUT	-	Spot	Drainage
400	Mailbox	Topo_Mailbox	NONHWY_MAILBOX	-	Spot	Buildings,Fences & Mailboxes
401	Oil Well	Topo_NonHighway Improvements	DRAIN_EX CATCH BASIN	-	Spot	Aboveground Utilities
402	Oil Storage Tank	Topo_Point SPC Cell	SURVEY_SPC	-	Spot	Aboveground Utilities
403	Grain Bin + Silo	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Buildings,Fences & Mailboxes
404	Oil Spill Dike	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Aboveground Utilities
405	Tree Deciduous - Inch	Topo_Vegetation	VEG_DECIDUOUS TREE	-	DNI	Vegetation Features
406	Tree Evergreen - Inch	Topo_Vegetation	VEG_EVERGREEN TREE	-	DNI	Vegetation Features
407	Stump - Inch	Topo_Vegetation	VEG_STUMP	-	DNI	Vegetation Features
408	Bush - Inch	Topo_Vegetation	VEG_BUSH	-	DNI	Vegetation Features
409	Shrub - Inch	Topo_Vegetation	VEG_BUSH	-	DNI	Vegetation Features
410	Timber Edge	Topo_Point SPC Cell	SURVEY_SPC	BL (Woods_Brush)	Break	Vegetation Features
411	Crop Line	Topo_Point SPC Cell	SURVEY_SPC	BL (Vegetation)	Break	Vegetation Features
412	Hedgerow	Topo_Point SPC Cell	SURVEY_SPC	BL (Woods_Brush)	Break	Vegetation Features

Code	Description	Level	Cell	Linestyle	DTM	Category
413	Cattle Guard	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Buildings,Fences & Mailboxes
414	Fence	Topo_Point SPC Cell	SURVEY_SPC	BL (Fence)	Break	Buildings,Fences & Mailboxes
415	Fence Corner	Topo_Fence	AS_OTHER ADVERTISING POINT	-	Spot	Buildings,Fences & Mailboxes
416	Fence End	Topo_Fence	AS_OTHER ADVERTISING POINT	-	Spot	Buildings,Fences & Mailboxes
417	Fence Post	Topo_Fence	AS_OTHER ADVERTISING POINT	-	Spot	Buildings,Fences & Mailboxes
418	Gate Post	Topo_Fence	AS_OTHER ADVERTISING POINT	-	Spot	Buildings,Fences & Mailboxes
419	Guardpost	Topo_Guardrail	RDWY_EX GUARDRAIL POST	-	Spot	Shldrs.,Medians, C & G
420	Guardrail	Topo_Point SPC Cell	SURVEY_SPC	BL (Guardrail_ Existing)	DNI	Shldrs.,Medians, C & G
421	Steel Plate Beam Guardrail	Topo_Point SPC Cell	SURVEY_SPC	BL (Guardrail_ Existing)	DNI	Shldrs.,Medians, C & G
422	End Section Guardrail	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Shldrs.,Medians, C & G
423	Sign	Topo_Advertising Sign	NONHWY_AD SIGN	BL (0)	Spot	Shldrs.,Medians, C & G
424	Sign Foundation	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Shldrs.,Medians, C & G
425	Landscape	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Spot	Vegetation Features
426	Cable Barrier	Topo_Point SPC Cell	SURVEY_SPC	BL (Cable_Barrier_ Existing)	DNI	Shldrs.,Medians, C & G
429	Pasture-Short grass	Topo_Point SPC Cell	SURVEY_SPC	BL (Vegetation)	Spot	Vegetation Features
430	Pasture-High grass	Topo_Point SPC Cell	SURVEY_SPC	BL (Vegetation)	Spot	Vegetation Features
431	Cultivated-No Crop	Topo_Point SPC Cell	SURVEY_SPC	BL (Vegetation)	Spot	Vegetation Features

Code	Description	Level	Cell	Linestyle	DTM	Category
432	Cultivated-Row Crop	Topo_Point SPC Cell	SURVEY_SPC	BL (Vegetation)	Spot	Vegetation Features
433	Cultivated-Field Crop	Topo_Point SPC Cell	SURVEY_SPC	BL (Vegetation)	Spot	Vegetation Features
434	Brush-Light	Topo_Point SPC Cell	SURVEY_SPC	BL (Woods_Brush)	Spot	Vegetation Features
435	Brush-Medium	Topo_Point SPC Cell	SURVEY_SPC	BL (Woods_Brush)	Spot	Vegetation Features
436	Brush-Dense	Topo_Point SPC Cell	SURVEY_SPC	BL (Woods_Brush)	Spot	Vegetation Features
437	Timber - Light Underbrush	Topo_Point SPC Cell	SURVEY_SPC	BL (Woods_Brush)	Spot	Vegetation Features
438	Timber - Heavy Underbrush	Topo_Point SPC Cell	SURVEY_SPC	BL (Woods_Brush)	Spot	Vegetation Features
439	Timber - Cleared with Stumps	Topo_Point SPC Cell	SURVEY_SPC	BL (Woods_Brush)	Spot	Vegetation Features
450	Railroad Center Line	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Railroad Features
451	Top of Rail	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	DNI	Railroad Features
452	Top Rail@ Guage Line	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	DNI	Railroad Features
453	Railroad Crossing Corner	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Railroad Features
454	Railroad Relay Box	Topo_Railroad	RR_EX CONTROL BOX	-	DNI	Railroad Features
455	Railroad Switch Control	Topo_Railroad	RR_EX CONTROL BOX	-	DNI	Railroad Features
456	Railroad Semaphore	Topo_Railroad	RR_EX FLASHING SIGNAL	-	DNI	Railroad Features
457	Railroad Crossbuck	Topo_Railroad	RR_EX CROSSBUCK	-	Spot	Railroad Features
458	Railroad Signal Cabinet	Topo_Railroad	RR_EX CONTROL BOX	BL (0)	Break	Railroad Features
459	Railroad Sig. Foundation	Topo_Railroad	RR_EX CONTROL BOX	-	Spot	Railroad Features

Code	Description	Level	Cell	Linestyle	DTM	Category
460	Railroad Battery Box	Topo_Railroad	RR_EX CONTROL BOX	BL (0)	Break	Railroad Features
461	Railroad Mile Post	Topo_Railroad	RDWY_EX TRAFFIC SIGN	-	DNI	Railroad Features
462	Railroad Point Of Switch	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Railroad Features
463	Railroad Point Of Frog	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Railroad Features
464	Railroad Derail	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Railroad Features
465	Railroad Flashing Signal	Topo_Railroad	RR_EX FLASHING SIGNAL	-	Spot	Railroad Features
466	Railroad Crossing Gate	Topo_Railroad	RR_EX CROSSING GATE	BL (0)	Spot	Railroad Features
467	Railroad Crossing Combination Mast Arm	Topo_Railroad	RR_EX CANT MAST ARM	BL (0)	Spot	Railroad Features
500	Curb	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
501	Curb - Top	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
502	Curb - Back	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
503	Curb - Depressed - Back	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
504	Curb - Depressed - Front	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
505	Curb - Type B - Top	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
506	Curb - Type B - Back	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
507	Curb & Gutter	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
508	Curb & Gutter - Type B-6-12 - Top	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
509	Curb & Gutter - Type B-6-12 - Back	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G

Code	Description	Level	Cell	Linestyle	DTM	Category
510	Curb & Gutter - Type B-6-12 - FL	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
511	Curb & Gutter - Type B-6-18 - FL	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
512	Curb & Gutter - Type B-6-18 - Top	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
513	Curb & Gutter - Type B-6-18 - Back	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
514	Curb & Gutter - Type B-6-24 - FL	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
515	Curb & Gutter - Type B-6-24 - Top	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
516	Curb & Gutter - Type B-6-24 - Back	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
517	Curb & Gutter - Type B-9-12 - FL	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
518	Curb & Gutter - Type B-9-12 - Top	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
519	Curb & Gutter - Type B-9-12 - Back	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
520	Curb & Gutter - Type B-9-18 - FL	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
521	Curb & Gutter - Type B-9-18 - Top	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
522	Curb & Gutter - Type B-9-18 - Back	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
523	Curb & Gutter - Type B-9-24 - FL	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
524	Curb & Gutter - Type B-9-24 - Top	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
525	Curb & Gutter - Type B-9-24 - Back	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
526	Curb & Gutter - Type M-6-06 - FL	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
527	Curb & Gutter - Type M-6-06 - Top	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G

Code	Description	Level	Cell	Linestyle	DTM	Category
528	Curb & Gutter - Type M-6-06 - Back	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
529	Curb & Gutter - Type M-6-12 - FL	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
530	Curb & Gutter - Type M-6-12 - Top	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
531	Curb & Gutter - Type M-6-12 - Back	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
532	Curb & Gutter - Type M-6-18 - FL	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
533	Curb & Gutter - Type M-6-18 - Top	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
534	Curb & Gutter - Type M-6-18 - Back	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
535	Curb & Gutter - Type M-6-24 - FL	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
536	Curb & Gutter - Type M-6-24 - Top	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
537	Curb & Gutter - Type M-6-24 - Back	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
538	Curb & Gutter - Type M-2-06 - FL	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
539	Curb & Gutter - Type M-2-06 - Top	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
540	Curb & Gutter - Type M-2-06 - Back	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
541	Curb & Gutter - Type M-2-12 - FL	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
542	Curb & Gutter - Type M-2-12 - Top	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
543	Curb & Gutter - Type M-2-12 - Back	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
544	Median - Type SB-6-06 - Top	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
545	Median - Type SB-6-06 - FL	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G

Code	Description	Level	Cell	Linestyle	DTM	Category
546	Median - Type SB-6-12 - Top	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
547	Median - Type SB-6-24 - FL	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
548	Median - Type SB-6-24 - Top	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
549	Median - Type SB-9-6 - FL	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
550	Median - Type SB-9-6 - Top	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
551	Median - Type SB-9-12 - Top	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
552	Median - Type SB-9-24 - FL	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
553	Median - Type SB-9-24 - Top	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
554	Median - SM-6-06 - FL	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
555	Median - SM-6-06 - Top	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
556	Median - SM-6-12 - FL	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
557	Median - SM-6-12 - Top	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
558	Median - SM-6-24 - FL	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
559	Median - SM-6-24 - Top	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
560	Median - SM-6-06 - FL	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
561	Median - Type M-2-06 - FL	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
562	Median - Type M-2-06 - Top	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
563	Median - Type M-2-12 - FL	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G

Code	Description	Level	Cell	Linestyle	DTM	Category
564	Median - Type M-2-12 - Top	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
565	Median - Type C-4	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
566	Median - Flowline - Type SB-6.12	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
567	Non-Standard Median	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
570	Gutter	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
571	Gutter - Back	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
572	Gutter - Depressed	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
573	Gutter - Edge	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
574	Gutter - Flag	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
575	Gutter - Flowline	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
576	Gutter - Outlet	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
577	Island	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
578	Median	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
579	Concrete Barrier	Topo_Point SPC Cell	SURVEY_SPC	BL (Concrete_Barrier)	Break	Shldrs.,Medians, C & G
580	Standard Outlet	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
590	Raised Reflective Pavement Marker - Amber 1 way	Topo_PMK Symbols	PM_EX_MARKER AMBER 1	-	DNI	Pavement Features

Code	Description	Level	Cell	Linestyle	DTM	Category
591	Raised Reflective Pavement Marker - Amber 2 way	Topo_PMK Symbols	PM_EX_MARKER AMBER 2	-	DNI	Pavement Features
592	Raised Reflective Pavement Marker - Crystal 1 way	Topo_PMK Symbols	PM_EX_MARKER AMBER 1	-	DNI	Pavement Features
600	Building - Commercial	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Buildings,Fences & Mailboxes
601	Building - Public	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Buildings,Fences & Mailboxes
602	Building - Private	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Buildings,Fences & Mailboxes
603	Profile	Topo_Point SPC Cell	SURVEY_SPC	-	Spot	Profiles
604	Ground Shot	Topo_Point Groud Shots	SURVEY_SPC	-	Break	Cross Sections
605	Riprap	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Drainage
606	Revetment Mat	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Drainage
607	Breakline	Topo_Breaklines	SURVEY_SPC	BL (0)	Break	DTM Line Codes
608	Building Deck	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Buildings,Fences & Mailboxes
609	Porch	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Buildings,Fences & Mailboxes
610	Bridge Section	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Bridges
611	Bridge Curb	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Bridges
612	Bridge Headwall	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Bridges
613	Abutment	Topo_Point SPC Cell	SURVEY_SPC	-	Spot	Bridges
614	Ground @ Abutment	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Bridges
615	Abutment - Top	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Bridges
616	Beam Seat	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Bridges
617	Bottom of Beam	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Bridges
618	Bridge Approach Slab	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Bridges
619	Bridge Deck	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Bridges
620	Bridge Seat	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Bridges
621	Deck	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	DNI	Bridges

Code	Description	Level	Cell	Linestyle	DTM	Category
622	Footing	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Bridges
623	Expansion Joint	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Bridges
624	Handrail	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	DNI	Bridges
625	Hub Guard	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Bridges
626	Low Concrete	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Bridges
627	Low Steel	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Bridges
628	Low Timber	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Bridges
629	Pier	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Bridges
630	Ground @ Pier	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Bridges
631	Pier - Top	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Bridges
632	Slope Wall	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Bridges
633	Parapet Wall	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Bridges
634	Wingwall	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Bridges
635	Wingwall - Top	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Bridges
639	Gasoline Monitoring Well	Topo_NonHighway Improvements	AS_LABEL_WELL	-	Spot	Buildings,Fences & Mailboxes
640	Inspection Well	Topo_Drainage Items	UTIL_EX BBOX	-	Spot	Buildings,Fences & Mailboxes
641	Stand Pipe	Topo_Drainage Items	DRAIN_EX FIELD VENT PIPE	-	Spot	Buildings,Fences & Mailboxes
647	Butt Joint	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Pavement Features
648	Gore	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Pavement Features
649	Entrance Edge	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Pavement Features
650	Entrance	Topo_Point SPC Cell	SURVEY_SPC	-	Spot	Pavement Features
651	Entrance - Centerline	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Pavement Features
652	Entrance - Commercial	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Pavement Features
653	Entrance - Commercial - Edge	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Pavement Features

Code	Description	Level	Cell	Linestyle	DTM	Category
654	Entrance - Field	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Pavement Features
655	Entrance - Field - Edge	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Pavement Features
656	Entrance - Private	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Pavement Features
657	Entrance - Private - Edge	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Pavement Features
658	Entrance - At Return	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Pavement Features
659	Handicap Ramp	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Sidewalks & Driveways
660	Alley	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Pavement Features
661	Alley - Centerline	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Pavement Features
662	Alley - Edge of Surf.	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Pavement Features
663	Road	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Pavement Features
664	Road - Centerline	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Pavement Features
665	Road - Edge of Surf.	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Pavement Features
666	Pavement	Topo_Point SPC Cell	SURVEY_SPC	-	Break	Pavement Features
667	Pavement - Centerline	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Pavement Features
668	Pavement - Edge	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Pavement Features
669	Pavement Station Number	Topo_Point SPC Cell	SURVEY_SPC	-	Spot	Pavement Features
670	Street	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Pavement Features
671	Street - Centerline	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Pavement Features

Code	Description	Level	Cell	Linestyle	DTM	Category
672	Street - Edge	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Pavement Features
673	Street - Sign	Topo_Traffic Sign	RDWY_EX TRAFFIC SIGN	-	Spot	Shldrs.,Medians, C & G
674	Shoulder	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Shldrs.,Medians, C & G
675	Surface - Edge	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Pavement Features
676	Surface - Centerline	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Pavement Features
677	Center of Lanes	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Pavement Features
678	Edge of Lanes	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Pavement Features
679	Parking Lot	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Sidewalks & Driveways
680	Parking Lot - Corner	Topo_Point SPC Cell	SURVEY_SPC	-	Spot	Sidewalks & Driveways
681	Parking Lot - Edge	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Sidewalks & Driveways
682	Parking Meter	Topo_Entrances	NONHWY_MAILBOX	-	Spot	Sidewalks & Driveways
683	Canopy	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	DNI	Buildings,Fences & Mailboxes
684	Gas Pump	Topo_NonHighway Improvements	UTIL_EX BBOX	-	Spot	Buildings,Fences & Mailboxes
685	Pump Island	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Spot & Break	Buildings,Fences & Mailboxes
686	Underground Tank Filler Cap	Topo_NonHighway Improvements	UTIL_EX BBOX	-	DNI	Buildings,Fences & Mailboxes
687	Parking Stall Stripe	Topo_Point SPC Cell	SURVEY_SPC	BL (1)	Break	Pavement Features
688	Underground Gas Pipe	Topo_Point SPC Cell	SURVEY_SPC	BL (Underground_ Gasline)	DNI	Underground Utilities

Code	Description	Level	Cell	Linestyle	DTM	Category
689	Underground Water Pipe	Topo_Point SPC Cell	SURVEY_SPC	BL (Underground_ Water)	DNI	Underground Utilities
690	Underground Oil Pipe	Topo_Point SPC Cell	SURVEY_SPC	BL (Underground_ Oil)	DNI	Underground Utilities
691	Flag Pole	Topo_NonHighway Improvements	AS_FLAG POLE	-	Spot	Buildings,Fence s & Mailboxes
692	Headstone	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	DNI	Buildings,Fence s & Mailboxes
693	L.P. Gas Tank	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Spot	Buildings,Fence s & Mailboxes
694	Lane Marking Stripe	Topo_Point SPC Cell	SURVEY_SPC	BL (1)	Spot	Pavement Features
695	Stop Bar	Topo_Point SPC Cell	SURVEY_SPC	BL (PMK_StopLine_ Existing)	Spot	Pavement Features
696	Mailbox Turnout	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Sidewalks & Driveways
697	Ramp	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Pavement Features
698	Misc AS Culture PNT	Topo_NonHighway Improvements	AS_CULTURE_PNT	-	DNI	Miscellaneous
699	Miscellaneous	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
701	Traverse Survey Point	Topo_Control Points	AS_HORIZ_CTRL_STA	-	DNI	Cross Sections
702	Cross - Section Survey Point	Topo_Control Points	XS_EX UTIL	BL (0)	Break	Cross Sections
703	Topo Survey Point	Topo_Control Points	AS_HORIZ_CTRL_STA	-	DNI	Cross Sections
704	LiDAR Ground Shot	Aerial_Survey LiDAR Mass PNTS	SURVEY_SPC	-	Break	Cross Sections
707	Cut Square	Topo_Miscellaneous	AS_VERT_CONTROL STA	-	DNI	Miscellaneous
711	Close Figure	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	DTM Line Codes
722	Left Turn	Topo_PMK Symbols	PM_EX_URB LT TRN ARROW	-	DNI	Pavement Features

Code	Description	Level	Cell	Linestyle	DTM	Category
723	Right Turn	Topo_PMK Symbols	PM_EX_URB RT TRN ARROW	-	DNI	Pavement Features
724	Left Turn Combo	Topo_PMK Symbols	PM_EX_URB COMB LT	-	DNI	Pavement Features
725	Right Turn Combo	Topo_PMK Symbols	PM_EX_URB COMB RT	-	DNI	Pavement Features
726	Left Turn Only	Topo_PMK Symbols	PM_EX_URB LT TRN ONLY	-	DNI	Pavement Features
727	Right Turn Only	Topo_PMK Symbols	PM_EX_URB RT TRN ONLY	-	DNI	Pavement Features
728	Thru Only	Topo_PMK Symbols	PM_EX_URB THRU ONLY	-	DNI	Pavement Features
729	Bi-Diretional Center Turn Lane Arrows	Topo_PMK Symbols	PM_EX_URB 2-WAY LT TRN	-	DNI	Pavement Features
741	Broken	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
742	Tubeco	Topo_Miscellaneous	BOUND_IRON PIPE FOUND	-	DNI	Miscellaneous
743	Apparen Line of Possesion	ROW_EX_Property Dashed Lines	BOUND_PROPERTY LINE	BL (Property)	DNI	Miscellaneous
744	Possible	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
745	On-Skew	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	DNI	Miscellaneous
746	Bent	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
748	Aboveground	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
749	Underground	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
750	Abandoned	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
751	Aerial	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	DNI	Miscellaneous
752	Aggregate	Topo_Miscellaneous	AS_LABEL_AGG	-	DNI	Miscellaneous
753	Aluminum	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
754	Axle	Topo_Miscellaneous	BOUND_IRON PIPE FOUND	-	DNI	Miscellaneous
755	Back	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
756	Barb	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
757	Baseline	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
758	Beginning	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous

Code	Description	Level	Cell	Linestyle	DTM	Category
759	Hot Mix Asphalt	Topo_Miscellaneous	AS_LABEL_HMA	-	DNI	Miscellaneous
760	Bolt	Topo_Miscellaneous	BOUND_IRON PIPE FOUND	-	DNI	Miscellaneous
761	Bottom	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
762	Brick	Topo_Miscellaneous	AS_LABEL_BRICK	-	DNI	Miscellaneous
763	Buried	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
764	Cable	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
765	Cable TV	Topo_Point SPC Cell	SURVEY_SPC	BL (Underground_ CableTV)	DNI	Miscellaneous
766	Cast Iron	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
767	Center	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
768	Centerline	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	Miscellaneous
769	Chain Link	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
770	Chiseled "X"	Topo_Miscellaneous	BOUND_X FOUND	-	DNI	Miscellaneous
771	Clay	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
772	CMP	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
773	CMPA	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
774	Concrete	Topo_Miscellaneous	AS_LABEL_CONC	-	DNI	Miscellaneous
775	Concrete Block	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
776	Corner	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
777	Cross Cut	Topo_Miscellaneous	BOUND_X FOUND	-	DNI	Miscellaneous
778	Crushed Stone	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
779	CS	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
780	Dirt	Topo_Miscellaneous	AS_LABEL_DIRT	-	DNI	Miscellaneous
781	Disk	Topo_Miscellaneous	BOUND_IRON PIPE FOUND	-	DNI	Miscellaneous
782	Door Sill	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
783	Drill Hole	Topo_Miscellaneous	BOUND_IRON PIPE FOUND	-	DNI	Miscellaneous
784	Ductile Iron Pipe	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
785	Edge	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous

Code	Description	Level	Cell	Linestyle	DTM	Category
786	Edge of Water	Topo_Point SPC Cell	SURVEY_SPC	BL (Water_Edge)	Break	Miscellaneous
787	Electrical	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
788	End	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
789	Face	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
790	Field	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
791	Mag Nail	Topo_Miscellaneous	ALI_EX PNT INDICATOR	-	DNI	Miscellaneous
792	Floor	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
793	Flowline	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Miscellaneous
794	Found	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
795	Foundation	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Miscellaneous
796	Front	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
797	Garage	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Buildings,Fences & Mailboxes
798	Gas	Topo_Point SPC Cell	SURVEY_SPC	Underground_Gasline	DNI	Miscellaneous
799	Gasoline	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
800	Gravel	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
801	House	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Buildings,Fences & Mailboxes
802	Inside	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
803	Intersection	Topo_Miscellaneous	AS_MASS PNT	-	DNI	Miscellaneous
804	Iron	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
805	Meander Line	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
806	Metal	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
807	Midpoint	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
808	Multiple Use	Topo_Miscellaneous	AS_LABEL_MULTIPLE USE	-	DNI	Miscellaneous
809	Nail	Topo_Miscellaneous	ALI_EX PNT INDICATOR	-	DNI	Miscellaneous
810	Oiled Earth	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
811	Oil & Chips	Topo_Miscellaneous	AS_LABEL_O C	-	DNI	Miscellaneous
812	Ornamental	Topo_Miscellaneous	AS_LABEL_ORNAMENTAL	-	DNI	Miscellaneous

Code	Description	Level	Cell	Linestyle	DTM	Category
813	Outside	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
814	Overhang	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
815	Painted	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	DNI	Miscellaneous
816	PC	Alignment_EX_50 Baseline	ALI_EX PI INDICATOR	-	DNI	Miscellaneous
817	PCC	Alignment_EX_50 Baseline	ALI_EX PI INDICATOR	-	DNI	Miscellaneous
818	Permanent Survey Marker	Topo_Control Points	BOUND_SURVEY MARKER	-	DNI	Miscellaneous
819	Petro	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
820	PI	Alignment_EX_50 Baseline	ALI_EX PI INDICATOR	-	DNI	Miscellaneous
821	Pin	Topo_Control Points	BOUND_IRON PIPE FOUND	-	DNI	Miscellaneous
822	Pinch Pipe	Topo_Miscellaneous	BOUND_IRON PIPE FOUND	-	DNI	Miscellaneous
823	Pipe	Topo_Miscellaneous	BOUND_IRON PIPE FOUND	-	DNI	Miscellaneous
824	PK Nail	Topo_Control Points	ALI_EX PNT INDICATOR	-	DNI	Miscellaneous
825	Plate	Topo_Miscellaneous	BOUND_IRON PIPE FOUND	-	DNI	Miscellaneous
826	Plug	Topo_Miscellaneous	BOUND_IRON PIPE FOUND	-	DNI	Miscellaneous
827	POBTE	Topo_Control Points	ALI_EX PNT INDICATOR	-	DNI	Miscellaneous
828	Rebar	Topo_Miscellaneous	BOUND_IRON PIPE FOUND	-	DNI	Miscellaneous
829	POC	Topo_Control Points	ALI_EX PNT INDICATOR	-	DNI	Miscellaneous
830	POFT	Topo_Control Points	ALI_EX PNT INDICATOR	-	DNI	Miscellaneous
831	POFTE	Topo_Control Points	ALI_EX PNT INDICATOR	-	DNI	Miscellaneous
832	POT	Topo_Control Points	ALI_EX PNT INDICATOR	-	DNI	Miscellaneous
833	PRC	Topo_Control Points	ALI_EX PI INDICATOR	-	DNI	Miscellaneous
834	Private	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
835	PT	Alignment_EX_50 Baseline	ALI_EX PI INDICATOR	-	DNI	Miscellaneous

Code	Description	Level	Cell	Linestyle	DTM	Category
836	PVC	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
837	PVC Pipe	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
838	Rail Road Spike	Topo_Control Points	BOUND_IRON PIPE FOUND	-	DNI	Miscellaneous
839	Ramp	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
840	RCP	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
841	RCPA	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
842	Roof Bolt	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
843	Rubber	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
844	Transitline	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
845	Sanitary	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
846	SC	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
847	Set	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
848	Shed	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Miscellaneous
849	Square Rod	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
850	ST	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
851	Steel	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
852	Step	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Miscellaneous
853	Stone	Topo_Miscellaneous	BOUND_IRON PIPE FOUND	-	DNI	Miscellaneous
854	Storm	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
855	Structure Entrance	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
856	Survey	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
857	Telephone	Topo_Point SPC Cell	SURVEY_SPC	Underground_ Telephone	DNI	Miscellaneous
858	Thalweg	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	DNI	Miscellaneous
859	Timber	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
860	Toe	Topo_Breaklines	SURVEY_SPC	BL (0)	Break	Miscellaneous
861	Top	Topo_Breaklines	SURVEY_SPC	BL (0)	Break	Miscellaneous
862	Top of Bank	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Miscellaneous
863	TS	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
864	Vegetation Line	Topo_Point SPC Cell	SURVEY_SPC	Woods_Brush	Spot	Miscellaneous

Code	Description	Level	Cell	Linestyle	DTM	Category
865	Vitrified Clay	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
866	Vitrified Clay Encased	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
867	Water	Topo_Point SPC Cell	SURVEY_SPC	BL (Water_Edge)	DNI	Miscellaneous
868	Wood Stake	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
869	Wood	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
870	Woven Wire	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
871	Pavement Edge, Left	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	DTM Line Codes
872	Pavement Edge, Right	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	DTM Line Codes
873	Shoulder, Left	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	DTM Line Codes
874	Shoulder, Right	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	DTM Line Codes
875	Top, Left	Topo_Breaklines	SURVEY_SPC	BL (0)	Break	DTM Line Codes
876	Top, Right	Topo_Breaklines	SURVEY_SPC	BL (0)	Break	DTM Line Codes
877	Ditch, Left	Topo_Point SPC Cell	SURVEY_SPC	BL (6)	Break	DTM Line Codes
878	Ditch, Right	Topo_Point SPC Cell	SURVEY_SPC	BL (6)	Break	DTM Line Codes
879	Flowline, Left	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	DTM Line Codes
880	Flowline, Right	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	DTM Line Codes
881	Top of Bank, Left	Topo_Breaklines	SURVEY_SPC	0	Break	DTM Line Codes
882	Top of Bank, Right	Topo_Breaklines	SURVEY_SPC	0	Break	DTM Line Codes
883	Fence, Left	Topo_Point SPC Cell	SURVEY_SPC	BL (Fence)	Break	DTM Line Codes
884	Fence, Right	Topo_Point SPC Cell	SURVEY_SPC	BL (Fence)	Break	DTM Line Codes
885	Cropline, Left	Topo_Point SPC Cell	SURVEY_SPC	BL (Vegetation)	Break	DTM Line Codes
886	Cropline, Right	Topo_Point SPC Cell	SURVEY_SPC	BL (Vegetation)	Break	DTM Line Codes
887	Toe, Left	Topo_Breaklines	SURVEY_SPC	BL (0)	Break	DTM Line Codes
888	Toe, Right	Topo_Breaklines	SURVEY_SPC	BL (0)	Break	DTM Line Codes
889	Center of Lanes, Left	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	DTM Line Codes
890	Center of Lanes, Right	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	DTM Line Codes
891	Median Edge, Left	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	DTM Line Codes
892	Median Edge, Right	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	DTM Line Codes
893	Edge of Lanes, Left	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	DTM Line Codes
894	Edge of Lanes, Right	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	DTM Line Codes

Code	Description	Level	Cell	Linestyle	DTM	Category
895	Top of Paved Ditch, Left	Topo_Point SPC Cell	SURVEY_SPC	3	Break	DTM Line Codes
896	Top of Paved Ditch, Right	Topo_Point SPC Cell	SURVEY_SPC	3	Break	DTM Line Codes
897	Bot. of Paved Ditch, Left	Topo_Point SPC Cell	SURVEY_SPC	BL (Ditch_Paved)	Break	DTM Line Codes
898	Bot. of Paved Ditch, Right	Topo_Point SPC Cell	SURVEY_SPC	BL (Ditch_Paved)	Break	DTM Line Codes
899	Ramp - Left	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	DTM Line Codes
900	Ramp - Right	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	Break	DTM Line Codes
901	Timber edge - Left	Topo_Point SPC Cell	SURVEY_SPC	BL (Woods_Brush)	Spot	DTM Line Codes
902	Timber edge - Right	Topo_Point SPC Cell	SURVEY_SPC	BL (Woods_Brush)	Spot	DTM Line Codes
903	Edge of water - Left	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	DTM Line Codes
904	Edge of water - Right	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	DTM Line Codes
905	Chiseled Square	Topo_Point SPC Cell	SURVEY_SPC	-	DNI	Miscellaneous
906	Catch Basin Peremiter	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Drainage
908	Drop Inlet Perimeter	Topo_Point SPC Cell	SURVEY_SPC	BL (0)	Break	Drainage
920	Cable TV, Above Ground - MAIN	Topo_Point SPC Cell	SURVEY_SPC	BL (Cable_Aerial)	DNI	Aboveground Utilities
921	Cable TV, Above Ground - FEED	Topo_Point SPC Cell	SURVEY_SPC	BL (Cable_Aerial)	DNI	Aboveground Utilities
922	Cable TV, Under Ground - MAIN	Topo_Point SPC Cell	SURVEY_SPC	BL (Underground_ CableTV)	DNI	Underground Utilities
923	Cable TV, Under Ground - FEED	Topo_Point SPC Cell	SURVEY_SPC	BL (Underground_ CableTV)	DNI	Underground Utilities
924	Cable TV, Above Ground - FIBER	Topo_Point SPC Cell	SURVEY_SPC	BL (Cable_Aerial)	DNI	Aboveground Utilities
925	Cable TV, Under Ground - FIBER	Topo_Point SPC Cell	SURVEY_SPC	BL (Underground_ CableTV)	DNI	Underground Utilities
930	Electric, Above Ground - MAIN	Topo_Point SPC Cell	SURVEY_SPC	BL (Cable_Aerial)	DNI	Aboveground Utilities

Code	Description	Level	Cell	Linestyle	DTM	Category
931	Electric, Above Ground - FEED	Topo_Point SPC Cell	SURVEY_SPC	BL (Cable_Aerial)	DNI	Aboveground Utilities
932	Electric, Under Ground - MAIN	Topo_Point SPC Cell	SURVEY_SPC	BL (Underground_ Electric)	DNI	Underground Utilities
933	Electric, Under Ground - FEED	Topo_Point SPC Cell	SURVEY_SPC	BL (Underground_ Electric)	DNI	Underground Utilities
940	Gas, Above Ground - MAIN	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	DNI	Aboveground Utilities
941	Gas, Above Ground - FEED	Topo_Point SPC Cell	SURVEY_SPC	BL (3)	DNI	Aboveground Utilities
942	Gas, Under Ground - MAIN	Topo_Point SPC Cell	SURVEY_SPC	BL (Underground_ Gasline)	DNI	Underground Utilities
943	Gas, Under Ground - FEED	Topo_Point SPC Cell	SURVEY_SPC	BL (Underground_ Gasline)	DNI	Underground Utilities
950	IDOT Electric, Above Ground	Topo_Point SPC Cell	SURVEY_SPC	BL (Cable_Aerial)	DNI	Aboveground Utilities
951	IDOT Electric, Under Ground	Topo_Point SPC Cell	SURVEY_SPC	BL (Underground_ Electric)	DNI	Underground Utilities
952	IDOT Telecommunication, Above Ground	Topo_Point SPC Cell	SURVEY_SPC	BL (Cable_Aerial)	DNI	Aboveground Utilities
953	IDOT Telecommunication, Under Ground	Topo_Point SPC Cell	SURVEY_SPC	BL (Underground_ Telephone)	DNI	Underground Utilities
960	Sanitary Sewer - MAIN	Topo_Point SPC Cell	SURVEY_SPC	BL (Underground_ Sanitary_Sewer)	DNI	Underground Utilities
961	Sanitary Sewer - FEED	Topo_Point SPC Cell	SURVEY_SPC	BL (Underground_ Sanitary_Sewer)	DNI	Underground Utilities

Code	Description	Level	Cell	Linestyle	DTM	Category
962	Storm Sewer - MAIN	Topo_Point SPC Cell	SURVEY_SPC	BL (Sewer_Storm_ Existing)	DNI	Underground Utilities
963	Storm Sewer - FEED	Topo_Point SPC Cell	SURVEY_SPC	BL (Sewer_Storm_ Existing)	DNI	Underground Utilities
970	Telephone, Above Ground - MAIN	Topo_Point SPC Cell	SURVEY_SPC	BL (Cable_Aerial)	DNI	Aboveground Utilities
971	Telephone, Above Ground - FEED	Topo_Point SPC Cell	SURVEY_SPC	BL (Cable_Aerial)	DNI	Aboveground Utilities
972	Telephone, Under Ground - MAIN	Topo_Point SPC Cell	SURVEY_SPC	BL (Underground_ Telephone)	DNI	Underground Utilities
973	Telephone, Under Ground - FEED	Topo_Point SPC Cell	SURVEY_SPC	BL (Underground_ Telephone)	DNI	Underground Utilities
974	Telephone, Above Ground - FIBER	Topo_Point SPC Cell	SURVEY_SPC	BL (Cable_Aerial)	DNI	Aboveground Utilities
975	Telephone, Under Ground - FIBER	Topo_Point SPC Cell	SURVEY_SPC	BL (Underground_ Fiber)	DNI	Underground Utilities
980	Water - MAIN	Topo_Point SPC Cell	SURVEY_SPC	BL (Underground_ Water)	DNI	Underground Utilities
981	Water - FEED	Topo_Point SPC Cell	SURVEY_SPC	BL (Underground_ Water)	DNI	Underground Utilities

APPENDIX J – OPENROADS SURVEY SETTINGS

The settings used by OpenRoads Survey are stored in Survey_Settings.dgnlib. A summary of the settings is included in the following table:

Setting	Value	Description
Create Log File	True	Allows creation of log file (audit trail) if needed
Append Notes to Descriptions	True	If survey data file contains notes which exist as separate records, then these notes are appended to any description which exists on the point.
Use Annotation Scale	True	Allows automatic resizing of cells and annotation by changing the DGN drawing scale.
Use VBA Macros	True	Enables use of VBA macros to be assigned to certain feature definitions.
VBA Feature Macros		At present only one macro is defined for creating 3D solids on pipes.
Validating Rules		None assigned
Import Coordinate Records	Always	Coordinate records in survey data file will always be imported.
Link Code Position	Before	The link codes (shown below) are placed before the point code. Example: “1.668” begins an edge of pavement line.
Linear Feature Linking Method	By Field Code	Determination of linear elements is based on the codes assigned to points.
Linear Feature Linking	By Linking Codes	Linear feature linking is always determined from the linking codes (as defined in previous setting) but this setting defines that linking codes also control start and end after the data is imported. If points need to be added or appended, then it might be necessary to convert to a pint list feature and then manage the point list directly.

Setting	Value	Description
Feature Exclusions	None Defined	Feature exclusions are used when linking method is “consecutive” or “matching” then list is used to define codes which are never made into lines.
Linking Codes		
Start	1.	Used to begin a line with first segment as a straight segment
End	2.	Used to end a line
Start PC	12.	Used to start a line with first segment as a curve
Arc PC	3.	Sets the point as the beginning of a curve which is tangent to the previous line segment
Arc PT	4.	Sets the point as the end of a curve which is tangent to the next line segment
Non Tan PC	5.	Sets the point as the beginning of a curve, the previous line segment is not considered for tangency
Non Tan PT	6.	Sets the point as the end of a curve, the next line segment is not considered for tangency
Arc Single	11.	Sets the point as the center of a curve, with the point previous and point after are used to make a curve
Arc to Arc	9.	Sets the point as a end of one curve and beginning of next curve, the curves are not necessarily related such as compound curve or reverse curve. The result could be two disjointed curves.
ArcToggle	8.	Sets the point as a curve point and all following points as curve points until arc toggle is used again
Close Shape	12.	Projects a line perpendicular from the first segment to intersect with a perpendicular to the last line segment to close a shape.
Close	7.	Closes a line from the last point directly back to the beginning point to form a shape.
Circle Diameter	CD	Survey a single point at center of a circle. This code forms a circle with the specified diameter. Example: “668 CD.12” will form a circle of code 668 with diameter of 12.
Circle Radius	CR	Survey a single point at center of a circle. This code forms a circle with the specified radius. Example: “668 CD.12” will form a circle of code 668 with radius of 12.

Setting	Value	Description
Rectangle	RECT	After shooting two points in a line add this code (Ex: RECT 60) to form a rectangle where one side is the two surveyed points and the other side of rectangle is the measured length (60 ft in this example)
Tape Distance	DIST	After surveying at least 1 segment of a line, enter taped values for distances to finish closing the shape. Example: Survey 1st and 2nd points of a building. On the 2nd point add " DIST 12,5,-5,10,17" will draw perpendicular segments of 12 ft to right, 5 ft to right, 5 ft to left and 10 feet to right
Join Point	JP	For a given point at beginning or ending of a line, join this point to some other point. Most used to close gaps between chains. Serves as an alternative method to append point command.
Template	TP	Used to minimize numbers of break lines collected in the field along regular shaped objects such as curbs. See templates presentation for examples.
Elevation	LV	Overrides the elevation of a point. Works only when processing raw observations.
Up/Down	UD	Adds or subtracts a value from the elevation of a point. Works only when processing raw observations
Left/Right	LR	Shifts a point left or right perpendicular from the line of observation. Works only when processing raw observations.
Front/Back	FB	Shifts a point forward or backward along the line of observation. Works only when processing raw observations.
Data Import Items		A variety of ASCII formats have been included, corresponding to IDOT survey practice. Most others have been toggled off. Consultants may find it necessary to toggle some of these back on.
Use Substitute Strings	True	This value is set to true to allow future use of substitute strings.

Setting	Value	Description
Substitute Strings	None Defined	There are no substitutions currently defined.
Description Separator	--	Double dash, using a single dash will interfere with negative values of taped distances when using rectangle and distance control codes.
Attribute Separator	=	Used to code attribute collection on the points while surveying.
Adjustment Defaults	Least Squares	All default settings are configured for least squares adjustment. IDOT does not process raw observations. Consultants who do will want to review these settings.
Element Symbology	None Defined	IDOT does not process raw observations so no observation symbology is needed. Consultants who do process raw observations will want to review these settings or make sure that the active level at time of processing is appropriate.
Create Terrain Model	False	IDOT has determined that automatic terrain model creation is a detriment to standard workflows. This can be toggled on, after a field book is created, if desired.
Name	Survey ExGround	The default name of the automatic terrain model. Adjust as needed.
Feature Defintion	Existing_Boundary	The feature definition assigned to the automatic terrain model. Adjust as needed.
Edge Method	Max Triangle Length	The default edge determination method of the automatic terrain model. Adjust as needed.
Length	75	The default edge length of the automatic terrain model. Adjust as needed.

APPENDIX K – LIDAR DATA COLLECTION AND PROCESSING OVERVIEW

CONTENTS

OVERVIEW AND INTRODUCTION

This document is intended to provide an overview of LiDAR workflows as a part of the project development process. Please see Section 2-3 of IDOT's *Computer Aided Design, Drafting, Modeling and Deliverables* Manual for additional information regrding point cloud deliverables and formats.

LiDAR is an acronym for Light Detection and Ranging. The technology utilizes scanning equipment which scan with a laser beam and measure the time it takes for a reflected laser signal to return to the scanner to measure the distance to the object which is struck by the laser. The time then is used to compute a distance which is combined with the known direction of the emitted laser to compute a 3D point. By scanning at determined increments in a 360° horizontal circle and nearly 180° vertical circle, a collection or "cloud" of points is created.

When viewed at some distance, this point cloud will give the appearance of a 3D model of everything in view from the perspective of the laser scanner.

In modern laser scanning equipment, each point can also be tagged with additional information:

- Intensity – brightly colored surfaces return a stronger signal and thus have a higher intensity. This is rendered in the point cloud as a brighter appearance when viewing the point cloud.
- Color – when paired with photo images produced by the same laser scanner, the photo is used to assign red, green, and blue color parameters to each point. The result is a point cloud which looks true to life as far as color is concerned.

This document is arranged into the following segments:

- Overview and Introduction – provides basic background information.
- Guidance – provides information on software capabilities and high-level discussion of point cloud workflows and integration of point clouds with traditionally surveyed data.

SECTION I. STATEMENT OF NEED

Data collection for existing conditions on a civil engineering project can be expensive, both in time and money. Exposure to traffic creates a safety hazard for survey crews working along highways. Additionally, lane closures along highways, for purposes of collecting survey data, increase the hazard to the survey crews and introduce safety concerns and lost time costs to the driving public.

With the adoption of more detailed 3D design processes and models, there is a need on many projects for collection by survey crews of higher resolution data than can be provided by traditional survey, so that existing slopes and elevations can be used for widening design and slope correction.

LiDAR technology can help lower the costs of data collection by:

1. Reducing survey crew exposure to traffic.
2. Reducing or eliminating the need for lane closures.
3. Increasing the density of the survey information.
4. For projects where the initial objectives are to analyze the adequacy of the existing conditions as part of the decision-making process, point clouds can provide a single source of information for performing this analysis and making the decision whether to advance a project.

SECTION II. LIMITATIONS OF LIDAR

It is worth noting that LiDAR technology and point clouds are not a panacea for all potential difficulties in data collection. It is one tool available in the surveyor's toolset. Some of the issues which LiDAR cannot solve, and situations it is not well suited for, include:

1. Underground – Traditional surveying techniques are still required for utility surveys, although it is possible to scan into manholes to locate the interiors.
2. Property and Right of Way – Generally, property corners will not show up in point clouds and must be traditionally surveyed.
3. Vegetated Areas – Vegetation presents one of the greatest obstacles to collecting LiDAR data. Every return signal is logged as a point; thus, every tree leaf and blade of grass will potentially create points in the cloud. These can be filtered by various means if the vegetation is not so dense that some percentage of points hit the ground surface, but very dense vegetation may produce voids in ground surface data.

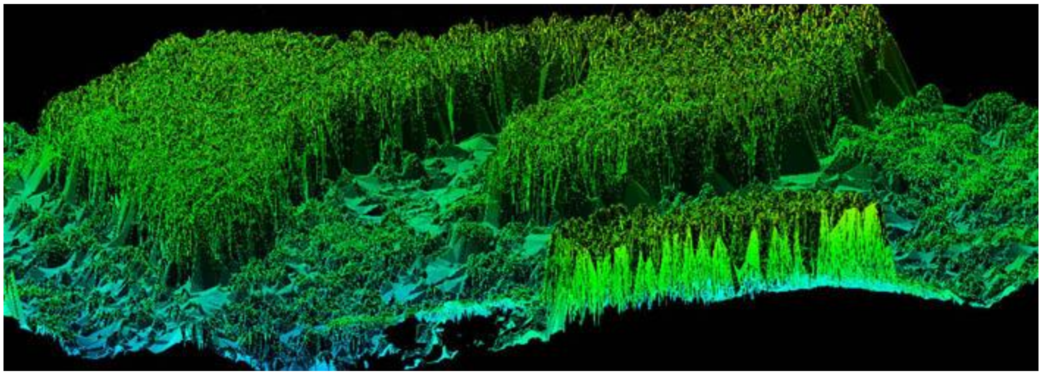


Figure 1 - Effect of Vegetation on Point Cloud

4. Highly Reflective natural light overwhelms the return signal of the laser.
5. Off-Pavement Break Lines – It can become logistically challenging to acquire data in sufficient locations so that all break lines outside the limits of pavement are accounted for in the point cloud, especially for terrestrial based scanning. Bottoms of ditches, for example, will often lie

in the “shadow” of the top of ditch unless the scanner is optimally positioned so that scanning can occur longitudinally down the ditch. Accounting for these additional scan positions can produce a condition of diminishing returns for the effort involved.

In short, LiDAR does not eliminate the need for traditional field survey operations.

SECTION III. DATA COLLECTION METHODS

Once LiDAR data is collected and processed, the result is a point cloud. However, the collection of the data in the field can be accomplished in various ways:

- Terrestrial – The LiDAR scanner is mounted on a tripod and a scan is initiated. Once the scan is complete, the scanner is moved to a new location and another scan is produced such that the area collected in the second scan overlaps areas in the first. The scans are produced from enough different locations to cover the desired site. Maximum effective scan distance for survey grade accuracy tends to be less than 200 ft but may vary by equipment manufacturer. Terrestrial scans are the most accurate, but also the most labor intensive.

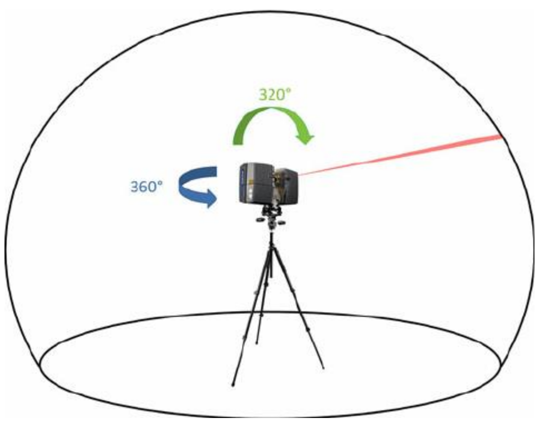


Figure 2 - Terrestrial LiDAR Scanning

- Mobile – The LiDAR scanner is mounted on a vehicle whose GPS location is continuously recorded. Scans are conducted while the vehicle moves at near-highway speeds. Mobile scans are faster than terrestrial scans but are somewhat less accurate due to the motion and reliance on global positioning system (GPS) location. Additionally, the capital investment can be significant.

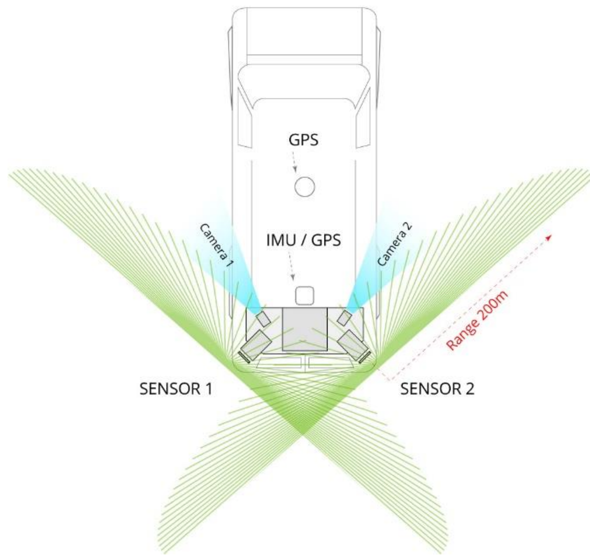


Figure 3 - Mobile LiDAR Scanning

- Airborne – The LiDAR scanner is mounted on an airborne vehicle. In the past, the vehicle was a plane or helicopter. In recent years, Unmanned Aerial Systems (UAS's, also known as drones) have become more common. Drone mounted scanners can be very cost effective and are very accessible means for collecting data. Data accuracy similar to mobile methods is possible with proper planning and lower elevations of flight. There are multiple legal and logistical challenges for flying drones over populated or traffic areas. Please see *14 CFR 107* for FAA guidance, or contact IDOT's Division of Aeronautics, when planning a mission involving drones.

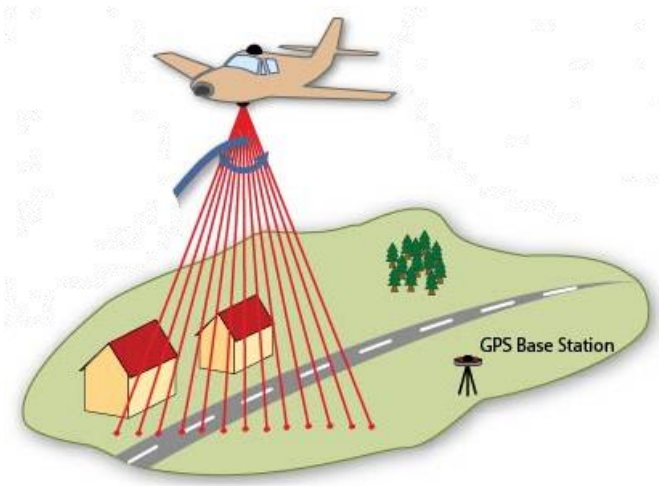


Figure 4 - Airborne LiDAR Scanning

GUIDANCE

This section describes, in general terms, the necessary data integration of LiDAR information into survey workflows and the impact on deliverables. “Data Integration” refers to the process of the surveyor taking data produced with LiDAR and integrating it with the data collected by traditional surveying methods. “Deliverables” means those data files which are passed from survey to the designer of the project for use during design.

SECTION IV. DATA INTEGRATION

Data Collection

Regardless of collection method, proper planning of a LiDAR survey will include configuring the scanner to collect a proper density of points. Very high-resolution point clouds are nice for viewing a project but produce computer hardware, storage, and networking challenges because of file size. For most roadway projects, configuring the scanner to a medium density (or even the low side of medium) will be sufficient.

For example, a high-resolution setting can result in points whose spacing average a few millimeters, which is not often needed. A very low-resolution setting may result in point spacing of 1-2 feet, which may miss some important features in the scan.

While it may sound attractive to collect very high-resolution point clouds, this must be balanced with file size. In addition to project length, the type of data being collected can have a dramatic impact on file size. As an example, a small bridge project of only a few hundred feet, scanned at medium resolution, can produce a point cloud of 2 GB in size, while a 5-mile-long project of a 5-lane roadway can produce a total of 120 GB of point cloud data.

Another consideration when collecting the scan data is whether or not to collect color values on the points. Color values are assigned to the points by collecting photographic data simultaneous with the laser scanning process and using the photo data to extract color values for each point. The camera is integrated with the scanning equipment.

The benefit of collecting the color values is that later viewing of the point cloud can then display those colors, making the point cloud much easier to interpret for many use cases, and by users less familiar with point clouds. The down-side is that scan times at each setup take a little longer and the files are little larger because each point carries more data.

Figure 5 - Left: No Color, Center: Intensity, Right: RGB Color

Recommendations:

- Collect data with an appropriate point density following manufacturer's recommendations.
- Collect R,G,B data while scanning, unless the additional time on station creates a safety hazard or undesired time delay. There is great value to the consumers of point cloud data in being able to see the points in color.

Available Processing Software

Currently, point cloud software including Bentley Descartes, Bentley Pointools, Open Roads Designer, Trimble Business Center Scanning module, Trimble RealWorks, Leica Cyclone, and TopoDOT/TopoCloud are available for internal staff use. See Section 2-3 of the *Computer Aided Design, Drafting, Modeling and Deliverables* Manual for discussion on file types included as part of LiDAR deliverables.

Data Tiling (Segmenting)

This document does not present a complete task list for the initial processing of LiDAR data, which will include (among other tasks): downloading from the field equipment, registering the data so that it is properly oriented into a coordinate system, and tiling of the data. This portion of the document is concerned only with the task of data tiling.

Data Tiling refers to the process of creating a collection of segments, or tiles, of point cloud data which are of manageable size. For this document, we are also including the initial processing of collected LiDAR data from multiple locations and combining them into a single cloud.

Regarding terminology, "tiling" and "segmenting" are used interchangeably here. It might seem more logical in our minds to think of the term "tiling" when referring to large areas which are both long and wide, and to think "segmenting" when referring to linear corridors such as roadways. In both cases, however, the goal is the same; to split the total cloud of points into multiple smaller point clouds of manageable size.

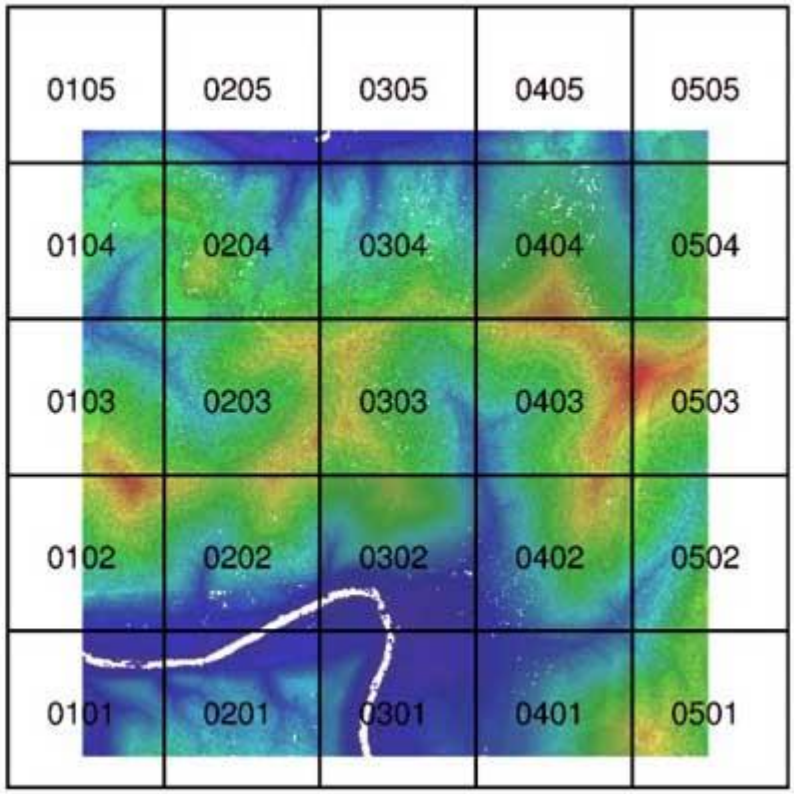


Figure 6 - Tiling of a Point Cloud

Thus, the initial processing will include tasks for:

1. Merging LiDAR data from multiple locations (i.e., multiple point clouds) into a single point cloud.
2. Tiling (segmenting) the composite data into smaller manageable pieces in a clean and logical manner.
3. Employing point filtering potentially at this time to further reduce file sizes by analyzing the point cloud to reduce the total number of points based on elevation filter values. This is different than defining the scan resolution in the field. In the field, reducing the resolution applies globally and will indiscriminately reduce the point spacing throughout the cloud. Filtering, as applied in the initial processing stage, applies various algorithms so that more points are removed in flat or planar areas than are removed in areas with curves or rapidly changing elevations.

Recommendation: The available storage medium and network speeds will likely encourage an optimal file size, and thus guide the tiling size. Currently, a maximum tile size of 2 GB and length of 1000 feet measured along the corridor alignment are recommended. Some experiments in a live work environment will be needed to get a feel for size as the technology expands and preferred software workflows are established. Please contact the Surveys, Mapping & Modeling Section of the Bureau of Design and Environment for more information.

Point Classification

Point classification refers to the process of assigning an attribute to every point which indicates the surface on which the point was measured. The American Society for Photogrammetry and Remote Sensing (ASPRS) update July 9th 2019 has defined the following standard classifications:

Classification value	Meaning
0	Never classified
1	Unclassified
2	Ground
3	Low Vegetation
4	Medium Vegetation
5	High Vegetation
6	Building
7	Low Point (noise)
8	Reserved
9	Water
10	Rail
11	Road Surface
12	Reserved
13	Wire - Guard (Shield)

Classification value	Meaning
14	Wire - Conductor (Phase)
15	Transmission Tower
16	Wire-Structure Connector (for example Insulator)
17	Bridge Deck
18	High Noise
19	Overhead Structure
20	Ignored Ground
21	Snow
22	Temporal Exclusion
23-63	Reserved
64-255	User Definable

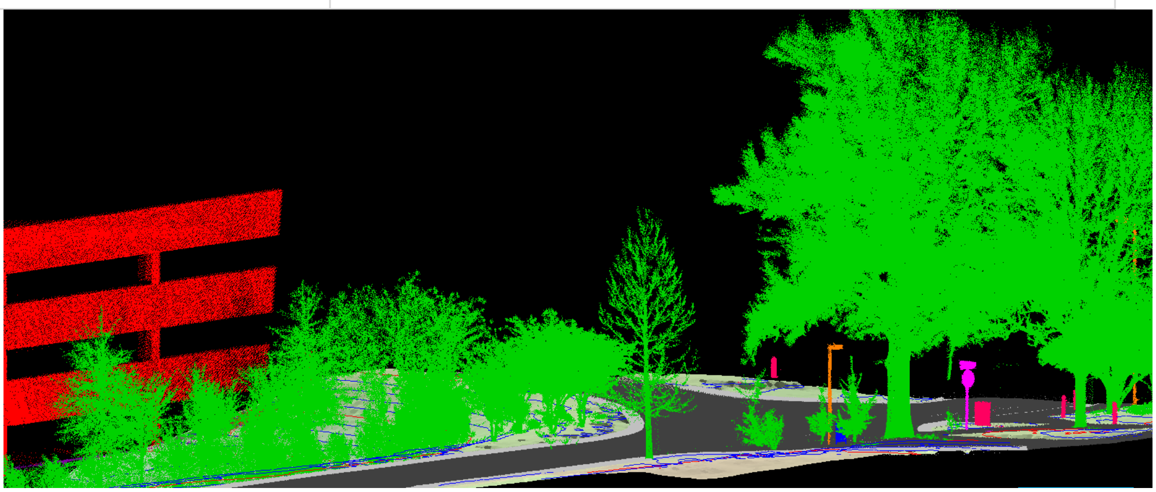


Figure 7 - Classified Point Cloud

There is great value in having all points classified, because it allows the consumer of the point cloud to manage point visibility by class, similar to how CADD levels are turned on and off. The ability to isolate points in the cloud by type increases the efficiency for consumers of the point cloud. However, the process of classifying points can be very labor intensive.

Some post processing software, but not all, can automate the classification of ground points (code 2 above). For example:

1. TopoDOT – advertises automatic classification of ground
2. Trimble software (purchased with or included with Trimble hardware purchase) – Automates ground classification
3. Leica Cyclone (purchased with or included with Leica hardware purchase) – automated ground classification is not listed as a feature of the software
4. Bentley Descartes – does not include automated ground point classification
5. Bentley Pointools – does not include automated ground point classification

It is a straightforward process with all software to classify the road and structure surfaces. Since the points on road surfaces, and points on bridge decks and beams, are usually free of vegetative and other clutter, selecting the points with normal CADD selection tools is not difficult. The process then would be:

- Orient the view of the point cloud so that the desired points are conveniently in view.
- Use a fence or shape to define a boundary which encloses the road or bridge points.
- Assign the appropriate classification to the selected points.

While not automatic, the process is simple and minimally laborious.

Other classifications can require much more work because the various points are not often easily segregated visually for selection. The classification effort then becomes a repetitive process of selecting some points and assigning the classification. It is noted however, that some software products do provide semi-automated tools for certain classifications, such as vegetation.

At the same time, the value of the remaining classifications may be of diminishing value, especially for roadway projects. For example, if a designer can easily segregate the point cloud into ground, roadway, bridge, and everything else, this may be sufficiently granular for many purposes on most projects, because the “everything else” will consist of items which are not important for design.

Workflows outside of the roadway design process benefit more from the classification of the remaining “everything else” points. Asset database workflows, for example, will benefit from classification of points on signs and other similar assets. In this regard, it is worth noting that TopoDOT software advertises the ability to automate the collection of asset information without the need for classifying the points.

Recommendation: As a beginning policy, it is recommended that the delivered point cloud should be classified into Ground, Building, Road, and Bridge classes and leave all remaining points unclassified.

Extract Linear Elements from Point Clouds

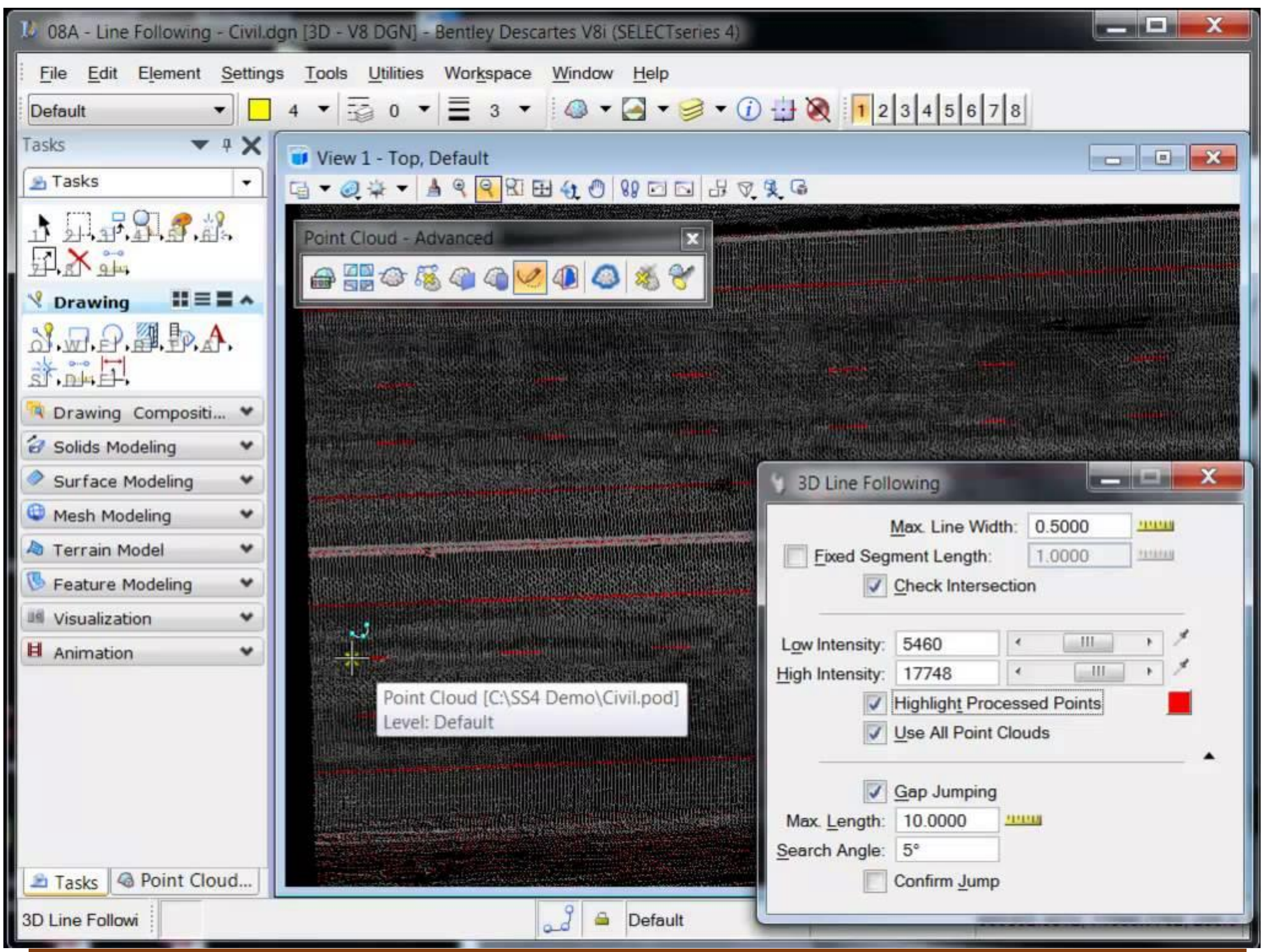
The collected LiDAR data will consist of a very large collection of points. No line work (neither for elements nor topographic break lines) will exist in the point cloud. However, most point cloud software for post processing will include tools for extracting element edges and break lines from the point cloud.

Extracting linear elements from the cloud provides the following benefits:

- Linear elements are needed for topographic map production. These lines will include edges of pavement, shoulders, guardrail, walls, etc.
- Collecting break lines (including those used for the topographic map) allows the point cloud density to be reduced, thus reducing the size of the existing ground terrain model delivered to designers.

Tools used for the extraction of lines fall into a few categories.

One type of tool, which exists in various forms in most post-processing software, is to use the intensity, which is collected during the scan, to determine locations of some linear features. Features which are brightly colored will register as a stronger signal in the point cloud and thus can be



differentiated from adjacent points. For example, pavement striping will show up very clearly in the point cloud. This intensity is then used to extract a CADD line showing the striping. In some software, the tracing of these lines requires the CADD operator to monitor the process as the software determines line location. TopoDOT software advertises that all lane striping can automatically be extracted with very little operator interaction.

Figure 8 - Extract Striping Using Intensity (Bentley Descartes)

Similar to tracing a high intensity line, there are tools which can automatically trace lines which are highly isolated, such as overhead utility lines. Since the collection of points representing these lines in point clouds are often isolated from other entities, most software has a tool to trace a line which represents the location of the overhead line.

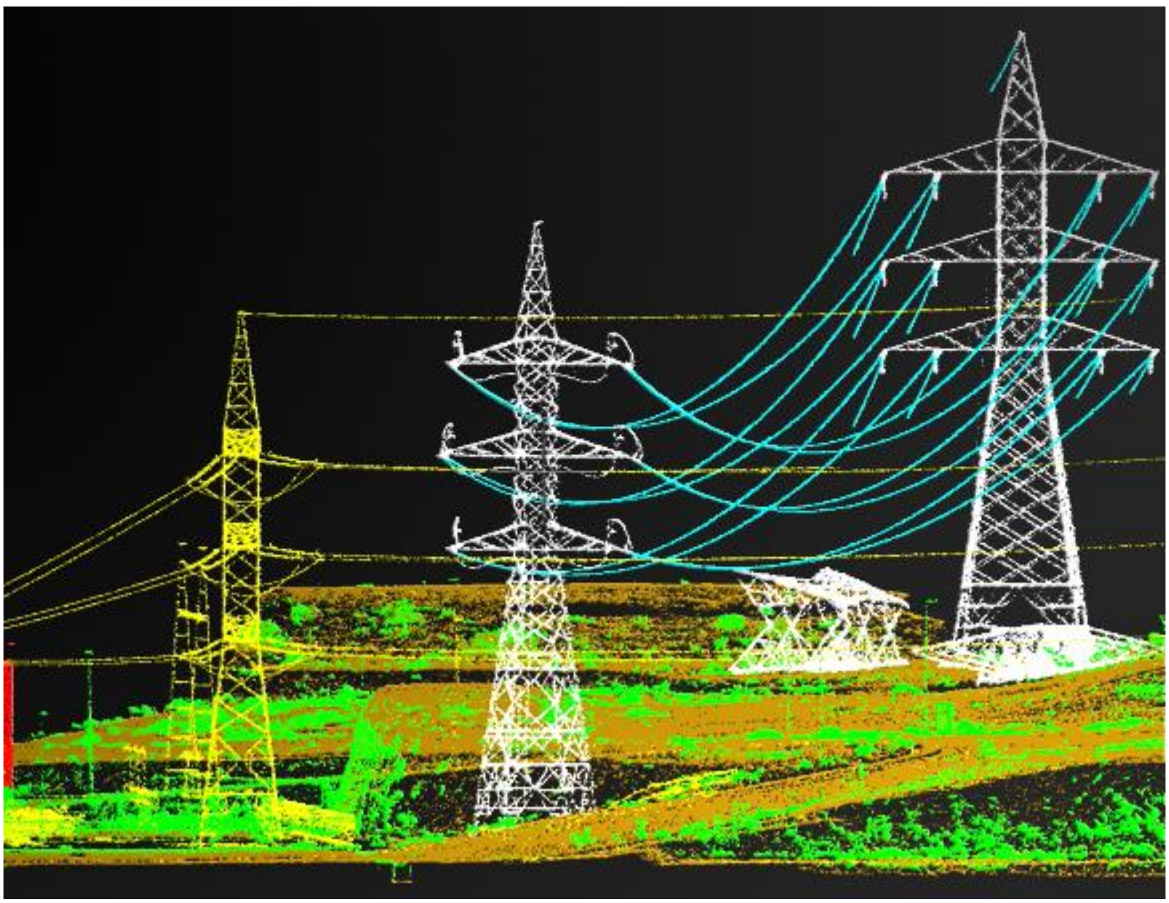


Figure 9 - Most Overhead Lines are Easily Extracted

Other lines, which are not isolated or not suitably intense, require other methods. Usually, the process makes use of a “cross-section” view of the cloud. From such a view it is then easier to see the slope breaks. Then the process becomes one of drawing lines, using the cross-section and plan views to guide the location of each vertex. The difference between software in this regard comes down to ease of use.

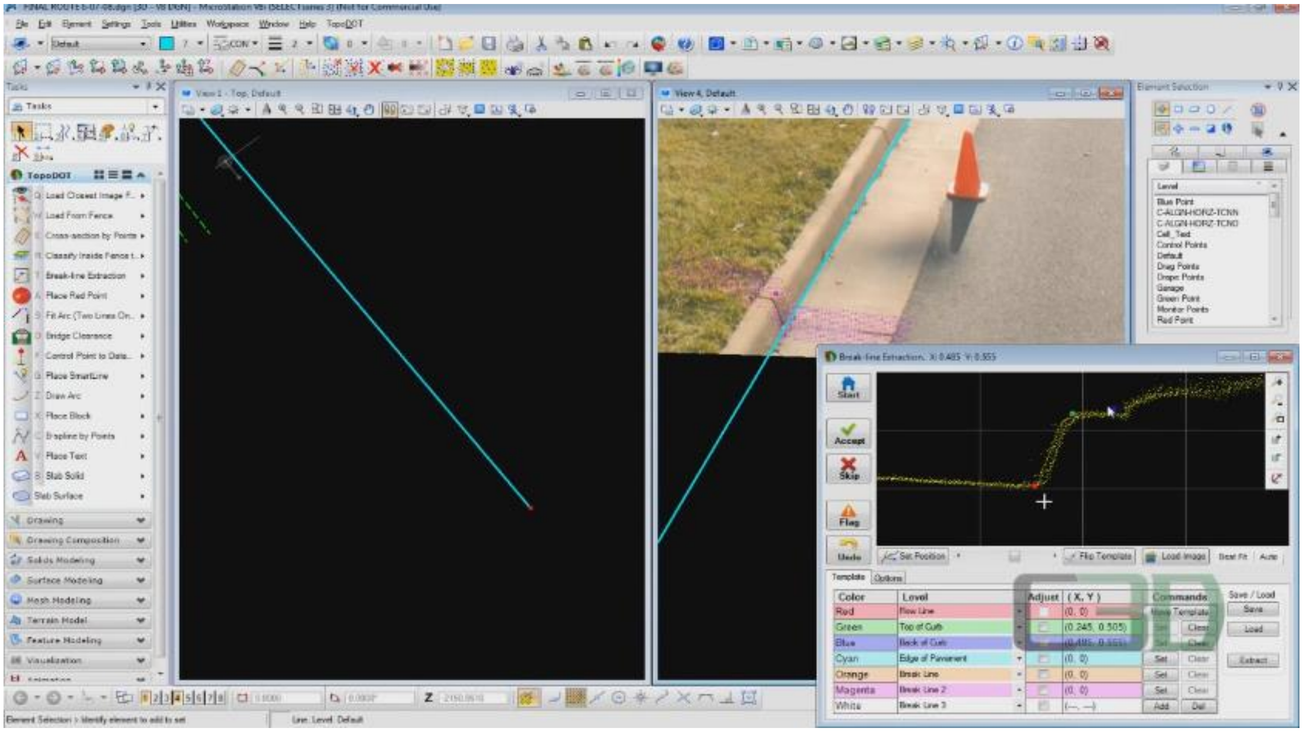


Figure 10 - Extracting Lines by Cross-Section (Top DOT)

Some software (most, perhaps) require the operator to snap each vertex, either in plan view or cross-section view, then advance the cross-section a distance interval and snap the next vertex. This is the process used by Bentley's products. While repetitive and potentially mundane, the process is fairly quick with practice.

TopoDOT advertises much more automation. Once an initial cross-section shape is defined, TopoDOT's online tutorials show automatic extraction of all the lines in the cross-section, until it gets to a point where the cross-section changes to no longer match the initial conditions. If truly as automatic as advertised, then this capability alone could decide choice of software for the surveyor/photogrammetrist.

TopoDOT also advertises automatic extraction of lines of more complex areas such as ADA ramps.

Recommendations:

- Extract line work for features which are normally shown in the topographic map from the point cloud. These need to be properly symbolized per CADD standards. For example: striping, edges of pavement, shoulders, walls, curbs, guardrail locations, etc. should be extracted. For the most part, any features which are needed for display purposes on the plan sheets and are visible in the cloud should be extracted.
- Extract break lines for producing terrain models as needed and as available.
- Coordinate line extraction with traditional field survey crews so that duplication of effort is minimized.

Extract Point Elements (Cells) from Point Cloud

In similar fashion to extracting line work, it is also possible to use the point cloud to place symbology for point features that need to be shown on the topographic map. Examples include signs, poles, manholes and inlets. Points for terrain model production would not be extracted since there is already more than enough points for this purpose. Thus, the workflow discussed here is purely for map production.

Various software packages provide different tools to help extracting point elements (cells) from the point cloud. Even at the least automated level, the process is not complex. The operator uses the point cloud as a guide and then uses the Place Cell command to place a symbol at the proper location. Again, TopoDOT advertises the most automatic solution.

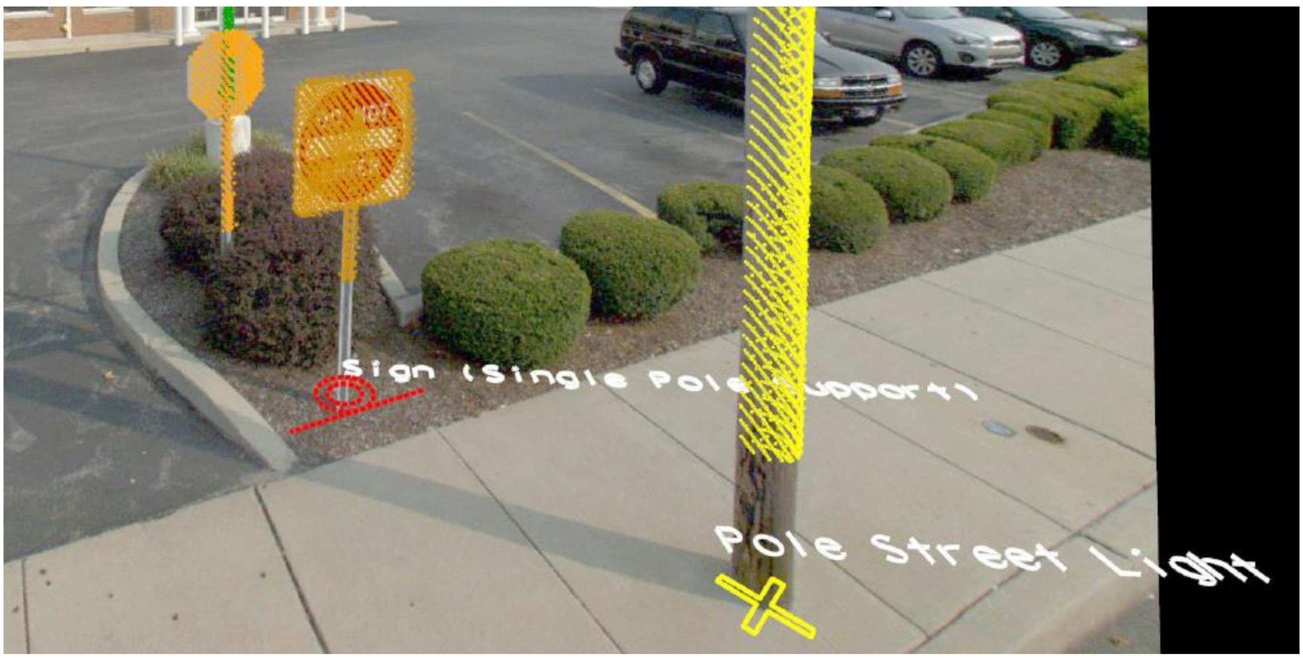


Figure 11 - Cells Placed by Using Point Cloud Location

Regarding these point features, there is another consideration; however, because the real-life feature is not a point. Historically, we have placed a symbol to indicate these features without consideration of whether the symbol accurately reflects the true size of the feature. For example, we would place a symbol for a pole which might measure 5 feet in diameter on the map, but the pole is only 1 foot in diameter. In another example, the symbol for a manhole might indicate the size of the 2-foot lid when the actual manhole is a flat top of 5 feet diameter. Historically, we have only been interested in defining the existence of such features but not their spatial extents. With point cloud data, in many instances, one could develop either a point feature or a solid model (see next Section) which indicates the actual size of the feature.

Recommendation: Use the point cloud to create the required cells used on a topographic map. Provide the point cloud as a deliverable to designers for use in determining clearances as needed during design.

Extract Solid Models or Meshes from Point Cloud

It is also possible to create solid models or surface meshes from the point cloud. For example, the points along a bridge deck can be used to create a solid model representing the concrete slab, or the individual beams can be created as solid models. Other features which are conducive to solid modeling are bridge piers, faces of buildings, and curbs (top surfaces). Such solid models or meshes are more easily consumed in design workflows by both bridge and roadway designers.

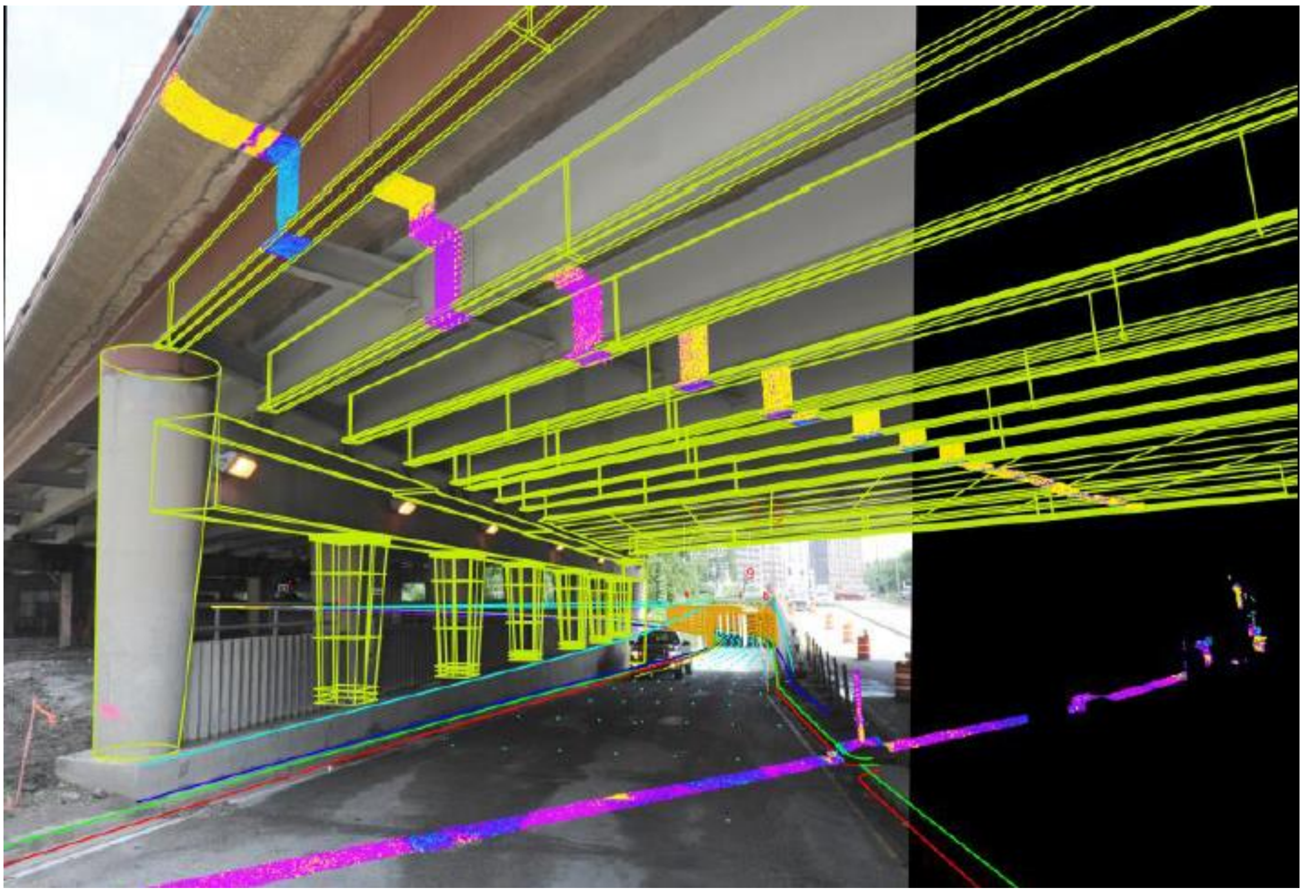


Figure 12 - Solids Extracted from Point Cloud

Creating meshes of surface elements provide even greater value for some specific design situations. The algorithm traditionally used in the creation of terrain or surface models develops a "triangulated irregular network" (TIN) and does not provide a mechanism for the storage of vertical faces or overhangs. The specific limitation is that for any given X,Y position a terrain model can only contain a single Z position. The terrain model then breaks down in vertical faces as well as overhangs and tunnels.

By creating a surface mesh from the point cloud, the road designer needs only to assign a feature definition to the mesh and then can use the mesh as a target for end conditions. Thus, a mesh of the inside of a tunnel could be used for designing the roadway within the tunnel. As another example, cliff areas in mountainous terrain could be modeled with a mesh element for designing roadways which need to consider the steep, often overhanging areas in design.

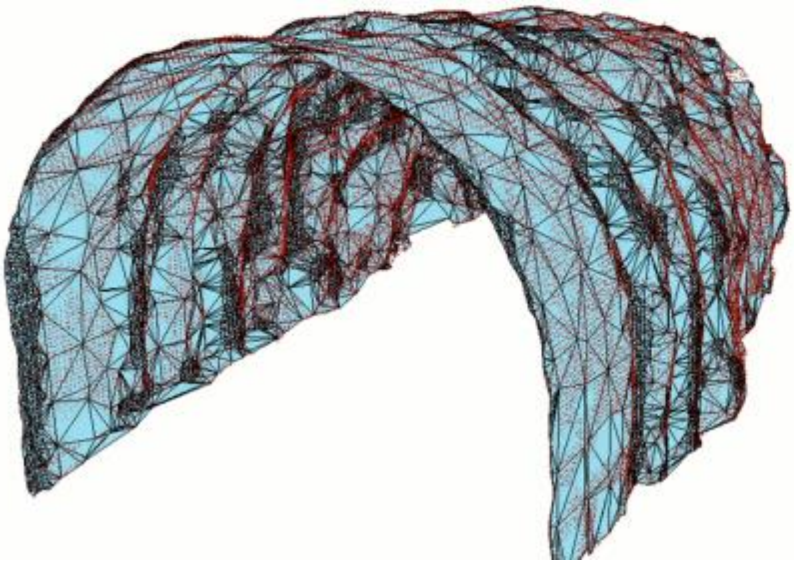


Figure 13 - A Mesh Element Generated from a Point Cloud can be Used by OpenRoads like a Terrain Model

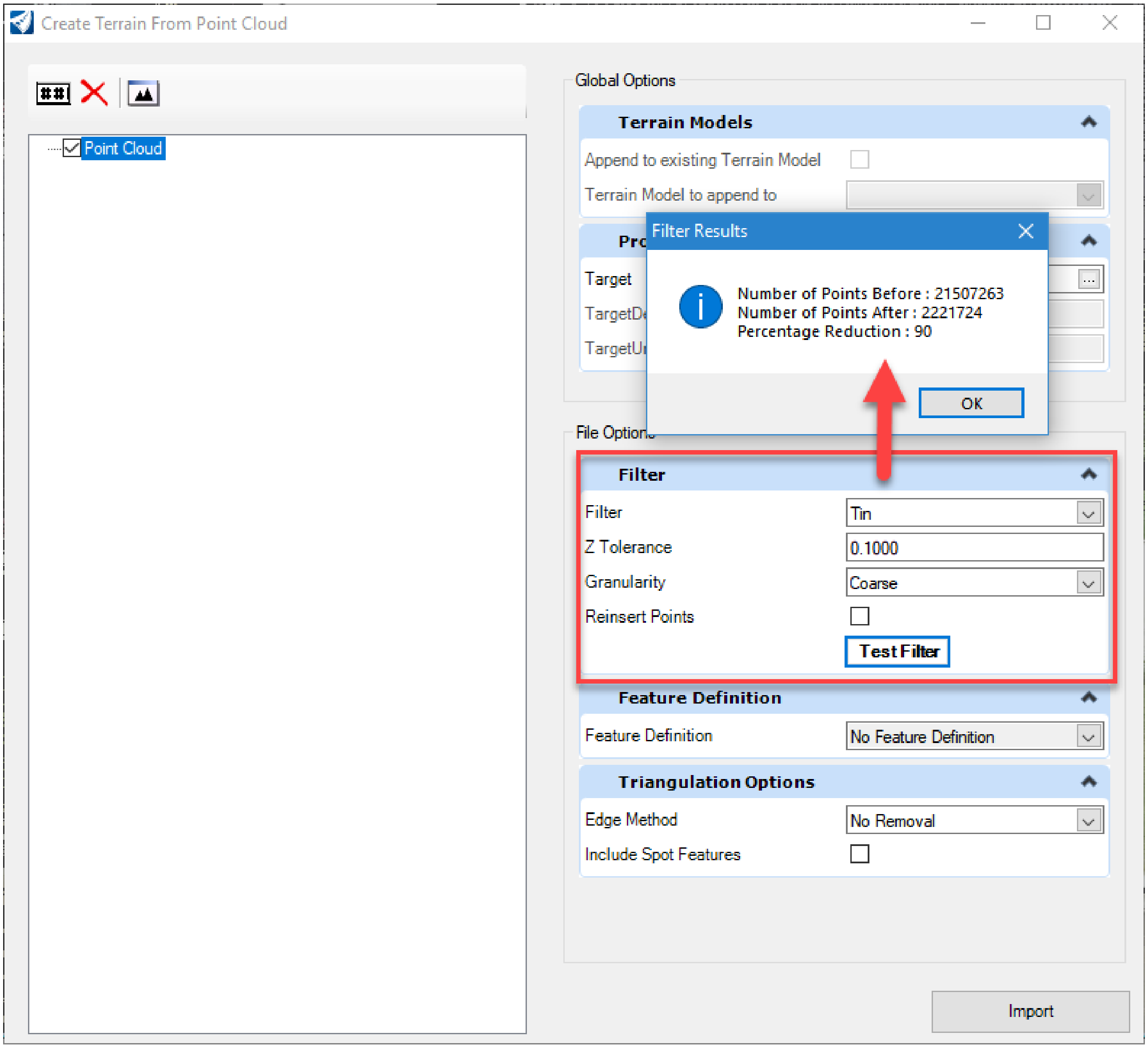
Recommendations:

1. Create mesh surfaces for tunnels.
2. Underpasses are a de-facto tunnel of very short length. If clearances are critical, create meshes or solids of the overpass substructure.
3. In steep rocky terrain, a mesh surface can better define the actual surface of the earth when adjacent roadways need to interact with the slope.
4. On projects where matching or correcting of cross-slopes is desired, or projects where existing curbs or median barriers need to be preserved, <u>consider</u> extracting solids for features such as median barrier and curbs.
5. For bridges, <u>consider</u> extracting solids for the beams and the bridge deck for use by the structure and roadway designers and for stakeholder engagement displays. Note: clash detection can be performed directly on the point cloud, and thus it is not necessary to create solids solely for the purpose of clash detection.
6. Provide the point cloud as a deliverable to designers for reference and use in extracting additional solids and meshes as needed.

Production of Ground Terrain Model

After production of the linear features and finishing the point classifications, a terrain model of the existing ground can be produced. Only the points which are classified as ground or road should be included in the terrain model and then the linear elements can be added as break lines. Later, the resultant terrain model can be merged with, or appended to, the terrain model produced from traditional survey workflows.

A terrain model can be produced directly from the point cloud using the OpenRoads tool "Create Terrain from Point Cloud". This tool includes the capability to reduce the number of points from the point cloud used in building the terrain model, as shown below. Due to the variability of point cloud data, there are no hard and fast rules for defining these parameters. Usually it becomes a trial and error process where the resultant terrain model is compared to known positions. Numbers of points can usually be reduced by 70%+ without adversely affecting the accuracy of the terrain.



Once the terrain model is produced from the cloud, the linear elements can be added to the terrain model as break lines.

At this point the terrain model will be complete within the limits of the scanned data but there will be additional information collected with traditional survey methods. The traditional survey data will exist as follows:

- Much of the data will lie outside the limits of the terrain model created from the point cloud and can be appended to the point cloud terrain model.
- Much of the data will not be suitable or necessary for the terrain model. For example, right of way markers, property corners, and utilities may have been surveyed either within or outside

the limits of the LiDAR scan and will not contribute much if any value to the terrain model, and thus can be ignored for purposes of the terrain model.

- Some data may exist within the limits of the scan and can be valuable to enhance the terrain model.

Thus, the workflow for combining the point cloud terrain with the traditional survey terrain is as follows:

1. Create the point cloud terrain as described above.
2. Create a survey terrain model according to current processes.
3. Surveyed features which lie within the point cloud terrain are reviewed for suitability for inclusion in the combined terrain model. Any features which will not be included are edited to set their terrain model attribute to “do not include”.
4. The point cloud terrain model is appended to the survey terrain model.

Summary of Computer Hardware and Network Requirements

Working with LiDAR data and point clouds can require a significant increase in needed computer resources than is required for traditional survey processing or roadway design. Every aspect of computer hardware is stressed. The very large files sizes demand larger and faster storage requirements. Moving these very large files over networks can challenge bandwidth limits. Display requirements are increased to allow quicker view manipulation and rendering, and, many of the tools are computationally intensive. Software storage platforms such as TopoCloud and ProjectWise, in addition to physical hard drives, are available for the transfer of project specific data. The ease of file transfer/upload and manipulation/utilization of point cloud data in the TopoCloud platform has led the Department to acquisition of the TopoDOT/TopoCloud software for agency use. Please contact the Engineer of Surveys, Mapping & Modeling, or the Technology Policy and Support Manager, in the Bureau of Design & Environment for additional information.

While software manufacturers will often publicize minimum requirements, it is important to provide hardware which will provide efficiency, not minimal functionality.

Recommended:

Processor: Intel Core i7-7820 or better

Memory: 32+ GB DDR4

Video Memory: 4+ GB video ram (NVIDIA GeForce 1060 or better)

Operating System: Windows 10 64 bit.

Hard Drive: 500+ GB Solid State Drive

Network: Be aware that network limitations may cause delays if transferring data across LAN/WAN connections.

SECTION V. DELIVERABLES

Please see Section 2-3 of IDOT's *Computer Aided Design, Drafting, Modeling and Deliverables* Manual for acceptable point cloud deliverables and formats.