237.14 Electronic Design Data Delivery

MoDOT uses Bentley Power GEOPAK for highway and bridge design and drafting. Power GEOPAK is based on a complete 3D design workflow in a total project context. Drawings that are part of these electronic deliverables are available to the consultant in a native CADD file format (.dgn) and a generic CADD file format (.dxf). Power GEOPAK electronic deliverable requirements pertain to road design, preliminary design, and survey projects only. These electronic deliverables are now referred to as 3D Digital Design Data. Bridge design projects do not require Power GEOPAK deliverables.

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237.14.1 Specifications for Electronic Delivery of 3D Digital Design Data

3D digital design data can be utilized for many purposes, for example it allows design features to be viewed from a 3D perspective, it allows design and construction to connect virtually throughout the design and construction phases, it can be used to estimate quantities, it can be exported and transferred to a global positioning system (GPS) machine control that guides and directs construction equipment (also known as Automated Machine Guidance (AMG)), etc. All of these allow for increased efficiency and productivity.

Electronic delivery of 3D digital design data is required for all MoDOT projects, but varies by type (see chart below for requirements). The 3D digital design data used in the development of the contract plans must be submitted along with all other project documents to Design via the ProjectWise document management system.

Based on the type of project, the 3D digital design data may include one or all of the following:

- Contents File Report
- Survey Report and ASCII file containing control points as delivered by survey or photogrammetry
- Geometry File (alignments and profiles)
- 3D Proposed Features
- 3D Existing Surface
- 3D Proposed Surface(s)
- 3D Engineered Model.

Specific 3D digital design data required for submittal varies based on the type of project. Requirements are as follows:

Type of Project	Survey Report	ASCII File (containing control points)	3D Existing Surface (TIN model)	Geometry File (alignments and profiles)	3D Proposed Surface(s)	3D Proposed Features
Bridge Replacement	X	X	n/a	X	n/a	n/a
Bridge Rehabilitation	X	X	n/a	X	n/a	n/a

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Resurfacing (1R) (EPG 128.2) • Contract leveling course (CLC).	n/a	n/a	n/a	n/a	n/a	n/a
Resurfacing and Restoration (2R) (EPG 128.2) • Thin Hot Mix Asphalt Overlay.	n/a	n/a	n/a	n/a	n/a	n/a
Resurfacing, Restoration or Rehabilitation of Non-Freeway Roadways (3R) (EPG 128.3)	X	X	X	X	X	X
Resurfacing, Restoration, Rehabilitation or Reconstruction of Interstate or Freeway Roadways (4R) (EPG 128.4)	X	X	X	X	X	X
Minor Routes Shouldering (EPG)	X	X	X	X	X	X
Guardrail	X	X	X	X	X	X
ADA	X	X	X	X	X	X
Roundabouts • Detailed intersection design that includes earthwork and pavement quantities.	X	X	X	X	X	X
Intersection Reconstruction • Intersection improvement that requires detailed design that includes earthwork and pavement quantities.	X	X	X	X	X	X
Expansion/New Construction	X	X	X	X	X	X

*** Required Formats: Native CADD File (.dgn), Generic CADD File (.dxf), LandXML, PDF**

All deliverables shall follow the file naming convention outlined in EPG 237.13.2 Electronic Design Data.

237.14.1.1 Contents File Report

This report gives a summary of the data on the project. It includes a Project Data Summary sheet and a Geometry Report/Alignment Information sheet. The Contents File Report shall be submitted in PDF format.

Comment [MoDOT1]: See attachment below for Project Data Summary Sheet

Comment [MoDOT2]: See attachment below for Geometry Report

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237.14.1.2 Survey Report and ASCII File

Comment [MoDOT3]: See attachment below for Survey Report

The Survey Report shall be provided in PDF format and is used for documenting the project control metadata and the method in which the topography and terrain information is obtained for a project. And the ASCII file contains control points as delivered by survey or photogrammetry.

237.14.1.3 Geometry File (alignments and profiles)

This file contains all final alignments used in the development of the contract plans. Alignments include all chains, existing and proposed profiles, control points and any special profiles used for drainage purposes or other design features such as sidewalks, retaining walls, etc. The geometry file should not contain any preliminary alignments. All geometry contained in this file shall follow the file naming convention for the designed alignments and features found in the plans. The Geometry File shall be provided in the following formats:

- Native CADD file (.dgn)
- Generic CADD file (.dxf)
- LandXML*

* MoDOT utilizes LiDAR to capture existing conditions; these are large files and may exceed the limit of LandXML file creation.

A summary of all geometry shall be captured in the Geometry Report and submitted as part of the Contents File Report in PDF format.

237.14.1.4 3D Proposed Features

These CADD files contain 3D Proposed Features. 3D proposed features consist of items such as edges of pavement, shoulders, curbs, gutters, sidewalks, retaining walls or any other feature used in the generation of a 3D model. The 3D Proposed Features shall be provided in the following formats:

- Native CADD file (.dgn)
- Generic CADD file (.dxf)
- LandXML*

* MoDOT utilizes LiDAR to capture existing conditions; these are large files and may exceed the limit of LandXML file creation.

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237.14.1.5 3D Existing Surface

This 3D surface represents the existing ground conditions as provided by Central Office survey staff, District survey party, or a combination of both. It is based on the survey information found in the Survey Report. The Existing 3D Surface shall be submitted in the following formats:

- Native CADD file (.dgn)
- Generic CADD file (.dxf)
- LandXML*

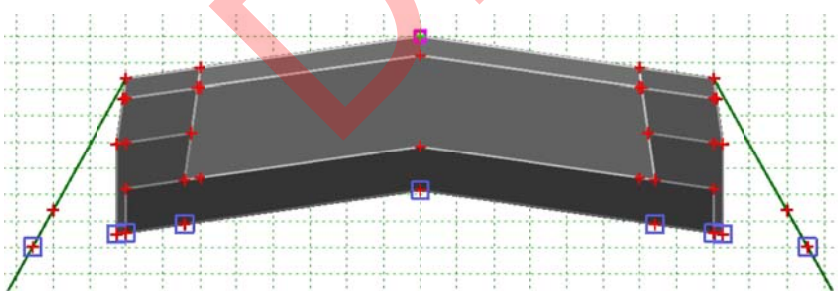
* MoDOT utilizes LiDAR to capture existing conditions; these are large files and may exceed the limit of LandXML file creation.

237.14.1.6 3D Proposed Surface(s)

Video by Bentley: Terrain Model Creation with Graphical Filter

3D Proposed Surface(s) represent a surface of a proposed design. There are different design surfaces that must be submitted as part of the 3D digital design data deliverables, when applicable based on the project type. The three, 3D Proposed Surfaces that need to be delivered, they are: (1) Subgrade 3D Surface, (2) Top of Base 3D Surface, and (3) Proposed Finished Grade 3D Surface.

(1) Subgrade 3D Surface – this surface represents the grading surface. It can be created from the graphical filter "Design - Bottom of Base - Daylighted".



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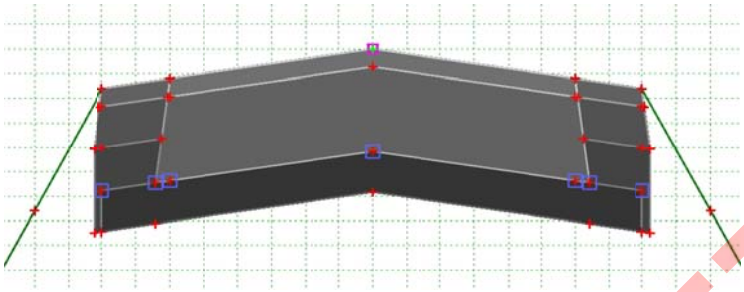
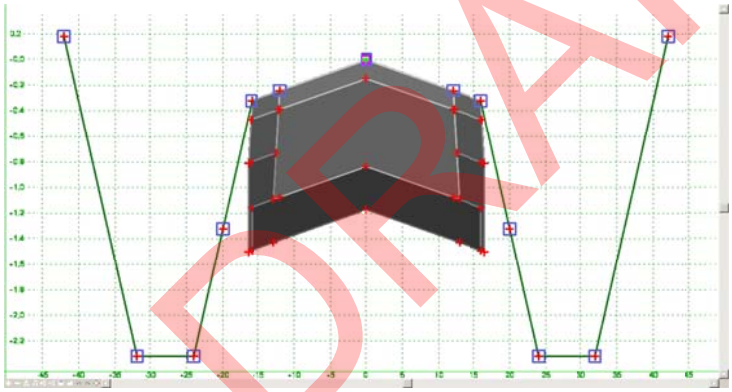
(2) Top of Base 3D Surface – this surface represents the top of base surface only and does not include sideslope conditions. It can be created from the graphical filter “Design - Top of Base“.



(3) Proposed Finished Grade 3D Surface – this surface represents the entire proposed finished grade surface which includes but is not limited to sideslope conditions, top of pavement, top of shoulder, curb, etc. It can be created from the graphical filter “Design - Proposed Finished Grade“.



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The 3D Proposed Surface(s) shall be submitted in the following formats (when applicable based on type of project):

- Native CADD file (.dgn)
- Generic CADD file (.dxf)
- LandXML*

* MoDOT utilizes LiDAR to capture existing conditions; these are large files and may exceed the limit of LandXML file creation.

237.14.1.7 3D Engineered Model

This model represents the entire project as designed for the development of contract plans. This model includes all roadway components and material assignments created from the Power GEOPAK modeler.

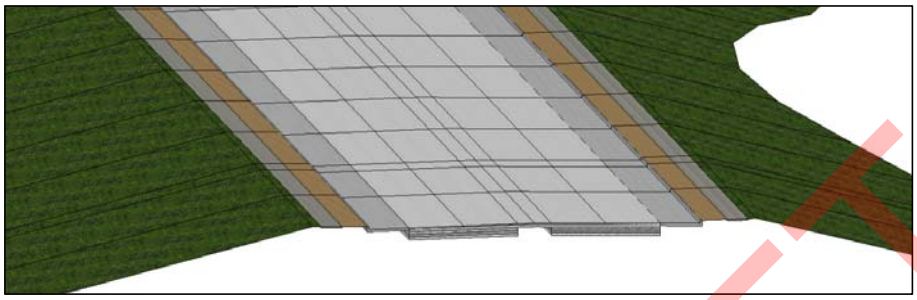

Figure 237.14.1.7a Example of a 3D Engineered Model

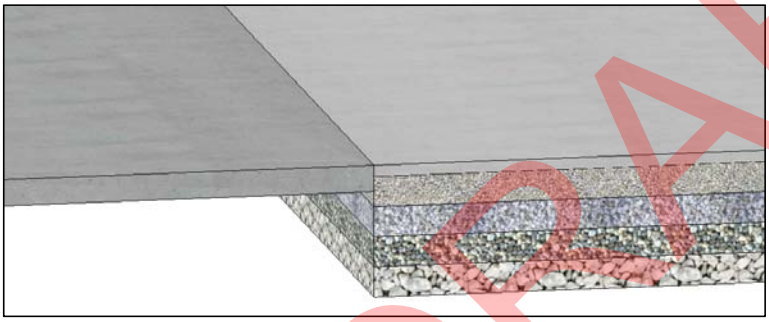

Figure 237.14.1.7b Detail of material assignments in a 3D Engineered Model

Figure 237.14.1.7c Example of a rendered 3D Visualization Model

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237.14.2 Other Specifications of Electronic Design Data Delivery

237.14.2.1 Preliminary Geotechnical Report

This is the report provided by the district geologist containing subsurface information. This file should be in a PDF format. Subsurface information is included in all contracts with cross-sections (see Sec 102.5.1). For additional information see Release of Subsurface Information.

237.14.2.2 Job Special Provisions

The Job Special Provisions (JSPs) are revisions to the standard specifications and general provisions for an individual project. Like the standard specifications, the JSPs contain information covering work methods, materials, measurements or basis of payment. The JSPs take precedence over all material contained in the bidding documents. JSP-05-05 "Electronic Information for Bidder's Automation" must be included on every project containing 3D digital design data.

Additional Information

125 CADD Services

JSP-05-05 "Electronic Information for Bidder's Automation"

How to Export a Job Folder for Construction from ProjectWise

Creating Subgrade Tie-in Components

237.14.2.3 Method of Delivery for the Letting

The district must submit all electronic design data compressed into one single file using WinZip (or other compression software package) via ProjectWise at the time contract plans and other PS&E documents are submitted. The file shall be placed in the "Contract Plans" folder within ProjectWise. The naming convention for this file shall be [job#]_Electronic_Deliverables.zip. **The district is responsible for all QA/QC of the files.** The Project Manager has the responsibility to ensure all data is accurate and represents the contract plans as signed and sealed.

237.14.2.4 File Naming Convention

All naming convention shall be in accordance with MoDOT's file naming convention as stated in EPG 237.13 File Naming Convention.

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237.14.3 Delivery of Electronic Design Data for Pavement

When available, pavement data shall be considered part of the Electronic Deliverables. The pavement data may include, but is not limited to, the pavement history, coring data and testing data of the existing pavement and subgrade. On a project containing cross-sections, the electronic pavement data shall be included in the same zip file with other digital design data as discussed in EPG 237.14.1.10 Method of Delivery for the Letting.

237.14.4 Delivery of Electronic Design Data for Project Offices

All digital design data for the letting shall be submitted to the appropriate district project office to provide the construction inspectors the necessary data for constructing the project.

Based on the type of project, one or all of the following may be submitted to the project office: Contents File Report, Survey Report and ASCII File containing control points as delivered by survey or photogrammetry, Geometry File (alignments and profiles), 3D Proposed Features, 3D Existing Surface, 3D Proposed Surface(s), 3D Engineered Model, and Preliminary Geotechnical Report as stated in EPG 237.14.1 and 237.14.2.

237.14.4.1 Method of Delivery for Construction

How to Export a Job Folder for Construction from ProjectWise

Roadway Plans.

The project folder shall be exported out of ProjectWise into a district network folder to be transferred to the appropriate project office by district information systems staff. It is advisable to export the entire job folder to ensure that ProjectWise reattaches all reference files. Once the job has been exported and before the project office is notified about the export, the designer shall remove any files not needed for construction.

Bridge or Structure Plans.

Electronic bridge plans will be made available upon request from the project office.

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237.14.5 Specifications of CADD Deliverable Contract Plans for Consultants

237.14.5.1 General CADD Requirements

1. The consultant shall furnish to MoDOT all of the contract plan drawings, for an entire project as Microstation drawings (DGN format). The consultant is responsible for verifying with MoDOT Design CADD Services for the current software version. All files shall be compatible with MoDOT's current CADD software version. All associated files that are attached to the drawing such as cell libraries, line definitions, and reference files must be included. The use of Microsoft Excel spreadsheet program can be used to create quantity summary sheets, however, any type of linking between the files to the contract plans is not permitted.

2. All design elements of the project shall be provided to the department in GEOPAK files completed with the MoDOT current version of the software.

3. Each drawing file that is part of the final contract set shall be a full size plan sheet of 22 in. x 34 in. (560 mm x 865 mm) nominal size. All images shall be within a border of 20.375 in. x 31.25 in. (520 mm x 800 mm). The border shall be centered on the plotted page to ensure no part of the drawing is cut off during reproduction. Other than cross-section sheets, there shall be one MicroStation drawing file that corresponds to each sheet of the plan set as submitted. The consultant may provide all cross-section sheets in a single MicroStation file but must reference MoDOT's border to each individual sheet.

4. The plan drawings shall be to a represented scale. The geometry shall be within a 2D file and consist of vector lines, which can be selected and manipulated. Drawings shall be created in real world modified state plane coordinates at a 1 to 1 scale where applicable and plotted to the represented scale.

5. All drawings shall be self-contained or furnished with the supporting library of symbols and details to make the drawings complete in the format provided. MoDOT plots all drawings in a WYSIWYG (What You See Is What You Get) format based upon a MoDOT specific border file attached as a reference file. The department will furnish the appropriate color table through its GEOPAK and MicroStation Drawing Standards internet site. All line style, cells and symbology are applied to the MicroStation drawing and not modified at plot time. Drawings that require specific commercial plotting software to create plots that match delivered contract

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documents will not be accepted. All drawings must be fully reproducible in black and white. Screening, shading and use of grayscale on plans will not be accepted for final plans delivery.

6. MoDOT will verify the computer drawings using the department's current version MicroStation and GEOPAK. The PDF contract plans will be checked against a MicroStation drawing (DGN format), or vice versa, furnished by the consultant. All information relating to plotting parameters shall be included in the drawing file (i.e. weights placed on lines, symbols shown as they should plot).

7. Drawings shall have a color table meeting department's standards to simplify the transfer process. MoDOT will furnish the appropriate color table through its GEOPAK and MicroStation Drawing Standards internet site.

8. All drawings shall conform to department drawing standards as established in the MoDOT workspace. All drawings shall follow the department's standards for names and colors and line weights as defined in the workspace.

9. Drawings shall be filed in drawing groups or directories with the project number as the name of the parent folder and with file names describing the types of sheet they contain. The MoDOT file naming convention is detailed in EPG 237.13 File Naming Convention.

10. Drawing files shall be submitted at the point in which all work covered by the contract is complete. Road project files shall be delivered to the project manager in the district or the project manager's assigned, responsible person in the district where the project is located. Bridge project files shall be delivered to the Structural Liaison Engineer responsible for the project.

11. Copies of MoDOT's format drawings, a copy of the department's standard library of details and the Missouri Standard Plans for Highway Construction are available on the department's internet site. Copies of these files will be supplied in MicroStation DGN format.

237.14.5.2 Specific GEOPAK Requirements

1. All elements representing existing topography features shall be plotted according to the current MoDOT Civil Survey Style File (MoDOT_Power_GeoPak_SMD.xml). MoDOT will furnish the appropriate Civil Survey Style File through MoDOTs workspace.

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2. All survey or photogrammetry information supplied by the consultant and included in the project's development shall be in compliance with EPG 238.1 Aerial Mapping and LiDAR Surveys. The feature codes used in the survey and photogrammetry information shall conform to the MoDOT standard feature codes as specified in the current MoDOT Civil Survey Style File(MoDOT_Power_GeoPak_SMD.xml.

3. The consultant shall utilize the MoDOT GEOPAK design feature library as provided in the MoDOT workspace. However, if the consultant adds any feature(s) they shall supply their feature library to MoDOT.

4. MoDOT provides superelevation preferences (SEP) files for the calculation of superelevation based on AASHTO standards. If the consultant uses something other than the provided MoDOT SEP files, they shall provide what was used to derive the superelevation.

5. Proposed cross-sections for roadway projects shall be created from the 3D design file.

6. MoDOT will provide a standard template library, civil cell library, and feature library. These files are available through MoDOTs workspace.

7. Consultant is not required to use the MoDOT standard libraries (MicroStation and/or Civil cells, roadway designer templates, drainage libraries, etc.). The consultant shall provide any custom libraries used as part of the project design. All custom libraries shall conform to the MoDOT standard roadway designer's styles.

8. The consultant shall submit ALL files used in the preparation of the 3D roadway design.

9. It is up to the District to determine payment method for earthwork. The choices include traditional end area method calculations using cross-sections or volumetric calculations using surface to surface (TIN-to-TIN) comparison, when available. If the project construction contract is not using volumetric calculations, the consultant shall provide MicroStation drawing files with cross-sections for the project. In this case, there shall be a separate cross-section file for each cross-section baseline along which earthwork is computed. The cross-sections in the cross-section file shall exactly match the 3D design model and the cross-section sheets shown in the contract plans.

10. Cross-sections may be submitted for but not limited to earthwork sections, entrance sections and superelevation transition sections. The superelevation

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transition sections included shall be at the following locations as described in Standard Plan 203.20 and Standard Plan 203.21: Section A-A (normal crown), Section B-B (0% superelevation), Section C-C (reverse crown) and Section D-D (full superelevation).

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Project Data Summary **Missouri Department of Transportation**

Submitted Date:

Project Information	
County:	
Project Number:	
Project Location:	
Project Description:	
Project Manager:	
Designer:	

Design File Information	
Geometry File name:	
3D Proposed Features name:	
3D Existing Surface name:	
3D Proposed Surface(s) name:	

Design File Information	
Survey Report name:	
DTM file name:	

Location of this File:

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Geometry Report (alignments and profiles)

Missouri Department of Transportation

Submitted Date:

Horizontal Alignment:	Enter Name	Enter Description
POB (station)	Enter Station	
POE (station)	Enter Station	
Vertical Alignment	Enter Name	Enter Description

Horizontal Alignment:	Enter Name	Enter Description
POB (station)	Enter Station	
POE (station)	Enter Station	
Vertical Alignment	Enter Name	Enter Description

Horizontal Alignment:	Enter Name	Enter Description
POB (station)	Enter Station	
POE (station)	Enter Station	
Vertical Alignment	Enter Name	Enter Description

Horizontal Alignment:	Enter Name	Enter Description
POB (station)	Enter Station	
POE (station)	Enter Station	
Vertical Alignment	Enter Name	Enter Description

Horizontal Alignment:	Enter Name	Enter Description
POB (station)	Enter Station	
POE (station)	Enter Station	
Vertical Alignment	Enter Name	Enter Description

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Alignment Information for Electronic Deliverables

Contents

Prerequisites: 1
Project Information 1
Clean Up the Vertical Geometry 2
Create the XML Report 3
Print to PDF 5
Export to Excel 6

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This document will discuss the necessary steps to create the Horizontal and Vertical Alignment information used with Electronic Deliverables required by the EPG.

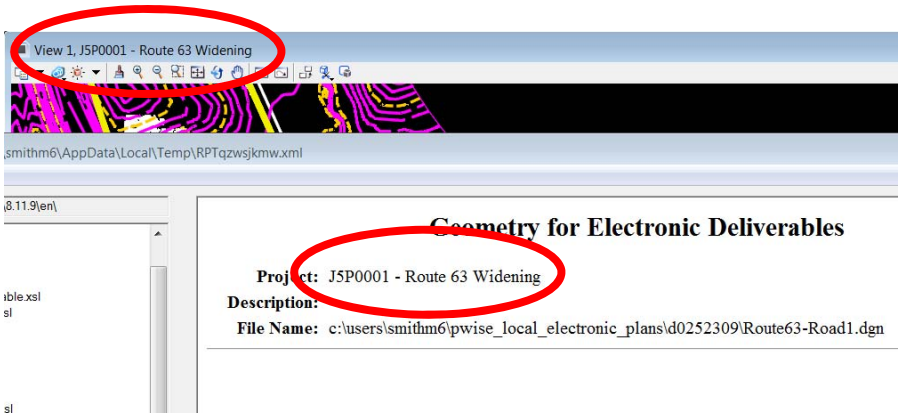
Prerequisites:

1. Horizontal Civil Geometry of all Alignments.
2. Vertical profile for all Alignments (existing and proposed).
3. Active Terrain Model (typically existing ground TIN)

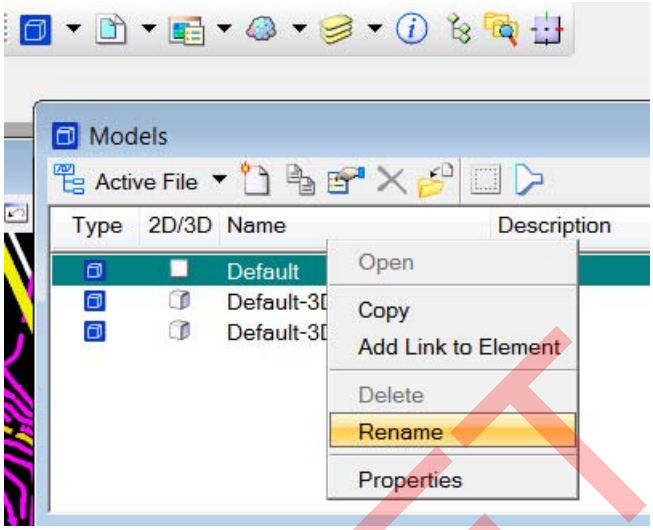
Project Information

The report checks the Model Name as the project information for a project. Therefore, users that do not change the Name of their Model from Default, will have the report return the word "**Default"** for their Project name.

Rename the Model name to the project name prior to running this report.



1. **Left Click** the mouse on the ***Models*** Icon.
2. On the Default Model, **Right Click** the mouse on the word ***Default***
3. Click **Rename**.



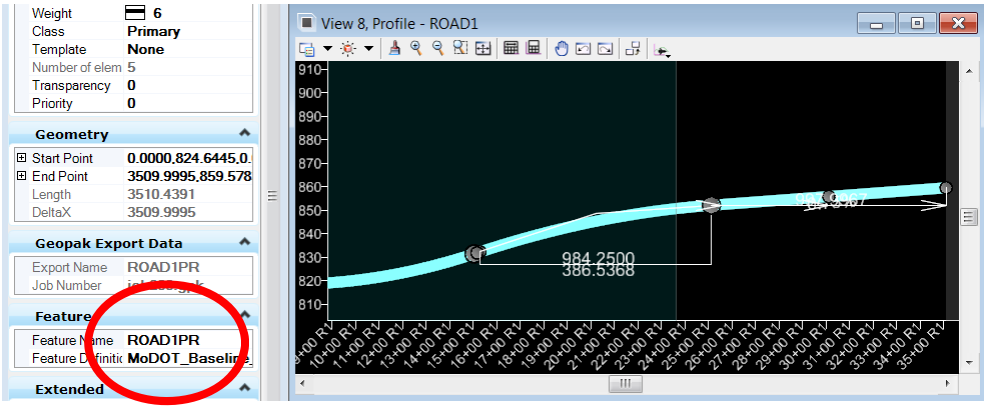
4. Type in the Project Name or information for the report. In this example, **J5P0001 – Route 63 Widening**. Hit **Enter**.

Now the report will display the correct information for the Project Field.

Clean Up the Vertical Geometry

The report will show all **NAMED** Vertical Alignments associated with the Horizontal Alignments selected. Users will want to remove any unwanted Profiles by deleting or removing their names.

1. Remove any unused profiles, or the profiles may remain if they are unnamed.
2. Make sure the Profiles to be listed are named. Users may look at the Element Information on a Profile to determine its name.



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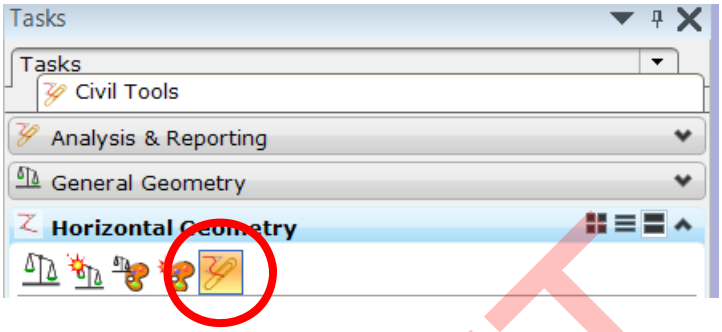
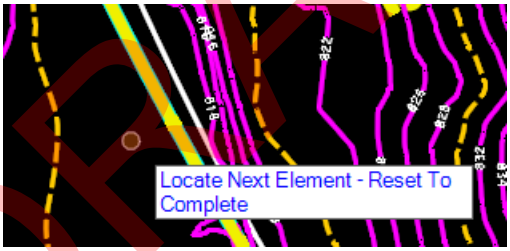
Create the XML Report

The first step in the process is to correctly run a Horizontal Geometry Report on the necessary alignments. There are several ways to obtain a Horizontal Geometry Report, but following the steps below will select all of the information necessary to create the needed report.

1. **Select** the ***Horizontal Geometry Report*** from the *Tasks > Horizontal Geometry* menu.



2. Follow the Heads Up (context sensitive) Prompt : *Locate First Element*. **Select** each Horizontal Alignment.
3. Follow the Heads Up (context sensitive) Prompt: Locate Next Element – Reset to Complete. Once all the Alignments have been selected, **Click the Right Mouse** Button to complete your selection.



4. The next prompt asks which Profiles to include. Use the **Up and Down Arrows** on the keyboard to have the dialog include **All** Profiles.

5. **Left Click the Mouse** to accept All Profiles.

After a few seconds, the Bentley Civil Report Browser will pop-up on the screen with the default report being displayed.

6. On the left side of the Report Browser window, if **CivilGeometry** is not already expanded, **Left Click the Mouse** on the folder to view the available XSL stylesheets.

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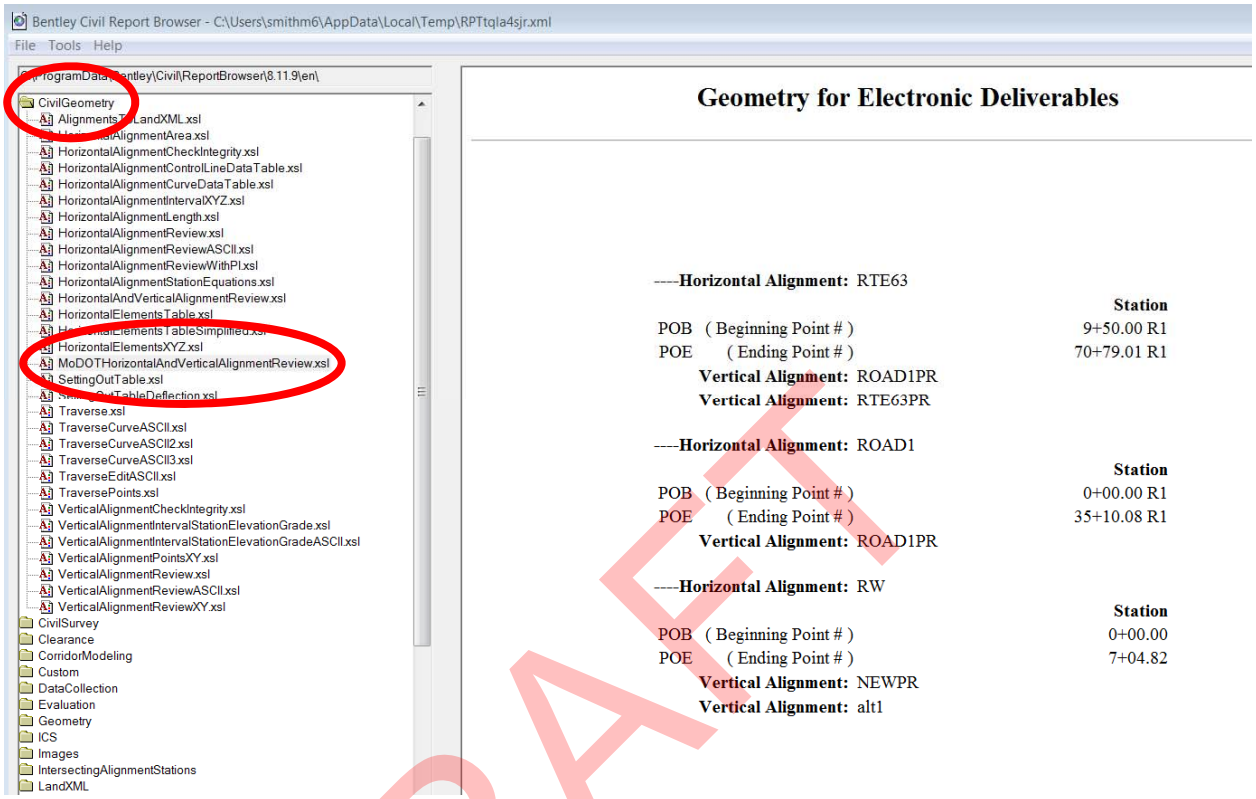
7. **Left Click the Mouse** on the stylesheet named **MoDOTHorizontaAndVerticalAlignmentReview.xsl.**



The stylesheet should look similar to the output in the image above.

This report can now be saved to Excel or printed to PDF.

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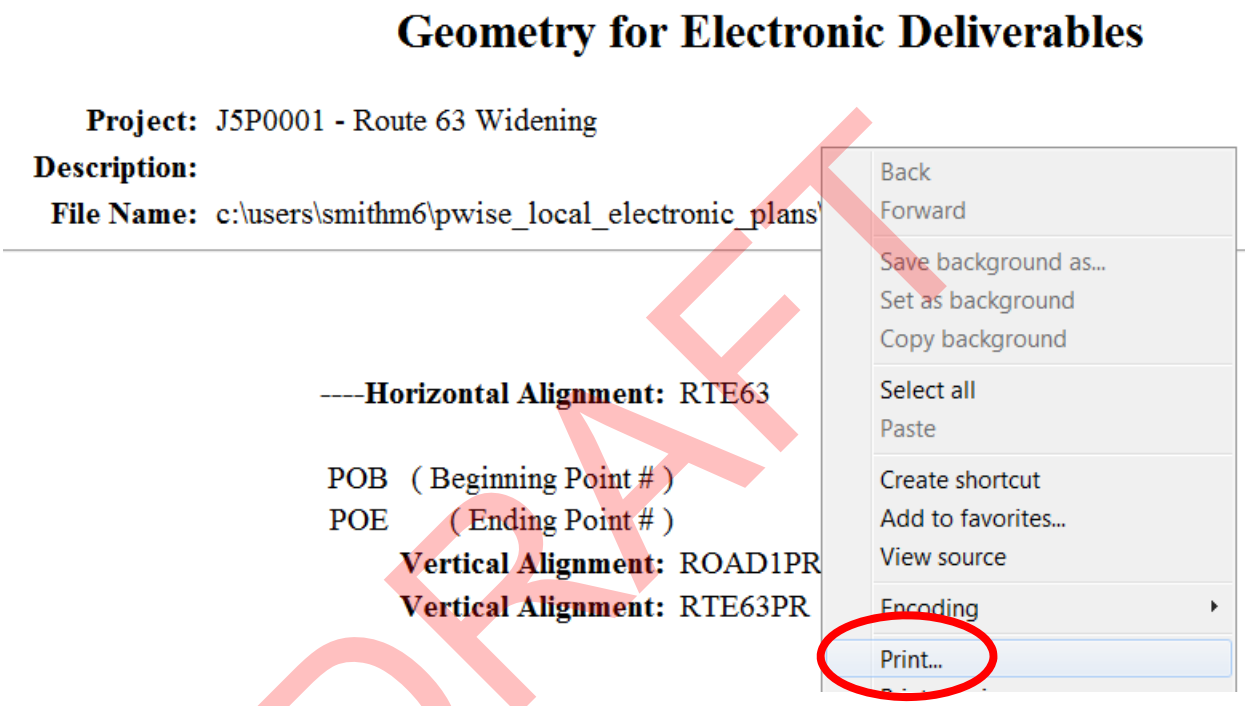
Print to PDF

The report will show the minimal information needed for the Electronic Deliverables Alignment Report. If the designer deems this information adequate for submittal, they may simply print this document to a PDF and add it to ProjectWise.

1. In the Bentley Civil Report Browser that displays the report, **Right Click the mouse** over any portion of the window that displays the Alignment Information,
2. **Left Click the mouse on *Print…***



3. In the Print dialog, choose **Adobe PDF**
4. Click **Print**
5. **Save** the PDF and Upload it to ProjectWise.

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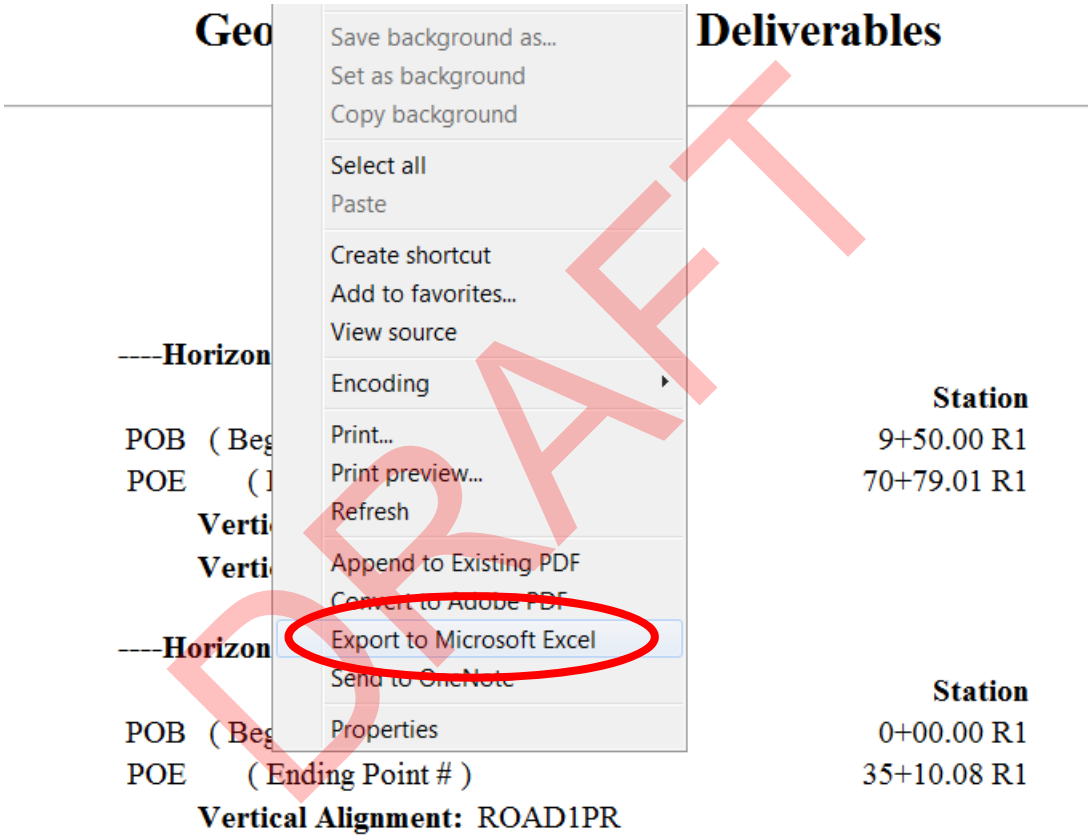
Export to Excel

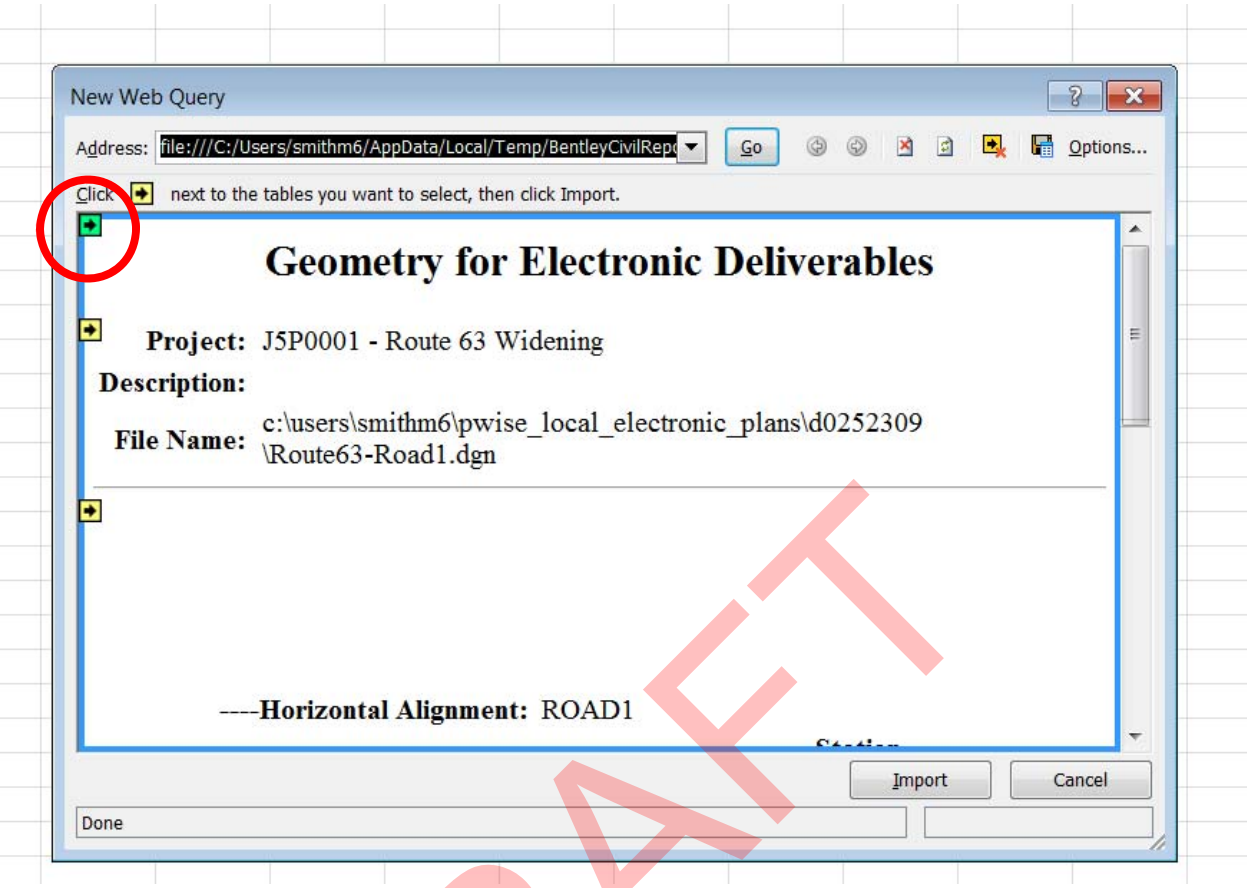
Excel offers more control and customization to the report. Once in Excel, the user may modify the report as needed, or add more description or information not found in the PowerGEOPAK file. The steps are similar as to creating a PDF.

1. In the Bentley Civil Report Browser that displays the report, **Right Click the mouse** In the UPPER LEFT portion of the window that displays the Alignment Information,
2. **Left Click the mouse on *Export to Microsoft Excel***

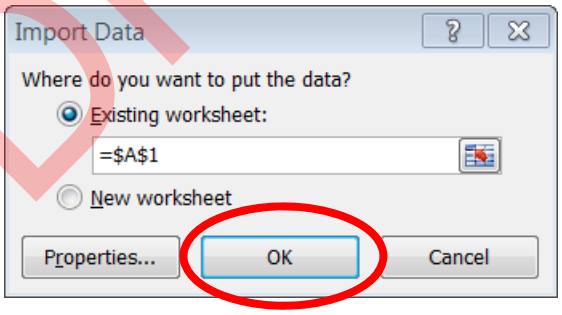


A simple Excel Spreadsheet is created for modifications. Make any changes or updates to the file.

3. In Excel, a New Web Query dialog should appear. **Left Click** on the Arrow in the upper left corner to select all of the information in the window.



4. Click **Import**
5. On the Import Data dialog, click OK to the prompt =A1



6. Make any modifications to the report as necessary.

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Example: Simple Export Modification

	A	B	C
1	Geometry for Electronic Deliverables		
2			
3	Project:	J5P0001 - Route 63 Widening	
4	Description:		
5	File Name:	c:\users\smithm6\pwise_local_electronic_plans\d0252309\Route63-Road1.dgn	
6			
7			
8	----Horizontal Alignment:		ROAD1
9			Station
10	POB	(Beginning Point #)	0+00.00 R1
11	POE	(Ending Point #)	35+10.08 R1
12	Vertical Alignment:		ROAD1PR
13	----Horizontal Alignment:		RTE63
14			Station
15	POB	(Beginning Point #)	9+50.00 R1
16	POE	(Ending Point #)	70+79.01 R1
17	Vertical Alignment:		ROAD1PR
18	Vertical Alignment:		RTE63PR
19	----Horizontal Alignment:		RW
20			Station
21	POB	(Beginning Point #)	0+00.00
22	POE	(Ending Point #)	7+04.82
23	Vertical Alignment:		NEWPR
24	Vertical Alignment:		alt1

Simple Export to Excel

	A	B	C	D	E	F	G
1	**Electronic Deliverables - Alignment Information for J5P0001**						
2							
3	**----Horizontal Alignment:**		**RTE63**	**Mainline for Route 63**			
4			Station				
5	POB	(Beginning Point #)	9+50.00 R1				
6	POE	(Ending Point #)	70+79.01 R1				
7	Vertical Alignment:		ROAD1PR	Offset Profile for Outer Road			
8	Vertical Alignment:		RTE63PR	Proposed Profile for Route 63			
9	**----Horizontal Alignment:**		**ROAD1**	**Outer Road Mainline**			
10			Station				
11	POB	(Beginning Point #)	0+00.00 R1				
12	POE	(Ending Point #)	35+10.08 R1				
13	Vertical Alignment:		ROAD1PR	New Profile for Outer Road			
14	**----Horizontal Alignment:**		**RW**	**Right of Way Alignment**			
15			Station				
16	POB	(Beginning Point #)	0+00.00				
17	POE	(Ending Point #)	7+04.82				
18	Vertical Alignment:		NEWPR	Possible new profile			
19	Vertical Alignment:		alt1	Profile on Existing TIN			
20							

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Project Information

Route	County	Job Number	District	Date of Survey

Mapping Data Acquisition

- ☐ Conventional
- ☐ Photogrammetry
- ☐ Aerial LiDAR
- ☐ Mobile LiDAR
- ☐ Terrestrial (Static) LiDAR
- ☐ UAV
- ☐ Other (explain)

Explanation

Project Control Metadata

Horizontal Control Reference Source	Adjustment Date	Epoch Date	Horizontal Datum	Coordinate System	State	Zone

Grid Factor	Method of Projection Calculation	Projection Factor	Vertical Control Reference	Vertical Datum	Geoid Model

Geodetic Control Reference Information

Designation	CORS_ID	PID	Type of Control	Adjustment Date	Epoch Date

Latitude (N)	Longitude (W)	Northing (m)	Easting (m)	Ellip. Ht (m)	Geoid Ht (m)	Ortho. Ht (m)	Grid Factor

Designation	CORS_ID	PID	Type of Control	Adjustment Date	Epoch Date

Latitude (N)	Longitude (W)	Northing (m)	Easting (m)	Ellip. Ht (m)	Geoid Ht (m)	Ortho. Ht (m)	Grid Factor

Professional Land Surveyor

Professional Land Surveyor	Title	License Number	State	Phone Number

MoDOT District or Company Name	Address	City	Zip Code

Signature	Date

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