

Earthwork Calculation Program

Design Manual
 Chapter 20
 Project Bid Items &
 Quantities

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Excel Calculation File

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General Information

Refer to the workflow diagram in Section [5A-1](#).

Detailed instructions about producing the files listed below can be found in Section [20F-30](#).

CPN Data

The first sheet in the earthwork calculation file is the ProjectInformation sheet, which provides the data needed to fill out the CPN on the bottom of the final sheets. The user enters information into the orange fields, including the File No. when appropriate.

CPN DATA	
INFORMATION ADDED BY DESIGNER	
Section Engineer	
Design Team	
County	
Project Number	
English or Metric	English
Revised	
Project Path	
Bridge Block	
File No.	

Figure 1: ProjectInformation Sheet.

The Add-ins ribbon contains a button labeled “Create Input Files”, see Figure 2. Clicking the tool calls a form, see Figure 3, the users only need to fill in once per cross section file.

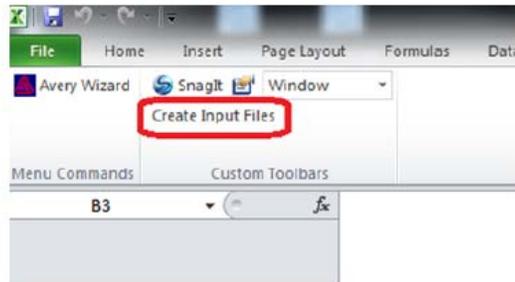


Figure 2: Create Input Files tool.

 A screenshot of the 'Creating Input Files' dialog box. The dialog has a title bar and a close button. It contains several sections:

- Select the Input Files to create:** A group box containing six checkboxes: Cut and Fill, Subgrade Treatment Undercut, Topsoil Stripping Cut, Topsoil Replacement Undercut, Existing Pavement Cut, and Plowing and Shaping Cut.
- Enter the Baseline:** A text input field.
- Enter the Job Number:** A text input field.
- Roadway Name:** A text input field with a note: 'Names are limited to 19 Characters.'
- Enter Stations:** Two text input fields labeled 'Beginning Station' and 'Ending Station'.
- Cross Section File Path and Name:** A text input field with a 'Browse' button.
- Select the folder to create Input files (.inp) in:** A text input field with a 'Browse' button.
- Select the folder to create Output files (.txt) in:** A text input field with a 'Browse' button.
- At the bottom, there are two buttons: 'Create Input Files' and 'Close Form'.

Figure 3: Create Input Files form.

Select the Input Files that are needed based on Chapter [20F-30](#), fill out the text fields, select the paths that are requested, and click the “Create Input Files” button. This will create the files and fill out the information within the files needed by GeoPak.

Make sure file naming convention on the .txt files is as follows:

- CutFill files start with CF_
- ExistingPavementCut files start with EXPC_
- PlowingShaping files start with PS_
- TopsoilStripping files start with TPS_
- Subgrade Treatment undercut files start with UCSG_
- Undercut Topsoil Replacement files start with UCTP_



For projects with staged cross sections, avoid including the word “stage” in the .txt file name.

All the files that correspond to each other need to be named identical with the prefixes above in order to string them together in the DataInput sheet and the DataInformation sheet. It is very important to use underbars “_” instead of spaces in the naming conventions. Accidental double spacing will cause problems for the program to find files that correspond to each other, and double spaces are sometimes very difficult to find. An example of a roadway naming convention using all six of the runs above would look like the following:

The CutFill file	CF_Jasper_North.txt
The ExistingPavementCut file	EXPC_Jasper_North.txt
The PlowingShaping file	PS_Jasper_North.txt
The TopsoilStripping file	TPS_Jasper_North.txt
The Subgrade Treatment Undercut file	UCSG_Jasper_North.txt
The Undercut Topsoil Replacement file	UCTP_Jasper_North.txt

Detailed explanations on the needs and functions of each input file refer to Section [20F-30](#).

DataInput Sheet

The DataInput sheet is where the raw data from Geopak is imported. Users don't do anything within this sheet other than use the options in the toolbar. Code manipulates and inserts all of the data on this page and on the DataInformation sheet. Below are screen shots of the toolbar and a brief description of what each tool does.

GAP Tool

The Gap Tool takes multiple runs and stitches them together into one file. This tool replaces the Skip tool for GeoPak.

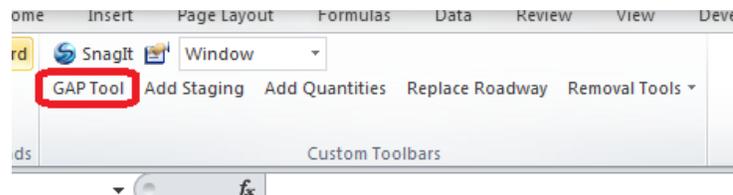


Figure 4: Location of GAP tool.

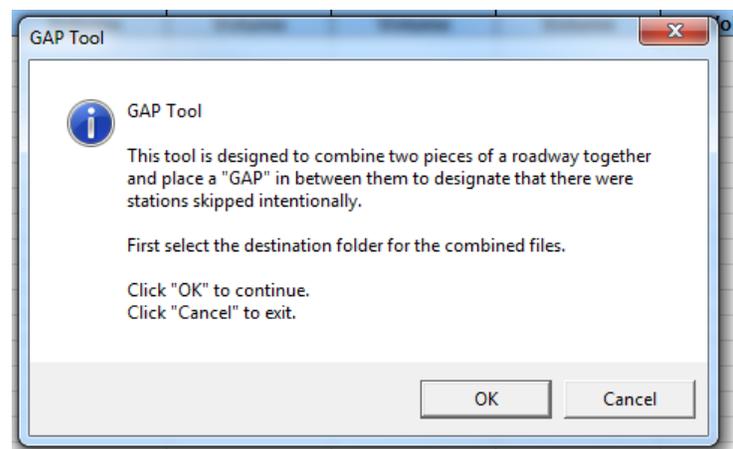


Figure 5: GAP tool prompt.

Instead of making one long run, as the Skip tool was designed to do, the user makes several short runs on the same roadway, labeling them with an underbar and a number on the end of each run (i.e. CF_US20_1, CF_US20_2, TPS_US20_1, TPS_US20_2). Each run must have an underbar and number for the GAP program to stitch them together, and all the files need to be in their own folder. In the example (Figure 8 below) the CF and TPS are shown in the same folder. Since the runs were

for the same roadway, those runs also needed to be grouped into the same folder to be stitched together. When the program is finished, it will have created a new .txt file with the file name of the run files without an underbar and number. In the file, the user will see the 2 initial files stitched together with the word GAP in between to separate them. This is the file the user will put with the finalized files that need to be loaded into the Earthwork spreadsheet program.

An example of where the user would use this tool would be if the user had a bridge in the roadway. The user would run an input file from the beginning station up to a station before the bridge. Then the user would run another input file using the first station after the bridge as the beginning station to make the run to the end of the roadway.

The multiple runs may be a result of breaks in running the CutFill. Intersections or bridges are two common examples. For this tool to run, all of the files need to be placed in the same folder. Each file name beginning needs to be the same with a number desinator on the end to differentiate each one.

Users will be prompted to select a file in which to place the new combined file.

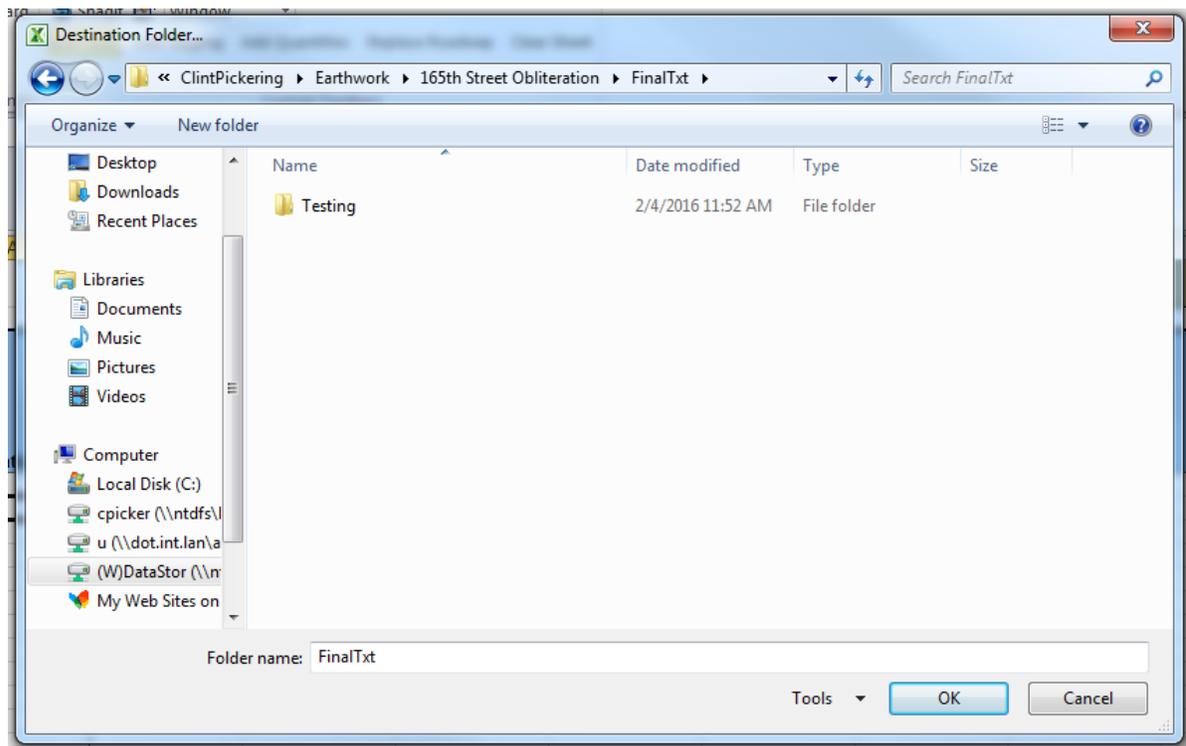


Figure 6: Navigate to File Folder.

Next, users select the first of the CutFill runs.

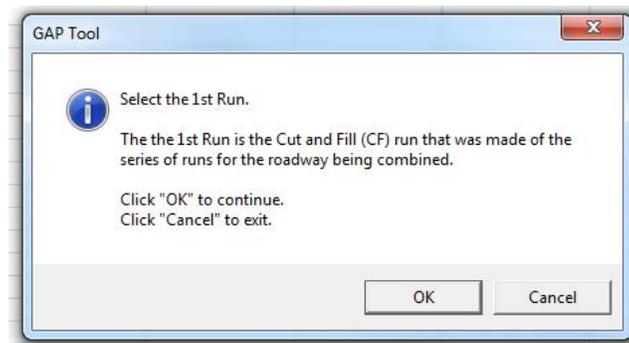


Figure 7: GAP Tool prompt

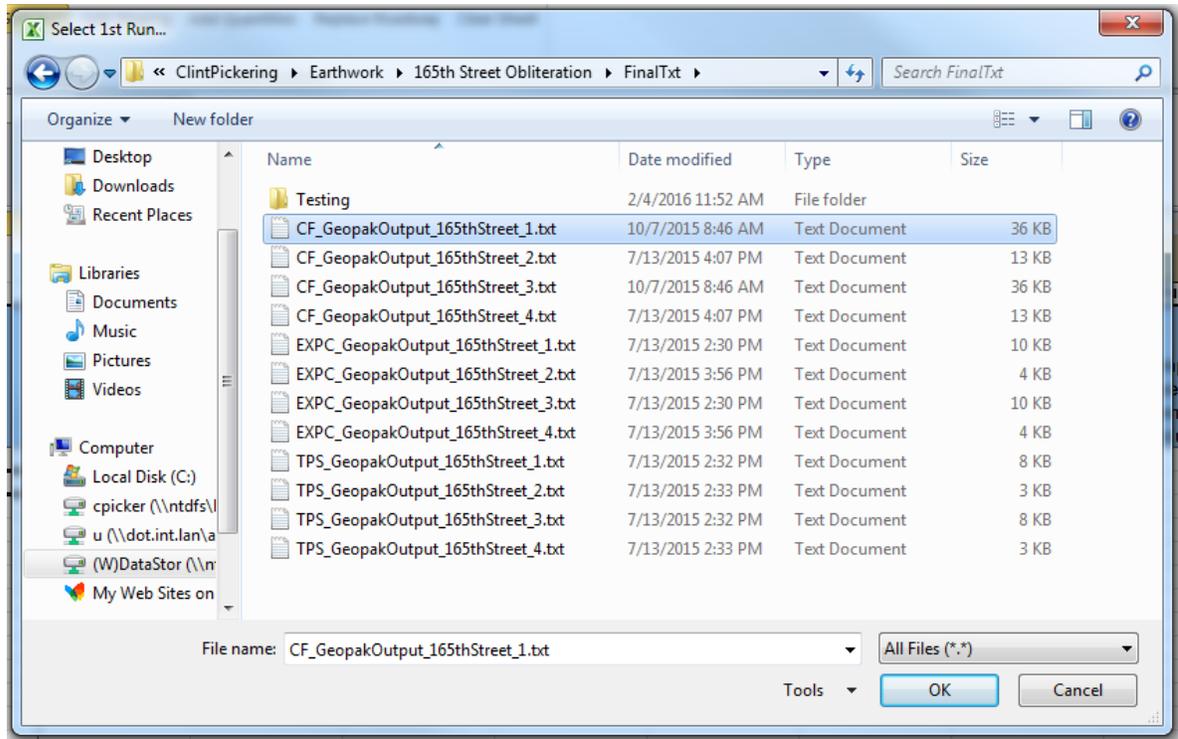


Figure 8: Sample GAP tool window.

Once loading is complete, users will be notified with the pop-up below. They can now see the new files that correspond with the file selected.

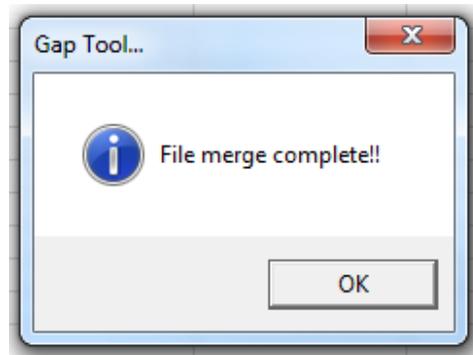


Figure 9: Gap Tool notification.

Add Staging Tool

The Add Staging tool adds a staging number to the beginning of each stage of Earthwork for the project. All files that are intended for each stage should be placed in their own stage folder and imported one stage at a time. This tool also allows the user to put multiple stages in one file instead of separate files like was done in the past. If you don't have any staging within your project, use the Add Quantities tool instead to load all of the files in the final folder.

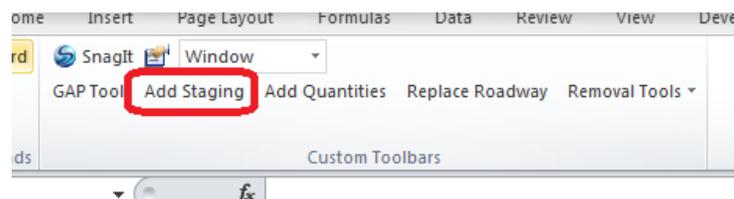


Figure 10: Add Staging tool location.

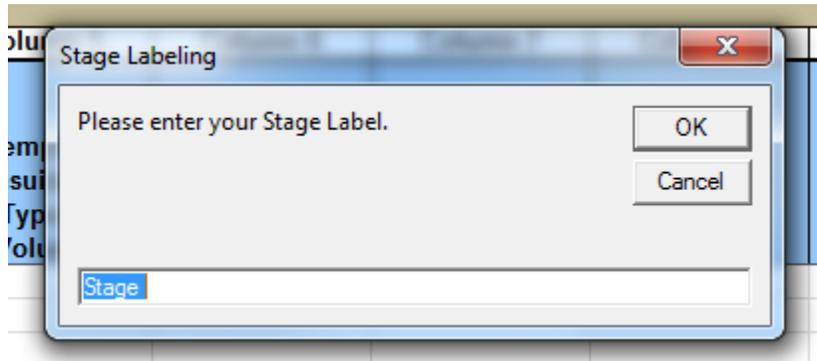


Figure 11: Stage Labeling prompt.

A prompt will appear once the stage is labeled. Select the folder location and click OK.

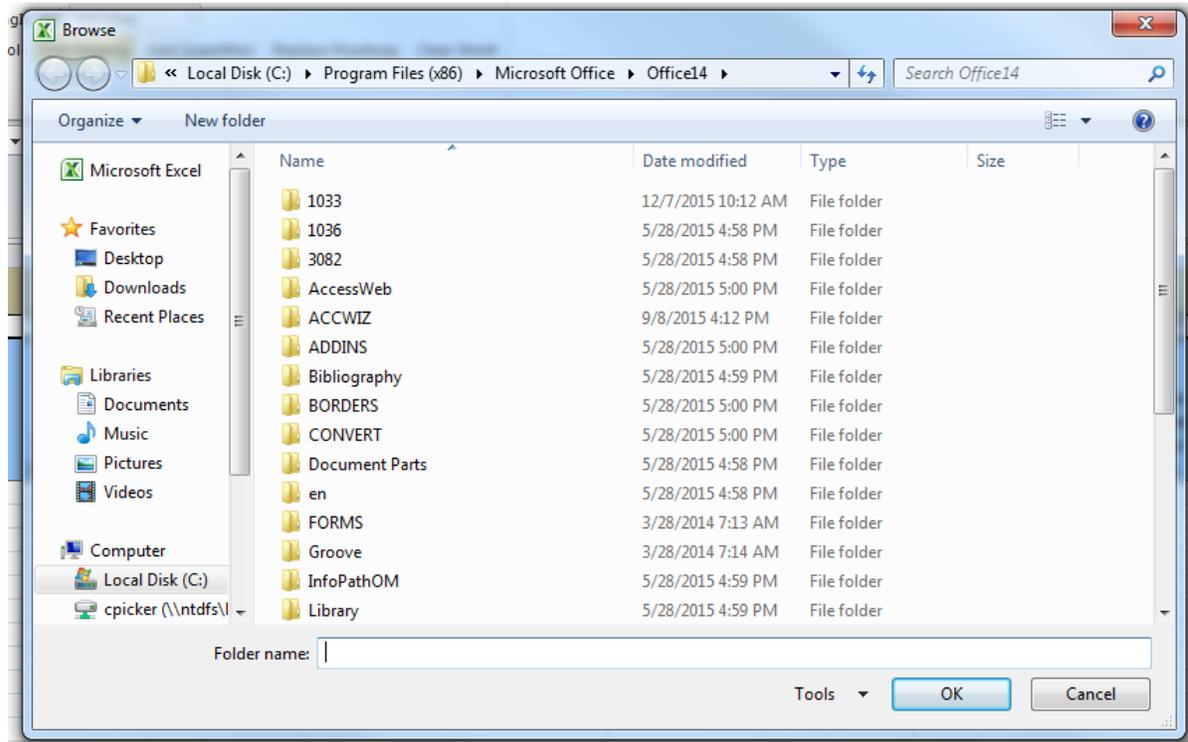


Figure 12: Select file location.

After the folder that contains these files is selected, the program will then look for the CutFill file for each run that was made and then find all the other files that correspond with the name given after the CF_ prefix. If the name of one of the corresponding files is not exactly like the CutFill file, it will be skipped and not found.

The name used after the CF_ must be less than 19 characters. If the roadway name is longer than 19 characters then the program will prompt users to shorten the name (see Figure 13) and then go through and correct all of the corresponding files with the same name.

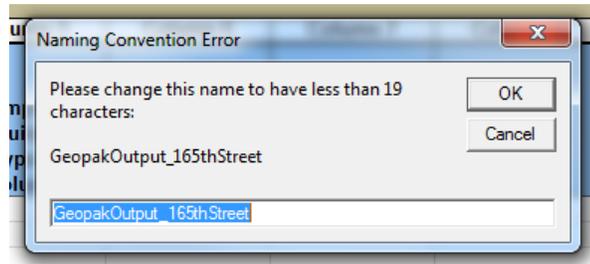


Figure 13: File name warning.

This is another reason to make sure that the name conventions are accurate and identical. It is recommended to create a FinalTXT folder and that all of the final .txt files for Earthwork be put into a FinalTxt folder to be selected when users are ready import the information into the Earthwork spreadsheet.

The dialog box shown below will pop up when the program is finished.

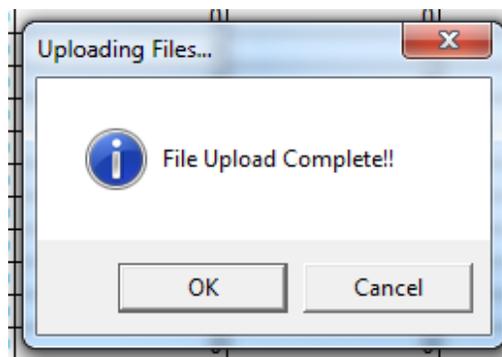


Figure 14: Completion notification.

Add Quantities Tool

If staging isn't needed, the Add Quantities tool loads the final .txt files within a select folder into the Earthwork spreadsheet.

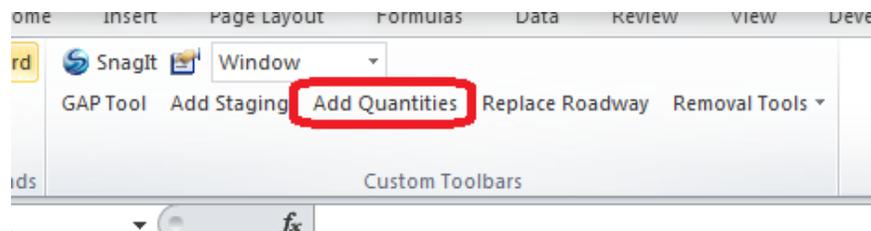


Figure 15: Add Quantities tool location.

Replace Roadway Tool

The Replace Roadway tool allows users to replace a roadway file that has been rerun in MicroStation with the new file. It shows users the CutFill files within the folder that they picked and finds the roadway within the Earthwork sheet from the CutFill file that they select from the folder.

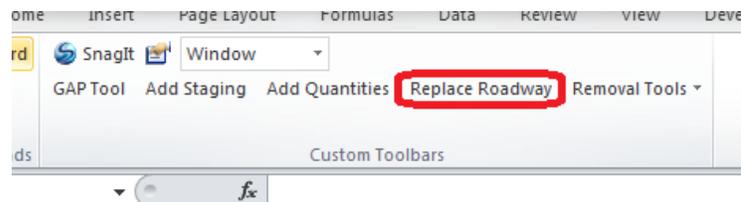


Figure 16: Replace Roadway tool location.

A dialog box will prompt users to select the CutFill file that was rerun. The program will then remove that roadway from the sheet and replace it at the bottom of the sheet.

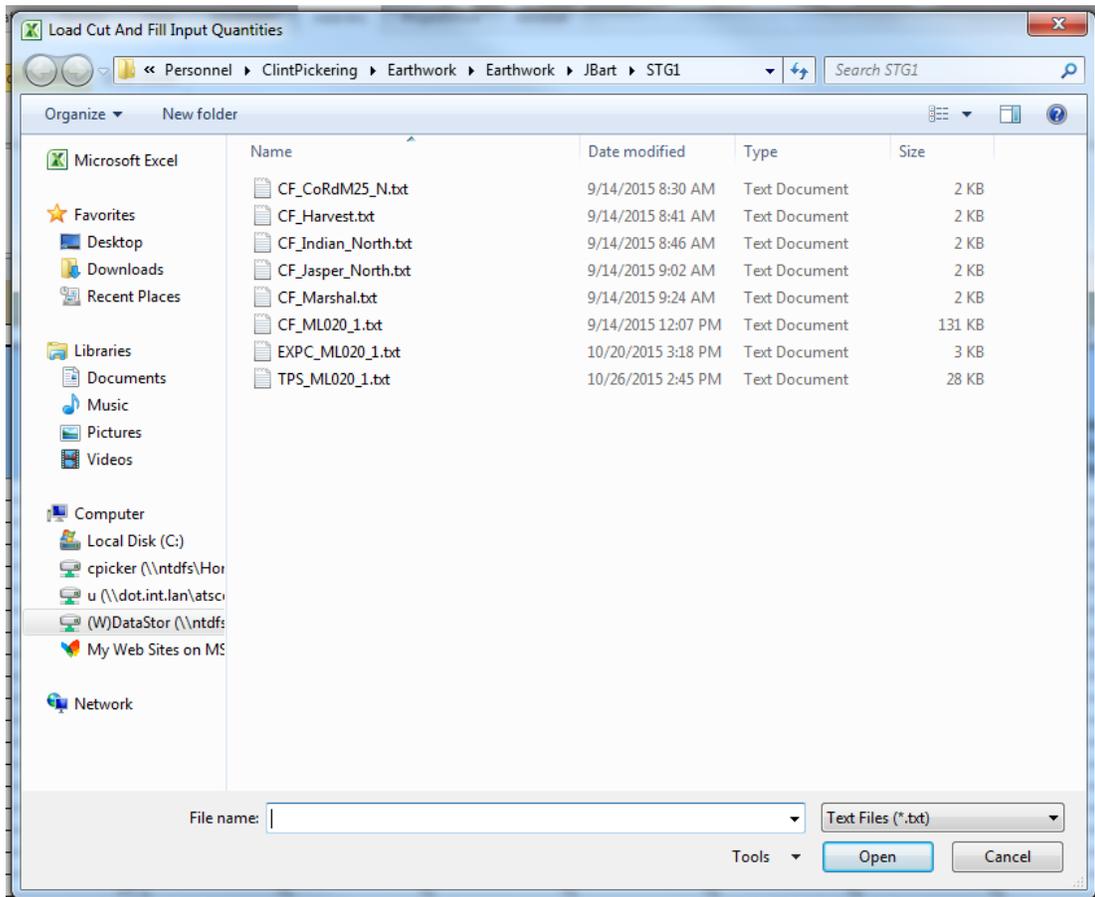


Figure 17: Prompt for new files.

This dialog will display when finished.

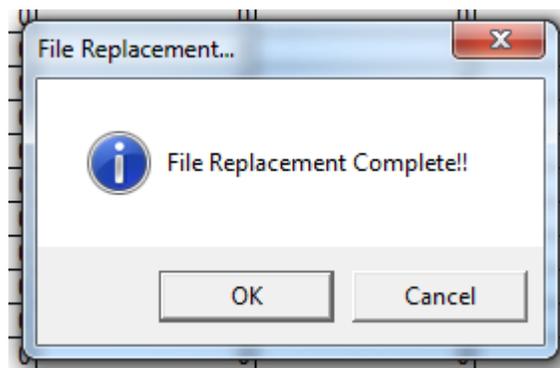


Figure 18: Completion notification.

Remove Roadway Tool

The Remove Roadway tool deletes a specific roadway for the DataInput sheet and the DataInformation sheet, removes the corresponding roadway tab along the bottom, and rebuilds the Summary sheet if the file has already been processed. It does not update the 107_28 sheet. The final sheets must be re-run in order to remove a roadway from them.

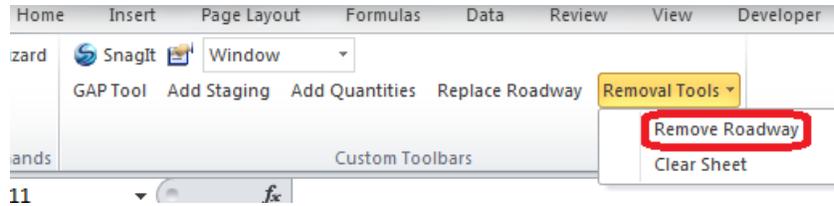


Figure 19: Remove Roadway tool location.

A warning prompts the user because this cannot be undone once it is executed.

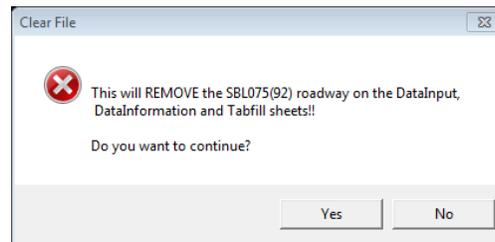


Figure 20: Warning prompt.

Clear Sheet Tool

The Clear Sheet tool clears the DataInput sheet and the DataInformation sheet, deletes the Tabfill sheet, and resets the 107_28 sheet.

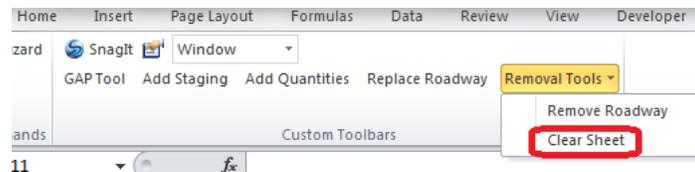


Figure 21: Clear Sheet tool location.

A warning prompts the user because this cannot be undone once it is executed.

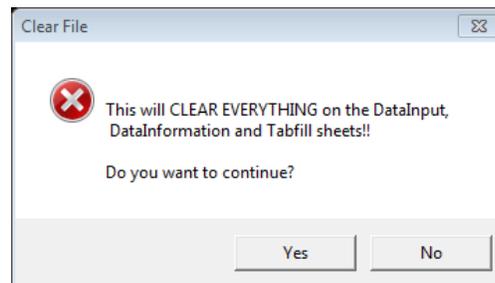


Figure 22: Warning prompt.

DataInformation Sheet

The DataInformation Sheet is where the raw data on the DataInput sheet is calculated.

Total Cut and Fill Adjustment								Add Quantities	Combined Material to be Placed as Fill
Shrink Factor	Shrink Factor	Swell Factor				Swell Factor	Shrink Factor		
1.3	1.2	1.1				0	1.3		
305128	0	0	0	56150	0	0	0	1814090	
Template Select Loam Volume	Template Select Sand Volume	Template Rock Volume	Template B & W Rock Volume	Template Waste Volume	Template Shale Volume	Template Rock Undercut Volume	Manually Calculated Cut Adjustments +/- Cut	Total Cut Adjusted	
0	0	0	0	0	0	0		134	

Figure 23: DataInformation column headings.

Hovering over any cell with a red triangle in the upper left-hand corner will provide information about that column.

Shrink Factor	Shrink Factor	Shrink Factor
1.3		
323003		
Total Class 10 Volume	Total Topsoil Cut Volume	Template Unsuitable Type A Volume

For user input.
1.3 is the default Shrink Factor

Figure 24: Comments describe column purpose.

Orange Column Headings

Many places within the sheet are colored orange. These cells indicate either data is necessary from the user, or that data may be changed by the user. Figure 21 shows some of the shrink factors on the sheet. They are orange and contain what has been predetermined to be the most common factor used for those soil types. The shrink factors can be changed by the user, though, if it is determined that a particular soil type on the project has a different shrink factor than the standard.

Green Column Headings

The green column headings indicate that the data below them are nothing more than summations for the original data from GeoPak.

Blue Column Headings

The blue headings indicate that a calculation was performed to manipulate the data. The cells below the blue headings should never be altered. If a quantity needs to be adjusted, either an orange column value needs to be changed or users should clear out the Earthwork file, make adjustments in the cross sections, run the necessary input files again, and reimport the changed data. By overriding formulas, the changed quantities may not transcend throughout the project properly.

Add Quantities

The DataInformation Sheet contains two “Add Quantity” columns that are for the user to use to manually calculated quantities. One is for the Cut side and one is for the Fill side. These columns can contain “+” or “-” quantities. Examples of manually calculated items include entrances and dikes.

Add Quantity	Add Quantity
Shrink Factor	
1.3	
0	0
Manually Calculated Cut Adjustments +/- Cut	Manual Calculated Fill Adjustments +/- Fill

Figure 25: Add Quantity column headings.

Weighted Average Shrink Factor

The individual shrink factors are combined to create a “Weighted Average Shrink Factor”. Figure 24 is an example of the weighted shrink factor showing, for this case, it is applied to the Total Adjusted Fill.

Weighted Average Shrink Factor
1.3
1666035.8
Total Fill Adjusted w/ Weighted Average 1.3 Shrink Factor
n

Figure 26: Shrink heading example.

Placement of Unsuitable Soil Types

The Unsuitable Placement Check is for the user to be able to determine the amount of unsuitable material that can be placed according to Standard Road Plan [EW-102](#).

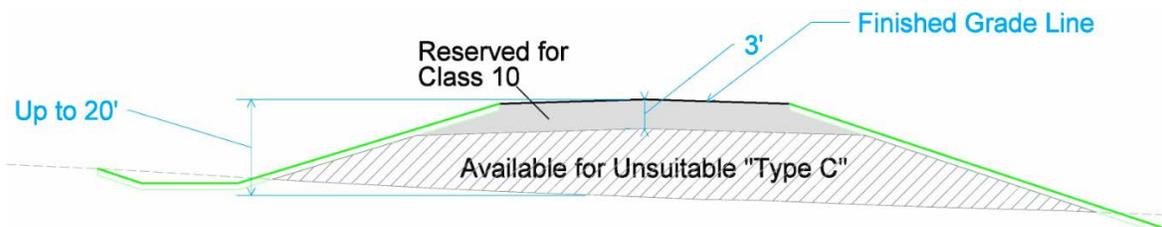


Figure 27: Example of Unsuitable placement calculation.

The user will enter minimum end areas of Class 10 fill (shaded gray in the above example) needed for each unsuitable placement situation (5 foot Minimum, 20 foot Maximum, 3 foot Minimum). For instance, some unsuitable “C” material can be placed anywhere more than 3 feet below the subgrade. The user draws a line 3 feet below the subgrade line and floods the area. This is the minimum amount of Class 10 needed at this cross section to be entered in the calculation file. The remaining fill area is available for unsuitable “C” placement (hatched in the above example), and is provided by the calculation file. Users need to pick a typical cross section that is representative of the project. It is not necessary to enter a value at every station. However, if the project has large changes, it may be proper to adjust the values, and independent roadways should all have individual values.

Note: the equation in the calc file accounts for topsoil stripping and plowing and shaping as long as the fill end area exceeds the minimum class 10 end area.

	5' Minimum Class 10 End Area Sq. Ft.	20' Maximum End Area Sq. Ft.	320925.8 Approx. Fill Vol. Below 5' & Above 20' w/ Shrink Cu. Yds.	3' Minimum Class 10 End Area Sq. Ft.	612397.5 Approx. Fill Volume Below 3' w/ Shrink Cu. Yds.
4	50	0	0	50	0
9	50	0	0	50	0
6	50	0	0	50	0
1	50	0	0	50	0
4	50	0	0	50	0
2	50	0	0	50	0

Figure 28: Check for unsuitable soil placement.

Large Core-Out Areas. The calculation file does not account for add quantities in the unsuitable placement columns (labeled above as “Approx. Fill Vol. Below 5’...”), making the volumes generally conservative. However, this may not be appropriate for areas with large core-outs. For projects with core-out volumes where 10,000 cubic yards or more of unsuitable material could be placed, the designers will need to manually adjust the fill volumes in the station ranges appropriate.

Topsoil Column Headings

The Topsoil columns show the typical thickness of cut and replacement, the replacement with shrink, and the difference of the cut minus the replacement with shrink. There is no user input here unless it is necessary to change the Shrink Factor for the topsoil.

AE	AF	AG	AH
Topsoil			
Typical thickness is 12"	Typical Thickness is 8"	Topsoil Replacement Shrink Factor	
561984	333503	1.4	
Total Topsoil Cut Volume	Template Topsoil Replacement Volume	Topsoil Replacement With 1.4 Shrink Factor	Topsoil Cut Minus Topsoil Replacement w/Shrink
561984	333503	466904.2	95080.9

Figure 29: Topsoil Column Headings.

Tab Sheet Production

The Add-Ins menu of the DataInformation sheet has two drop down menus: Tab Sheets and T-Sheets.

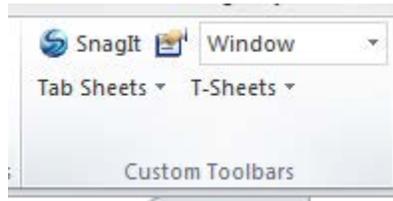


Figure 30: Add-In menu on DataInformation sheet.

The Tab Sheets has 2 choices: Build Tab Sheets and Rebuild Summary Tab Sheet Only. The first will create the Tabs Sheets and the second will recreate the Summary sheet once the user rearranges the Tab Sheets.

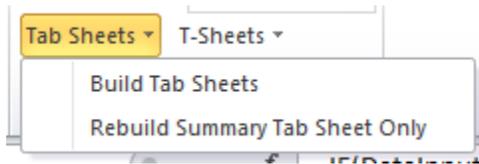


Figure 31: Tab Sheets tools.

After the Build Tab Sheets tool has been run, a grey colored Tab Sheet for each roadway appears across the bottom of the workbook, including the Summary sheet at the end.

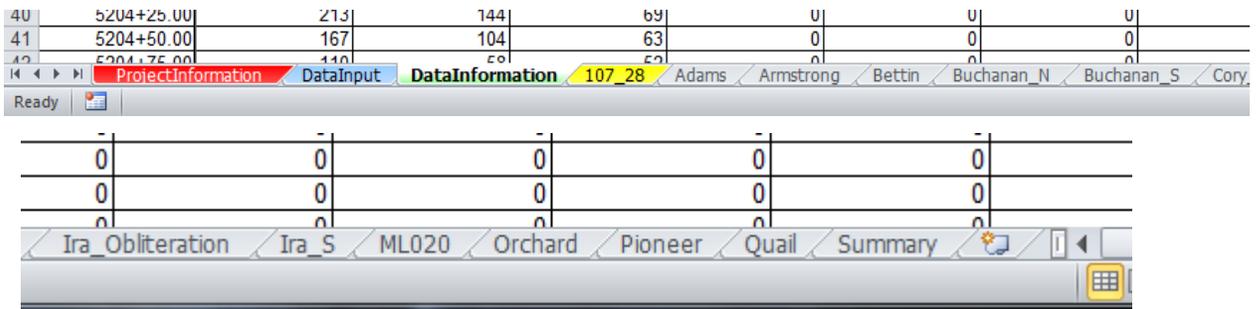


Figure 32: Sheets for each roadway.

1	Station	Template Cut Volume	Total Class 10 Volume	Total Topsoil Cut Volume	Unsuitable Type B Volume	Unsuitable Type C Volume	Pavement Removal Volume
2							
3	Summary:						
4							
5	Adams	2029	2029	0	0	0	0
6	Armstrong	832	22	329	0	480	85
7	Bettin	1470	881	589	0	0	0
8	Buchanan_N	9835	3388	1824	3301	0	0
9	Buchanan_S	2313	1861	452	0	0	0
10	Cory_N	150	82	68	0	0	0
11	Cory_S	197	0	0	0	84	37
12	Dean_N	1351	1214	137	0	0	58
13	Dean_S	1961	1899	62	0	0	0
14	Esther_N	744	244	500	0	0	0
15	Esther_S	724	248	476	0	0	0
16	Fox_N	469	418	51	0	0	0
17	Fox_S	14246	175	201	0	0	307
18	Gard_N	1717	1201	0	0	0	130
19	Gard_S	244	196	48	0	0	0
20	Hope_N	3946	3946	0	0	0	0
21	Hope_S	5076	5076	0	0	0	0
22	Ira_N	4699	1947	2752	0	0	0
23	Ira_Obliteration	17486	17486	0	0	0	0
24	Ira_S	9540	7754	1669	17	100	0
25	ML020	2350148	823263	552028	301898	327467	56845
26	Orchard	1028	385	643	0	0	0
27	Pioneer	1165	1130	35	0	0	0
28	Quail	890	770	120	0	0	66
29							
30							
31	Project						
32	Totals:	2432260	875615	561984	305216	328131	57528
33							
34							

Figure 33: Summary Sheet.

To change the order of the roadways in the Summary sheet, drag the Tab Sheets around into the desired order and click the Rebuild Summary Tab Sheet Only button to rebuild the Summary Sheet.

A	B	C	D	E	F	G	T
Station	Template Cut Volume	Total Class 10 Volume	Total Topsoil Cut Volume	Template Unsuitable Type B Volume	Template Unsuitable Type C Volume	Template Pavement Removal Volume	Se
Summary:							
ML020	2350148	823263	552028	301898	327467	56845	
Adams	2029	2029	0	0	0	0	
Armstrong	832	22	329	0	480	85	
Bettin	1470	881	589	0	0	0	
Buchanan_N	9835	3388	1824	3301	0	0	
Cory_N	150	82	68	0	0	0	
Cory_S	197	0	0	0	84	37	
Esther_S	724	248	476	0	0	0	
Esther_N	744	244	500	0	0	0	
Dean_N	1351	1214	137	0	0	58	
Dean_S	1961	1899	62	0	0	0	
Fox_N	469	418	51	0	0	0	
Buchanan_S	2313	1861	452	0	0	0	
Fox_S	14246	175	201	0	0	307	
Gard_N	1717	1201	0	0	0	130	
Gard_S	244	196	48	0	0	0	
Hope_N	3946	3946	0	0	0	0	
Hope_S	5076	5076	0	0	0	0	
Ira_N	4699	1947	2752	0	0	0	
Ira_Obliteration	17486	17486	0	0	0	0	
Ira_S	9540	7754	1669	17	100	0	
Orchard	1028	385	643	0	0	0	
Pioneer	1165	1130	35	0	0	0	
Quail	890	770	120	0	0	66	
Project							
Totals:	2432260	875615	561984	305216	328131	57528	

Figure 34: Summary Sheet.

T-Sheet Production

The T-Sheets drop down menu contains two options: Build T-Sheets and Build Summary Sheet Only.

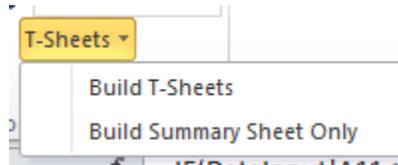


Figure 35: T-Sheets Menu

Double Sheet Project:
(To accommodate more columns for soil layers)

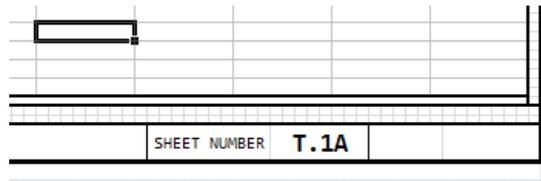


Figure 39: T.1A Sheet (Cut Columns)

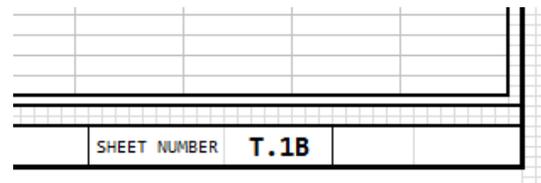


Figure 40: T.1B Sheet (Fill Columns)

The 107_28 sheet has 2 buttons. One button is for adding an addenda line or removing an addenda line to the bottom of whatever sheet the user has selected a cell in. The bottom of the sheet will appear as in the figure below. The other button is for publishing the final sheets to a .pdf file, and the user is prompted to select a location to create it.



Figure 41: Addenda line.

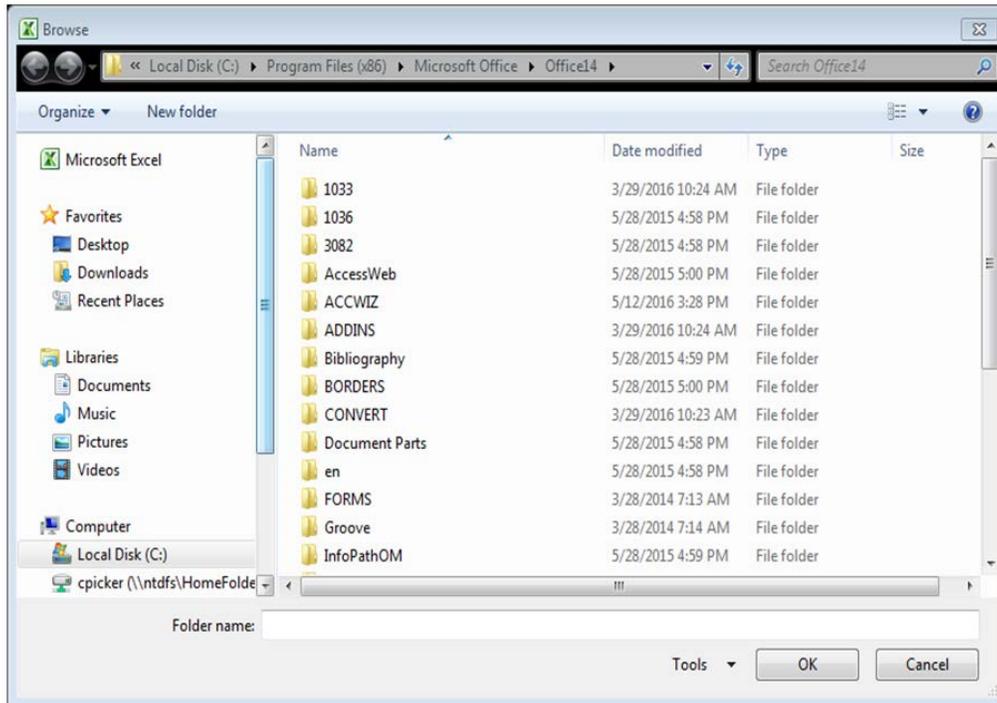


Figure 42: Prompt for .pdf creation location.

Chronology of Changes to Design Manual Section:

020J-062 Earthwork Calculation File

- | | | |
|-----------|---------|--|
| 9/14/2016 | Revised | Added a roadway removal tool. Updated some code to the calc file that allows for multiple plowing and shaping runs within a roadway. Updated the formulas in the "Approx. Fill Vol. Below 5' & Above 20' w/ Shrink" and "Approx. Fill Volume Below 3' w/ Shrink" to include Existing Topsoil Undercut and Existing Topsoil Stripping Undercut. |
| 8/17/2016 | Revised | Corrected the naming convention for the Subgrade Undercut run. Changed it from "UCCF" to "UCSG". |
| 8/5/2016 | Revised | Revised section to coordinate with new earthwork calculation files. Shrink has moved from cut to fill. |
| 7/31/2015 | NEW | New |