Technical Training and Certification Program

USDA United States Department of Agriculture
Natural Resources Conservation Service

MASWCD
Minnesota Association of Soil and Water Conservation Districts

BWSR

EFT

Terrace Design Tool

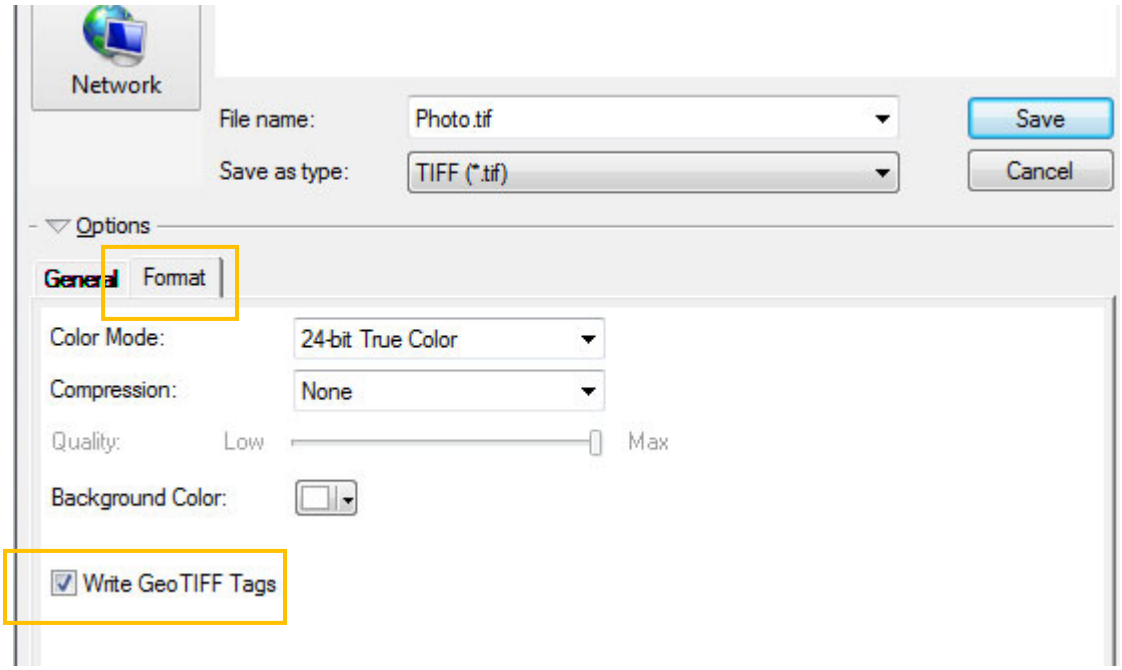
Workflow

Updated 11/15/21

Create Background Image

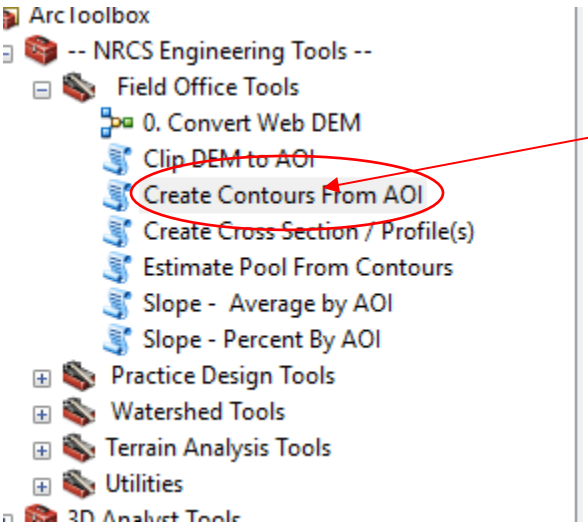
In ArcMap

a. Zoom into the area that you would like to display as a background image (<u>your entire screen's viewable extents will be exported</u>, including any visible layers.)
b. Click "File" menu – Export Map
c. Specify Save Location
d. Enter File Name
e. Save as type: TIFF (*.tif)
f. Under "Options":
    i. Click the Format tab
    ii. Select 'Write Geo TIFF Tags'
g. Select Save



This reference guide covers the method for exporting a DEM from ArcMap for use in Engineering Field Tools. This ground surface can be used in preliminary planning of conservation practices including waterways, terraces as well as water and sediment control basins.

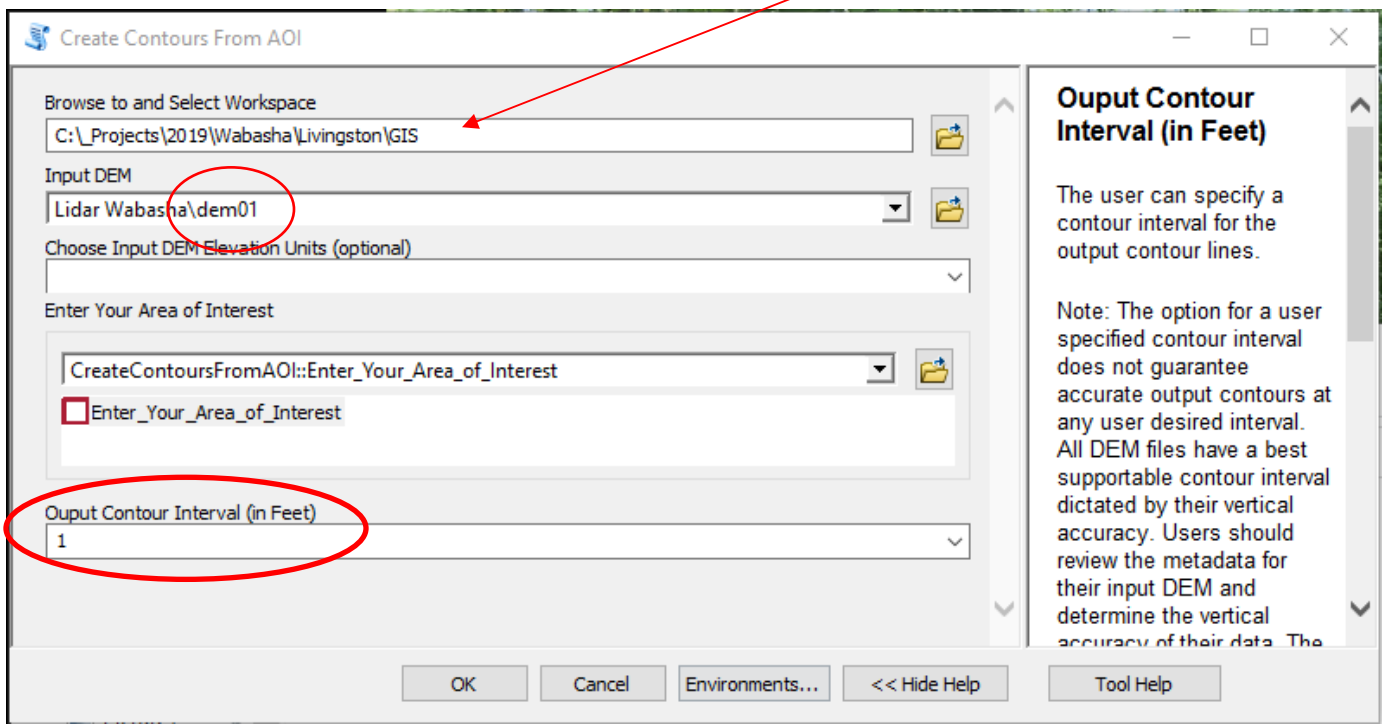
Creating a GIS DEM for EFT



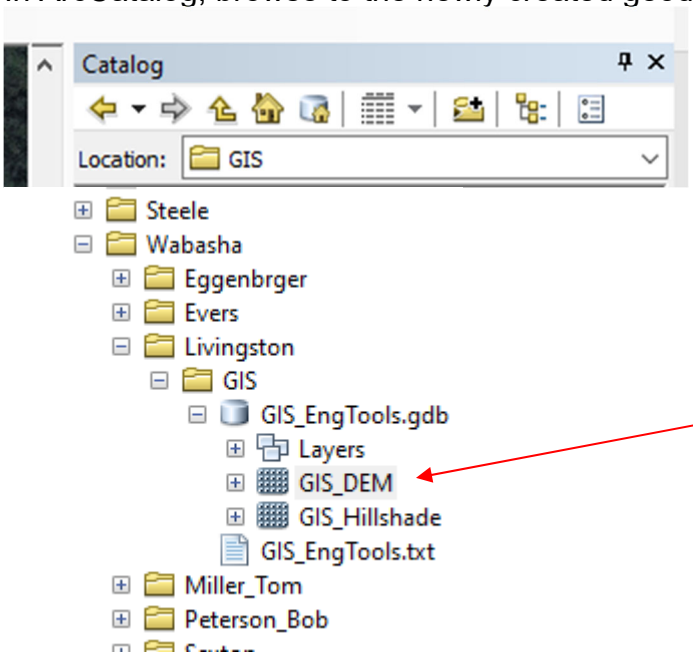
When in ArcMap access the NRCS Engineering Tools toolbox and double click on the Create Contours from AOI.

Below is an screenshot with the information completed to complete the tool. ****Pay special attention to the red circled areas. Note: **Use a 1m DEM** for the Input DEM.

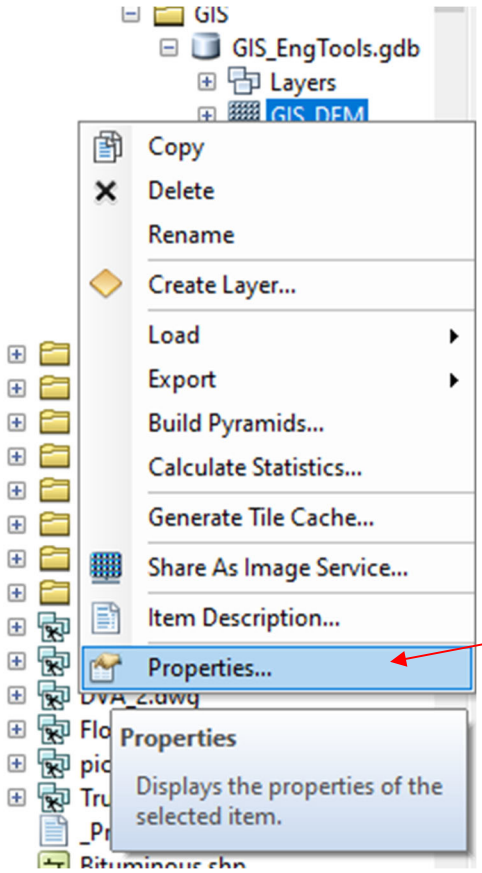
Folder to save files



In ArcCatalog, browse to the newly created geodatabase:

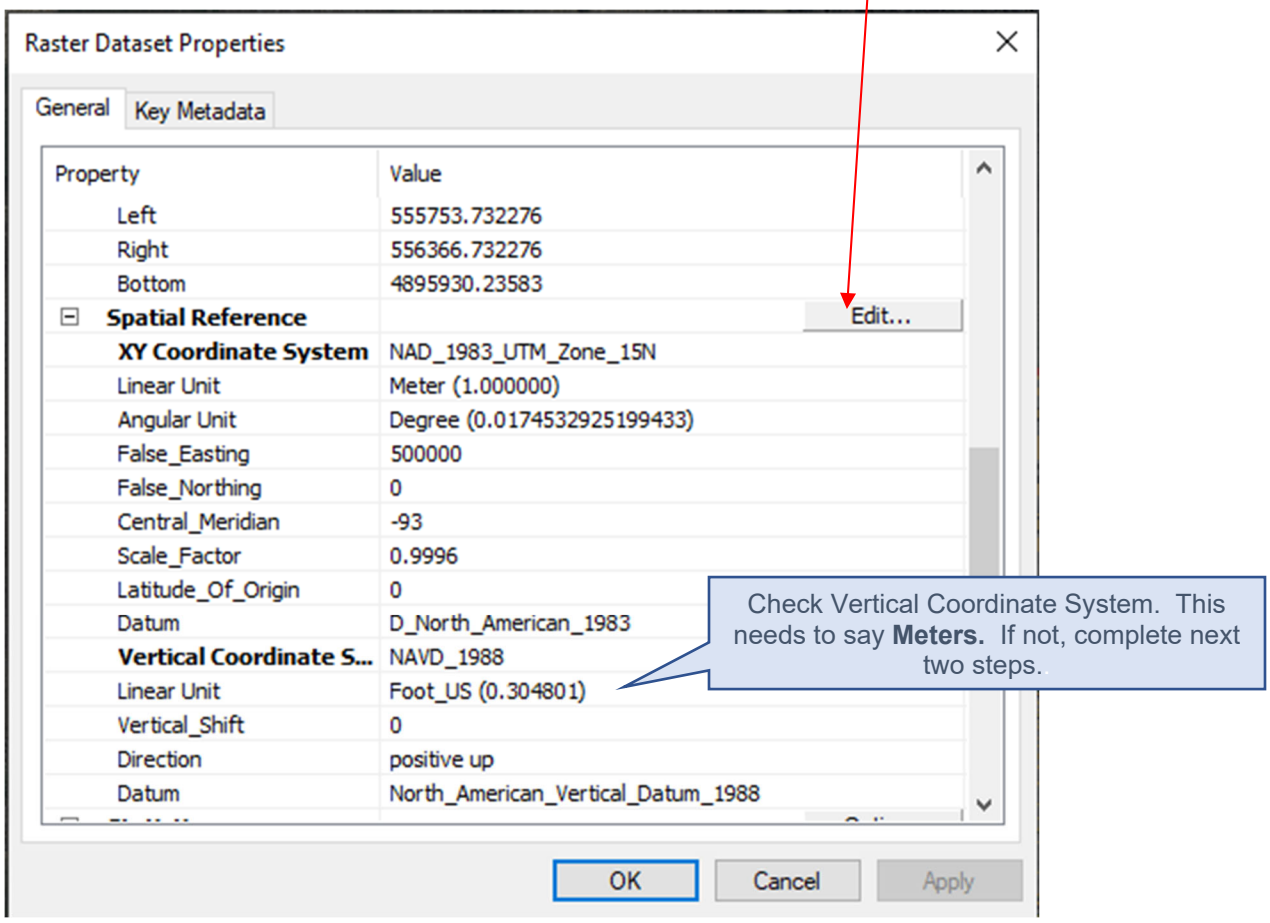


This tool creates a GIS_DEM that may need to have some adjustments done for units.

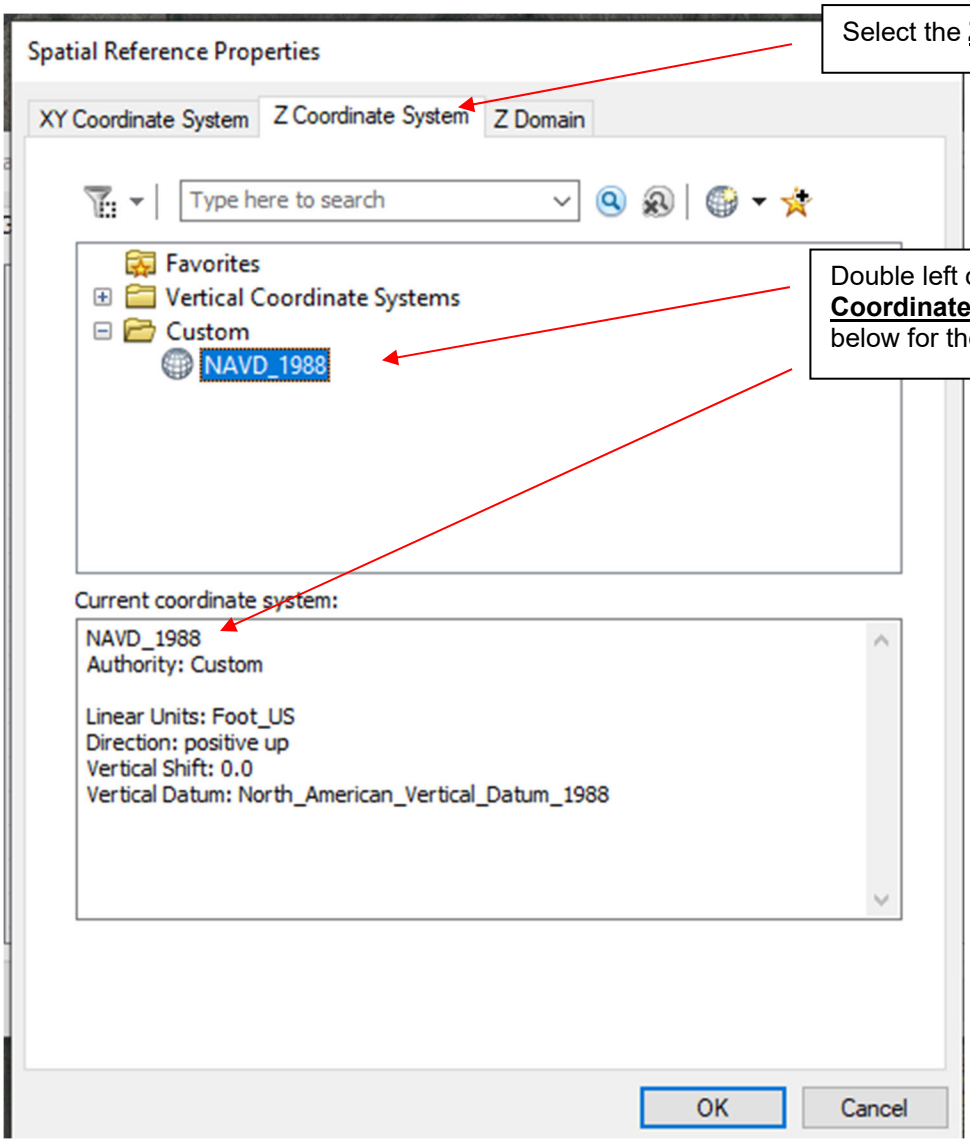


Right click on the GIS_DEM and select properties.

Scroll down in the resulting dialogue box on the **General** tab. Left click the Edit button in the **Spatial Reference** row.

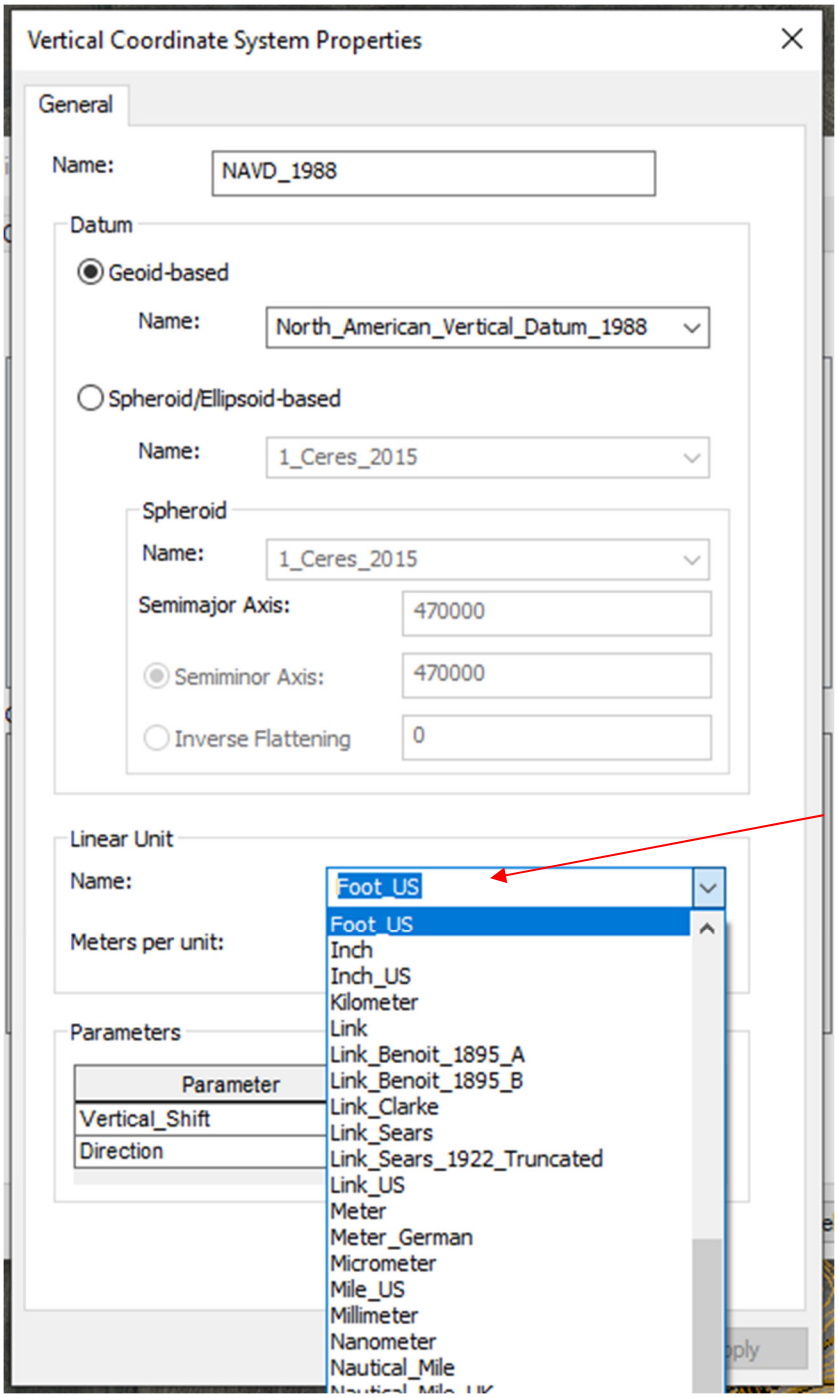


Check Vertical Coordinate System. This needs to say **Meters.** If not, complete next two steps.

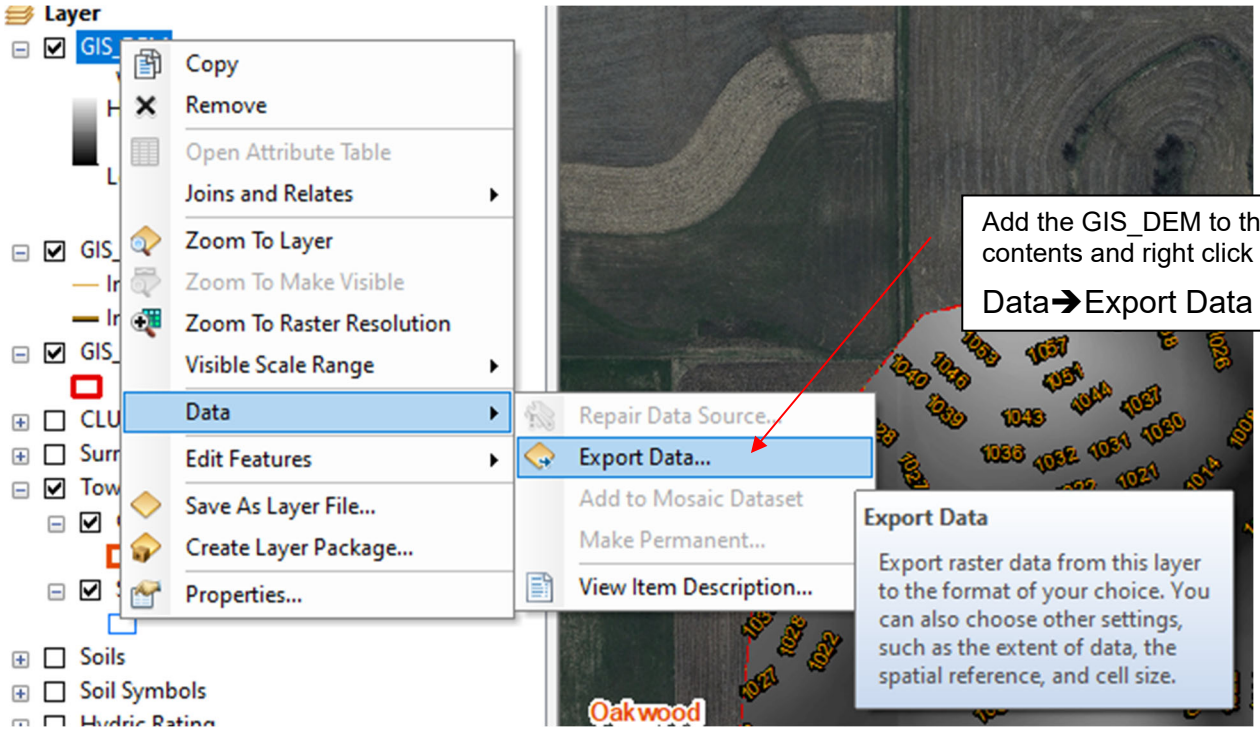


Select the **Z Coordinate System** tab.

Double left click on the **Current Coordinate System**. Reference the box below for the current system used.

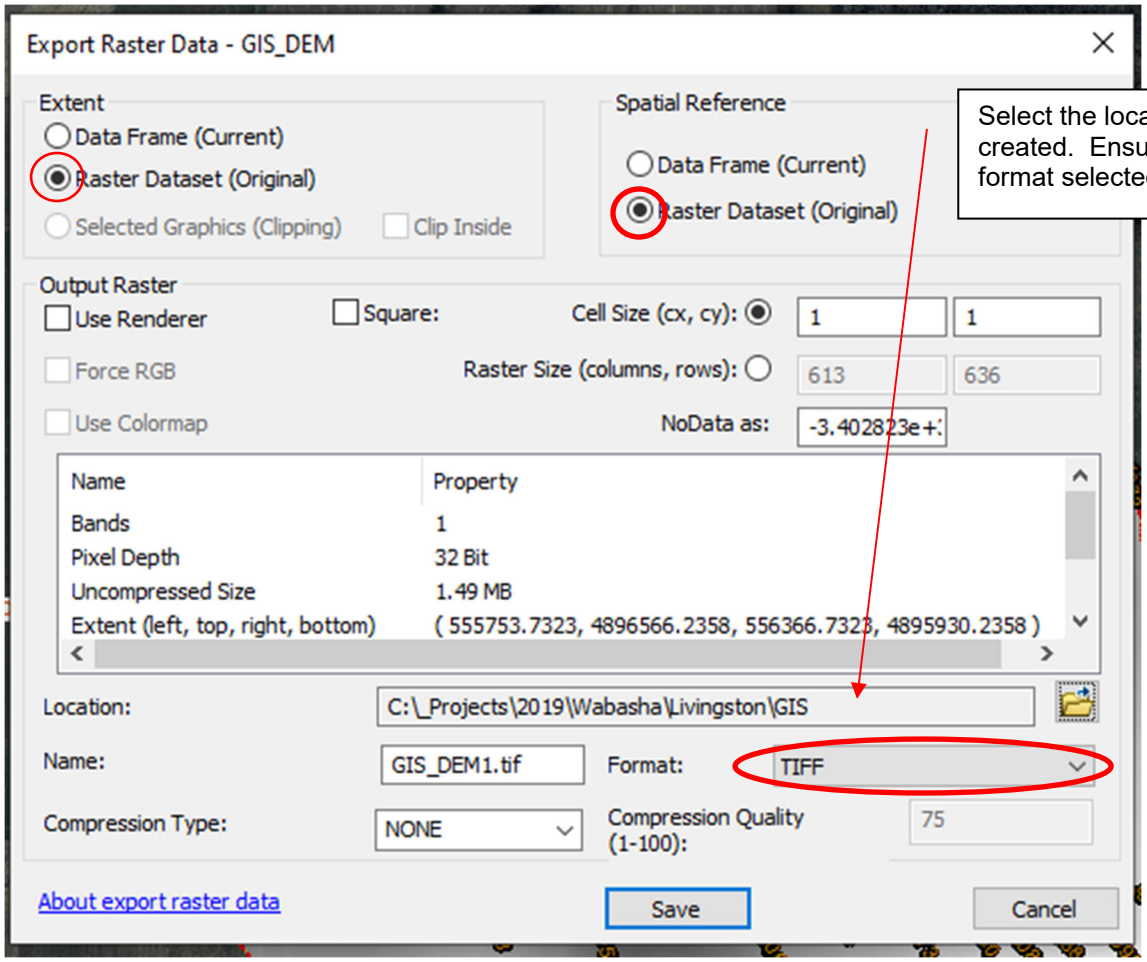


This Linear Unit may need to be changed to Meters. ****If this unit is already meters nothing needs to be completed at this level.

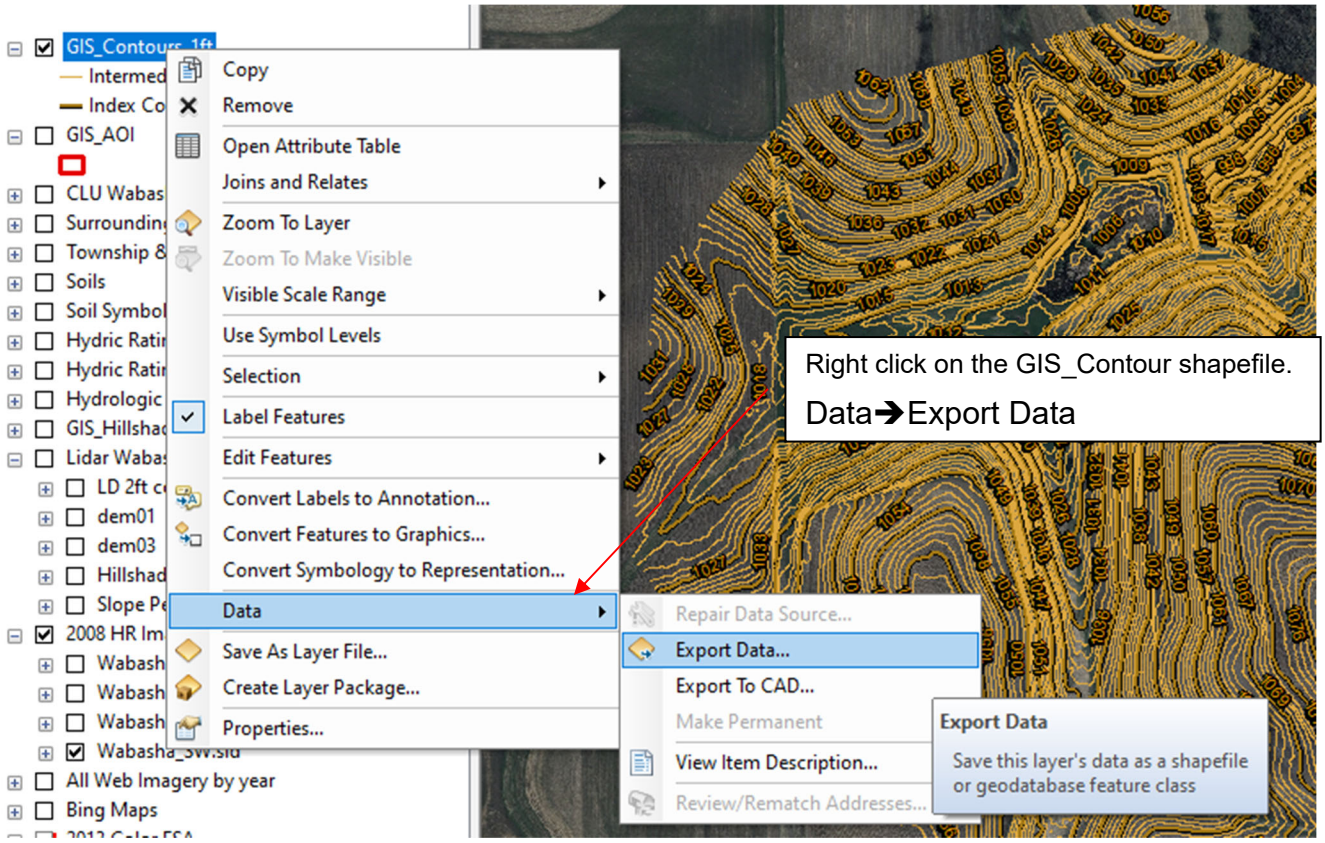


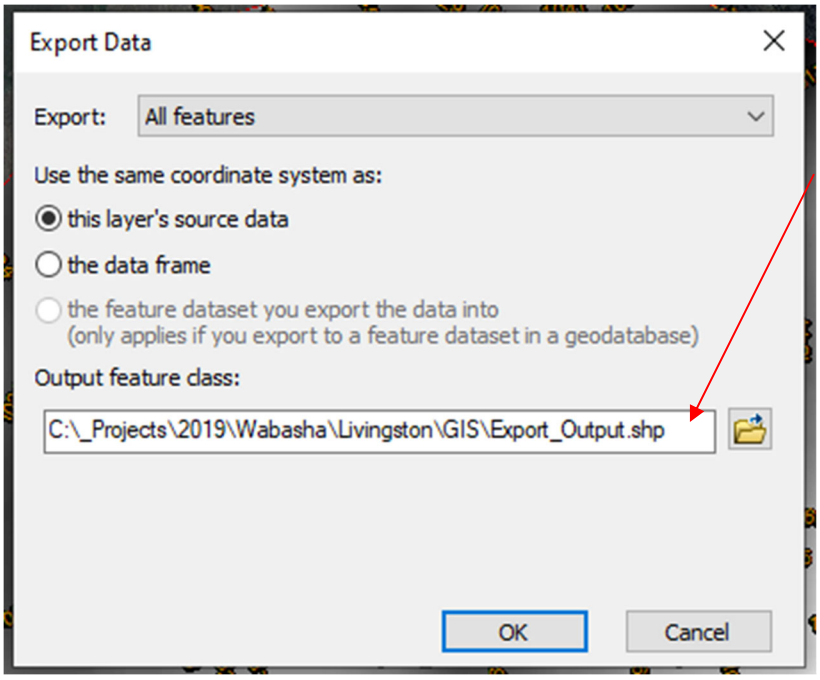
Add the GIS_DEM to the table of contents and right click on that file.

Data➔Export Data



Select the location of the file to be created. Ensure that TIFF is the file format selected.

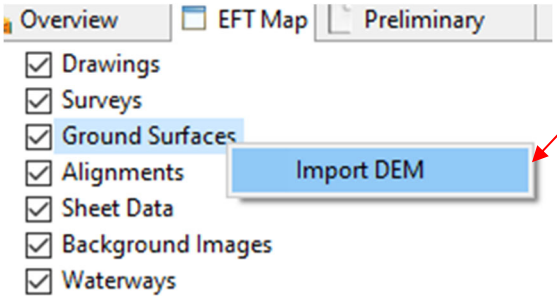




Choose the location to place the resulting .shp file.

Importing DEM into Engineering Field Tools

Create a new survey, terrace or waterway design in a selected customer/project folder.

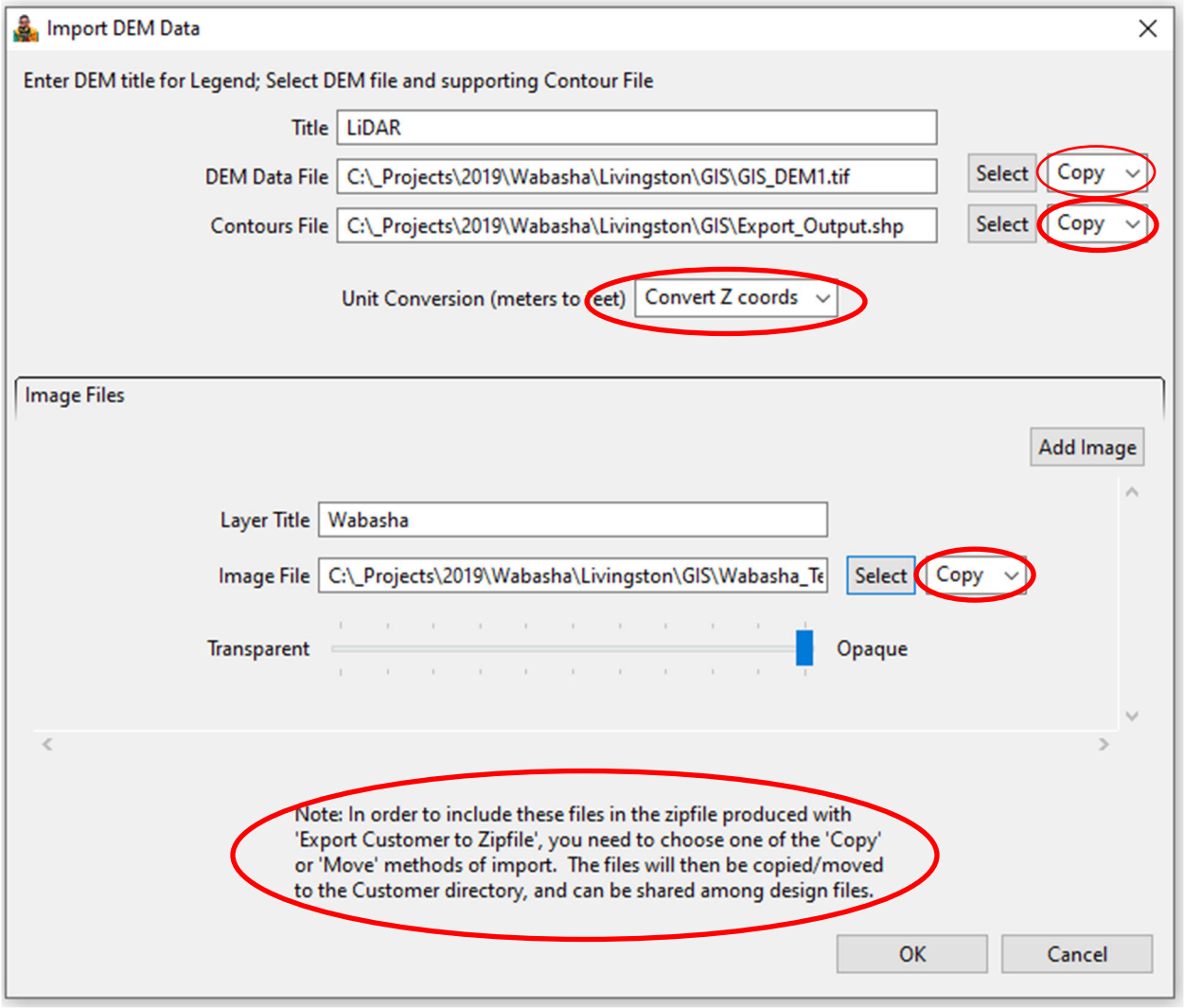


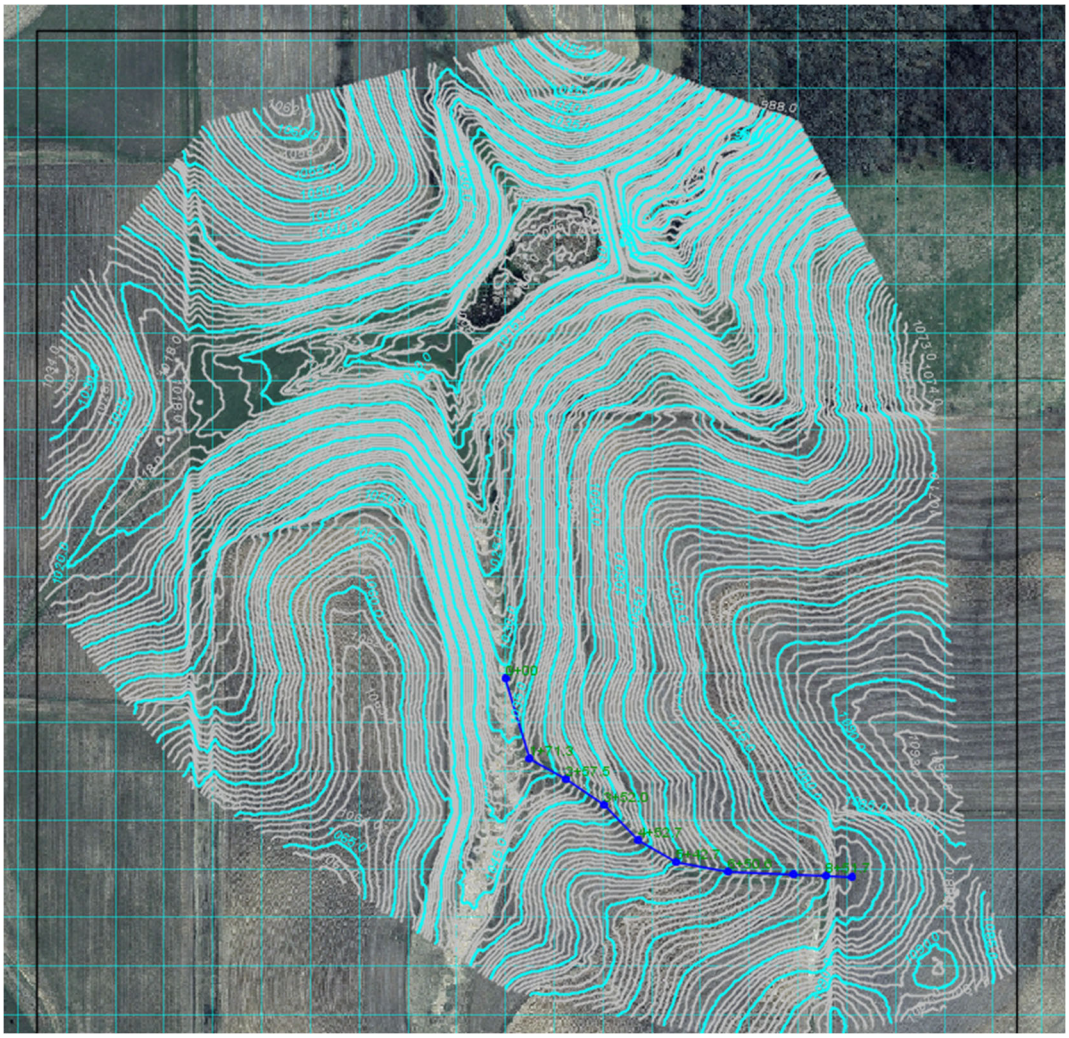
Right click on Ground Surfaces.

Select **Import DEM**

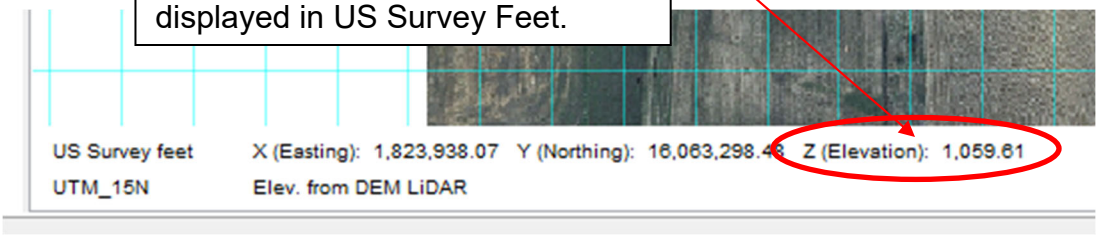
Below is a screenshot of the window and fields completed for importing the DEM, Contour shapefile and imagery (if needed).

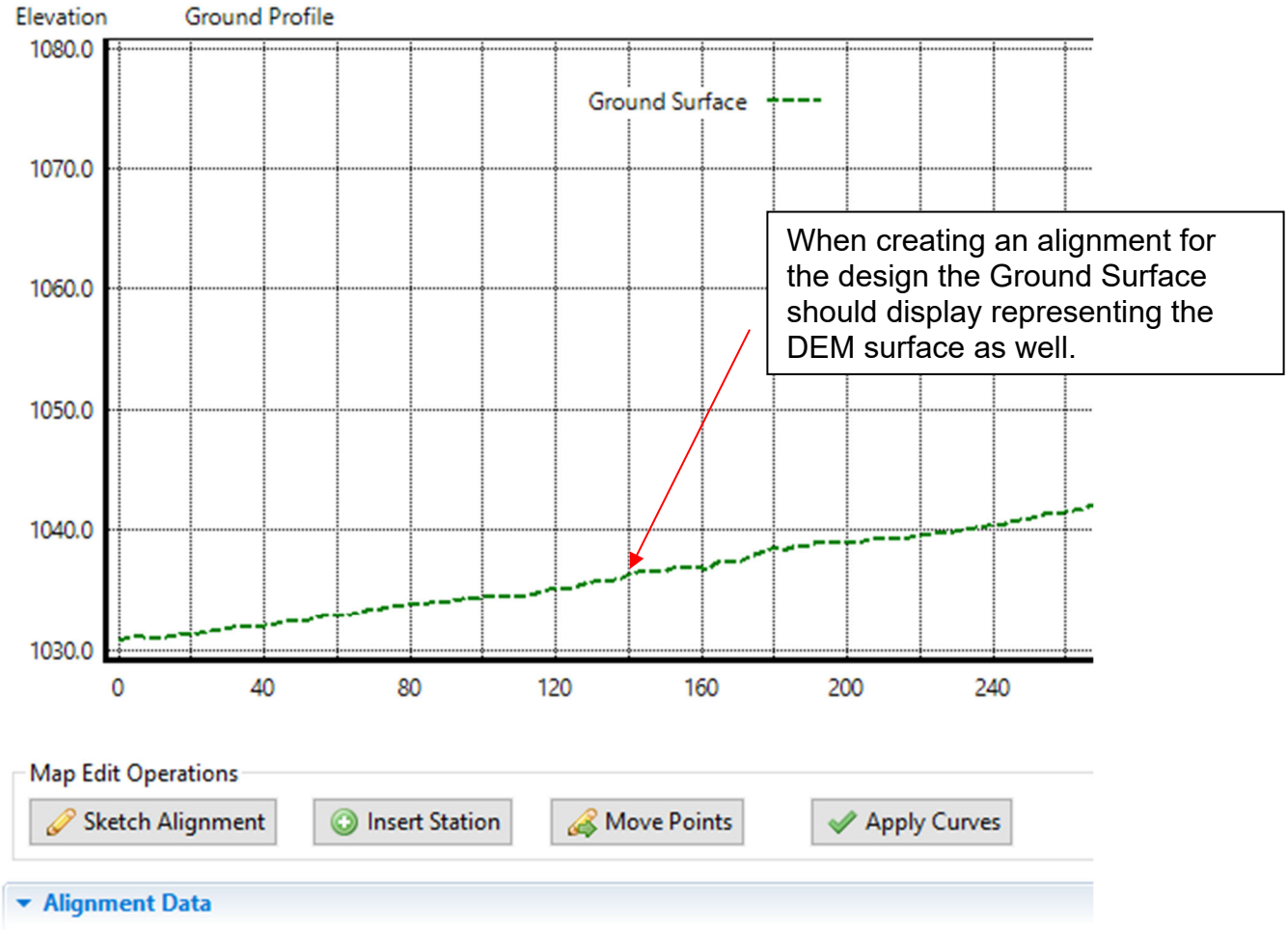
****Pay special attention to the red circled options.





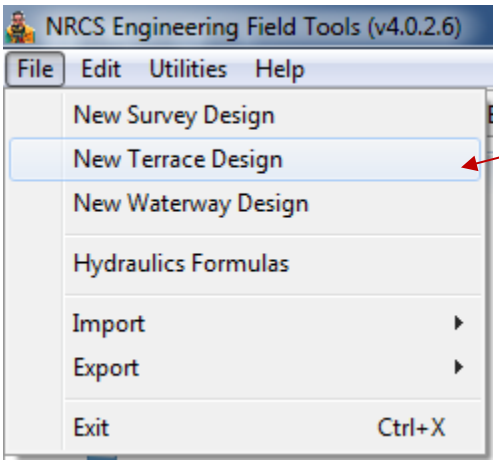
If done correctly, when the cursor hovers over the DEM/Contour Area, the elevation should be displayed in US Survey Feet.



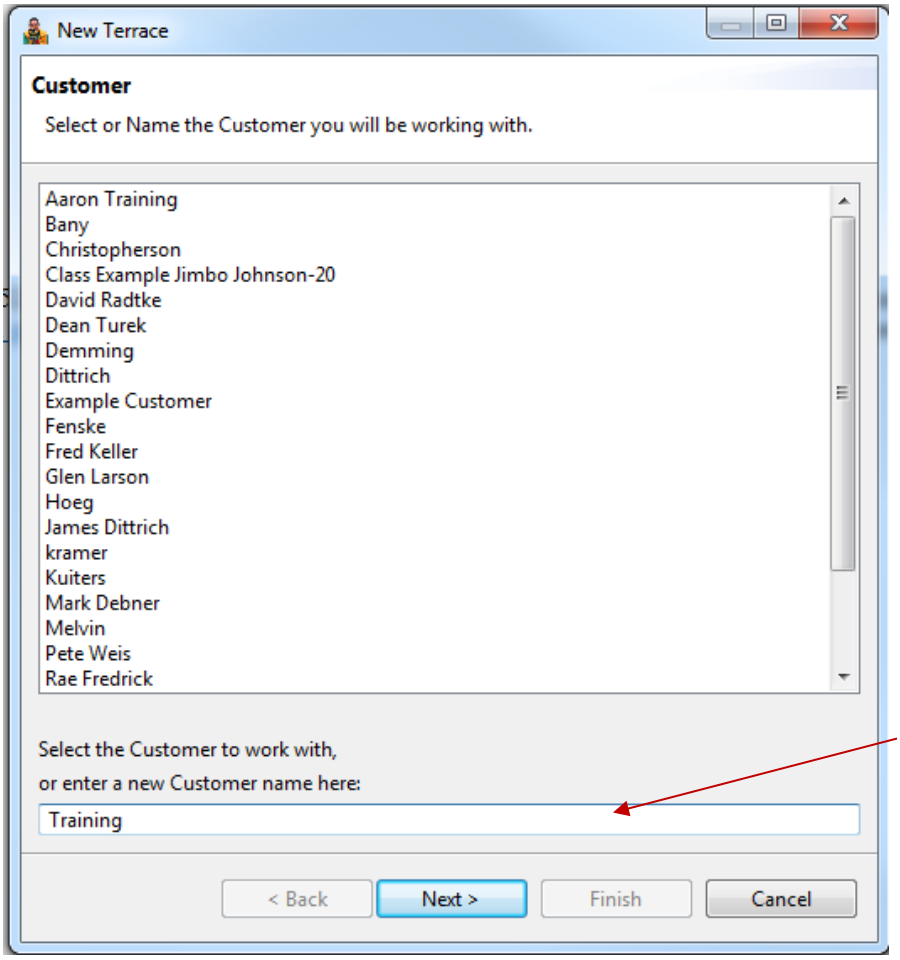

Elevation
Ground Profile
1080.0
1070.0
1060.0
1050.0
1040.0
1030.0
0
40
80
120
160
200
240
Ground Surface
When creating an alignment for the design the Ground Surface should display representing the DEM surface as well.
Map Edit Operations
Sketch Alignment
Insert Station
Move Points
Apply Curves
Alignment Data

This reference guide covers the design of a simple water and sediment control basin using the Engineering Field Tools program as provided by the Natural Resources Conservation Service.

Creating a New Design

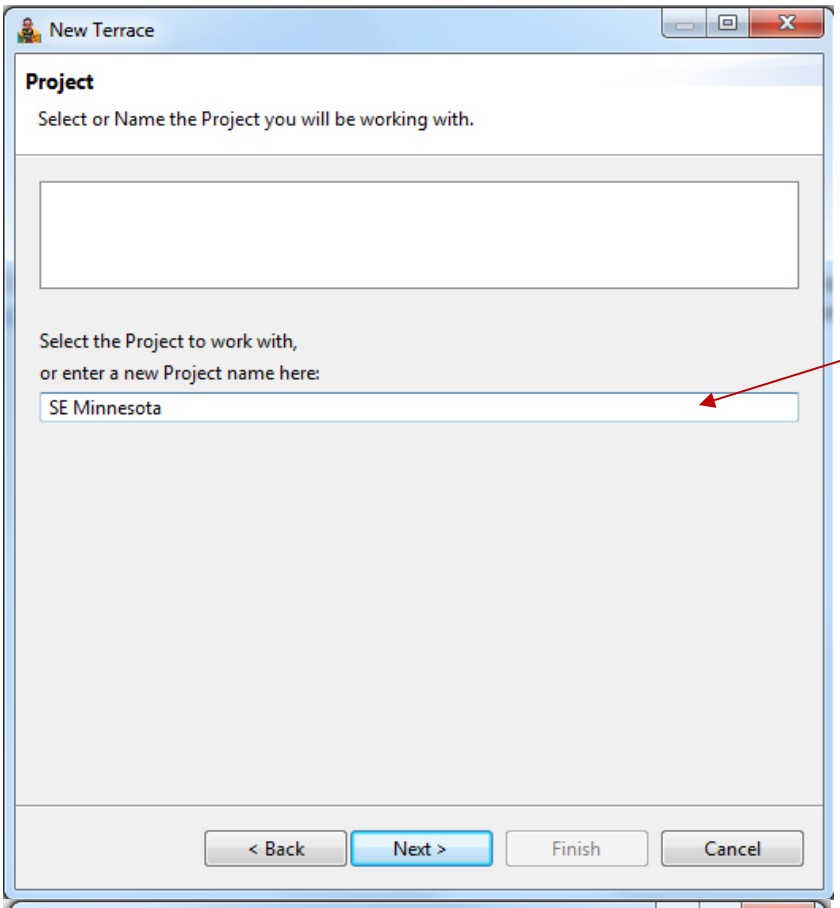


Under the File menu Select “New Terrace Design”

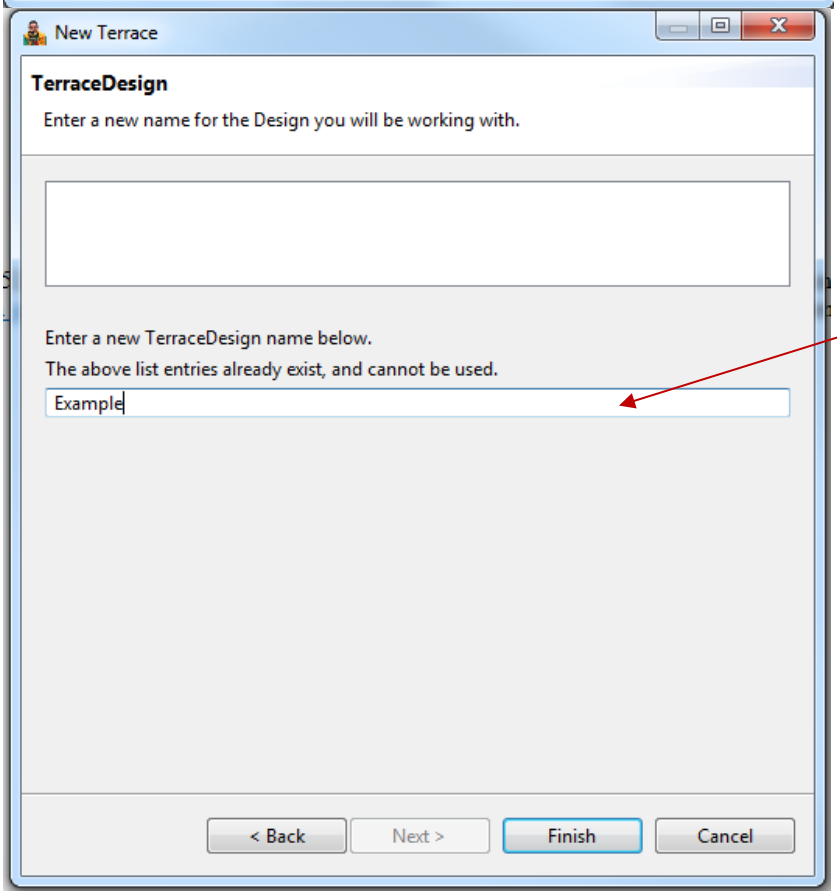


Create a new customer or select an existing customer

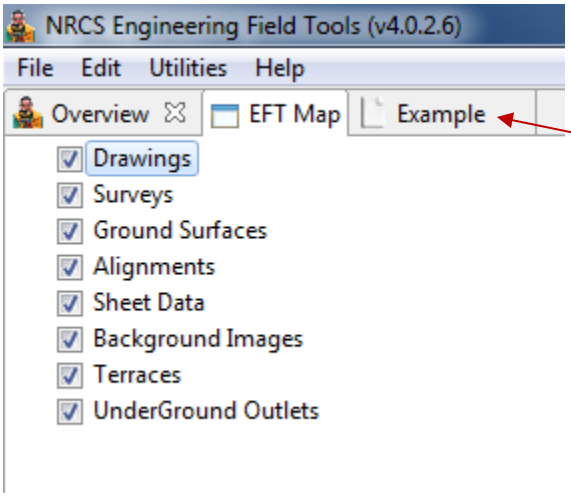
(Landowner)



Select a project from the list to work with if you have an existing customer or create a new project. Ex: Location (Township/Section)



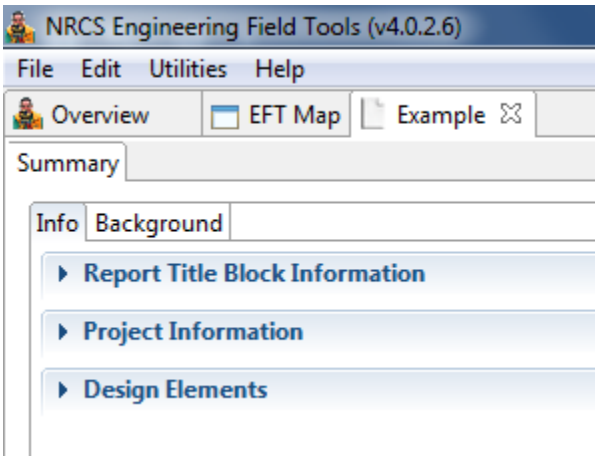
Enter the name of the design.
(Type: Basin/Waterway)



You will now have three tabs located near the top of the page.

Overview
EFT Map
Example (Project Name)

Highlight the project name to begin the design.



The project tab will have a Summary tab that includes an Info tab and Background Tab. (Expand both of these tabs to see the input information)

Info

Report Title Block Information – Project name, designed, drawn, checked, approved, applicable dates, location of project

Project Information – Description of the project, benchmark description and elevation

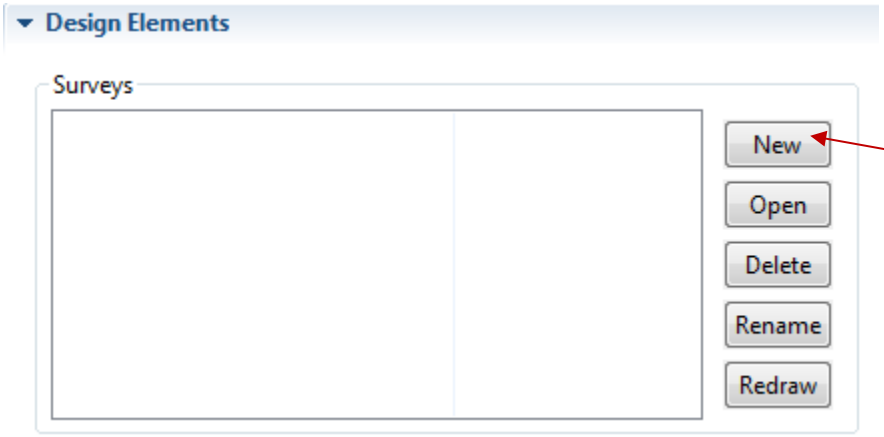
Design Elements – *The majority of the work will be done here.*
Surveys, Alignments, Terrace, UGO, Forms

Background

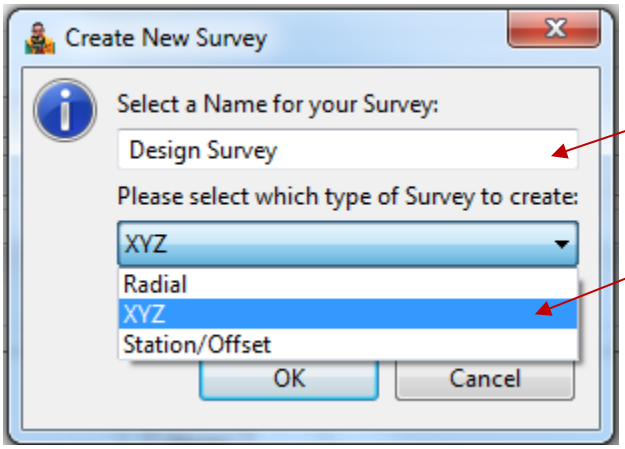
Landowner Preferences – Equipment width, Crops, Tillage, type of structure, type of oultet

Site Characteristics – Soils, Soil loss, Landscape Characteristics, Assumptions

Importing a Survey



Under the Survey Window select New.

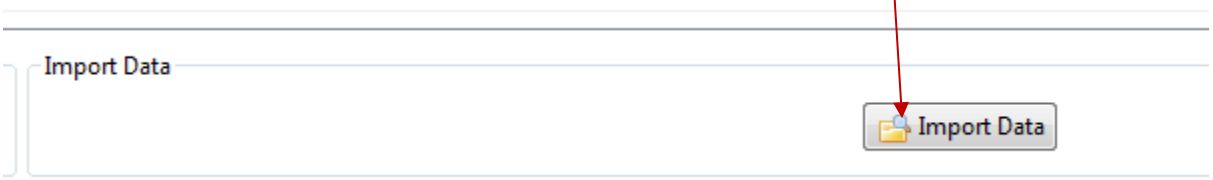


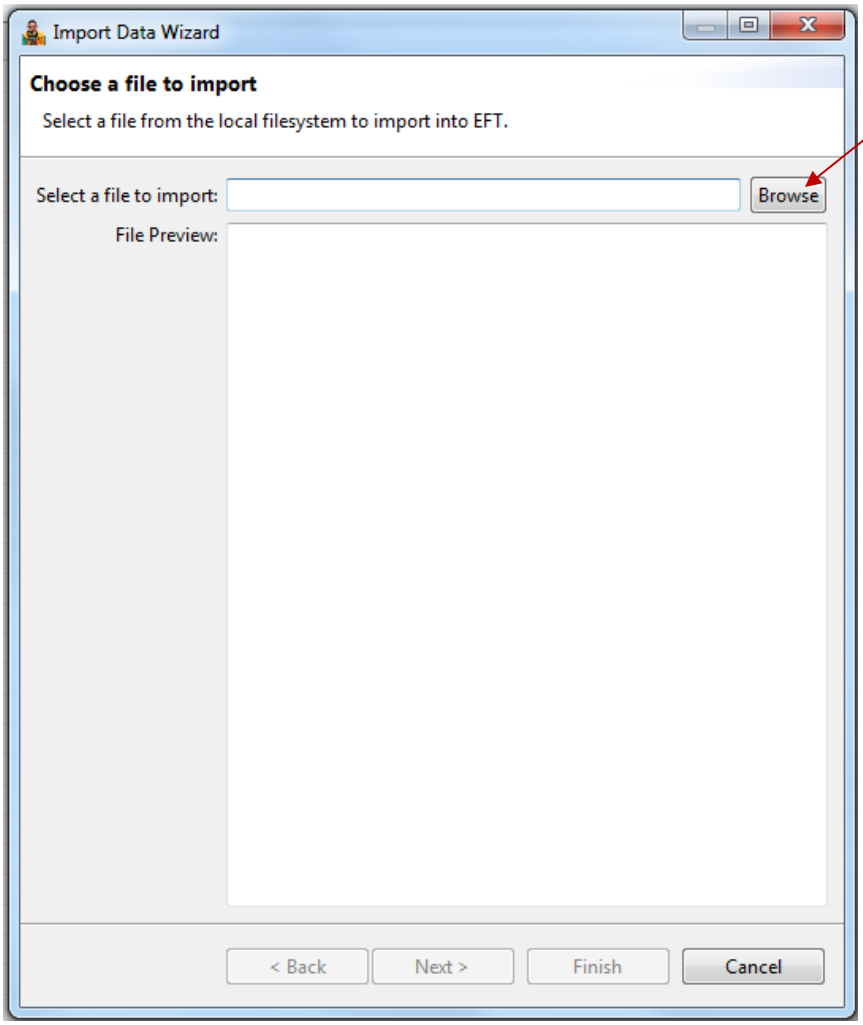
-Name the survey that you would like to import.

-Make sure that the XYZ option is selected to import **electronic survey points**

-Click OK

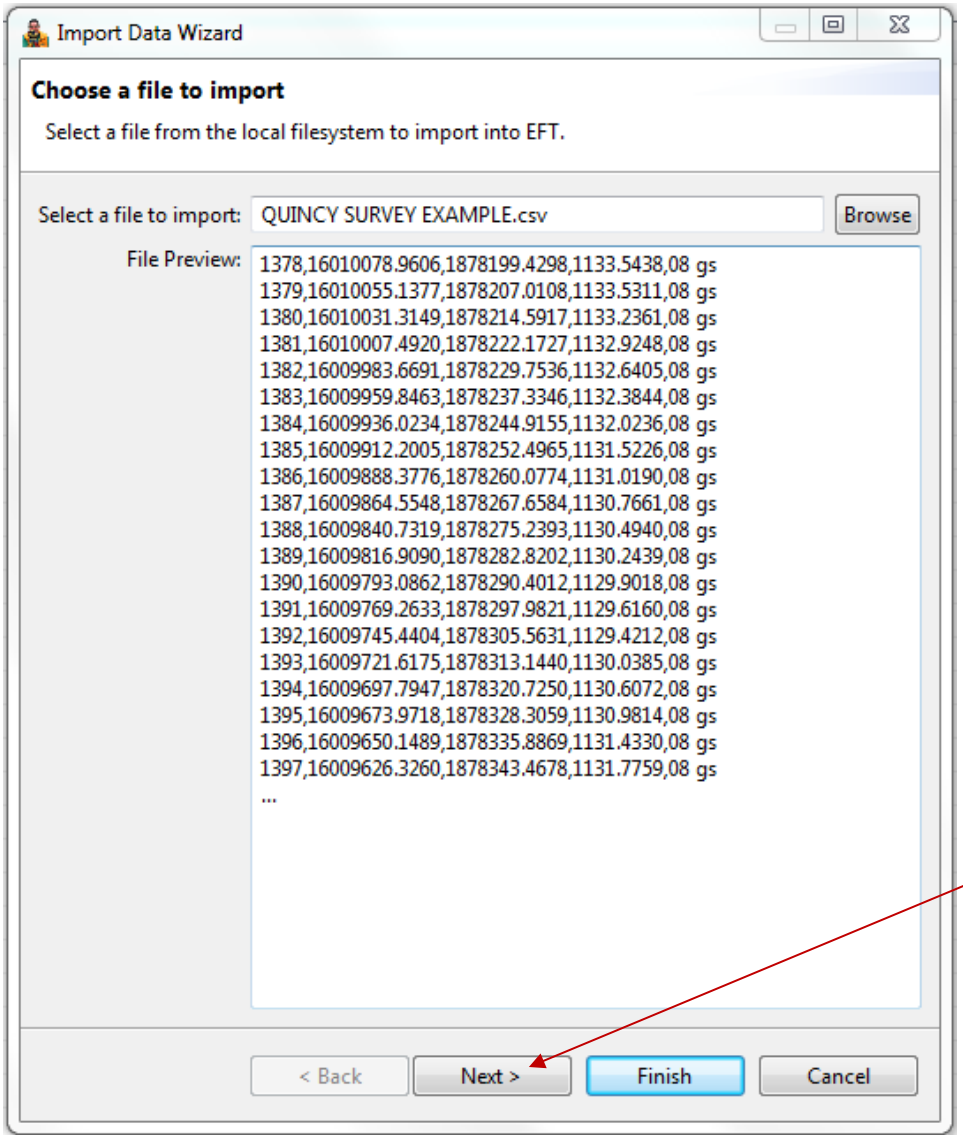
Select “Import Data”





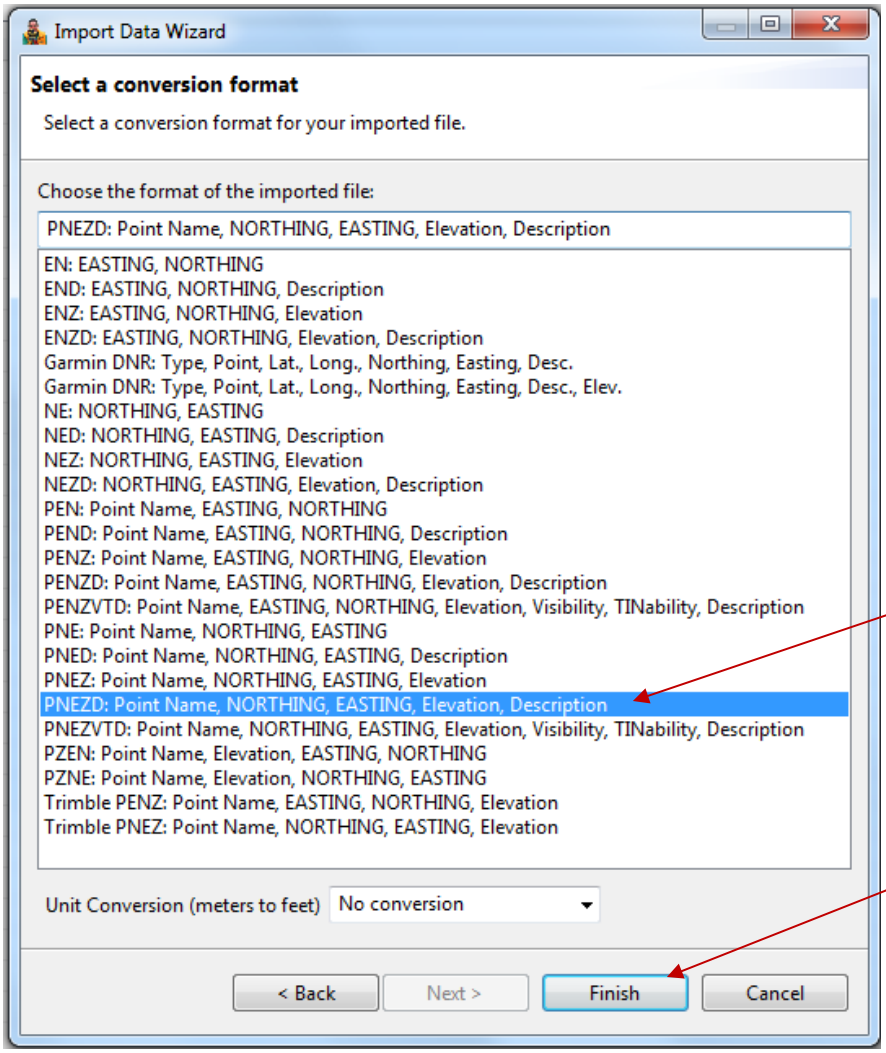
Click Browse to locate .csv file from desired folder.

(make sure that the file type is set to .csv)



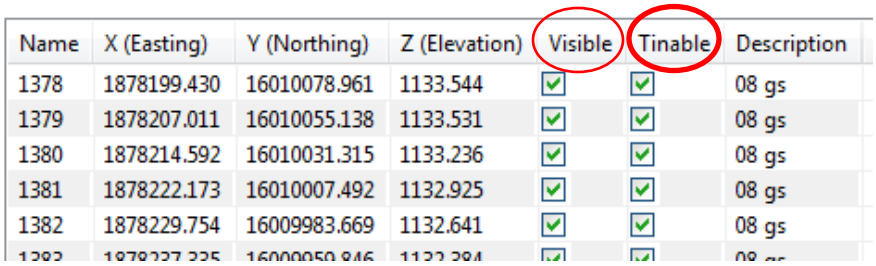
The file preview will show an example of the points that you are importing. This is *just an example* and not the full list of points

-Click Next



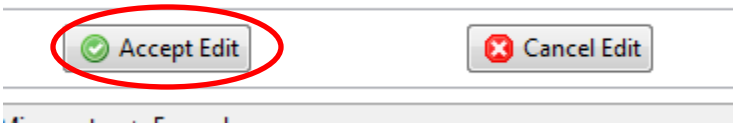
Select a conversion format. You should be selecting "**PNEZD**" as this is the standard format used with most of the electronic survey equipment.
(this can be preset in the preferences)
-***No conversion

-Click "Finish"

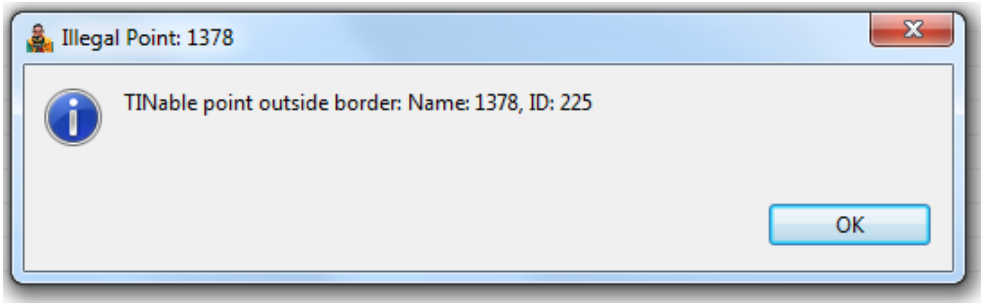


Name	X (Easting)	Y (Northing)	Z (Elevation)	Visible	Tinable	Description
1378	1878199.430	16010078.961	1133.544	☑	☑	08 gs
1379	1878207.011	16010055.138	1133.531	☑	☑	08 gs
1380	1878214.592	16010031.315	1133.236	☑	☑	08 gs
1381	1878222.173	16010007.492	1132.925	☑	☑	08 gs
1382	1878229.754	16009983.669	1132.641	☑	☑	08 gs

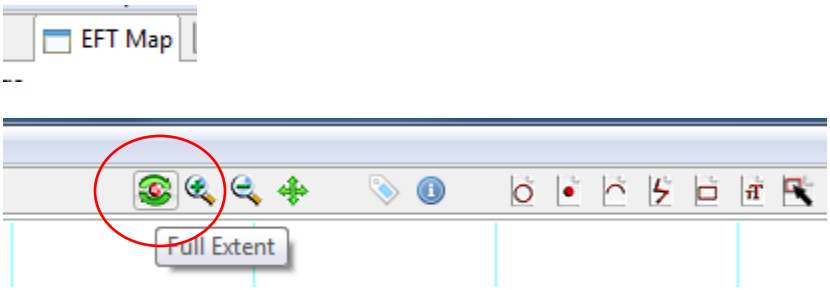
Points will be added to the list in the survey. There are options to make each point visible and tinable. All points that would be included in a surface should be tinable. Benchmarks and survey points on pipes, walls or other structures that do not represent the landscape should **not be** tinable.



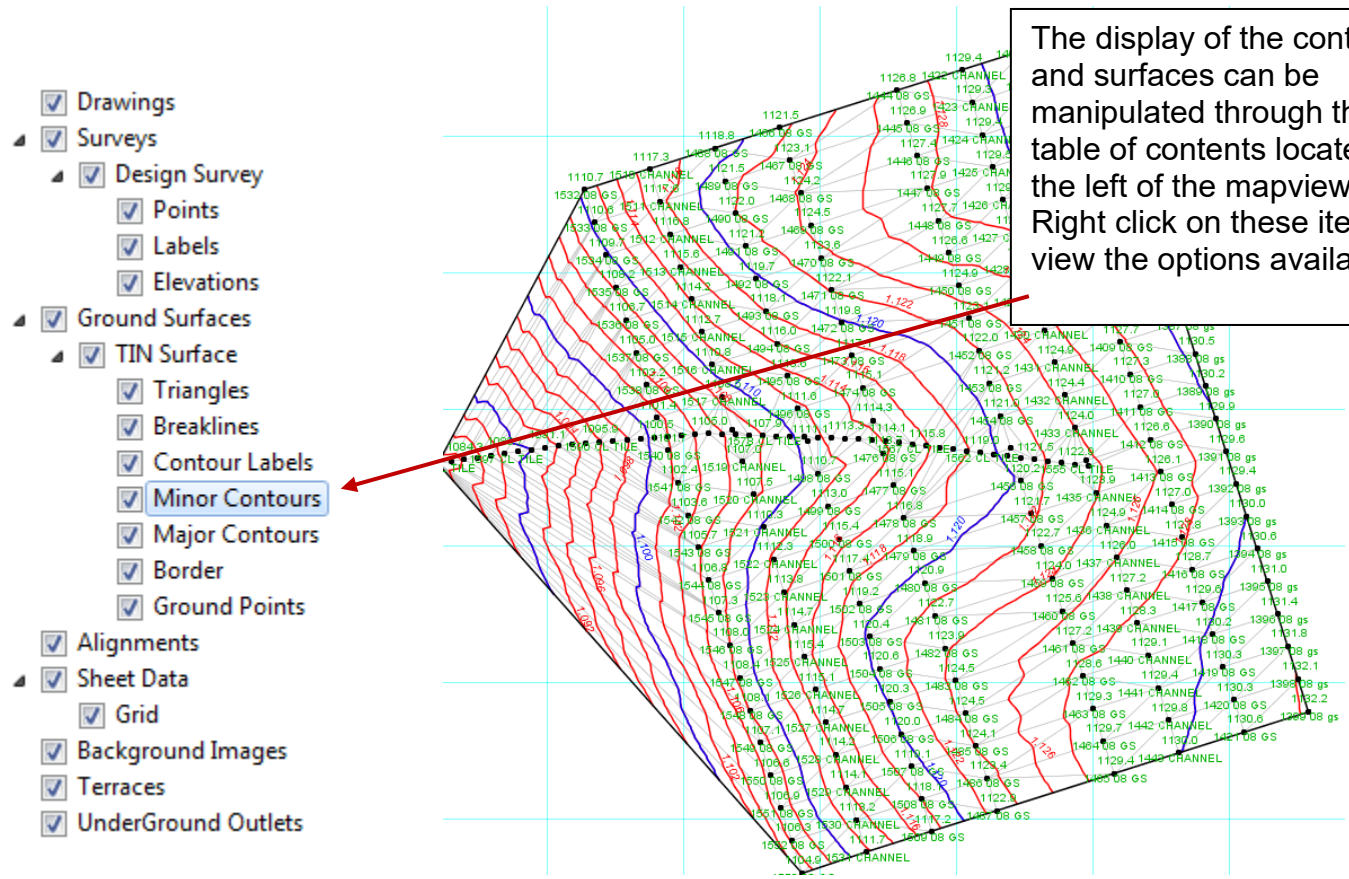
Select Accept Edit to confirm and close this window.



You may see this warning box indicating that certain points are outside the border. Click **OK** and go back into the survey and find the name of the point (1378) and uncheck the Tinable box for that point. At times there has been more than one point to be modified.



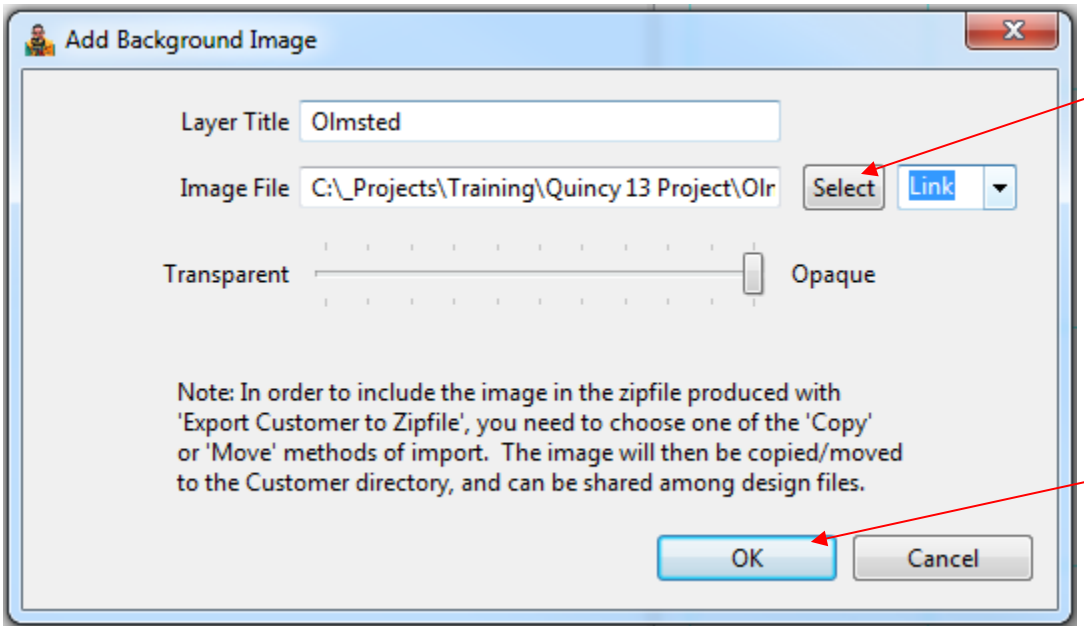
Go to the EFT Map tab. This is where your survey should show up. You will have to click the full extent button to zoom to the surveyed area.



The display of the contours and surfaces can be manipulated through the table of contents located to the left of the mapview. Right click on these items to view the options available.

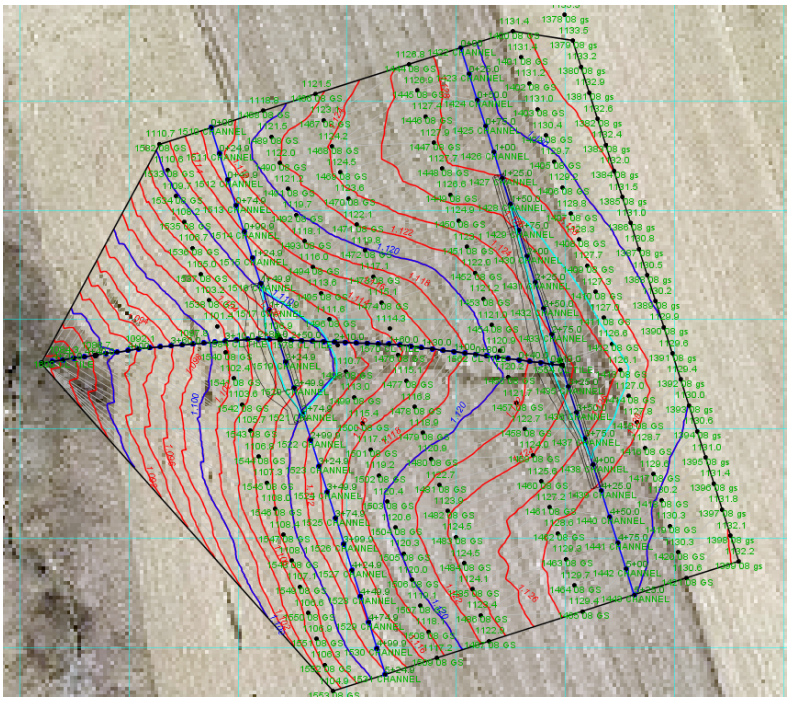
Adding an image to the map

Right Click on Background Images.



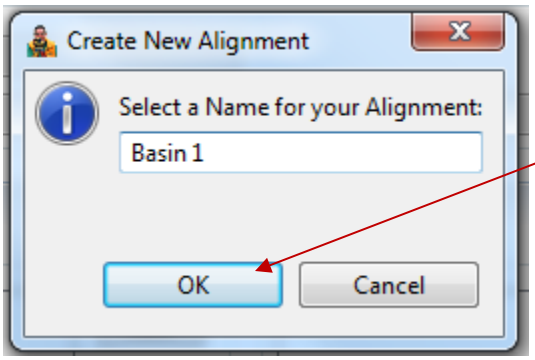
Browse to image file. May need to change file type to view needed file.

Select OK

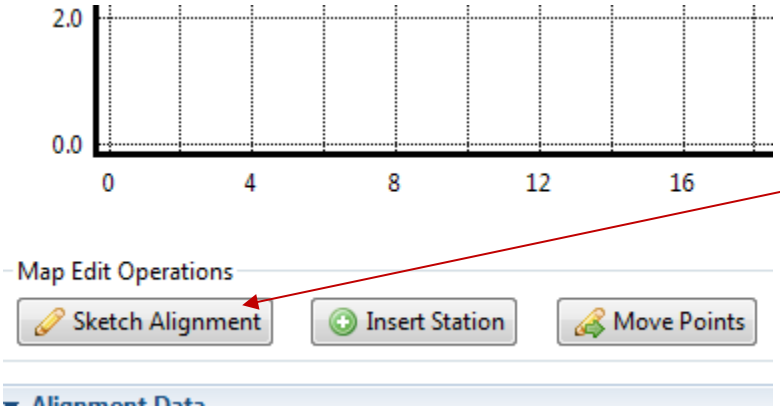


After the survey has been imported Alignments will need to be created. These are the channel alignments for the basins and tile.

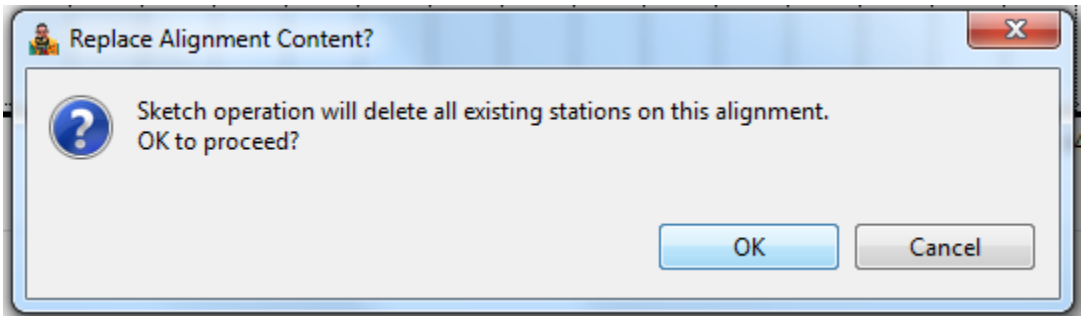
-Select New

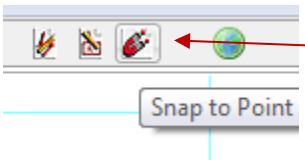


Name the alignment and click **OK**.

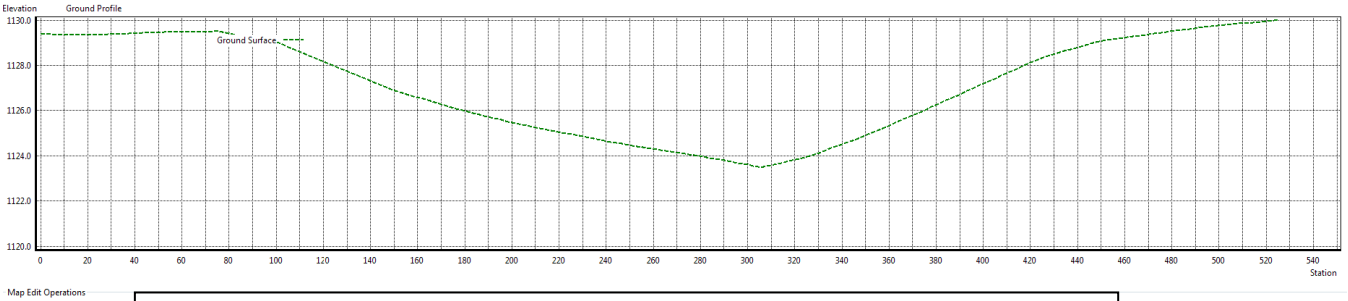


Click **Sketch Alignment**
-a window appears reminding the user that this operation will overwrite any existing alignment that has been created. Click **OK**



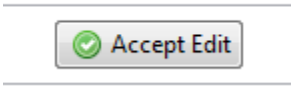


Selecting “Snap to Point” will allow you to create an alignment exactly where you surveyed the channel.



A profile of the existing ground surface will be generated from the alignment that is drawn by "snapping" to the channel's surveyed points.

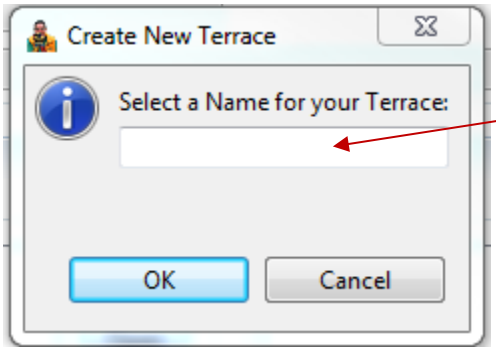
***If there are corners in the alignment, it is suggested to click Apply Curves for the alignment. This aids in the drawing of the embankment surface.**



Select "Accept Edit" when completed.

Design a WASCOB

Select "New" to create a new terrace design.

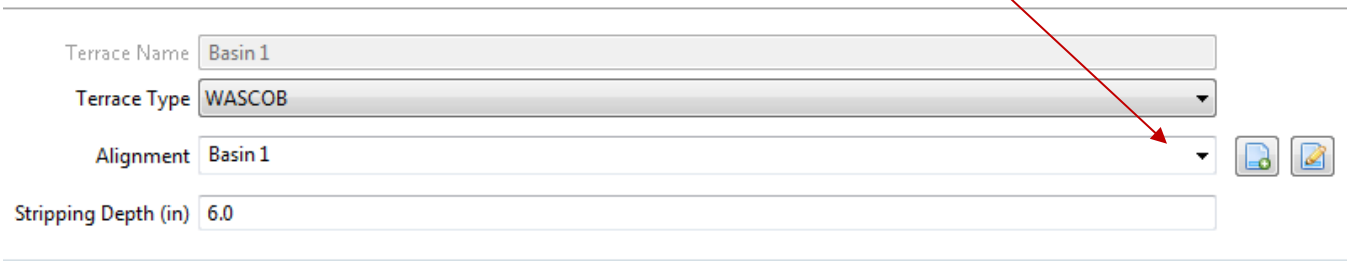


Name the new terrace/basin and select "OK". (Eg. Basin 1)

Info tab

The design will open with multiple tabs.

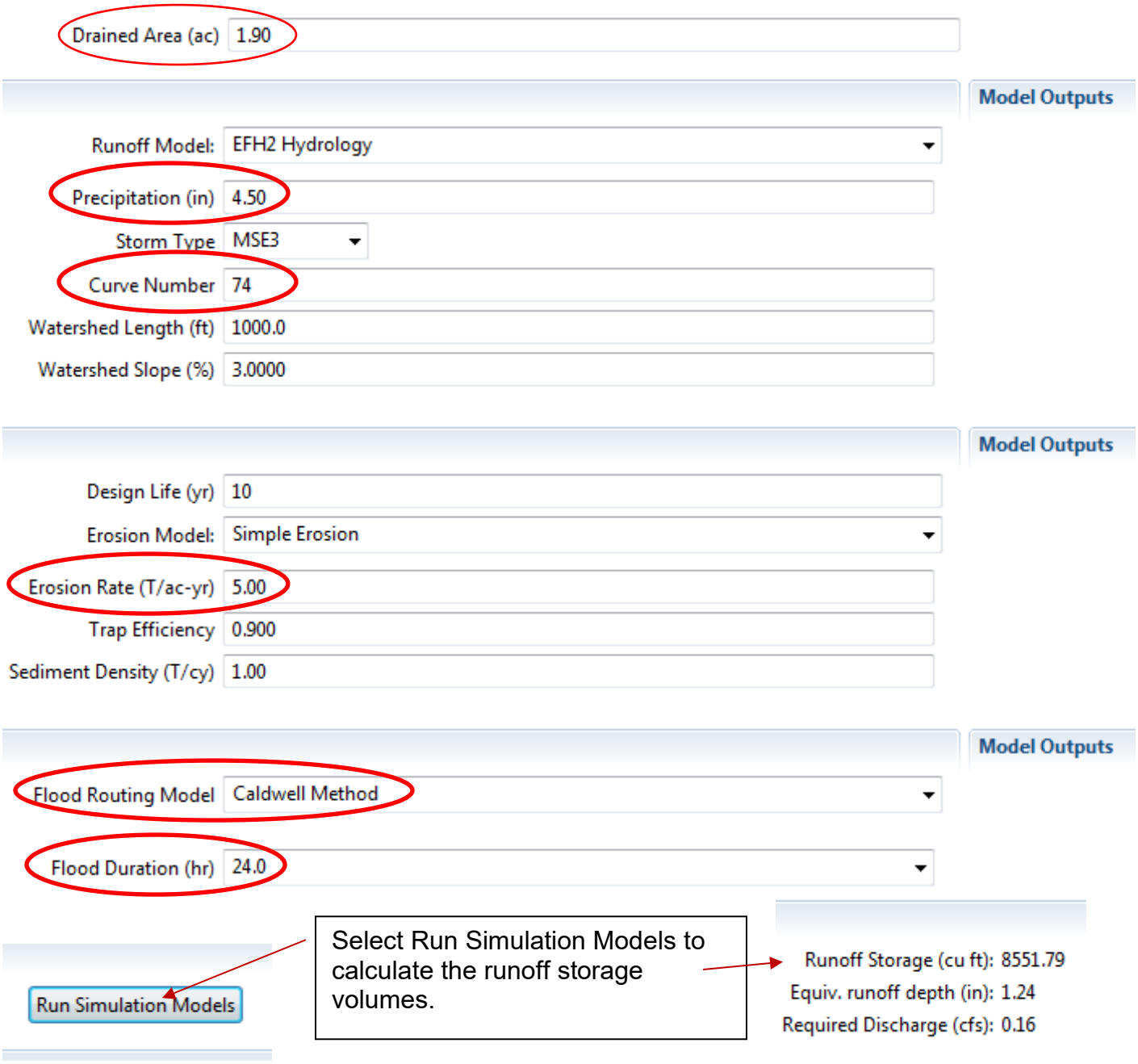
The Info tab requires us to chose an alignment from the menu.



Select “Set Terrace Benchmark” to be able to fill out an Elevation and Description of the location.

Hydrology tab

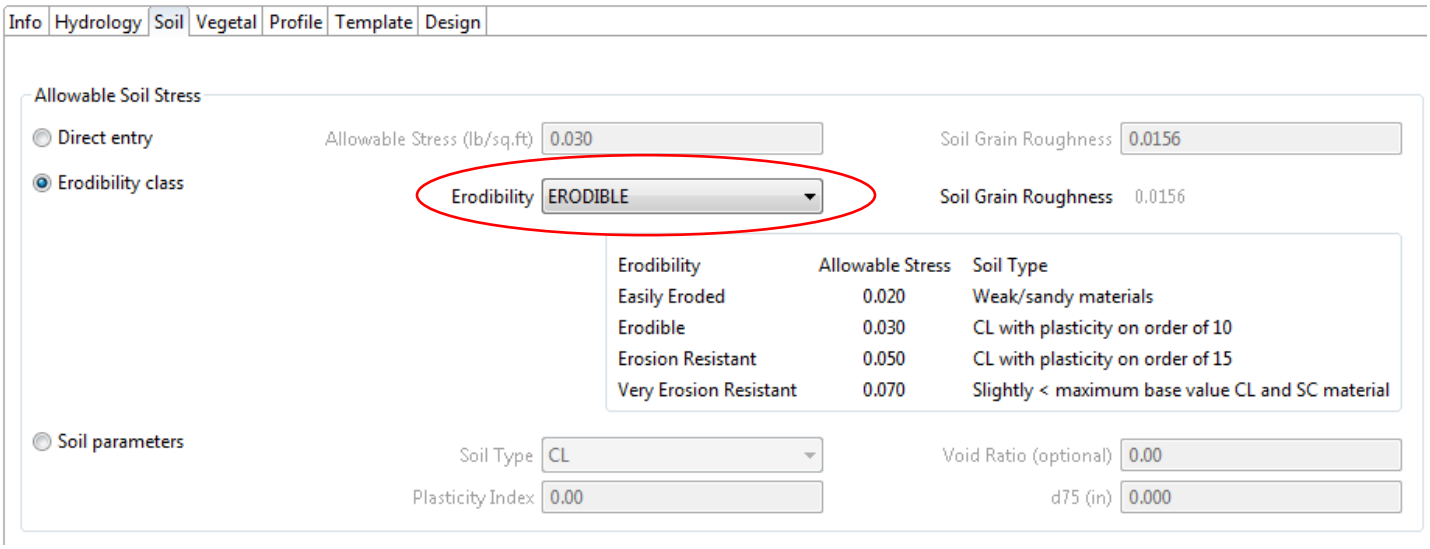
This is self explanitory but make sure the Drainage Area is filled out in acres, the Precipication in inches and a Curve Number is defined. The watershed length and slope can be documented but are not needed for determinining the runoff volume (these affect channel velocities in PS 600 Terrace design). Ensure that the correct sedimentation rate is chosen. Lastely make sure that the Caldwell Method is the Flood Routing Model selected and start the first design with a Flood Duration of 24 hours (recommended). **The flood duration can be adjusted by the hour if the MN Preferences were set prior to beginning the project.



Soils Tab

The erodibility class has to be chosen based on the soil type classification from the soil survey. This is intended to determine the tractive stress properties of the soils in the channel. Below is a decision tree for deciding which erodibility class one should use for their respective soils which is derived from the MN Engineering Field Handbook Part 650 Chapter 7 (MN 7-13.8)

https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_021665.pdf

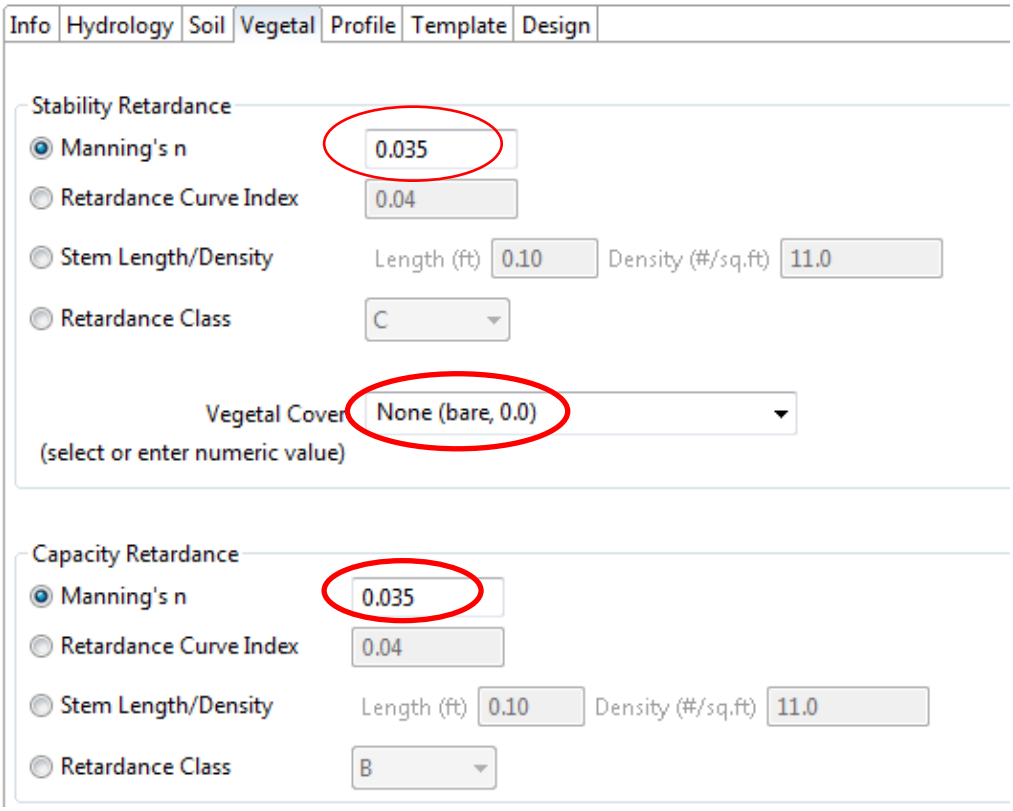


Decision Tree

If the soil textural class is	And the reference PI is	the erodibility class is
CL	Any value	Erosion resistant (ER)
CH	Any value	Very erosion resistant (VER)
CL-ML	PI < = 16	Erodible (E)
CL-ML	PI > 16	Erosion resistant (ER)
ML	PI < 5	Easily erodible (EE)
ML	5 <= PI < 19	Erodible (E)
ML	PI >= 19	Erosion resistant (ER)
MH (elastic silts)	PI <= 15	Erodible (E)
MH (elastic silts)	PI > 15	Erosion resistant (ER)
SC, SC-SM, SM	PI < 5	Easily Erodible (EE)
SC, SC-SM, SM	PI > =5	Erodible (E)
SP, SP-SM, PT, organics	Any value (typically PI < 5)	Easily erodible (EE)

Vegetal Tab

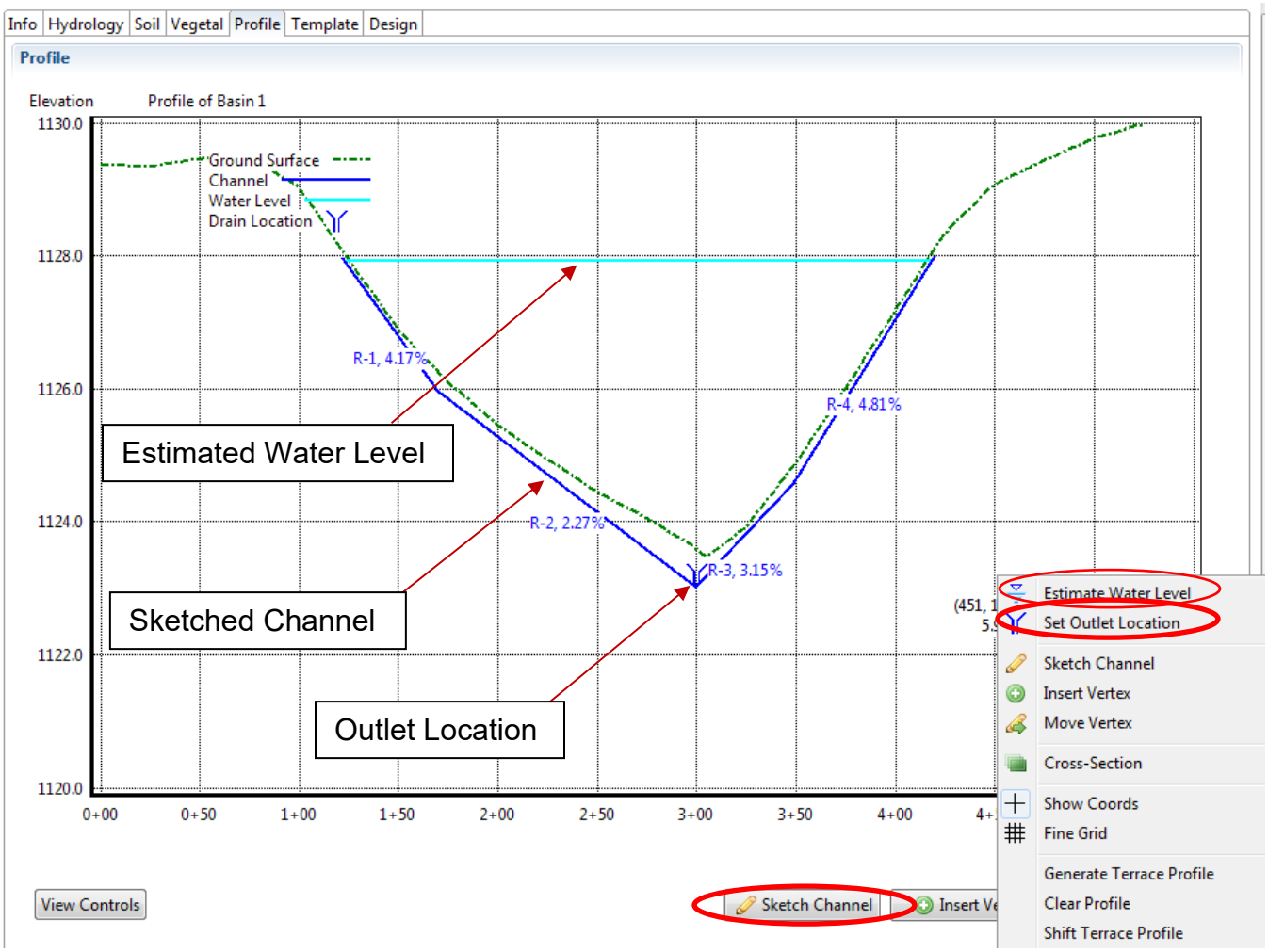
This tab defines the vetation that is to be used in the channel of the basin/terrace. In most cases there is not any vegation in the channel. For this reason the Mannings n values for both Stability and Capacity should be set to 0.035, the value for bare earth. The vegetal cover should be set to None (bare, 0.0) indicating there is no vegetation.



Profile Tab

This tab is where the planned channel grades will be determined. Follow the steps below to draft a final gradeline for the basin channel. Tip: When hovering on the profile view the station and elevation can be displayed by turning this option on from the **View Controls** button.

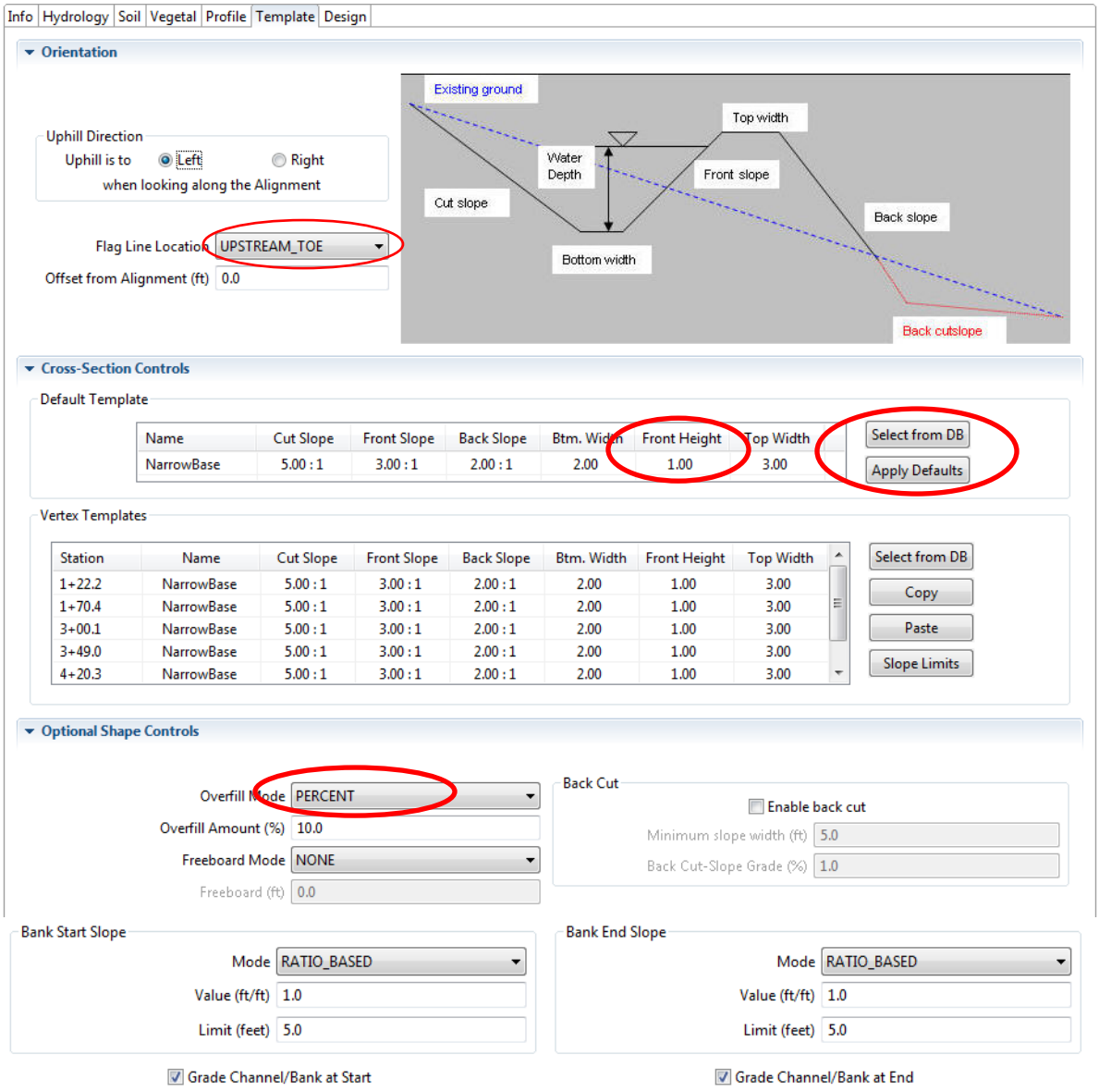
1. Select **Sketch Channel** to begin drawing final channel.
    a. Pick an elevation along the ground line above what you estimate the height needed. ***Make sure the planned channel is slightly below the orginal ground.
2. Right click on the profile view and select **Set Outlet Location**. Then click on the profile at the location where you would like to place the intake (station and elevation). A window will appear where you can define the Drain, Drain Fraction, Offset and connect it to an underground outlet. ***You will not have an underground outlet to connect to as it has not been defined yet.
3. Right click on the profile view and select **Estimate Water Level**. Then click on the profile at the elevation which you would estimate the maximum water level for this structure. This aids in the initial design run of the structure.



Template Tab

This tab will define the cross section of the planned basin dimensions. Follow these steps to accuarately define the desired dimensions for your project.

1. Orientation: Choose the direction of the cross-section. When looking along the chanel alignment in a direction of increasing stations what direction is uphill from the flagline location. The **UPSTREAM_TOE** should be selected.
2. Cross-Section Controls: These options control the shape. **Select from DB** to choose narrow base, grassed-backed, or broadbase. The dimensions of each can be modified by double clicking on an item in the **Default Template**. Make sure you **Apply Defaults** if changes are made. **The **Front Height** refers to the minimum height to be built. This will have an effect on the ends of the basin.
3. Optional Shape Controls: These control the overfill amounts and reactions of the berm at the ends of the structures.



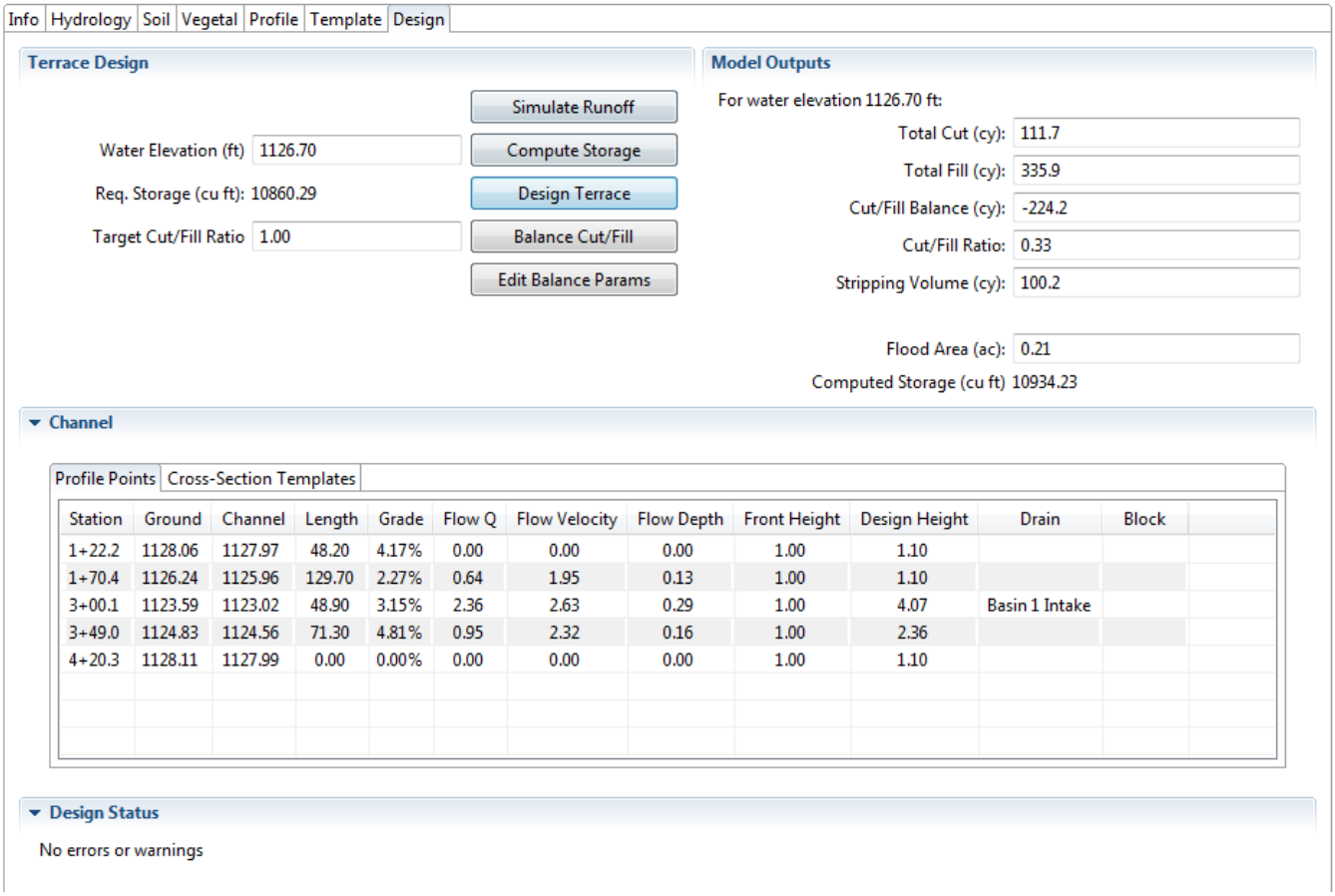
Design Tab

This tab will run the design parameters against the hydrology requirements to develop a required height. Follow the steps below to complete the design.

1. **Simulate Runoff** to ensure you have an up to date storage volume requirement.
2. **Compute Storage** at the estimated water level. This may give you a warning on fill height as it is running the design at whatever you picked.
3. **Design Terrace** to run the design and calculate the actual height and elevation of the top of the berm.

The model outputs section displays the required elevation as well as quantities of earthfill/excavation. Also included are the Flooded Area acres and Computed Storage volume in cubic feet.

The channel section displays the channel profile and cross-section templates. You may need to make some modifications, in both the profile and cross-section tabs like channel elevations and topwidths.

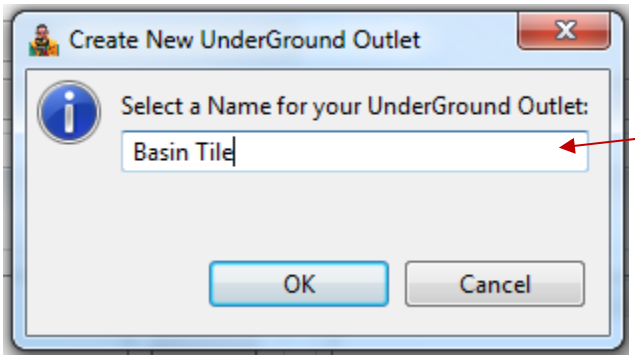


***This completes the design for Basin 1. Select **Accept Edit** to close the window and return to the Summary page. Use the previous pages to design additional basins. Once completed an Underground Outlet Design will be built.

Design of Tile Outlet

Select New in the Underground Outlets box.

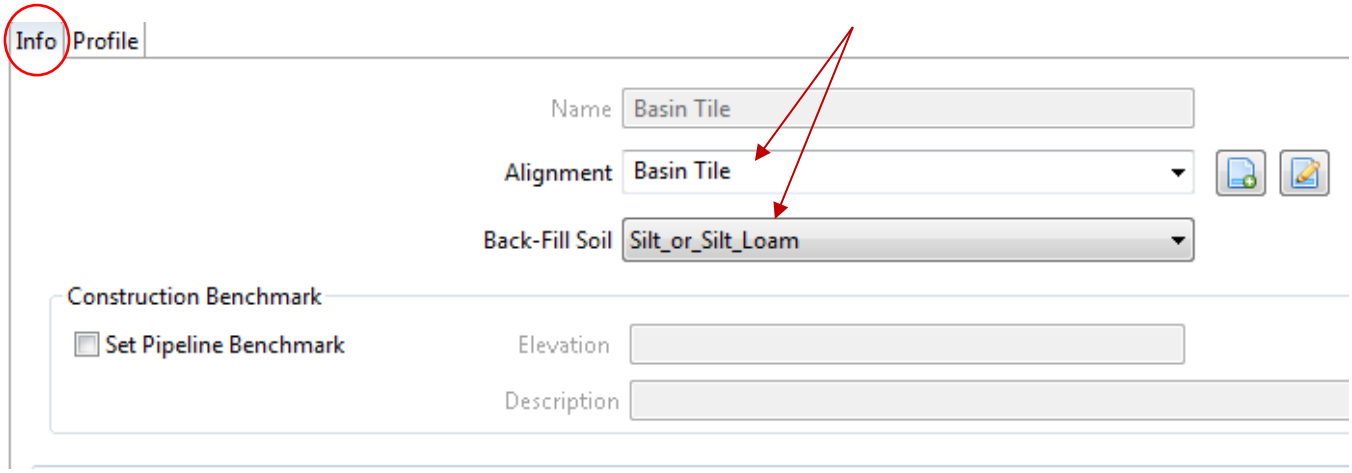
*The alignment for this needs to be already drawn.



Name the tile line and select **OK.**

Ensure that the alignment for the tile is selected. Also make sure the soil type along the tile route is correct to check allowable velocities

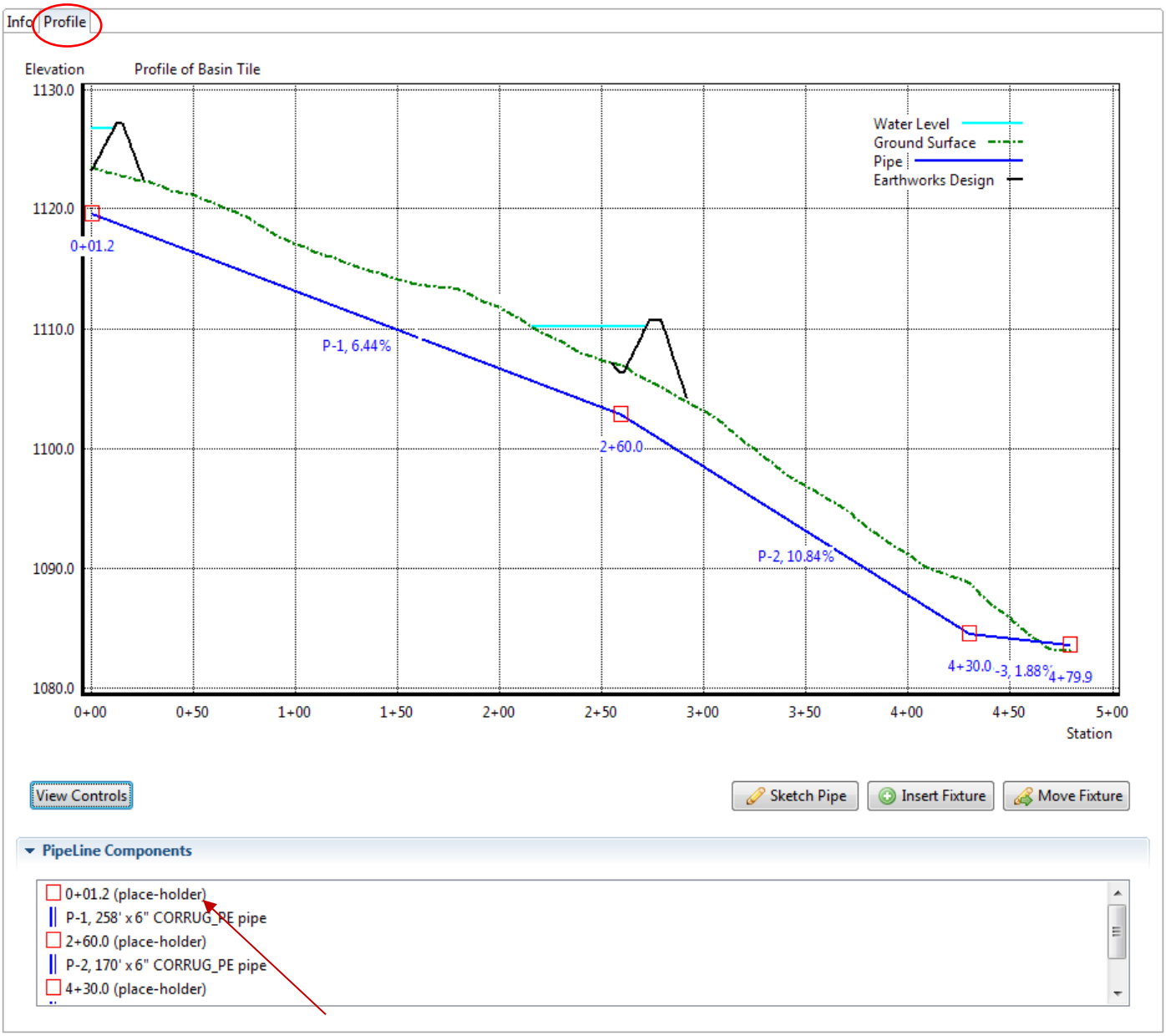
Info Tab

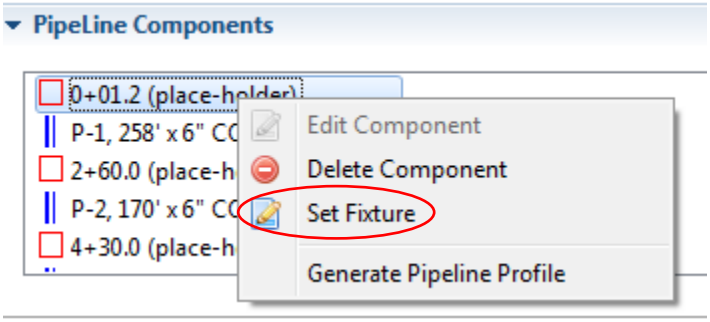


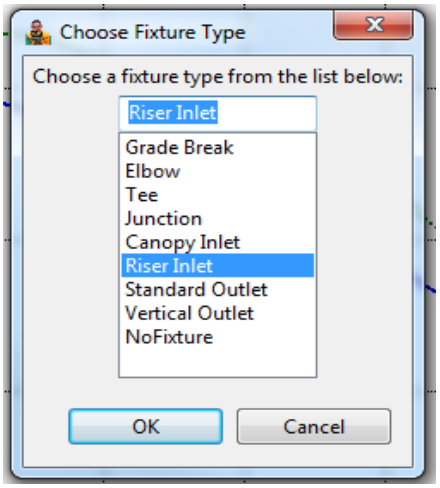
Profile Tab

This is where you will draw the profile, insert grade breaks and inlets. Use the steps below to design the underground outlet for the basins. (Graphics on next pages)

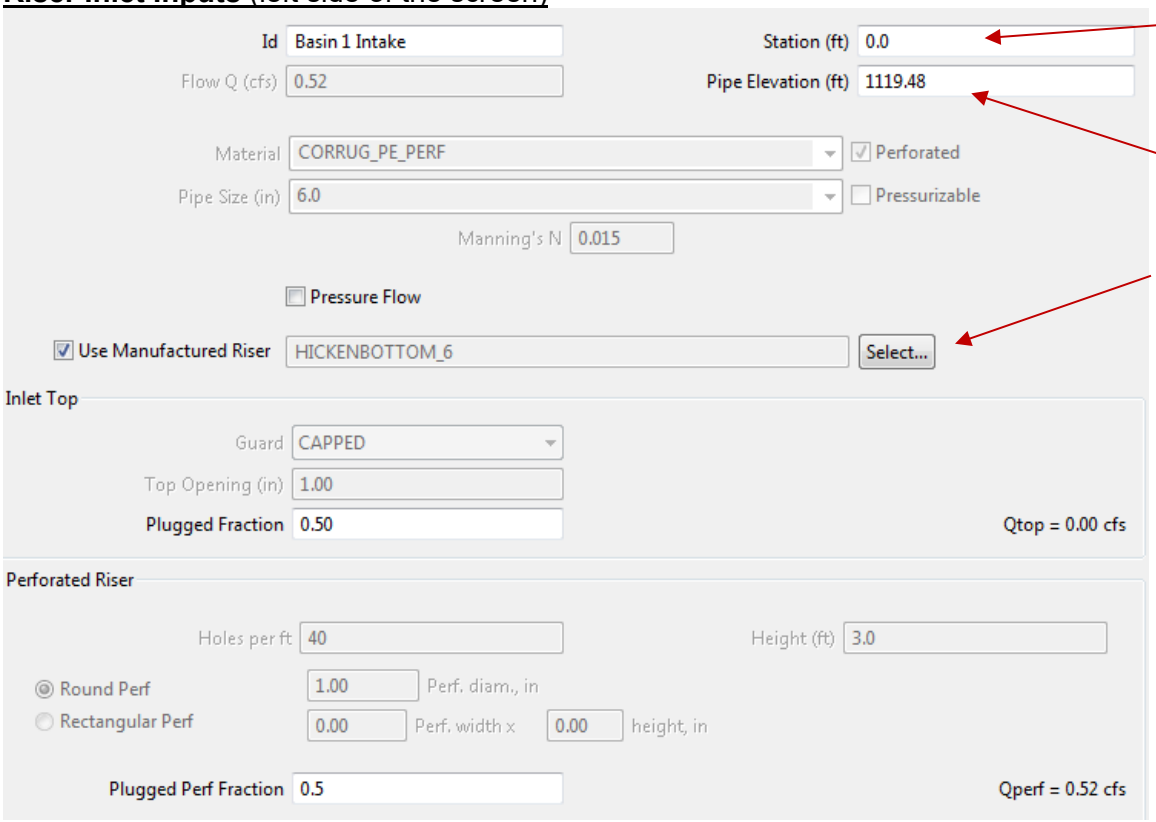
1. Select Sketch Pipe to begin drawing the profile. I start with the left side. Some assumptions can be made to the starting station and elevation but if the Cursor Coordinates are on (View Controls) you will see this information. You will see the table populate below showing the grade breaks and associated slopes. A predetermine pipe size has been assumed from previous settings.


Info
Profile
Elevation
Profile of Basin Tile
1130.0
1120.0
1110.0
1100.0
1090.0
1080.0
Water Level
Ground Surface
Pipe
Earthworks Design
0+01.2
P-1, 6.44%
2+60.0
P-2, 10.84%
4+30.0
-3, 1.88%
4+79.9
0+00
0+50
1+00
1+50
2+00
2+50
3+00
3+50
4+00
4+50
5+00
Station
View Controls
Sketch Pipe
Insert Fixture
Move Fixture
PipeLine Components
0+01.2 (place-holder)
P-1, 258' x 6" CORRUG_PE pipe
2+60.0 (place-holder)
P-2, 170' x 6" CORRUG_PE pipe
4+30.0 (place-holder)





Riser Inlet Inputs (left side of the screen)

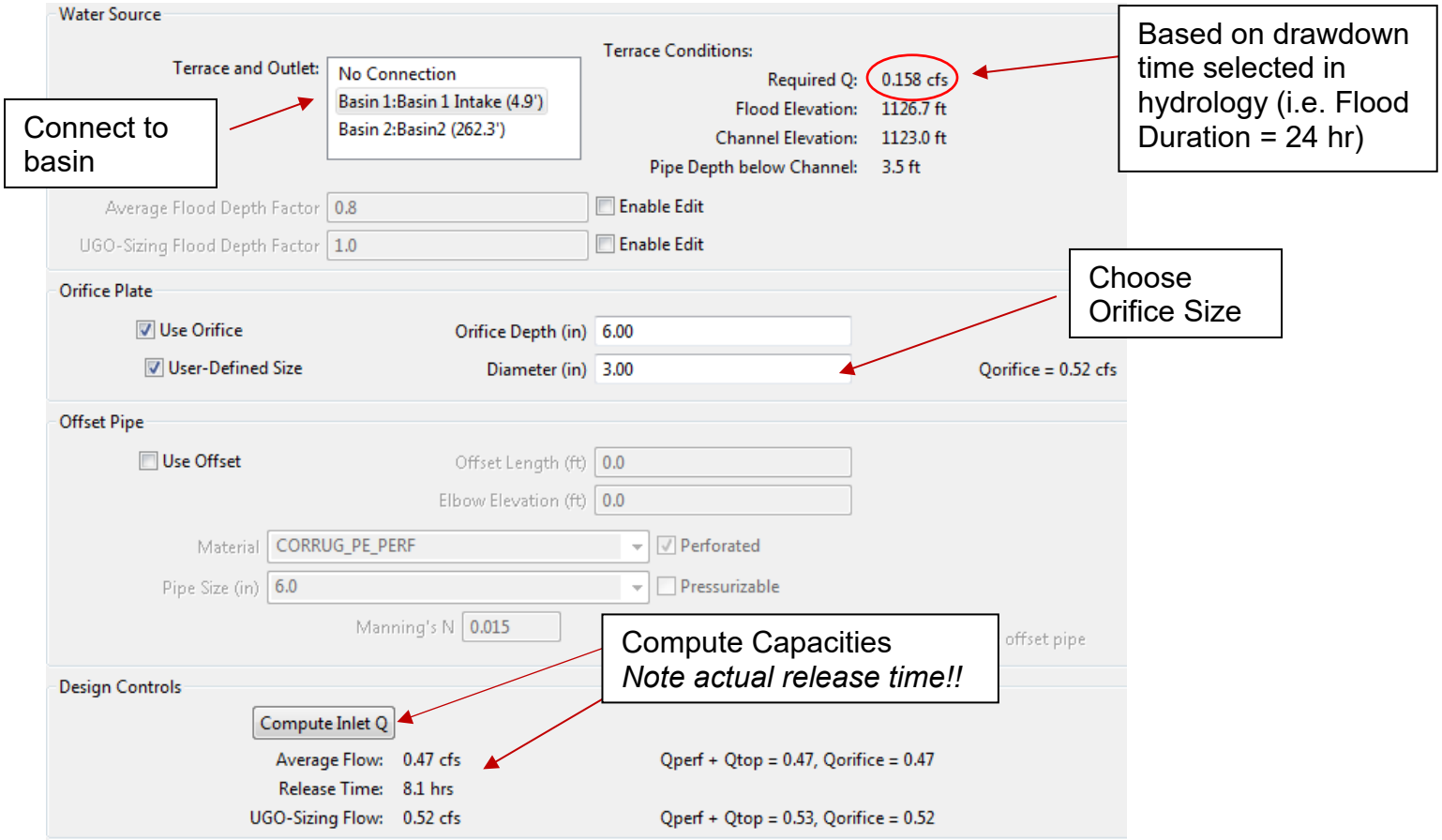


Intake Stations

Tile elev

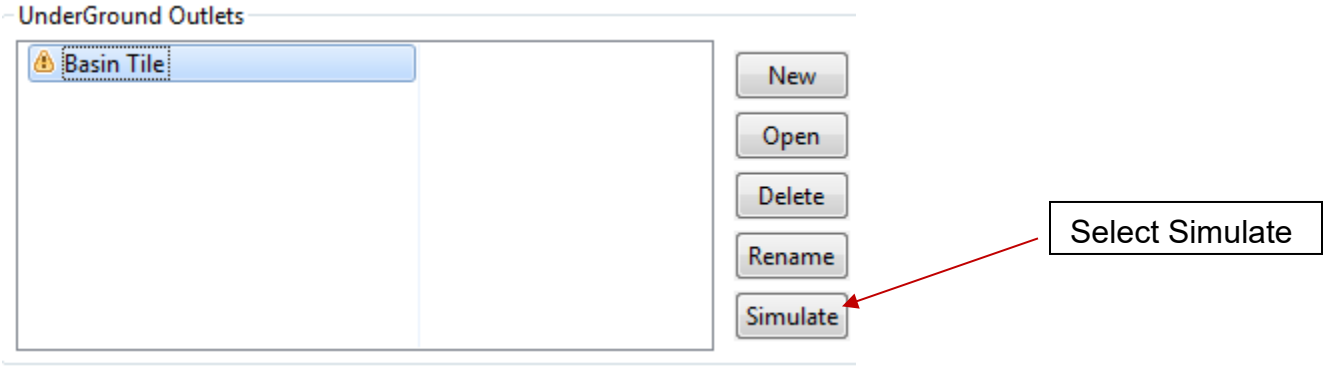
Select Intake

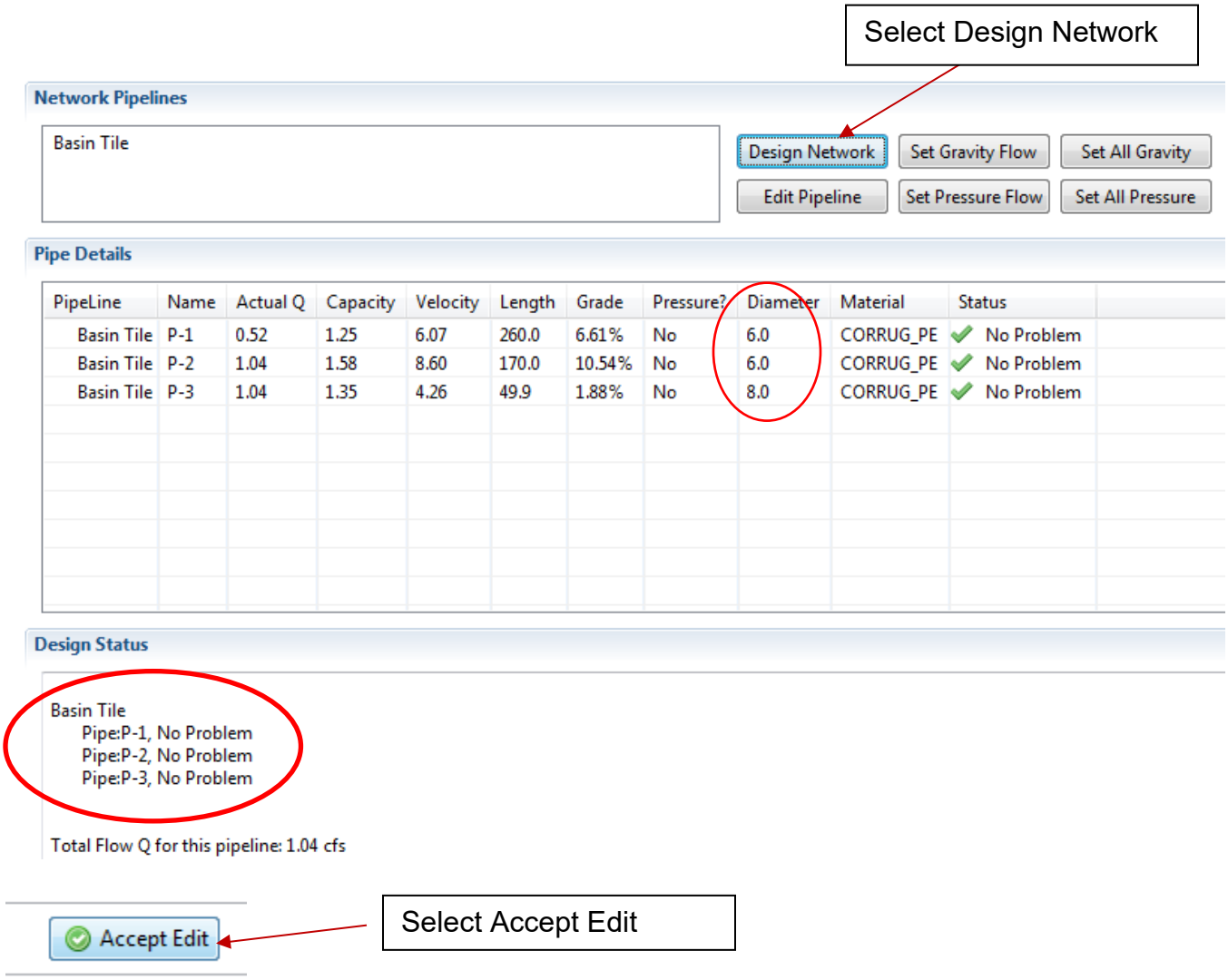
(right side of the screen)



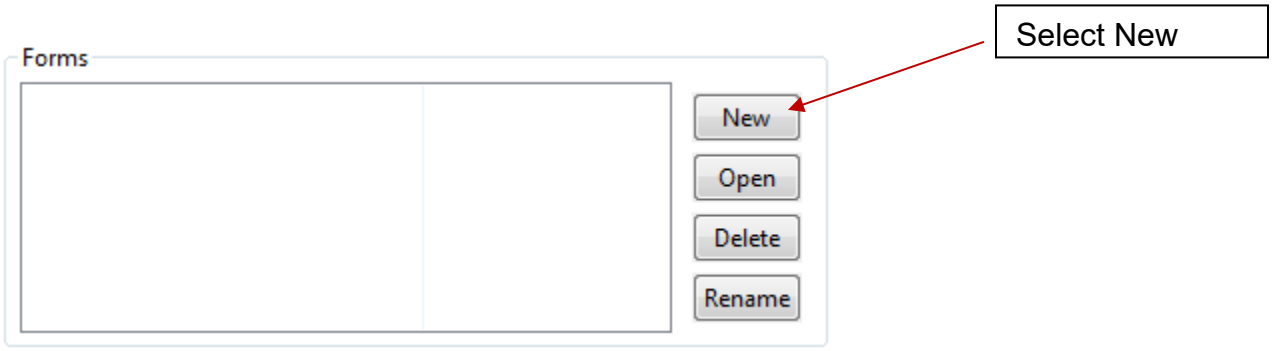
The release time and the basin's flood duration (in Hydrology tab) should be very close. However, a longer flood duration compared to the release time simply means the embankment is over-designed.

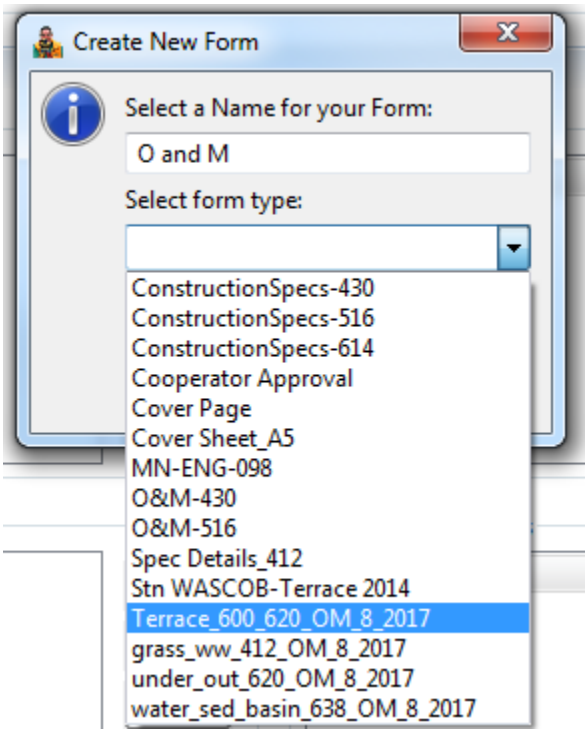
3. The designed underground outlet needs to be Simulated. Click on **Simulate** when the desired tile line design is selected. This simulation will adjust the tile sizes based on voume of water delivered.




Select Design Network
Network Pipelines
Basin Tile
Design Network
Set Gravity Flow
Set All Gravity
Edit Pipeline
Set Pressure Flow
Set All Pressure
Pipe Details
PipeLine Name Actual Q Capacity Velocity Length Grade Pressure? Diameter Material Status
Basin Tile P-1 0.52 1.25 6.07 260.0 6.61% No 6.0 CORRUG_PE No Problem
Basin Tile P-2 1.04 1.58 8.60 170.0 10.54% No 6.0 CORRUG_PE No Problem
Basin Tile P-3 1.04 1.35 4.26 49.9 1.88% No 8.0 CORRUG_PE No Problem
Design Status
Basin Tile
Pipe:P-1, No Problem
Pipe:P-2, No Problem
Pipe:P-3, No Problem
Total Flow Q for this pipeline: 1.04 cfs
Accept Edit
Select Accept Edit

Standard Forms





Standard forms can be incorporated into the design so they will automatically print with the design.

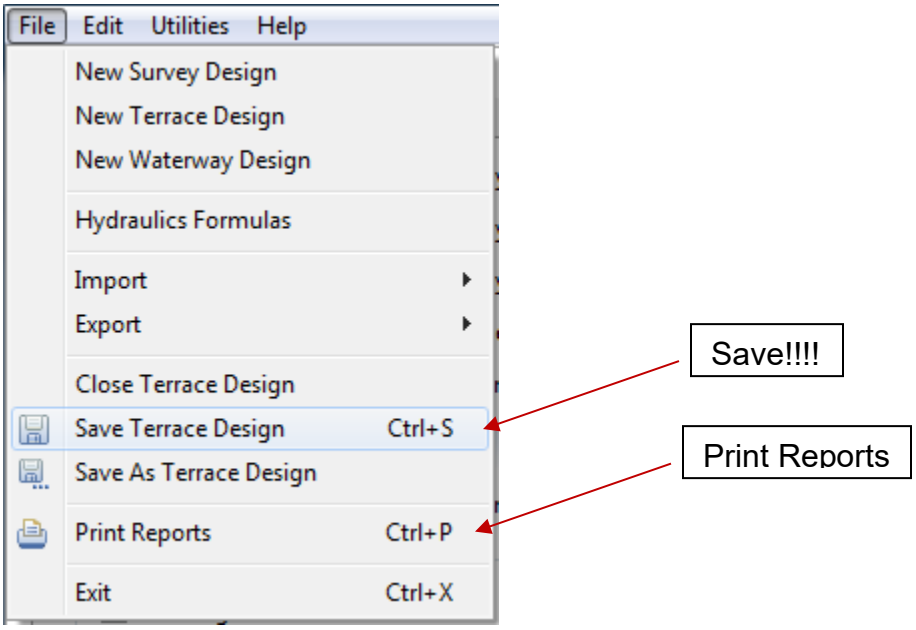
These forms need to be placed in the following location.

C:\Users*your user name*\AppData\Local\EFT\.eft\workspace\formTemplates

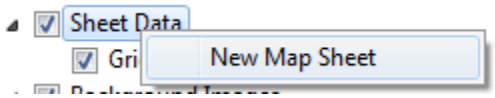
-Seeding Sheets
-GSOC
-O&M
-Specifications

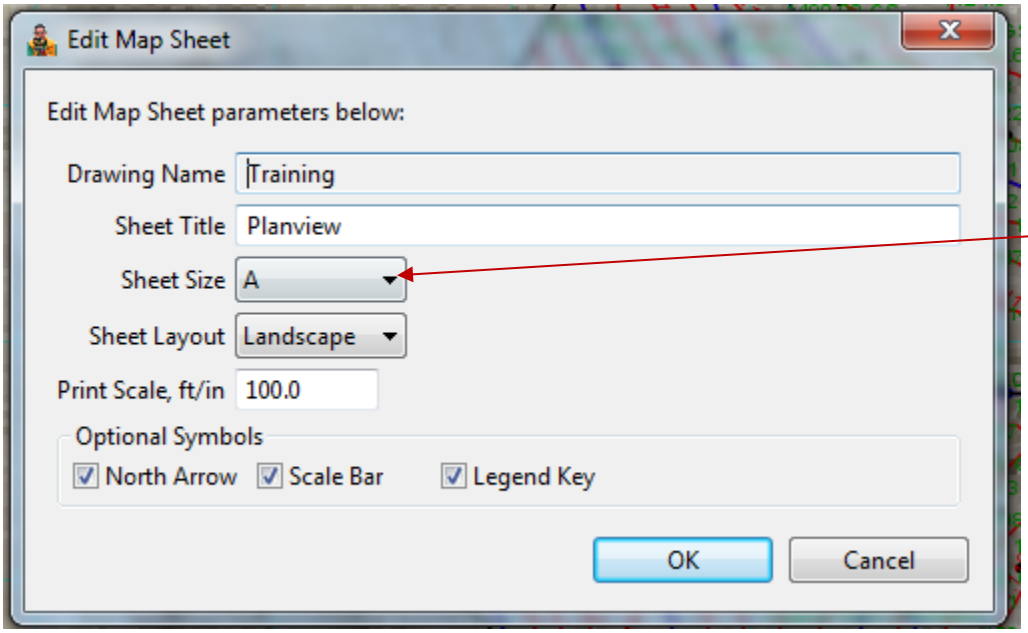
Print Reports

***Make sure you save your design before Printing Reports to ensure it has the most up to date information.



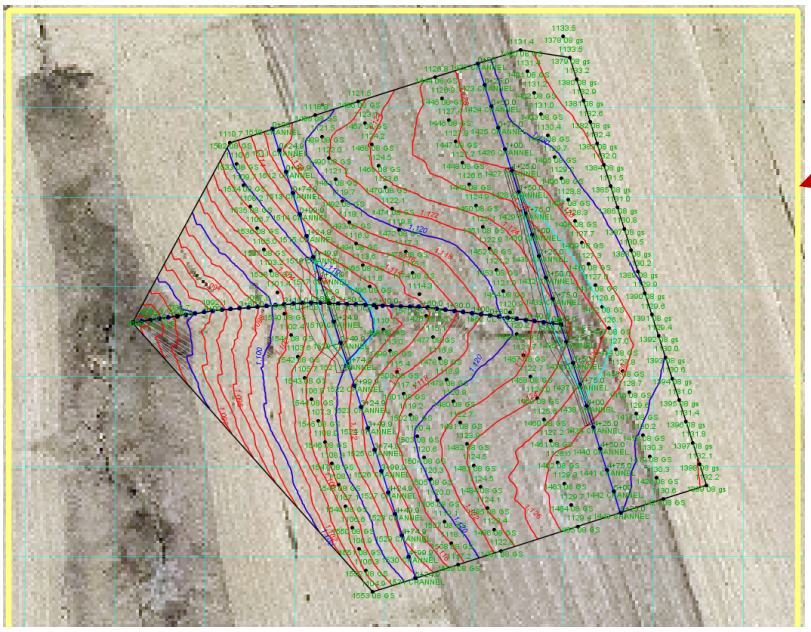
***Before we print the reports we should develop a Map Sheet (Cover Sheet). This is located on the Map tab in the table of contents.



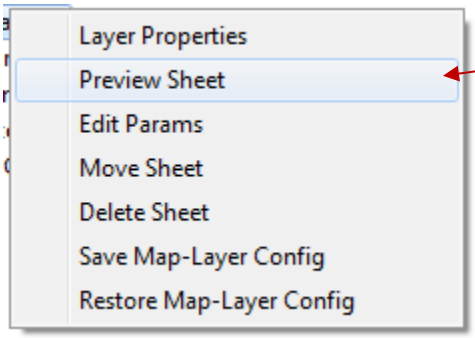


Sheet Size

A – 8.5x11
B – 11x17
D – 22x34



Boundary of created sheet (Color can be changed)

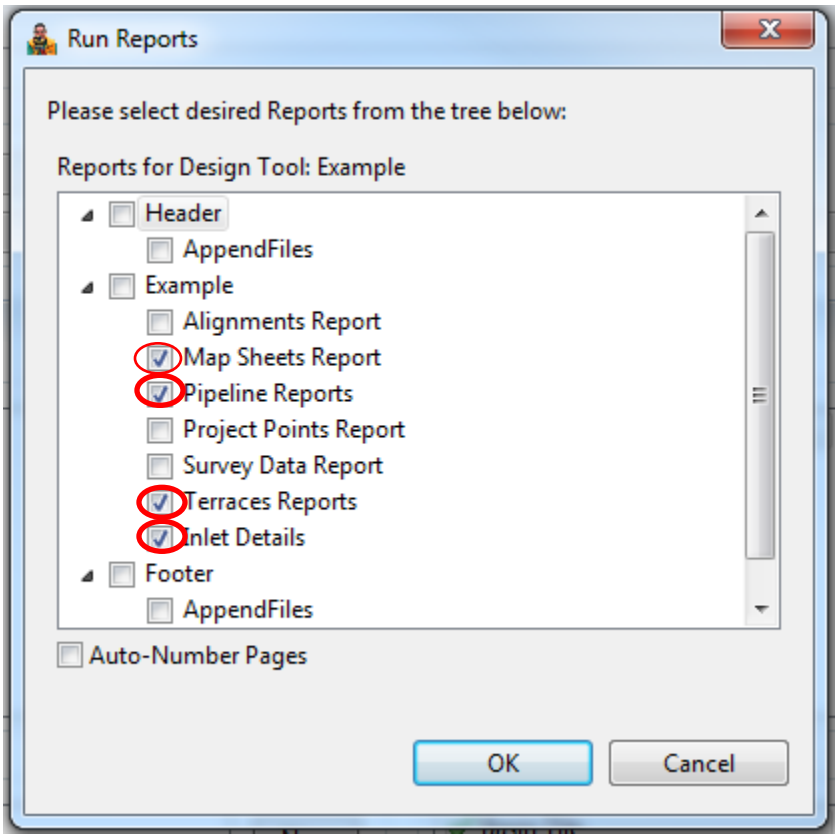


Select **Preview Sheet** or move sheet to encompass the area to be displayed.

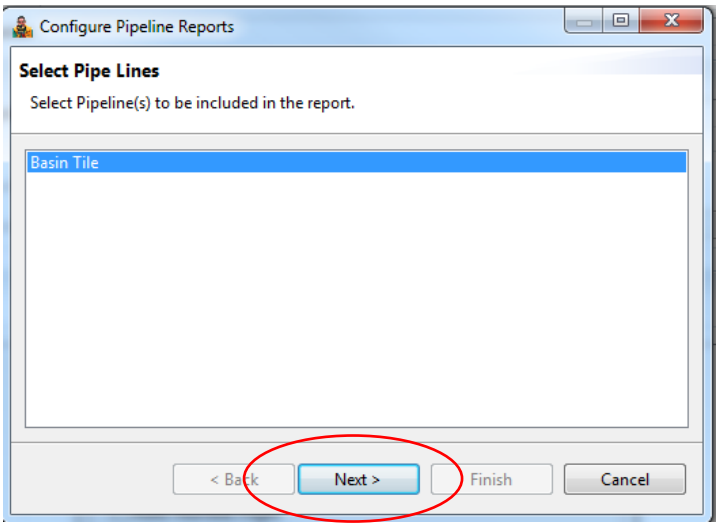
Too much showing?

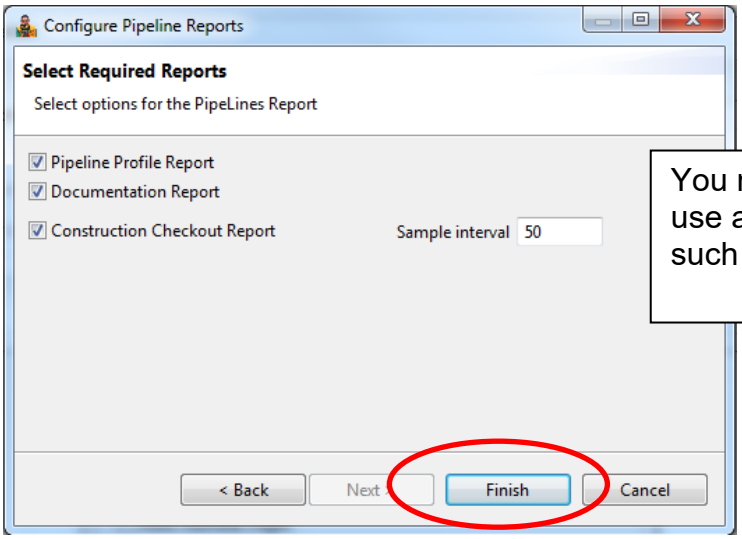
Suggestions:
-turn off layers in table of contents to reduce legend items.
-shut off points
-change colors of contours….
-change colors of alignments

--Go back to File>>**Print Reports**

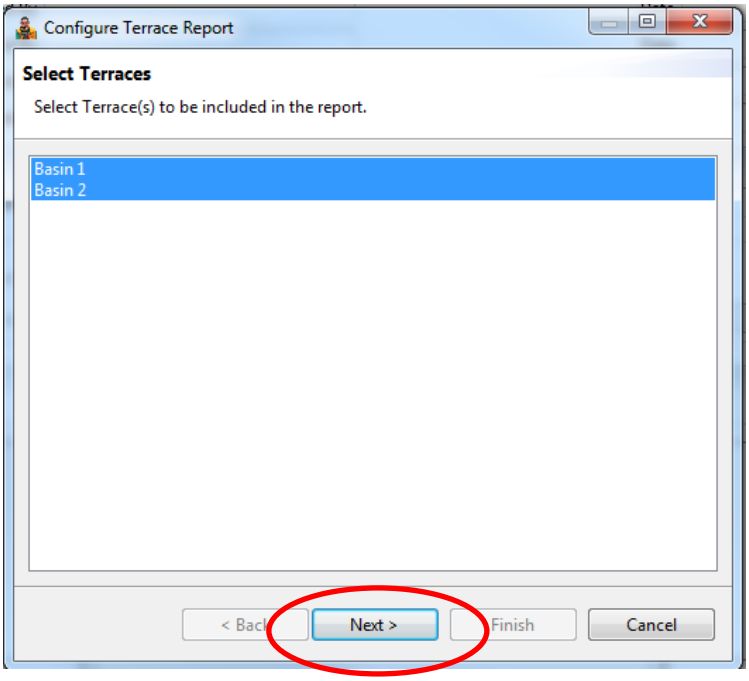


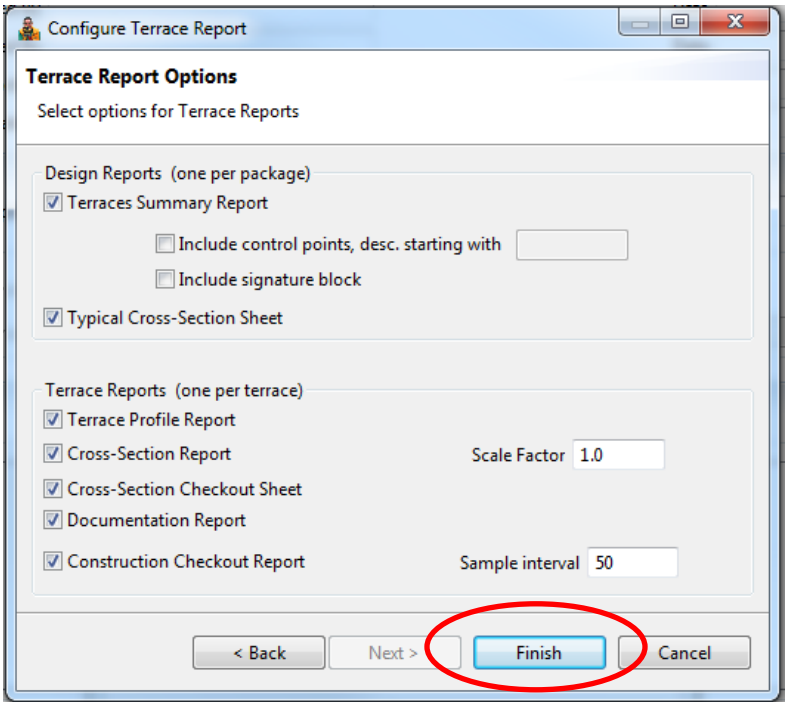
Upon checking each box, you will be asked to configure each report.

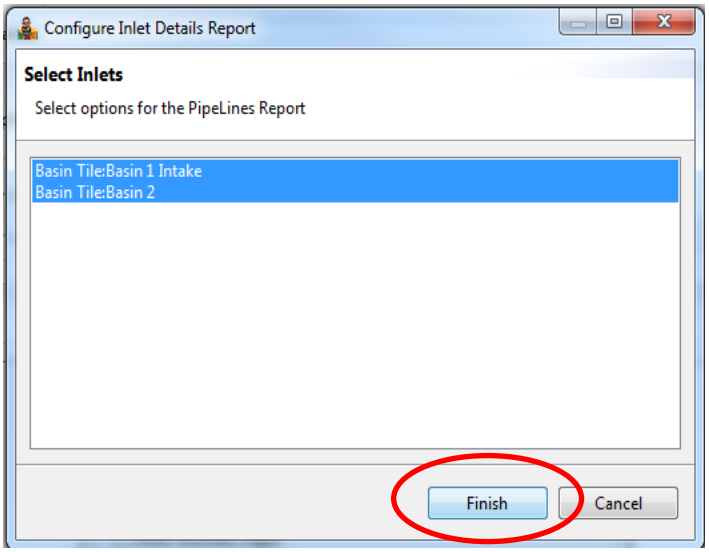


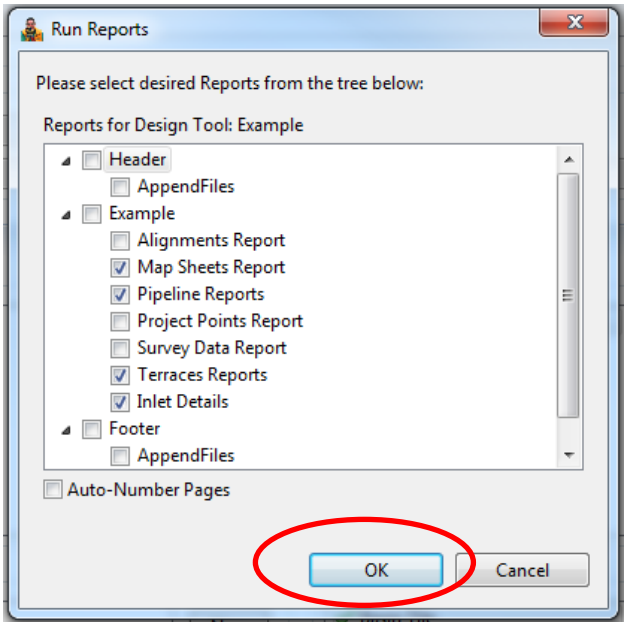


You may wish to use a bigger interval such as 100’




Configure Terrace Report
Terrace Report Options
Select options for Terrace Reports
Design Reports (one per package)
Terraces Summary Report
Include control points, desc. starting with
Include signature block
Typical Cross-Section Sheet
Terrace Reports (one per terrace)
Terrace Profile Report
Cross-Section Report
Scale Factor 1.0
Cross-Section Checkout Sheet
Documentation Report
Construction Checkout Report
Sample interval 50
< Back
Next >
Finish
Cancel


Configure Inlet Details Report
Select Inlets
Select options for the PipeLines Report
Basin Tile:Basin 1 Intake
Basin Tile:Basin 2
Finish
Cancel


Run Reports
Please select desired Reports from the tree below:
Reports for Design Tool: Example
Header
AppendFiles
Example
Alignments Report
Map Sheets Report
Pipeline Reports
Project Points Report
Survey Data Report
Terraces Reports
Inlet Details
Footer
AppendFiles
Auto-Number Pages
OK
Cancel