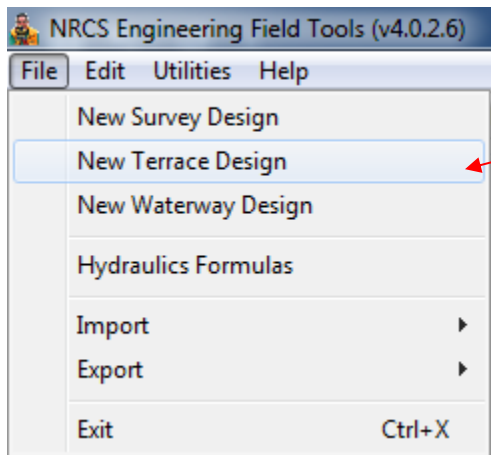
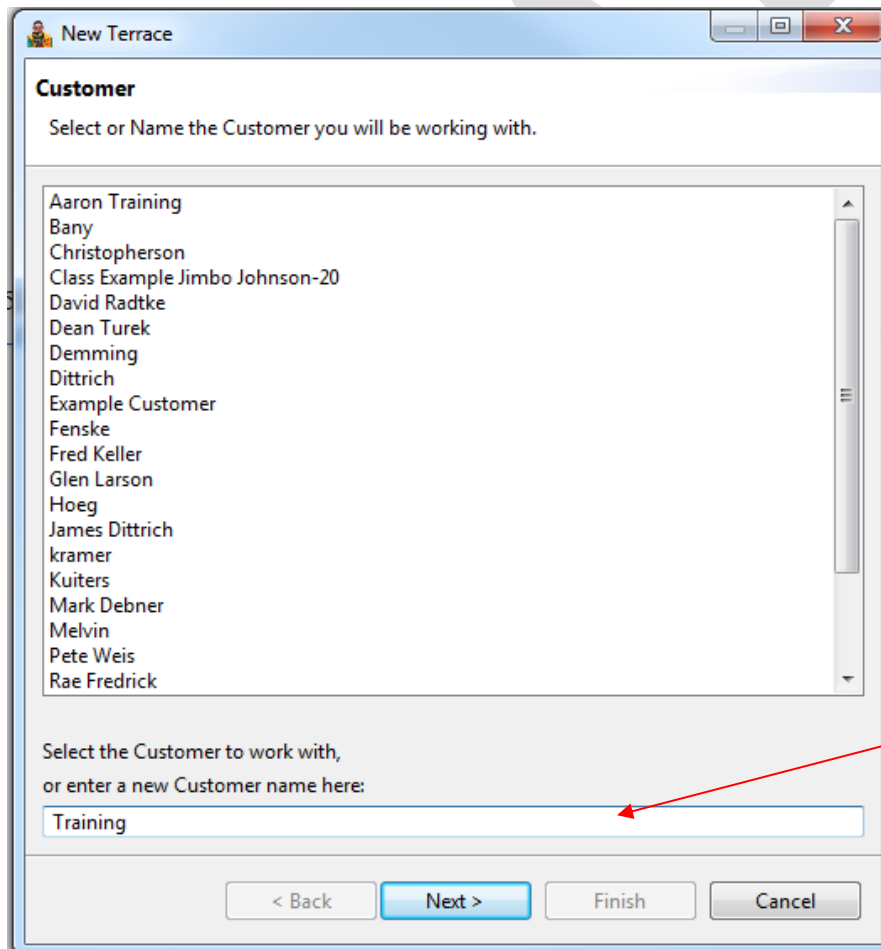


This reference guide covers the design of a simple water and sediment control basin using the Engineering Field Tools program as provided by the Natural Resources Conservation Service.

### Creating a new design



Under the File menu Select "New Terrace Design"



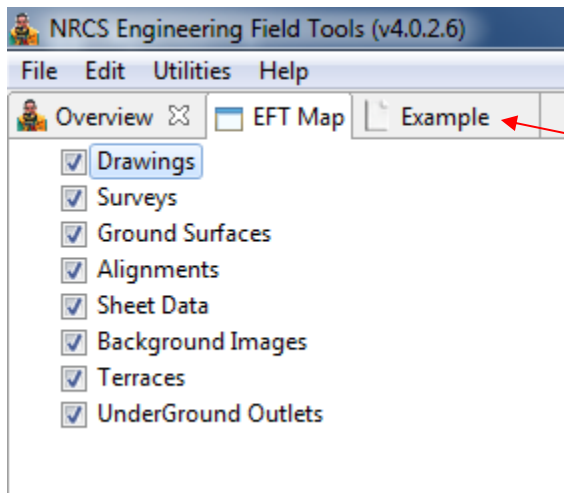
Create a new customer or select an existing customer (Landowner)

The screenshot shows the 'New Terrace' dialog box with the 'Project' section selected. The title bar reads 'New Terrace'. Below the title bar, the section is titled 'Project' and contains the instruction: 'Select or Name the Project you will be working with.' There is a large empty text box. Below that, it says 'Select the Project to work with, or enter a new Project name here:' followed by a text input field containing 'SE Minnesota'. At the bottom, there are four buttons: '< Back', 'Next >', 'Finish', and 'Cancel'.

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

The screenshot shows the 'New Terrace' dialog box with the 'TerraceDesign' section selected. The title bar reads 'New Terrace'. Below the title bar, the section is titled 'TerraceDesign' and contains the instruction: 'Enter a new name for the Design you will be working with.' There is a large empty text box. Below that, it says 'Enter a new TerraceDesign name below. The above list entries already exist, and cannot be used.' followed by a text input field containing 'Example'. At the bottom, there are four buttons: '< Back', 'Next >', 'Finish', and 'Cancel'.

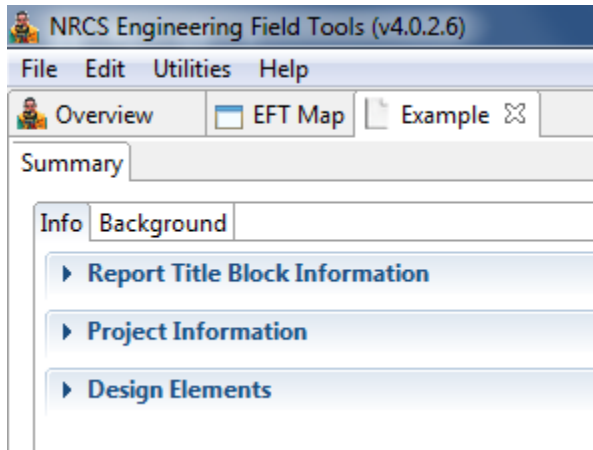
Enter the name of the design. (Type: Basin/Waterway)



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

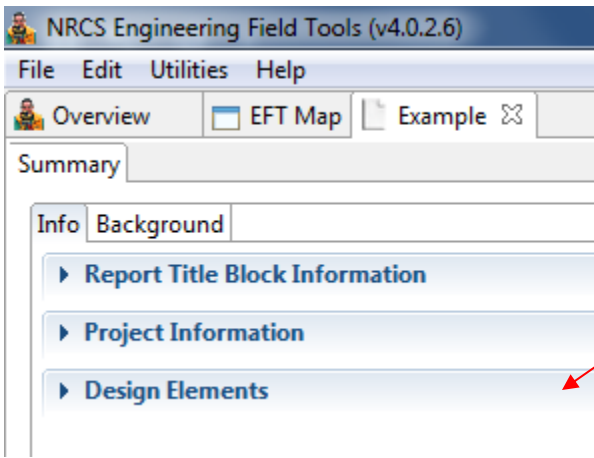
Project Information – Description of the project, benchmark description and elevation

Design Elements – Surveys, Alignments, Terrace, UGO, Forms

### **Background**

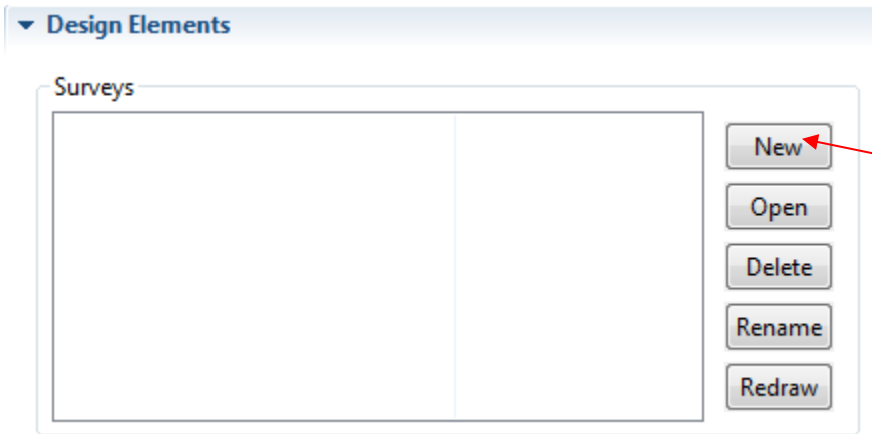
Landowner Preferences – Equipment width, Crops, Tillage, type of structure, type of outlet

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

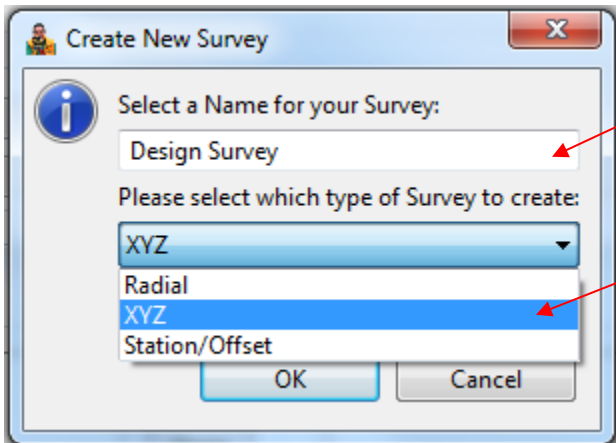


The majority of the work will be done in "Design Elements" under the Info tab.

**Importing a Survey**

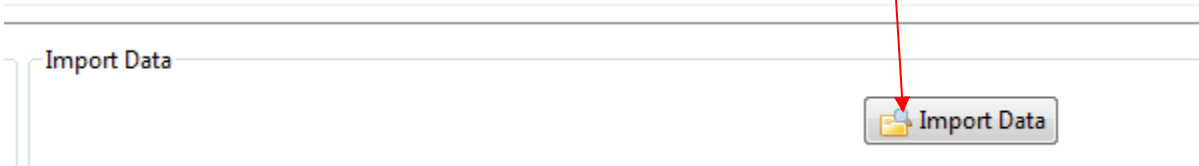


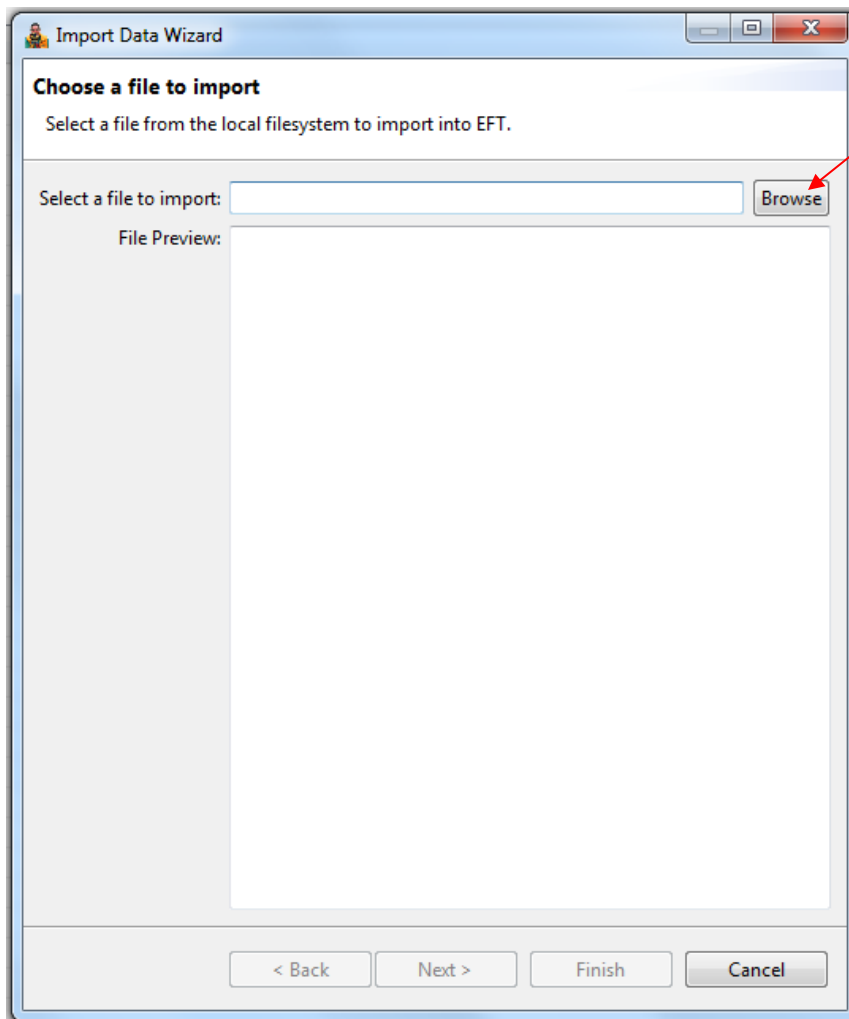
Under the Survey Window select New.



-Name the survey that you would like to import.  
 -Make sure that the XYZ option is selected to import **electronic survey points**  
 -Click OK

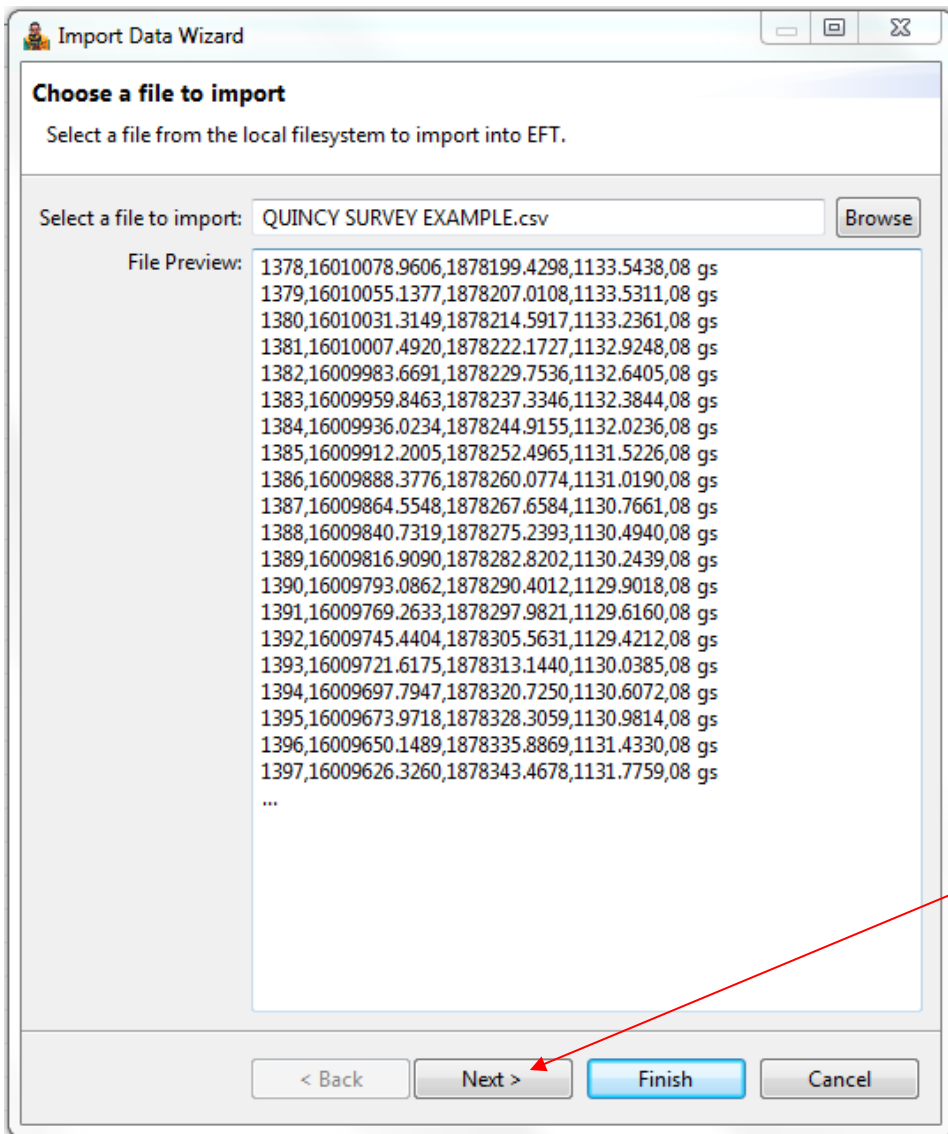
Select "Import Data"





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

**Import Data Wizard**

Select a conversion format

Select a conversion format for your imported file.

Choose the format of the imported file:

PNEZD: Point Name, NORTHING, EASTING, Elevation, Description  
 EN: EASTING, NORTHING  
 END: EASTING, NORTHING, Description  
 ENZ: EASTING, NORTHING, Elevation  
 ENZD: EASTING, NORTHING, Elevation, Description  
 Garmin DNR: Type, Point, Lat., Long., Northing, Easting, Desc.  
 Garmin DNR: Type, Point, Lat., Long., Northing, Easting, Desc., Elev.  
 NE: NORTHING, EASTING  
 NED: NORTHING, EASTING, Description  
 NEZ: NORTHING, EASTING, Elevation  
 NEZD: NORTHING, EASTING, Elevation, Description  
 PEN: Point Name, EASTING, NORTHING  
 PEND: Point Name, EASTING, NORTHING, Description  
 PENZ: Point Name, EASTING, NORTHING, Elevation  
 PENZD: Point Name, EASTING, NORTHING, Elevation, Description  
 PENZVTD: Point Name, EASTING, NORTHING, Elevation, Visibility, TINability, Description  
 PNE: Point Name, NORTHING, EASTING  
 PNED: Point Name, NORTHING, EASTING, Description  
 PNEZ: Point Name, NORTHING, EASTING, Elevation  
**PNEZD: Point Name, NORTHING, EASTING, Elevation, Description**  
 PNEZVTD: Point Name, NORTHING, EASTING, Elevation, Visibility, TINability, Description  
 PZEN: Point Name, Elevation, EASTING, NORTHING  
 PZNE: Point Name, Elevation, NORTHING, EASTING  
 Trimble PENZ: Point Name, EASTING, NORTHING, Elevation  
 Trimble PNEZ: Point Name, NORTHING, EASTING, Elevation

Unit Conversion (meters to feet) No conversion

< Back    Next >    **Finish**    Cancel

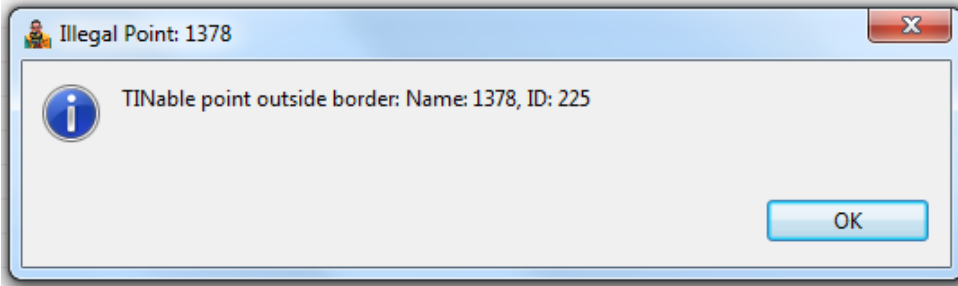
Select a conversion format. You should be selecting "PNEZD" as this is the standard format used with most of the electronic survey equipment. (this can be preset in the preferences)  
 -\*\*\*No conversion

-Click "Finish"

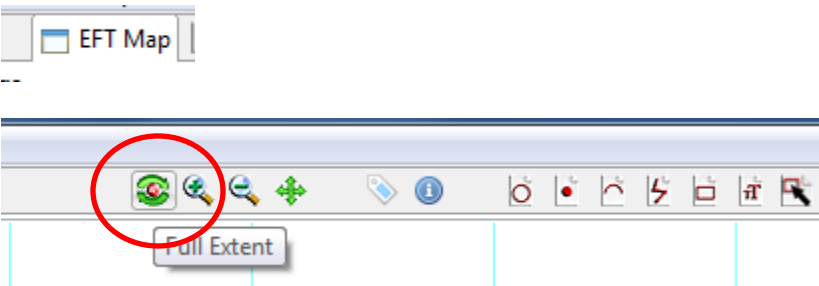
Name	X (Easting)	Y (Northing)	Z (Elevation)	Visible	Tinable	Description
1378	1878199.430	16010078.961	1133.544	✓	✓	08 gs
1379	1878207.011	16010055.138	1133.531	✓	✓	08 gs
1380	1878214.592	16010031.315	1133.236	✓	✓	08 gs
1381	1878222.173	16010007.492	1132.925	✓	✓	08 gs
1382	1878229.754	16009983.669	1132.641	✓	✓	08 gs
1383	1878237.235	16009959.846	1132.384	✓	✓	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.

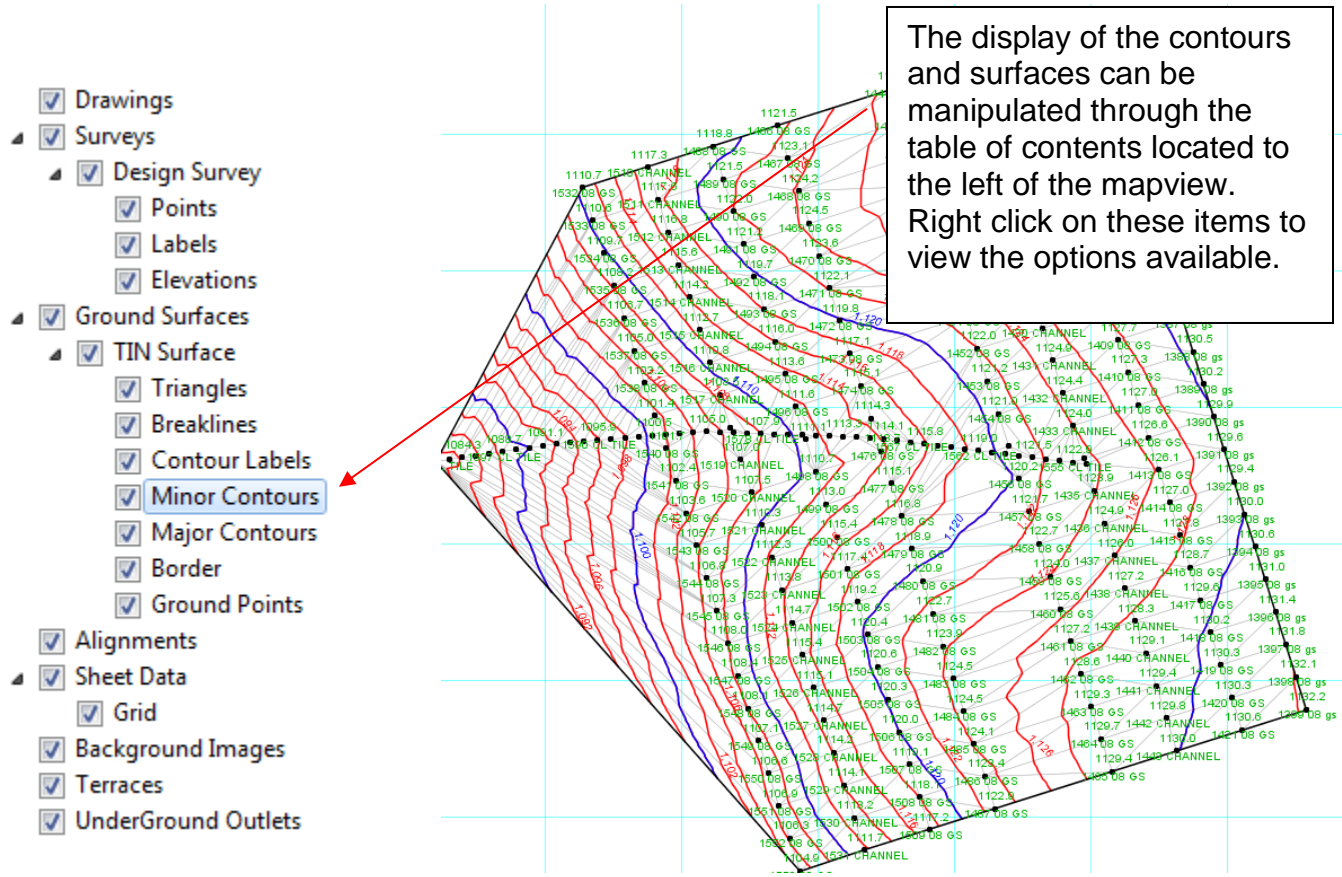
Select Accept Edit to confirm and close this window.



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 ben more than one point to be modified.



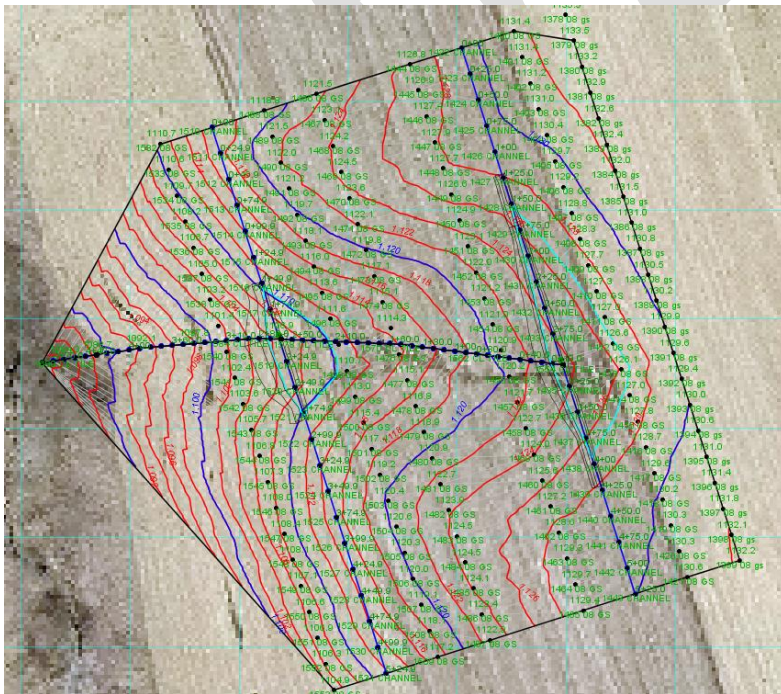
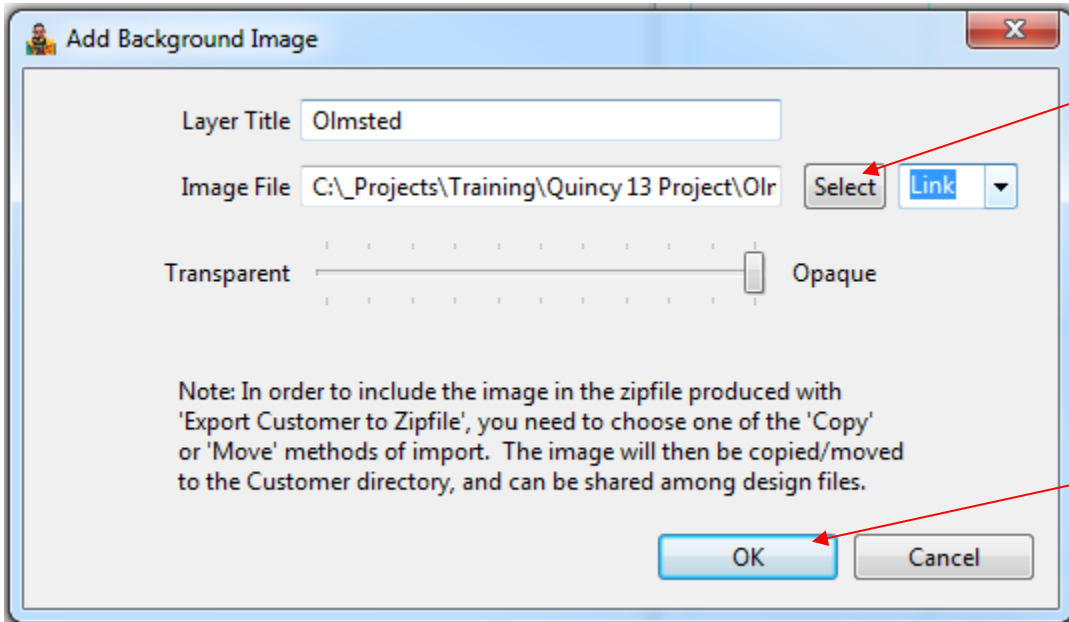
Go to the EFT Map tab. This is where your survey should show up. You will have to click the full extent button to zoom to the surveyed area.

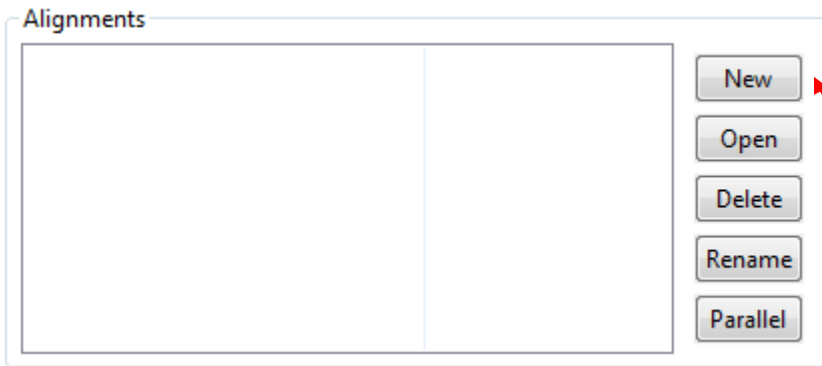


The display of the contours and surfaces can be manipulated through the table of contents located to the left of the mapview. Right click on these items to view the options available.



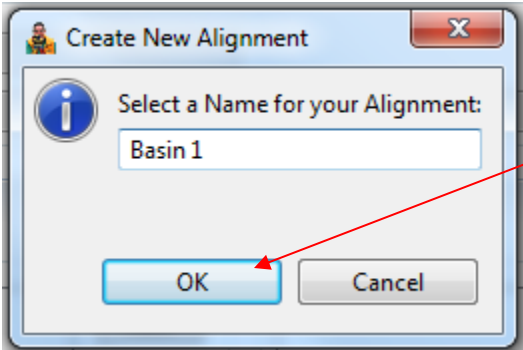
### Adding an image to the map



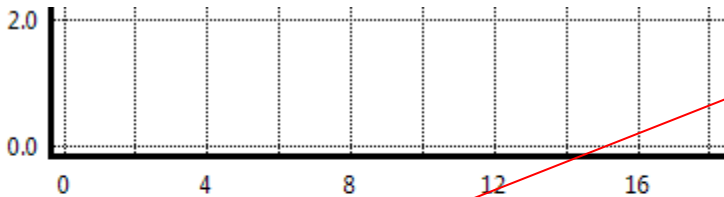


After the survey has been imported Alignments will need to be created. These are the channel alignments for the basins and tile.

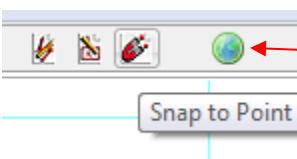
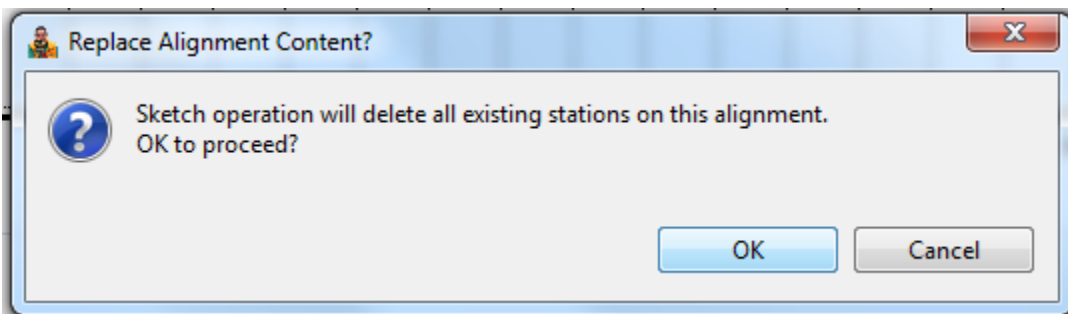
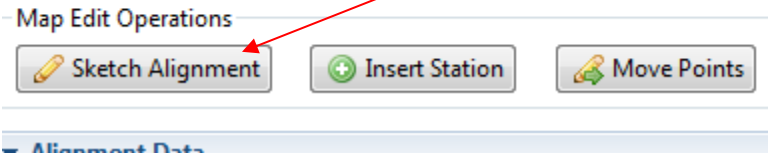
-Select New



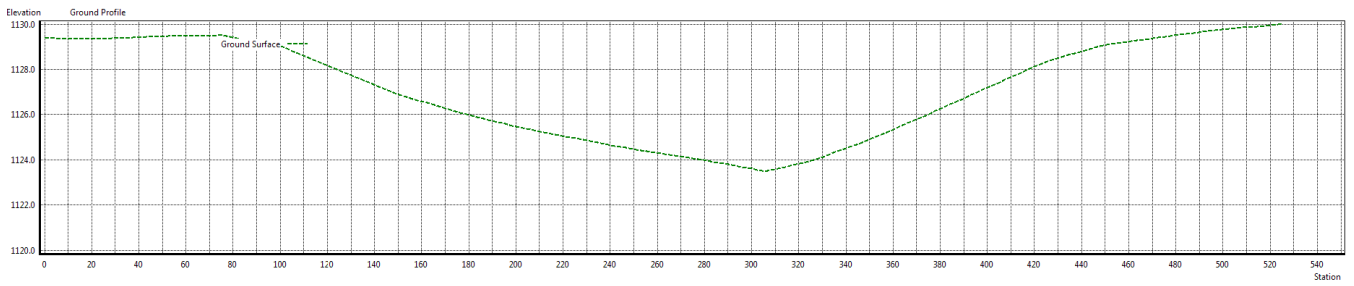
Name the alignment and click **OK**.



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.



Map Edit Operations

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

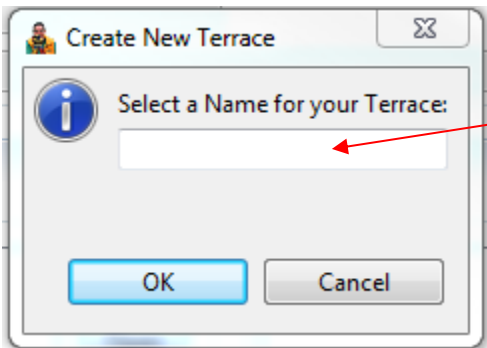
**\*If there are corners in the alignment, it is suggested to click apply curves to the alignment. This aids in the drawing of the embankment surface.**



Select “Accept Edit” when completed.

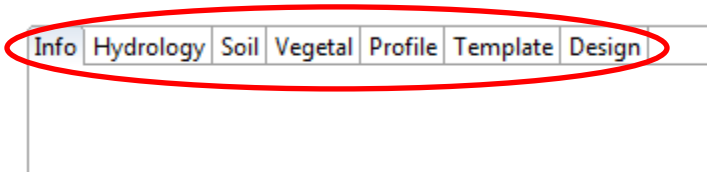


Select “New” to create a new terrace design.



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



The design will open with multiple tabs available.



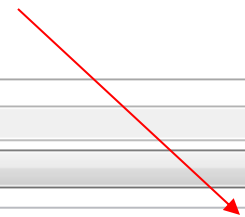
The Info tab requires us to choose an alignment from the menu.

Terrace Name

Terrace Type

Alignment   

Stripping Depth (in)



Construction Benchmark

Set Terrace Benchmark

Elevation

Description



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

## Hydrology Tab

This is self explanatory but make sure the Drainage Area is filled out in acres, the Precipitation in inches and a Curve Number is defined. The watershed length and slope can be documented but are not needed for determining the runoff volume. Ensure that the correct sedimentation rate is chosen. Lastly make sure that the Caldwell Method is the Flood Routing Model selected and start the first design with a Flood Duration of 24 hours. \*\*The flood duration can be adjusted by the hour if the MN Preferences were set prior to beginning the project.

Drained Area (ac)	1.90	
Runoff Model:	EFH2 Hydrology	Model Outputs
Precipitation (in)	4.50	
Storm Type	MSE3	
Curve Number	74	
Watershed Length (ft)	1000.0	
Watershed Slope (%)	3.0000	
Design Life (yr)	10	Model Outputs
Erosion Model:	Simple Erosion	
Erosion Rate (T/ac-yr)	5.00	
Trap Efficiency	0.900	
Sediment Density (T/cy)	1.00	
Flood Routing Model	Caldwell Method	Model Outputs
Flood Duration (hr)	24.0	
Run Simulation Models	Select Run Simulation Models to calculate the runoff storage volumes.	Runoff Storage (cu ft): 8551.79 Equiv. runoff depth (in): 1.24 Required Discharge (cfs): 0.16

## 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.

[https://www.nrcs.usda.gov/Internet/FSE\\_DOCUMENTS/nrcs142p2\\_021665.pdf](https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_021665.pdf)

Info Hydrology Soil Vegetal Profile Template Design

Allowable Soil Stress

Direct entry Allowable Stress (lb/sq.ft) 0.030 Soil Grain Roughness 0.0156

Erodibility class

Erodibility **ERODIBLE** Soil Grain Roughness 0.0156

Erodibility	Allowable Stress	Soil Type
Easily Eroded	0.020	Weak/sandy materials
Erodible	0.030	CL with plasticity on order of 10
Erosion Resistant	0.050	CL with plasticity on order of 15
Very Erosion Resistant	0.070	Slightly < maximum base value CL and SC material

Soil parameters

Soil Type CL Void Ratio (optional) 0.00

Plasticity Index 0.00 d75 (in) 0.000

### 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

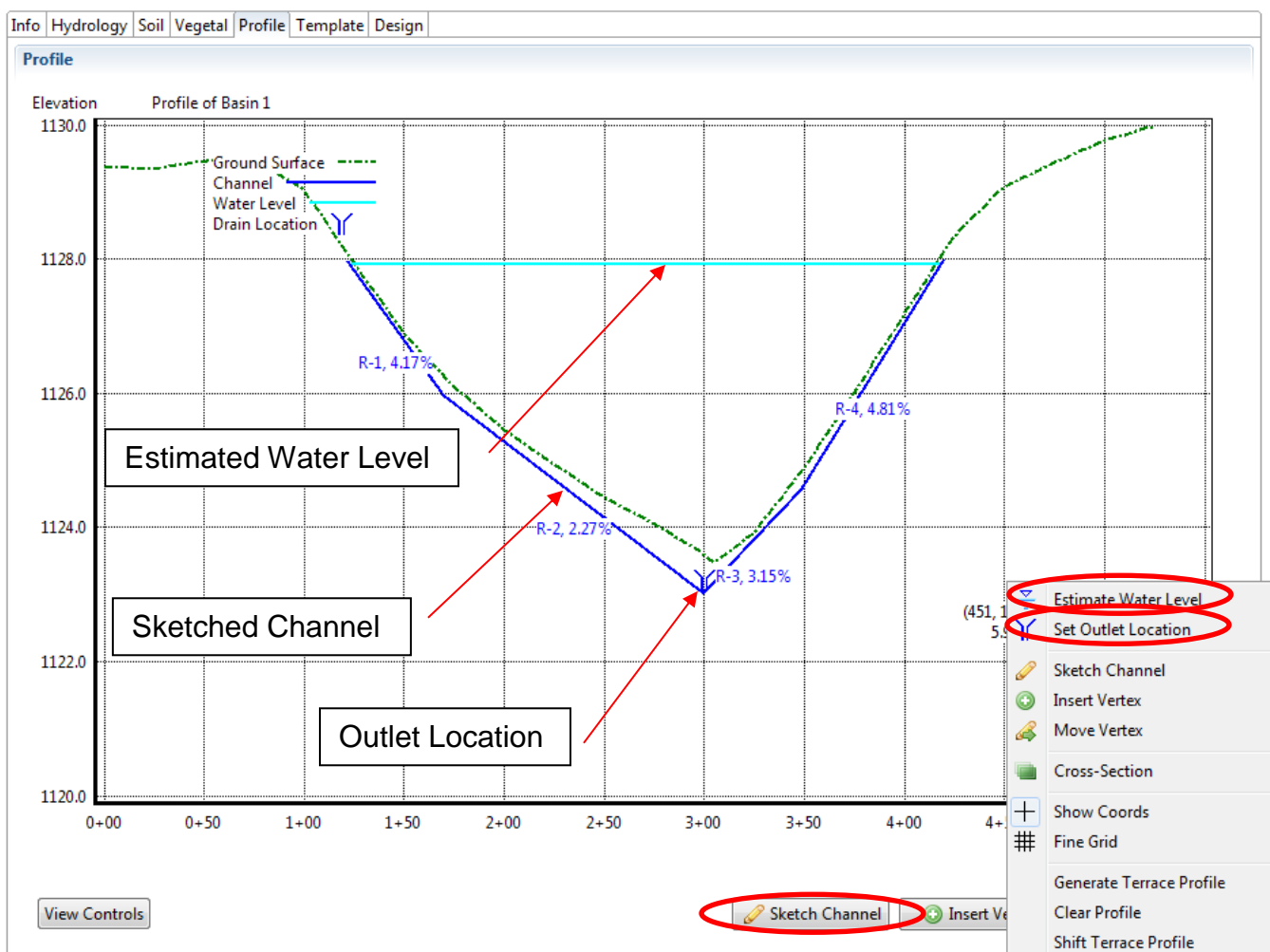
This tab defines the vegetation that is to be used in the channel of the basin/terrace. In most cases there is not any vegetation in the channel. For this reason the Mannings n values for both Stability and Capacity should be set to 0.035, the value for bare earth. The vegetal cover should be set to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

Info	Hydrology	Soil	Vegetal	Profile	Template	Design
<b>Stability Retardance</b>						
<input checked="" type="radio"/>	Manning's n		0.035			
<input type="radio"/>	Retardance Curve Index		0.04			
<input type="radio"/>	Stem Length/Density	Length (ft)	0.10	Density (#/sq.ft)	11.0	
<input type="radio"/>	Retardance Class		C			
	Vegetal Cover	None (bare, 0.0)				
	(select or enter numeric value)					
<b>Capacity Retardance</b>						
<input checked="" type="radio"/>	Manning's n		0.035			
<input type="radio"/>	Retardance Curve Index		0.04			
<input type="radio"/>	Stem Length/Density	Length (ft)	0.10	Density (#/sq.ft)	11.0	
<input type="radio"/>	Retardance Class		B			

## 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 original 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 accurately define the desired dimensions for your project.

1. **Orientation:** Choose the direction of the cross-section. When looking along the channel 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.

Info Hydrology Soil Vegetal Profile Template Design

**Orientation**

Uphill Direction  
 Uphill is to  Left  Right  
 when looking along the Alignment

Flag Line Location: **UPSTREAM\_TOE**

Offset from Alignment (ft) 0.0

**Cross-Section Controls**

Default Template

Name	Cut Slope	Front Slope	Back Slope	Btm. Width	Front Height	Top Width
NarrowBase	5.00 : 1	3.00 : 1	2.00 : 1	2.00	1.00	3.00

Vertex Templates

Station	Name	Cut Slope	Front Slope	Back Slope	Btm. Width	Front Height	Top Width
1+22.2	NarrowBase	5.00 : 1	3.00 : 1	2.00 : 1	2.00	1.00	3.00
1+70.4	NarrowBase	5.00 : 1	3.00 : 1	2.00 : 1	2.00	1.00	3.00
3+00.1	NarrowBase	5.00 : 1	3.00 : 1	2.00 : 1	2.00	1.00	3.00
3+49.0	NarrowBase	5.00 : 1	3.00 : 1	2.00 : 1	2.00	1.00	3.00
4+20.3	NarrowBase	5.00 : 1	3.00 : 1	2.00 : 1	2.00	1.00	3.00

**Optional Shape Controls**

Overfill Mode: **PERCENT**

Overfill Amount (%) 10.0

Freeboard Mode: **NONE**

Freeboard (ft) 0.0

Back Cut

Enable back cut

Minimum slope width (ft) 5.0

Back Cut-Slope Grade (%) 1.0

Bank Start Slope	Bank End Slope
Mode: <input type="text" value="RATIO_BASED"/>	Mode: <input type="text" value="RATIO_BASED"/>
Value (ft/ft): <input type="text" value="1.0"/>	Value (ft/ft): <input type="text" value="1.0"/>
Limit (feet): <input type="text" value="5.0"/>	Limit (feet): <input type="text" value="5.0"/>
<input checked="" type="checkbox"/> Grade Channel/Bank at Start	<input checked="" type="checkbox"/> Grade Channel/Bank at End

## 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.

Info
Hydrology
Soil
Vegetal
Profile
Template
Design

**Terrace Design**

Water Elevation (ft)

Req. Storage (cu ft):

Target Cut/Fill Ratio

Simulate Runoff

Compute Storage

Design Terrace

Balance Cut/Fill

Edit Balance Params

**Model Outputs**

For water elevation 1126.70 ft:

Total Cut (cy):

Total Fill (cy):

Cut/Fill Balance (cy):

Cut/Fill Ratio:

Stripping Volume (cy):

Flood Area (ac):

Computed Storage (cu ft) 10934.23

**Channel**

Profile Points
Cross-Section Templates

Station	Ground	Channel	Length	Grade	Flow Q	Flow Velocity	Flow Depth	Front Height	Design Height	Drain	Block
1+22.2	1128.06	1127.97	48.20	4.17%	0.00	0.00	0.00	1.00	1.10		
1+70.4	1126.24	1125.96	129.70	2.27%	0.64	1.95	0.13	1.00	1.10		
3+00.1	1123.59	1123.02	48.90	3.15%	2.36	2.63	0.29	1.00	4.07	Basin 1 Intake	
3+49.0	1124.83	1124.56	71.30	4.81%	0.95	2.32	0.16	1.00	2.36		
4+20.3	1128.11	1127.99	0.00	0.00%	0.00	0.00	0.00	1.00	1.10		

**Design Status**

No errors or warnings

\*\*\*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**

**UnderGround Outlets**

New

Open

Delete

Rename

Simulate

Select New in the Underground Outlets box.

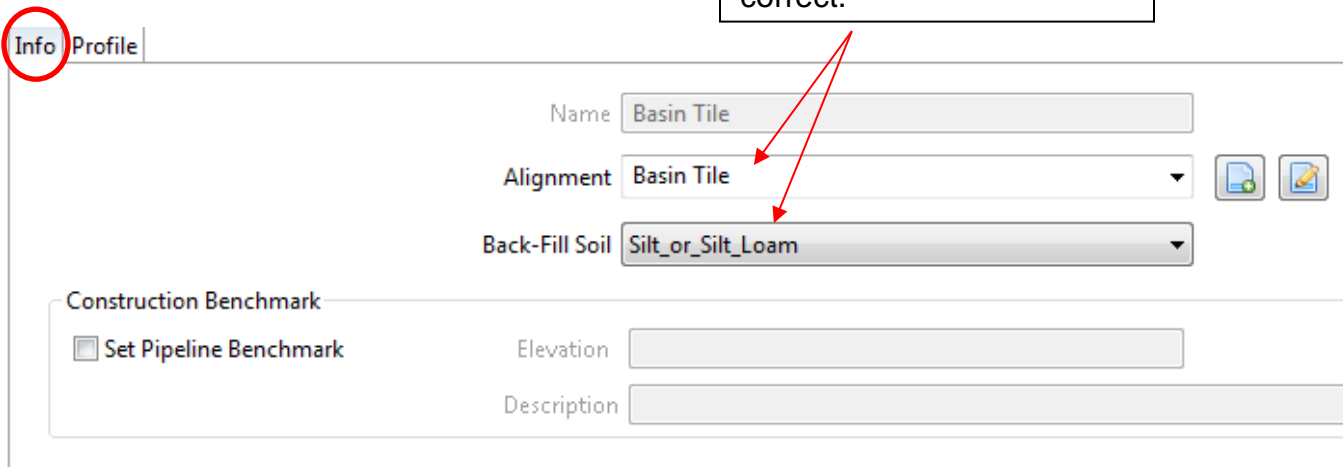
\*The alignment for this needs to be already drawn.



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

Ensure that the alignment for the tile is selected. Also make sure the soil type is correct.

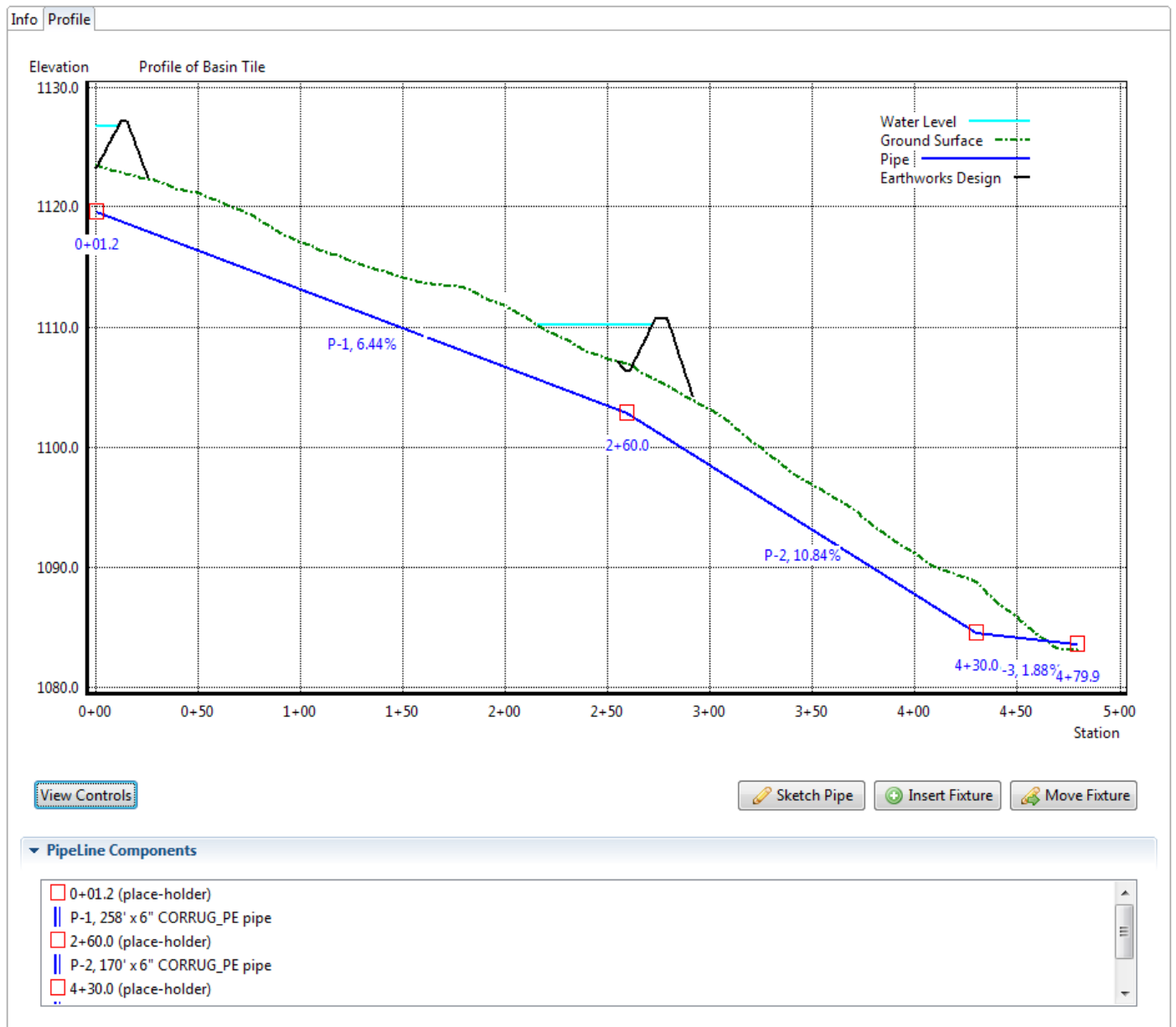
## Info Tab



## Profile Tab

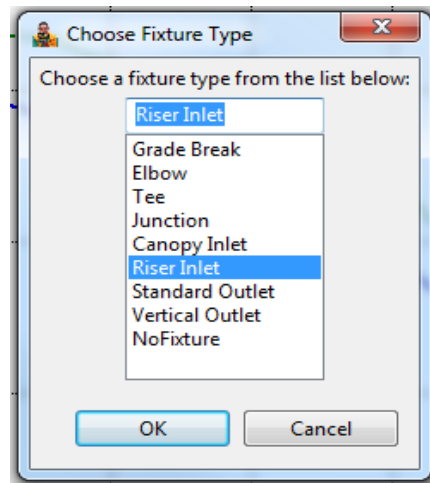
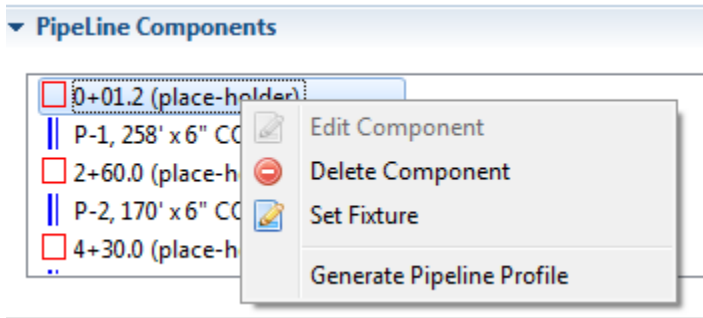
This is where you will draw the profile, insert grade breaks and inlets. Use the steps below to design the underground outlet for the basins. (Graphics on next pages)

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.



- Right click on one of the (place holders) in the pipeline components to **Set the Fixture**. The intakes should be pretty evident by the stationing on where they are. Then choose the correct fixture type. Each one of these components indicated with a red box  needs to be set in order for the design to work correctly. The blue pipelines can be left alone for the time being. Accept these edits when completed.





**Riser Inlet Inputs**

Id       Station (ft)       Pipe Elevation (ft)

Flow Q (cfs)

Material       Perforated

Pipe Size (in)       Pressurizable

Manning's N

Pressure Flow

Use Manufactured Riser           

**Inlet Top**

Guard

Top Opening (in)

Plugged Fraction      Qtop = 0.00 cfs

**Perforated Riser**

Holes per ft       Height (ft)

Round Perf       Perf. diam., in

Rectangular Perf       Perf. width x       height, in

Plugged Perf Fraction      Qperf = 0.52 cfs

Annotations with red arrows:
 

- "Intake Stations" points to the Station (ft) field.
- "Tile elev" points to the Pipe Elevation (ft) field.
- "Select Intake" points to the "Select..." button.

**Water Source**

Terrace and Outlet:  No Connection  Basin 1:Basin 1 Intake (4.9')  Basin 2:Basin2 (262.3')

Terrace Conditions:

- Required Q: 0.158 cfs
- Flood Elevation: 1126.7 ft
- Channel Elevation: 1123.0 ft
- Pipe Depth below Channel: 3.5 ft

Average Flood Depth Factor: 0.8  Enable Edit

UGO-Sizing Flood Depth Factor: 1.0  Enable Edit

---

**Orifice Plate**

Use Orifice  User-Defined Size

Orifice Depth (in): 6.00

Diameter (in): 3.00 Qorifice = 0.52 cfs

---

**Offset Pipe**

Use Offset

Offset Length (ft): 0.0

Elbow Elevation (ft): 0.0

Material: CORRUG\_PE\_PERF  Perforated  Pressurizable

Pipe Size (in): 6.0

Manning's N: 0.015 No offset pipe

---

**Design Controls**

Average Flow: 0.47 cfs Qperf + Qtop = 0.47, Qorifice = 0.47

Release Time: 8.1 hrs

UGO-Sizing Flow: 0.52 cfs Qperf + Qtop = 0.53, Qorifice = 0.52

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.

**UnderGround Outlets**

Basin Tile

New

Open

Delete

Rename

Simulate

Select Simulate

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

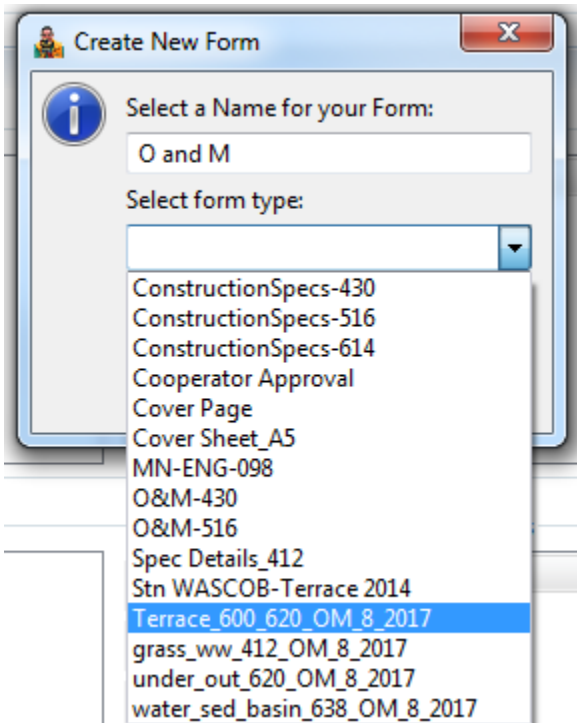
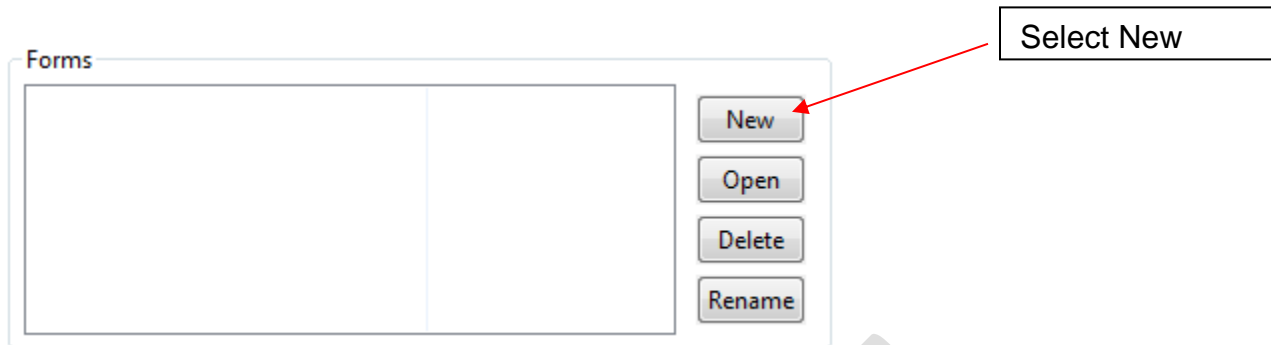
Total Flow Q for this pipeline: 1.04 cfs

Accept Edit

Select Accept Edit



## Standard Forms



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

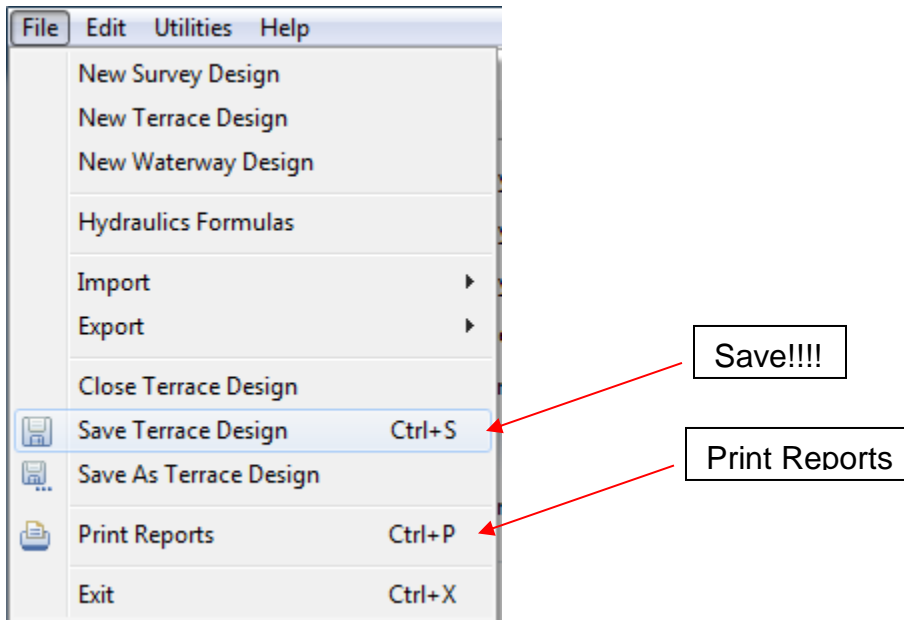
These forms need to be placed in the following location.

C:\Users\your user name\AppData\Local\EFT\eft\workspace\form Templates

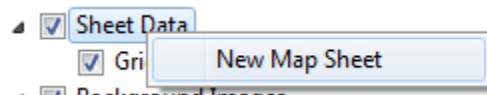
- Seeding Sheets
- GSOC
- O&M
- Specifications

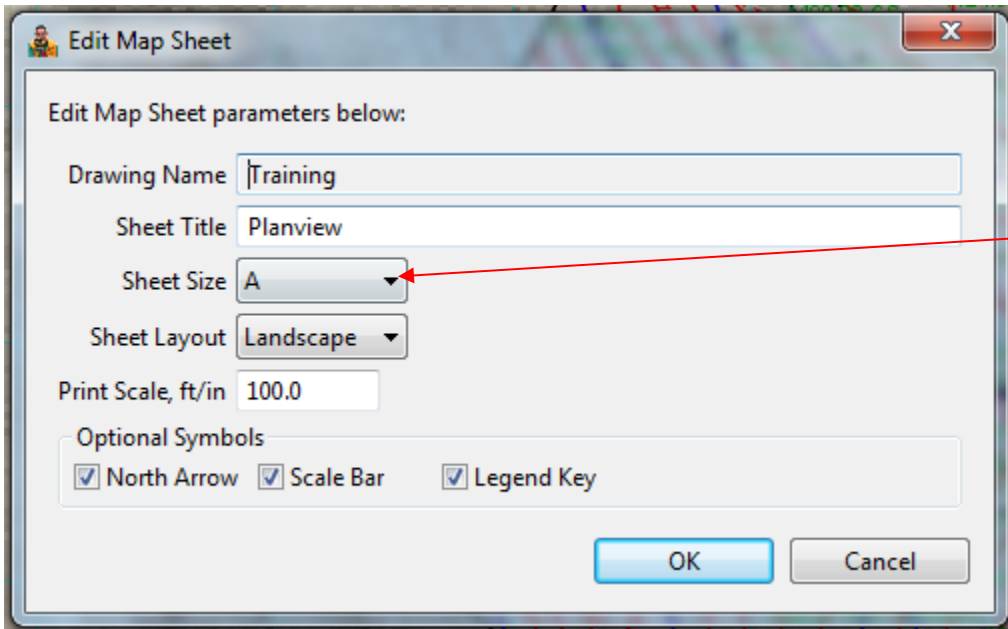
## Print Reports

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

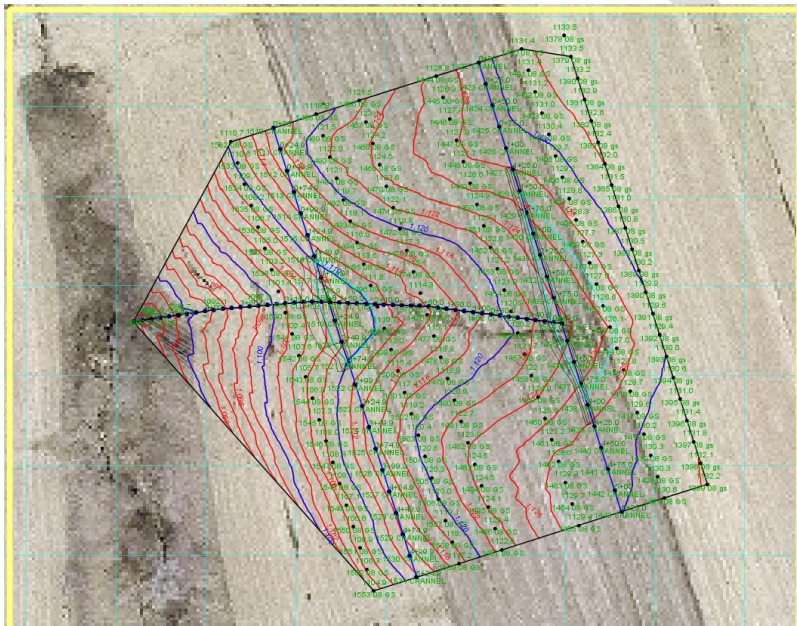


\*\*\*Before we print the reports we should develop a Map Sheet (Cover Sheet). This is located on the Map tab in the table of contents.

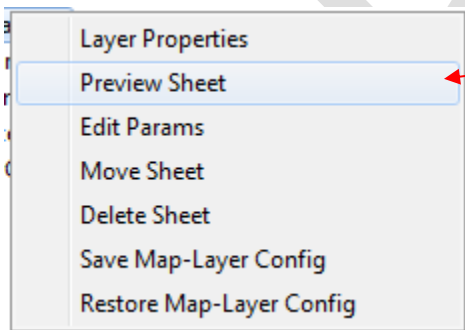




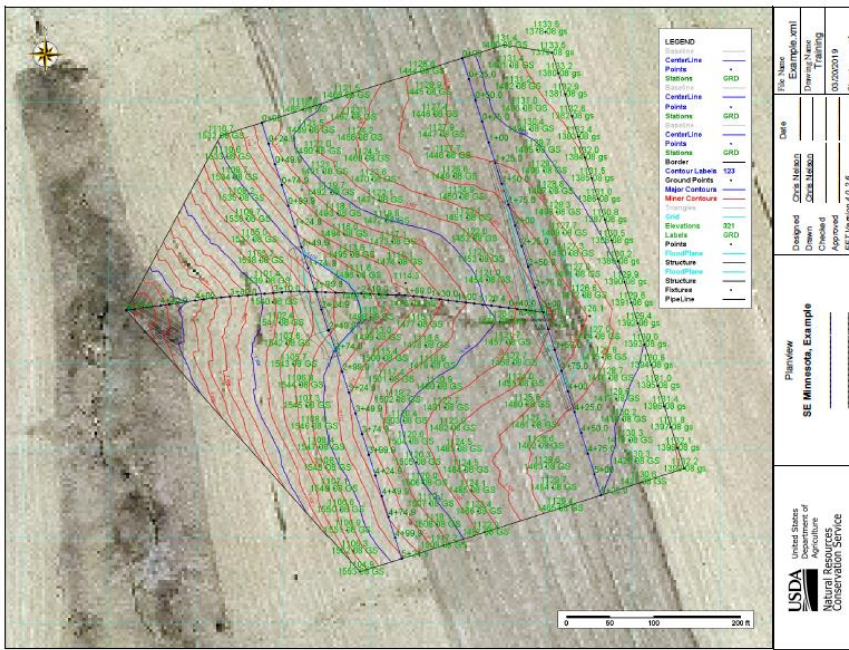
Sheet Size  
A – 8.5x11  
B – 11x17  
D – 22x34



Boundary of created sheet (Color can be changed)



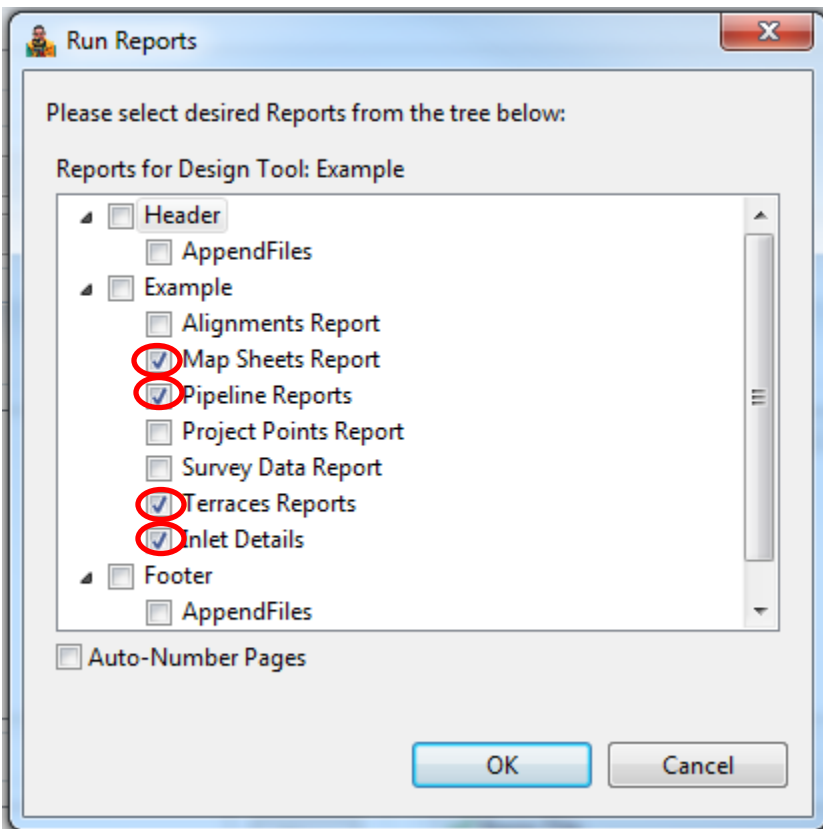
Select **Preview Sheet** or move sheet to encompass the area to be displayed.



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.

