Office of Engineering
Division of Facilities & Transit

AEC APPLICATIONS

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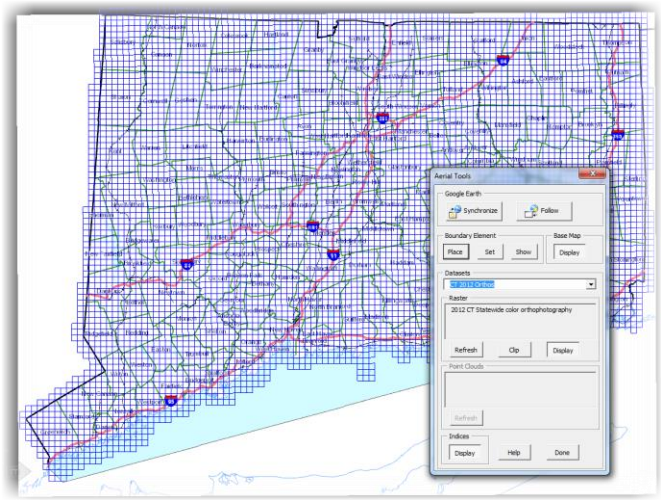

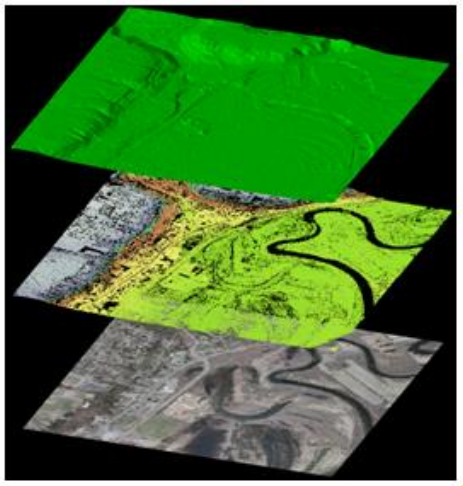

Guide to the Earth Exploration Toolset with MicroStation V8i and OpenRoads

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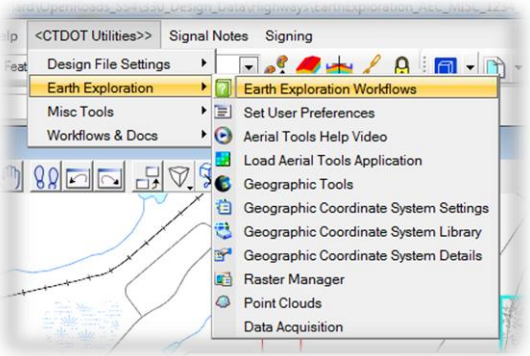
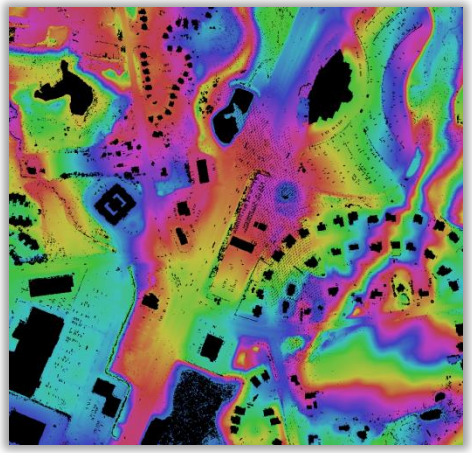
Chapter 1 Introduction



The required versions are as follows:
ProjectWise Explorer V8i (SELECTseries 4) - Version 08.11.11.566
MicroStation V8i (SELECTseries 4) - Version 08.11.09.832
InRoads Suite V8i (SELECTseries 4, OpenRoads) - Version 08.11.09.872

The CTDOT MicroStation Earth Exploration toolset was created to improve the process of attaching aerial photography, reprojecting data and creating terrains from LiDAR Data. The CTDOT MicroStation Earth Exploration toolset can be found on the CTDOT Utilities menu bar under Earth Exploration. The menu includes the Aerial Tools Application, a tool that attaches aerial photography and LiDAR Data right into MicroStation. All of the tools except for Load Aerial Tools Application can be accessed from other areas of MicroStation; however they have been put in this menu to provide easy access to the tools required throughout the workflows in this document.
To use this workflow you will need to be working in ProjectWise with geo-coordinated MicroStation files. By opening a MicroStation file through ProjectWise you will have access to the latest MicroStation V8i/OpenRoads workspace; this workspace will connect you to the custom CTDOT Earth Exploration menu.



NOTE: If you are working on the X Drive (Network Project) please go to the Workflows on the SELECTSeries Website for separate sets of directions.

Section 1.1 Statewide Arial Photos

Statewide Arial Photos can be found in several locations. Keep in mind file formats found on websites might not be compatible with MicroStation V8i. Recently 4 band orthoimagery (MrSID4) for the Statewide 2016 Orthophotograhy flight was published on the NOAA Website and the UCONN/CT ECO Website, this format is not compatible with MicroStation V8i. The Statewide 2016 Orthophotograhy flight also released statewide 3 band orthoimagery (MrSID3) that is compatible with MicroStation V8i.

Known Locations of Connecticut Orthophotograhy

	Combatable with MicroStation V8i
ProjectWise	
Statewide 2016 Orthos MrSID3	**YES** ✓
Statewide 2012 Orthos MrSID3	**YES** ✓
CRCOG 2009 MrSID3	**YES** ✓
USGS Topos	**YES** ✓
Statewide 2004 Orthos	**YES** ✓
NOAA Website	
Statewide 2016 Orthos MrSID4	**NO** ✗
UCONN/CT ECO	
Statewide 2016 Orthos MrSID3	**YES** ✓
Statewide 2016 Orthos MrSID4	**NO** ✗

Section 1.2 Statewide LiDAR

Statewide LiDAR can also be found in several locations. Keep in mind file formats found on websites might not be compatible with MicroStation V8i. Statewide LiDAR compatible with MicroStation V8i can be found in two places.

NOAA website - 2016 Flight, available at https://coast.noaa.gov/dataviewer/#/lidar/search/ Data is retrieved and downloaded from the website and then imported into a MicroStation Point Cloud POD file.

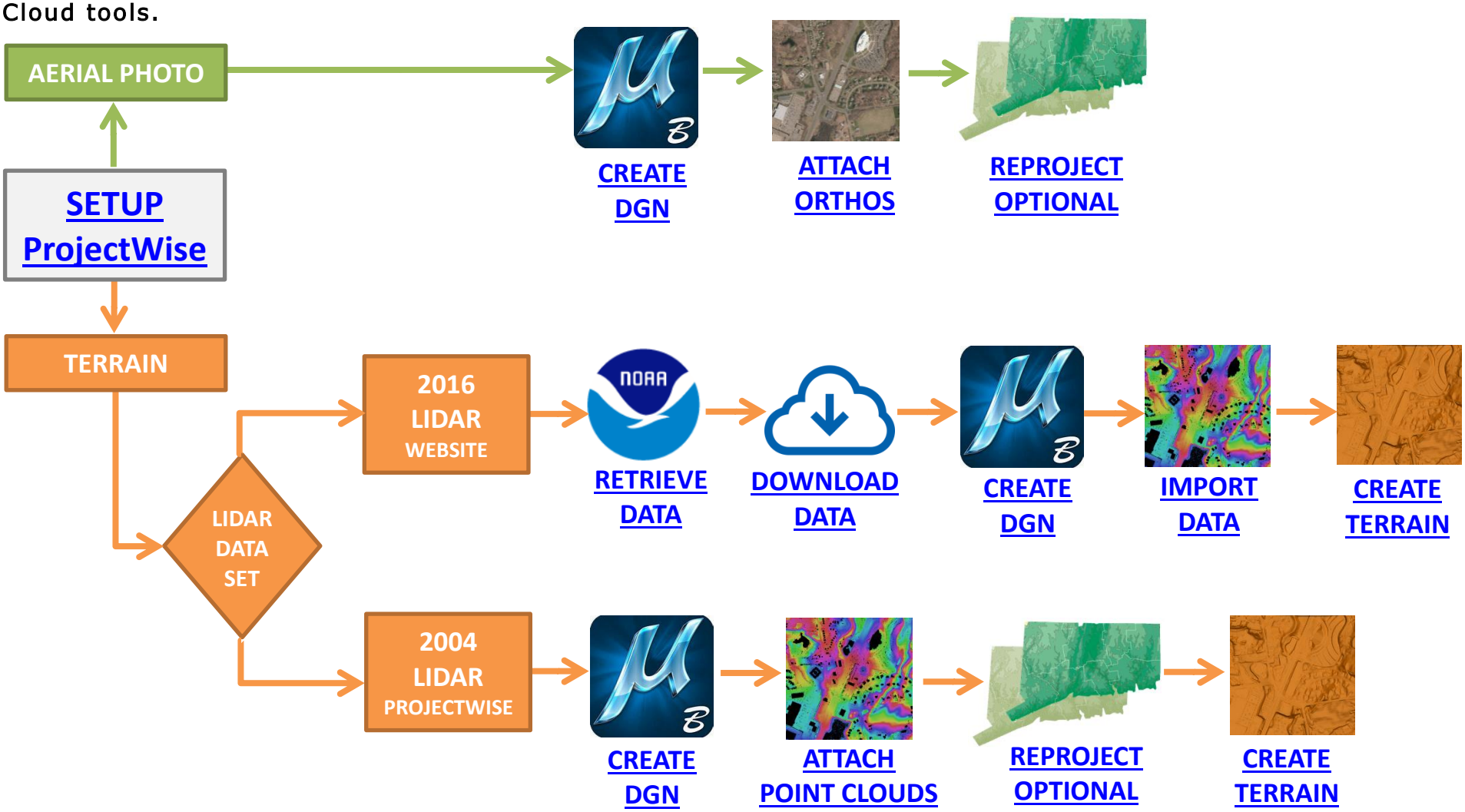
ProjectWise – 2004 Flight, available through the Aerial Tools Application that runs inside of MicroStation and gets attached as a MicroStation Point Cloud POD file.

Known Locations of Connecticut LiDAR Data

	Combatable with MicroStation V8i
ProjectWise	
Statewide 2004 5 FT Point Clouds	**YES** ✓
NOAA Website	
2016 CRCOG LiDAR: Connecticut Statewide Points – ASCII X,Y,Z Pts	**YES** ✓
2016 CRCOG LiDAR: Connecticut Statewide Points - LAS	**NO** ✗
2016 CRCOG LiDAR: Connecticut Statewide Points - LAZ	**NO** ✗
UCONN/CT ECO	
Statewide 2016 DEM	**NO** ✗
Statewide 2016 LAS	**NO** ✗

Section 1.3 Workflow Options

The flow chart below has reprojections as optional, these are only needed if the final output is something other than NAD 83/NAVD 88. The NOAA website has options to output and deliver reprojected liDAR data so reprojections on this data will most likely not need to be done using MicroStation. **Prerequisites for using this workflow include basic MicroStation knowledge including understanding the Raster Manager and Point Cloud tools.**



Section 1.4 Getting Started

Before getting started with the Earth Exploration Tools set users will need to follow the Set up and Start up workflows in the CTDOT OpenRoads Manual

CTDOT OpenRoads Manual

ProjectWise Set Up - Chapter 2
Follow steps 1 to 6

Project Start Up - Chapter 3
Follow steps 1 and 2

Users will now switch over follow the links below located in this manual (Guide to the Earth Exploration Toolset with MicroStation V8i) for creating and opening MicroStation files, the seed file used will be based on the specific portion of this manual you are working on, the horizontal and the vertical datum.

Creating a DGN File Container for Aerial Photos

Creating a Terrain DGN File for 2016 LiDAR Data

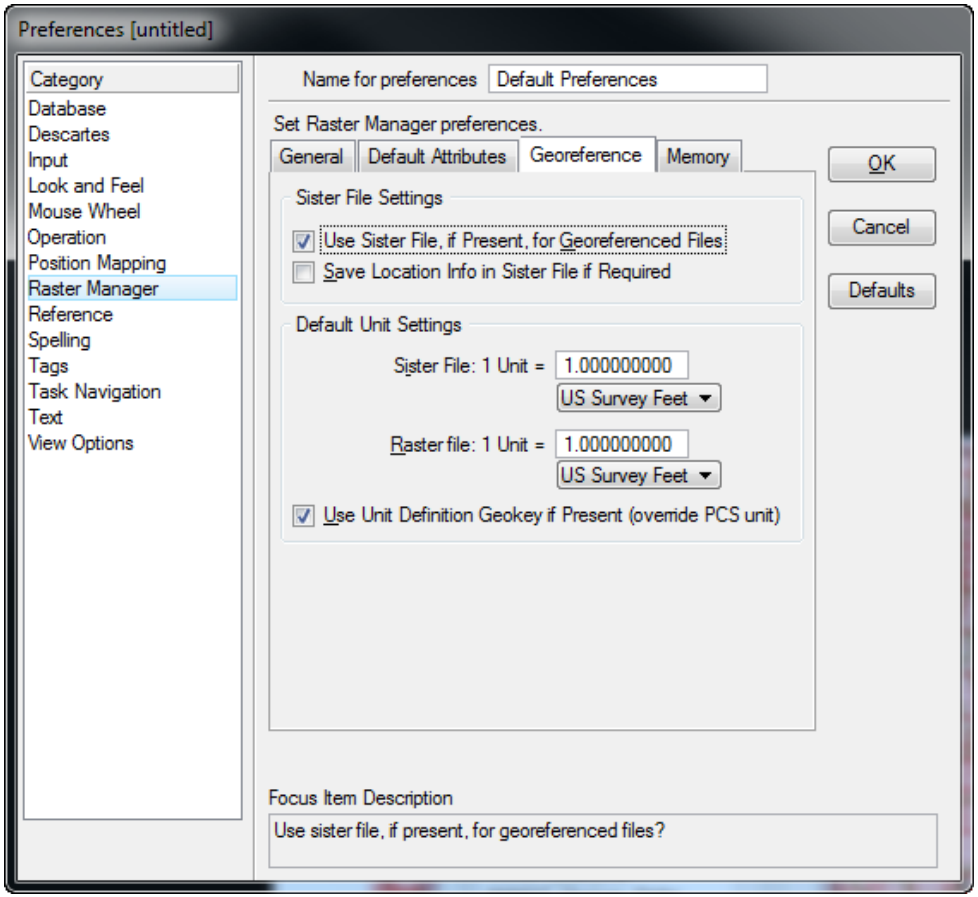
Creating a Terrain DGN File for 2004 LiDAR Data

Chapter 2 Aerial Photos

Section 2.1 Creating a DGN File Container for Aerial Photos

1. In ProjectWise Explorer browse to your working location. On the ProjectWise Explorer Main Menu, select *Document > New Document*.
2. In the Select a Wizard Dialog Box, select Advanced Wizard then OK. On the Advanced Document Creation Wizard Welcome dialog box select Next >. When prompted to Select Target Folder, verify that you are pointed to the correct folder and select Next >.
3. From the Select a Template options, toggle on Use ProjectWise as a template and click the Select button.
4. A Select Template Document dialog box will appear. Browse to the seed file location:
5. *0 5. 0 - Workspace Resources\3_Workspace_V8i \Civil_Standards\seed*
6. Choose the 2D seed file 2D_OpenRoads_DesignSeed_83.dgn
7. Select the Open button.
8. The template is now populated for Advanced Document Creation. Select Next >.
9. Select the fields to Define Document Attributes. Tab to accept each field. The document file name will be built from these fields. Be sure to enter a *Label* and *Description*. These fields will be displayed and used for searching rather than the file name. Select Next >.
10. On the Document Properties Dialog Box select Next >. On the Create a Document Dialog box select Next >.
11. Click Finish to close. The new file will now appear in ProjectWise. To update the ProjectWise Explorer Document View data point in the view and then select F5 on the keyboard. This will refresh Label and Description.
12. Right click on the DGN file and select Open With. In the Open document with dialog box locate the Description column and select *OpenRoads SS4* and click OK.

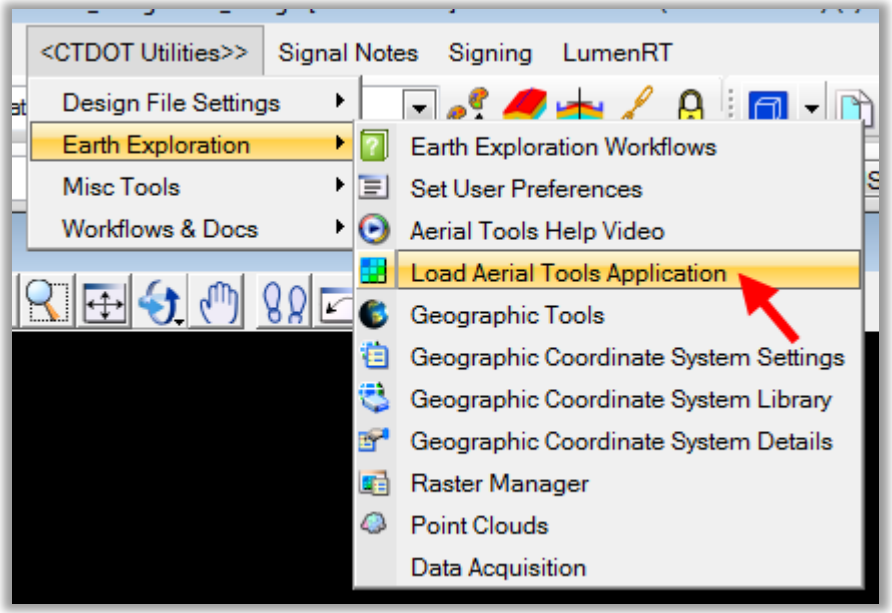
13. On the MicroStation main menu select *CTDOT Utilities > Earth Exploration > Set User Preferences*. Select the **Georeference** Tab. Verify the settings and select the **OK** button.
14. Use Sister File *is toggled on*
15. Default Unit Settings
16. Sister File: 1 Unit = *1 US Survey Feet*
17. Raster file: 1 Unit = *1 Us Survey Feet*
18. Use Unit Definition Geokey if Present (override PCS unit) *is toggle on*

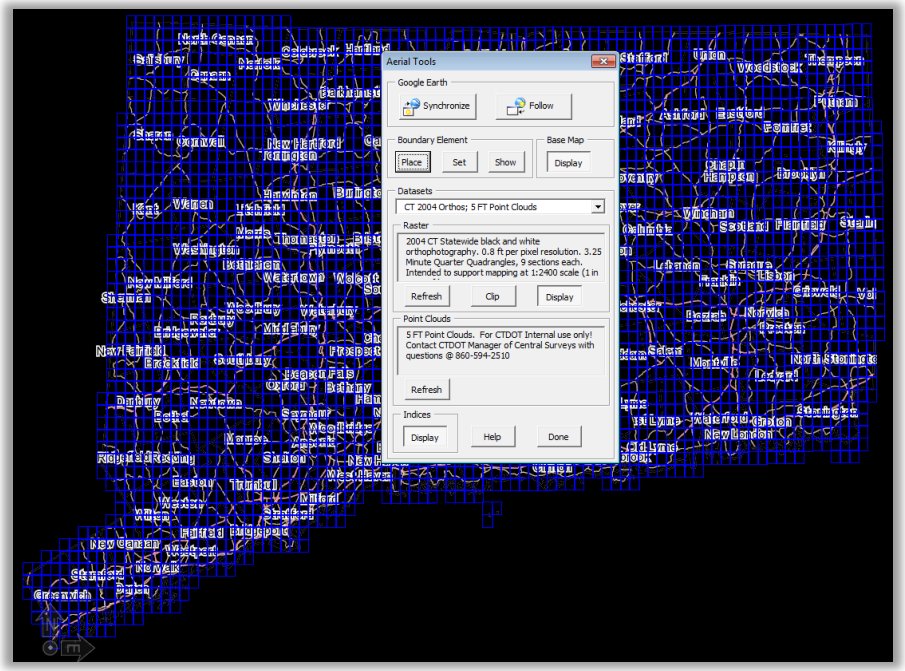


Section 2.2 Attaching Rasters Using the Aerial Tools Application

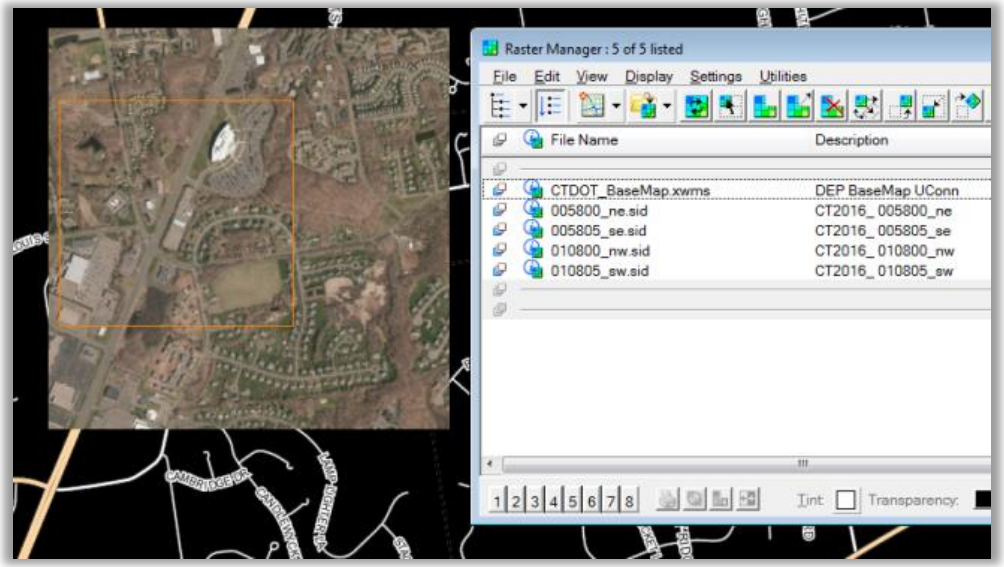
The Aerial Tools Application is specifically programmed for use with CTDOT data. It is used to locate and attach rasters (aerial photos) into MicroStation. A detailed map of the state of Connecticut will automatically get attached when Aerial Tools is accessed. This MicroStation file can be referenced into other MicroStation files and used as a background for laying out designs after attaching photos and applying any needed reprojection.

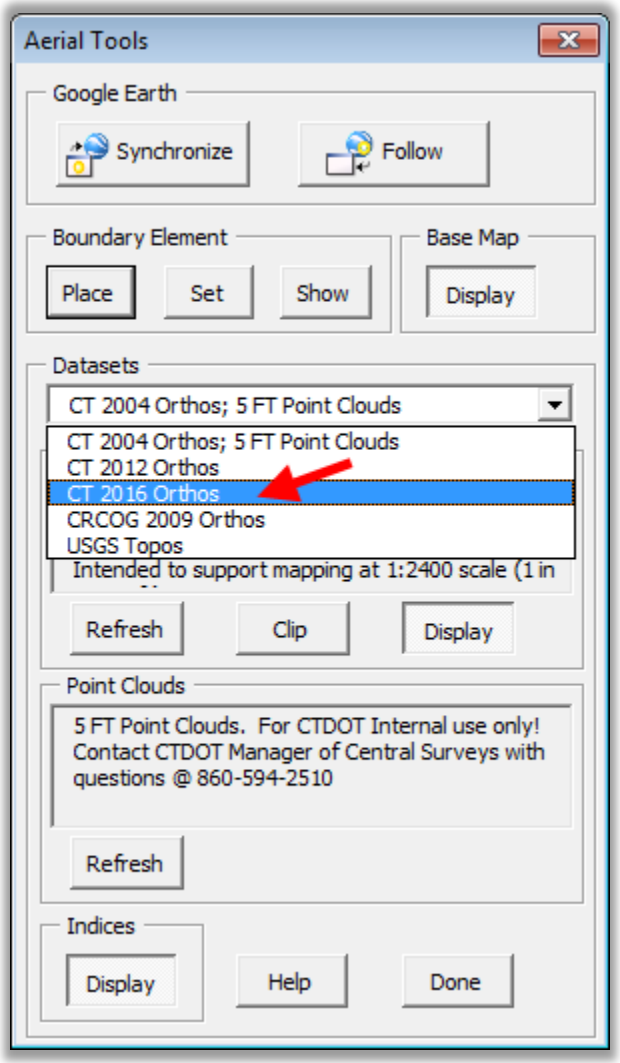
1. To start using the Aerial Tools Application go to the MicroStation Main menu and select *CTDOT Utilities > Earth Exploration > Load Aerial Tools Application*. A help video can be accessed by clicking on Aerial Tools Help Video above the load application.





2. On the Aerial Tools dialog box select the *desired data set* from the picklist.
3. In the MicroStation view zoom to the *area of interest*.
4. On the Aerial Tools Dialog box click the **Place** button and the MicroStation Place Shape command will load. Place a shape around the area you would like data to appear. Using MicroStation Element Section add the shape to your selection set.
5. On the Aerial Tools Dialog box click the **Set** button. If prompted with the Boundary Element Box select **Yes**.
6. On the Aerial Tools Dialog box click the **Refresh** button in Raster area. It may take a few minutes to update if you are loading several files at once.
7. Click **Done** on the Aerial Tools Dialog Box and the application will close. The photos will be displayed in the view and be listed in the Raster Manager dialog box.





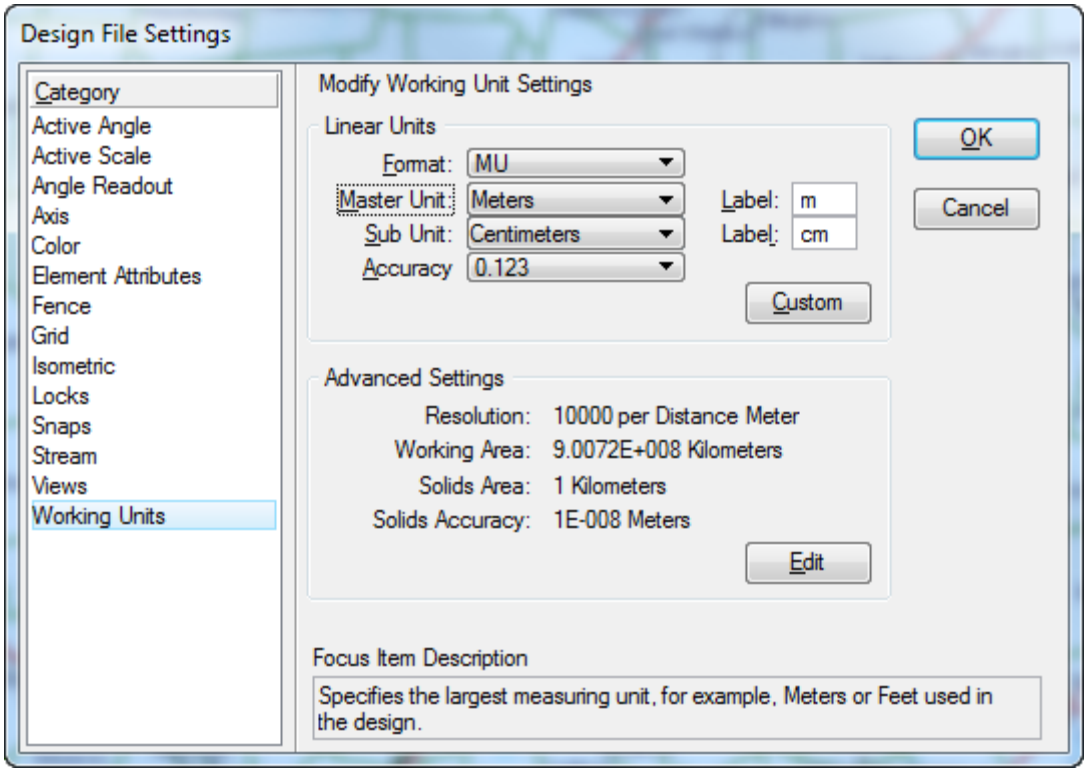
Section 2.3 Reprojecting Photos

At this point you must have the needed aerial photos attached. You are currently working in the NAD 83 coordinate system and will follow this workflow if you need to reproject these files to a different system. Most needed reprojections will be English NAD 83 to English NAD 27 and in some cases metric reprojections are needed.

2.3.1 Convert to Metric

If you need to work in metric you will need to change your working units, select *Settings > Design File*. Click on Working Units and change as follows. Click OK to close the dialog box.

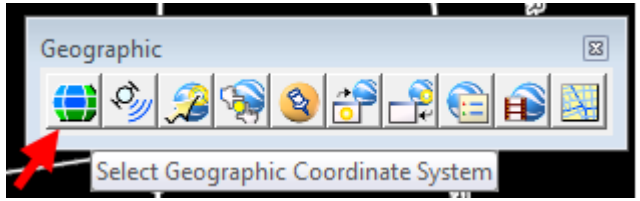
Format: *MU*
Master Unit: *Meters*
Sub Unit: *Centimeters*
Accuracy: *.123*



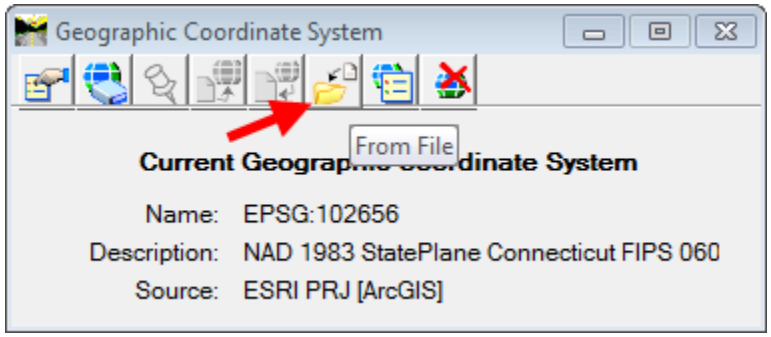
2.3.2 Horizontal Re-projection

1. To change the Coordinate System, select *CTDOT Utilities > Earth Exploration > Geographic Tools*.

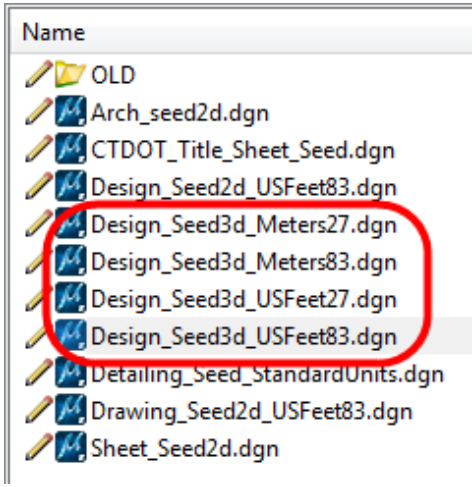
2. On the Geographic Tool Box choose Select Geographic Coordinate System.



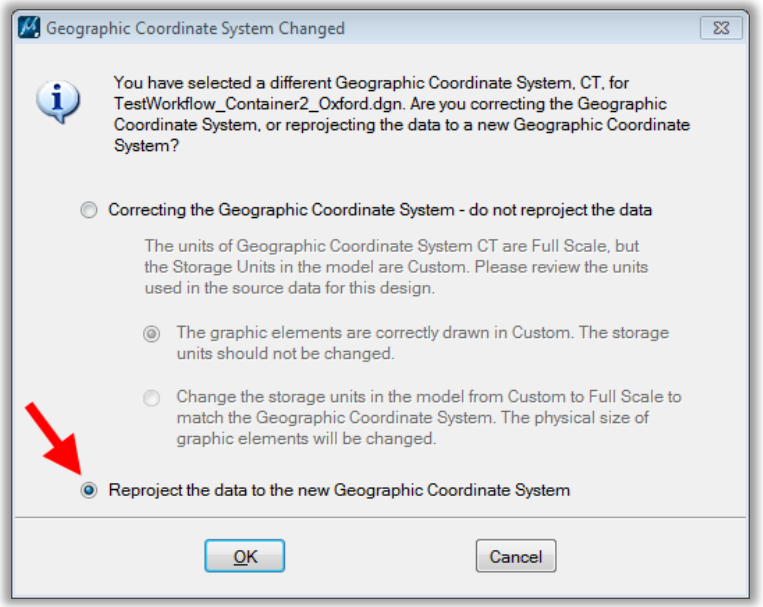
3. On the Geographic Coordinate System Tool Box select From File.



4. In ProjectWise browse to *05.0 - Workspace Resources\3_Workspace_V8i\Standards\seed* and select the needed Geospatial File.

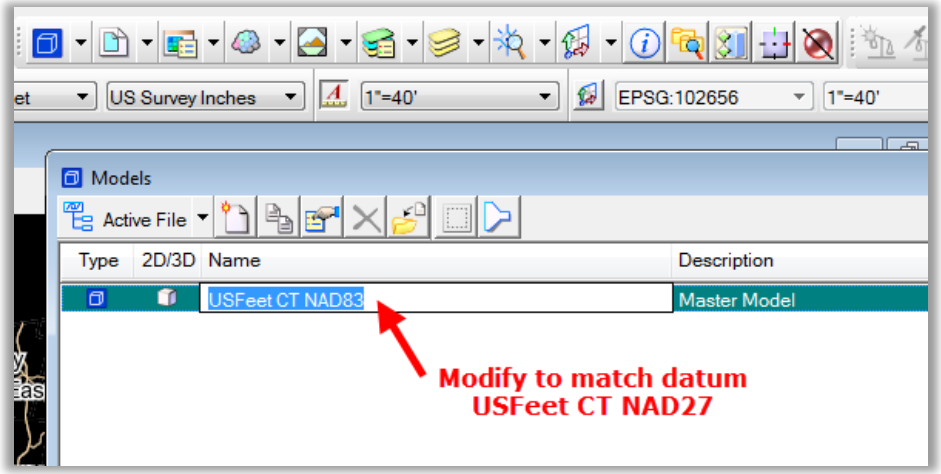


5. On the Geographic Coordinate System Changed dialog box select Reproject the Data to the new Geographic Coordinate System and select OK.



6. Update the name of your model in the Models Dialog box to match the reprojection.

7. If you need to use Aerial tools again you will need to repeat steps 1 to 4 and set the coordinate system back to English NAD 83.



Chapter 3 LiDAR

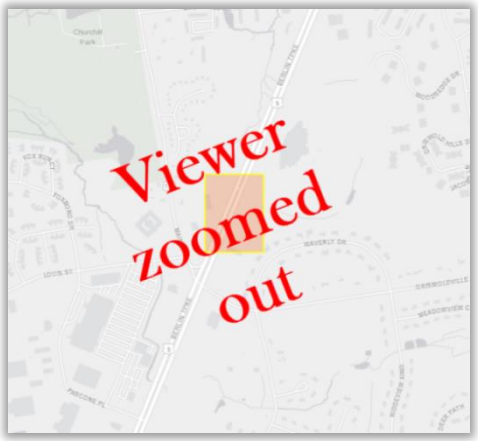
Statewide LiDAR compatible with MicroStation V8i can be found in two places.

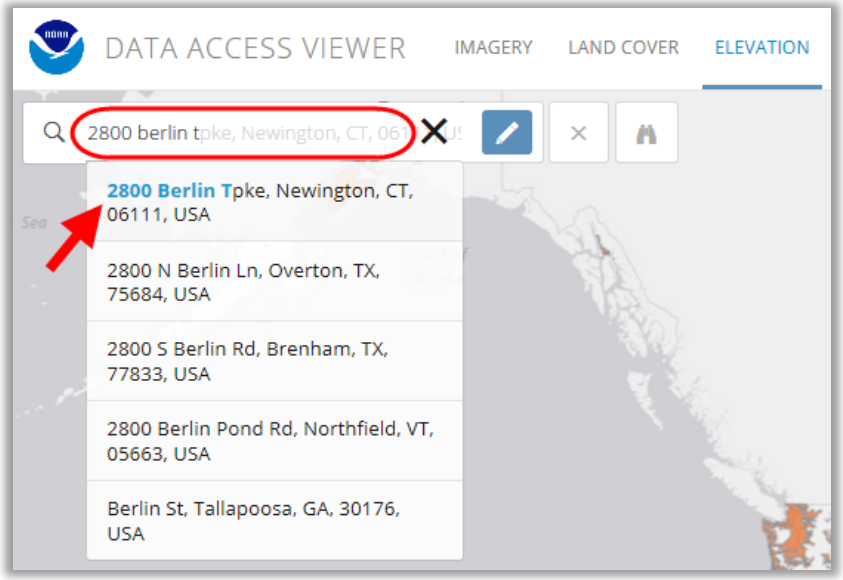
- **NOAA website - 2016 Flight**, available at https://coast.noaa.gov/dataviewer/#/lidar/search/ Data is retrieved and downloaded from the website and then imported into a MicroStation Point Cloud.
- **ProjectWise – 2004 Flight**, available through the Aerial Tools Application that runs inside of MicroStation and gets attached as a Point Cloud POD file.

Section 3.1 2016 LiDAR Data

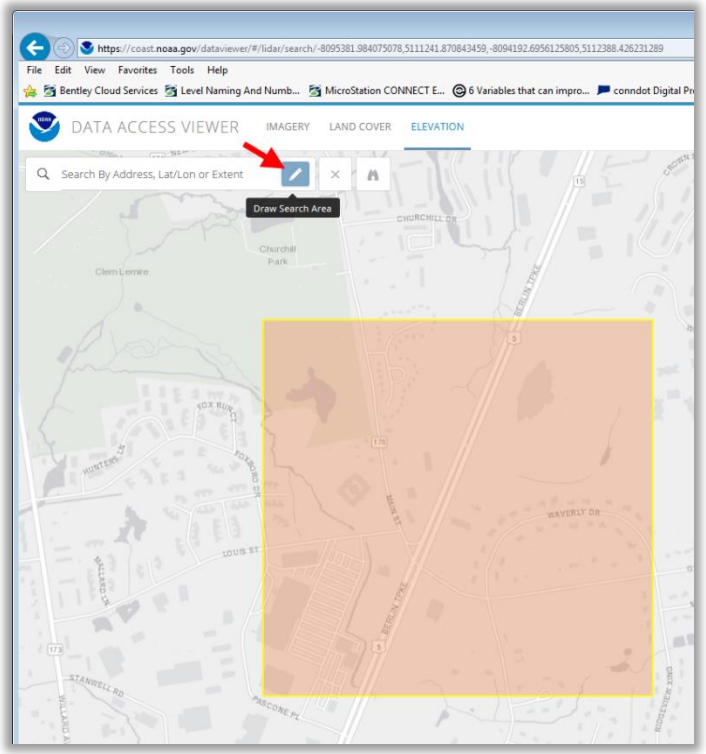
3.1.1 Retrieving LiDAR Data from NOAA

1. Go to the NOAA Data Access Viewer and search for your location.
2. https://coast.noaa.gov/dataviewer/#/lidar/search/
3. After entering a location or address the viewer may make the map zoomed in too far, you may need to zoom out a bit to see the map information.

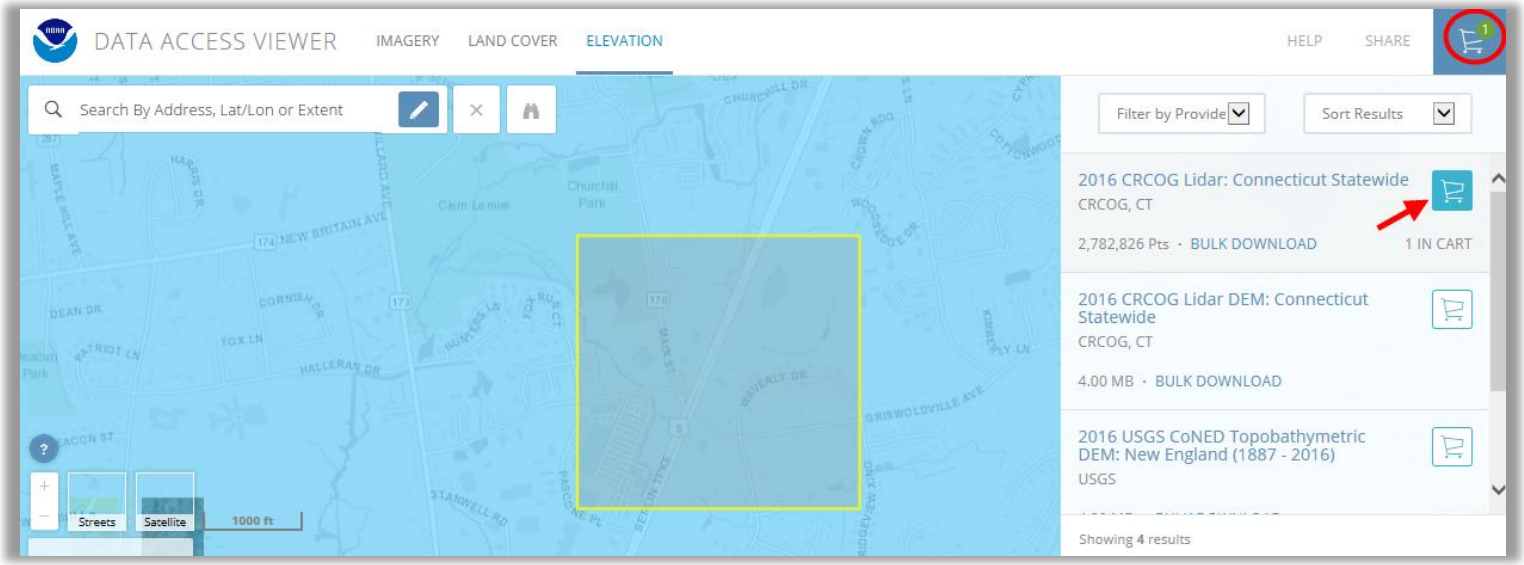




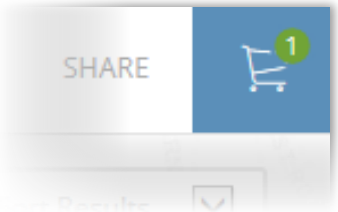
4. Click the Draw Search Area icon. Click and Drag from left to right to create a selection area. The area should be shaded.



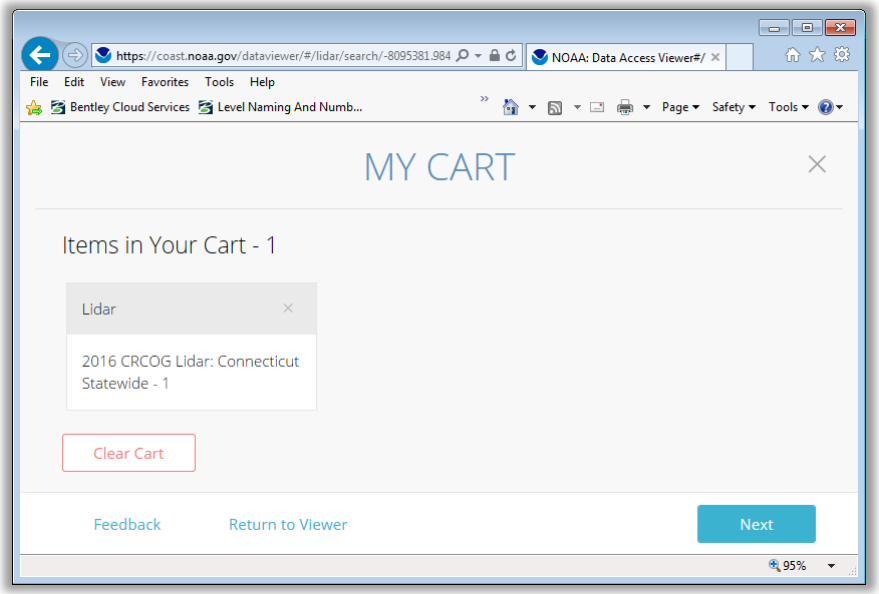
5. To select a data set, click the Cart icon next to the *2016 CRCOG Lidar: Connecticut Statewide* data set title the cart icon in the upper right should update and show the number of items added.



6. Click on the shopping cart icon.

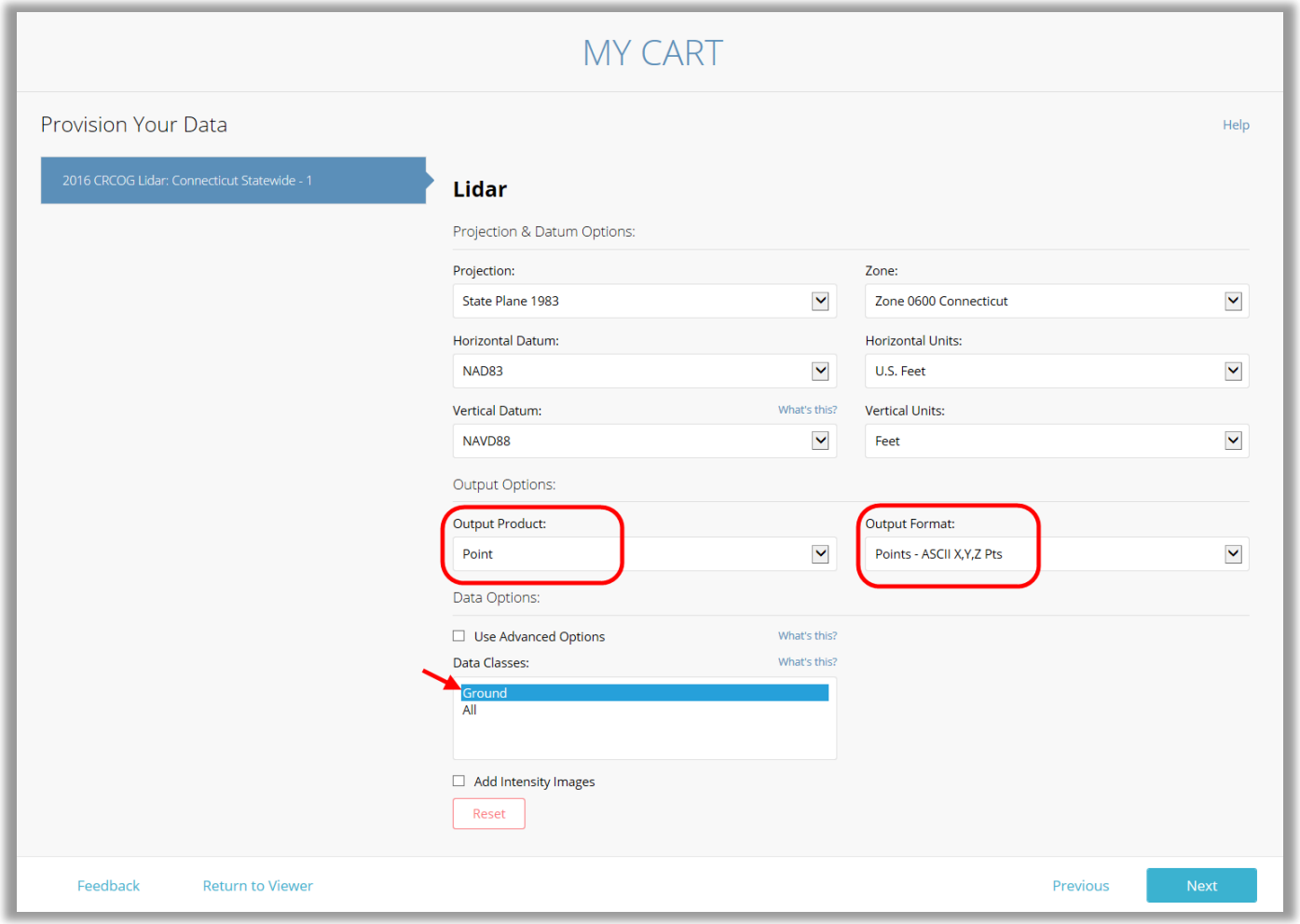


7. The MY CART page should appear, the data source you selected should be shown. Click Next.

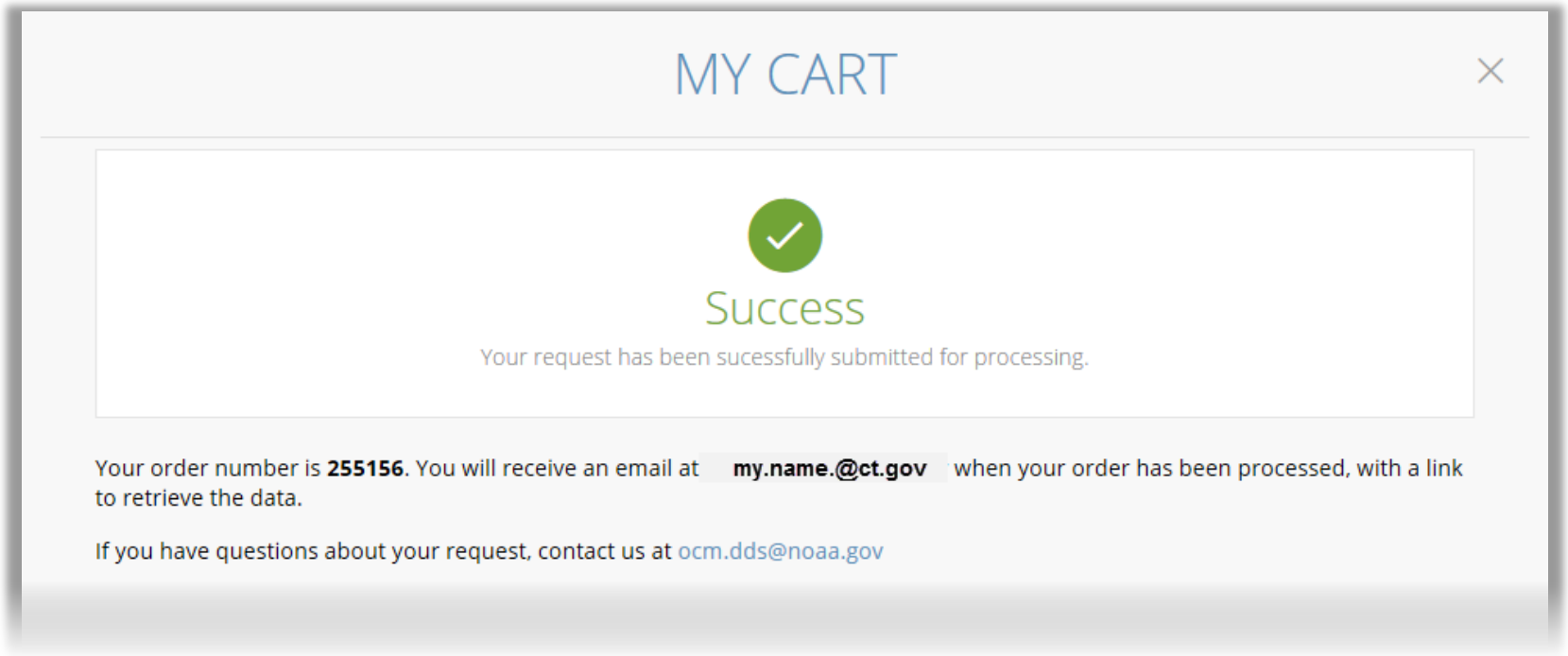


8. The next page shows projection options. Set the *Projection, Datum and Unit fields* to those matching your survey ground file, if you do not have a survey file select NAD83 and NAVD88. Set the *Output Product* to **Point**, and the *Output Format* to **Points – ASCII X,Y,Z Pts**. then Click **Next**.

   NOTE: See AEC for further instruction if your survey is Horizontal Datum NAD27 and Vertical Datum NAVD88. Extra steps will need to be completed as this is not an option on the NOAA website the reprojection will need to be completed in MicroStation.

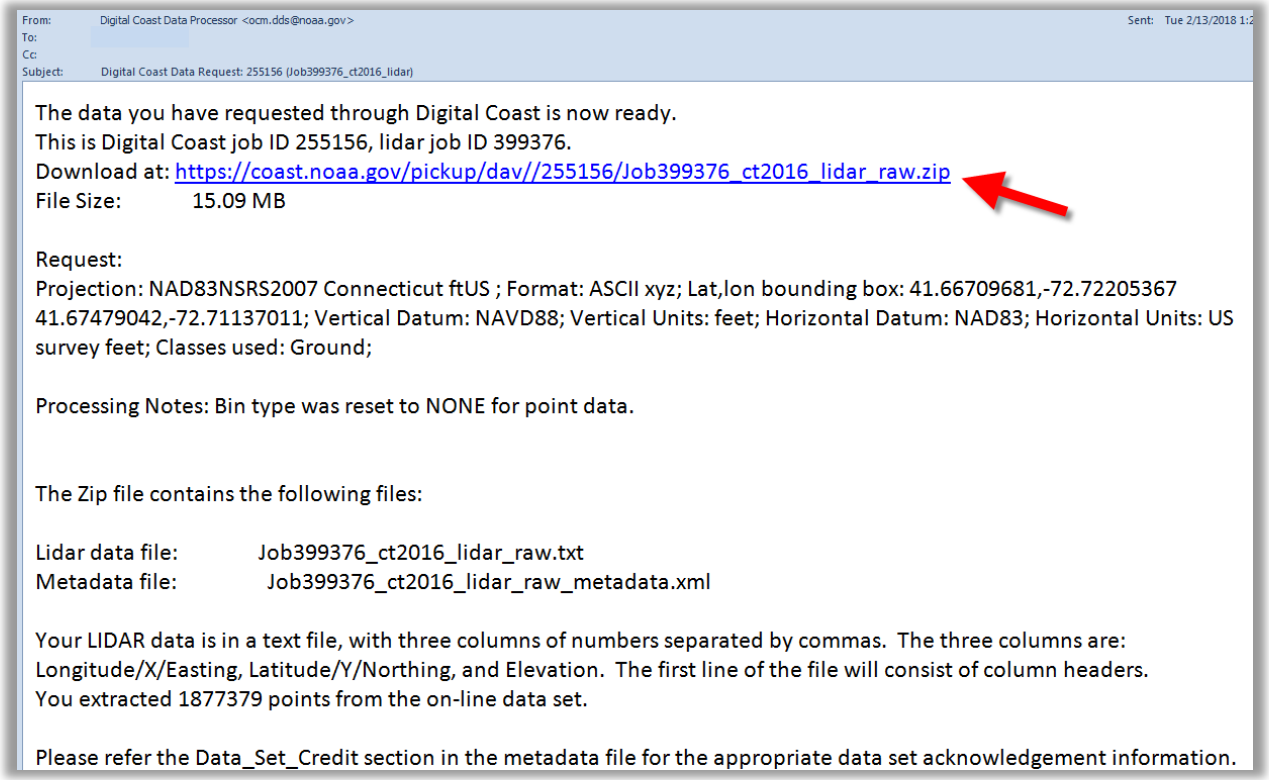


9. On the next page enter your state email address. Click **Next**.
10. Review your selections and if correct, click **Submit**.
11. Take note of the *order number* provided on the confirmation page and make a note for the location, this will make it easier to sort out emails received later with the data links.



3.1.2 Downloading and Saving the LiDAR Data Set

1. The first email you receive from Digital Coast is a confirmation of the data request. No action needs to be taken with this email. The second email contains the *download link* for the data. Click the link in the email and save the zip file to your project. The third email you receive also contains links to the same data in the second email. This email can be ignored. Emails may take a few minutes to receive; your wait time will be longer for larger data sets.



From: Digital Coast Data Processor <ocm.dds@noaa.gov> Sent: Tue 2/13/2018 1:2
To:
Cc:
Subject: Digital Coast Data Request: 255156 (Job399376_ct2016_lidar)

The data you have requested through Digital Coast is now ready.
This is Digital Coast job ID 255156, lidar job ID 399376.
Download at: https://coast.noaa.gov/pickup/dav//255156/Job399376_ct2016_lidar_raw.zip
File Size: 15.09 MB

Request:
Projection: NAD83NSRS2007 Connecticut ftUS ; Format: ASCII xyz; Lat,lon bounding box: 41.66709681,-72.72205367 41.67479042,-72.71137011; Vertical Datum: NAVD88; Vertical Units: feet; Horizontal Datum: NAD83; Horizontal Units: US survey feet; Classes used: Ground;

Processing Notes: Bin type was reset to NONE for point data.

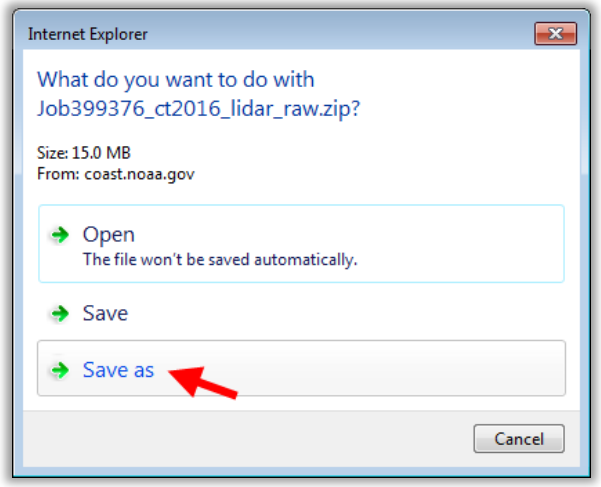
The Zip file contains the following files:

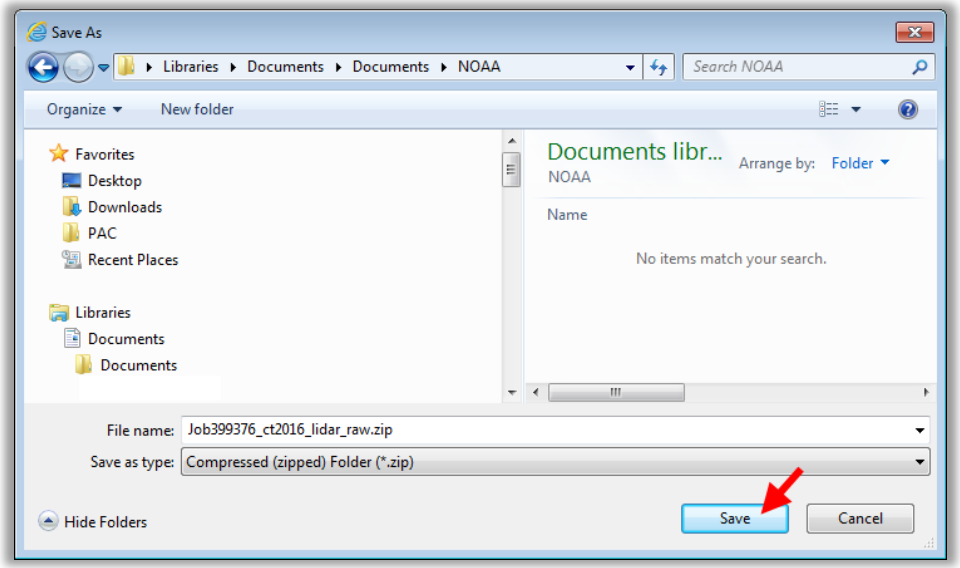
Lidar data file: Job399376_ct2016_lidar_raw.txt
Metadata file: Job399376_ct2016_lidar_raw_metadata.xml

Your LIDAR data is in a text file, with three columns of numbers separated by commas. The three columns are: Longitude/X/Easting, Latitude/Y/Northing, and Elevation. The first line of the file will consist of column headers.
You extracted 1877379 points from the on-line data set.

Please refer the Data_Set_Credit section in the metadata file for the appropriate data set acknowledgement information.

2. After clicking the link, Select **Save as**. Browse to *my documents* on your D drive. Create a folder called NOAA and click **Save**.



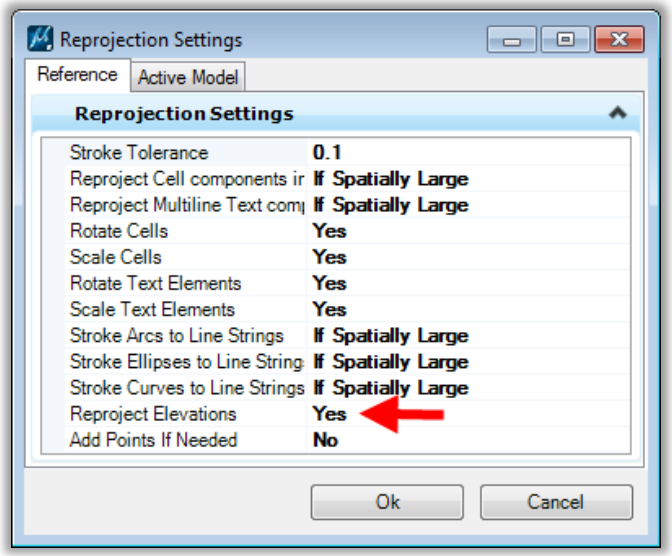


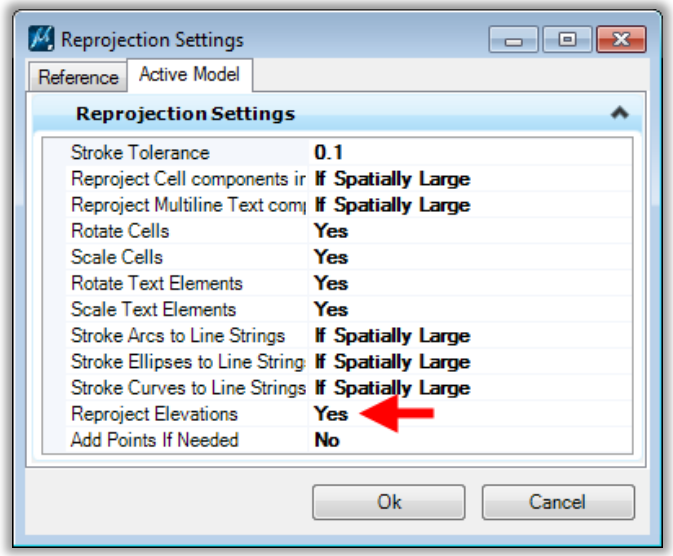
3. In window explorer select the zip file, right click and *choose* **Extract All.** The files will extract into a folder and contain a .txt file(s) and an .xml file.

3.1.3 Creating a Terrain DGN File for 2016 LiDAR Data

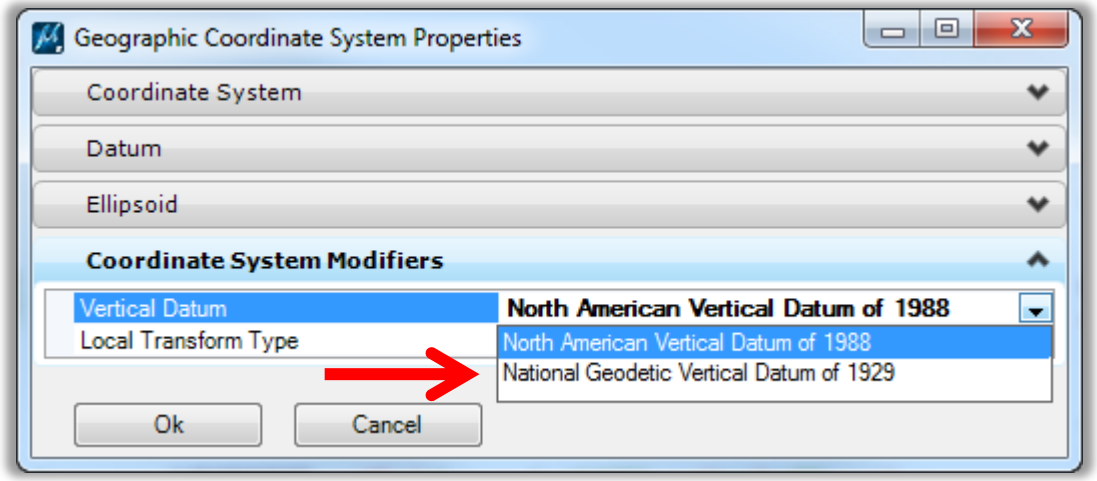
1. In ProjectWise Explorer browse to your working location. On the ProjectWise Explorer Main Menu, select *Document > New Document*.
2. In the Select a Wizard Dialog Box, select Advanced Wizard then OK. On the Advanced Document Creation Wizard Welcome dialog box select Next >. When prompted to Select Target Folder, verify that you are pointed to the correct folder and select Next >.
3. From the Select a Template options, toggle on Use ProjectWise as a template and click the Select button.
4. A Select Template Document dialog box will appear. Browse to the seed file location:
5. *0 5. 0 - Workspace Resources\3_Workspace_V8i \Civil_Standards\seed*
6. Choose the correct 3D seed file 3D_OpenRoads_DesignSeed_83.dgn or 3D_OpenRoads_DesignSeed_27.dgn
7. Select the Open button. The template is now populated for Advanced Document Creation. Select Next >.
8. Select the fields to Define Document Attributes. Tab to accept each field. The document file name will be built from these fields. Be sure to enter a *Label* and *Description*. These fields will be displayed and used for searching rather than the file name. Select Next >.
9. On the Document Properties Dialog Box select Next >. On the Create a Document Dialog box select Next >.
10. Click Finish to close. The new file will now appear in ProjectWise. To update the ProjectWise Explorer Document View data point in the view and then select F5 on the keyboard. This will refresh Label and Description.
11. Right click on the DGN file and select Open With. In the Open document with dialog box locate the Description column and select *OpenRoads SS4* and click OK.

12. On the main MicroStation menu bar select *CTDOT Utilities > Earth Exploration > Geographic Coordinate System Settings*. Change Reproject Elevations to Yes on both the Reference and Active Model tabs.



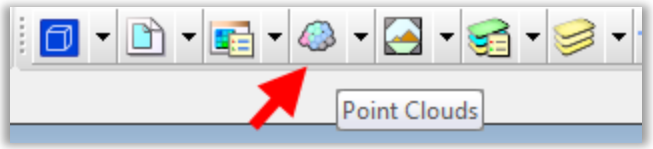


13. If you downloaded a 1983 State Plane data set with NAD83 horizontal information and chose a vertical datum of NGVD29 (rather than the typical NAVD88) you will need to adjust the Vertical Datum setting in MicroStation before importing the points. Select *CTDOT Utilities > Earth Exploration > Geographic Coordinate System Details*. Change the Vertical Datum to *National Geodetic Vertical Datum of 1929* and select **OK**.
14. On the Geographic Coordinate System Changed dialog box select **Reproject the Data to the new Geographic Coordinate System** and select **OK**.
15. On the MicroStation main menu select *File > Save Settings*.

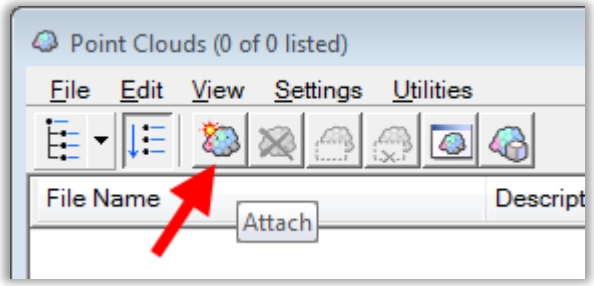


3.1.4 Creating Point Clouds from LiDAR Data

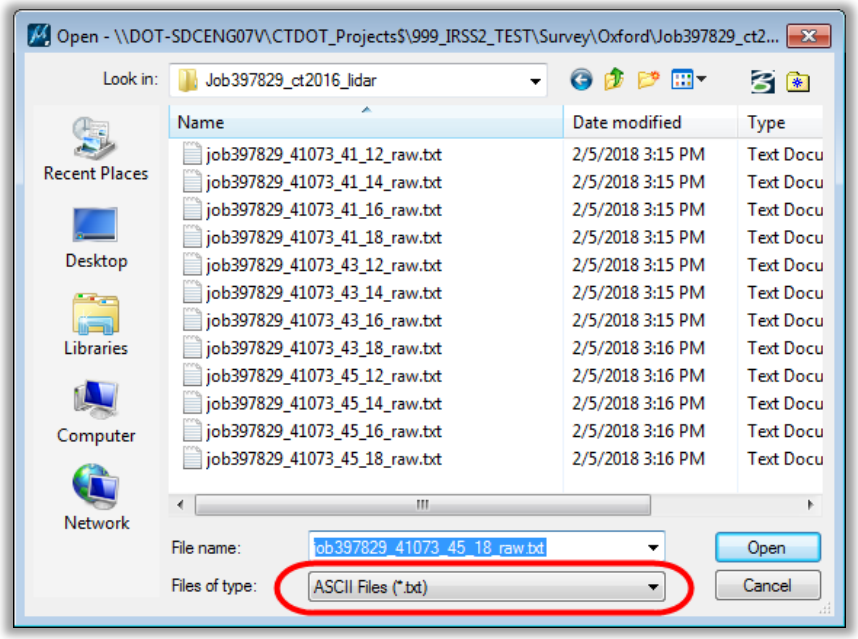
1. In the MicroStation window click the Point Clouds Icon.



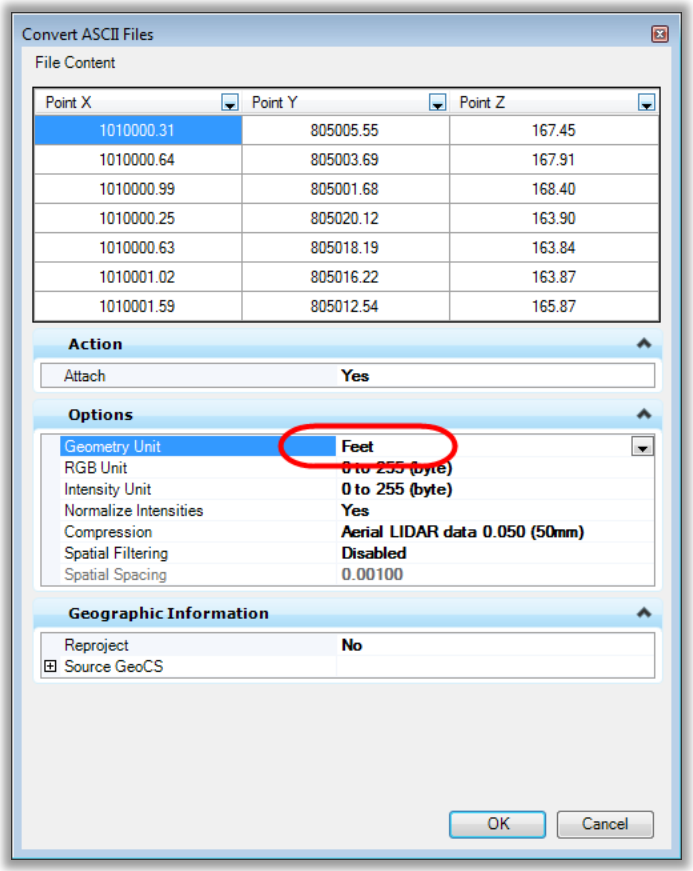
2. The Point Clouds dialog will appear, Click the Attach button.



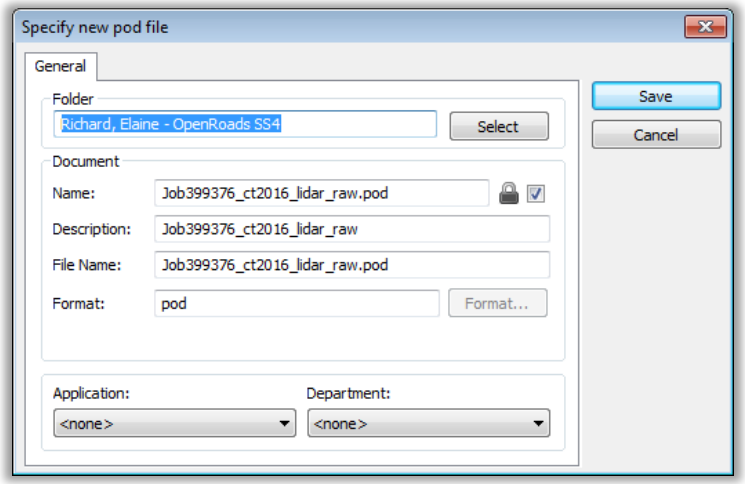
3. A ProjectWise dialog box will appear, click Cancel and a Windows Explorer dialog box will appear, browse to and *select the text file* that was downloaded from the NOAA site. Change the Files of Type: to ASCII Files (*.txt) and click Open.



4. A dialog for converting ASCII will open, make sure the columns are set to x, y, z and the Geometry Units are set to *Feet* if the job is in English and Meters if the job is in Metric. Click **OK**.
5. The Select a Wizard dialog box will appear, select **No Wizard** and click **OK**.

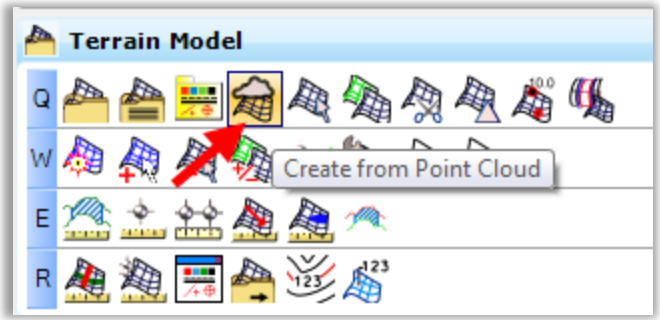


6. The Specify new pod file dialog box will appear, **Save** the file as a .pod file ensuring it will go into the correct folder in ProjectWise. It may take some time, wait until cursor comes back.
7. Click **Fit View** to see the points.
8. To make the points easier to see, go to the **View Attributes** dropdown and set the *Point Cloud Presentation Style* to **Elevation**. To change the display click on the Magnifying Icon under Point Cloud Presentation. Select the desired look under Depth and Colorization and click Save Settings. For more information about Point Clouds go to Section 4 - Working with Point Clouds. You can also set this from the Point Clouds dialog, choose *Settings>Presentation* and select Elevation. Right click to apply to open views.

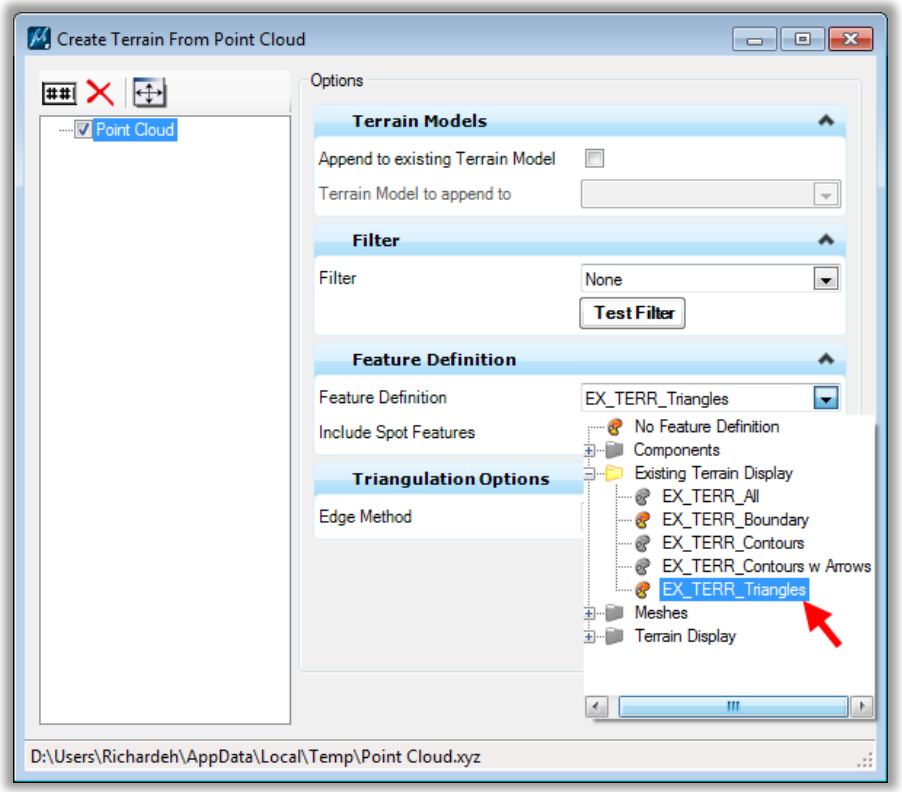


3.1.5 Creating a Terrain from Point Clouds

1. On the MicroStation Task menu select *Civil Tools > Terrain Model* and select the Create from Point Cloud Icon.



2. On the Create Terrain From Point Cloud dialog box select the following:
3. Filter: *None*
4. Feature Definition: *EX_TERR_Triangles*
5. Edge Method: *No Removal*
6. Click on the Import Button and triangles will appear on your screen.



> **NOTE:** If the file spins out and you experience a crash the file you are trying to create maybe too big. Go to Section 5.1 for directions on how to reduce the size of the import.

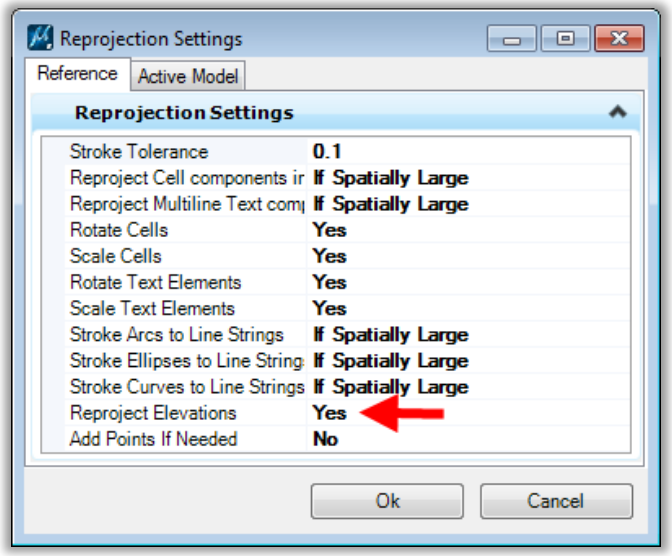
7. You should now detach the POD file so only the Terrain is in the files.
8. Hoover over the triangles and set the Terrain active. The Terrain is now part of the MicroStation DGN. This file can be referenced in and used as the existing terrain for an OpenRoads preliminary design work.

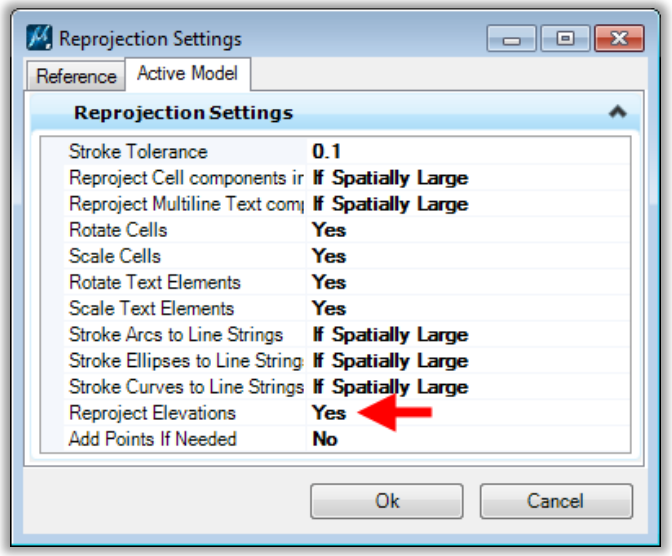
Section 3.2 2004 LiDAR Data

3.2.1 Creating a Terrain DGN File for 2004 LiDAR Data

1. In ProjectWise Explorer browse to your working location. On the ProjectWise Explorer Main Menu, select *Document > New Document*.
2. In the Select a Wizard Dialog Box, select Advanced Wizard then OK. On the Advanced Document Creation Wizard Welcome dialog box select Next >. When prompted to Select Target Folder, verify that you are pointed to the correct folder and select Next >.
3. From the Select a Template options, toggle on Use ProjectWise as a template and click the Select button.
4. A Select Template Document dialog box will appear. Browse to the seed file location: *0 5. 0 - Workspace Resources\3_Workspace_V8i \Civil_Standards\seed*
5. Choose the correct 3D seed file 3D_OpenRoads_DesignSeed_83.dgn
6. Select the Open button. The template is now populated for Advanced Document Creation. Select Next >.
7. Select the fields to Define Document Attributes. Tab to accept each field. The document file name will be built from these fields. Be sure to enter a *Label* and *Description*. These fields will be displayed and used for searching rather than the file name. Select Next >.
8. On the Document Properties Dialog Box select Next >. On the Create a Document Dialog box select Next >.
9. Click Finish to close. The new file will now appear in ProjectWise. To update the ProjectWise Explorer Document View data point in the view and then select F5 on the keyboard. This will refresh Label and Description.

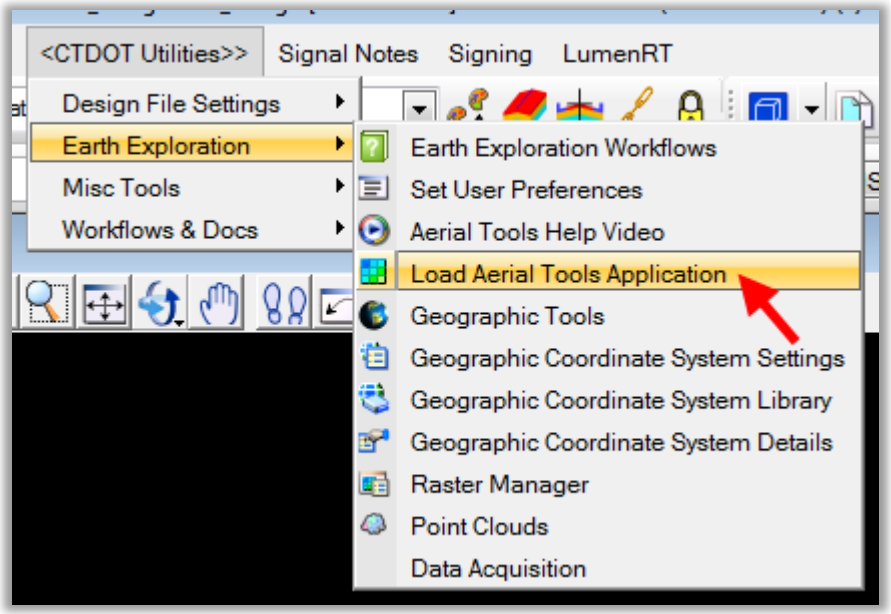
10. Right click on the DGN file and select **Open With.** In the Open document with dialog box locate the Description column and select *OpenRoads SS4* and click **OK**.
11. On the main MicroStation menu bar select *CTDOT Utilities > Earth Exploration > Geographic Coordinate System Settings*. Change Reproject Elevations to **Yes** on both tabs.

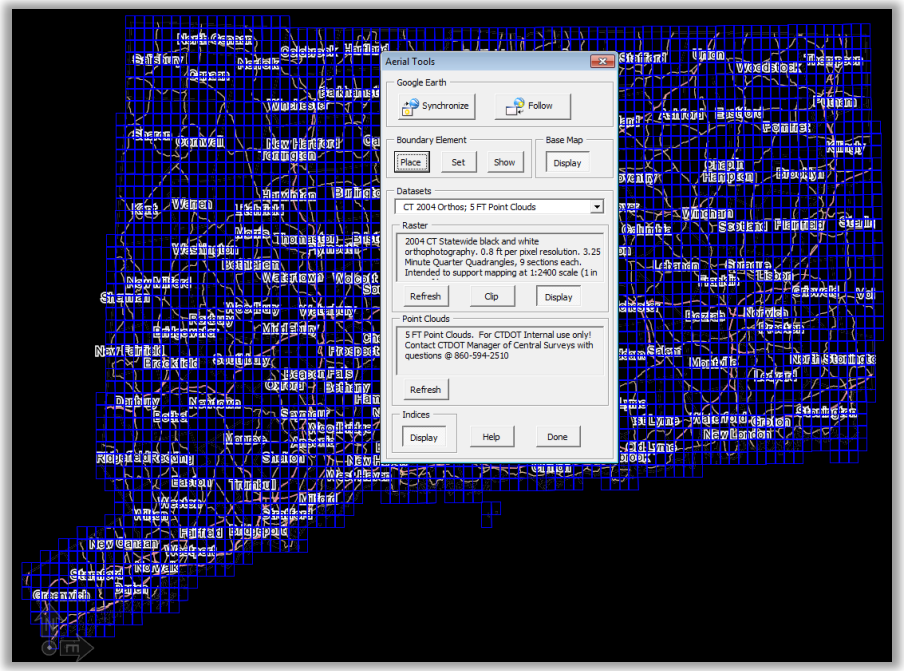




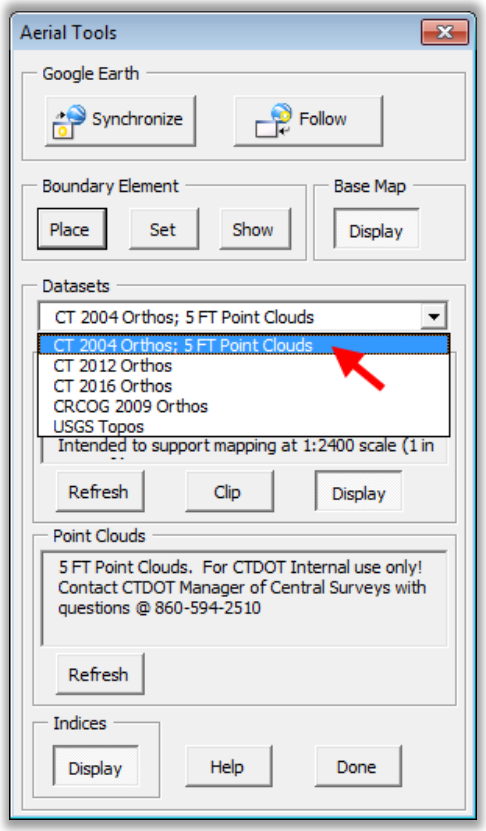
3.2.2 Attaching POD Files using The Aerial Tools Application

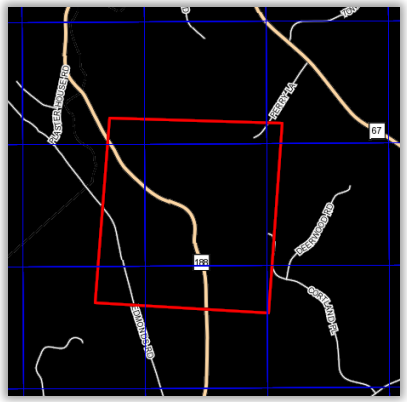
1. To start using the Aerial Tools Application go to the MicroStation Main menu and select *CTDOT Utilities > Earth Exploration > Load Aerial Tools Application*. A help video can be accessed by clicking on *Aerial Tools Help Video* above the load application.





2. On the Aerial Tools Dialog box select CT 2004 Orthos, 5FT Point Clouds from the Picklist.
3. In the MicroStation view zoom to the area of interest.
4. On the Aerial Tools Dialog box click the Place button and the MicroStation Place Shape command will load. Place a shape around the area you would like data to appear. Using MicroStation Element Section add the shape to your selection set.
5. On the Aerial Tools Dialog box click the Set button. If prompted with the Boundary Element Box select Yes.
6. On the Aerial Tools Dialog box click the Refresh button in Point Clouds area. It may take a few minutes to update if you are loading several files at once. Click Cancel on the Attach Point Cloud Reference File dialog box, this box may pop up several times just continue to hit cancel until it no longer comes up.
7. Click Done on the Aerial Tools Dialog Box and the application will close.
8. To make the points easier to see, go to the View Attributes dropdown and set the *Point Cloud Presentation Style* to Elevation. To change the display click on the Magnifying Icon under Point Cloud Presentation. Select the desired look under Depth and Colorization and click Save Settings. For more information about Point Clouds go to Section 4 - Working with Point Clouds. You can also set this from the Point Clouds dialog, choose *Settings>Presentation* and select Elevation. Right click to apply to open views.





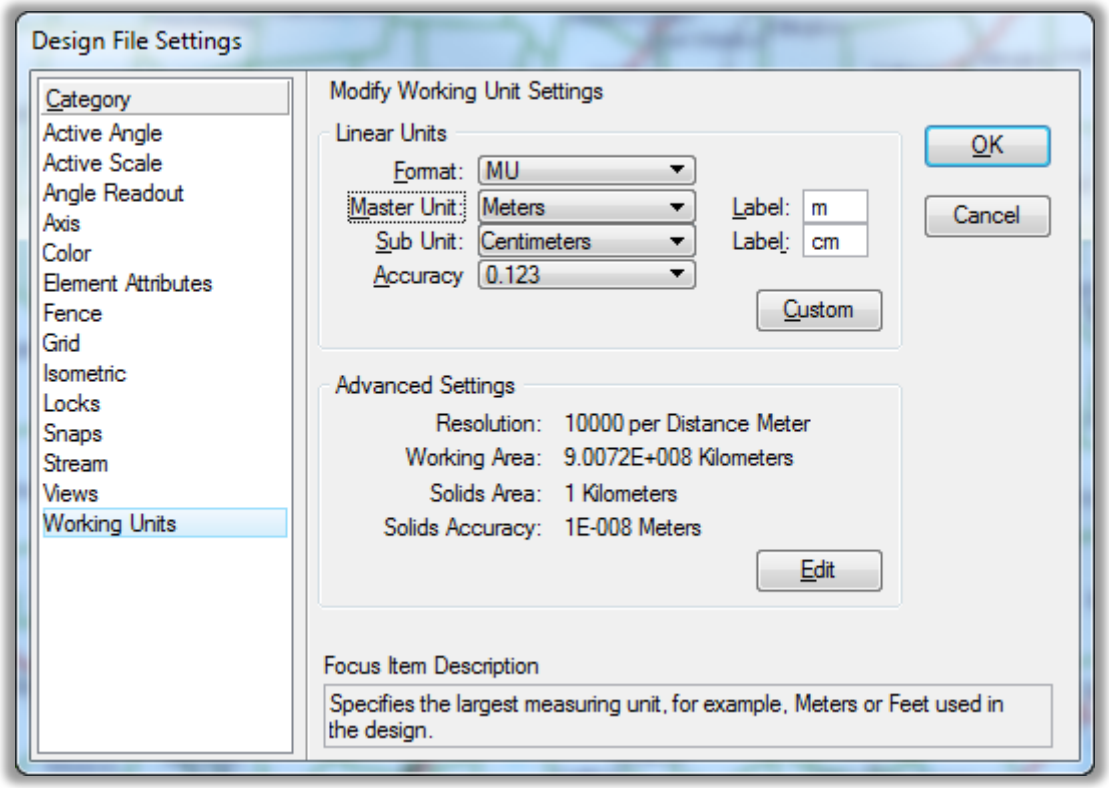
3.2.3 Re-Projecting Data

At this point you must have the needed point clouds attached. You are currently working in the NAD 83 coordinate system and will follow this part of the workflow only if you need to repoject these files to a different system. Most needed reprojections will be English NAD 83 – NAVD 88 to English NAD 27 to NAVD 29. But in some cases the English NAD 83 – NAVD 29, English NAD 27 – NAVD 88 and metric reprojections may be needed.

3.2.3.1 Convert to Metric

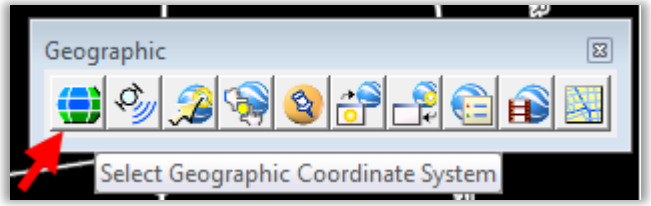
If you need to work in metric you will need to change your working units, select *Settings > Design File*. Click on **Working Units** and change as follows.

Format: *MU*
Master Unit: *Meters*
Sub Unit: *Centimeters*
Accuracy: *.123*

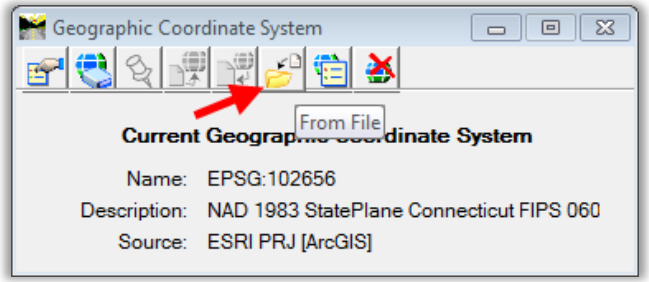


3.2.3.2 Horizontal Re-projection

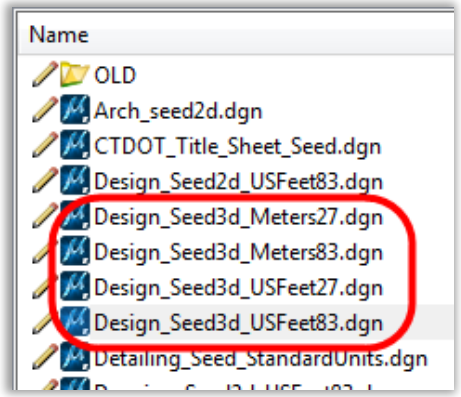
1. To change the Coordinate System, select *CTDOT Utilities > Earth Exploration > Geographic Tools*.
2. On the Geographic Tool Box choose **Select Geographic Coordinate System**.



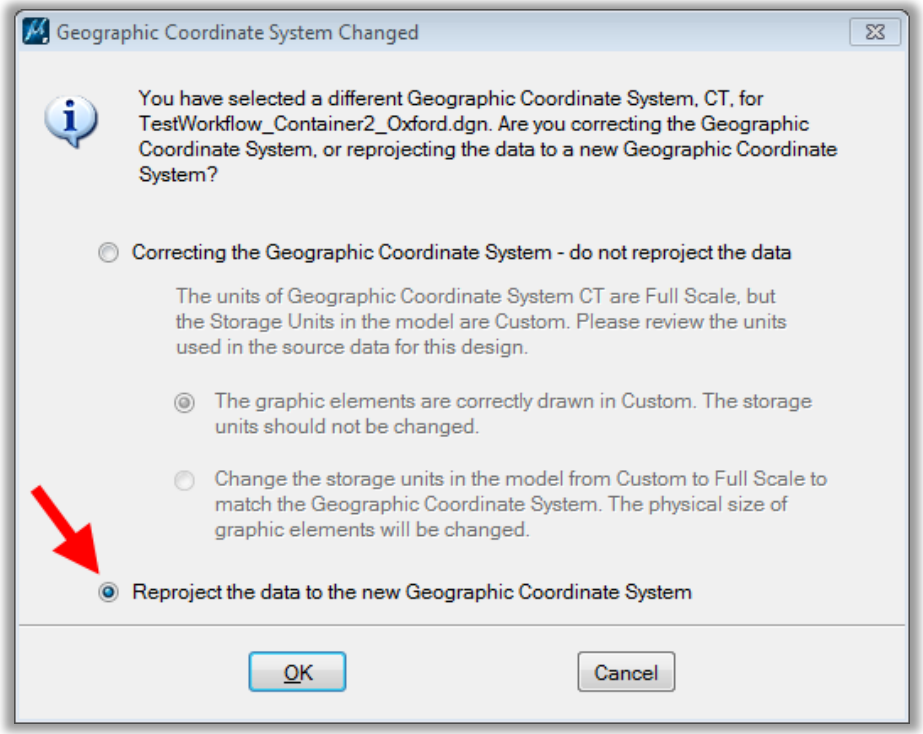
3. On the Geographic Coordinate System Tool Box select **From File**.



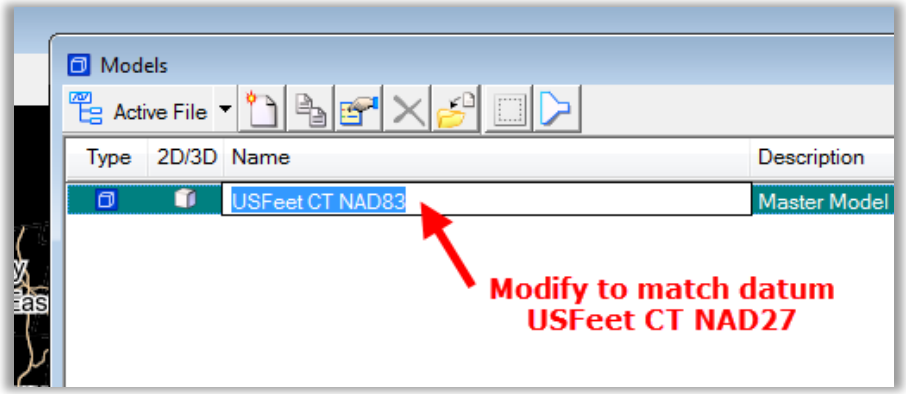
4. Browse to *05.0 - Workspace Resources\3_Workspace_V8i\Standards\seed* and select the needed Geospatial File.



5. On the Geographic Coordinate System Changed dialog box select Reproject the Data to the new Geographic Coordinate System and select OK.

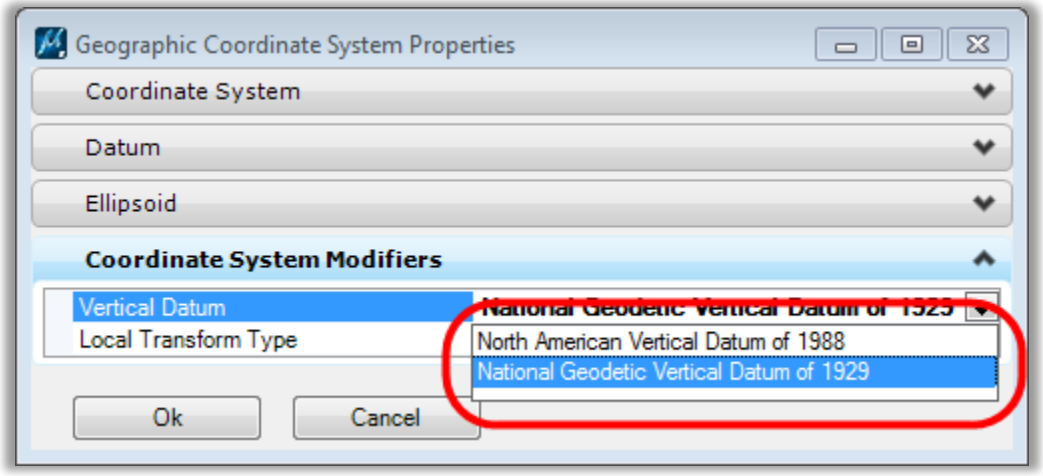


6. Update the name of your model in the Models Dialog box to match the reprojection.



3.2.3.3 Vertical Re-projection

1. Check the correct NAVD is being used. Select *CTDOT Utilities > Earth Exploration > Geographic Coordinate System Details*. Change the Vertical Datum to the required NAVD and select OK.

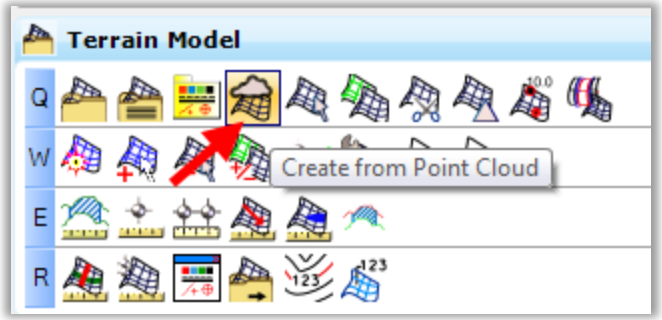


2. On the Geographic Coordinate System Changed dialog box select Reproject the Data to the new Geographic Coordinate System and select OK.

> **NOTE:** If you need to use The Aerial Tools Application again it is recommended you start with a brand new DGN file.

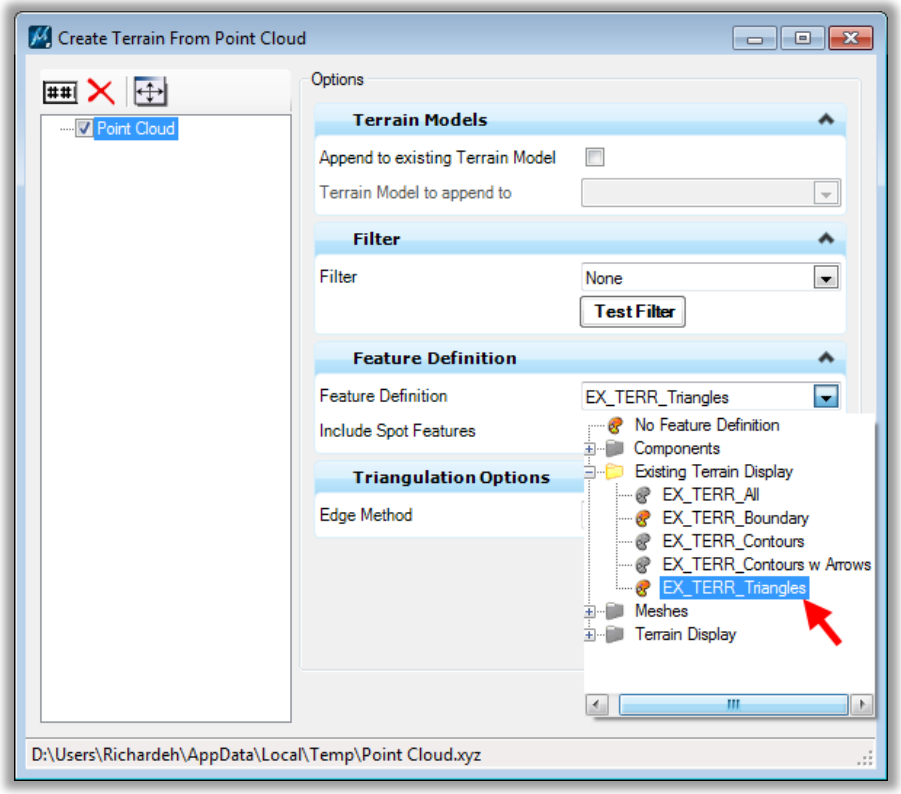
3.2.4 Creating a Terrain from Point Clouds

1. On the MicroStation Task menu select *Civil Tools > Terrain Model* and select the Create from Point Cloud Icon.



2. On the Create Terrain From Point Cloud dialog box select the following:
   Filter: *None*
   Feature Definition: *EX_TERR_Triangles*
   Edge Method: *No Removal*

3. Click on the Import Button and triangles will appear on your screen.

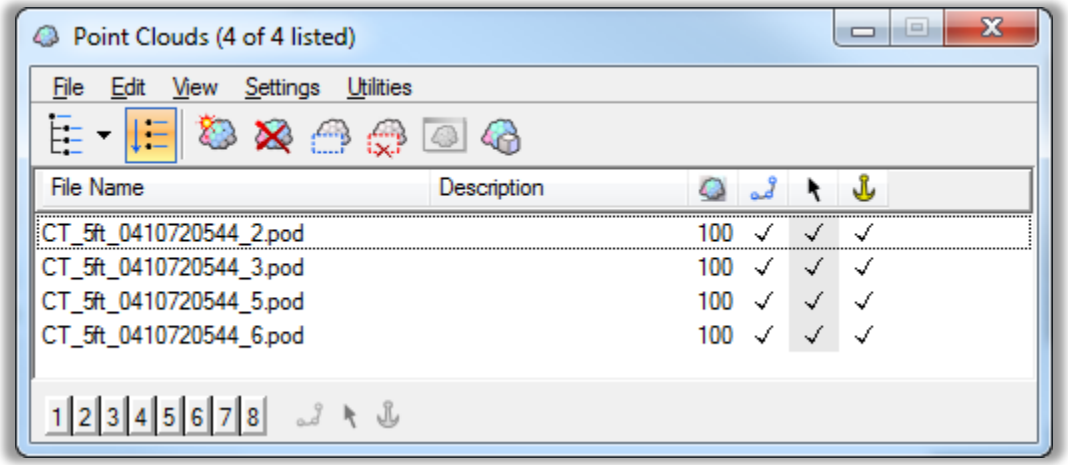


> **NOTE:** If the file spins out and you experience a crash the file you are trying to create maybe too big. Go to Section 5.1 for directions on how to reduce the size of the import.

4. You should now detach the POD file so only the Terrain is in the files.
5. Hoover over the triangles and set the Terrain active. The Terrain is now part of the MicroStation DGN. This file can be referenced in and used as the existing terrain for an OpenRoads preliminary design work.

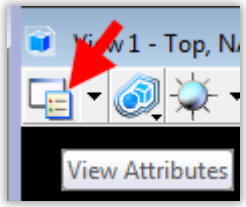
Chapter 4 Working with Point Clouds

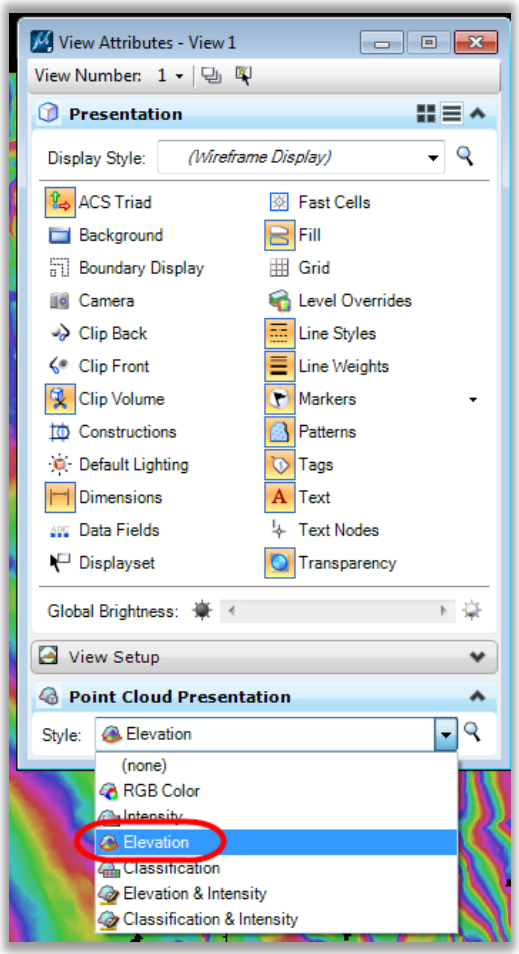
A point cloud is a data file which can include a large number of points on the surface of an object. A point cloud is a set of vertices in a 3D coordinate system and these vertices are defined the by X, Y and Z coordinates. Point clouds are usually created by 3D scanners. These devices measure a large number of points on the surface of an object and output a point cloud as a data file. The point cloud represents the visible surface of the object that has been scanned or digitized. Point clouds are used for many purposes, especially to confirm measurements between the DGN model and the real world.

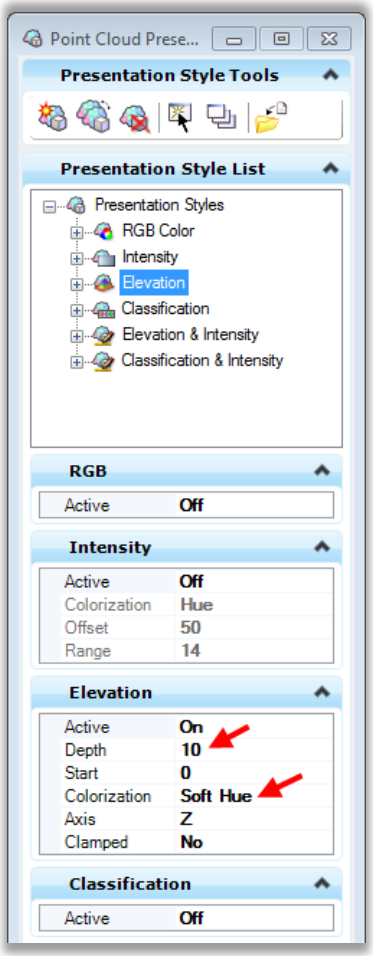


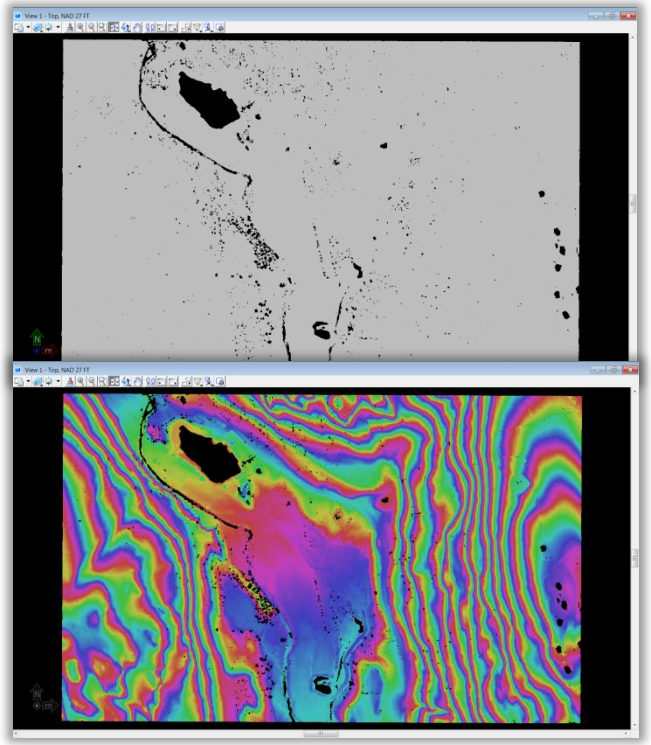
Section 4.1 Point Cloud Display

1. Select the View Attributes icon on your View window.
2. For Point Cloud Presentation select Elevation.
3. To change the display click on the Magnifying Icon under Point Cloud Presentation. Select the desired look under Depth and Colorization and click Save Settings.
4. Tip: You can also set this from the Point Clouds dialog, choose *Settings>Presentation* and select Elevation. Right click to apply to open views.









Section 4.2 Using Point Clouds

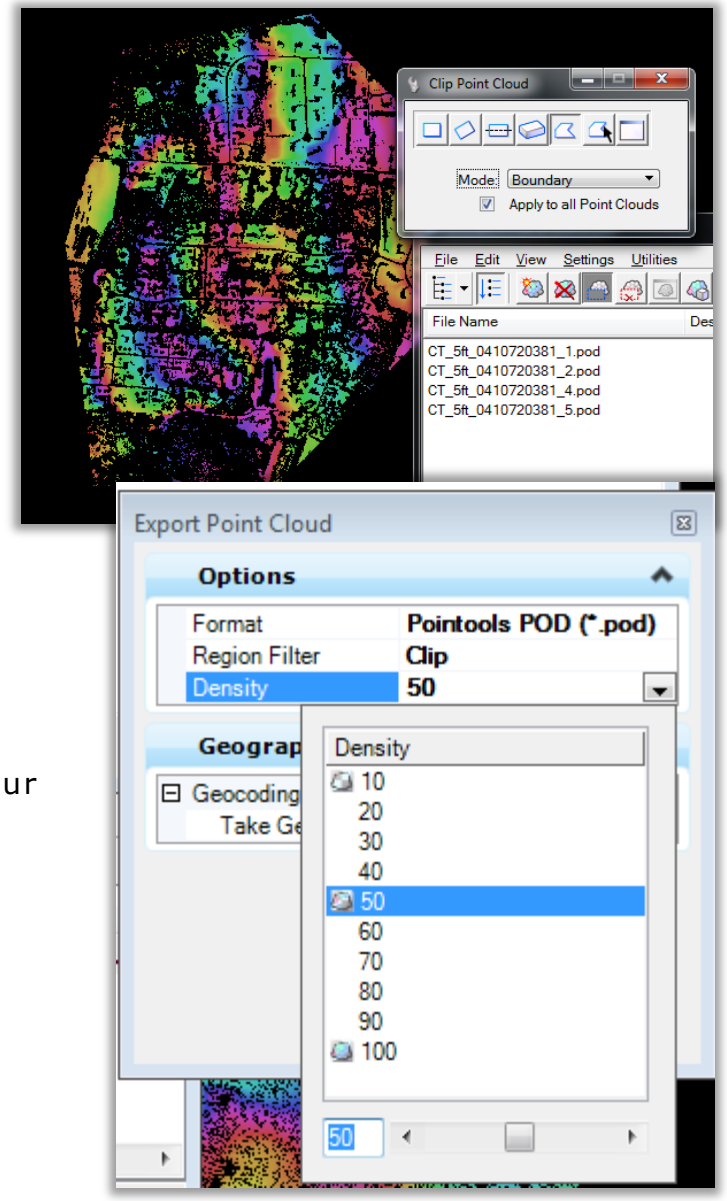
The Point Clouds tools allow you to import, control, visualize and manipulate point cloud images. You can import a point cloud into a DGN and use it as a visual reference. The Point Cloud dialog (File > Point Clouds), along with the Point Cloud toolbox (Tools > Point Cloud), lets you control all aspects of attaching and manipulating point cloud image files. A point cloud is treated as any standard element and can be part of a model or level. MicroStation Point Clouds are POD files, this format allows you to work with huge point clouds at a great performance.

You can open multiple point cloud files simultaneously. Also, you can batch convert multiple point clouds files either to one POD file, convert the data to AACII format or create a terrain model.

To	Select in the Point Cloud toolbox
Open the Point Clouds dialog, which is used to control the display of the point clouds.	 *Open Point Clouds Dialog*
Opens the Open dialog, which allows you to attach a point cloud.	 *Attach Point Cloud*
Detach a point cloud.	 *Detach Point Cloud*
Clip a point cloud.	 *Clip Point Cloud*
Delete a clip from a point cloud.	 *Delete Clip from Point Cloud*
Open the Point Cloud Presentation dialog.	 Point Cloud Presentation

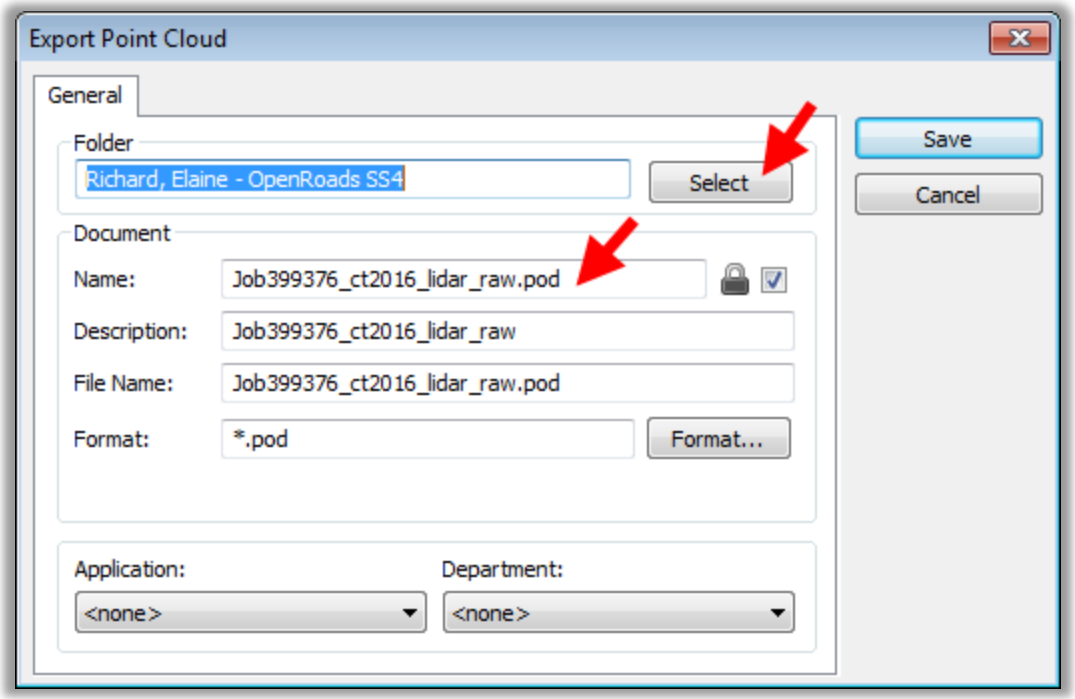
Section 4.3 Modifying a Point Cloud

A point Cloud and be clipped and the density of the points can be filtered down. This may need to be done on extremely large data sets so when the terrain gets created you will have manageable size data. OpenRoads Terrains and be much larger than the traditional InRoads DTMs. OpenRoads Terrain uses a scalable technology allowing for much larger files. There is a limit, please do not try to get a surface from point clouds for the entire state of Connecticut, your computer and the software will surely lock up.



1. Select *Edit > Clip* in the Point Clouds dialog box, in the Clip Point Cloud Dialog box select the placement method.
2. Highlight all the point clouds and select *File > Export*. In the Export Point Cloud box set the following:
   Format = *Pointools POD (*.pod)*
   Region Filter = *Clip*
   Density = *set as desired*
   Click OK.
3. Select No Wizard and OK, when the next box appears select your project folder and rename the clipped POD file. C lick Save.

4. In the Point Cloud dialog box attach the new clipped POD file and compare. Make sure you are happy with the density of the new POD file. The key is to flush out as many points as necessary but still maintain the same basic contour lines. When you are satisfied detach all the unneeded POD files.



Chapter 5 Filter Descriptions

The **Tile Filter** uses an algorithm that divides the LIDAR data set into tiles. A best fit plane is calculated for each tile, and LIDAR points are removed if they fall within the user set Z tolerance to the plane.

The **TIN Filter** first separates the LIDAR points into tiles with a maximum of 2 million points and then repetitively triangulates each tile, filtering out points. The TIN Filter algorithm filters out the points if they fall within the user set Z tolerance of the triangle planes.

No Filter – No filtering is applied

Z Tolerance - common to both algorithms and is basically the variation in the Z coordinate that the surface is allowed to move during the filtering process. Typically for the first invocation of the filtering function, the Z tolerance should be set from 0.5 to 1.0 for imperial data sets and from 0.25 to 0.5 for metric data sets. Depending on the outcome and the desired result, the Z tolerance can be varied up or down.

Max. Tile Points - specifies that a tile will not be subdivided if it has less than this number of points. Typically this is set to five.

Max. Tile Divisions - the allowable level of recursion allowed and is the number of time the initial tiling set can be subdivided. Typically this is set to five.

Start Tile Length – The LIDAR data set is initially divided into tiles of this size, prior to recursion to the minimum tile points. The setting of this parameter requires some knowledge of the distance between the LIDAR points, which requires an inspection of the LIDAR points in MicroStation to determine. Typically set this to 10 times the distance between the LIDAR points.

Course Filter (TIN option only) – Filter more points with some blurring of ridges and valleys

Fine Filter (TIN option only) – Filters fewer points with less blurring of ridges and valleys Points

Before Filter/Points After Filter/Reduction % - Display of the number of points before and after filtering, plus the percentage reduction of points from before and after

Section 5.1 Bentley Recommendations for Creating a Large Terrain from a Point Cloud

Always use the "Tin Filter".
Input the "Z" Tolerance.
Always use the "Coarse" option.
Always use "Reinsert Points" option.
Do not specify a feature definition; change it after the import is complete.