

LIDAR



VERMONT SOCIETY
of **LAND SURVEYORS**

www.es-e-llc.com/vsls

J. Thaddeus "Thadd" Eldredge

ELDREDGE SURVEYING & ENGINEERING, LLC

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www.es-e-llc.com

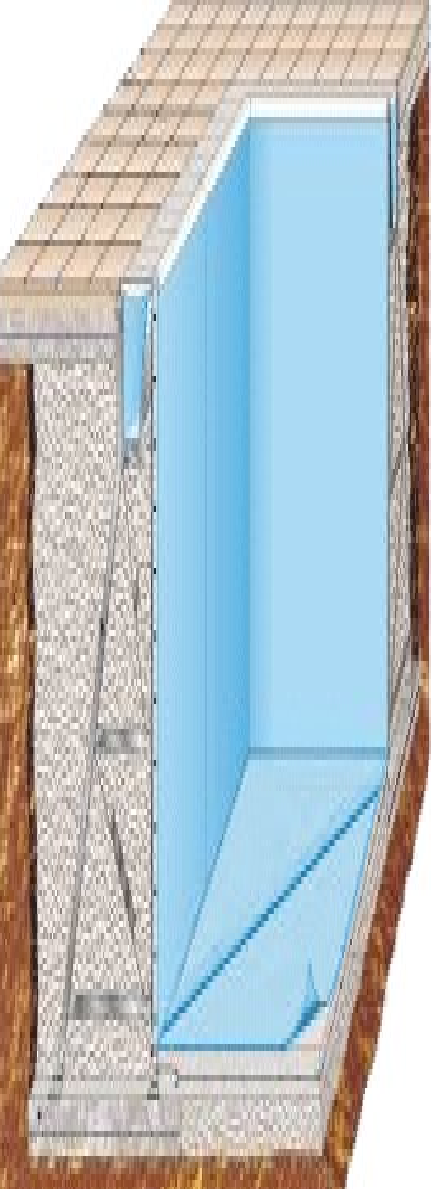
J. THADDEUS

“THADD” ELDREDGE

- BA in Theoretical Mathematics, Colby College
- PLS Certificate from Wentworth Institute of Technology
- PLS 46471, MA
- Soil Evaluator, MA
- Certified Floodplain Manager, USA
- Has a fancy pants name; goes by Thadd.
- I will try to not put you to sleep.

***IN 2014 I JUMPED INTO THE DEEP
END OF THE LIDAR POOL***





The deep end is rather deep

Acquisition – Mobile
Acquisition – Static
Registration – Mobile – Trajectory, Adjustment, Processing
Registration – Static – Combination, QAQC
QAQC – Mobile & Static
Colorizing
Extraction

LiDARUSA Scanlook Suite
FARO Scene
LASTools
Global Mapper
Quick Terrain Reader & Quick Terrain Modeler
Carlson Point Cloud

Fugro Viewer
Arc
Civil3d
Fusion
Cloud Compare
ReCap
MeshLab
PointCloudViz
And more...

Aerial LiDAR data is readily available. While it has limitations, it is an excellent starting point for anybody interested in using LiDAR.

I would have started using this data years ago had I known how well it can be integrated into a Surveying Office.

We got into it because we cannot hire or subcontract enough field crews for the amount of surveying we perform. The use of LiDAR has reduced the amount of field work. It has increased the amount of office work. It has increased the number of services offered.

SALES PITCH

I am a Global Mapper Reseller. If you want a license and work with a reseller, go to them. If you want a license and have no reseller, drop an e-mail. I do provide workflows on my site.

www.ese-llc.com/gmworkflows Password: gm

Global Mapper Geographic Calculator Software Development Purchase Download Support About Us

 **GlobalMapper19**
NOW AVAILABLE

REAL-TIME HILL SHADE RENDERING

DRAG AND DROP WINDOW DOCKING

ADVANCED ATTRIBUTE MANAGEMENT

NAME	LOT	BLOCK	YEAR_BUILT	STATE	ZONE	SECTION
RL...	4	7	2003	MI	Re...	
RL...	8	1	0	MI	Re...	
RL...	5	3	0	MI	Re...	
RL...	00A	0	0	MI	Re...	
RL...	7	1	2004	MI	Re...	
RL...	5	3	0	MI	Re...	
Y...	4	2	0	MI	Co...	
RE...		0	0	MI	Co...	
RL...	5	1	0	MI	Re...	
RL...	7	1	2018	MI	Re...	
RL...	5	1	0	MI	Re...	
Y...	1	2	0	MI	Co...	
Y...	2	2	0	MI	Co...	
RL...	4	1	0	MI	Re...	
RL...	5	1	0	MI	Re...	
AT...	3	1	0	MI	Re...	
			0		Co...	
			0		Co...	
RL...	5	1	0	MI	Re...	
Y...	8	3	1973	MI	Co...	
Y...	7	1	0	MI	Co...	

SALES PITCH

Global Mapper + Lidar – Stuck on one computer \$1,000
Global Mapper + Lidar – USB license \$1,400
VT LiDAR on a Hard Drive * \$300 from VCGI

*There is data available for download from VCGI and USGS Earth Explorer.
Values have been rounded.

[Global Mapper](#) [Geographic Calculator](#) [Software Development](#) [Purchase](#) [Download](#) [Support](#) [About Us](#)

The image shows a promotional banner for Global Mapper 19. The banner features a background of a 3D terrain model with hill shading. On the left, the text reads "Global Mapper 19 NOW AVAILABLE". Below this, a dark blue box contains the text "REAL-TIME HILL SHADE RENDERING". On the right, there are three overlapping screenshots of the software interface. The top screenshot shows a 3D terrain view with a white camera icon and the text "DRAG AND DROP WINDOW DOCKING". The middle screenshot shows a 2D map view with a white camera icon and the text "ADVANCED ATTRIBUTE MANAGEMENT". The bottom screenshot shows a table of data with columns for NAME, LOT, BLOCK, YEAR_BUILT, STATE, ZONE, and SECTION. The table contains several rows of data, including lot numbers, block numbers, and years built.

NAME	LOT	BLOCK	YEAR_BUILT	STATE	ZONE	SECTION
RL...	4	3	2003	MI	Re...	
RL...	8	1	0	MI	Re...	
RL...	5	3	0	MI	Re...	
RL...	00A	0		MI	Re...	
RL...	7	1	2004	MI	Re...	
RL...	5	3	0	MI	Re...	
Y...	4	2	0	MI	Co...	
RE...		0		MI	Co...	
RL...	5	1	0	MI	Re...	
RL...	7	1	2018	MI	Re...	
RL...	5	1	0	MI	Re...	
Y...	1	2	0	MI	Co...	
Y...	2	2	0	MI	Co...	
RL...	4	1	0	MI	Re...	
RL...	5	1	0	MI	Re...	
AT...	3	1	0	MI	Re...	
			0		Co...	
			0		Co...	
RL...	5	1	0	MI	Re...	
Y...	8	3	1973	MI	Co...	
Y...	7	1	0	MI	Co...	

Blue Marble Geographics provides a more comprehensive training.

They just added Pixel to Points... It converts drone imagery to point clouds...

[Global Mapper](#) [Geographic Calculator](#) [Software Development](#) [Purchase](#) [Download](#) [Support](#) [About Us](#)

 **GlobalMapper19**
NOW AVAILABLE

REAL-TIME HILL SHADE RENDERING

DRAG AND DROP WINDOW DOCKING

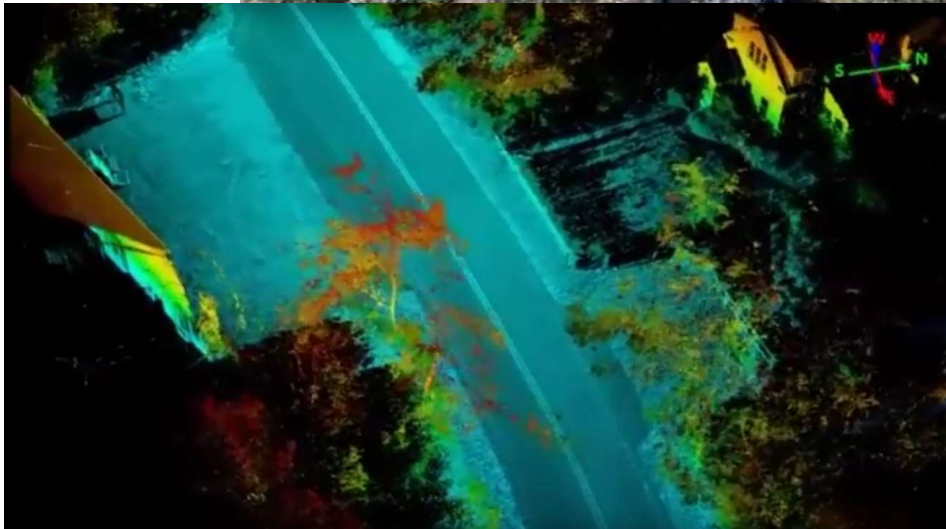
ADVANCED ATTRIBUTE MANAGEMENT

Attribute Editor (Doc_Points.shp)

NAME	LOT	BLOCK	YEAR_BUILT	STATE	ZONE	SECTION
RL...	4	3	2003	MI	Re...	
RL...	8	1	0	MI	Re...	
RL...	5	3	0	MI	Re...	
RL...	00A	0		MI	Re...	
RL...	7	1	2004	MI	Re...	
RL...	5	3	0	MI	Re...	
Y...	4	2	0	MI	Co...	
RE...		0		MI	Co...	
RL...	5	1	0	MI	Re...	
RL...	7	1	2018	MI	Re...	
RL...	5	1	0	MI	Re...	
Y...	1	2	0	MI	Co...	
Y...	2	2	0	MI	Co...	
RL...	4	1	0	MI	Re...	
RL...	5	1	0	MI	Re...	
AT...	3	1	0	MI	Co...	
					CL...	
					CL...	
RL...	5	1	0	MI	Re...	
Y...	8	3	1973	MI	Co...	
Y...	7	1	0	MI	Co...	

WHO IS USING LIDAR?

- Aerial
- Static
- Mobile
- Drone



POINT CLOUD

```
474600.910 124599.670 875.690 20 1 3 1 10 0 1072 101574398.863897 14848 18944 20736 0 0 0 0 0 0 0 no_waveform
474600.910 124599.200 871.840 49 2 3 1 10 0 1072 101574398.863897 19456 23552 25344 0 0 0 0 0 0 0 no_waveform
474601.020 124599.020 857.300 116 2 2 2 10 0 1072 101574398.863911 22272 26368 27648 0 0 0 0 0 0 0 no_waveform
474600.140 124599.330 856.770 238 1 1 2 10 0 1072 101574399.670091 14592 18432 21248 0 0 0 0 0 0 0 no_waveform
474601.000 124599.380 856.920 142 2 2 2 10 0 1072 101574399.681418 18176 22272 23808 0 0 0 0 0 0 0 no_waveform
474602.280 124599.730 859.690 157 1 1 1 10 0 1072 101574398.881623 16640 21248 20736 0 0 0 0 0 0 0 no_waveform
474602.160 124599.800 873.240 15 1 2 1 10 0 1072 101574398.881623 16640 21248 20736 0 0 0 0 0 0 0 no_waveform
474602.120 124599.630 878.230 2 1 2 1 10 0 1072 101574398.881623 16640 21248 20736 0 0 0 0 0 0 0 no_waveform
474602.060 124598.800 878.010 15 1 3 1 10 0 1072 101574398.881623 16640 21248 20736 0 0 0 0 0 0 0 no_waveform
474603.080 124599.360 877.820 19 1 3 1 10 0 1072 101574398.881623 16640 21248 20736 0 0 0 0 0 0 0 no_waveform
474603.130 124599.310 871.030 18 1 2 1 10 0 1072 101574398.881623 16640 21248 20736 0 0 0 0 0 0 0 no_waveform
474603.180 124599.630 867.110 60 1 2 1 10 0 1072 101574398.881623 16640 21248 20736 0 0 0 0 0 0 0 no_waveform
474603.240 124599.270 857.780 94 2 2 1 10 0 1072 101574398.881623 16640 21248 20736 0 0 0 0 0 0 0 no_waveform
474604.600 124599.860 856.200 174 2 2 2 10 0 1072 101574398.881623 16640 21248 20736 0 0 0 0 0 0 0 no_waveform
474604.540 124599.140 856.860 101 2 2 2 10 0 1072 101574398.881623 16640 21248 20736 0 0 0 0 0 0 0 no_waveform
```



Too many points for numbers.
Never enough points for a perfect model.
'Grainy 3d BMP'
All kinds of other attributes.
Quick 3d models.

ATTRIBUTES

THESE ARE MORE THAN JUST POINTS

Point Query

Model: Job313664_2013_2014_usgs_post_sandy_ma_nh_ri

Model Info		Source File Info	
X:	1,066,735.22 ft	File:	Job313664_2013_2014_usgs_post_san
Y:	2,720,692.32 ft	Folder:	C:\\Users\\Thadd\\AppData\\Local\\1
Z:	76.57 ft	X:	1,066,735.220 ft
Intensity:	248	Y:	2,720,692.320 ft
		Z:	76.575 foot
		Intensity:	247
		Return Number:	1
		Number Returns:	1
		Scan Direction:	1
		Line Edge:	0
		Classification:	18
		Classification (8-Bit):	18
		Scan Angle:	12.7559 deg
		User Data:	0
		Point Source ID:	1,251
		Withheld:	0
		Synthetic:	0
		Keypoint:	0
		Time:	80,836,473.4150913 sec (RAW)

Create Marker Here Do It! Copy to Clipboard Help Close

Classifications (Right-Click to Change Color/Name)

Code	Description
<input type="checkbox"/> 0	Created, never classified
<input type="checkbox"/> 1	Unclassified
<input checked="" type="checkbox"/> 2	Ground
<input type="checkbox"/> 3	Low Vegetation
<input type="checkbox"/> 4	Medium Vegetation
<input type="checkbox"/> 5	High Vegetation
<input type="checkbox"/> 6	Building
<input type="checkbox"/> 7	Low Point (Noise)
<input type="checkbox"/> 8	Model Key-point (mass point)
<input type="checkbox"/> 9	Water
<input type="checkbox"/> 10	Railroad
<input type="checkbox"/> 11	Road
<input type="checkbox"/> 12	Overlap
<input type="checkbox"/> 13	Wire - Guard (Shield)
<input type="checkbox"/> 14	Wire - Conductor (Phase)
<input type="checkbox"/> 15	Transmission Tower
<input type="checkbox"/> 16	Wire-structure Connector
<input type="checkbox"/> 17	Bridge
<input type="checkbox"/> 18	High Point (Noise)
<input type="checkbox"/> 19	Reserved for ASPRS Definition

Enable All Disable All

Return Types to Display

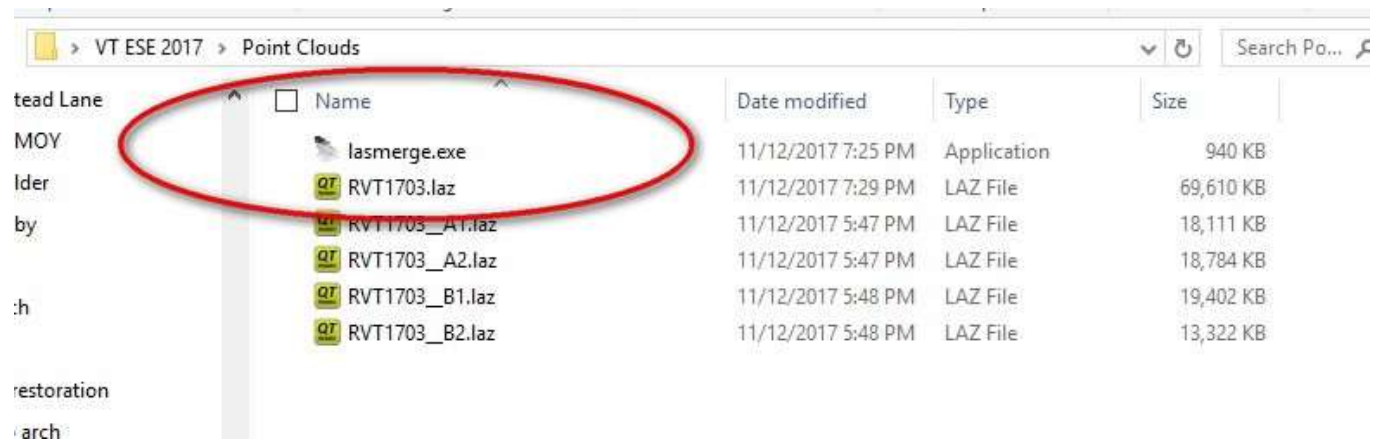
Return Type
<input checked="" type="checkbox"/> Unknown
<input checked="" type="checkbox"/> First
<input checked="" type="checkbox"/> Second
<input checked="" type="checkbox"/> Last
<input checked="" type="checkbox"/> Single
<input checked="" type="checkbox"/> First-of-Many

Restore Default Settings

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DATA PREPARATION

- LAS Tools are the tools created for LAS and LAZ manipulation.
- The download comes with toolboxes for ARC and QGIS.
- You should have **lasmerge.exe** in the **Point Cloud** folder.
- **Double click it.**
- It will start in the Point Cloud folder (convenient...)



C:\Users\Administrator\Desktop\VT ESE 2017\Point Clouds\lasmerge.exe

```
Note that not all of LASTools is "free" (see http://lastools.org/contact 'martin.isenburg@rapidlasso.com' to clarify licensing. ERROR: cannot open 'pcs.csv' file. maybe your LASTools distrib has no .\LASTools\bin\serf\geo\pcs.csv file. download t latest version at http://lastools.org/download/LASTools set ProjectedCSTypeGeoKey: look-up for 32145 not implemented ERROR: cannot open 'pcs.csv' file. maybe your LASTools distrib has no .\LASTools\bin\serf\geo\pcs.csv file. download t latest version at http://lastools.org/download/LASTools set ProjectedCSTypeGeoKey: look-up for 32145 not implemented ERROR: cannot open 'pcs.csv' file. maybe your LASTools distrib has no .\LASTools\bin\serf\geo\pcs.csv file. download t latest version at http://lastools.org/download/LASTools set ProjectedCSTypeGeoKey: look-up for 32145 not implemented ERROR: cannot open 'pcs.csv' file. maybe your LASTools distrib has no .\LASTools\bin\serf\geo\pcs.csv file. download t latest version at http://lastools.org/download/LASTools set ProjectedCSTypeGeoKey: look-up for 32145 not implemented
```

- New folder
- Our Abby
- powers
- Research
- rogers
- rogers restoration
- send to arch
- Sheehan
- South Chatham Village Hall
- Union Cemetary Data
- ZONE II
- Topcon_USB_Driver_v7_13
- v7.13
- VLS 2017
- images
- VT
- VT ESE 2017
- Imagery
- Point Clouds

5 items 1 item selected 940 KB

lasmerge - merges several LiDAR files into one (or splits them into several parts)

File List:

- RVT1703__A1.laz
- RVT1703__A2.laz
- RVT1703__B1.laz
- RVT1703__B2.laz

Wildcard: *.laz

Directory: E:\

.las .laz .bin

.asc .bil .dtm

ASCII files ...

Filter: ...

Transform: ...

Projection: ...

Overlays: ...

LAS version: 1.2
source ID: 0 created: 70/2015
'Quantum Spatial'
'Global Mapper'
of points: 2890704
point type: 1 point size: 28
x: 475300 475999.99
y: 123200 123899.98

LICENSE
LASTools (c) 2017
= open license =
by Martin Isenburg
(version 171030)

clip input
 lower left x: 0 upper right x: 0
 lower left y: 0 upper right y: 0

selected file: C:\Users\Administrator\Desktop\VT ESE 2017\Point Clouds\RVT1703__B2.laz

Options:

- selected file only
- process all files
- verbose

sample points: 5000000

- files are flightlines
- apply file source ID

Run: RVT1703

- split every x points
- every: 10000000
- file names: split0000
- format: laz

Ready? Hit Run

Double Click the files and they will appear above. The extents of the files with show up in the middle.

Provide a new filename, the original file was split to allow for some smaller files. Now we are putting the pieces back together into the original file.

Ready? Hit Run

lasmerge -lof file_list.15804.txt -o "RVT1703.laz"

files in 'file_list.txt' ...

START
COPY
CANCEL

Yes, you can run all the LASTOOLS from a command line.
This would be the command line.
Since we are not here to program, just press START.

```
has no .LASTools\bin\serf\geo\pcs.csv file. download
latest version at http://lastools.org/download/LAStools
set_ProjectedCSTypeGeoKey: look-up for 32145 not implemented
ERROR: cannot open 'pcs.csv' file, maybe your LASTools distrib
has no .LASTools\bin\serf\geo\pcs.csv file, download t
latest version at http://lastools.org/download/LAStools
set_ProjectedCSTypeGeoKey: look-up for 32145 not implemented
lasmerge -lof file_list.15804.txt -o "RVT1703.laz"
```

- New folder
- Our Abby
- powers
- Research
- rogers
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- Sheehan
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- Union Cemetary Data
- ZONE II
- Topcon_USB_Driver_v7_13
- v7.13
- VSLs 2017
- images
- VT
- VT ESE 2017
- Imagery
- Point Clouds

6 items 1 item selected 940 KB

browse ...

\

- RVT1703__A1.laz
- RVT1703__A2.laz
- RVT1703__B1.laz
- RVT1703__B2.laz

wildcard: *.laz add

directory: E:\ go

.las .laz .bin
 .asc .bil .dtm

ASCII files ...

filter ...
transform ...
projection ...
overlays ...

LAS version: 1.2
source ID: 0 created: 70/2015
'Quantum Spatial'
'Global Mapper'
of points: 2890704
point type: 1 point size: 28
x: 475300 475999.99
y: 123200 123899.98

LICENSE
LASTools (c) 2017
= open license =
by Martin Isenburg
(version 171030)

clip input

pick lower left x: 0 upper right x: 0 use square file
disable lower left y: 0 upper right y: 0 tile size: 1000

selected file: C:\Users\Administrator\Desktop\VT ESE 2017\Point Clouds\RVT1703__B2.laz

selected file only
 process all files
 verbose

VIEW

sample points: 5000000

files are flightlines
 apply file source ID

name: RVT1703

split every x points
every: 10000000

file names: split0000

format: laz

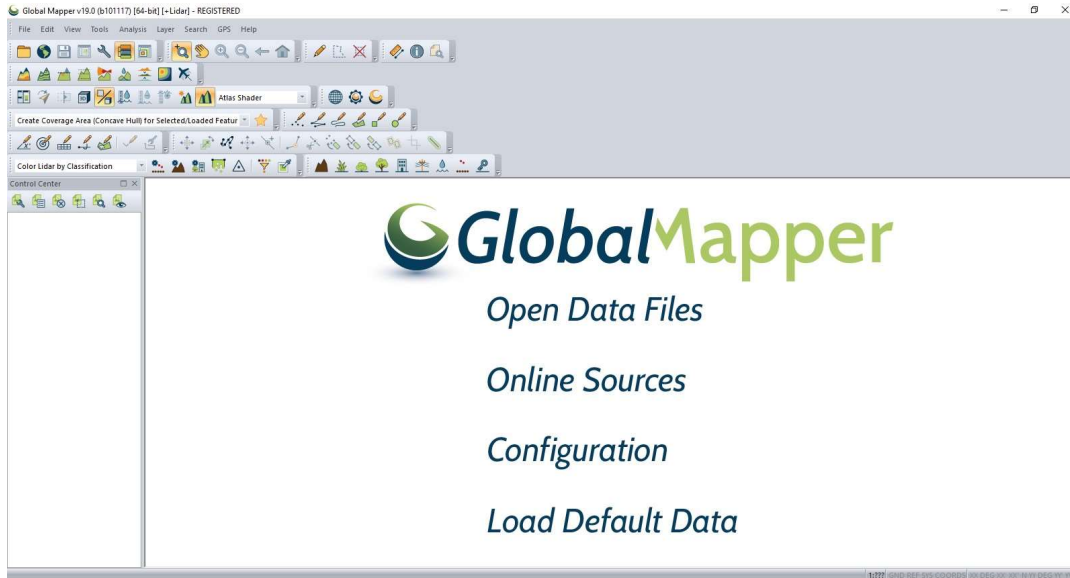
RUN

README <Q>UIT

LAS TOOLS

- What Else? (The really good tools are subject to a license.)
-
- E572las – **E57** is another format. Convert it to LAS/LAZ.
- Las2las – Need to convert **LAZ to LAS?** (Recap)
- Las2txt – You can go to an **ASCII** format (if you really need to)
- LasZip – Have LAS and want **LAZ?** (great compression)
- Txt2las – **Got ASCII?** It can't handle the clouds, so make it LAS/LAZ.
- **Classification tools** (subject to license) We'll go through similar tools in Global Mapper.
- PointZip – This will convert **PTS to LAS/LAZ.** (Separate download)

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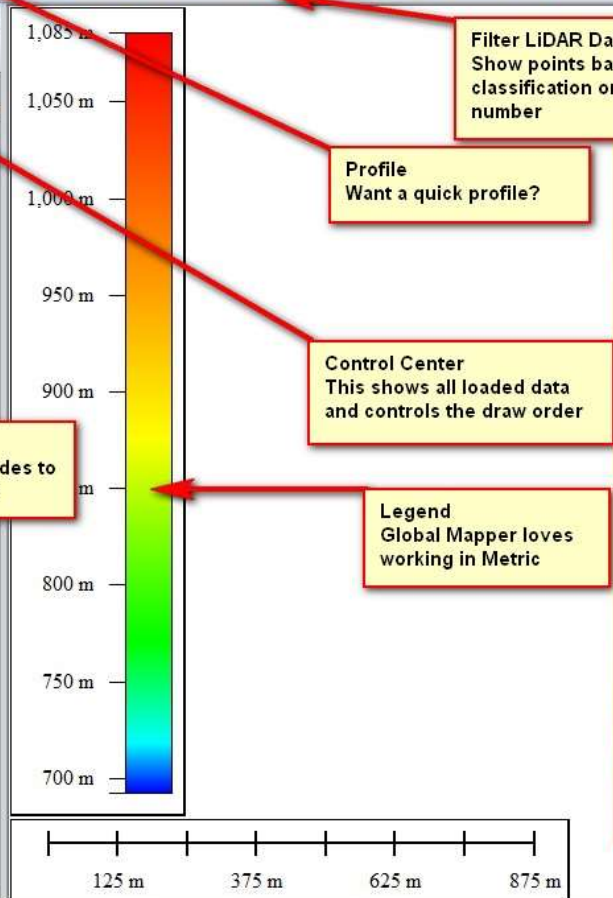
- **Open Global Mapper**
There's a few ways to load the data, I like the drag & drop
- Open the **Project Folder VT ESE 2017**
- Open the **Point Cloud folder**
- Highlight the RVT1703.laz
- **Drag & Drop** into Global Mapper
- LiDAR Load Options – Just say **OK!**
If a splash pops up, just click **OK.**



Control Center (1 Layers)

- Current Workspace
- RVT1703.laz [14,407,660]

LiDAR Visualization
There are several modes to view the point clouds

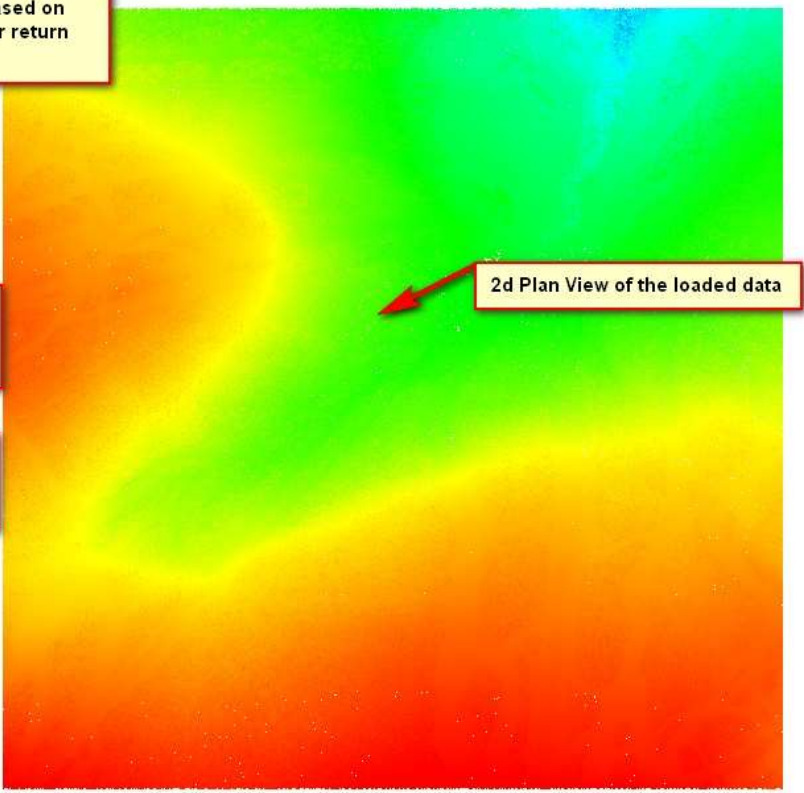


Filter LiDAR Data
Show points based on classification or return number

Profile
Want a quick profile?

Control Center
This shows all loaded data and controls the draw order

Legend
Global Mapper loves working in Metric



POINT CLOUD: MASSES OF POINTS

- Obtained from a **Robotic Total Station with Reflectorless EDM set to hyperactive.**

Limitations:

Line of sight – There are shadows or missing sections of data.

Angular Spread – The density of points decreases further from the scanner.

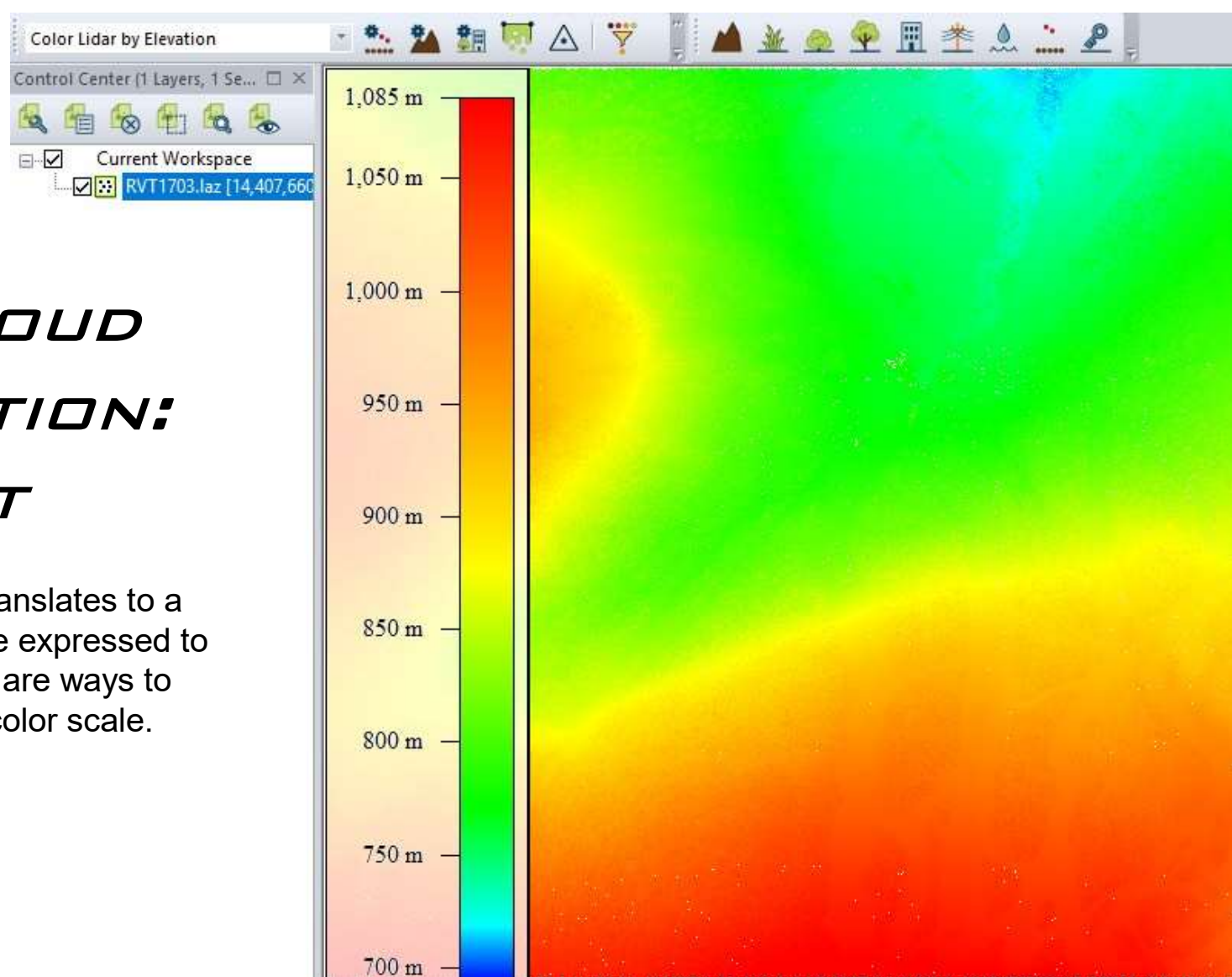
Reflectivity – Water? Mirrors? Glass? Ice? Snow? Well, your cloud will have some noise. You can remove it or just work around it.

Stuff – It will scan everything. Don't want the car scanned? Get it out of the way? How about the leaves on the ground? Sand on the roads?

- Most software packages offer 3d and 2d views.

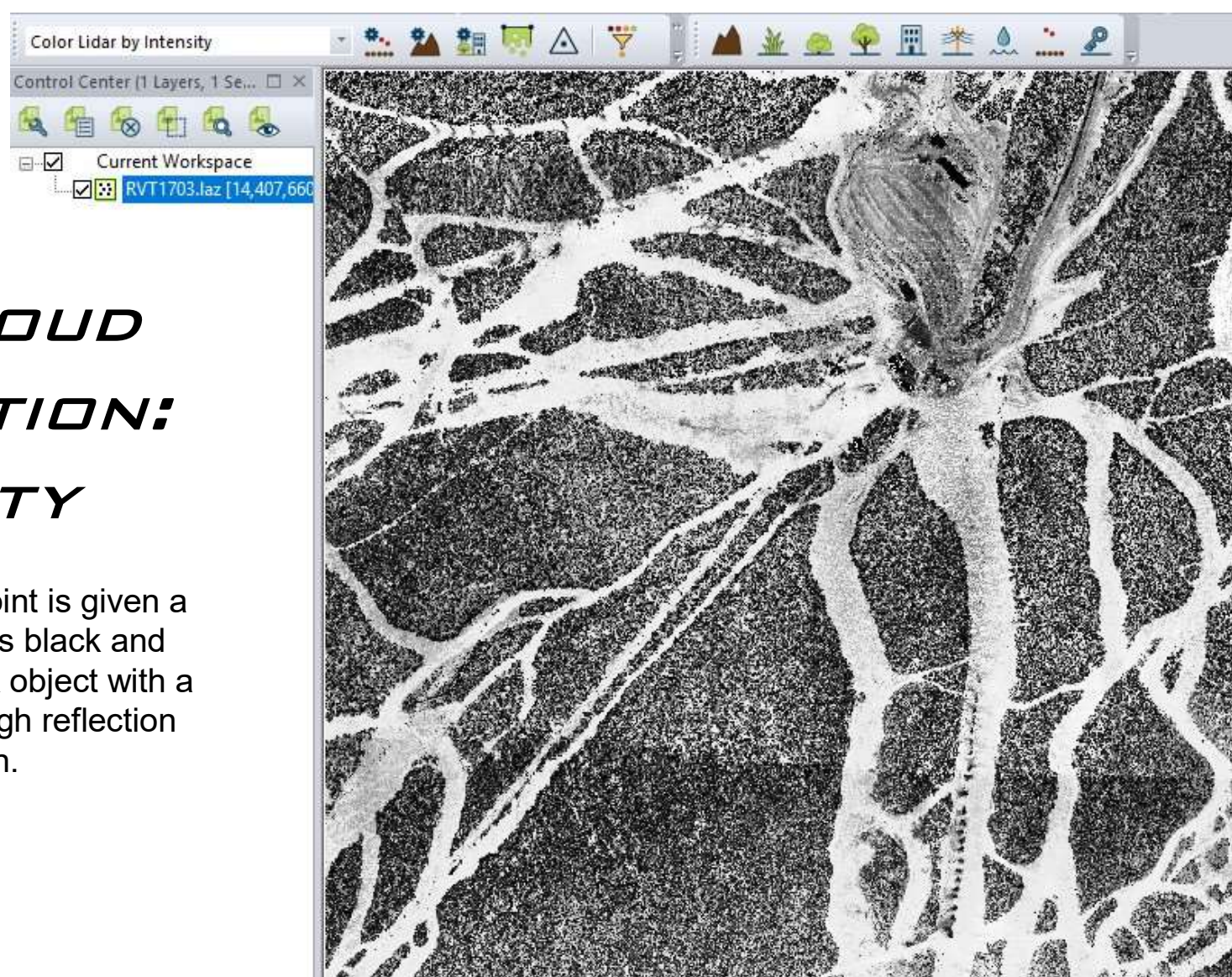
POINT CLOUD VISUALIZATION: HEIGHT

The **height** of each point translates to a **color** along a rainbow scale expressed to the left of the cloud. There are ways to change the range and the color scale.



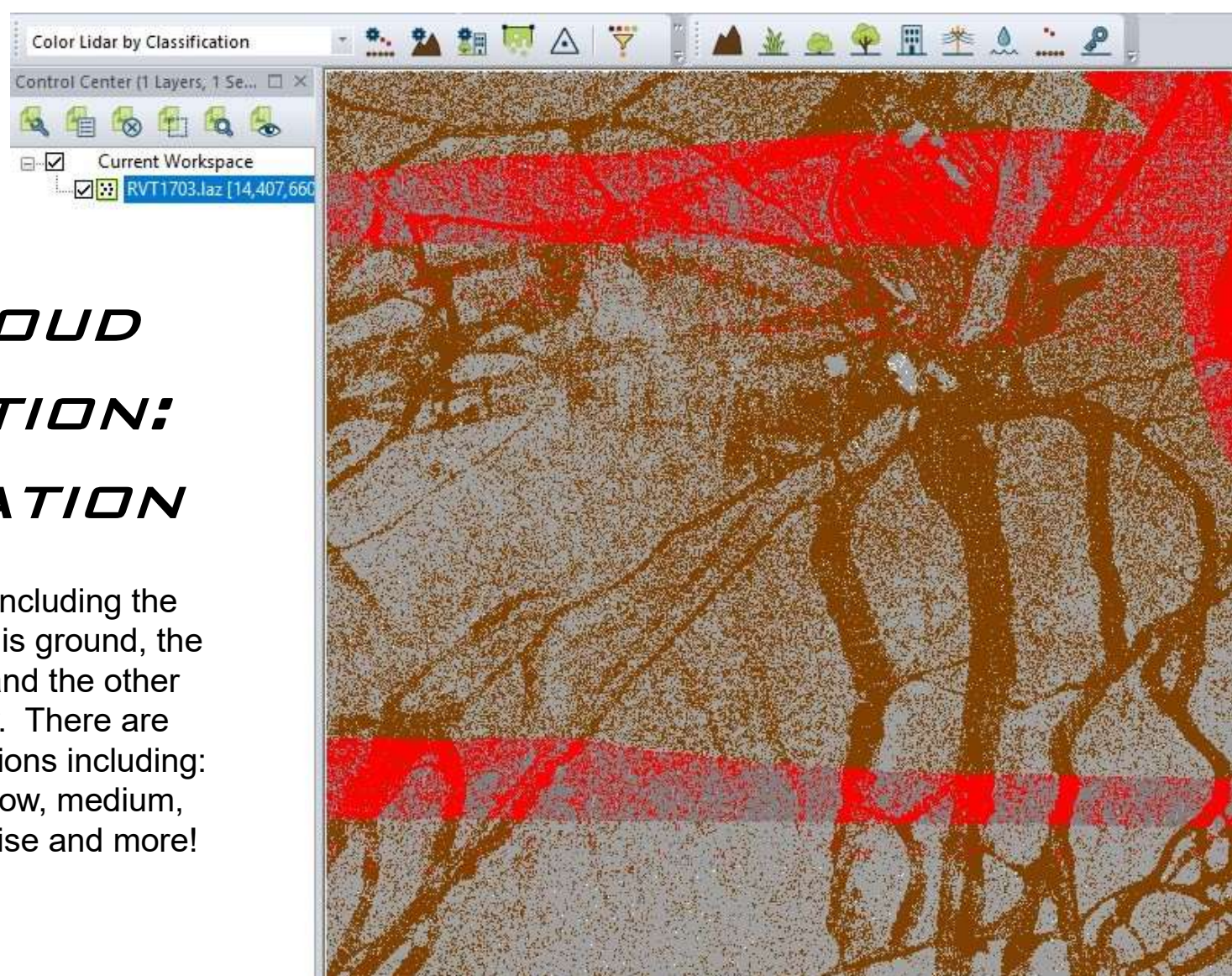
POINT CLOUD VISUALIZATION: INTENSITY

The **reflectivity** of every point is given a gray scale value. This looks black and white and almost is. A dark object with a high sheen will provide a high reflection and will be white in the scan.



POINT CLOUD VISUALIZATION: CLASSIFICATION

Points are given attributes including the **classification**. The brown is ground, the red are the overlap points and the other points are unclassified gray. There are several standard classifications including: ground, water, vegetation (low, medium, high), utilities, buildings, noise and more!

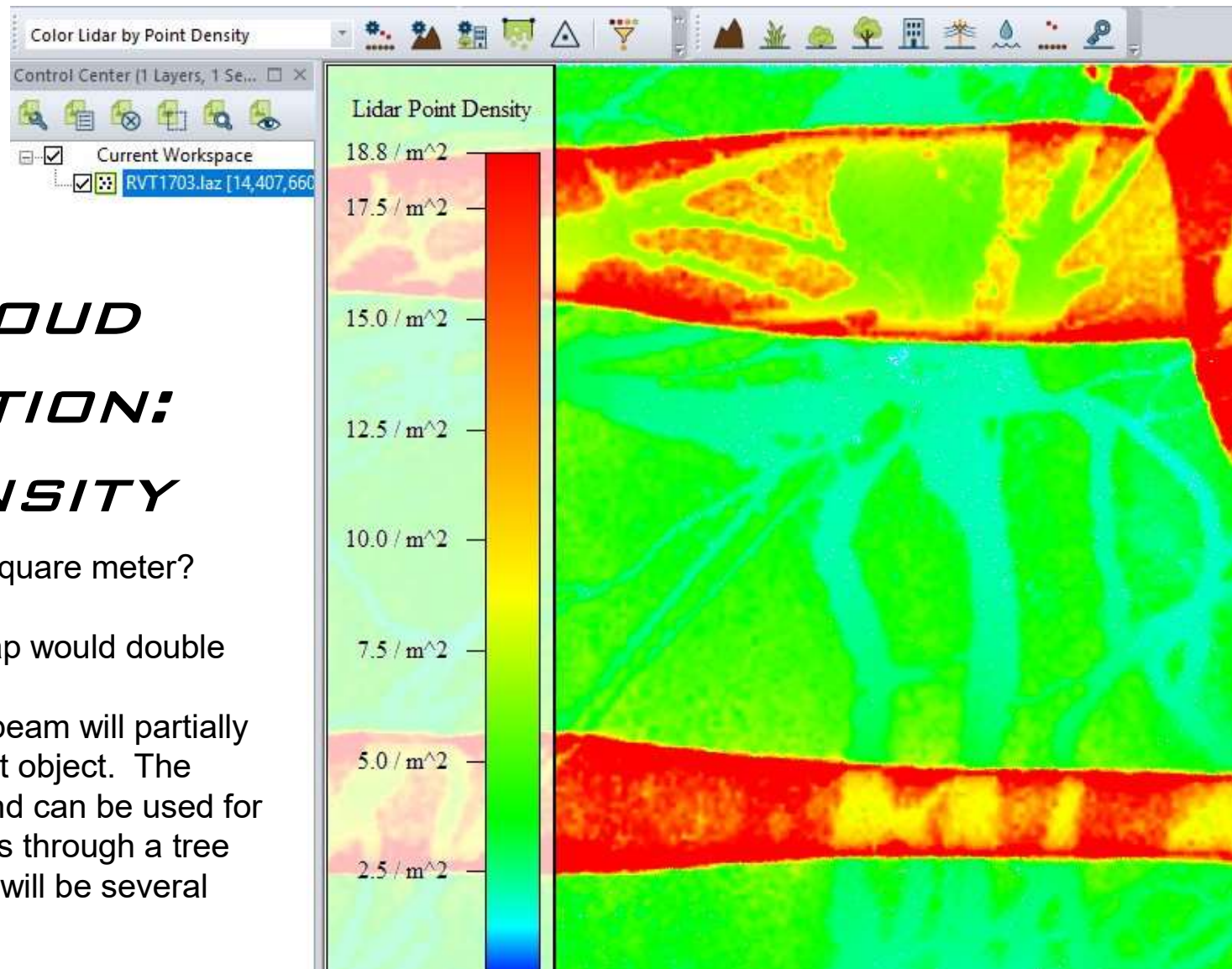


POINT CLOUD VISUALIZATION: POINT DENSITY

How many points are there per square meter?
2-18.

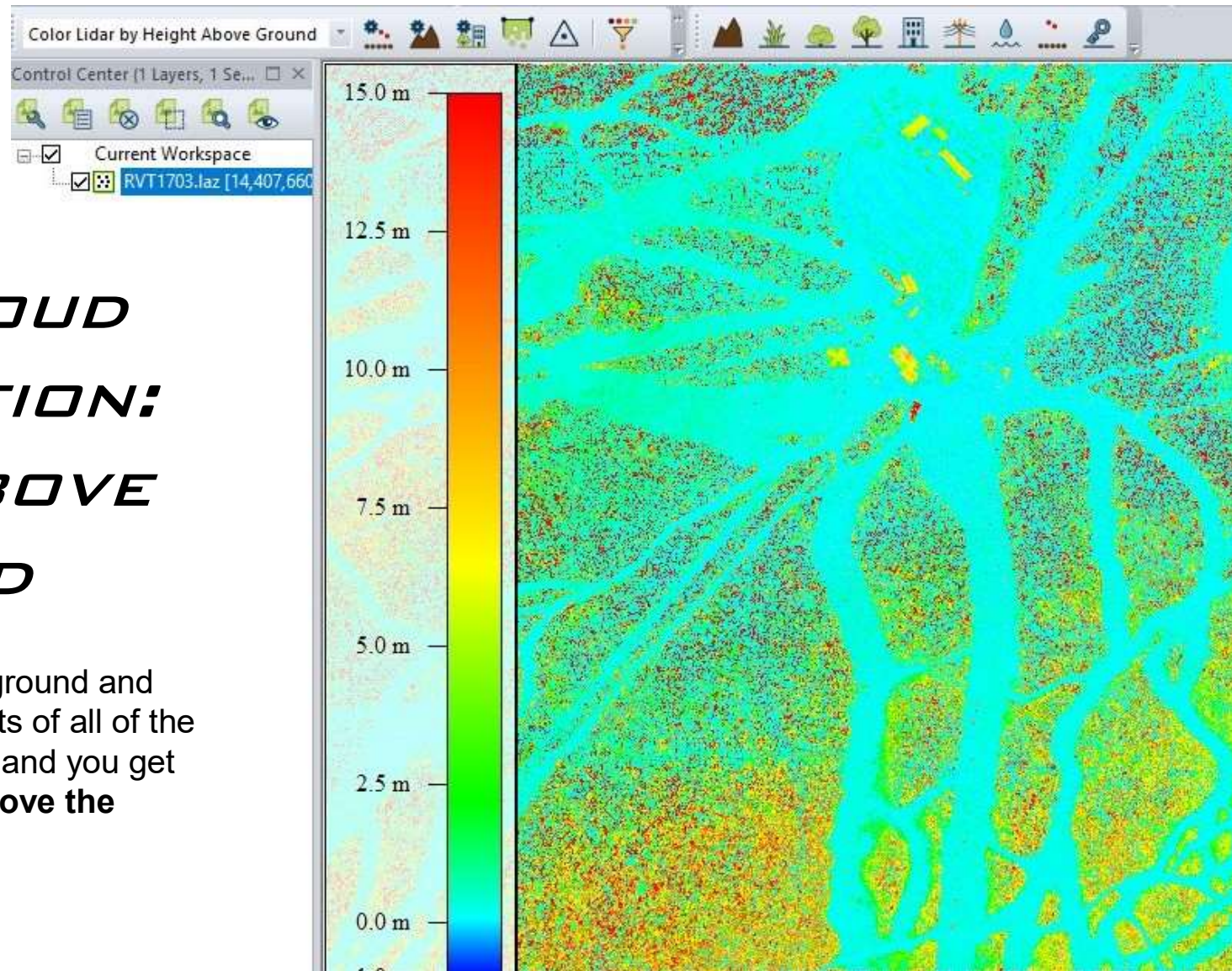
18? How do you get 18? Overlap would double
the number of points and:

Lasers are not infinitesimal; the beam will partially
hit objects on their way to the last object. The
multiple hits are called returns and can be used for
some modeling. If a laser passes through a tree
and hits several branches, there will be several
points.



POINT CLOUD VISUALIZATION: HEIGHT ABOVE GROUND

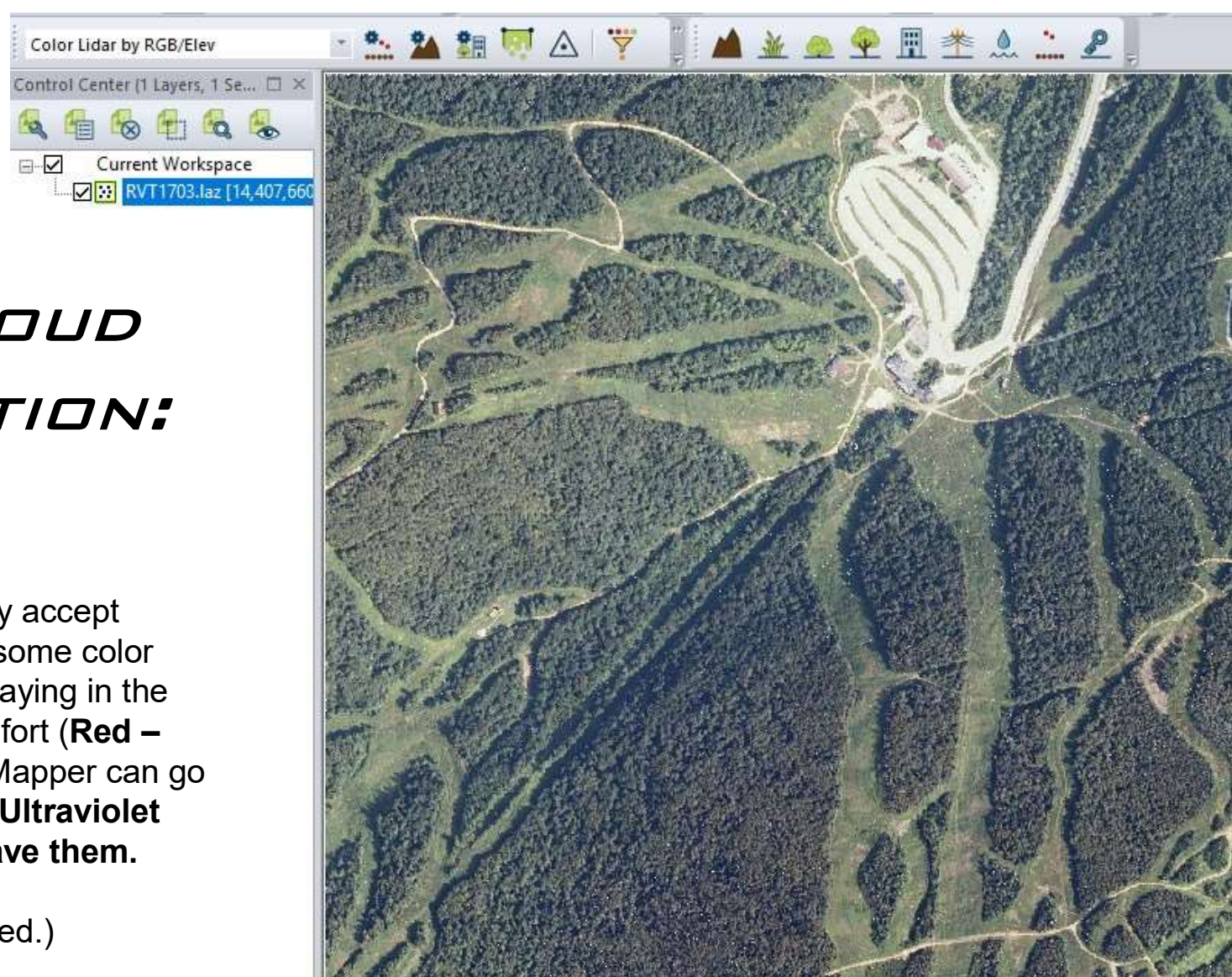
There was some classified ground and the cloud includes the heights of all of the points... Put those together and you get the **height of the points above the ground.**



POINT CLOUD VISUALIZATION: RGB

The LiDAR Points will gladly accept imagery information to tag some color information. I have been playing in the visible spectrum out of comfort (**Red – Green – Blue**) but Global Mapper can go beyond and add **InfraRed, Ultraviolet and other bands** if you have them.

(Your data is not yet colorized.)



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INSTANT PROFILES – LEFT CLICK, RIGHT CLICK

Global Mapper v19.0 (b101117) [64-bit] [+Lidar] - REGISTERED

File Edit View Tools Analysis Layer Search GPS Help

Create Coverage Area (Concave Hull) for Selected/Loaded Features

Color Lidar by RGB/Elev

Control Center (1 Layers, 1 Se...)

- Current Workspace
 - RVT1703.laz [14,407,660]

LEFT CLICK

RIGHT CLICK

0 m 125 m 250 m 375 m 500 m

Path Profile/Line of Sight

Click or Drag to Select and Edit Lidar Points

Use Global Setting from Toolbar

From Pos: 475051.948, 124400.352 To Pos: 475296.200, 124089.701

860 m
840 m
820 m
800 m

50 m 100 m 150 m 200 m 250 m 300 m 350 m 395 m

For Help, press F1

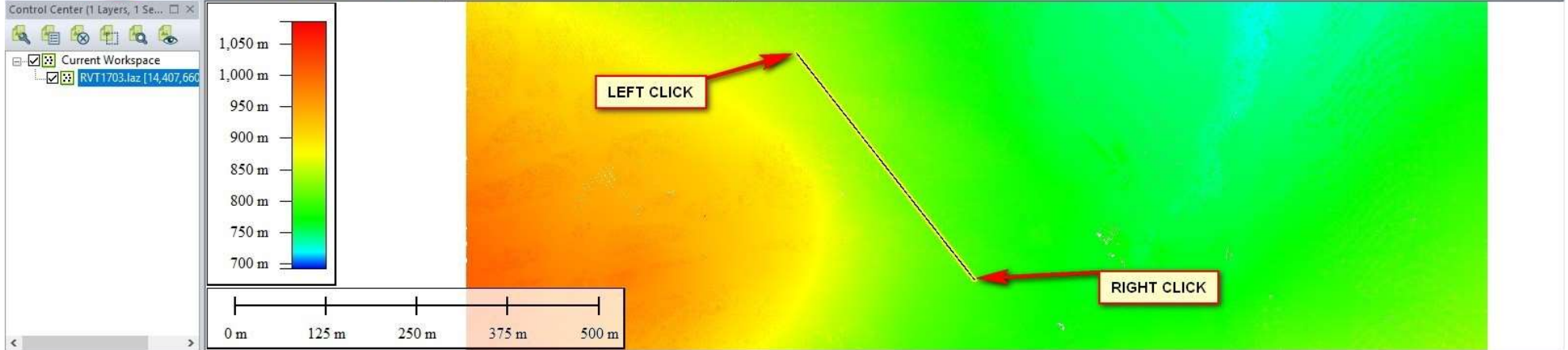
1:5058 | SPCS (NAD83) | (475928.321, 124683.078) | 43° 37' 19.1002" N, 72° 47' 53.6855" W

11:21 PM

CHANGE VISUALIZATION – BY ELEVATION

Global Mapper v19.0 (b101117) [64-bit] [+Lidar] - REGISTERED

File Edit View Tools Analysis Layer Search GPS Help



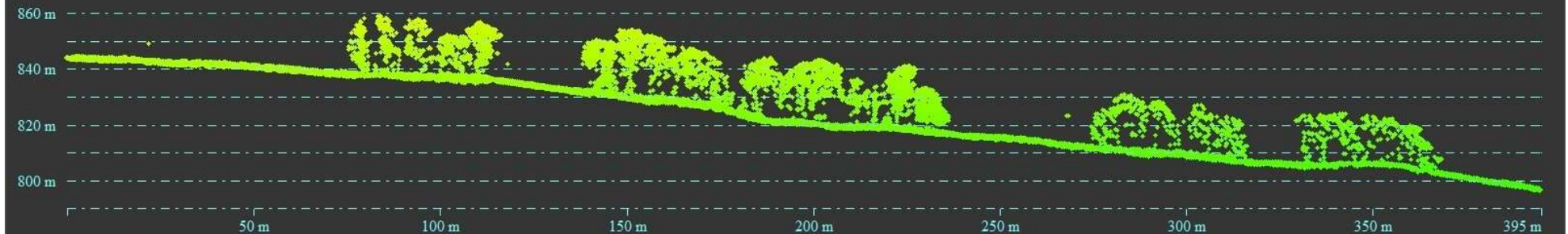
Path Profile/Line of Sight

Click or Drag to Select and Edit Lidar Points

Use Global Setting from Toolbar

From Pos: 475051.948, 124400.352

To Pos: 475296.200, 124089.701



Left click to start adding points.

1:5058 | SPCS (NAD83) | (474531.086, 124179.859) | 43° 37' 02.6274" N, 72° 48' 55.9212" W

11:23 PM

CLASSIFICATION - GROUND

The screenshot shows a software interface for ground point classification. On the left, a vertical elevation scale ranges from 700 m to 1,085 m, with a color gradient from blue at the bottom to red at the top. The main window displays a 3D point cloud visualization. A dialog box titled 'Automatic Classification of Ground Points' is open, showing the following settings:

- Select Unclassified Point Cloud(s) to Find Likely Ground Points In: RVT1703.laz
- Only Classify Lidar Points Selected in Digitizer Tool
- Base Bin Size to Check for Curvature Deviations: 2 Meters
- Minimum Height Departure from Local Mean for Non-Ground Point: 0.3 meters
- Removal of Likely Non-Ground (i.e. Building/Vegetation) Points:
 - Maximum Height Delta: 50 meters (use larger values for high relief areas)
 - Expected Terrain Slope: 7.5 degrees (use larger for steep terrain)
 - Maximum Building Width: 100 meters (larger values are slightly slower)
- Reset Existing Ground Points to Unclassified at Start

Buttons at the bottom of the dialog include 'Specify Bounds...', 'Filter Points...', 'Restore Defaults', 'OK', and 'Cancel'.

This tool will determine ground points based on some mathematical modeling. The GM trainer was not able to provide more detail on how these variables work. Play with the values and be ready to run some edits.

CLASSIFICATION - GROUND

Automatic Classification of Ground Points

Select Unclassified Point Cloud(s) to Find Likely Ground Points In

RVT1703.laz

Only Classify Lidar Points Selected in Digitizer Tool

Base Bin Size to Check for Curvature Deviations: Point Spacings

Minimum Height Departure from Local Mean for Non-Ground Point

Specify the minimum height above the local average minimum elevation that a point has to be in order to be considered a non-ground point. Larger values require greater vertical deviation from local averages to make a point non-ground.

meters

Removal of Likely Non-Ground (i.e. Building/Vegetation) Points

The following parameters control the automatic removal of likely non-ground (i.e. building) points using a morphological filter. Use larger slope and height delta in areas with high relief, or smaller values in flatter, more urban areas.

Maximum Height Delta: meters (use larger values for high relief areas)

Expected Terrain Slope: degrees (use larger for steep terrain)

Maximum Building Width: meters (larger values are slightly slower)

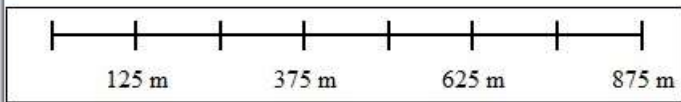
Reset Existing Ground Points to Unclassified at Start

Specify Bounds... Filter Points... Restore Defaults



“...keep in mind automatic classification will always have some mis-classifications, no automatic algorithms get better than 85-90% accuracy.”

- Mike, a Global Mapper Guru on their forum.



CLASSIFICATION – NON-GROUND

This tool comes with the same hands on experience as the classify ground tool. Play with the settings, use the profile tool to see how it checks out.

Auto-Classify Ground Points

Automatic Classification of Non-Ground Lidar Points

Building/High Vegetation Classification Setup

Find and Classify Likely Building and High Vegetation Points

Base Bin Size to Check for Planar Points: Meters

ADVANCED: Threshold Values for Building/High Vegetation

The following parameters control how close to a calculated local best-fit plane that points need to be in order to be considered a potential building or a likely vegetation area. Use values larger than the expected error in the elevations.

Minimum Height Above Ground: meters

Maximum Co-Planar Distance: meters

Minimum Vegetation Distance: meters

Max Co-Planar Angle Difference: degrees

Powerline Classification Setup

Find and Classify Likely Powerline Points

Minimum Height Above Ground: meters

Maximum Dist from Best Fit Line: meters

Bin Size to Check for Linear Points: meters

Maximum Height Change Per Meter: meters

Select Unclassified Point Cloud(s) to Find Likely Non-Ground Points

RVT1703.laz

Only Classify Lidar Points Selected in Digitizer Tool

Reset Existing Non-Ground Points to Unclassified at Start

Specify Bounds... Filter Points by Elev/Class/etc...

Restore Defaults OK Cancel

CLASSIFICATION – NON-GROUND

Automatic Classification of Non-Ground Lidar Points

Building/High Vegetation Classification Setup

Find and Classify Likely Building and High Vegetation Points

Base Bin Size to Check for Planar Points: Meters

ADVANCED: Threshold Values for Building/High Vegetation

The following parameters control how close to a calculated local best-fit plane that points need to be in order to be considered a potential building or a likely vegetation area. Use values larger than the expected error in the elevations.

Minimum Height Above Ground: meters

Maximum Co-Planar Distance: meters

Minimum Vegetation Distance: meters

Max Co-Planar Angle Difference: degrees

Powerline Classification Setup

Find and Classify Likely Powerline Points

Minimum Height Above Ground: meters

Maximum Dist from Best Fit Line: meters

Bin Size to Check for Linear Points: meters

Maximum Height Change Per Meter: meters

Select Unclassified Point Cloud(s) to Find Likely Non-Ground Points

RVT1703.laz

Only Classify Lidar Points Selected in Digitizer Tool

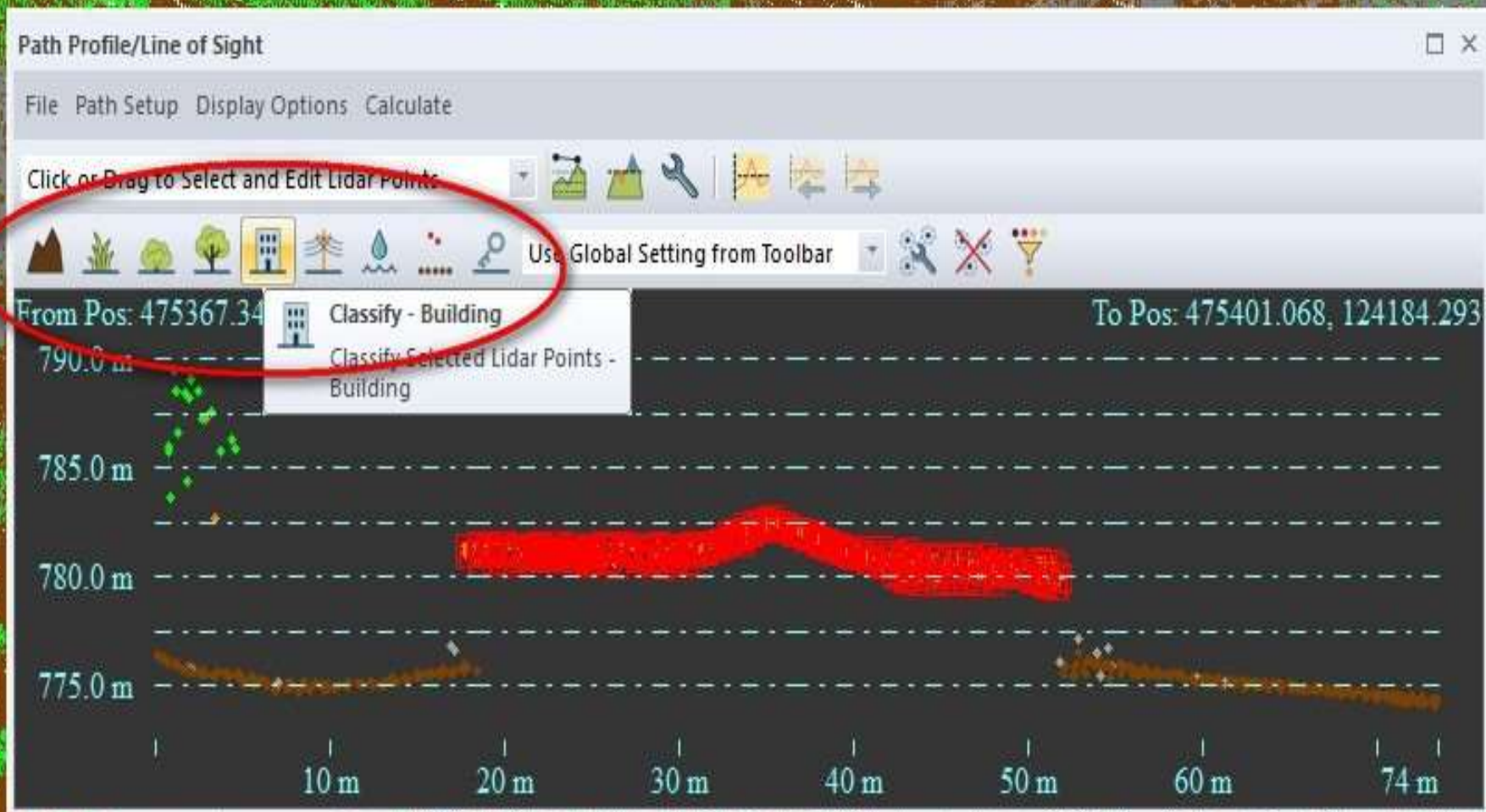
Reset Existing Non-Ground Points to Unclassified at Start

Specify Bounds... Filter Points by Elev/Class/etc...

Restore Defaults OK Cancel

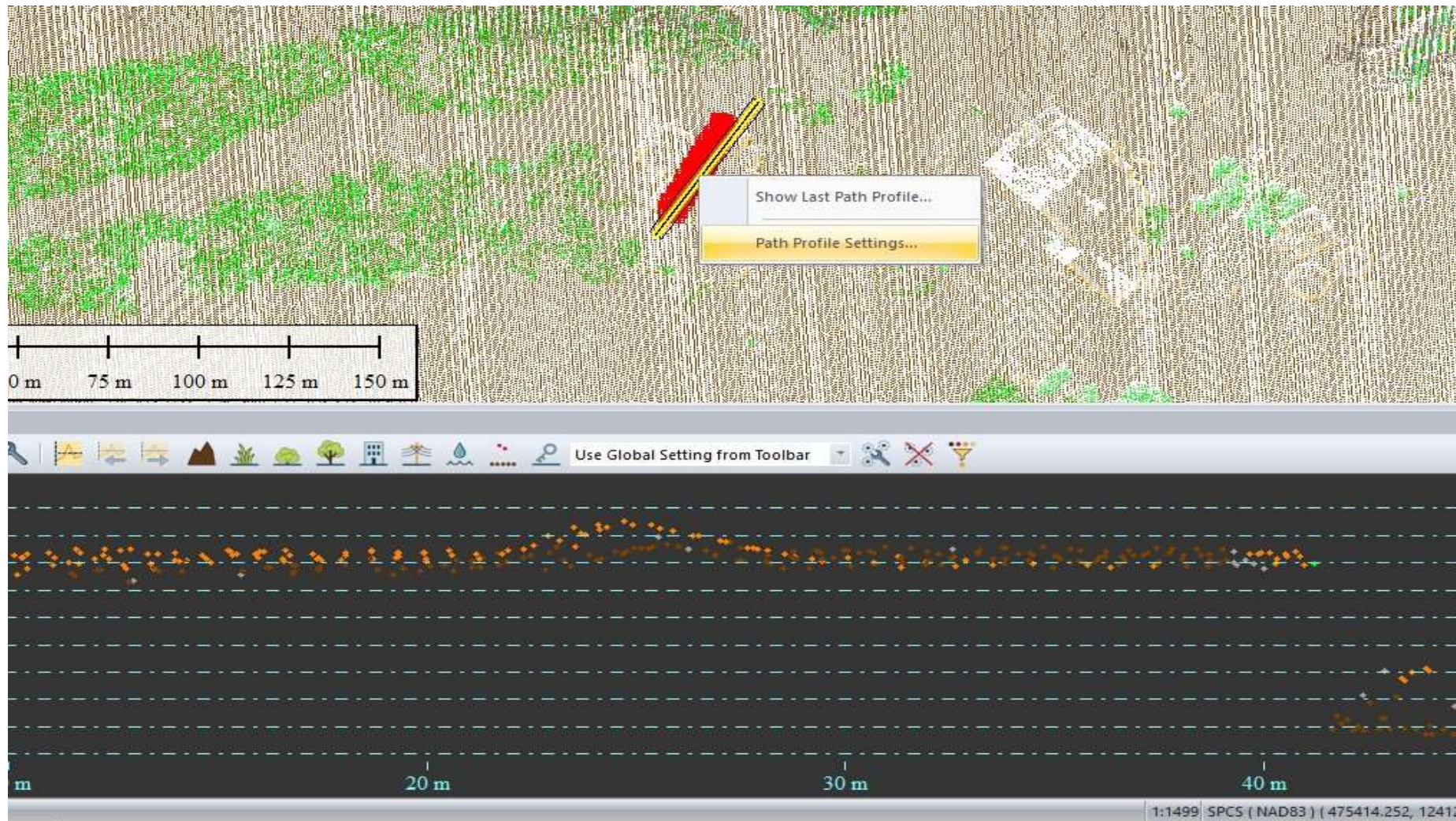
The settings need to change based on the cloud. Make little changes until you see the desired results.

CLASSIFICATION - BY PROFILE (MANUAL)



- Ground
- Low Vegetation
- Medium Vegetation
- High Vegetation
- Building
- Powerline
- Water
- Noise

PATH PROFILE SETTINGS



Right
Click

AN OVERWHELMING MENU!

Path Profile Settings

General Settings

Elevation Display Units:

Scale Start Distance:

Elevation Corridor (Use Elevations to Either Side of Path)

Type:

Distance from Path:

3D Display Options

3D Display Mode:

Display Location of Each Line Vertex

Draw Selected Line Path

Draw Line/Area Features that Cross Path

Draw Separate Line for Path from Each Terrain Layer

Draw Elevation Guide Lines

Draw Start and Stop Position Labels

Display From/To Coordinates in Selected View Projection

Interpolate Elevations to Fill No Data Regions

Display Path Profile Cutaway Walls in 3D

Perpendicular Profile

Display Series of Profiles Perpendicular to Path

Perpendicular Path Length:

Restrict Elevation Range Near Extracted Features

Elevation Range / Scale

Clamp Top Displayed Elevation to

Clamp Bottom Displayed Elevation to

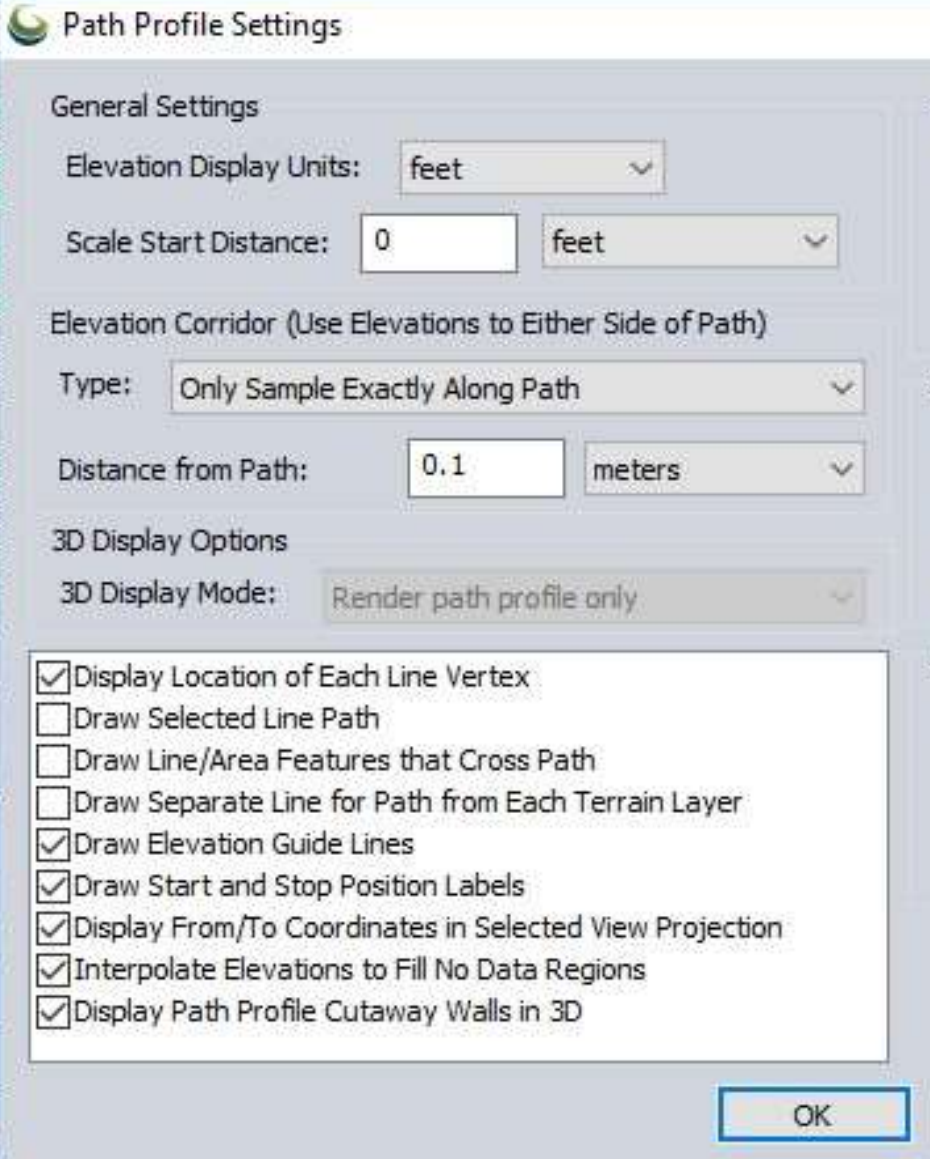
Match Elevation Scale to Distance Scale Using Scale Factor of

Lidar Display Options (Requires Lidar Module)

Display Lidar Points Along and Near the Path

Distance from Path to Show [Normal]:

Distance from Path to Show [Perp]:



Units can be changed from metric. (please hold applause)

Scale start distance is to modify the 0+00

Samples a surface model to return highs, averages, lows within a distance from the path.

This enables terrain cutaways in the 3d viewer

If your profile has bends the vertices will show ??? (The help file does not know either)

Draw lines and they will show up

If you have two surfaces they will show extra lines

Elevation Guides

Coordinates of the from and to points

Projection or Lat/Long

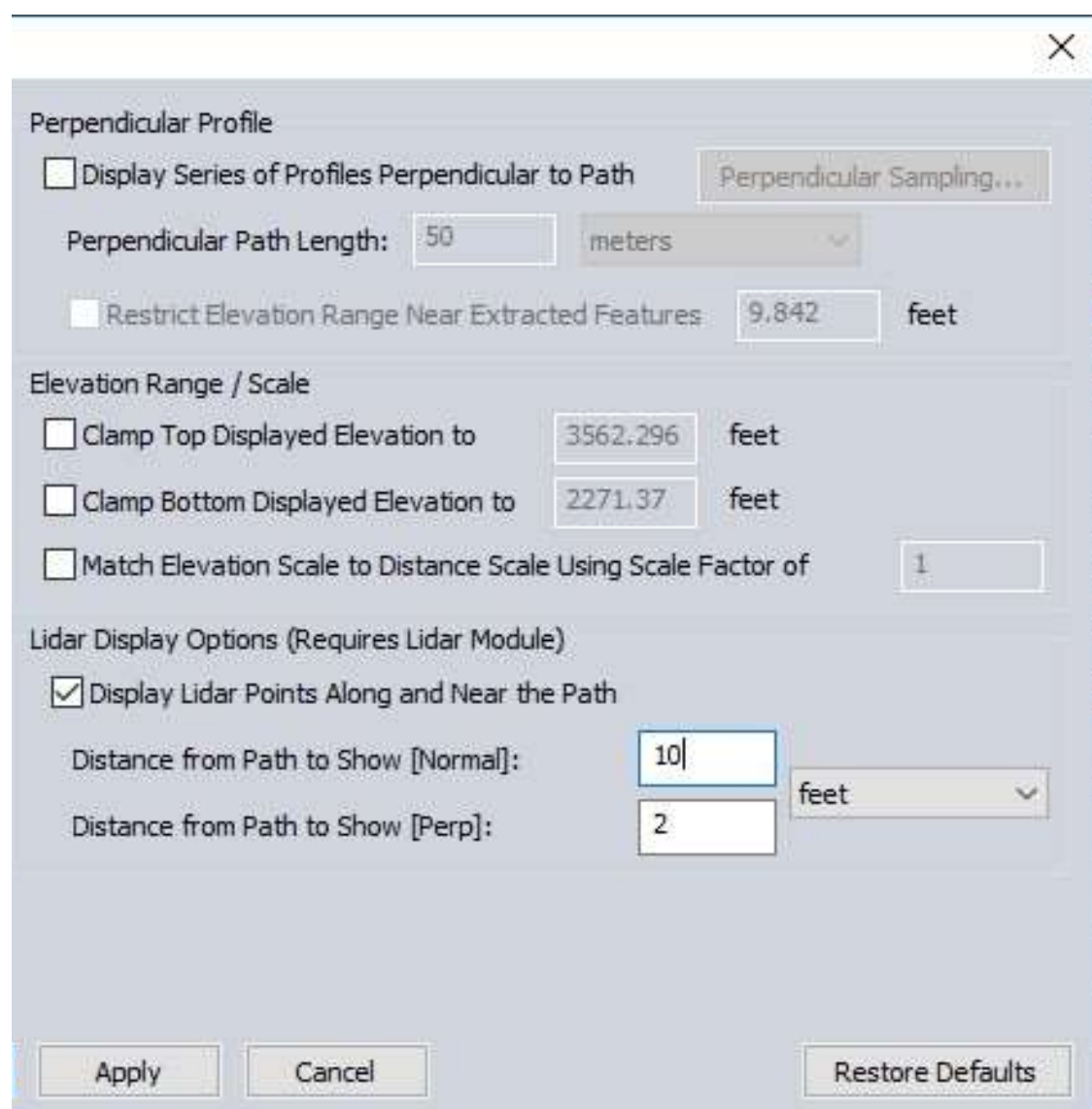
Interpolation to fill in the gaps

Back to the 3d viewer

This will show you cross sections along the profile and it allows you to extract data along the sections. It is better for dense scan data.

These settings change the height and position of the profile or sections. The elevation scale will be best fit if you don't choose something.

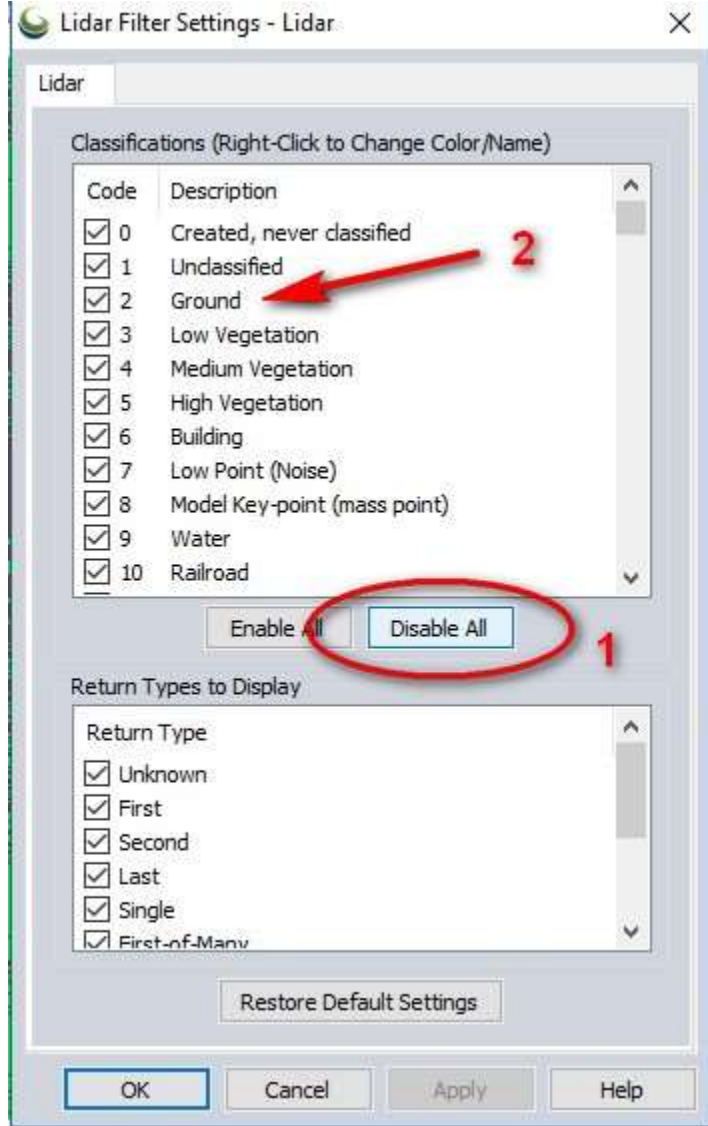
Toggle the display of the LiDAR points.
How wide is your swath?
How wide are your sections?



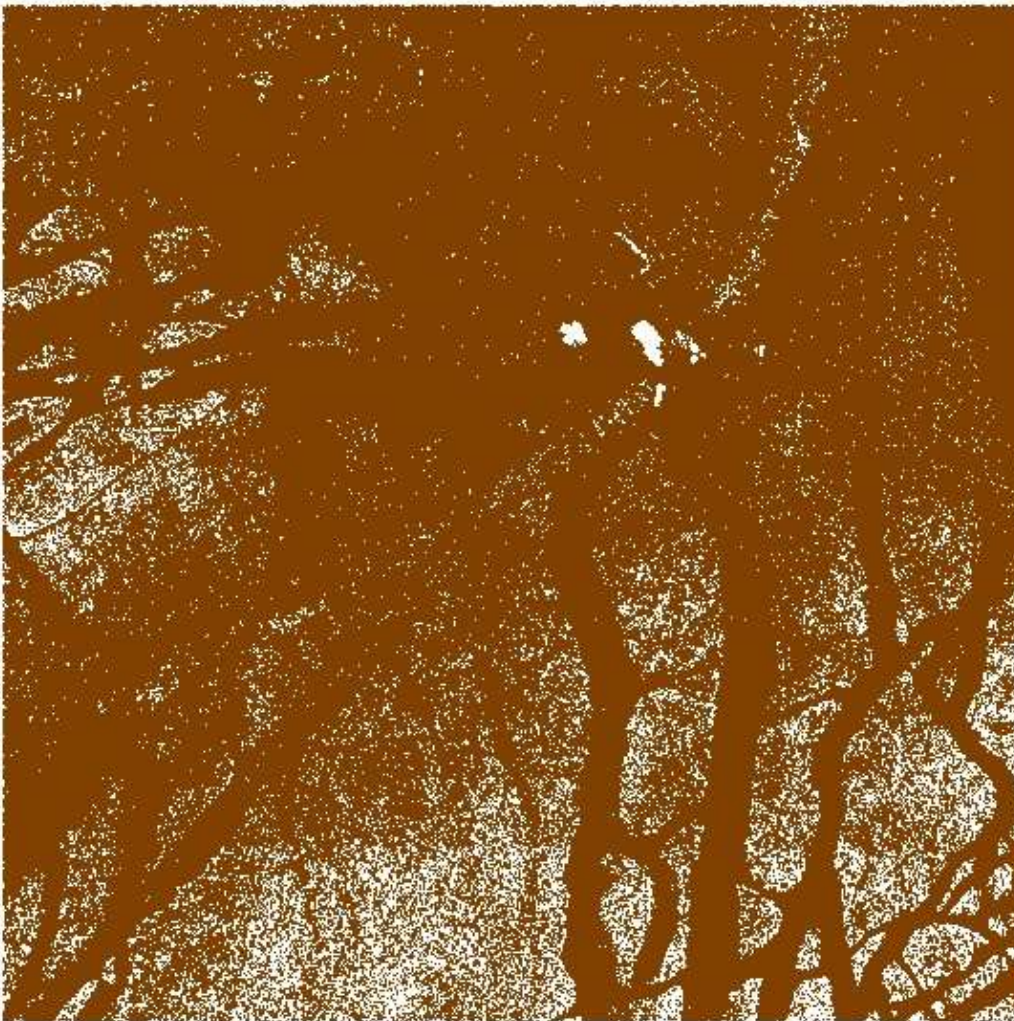
www.eselc.com/vsls



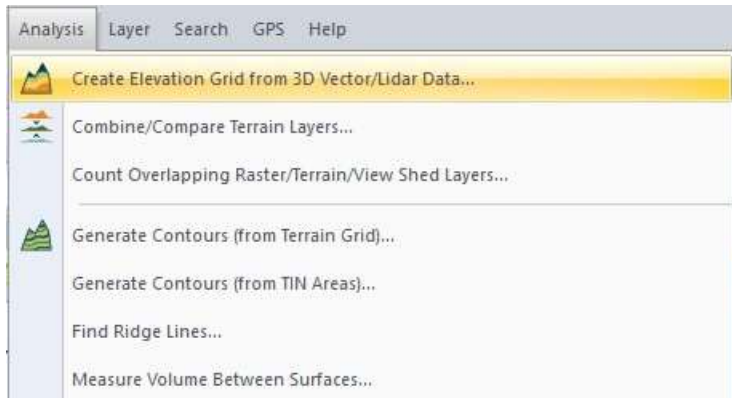
Use the LiDAR Filter Settings to isolate the Ground points in preparation of creating a surface model.



GROUND SURFACE MODEL



GROUND SURFACE MODEL

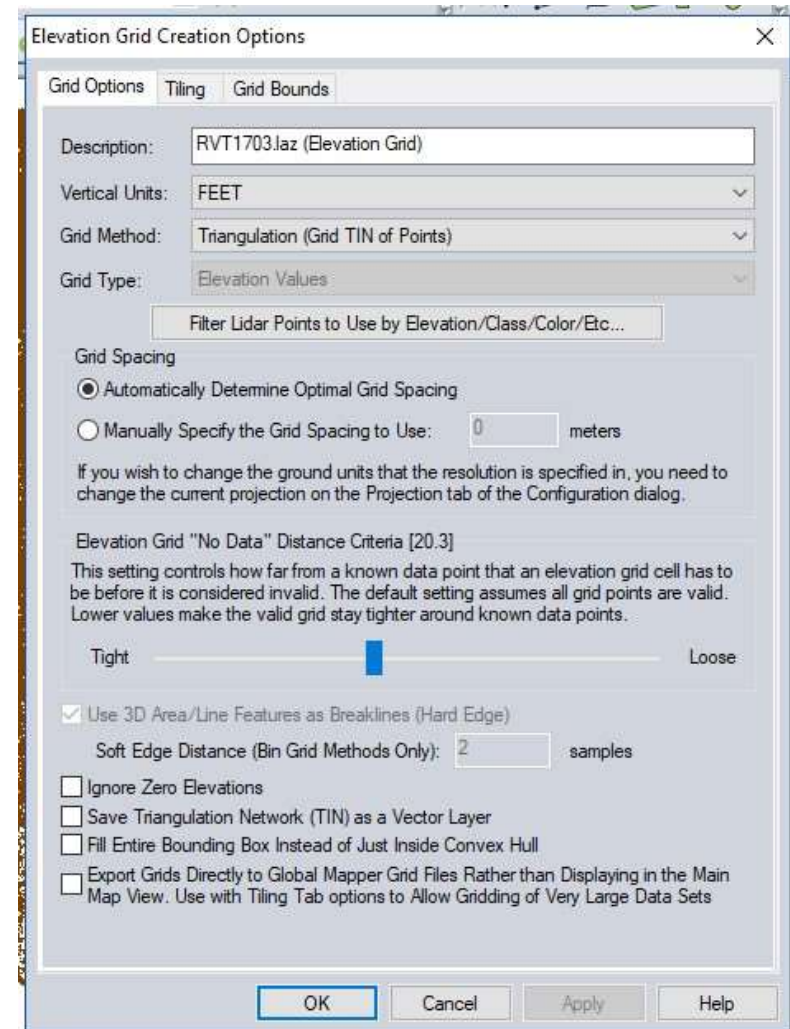


Layer Name
Vertical Units
Grid Method (TIN for now)

Start with Auto

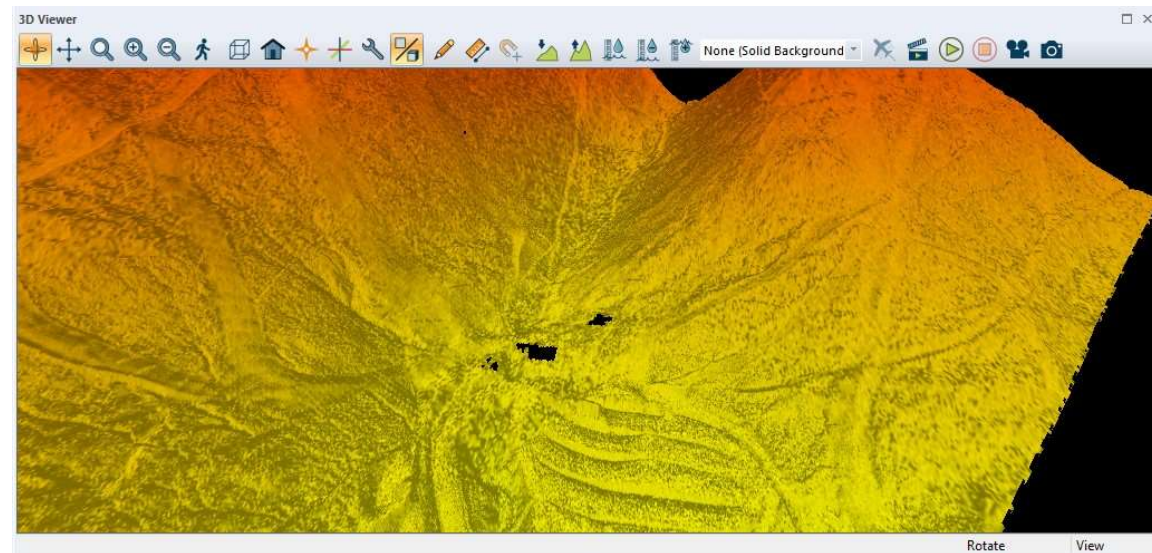
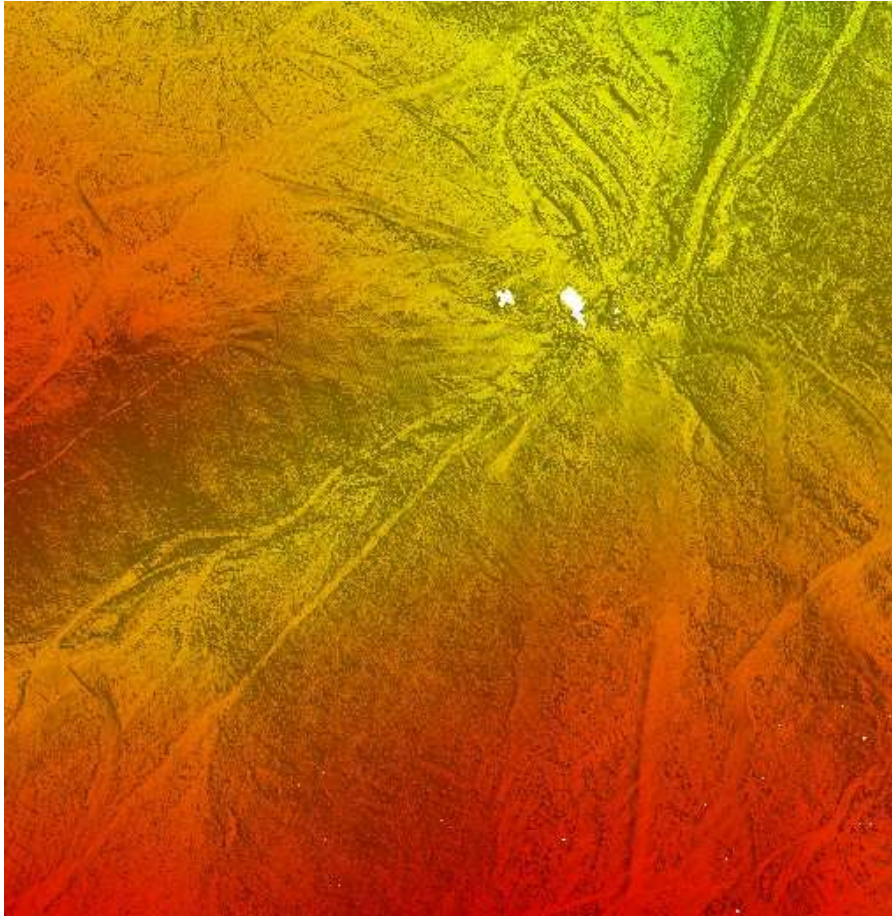
Choose something between tight and loose for gap filling

We can add more data to model including digitizing breaklines.
Ignore zero is typical.
Don't save the TIN at first. It will be large.
This is for large files.



GROUND SURFACE MODEL

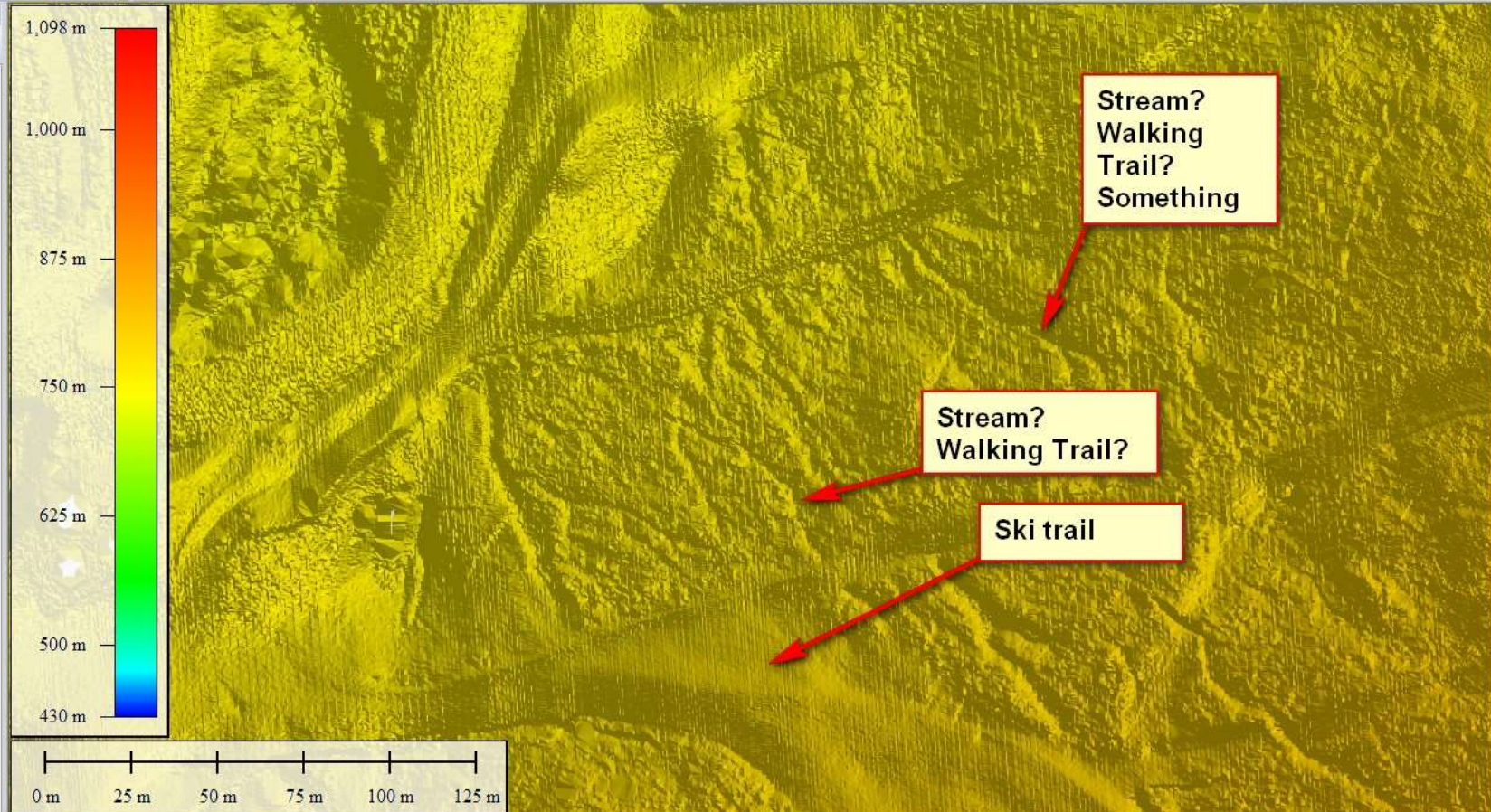
What good is a surface model without looking at it in 3-d?
Turn off the points layer (LAZ) if they are getting in the way.





Control Center (3 Layers, 1 Selected)

- Current Workspace
- RVT1703.laz [14,407,660 Features]
- Aerial Color 2009.tif
- RVT1703.laz (Elevation Grid)



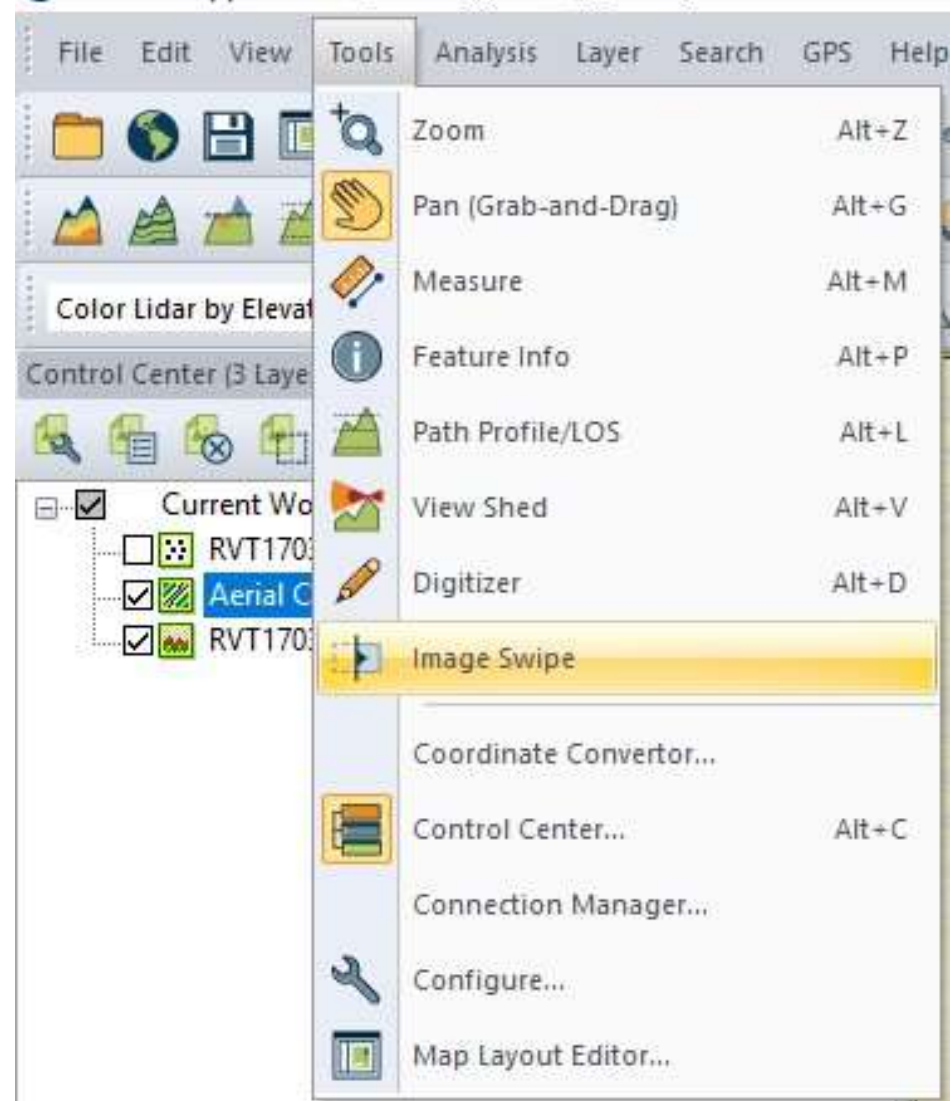
Draw order
Image in Back
(It does not
have to be)

We can see some distortions in the surface model... paths, trails, roads, streams, walls and all those changes in the surface will show up.

Height = 2496.682 us-ft (RVT1703.laz (Elevation Grid))

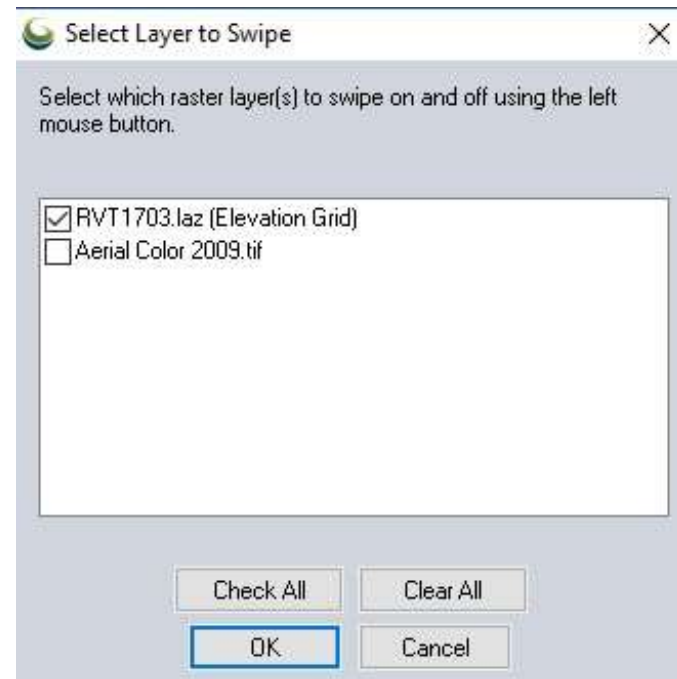
1:1312 SPCS (NAD83) (-475491.919, 124126.203) 43° 37' 01.0048" N, 72° 48' 13.0596" W



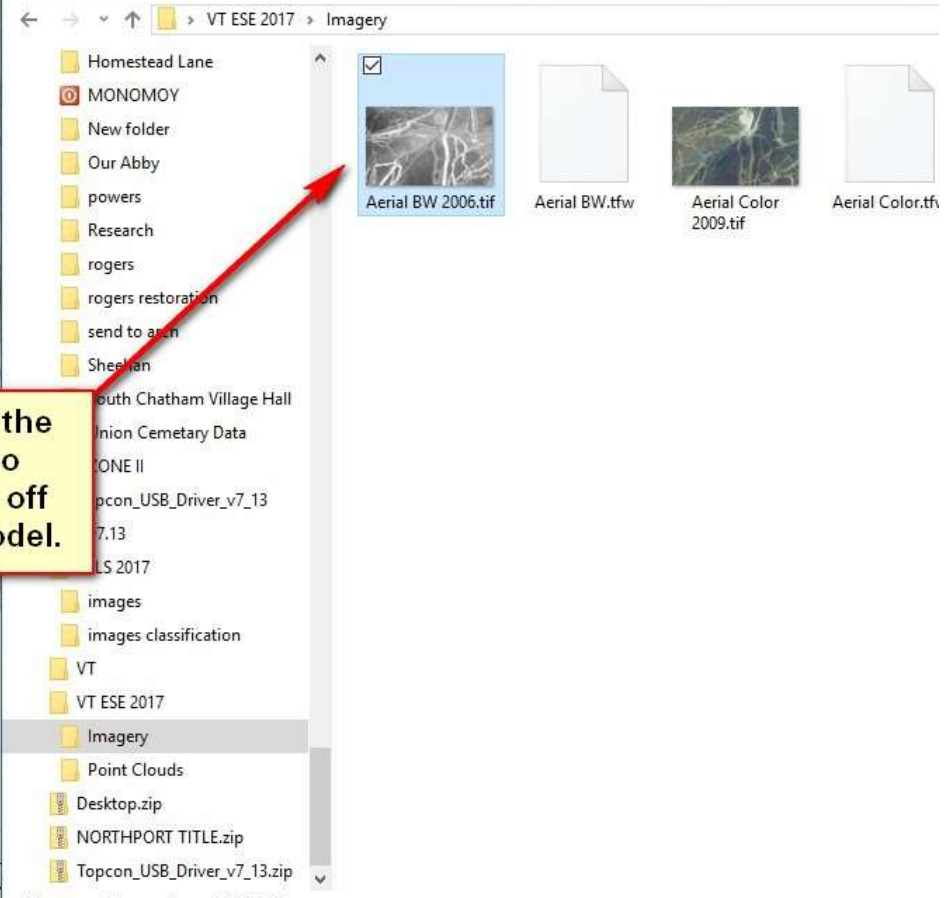
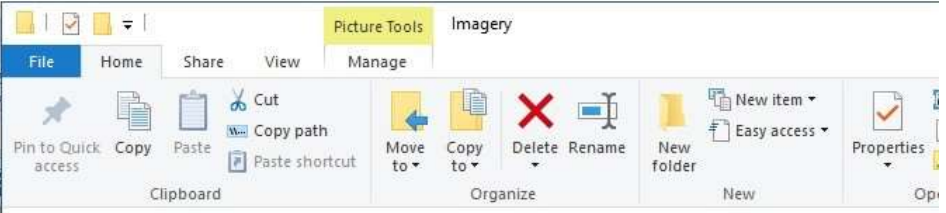
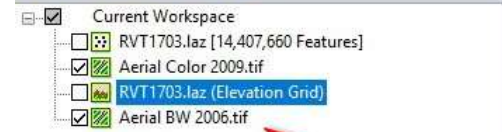
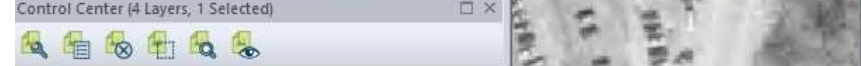


Select the Image Swipe tool from the Tools Menu.

Then select the layer that is on top of the other layer.

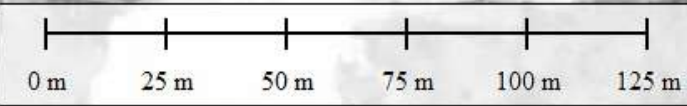






Drag and drop the B&W image into place and turn off the Surface Model.





Want to see the history? You will need the imagery. Historical Buffs love this stuff.

EE EarthExplorer x

Secure | https://earthexplorer.usgs.gov

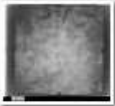
Apps MASSACHUSETTS C-I-TOWNS MAPS MUSIC SURVEYOR UNITED STATES TECHNICAL Latest The Ultimate 3D Print

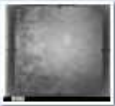
Data Set [Click here to export your results »](#)

Aerial Photo Single Frames

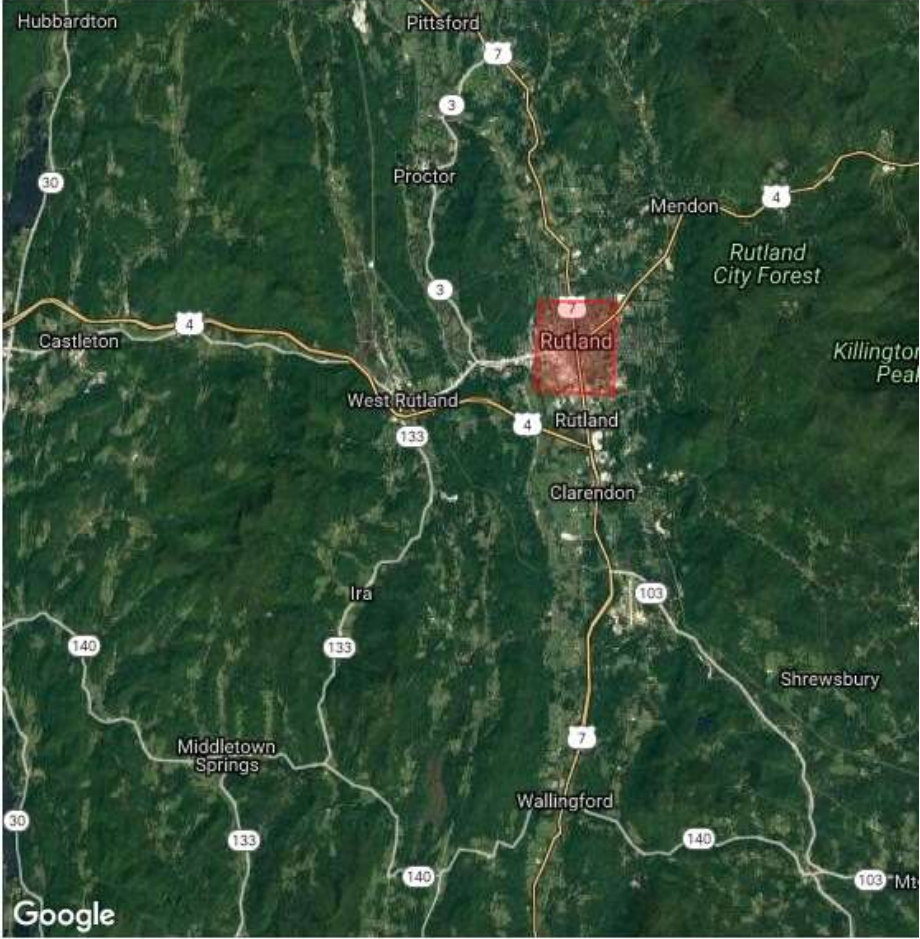
« First < Previous 6 ▾ Next > Last »

Displaying 51 - 52 of 52 ⓘ

51  Entity ID:AR1AE0000140035
Coordinates:43.576763 , -73.02502
Acquisition Date:03-OCT-42
Scale:27200

52  Entity ID:AR1AE0000140148
Coordinates:43.608268 , -72.921812
Acquisition Date:03-OCT-42
Scale:27200

« First < Previous 6 ▾ Next > Last »

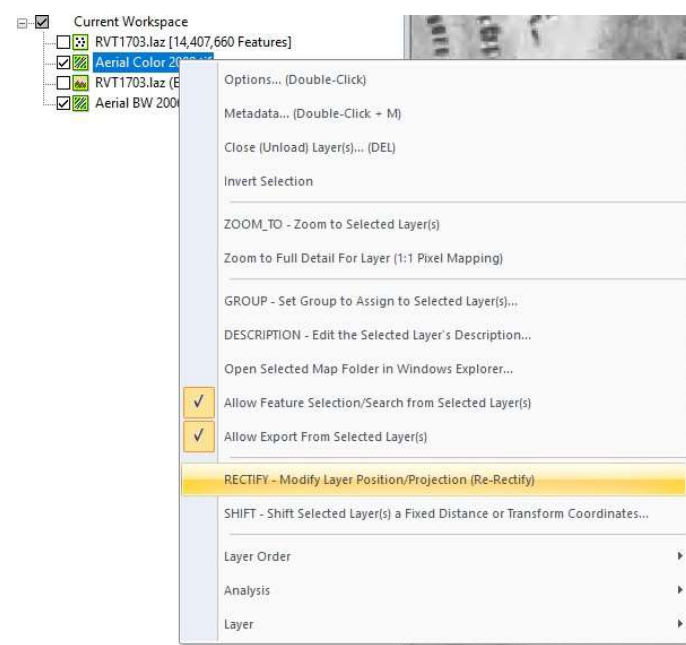


The up-to-date Google map is not for purchase or for download; it is to be used as a guide for reference

You might need some older imagery.

The USGS Earth Explorer can provide some pretty old images.

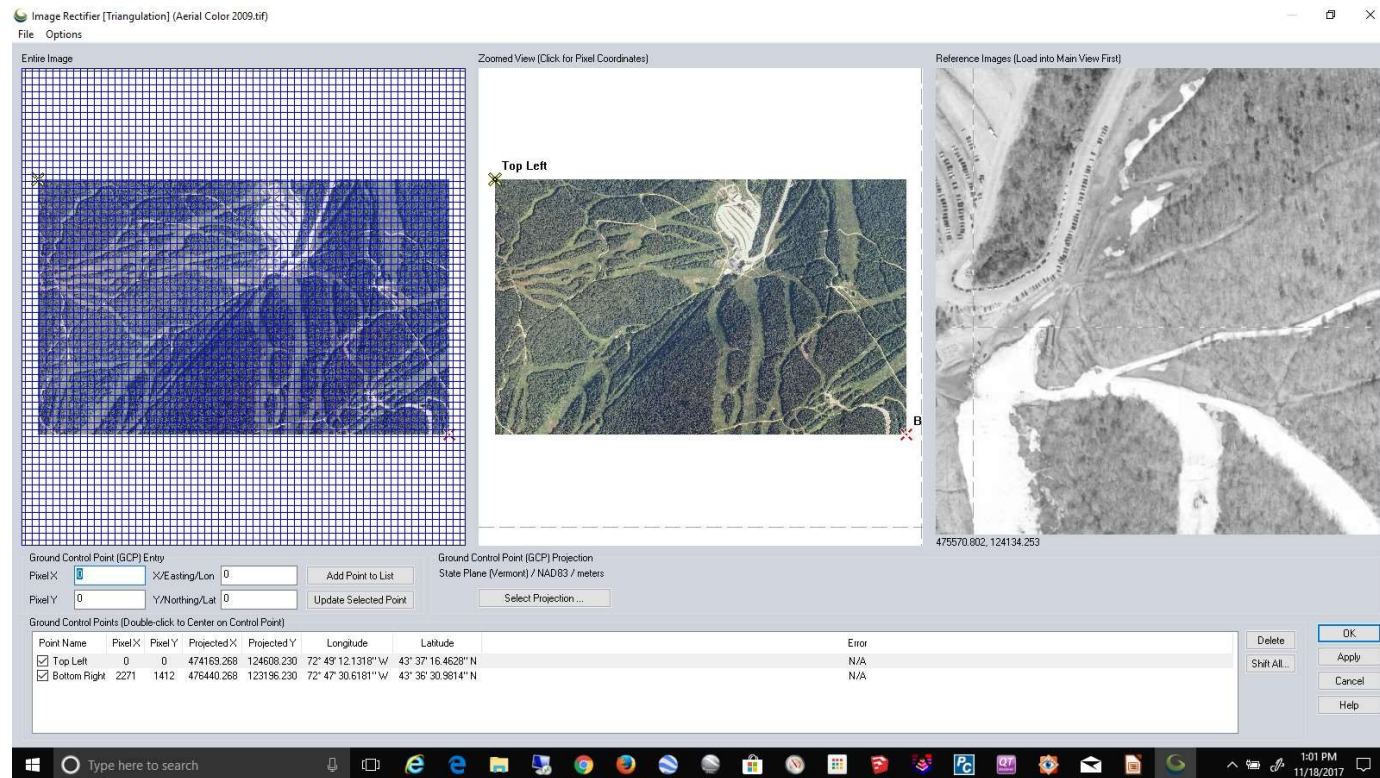
Unfortunately, these usually are not georeferenced. Global Mapper has a georeferencing tool. You can also fix an image you have in the project because you will soon learn that not all aerial images are correctly rectified.



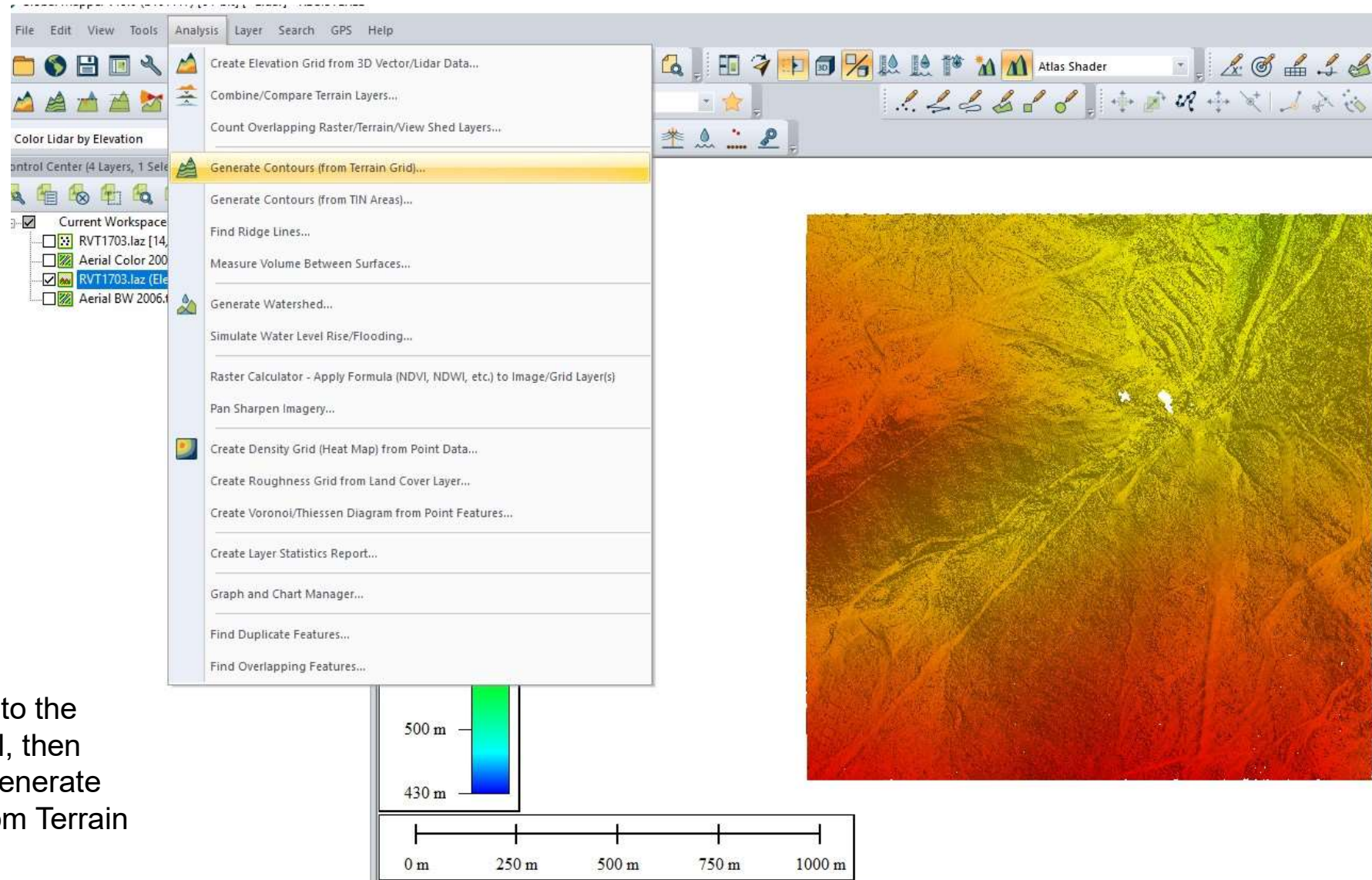
Future Exercise. (This is how you get to it, you can play with this later.)

Right click on the Layer, select RECTIFY and you get a window that allows you to pick pairs of points. BE SURE TO ADD POINTS TO LIST. (It is easy to forget). There are several mathematical methods to select from and you can either rectify an image or distort it beyond recognition. I have done both.

You can pull in the older images and rectify those to the current images or to vector layers. Exporting the Layers will be covered in a little bit and once you have mastered this, you can export to a format that works in other programs.



www.eselc.com/vsls



Let's go back to the surface model, then Analysis → Generate Contours (From Terrain Grid).

Another Menu with TMI

Description is the layer name
Contour interval

Minor and Major Intervals

Range to contour

Resolution & Resampling
See further into the presentation

Colorful contours

Spot elevation for Max and Min (only 2 per set)

Fill in the gaps

Labels with units

Smooth

Direct export (a step closer to automation)

Shoreline generation

Discard shorties (you get many where it is Flat)

Contour Generation Options

Contour Options | Simplification | Tiling | Contour Bounds

Description: GENERATED CONTOURS

Contour Interval: 2 FEET Only Generate Contour Lines at Specified Height

ADVANCED - Contour Interval Multiplier
Minor Contours: 2 Major Contours: 10

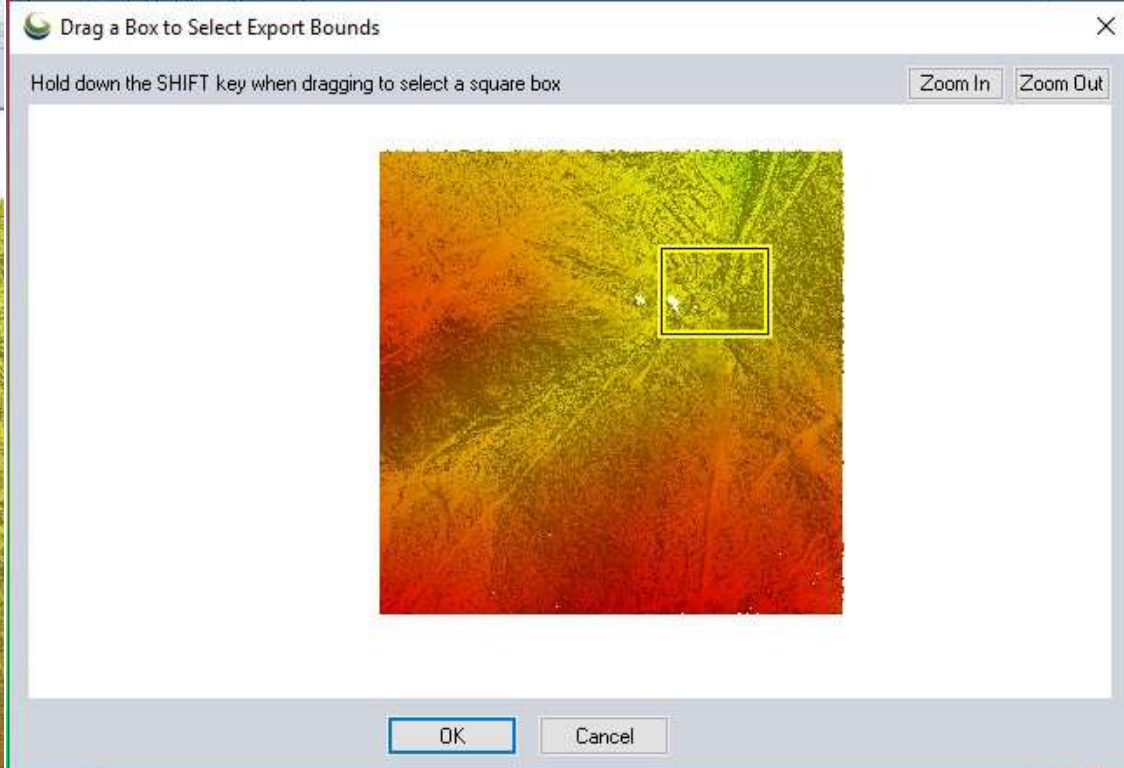
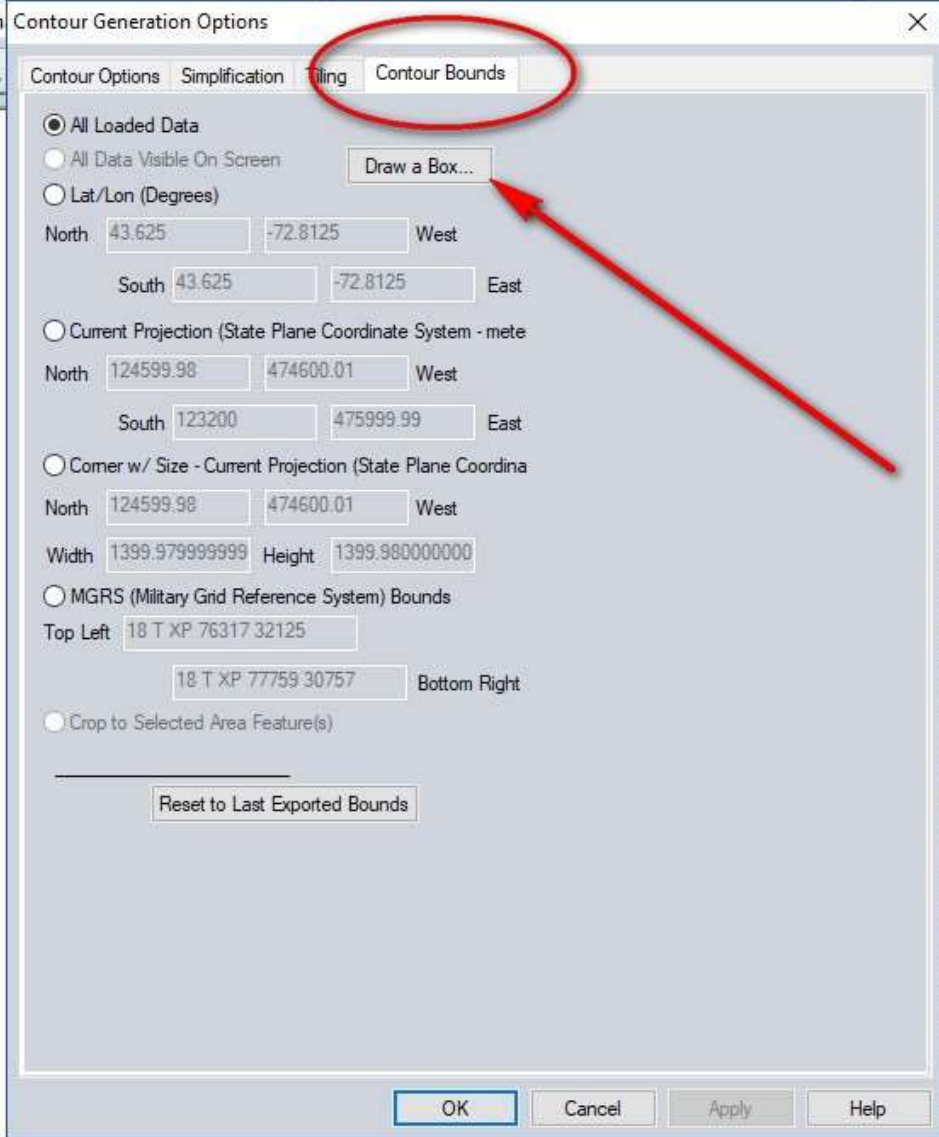
Elevation Range (Default is Entire Loaded Range)
Generate contours within following range of elevations:
1410.1 to 3605 FEET Start at Minimum Elevation Instead of at First Interval Multiple Within Specified Range

Resolution (in Current Projection Units)
The resolution affects fidelity with which contours are generated. Larger numbers result in less detailed contour lines that take up less space. Typically you'll just want to accept the defaults.
X-axis: 0.137509085551519 meters
Y-axis: 0.134613461538462 meters
Resampling: No Resampling (Nearest Neighbor)

Generate Area Features Colored Based on the Current Elevation Shader in Addition to Contours
 Generate Spot Elevations at Min/Max Elevations
 Interpolate to Fill Small Gaps in Data
 Append Unit Labels (m' or ft') to Elevation Labels
 Smooth Contour Lines/Areas to Improve Appearance
 Export Contours Directly to Package Files Rather Than Displaying in the Main Map View. Use with Gridding Option to Allow Contouring of Very Large Areas

Advanced Options
 Create Contours Where Elevations Pass Down to Contour Value Rather Than as They Go Down From One (Good for Shoreline Generation)
 Discard Closed Contour Lines Shorter than 5 meters

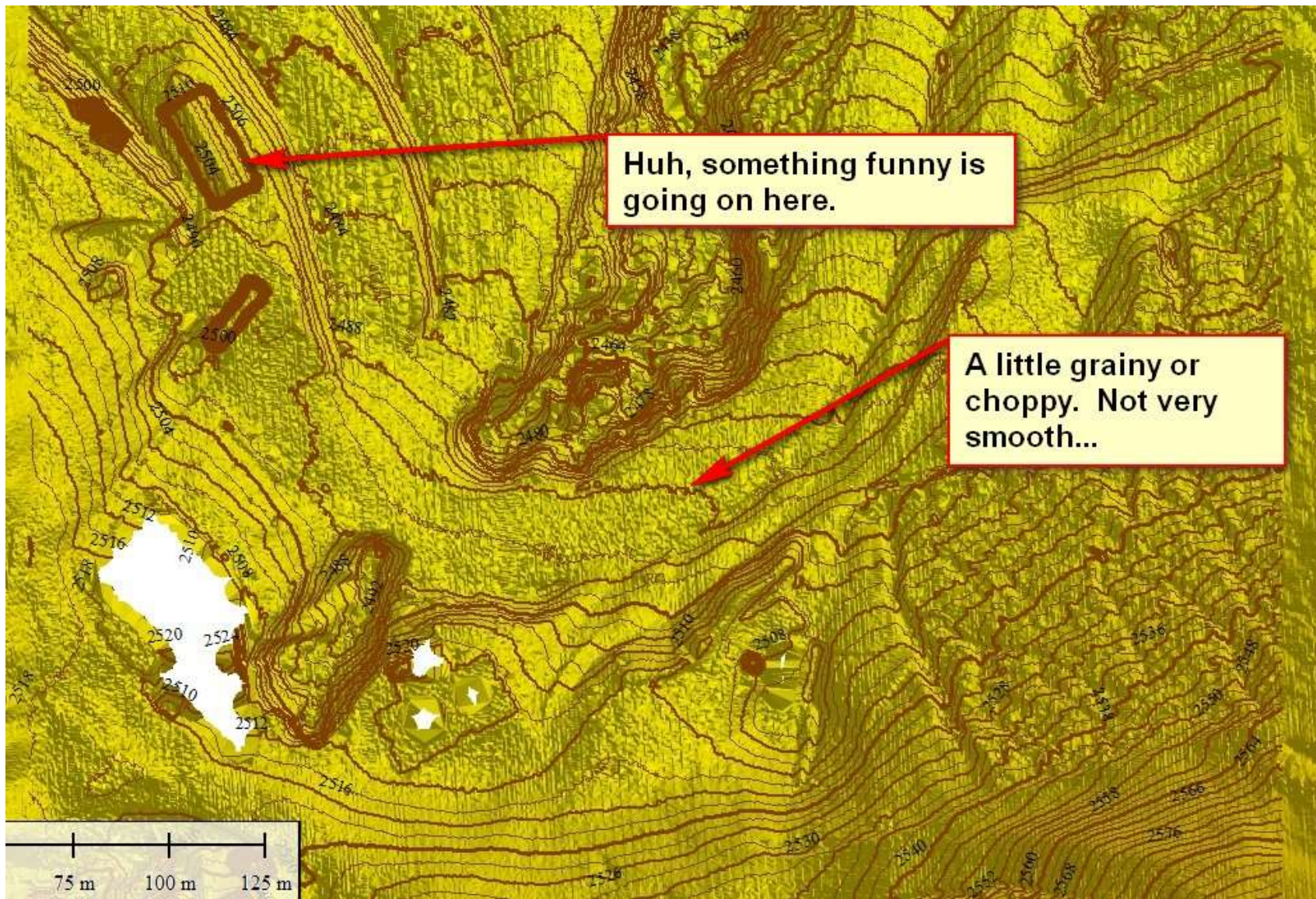
OK Cancel Apply Help

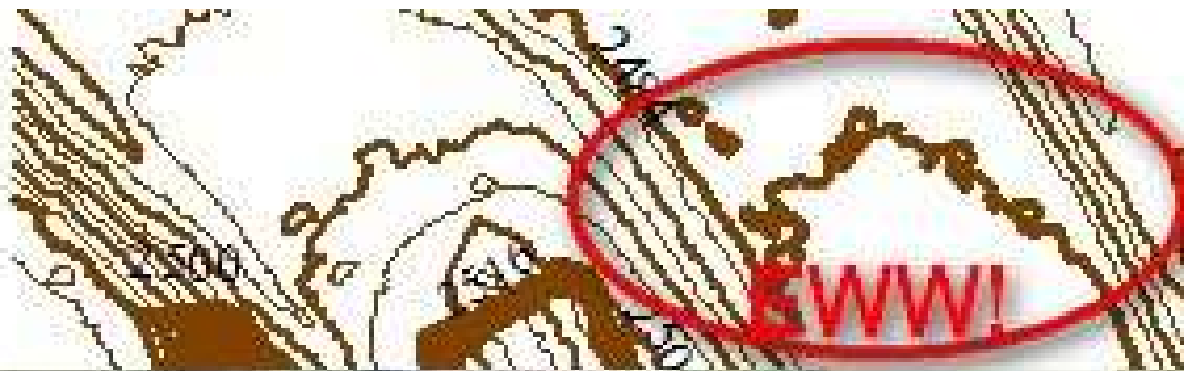


The simplification tab helps to simplify the contours (not recommended). The Tiling will cut up the contour layers. The Contour Bounds allows you to select a small area. Since large areas take longer, let's select a small box to contour.

Review the documentation for the LiDAR quality for the contour interval. You can safely drop the interval to 1' for much of the LiDAR available.

Wonderful for
planning,
drainage /
watershed
analysis,
preliminary
design,
augmenting
surveys.





So, our classification called a building and some trees ground...

I turned off the surface, turned on the imagery, changed the draw order and used the image swipe tool to see what was going on with these odd / dense contours.

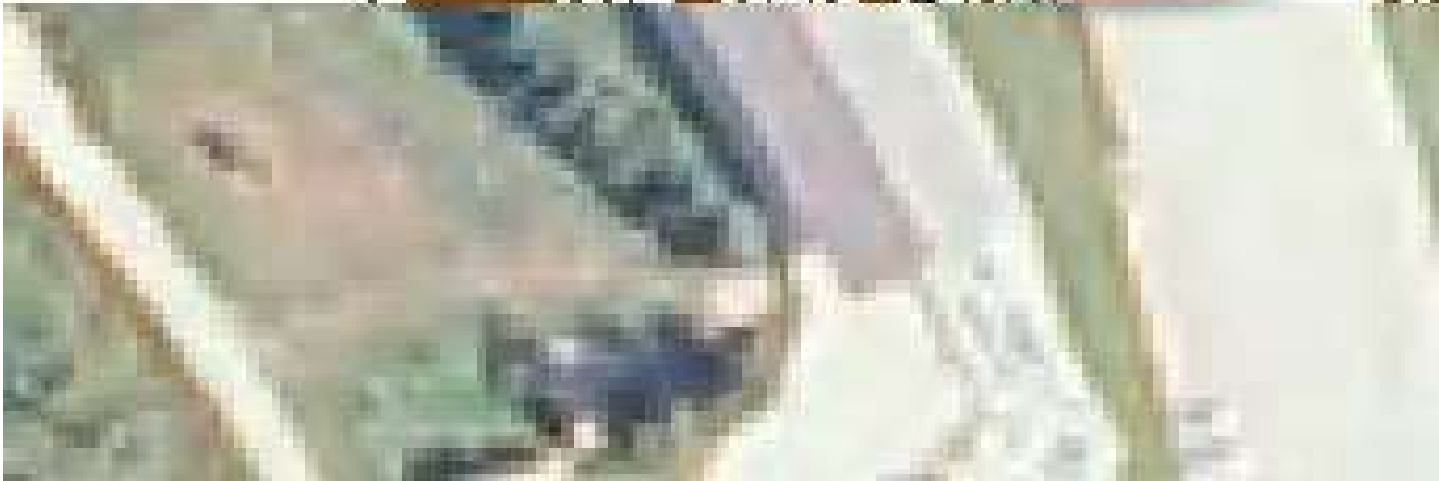
The Point Clouds provided by the State have the Ground already classified and it is best to just use theirs. You still may run into a false positive that you have to remedy.

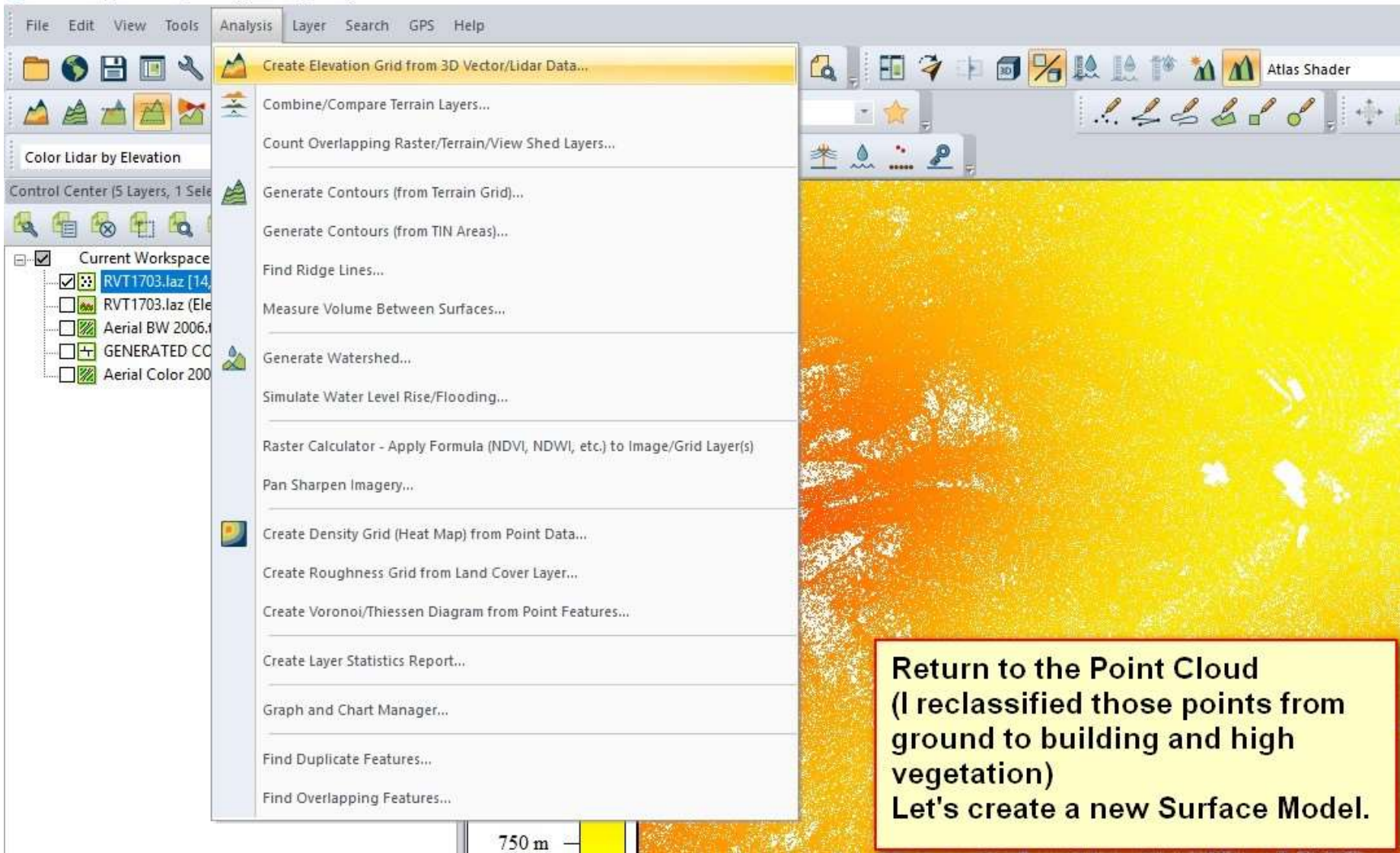
Why learn it? If you obtain a raw cloud, you may want to classify the ground points. Where do you get a raw cloud? Scanner, Drone or from others.

EWWW! That contour looks insane. Who would ever want to work from some nasty looking contour like that? Is this data that worthless?

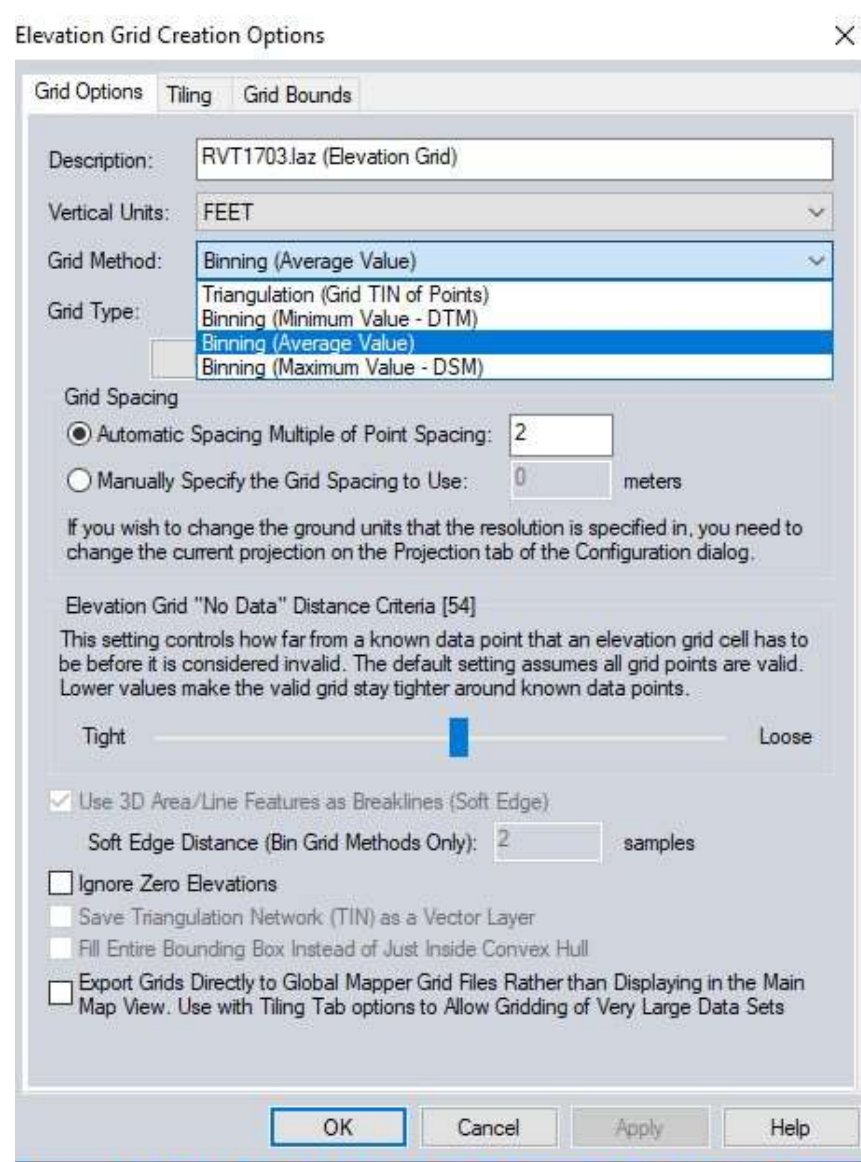
No. We passed by the Resolution and Resampling options in the contouring options. We can make the contours look better using other methods.

(Well, why did you waste our time with this TIN?) (So you could learn.)





**Return to the Point Cloud
(I reclassified those points from
ground to building and high
vegetation)
Let's create a new Surface Model.**



Back in the Surface Model (Elevation Grid) we are going to jump into the BIN rather than the TIN.

The TIN will create a surface from point to point. The positional tolerance of our points is a half foot.

Surveyors usually deal with a workable number of points: tens, hundreds, thousands. These points are obtained and have a positional tolerance of 0.01' to 0.10' (usually). TINs work.

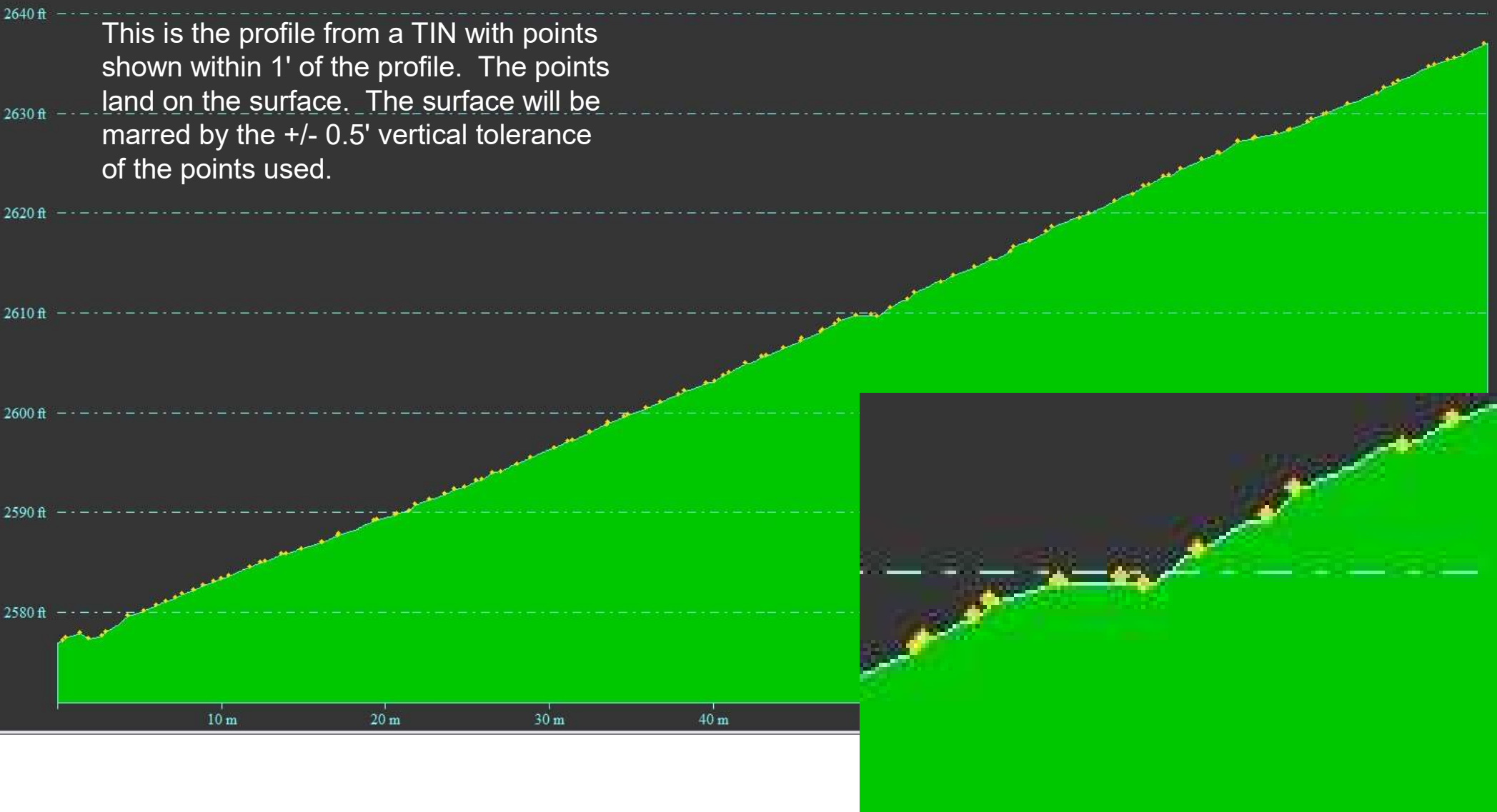
LiDAR provides too many points to edit. And their position is not as tight as surveyed points (unless you use your own scanner or a drone, then they can be about equal to or better than surveyed points and even more numerous.)

So the BIN will average out the elevation at the point based on the nearby points. If the positional tolerance follows normal distribution, then the average of a few points should result in a better position.

Should is not always.

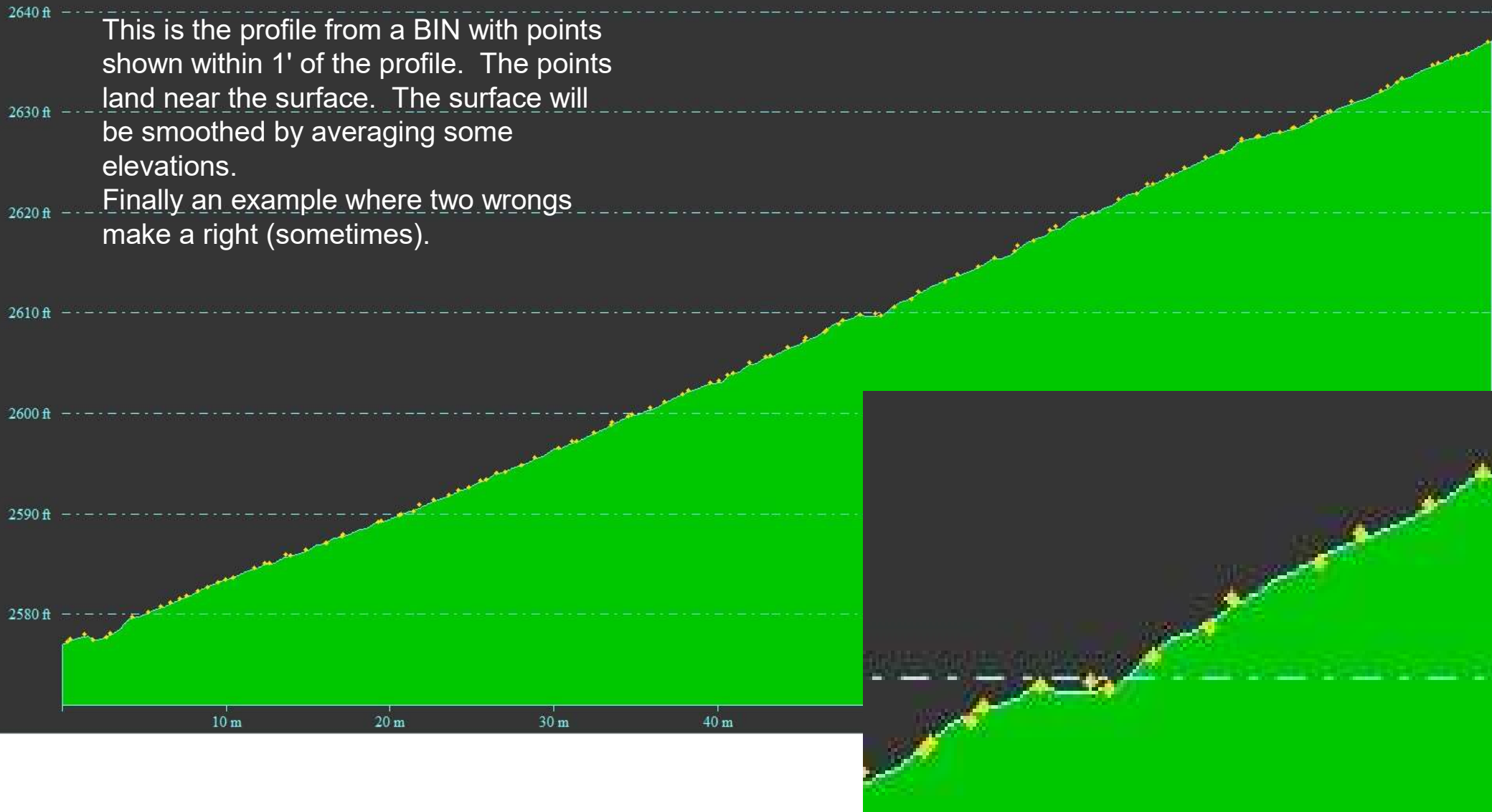
Do not get on high horses. I have found some LiDAR surfaces from aerials that are better than the surveyed surfaces especially in the thick areas where breaklines cannot be seen or located. Even worse, I have seen better LiDAR surfaces in the wide open where surveyors have not obtained sufficient points to make an accurate surface model.

This is the profile from a TIN with points shown within 1' of the profile. The points land on the surface. The surface will be marred by the +/- 0.5' vertical tolerance of the points used.



This is the profile from a BIN with points shown within 1' of the profile. The points land near the surface. The surface will be smoothed by averaging some elevations.

Finally an example where two wrongs make a right (sometimes).



90% of all well-defined features, with the exception of those exaggerated by symbolism, will be depicted within 1/50”.

90% of all well-defined features, with the exception of those exaggerated by symbolism, will be depicted within 1/2 of the base contour interval.

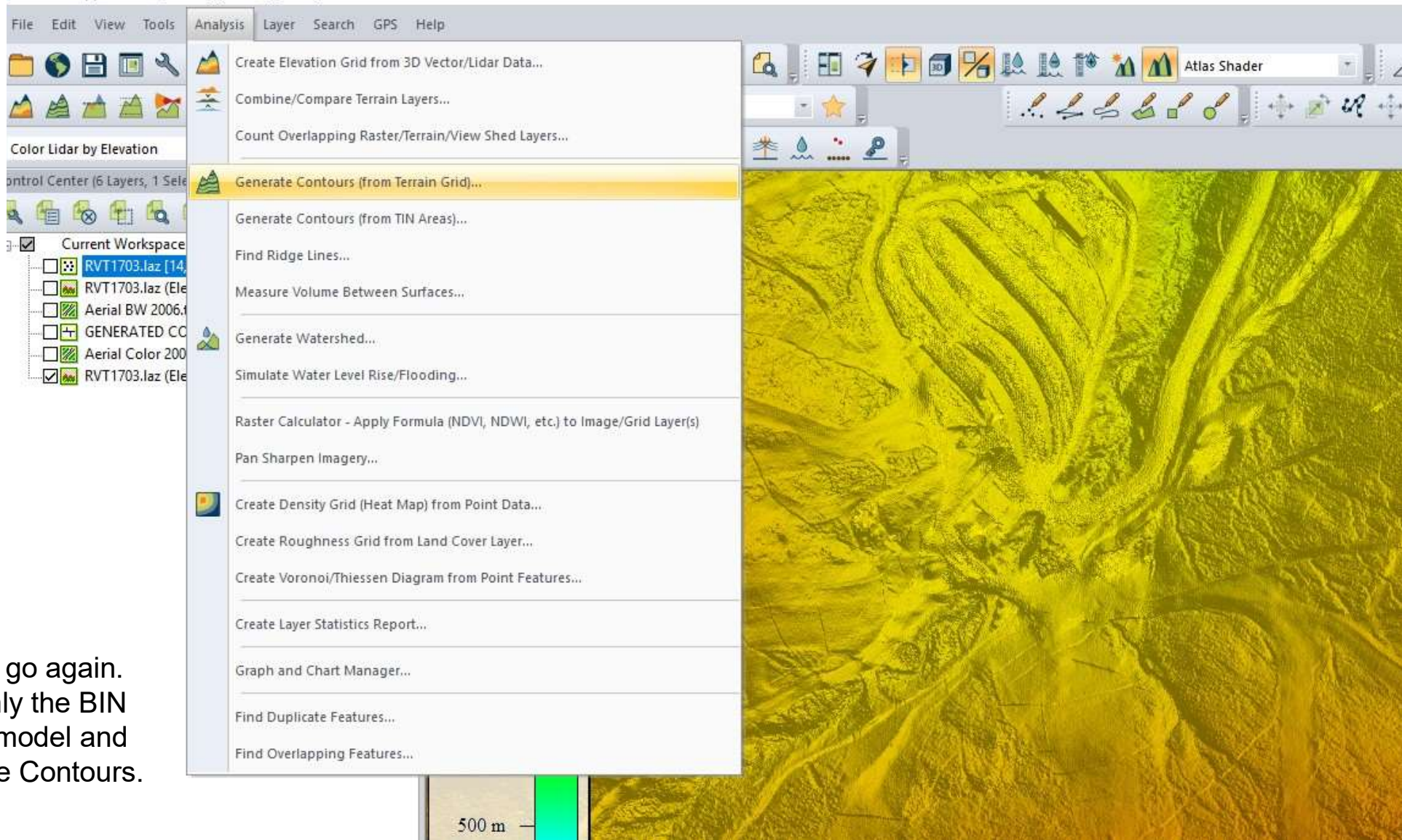
Combining the LiDAR with aerial imagery should allow one to digitize well-defined features within a foot or two or better. Vertically, we generally have half a foot in the wide open.

Running the math, we can produce maps / plans from this information that meet the National Map Accuracy Standards for a **50 to 100 scale map with 1' contours**. You can always zoom into the data, you just need to make the recipient of the data aware that the positional tolerance of the map will become noticeable.

The BIN is noticeably smoother. You can use the Image Swipe Tool to compare between the two surfaces.



The TIN will better show some of the deflections – walls, paths, ditches, streams. Both surfaces have uses.



Here we go again.
Show only the BIN
surface model and
Generate Contours.

Contour Generation Options

Contour Options Simplification Tiling Contour Bounds

Description: GENERATED CONTOURS

Contour Interval: 1 FEET Only Generate Contour Lines at Specified Height

ADVANCED - Contour Interval Multiplier
 Minor Contours: 1 Major Contours: 5

Elevation Range (Default is Entire Loaded Range)
 Generate contours within following range of elevations:
 1410.1 to 3604.6 FEET Start at Minimum Elevation Instead of at First Interval Multiple Within Specified Range

Resolution (in Current Projection Units)
 The resolution affects fidelity with which contours are generated. Larger numbers result in less detailed contour lines that take up less space. Typically you'll just want to accept the defaults.

X-axis: 0.512695746826199 meters
 Y-axis: 0.512695746826193 meters
 Resampling: No Resampling (Nearest Neighbor)

Generate Area Features Colored Based on the Current Elevation Shader in Addition to Contours
 Generate Spot Elevations at Min/Max Elevations
 Interpolate to Fill Small Gaps in Data
 Append Unit Labels (m' or ft') to Elevation Labels
 Smooth Contour Lines/Areas to Improve Appearance
 Export Contours Directly to Package Files Rather Than Displaying in the Main Map View. Use with Gridding Option to Allow Contouring of Very Large Areas

Advanced Options
 Create Contours Where Elevations Pass Down to Contour Value Rather than as They Go Down From One (Good for Shoreline Generation)
 Discard Closed Contour Lines Shorter than: 5 meters

OK Cancel Apply Help

Let's try for some 1' contours with Min / Maj intervals at 1 and 5 feet.

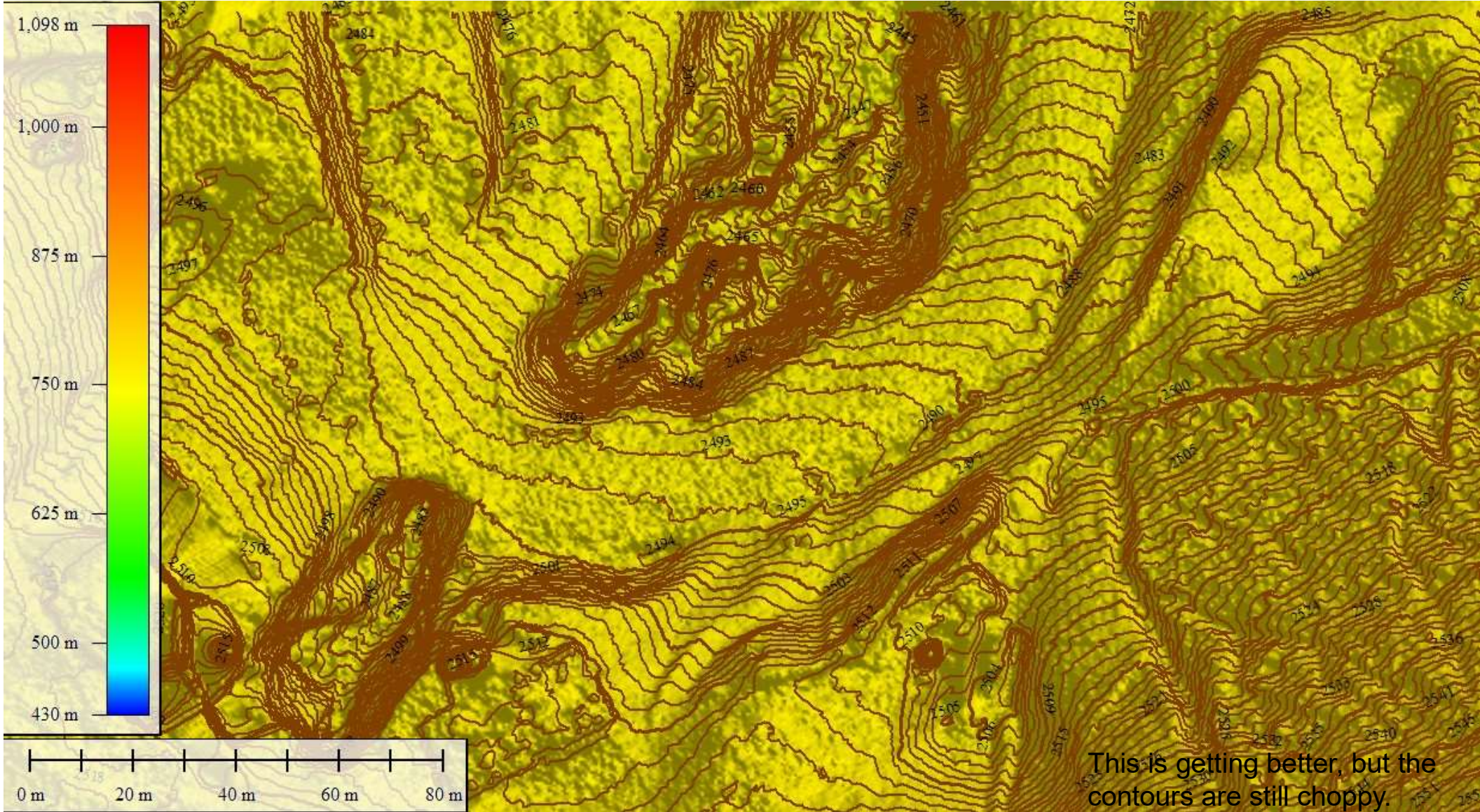
Don't forget to select Contour Bounds for a little area.

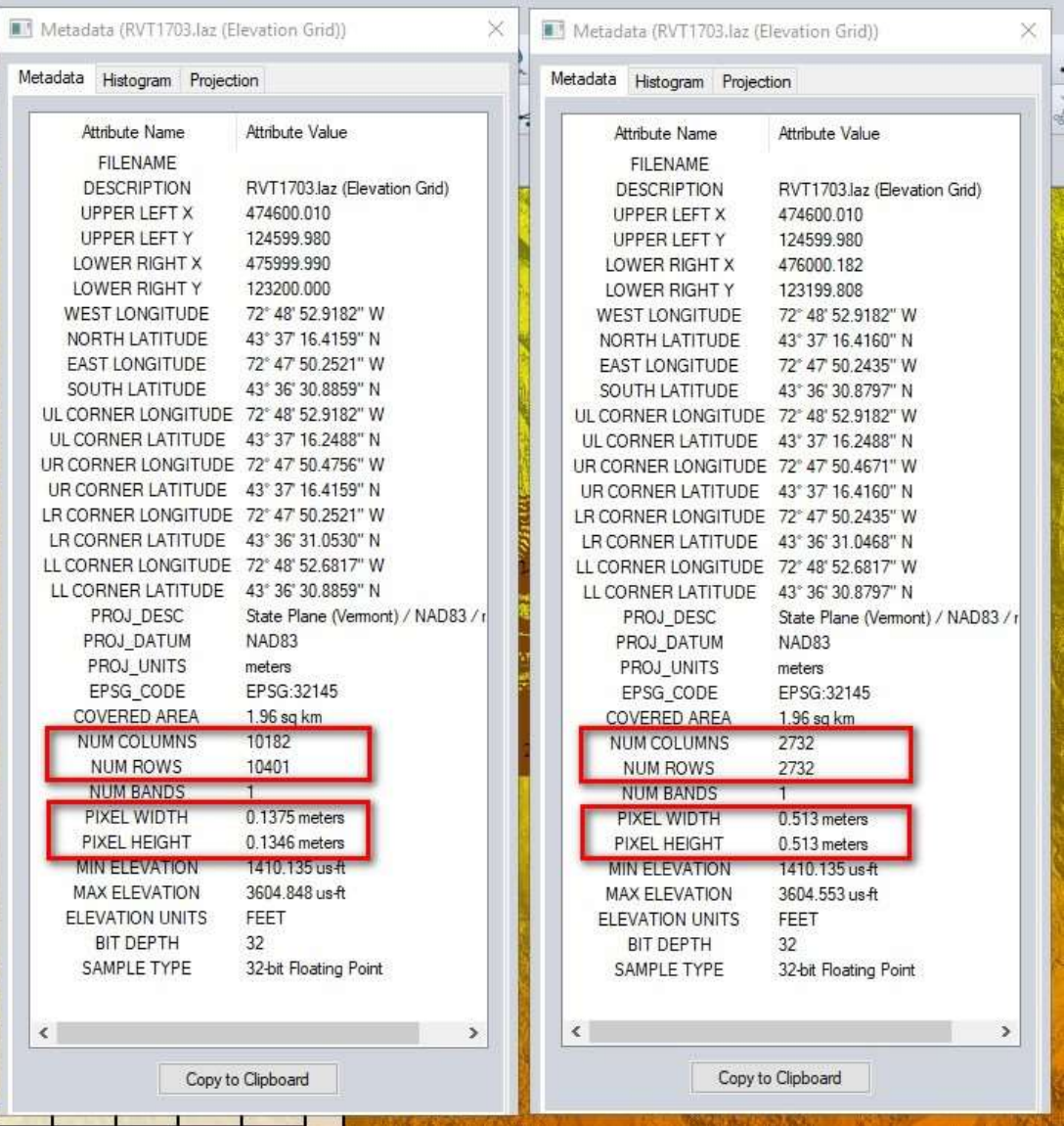
Did you notice that the resolution is different?

Below is the resolution from the previous TIN contouring... The surface is not as dense, we averaged things out to make a

Resolution (in Current Projection Units)
 The resolution affects fidelity with which contours are generated. Larger numbers result in less detailed contour lines that take up less space. Typically you'll just want to accept the defaults.

X-axis: 0.137509085551519 meters
 Y-axis: 0.134613461538462 meters
 Resampling: No Resampling (Nearest Neighbor)



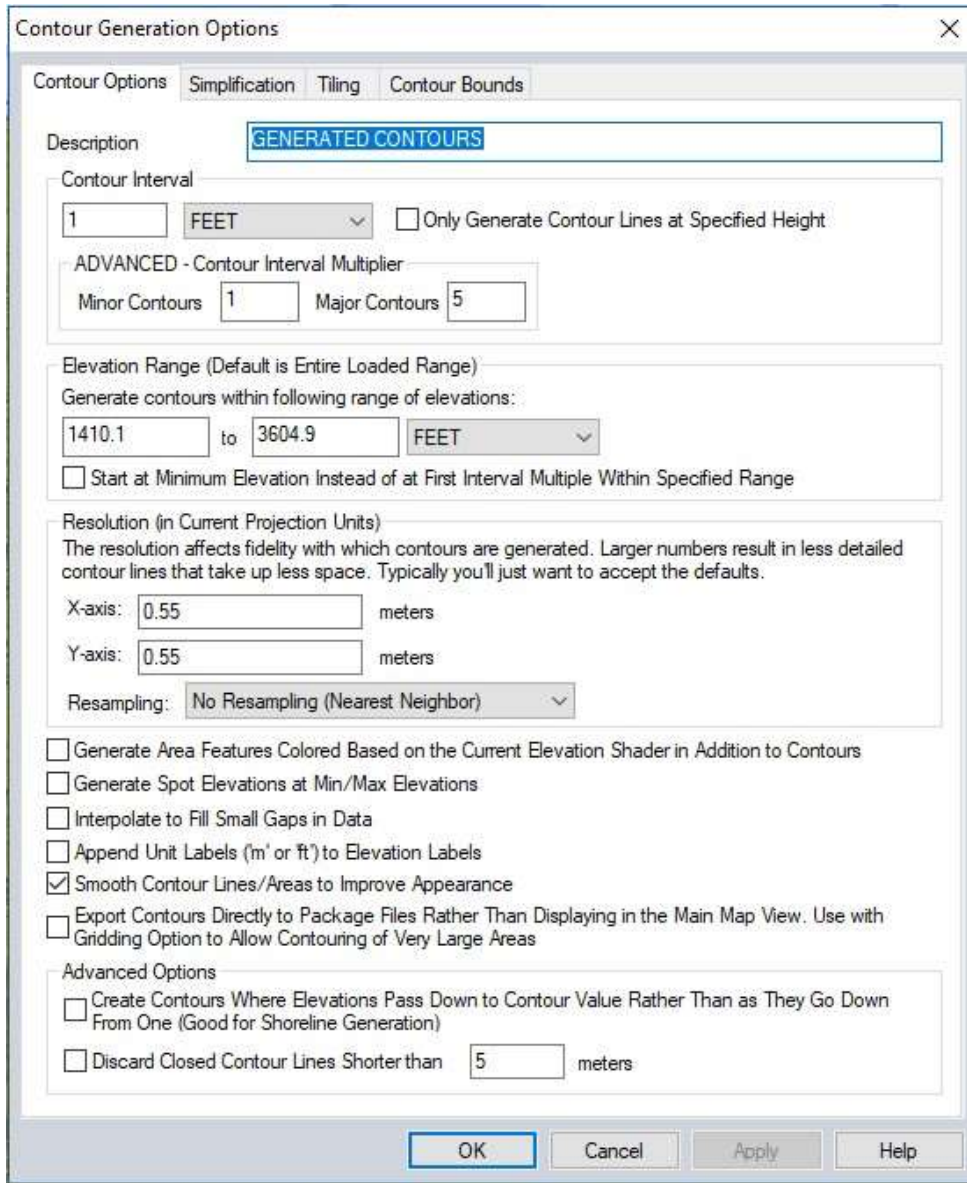


Right clicking on the Layer (surface model in this case) allows one to view the MetaData for that layer.

To the left is the TIN and to the right is the BIN. Both surface models are Grids with different resolutions.

You cannot contour from a better resolution than the Surface Model starts with.

You can contour with a lesser resolution.

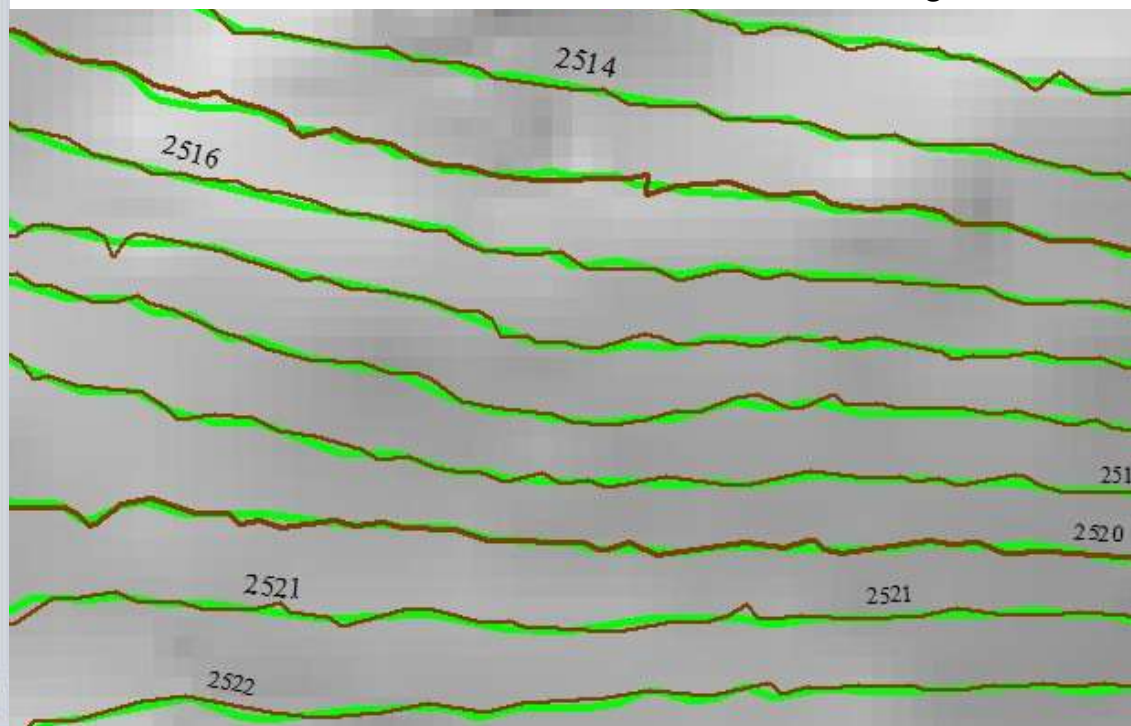


So the BIN is producing better contours than the TIN... But if we resample the resolution of the TIN to be about the resolution of the BIN, what do we get? The brown contours are from the BIN and the green contours are from the resampled BIN.

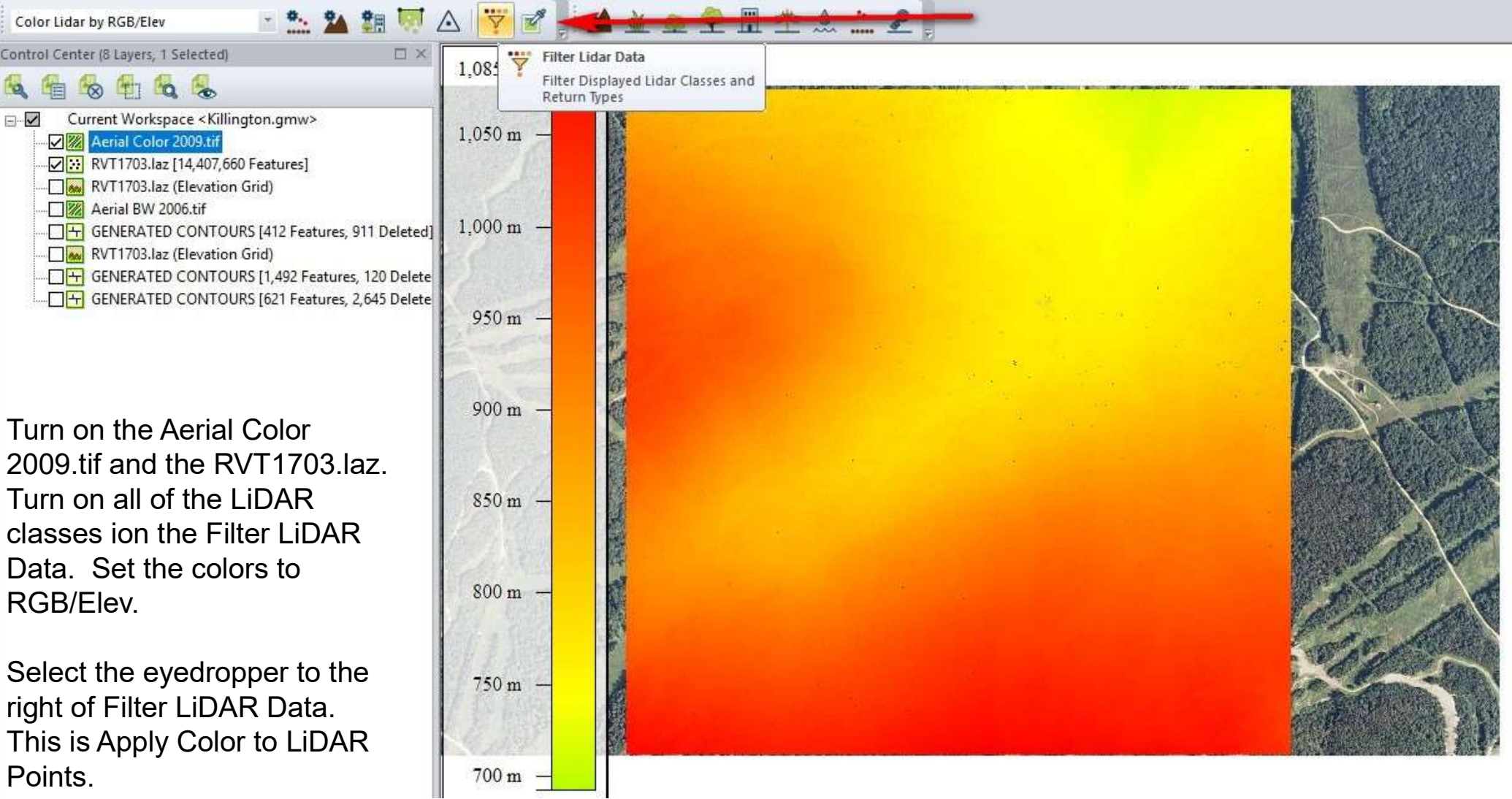
Those are pretty good.

So, which is better TIN or BIN or TIN resampled? It all depends on what the client desires.

NOTE: Different data sets will need different settings.

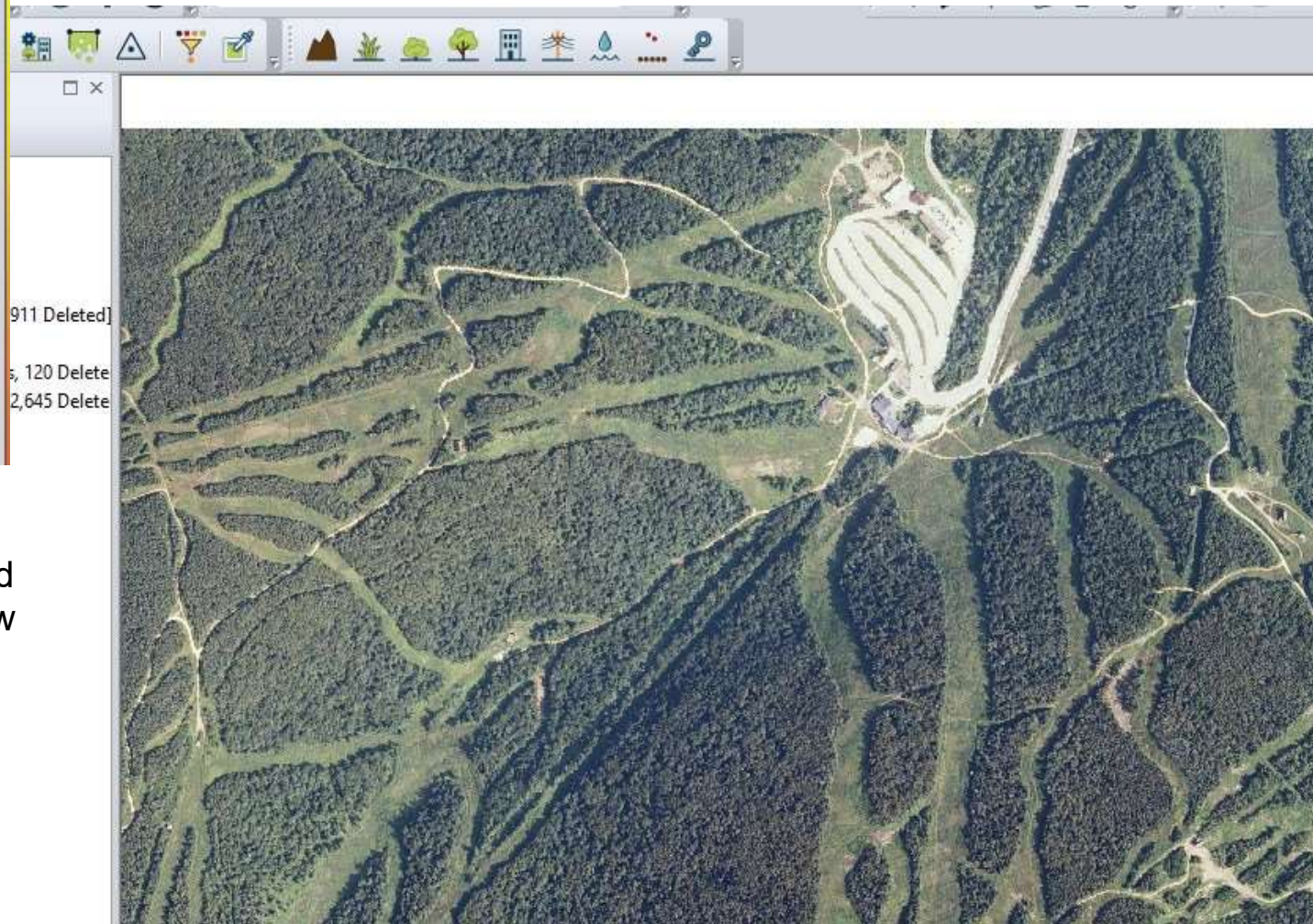
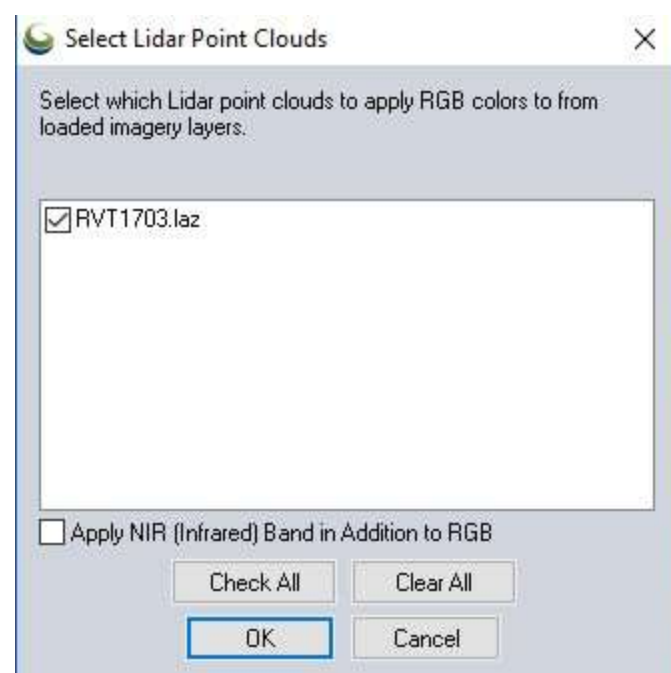


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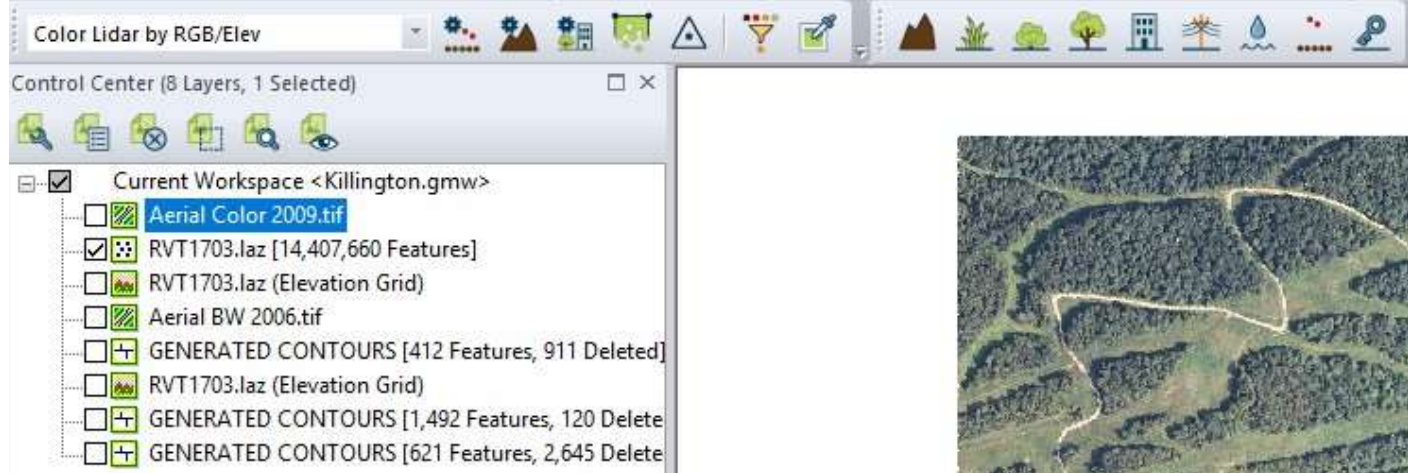
Turn on the Aerial Color 2009.tif and the RVT1703.laz. Turn on all of the LiDAR classes on the Filter LiDAR Data. Set the colors to RGB/Elev.

Select the eyedropper to the right of Filter LiDAR Data. This is Apply Color to LiDAR Points.



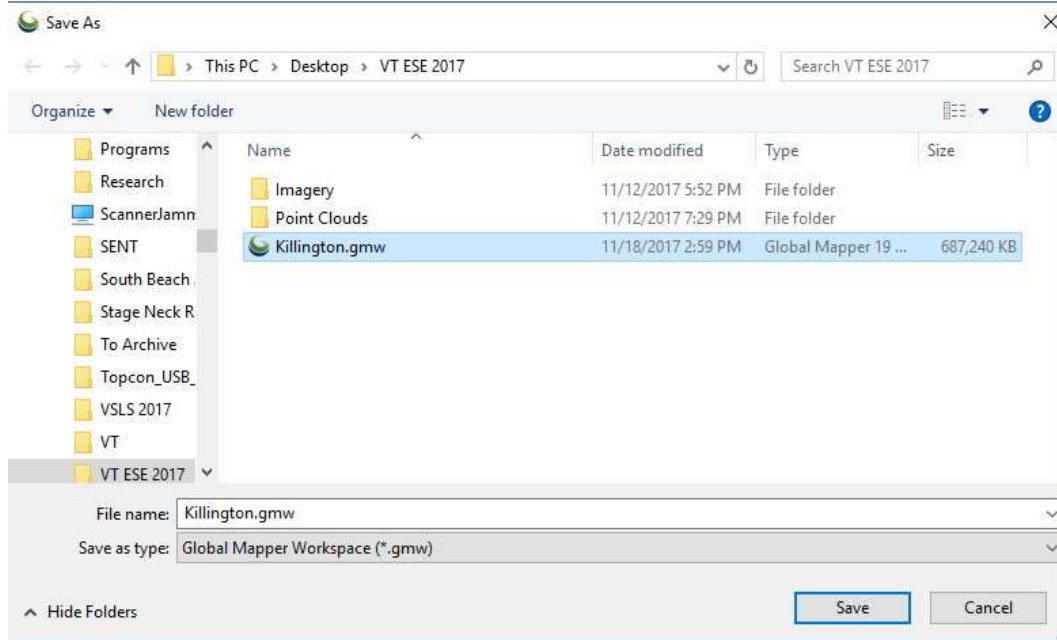
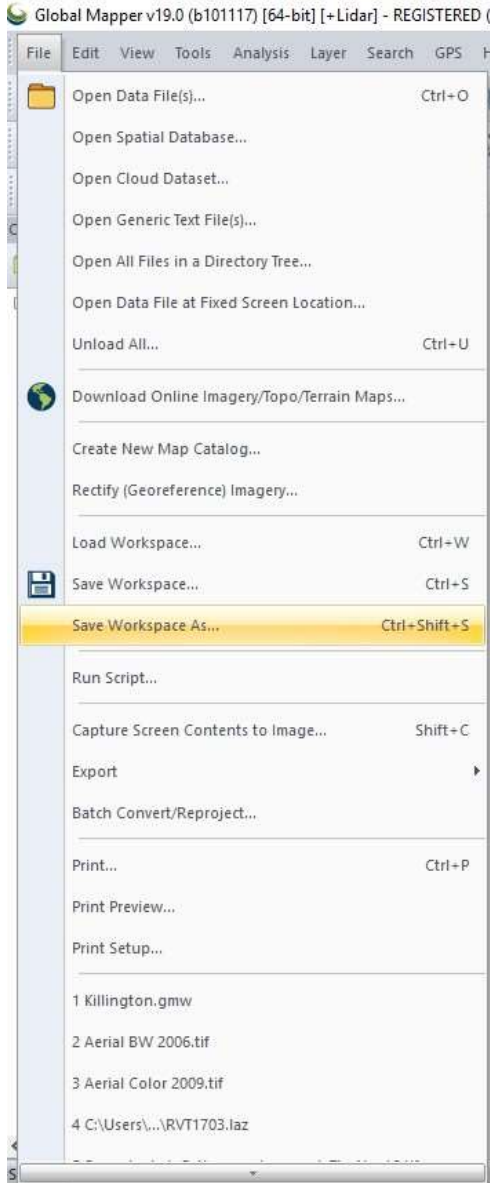
Of course you get to choose options. I like to keep things turned on and off to make it easier to know which data I am working with...

Wait, where did the cloud go?



Turn off the Aerial Color 2009.tif layer and what you are left with is a colorized cloud. Colorizing LiDAR is never perfect as the LiDAR is acquired from one sensor and the imagery is acquired from another. Static scanners have internal cameras but they take images before or after the cloud is acquired so wind will often change things to make the images just a little different than the scans...





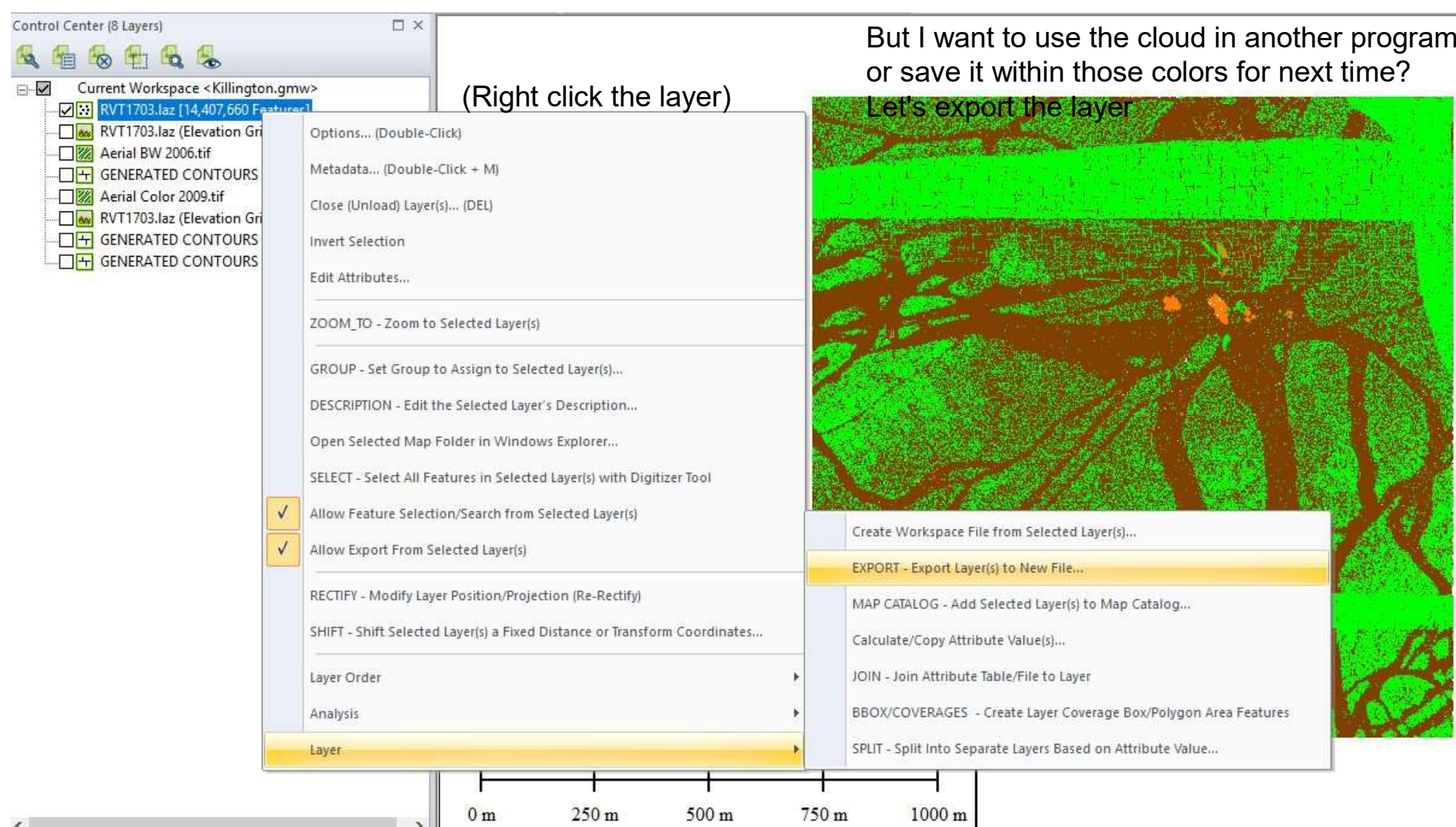
We can save the workspace.

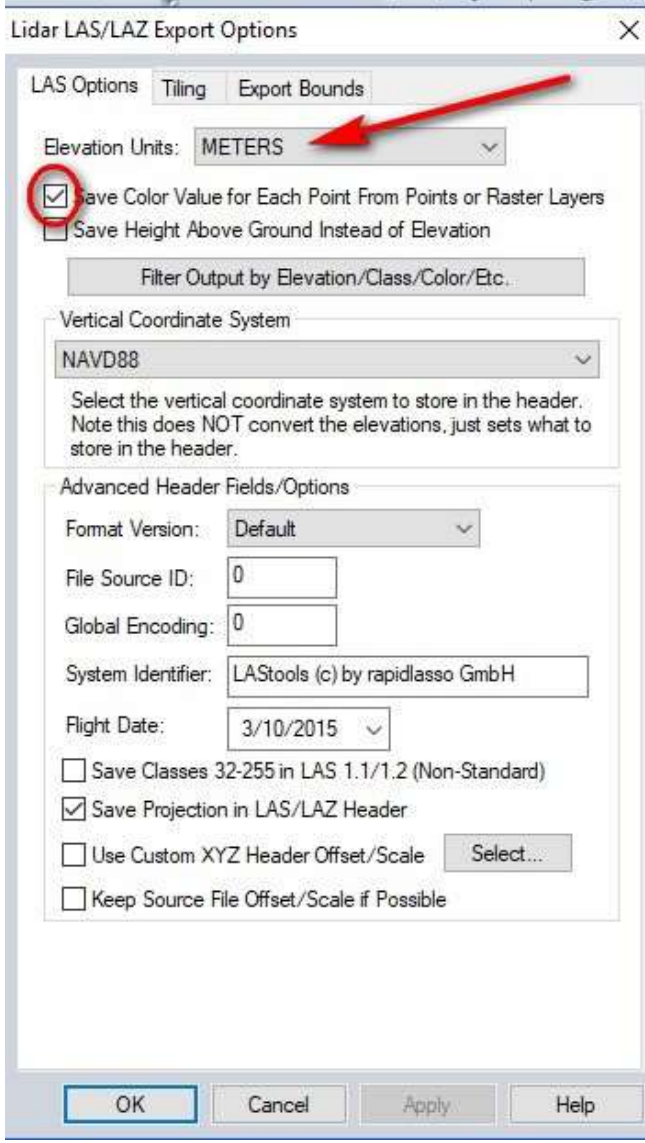
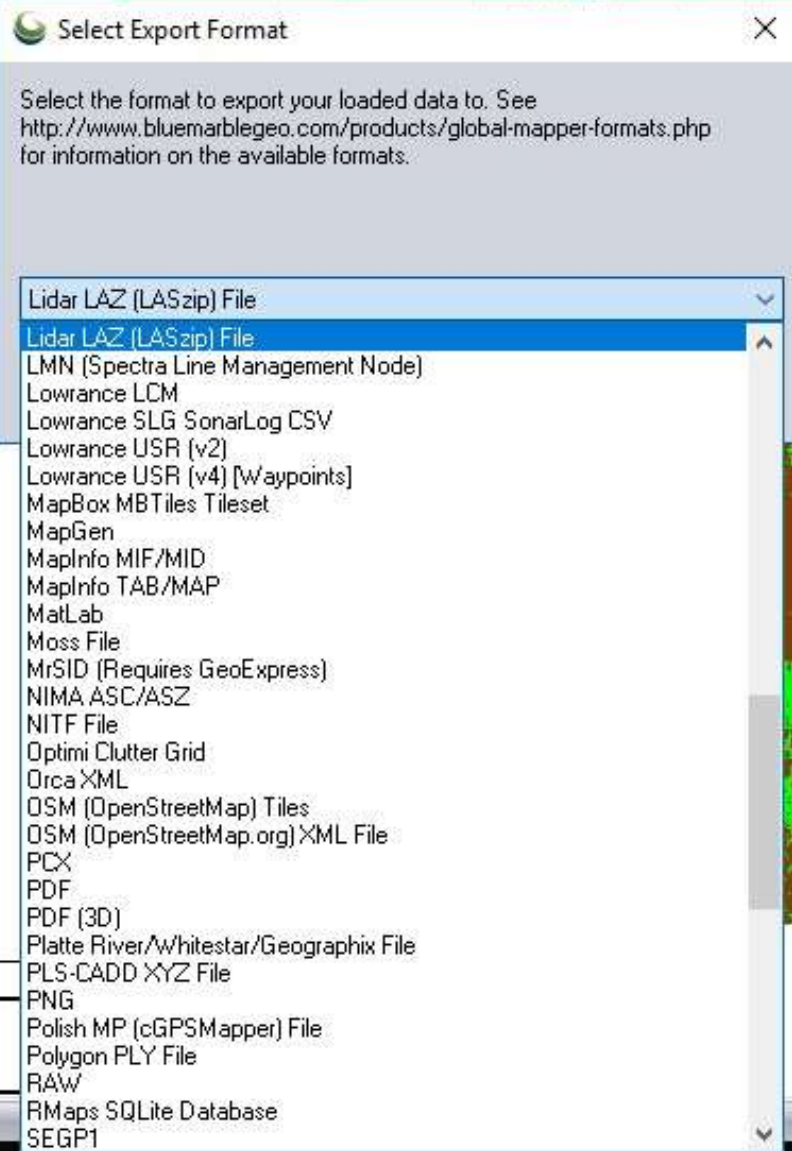
It is important to note that the data files / layers are not saved. Their paths are mapped and the changes to those layers are saved.

But I want to use the cloud in another program or save it within those colors for next time?

(Right click the layer)

Let's export the layer



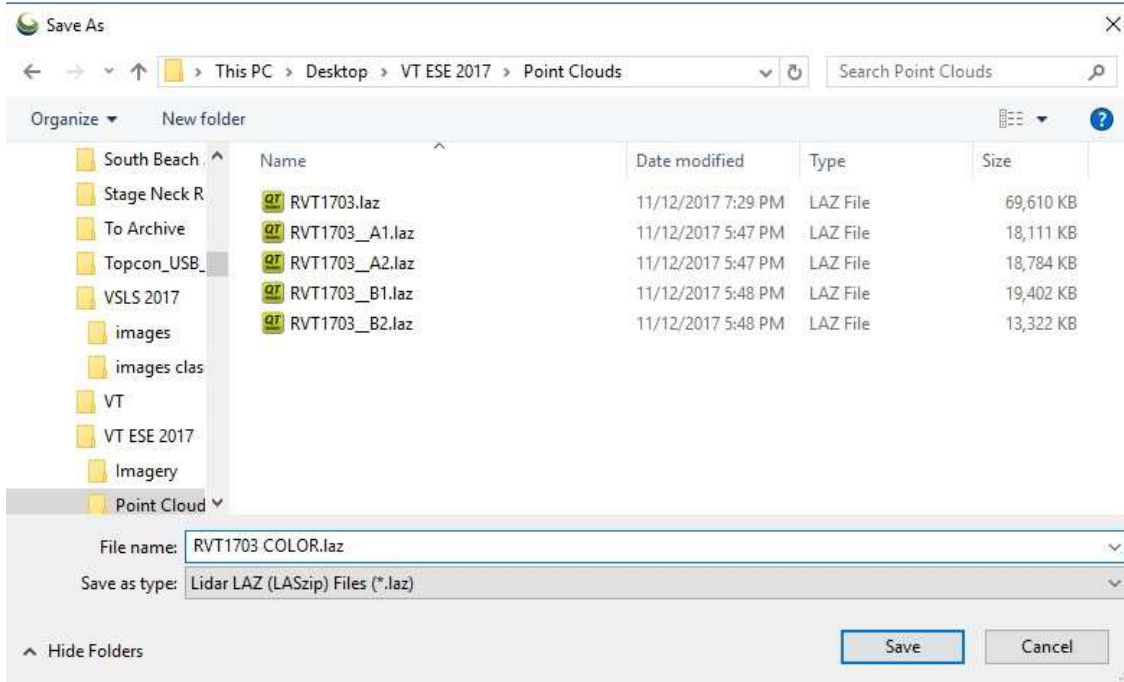


The export options are numerous. Global Mapper has accepted every format I have thrown at it. It will export oodles of formats as well.

We want to export a LAS/LAZ.

The Elevation units remain in Meters (weird but you get used to it.)

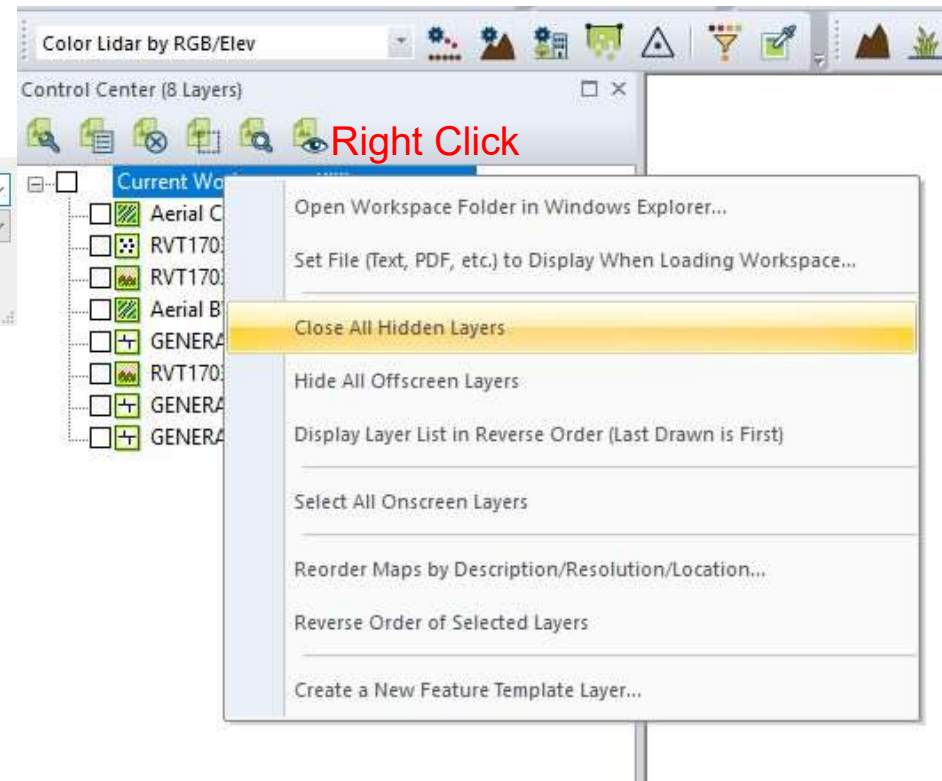
Save the Color Value for Each Point.



We can put it back into the folder and add COLOR to the name.

Then turn off all the Layers and Close All Hidden Layers.

Save the workspace if you want.



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The single most important function of the Land Surveyor is to determine the boundaries of Real Property.

The second most difficult properties to survey are those that time has forgotten. The most difficult are those that include considerable errors by the original surveyor. These are caveats to keep in mind with using this data for boundary:

1. The data is aerial. It was acquired from a couple thousand feet in the sky. The actual altitude is somewhere in the metadata and ultimately makes no difference. It is important to note that it was acquired from a distance away.
2. The laser accuracy is about half a foot, so any point is that plus or minus half a foot. While it does not sound great, for aerial data this is awesome.
3. The surface model is based on a strict TIN - point to point. It's a nasty surface compares to a BIN which will create an average elevation around every desired point. The BIN does not provide the clarity in ridges, ditches and roads but produces a smoother surface model. There is reason for this selection and just know that there are other methods used for other purposes.
4. The surface model helps to visualize. These should be used to help determine where to look for the differences in the surface model. They should never be used in place of boots on the ground surveys. I use these models for approximation, deed compilation and survey planning.
5. I would not hesitate to use these in a court. I would provide all the pertinent caveats and I would overlay my own survey data to show how well the model worked and I would not hesitate to show where the surface model failed. Judges generally respond well to complete honesty. "We know the data is an excellent resource. We know the data is not as accurate as 'boots on the ground' survey data. These are the instances where the model worked within tolerance. These are the instances where it failed or provided false positives."

Story:

Otis Dyer, Jr., PLS of Rehoboth, MA performed a survey in Berkeley, MA. It was being contested and the neighbor hired a Big surveying firm.

Otis, Jr. passed away unexpectedly and his father, Otis Dyer, Sr., PLS came out of retirement at 93 to complete Otis Dyer, Jr.'s projects.

Moe Joyce, the Title Examiner, told me about the project. I told him that the aerial LiDAR could help. I offered to travel to Rehoboth to show them what it could do. They did not take me up on my offer.

I eventually prepared a surface model, exported it to a KMZ file, uploaded it to an FTP server and provided instructions to Moe Joyce.

With some help, Moe was able to download the file and load it into his laptop. He was giddy with excitement at what he saw. He took it to Otis, Sr. who was giddy with excitement by what he saw.

With the surface model, Otis Dyer, Sr., PLS, and a younger field crew were able to recover the original stone walls and roadway that had been covered with vegetation.

After they returned from Depositions, Moe was kind enough to share with me those details he could share with me: They took the Big surveyors by surprise, they took the attorneys for the other side by surprise and they may have forced a resolution before this goes to court by using superior evidence.

None of the surveyors involved had been successful in recovering these monuments before knowing where to look.

They could have been more diligent.

They could have cleared out or burned all of the vegetation to recover these monuments.

They could have moved forward with the evidence they had.

They used some technology to help resolve the problem. More importantly: **a 93 year old out of retirement surveyor used LiDAR to recover the original and controlling monuments.**

Maurice F. Joyce

"Land Court Trial Qualified Title Expert"

399 Brook Street

Dighton, MA 02715

MoeJoycell@hotmail.com

1-508-287-4768

November 16, 2017

J. Thaddeus Eldredge, PLS, CFM
Eldredge Surveying & Engineering, LLC
1038 Main Street
Chatham, MA 02633

Re: **LiDAR assistance for surveying**

Dear Mr. Eldredge:

As you are aware I have been working on a boundary line dispute case in South Eastern Massachusetts. The most critical issue in the case was the location of stone walls.

Our engineers had spent a great deal of time in the field prior to my entry into the case. Upon my entry, one of the first steps I took was to contact you for a LiDAR picture of the area in question. Because of this picture, our engineer and his field crew went back out and confirmed the wall positions revealed by LiDAR. Based on this new data, a supplemental plan was created giving our client more land than originally determined.

Recently I was Deposed in the case for six hours; based upon what the LiDAR picture revealed, I had a very good day making two points.

1. The location of the walls based on physical inspection by the survey field crew using LiDAR Data as a starting point; and
2. The lack of any other discernible walls in the area claimed by the opposition.

LiDAR is a great addition to the quiver of arrows that are available for use in cases of this nature.

Thank you,

Maurice F. Joyce

Moe Joyce was kind enough to send a brief letter. Please excuse his inability to write Surveyor. After all, he is a Land Court Trial Qualified Title Expert. For those not familiar, the Land Court System has an Engineering Department whose staff completes all of the Surveying tasks.

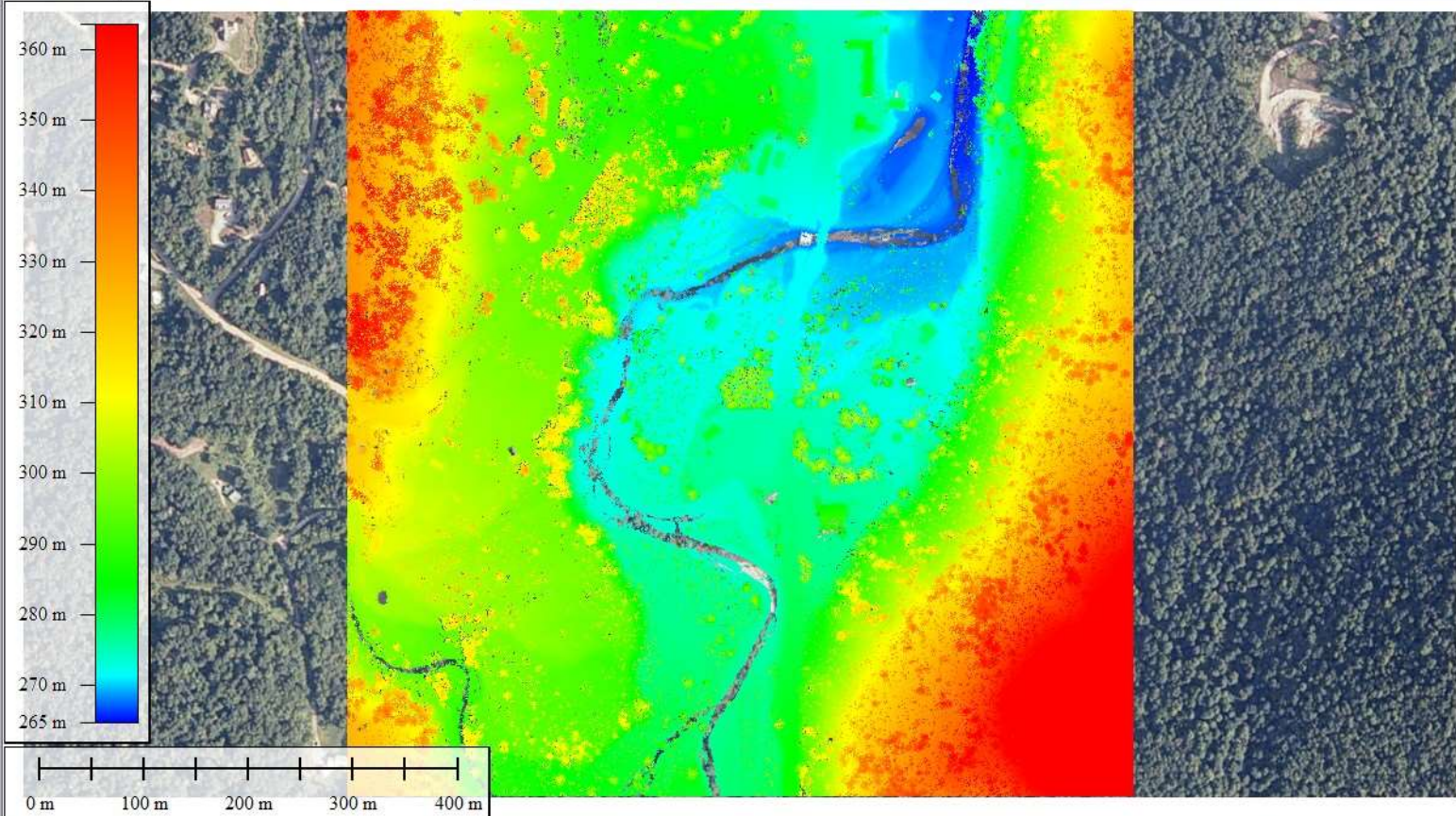
Excited?



Color Lidar by Elevation

Control Center (2 Layers)

- Current Workspace <Killington.gmw*>
 - WALL Color 2009.tif
 - WALL.laz [3,026,101 Features]



Load the Wall Color 2009.tif and Wall.Laz.



Color Lidar by Elevation

Control Center (2 Layers, 1 Selected)

- Current Workspace <Killington.gmw>
 - WALL Color 2009.tif
 - WALL.laz [3,026,101 Features]

Lidar Filter Settings - Lidar

Lidar

Classifications (Right-Click to Change Color/Name)

Code	Description
<input type="checkbox"/> 0	Created, never classified
<input type="checkbox"/> 1	Unclassified
<input checked="" type="checkbox"/> 2	Ground
<input type="checkbox"/> 3	Low Vegetation
<input type="checkbox"/> 4	Medium Vegetation
<input type="checkbox"/> 5	High Vegetation
<input type="checkbox"/> 6	Building
<input type="checkbox"/> 7	Low Point (Noise)
<input type="checkbox"/> 8	Model Key-point (mass point)
<input type="checkbox"/> 9	Water
<input type="checkbox"/> 10	Railroad

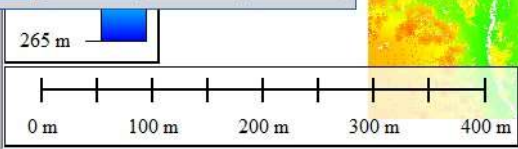
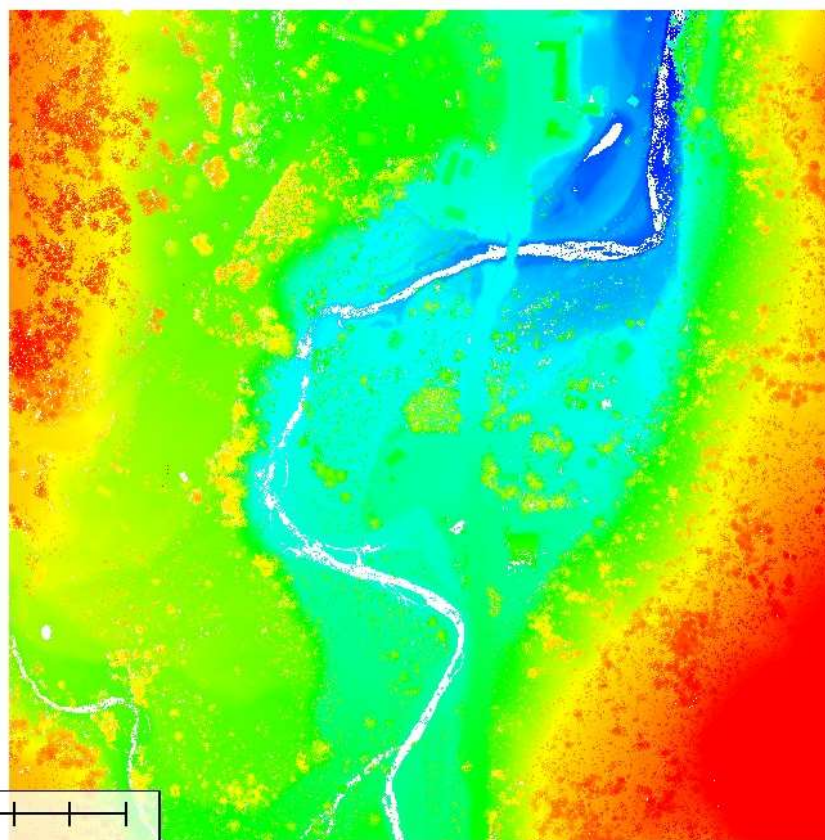
Enable All Disable All

Return Types to Display

Return Type
<input checked="" type="checkbox"/> Unknown
<input checked="" type="checkbox"/> First
<input checked="" type="checkbox"/> Second
<input checked="" type="checkbox"/> Last
<input checked="" type="checkbox"/> Single
<input checked="" type="checkbox"/> First-of-Many

Restore Default Settings

OK Cancel Apply Help



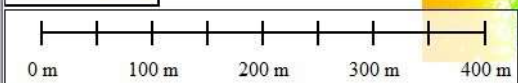
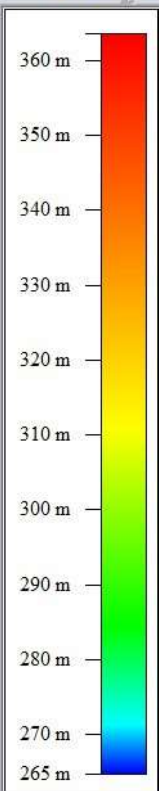
Isolate the WALL.laz and show only the ground points.



Color Lidar by Elevation

Control Center (2 Layers, 1 Selected)

- Current Workspace <Killington.gmw>
 - WALL Color 2009.tif
 - WALL.laz [3,026,101 Features]



Elevation Grid Creation Options

Grid Options | Tiling | Grid Bounds

Description: WALL.laz (Elevation Grid)

Vertical Units: FEET

Grid Method: Triangulation (Grid TIN of Points)

Grid Type: Elevation Values

Filter Lidar Points to Use by Elevation/Class/Color/Etc...

Grid Spacing

Automatically Determine Optimal Grid Spacing

Manually Specify the Grid Spacing to Use: 0 meters

If you wish to change the ground units that the resolution is specified in, you need to change the current projection on the Projection tab of the Configuration dialog.

Elevation Grid "No Data" Distance Criteria [20.3]

This setting controls how far from a known data point that an elevation grid cell has to be before it is considered invalid. The default setting assumes all grid points are valid. Lower values make the valid grid stay tighter around known data points.

Tight Loose

Use 3D Area/Line Features as Breaklines (Hard Edge)

Soft Edge Distance (Bin Grid Methods Only): 2 samples

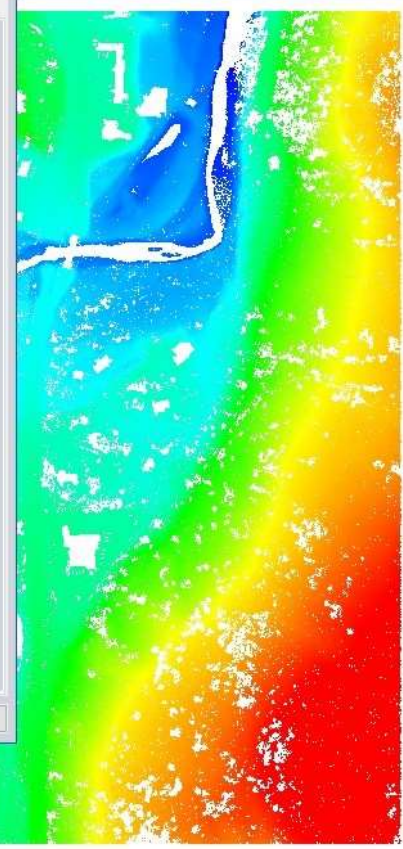
Ignore Zero Elevations

Save Triangulation Network (TIN) as a Vector Layer

Fill Entire Bounding Box Instead of Just Inside Convex Hull

Export Grids Directly to Global Mapper Grid Files Rather than Displaying in the Main Map View. Use with Tiling Tab options to Allow Gridding of Very Large Data Sets

OK Cancel Apply Help



Create a surface model (Elevation Grid) TIN.

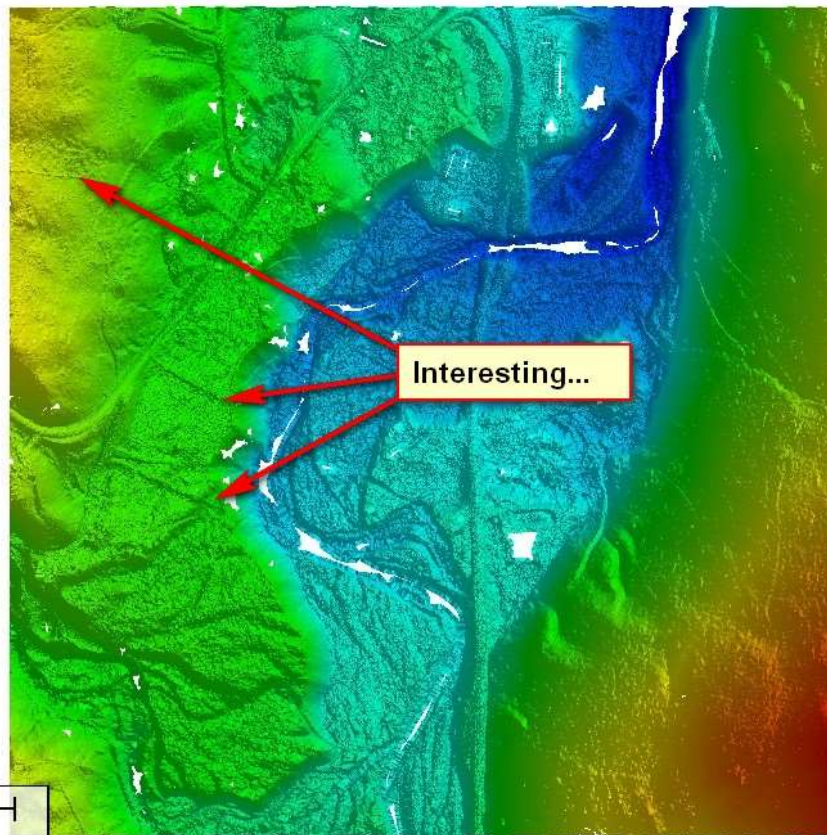
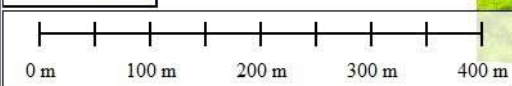
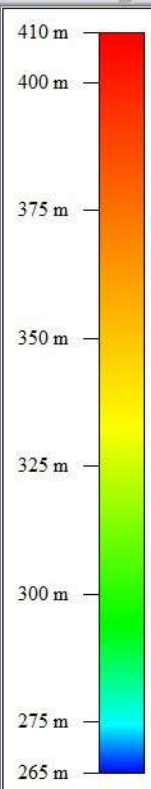


Color Lidar by Elevation

Control Center (3 Layers, 1 Selected)

- Current Workspace <Killington.gmw>
 - WALL Color 2009.tif
 - WALL.laz [3,026,101 Features]
 - WALL.laz (Elevation Grid)

Take a look around the surface model. Look for roads, paths, rivers, escarpments, bridge abutments, building footprints, walls and other features. Look at the 3 features identified as Interesting.

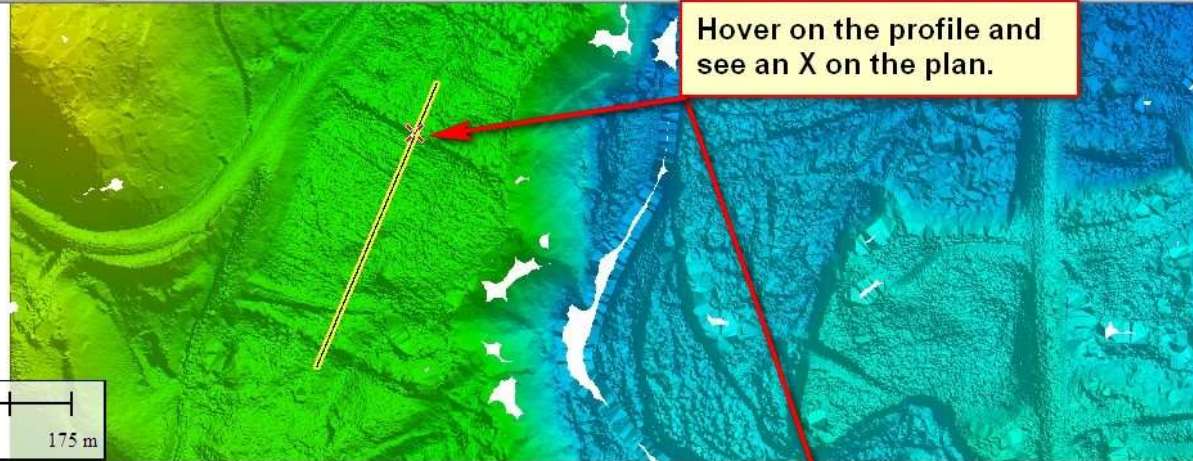
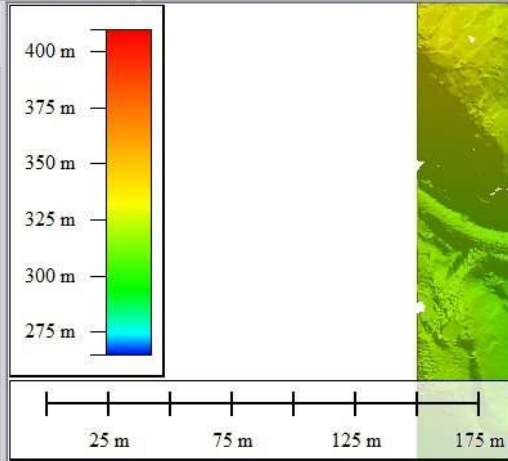




Color Lidar by Elevation

Control Center (3 Layers, 1 Selected)

- Current Workspace <Killington.gmw>
 - WALL Color 2009.tif
 - WALL.laz [3,026,101 Features]
 - WALL.laz (Elevation Grid)



Hover on the profile and see an X on the plan.

The Path Profile Tool will help you see if the deviations are convex or concave, the rough height and otherwise.

Path Profile/Line of Sight

Click to Measure SubPath on Profile

From Pos: 473873.742, 139065.783 To Pos: 473922.380, 139180.545



Drag the profile to the bottom or side or top and it will dock there. There may be a shape to dock to or there may be just an outline when you are in position.

Left click to start adding points. --> Height = 989.895 us-ft (WALL.laz (Elevation Grid))

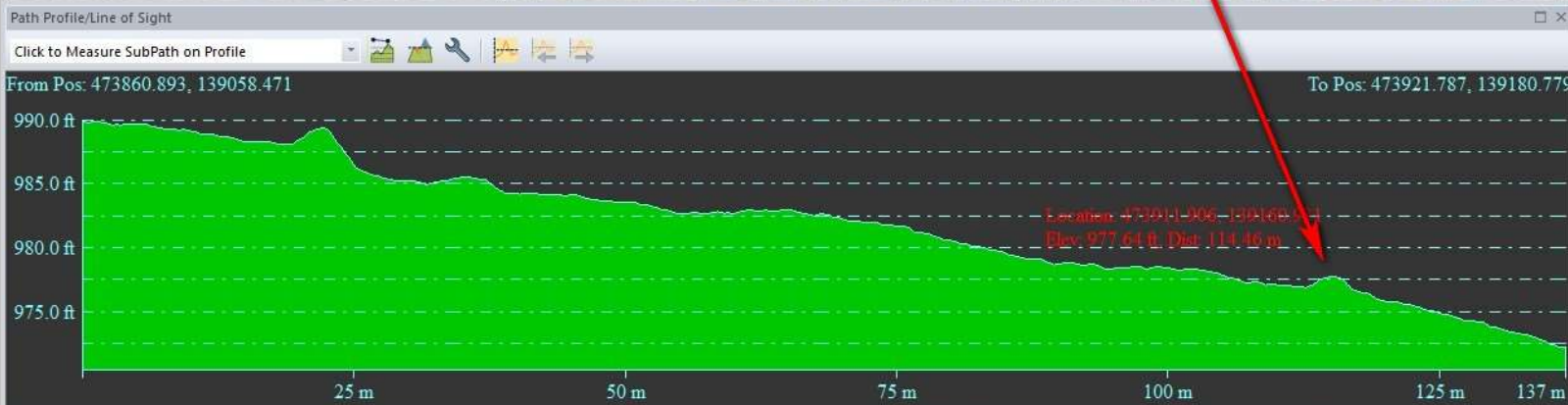
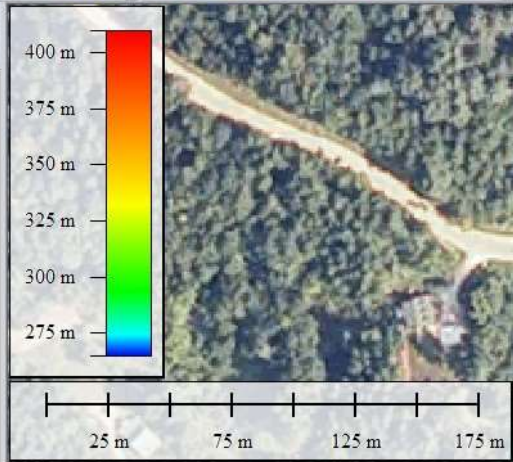
1:1967 | SPCS (NAD83) (474119.303, 138917.686, 277.158 m) 43° 45' 00.1130" N, 72° 49' 16.8328" W



Color Lidar by Elevation

Control Center (3 Layers, 1 Selected)

- Current Workspace <Killington.gmw>
 - WALL.laz [3,026,101 Features]
 - WALL.laz (Elevation Grid)
 - WALL Color 2009.tif



Left click to start adding points. --> Height = 973.124 us-ft, Pal Idx 81 - RGB(115,122,120) (WALL Color 2009.tif) 1:1967 | SPCS (NAD83) (474129.972, 138912.221, 277.108 m) 43° 44' 59.9373" N, 72° 49' 16.3549" W

Turn on the image. You can see that these walls are alongside a field. No great leap to get to the conclusion that there are walls alongside a field.

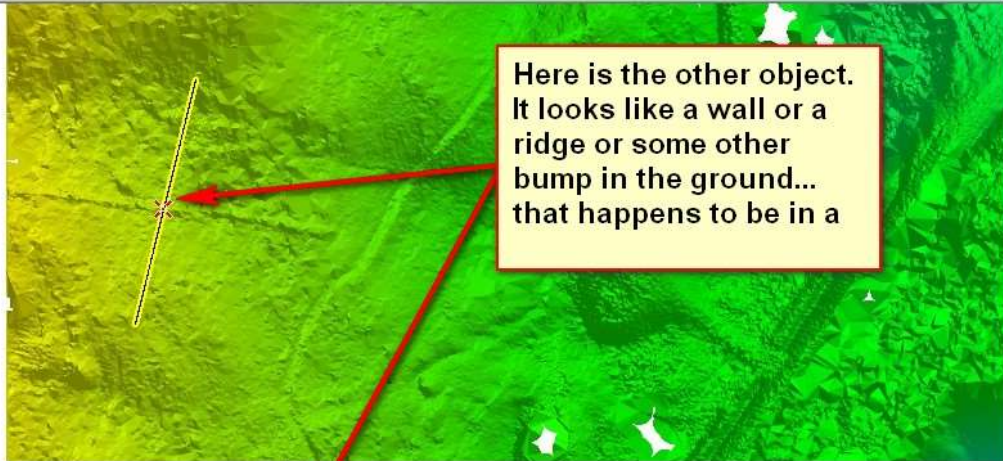
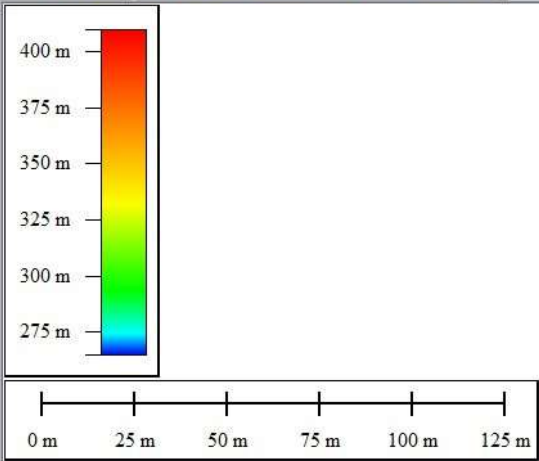
The imagery helps tell the story. This looks like a field and fields often have walls around them. You could have figured that out from the imagery...



Color Lidar by Elevation

Control Center (3 Layers, 1 Selected)

- Current Workspace <Killington.gmw>
 - WALL.laz [3,026,101 Features]
 - WALL.laz (Elevation Grid)
 - WALL Color 2009.tif



Here is the other object. It looks like a wall or a ridge or some other bump in the ground... that happens to be in a

Turn off the image and take a look at the other object. It's a bump...

Path Profile/Line of Sight

Click to Measure SubPath on Profile

From Pos: 473784.559, 139316.967 To Pos: 473800.867, 139382.892



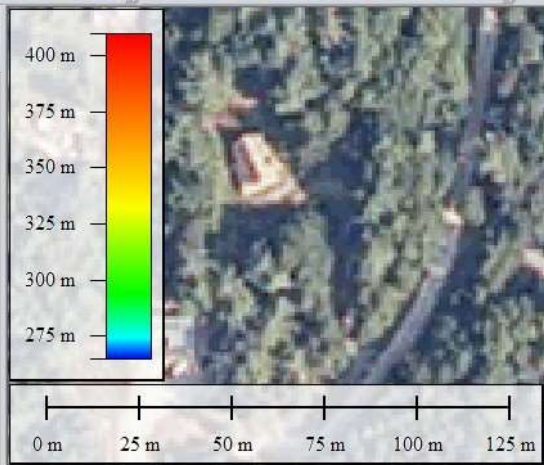
Left click to start adding points. --> Height = 964.059 us-ft (WALL.laz (Elevation Grid)) 1:1311 | SPCS (NAD83) (473801.908, 139211.487, 323.938 m) 43° 45' 09.5926" N, 72° 49' 31.0712" W



Color Lidar by Elevation

Control Center (3 Layers, 1 Selected)

- Current Workspace <Killington.gmw>
 - WALL.laz [3,026,101 Features]
 - WALL.laz (Elevation Grid)
 - WALL Color 2009.tif



If this is a wall and is called for in a deed, one would not see it within the aerial imagery. This is a quick way to know where to look. It can also be used for research efforts when compiling deeds.

And this bump is in the middle of the woods. This is a potential stone wall or ridgeline. It is ill advised to accept this as anything more than potential until you see it. Fortunately, you can digitize it, export it, put it in CAD and add some points to walk right to it.

Path Profile/Line of Sight

Click to Measure SubPath on Profile

From Pos: 473784.559, 139316.967 To Pos: 473800.867, 139382.892



Left click to start adding points. --> Height = 1009.188 us-ft, Pal Idx 194 - RGB(182,182,153) (WALL Color 2009.tif) 1:1311 | SPCS (NAD83) (473802.949, 139207.323, 323.802 m) 43° 45' 09.4578" N, 72° 49' 31.0240" W

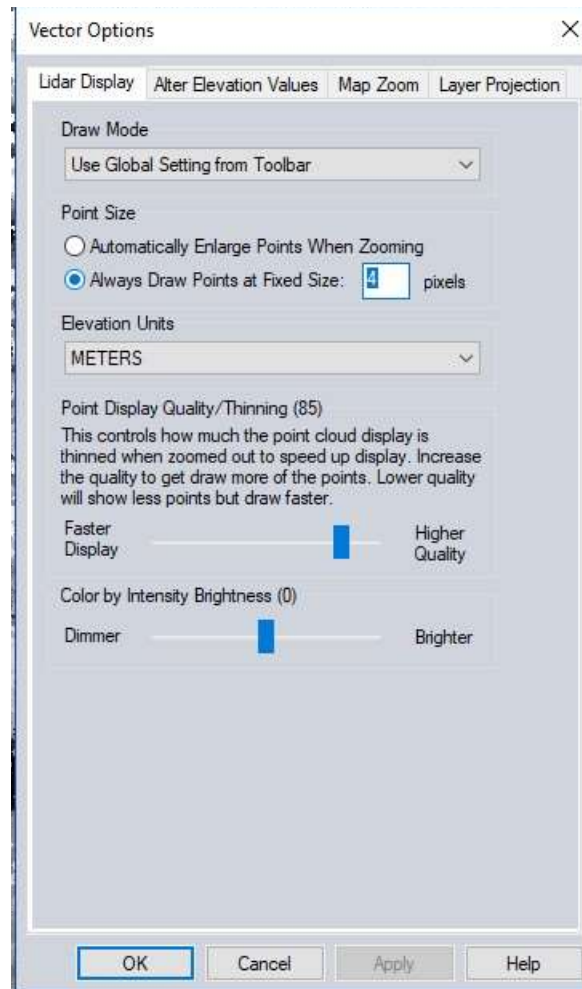
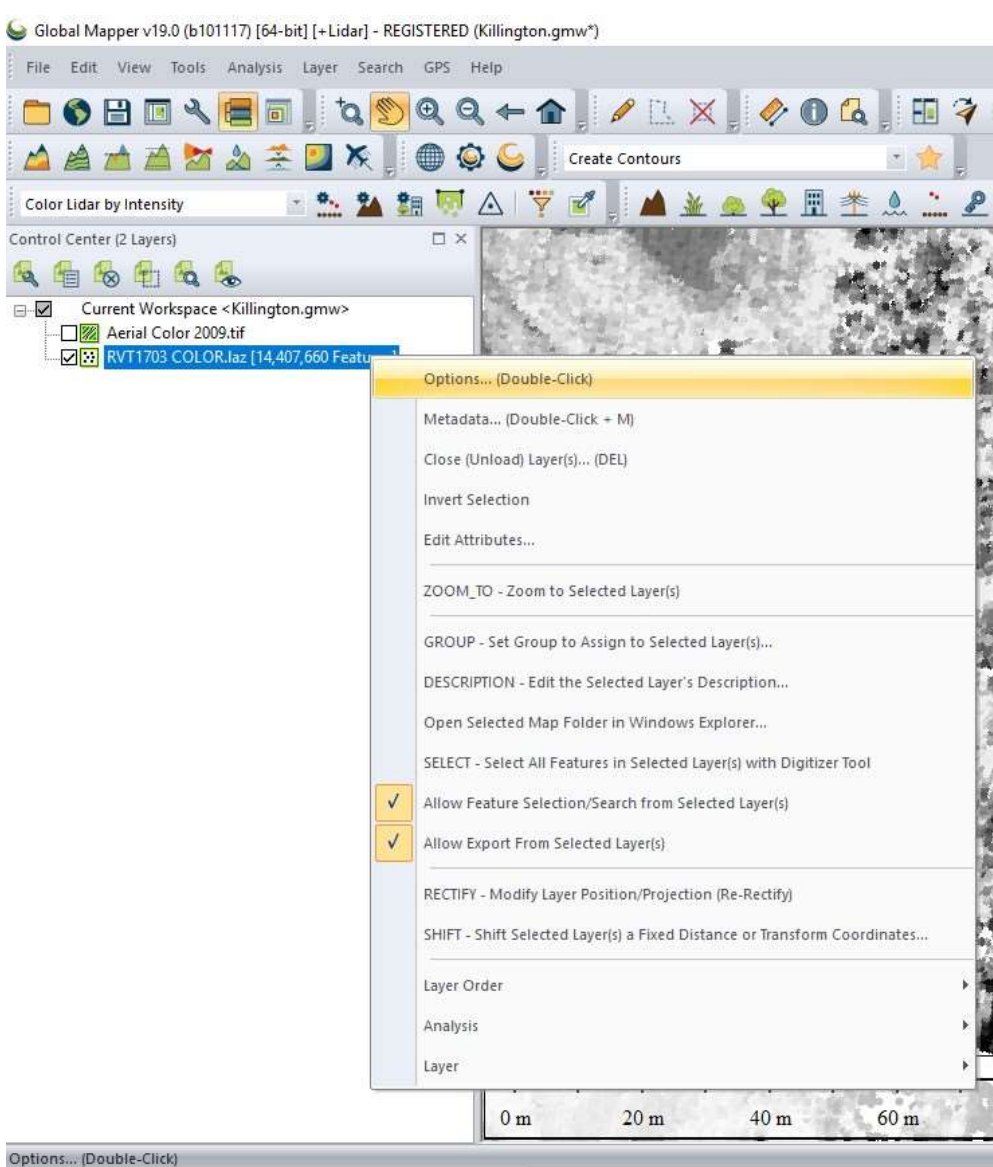
This is a rough staking sheet for a property in Harwich, MA. It was forgotten about over a century ago. The monuments sought include:

- Rings of stones
- Old Roads (now paths at best)
- Ridges (Remnants of roads or plow lines often the only demarcation of occupation or boundary)

The crew was able to recover much of the evidence needed to fix the poor deed descriptions.



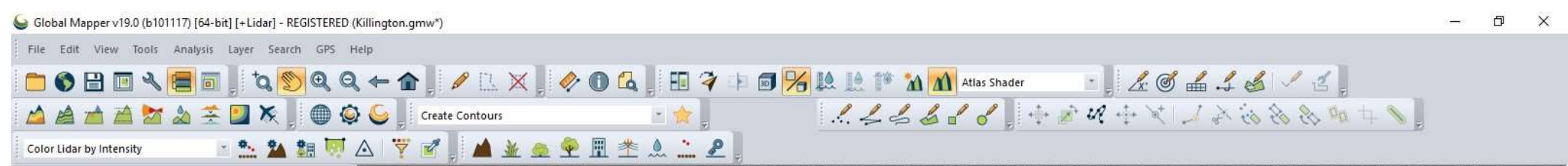
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The little points are hard to see, so change the size.

Zoom in to an area of interest or a scale you want to digitize at.

Right click on the Layer, Options, Draw points at a Fixed Size. Press Apply as you change the size and watch it change behind.

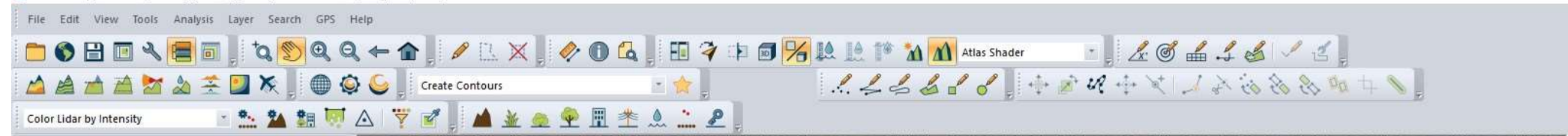


Control Center (2 Layers)

- Current Workspace <Killington.gmw>
 - Aerial Color 2009.tif
 - RVT1703 COLOR.laz [14,407,660 Features]

Now you can see a near continuous image from the LiDAR.



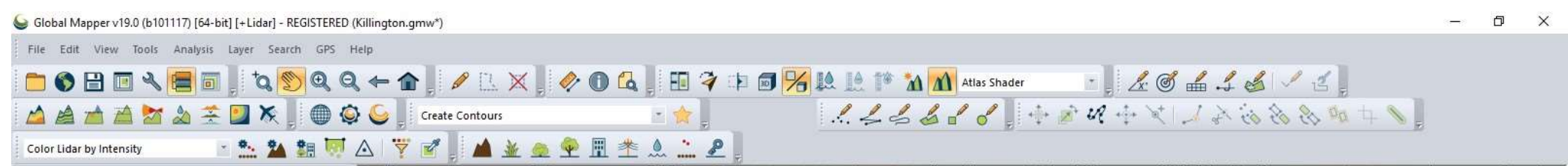


Control Center (2 Layers, 1 Selected)

- Current Workspace <Killington.gmw>
 - Aerial Color 2009.tif
 - RVT1703 COLOR.laz [14,407,660 Features]

It starts to get a little grainy as you get closer.
Cars cause gaps in the cloud.





Control Center (2 Layers, 1 Selected)

- Current Workspace <Killington.gmw>
 - Aerial Color 2009.tif
 - RVT1703 COLOR.laz [14,407,660 Features]

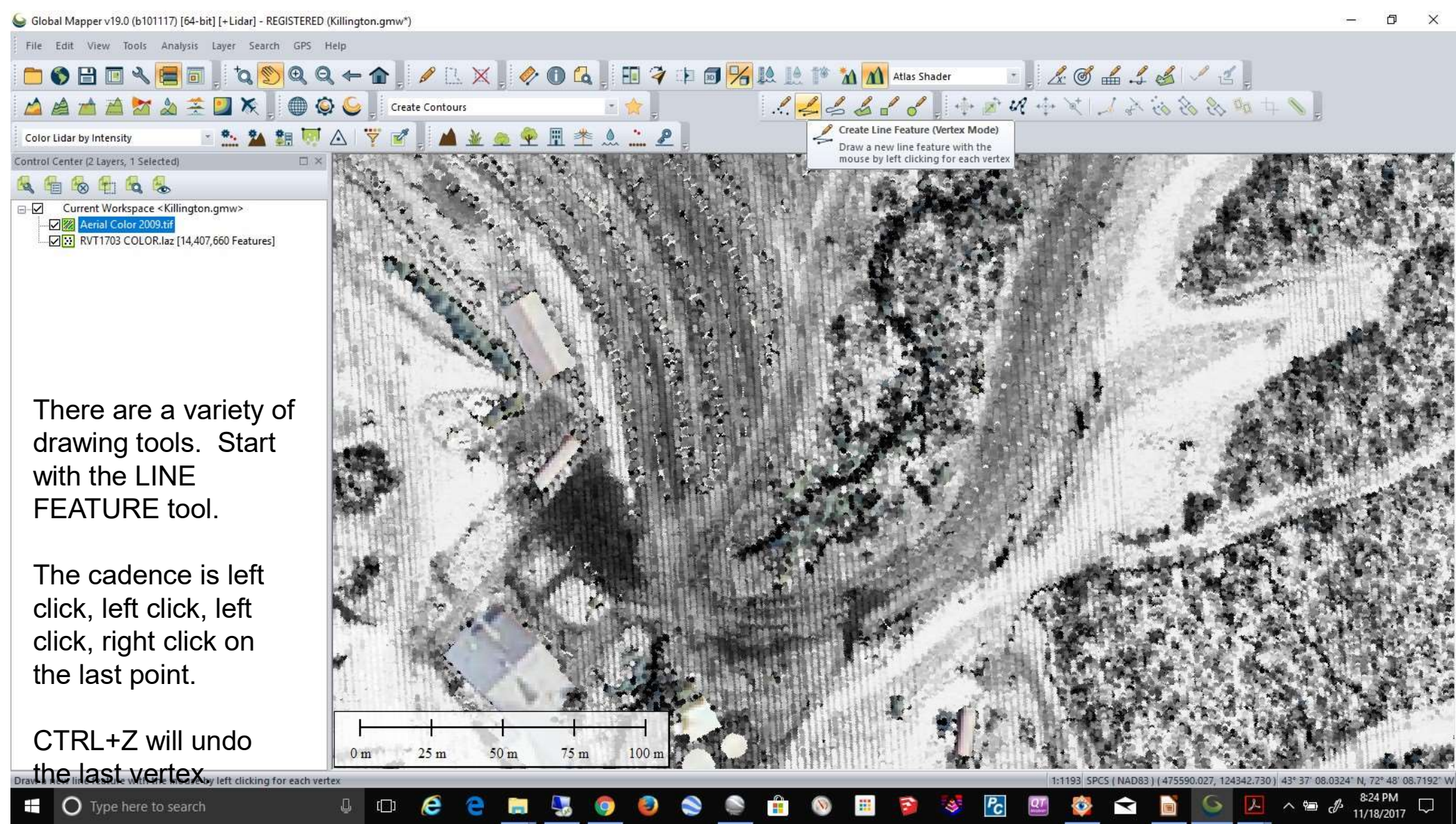


As you get closer, you can see the image hiding behind. As you digitize, you can check against the image. Beware of parallax in which case, you may have to rely on the LiDAR.

<INTENSITY => Ground [LIDAR, Ground Shot] [754.86 m]

1:236 | SPCS | (NAD83) | (475551.190, 124257.082) | 43° 37' 05.2526" N, 72° 48' 10.4375" W

8:23 PM 11/18/2017



There are a variety of drawing tools. Start with the LINE FEATURE tool.

The cadence is left click, left click, left click, right click on the last point.

CTRL+Z will undo the last vertex.



Modify Feature Info

Name:

Feature Type

- Unclassified Line Feature
- Major Political Boundary (State)
- Major/US Highway
- Marine Route
- Measurement
- Minor Political Boundary (County)
- Park Boundary
- Pipeline
- Powerline
- Processing/Closure Line
- Railroad
- Railroad, Class 1A
- Railroad, Class 1B
- Ramp
- Range Ring Radial Line
- Residential Road
- River, < 20 km
- River, > 250 km
- River, 100 - 250 km
- River, 20 - 50 km
- River, 50 - 100 km
- River, Unknown Length
- Selected Line
- Shoreline
- State Highway
- Stream
- Tracklog
- Trail
- Unclassified Line Feature
- Unknown Line Type
- Unpaved Road

Create New Type...

Sample Label

Attribute Value

231.46 m

2° 09' 45.2"

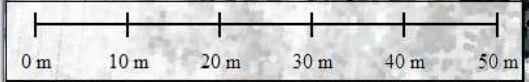
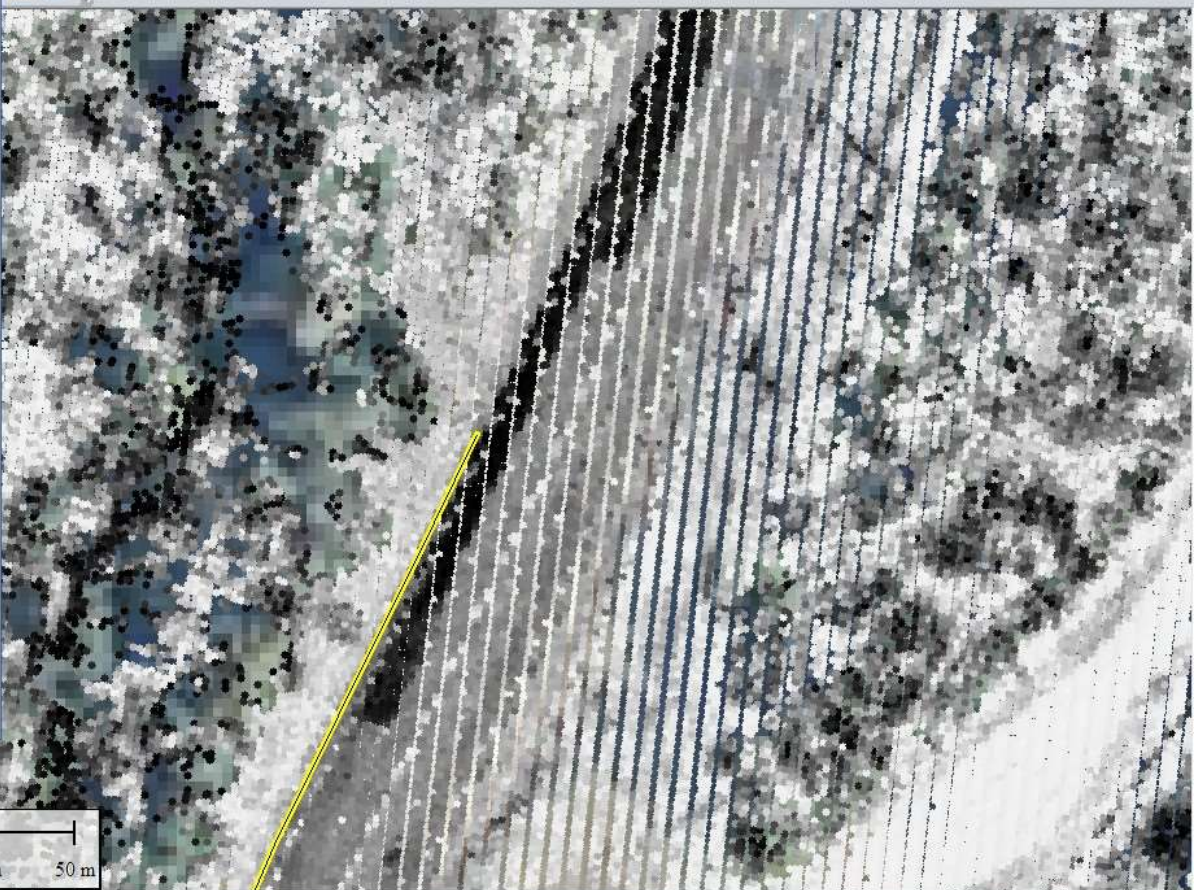
<(s)... Add Time Stamp

Apply Settings from Selected Feature Apply Settings from Previous Feature

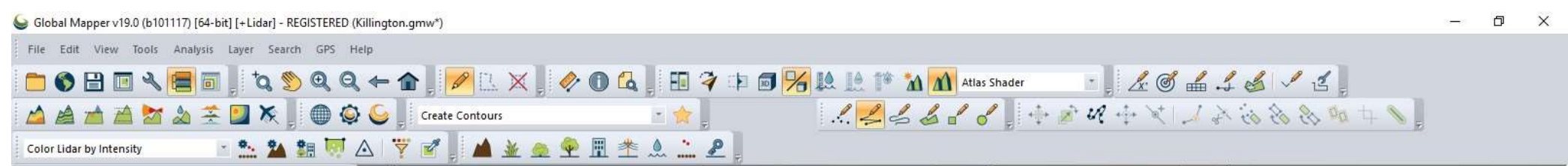
Edit Fly-Through Path... Copy Attr Names from Feature Layer

Automatically apply these settings to new features of the same type

OK Cancel

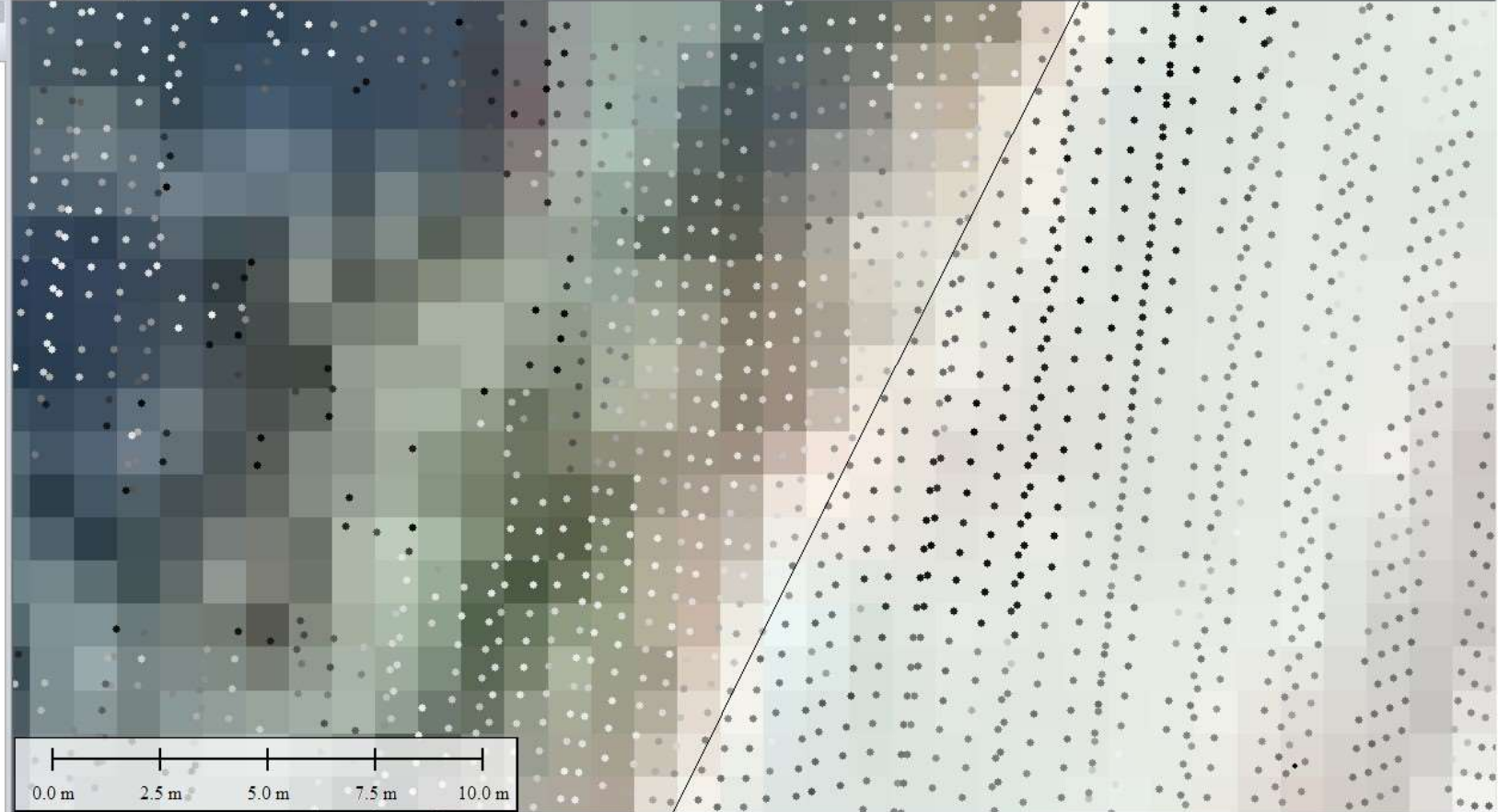


Once the line is drawn, you can classify the line. This will provide a linetype and color. You can add a name as desired.



Control Center (3 Layers, 1 Selected)

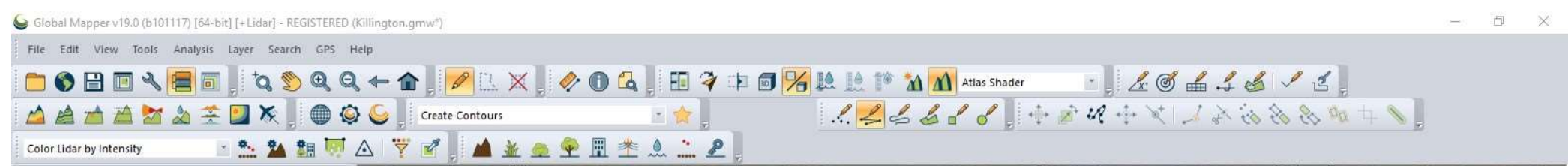
- Current Workspace <Killington.gmw>
 - Aerial Color 2009.tif
 - RVT1703 COLOR.laz [14,407,660 Features]
 - User Created Features [1 Features]



You can check against the image as you go or after.

There are editing tools you can use to fix the drawn items after.

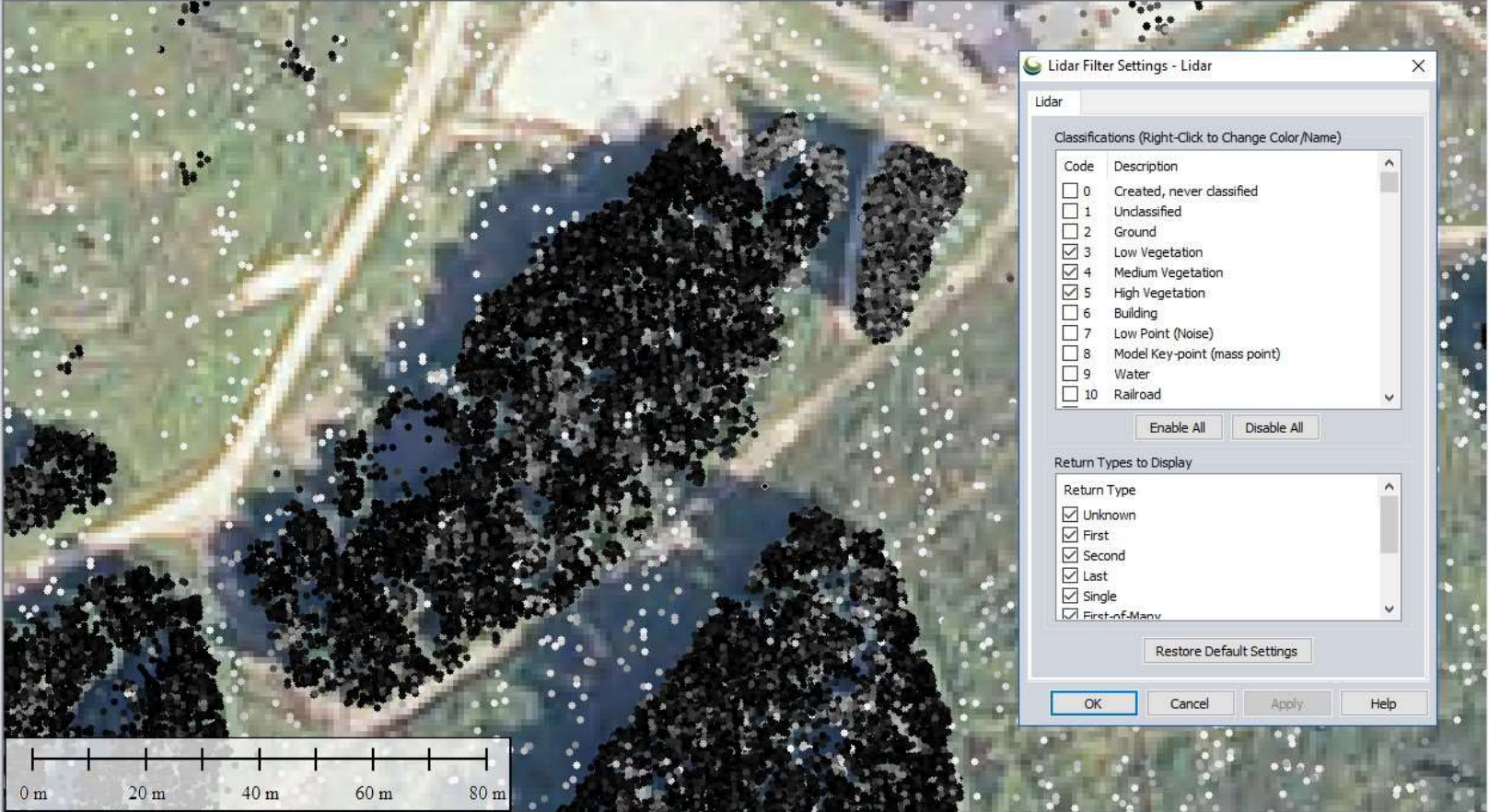
You are not making a watch.



Control Center (3 Layers, 1 Selected)

- Current Workspace <Killington.gmw>
 - Aerial Color 2009.tif
 - RVT1703 COLOR.laz [14,407,660 Features]
 - User Created Features [1 Features]

You can digitize some treelines.



Lidar Filter Settings - Lidar

Lidar

Classifications (Right-Click to Change Color/Name)

Code	Description
<input type="checkbox"/> 0	Created, never classified
<input type="checkbox"/> 1	Unclassified
<input type="checkbox"/> 2	Ground
<input checked="" type="checkbox"/> 3	Low Vegetation
<input checked="" type="checkbox"/> 4	Medium Vegetation
<input checked="" type="checkbox"/> 5	High Vegetation
<input type="checkbox"/> 6	Building
<input type="checkbox"/> 7	Low Point (Noise)
<input type="checkbox"/> 8	Model Key-point (mass point)
<input type="checkbox"/> 9	Water
<input type="checkbox"/> 10	Railroad

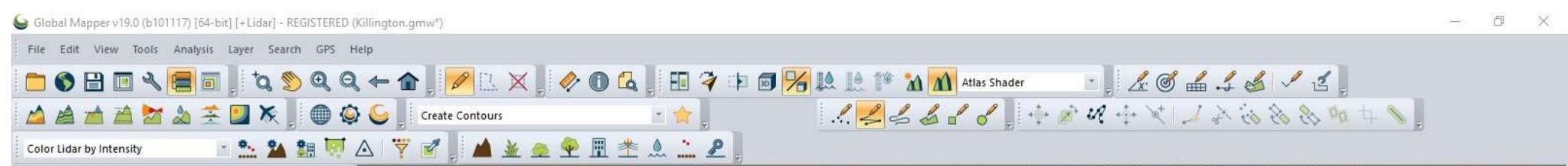
Enable All Disable All

Return Types to Display

Return Type
<input checked="" type="checkbox"/> Unknown
<input checked="" type="checkbox"/> First
<input checked="" type="checkbox"/> Second
<input checked="" type="checkbox"/> Last
<input checked="" type="checkbox"/> Single
<input checked="" type="checkbox"/> First-of-Many

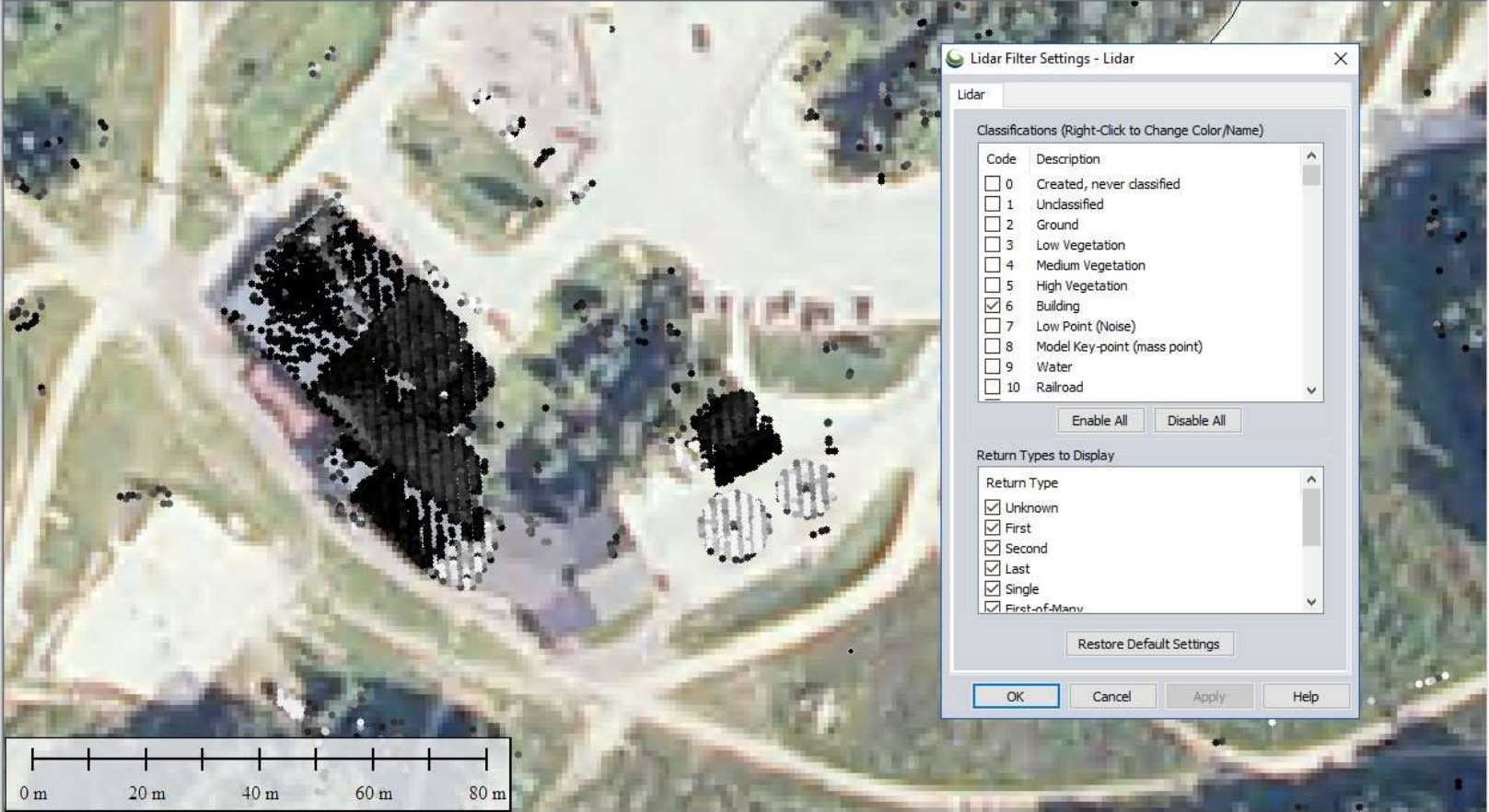
Restore Default Settings

OK Cancel Apply Help



Control Center (3 Layers, 1 Selected)

- Current Workspace <Killington.gmw>
 - Aerial Color 2009.tif
 - RVT1703 COLOR.laz [14,407,660 Features]
 - User Created Features [1 Features]



Lidar Filter Settings - Lidar

Lidar

Classifications (Right-Click to Change Color/Name)

Code	Description
<input type="checkbox"/> 0	Created, never classified
<input type="checkbox"/> 1	Unclassified
<input type="checkbox"/> 2	Ground
<input type="checkbox"/> 3	Low Vegetation
<input type="checkbox"/> 4	Medium Vegetation
<input type="checkbox"/> 5	High Vegetation
<input checked="" type="checkbox"/> 6	Building
<input type="checkbox"/> 7	Low Point (Noise)
<input type="checkbox"/> 8	Model Key-point (mass point)
<input type="checkbox"/> 9	Water
<input type="checkbox"/> 10	Railroad

Enable All Disable All

Return Types to Display

Return Type
<input checked="" type="checkbox"/> Unknown
<input checked="" type="checkbox"/> First
<input checked="" type="checkbox"/> Second
<input checked="" type="checkbox"/> Last
<input checked="" type="checkbox"/> Single
<input checked="" type="checkbox"/> First-nf-Many

Restore Default Settings

OK Cancel Apply Help

Or extract some building footprints.

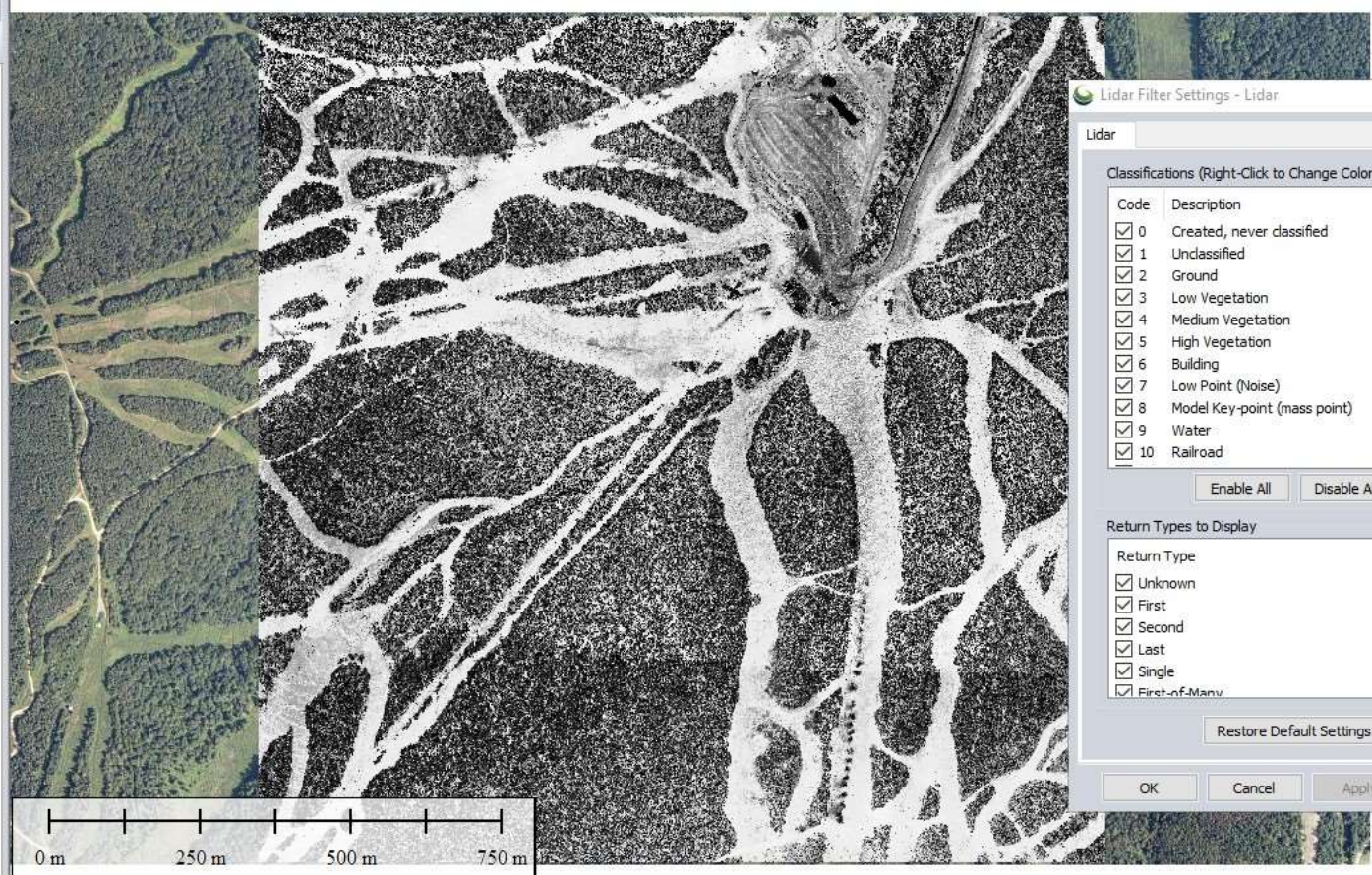
There are automated tools to help with these extractions.

www.eselc.com/vsls

Control Center (4 Layers, 1 Selected)

- Current Workspace <Killington.gmw>
- Aerial Color 2009.tif
- RVT1703 COLOR.laz [14,407,660 Features]
- RVT1703 COLOR.laz (Elevation Grid)
- User Created Features [1 Features]

Reset back to the start. Turn on all classes, double click the LAZ, change the point size to automatic, view by Intensity.



Lidar Filter Settings - Lidar

Lidar

Classifications (Right-Click to Change Color/Name)

Code	Description
<input checked="" type="checkbox"/> 0	Created, never classified
<input checked="" type="checkbox"/> 1	Unclassified
<input checked="" type="checkbox"/> 2	Ground
<input checked="" type="checkbox"/> 3	Low Vegetation
<input checked="" type="checkbox"/> 4	Medium Vegetation
<input checked="" type="checkbox"/> 5	High Vegetation
<input checked="" type="checkbox"/> 6	Building
<input checked="" type="checkbox"/> 7	Low Point (Noise)
<input checked="" type="checkbox"/> 8	Model Key-point (mass point)
<input checked="" type="checkbox"/> 9	Water
<input checked="" type="checkbox"/> 10	Railroad

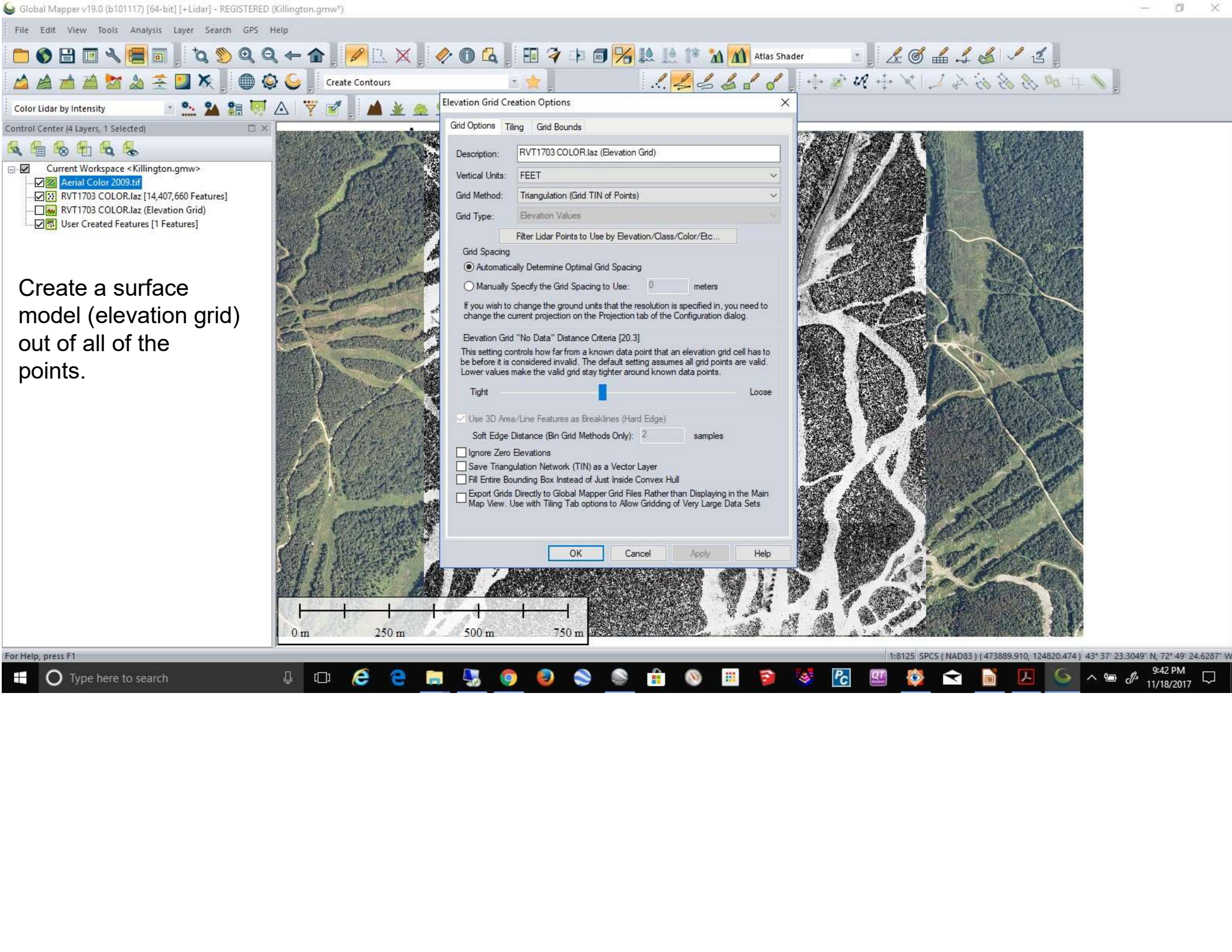
Enable All Disable All

Return Types to Display

Return Type
<input checked="" type="checkbox"/> Unknown
<input checked="" type="checkbox"/> First
<input checked="" type="checkbox"/> Second
<input checked="" type="checkbox"/> Last
<input checked="" type="checkbox"/> Single
<input checked="" type="checkbox"/> First-of-Many

Restore Default Settings

OK Cancel Apply Help



Create a surface model (elevation grid) out of all of the points.

Elevation Grid Creation Options

Grid Options | Tiling | Grid Bounds

Description: RVT1703 COLOR.laz (Elevation Grid)

Vertical Units: FEET

Grid Method: Triangulation (Grid TIN of Points)

Grid Type: Elevation Values

Filter Lidar Points to Use by Elevation/Class/Color/Etc...

Grid Spacing

Automatically Determine Optimal Grid Spacing

Manually Specify the Grid Spacing to Use: 0 meters

If you wish to change the ground units that the resolution is specified in, you need to change the current projection on the Projection tab of the Configuration dialog.

Elevation Grid "No Data" Distance Criteria [20.3]

This setting controls how far from a known data point that an elevation grid cell has to be before it is considered invalid. The default setting assumes all grid points are valid. Lower values make the valid grid stay tighter around known data points.

Tight Loose

Use 3D Area/Line Features as Breaklines (Hard Edge)

Soft Edge Distance (Bin Grid Methods Only): 2 samples

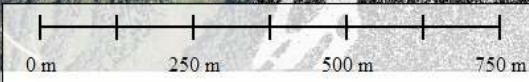
Ignore Zero Elevations

Save Triangulation Network (TIN) as a Vector Layer

Fill Entire Bounding Box Instead of Just Inside Convex Hull

Export Grids Directly to Global Mapper Grid Files Rather than Displaying in the Main Map View. Use with Tiling Tab options to Allow Gridding of Very Large Data Sets

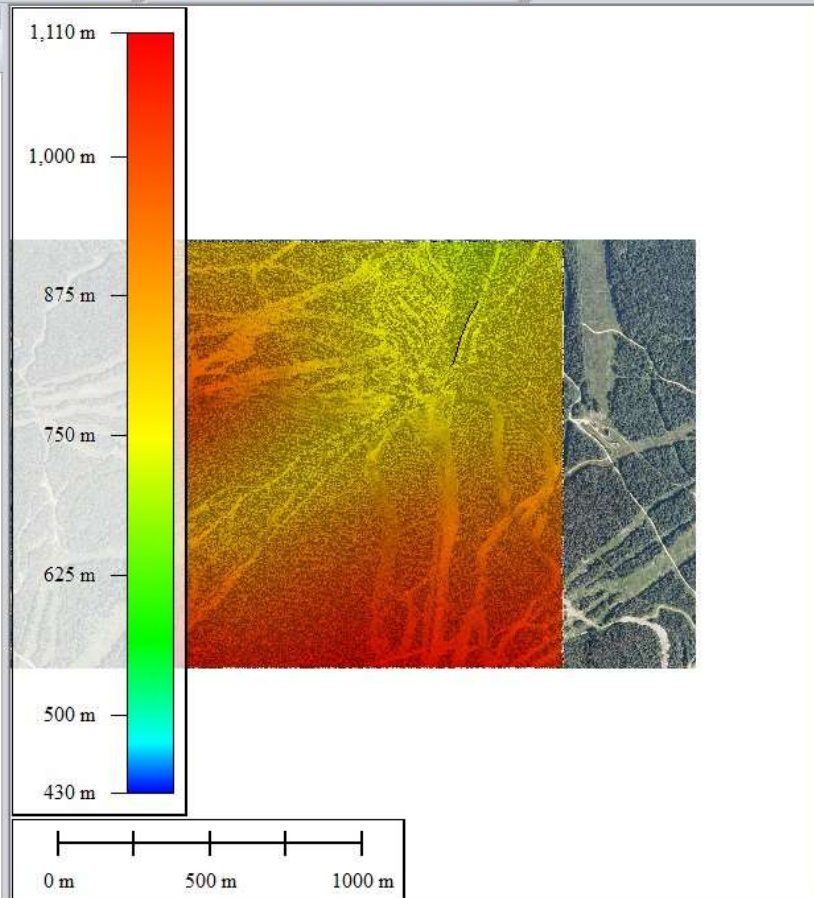
OK Cancel Apply Help



Control Center (4 Layers, 1 Selected)

- Current Workspace <Killington.gmw>
- Aerial Color 2009.tif
- RVT1703 COLOR.laz [14,407,660 Features]
- RVT1703 COLOR.laz (Elevation Grid)
- User Created Features [1 Features]

Open the 3d viewer.
Notice that the image
is hiding at the
bottom. Change the
draw order.



3D Viewer

None (Solid Background)

Edit Mode: Line
Edit location: 0.0000, 0.0000, 0.0000

Left Click to Start New Line [Unknown Line Type], Right Click or Esc to Cancel Rotate Edit: Line

1:16390 SPCS (NAD83) (476049.582, 122789.983) 43° 36' 17.7731" N, 72° 47' 47.9754" W

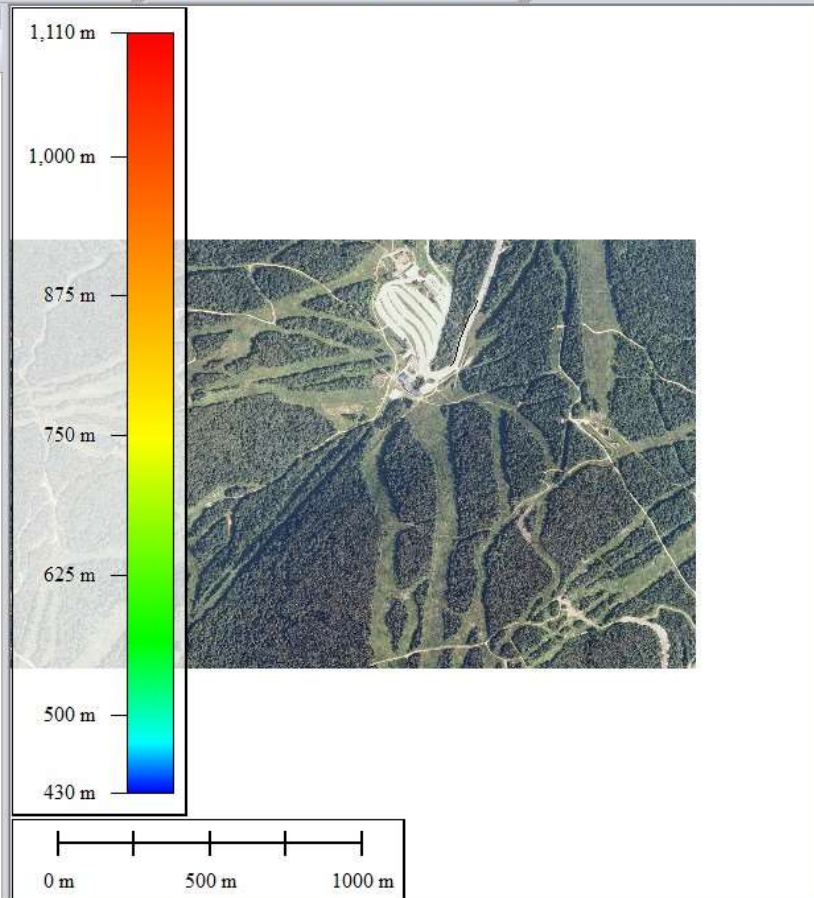
9:43 PM
11/18/2017

This block contains the 3D Viewer window. It displays a 3D point cloud of a terrain surface. The points are colored according to their elevation, matching the 2D grid. The terrain shows a central valley with ridges on either side. The viewer includes standard navigation tools like pan, zoom, and rotate. A status bar at the bottom of the viewer shows the current edit mode (Line) and location coordinates. The Windows taskbar is visible at the very bottom of the screen.

Control Center (4 Layers, 1 Selected)

- Current Workspace <Killington.gmw>
- RVT1703 COLOR.laz [14,407,660 Features]
- RVT1703 COLOR.laz (Elevation Grid)
- Aerial Color 2009.tif
- User Created Features [1 Features]

Now the image is draped over the surface model. It's not perfect, but it is a great quick and dirty 3-d representation of the area.



3D Viewer

None (Solid Background)

Select Mode

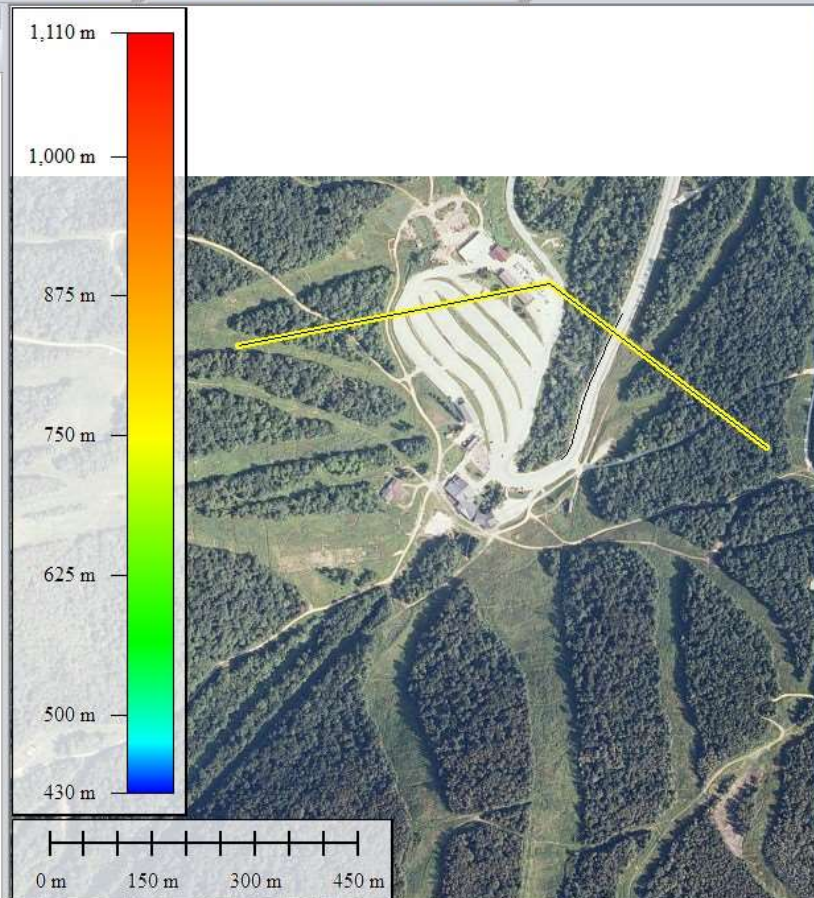
Right-click to display Option Menu

Rotate Select

Control Center (4 Layers, 1 Selected)

- Current Workspace <Killington.gmw>
- RVT1703 COLOR.laz [14,407,660 Features]
- RVT1703 COLOR.laz (Elevation Grid)
- Aerial Color 2009.tif
- User Created Features [1 Features]

Draw a line in the plan view. The feature type really does not matter. Add the name flightpath.



Modify Feature Info

Name:

Feature Type:

Feature Layer (Right Click for More Options):

Feature Description:

Feature Style: Use Default Style for Selected Feature Type Specify Style to Use When Rendering Feature

Attribute Name	Attribute Value
LENGTH	860.31 m
BEARING	280° 41' 25.6"

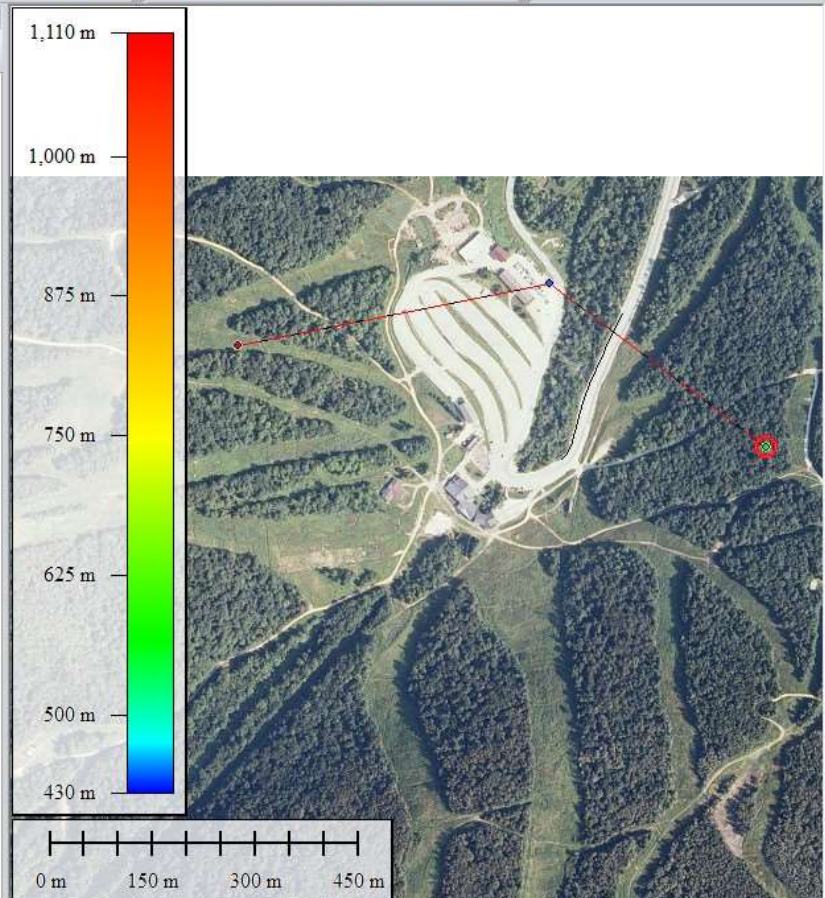
Altitude Mode:

Automatically apply these settings to new features of the same type

Control Center (4 Layers, 1 Selected)

- Current Workspace <Killington.gmw>
- RVT1703 COLOR.laz [14,407,660 Features]
- RVT1703 COLOR.laz (Elevation Grid)
- Aerial Color 2009.tif
- User Created Features [2 Features]

In the 3-d view select the Edit Path tool. Double Click on the flightpath in the Plan.



3D Viewer

Select Mode

Edit path

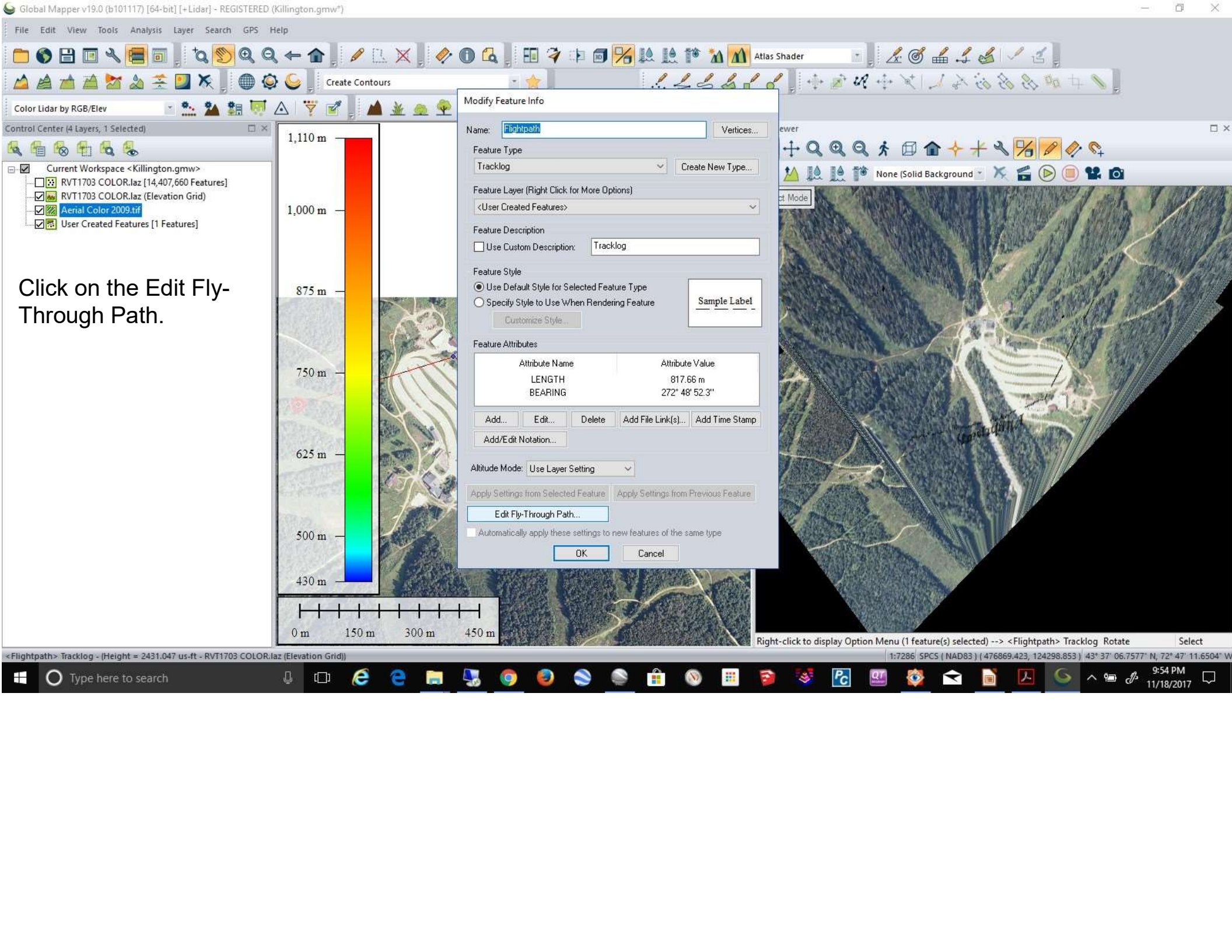
Edit Fly-through path

Right-click to display Option Menu (1 feature(s) selected)

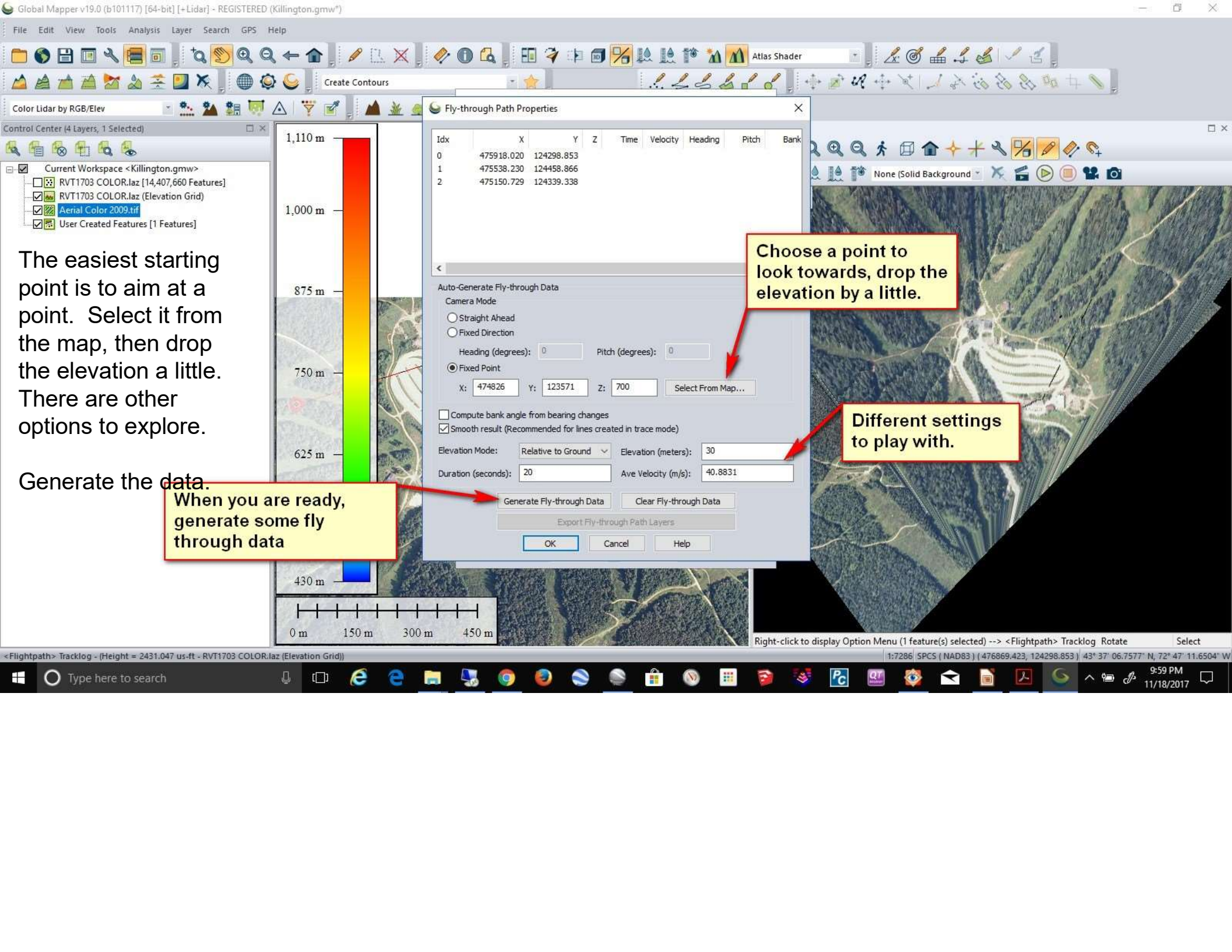
Rotate Select

1:7286 | SPCS (NAD83) | (476635.187, 124724.912) | 43° 37' 20.5368" N, 72° 47' 22.1637" W

The 3D Viewer shows a perspective view of the same terrain. A red dashed line with red dots at each segment represents the flight path. A context menu is open over the path, showing 'Edit path' and 'Edit Fly-through path' options. The status bar at the bottom shows coordinates and projection information.



Click on the Edit Fly-Through Path.



The easiest starting point is to aim at a point. Select it from the map, then drop the elevation a little. There are other options to explore.

Generate the data.

When you are ready, generate some fly through data

Choose a point to look towards, drop the elevation by a little.

Different settings to play with.

Fly-through Path Properties

Idx	X	Y	Z	Time	Velocity	Heading	Pitch	Bank
0	475918.020	124298.853						
1	475538.230	124458.866						
2	475150.729	124339.338						

Auto-Generate Fly-through Data

Camera Mode
 Straight Ahead
 Fixed Direction
 Fixed Point

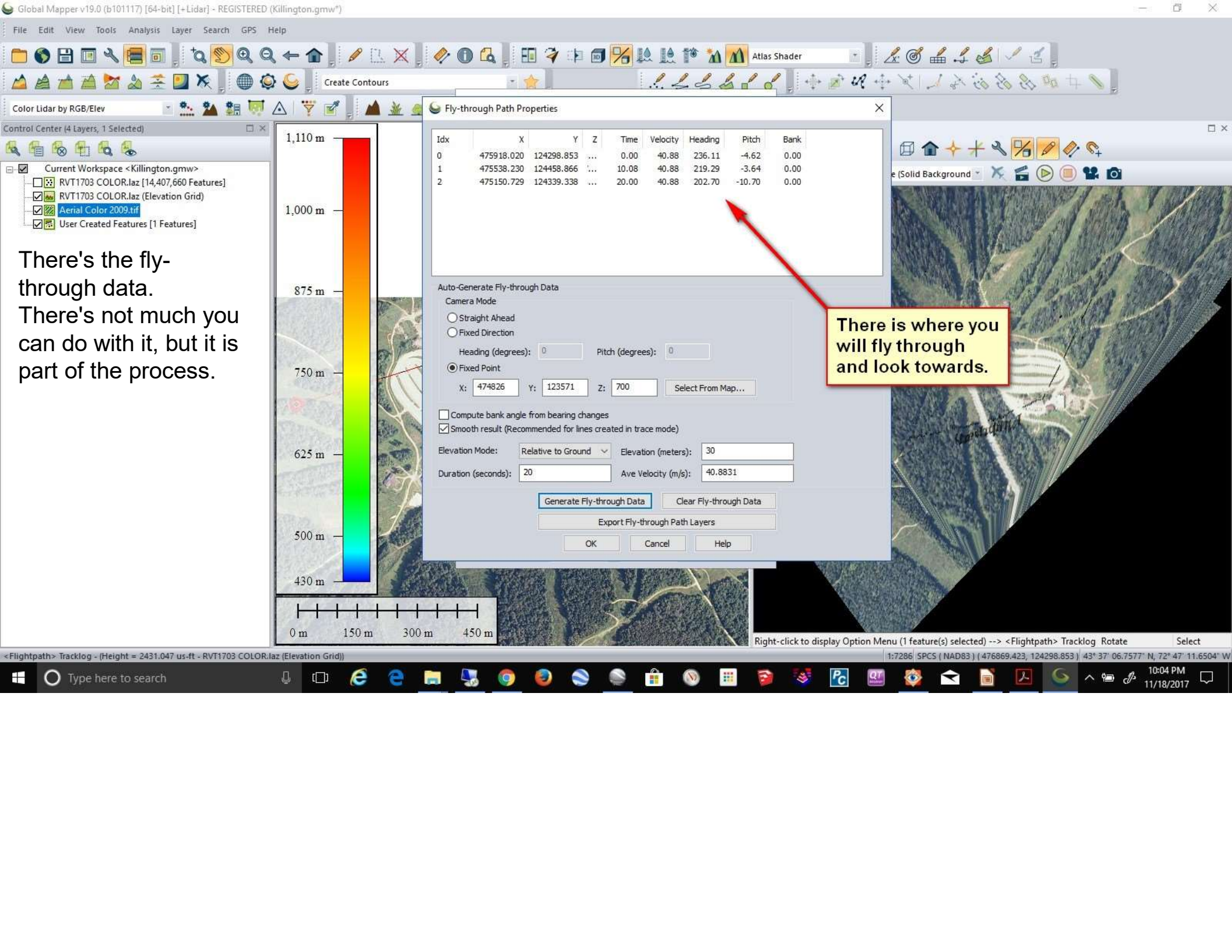
Heading (degrees): 0 Pitch (degrees): 0

X: 474826 Y: 123571 Z: 700

Compute bank angle from bearing changes
 Smooth result (Recommended for lines created in trace mode)

Elevation Mode: Relative to Ground Elevation (meters): 30
Duration (seconds): 20 Ave Velocity (m/s): 40.8831

Export Fly-through Path Layers



There's the fly-through data. There's not much you can do with it, but it is part of the process.

There is where you will fly through and look towards.

Idx	X	Y	Z	Time	Velocity	Heading	Pitch	Bank
0	475918.020	124298.853	...	0.00	40.88	236.11	-4.62	0.00
1	475538.230	124458.866	...	10.08	40.88	219.29	-3.64	0.00
2	475150.729	124339.338	...	20.00	40.88	202.70	-10.70	0.00

Auto-Generate Fly-through Data

Camera Mode

Straight Ahead

Fixed Direction

Heading (degrees): Pitch (degrees):

Fixed Point

X: Y: Z:

Compute bank angle from bearing changes

Smooth result (Recommended for lines created in trace mode)

Elevation Mode: Elevation (meters):

Duration (seconds): Ave Velocity (m/s):

Control Center (4 Layers, 1 Selected)
Current Workspace <Killington.gmw>
RVT1703 COLOR.laz [14,407,660 Features]
Fly-through Frame Properties

Camera Position
X: 475918.0199616 Layer Horizontal Units
Y: 124298.8529342 Layer Horizontal Units
Z: 306.062 Meters

Camera Angle
Heading: 236.11 Degrees (0 North)
Pitch: -4.62048 Degrees (+ Up)
Bank: 0 Degrees (+ CCW)

Time (s): 0 Velocity (m/s): 40.8831

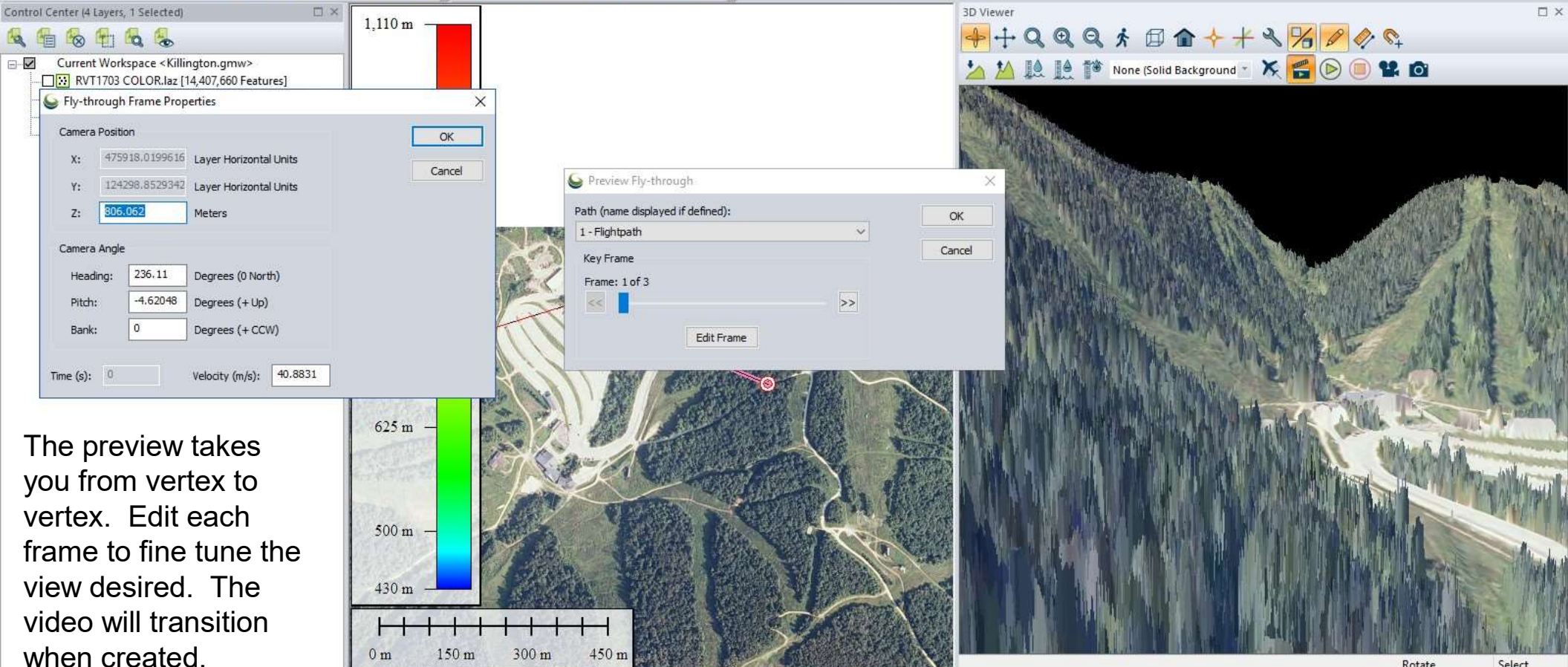
1,110 m

625 m
500 m
430 m

0 m 150 m 300 m 450 m

3D Viewer
None (Solid Background)

Preview Fly-through
Path (name displayed if defined): 1 - Flightpath
Key Frame
Frame: 1 of 3
Edit Frame



The preview takes you from vertex to vertex. Edit each frame to fine tune the view desired. The video will transition when created.

Control Center (4 Layers, 1 Selected)

- Current Workspace <Killington.gmw>
- RVT1703 COLOR.laz [14,407,660 Features]
- RVT1703 COLOR.laz (Elevation Grid)
- Aerial Color 2009.tif
- User Created Features [1 Features]

This preview will run through video at low resolution.

Fly-through Options

Select path (name displayed if defined): All Paths

Play as loop (automatic repeat)

Save To File Options

Resolution (frame size): 360p (640 x 360)

Frame Rate (frames per second): 15

Create MPEG-4 movie

Create AVI movie

AVI Options

Codec (Compression method. Your AVI player may not support all options): Uncompressed

Quality: Not Applicable

Create image file for each frame

Frame Image Options

Format: JPG

0 m 150 m 300 m 450 m

1,110 m

1,000 m

875 m

750 m

625 m

500 m

430 m

None (Solid Background)

Rotate Select

Control Center (4 Layers, 1 Selected)

- Current Workspace <Killington.gmw>
- RVT1703 COLOR.laz [14,407,660 Features]
- RVT1703 COLOR.laz (Elevation Grid)
- Aerial Color 2009.tif
- User Created Features [1 Features]

Let's go for final. It takes some time at higher resolutions, so let's keep it light for now.

Fly-through Options

Select path (name displayed if defined): All Paths

Play as loop (automatic repeat)

Save To File Options

Resolution (frame size): 1080p (1920 x 1080)

Frame Rate (frames per second): 30

Create MPEG-4 movie

Create AVI movie

AVI Options

Codec (Compression method. Your AVI player may not support all options): Uncompressed

Quality: Not Applicable

Create image file for each frame

Frame Image Options

Format: JPG

1,110 m

1,000 m

875 m

750 m

625 m

500 m

430 m

0 m 150 m 300 m 450 m

None (Solid Background)

Rotate Select

Control Center (4 Layers, 1 Selected)

- Current Workspace <Killington.gmw>
 - RVT1703 COLOR.laz [14,407,660 Features]
 - RVT1703 COLOR.laz (Elevation Grid)
 - Aerial Color 2009.tif
 - User Created Features [1 Features]

Save the file and wait... ..

Save As

This PC > Desktop > VT ESE 2017

Search VT ESE 2017

Organize New folder

Name	Date modified	Type	Size
Imagery	11/18/2017 5:43 PM	File folder	
Point Clouds	11/18/2017 4:20 PM	File folder	

File name: Killington Video

Save as type: AVI Files (*.avi)

Save Cancel

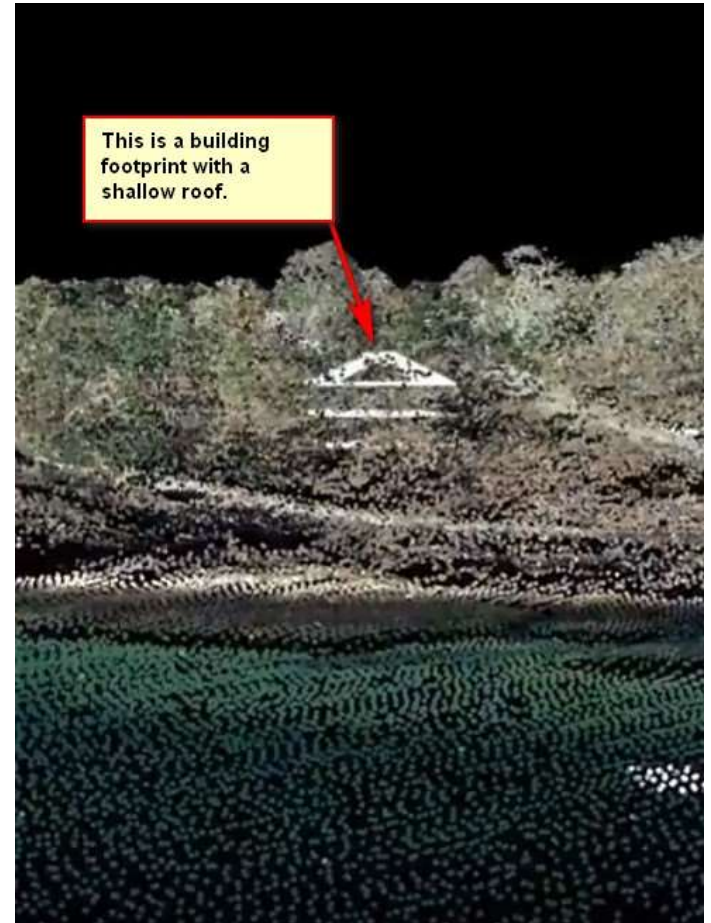
Rotate Select

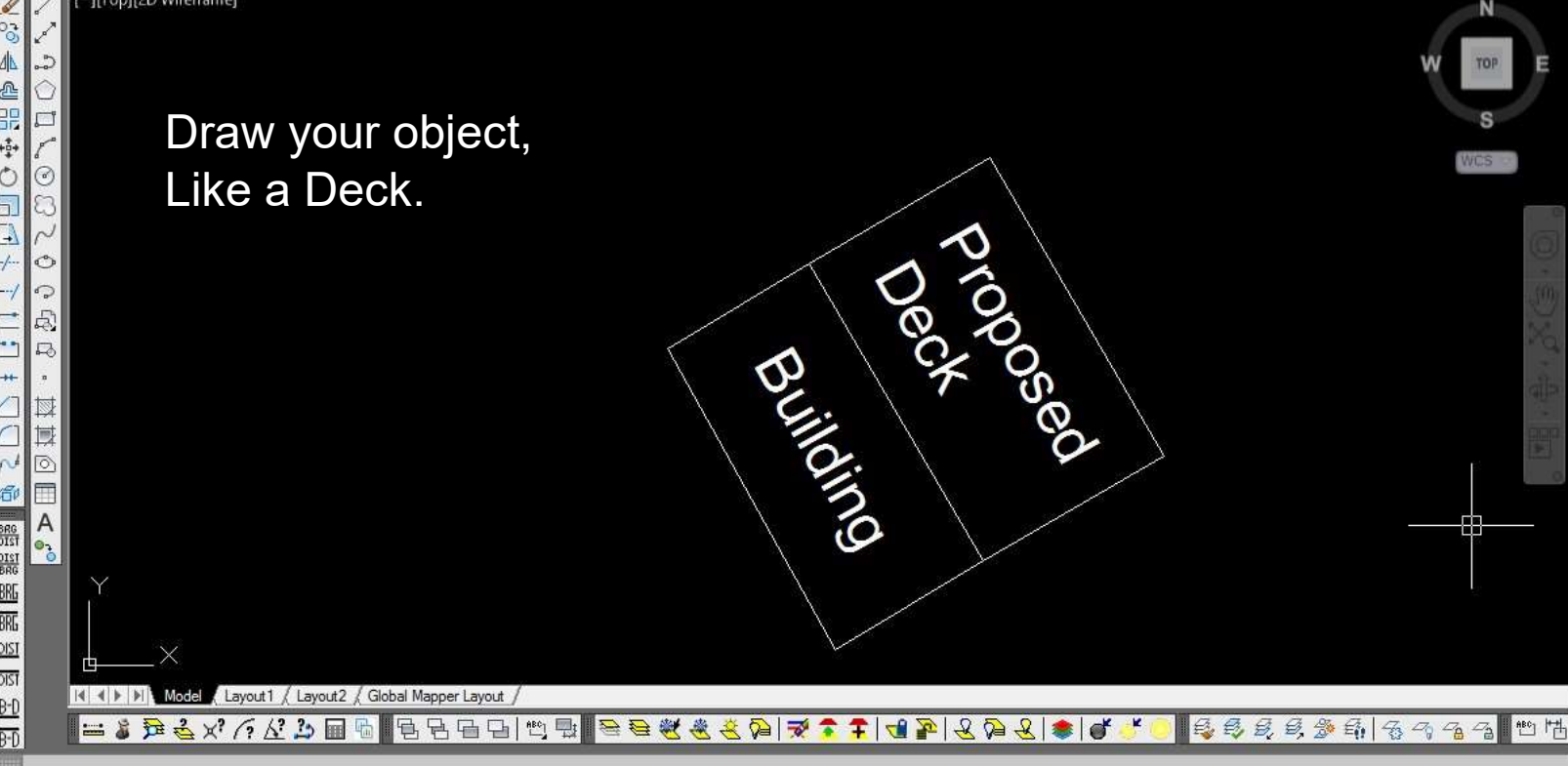
www.eselc.com/vsls

DATA EXTRACTION

I often would like to get something from CAD into the cloud. How about a conceptual building footprint in 3-d? Create some dense dot hatches in CAD at specific elevations. You can also offset polylines with elevation (Offset 3d Polyline in Carlson). Explode the hatches and run DENSEPL in Carlson, then explode the polylines. Now you need AutoDesk and the DATAEXTRACTION function. After about 8 screens of questions it will export a CSV with NEZ values for the endpoints of every line. (The exploded dots are just lines).

	A	B	C	D
1	End X	End Y	End Z	
2	1076370.500	2703677.700	63.00	
3	1076369.800	2703677.000	63.00	
4	1076369.100	2703676.300	63.00	
5	1076371.300	2703678.400	63.00	
6	1076373.400	2703680.500	63.00	





Draw your object,
Like a Deck.

Properties

No selection

Design

Object Class

Display

Display (2)

Extended Data

General	
Color	<input type="checkbox"/> ByLayer
Layer	0
Linetype	ByLayer
Linetype scale	1.0000
Lineweight	ByLayer
Transparency	ByLayer
Thickness	0.0000
3D Visualization	
Material	ByLayer
Shadow display	Casts and Receives Shad...
Plot style	
Plot style	ByColor
Plot style table	None
Plot table attached to	Model
Plot table type	Not available
View	
Center X	475497.0103
Center Y	124272.4375
Center Z	0.0000
Height	64.1485
Width	136.7785
Misc	
Annotation scale	1:1
UCS icon On	Yes
UCS icon at origin	Yes
UCS per viewport	Yes
UCS Name	
Visual Style	2D Wireframe

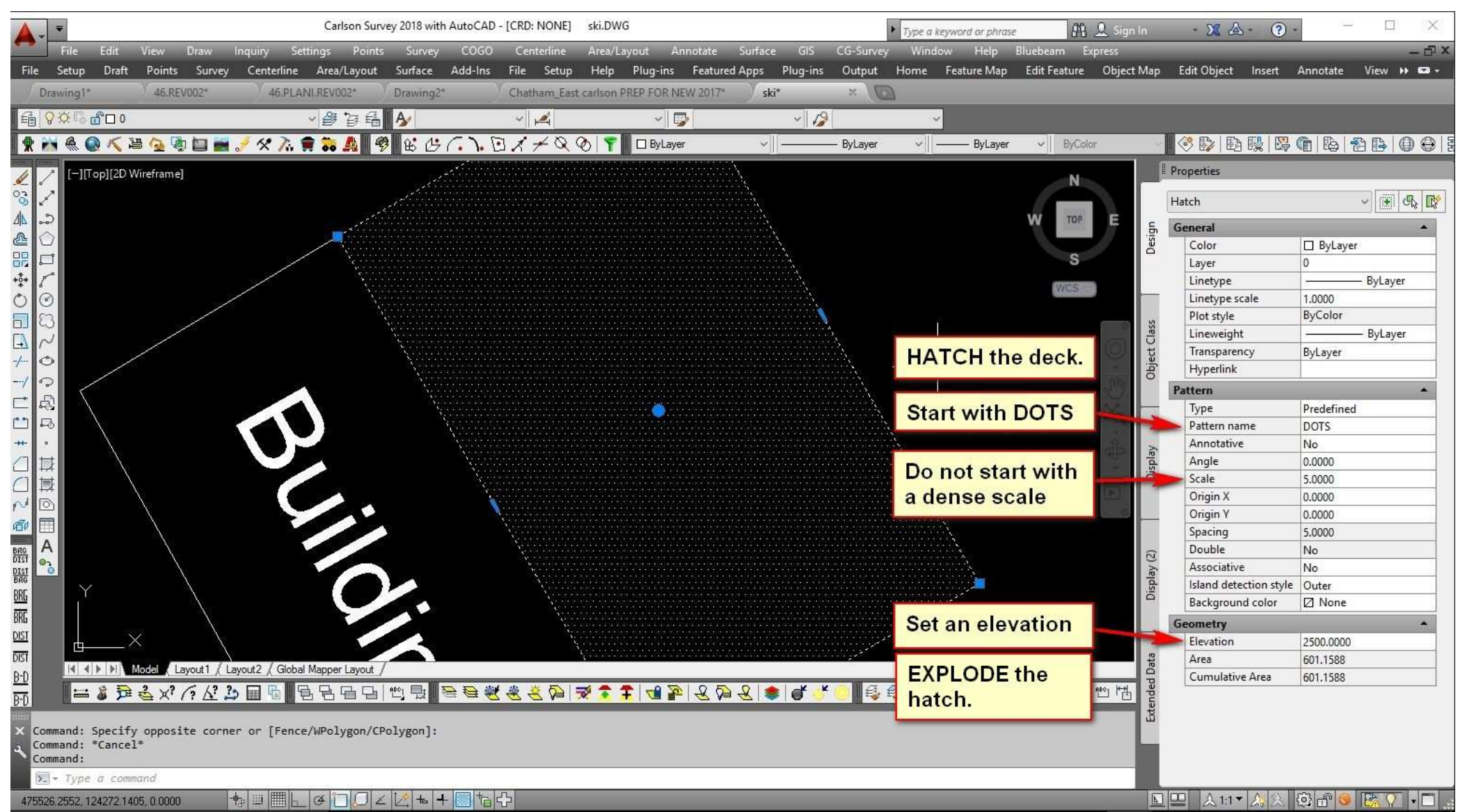
Command: *Cancel*

Command: *Cancel*

Command: *Cancel*

Type a command

475556.3884, 124254.8503, 0.0000



HATCH the deck.

Start with DOTS

Do not start with a dense scale

Set an elevation

EXPLODE the hatch.

Hatch	
General	
Color	<input type="checkbox"/> ByLayer
Layer	0
Linetype	ByLayer
Linetype scale	1.0000
Plot style	ByColor
Lineweight	ByLayer
Transparency	ByLayer
Hyperlink	
Pattern	
Type	Predefined
Pattern name	DOTS
Annotative	No
Angle	0.0000
Scale	5.0000
Origin X	0.0000
Origin Y	0.0000
Spacing	5.0000
Double	No
Associative	No
Island detection style	Outer
Background color	<input checked="" type="checkbox"/> None
Geometry	
Elevation	2500.0000
Area	601.1588
Cumulative Area	601.1588

[-][Top][2D Wireframe]

**Command:
DATAEXTRACTION**

**Start with the defaults
and NEXT**

Data Extraction - Begin (Page 1 of 8)

The wizard extracts object data from drawings that can be exported to a table or to an external file.

Select whether to create a new data extraction, use previously saved settings from a template, or edit an existing extraction.

Create a new data extraction

Use previous extraction as a template (.dxe or .blk)

Edit an existing data extraction

Next > Cancel

Command: *Cancel*
Command: *Cancel*
Command: dataextraction

Type a command

475539.9582, 124265.3118, 0.0000

Properties

No selection

General

Color	<input type="checkbox"/> ByLayer
Layer	0
Linetype	ByLayer
Linetype scale	1.0000
Lineweight	ByLayer
Transparency	ByLayer
Thickness	0.0000

3D Visualization

Material	ByLayer
Shadow display	Casts and Receives Shad...

Plot style

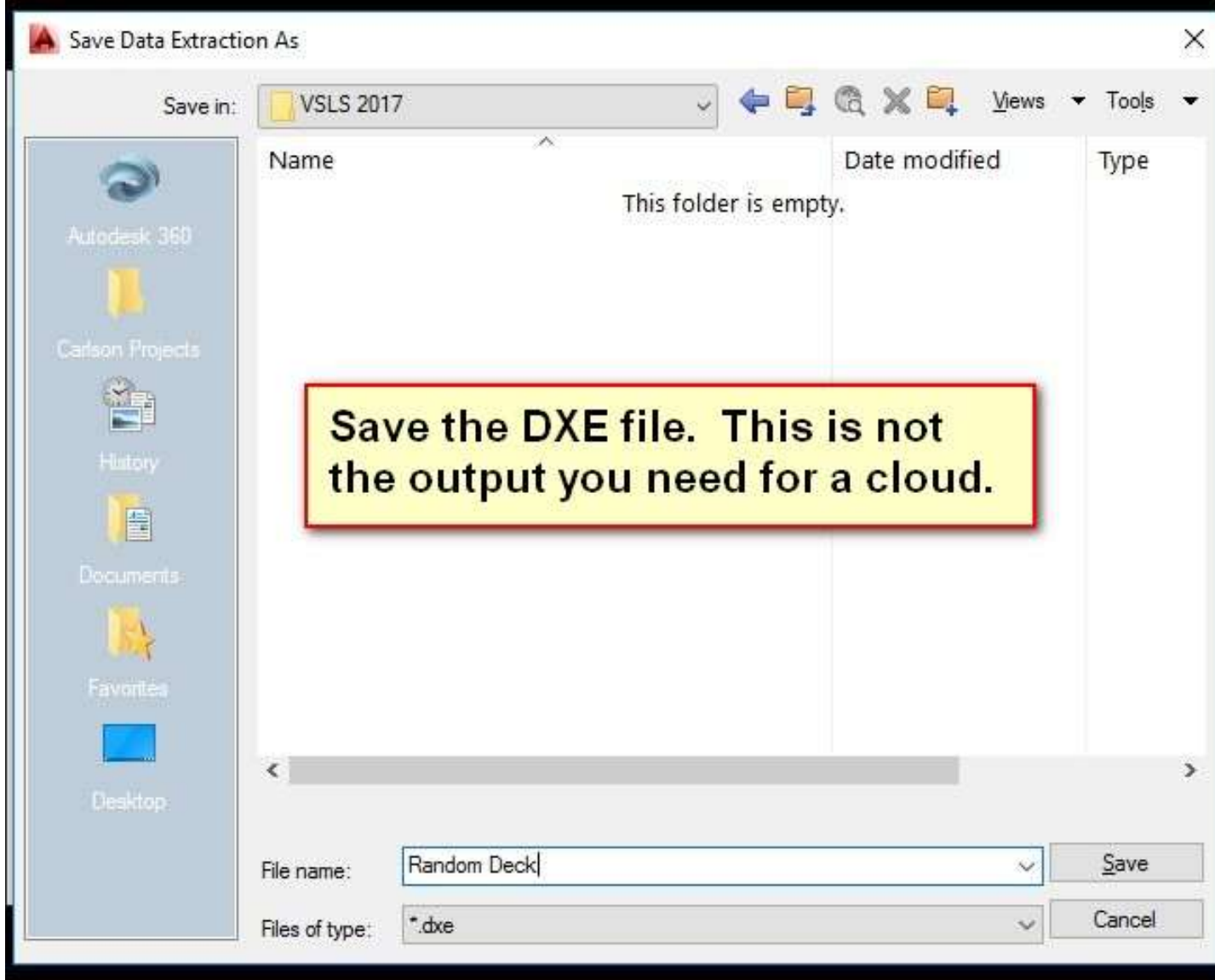
Plot style	ByColor
Plot style table	None
Plot table attached to	Model
Plot table type	Not available

View

Center X	475500.5675
Center Y	124271.4999
Center Z	0.0000
Height	64.6451
Width	137.8373

Misc

Annotation scale	1:1
UCS icon On	Yes
UCS icon at origin	Yes
UCS per viewport	Yes
UCS Name	
Visual Style	2D Wireframe



Data source

- Drawings/Sheet set
- Include current drawing
- Select objects in the current drawing



Choose the Select Objects and SELECT all the DOTS.

Drawing files and folders:

- Drawings
 - C:\Users\Thadd\Desktop\ski.DWG (Current drawing)

Add Folder ...
Add Drawings ...
Remove
Settings...

Select the objects to extract data from:

Objects

Object	Display Name	Type
<input checked="" type="checkbox"/> Line	Line	Non-block

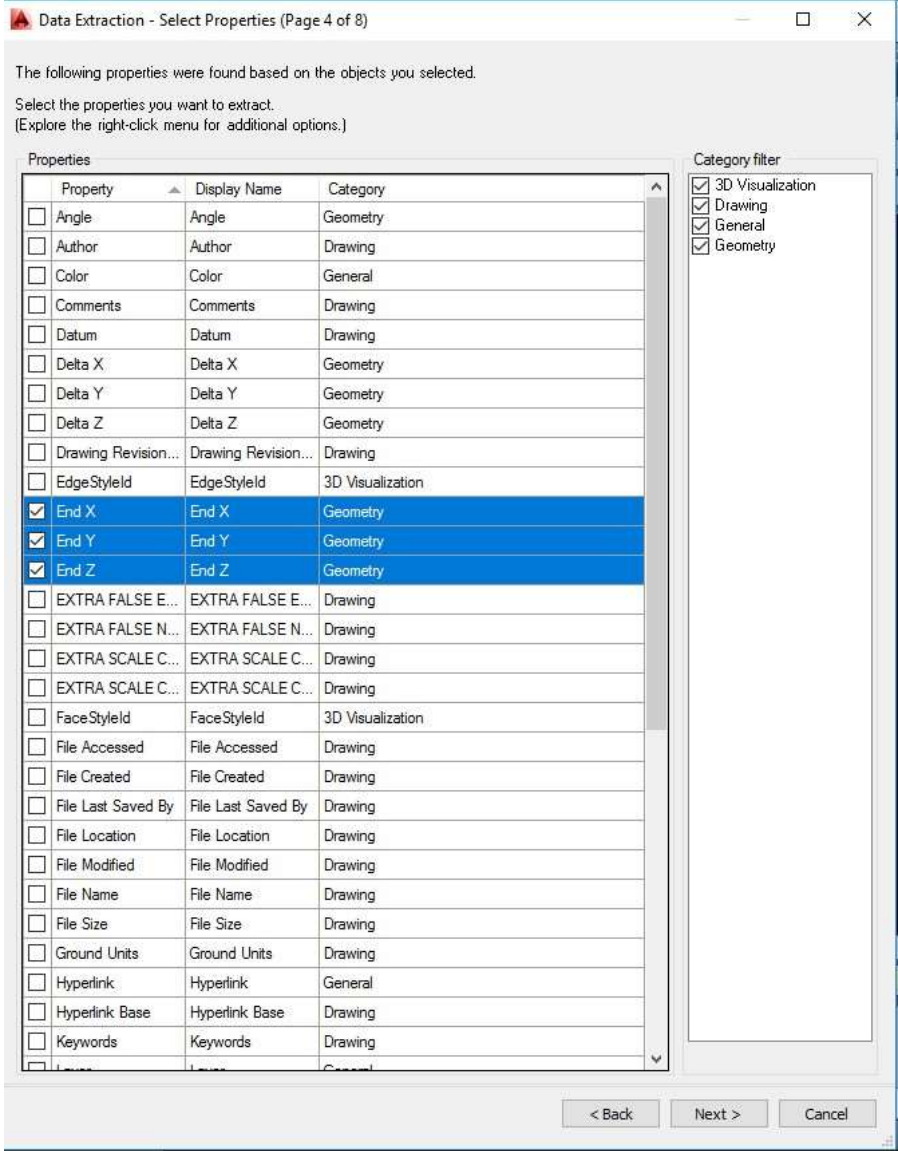
**For now, there is nothing to work with here... move along... NEXT
(Come back when you have a more complex selection set.)**

Preview

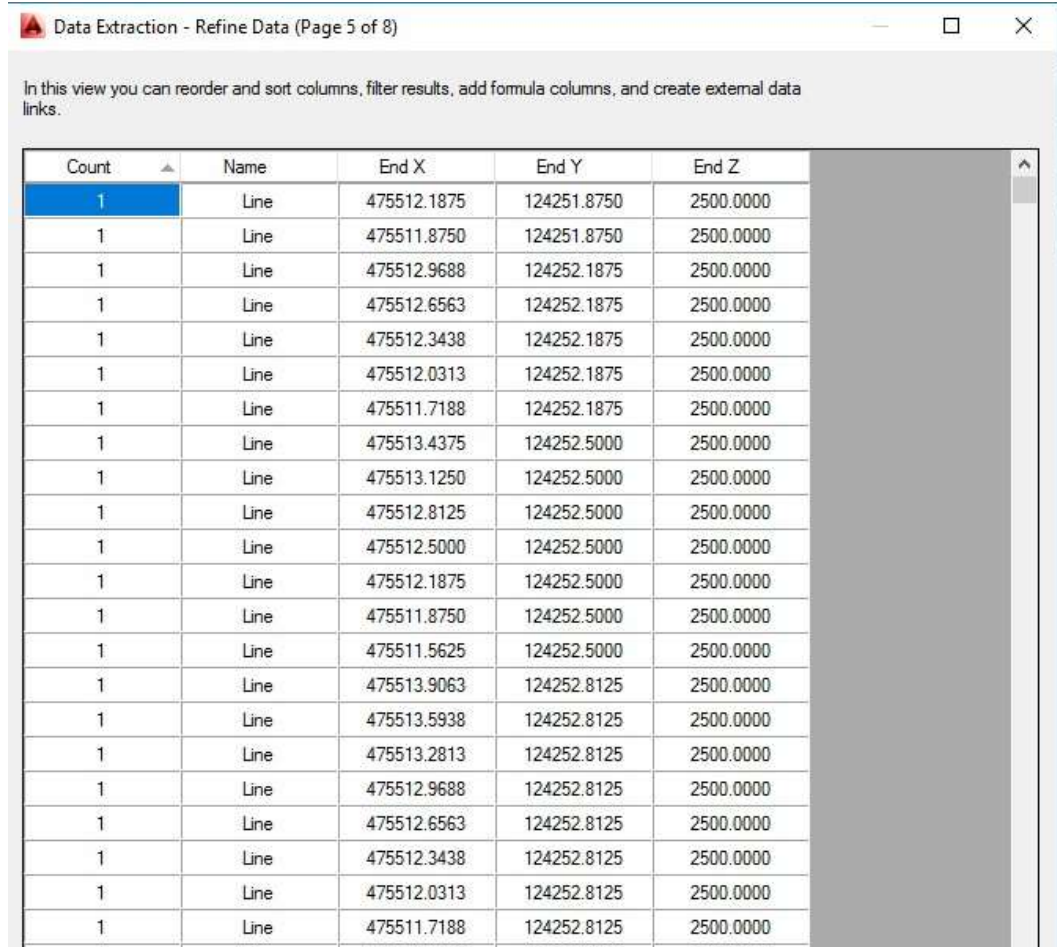
Display options

- Display all object types
- Display blocks with attributes only
- Display blocks only
- Display objects currently in-use only
- Display non-blocks only

< Back **Next >** Cancel



So many options. The exploded points are 0 length lines. Choose the start point or the end point. It will provide some data and an XYZ for every point.




In this view you can reorder and sort columns, filter results, add formula columns, and create external data links.


End X	End Y	End Z
475515.1563	124274.6875	2500.0000
475515.1563	124275.3125	2500.0000
475515.1563	124275.9375	2500.0000
475515.1563	124272.8125	2500.0000
475515.1563	124273.4375	2500.0000
475515.1563	124274.0625	2500.0000
475515.1563	124278.4375	2500.0000
475515.1563	124279.0625	2500.0000


Combine identical rows

Show count column

Show name column

 Link External Data...

 Sort Columns Options...

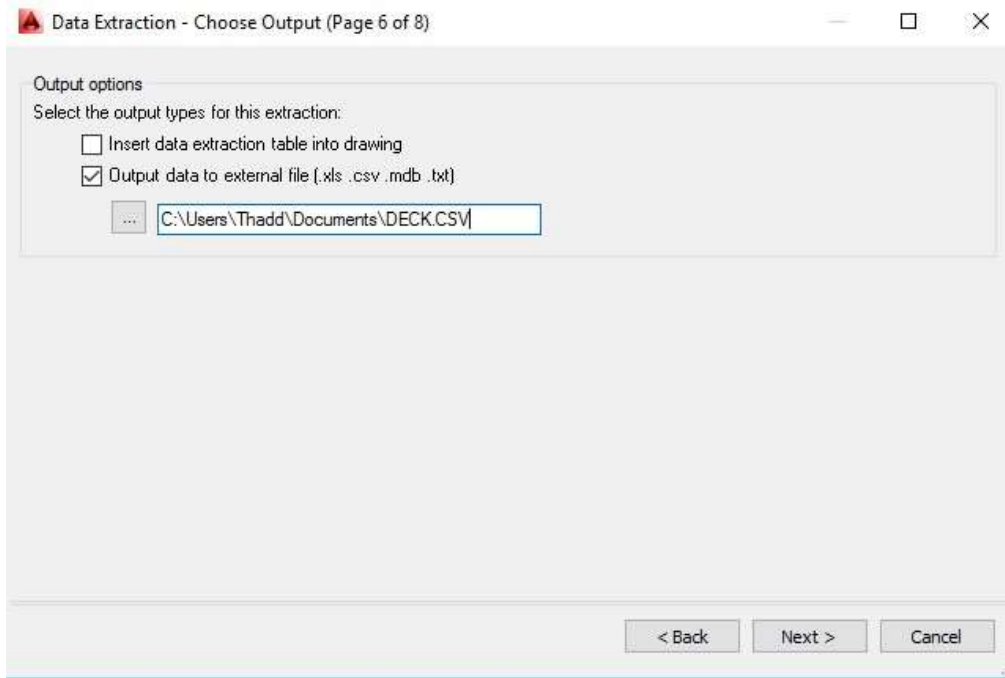
 Full Preview...

< Back

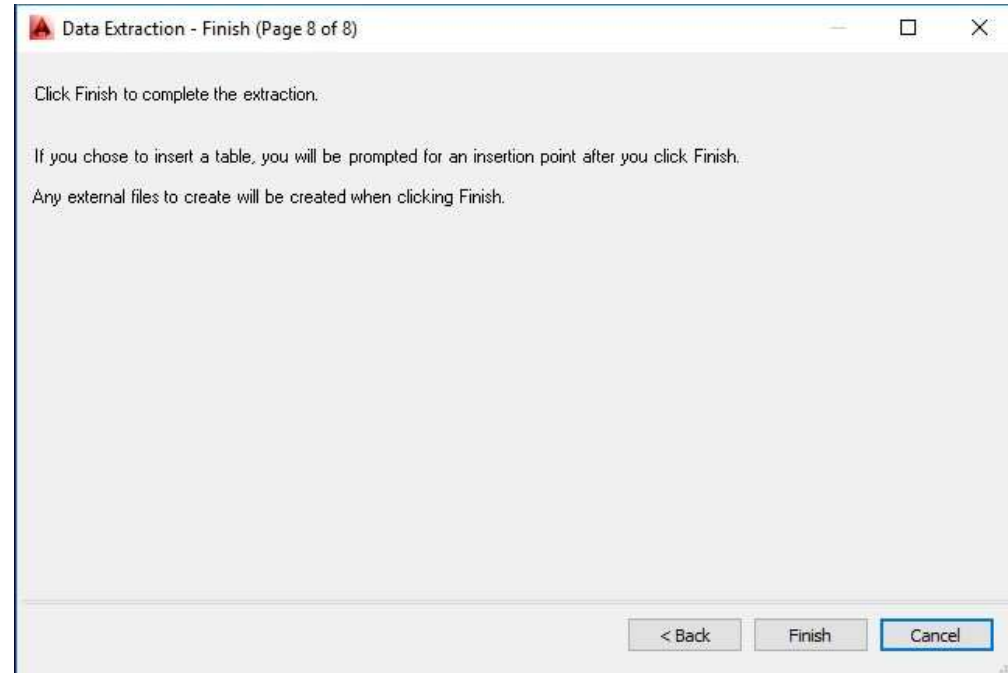
Next >

Cancel

The lower options allow for the removal of the COUNT and the NAME. This leaves you with the points.

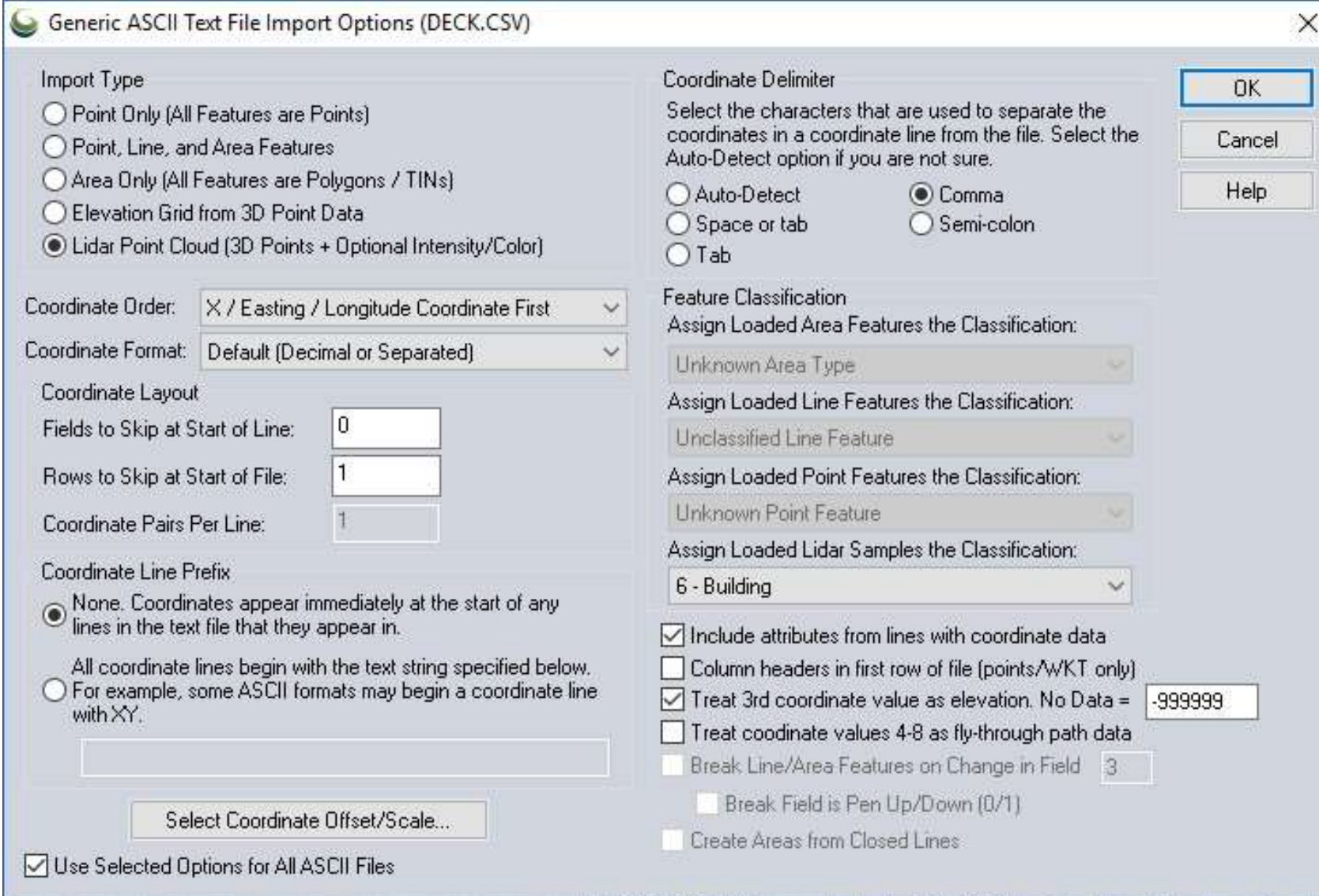


Extract the data to a CSV and blast through the finish screen.



```
1 End X,End Y,End Z␣␣␣
2 475496.0394,124278.7208,0.0000␣␣␣
3 475496.2500,124278.7500,2500.0000␣␣␣
4 475496.4063,124278.4375,2500.0000␣␣␣
5 475496.5625,124278.7500,2500.0000␣␣␣
6 475496.5625,124278.1250,2500.0000␣␣␣
7 475496.7188,124279.0625,2500.0000␣␣␣
8 475496.7188,124278.4375,2500.0000␣␣␣
9 475496.7188,124277.8125,2500.0000␣␣␣
10 475496.8750,124278.7500,2500.0000␣␣␣
11 475496.8750,124278.1250,2500.0000␣␣␣
12 475496.8750,124277.5000,2500.0000␣␣␣
13 475497.0313,124278.4375,2500.0000␣␣␣
14 475497.0313,124279.0625,2500.0000␣␣␣
15 475497.0313,124277.1875,2500.0000␣␣␣
16 475497.0313,124277.8125,2500.0000␣␣␣
17 475497.1875,124278.7500,2500.0000␣␣␣
18 475497.1875,124279.3750,2500.0000␣␣␣
19 475497.1875,124278.1250,2500.0000␣␣␣
20 475497.1875,124276.8750,2500.0000␣␣␣
21 475497.1875,124277.5000,2500.0000␣␣␣
```

It's a bunch of points.



Drag and drop into Global Mapper. Take a look at the settings.

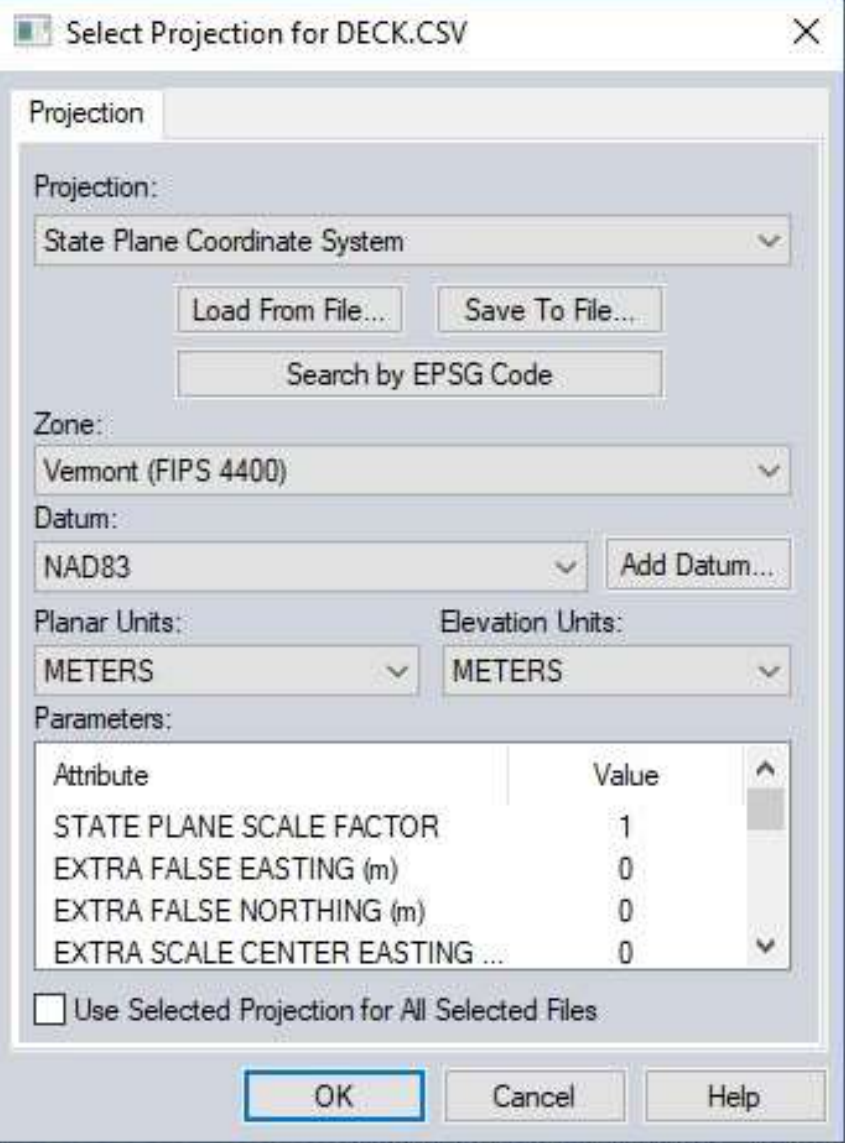
Import LiDAR points.

Coordinate order was exported X first...

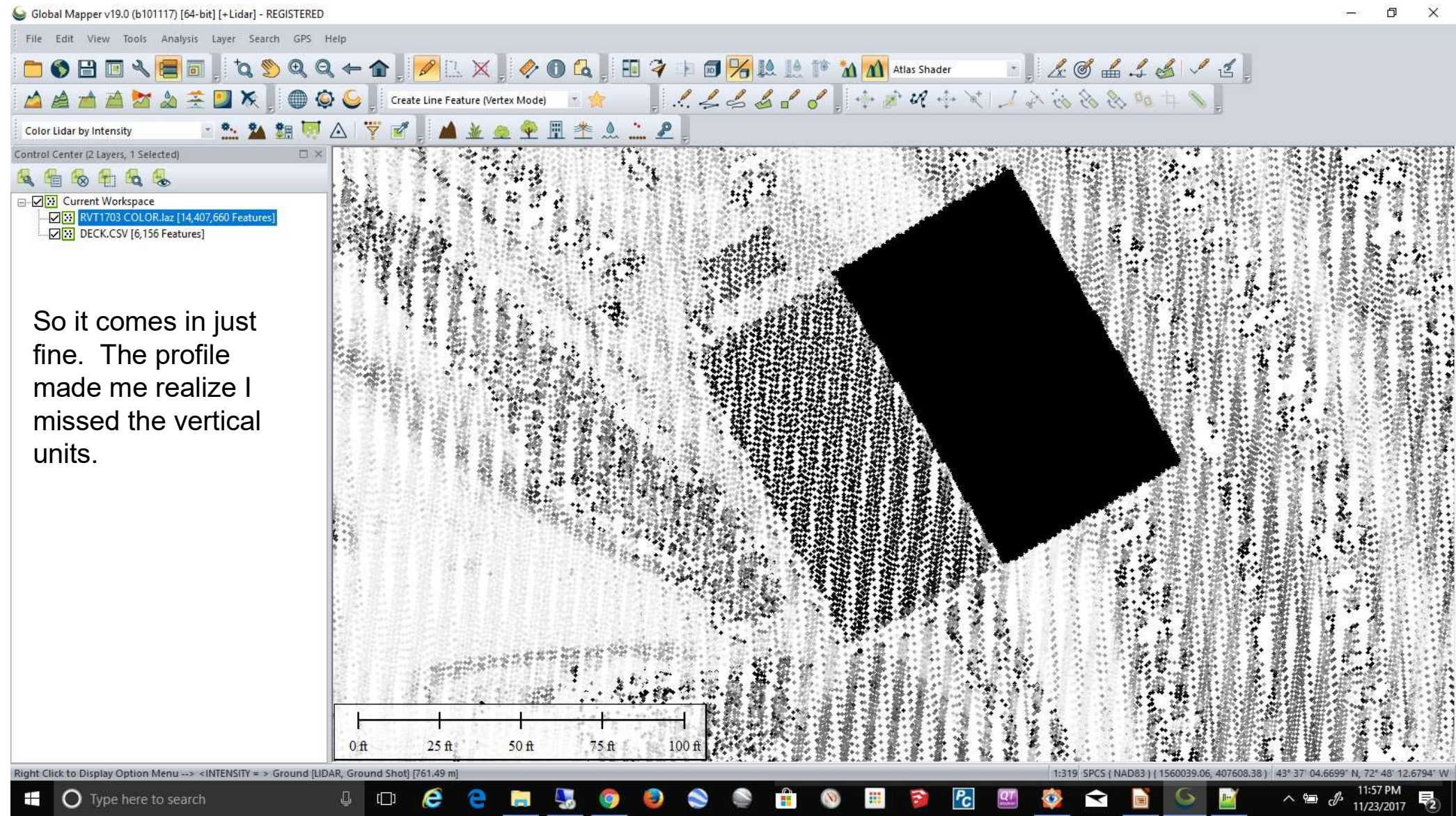
Skip the first row.

Comma delimiter.

Classify to 6-Building.



I went too fast... The vertical is in Feet and the Horizontal is in Meters. You can change it here, but I forgot...



So it comes in just fine. The profile made me realize I missed the vertical units.

File Edit View Tools Analysis Layer Search GPS Help

Atlas Shader

Create Line Feature (Vertex Mode)

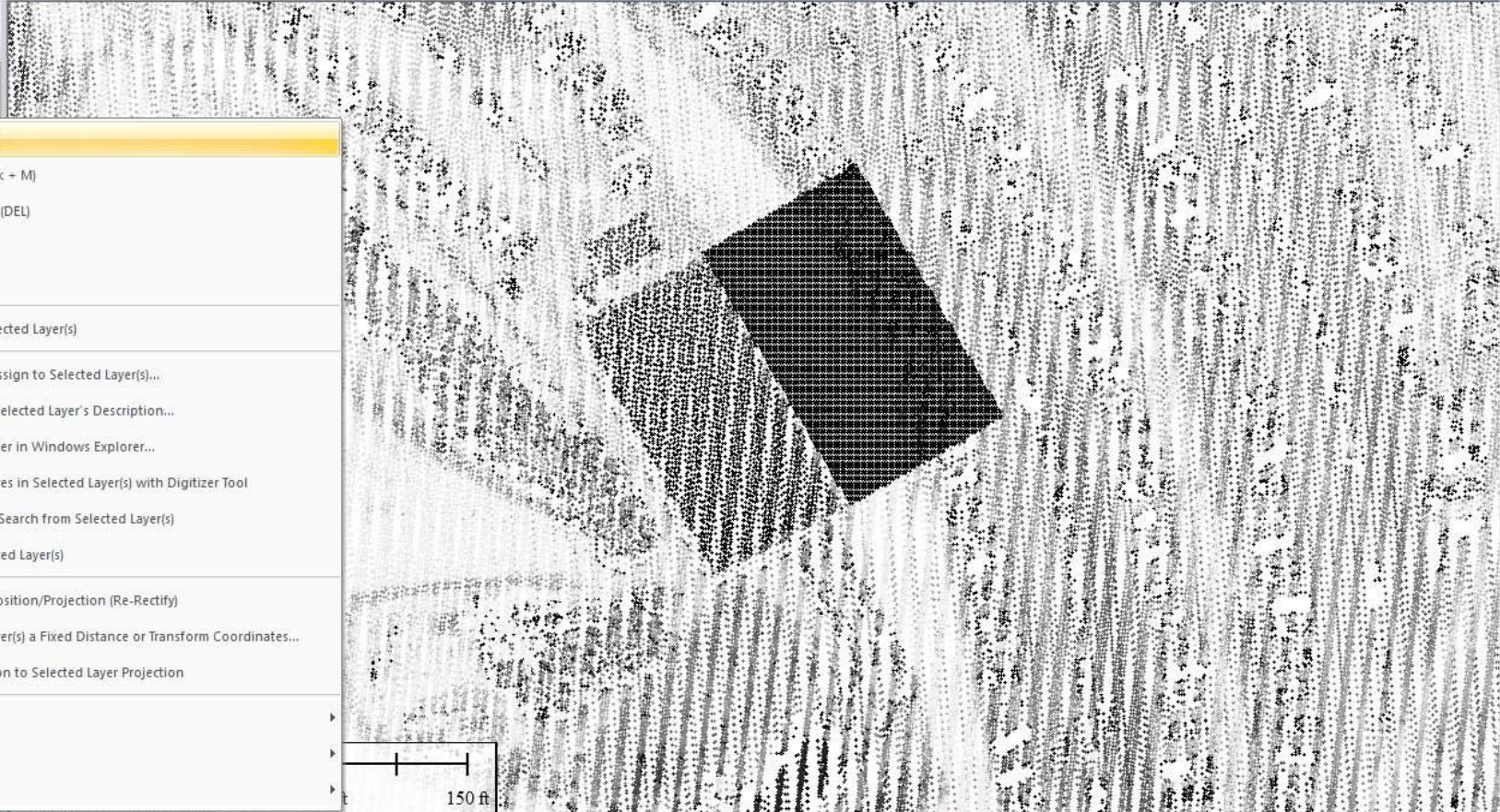
Color Lidar by Intensity

Control Center (2 Layers)

- Current Workspace
 - RVT1703 COLOR.laz [14,407,660 Features]
 - DECK.CSV [6,156 Features]

Options... (Double-Click)

- Metadata... (Double-Click + M)
- Close (Unload) Layer(s)... (DEL)
- Invert Selection
- Edit Attributes...
- ZOOM_TO - Zoom to Selected Layer(s)
- GROUP - Set Group to Assign to Selected Layer(s)...
- DESCRIPTION - Edit the Selected Layer's Description...
- Open Selected Map Folder in Windows Explorer...
- SELECT - Select All Features in Selected Layer(s) with Digitizer Tool
- Allow Feature Selection/Search from Selected Layer(s)
- Allow Export From Selected Layer(s)
- RECTIFY - Modify Layer Position/Projection (Re-Rectify)
- SHIFT - Shift Selected Layer(s) a Fixed Distance or Transform Coordinates...
- Set View/Export Projection to Selected Layer Projection
- Layer Order
- Analysis
- Layer

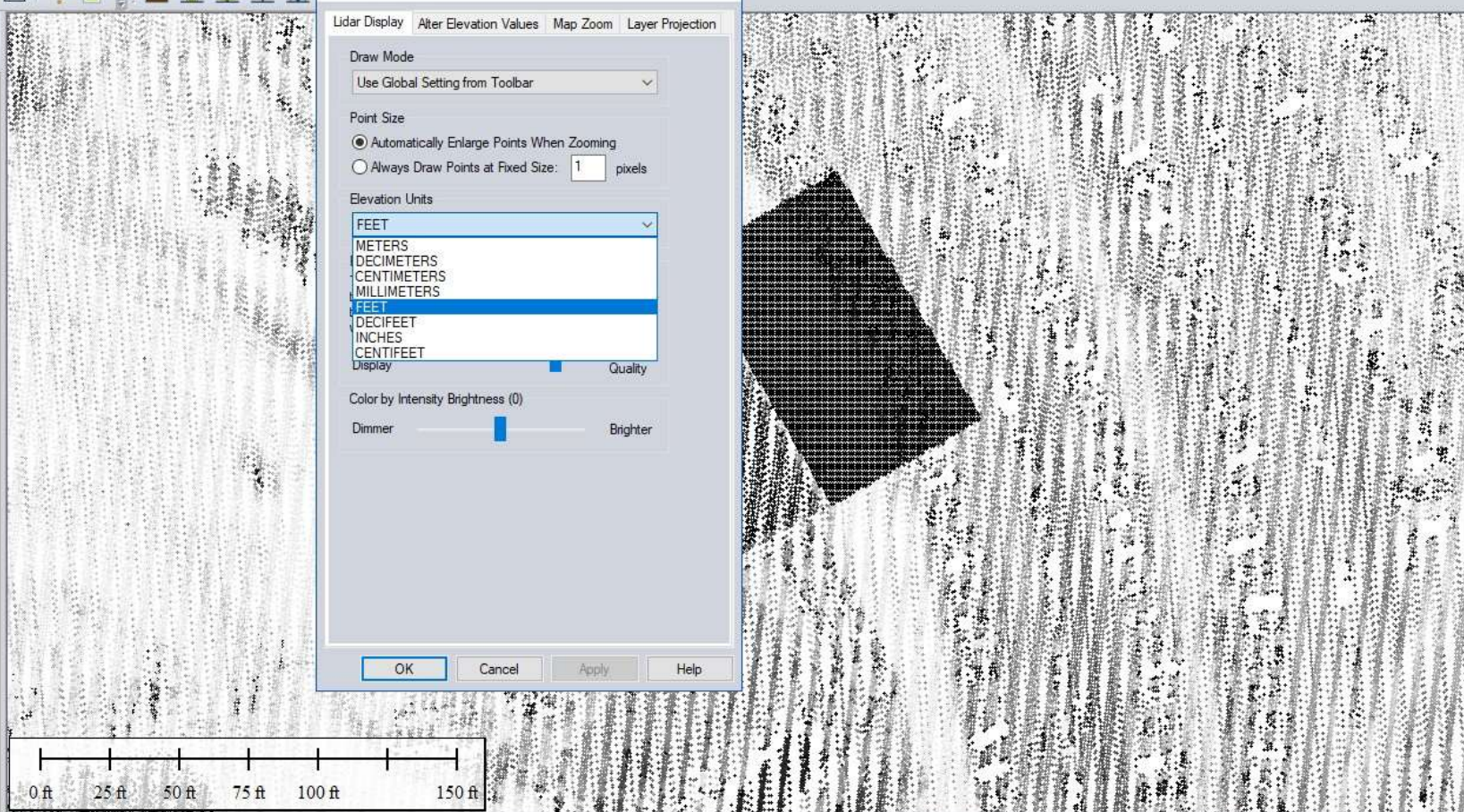




Color Lidar by Intensity

Control Center (2 Layers)

- Current Workspace
 - RVT1703 COLOR.laz [14,407,660 Features]
 - DECK.CSV [6,156 Features]



Vector Options

Lidar Display Alter Elevation Values Map Zoom Layer Projection

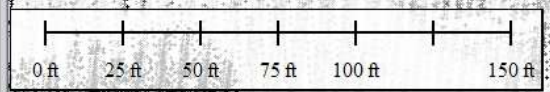
Draw Mode
Use Global Setting from Toolbar

Point Size
 Automatically Enlarge Points When Zooming
 Always Draw Points at Fixed Size: 1 pixels

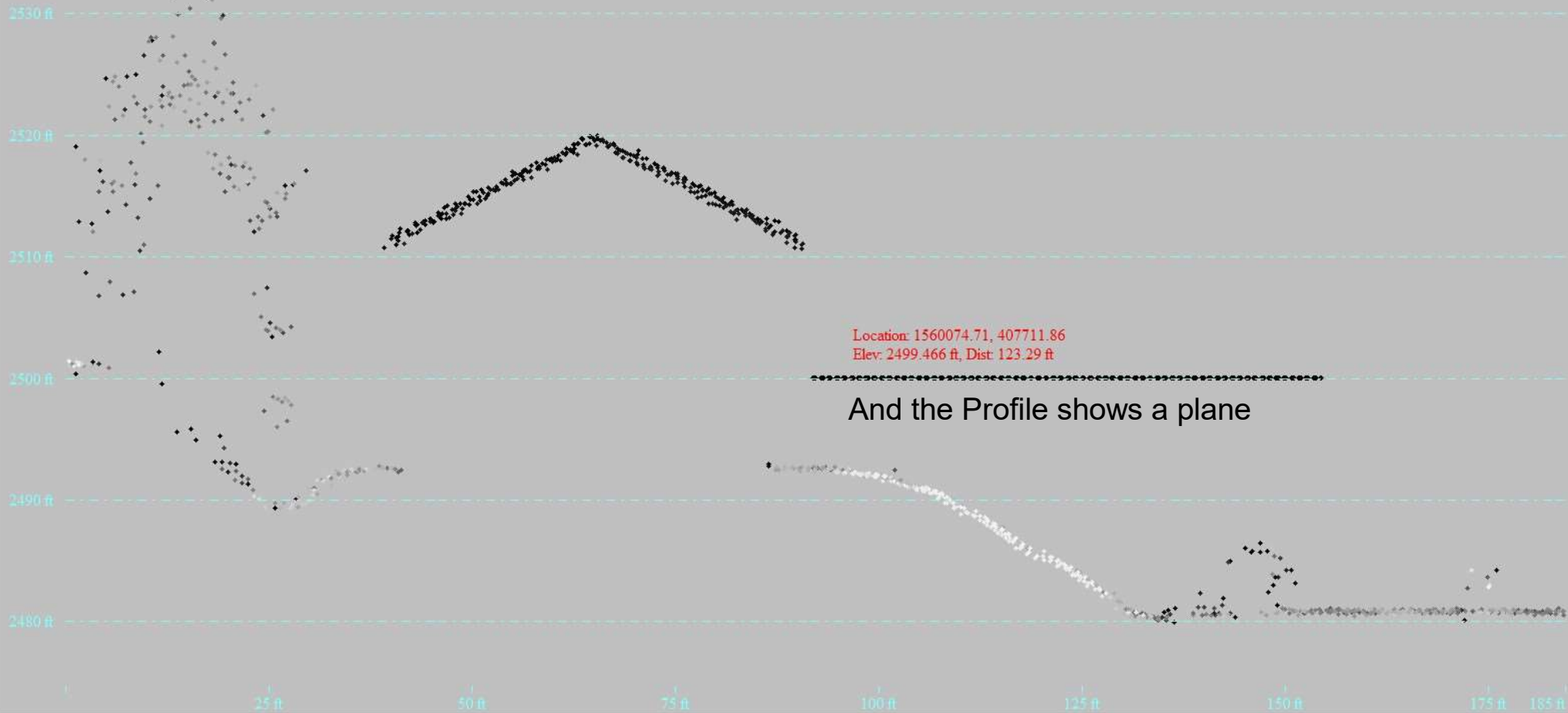
Elevation Units
FEET
METERS
DECIMETERS
CENTIMETERS
MILLIMETERS
FEET
DECIFEET
INCHES
CENTIFEET
Display Quality

Color by Intensity Brightness (0)
Dimmer Brighter

OK Cancel Apply Help



Phew, we can remedy the import...



Some thoughts:

The planes of points are fairly rudimentary shapes. You can add more or Extract an exploded hatch, then move it vertically, Extract it, move it vertically and so on to obtain multiple layers of points.

You can draw some polylines and use the DENSEPL (Carlson) function or an equivalent to break the polylines into segments. Explode those and grab the END POINTS.

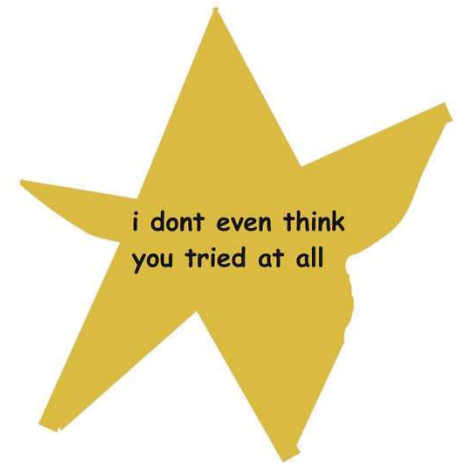
2d Polylines with Elevation are easier to manipulate into more complex shapes. Contours, ridges and other shapes can be made.

3d drafting in CAD is OK, but who really does it? If you get the knack, you could do some great things.

The points can be converted to surface models to make things look better.

www.eselc.com/vsls

Convinced? Doubtful?
Optimistic? Overwhelmed?
It's all good. Have a Gold Star.



LIDAR



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