Using LAS LiDAR Data in AutoCAD Civil 3D

Overview: Use the following processes for accessing LiDAR data in an LAS/LAZ format from the USDA GeoCue server or USGS The National Map (TNM), and then importing into Autodesk Civil 3D. The coordinate system of the LAS data and the drawing needs to be known. (E.g. The Iowa NRCS template uses NAD 83 UTM Zone 15, International feet.)

USDA GeoCue: Data is normally delivered in 1 file with the option to clip data to a user specified area. Ground only, All Points, or Model Key Points can be picked as the delivery option. Potential for smaller C3D drawing size.

USGS TNM: Data coverage is more widespread. Preset tiles are delivered so multiple files are often needed. Data in all classification categories are included (ground, unclassified, etc).

Software: AutoCAD Civil 3D 2020, Civil 3D Workspace, NRCS C3D 2020 template, DotSoft LiDAR Tools

Notation Method
Button to Press *Displayed Text* **Icon** Action {Text to Enter} *Menu Item…*

A. Identify project location and extent of data needed for the area being worked on.
B. Download LAS file from USDA GeoCue LiDAR server or USGS TNM.
**C. Create the surface within Civil 3D using LAS/LAZ files.**

Prerequisites

Set/Verify the Coordinate System and Zone of the drawing

1. Toolspace>Settings… Right click on the current Drawing name…
2. Click *Edit Drawing Settings… Units and Zone* tab
3. Click into the *Selected coordinate system code* and input value
   E.g. {UTM83-15IF}for IA.
4. Click OK
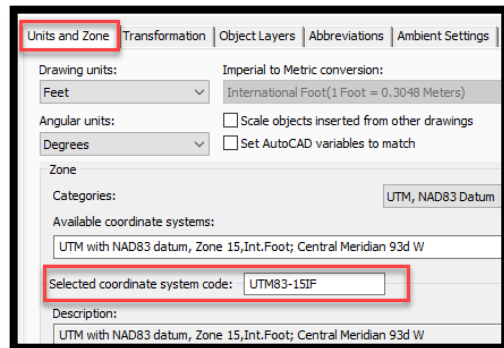
5. Within Civil 3D 2020, sign in to Autodesk at the top of window.
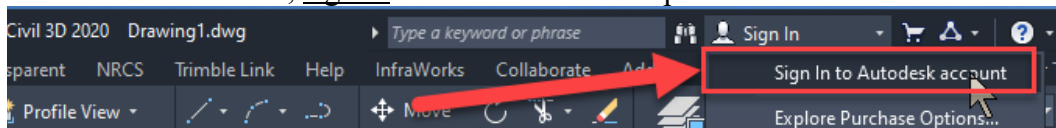
The Sign in screen allows the user to **Create Account** if you haven't done so yet.

A. Identify project location & extent of LiDAR data needed

<u>Use Survey Points and/or Georeferenced Image to Locate Site</u>

6. Optional: Insert GNSS survey points (See **Importing Survey Point Files** instructions)
7. <u>Click</u> *Geolocation… Online Map… Map Aerial…* (or whichever type of map you want to see.) The map should display in your entire drawing area.
8. <u>Zoom</u> to the location that you are working at.

<u>Draw a boundary for the LiDAR Data limits</u>

Use a geo-referenced image or points to help you place the boundary correctly.
9. Tool Palette>NRCS 11x17B… <u>Click</u> *Breaklines and Boundaries…Boundary Line…*
    ⌖ Boundary Line (Ctrl + 3 to toggle Tool Palettes on/off)
10. While not snapping to survey points, <u>click</u> to draw a border around outside of the planned LiDAR boundary limit. (F3 toggles Osnaps on/off.) To close the line cleanly, <u>type</u> {C} and <u>press</u> Enter.

<u>Export the proposed LiDAR boundary closed polyline as a Google KML or SHP file</u>

Use a KML or a zipped SHP file set for downloading LiDAR from USDA GeoCue or from USGS TNM Download.
11. <u>Type</u> {Mapexport} <u>Press</u> Enter
12. <u>Pulldown</u> "File of Type" to *Google KML or ESRI Shapefile*
13. <u>Browse</u> to the location where you want to save the boundary file.
14. <u>Input</u> a filename for the export E.g. {OpenRange LBoundary} <u>Click</u> OK
15. From the Selection Tab

    a) Use *Select Manually* & <u>click</u> **Select Objects** 🔬 to pick the lines in CAD. When done selecting items <u>press Enter.</u>
    b) If exporting as shapefile: <u>Set</u> *Object Type = Polygon*
16. From the Option Tab
    a) <u>Checkmark</u> *Treat Closed Polyline as Polygons*
17. <u>Click</u> OK The processing screen will display the numbers of objects and will disappear once the file has been created.
18. If the SHP was used, <u>browse</u> to the export folder, <u>select</u> the files associated with the .shp and <u>zip</u> them up together. (.dbf, .idx, iprj, .shp, .shx, etc)

B. Download Option 1 - LAS file from USDA GeoCue LiDAR server.

<u>Identify and Download data from GeoCue Server</u>

19. Using an Internet browser such as Microsoft Edge, Firefox, or Google Chrome <u>browse to</u> *lidar.sc.egov.usda.gov*
20. <u>Select</u> the Grid Index tab at the top to dialog to view available projects in a grid format.

21. <u>Scroll down</u> to the state and county e.g *IA – Fayette* or *IA_NorthCentral2_2020* and <u>click</u> **View Metadata** to note the details of the coordinate system and units of the data. (E.g. The IA_Fayette shows UTM zone 15N and Meters which is **UTM83-15**.)

22. <u>Close</u> the metadata screen and <u>click</u> the title link for your data. The map of the area and the LiDAR tiles will appear.

23. In *Layers* <u>checkmark</u> *Boundaries*

24. <u>Select</u> the *Download LIDAR+* section to expand it.

25. <u>Click</u> the **Import Polygon** function and <u>browse</u> to the Google KML or zipped SHP file of your project boundary. E.g. *OpenRange LBoundary.kml* or *.zip* file. <u>Click</u> [Open] and the page will zoom in to the boundary.
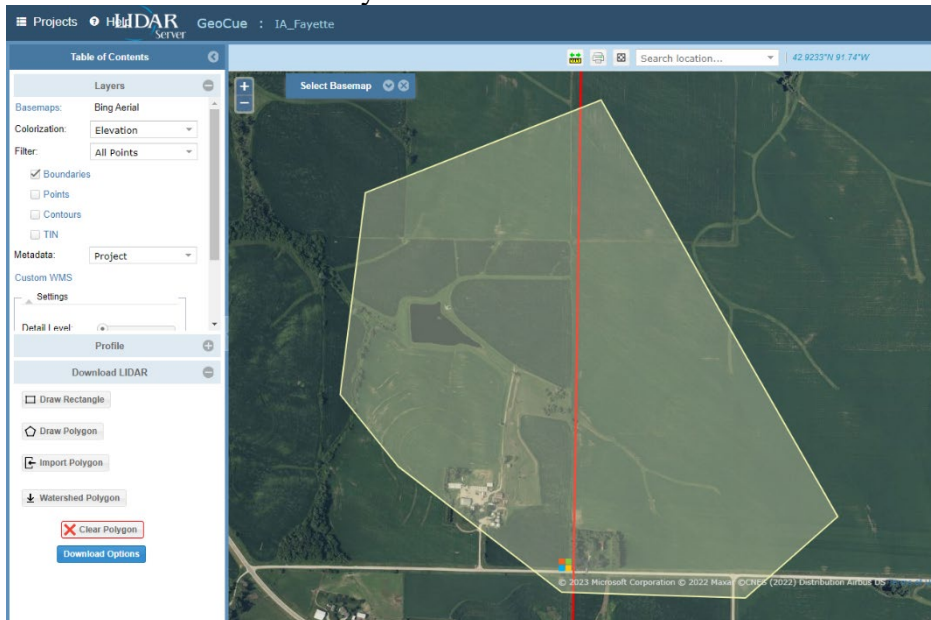
<u>Verify</u> that the area is within the red boundary of the GeoCue data. The data might extend into multiple grids.

26. <u>Click</u> **Download Options.** Then <u>set</u> the *Filter* to *Ground* <u>Checkmark</u> *Enable Clipping of LAS Data* and *Compress to LAZ.*

27. <u>Click</u> **Start Download** to download the LAS data based on the loaded polygon extent. Your browser will either save the file to your downloads folder or allow you to set the location. Click **Download**. **Note:** Download times of 1 to 20 minutes are likely, depending on file size and connection.

28. If needed <u>move</u> the downloaded file from downloads into your project folder.
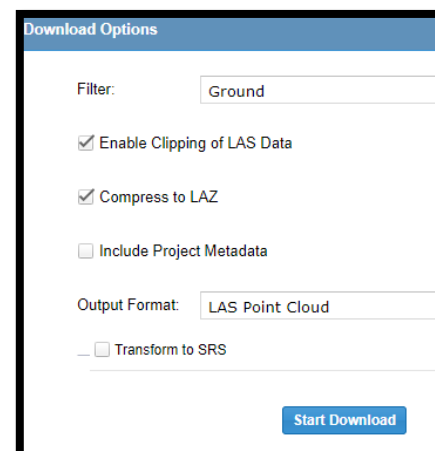
C. Download Option 2 - LAS file from USGS The National Map (TNM) Download.

Identify and Download data from USGS TNM Download

29. Using an Internet browser such as Microsoft Edge, Firefox, or Google Chrome browse to apps.nationalmap.gov/downloader
30. On the *Datasets* tab in the *Data* section checkmark *Elevation Source Data (3DEP) – LiDAR, IfSAR*
31. In *Subcategories* checkmark *Lidar Point Cloud (LPC).* If you click *Show* the map will shade areas that have data available.
32. Set *File Formats* as *LAS,LAZ.* Clicking *Show legend* will display a legend with shadings of various data quality.
33. If there are multiple LiDAR data sets at your location you can filter by date. Click **Advanced Search** to expand it. Dropdown the *Date* to *Publication Date* and set the *Start* date and the *End* date to filter for the data that you want to download.
34. Upload a kml or shp file of your site boundary.
    a. Click the Upload KML button and browse to the kml file of your project boundary. E.g. *OpenRange LBoundary.kml* file. Click Open and then zoom in to the boundary. Or:
    b. Click the Upload Shapefile button and browse to the zipped SHP file of your project boundary. E.g. *OpenRange LBoundary.zip* file. Click Open and the page will zoom in to the boundary.
35. The area for download will default to the zoomed area on the screen. To restrict the area more, click Polygon to create a limited area for downloading.
36. Click the Search Products button and files will be displayed on the *Products* tab.
37. Moving your cursor over the listing of the file will highlight an outline of that data on the map.
38. For each file that you want to obtain click **Download Link (LAZ)**. Your browser will either save the file to your downloads folder or allow you to set the location.
39. Click *Info/Metadata* to see dates the data was collected. Then scroll down to *Product Metadata* and click to see the metadata file.
40. Look for <gridsysn> to find the coordinate system and units of the LAS download. (E.g. An IA dataset shows:
    "<gridsysn>NAD83(2011) / UTM zone 15N (Meters)</gridsysn>" which is **UTM83-15**.)
41. Close the metadata screens
42. **Note:** Download times of 1 to 20 minutes are likely, depending on file size and connection.
43. If needed move the files from the Downloads folder into your project folder.

**D. Create the surface within Civil 3D using LAS/LAZ files.**

Civil 3D Steps

Note: If you receive this security pop-up using LiDAR Tools, click Always Load
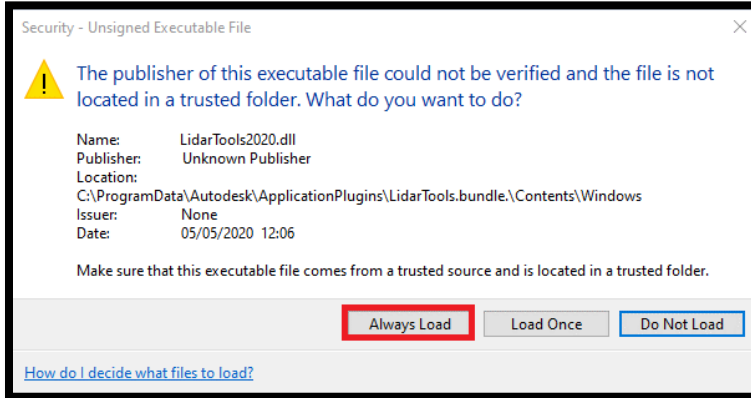
Reproject the LAS Data to the Correct Coordinate System (if needed)

44. Click *Add ins… LiDAR Tools…* *LiDAR Project…*
45. Browse to the LAS/LAZ file that was downloaded. E.g. *lsjob17n5424.laz* Click Open
    Note that multiple files can be selected for processing at the same time.
46. From the metadata of the LAS data, input he Source File System code
    E.g. {UTM83-15} Press Enter
47. Using the value of the drawing coordinate system, input the Target File System code E.g.
    {UTM83-15IF} Press Enter
    An LAZ file with the target code included will be created.
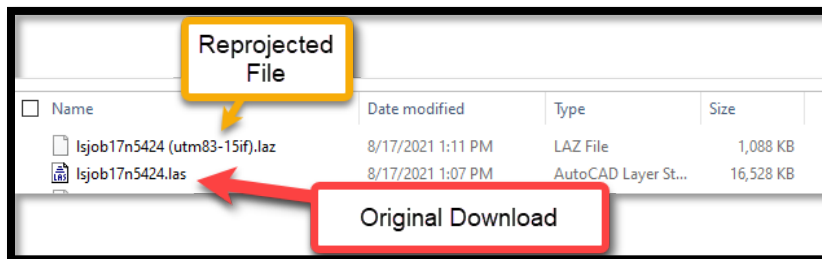
Place the Tile Limits of the LAZ/LAS Data into the Drawing

48. Click *Add ins… LiDAR Tools…* *LiDAR Tiles…*
49. Browse to the LAZ/LAS file that was reprojected/downloaded.
    E.g. *lsjob17n5424 (utm83-15if).laz* Click Open
50. At Point Cloud Class Counts Type {Y} Press Enter
    A rectangular boundary around the limits of the LiDAR Data will appear. Compare this to
    the Georeferenced map to make sure the coordinate systems are in sync.

<p style="text-align:center">Create the LiDAR Surface from the LAZ/LAS Data</p>

51. Click *Add ins… LiDAR Tools…* *Create LiDAR Tin…*
52. Browse to the LAZ/LAS file that was reprojected/downloaded.
    E.g. *lsjob17n5424 (utm83-15if).laz* Click Open
53. At Classes Counts Type {2} Press Enter
54. At First Corner click outside of lower left corner of tile rectangle
55. At Other Corner click outside of upper right corner of tile rectangle.
    Note: Patiently wait for the message to disappear below the command line.
    Note: If *Level of Detail Display* appears, click Keep the current display mode.
    A boundary of the LiDAR Surface will appear. The surface will appear in Toolspace with a name in the format of YYYYMMDDxxxxxxxx.
Rename the surface:
56. Select the surface in the drawing. Right click… *Surface Properties… Information…*
57. Input new name: {Ognd LiDAR LAS}. Click Ok.

<p style="text-align:center">Force contours to stay inside of the boundary</p>

If a concave boundary was used contours that extend past the boundary can be eliminated.
58. Toolspace> Prospector… *Surfaces... Ognd LiDAR LAS... Definition…* Right click *Boundaries*
59. Click *Add*
60. In the *Add Boundaries* Box set the Type to *Outer* and uncheckmark *Non-destructive breakline*.
61. Click Ok and select the previously drawn boundary line object.

<p style="text-align:center">Reduce the Data size of the LiDAR Surface</p>

Do NOT use on a thinned set of Ground points. If you used *Model Key Points* as a data filter when downloading then you have already carried out a similar process.

62. In Toolspace> Prospector… *Surfaces... Ognd LiDAR LAS... Definition…* Right-click *Edits*
63. Click *Simplify Surface*
64. Select *Point Removal*….(Notice the numbers of points in region) Click Next
65. Select Use existing surface border…. Click Next
66. Checkmark Percentage of points to remove….Try 99%
67. Checkmark Maximum change in elevation….Try 0.1
68. Click Finish and wait for the dialog box to disappear

69. To see the number of points removed: Toolspace> Prospector… *Surfaces... Ognd LiDAR LAS... Definition…* Click *Edits* … and look at the description of the edit.
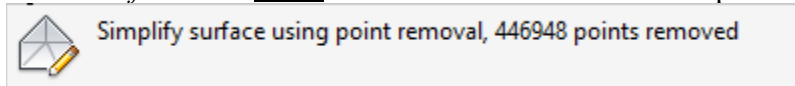
The information is also found on the *Surface Properties… Definition* tab.

Display the Contour lines in CAD

70. Toolspace> Prospector… *Surfaces...* <u>Right click</u> *Ognd LiDAR LAS...* <u>Click</u> *Surface Properties…*
71. <u>Click</u> the *Information* tab and <u>Set</u> the *Surface Style* to a no smoothing display that you want. E.g. *Ognd Contours (2 and 10) No Smoothing*
72. <u>Click</u> OK
73. If the display does not refresh type {rea} and <u>Press Enter</u>
74. If not all contours display while zooming in and out you can turn off Level of Detail by <u>typing</u> {LEVELOFDETAILOFF} <u>Press Enter</u>.
75. If an image is present you may need to send it behind the contours. <u>Select</u> the image. <u>Right-click</u> *Display Order…Send to back…*
76. Review the contours.

Locking a Surface to Protect it
(Highly Recommended)

Lock the surface model once you are satisfied with it.
77. In Toolspace> Prospector… *Surfaces...* <u>Right click</u> *Ognd LiDAR LAS...* <u>Click</u> *Lock…*

View Statistics about the LiDAR Surface

78. Toolspace> Prospector… *Surfaces...* <u>Right click</u> *Ognd LiDAR LAS...* <u>Click</u> *Surface Properties…*
79. <u>Click</u> the *Statistics* tab and <u>expand</u> the *General, Extended,* and *TIN* details
80. <u>Click</u> OK