RC10388

# Demystifying Large Point Cloud Data Sets for Simple Integration on Complex Projects

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## Learning Objectives

- Learn how to plan and budget for laser scans

- Learn how to manage large data sets across a multi-office environment

- Learn how to break up the point clouds into manageable file sizes

- Learn strategies for modeling existing data vs  reliance on point cloud only

## Description

This class will guide participants on how to plan for using large amounts of point cloud data across multiple offices quickly and efficiently. The key planning aspects we will cover will be how to handle all sizes of laser scanning projects and how to define an accurate scope when doing a scanning request for proposal (RFP). The project examples for this class will highlight how 500 GB-plus of point cloud data with staff members in 7 offices across the United States and an office in India was set up to decrease wide-area network latency and also improve workstation performance. Software workflows will show how laser scans were set up, including existing conditions model, demonstration drawings creation, and new design coordination with existing point clouds. The software discussed in this class will focus on ReCap 360 software, Navisworks software, and Revit software.

## Your AU Expert

*Mark LaBell Jr is a Technical Leader in the VDC Global Initiatives department at SSOE Group, a global engineering, procurement, and construction management firm.  Mark has a passion and unparalleled dedication for the practice of VDC methods in the AEC industry. He has served as a user and customization expert in 3D BIM/CAD software for over 15 years and provides support and training for users to educate them on how to maintain a sound and practical user environment. Always looking for the next best thing, whether process improvement, software, or hardware when it comes to practical design and user experience, LaBell has learned that there is never a "one-sized fits all" approach no matter what the client requirements dictate. He received his Bachelor of Science in Computer Aided Design and Manufacturing from Eastern Michigan University and works in SSOE's global headquarters located in Toledo, Ohio.*

## Autodesk ReCap tips

- Always edit all ReCap data on a Solid State Drive (SSD) on your computer. The SSD doesn't have to be the primary drive with the OS. SSOE's standard SSD is the Samsung Pro based on our benchmark results.
- Make sure that you are always in ortho view mode when adding points to regions, otherwise you will grab extra points and assign them to the wrong region.
- When you begin to see a slowdown of associating points to a region (known as spinning wheel of death) export your model as it is, assigning each region as its own model. You can always combine multiple RCS files later to make the master for that region.
- Always unify all scans as a single (or multiple for larger projects) prior to adding points to a region. Exporting points that are not unified will take much longer when creating a RCS based on regions.
- Have a minimum of two computers to post process data, otherwise a lot of time is spent waiting for an export.
- +/- of RCP files with regions
    + Saves time for exporting each region as its own RCS file since there is no export required
    - Navisworks and Revit do not allow to control visibility of Regions in a RCP
    + Regions can be controlled for display purposes in AutoCAD based projects and Recap
    - The concept of a region doesn't really resonate for people that don't utilize Recap for Point cloud editing, so extra training is required to understand the concept.

## Breaking up your point clouds

### 1. Purpose and Definitions

Point cloud editing is the process of taking the raw data received from laser scanning vendors, and converting it into file sets that will be useful for design, coordination, clash detection, and more within the various design and review software.

The following terms are used throughout this document:

.RCP file – This is a ReCap project file that contains the settings, selections, regions, etc., for the point cloud data, and is the file you work in within ReCap, but it does not contain the point cloud data itself.

.RCS file – This is the actual point cloud data file that is linked into other programs. To edit an .RCS file in ReCap, you will need to load it into an .RCP file.

Region – A region is a saved selection or group of points. Selected points can be added to or removed from any created regions.

Clipping – Clipping will remove points from the view without deleted them or adding them to a region. This can be useful to temporarily hide points without greatly effecting file performance.

Exporting – Exporting is the creation of a new file from the point cloud data that is displayed on the

screen at the time of export. Controlling the visibility of points with clipping or regions allows the elimination of specific points from the newly created file.

(C:) drive – Personal computer hard disk.

(P:) drive – Network point cloud drive

## 2. Starting a new ReCap project

When starting a new ReCap project, it is imperative for file performance that the files you are working in are on your local (C:) drive rather than on a network drive. ReCap files generally have very large file sizes, and using them will be extremely slow over a network connection.

Once you have copied the building file to your (C:) drive, you can open ReCap to start a new project.
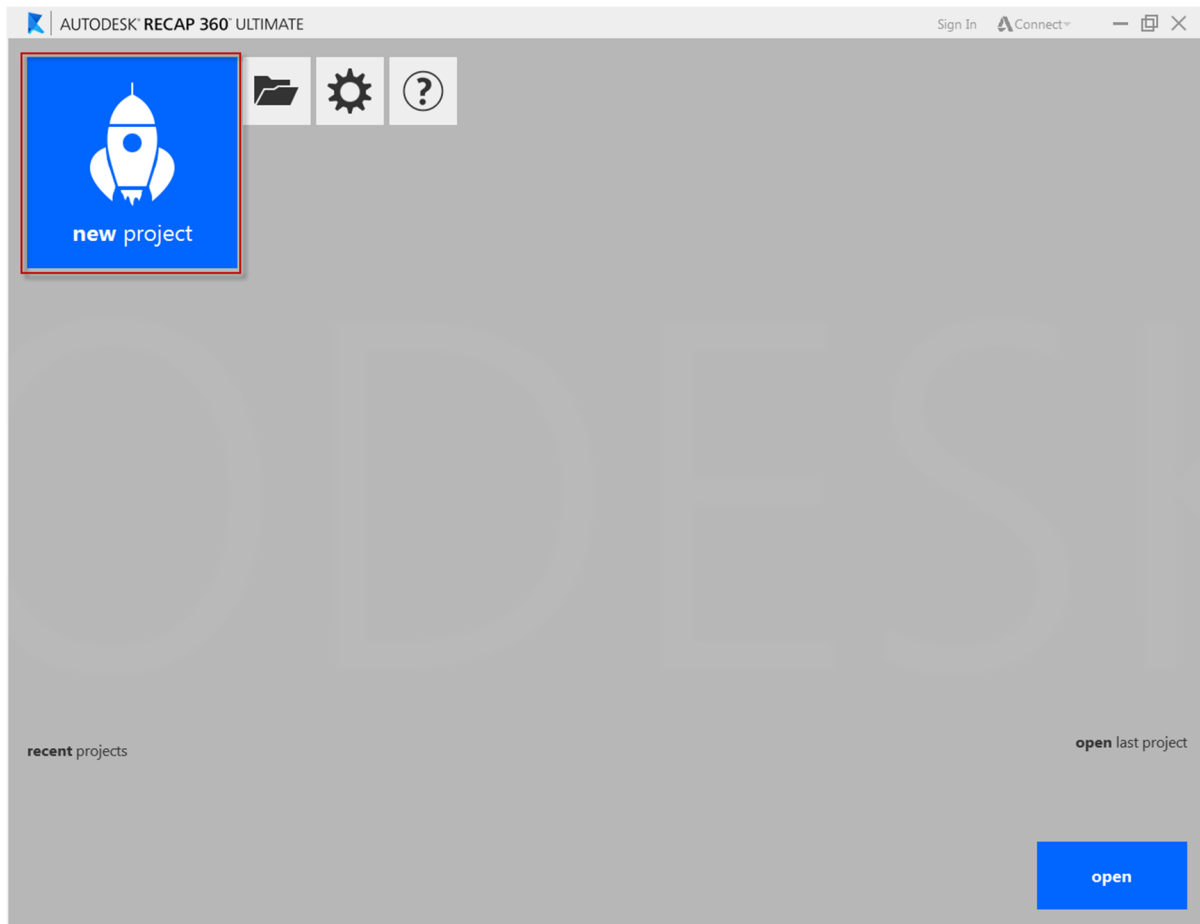


Figure 1: Starting a new project

In the home screen of ReCap, you can choose to open existing files or to start a new project. For this step you will click "new project" as shown in Figure 1.

Upon clicking "new project" a dialog box will appear prompting to choose the name and location for your file (Figure 2). After selecting a file name and location, click "Proceed." Next will be displayed a dialogue box that prompts you to select files to import (Figure 3). This is where you will choose the .RCS file that you copied to your (C:) drive.
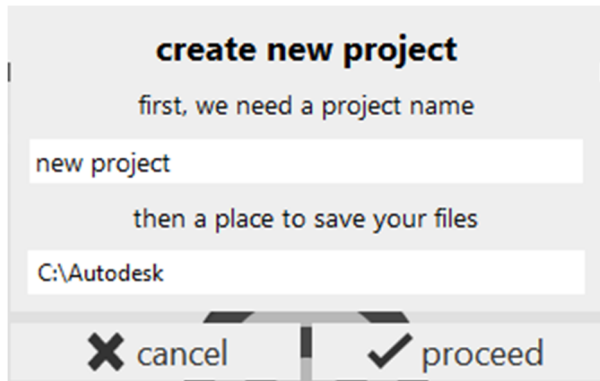


Figure 2: Select files to import



Figure 3: "Create new project" dialogue box
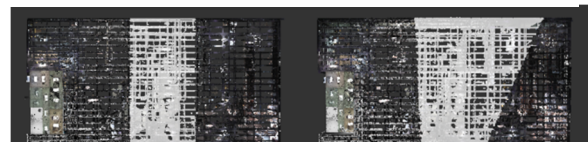


Figure 4: Selection with orthographic (left) vs. perspective (right)

After selection your files, simply click "Launch Project," and your point cloud will be displayed. Before proceeding it is advisable to turn perspective mode off under your view settings (Figure 4).

The reason for turning off the perspective view is that points often need to be selected in an orthographic fashion. If perspective mode is on, your selection will become skewed. Figure 5 shows in plan the same selection made from an elevation view in both orthographic and perspective view modes.

You will need to turn on the perspective mode if you wish to get inside the building or to use the "Fly" tool. It can also be useful in general navigation. Just be aware of how it effects your selection. Mention that buttons that are blue indicate the feature is toggled on.



Figure 5: Turn off perspective mode

### 3.  Splitting files into areas

Most building projects will require point cloud data to be split into different building "areas" for two reasons: 1) to create manageable file sizes, and 2) to allow for greater control of the visibility of point cloud files in other applications.

The first step with a file in ReCap is to eliminate unnecessary points from the cloud. These "spray" points can be can removed by putting them on a hidden region and exporting. First, select the spray points (multiple selections can be made by holding the SHIFT key). After the points are selection, click on the "New Region" button as shown in Figure 6 below.
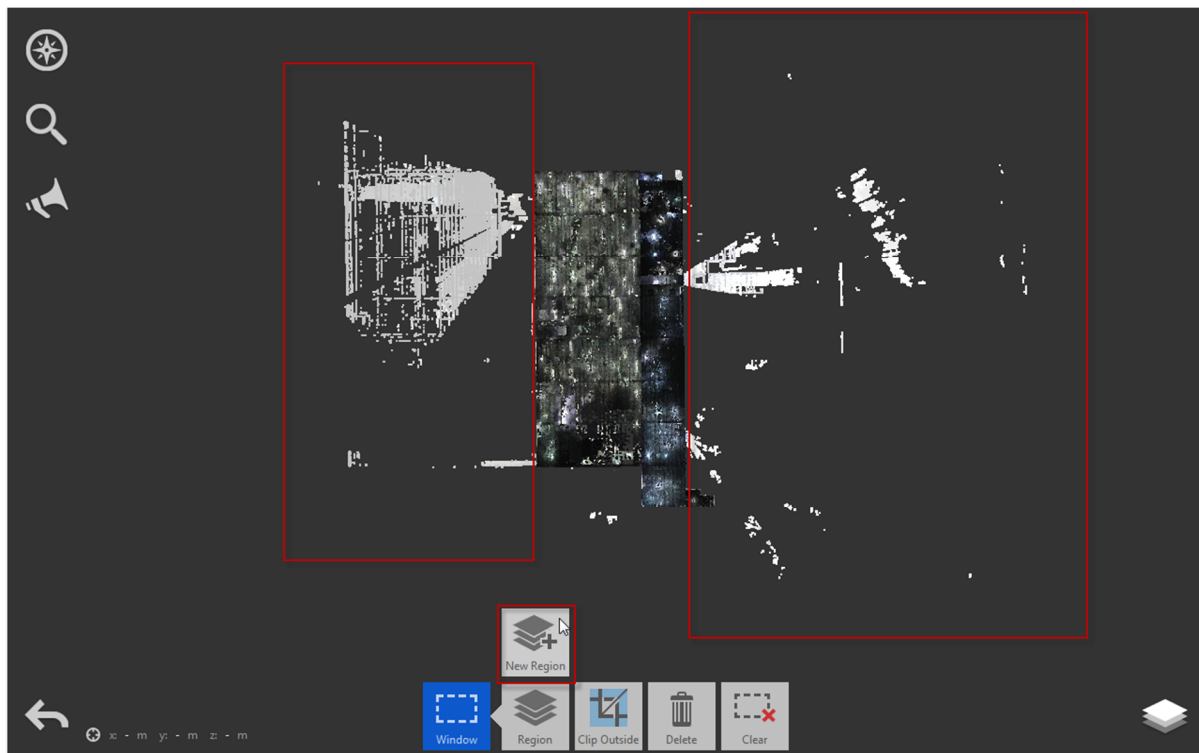


**Figure 6: Removing "spray" points**

Spray points are extra points that the laser scan unintentionally captured. They increase file size and are not needed in the point cloud model, so it is best to remove them immediately.
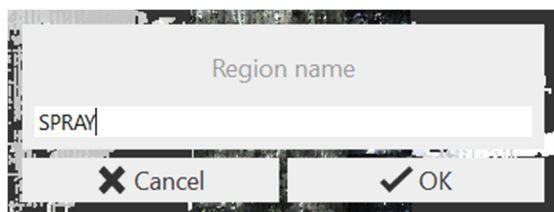


After you have made your selection and clicked "New Region" you will be prompted to give the region a name. In this case, title it "SPRAY" (Figure 7)
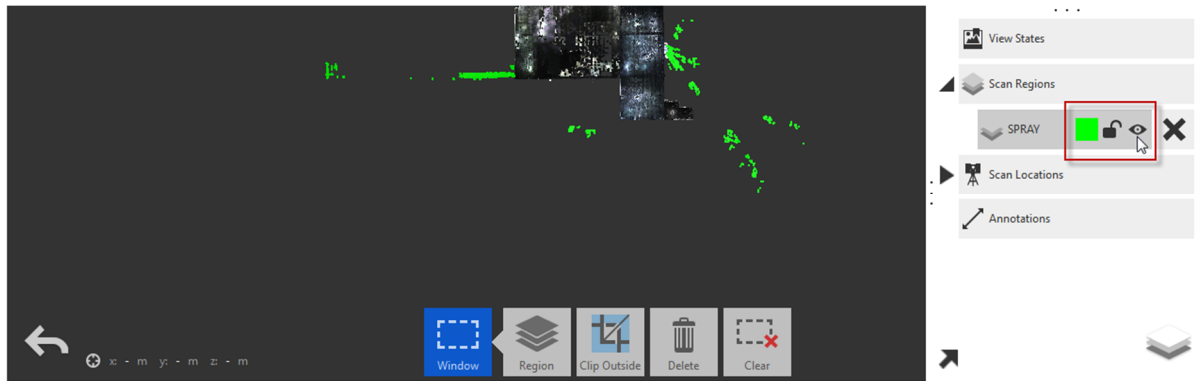
**Figure 7: New region**

**Figure 8: Hiding a region**

You will then be able to turn the region off by clicking the eye icon as shown in Figure 8.

Once the spray points are no longer visible, you can select the area of the building that you want to export into a separate file. Note: You will want to draw your selection window slightly larger than the area you wish to capture. This overlap (Figure 9) ensures that no points will be lost between areas in the process of editing the files.
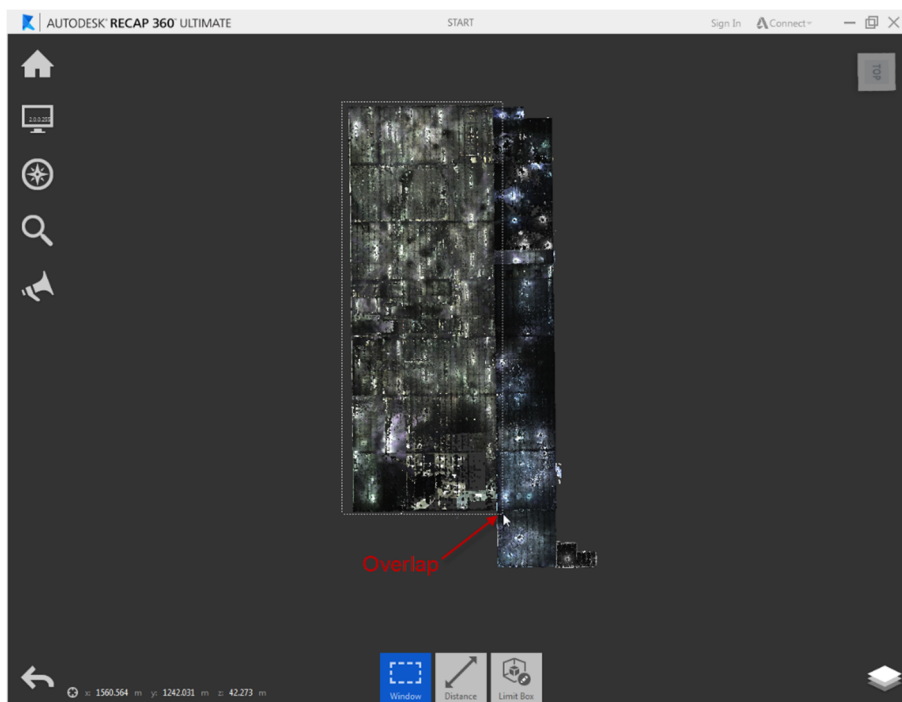


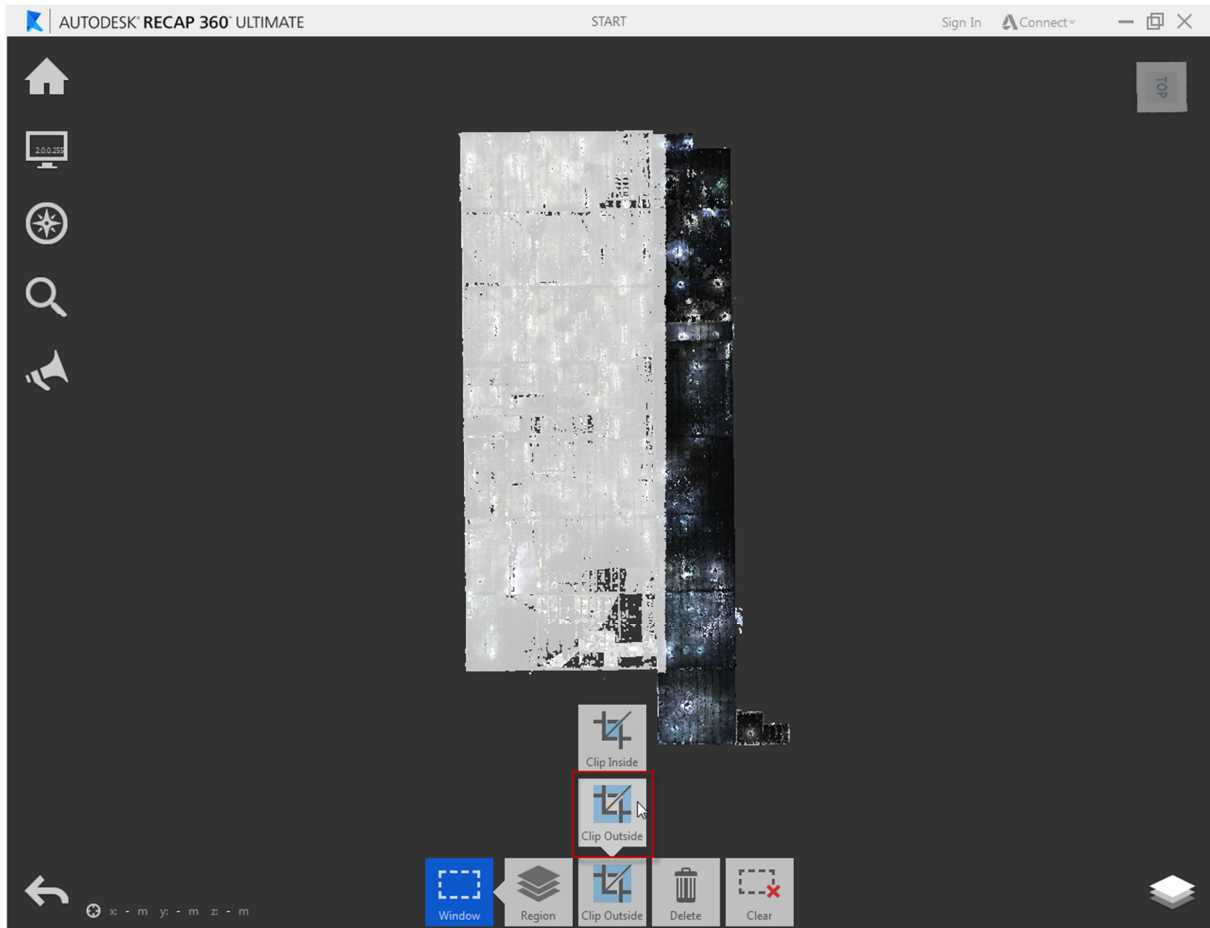**Figure 9: Selecting an area**

**Figure 10: Clipping points outside selection**

After selecting the necessary points (again, multiple selections can be made with the SHIFT key – you may also want to use the Fence selection tool for areas of the building that are not rectangular), you will want to hide all other points by clicking the "Clip Outside" button (Figure 10).

Now that only the points you want to export is visible, you can go to the top menu and click the export button (Figure 11). This will display a Save As dialogue (Figure 12) box where you can select the file type and the name of the file. For this step you will want to choose an .RCP file type and name the file following this format: P-LIDR-AREA. This will auto-generate a support folder that will contain the new .RCS file.
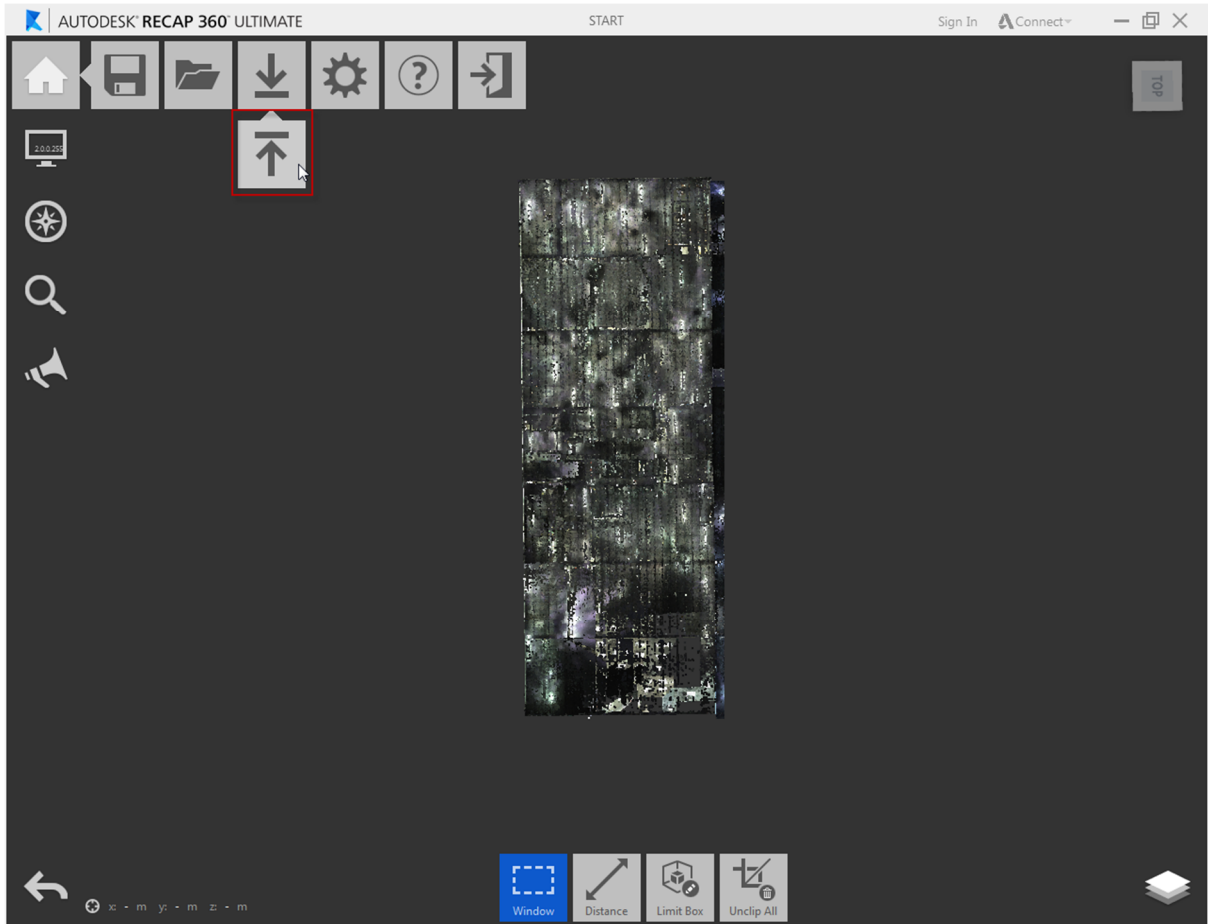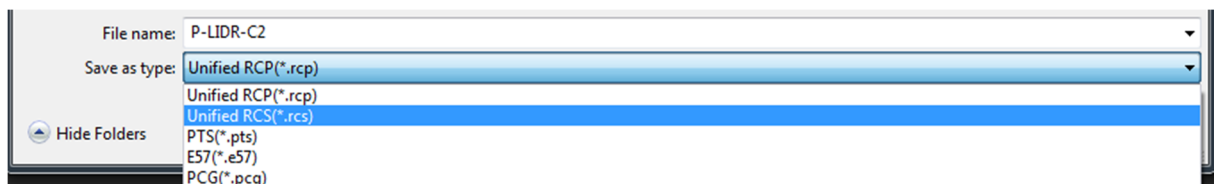


**Figure 12: Exporting an area**



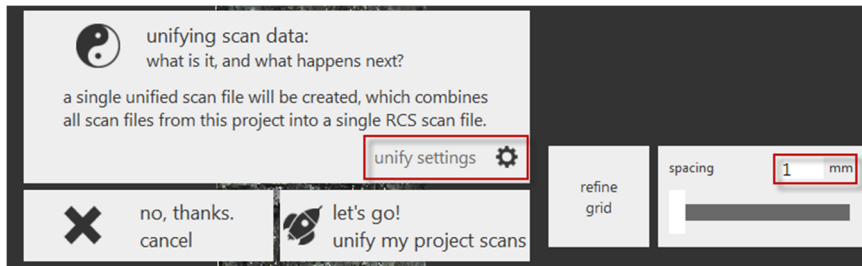**Figure 11: Selecting file name and file type**

**Figure 13: Unify settings dialogue box**

The "unify settings" for most exports should be set to 1 mm. (For roofs and floors set to 30mm). Essentially, the unify settings will eliminate any duplicate points within the specified distance.

After the unify settings are correct, click "let's go!" to start the export. Depending on the size and complexity of the file, the export may take from five minutes to multiple hours (if an export takes longer than two hours, try some of the tips to reduce export time found in the file breakdown appendix).

After the export has finished, you can click "Unclip All" to unhide the previously hidden points (Figure 14). This will allow you to select and export other areas by following the same steps.
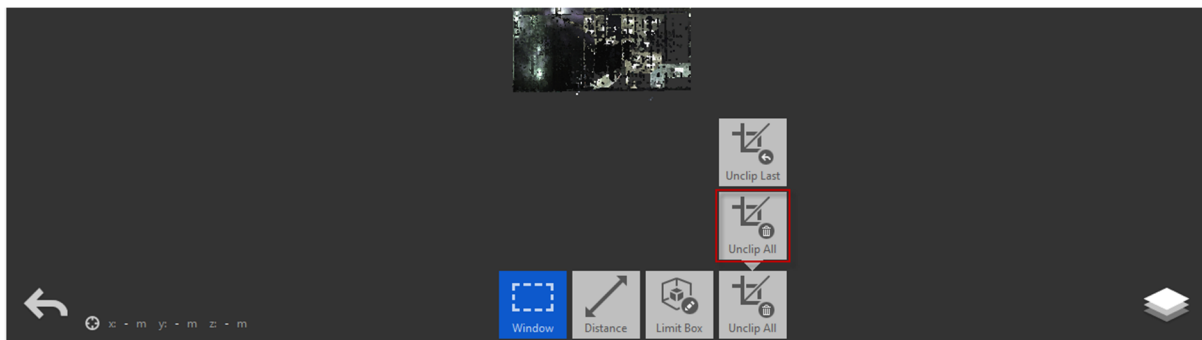


**Figure 14: Unclipping points**

## 4. Breaking areas into components

After exporting all of the individual areas you will have new data files containing just the points from those areas, which can be broken down into components (i.e. equipment, structure, walls, etc.).

If in the previous steps you exported to an .RCP file, then you can simply open the project file and begin from there. However, if you exported to an .RCS file, you will need to set up a new ReCap project (this can be done from the ReCap home screen or by double clicking the .RCS file, which will then prompt you to create a project).

In breaking out the components, it is typically best to start with the roof and floors. ReCap has a selection feature, "Plane," (Figure 15) that allows for easy selection of these items.
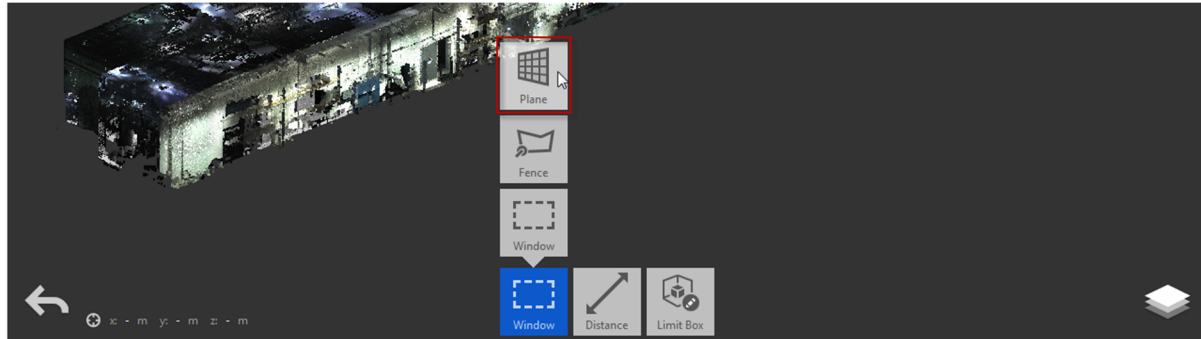


Figure 15: Plane selection tool

To select the roof with the Plane tool, choose individual points of the surface of the roof. ReCap will automatically select all points that lie within the same plane. Use the "Plane Depth" meter (Figure 16) to specify the distance to either side of the plane that points will be selection. The default setting of 50 mm is generally adequate, but the plan may need to be adjusted to capture the entire roof.

After the selection has been made it is a good idea to check that there are no unintentionally selected points (you may need to turn on perspective mode in order to do this). Try to capture the roof without cutting too deeply into the underlying structure, which will be set on a separate region.
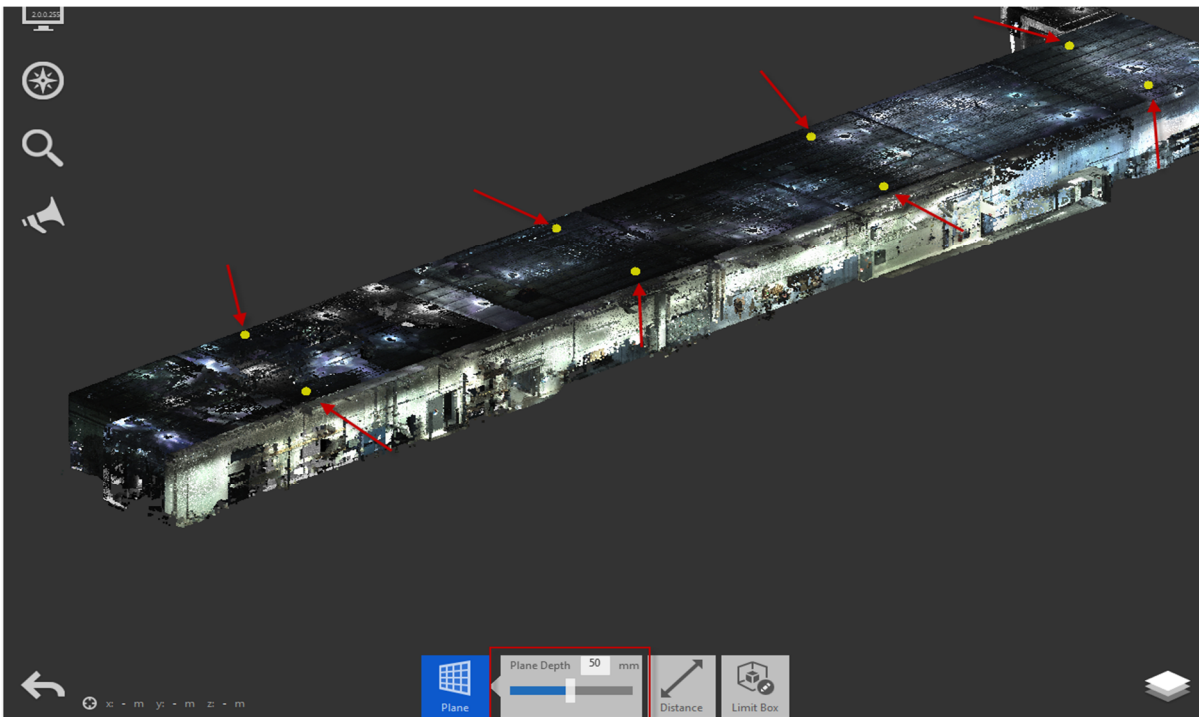


Figure 16: Selecting points on a plane

After your selection is complete, move your mouse over the "Region" button at the bottom of the screen and click the "New Region" button that appears. The "Region name" dialogue box will appear (Figure 17). Type in "ROOF" and click okay, and the selected points will be added to the region.

After the selected points have been assigned to the region, you can repeat the same process to select the floor slab (Tip: You can generally select the floor with a smaller plane depth, as it will be more uniform).
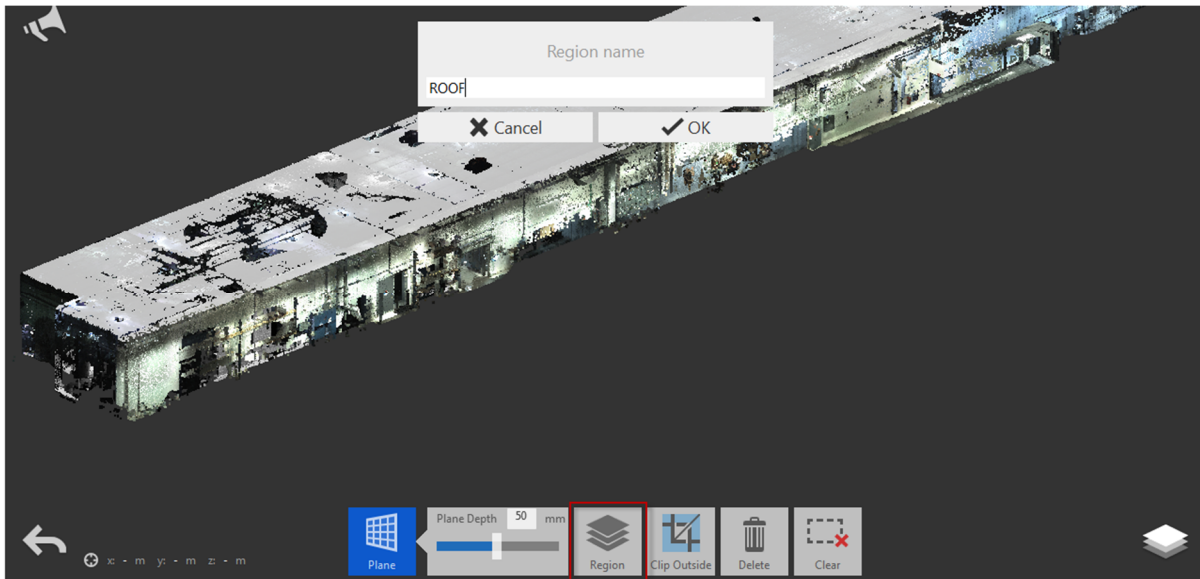


Figure 17: Assigning selected points to a region

After the roof and floors have been put on their own regions, you will want to hide them before selecting the walls (Figure 18). This can be done by opening the Project Navigator (lower right hand of your screen), expanding the regions, and clicking the eye icon

After these regions are hidden, you can begin selecting the walls. You will want to do this from an orthographic top view, as in (Figure 19). The walls can be selected using the "Fence" selection option. Again, if you cannot select all the walls at once, you can hold the SHIFT key to make multiple selections.

The selection for the walls should be drawn slightly larger than necessary to capture the wall points. This will allow for any piping, conduit, etc. attached to the wall to be selected as well.
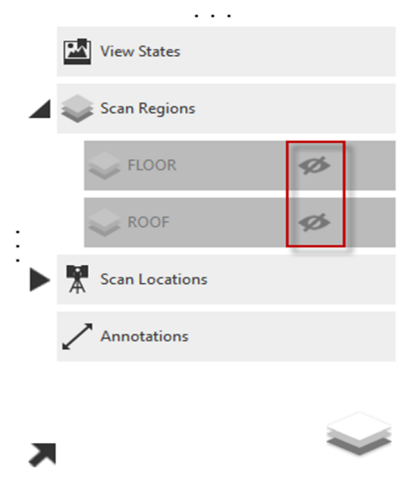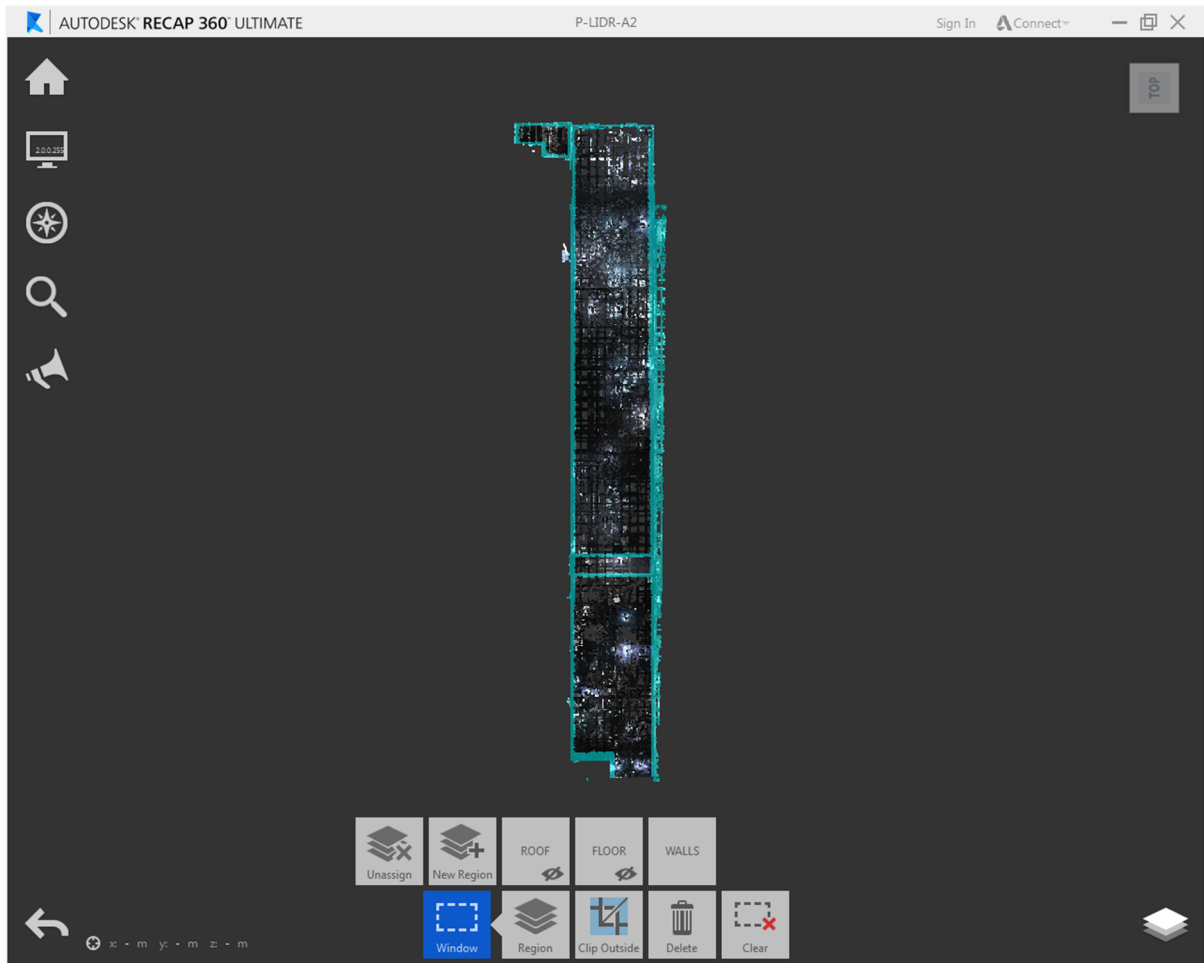


Figure 18: Hide regions

**Figure 19: Selecting the walls**

After you have created the ROOF, FLOOR, and WALLS, regions, you can export the remaining points to a new file that will be further broken down (it is not recommended to try to break the pieces down any further within the current file, as adding more regions will significantly affect ReCap's performance and speed). To do this, hide all of the regions you have created and click export from the top menu (Figure 20). When prompted to select the file name and file type, name the file

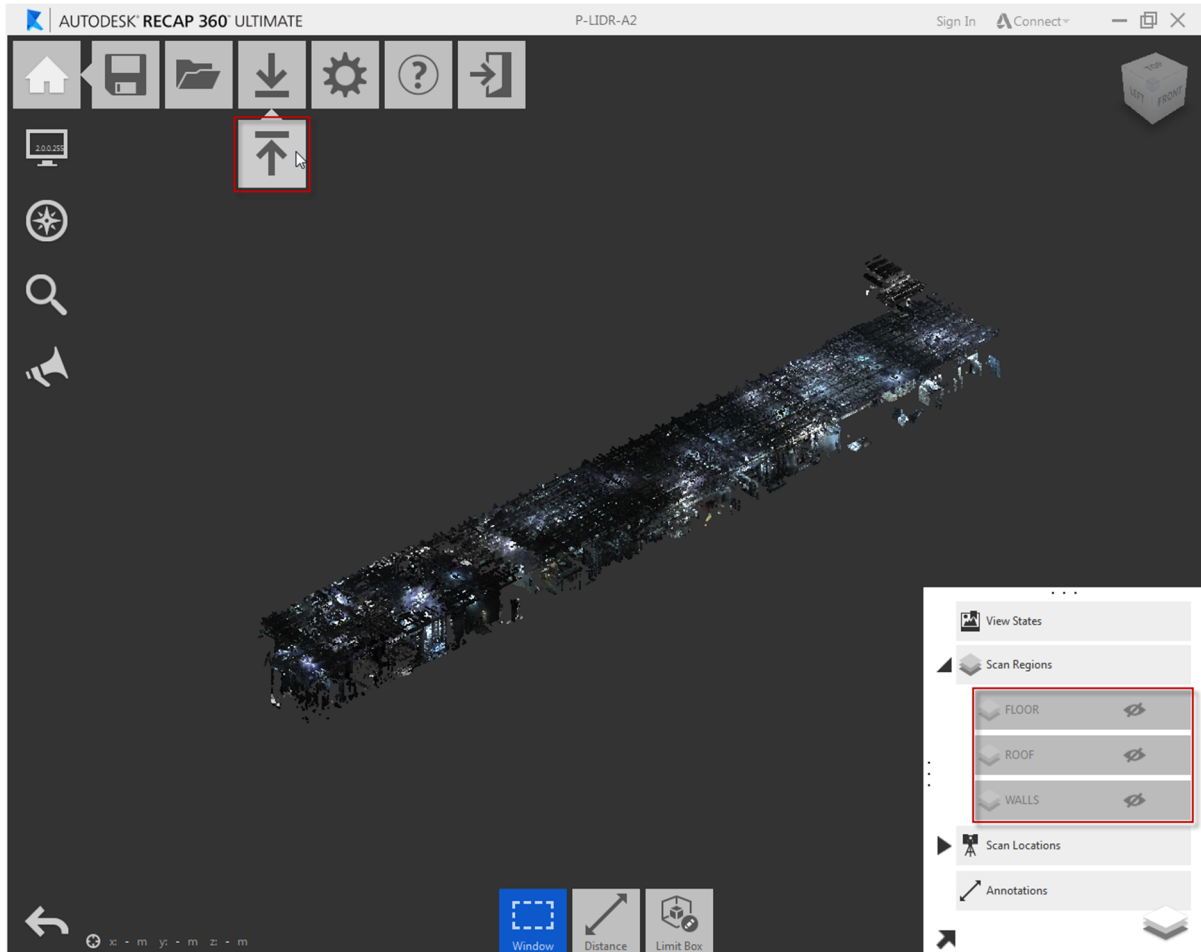 "P-LIDR-[AREA]-OTHER" and choose the .RCP file type.

Figure 20: Export remaining points

After you have exported the remaining points, select it and put it on its own region titled "OTHER." You can then begin exporting the other regions by hiding all of the regions other than the one you wish to export (Figure 21).

These regions should each be exported to their own .RCS file and named P-LIDR-[AREA]-[REGION]. Those files are the completed stage which will be placed in the project reference folder on the (P:) drive.
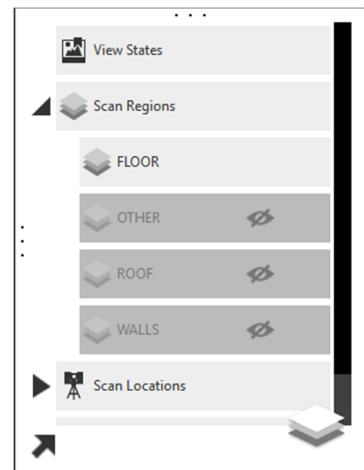


Figure 21: Isolating regions

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**5. File breakup Appendix**

a) *Improving file performance and reducing export time*

Point cloud files contain a lot of data, and as such tend to have very large file sizes. These large files can bog down your computer as you try to work in them. When you select/region/clip points within a file, the performance of ReCap starts to slow down significantly, and export times increase exponentially. Here are a few tips to keep in mind to prevent files from becoming unworkably slow:

(1) <u>Export often</u> – it may seem counter-productive, but exporting frequently, even if you aren't finished working on a file, is one of the best ways to keep performance steady. Exports will take minutes instead of hours, and the files will be much easier to work in.

(2) <u>Don't "over-region"</u> – creating too many regions will negatively affect your file. This is why it is recommended to break regions out piece by piece, rather than all in the same file. As an example, one file that had eight regions with data in them only reached 3% after twenty-four hours of exporting.

(3) <u>Be patient</u> – Sometimes point cloud files are just going to be slow and you have to manage it as part of the process. Find other tasks you can do while exports are running the background, or access a remote desktop to continue working in ReCap while an export is going (covered in the next section). Also keep in mind that exports may not take as long as they are appearing to. Generally once an export reaches about 36% it speeds up significantly.

b) *Making effective use of a remote desktop for point cloud editing*

One way to increase your efficiency while you are editing point cloud files in ReCap is to use a remote desktop in tandem with your own computer. If you do not have access to a remote desktop, contact your project technology coordinator and helpdesk to facilitate access. Here are some methods to follow when using a remote desktop for point cloud editing:

(1) <u>Save before exporting</u> – Saving the file you are working in on your main computer before you begin exporting pieces of it allows you to copy it to a remote desktop, where you can continue working or run a second export. A couple of notes on this:

(i) Copy *both* the .RCP file and the associated support folder. You won't be able to work in the project without the underlying data.

(ii) Export a different region within the file. Consider using the remote desktop for larger exports that you can just let sit.

(2) <u>Work on multiple areas at once</u> – Another advantage of splitting files out often is that you can have two different files to work in on your personal computer and the remote desktop (e.g. you could be working on Area A on one computer and Area B on the other <u>or</u> you could run exports for Area A roof, floor, and walls on one computer while

running exports for Area A equipment and structure on the other.

    (3) <u>Use when necessary</u> – Don't feel like you have to be jumping between desktops if your exports are going quickly and you can't keep up and stay organized between the two computers. The remote desktop is for efficiency; only use it when it is efficient.

c) *Working on your (C:) drive instead of network drives*

You should <u>never</u> try to edit files located on a network drive using ReCap, as you will slow down an already memory and hard disk intensive process. Instead, copy the files to a location on your (C:) drive, and copy the completed files to the P:\ after you have finished working on them.

d) *Making changes in files that have already been referenced into other programs*

Completed files stored within a reference folder in the project's location on the (P:) drive. If these files are in use in other programs, you will not be able to overwrite them. To get the files replaced, use the following progression.

    (i) Copy the files to your computer.

    (ii) Make the necessary changes and export to a new file, replacing the original on your personal (C:) drive.

    (iii) Create a folder inside the (P:) drive reference folder called "Temp."

    (iv) Copy the file into the Temp folder and notify the project team member responsible for distributing files across offices. They will overwrite the file during off-hours when no one is using it.

e) *Eliminating random points from point cloud files*

Occasionally point clouds will contain random points that are a long distance away from the main building, and are not visible to select and remove within recap. However, these points will show up within other programs and can hurt their performance. Follow these steps to remove random points that appear in other programs:

    (i) Isolate the effected files (this is done by selected the random points within the program and seeing which linked files are selected)

    (ii) Copy the effected files from the (P:) drive to your computer (follow steps in the previous section)

    (iii) Open the file in ReCap, draw a selection box around the visible points

    (iv) Click "Clip Outside" and re-export.

f) *As part of the planning process of scanning your project you need to pay attention to how the*

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*data will be broken apart based on your 2D sheet breakup. This is a critical and most often overlooked piece to a laser scanning project. This allows the end users to turn on and off the information when needed and increases the opening time of the design models.*

Review the sheet breakdown for the project and give this breakdown to your scanning vendor. Once scanning is complete they will then deliver files per the sheet breakdown.

(i) Specify when the vendor breaks up the files per sheet that there is 3' of scan overlap. Generally a column line is a typical reference line for model breakup.



Red boxes are sheets
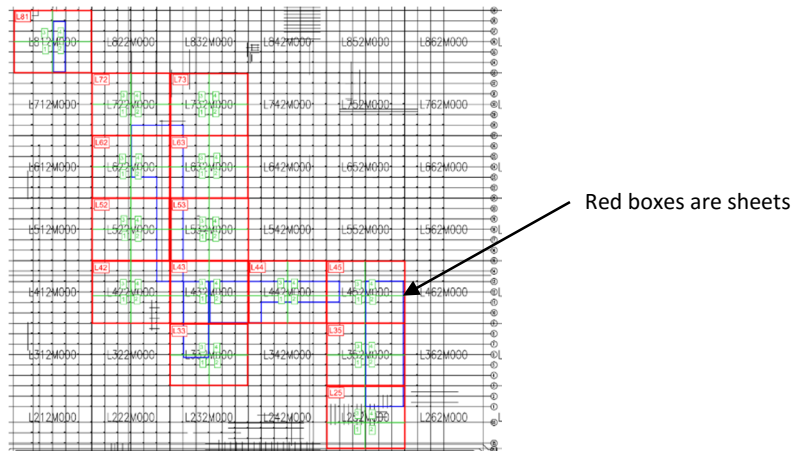
g) *Once the files are received from the scanning vendor per breakout in step 1 we can begin to break up the scans into smaller sections per project scope. Project example: all equipment in the factory was to be demolished, including the floor slab. We also removed the Roof deck for two reasons.*

(i) The roof deck is a solid surface like the floor, there are millions of points which make up this surface. Making it very dense and also a large portion of the file size.

(ii) The roof deck also blocks the view when we create 2D plans of everything below it. While you can use crop regions in Revit or AutoCAD, these generally slow down the performance of the design models.

(iii) In the below image there are four sections, "Truss Space" was exported at 1mm, while the others were exported at 10mm. This was done since the critical information was in the Truss Space, whereas all other data was good enough with higher compression and was rarely every referenced throughout the course of a project.
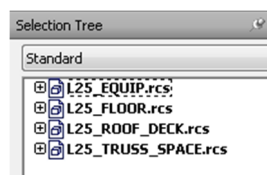
(iv) Project example: when the point cloud files were segmented based on the scope of work they comprised of 7GB of data, whereas the non-segmented RCS files amounted to 45GB of data or 85% more data.  This example was roughly 10% of our entire project area and the results were similar throughout all areas of the facility.

h) *If there are systems to be demolished, IE fire protection, lighting, cable tray, etc. we have removed those points from the model.*

(i) This will reduce the amount of necessary data to copy from offices.

(ii) This will simplify clash results.

(iii) Potential revenue provider for A/E's to get more fee during design phase to edit point clouds and provide to the entire construction team.

(iv) The blue objects in the image below are a fire protection line that was to be demolished after construction was complete.  This item was removed from the scan to remain and was exported to its own RCS file for construction sequencing and clash
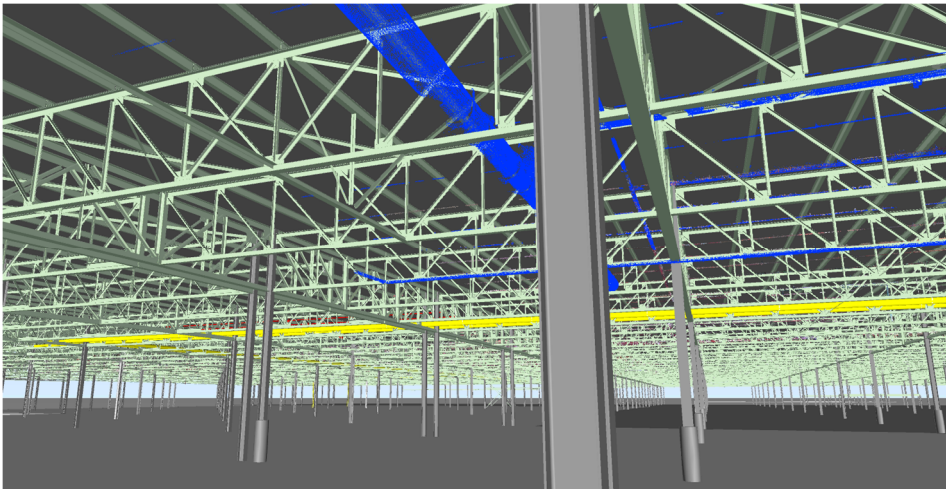
## Reviewing Demolition scope

Since we have spent time removing points from the laser scans that correlate to the demolition scope of work we need to have a process in order to back check we have not removed too much or missed some areas. Back checking is not only a good QA/QC process but also will provide peace of mind that we have removed all work and are giving the best routing conditions in the field for all new construction. For this process you will need three applications besides the authoring software that created the demo drawings: Autodesk ReCap and Autodesk Navisworks Simulate or Manage and AutoCAD. Navisworks will act as the glue to review the exports of the Demo sheets and track progress. AutoCAD will act as the drafting tool to edit the exported 2D Demo sheets. Autodesk ReCap will edit the point clouds in the previous methods shown above.

1. In your authoring software export the demolitions sheets as their own DWG file.

2. In AutoCAD attach each of the sheets that corresponded to a particular discipline.

3. You will need to explode all of the hatching in AutoCAD. Navisworks only reads 2D line work and hatch does not show up. Also make sure to clean up any errant notes, dimensions or line work that is not required to overlay the point cloud with the demo drawings.

4. Save the file in AutoCAD as a XXX demo master.DWG, where the XXX stands for the particular discipline

    a. This is done so that is we need to re-export a particular sheet because of a bulletin it is simple to remove in the master. This also helps with isolating particular files for review in Navisworks.

5. In Navisworks create a new NWF, this NWF will be only for review of demo point cloud removal and not your typical 3D coordination.

6. Next attach the point clouds that were exported to be "Existing to Remain".
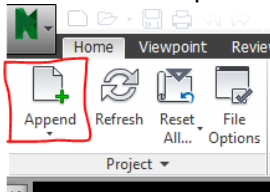


7. Next attach the XXX demo master.DWG files. Your selection tree in Navisworks should begin to look like the below image.
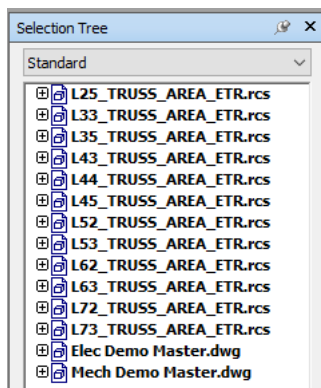
8. Now you can review if there is point cloud information that is in a hatched area.

    a. To help organize the data we broke the viewpoints into several folders.
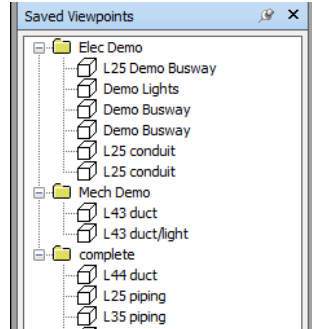


9. If there is an area that needs to have additional removal of points we used the markups and comments to export a report for each employee.  The little circles in the image below are ducts that were missed by the original designer when removing points within Autodesk ReCap.
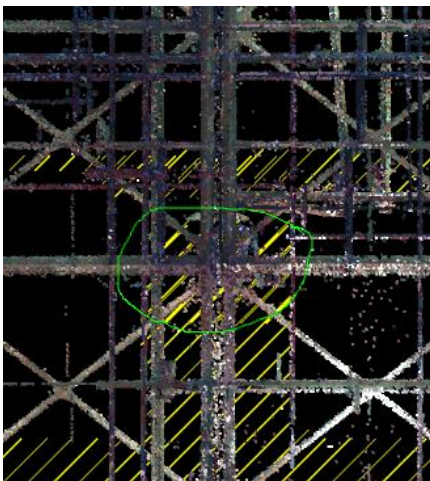


10. Once the work was complete we re-imported the "ETR" point clouds and reviewed each of the comments.  All resolved comments went to the completed folder while the active comments remained in their current location.

## File Naming Convention

While this may seem like an obvious fact but having a standard file naming convention for point clouds should be in place.  That will take the mystery of what each file contains.  We took our naming convention from the NCS (National CAD Standard) playbook.  P-LIDR-A01-ROOF

The first group is the status of the scan **P**-LIDR-A01-ROOF.

P – Pre-demo point clouds, these are the scans done before a project with only the broken up items mentioned in prior steps.

D – Demolished items from the point cloud.

E – Existing to remain data that remains after demolished items are removed from the **P** series point cloud.

A – As-built scan data acquired post construction.

The second group is the type of scan P-**LIDR**-A01-ROOF.  We find it important to denote the type of scan because it can quickly tell you the level of accuracy contained in the RCS file.

LIDR – LiDAR type scan

PHGM – Photogrammetry scan

The third group is the functional area of the facility P-LIDR-**A01**-ROOF.  This is generally free flowing to match either company or client guidelines for key map or sheet breakdown.  For this project A01 stood for Area A (Key map) and 01 stood for first floor.

The fourth group is the contents of the RCS file P-LIDR-A01-**ROOF**.  This can change based on the scope of the project and how you break up data.  Some examples, ROOF, FLOR, EQPM, TRUS, HVAC.


## How to copy information across offices
*You will need to have an understanding in networking topology, server/computer hardware, server tasks and batch files.  Find your IT person's favorite food/drink and bribery will be necessary.*

A key to getting information to each office is a robust network.  Our bandwidth varies between size of the office and the type of work they do, for example we have 50MBS MPLS line between some offices but have as low as 5MBS MPLS to others.  The key is we are on an optimized MPLS line rather than a traditional T1 or other internet based network infrastructure.

We rely on Riverbed technology to help streamline traffic between offices.  With Point clouds these files are a one-time transaction between offices so Riverbeds do not have an impact per se with copying point clouds.  The Riverbed will compress all other data that is being transferred constantly between offices resulting in more available bandwidth between offices.  To get the data from office to office we have two options depending on their connection speed.

1. Create a batch file (robocopy see below example) with a windows server task to work during off hours.  This will allow max bandwidth consumption for faster file transfer without negatively effecting production during the day.  The task will stop at 6AM and restart at 6PM until all data is copied.
2. Send an external HDD overnight to the office and copy data to their local Point cloud drive.

For projects where point clouds are <50GB we rely on the data being stored only on a server.  While most networks operate on a 1GB network, it should be noted to never work on Wi-Fi with point clouds since you will be operating at a best 1/3 max bandwidth from a hard wire connection.  The fastest data transfer rates that are achievable from a 1GB network connection are ~100MBS from server to client.  To achieve our max throughput when accessing point clouds from a network location our storage device is a Dell MD3000 in a RAID6 with an onboard SCSI RAID Array.

For projects where point clouds are >50GB we rely on a 2nd SSD to store the point clouds.  This drive has the same letter mapped as our network point cloud storage in the case that a person is assigned to work

on the project temporarily and the references for all applications do not need to be changed.  Each person assigned to those large projects is given a batch file to run a copy routine to update the data from the network location.  When updates are made to point cloud files on the network each user will then run the file to update their local drives.  The batch file utilizes Windows ROBOCOPY functions for faster file copies.

A sample snippet for a robocopy job:

```
echo ***This will mirror all files from the PointCloud Server***
echo ***All files updated locally will be deleted and not copied to the server***
set robo=/e /mir /r:1 /np /ns
SET /P ANSWER=Do you want to continue (Y/N)?
if /i {%ANSWER%}=={y} (goto :yes)
if /i {%ANSWER%}=={yes} (goto :yes)
goto :no
:yes
robocopy "source path" "dest path" %robo%
:no
echo ***You pressed no***
pause
exit /b 0
```

## Working remotely in Autodesk ReCap

Autodesk ReCap depending on the graphics card and version of the application may not appear to work while using Remote Desktop, refer to below image when starting ReCap.
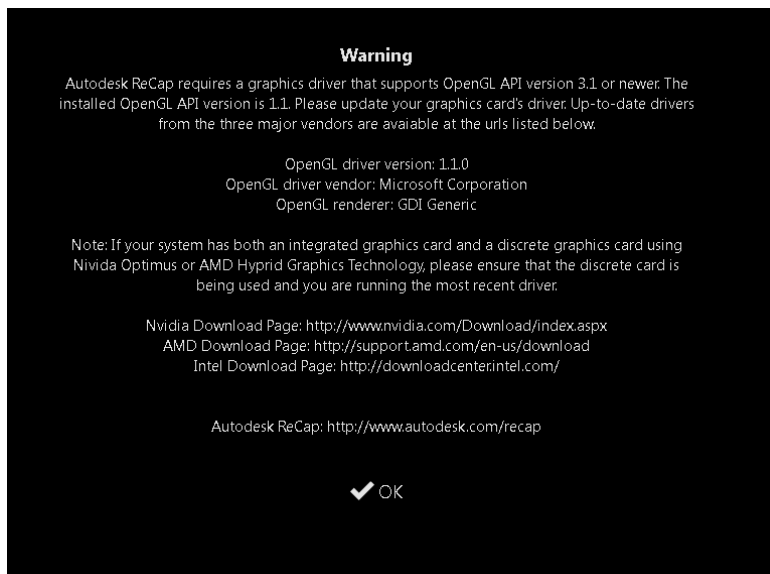


To be able to access Autodesk ReCap from a Remote desktop session you will need to run a batch file that will terminate the remote desktop session, then start ReCap.  Once the batch file has run, you will need to re-logon to the desktop.

Contents of the BAT file.
tscon 2 /dest:console
cd "C:\program Files\Autodesk\Autodesk Recap"
start Recap.exe

1. Open Notepad, or other text based editor and copy the above contents into the editor.
2. Save the file on a network so that you can run from multiple computers that has ReCap installed.
   a. Note: You may need to change the value of "TSCON 2" to a 1, or 3. It depends on how many active remote sessions are running from your computer.
3. Double click the BAT file while in a remote session with a computer that has ReCap installed.

## Cleaning up the mess on your C:\

Autodesk ReCap will begin to bloat your computer's hard drive after you have edited multiple ReCap projects or linked ReCap data to design software. We have added code to our logon script that cleans out the "C:\ProgramData\Autodesk\RECAP" at each logon. Below are several screen captures showing that after a few short months I had over 12GB of bloat on my local HDD. The contents are an auto save of the RCP file, an XML file for backup purposes and the 2 thumbnails of the saved RCP file.

## Hardware recommendations

Editing ReCap

- HDD: 500GB Samsung Pro Series SSD
- RAM: 8-16GB, not a critical component to ReCap for doing editing (processing scan data may require higher amounts)
- CPU: 3.0Ghz, 3.4+Ghz preferred.  Should utilize a processor generation no older than 3 years old.
- Video Card: NVIDIA Quadro K600

Modeling software

- HDD: 500GB Samsung Pro Series SSD
- RAM: 24-32GB
- CPU: 3.0Ghz, 3.4+Ghz preferred.  Should utilize a processor generation no older than 3 years old.
- Video Card: NVIDIA Quadro K2000

## Defining a Scanning Spec

Refer to [USIBD](#) for a great set of templates, for those defining their own or would like a hybrid the below is keys that you would need to define.

- Define processes and methods for surveying/benchmarks, scanning, colorizing and the minimum models of terrestrial laser scanners to do your work.  This is a very powerful method to make sure that you don't get anyone that can rent a scanner and call themselves a laser scanning service provider.  There are a lot of people that have also purchased bargain deal scanners that are 6-7 years old and can only capture a fraction of the data new scanners can capture in the same time which will add to their field time.  Additionally these older scanners only support black and white and sometimes do not capture RealViews which are a key to project success for senior staff.
- Project scope, this is critical in defining a successful project.  Otherwise the vendor may only quote enough time to get a scan of the area but all detail is missed.

     **Bad scope write-up:**  Area to be scanned is to support the expansion of a MFG facility.  Scanning will need to be completed for all 10 bays along the proposed addition and 2 bays deep.

     **Good scope write-up**: The purpose of this project is to expand the manufacturing area of an existing facility where all piping, HVAC. Electrical utilities will be extended from the current facility.  Areas to be scanned will be 10 bays along the existing wall to be demolished and the 2 bays deep.  Additional bays of scanning may be required when on site with scanning team based on where the A/E may be tying into the existing utilities.  All existing utilities along the existing wall to be demolished will need high detail in order for A/E to plan demolition plans and construction sequence for plant shutdown activities.  Columns along the existing walls will also need to have 3 sides covered in order for engineer to determine design loading for expansion.

- Send 2D documents of the project scope highlighting critical tie in points.  Supplement 2D files with pictures.  Use your smartphone, Microsoft Photosynth is an excellent tool.
- Use Google Earth to create a simplified point cloud
     - For a good start on this process view [this](#) website for all technical content.
- Use Google Maps to measure a perimeter of your project site and convey critical areas to scanning vendor.
     1. In Google Maps zoom into your site, and ensure that Satellite is enabled.
     2. Right click on a point of the map that is the outer perimeter of your scanning area and select

- Scanning service requested, pre demo, post demo, post construction, slab flatness, point layout, site survey, other.
- Scanning area; interior, exterior, roof, above ceiling grid, etc.
- Declare safety requirements, or training required, this is additional site time that the scanning vendor needs to be paid for.
- Deliverables
    - File formats (important to request raw data in case you need to reimport)
    - Delivery method, external HDD, Dropbox, FTP, etc.
- File Breakdowns, how do you want the data to be broken up and to what decimation factor.  Do you want the point clouds to be aligned to a volume that corresponds with sheet breakdown in design applications or to align to logical operation areas of a facility?  Also set the required decimation of the scan to be received.  Once we had a vendor send us a scan for a very small mechanical space a decimation of 10mm, and a lot of small piping was missing.  We caught the error very quickly and they re-exported the files and sent in ReCap.  This is why we now ask for the PTX/FLS data to be sent along with the processed RCS data.