

Monitoring Borrow Pit Volumes

Subject: Using point clouds over time to analyze the change in volume of borrow pits.
Software: LP360 for Windows, LP360 for ArcGIS, Standard edition
Version: 2015.1.76.0 or later
Date: 14 January 2016

Introduction:

A borrow pit is an area where soil and/or rock is removed, added or both for use at some other location (for example, in obtaining fill dirt for highway construction projects). The arrangements for borrow pits usually requires auditing the amount of material change in the pit (volumetric change).

A point cloud derived from dense image matching (DIM) from imagery collected by a small Unmanned Aerial System (sUAS) is ideal for this application. The sUAS is flown prior to the start of operations to collect a baseline. The sUAS is reflown each time a new borrow computation is desired. This method is economical and non-disruptive (since the flight time for most borrow pits will be less than ½ hour).

Stating the obvious but any elevation bias errors will lead to a big error in the volume change computations. A 6" vertical error is about 800 cubic yards per acre.

We use surface to surface in volumetrics to compute the volume change of a borrow pit. We use negative volume to mean the volume of the pit decreased (net removal of material), positive volume means a net gain of material.

Let's suppose I base line the pit in NOV and then do the first computation from data collected in DEC.

Thus I have the original LAS data labeled NOV and the December flight on a separate layer in LP360 labeled DEC.

Set the Surface Generation method for both Base and Hull to "Use LAS Points"

Set the Base as the original baseline point cloud (NOV)

Set the Hull as the comparison point cloud (DEC)

Set the computation method to "Cut – Fill"

Draw or import a base polygon to denote the borrow pit area. Note that this polygon is used in 2D fashion only so no care need be taken in the Z aspect of this.



Set the Hull polygon checkbox to “Use Base Polygon”

If you want to use the cut/fill image for analysis (note that when doing borrow pits as opposed to volumes, the below logic feels reversed!)

The Cut color will indicate where volumes have Increased.

The Fill color will indicate where Volumes have Decreased.

The image will be transparent where the surface difference is less than “Epsilon”

The Resultant Volume will provide the net volume change in the borrow pit (positive means there is more material in the pit in DEC than there was in NOV – material was added to the pit. Negative means material was removed from the pit – there is less material in DEC than there was in NOV).

Note that this works regardless of the change in topography of the borrow pit so long as all activity is contained within the base polygon.