

## User Manual

# 3GSM

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# VolumeCalculator



**User Manual  
for Version 5.0**

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*Subject to change without notice*

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## 1 Introduction

The software permits volume estimations from scaled 3D models in .jm3x file format. Three modes are available in the *VolumeCalculator*:

1. *Heap Mode - One Model*: Calculates the volume between a single 3D surface and a user-defined *Boundary Plane*. It is ideal for rapid assessment of material stockpiles or heaps from a single survey.
2. *Heap Mode - Two Models*: Calculates the volume between two superimposed 3D models (pre and post). It is an ideal tool for tracking material changes over the time.
3. *Underground Mode*: Generates watertight volume meshes between two trimmed 3D models. Purpose-built for underground excavations and tunnel analysis.

This user manual addresses all topics related to the *VolumeCalculator* i.e. installation, user interfaces, features and operations. Let us know if we can support you, and give us your valuable feedback. Only this way it remains possible to keep the system both, flexible enough for broad usage and sufficiently specific for your applications.

We wish you success with the *VolumeCalculator*.

The Team of 3GSM

Graz, August 2025

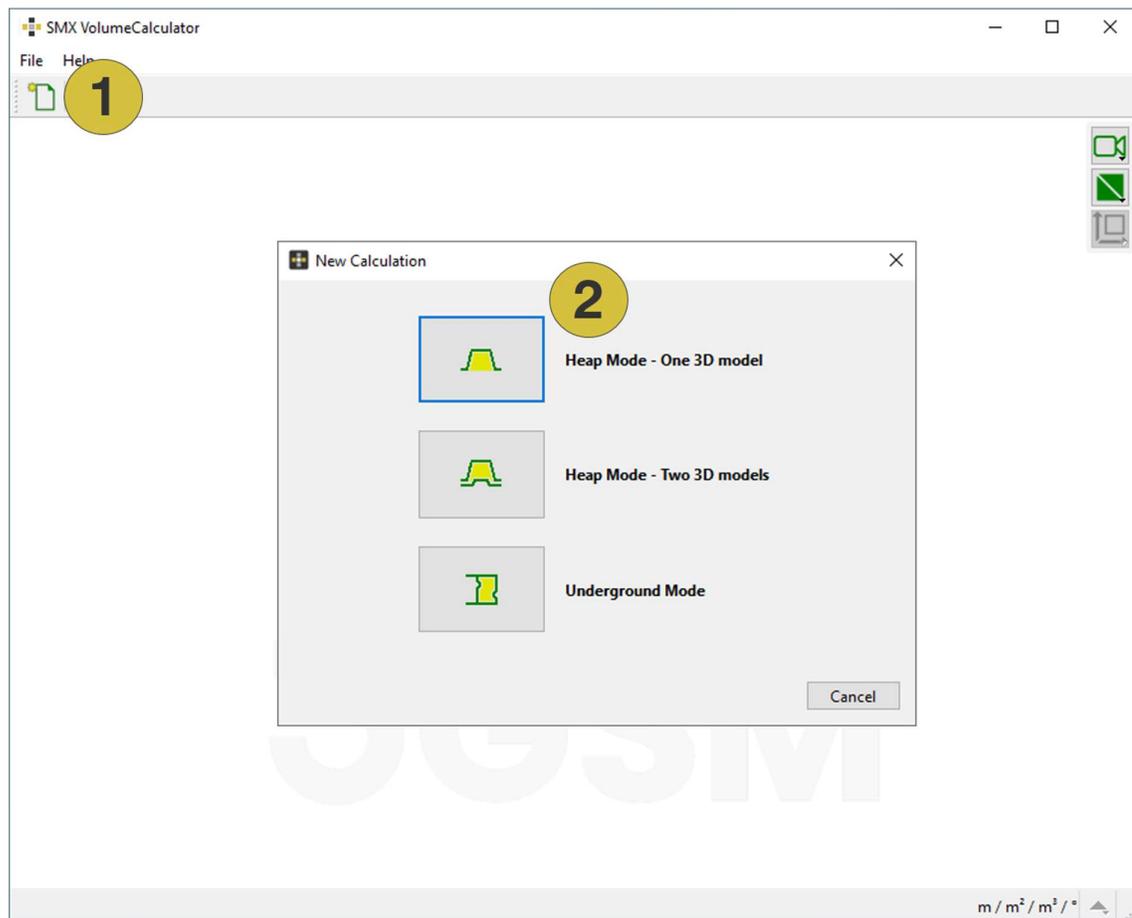
## 2 General

### Attention:

*VolumeCalculator* reads files exclusively in “.jm3x” file format. Models from previous versions in “.jm3” file format are not supported in the present version. Please note that “.jm3” files from previous versions can be converted into a “.jm3x” file via the *ModelEditor*. See corresponding user manual for further information.

### User interface

The user interface of the *VolumeCalculator* (Figure 1 and Figure 2) comprises the menu bar, toolbars, the view options and the 3D viewer.



1 New Calculation

2 Modes

Figure 1: Start interface of the VolumeCalculator - Selection of Mode

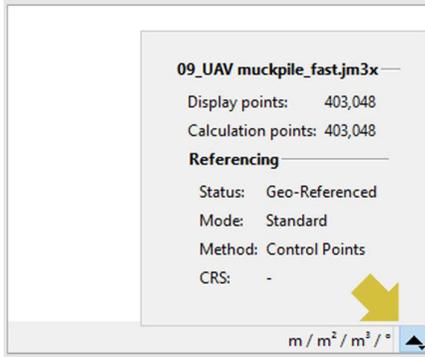


- 1 Menu bar
- 2 Toolbar
- 3 3D viewer
- 4 Tools pane
- 5 View options

Figure 2: User interface of the VolumeCalculator Heap Mode - Two 3D Models

**Hint:**

The unit of measurement is displayed on the right bottom of the user interface. The foldable dialog next to it displays information on the 3D model, i.e. geometry reproduction on the screen (adjustable via the Central Window Settings) and information on referencing and scaling.

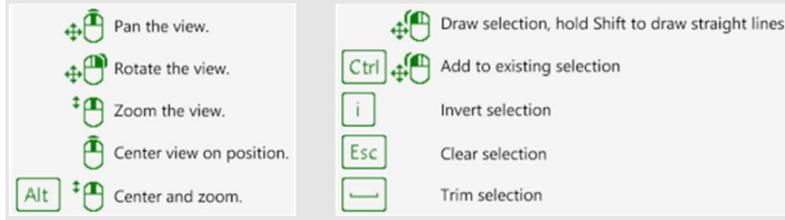


### 3 Features

This section describes the available functions of the *VolumeCalculator*.

#### Attention:

By pressing F1 on the keyboard tooltips for navigation as well as for editing are available in the 3D viewer. Examples:



#### 3.1 Toolbar of the 3D viewer

##### 3D View Options

*Move to Home Position*



Sets the viewer to its initial position

*View All*



Zooms out from the current view. Zooms to the previous view again

*Top Down View*



Orientates the 3D model from the camera view (top down)

*Auto Rotate (fixed or view)*



Rotates the 3D model from a fixed point (top down) or from the current point of view

*Projection type*



Toggles between perspective and orthographic projection

*Fullscreen*

Switches between the fullscreen display and the windowed display

**Mesh Draw Mode** *Draw as is*

The 3D topography is completely overlaid by the digital photograph

*Wireframe*

A triangulated red coloured point cloud is forming the topography

*Wireframe Overlay*

The 3D model and a red coloured overlay of the wireframe is forming the topography

*Points*

The point cloud of the scene shown

*Show Texture*

Displays the 3D model with texture in the viewer (shortcut key "Ctrl" T)

**3D View Visibility** *Show Axes*

Turns the co-ordinate axes on and off

*Show Bounding Box*

Turns the bounding box surrounding of the 3D model on and off

## 3.2 Navigation

**Mouse navigation***Pan View*

The middle mouse button is used to pan the 3D model

#### Rotate View



The right mouse button rotates the 3D model. Just keep the right button pressed and move the mouse around to see the 3D model rotating.

#### Zoom View



When turning the wheel of a mouse the 3D model is zoomed

#### Center View on Position



Centers to the current position

#### Center and Zoom



Pressing “Alt” and turn the mouse wheel centers the and zoom to the current position

### Keyboard navigation

- Rotation of the 3D model in a desired direction is performed with the corresponding arrow key “Left”, “Right”, “Up” or “Down”
- Straight motion is performed by pressing “Shift” simultaneously with the corresponding arrow key “Left”, “Right”, “Up” or “Down”
- Zooming is performed by pressing “Ctrl” simultaneously with the arrow key “Up” for zooming in and the arrow key “Down” for zooming out

### 3.3 Menu bar

The menu bar comprises two main menus – *File* and *Help*. The menu commands are accessible using the mouse cursor.

#### Menu File

<i>New Calculation</i>	Starts a new project
<i>Generate Screenshot</i>	Generates a user-defined screenshot
<i>Generate Report</i>	Writes a report directly to a “.pdf” file
<i>Reset User Interface</i>	Resets the layout to default

*Exit* Closes the program

### Menu Help

*User Manual* Opens the manual of the software component

*Units* Displays the units used by the software

*About Volume Calculator* Displays versions and release information of the software component

## 3.4 Toolbar

### Toolbar



#### *New Calculation*



Starts a new project

#### *Load 3D Models*



Loads 3D models (“.jm3x” files)

#### *Load Project*



Loads a project file (“.vol” file)

#### *Save Project*



Saves the volumes (“.vol” file)

#### *Save Project as*



Renames and saves the volumes (“.vol” file)

#### Undo



Revokes the previously executed commands step by step

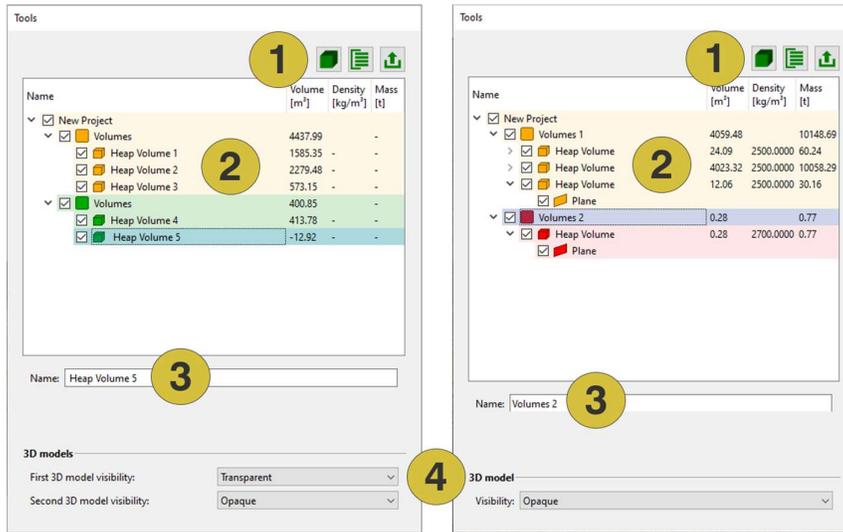
Redo



Redoes commands revoked by the “Undo” function step by step

### 3.5 Tools pane - Heap Modes

The *Tools* pane shown in Figure 3 provide features for the *Heap Mode* including the results displayed in the *Volume* list. In addition the visibility of the 3D model(s) can be adjusted.



- 1 Toolbar
- 2 Volumes list
- 3 Rename
- 4 Visibility of 3D model(s)

Figure 3: Left: Tools pane Heap Mode (Two Models). Right Tools pane Heap Mode (One Model)

New Heap Volume



Activates the features of the toolbar for defining a heap volume by a polygon

New Group



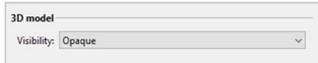
Adds a new group of volumes

Export



Exports heap volume data as “.obj” or “.dxf” files

**3D Models Heap Mode - One Model**



Changes the visibility of the 3D model on the screen

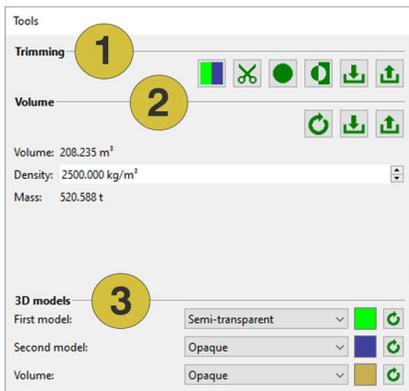
**Heap Mode - Two Models**



Changes the visibility of the first and second loaded 3D model on the screen

**3.6 Tools pane - Underground Mode**

The *Tools* pane shown in Figure 3 provide features for the *Underground Mode* including the result. In addition the visibility of the 3D models and the volume can be adjusted.



- 1 Toolbar
- 2 Result
- 3 Visibility and colour

Figure 4: Tools pane Underground Mode

**Trimming**

*Toggle Target*



Toggles between the target models to be trimmed, i.e. the first, the second, or both models at the same time

*Trim Model(s)*



Divides a point cloud (3D model) into two segments using a polygon

*Trim model(s) with Sphere*

Selects a group of points enclosed by a sphere

*Invert Selection*

Inverts the selection of points to delete

*Import Trim History*

Imports a trim process (".trim")

*Export Trim History*

Exports a trim process (".trim")

**Volume***Recalculate*

Start volume calculations

*Import Volume from OBJ*

Imports volume data from ".obj"

*Export Volume*

Exports volume data as ".obj" or ".dxf" file

*Volume, Density and Mass*

Volume:	209.309 m <sup>3</sup>
Density:	2500.000 kg/m <sup>3</sup> 
Mass:	523.272 t

### 3D Models

*Changes the visibility and colour of the first and second 3D model as well as the volume body*

3D models		
First model:	Opaque	 
Second model:	Opaque	 
Volume:	Opaque	 

## 4 Heap Mode - One 3D Model

The *Heap Mode - One 3D Model* features volume calculations between a 3D model and a *Boundary Plane*. The *Boundary Plane* is generated automatically by the software from the volume polygon drawn on the 3D model by the user. However, the position of the *Boundary Plane* can be modified interactively.

**Note:**

*Boundary Planes* are calculated for each individual volume.

### 4.1 Standard operation procedure

1. Select “*Heap Mode - One 3D Models*” after launching the *VolumeCalculator* (see Figure 1).
2. Load the 3D model one after the other by clicking the “*Load 3D Model*”  icon in the toolbar.
3. Define a heap volume by following procedure (see Figure 9):
  - a. Click in the “*New Heap Volume*”  in the *Tools* pane of use the short key “*H*”.
  - b. Define the boundary of the volume to be calculated on the 3D model by clicking the left mouse button. A polygonal line grows instantaneously. At least three points are required.
  - c. Confirm the boundary of the volume by a click on the “*Return*” button on the keyboard. The volume is calculated and appears coloured in the viewer whereas the results is available in *Volume* list in the *Tools* pane. Next to the volume the *Boundary Plane* is visualized in the 3D viewer as well as in the *Volume* list.
  - d. Optional, enter the rock density for weight calculations in the tree widget for volumes.

**Note:**

Invert the sign of calculated volumes by clicking “*Invert*” in the context menu of the *Volume*.

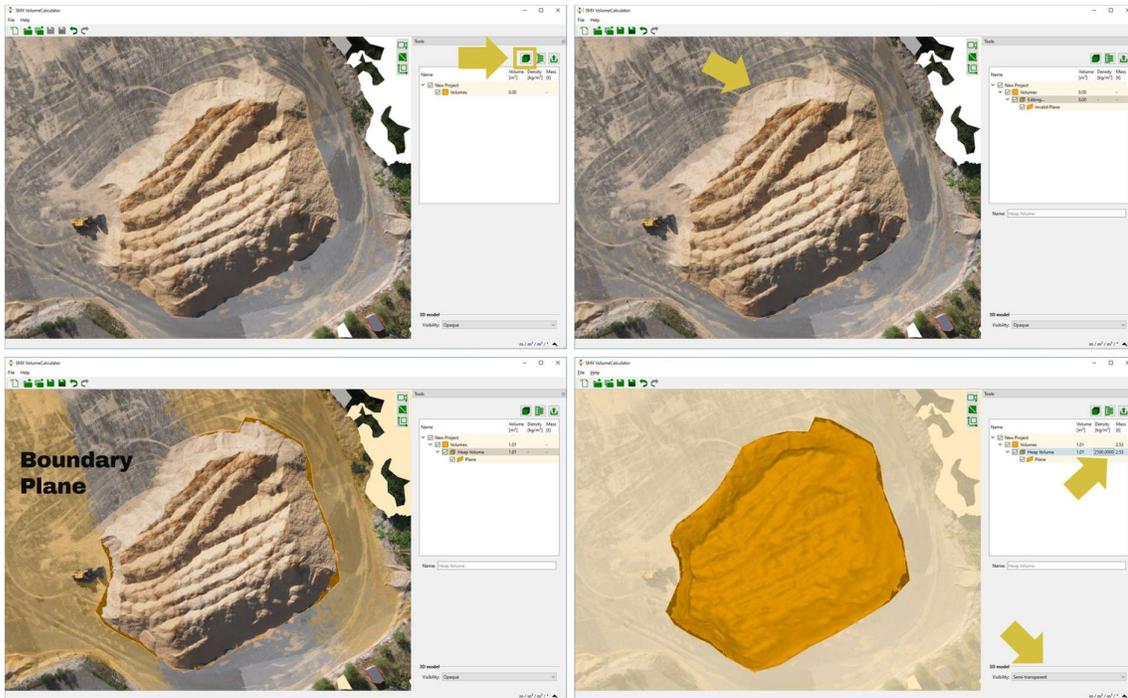


Figure 5: Top left: Top left: Activation of new heap volume. Top right: Definition of the boundary by drawing a polygon. Bottom left: Confirmation of the polygon. The defined volume body is coloured and the results is shown in the Tools pane. In addition the corresponding Boundary Plane is visualized in the viewer. Bottom right: Weight calculations require the input of the rock density in the tree widget. Adjustment of the 3D model visibility helps for a better visualization of the volume.

#### Hint:

A number of volumes in individual groups can be determined by repeating step 3 of the standard operation procedure (see Figure 10). Using the “Space” button instead of “Enter” starts a new volume calculation in the *Volume Group*.

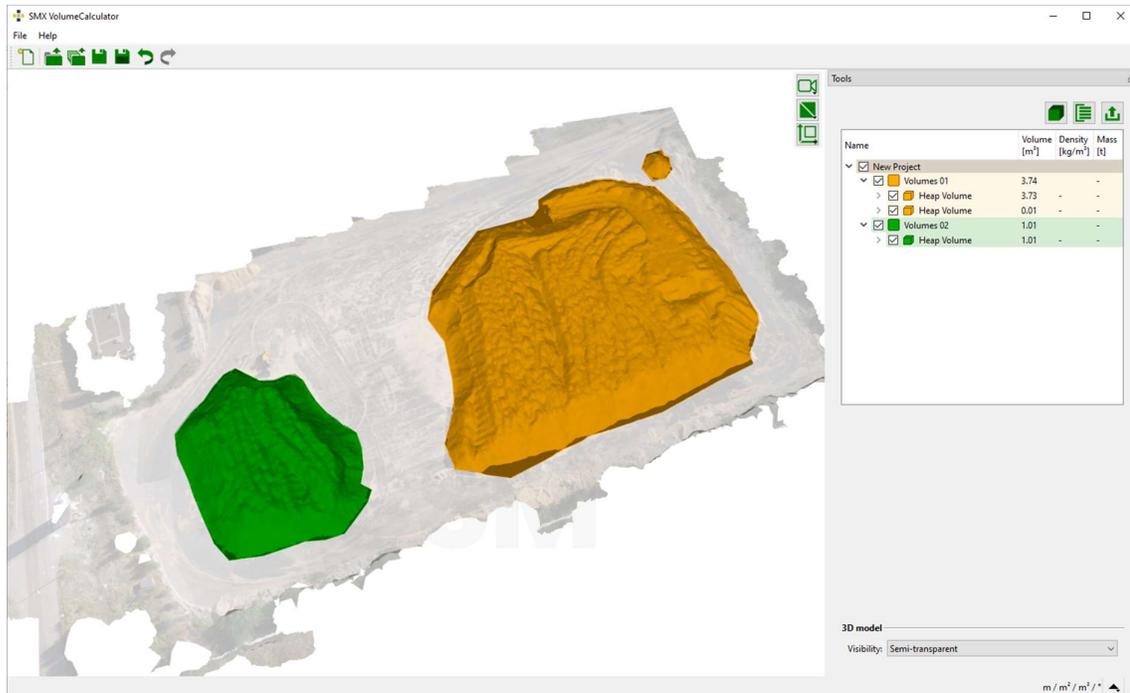
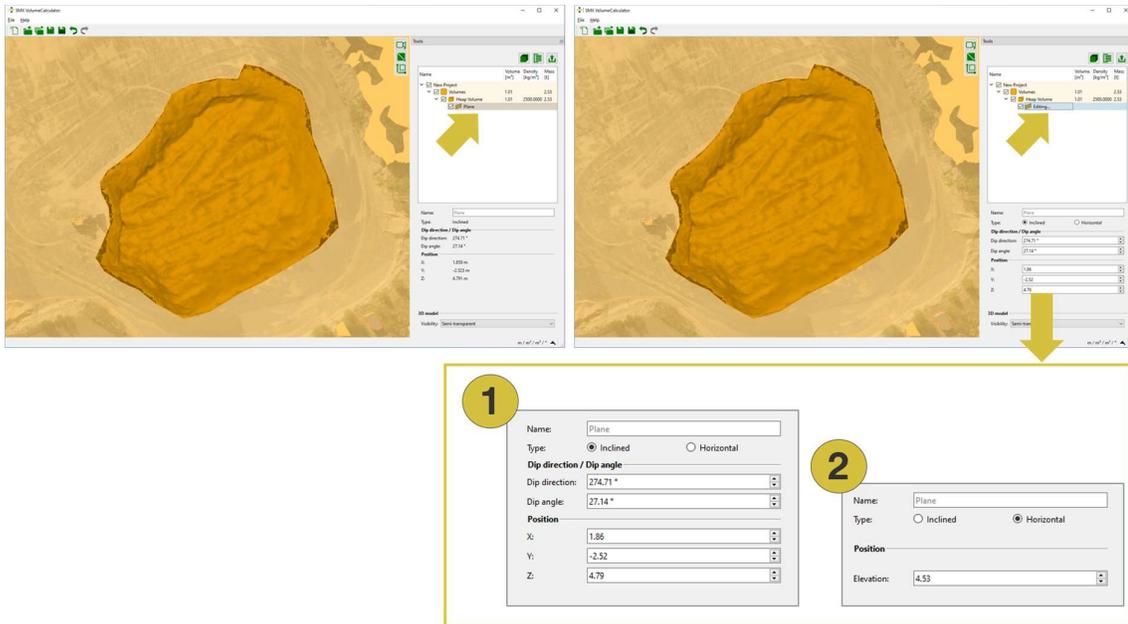


Figure 6: Determination of multiple volumes

## 4.2 Adjustment of the Boundary Plane

The position of the *Boundary Plane* can be adjusted as follows (see Figure 7):

1. Select the *Boundary Plane* in the *Volume* list. The current position is given in the properties field below.
2. Enter the context menu by clicking the right mouse button and click "*Edit*".
3. *Adjust* the *Boundary Plane* on the basis of the input parameters :
  - a. Inclined plane
    - Dip direction and dip angle
    - Position: Easting (x), Northing (y) and Height (z)
  - b. Horizontal plane
    - Elevation
4. Confirm the position by pressing the "*Enter*" button.



1 Define inclined plane

2 Define horizontal plane

Figure 7: Dialog for adjusting the Boundary Plane

### 4.3 Editing of heap volumes

Select the *Volume* to be edited in the list, enter the context menu by clicking the right mouse button and click “*Edit*” or select the boundary polygon of the volume in the 3D viewer by a double click. The following options are provided:

- Insert a point - Press “*Ctrl*” and use the left mouse button
- Delete a point - Press “*Alt*” and use the left mouse button
- Delete the last point – Press “*Alt*” and use the RIGHT mouse button
- Move a point - Press “*Shift*” and use the left mouse button to move single points of the boundary polygon.

## 4.4 Context menu

The context menu is opened by a click on the right mouse button in the tree widget. Provided features may differ in respect to the selected item.

### Group Volumes

#### *New Group*

Adds a new group of volumes to the list

- *Set Colour*  
Defines the colour for the volumes in the group
- *Set Active*  
Activates (shows) and deactivates (hides) by a controlled filtering of the volume size
- *Delete*  
Deletes the group

### Heap Volumes

- *Edit*  
Allows for editing the boundary polygon of the heap volume. Add a point by clicking the right mouse button. Insert a point by holding “*Ctrl*” and clicking the right mouse button. Delete a point by holding “*Alt*” and clicking the right mouse button. Move a point by holding “*Shift*” and clicking the right mouse button
- *Invert*  
Inverts the determined volume value i.e. negative to positive balance and vice versa
- *Assign Density to Group*  
Assigns the density to all volumes of the group
- *Add Boundary Plane*  
Adds a Boundary Plane to the selected *Volume*
- *Move to*  
Moves the *Volume* to another group
- *Look at*  
Centers the *Volume* in the 3D viewer
- *Look at and Zoom*  
Centers and zoom the *Volume* in the 3D viewer
- *Set Colour*  
Defines a new colour for volumes in the group

- *Active*  
Activates (shows) and deactivates (hides) the selected *Volume*
- *Delete*  
Deletes the selected *Volume*

### **Boundary Plane**

- *Edit*  
Allows to adjust the position of the *Boundary Plane*
- *Assign Plane to Group*  
Assign the position of the *Boundary Plane* to all *Volumes* in the group
- *Assign from Heap Volume*  
Assign the *Boundary Plane* from a selected *Volume*
- *Look at*  
Centers the *Boundary Plane* in the 3D viewer
- *Look at and Zoom*  
Centers and zoom the *Boundary Plane* in the 3D viewer
- *Set Colour*  
Defines a new colour for *Boundary Plane*
- *Active*  
Activates (shows) and deactivates (hides) the selected *Boundary Plane*

## 5 Heap Mode – Two 3D Models

The *Heap Mode - Two 3D Models* supports volume calculations from two 3D models derived from repeated digital imaging of a region (pre and post situation). Primary settings, e.g. pre-existing heap on the floor level or roughed terrains, are considered in volume calculations.

### Note:

Models must share a common coordinate system for comparison modes.

### 5.1 Standard operation procedure

1. Select “*Heap Mode - Two 3D Models*” after launching the *VolumeCalculator* (see Figure 1).
2. Load the 3D models one after the other by clicking the “*Load 3D Models*”  icon in the toolbar. Inspect the 3D models by changing the visibility of each by using the pull-down menu “*First Surface Visibility*” and “*Second Surface Visibility*” (see Figure 8).
3. Define a heap volume by following procedure (see Figure 9):
  - a. Click in the “*New Heap Volume*”  in the *Tools* pane or use the short key “*H*”.
  - b. Define the boundary of the volume to be calculated on the 3D model by clicking the left mouse button. A polygonal line grows instantaneously. At least three points are required.
  - c. Confirm the boundary of the volume by a click on the “*Return*” button on the keyboard. The volume is calculated and appears coloured in the viewer whereas the results is available in *Volume* list in the *Tools* pane.
  - d. Optional, enter the rock density for weight calculations in the tree widget for volumes.

### Note:

Invert the sign of calculated volumes by clicking “*Invert*” in the context menu of the *Volume*.

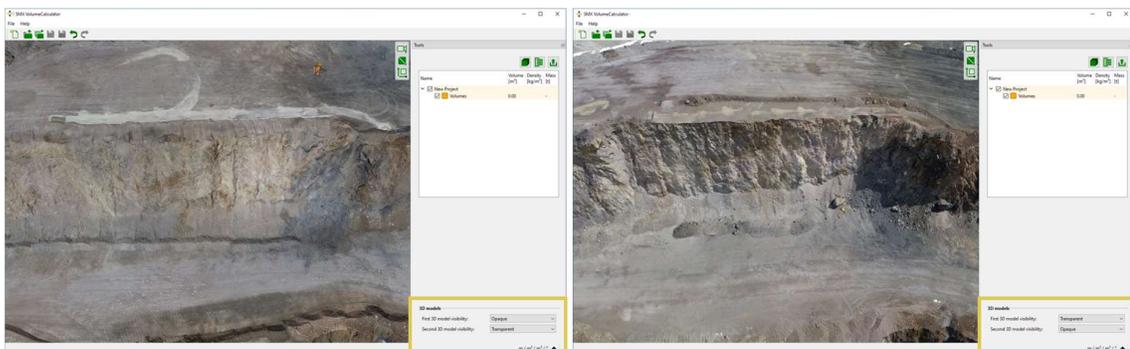


Figure 8: Loaded 3D models of a quarry: pre (left) and post (right) situation

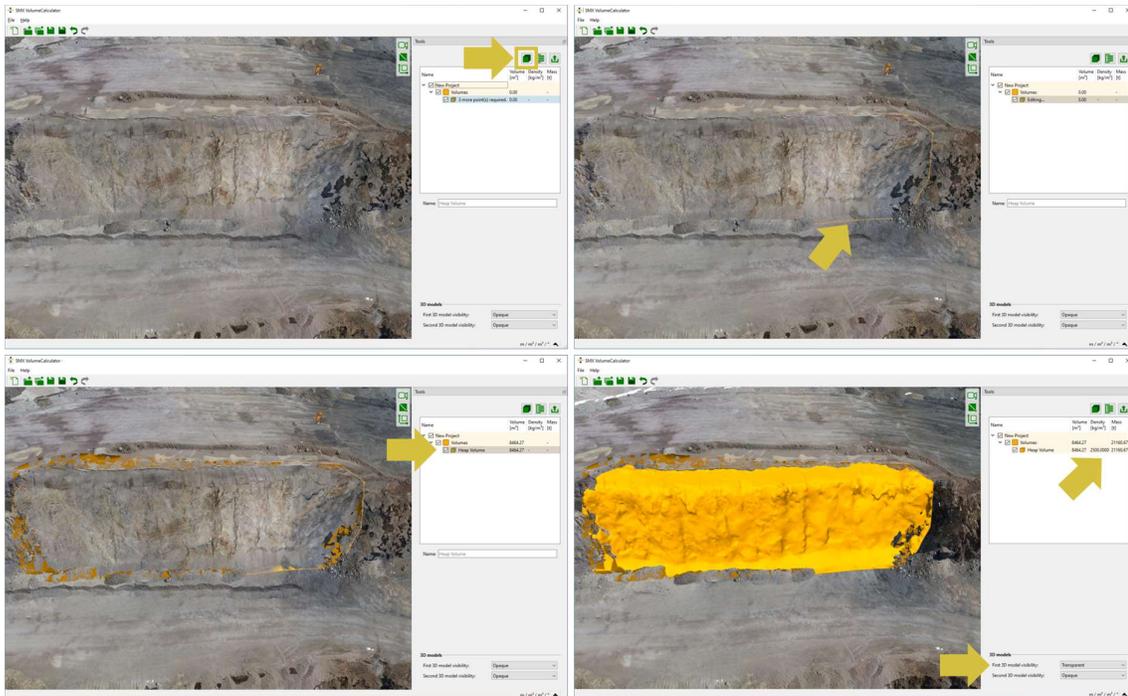


Figure 9: Top left: Activation of new volume. Top right: Definition of the boundary by drawing a polygon. Bottom left: Confirmation of the polygon. The defined volume body is coloured and the results is shown in the Tools pane. Bottom right: Weight calculations require the input of the rock density in the tree widget.

#### Hint:

A number of volumes in individual groups can be determined by repeating step 3 of the standard operation procedure (see Figure 10). Using the “Space” button instead of “Enter” starts a new volume calculation in the *Volume Group*.



Figure 10: Determination of multiple volumes

## 5.2 Adding of a Boundary Plane

The calculation of the mesh of the 3D model in the *MultiPhoto* is may not feasible in some areas due to e.g. insufficient overlapping of images. This “empty area” can be replaced for volume calculation by adding a plane replacing this surface in this particular area. The plane is added by click on the “Add Boundary Plane” in the context menu of *Volumes*. See Figure 11 as usage example.

The position of the *Boundary Plane* can be adjusted as follows (see Figure 7):

1. Select the *Boundary Plane* in the *Volume* list. The current position is given in the properties field below.
2. Enter the context menu by clicking the right mouse button and click “Edit”.
3. Adjust the *Boundary Plane* on the basis of the input parameters :
  - a. Inclined plane
    - Dip direction and dip angle
    - Position: Easting (x), Northing (y) and Height (z)
  - b. Horizontal plane
    - Elevation
4. Confirm the position by pressing the “Enter” button.

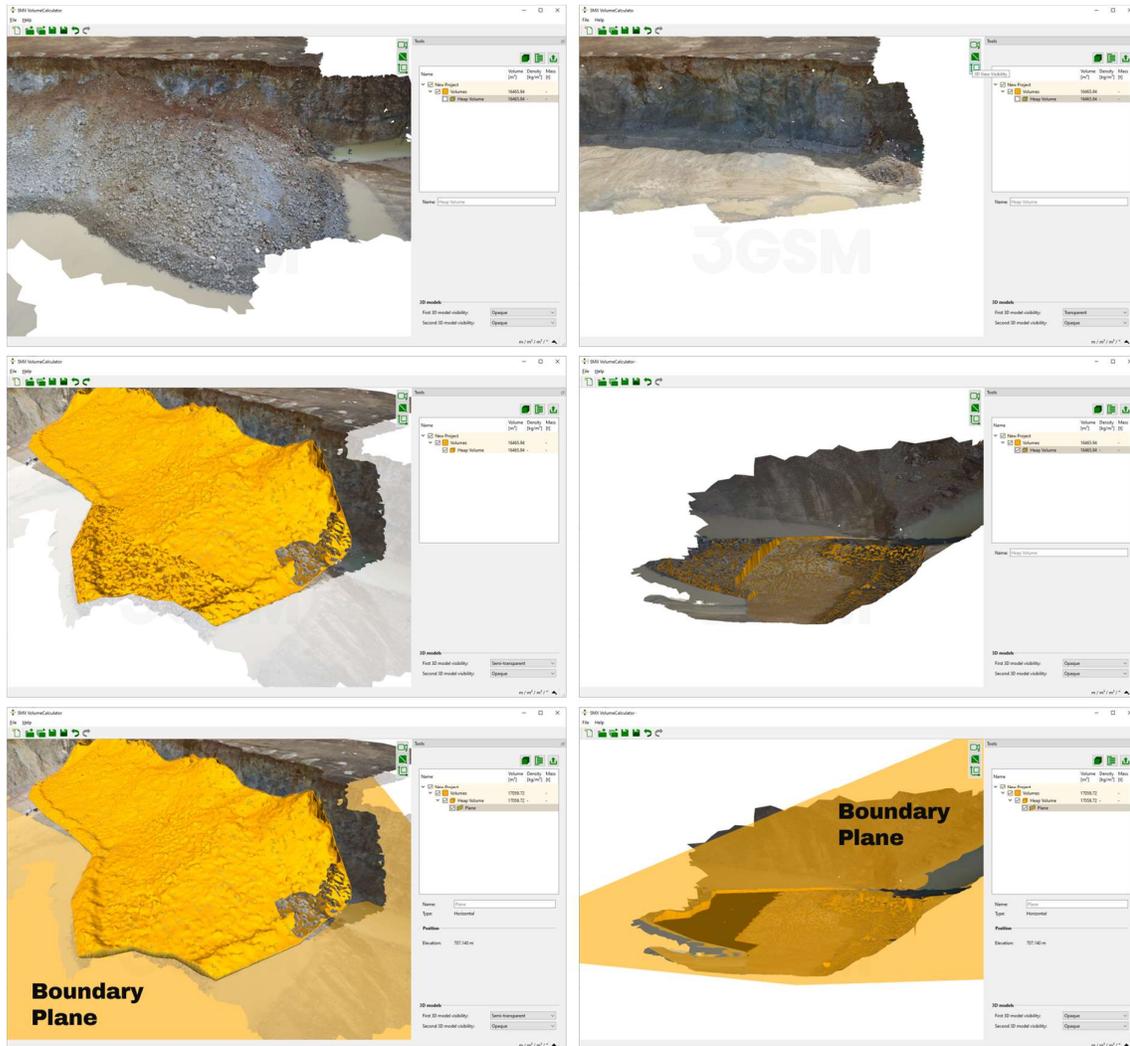


Figure 11: Top left and right: First and second 3D model. Middle left and right: Volume calculation whereas the areas of the second surface are missing. Bottom: Adding a Boundary Plane overcomes this issue and missing areas is replaced by the Boundary Plane and used for volume calculation.

### 5.3 Editing of heap volumes

Select the *Volume* to be edited in the list, enter the context menu by clicking the right mouse button and click “*Edit*” or select the boundary polygon of the volume in the 3D viewer by a double click. The following options are provided:

- Insert a point - Press “*Ctrl*” and use the left mouse button
- Delete a point - Press “*Alt*” and use the left mouse button
- Delete the last point – Press “*Alt*” and use the RIGHT mouse button
- Move a point - Press “*Shift*” and use the left mouse button to move single points of the boundary polygon.

## 5.4 Context menu

The context menu of *Group Volumes* by a click on the right mouse button in the tree widget. In addition following features are available:

- *New Group*  
Adds a new group of volumes to the list
- *Set Colour*  
Defines the colour for the volumes in the group
- *Set Active*  
Activates (shows) and deactivates (hides) by a controlled filtering of the volume size
- *Delete*  
Deletes the group

### Heap Volumes

- *Edit*  
Allows for editing the boundary polygon of the heap volume. Add a point by clicking the right mouse button. Insert a point by holding “*Ctrl*” and clicking the right mouse button. Delete a point by holding “*Alt*” and clicking the right mouse button. Move a point by holding “*Shift*” and clicking the right mouse button
- *Invert*  
Inverts the determined volume value i.e. negative to positive balance and vice versa
- *Assign Density to Group*  
Assigns the density to all volumes of the group
- *Add Boundary Plane*  
Adds a Boundary Plane to the selected *Volume*
- *Move to*  
Moves the *Volume* to another group
- *Look at*  
Centers the *Volume* in the 3D viewer
- *Look at and Zoom*  
Centers and zoom the *Volume* in the 3D viewer
- *Set Colour*  
Defines a new colour for volumes in the group
- *Active*  
Activates (shows) and deactivates (hides) the selected *Volume*

- *Delete*  
Deletes the selected *Volume*

**Boundary Plane (available only if set by the user)**

- *Edit*  
Allows to adjust the position of the *Boundary Plane*
- *Assign Plane to Group*  
Assign the position of the *Boundary Plane* to all *Volumes* in the group
- *Assign from Heap Volume*  
Assign the *Boundary Plane* from a selected *Volume*
- *Look at*  
Centers the *Boundary Plane* in the 3D viewer
- *Look at and Zoom*  
Centers and zoom the *Boundary Plane* in the 3D viewer
- *Set Colour*  
Defines a new colour for *Boundary Plane*
- *Active*  
Activates (shows) and deactivates (hides) the selected *Boundary Plane*

## 6 Underground Mode

The *Underground Mode* supports volume calculations from two 3D models derived from repeated digital imaging of a region (pre and post situation). The volume is achieved by the generation of a watertight volume mesh. Therefore, 3D models need to be trimmed, that only the two surfaces enclosing the volume to be calculated remains.

### Note:

Models must share a common coordinate system for comparison modes.

### Standard operation procedure

1. Select “*Underground Mode*” launching the *VolumeCalculator*.
2. Load the 3D models one after the other by clicking the “*Load 3D Models*”  icon in toolbar. Check the images for plausibility with the sliders “*First Model*” and “*Second Model*” (see Figure 12).

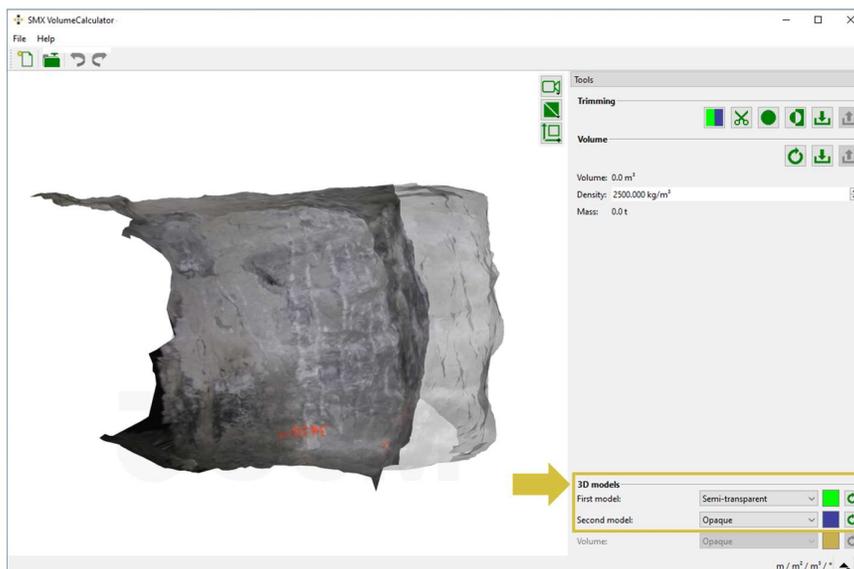


Figure 12: Loaded 3D models of a tunnel excavation

3. Trim the 3D models that only the volume body to be calculated remains:
  - a. Start the trimming procedure by clicking the “*Trim Model(s)*” icon  in the *Tools* pane. The 3D models are displayed with a colour overlay in the viewer (Figure 13).

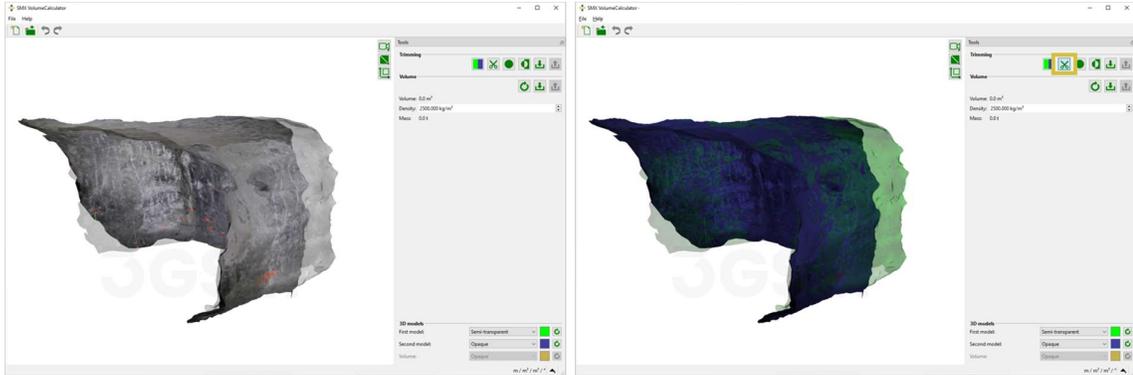


Figure 13: Left: 3D models (first and second) in the 3D viewer. Right: The 3D models are displayed with a colour overlay after activating the trimming procedure.

#### Note:

The colour overlay is customized in the *Colour* dialog which opens by clicking the “Pick Colour”  icon in the *Tools* pane.

- b. Toggle between the target 3D model, i.e. the 3D model to be trimmed, by clicking “Toggle Target”  in the *Tools* pane. Only the chosen model(s) to be trimmed appear(s) with the defined colour overlay.
- c. Enclose the region to delete by dragging the cursor across the 3D model while keeping the left mouse button pressed. After releasing the mouse button, the selected region is highlighted in red (Figure 14).
- d. Apply the trim selection by clicking the “Space” button or apply the trim selection and finish editing by clicking the “Enter” button.

#### Hint:

Press “Shift” while keeping the left mouse button pressed to draw a straight line.

#### Hint:

The selection of points is inverted by clicking the “Invert Selection”  icon in the *Tools* pane. Previously unselected areas are now highlighted and will be deleted by pressing the middle mouse button.

- e. Go on trimming until the surfaces of the 3D models are reduced to the volume to be calculated.
- f. Press the “Recalculate”  icon in the toolbar of the *Tools* pane to start volume calculation. A watertight volume body is generated and the result is immediately displayed on the 3D viewer and in the *Tools* pane.

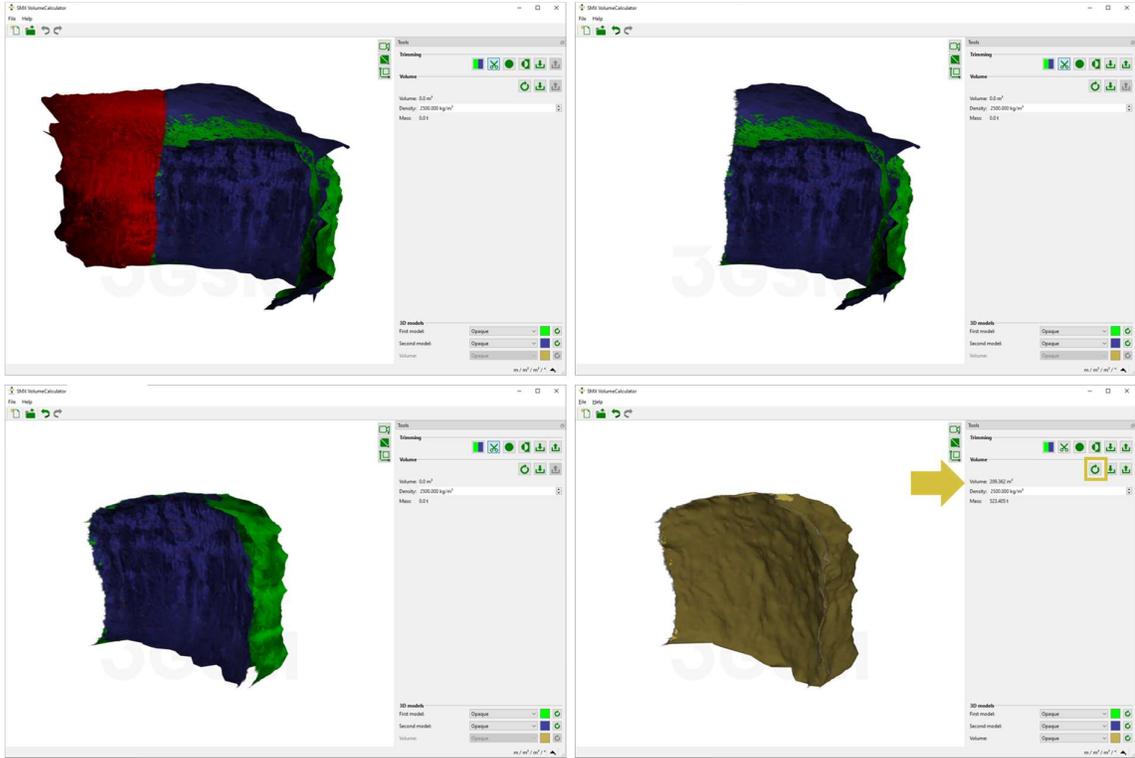


Figure 14: Top left: Region to delete enclosed by a polygon- Top right: Trimming of the 3D model. Bottom left: Trimmed 3D models. Bottom Right: Volume body.

## 7 Report and export

### 7.1 Report

The *VolumeCalculator* automatically generates a report to a “.pdf” file by clicking “File | Generate Report” (Figure 15). The report includes the key data of the current project (date of report generation, project name, data and description), an ortho-photo with the volumes and the corresponding parameters (volume, rock density and mass).



Figure 15: VolumeCalculator Report

## 7.2 Export and Import

### Heap Modes

The volume data is exported as “.obj” or “.dxf” by clicking the “Export”  icon in the *Tools* pane or in the context menu of the volume.

Example “Export Volumes as CSV”:

```
"ID";"Name";"Volume [m³]";"Density [kg/m³]";"Mass [t]"  
1;"Volume";2236,3585;2700;6038,16  
2;"Volume";7064,039;2700;19072,90  
3;"Volume";3223,1075;2700;8702,38
```

### Underground Mode

The volume data is exported as “.obj” or “.dxf” by clicking the “Export Volume”  icon in *Volume* in the *Tools* pane and choosing “Volume Model as OBJ” or “Volume Model as DXF”. Volumes in “.obj” file format can be reloaded by clicking “Import Volume from OBJ”  icon in *Volume* in the *Tools* pane. The trim history is saved or reloaded as “.trim” file by clicking the corresponding “Export Trim History”  icon or “Import Trim History”  icon in *Trimming* in the *Tools* pane.

## 7.3 Screenshot

Menu bar: “File | Generate Screenshot”: Writes a “.jpeg” file of the scene in the 3D viewer using off-screen rendering, i.e. the screen shot model is dependent from the native of the monitor display. The export of the screenshot can be modified in the screenshot dialog (Figure 16), which opens subsequently after calling the command. Camera type, camera position and direction, and several settings options can be selected for the screenshot export.

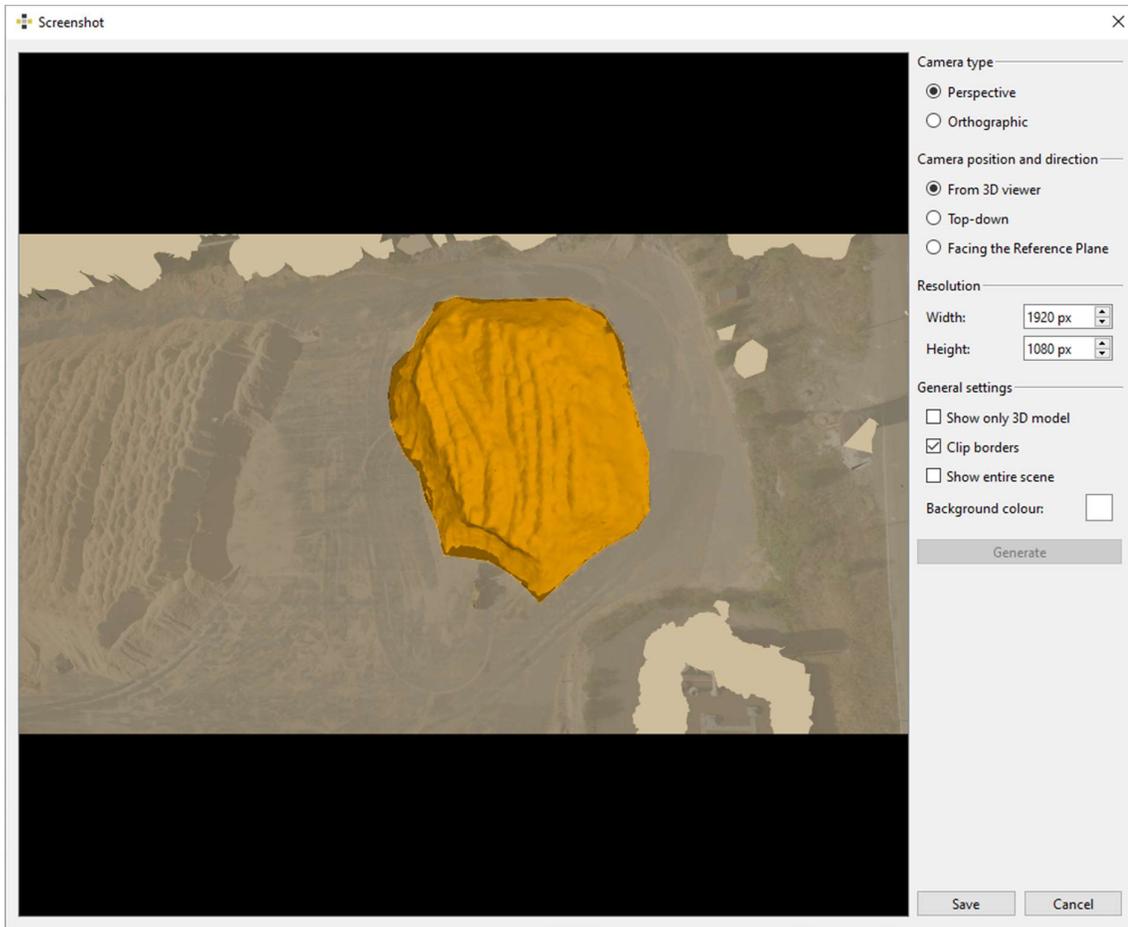


Figure 16: Export dialog for screenshot