EdenScape by Linda B Helendale

Terraforming with no limits

EdenScape Creator

Create terrains from a height maps created external to SL.
Copy-paste terrains in-world.
Save backup of the sim terrain, and restore the whole parcel or any part of it.

EdenScape Backup

Save backup of the sim terrain, and restore the whole parcel or any part of it.

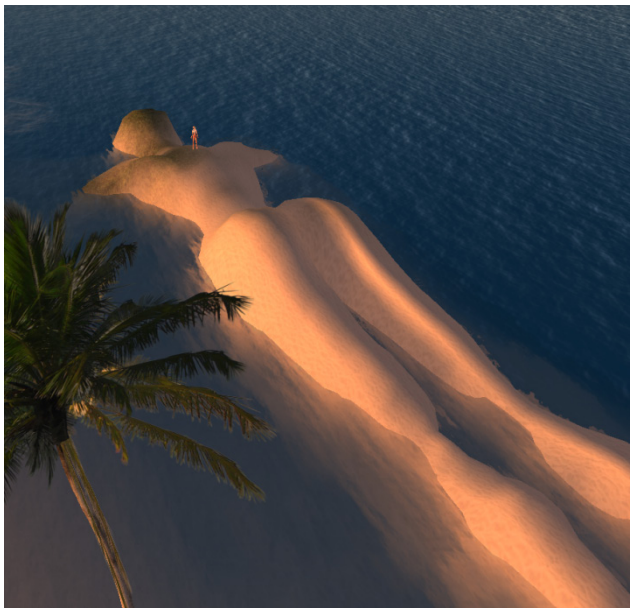
EdenScape terraform Stencil

Area tool to terraform the whole parcel or any area set by coordinates or corner markers.
Smooth surfaces, flat leveling, raise/lower the area preserving the terrain shape.

EdenScape terraform Brush

Free tool for applying any terraform action in step-wise or continuous mode.

Spiral mountain, 100x100m, 71 m high



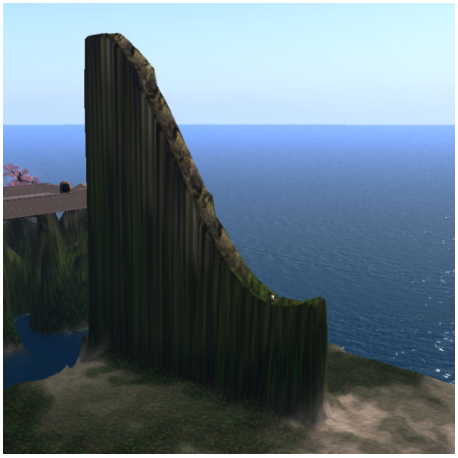
Island made from the avatar shape, 64x30m

1. What is the tool for?

Scripted terrain modification has never been as easy… maybe it's not so easy but certainly manageable with this tool. The basic functions of the tool are

- Take backup and restore the terrain from backup, copy-paste terrains in-world
- Create terrain from a height map saved on a notecard

Rez the tool and left-click it for the menu. In the following, the menu buttons are shown in blue color. For example, Apply stencil means you should press a button with label "Apply stencil".

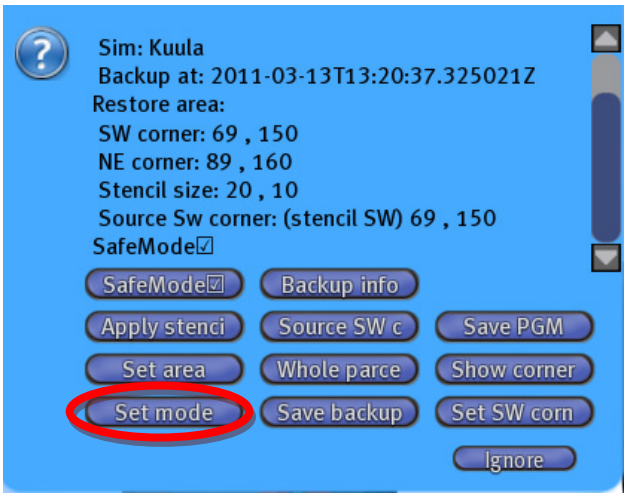


Left: Yin-Yang islands clipped from a public domain image. Right: 70 m high ski jump hill, with perfectly smooth spline contour, giving a great jump for any physical object or sledge.

Main menu

Rez the tool EdenScape on the ground and left-click to access the menu.
The tool supports two modes, Notecard and Backup. Press the button Set mode to choose the mode.

- Notecard : terrain patch (called stencil in the following) is read from a notecard
- Backup : save and restore a parcel or part of a parcel, and copy-paste terrains in-world



The light version **EdenScape Backup** has only the backup mode, for saving and restoring parcel terrain. For users of the EdenScape Backup the following chapters are relevant: **Chapter 2. Restoring terrain from backup**; in Chapter 3 sections **SafeMode** and **Stencil corners**, and Chapter 4 for additional information (which is definitely not required reading for using the tool).

Emergency stop button

The tool comes with an object 'EdenScape stop button' that can be used to stop the terraforming tool while it is processing. Attach it as HUD before starting the tool. Clicking the upper red button sends the EdenScape tool a command that resets the main script and immediately stops any processing. . You can also shout command `/911911 stop` for emergency stop. Clicking the lower button requests the tool to stop softly, after the current row of the stencil is processed.

In typical use the stop button should not be needed. The button is provided for additional safety when processing large areas, to stop the tool if the settings appear to be clearly wrong and risk messing up existing terrain. Note that the backup facility can be used to save the terrain before starting the terraforming and restoring the terrain if the result is not as desired.

It is advised to always check the processed area, using Show corners button, before starting the terraforming.

2. Restoring terrain from backup

First we present some example scenarios for restoring the terrain from backup. A complete list of buttons in the backup menu follows. The tool has modify permissions to allow renaming it to easily find your backups from inventory.

Example scenarios

- You have rented or bought a parcel where you have terraform rights. You don't have terraform rigths in neighboring parcels (that is, you can safely apply terraform operations outside your parcel without adverse effects)
  1. Save backup
     - Rez the tool on your parcel and press Save backup
  2. Restore the parcel
     - Rez the tool on your parcel
     - To check the backup, press Backup info
     - Set mode > Backup
     - Uncheck SafeMode
     - Whole parcel
     - Apply stencil

  If you have terraform rights on neighboring parcels, check SaveMode .

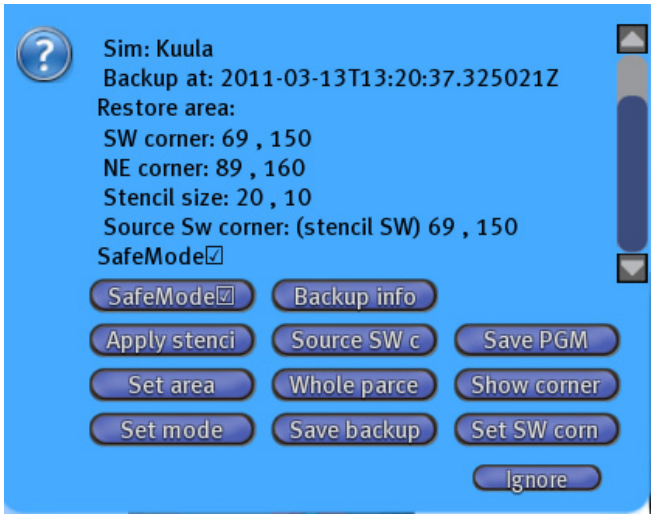
- Restore 15 x 25 m area from the backup, with the tool at the SW corner of the area
  - Set mode > Backup
  - Set area , type 15 25 and press Send
  - Apply stencil

- Interactively select the area to restore from backup
  - Set mode > Backup
  - Show corners, right click/edit and move the corners to set the area
  - (Hide corners)
  - Apply stencil

- Copy-paste 100 x 150 m area from sim A at 13, 180 to sim B starting at 30,80
  - Go to sim A and rez the tool and press Save backup
  - Go to sim B and rez the tool
  - Set mode > Backup
  - Source SW corner, type 13 180 and press Send
  - Set area , type 100 150 and press Send
  - Set SW corner, type 30 80 and press Send
  - (To check the area, press Show corners and Hide corners)
  - Apply stencil

- Interactively select the positions to copy-paste an area from sim A to sim B
  - Go to sim A, rez the tool and press Save backup
  - Set mode > Backup
  - Show corners, click any corner to switch the corner markers to resize mode, (blue corners), and edit/move the corners to set the position
  - Source SW corner, type the current SW corner coordinates, and Send
  - Go to sim B and rez the tool
  - Set mode > Backup
  - Show corners, edit/move the corners in move mode (pink corners) to the desired location
  - Apply stencil

Menu buttons in Backup mode



- Save backup: saves the whole sim terrain map in the clipboard memory
- Set SW corner: opens a textbox to set the South-West corner of the target area, in region coordinates
- Set area: opens a textbox to set the size of the target area, as <Xsize> <Ysize> meters
- Whole parcel: sets the target area as the bounding box of the parcel where the tool is
- Source SW corner : sets the South-West corner in the stored backup, for copy-pasting terrain from one area to another. The source may be in another sim, in which case the tool gives a warning.
- Save PGM : prints the defined area in PGM format (see **4.4. Using the terrain maps in external programs**)
- SafeMode : see section **Safe mode** below. Uncheck this if you do not have terraform rights in neighboring parcels.
- Backup info: requests the backup headers from the clipboard memory scripts. You can use this to update the backup info settings at any time. Resetting the main script will not clear the backup data.

3. Creating terrain from a height map

The tool supports creating terrain maps outside of SL, and recreating the terrain in SL. The terrain maps are stored as ASCII PGM image files, supported by many image processing software tools. See section **4.2. PGM file format** for more info on creating and converting the terrain maps.

To start creating the terrain, press Set mode > Notecard , which opens a menu to choose the notecard. After reading the notecard, the tool opens a menu showing information of the loaded stencil and settings that determine how the stencil is applied. When you are satisfied with the settings, press Apply stencil to start terraforming. Every terraforming action has a confirmation menu to avoid accidentally starting it.

Settings of the stencil:

- Set SW corner : sets the South-West corner of the area where the stencil is applied. The default position is the position of the tool when loading the notecard, or it can be set in the notecard (see section 4.3. PGM file format) . The SW corner of the stencil is not changed if you move the tool.
- Set level : sets the ground level of minimum height in the stencil. The default value can be set in the notecard,with a line "# minground <level>". The submenu has the following options:
  - Ground SW : sets the level to the ground height at the SW corner
  - Tool Z : sets the level to the tool position z-coordinate
  - Type level: opens a textbox to type in the level
- Set range : sets the height range. The default value may be set in the notecard, by comment lines "#minground <level>" and "maxground <level> ". For example, the notecard may have a setting "# minground 25" and "# maxground 40", giving the basic level 25 and range 15 as the default apply settings. To create the terrain at level 20 with range 10, use Set level / Type level , type "20" and Set range, type "10".
- SafeMode : see section **Safe mode** below.
- Show corners : rezzes corner markers to set the position of the area. See section **Stencil corners**.
- Apply stencil : starts the terraforming, with a confirmation menu to avoid accidental button presses.
- Undo stencil : restores the stencil area from the backup. The undo is not perfect, see section **Safe mode** for artifacts on the area boundaries. The backup is not automatically saved prior to applying a stencil from notecard, use Save backup to save it. You can also restore the area by using the backup mode, see section **2. Restoring areas from backup.**
- Alpha **:** use alpha mask, see section 4.2. Alpha mask. Values 0 in the notecard are not rendered.

Some old viewers do not support the textbox UI component. (LL viewers prior to 2.4 and some TPV's.) The unsupported viewers will display a dialog menu with a single button "!!llTextBox!!". To support users on those viewers, when launching a textbox the tool shows instructions in chat how to input the text via chat command.

The tool does not support rescaling or rotation of the terrain maps in notecards. If you need to rotate or rescale the terrain maps, save the notecard in text file, load it in any image manipulation program (such as IrfanView, see section **4.4. Using the terrain maps in external programs**) , apply the transformations and save as ASCII PGM file, and copy it on a notecard and drop in the tool.

Safe mode

The tool has a setting SafeMode that controls how the borders of the processed area are handled, and whether the tool is allowed to terraform outside the parcel. See section **4.1. Terraforming explained** for introduction to the way the tool works. SafeMode options are:

- SafeMode OFF :
    - Simple rule: use this in restoring backup if you do *not* have terraform rights in neighboring parcels
    - Description: with this setting the full stencil area is processed, producing perfect result inside the area, but leaving artifacts on the North and East borders outside of the area. Note that when restoring the whole parcel from backup, or any area at the parcel boundary, this causes terraforming in the adjacent parcel, in case you have terraform rights for the other parcel. If you do not have terraform rights on adjacent parcels to North and East, this setting is recommended for restoring the parcel.

- SafeMode ON :
    - Simple rule: use this if the area you process touches other parcels and you have terraform rights in those parcels
    - Description: with this setting all processing is strictly inside the area and only in the parcel where the South-West corner is, thus not affecting existing terrain out of the area. This is useful if you create a patch of terrain very near to terrain you have to preserve. This is useful also if you have terraform rights on the neighboring parcel and the area is less than 2 meters from the North and East boundaries.

Stencil corners

The position of the stencil, and the size for the backup restore, can be adjusted interactively from the button Show corners, which rezzes pink corner markers. The corners can be moved by normal editing tools (right click / edit, drag the red, blue or green arrows). The corners snap to the terrain grid automatically after they are moved.

In Backup mode the size of the area can be changed by clicking any of the corners (r-click/touch if the prim is in edit). The resize mode is indicated by blue color. Clicking Hide corners the corners are deleted and the menu is updated with the current values. (The values are sent to the tool immediately after the corner is moved but the dialog menu cannot show the update until it is refreshed; you can also remove the menu by 'Ignore' and click the tool for updated menu.).

If a corner moves to a different parcel it changes the color to bright red. Use SafeMode setting to choose whether the terrain in other parcels is processed.

If the corners are left accidentally visible after you derez the tool, you can remove them by shouting
/8 stencil|die

Pink corners: move the stencil

Blue corners: resize the stencil

4. Technical information

This looks boring. You don't need to read it, unless you want to create terrains that fit tightly to existing terrains. The terraforming brush available in SL is rather clumsy, and causes side-effects – think of painting one centimeter details with three centimeter brush; after painting one spot you have to paint over the extra paint in the brush area, and this is how the terraform brush works also. See also the SafeMode above for handling those side-effects.

4.1. Terraforming explained

The terrain in SL is defined in 1 m x 1 m grid, but the function modifying the terrain (llModifyLand) affects minimum of 2 m x 2 m area (3 x 3 grid points), requiring carefully planned order of the terrain brush actions to obtain the 1 m resolution. The tool uses a very simple terraforming pattern that has caveats: getting the terrain exactly correct inside the processed area the tool needs to process 2 m wide zones outside the North and East borders. Respectively, restricting the processing strictly inside the area leaves 2 m wide zones with artifacts inside the North and East borders. (While it is possible to build any terrain with processing only inside the area, finding out the appropriate sequence of terraform actions requires solving a large set of simultaneous equations *(for a 30 x 40 m area it requires inverting a matrix of size 1200 x 1200*), or alternatively a lengthy iterative optimization, which are prohibitively costly in terms of memory and CPU in lsl, unless someone comes up with really good heuristics for the optimization.)

To demonstrate the way the terraforming is done by the tool, consider following stencil:

26	27	28	29
22	23	24	25
18	19	20	21
14	15	16	17
10	11	12	13

Let us assume flat ground with height 1 and apply the stencil with the SW-corner at (3,3). The resulting terrain is shown below, with the stencil area shown on red.

1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	26	27	28	29	29	29	1	1	1
1	1	1	26	27	28	29	29	29	1	1	1
1	1	1	26	27	28	29	29	29	1	1	1
1	1	1	22	23	24	25	25	25	1	1	1
1	1	1	18	19	20	21	21	21	1	1	1
1	1	1	14	15	16	17	17	17	1	1	1
1	1	1	10	11	12	13	13	13	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1

In the safe mode the terraforming is confined strictly inside the area, and the last two rows and columns of the stencil are ignored, leaving errors inside the area. The correctly terraformed area is shown on dark red.

1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	18	19	19	19	1	1	1	1	1
1	1	1	18	19	19	19	1	1	1	1	1
1	1	1	18	19	19	19	1	1	1	1	1
1	1	1	14	15	15	15	1	1	1	1	1
1	1	1	10	11	11	11	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1

The artifacts can be avoided if the terrain around the stencil area is sufficiently flat, by adding one row and column to the stencil, with values set to the surrounding ground. (See Set level menu option and # `minground` default setting in the PGM image file.) Below is the modified stencil.

1	1	1	1	1
26	27	28	29	1
22	23	24	25	1
18	19	20	21	1
14	15	16	17	1
10	11	12	13	1

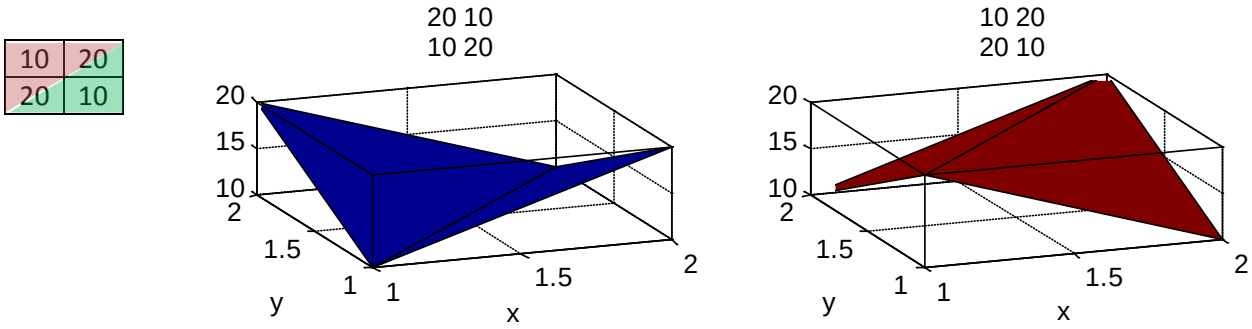
Applied in SafeMode OFF, the resulting terrain is:

1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	26	27	28	29	1	1	1	1	1
1	1	1	22	23	24	25	1	1	1	1	1
1	1	1	18	19	20	21	1	1	1	1	1
1	1	1	14	15	16	17	1	1	1	1	1
1	1	1	10	11	12	13	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1

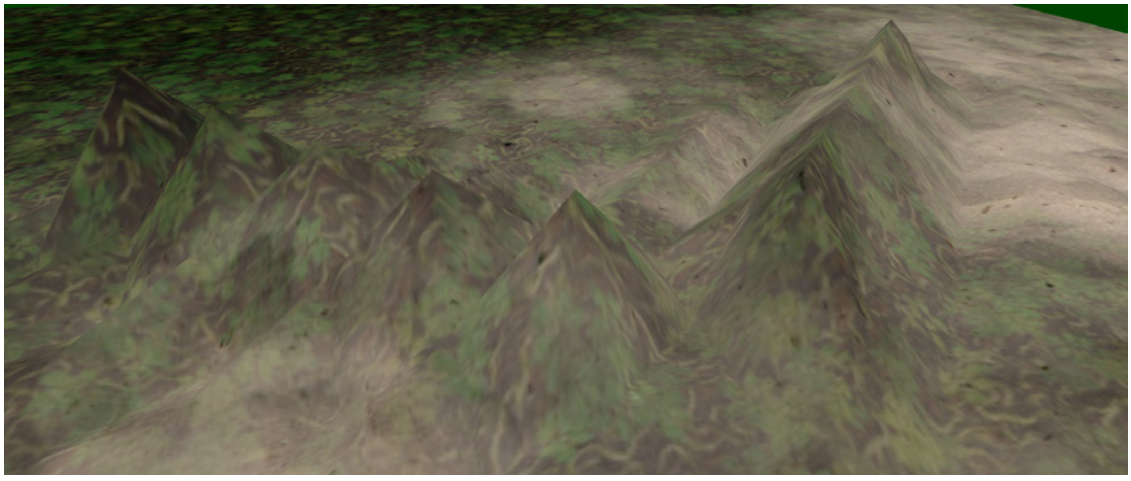
The stencil area is marked as red and the artifacts produced by the tool outside the area as blue. Alternatively, the stencil may be padded by 3 columns and rows and the tool applied with the Safe mode ON. This helps to see the exact area affected by the tool, using the Show corners function.

Other issues

Ragged diagonal edges. The terrain in SL is defined in a grid with 1 m resolution, and the ground is interpolated linearly between the grid points, with every square meter split to two triangles diagonally in direction SW to NE. The left figure below shows the triangles in an example; the other figures show the effect on how ground is rendered. Diagonal structures in SW - NE are preserved but diagonal structures in NW - SE are not (see the middle figure).

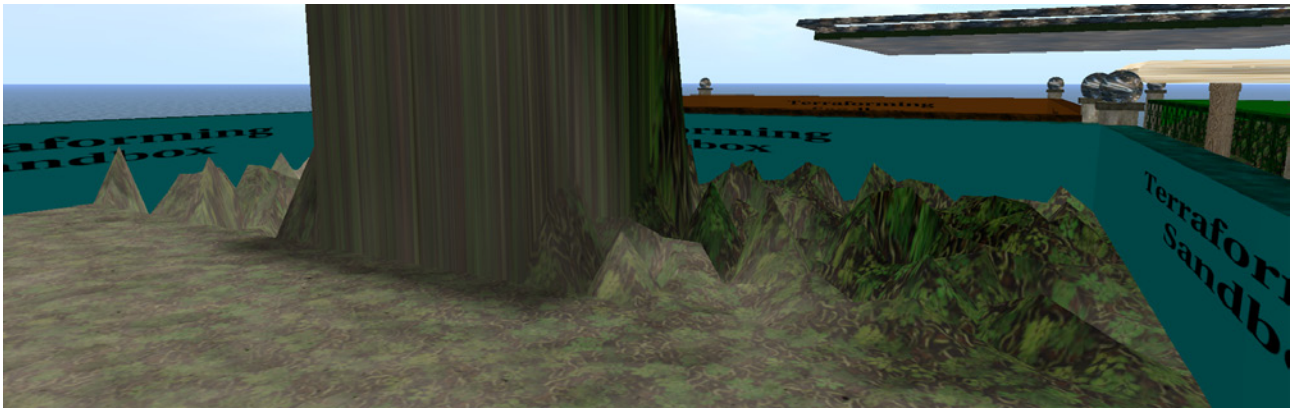


Left: example of 1 m x 1 m terrain patch, showing the triangles used in interpolation in viewer and llGround()
Middle: resulting terrain when the high ridge is in NW-SE direction
Right: resulting terrain when the high ridge is in SW-NE direction



Actual terrain example.
On the left side, diagonal ridge in NW - SE direction
On the right side, diagonal ridge in SW- NE direction

Flat areas showing rough. The SL viewer adds noise on the ground during rendering, apparently to simulate natural terrains. Near steep edges the noise is added 4 to 8 m from the edge. To avoid this, smoothen the corners of steep edges. The figure below shows the effect; the ground as returned by llGround() is perfectly flat in the image.



Noise added by the viewer in rendering the terrain. The ground around the high area is perfectly flat.

SL BUGS in terraforming: sometimes the ground is rendered wrong after terraform operations, see JIRA https://jira.secondlife.com/browse/VWR-24882 . This bug affects the borders of the areas processed by the tool; when the bug is expressed it looks like the tool has not processed the last meter near the edges, but checking the ground by llGround() function shows the desired result, and the rendered ground is incongruent with the result of llGround() function. The incidence rate of the bug is not known.

4.2. Alpha Mask

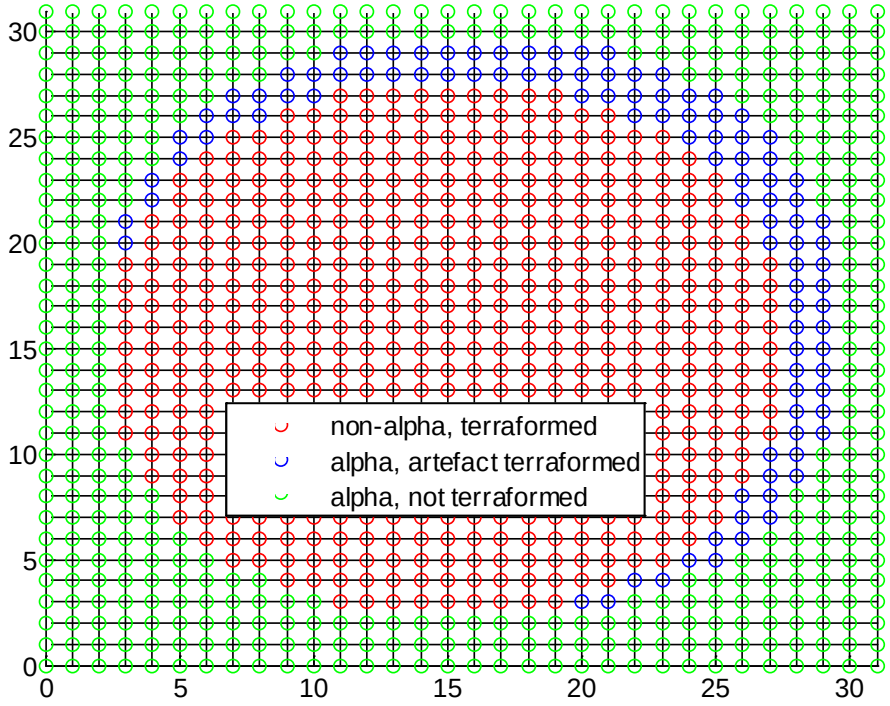
For creating non-rectangular terrain patches over existing terrain, without need to copy the existing terrain into the stencil, the stencil specification has a simple optional alpha mask: when alpha mask is used, the value 0 in the notecard defines position that is not terraformed. Alpha mask can be switched ON or OFF by the Alpha menu button, and the default value can be set ON in the PGM-file notecard with comment line `# alpha.`

When alpha mask is used, the exact value set to the base level is not possible, the lowest value terraformed is base level + 1/<Maxval>*range. For example, if the stencil terrain range is 100 m and the base level is 20 m, and <Maxval> is 1000, the notecard pixel values map to following ground heights.

NC	Heigth	
0	20	Not terraformed with alpha mask ON
1	20.1	Lowest ground height terraformed
2	20.2	
1000	120	

The areas masked as alpha have the same boundary artifact issue as described above for the stencil boundaries. Every non-alpha pixel causes 2 m x 2 m area to the East and North affected, hence the alpha is usable only for masking out larger areas, not individual positions.

The figure below demonstrates the effect. We add a round patch of terrain and try to avoid touching the existing terrain around the patch by alpha mask. The red circles show the pixels with non-alpha values defining the target terrain in the 32 x 32 stencil. The green and blue pixels are alpha in the notecard. Due to the terraforming algorithm the blue positions are terraformed as side effect of applying the terrain brush in the red positions. Consequently, the stencil needs to have suitable non-alpha values on borders next to alpha values to the North and East. For example, if the stencil below has a constant value on the border of the non-alpha area (red), the blue area will be filled with that value, and setting the value correspond to the surrounding ground, the new patch blends into the terrain.



4.3. PGM file format

The terrain stencils are stored as PGM image files. If the tool you use does not support ascii PGM-format, Irfan view (http://www.irfanview.com/) is handy free program for converting between image formats. To save the file in Irfan view, choose `File/Save As`, and `Save as type: PGM - Portable Graymap`, and set the ascii option in the pop-up window: `Save options: Ascii encoding`.

The ascii PGM image consists of the following :
(See http://netpbm.sourceforge.net/doc/pgm.html)

1. A "magic number" for identifying the file type. *The tool uses ASCII PGM files with tag "P2"*
2. Whitespace (blanks, TABs, CRs, LFs).
3. A width, formatted as ASCII characters in decimal.
4. Whitespace.
5. A height, again in ASCII decimal.
6. Whitespace.
7. The maximum gray value (Maxval), again in ASCII decimal. Must be less than 65536, and more than zero.
8. Newline character

9. A raster of Height rows, in order from top to bottom. Each row consists of Width gray values, in order from left to right. Each gray value is a number from 0 through Maxval, with 0 being black and Maxval being white*. In the tool the rows run from West to East and the columns from South to North. As images typically have origin in top left, displaying the terrain map as an image with North up, you need to flip the image vertically*.

Lines starting with "#" are comments, and can appear anywhere in the file. The tool recognizes also "[" as a comment tag, to allow copy-pasting the tool output directly on a notecard.

The tool recognizes the following comment lines as terraform prameter default values:

```
# minground <float_value>  : specifies the default ground level of pixel value 0
# maxground <float_value>  : specifies the default ground level of pixel value <Maxval>
# Parcel SW corner: <integer_x> <integer_y> : specifies the default SW-corner of the stencil,
        in region coordinates
# alpha : turns on alpha mask, with positions with pixel value 0  not terraformed
```

Example of the stencil PGM file:

```
P2
# minground 15.000000
# maxground 71.000000
# Parcel SW corner: 103 77
# alpha
104 104
999
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2 3 5 7 11 15
20 25 31 36 41 46 51 53 53 53 53 53 53 53 53 53 51 46 41 36 31 25 20 15 11 7 5 3
2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
...
```

To use the file with the tool, open the file in any text editor, copy the contents on a notecard, and drop the notecard into the tool. Note the notecard limits: maximum line length is 255 characters, and maximum notecard size is 64K. Large files that don't fit on one notecard can be split, with continuation parts named as <main notecard>_Part2, <main notecard>_Part3, etc. The files can be clipped at any row, but not inside a row. For example, to create a full sim terrain map (64K positions) with <Maxval> 999, each position requires roughly 4 bytes and the whole map requires 4 notecards, for example,

mysim
mysim_Part2
mysim_Part3
mysim_Part4

The terrain values are stored internally as 15-bit integers, independent of the <Maxval> value in the PGM file. Using larger <Maxval> gives higher vertical resolution, and produces larger image files. As an example, <Maxval> value 1000 with 10 m range (i.e., <maxground> - <minground>) gives resolution 10 mm for the height mapping.

Internally the height maps are stored as 15-bit integers, with the actual height as <value>/128 meters, yielding maximum vertical resolution of 1/128 m, or 8 mm.

Typical image manipulation programs support 8-bit images, corresponding to <Maxval> of 255. The maximum terrain height with terraforming is 255 but in many sims it is limited to around 100 m. The 8-bit depth allows 25 cm height resolution for terrains with range of 64 m, which should be often sufficient. For higher resolution it is possible to use 16-bit images (with e.g. Photoshop), but tools to convert the images

to ascii PGM format may not be easily accessible. . In section **4.5 GNU Octave example** we give example routine for saving the 16-bit PGM file using GNU Octave tool, that can also read almost any image format.

4.4. Using the terrain maps in external programs

Use menu option Print PGM to print the selected area (or the whole parcel) in PGM-file format. The output can be copy-pasted directly on notecard to be used as a stencil, with all the parameters set correctly (SW corner, levels, alpha). Editing the terrain with external tools requires some manual editing: the lines starting with "[<timetag>] tool name: " need to be commented out, by replacing [with #.

!! Find and replace "[" to "#" in the whole file

The Print PGM option lists the vertical resolution of the area for 8-bit and 16-bit images, and lets the user choose the format. The 8-bit format rescales the terrain to use the full range of 256 values, and stores the scaling information in the # minground and # maxground comment fileds; thus the resolution depends on the terrain range. The 16-bit image uses the tool internal resolution of 8 mm and absolute height levels.

Bugs: all messages in SL are asynchronous. It is possible that the rows of the terrain map come out in wrong order in the printout. Each output message contains a comment indicating the row index. You may need to check, manually or programmatically, that the rows are in order.

Note that the way image manipulation software handle images with more than 8 bits varies. The image may be converted to 8 bits during loading. In 16-bit systems the pixel values may be converted to full 16 bit range; the tool sets <Maxval> to 32768 (256 m * 128 steps/meter), which corresponds to 'white' in the PGM image and may be represented as value 65535 (2^16-1) in the image software. In that case the mapping between the actual ground height and pixel value is *ground = pixelvalue/256.* The default formula for calculating the ground level from the pixel value is printed as a comment, that is valid if the image manipulation application does not apply any rescaling.

Adobe Photoshop supports 16-bit images but it appears to have a bug in reading 16-bit ASCII PGM images and has no option to write ASCII PGM format. Gimp does not support 16-bit images yet. Gimp produces rather inefficient ASCII PGM files, with one pixel on each line, which is extremely slow to read in SL scripts.

IrfanView (http://www.irfanview.com/) is a handy tool for converting 8-bit images and applying basic transformations, such as rescaling, rotation, flipping.

Netpgm package (http://netpbm.sourceforge.net/) should work for converting the images but has not been tested.

4.5 GNU Octave example

For manipulating the image files, GNU Octave (http://www.gnu.org/software/octave/) is a free numerical math software tool, and has been tested to work. You can use it for converting to other 16-bit formats also. As an example, save the parcel by Save backup, Set mode > Backup, Whole parcel, Print PGM and copy/paste the printout in a file, say 'myparcel.pgm'. With any text editor, do global replacement of '[' to '#'. Start Octave and use the following commands

```
data=imread('myparcel.pgm');
ground = double(data)/128; % scale back to meters

imagesc(ground);        % see the height map
axis xy equal square % set origo in lower left corner

surf(ground);        % show the ground as a surface
```

```
% save as 16-bit png file that works in PS
imwrite(data,'myparcel.png','png');
```

GNU Octave is very handy tool with rich scripting language for creating the terrains. For an arbitrary example, you have a nice mountain but it's too high, and we flatten the height range above the sea level by factor of two, but preserve the sea depth.

```
waterlevel=20;
data=imread('myparcel.pgm');
ground = double(data)/128; % scale back to meters
J = find(ground>waterlevel);
ground(J) = (ground(J)-waterlevel)/2 + waterlevel;

% save with the same scaling it was,
% the routine write_pgm is given below

write_pgm(ground*128, 'after_iceage.pgm',0,256,[],[],32767);

% we can also scale to 3-digit integer to fit larger area in one
% file and set the min/max ground. (With about 4 bytes per pixel
% one file (65000 B) can fit ~ 17 000 m2, or 100 x 170 area)
gmin=min(ground(:));
gmax=max(ground(:));
img=round((ground-gmin)/(gmax-gmin)*1000);
write_pgm(img,'after_iceage.pgm',gmin,gmax);
```

Note: edit and copy/paste the comment line setting the parcel SW corner from the original file to the new file, or set Full Parcel in the terraform tool

```
# Parcel SW corner:
```

Below is a Matlab/Octave function to save the data as ASCII PGM file compatible with the terraform tool.

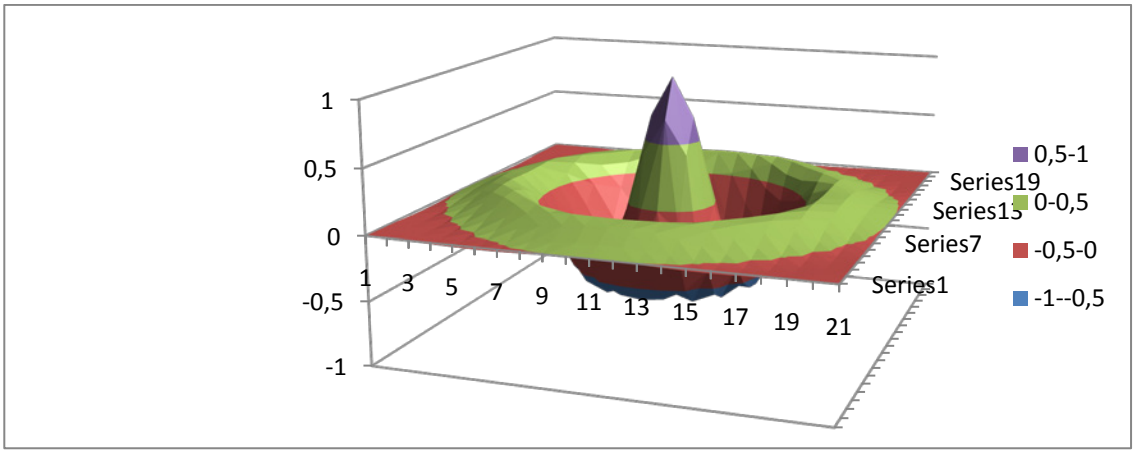
```
function write_pgm(m,fileName,minground,maxground, comments, maxFileSize,maxval)
% write_pgm(m,fileName,minground,maxground, comments, maxFileSize,maxval)
% Writes data as ASCII PGM file compatible with EdenScape terraform tool
%   m - image data
%   fileName - output file
% Optional arguments
%   minground - default ground level of pixel value 0
%   maxground - default ground level of pixel value maxval
%   comments  - string or cell array of additional comments,
%               e.g. {'comment1','comment2'}
%   maxFileSize - maximum output file size, default 65000 bytes
%   maxval    - maxval used in scaling the data, default is
% Empty values are replaced by defaults, f.ex.
%       write_pgm(m,'island.pgm',[],[],'alpha');

if ~exist('minground','var') || isempty(minground), minground=0; end
if ~exist('maxground','var') || isempty(maxground), maxground=255; end
% default max file size is the SL notecard max size
if ~exist('maxFileSize','var') || isempty(maxFileSize), maxFileSize=65000; end
if ~exist('comments','var') comments={}; end
if ~iscell(comments) comments = { comments };end
if ~exist('maxval','var') || isempty(maxval), maxval=max(m(:)); end

partNumber=1;

file=fileName;
f=fopen(file,'w');
fprintf(f,'P2\n# minground %f\n# maxground %f\n',minground,maxground);
for k=1:length(comments),
```

```
    fprintf(f,'# %s\n',comments{k});
end
fprintf(f,'%d %d\n%d\n',size(m,2),size(m,1),maxval);
for k=1:size(m,1),
    s='';
    for j=1:size(m,2),
        t=sprintf('%d ',m(k,j));
        % check the current file size, slow but proof
        D=dir(file);
        if D.bytes + length(t) + length(s) > maxFileSize,
            % need another part
            [pathstr, basename, ext] = fileparts(fileName);
            fclose(f);
            partNumber=partNumber+1;
            newfile=fullfile(pathstr,sprintf('%s_Part_%d%s',basename,partNumber,ext));
            f=fopen(newfile,'w');
            disp(sprintf('File %s full, opened new file %s',file,newfile));
            file=newfile;
        end
        % check for max NC line length
        if length(s)+length(t)>255,
            s(end)='';
            fprintf(f,'%s\n',s);
            s='';
        end
        s = [s t];
    end
    if length(s)>0, s(end)=''; fprintf(f,'%s\n',s); end
end
fclose(f);
```

4.6 MS Excel example

In the following example we generate a terrain patch like a droplet dropping in water: a sinusoidal radial wave with wavelength 8 m, damped by Gaussian bell curve with standard deviation 4. The table below shows part of the excel table for generating the data. We define row of x values (-10 to 10) and a column of y values and set up the equation; the sinusoidal wave is COS(R *2*3.14/L) where the radial variable R is SQRT(B$2^2 + $A5^2), and the wavelength L is 8. The Gaussian envelope is EXP(-(B$2^2 + $A5^2)/(2*S^2)) where the s.t.d parameter is 4.

x	-10	-9	-8	-7	-6	-5	-4	-3
y	=COS(SQRT(B$2^2 + $A5^2)*2*3.14/8)*EXP(-(B$2^2 + $A5^2)/(2*4^2))							
-10	0	-0	-0	-0.01	-0.01	-0.02	-0.02	-0.01
-9	-0	-0.01	-0.01	-0.02	-0.02	-0.01	0.01	0.02
-8	-0	-0.01	-0.02	-0.01	0	0.03	0.06	0.09
-7	-0.01	-0.02	-0.01	0	0.04	0.09	0.13	0.16
-6	-0.01	-0.02	0	0.04	0.1	0.15	0.16	0.13
-5	-0.02	-0.01	0.03	0.09	0.15	0.16	0.09	-0.05
-4	-0.02	0.01	0.06	0.13	0.16	0.09	-0.1	-0.32
-3	-0.01	0.02	0.09	0.16	0.13	-0.05	-0.32	-0.56
-2	-0.01	0.04	0.12	0.16	0.07	-0.19	-0.5	-0.63
-1	-0	0.05	0.13	0.16	0.02	-0.29	-0.59	-0.58



Next we define another table for the rounded values normalized to 0...255, with aid of cells that tally the min and max of the values. The formula for the pixel values is (relative to the top left cell) =ROUND(255*(B5-F27)/(F28-F27);0) whereF28 is the max cell and F27 the min cell. We add a comment for the flat level, that is the zero value, so we can later adjust it to blend in the terrain. The formula in the flat level cell is just mapping of 0 by the same way as the other values; =(0-F27)/(F28-F27)*E31 where E31 is the maxground value typed in.

```
P2
# maxground 10
# flat level 3.88
 21  21
255
 99  99  98  97  97  96  97  97  98  99  99  99  98  97  97  96  97  97  98  99  99
 99  98  97  97  97  98 100 103 105 107 108 107 105 103 100  98  97  97  97  98  99
 98  97  97  97  99 103 108 113 117 119 120 119 117 113 108 103  99  97  97  97  98
 97  97  97 100 105 113 119 123 124 123 123 123 124 123 119 113 105 100  97  97  97
 97  97  99 105 114 122 124 119 110 102  99 102 110 119 124 122 114 105  99  97  97
 96  98 103 113 122 123 112  92  70  54  48  54  70  92 112 123 122 113 103  98  96
 97 100 108 119 124 112  84  48  21   8   4   8  21  48  84 112 124 119 108 100  97
 97 103 113 123 119  92  48  12   0   9  16   9   0  12  48  92 119 123 113 103  97
 98 105 117 124 110  70  21   0  25  74  99  74  25   0  21  70 110 124 117 105  98
 99 107 119 123 102  54   8   9  74 164 206 164  74   9   8  54 102 123 119 107  99
 99 108 120 123  99  48   4  16  99 206 255 206  99  16   4  48  99 123 120 108  99
 99 107 119 123 102  54   8   9  74 164 206 164  74   9   8  54 102 123 119 107  99
 98 105 117 124 110  70  21   0  25  74  99  74  25   0  21  70 110 124 117 105  98
 97 103 113 123 119  92  48  12   0   9  16   9   0  12  48  92 119 123 113 103  97
 97 100 108 119 124 112  84  48  21   8   4   8  21  48  84 112 124 119 108 100  97
 96  98 103 113 122 123 112  92  70  54  48  54  70  92 112 123 122 113 103  98  96
 97  97  99 105 114 122 124 119 110 102  99 102 110 119 124 122 114 105  99  97  97
 97  97  97 100 105 113 119 123 124 123 123 123 124 123 119 113 105 100  97  97  97
 98  97  97  97  99 103 108 113 117 119 120 119 117 113 108 103  99  97  97  97  98
 99  98  97  97  97  98 100 103 105 107 108 107 105 103 100  98  97  97  97  98  99
 99  99  98  97  97  96  97  97  98  99  99  99  98  97  97  96  97  97  98  99  99
```

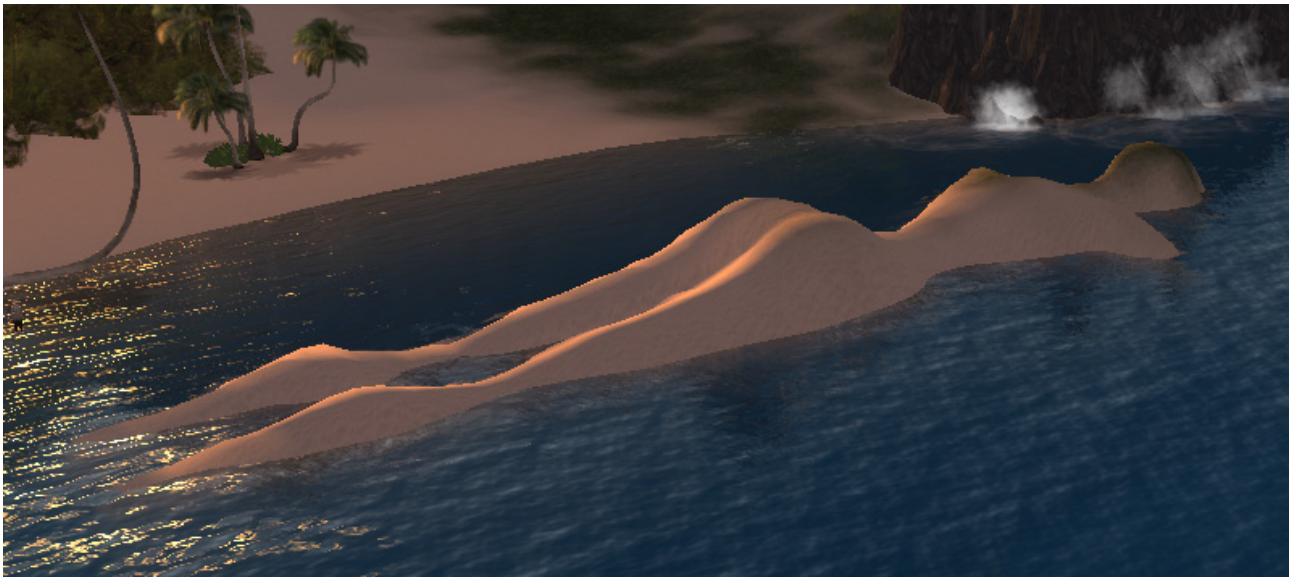
Next we copy the table above on a notecard in SL, and load it in the tool, and set the base level as 3.88 m below the surrounding terrain. The result is shown below, with Linda B sitting on the wave.

EdenScape by Linda B Helendale

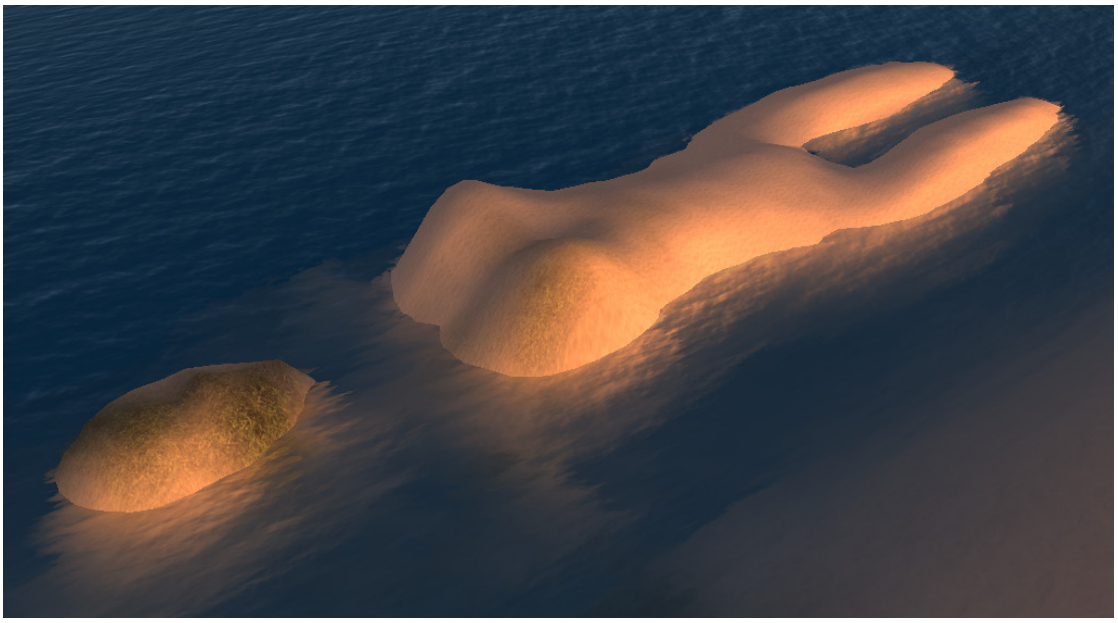
Description of the terrain notecards included in EdenScape Creator purchase

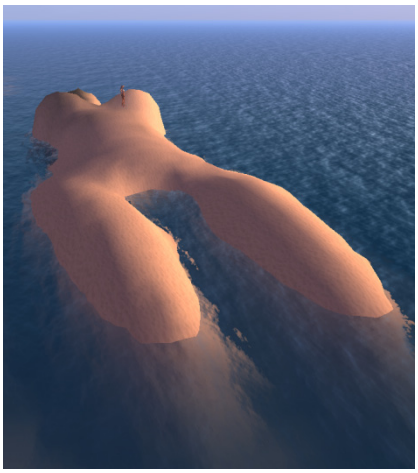
SpiralMountain 100x100 : 100 x 100 m spiral mountain with four paths leading to the top.

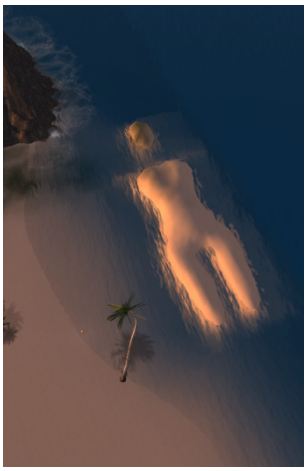
Fback 64x32 : 64 x 32 m island with shape from the SL female avatar

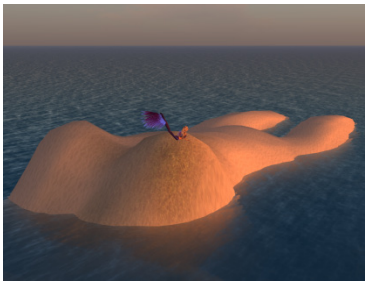


Ffront 64x30 : 64 x 30 island with shape from the SL female avatar

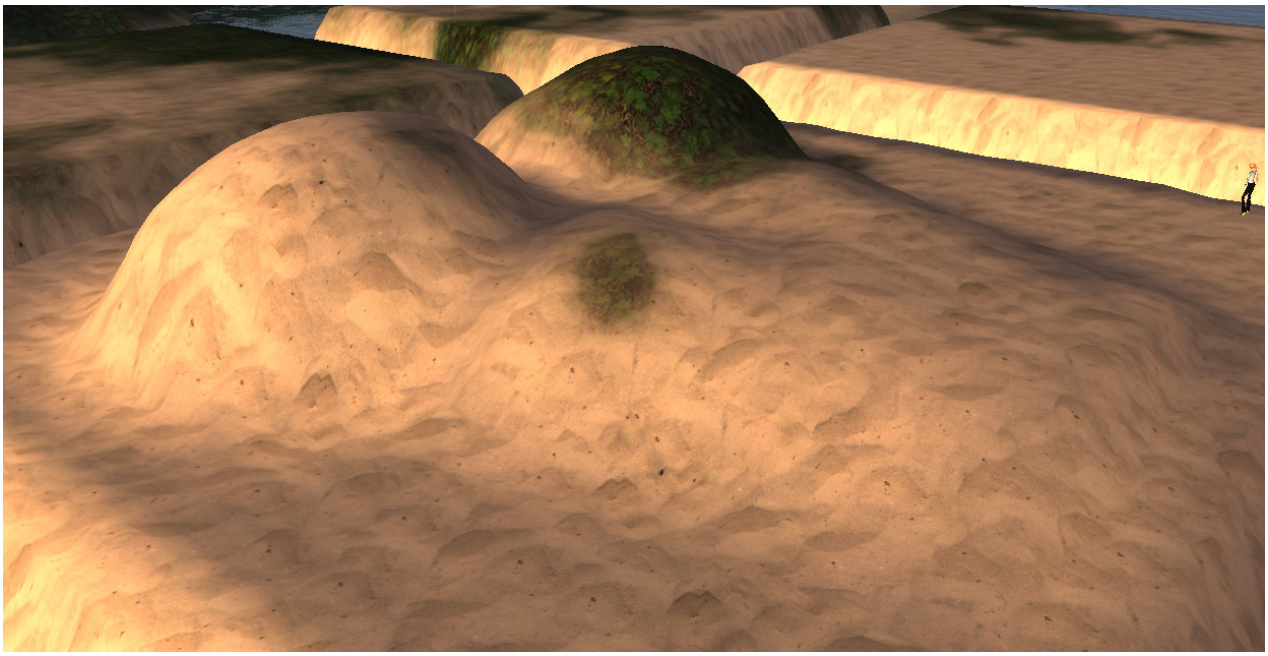




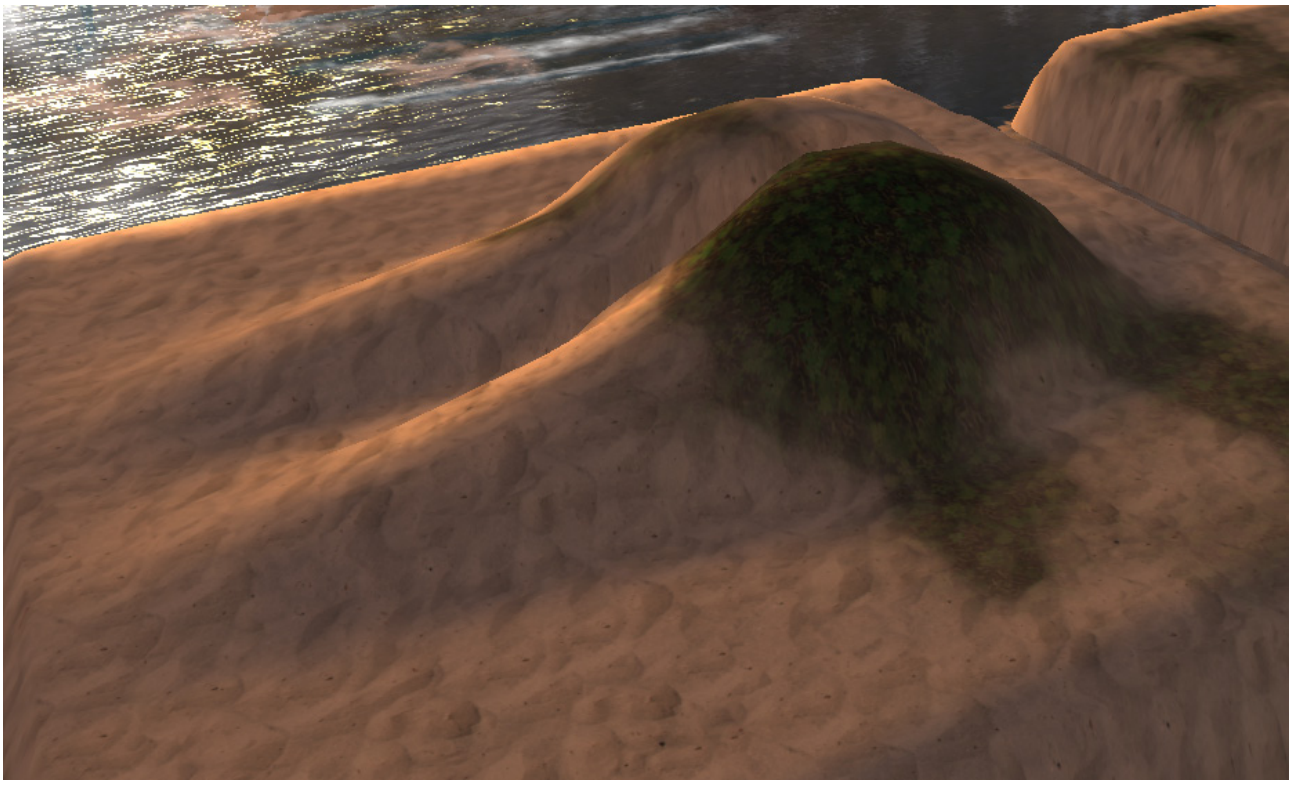


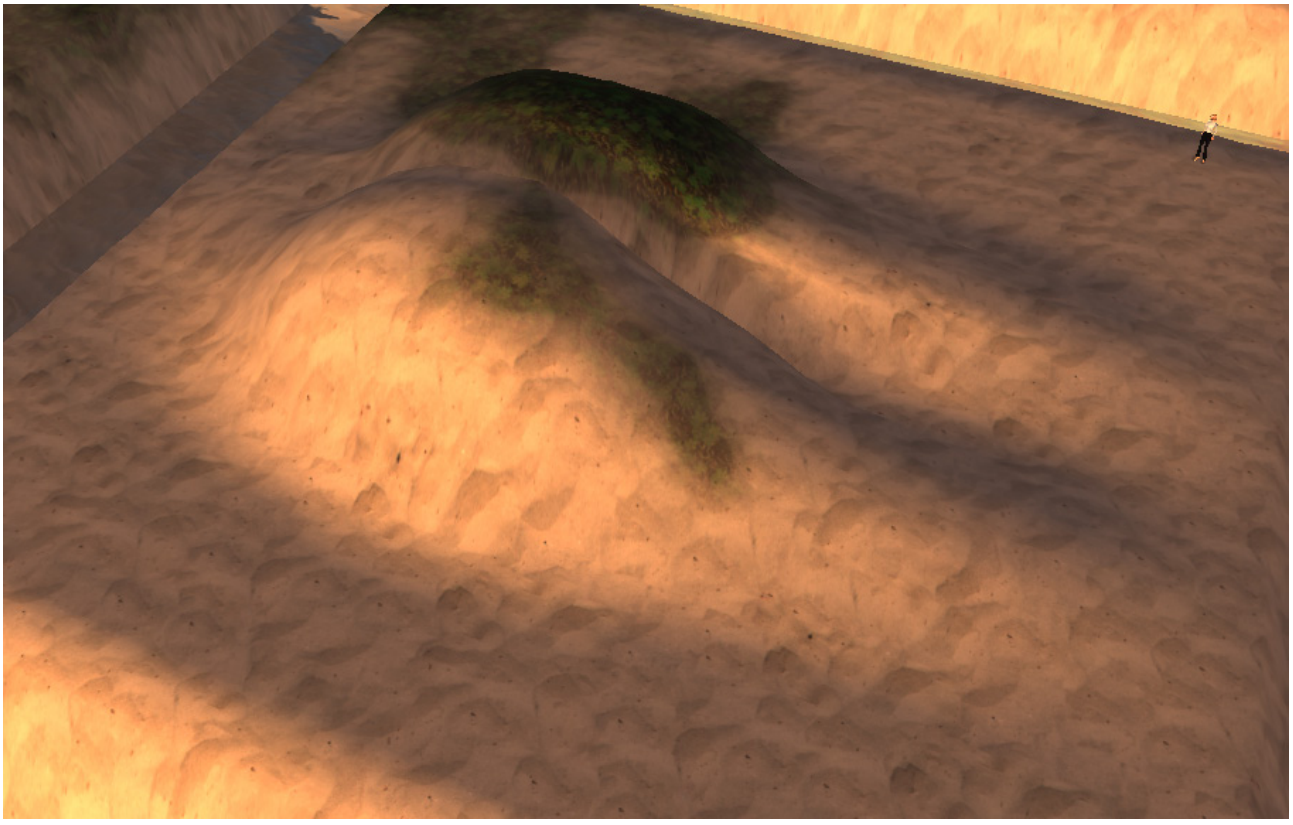


Ftop 32x32 : 32 x 32 hill made from SL female avatar torso



Fbum 32x32 : 32 x 32 hill made from SL female avatar lower body





Jin-Jang 57x64 : 57 x 64 m island made from a jin-jang image

excelExample : 21 x 21 m droplet wave shape; the user manual shows how to make this terrain map in MS Excel spreadsheet

Maze 32x32 : 32 x 32 m maze generated with a maze script; any maze raster image can be used to make a terrain maze