Investigating the Spline tools in Vue

(a self-tutorial by Robert Woudsma: etherealcanvas.ca)

Introduction

The best way to begin our look at splines is probably to create a simple heightfield terrain, say 100m x 100m large and standard height. Then raise the camera up and back to look down on the terrain.

➢ Now select the spline tool: S There are actually two tools, if you right-click on the spline tool you will that the other is a road spline tool: |:| We'll start with the regular spline tool to start. We'll look at the Road Spline on page 20.

When you click on the spline tool a **Spline Editor** window will be displayed. Initially, only the upper icons of the Spline Editor will be active, specifically, the Spline points draw tool: ➔ as the tool-tip for this icon says: Toggle On to Add Control Points, Off to Edit Control Points when it is ON you can add points to the overall spline. When it is OFF you can edit the points that have been placed.

➢ Place several spline points from one side of the terrain to the other, then turn off the Spline points draw tool.
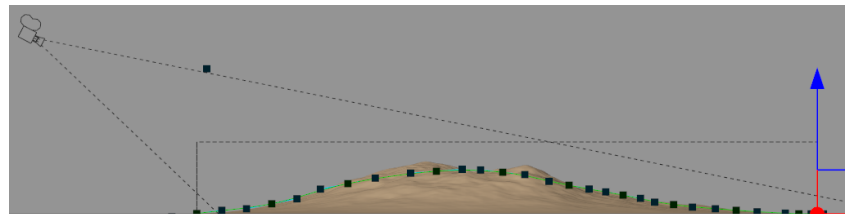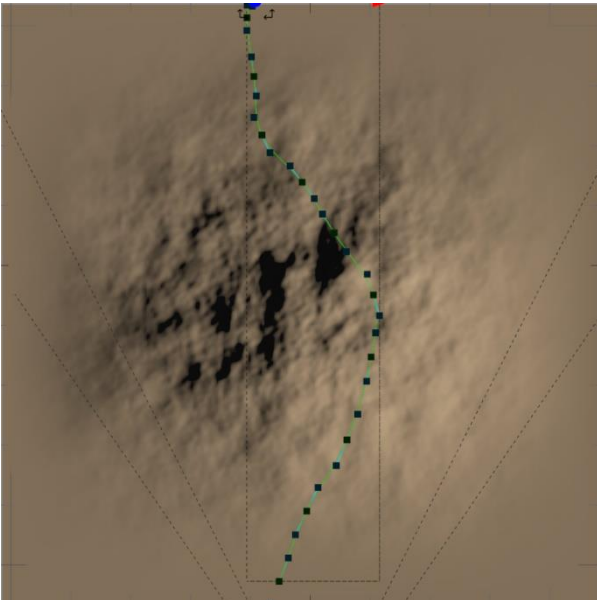
Notice that each spline point consists of the point (control point) plus an IN tangent adjustment point and an OUT tangent adjust point (normal) to manipulate the tangent angle of the spline at that control point. We'll test these shortly.

Notice also that the points of the spline generally follow the height contour of the terrain.

Spline Points Adjustment

Each point of the spline will be listed under the spline name in the **World Browser**. Expand the spline name to view the list. One way to select a **point** along the spline is to select it in the list.
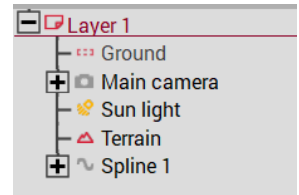
➤ Select **point 1** from the list and move it about a bit. Try it in each of the various view windows.

As you can see, selecting a point allows you to adjust the placement of that point <u>in any view</u>.
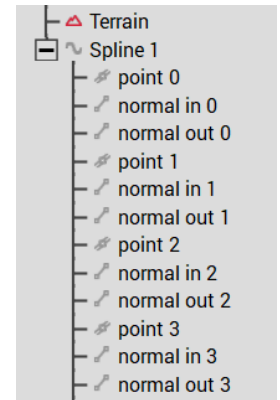
➤ Now select the **normal in 1** and adjust it about a bit. The **normal in** to a point adjusts the curve of the spline to make it enter the point at an angle of 90° and exit at 0°.
➤ Now select normal out 1 and adjust it a bit. The normal out to a point also adjusts the curve of the spline to make it enter the point at an angle of 90° and exit at 0°.

The length of either the normal in or normal out points in relation to the control point will change the radius of the in and out curves to the control point. Selecting the spline curve in any view or selecting the spline's name in World Browser will allow you to move the complete spline around.

NOTE: If you open the **Spline Editor** and turn off the **Spline Points Draw** tool then the **Realign Tangents** tool: can be used to select a spline point in any **View Window** and accomplish the same functions as listed above.

The 180° angle of the normal points can be change by Breaking the tangents angle with a left-click and locked again with a right-click of this **Tangent Break/Lock** tool
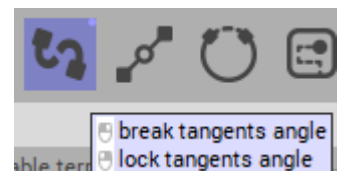
A spline curve can be closed with the **Spline Close** tool. This will leave an enclosed area bounded by the spline, often to define an area to be filled with an ecosystem.

Three Spline Effects

There are three effects windows below the spline icons that control the way the spline will operate; the Material Effect, the Geometry Effect and the Terrain Effect. We'll begin with the Terrain Effect.

Terrain Effect

➢ In preparation for this, Highlight the spline and in the Side View, lower spline points 2 and 3 somewhat below where they were originally placed.
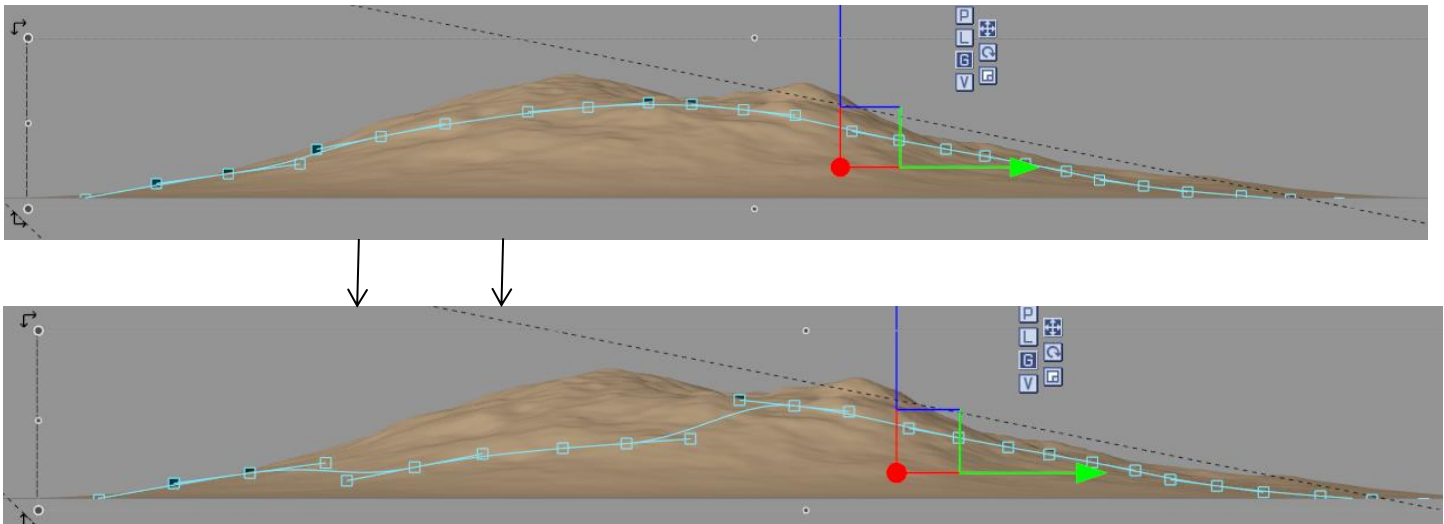
➢ Right-click the spline in World Browser and select Edit Object. This will open the Spline Editor with the Draw tool turned off.
➢
➢ Under the right-most, **Terrain Effect** tab, select the upper-left box to **Enable** terrain effects. Then at the upper-right of the List of influence window enable Terrain.

Immediately, the spline will reshape the terrain around the spline such that a channel is cut into or raised above the terrain depending on the spline's path.
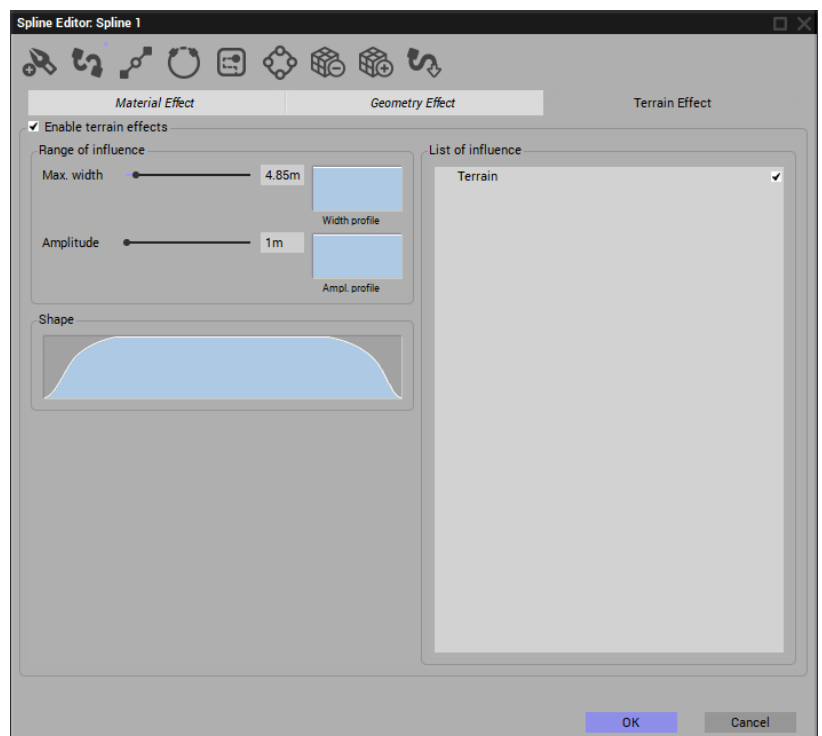
There are two items in the **Range of Influence** for the shape that the spline creates: the **Max width** and the **Amplitude**
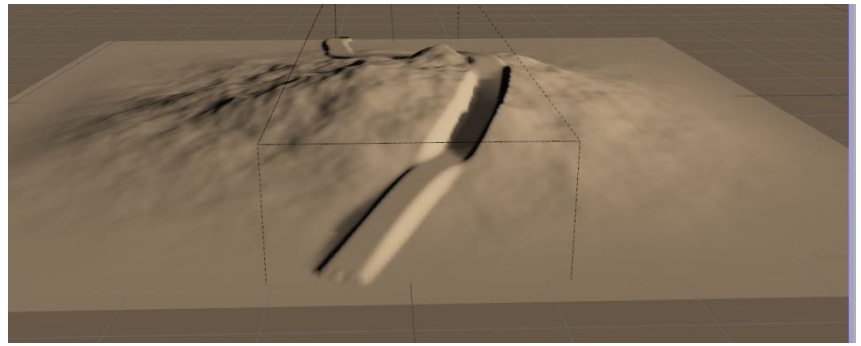
The **Max width** of the channel is initially set to a value of 4.85 meters.
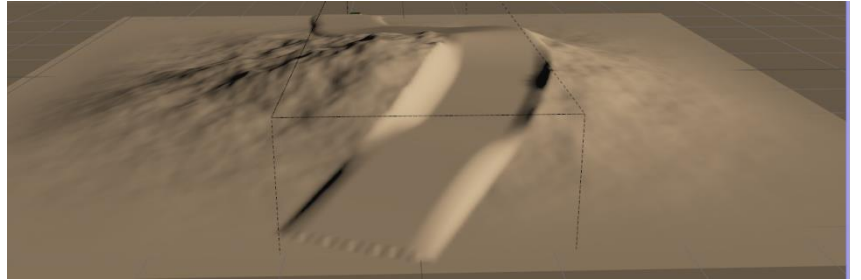
➢ Enter a new values to change this; try a value of 15 meters width.

The **Amplitude** of the channel above or below the points that define the spline is initially set to 1 meter. From here it can set higher or lower.
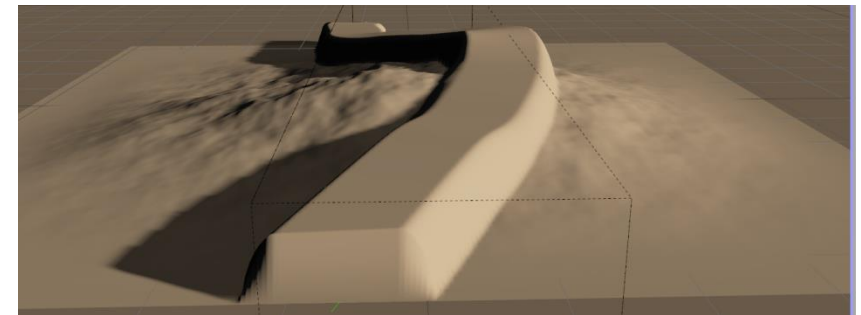
➢ Enter a value of 5 meters:

➢ Now try an amplitude value of -2 meters:
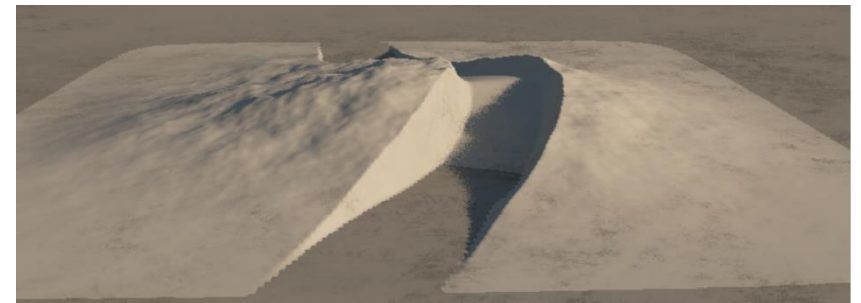
You still have the ability, (weather using the Spline Editor's **Realign tangents** icon or accessing them through the spline list in the **World Browser**) to adjust the position and height of each point of the spline. The terrain will immediately respond accordingly.

Width and Amplitude Profiles

Width Profile:

The profile of the spline's width refers to spline's relative width along the length of the spline.

➢ For example. Start a new terrain that is relatively flat and place a 4 point spline of 10 meters wide and -2 meters in amplitude in its center.

➢ In the **Spline Editor**, double-click on the **Width profile** window to open the **Filters** selection window.
➢ In the **Filters** window select the right-most **Time Splines** tab and then select the **Perpendicular twice** filter.
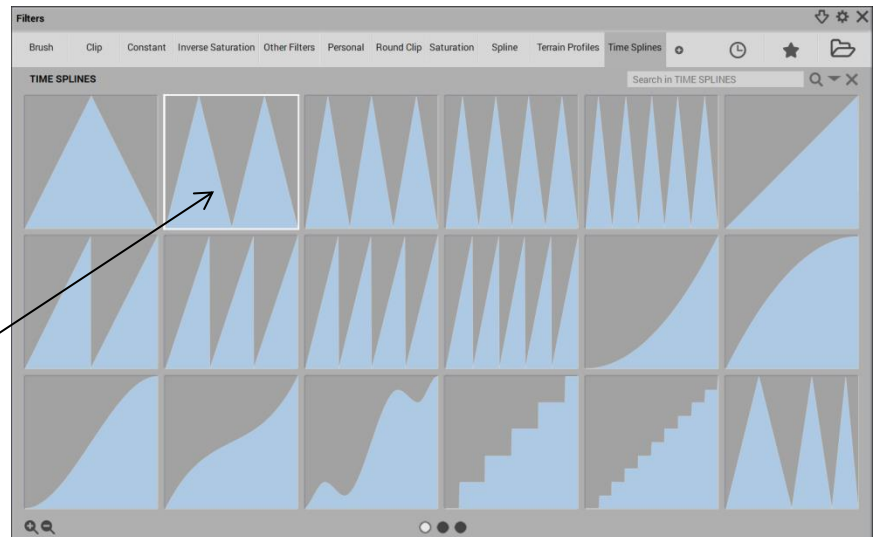
➢ Note that along the <u>length</u> of the spline, the spline channel <u>width</u> follows the double-triangle of the filter.

Reset the width profile to its original by double-clicking the Width profile window again and selecting **Fitters/Spline/01_one**

Amplitude profile

The profile of the spline's amplitude refers to spline's relative height along the length of the spline.

➢ Again, we'll begin with the spline channel cut into the terrain.

➢ In the **Spline Editor**, double-click on the **Ampli. profile** window to open the **Filters** selection window.
➢ In the **Filters** window select the right-most **Time Splines** tab but this time go to the third Time Splines window and then select the **Fast Perpendicular 3 Times** filter.

➢ Note that along the <u>length</u> of the spline, the spline channel **height** or **amplitude** follows the triple sign wave shape of the filter.

Reset the width profile to its original by double-clicking the Width profile window again and selecting **Fitters/Spline/01_one**
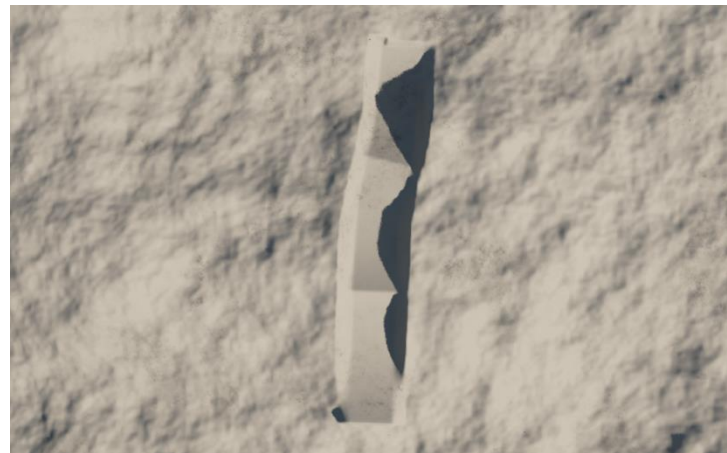
Spine Shape Profile

The **Shape** of the spline is the profile of
the spline channel across its <u>width</u>. We
will illustrate this by looking endwise at
the channel. The channel will have a wall
across it to more clearly show its cross-
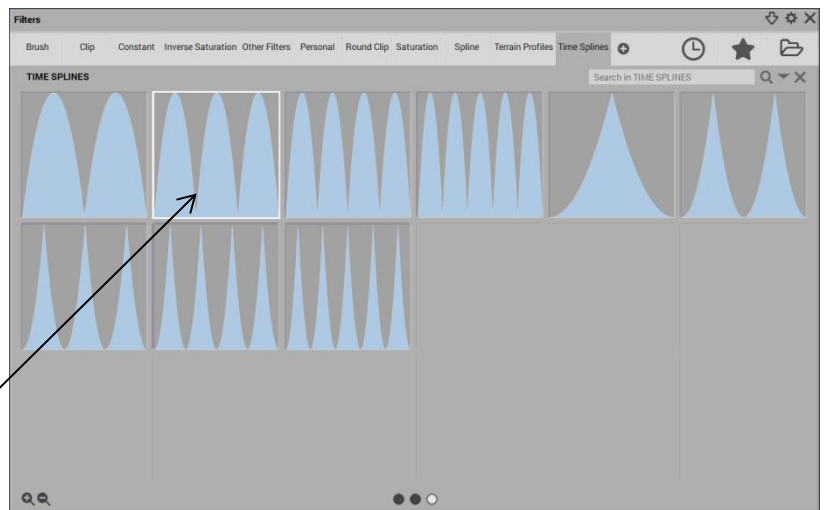section. The shape profile will be in the
direction shown above if its amplitude is
positive but our channel will be negative;
the inverse.

Adjusting the channel shape.

As with the **Max width** and **Amplitude** profiles, the cross-sectional shape of the
channel can be defined by using any of the Filter presets.

➢ Double-click on the **Shape** to
open the **Filters** window and
select the **Time Splines/Slow
Perpendicular Once** filter.
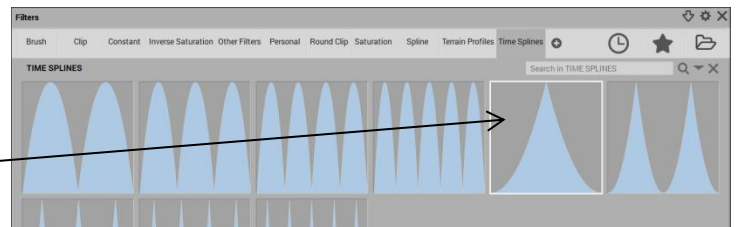
The channel takes on the parabolic "V"
shape. (inverse from filter shape because
of our negative Amplitude value)
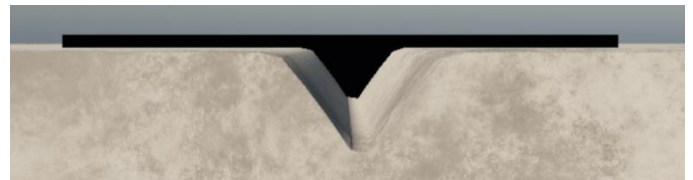
Filter Editor (Spline Effect)

There is another way to influence the spline channel's shape. This by using a
Filter Editor. This is actually available in all filter/profile windows including the
previous **Width** and **Amplitude** profiles.

➢ Right-click on the **Shape**
window and select **Edit
Filter** from the list to open it.

This filter editor is called the
Spline Effect editor
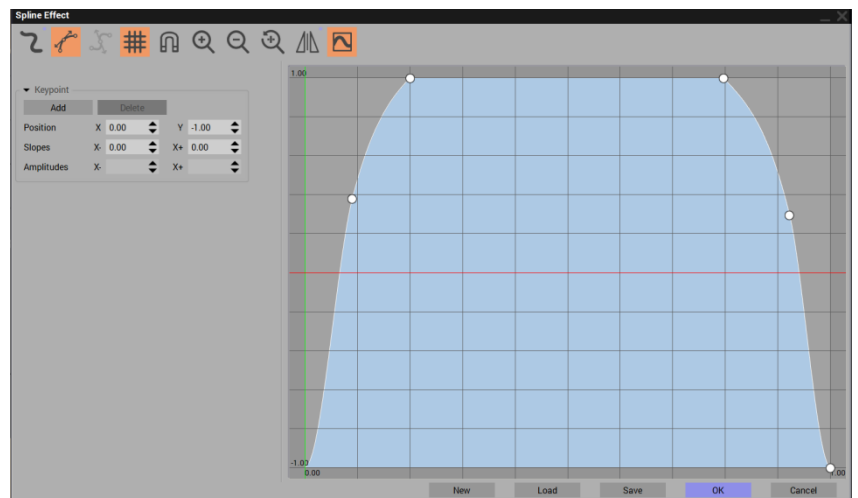
The **Spline Effect** filter editor, like all filter editors, has a window displaying some sort of profile. In this case; the profile of the spline's channel cross-section shapes.
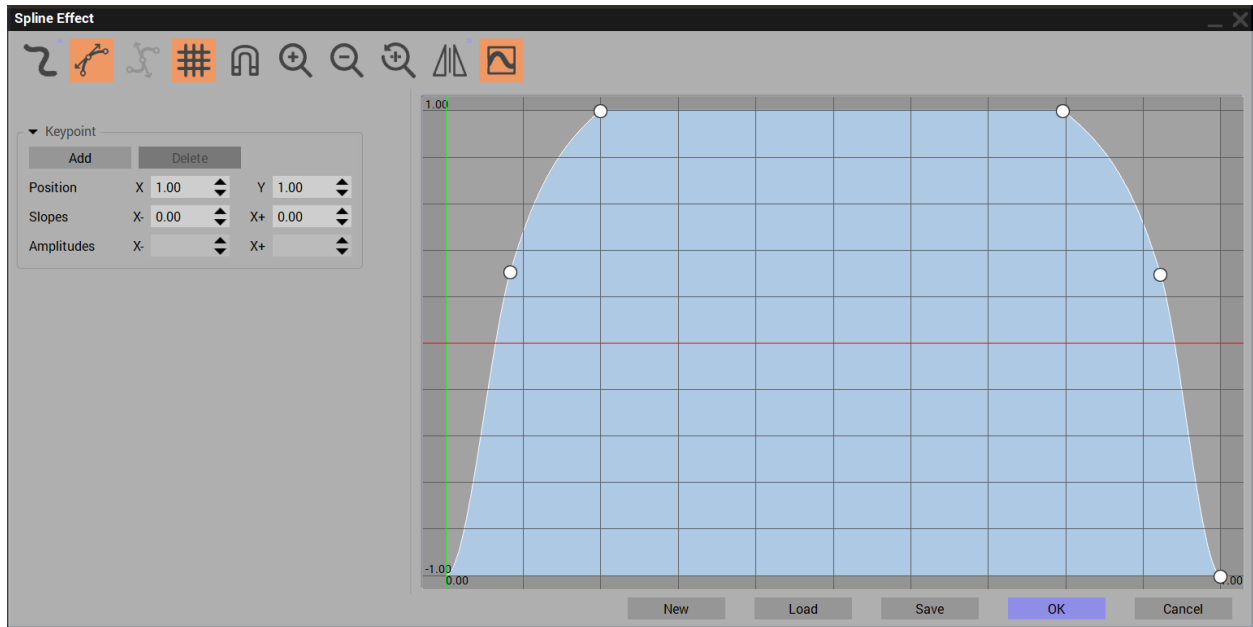
There are a number of dots on the profile which are referred to as **Keypoints**. The keypoints can be moved to influence the shape of the profile. Keypoints can be added and deleted and the X-Y position and slope of a selected keypoint is shown.

➢ Double click at the center-top of the profile to place a keypoint there.

➢ Click on the new keypoint and drag it down by about three grid lines.

➢ Now drag it down to a gridline below the red center-line.

The red center line is considered the zero point of the filter. Drawing the profile below this line will cut off the resulting terrain.
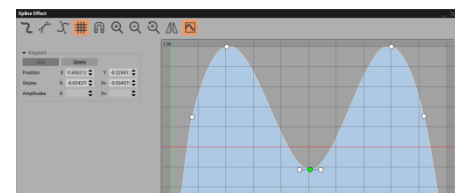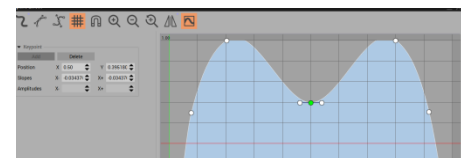
Geometry Effects

The second effect tab is called the Geometry effect. It could certainly be combined with the Terrain effect but we'll look at it here on its own.

- ➢ Begin with a terrain of 1k by 1k and a height of about 50m
- ➢ We will then create a spline over the terrain from one end to the other in a bit of a meandering path.
- ➢ Double-click the spline in the **World Browser** to open the Spline Editor.
- ➢ This time, click the center, Geometry tab and click on the **Enable geometry effects** check box.
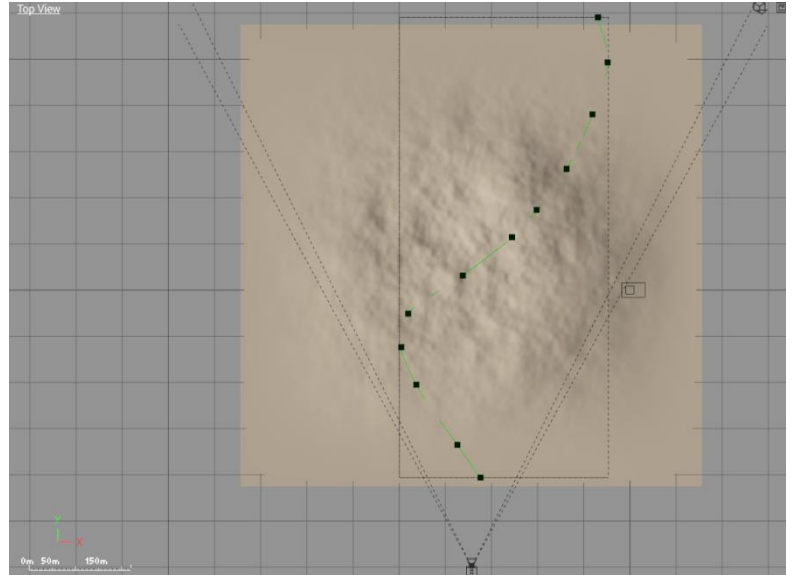
Immediately you see the Geometry section activate and a half-tube following the spine path on the terrain.
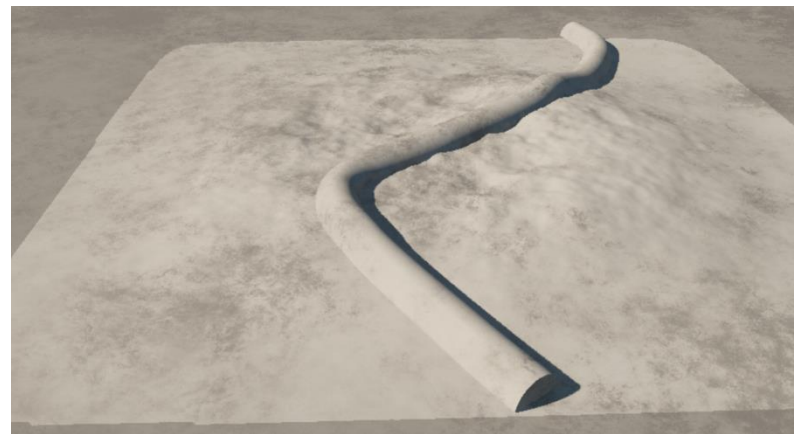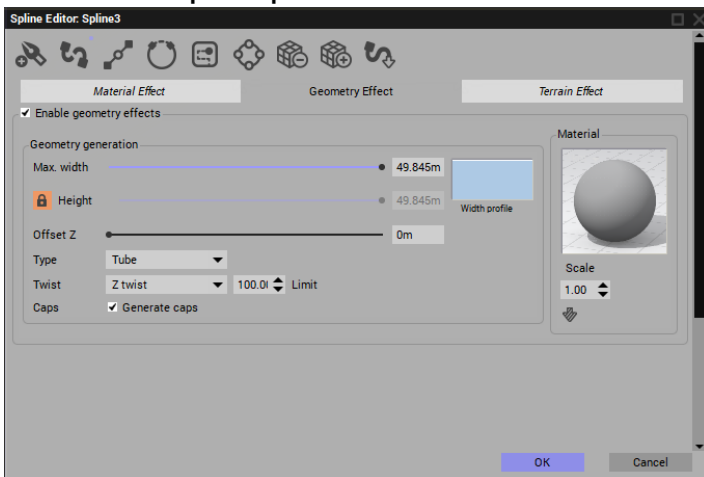
- In the Geometry generation section we have the familiar **Max width** slider and the **Width profile** window. These work as they did for the Terrain effect.
- Below this is a **Height** slider which can be locked to the Width proportions or left to be freely adjustable.
- Below this is the **Offset Z** slider that can be used to raise the entire spline geometry above the spline path in the Z direction.

Geometry Types:

Below the **offset Z** is the geometry **Type**.

It is set to **Tube** initially, it can be changed to a standard **Road** (lock the height for this)
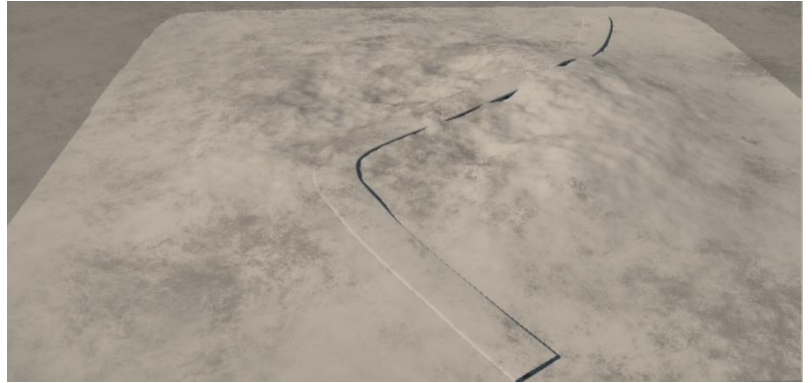
Or it can be set to a "**Cobble**" which is a hollow square tube. (unlock the **Height** to change its height)

[this view is out of one end of the cobble]

Finally, it can be set to an infinitely thin **Ribbon**.

(This ribbon was **offset Z** by about 10m to see it better above the spline on the terrain)

Below the geometry type is a parameter listing called **Twist**.

There are two types of twists. The default; **Z twist** and the **Frenet twist**.

The **Z twist** generates normal paths, tunnels or roads that follow the rise and fall, right and left of the underlying terrain surface but they stay perfectly horizontal <u>across</u> their surface.

This road was made under **Z twist** conditions.
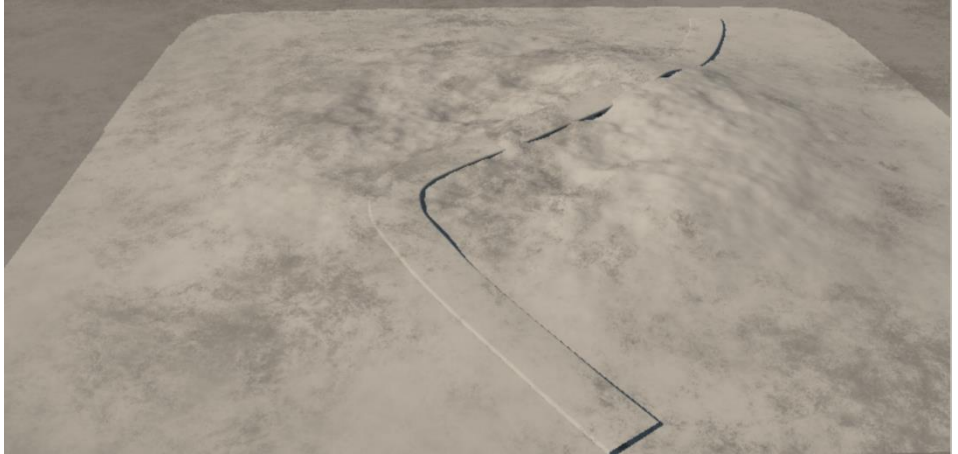
The **Frenet twist** generates geometries that follow the contours of the underlying structure or terrain surface, that it is applied to. There is a Limit parameter, next to the **Twist** type that will limit the amount of twist that can be applied. (0 – 100%)

[this does not seem to work well initially. Even when laying a flat road on a perfectly flat terrain surface, the **Frenet twist** causes radical twists.]

(The **Rotation gizmo** can cause correction by twisting back at each spline point though)

So for now use the default; **Z twist!** The tube, road and cobble can be capped at each end by checking the **Caps** box if desired.
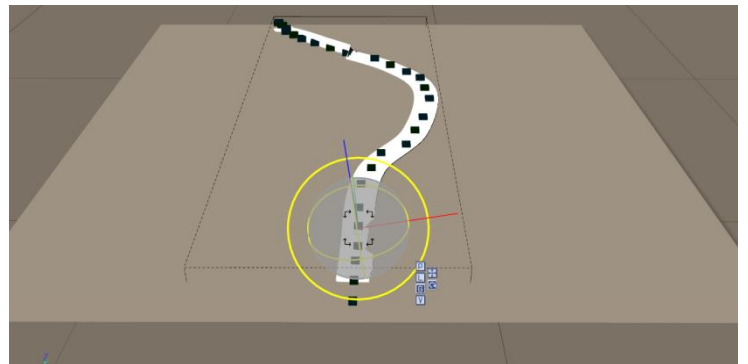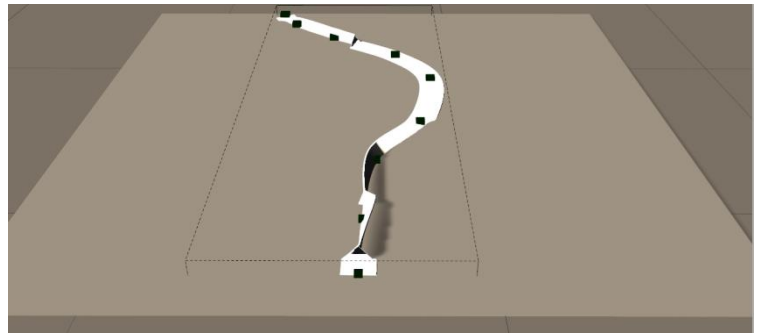
Geometry Material

Finally, there is a **Material** sphere at the top-right of the **Geometry Effect** window with ability to change a materials **Scale** below it. To load a new material, click on the **Load Material** arrow below the scale value.
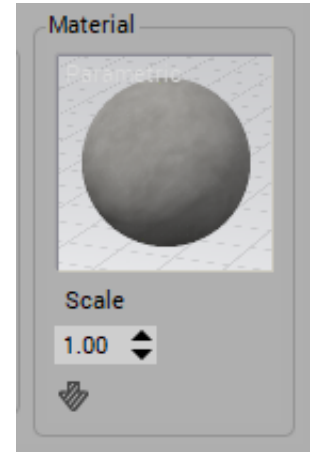
➢ Click the **Load Material** arrow and load the **Road with double centerline** material.
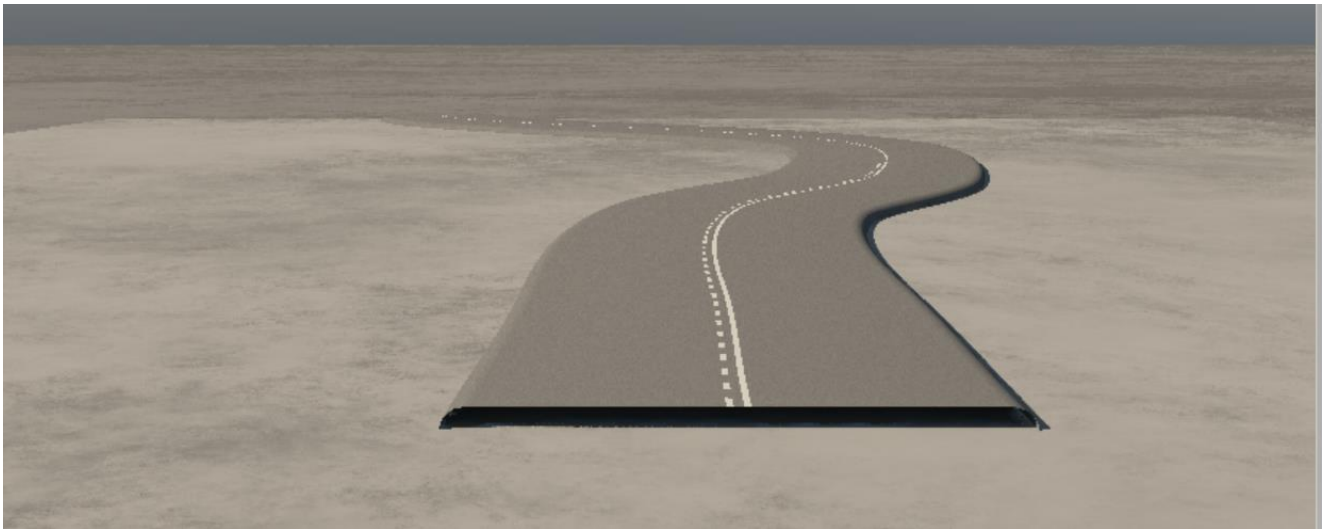
Advanced Material Editor

The Material Editor is always available for advanced material manipulation by double-clicking the material sphere. When it is launched it becomes a second tab, to the right of the Spline Editor.
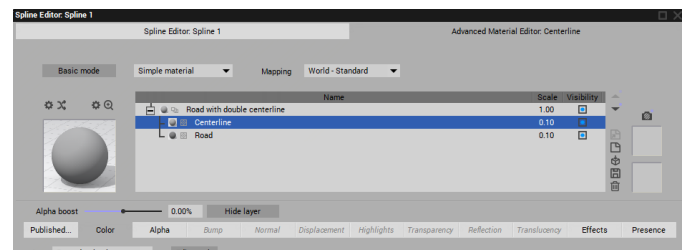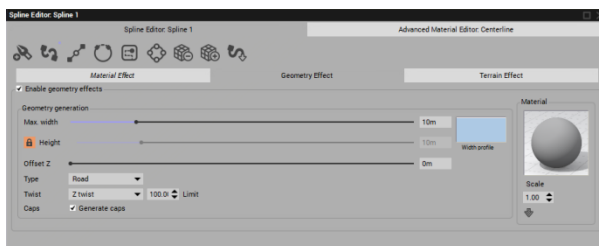
To remove the **Advanced Material Editor** tab click the **Cancel** button at the bottom and then re-launch the **Spline Editor** by double-clicking the spline.

The Material Effect

The third effect that can be used with splines is the Material/Ecosystems effect.
In the Material Effect window, it has two functionalities; Stroke and Fill.

New scene:

➢ The best way to see these effects is to create a new scene with a terrain of
  100m x 100m and 5m in height. Make its material Natural 3.
➢ We will add a gently wavy spline at the right area of the terrain.
➢ Set the **Terrain Effect** on with a Max width of 10m and an Amplitude of -1m
  and the List of influence – Terrain checked ON.
➢ Set the **Geometry Effect** on, again a **Max width** of 9m, unlocked **Height** of
  .5m and the Type set to road. Then load the Material: Road with double-
  yellow centerline. Darken the road colour a bit. Call it **Main Road** spline 1

➢ Create another spline another
  spline about 10m left of the Main
  Road spline from the back to the
  front of the terrain generally
  following the road contour. Call
  this spline **Tree Line spline 2**
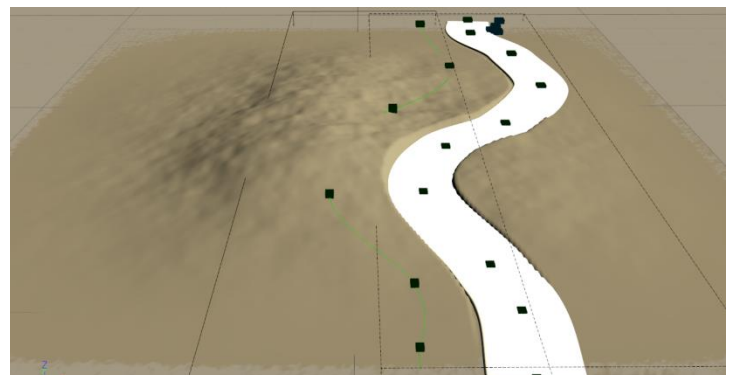
Stroke Function

In the **Stroke function** a material/ecosystem is applied generally along the Path of a spline. Here, we'll create the tree line.

➤ Only enable the left-most; **Material Effect** tab. In the **Stroke** area, set the **Max width** (of the path, now) to 8m and turn the **Preview as ribbon** on. (We won't be changing the **Width profile** at all)
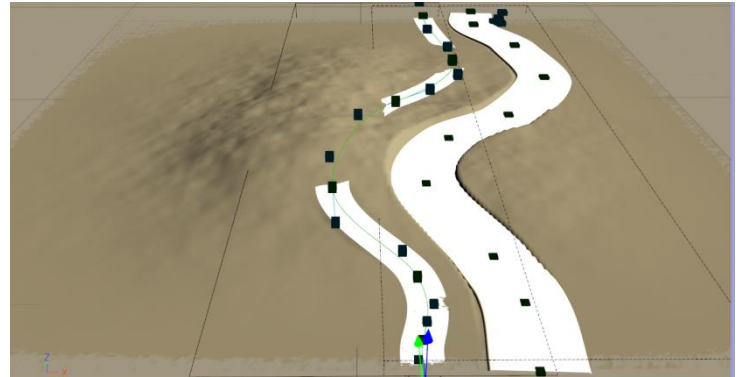
We will now see the path shown in each View window following along the Tree Line spline curve:

➤ Check the **Populate with an EcoSystem** box and see that the **Populate….along the path itself** option is automatically selected.
➤ The material sphere to the left will become active. Double-click the sphere to add and open the Advanced Material Editor window.

This works much the same is it did in the Geometry Effect. There will be a default **Material** listed in the material list window that you cannot get rid of. It is highlighted by default so we will select the ecosystem material to apply by just changing the Simple material shown in the text box above to an EcoSystem-Particles material.

➤ Change the **Simple Material** to **EcoSystems/Particles** in the text box. You will get this warning…

VUE Creator

ⓘ   Because this layer is the lowest in the stack, a new layer will be created for the EcoSystem/Particles above it.

☐ Don't show again.   [OK]
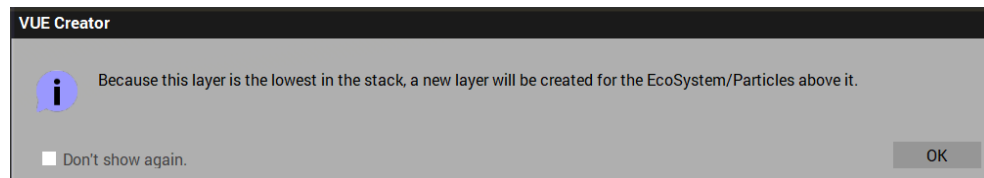
➤ …..just click on **OK** and the **Advanced Material Editor** will open with the eco layer shown below the Simple Material.
➤ Change the name of the Ecomaterial to **Tree Line spline 2**
➤ Under the **General** tab click on **Add Item** and pick a coniferous Plant or VOB to add to the **EcoSystem population** list.
➤ Once the tree has loaded, click on the <u>Populate</u> button, above the **General** tab (**Paint** won't work here) to apply the trees to the spline path.

Spline Editor: Tree Line Spline 2

Material Effect | Geometry Effect | Terrain Effect

☑ Enable material effects

Stroke

Width profile

Max. width — 8m
☑ Preview as ribbon

☐ Apply material on influenced objects
☐ Cut out other EcoSystems
☑ Populate with an EcoSystem
  Populate...
  ● ...along the path itself
  ○ ...by projecting onto objects

☐ Align instances along path

List of influences

Apply material/population on what?
● All objects, by   100.00%
○ Only selected objects

Cut out existing EcoSystems
● All EcoSystems, by   100.00%
○ Only selected EcoSystems

Name	Action	Ratio

When you double-click on the left Material sphere, above, the Advanced Material Editor, below, appears.

Spline Editor: Tree Line Spline 2

Spline Editor: Tree Line Spline 2 | Advanced Material Editor: Tree Line Spline 2

Basic mode   EcoSystem/Particles ▼   Mapping   World - Standard ▼

Name	Scale	Visibility
Material	1.00	
Tree Line spline 2	1.00	
Material	1.00	

☐ Dynamic population   Populate   Clear   Randomize   Paint   40 instances

General | Density | Scaling & Orientation | Color | Presence | Animation

EcoSystem population

Preview	Name	Scale	Presence
	Cl03y	1.00	100.0

☐ Particle motion
  Edit   Bake

☐ Fast population mode

Display options

Applying an underlying spline path material

There is a check box in the **Material Effects** window called **Apply material on influenced objects**. This refers to the material of the spline path that is being used to place the coniferous trees.

➤ Check it on now. The 8m path for the spline of the tree line will appear in the **Main Camera** view now as well.
➤ In the **Advanced Material Editor**, there is a **Material** listing, below the **Tree Line spline 2** listing in the list window. The left sphere for it is just gray.
➤ Double-click the sphere to open the materials selection window and select the **Landscapes/Desert Stones** material.

The path of the Tree Line spline will take on the new material appearance. The sphere in the Material effect tab will show both the underlying material and the ecosystem that was used.

Note that some trees are still hovering in the air. To keep them on the ground change **Populate..** in the **Material Effects** tab from **….along path itself** to **….by projecting onto objects**. The **Advanced Material Editor** - **density** will increase drastically and will have to be reduced.
In each case of a change, the ecosystem should be cleared and re-populated.

Constrain EcoSystem Instances to Path

To constrain ecosystem instances to a single file on the spline path the **Max width** of the path should be less than the width of an instance or even zero. This will, of course, change the width of the underlying path material (if used) as well. To avoid this, reduce the path to zero and clear/repopulate the ecosystem. Once the single row has been created, widen out the path without re-populating the ecosystem again.

Align Instances along the path:

Often, on the side of a road there will be road-side signs, facing the traffic and situated just off the edge of the road. This is accomplished with a third spline constructed on the right side of the road.

- In the Spline Editor – Material Effects tab, enable the materials effects.
- In the Stroke section set the Max Width to 0m
- Check populate with an EcoSystem and select the …by projecting onto objects option.
- Double-click the material sphere to open the Advanced Material Editor
- Add a new material layer and make it an **EcoSystem/Particles** layer
- In the General tab click Add Item and select the 25 mph a road sign .VOB

When you click **Populate**, you will see a huge amount of the signs of various sizes along the spline but initially facing in various directions…
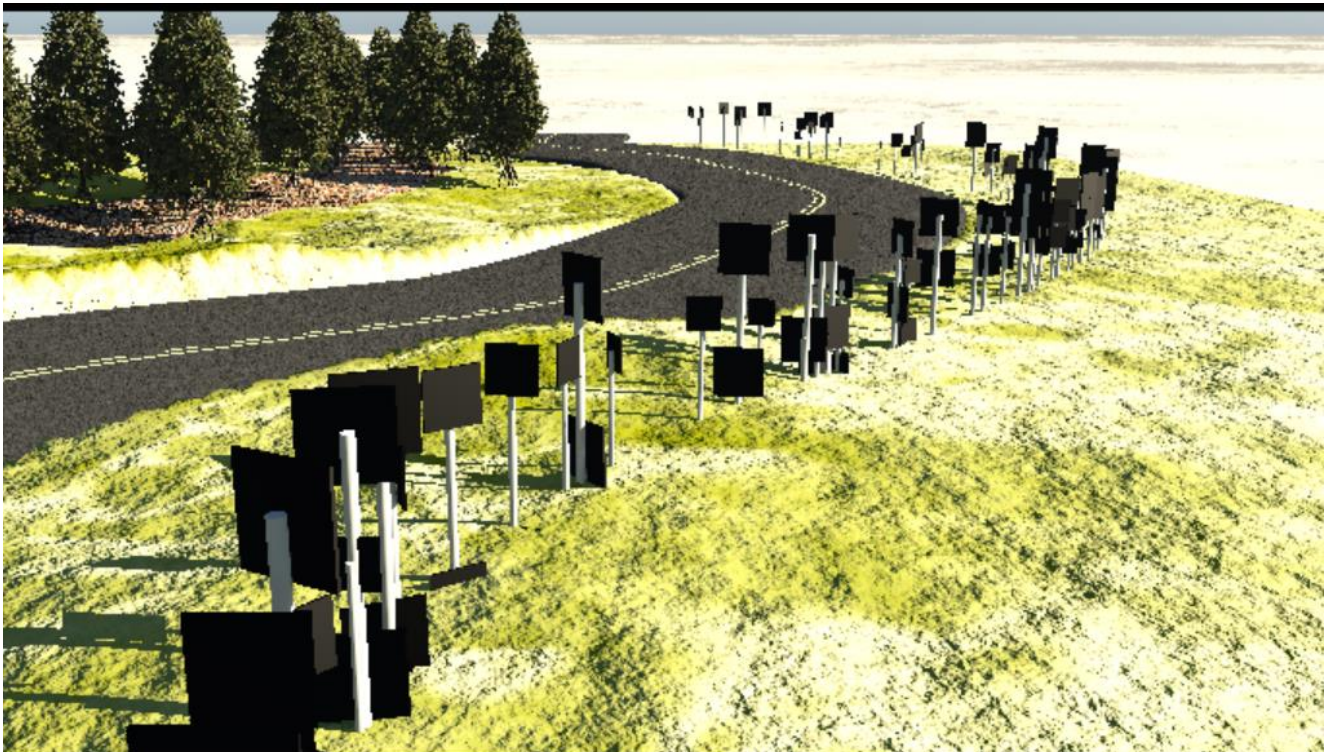
Now much of the behaviour of the spline instances will be determined by the **Advanced Material Editor** itself under various tabs.

Density tab:
Reduce the amount of signs by bringing the **Overall density** down to .1%
Set the signs to appear at regular intervals by checking the **Force regular alignment of instances** to on.
Set the **Absolute offset from surface** on at 0m

Scaling & Orientation tab:
Set **Maximum size variation** on X to 0.00
Ensure that **Keep proportions** is at 100% **uniform**
Set the **Direction from surface** to **Vertical** 0.00%
Make sure **Rotation** is set to **Up axis only**

We need to rotate the signs to be facing traffic. One way is with the **Rotation - Maximum angle**. But this is limited to 0° to 180°.

Another way is to set the **Maximum angle** under **Rotation** to 0.00^O and use the Spline Editors **Align instances along path** and then the **Rotate instances around path direction**. Set the **Variability** to 0 and adjust the **Angle** which can be from -180° to $+180^O$ (-85°). But this can cause a deviation from vertical on some instances

Fill Function

The lower section in the **Material Effects** tab is the **Fill** function. Here we'll create an enclosed spline to contain an ecosystem of trees of various types.

➢ To the left of the line of conifers we created earlier, create a new spline covering most of the area and then close the spline with the **Close Spline** icon. We'll call it **Forest Area spline 3**

➢ Enable the Material Effect tab and check box. Then in the lower, **Fill** section, check the **Populate with an EcoSystem** box.

➢ Double-click the left, material sphere to open the **Advance Material Editor** as before.

➢ Change the listed **Material** to an **EcoSystem/Particles** material and accept the warning

➢ Under the **General tab** of the **Advanced Material Editor** click on **Add Item** and select some version of a **Plant** or **Plant VOB.**

➢ Above the General tab click on Populate to fill the enclosed spline area with the selected plant.

As with the **Stroke** function, we could set the **Apply material on influenced objects** ON to show some selected material under where the **Forest Area** spline was placed.

Multiple Ecosystems -

Using spline areas, multiple ecosystems can be intermingled with each other and occupy portions or all of the same area.

➢ Create another closed spline in the lower portion of the Forest Area. Call the new spline: Red Trees Area.
➢ In the **Fill** section of the **Material Effect** click on **Populate with a Ecosystem.**
➢ Follow the earlier two procedures to populate the inside of this spline with a few red trees.

Notice that the red trees mingle with the Forest Area with both present.
 (the terrain material was changed here for some more ground-tree contrast)


Cut Out other Ecosystems

An Ecosystem can be placed within another ecosystem and the **Cut out other EcoSystem** option can be checked ON (in either Stroke or Fill function) to eliminate any or specific ecosystems occupying the same area.
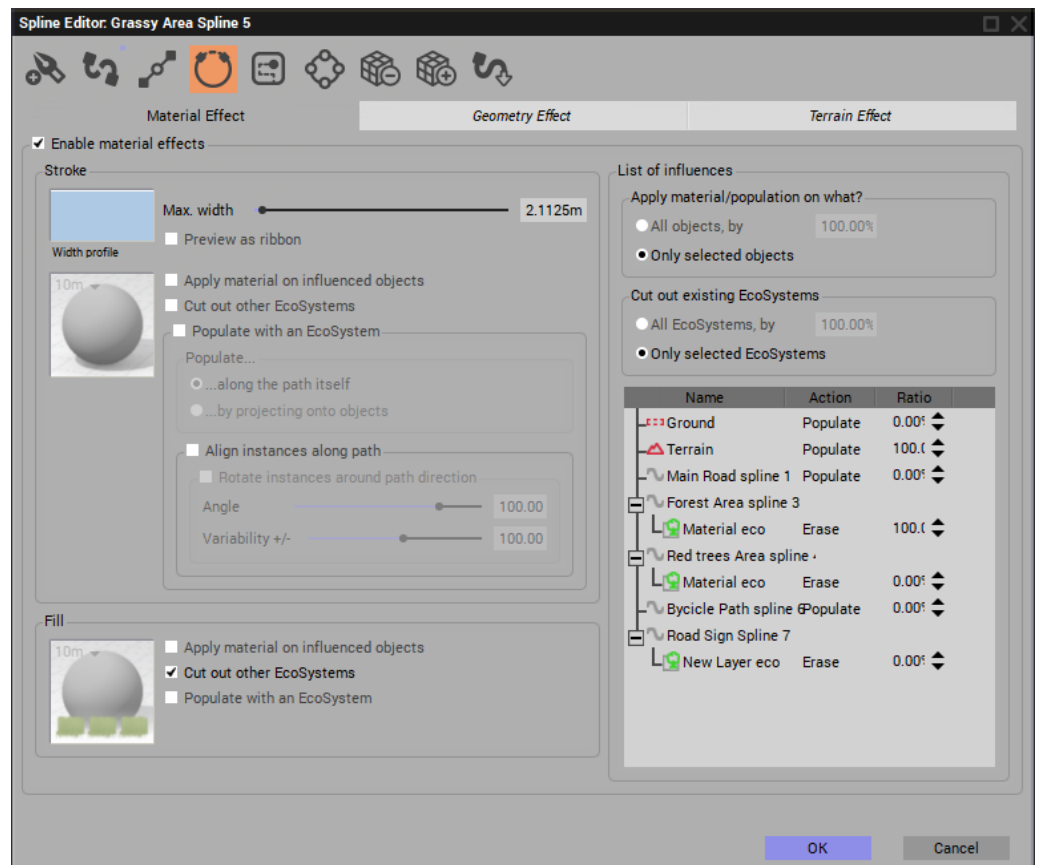
We are going to create a grassy area and then cut out some of the forest area instances within that grassy area.

➢ Create yet another closed spline in the upper part of the Forest Area and have it extend beyond the forest area at one point, almost to the tree Line spline 2.
➢ Call this, **Grassy Area** spline 5
➢ Follow the earlier three procedures to fill the spline area with a grass. (used tropical grass at density of 70)
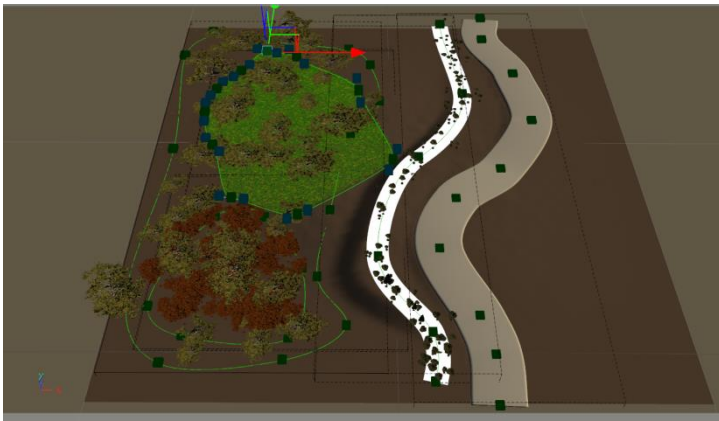
The grass cover appears below the trees and extends beyond the **Forest Area**, almost to the **Tree Line** spline 2.

➢ Now double-click the **Grassy Area spline 5** to open its **Spline Editor**.
➢ Under the **Material Effects** tab and under the **Fill** function, check the **Cut out other EcoSystems** box to ON.

Spline Editor: Grassy Area Spline 5

| Material Effect | Geometry Effect | Terrain Effect |

☑ Enable material effects

Stroke

Max. width — ● —————————— 2.1125m
☐ Preview as ribbon

Width profile

☐ Apply material on influenced objects
☐ Cut out other EcoSystems
☐ Populate with an EcoSystem
Populate...
◉ ...along the path itself
○ ...by projecting onto objects

☐ Align instances along path
☐ Rotate instances around path direction
Angle ———————————●— 100.00
Variability +/- ——————●———— 100.00

Fill

☐ Apply material on influenced objects
☑ Cut out other EcoSystems
☐ Populate with an EcoSystem

List of influences

Apply material/population on what?
○ All objects, by   100.00%
◉ Only selected objects

Cut out existing EcoSystems
○ All EcoSystems, by   100.00%
◉ Only selected EcoSystems

Name	Action	Ratio
Ground	Populate	0.00% ↕
Terrain	Populate	100.0 ↕
Main Road spline 1	Populate	0.00% ↕
Forest Area spline 3		
Material eco	Erase	100.0 ↕
Red trees Area spline ·		
Material eco	Erase	0.00% ↕
Bycicle Path spline 6	Populate	0.00% ↕
Road Sign Spline 7		
New Layer eco	Erase	0.00% ↕

OK   Cancel

- In the right: **List of influences** section, set the **Only selected objects** option ON.
- In the right: **Cut out existing EcoSystems** section, set **Only selected EcoSystems** option to ON.
- We only want to erase the trees that are contained within the **Grassy Area** so beside the **Forest Area spline 3** line set the Erase Action **Ratio** to 100%
- Press Okay at the bottom of the Spline Editor.

Nothing will appear to happen yet. The effected ecosystem will now have to be repopulated for the action to take effect. In our case it was the **Forest Area spline 3** that would have the trees with grass below them removed. We will then repopulate the **Forest Area spline 3** to have them removed.

- In the **World Browser**, select the **Forest Area spline 3**.
- In the **Object Aspect** material sphere, double-click the sphere to open the **Advanced Material Editor** and highlight the EcoSystem layer (whatever it's called, **Material eco**, here)
- Click on **Populate** to repopulate the ecosystem. The trees on the grassy area should now be gone.

Before cutting the Forest Area trees

After cutting the **Forest Area EcoSystem** that was on the **Grassy Area EcoSystem**.
Only the trees that were on the grass are gone.

Spline – Road option

A right-click on the main spline tool icon will reveal the **Road Spline**:

Once the **Road Spline** has been selected, it becomes the default spline type shown in Vue's left toolbar.

The **Road Spline** launches and works the exact same wat as the regular spline except that the **Terrain Effect** and the **Geometry Effect** are both automatically enabled.
One other difference is that in the **Geometry Effect**, the geometry **Type** is initially set to **Road** instead of to **Tube**.

We're going to create a bicycle path to the right of the previous main road. We will leave the default settings for this new roadway as they are.

➢ Plot a series of control points to the right side of the current road.
➢ In the Geometry Effect, we could change the Max width from 1 meter to 2 meters.

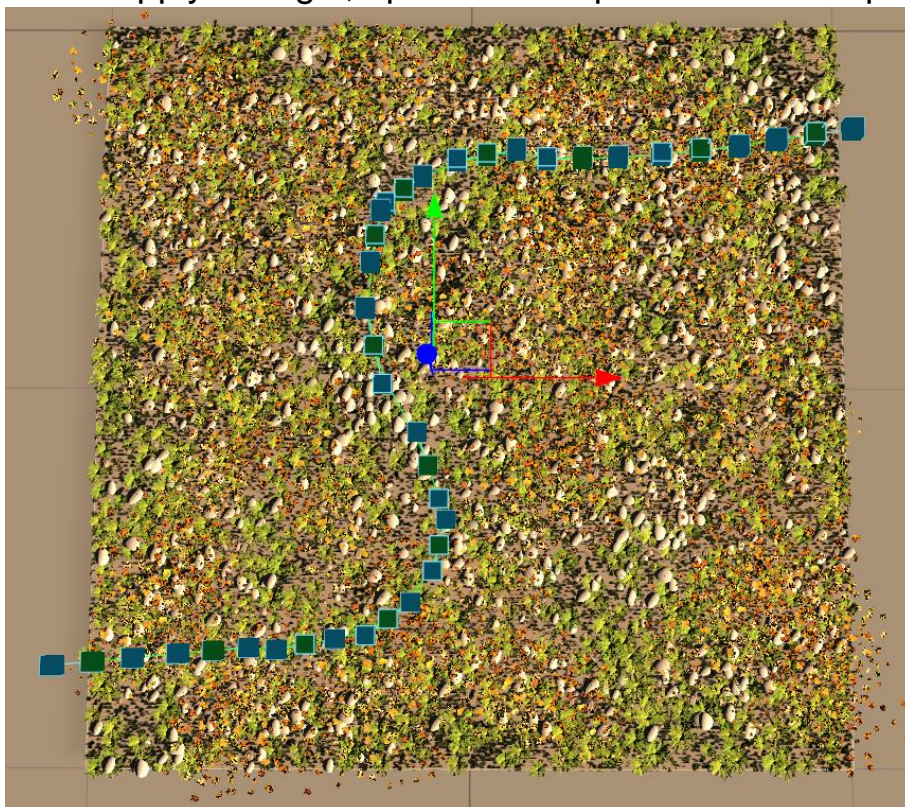Note that the bicycle path has a center line drawn on it by default.

Cutting a path through an EcoSystem

For the following demonstration we will use a Plane with a soil base material and populated with a number of Ecosystems: stones, undergrowth, grass and leaves.
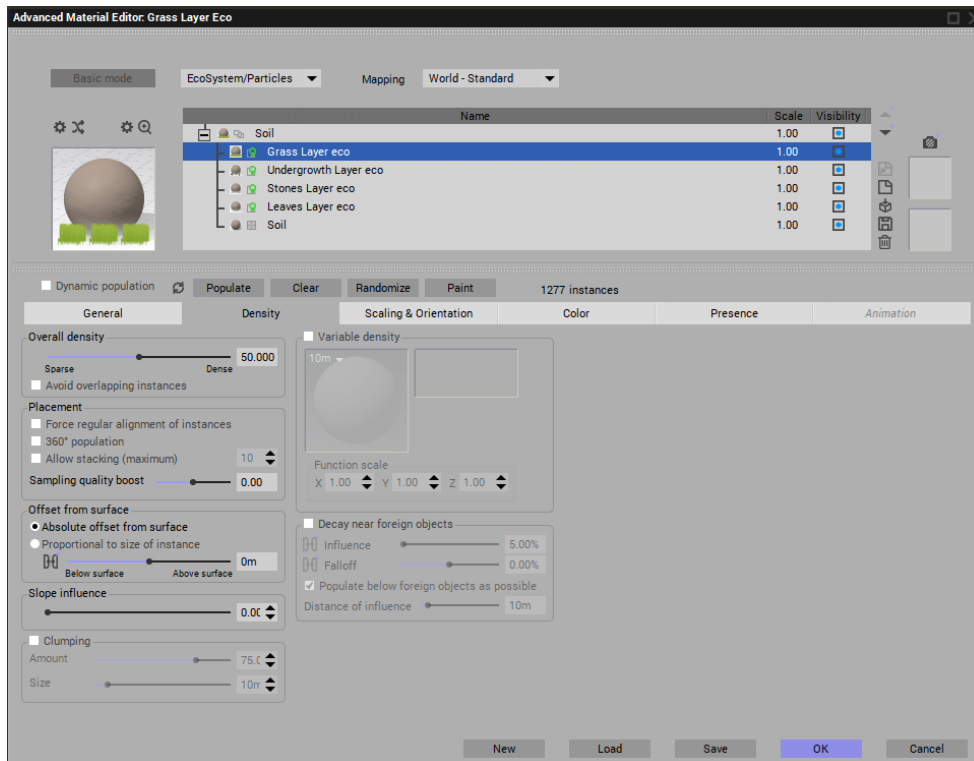
➢ Now we will apply a single, open-ended spline across the plane.

➢ Now double-click the **Spline** in the **World Browser** to open its editor and select the **Material Effects** tab at the left.
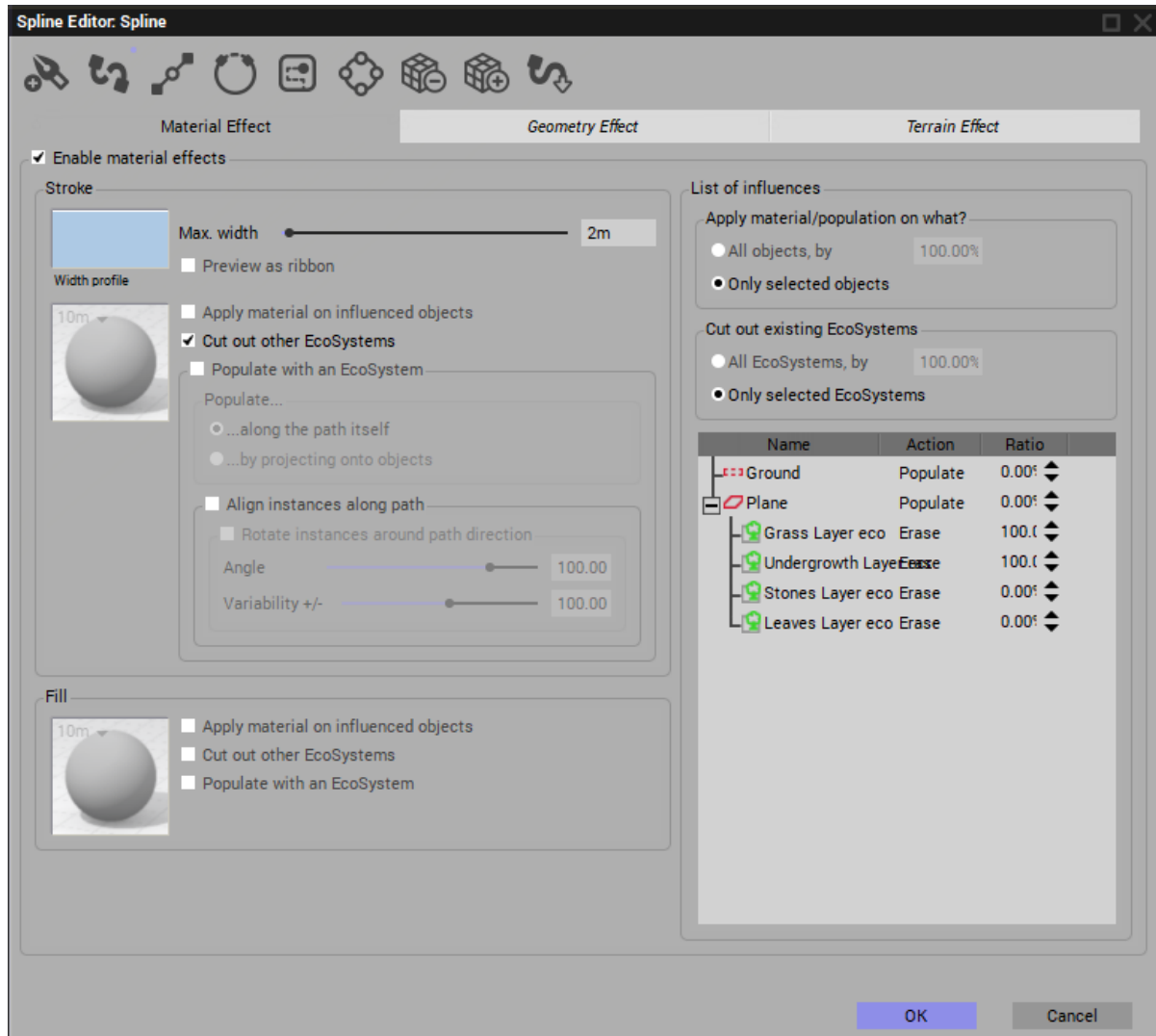
➢ Enable the **Material effects** check box and set the **Max width** to 2m

➢ In the **Stroke** section, check the **Cut out other EcoSystems** box

➢ For the **List of influences** check the option: **Only selected objects**.

➢ For **Cut out existing EcoSystems** check the option: **Only selected EcoSystems.**

➢ For the Grass and Groundcover ecosystems, set the **Action / Erase – Ratio** to 100%. The Stones and Leaves layers which we'll keep at 0% .

➢ Click on **OK** to close the Spline Editor.

➢ Now select the **Plane** in the **World Browser** and open the **Advanced Material Editor.**

➢ Since the Grass and Groundcover ecosystems are set to be changed by erasing them, they are the only ones that have to be re-populated.

The resulting path is cut out of the existing EcoSystems leaving only the Stones in the pathway.
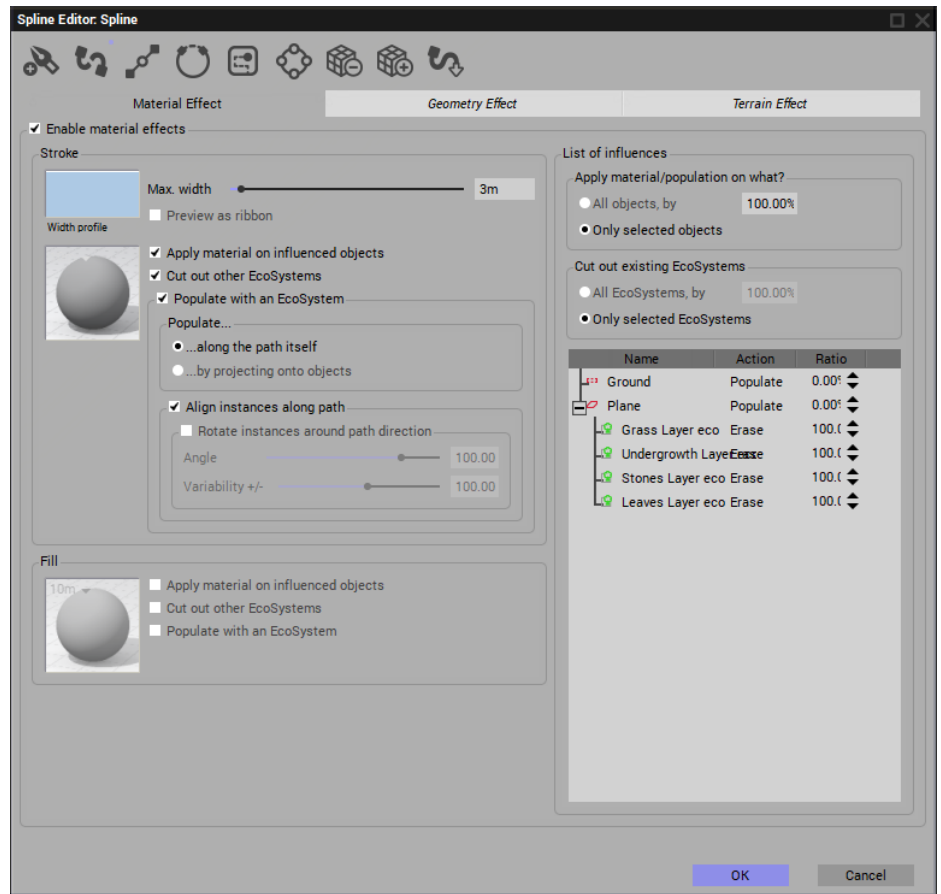

If we set the erase level of the grass ecosystem to 70% instead 100%, we will have some remnants of the grass scattered about the path once we re-populate it.

Cutting & Replacing with other Ecosystems

Once again we will open with the plane covered with the four EcoSystems.
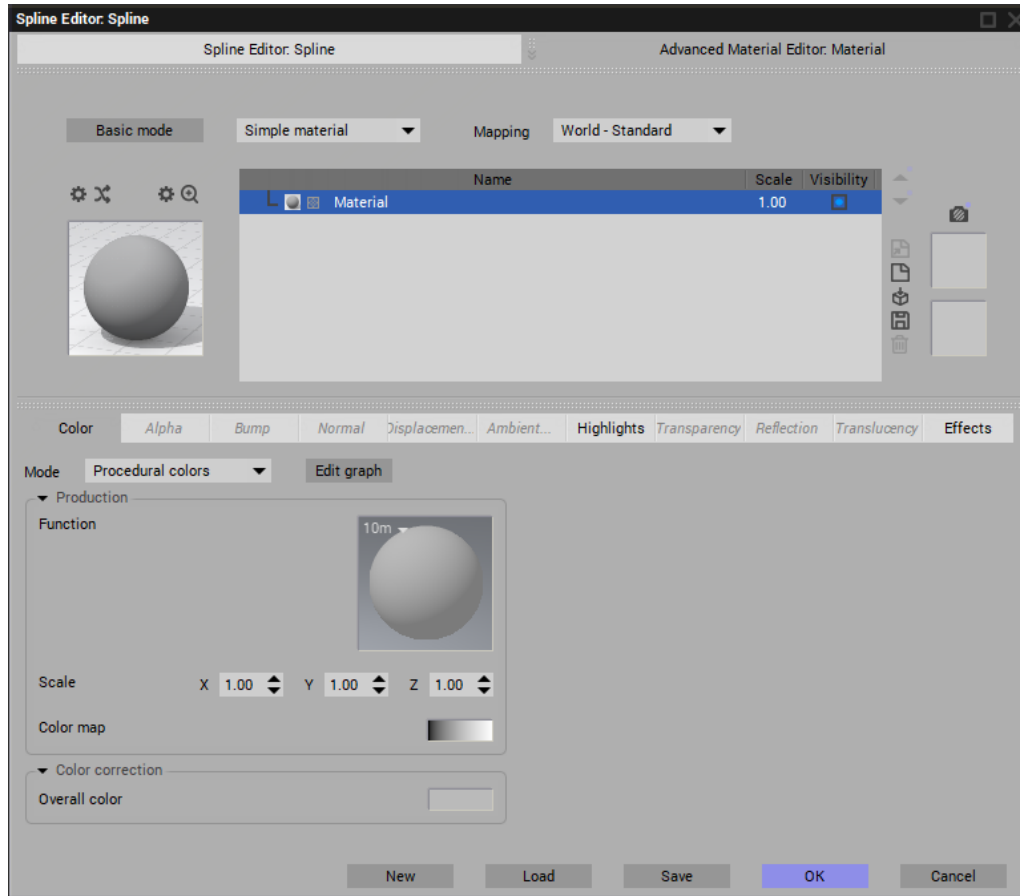

We set a new spline and erase all of the plane ecosystems by 100%

Selecting the spline editor again we found when we checked the **Populate with an EcoSystem** that the material sphere to the left of that became active.

➢ Double-click on the sphere to open the **Advanced Material Editor** opening to the right side of the **Spline Editor**:

➢ Change the material from **Simple material** to an **EcoSystem/Particles** material.

➢ In the **General** section of the **Advanced Material Editor**, select some sort of flowers or mushrooms as plants or .vob objects from a file.
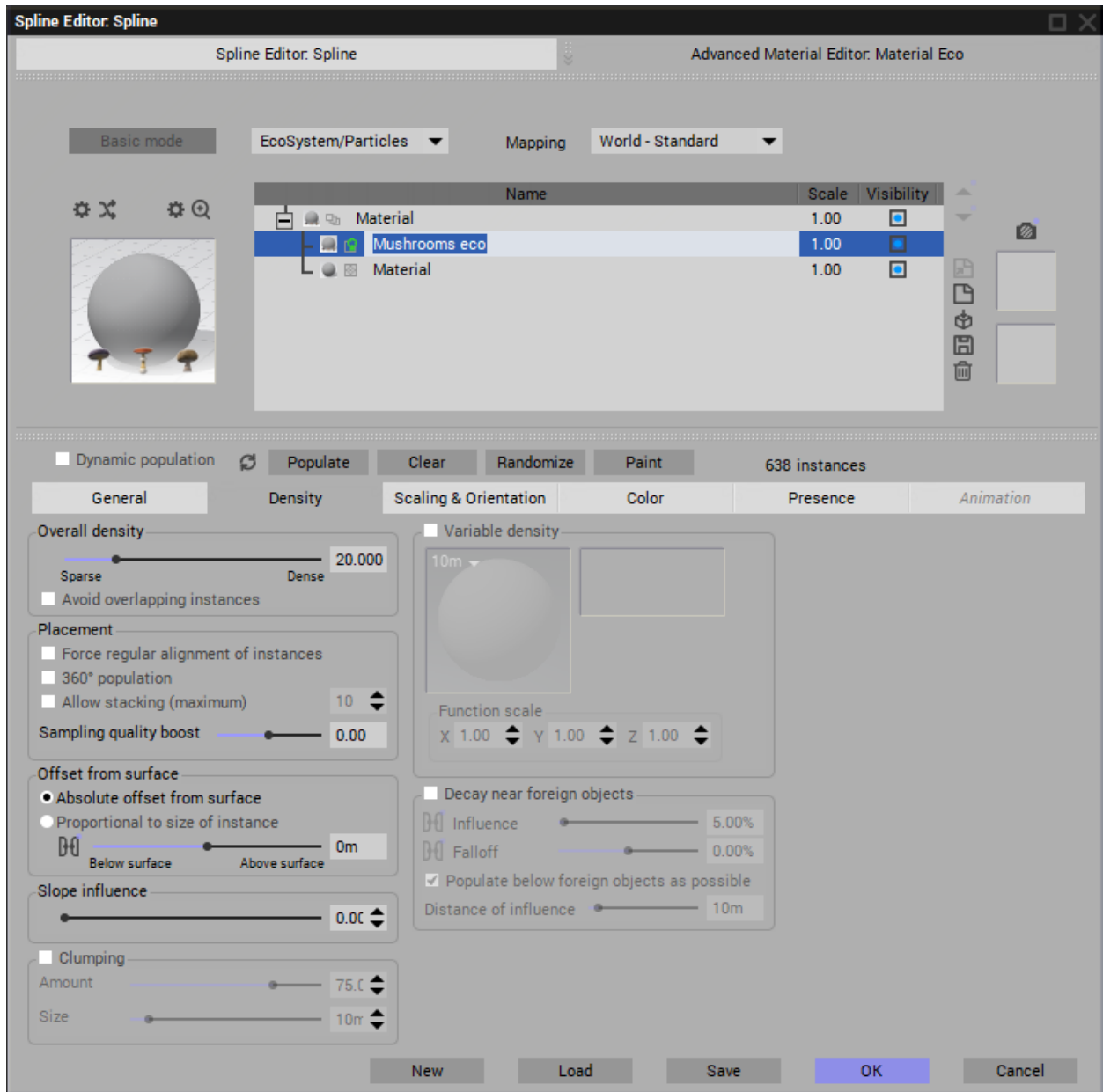
➢ Select **Populate**. You may need to adjust the Density and Scaling and then re-populated again to get the distribution and size just right. Clear and Populate again.

The resulting ecosystem of mushrooms follows the spline path.

Now notice that not all of the applied mushrooms are placed directly on the plane. Many are floating above it though they are constrained to the width of the spine path.

Projecting the EcoSystem onto an object

When the **Populate with an EcoSystem** box is checked then there are the two options: **….along the path itself** or **…by projecting onto objects**. We had already tried the first option: …along the path itself. This resulted in the mushrooms following the spline path but at random heights above the plane.

➢ Select the **Spline Editor** again. Populate with an EcoSystem should still be checked on.
➢ In the Populate area of the Stroke section, click on the **….by projecting onto objects** option button.
➢ Now we want to project the mushrooms onto the plane. In the right action window, beside the **Plane** item set its **Populate Ratio** to 100%.
➢ Click on the right side of the **Spline Editor** which will display the **Advanced Material Editor.**
➢ Click **Clear** first to remove all of the current mushroom ecosystem, then click Populate.

Now the mushrooms are all nicely placed on the plane and within the spline path.

Projecting Spline EcoSystems onto more than one object

In this strange scene there are a number of features of projected splines.

The scene shows three splines. Spline1 is open ended, 10cm wide and populated with purple flowers. It is projected on the building, not the stump, on the 1st rock and even on top of (and also below) the white wolf.

Spline2 is closed but unfilled, 50cm wide, with orange flowers. It is projected on top of the vertically suspended birch log (but not below it ?), the 2nd brown rock, the 1st rock and onto the building but there, at only 20% density.

Spline 3 is a closed spline with a simple grass ecosystem within it. It is placed directly in the path of spline2 to erase spline2 only within the bounds of spline3

The two flower splines; 1 & 2 were created 24meters above the ground yet the projected spline flowers are placed directly below each spline vertically onto the ground or object defined as populated (at 100% for most)

Spline3 for the grass area was created at ground level

Below are the three splines used in the scene and the settings used.

Spline1 (purple flowers) is set in the Spline Editor - **Stroke** section to **Populate with an EcoSystem** and **..by projecting onto objects.**

It will **Populate** at 100% density onto everything its path follows except the **Tree Stump**, where it populates at 0% density.

Though all the objects of the scene are listed, the **Spline1** path does not pass over some of them so the **Populate** or **Erase %** does not affect them.
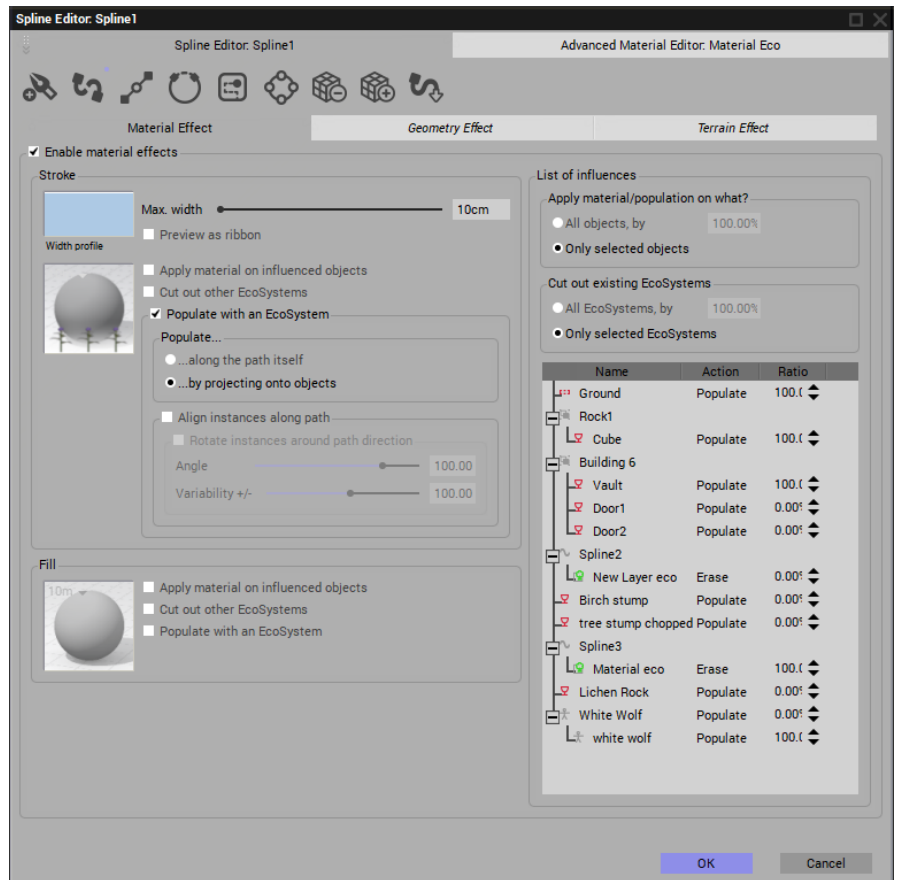
Spline2 (orange flowers) is a closed spline, set in the Spline Editor -**Stroke** section to **Populate with an EcoSystem** and **..by projecting onto objects.**

It will **Populate** at 100% density onto everything its path follows except the **Building6 -vault**, where it populates at only 20% density.

It does populate the **Birch stump** at 100% on top but not underneath it
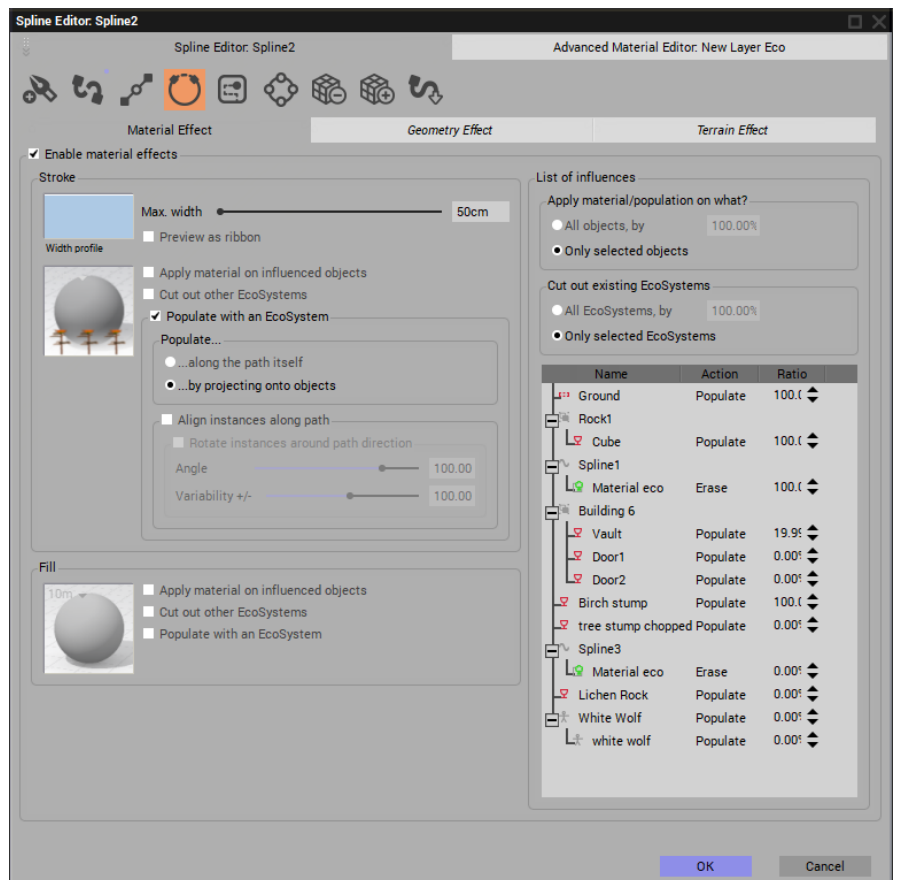
Spline3 is a closed and filled system. This is filled with a grass EcoSystem and placed in the path of spline2.

It is set to Populate its material (Grass) onto the Ground object by a value of 100%.

Spline 3 is set to cut out and existing ecosystem in its path. Here, the spline2 ecosystem is set to erase by 100% at spline3.