GAIA

By Procedural Worlds

QUICK START GUIDE

Gaia enables the rapid and precise creation of beautiful worlds.

Contents

Introduction

Thank you for purchasing Gaia.

Gaia is a set of assets, tools and processes to create beautiful 3D worlds.

Quality environments contribute to the success of your game with a combination of enhanced realism, visual storytelling, immersion, engagement, aesthetic appeal.

Our intention with Gaia is to make world building easy for newcomers, flexible for pros, and to free you up to create the engaging and satisfying player experiences that lead to positive word-of-mouth, critical acclaim, and ultimately higher sales and success for your game!

Gaia exists to help you succeed, and this document exists to help you succeed with Gaia!

In a nutshell:

- Gaia workflows start with Gaia Manager. Gaia Manager allows you choose the operation you want, and then instantiates and configures the tools needed.

- Terrain Shaping is done via Stampers. A stamper treats your terrain like cookie dough, and 'stamps' interesting shapes into it, such as mountains, hills, mesas, valleys and rivers. Stamps are designed to be mixed and matched to create any terrain you want.

- Terrain Population is done via Spawners and Biomes. Biomes are sets of spawners that contain assets and the rules needed to apply those assets into your scene. You can use our biomes or create your own.

- Runtime Systems are controlled via Gaia Runtime. Runtime systems include skies, lighting, weather, water, audio, culling and streaming and player control. These systems are provided as a convenience and are optional.

- Adhoc Tools are accessed via the Advanced Tab in Gaia Manager. Tools include a Scanner to create new stamps, a Stitcher to stitch terrains together and a Terrain to mesh converter for the creation and optimization of low poly environments for mobile and VR.

For a deeper dive including video tutorials, support forums, your free stamp packs, and more products, please go to Canopy.

Gaia is a labour of love. I hope you enjoy using it as much as we enjoyed creating it!

Warm regards,

Adam Goodrich.
Founder, Procedural Worlds.

What can I create with Gaia?

These images were all created with Gaia using the same basic workflow.

Create a terrain, populate it with a biome, and then detail it to make it interesting and relevant to the game.

Some of these are included with your version of Gaia, and all of this is possible with Gaia if you create your biomes.

Gaia worlds are used on desktop, mobile and even VR. Your environments need to be created with the target platform and performance optimization in mind.

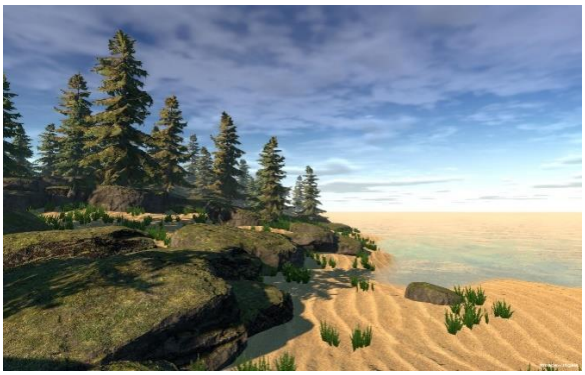
Your levels will also need detailing for your unique story. Detailing is the process of creating towns, buildings, roads, paths, and rivers. Gaia's stable mate GeNa can help.



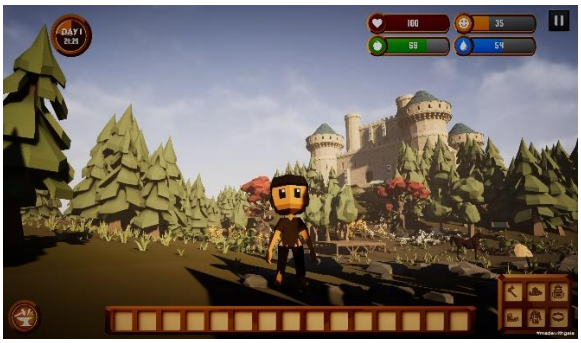






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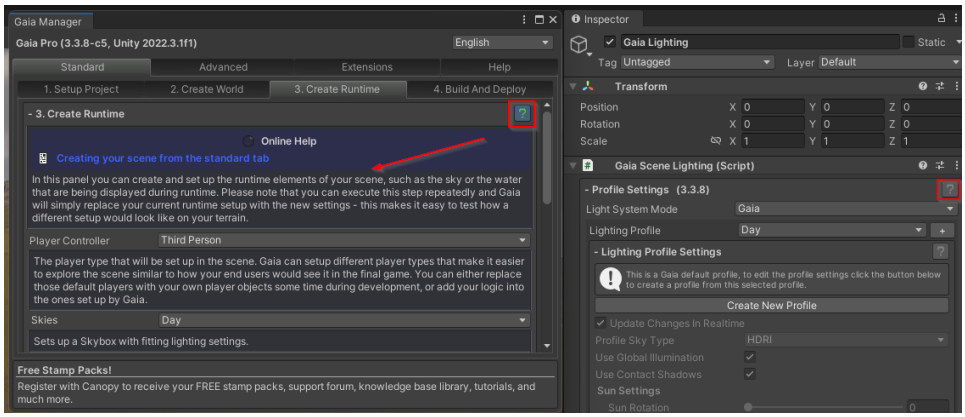
Inline help, library, and support forums

Inline Help

Most of the systems in Gaia contain inline help.

In the image below you can see a '?'. Clicking on this opens and closes the help system. The help system can also link to web pages with more detailed information.



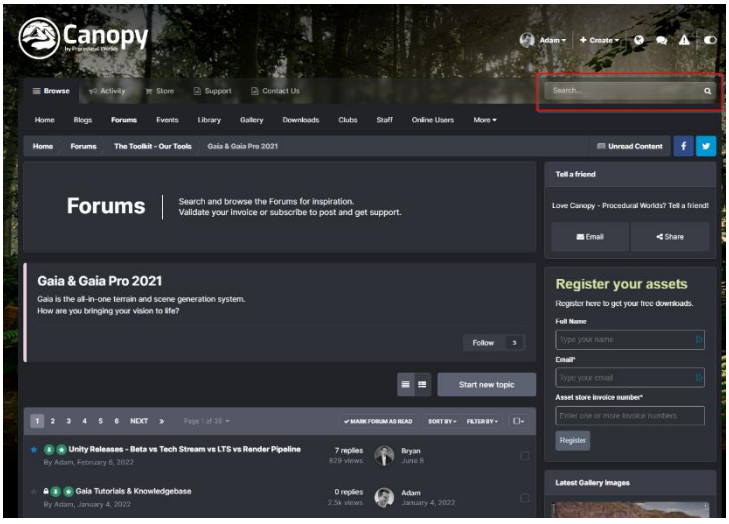
Canopy Library

The Gaia section in the Canopy Library is where we store our latest documents and video tutorials. Click here to view it. You can also access this via the Help Tab in Gaia Manager.

Canopy Forums for inspiration and support

If you need help, then please browse or search the Gaia forum on Canopy. You can find the forums here. The search box is highlighted in red.

If you are unable to find the solution you are looking for, then register and put your own post into the forum. Video or screen shots are best so we have the information needed to help you.



The forums do not always notify us of your request, so if you do not get a response within two business days then send us a message on Discord with a link to your post.

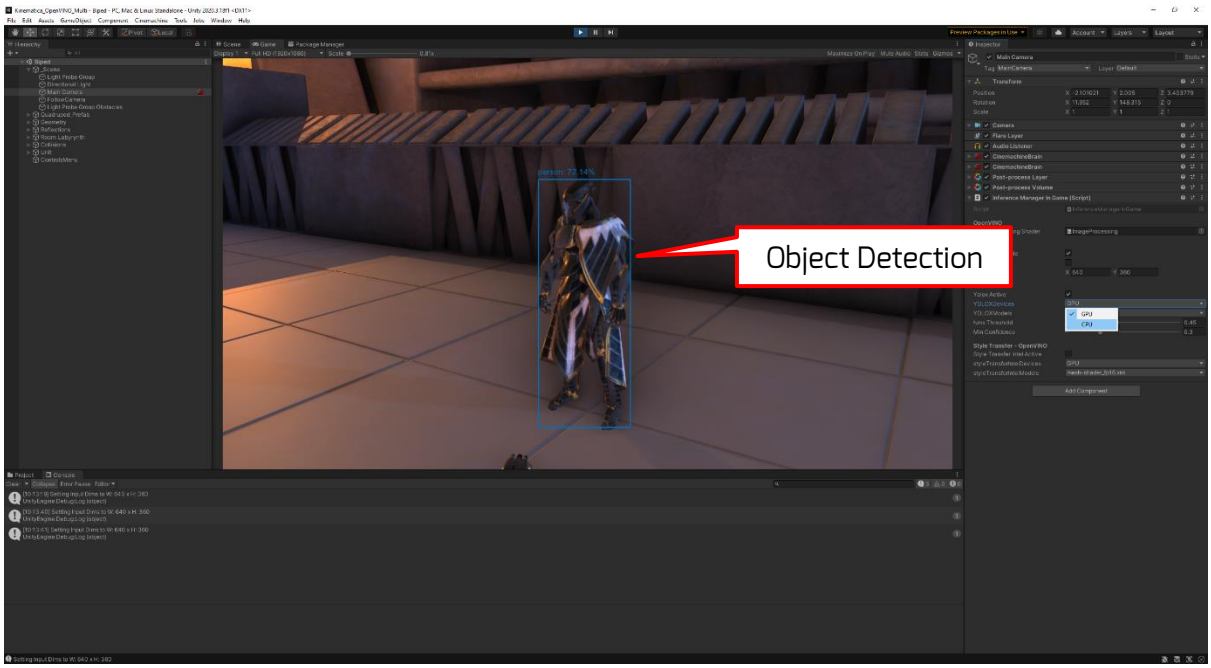
Gaia by Procedural Worlds

Inferencing with the Intel AI Gamedev Toolkit

In partnership with Intel, we have integrated Intel's OpenVINO inference engine into Gaia, and created frameworks around it to explore the use of ML based inferencing.

The toolkit includes samples of object detection or style transfer directly in the scenes that you made with Gaia.

This integration works with all Editions of Gaia (Gaia ML, Gaia 2021, Gaia Pro 2021). To learn more, visit the AI Gamedev Toolkit page on Canopy.




Style Transfer

Additional products and services

Canopy for product and subscription services

We have over fifty assets ranging from tools to procedural content packs, to game templates and game ready levels. Check them out on Canopy, or the Unity Asset Store.

We also have a special subscription offer at Canopy. With this you get access to all our non-enterprise products at substantially cheaper rates than purchasing them outright.

Massive runtime worlds and more performance with Storm

For massive open worlds on mobile and desktop then please consider Storm.

Storm delivers crazy draw distances and frame rate improvements of up to 100x on mobile and desktop, with support for all pipelines.

This is an advanced system is for professionals who are serious about delivering the best possible quality and performance with Unity. To learn more please contact us.

Custom solutions & professional services

In addition to creating tools we also offer professional services. Some of the companies we have worked with include Wargaming.net, Unity, BMW and Google.

If your project could benefit from our unique expertise in procedural generation, world building at scale, and advanced rendering then please contact us.

Gaia by Procedural Worlds

Setup

Version Differences:

This guide covers the Intel AI GameDev Toolkit, Gaia 2021 and Gaia Pro 2021.

- Intel AI Gamedev Toolkit – free light version of Gaia + AI Wrapper framework + Intel OpenVINO.
- Gaia – light version of Gaia Pro.
- The full Gaia system

Gaia Pro adds more systems and biomes. Some of the more significant enhancements include:

- More biomes and sample assets
- Large world support and terrain streaming support
- Additional stamping, erosion and masking operations
- Low poly and terrain impostor support
- Weather systems, and more.

If you already have Gaia and want to upgrade to Gaia Pro, we have sweetened the deal for you by removing the cost of Gaia from the upgrade price. The upgrade process itself is seamless.

Prerequisites:

To get the best out of Gaia we recommend the following:

- Use a decent development machine. A good base build is an Intel Core i5 or better, 16gb ram or better, and a Nvidia 2060 or better. A fast SSD will also speed your process up substantially as Unity is disk intensive.

- Make sure your GPU is relatively recent and has at least 4GB VRAM. Gaia makes extensive use of the GPU to do its magic. If your GPU does not have enough VRAM then you will experience crashes.

- Make sure your graphics drivers are up to date. Old drivers are a common cause of random crashes.

- Make sure that automatic light baking is turned off in the Unity editor. This system has a long history of causing crashes.

- Stick to LTS releases of Unity. Everything else is considered by Unity to be a technical preview, and they are often quite buggy.

- The bigger your environment is, the longer it will take to generate, especially on large multi tile worlds. World creation is computationally expensive.

- Use source control. Everyone loses their work at some point. If you are backing it up, then no problem! We added some useful settings for this later in this document.

Installation Directories:

Gaia is installed into the Procedural Worlds directory. Gaia cannot be moved from here, as it contains hard coded references to these directories.

\Procedural Worlds

\Flora	– Grass system for URP and HDRP.
\Frameworks	- Common frameworks across all products
\Gaia	- Gaia code, stamps, biomes etc.
\Gaia User Data	- User generated sessions and settings

The Gaia User Data directory where we store global settings and Sessions.

A new Session directory is created for every terrain you make with Gaia. It contains the terrain data, the session itself, and all the creation and biome settings for that terrain. Sessions are useful as they store the steps that were used to create a terrain and can be used to re-create it later.

Installation Tips:

Before you start with Gaia, please make sure Gaia is correctly installed in your project.

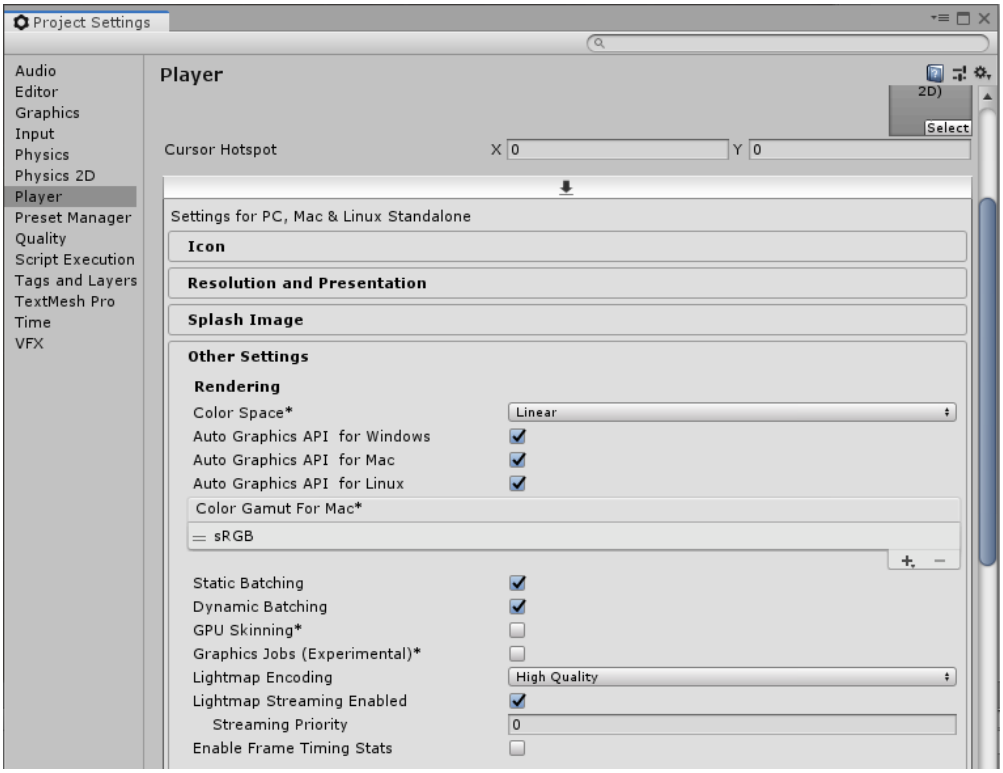
While these instructions may seem long, most of the text here is informational, the actual process is just a few clicks.

1. Create a new project in Unity and open it.

2. In most cases you will work in the linear colour space and it will save time if you switch your project to “Linear” before importing Gaia.

   To learn more about colour spaces please read the official information from Unity. Unless you are developing for Mobile or VR or have special requirements, you will usually want linear.

   To switch colour spaces, open Edit > Project Settings > Player and adjust the colour space under “Other Settings”



   Don’t worry if you are not sure about this setting – you can always change the colour space later.

3. Install Gaia from the Package Manager under Window > Package Manager.

   If you purchased Gaia from Canopy, download and unzip the file, and then install the Gaia '.unitypackage' via Assets > Import Package > Custom Package... in the Unity editor.

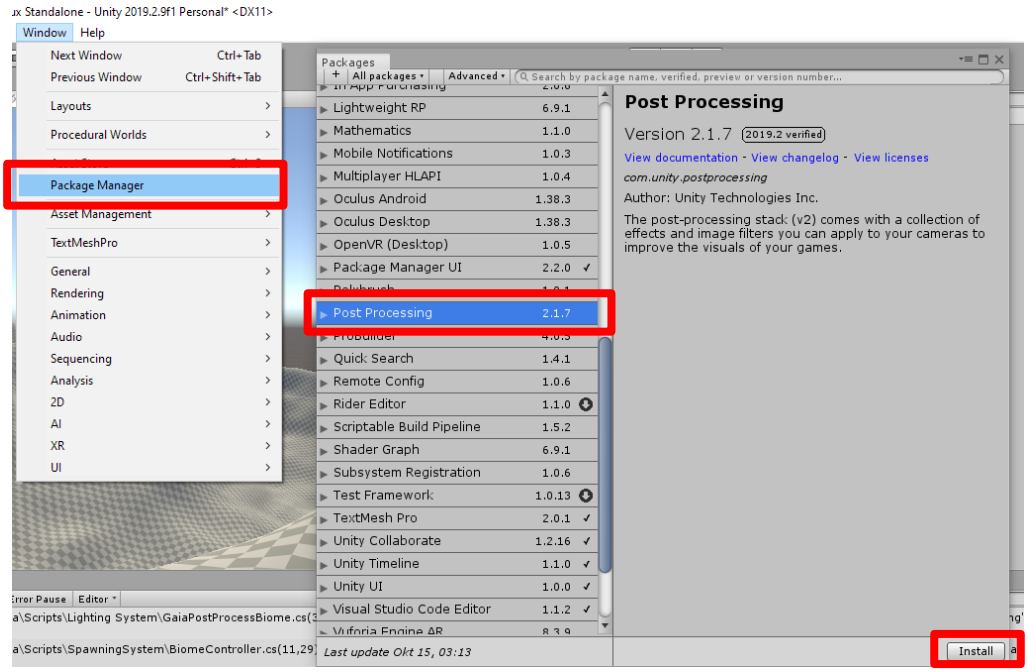
   Note: On Apple systems, the Finder will also unzip the .unitypackage file itself. Ensure that you only unzip the .unitypackage file and not its contents. To change this setting in the Finder, open its preferences (Archive Utility > Preferences) and turn "Keep expanding if possible" off.

4. Pipeline Specific:

   Built-in:

   For nicer visuals install the Post Processing Package from the package manager. Gaia will work fine without it, but underwater effects won't work and your scenes will not look as good.

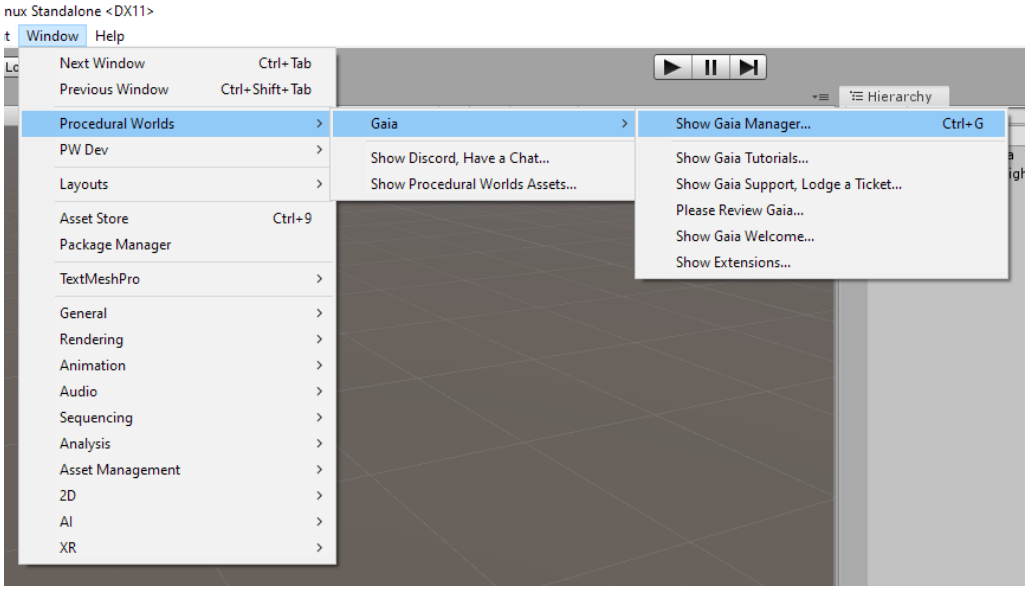
   To install post processing in your project, please open the package manager from Window > Package Manager and locate and install the post processing package:



   URP & HDRP:

   This step is not required when using URP & HDRP as these pipelines install their own post processing automatically.

5. Open Gaia Manager from the Window Menu or by pressing Control + G:



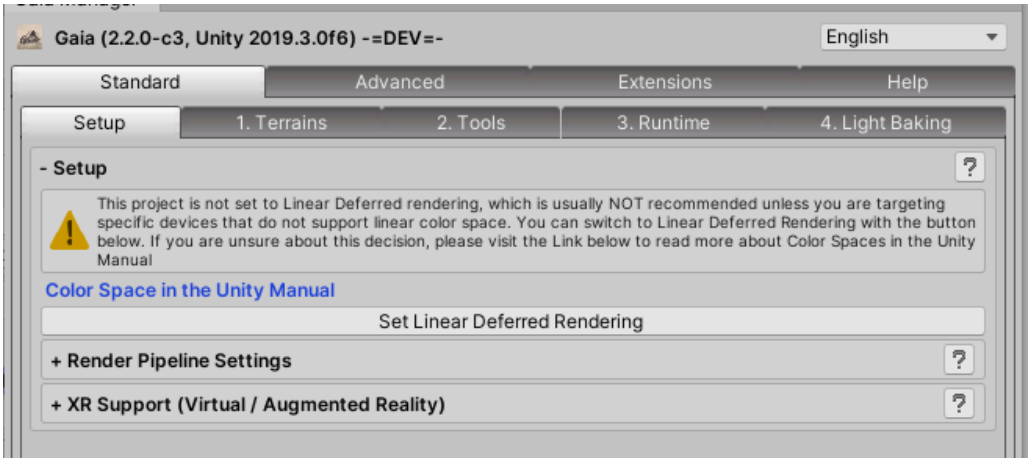
If the Gaia Manager Menu entry does not appear: This is caused by compilation errors in the project. Please read your console to determine what caused the issue.

To check if this is a compatibility issue with a new Unity project, install Gaia by itself. If you see issues, then report this to us via the Gaia Forums and we will resolve it for you.

In larger projects, particularly those that include other assets from the asset store, there can be conflicts due to inconsistent namespaces. Contact us and we will help you track down the offending asset, and then get in contact with the author.

Make sure you send us the content of your console log so that we can help you.

6. When Gaia Manager is opened for the first time after installation or update, it will perform a setup process. This happens once, and you should always follow this process.



Click these buttons to set your project's colour space to linear and your rendering path to deferred to get the best visuals and performance.

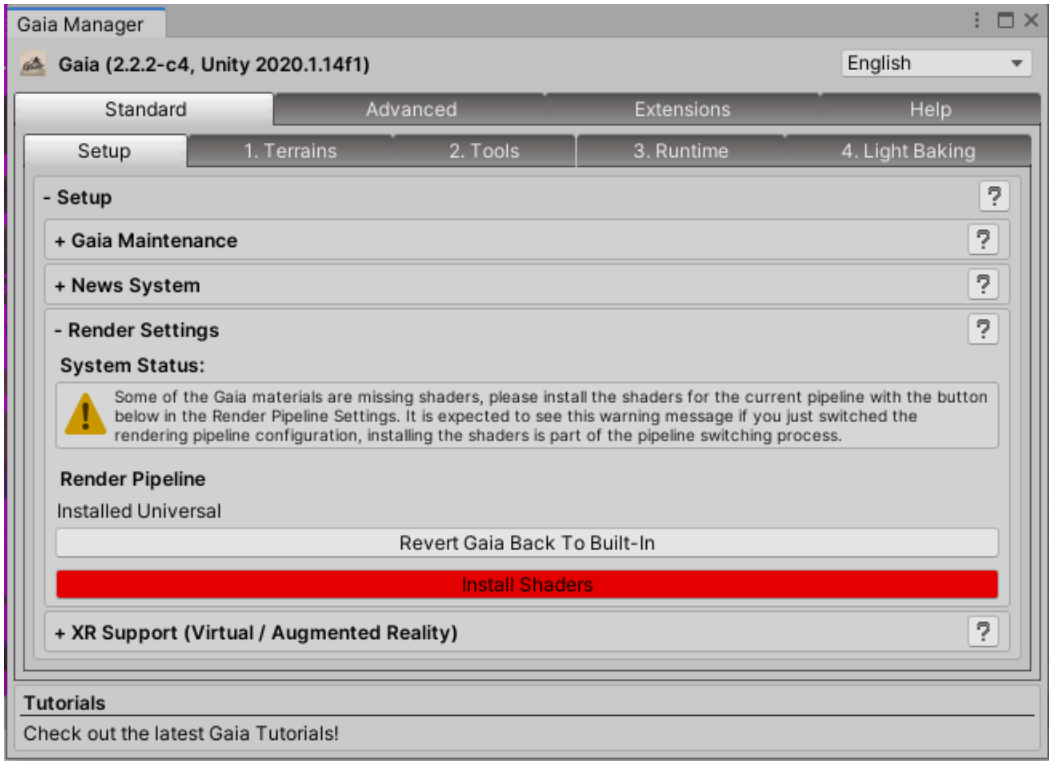
NOTE: If you are using gamma colour space you can ignore this step!

7. At this point, if you are using the Built-in pipeline you are done.

   However, if you want to use one of the other pipelines you will need to follow the instructions provide in the setup tab until Gaia has been fully configured.

   The installation will take 20-60 seconds to complete, as the project needs to be recompiled. During the installation you might be asked if you want to use Gaias Rendering Pipeline asset or use your own, or if you want to switch out terrain shaders as well. If you are not sure about these questions, choose "Yes" to all questions being asked.

   After you configured the rendering pipeline, click the "Install Shaders" button. This will install the shaders for the water and the vegetation for the correct Unity version and pipeline. If the correct shaders are already installed, this button will not appear.



   The Gaia setup process is now done.

Workflows

Gaia offers two "workflows" when creating a new word via Standard tab in Gaia Manager.

Stamper based gives you complete control over the process of terrain shaping, and World Designer automates this for you.

Please run through both tutorials. Each adds different insights on the use of Gaia, and you should be able to complete both in fifteen minutes or so.

Gaia tools and components

Before jumping into specific workflows, take a moment to review the tools that come with Gaia. Many of these tools are optional, and have been provided because they add value.

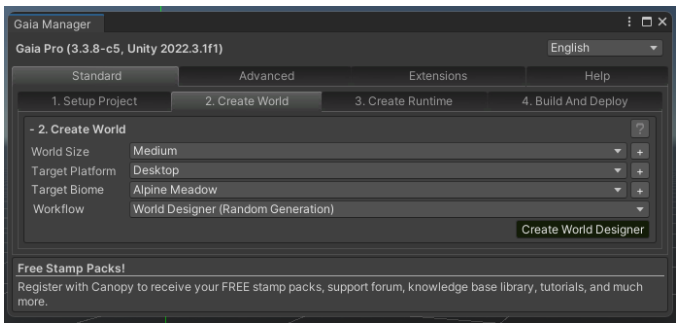
Gaia Manager

All workflows start with the Gaia Manager. To open Gaia Manager choose Window/Procedural Worlds/Gaia/Show Gaia Manager..., or hit Ctrl + G.

Gaia Manager has four main tabs, Standard, Advanced, Extensions and Help:

- *Standard*: A process-based wizard for world creation.
- *Advanced*: Adhoc access to tools as you need them.
- *Extensions*: A legacy extension system that is no longer used.
- *Help*: Access to Gaia help and support.

Standard Tab



The Standard tab acts as a wizard to guide you through the world creation process.

1. Setup Project:

    - Happens the first time you run Gaia Manager. Takes care of project configuration, shader installation, and material and asset conversion for your pipeline.

2. Create World:

    - Choose the size, platform, biome, and workflow for your world, and then create it. The choices you make here help to optimize your environment for performance on the selected target platform.

      You can choose either stamper-based, world designer based or a hybrid of both for terrain creation:

        - Stamper allows full control with precise placement. You blend stamps together to create exactly what you want.

        - World Designer is fully procedural. You tell it what types of features you want, and it uses this as a guide.

        - World Designer and then Stamper. Create your world with World Designer, and then go to Advanced Tab, and add a custom Stamper to refine it.

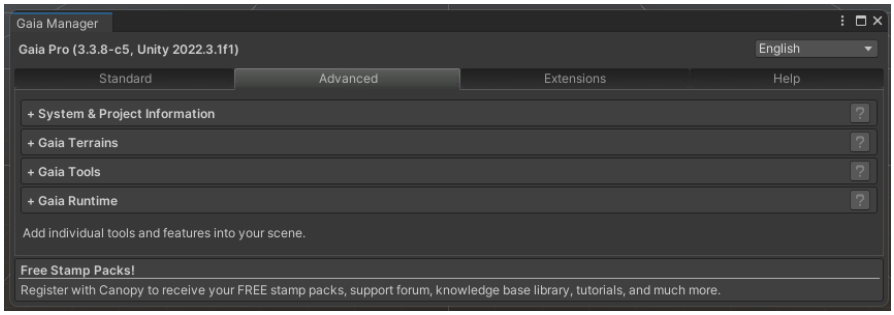
3. Create Runtime (Optional):

    - This step automates your scene's runtime setup. It is provides handy configuration for things like your player controller, skies, and water, and is completely optional.

4. Build and Deploy (Optional):

    - This advanced step that can help with the configuration of your project for deployment. It provides handy helpers for addressable and mmo server builds. This step is not required for most people.

Advanced Tab



The Advanced Tab provides access to individual tools and utilities that you can use when you need them.

For example, I love this faceted low poly style!

Gaia created the scene, and the Terrain Mesh Converter converted it to a stylized low poly mesh that would be great for a mobile game.

Meshes are more performant in some scenarios than Unity terrain and in particular should be considered for mobile and VR based games.

The biome shown here is the Synty biome, and the game play comes from our Rails Shooter Pack.

System & Project Information

This panel shows information about your Unity project. It has a button that allows you to copy these settings. Please use this when asking support questions in the Gaia Forums as it helps us to understand what you are doing.

Gaia Terrains

This panel allows you to create a new terrain with either the stamper or the world designer workflows.

Gaia Tools

This panel provides access to biomes, spawners and tools.

These include:

- *Biomes / Spawners:*
    - *Create new or Add existing Biomes*
      Biomes are collections of Spawners.
    - *Create new or Add existing Spawners*
      Biomes apply assets to your world via Spawners and can be masked so that they only affect a small part of the world. Be wary when spawning over manually placed assets, as they can be overwritten unless masked first. If you are unsure, backup your project first!
- *Gaia 1 Stamp Converter*
  A tool that allows the conversion and import of legacy stamps from Gaia 1.
- *Location Manager*
  A tool that makes it easy to mark, and then move between locations in your scene.
- *Mask Map Exporter*
  A powerful mask and mask visualization system that you can use to export masks derived from your environment for use by other systems.
- *Mass Edit Terrains*
  A tool to apply simple settings such as flattening to all the terrains in your scene.

- *Resource Helper*
  Can be used to apply resources from one terrain onto other terrains. Ensures that all terrains in your scene are using common sets of assets. You would use this when manually adding new terrain tiles to your scene.

- *Scanner*
  Allows you to create new stamps from a wide range of sources. You can even scan 3D objects like walls and buildings and turn them into features that can be used to influence your terrain.

- *Session Manager*
  Links to the session manager in your scene. The session manager tracks all of the operations that Gaia performs on your terrain. You can 'play it back' in fresh scenes to re-create the terrain, and you can also enable and disable steps in the playback to see or negate their impact.

- *Stamper*
  Allows you to create a stamper to modify your terrain. The stamper has a visualizer to see its effect, is maskable, and has many modes of operation. You can create literally any shape you want with time and creativity. TIP: Your stamper remembers everything you did to it, so if you get it into a mess, delete it, and add another one!

  The stamps we provide with Gaia have been designed to be mixed and matched to create an infinite number of possibilities. You can purchase more stamp packs from Canopy.

- *Terrain to Mesh Converter / Impostor Generator*
  This tool has many uses. You can use it to 'crystalize' a terrain and export it as a low poly mesh that works well on mobile with assets from publishers like Synty, or just as an export for a low poly mesh for mobile, VR and AR. You can also use the impostor generator for your large worlds. This works with Gaia's streaming system and will load meshes in the distance instead of Unity terrains. This can deliver a substantial performance improvement.

- *Terrain Stitcher*
  When integrating terrains created by other tools, sometimes your terrain seams will not match properly leading to cracks in the terrain meshes. This tool will do its best to fix them for you. Be gentle though, it is not a miracle worker!

Gaia Runtime

This panel automates the application of individual Gaia Runtime based components to your scene. These are all optional, and can be a handy time saver.

- *Add Character*
  Add a character into the scene.

- *Add Screen Shotter*
  Add the screen shotter into your scene. A handy utility to create screen shots.

- *Add Wind Zone*
  Adds a wind zone into the scene. Controls the effect of wind.

- *Add Water*
  Adds Gaia Water into the scene.

- *HDRP Time Of Day PREVIEW*
  Adds a preview of our time-of-day lighting system for HDRP.

Extensions Tab

The extension system is a legacy system, and no longer used.

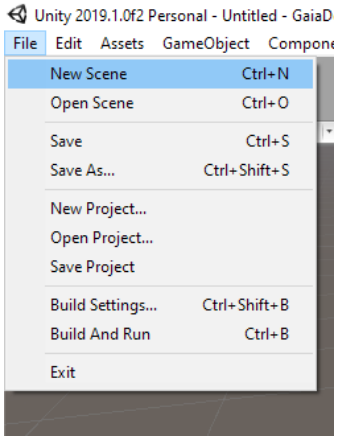
Help Tab

The help tab provides handy links to the support forums and documentation on Canopy.

Create a terrain using the stamp-based workflow (manual generation)

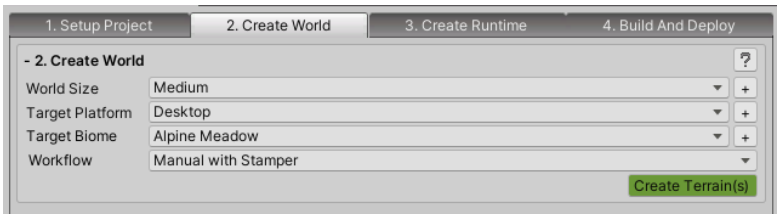
In this scenario we will use Gaia to generate a new world using stamps and a biome preset.

1. Create a new scene, File -> New Scene



2. Open the Gaia Manager, Window/Procedural Worlds/Gaia/Show Gaia Manager...

3. Choose your World Size, Target Platform, Target Biome, and Workflow.

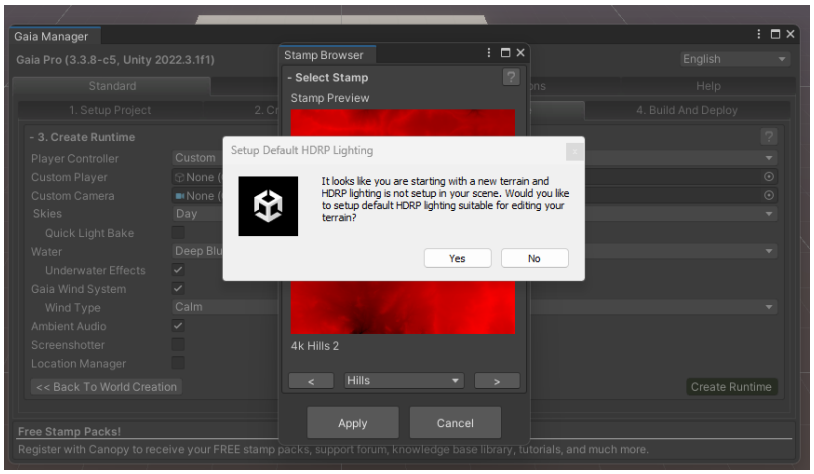


- World Size is the size of your world. For now, leave this at the default setting.
- Target Platform is what you are targeting your world to run on. Gaia will use this as a guide for how it sets up your scene.
- Target Biome is the Biome that will apply to your world. Gaia Pro provides a more biomes to use, and you can also create your own.
- Workflow is the world creation workflow that you will use. In this case we are creating new world with a stamper.

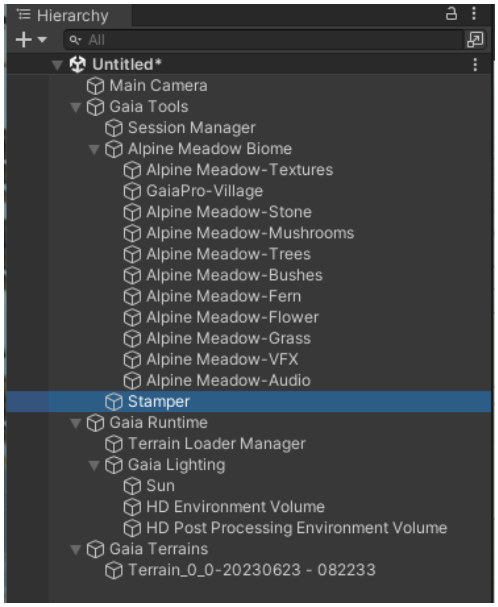
If you are curious, you can click the small "+" buttons to see the detailed world size and quality options. These options impact how the world is created, and you should leave these at their default settings unless you are an advanced user.

4. Select the "Manual with Stamper" workflow, then click on "Create Terrain(s)" to create the terrain and set up a stamper tool.

Depending you your pipeline, Gaia will also ask you to set up your lighting. Select Yes.



5. Gaia just did a huge amont amount of work for you! Lets unpack this by taking a look at the scene hierarchy.



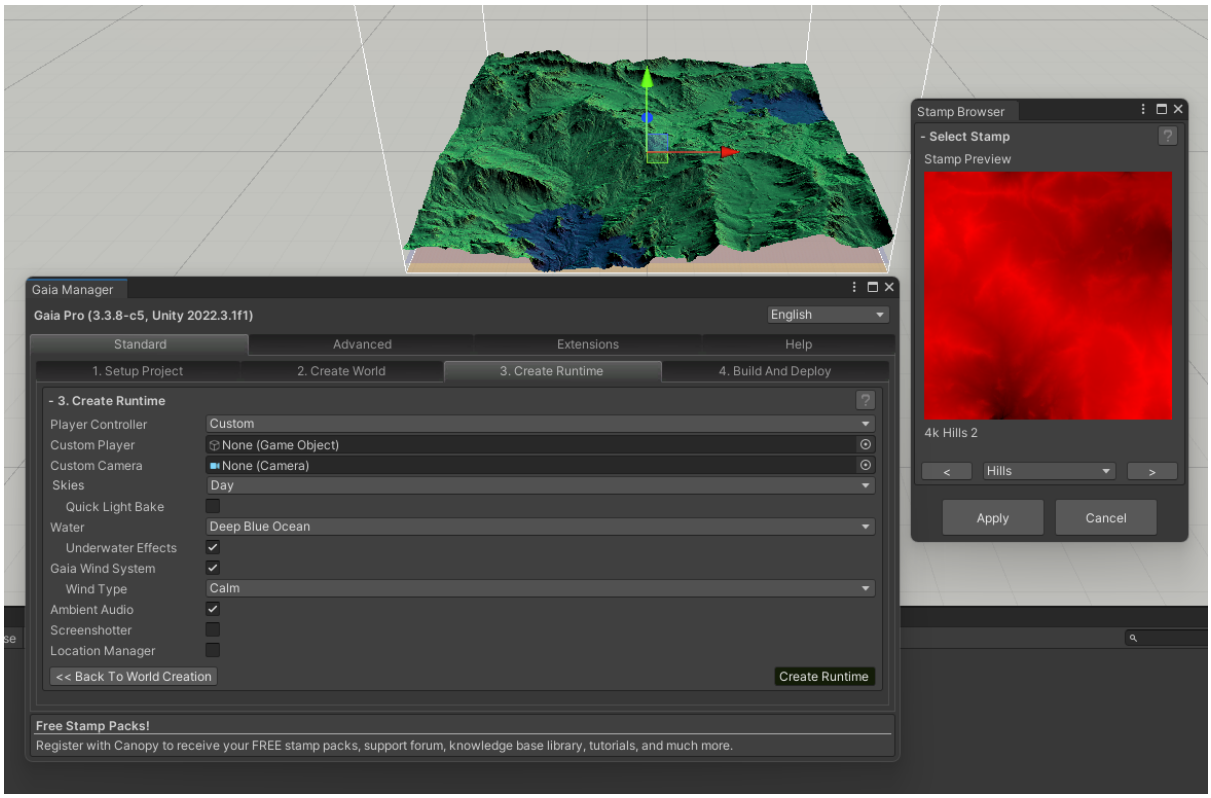
There are three main object groups:

Gaia Tools
– These are the tools that Gaia uses to do work on your scene. The Session Manager tracks all the operations performed, The Alpine Meadow Biome controls the spawners that add it into your scene, and the Stamper which is used to shape your terrain.

Gaia Runtime
- These are helpers for Gaia runtime operations. You can see the lighting that you just added by selecting Yes in the previous step.

Gaia Terrains
- This is the terrain that Gaia created and added to your scene.

6. Back in the main area of the scene we have the following components.



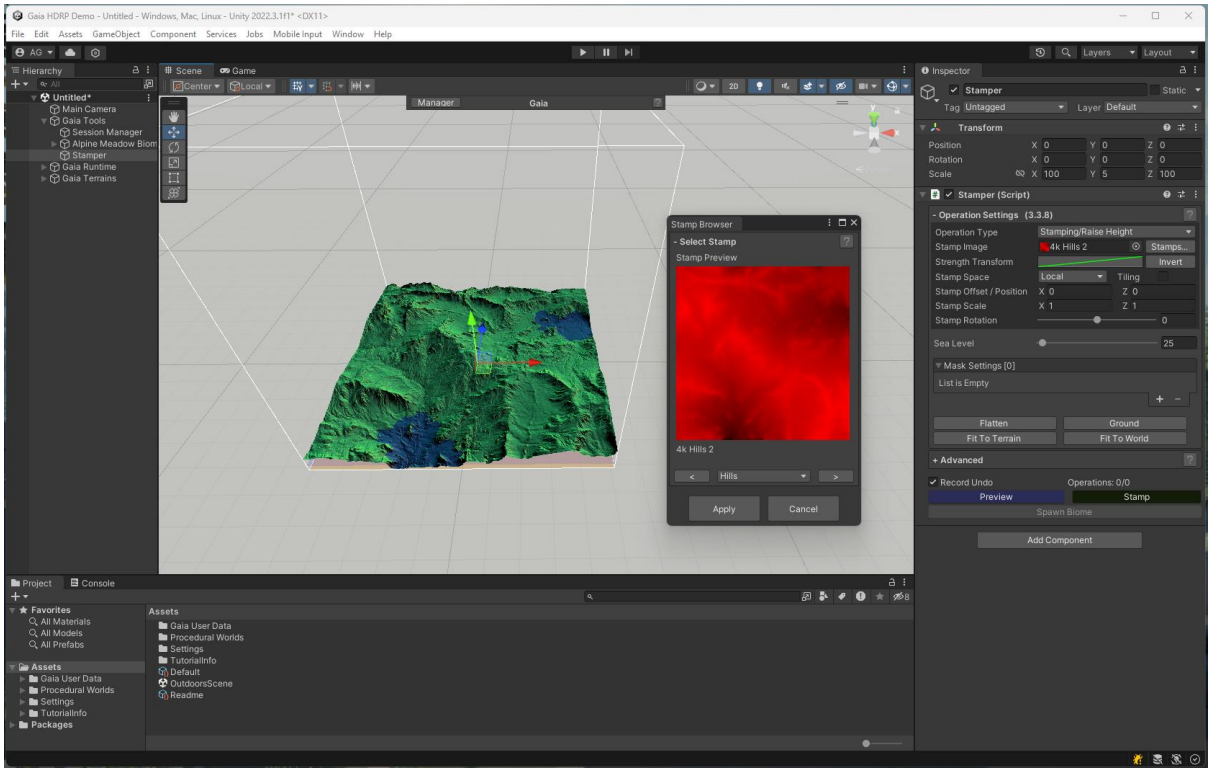
The blue-greenish image you see in the scene view is a low fidelity preview of the terrain shape we are about to create. You can see the terrain we created under it.

You will also see a stamp browser window which allows you to select a stamp ("terrain shapes") that come with Gaia.

At this point you can click on Create Runtime in the Gaia Manager, or close it and optionally do this later.

I often like to add my runtime now, as it has nice lighting, post fx and water, but for simplicity close Gaia Manager for now so that we can focus on the stamper.

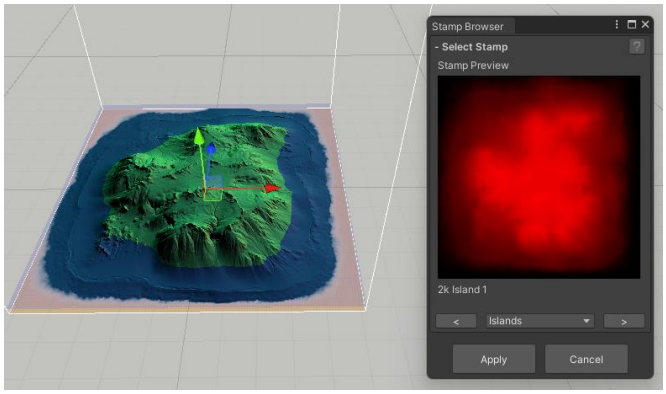
7. We have a preview world in green, the Stamp Browser in red, and a stamper component has been created under Gaia Tools in your scene hierarchy.



The Stamper is a tool that applies stamps into your scene. It shows a low fidelity mesh preview in real time.

You can also see the 'sea level' as a blue plane to give you a guide on where the water would be in your scene.

8. Selected the Island drop down and then use the right and left arrows on the Stamp Browser to preview different stamps.

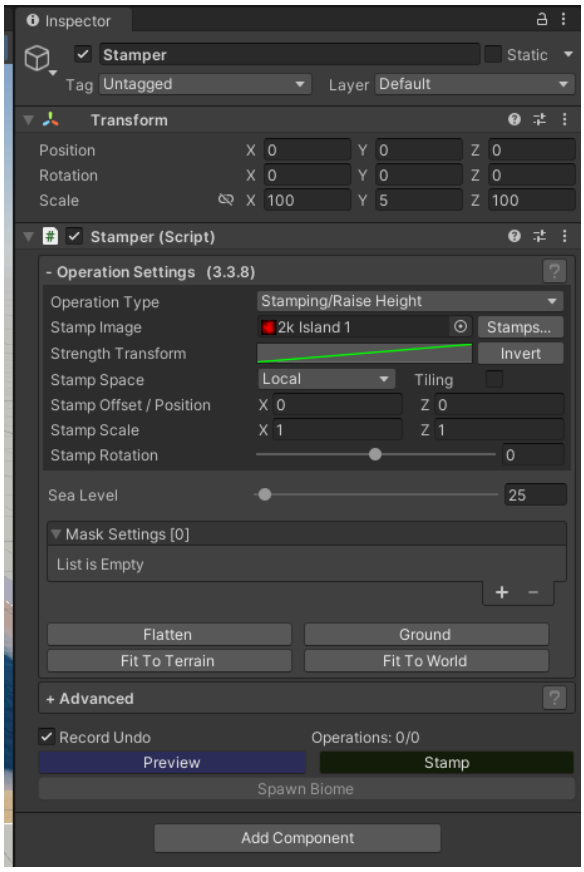


The preview updates, and you can see that the edges of the stamp would now be under water.

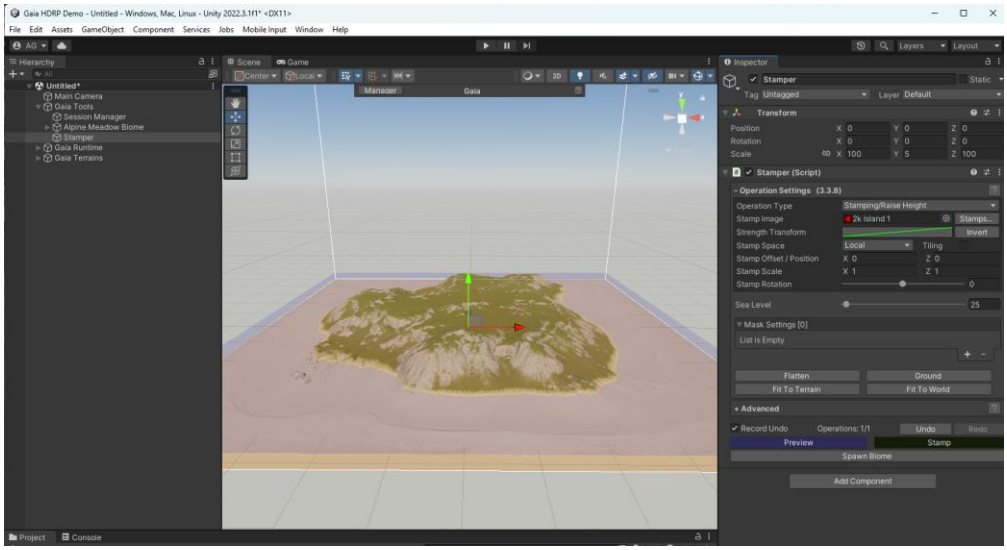
The lighter section of the stamp preview represents high points on the terrain, and darker areas represent low points on the generated terrain. You can see this reflected in the preview.

Click the Apply button to select that stamp.

9. The Stamper is now selected. Click the “Stamp” button to stamp your terrain!

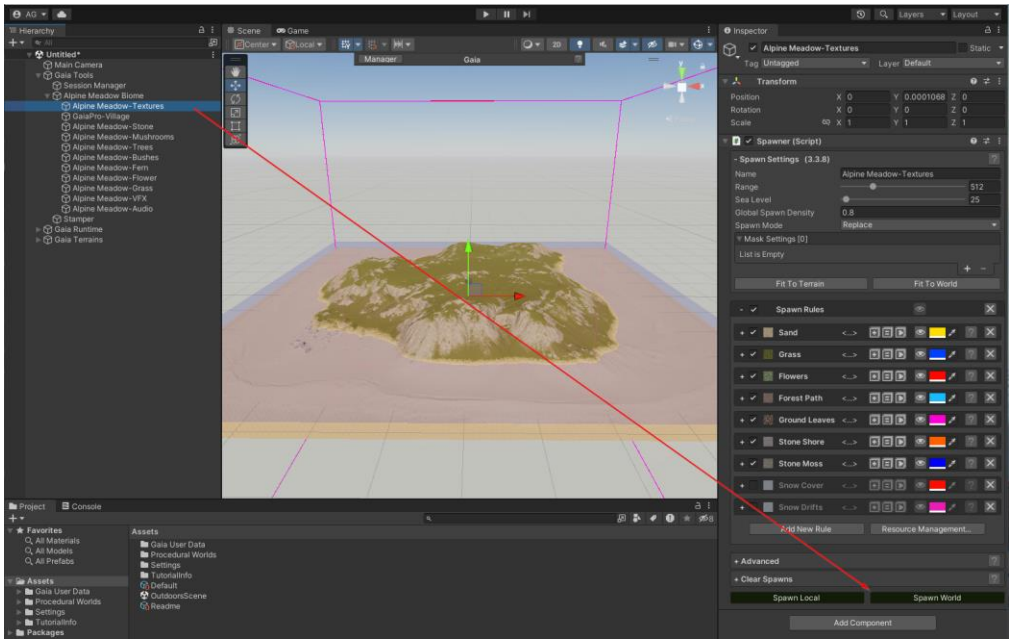


10. Gaia has now applied the stamp into your terrain and textured it as well!



So what just happened?

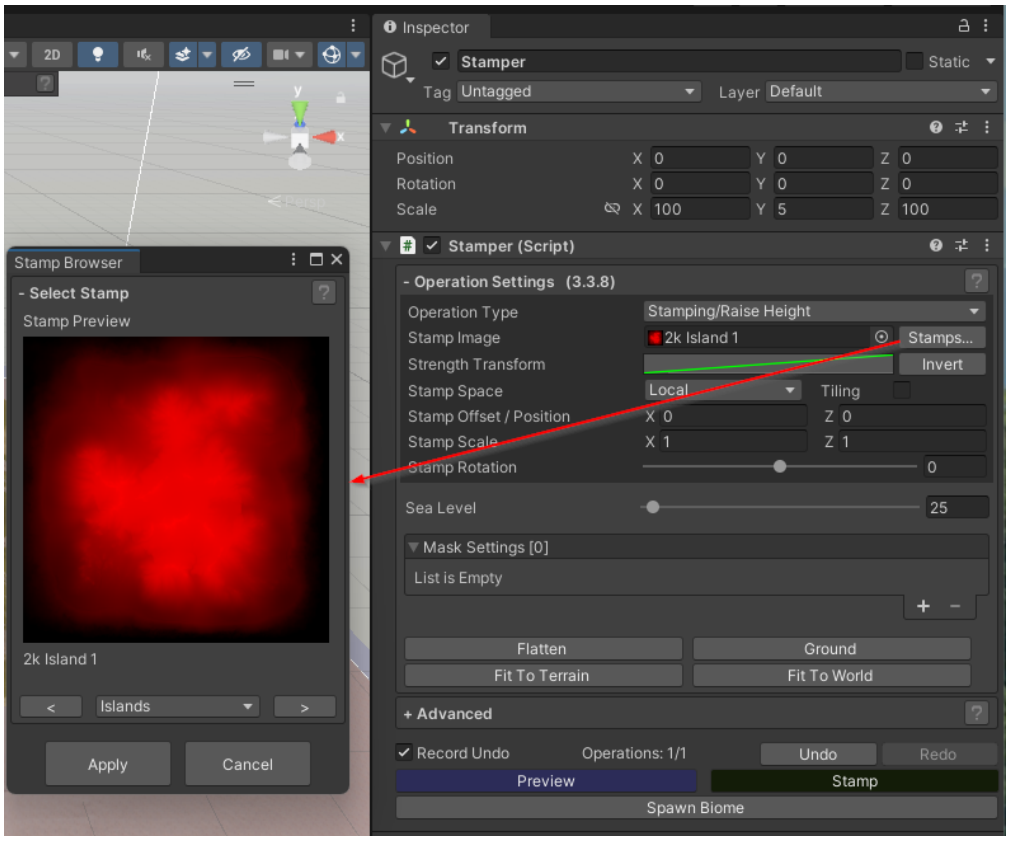
Gaia used the Stampers “Stamping / Raise Height” Operation to apply that stamp to the scene, and then called the Alpine Meadows – Textures spawner in the Alpine Meadow Biome to texture it for you.



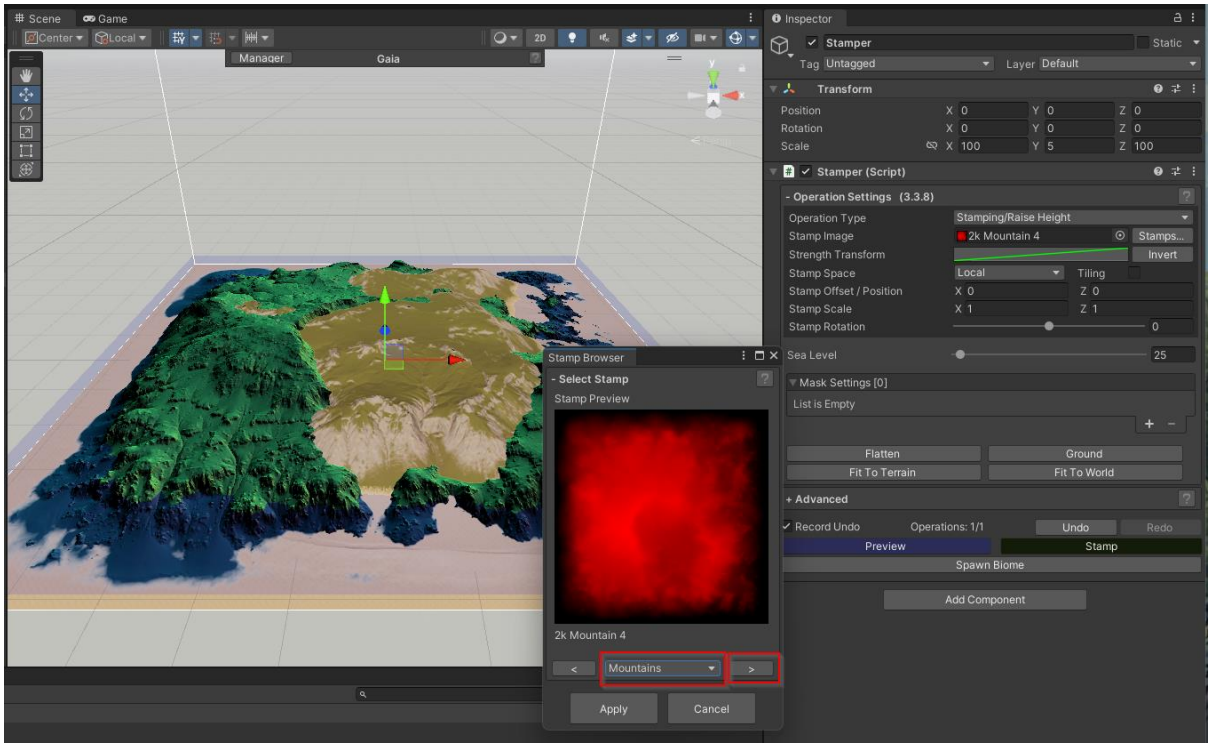
Auto texturing is a handy short cut that gives you a sense of how your scene will eventually look. As you become more proficient with Gaia over time, you can customize these Biomes or create new ones to create your own look.

11. Lets add another stamp to customize your scene further.

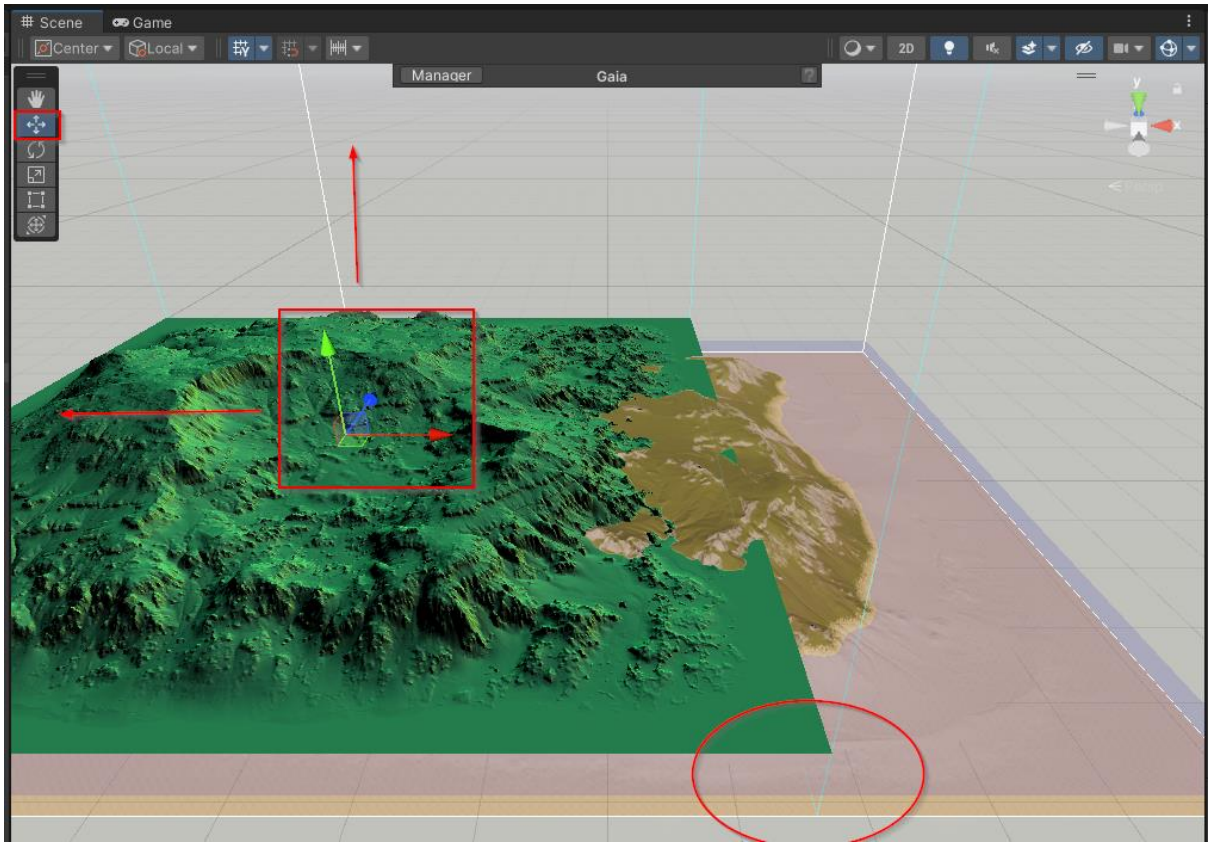
    Make sure that your Stamper is selected in the hierarchy, and click on the Stamps button to open the stamp browser.



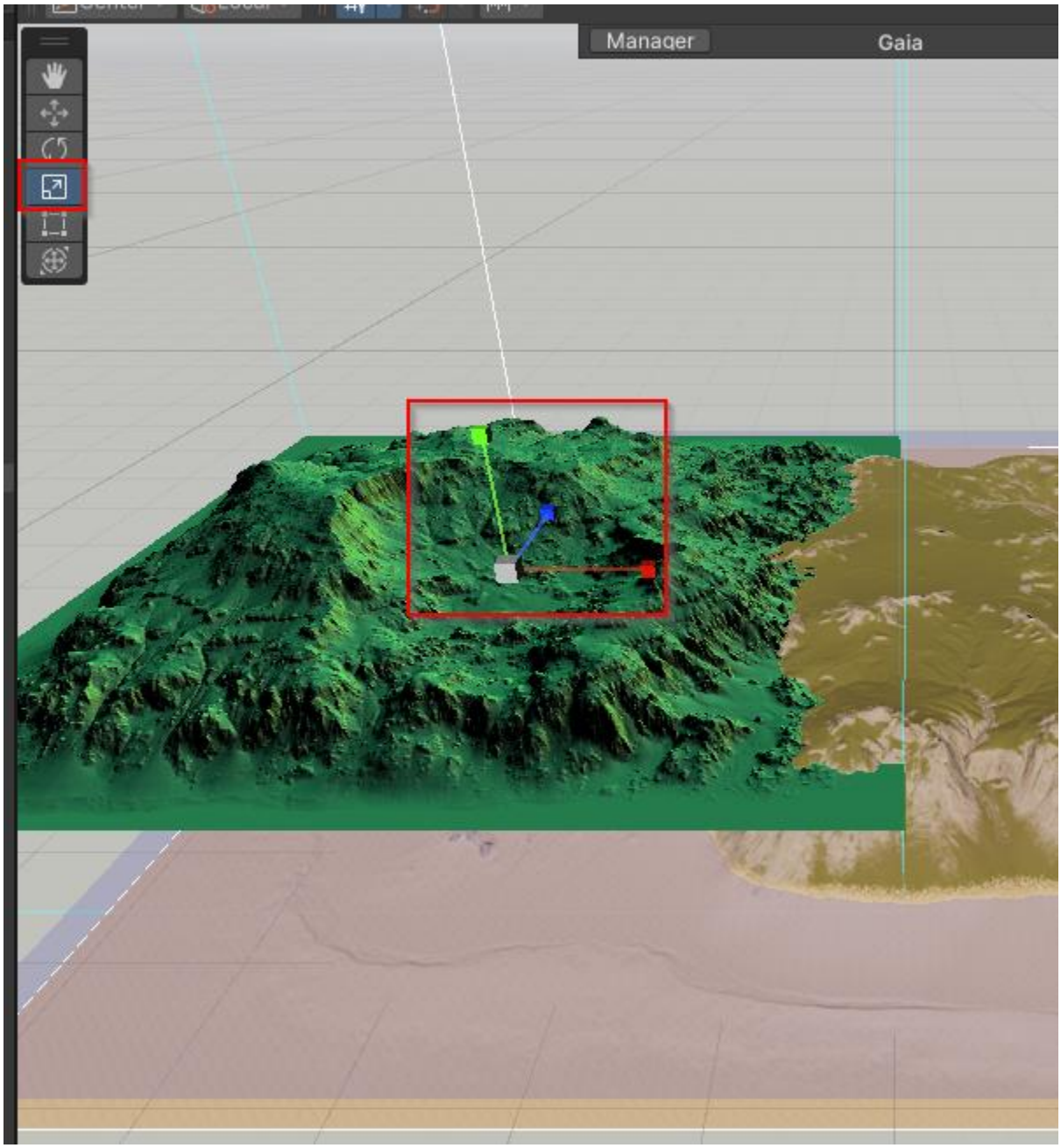
Browse to Mountains, and hit the arrow buttons to select 2k Mountain 4. Notice how the blue/green preview updates in the background. Hit the Apply button to select it.



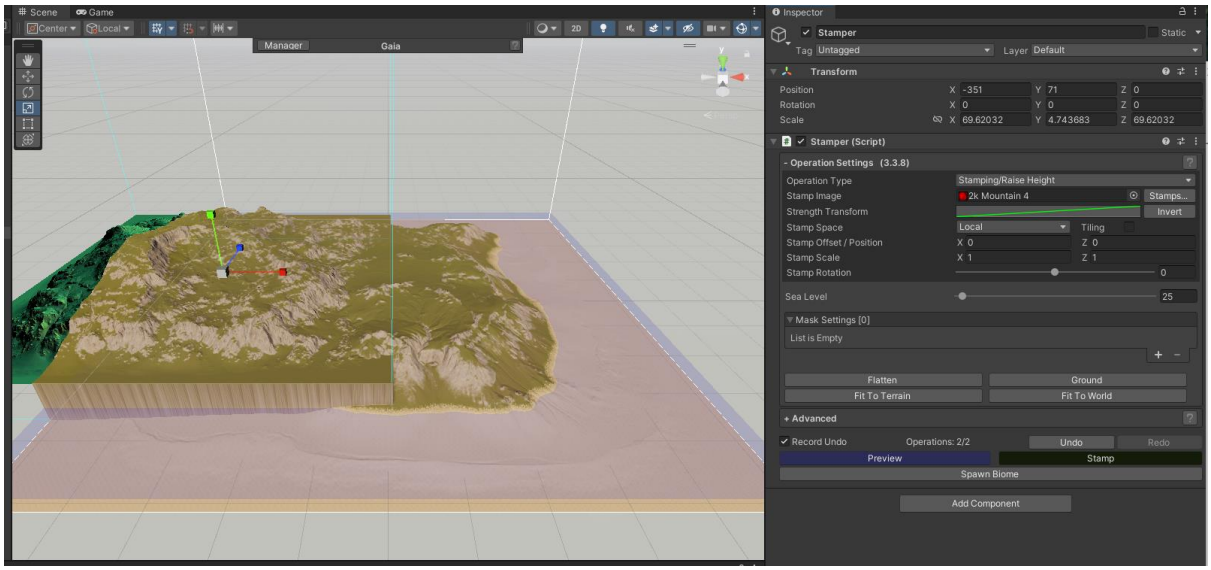
Make sure that the Mover tool is selected, and then both lift the Stamp preview, and then drag it to the left. Notice how the stamp is sitting well above the underlying terrain.

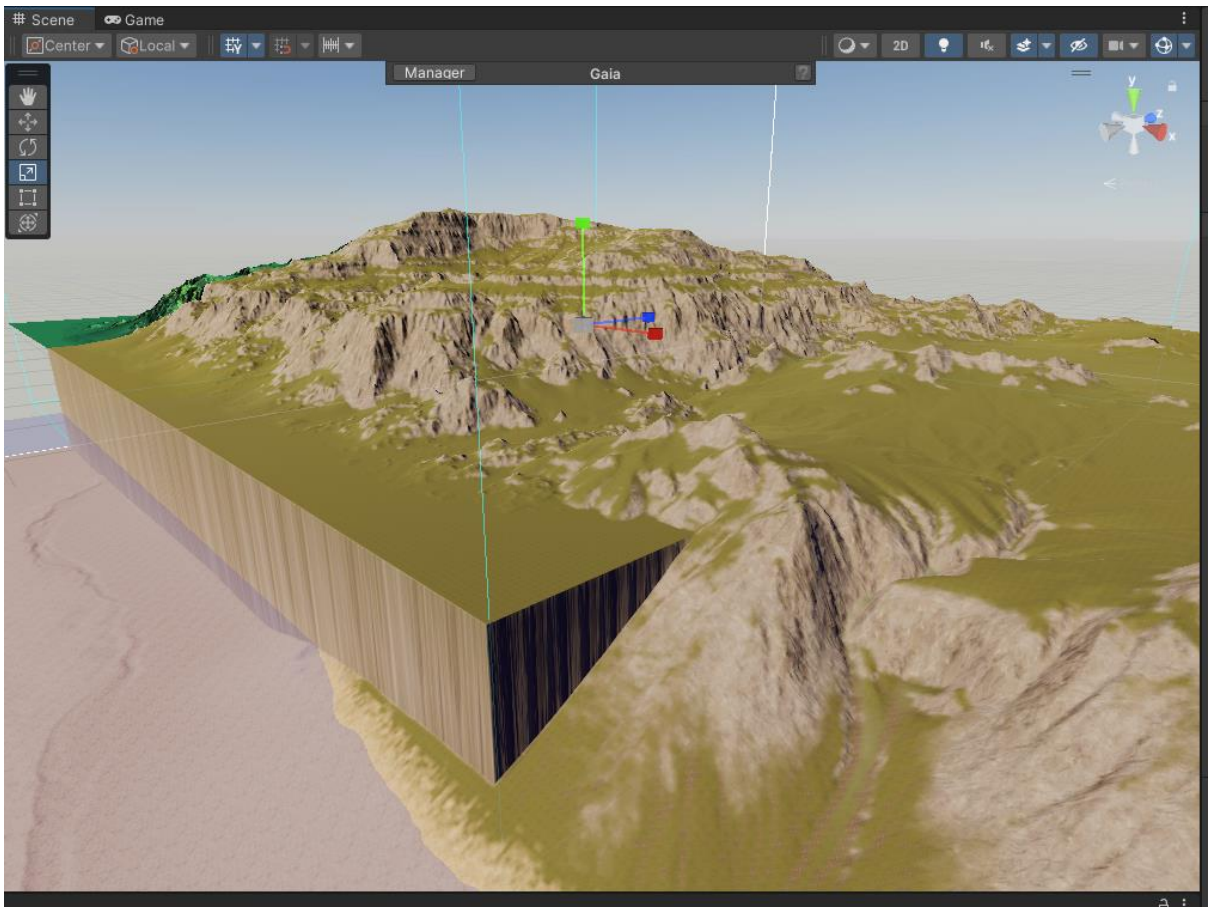


Next select the scale tool to make the Stamp smaller and higher.



And now hit the stamp button.

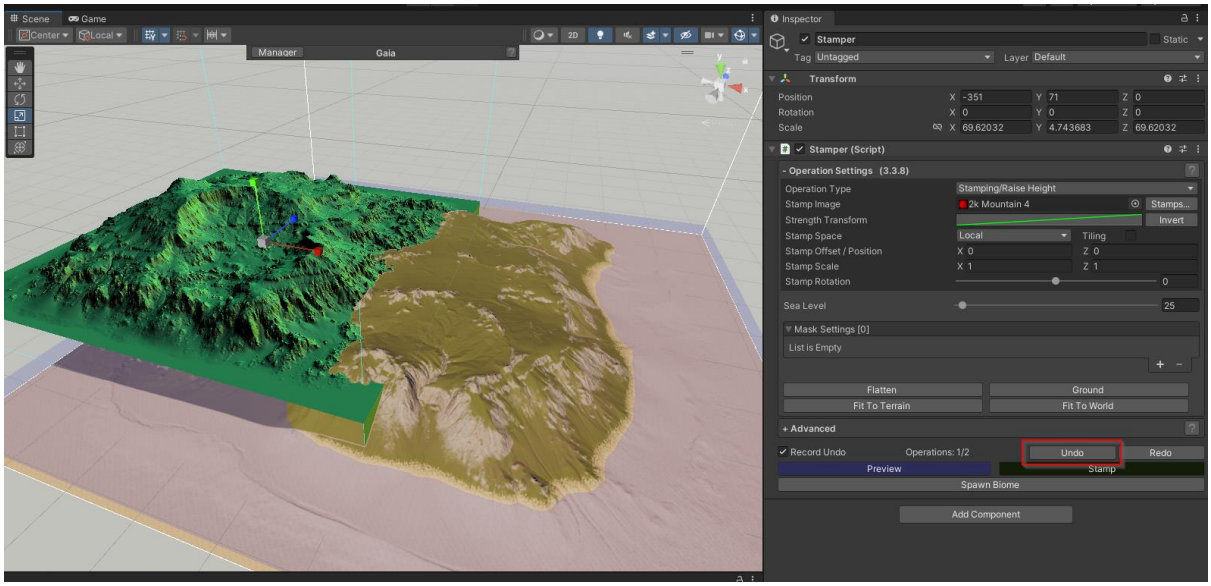




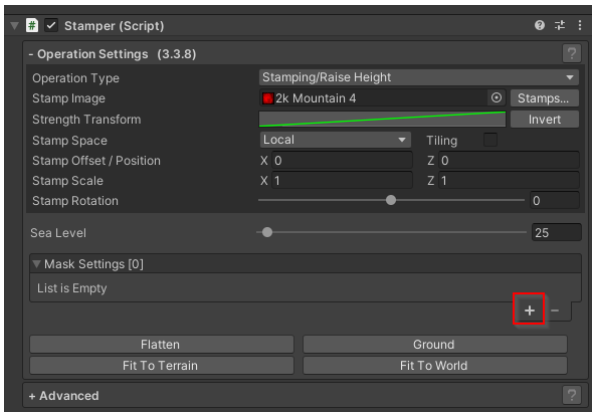
Awesome. Gaia added and textured the stamp, but.. Houston we have a problem!

To fix it hit the Undo button. This will undo your last operation.

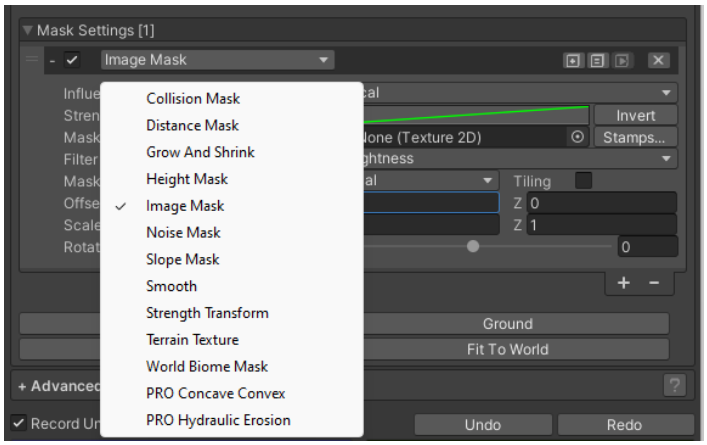
Warning: The Undo list will be lost if you hit play!



12. Now lets use a Mask to fix this issue!

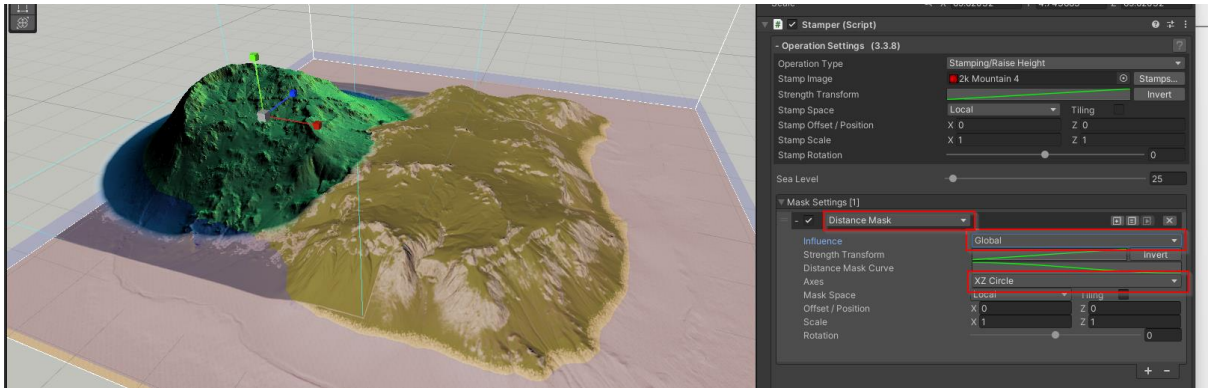


Click "+" on the the Mask Settings list on the stamper and add a Mask.



Gaia has an incredibly powerful masking system and you and use these to get many sorts of effects.

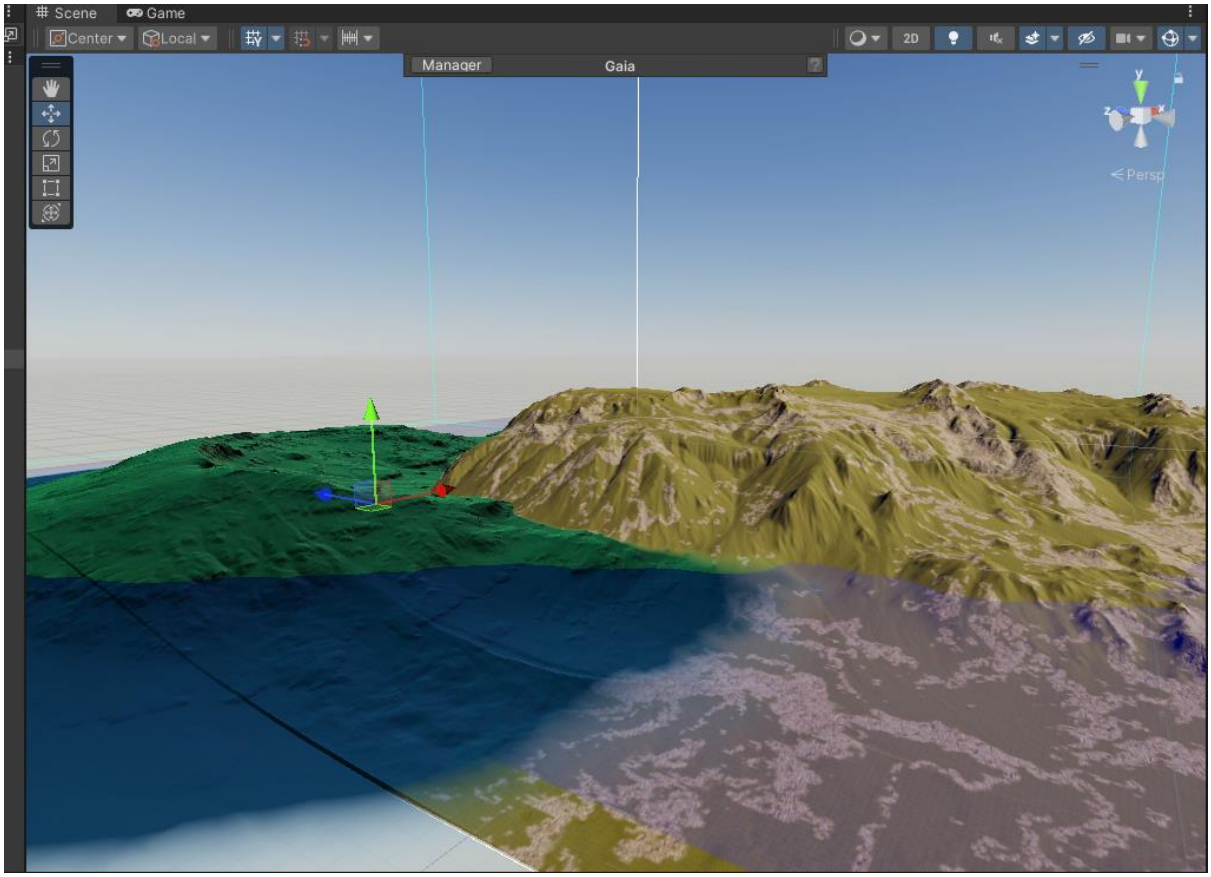
13. Select Distance Mask, and then set its influence to Global, and its Axes to XZ Circle. You will see that the stamp preview is now being blended to the underlying terrain.



We now have a problem because the stamp's scale does not work well. We need change this to make it look more natural.

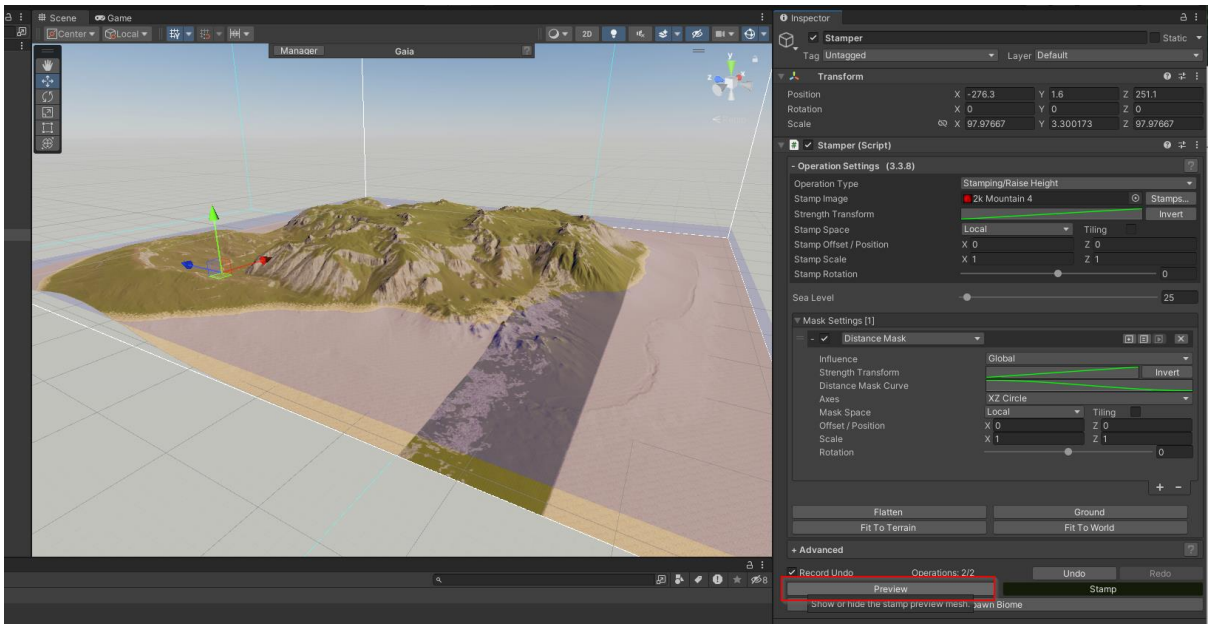
14. Use the Mover and Scaler tools, and adjust the position and scale of the stamp. If you accidently unselect the stamper, just select it again in the hierarchy to get the preview back. You can see how the Distance mask blends the stamp nicely into my scene.

    When you are ready, hit the Stamp button!



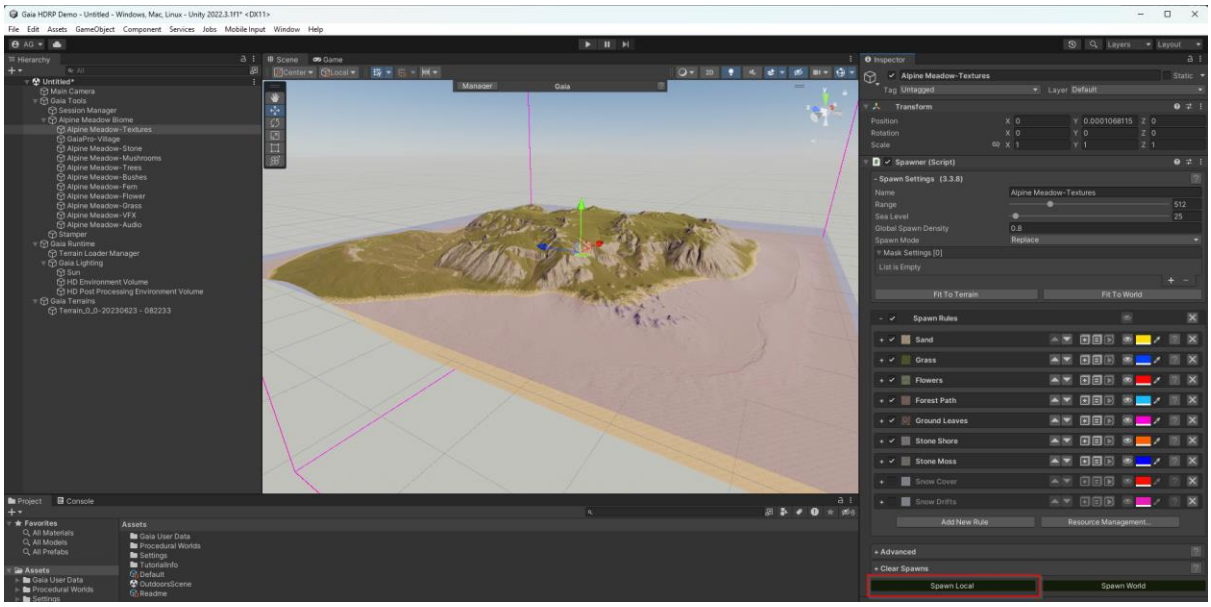
    Tip: You can also use the rotation tool to rotate the stamp as well!

15. Turn the preview off to see your work, and then turn it on again.



Notice that the texture operation is only called in the context of where the stamp currently is.

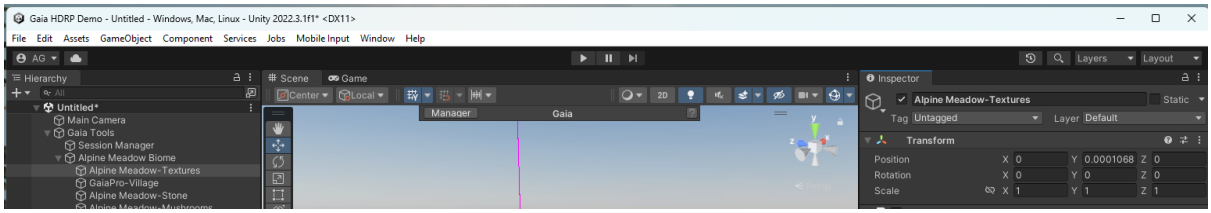
16. To fix this, click on the Alpine Meadow-Texures object and hit the Spawn Local button.



Nice. Now we have re-textured the terrain, and it looks pretty good!

17. Lets get a sense of how this looks ‘in game’.

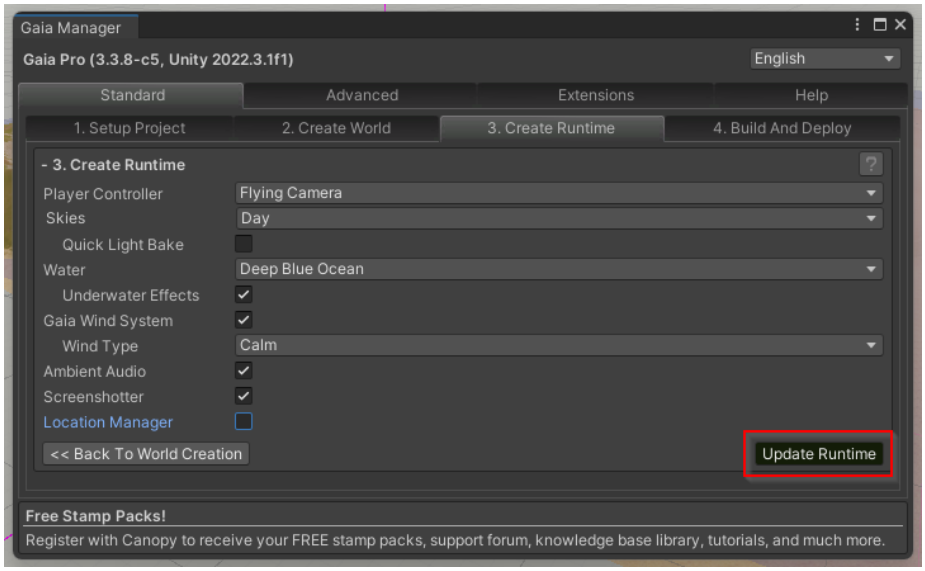
    Click on the Manager button at the top of your Scene view to open Gaia Manager up.



    We are now going to add in a player controller, some nice skies, some water, wind and a screen shotting system into your Runtime.

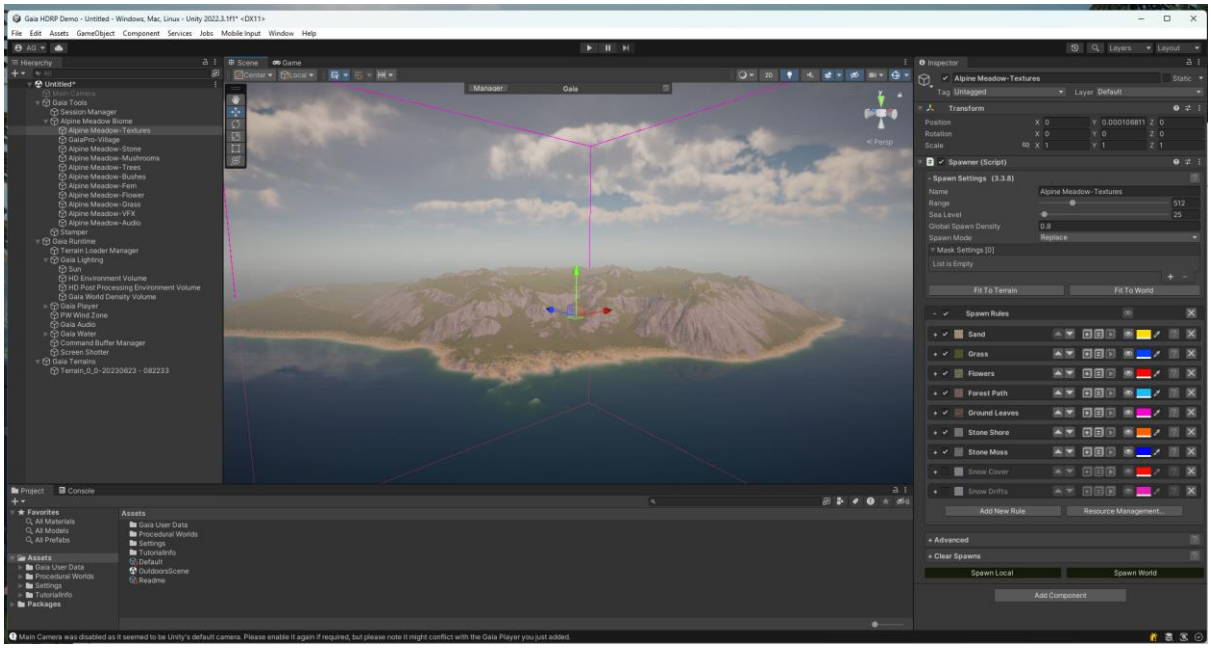
    Click on ‘Update Runtime’.

    You can configure or even disable these settings as you prefer.

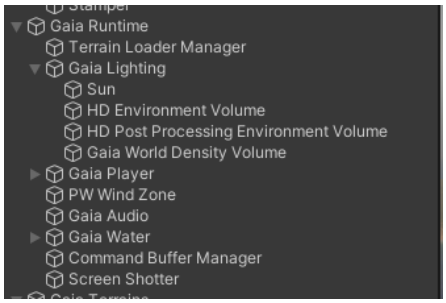


18. Gaia will ask for confirmation, and when you have done this, close the Gaia Manager again.

    We now have skies, water, post fx, audio fx, a screen shotter and a player controller in our scene!



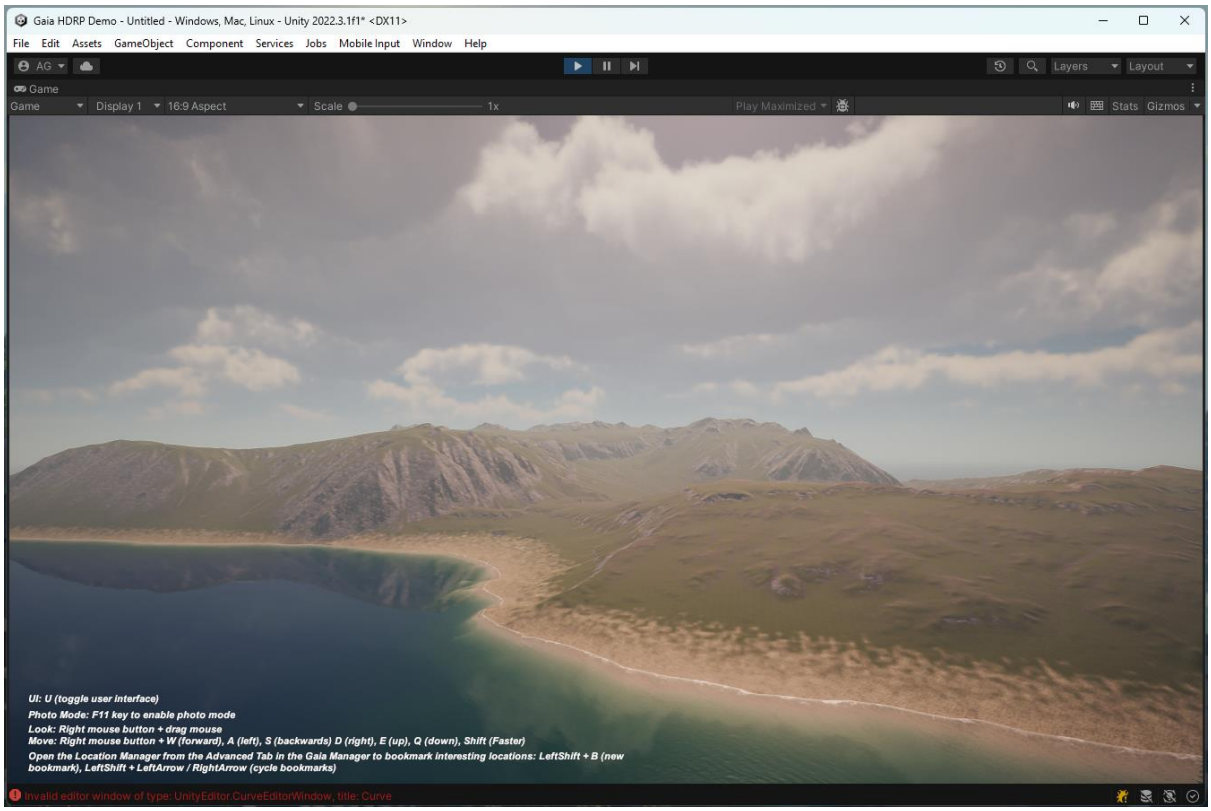
    You can see these in your screen hierarchy under Gaia Runtime. We did a lot of work for you and this is a big time saver!



    For new scenes this appoach makes it easy to prototype, and check its scale. You can remove the runtime later.

19. Hit Play and enjoy your scene!

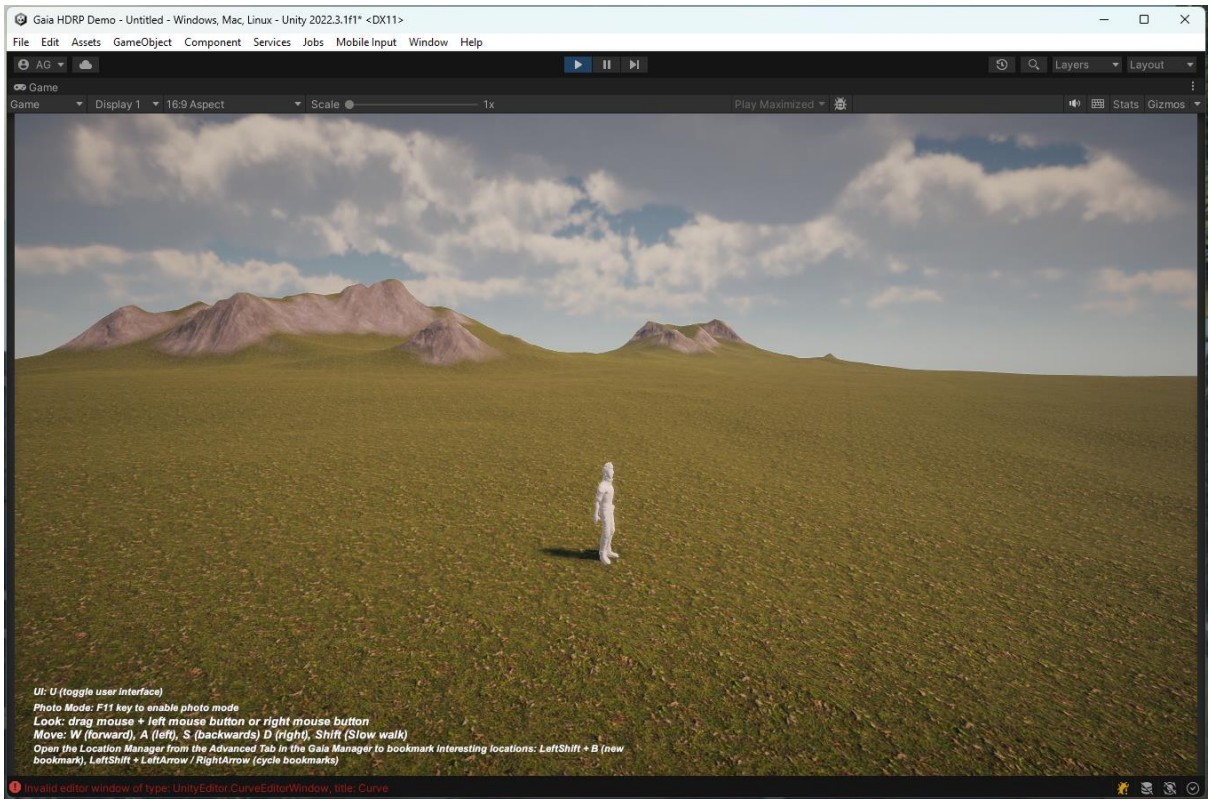
    Notice that we created a runtime user interface down at the bottom left of your screen. Read this to learn how to control the Fly Camera we put into your scene.



20. Stop the game, and go back to Gaia Manager. Change the Player controller to a 3rd Person Controller, hit the Update Runtime button, and then press Play again.

    Gaia will update your runtime based on any changes you made.

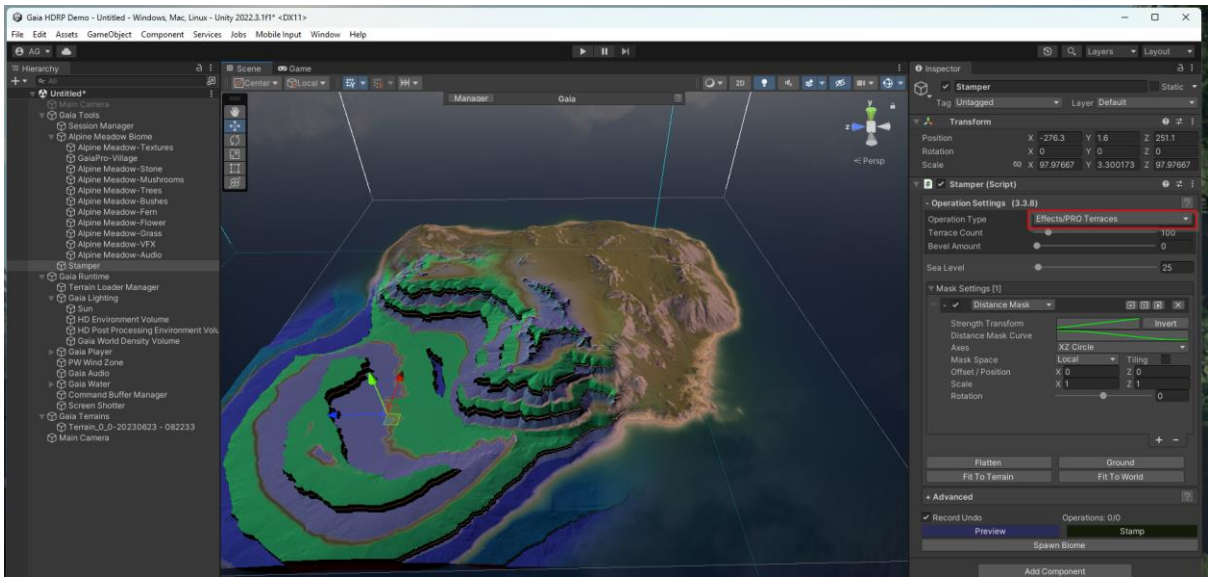
    The interface at the bottom of the screen shows how to control the player. You can use the middle mouse wheel to zoom in and out as well!



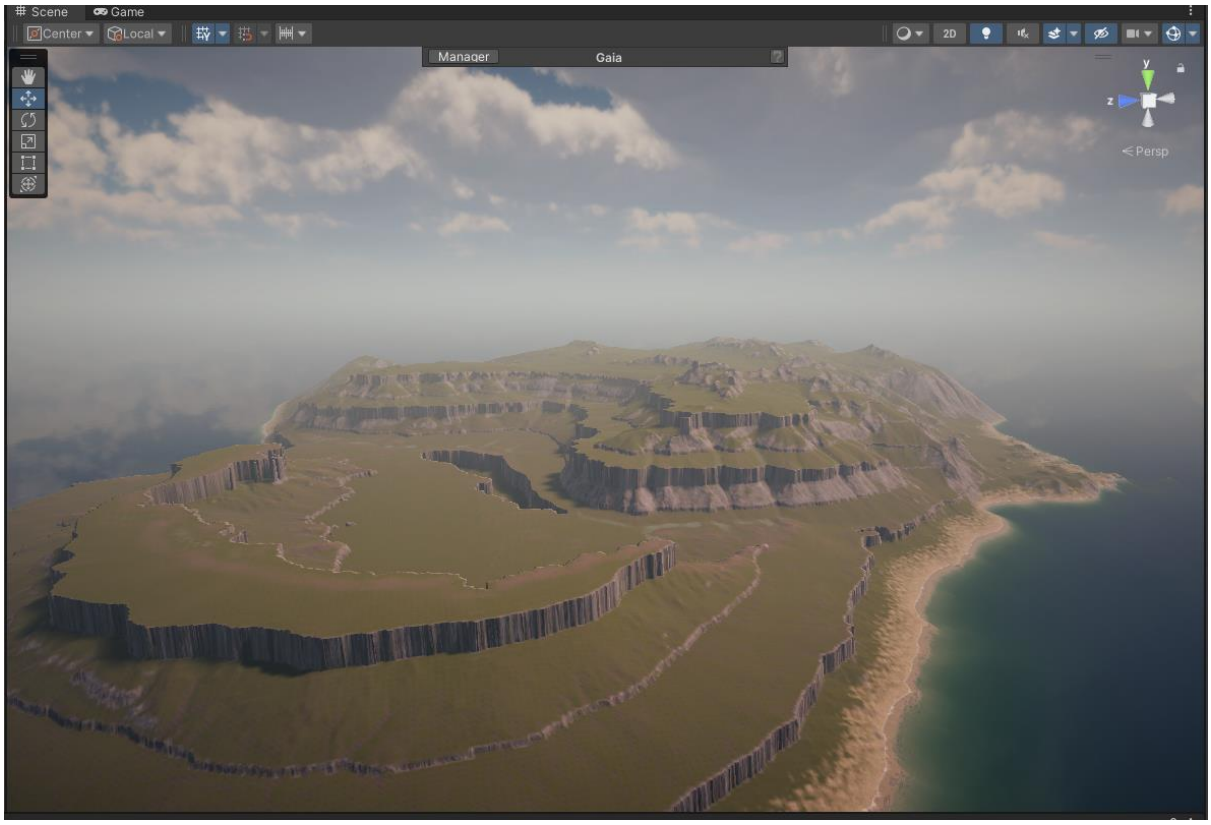
21. Ok, last demonstation of the stamper before we finish this world.

    Choose one of the Effects Operations. In this case I am going to choose Effects / PRO Terraces. This is a Gaia Pro feature.

    The preview will update to give you a sense of how this effect would be applied to your scene. You can move and scale the stamp to contol its area of effect. You can also influence this with masking.

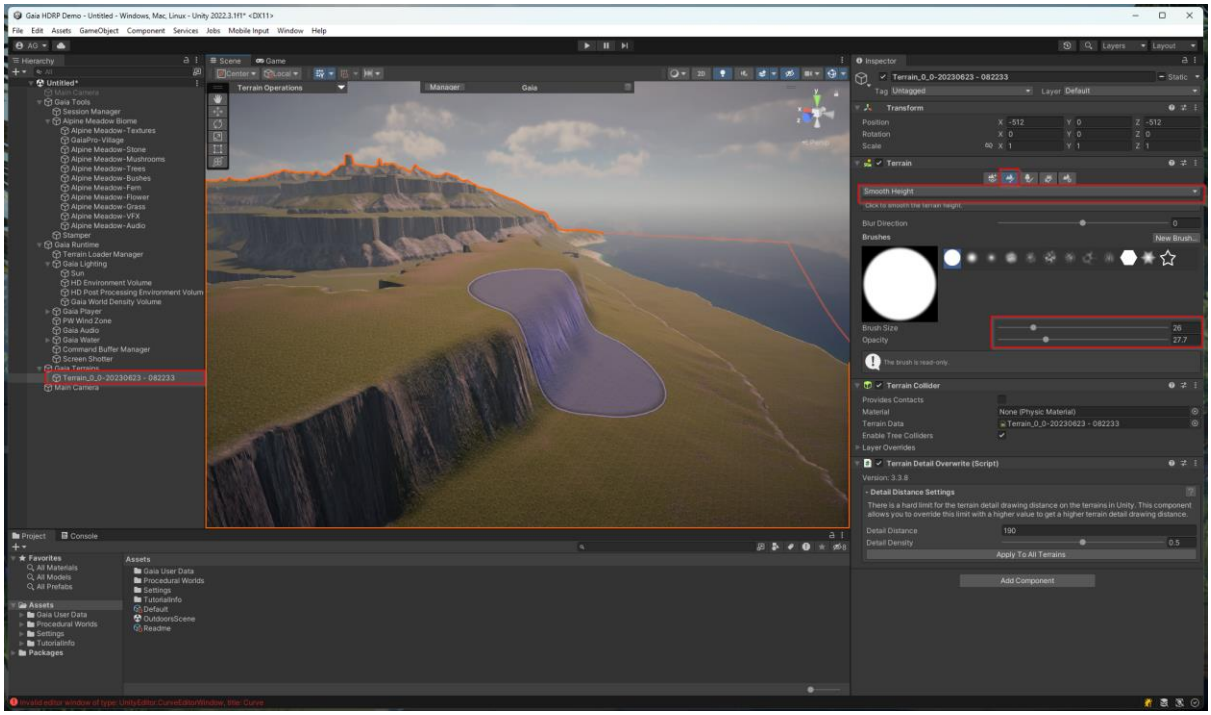


22. Experiment with your settings and then hit the Stamp button.



23. Neat… but these terraces are a bit extreme… we could fix this with Gaia… but part of the power of Gaia is that you can mix and match.

    Lets use the Unity terrain itself to soften this. Paint the effect you want directly onto the terrain!



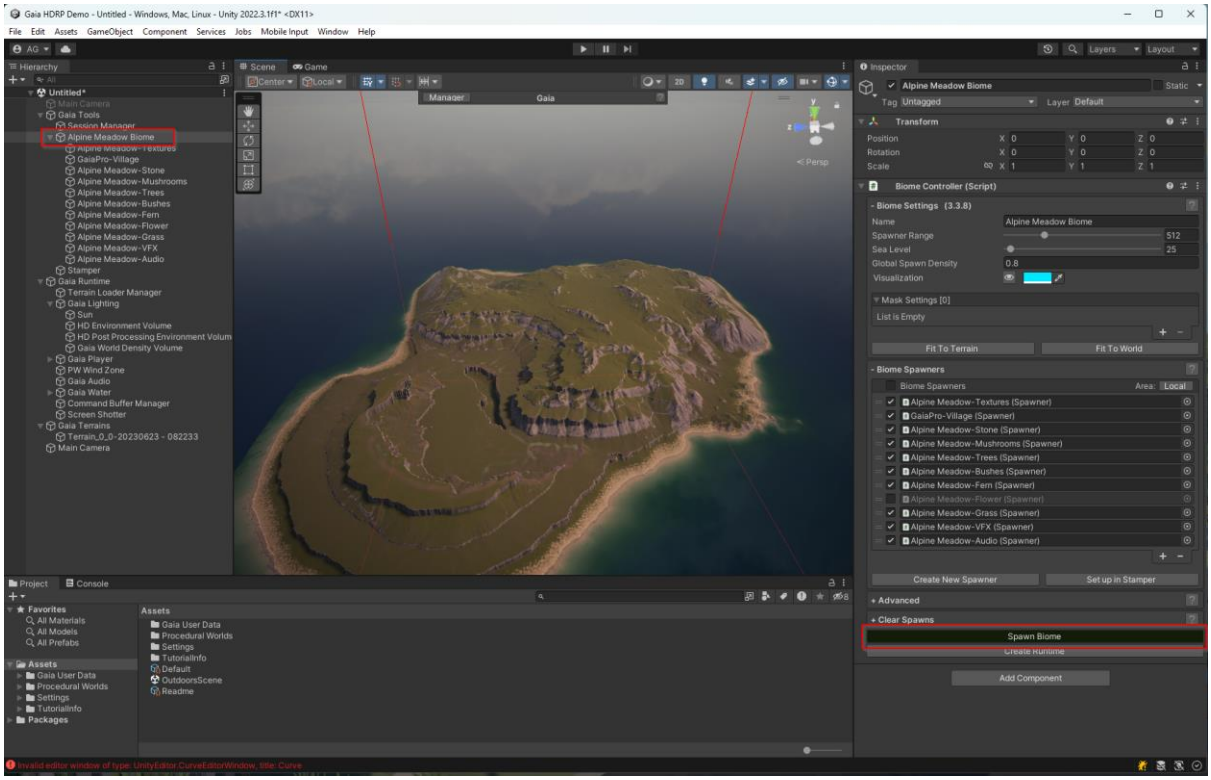
    The masking and stamping system in Gaia is extremely powerful for more information please check out the following links.

    Tutorial overview
    How to create your own stamps with the Scanner
    Stamper Introduction : How to use the Stamper
    How to mix and blend stamps
    Introduction to masks

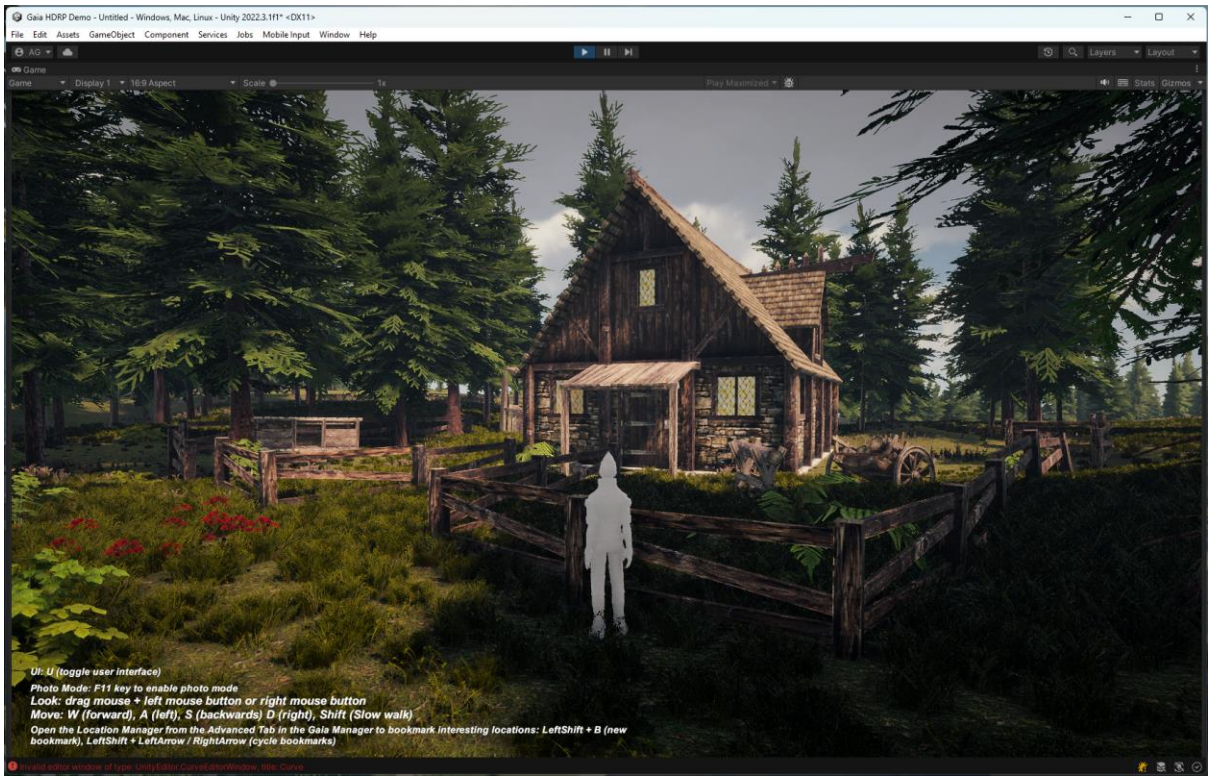
24. Lets spawn the biome!

    Select the Alpine Meadow Biome, and then hit the Spawn Biome button!

    Depending on the speed of your machine you will need to wait a bit. On my machine with this demo, it took about 2 seconds.



25. And now hit play and go exploring!

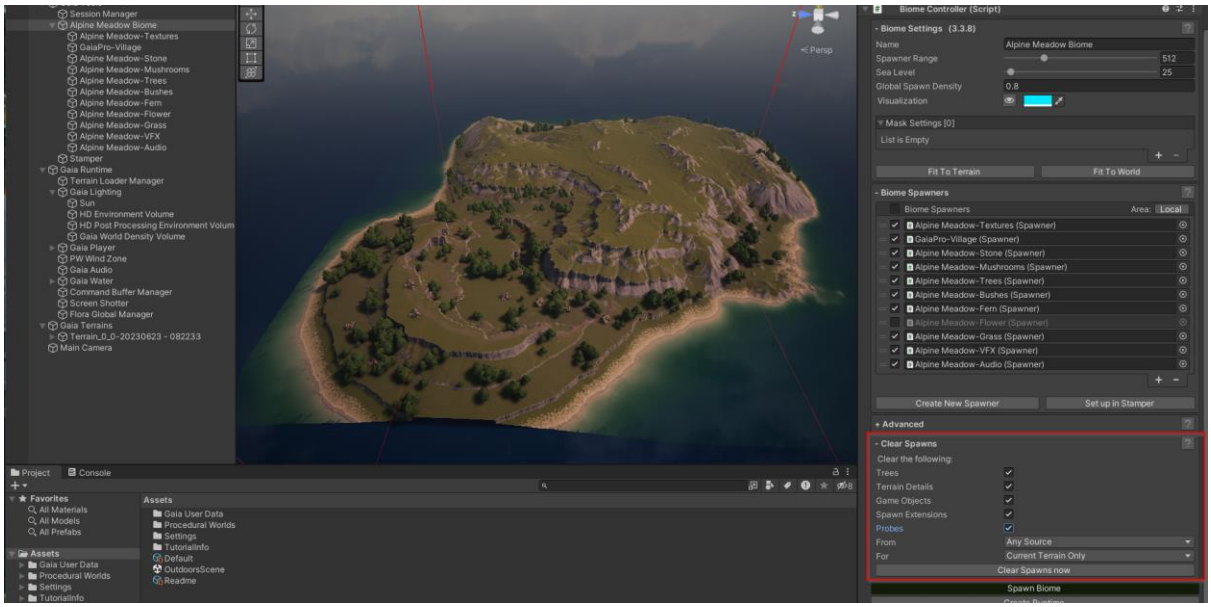


26. For a different look to the game, stop the game, then click on the Gaia Lighting object, change the lighting profile and explore different lighting setups!

27. To further refine the environment, remove all of the assets using the biome controller, so that you can then get in with the Stamper to do more work.

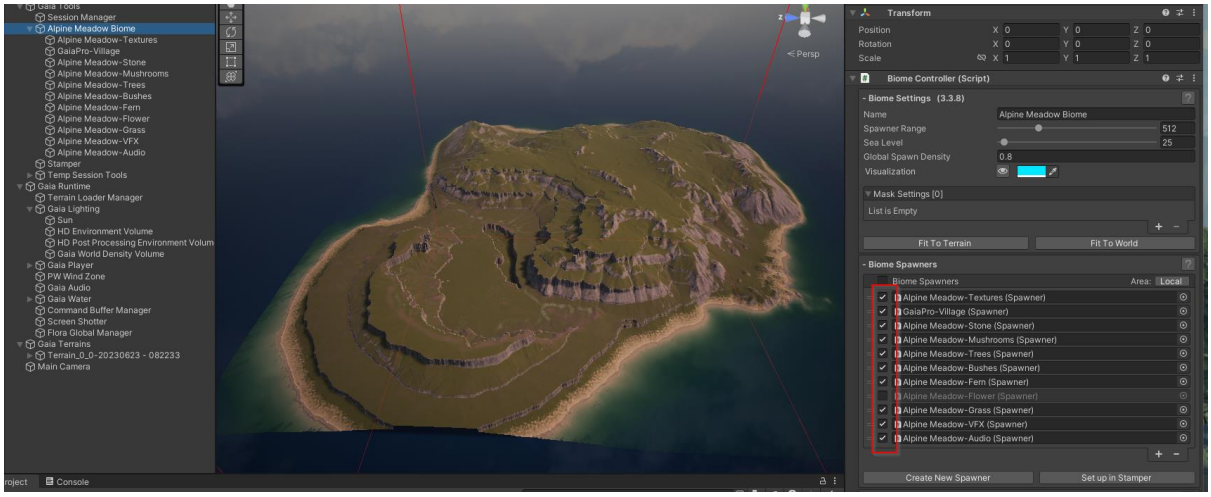
    Select the object types you want removed and hit the Clear Spawns button. You can then use the stamper to refine your world.

    You can run the Biome again at any time.

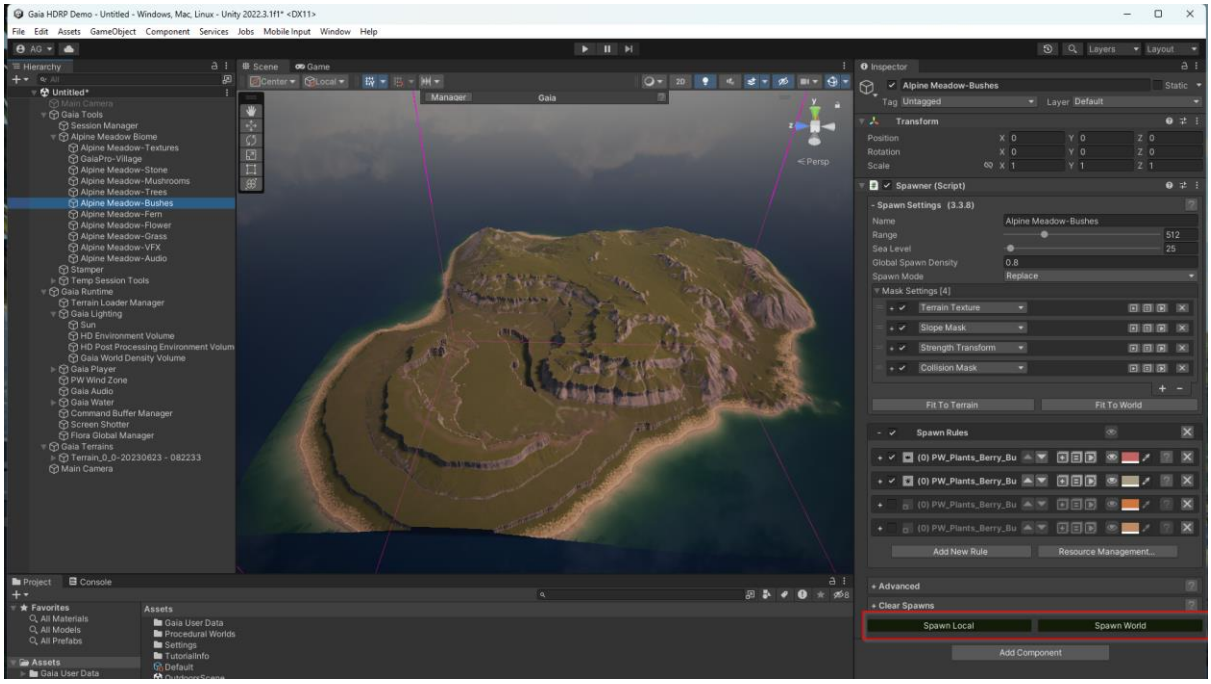


    Warning: The biome system will overwrite what is in your scene so please treat it with care. If you have done some manual texturing or vegetation placement, it will be lost!

28. You can also enable and disable individual asset types in the Biome before spawning it again.



Or even just select the spawner itself to configure and spawn it alone.

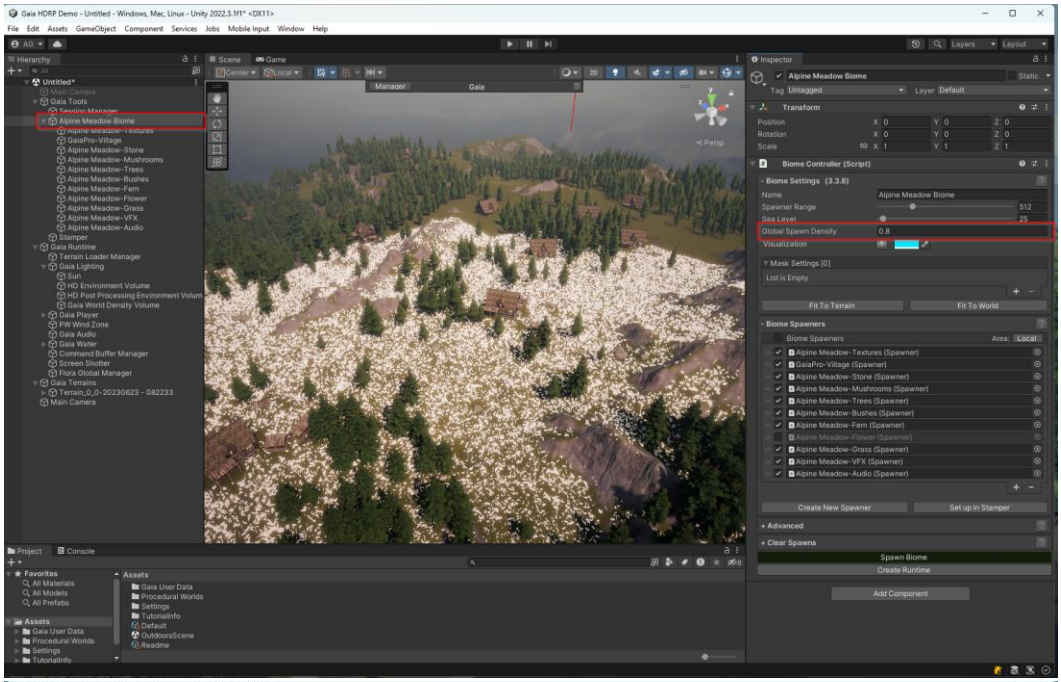


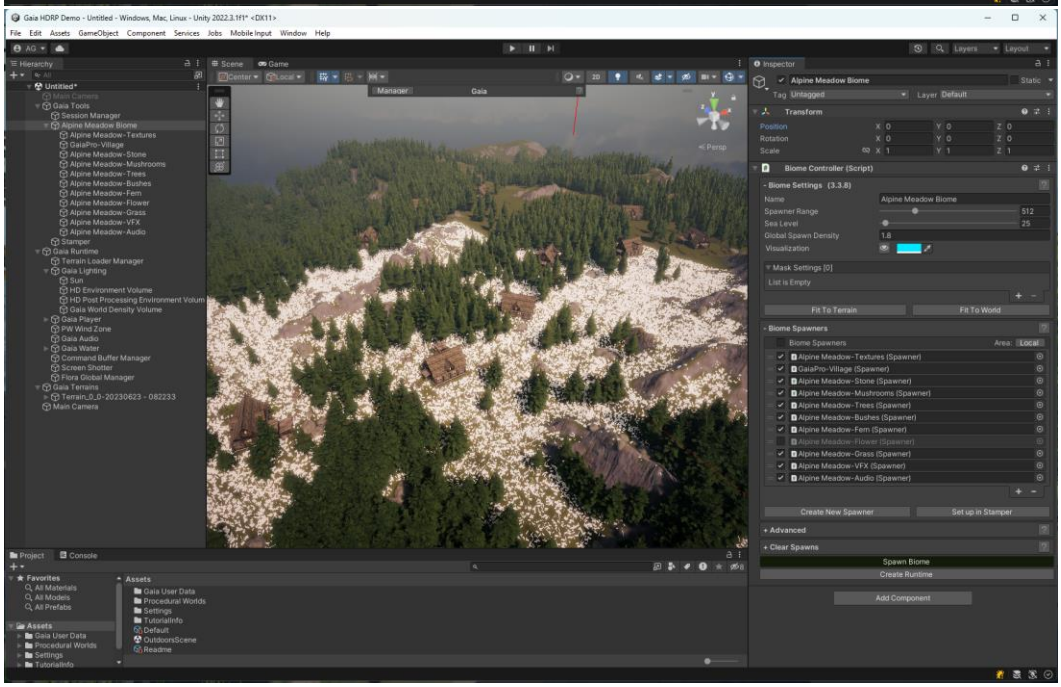
The Biome and Spawner system in Gaia is quite deep. Its is well worth your time to work out how to use it to get the look you want.

29. Depending on the biome, the spawn might be too sparse, or conversely, too dense. To change this use the Global Spawn Density.

    Use with care! The more you spawn, the more your computer generates and renders. You can easily crash Unity with out of memory errors!

    Don't worry about the white cover there. For the longest time HDRP did not have a grass shader. We created a system called Flora to render grass, and it will be fine when you press play.



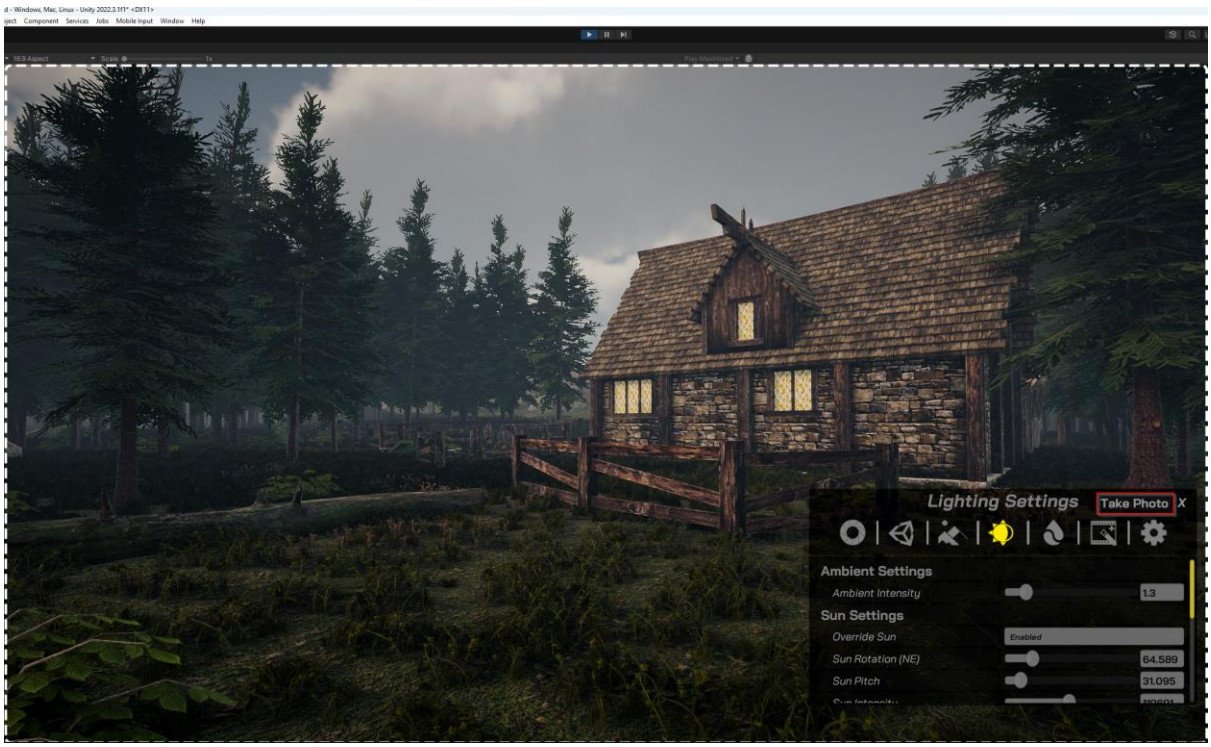


30. Personally, I love lush environments, but Unity will struggle to render them.

For a solution that is capable of rendering incredibly dense environments you can ask about the Storm render engine. We included a section on this in the additional products and services section at the beginning of this document.

31. Gaia Runtime comes with a screen shotting system. You can add it into your scene and then access it at runtime to make screen shots of your game in action.

    If you added it, then you can switch it on by pressing F11. You can override many of the settings to customize the look as you want.



    Screen shots are stored in your Gaia User Data / Screenshots directory.

Create a terrain using the world designer workflow (random generation)

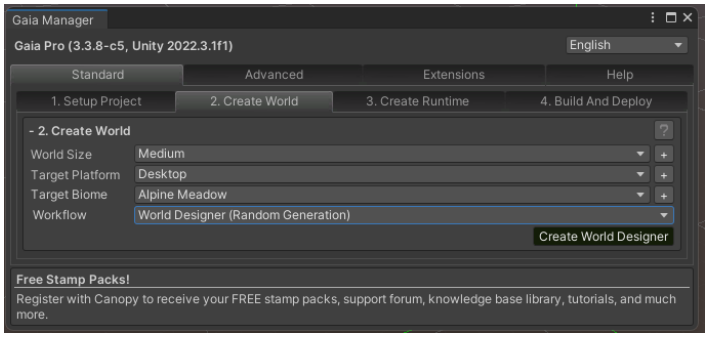
The previous section explained the how to create a terrain manually using the Stamper.

The World Designer replaces the Stamp workflow with an automated approach to terrain generation.

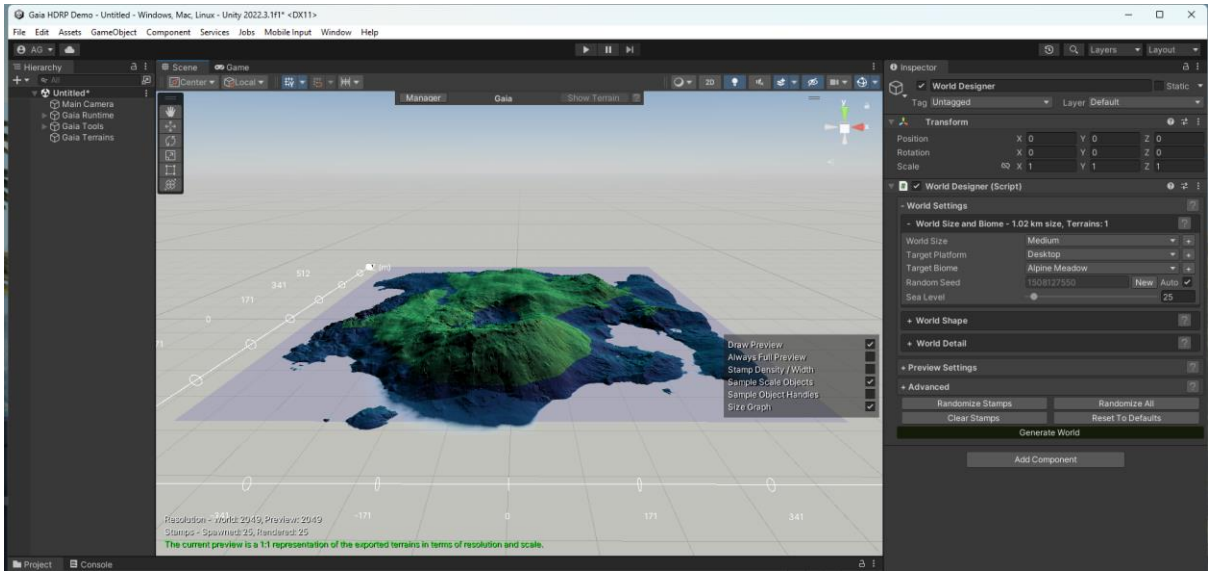
It's a great way to rapidly iterate on environments, especially larger ones, and you can refine them further manually with a Stamper after they have been generated.

The previous stamper workflow showcased how to blend stamps, and some of the features of the runtime system. Please complete that section before this one.

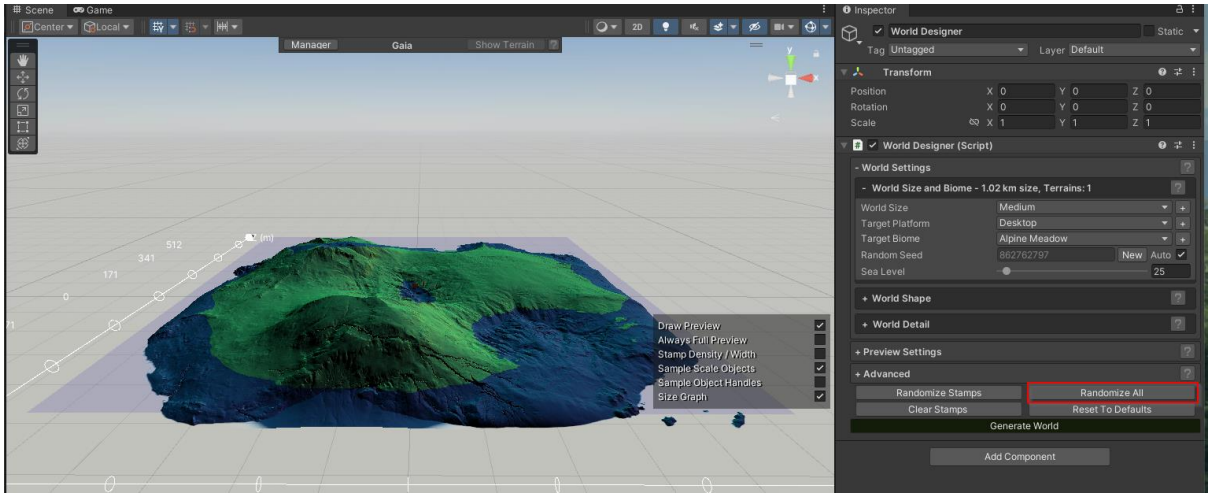
1. Open a new scene and bring up the Gaia Manager again. The default settings will be fine, but this time we will switch the workflow to "World Designer (Random Generation)"



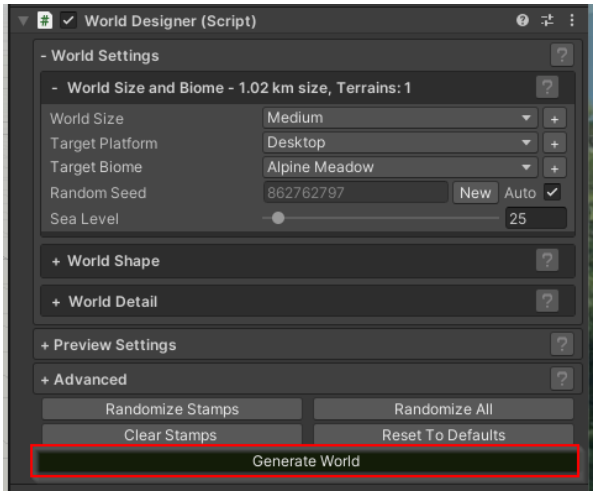
2. Click the "Create World Designer" button. Gaia will open the world designer tool for you and will show you a terrain preview that matches the world size.



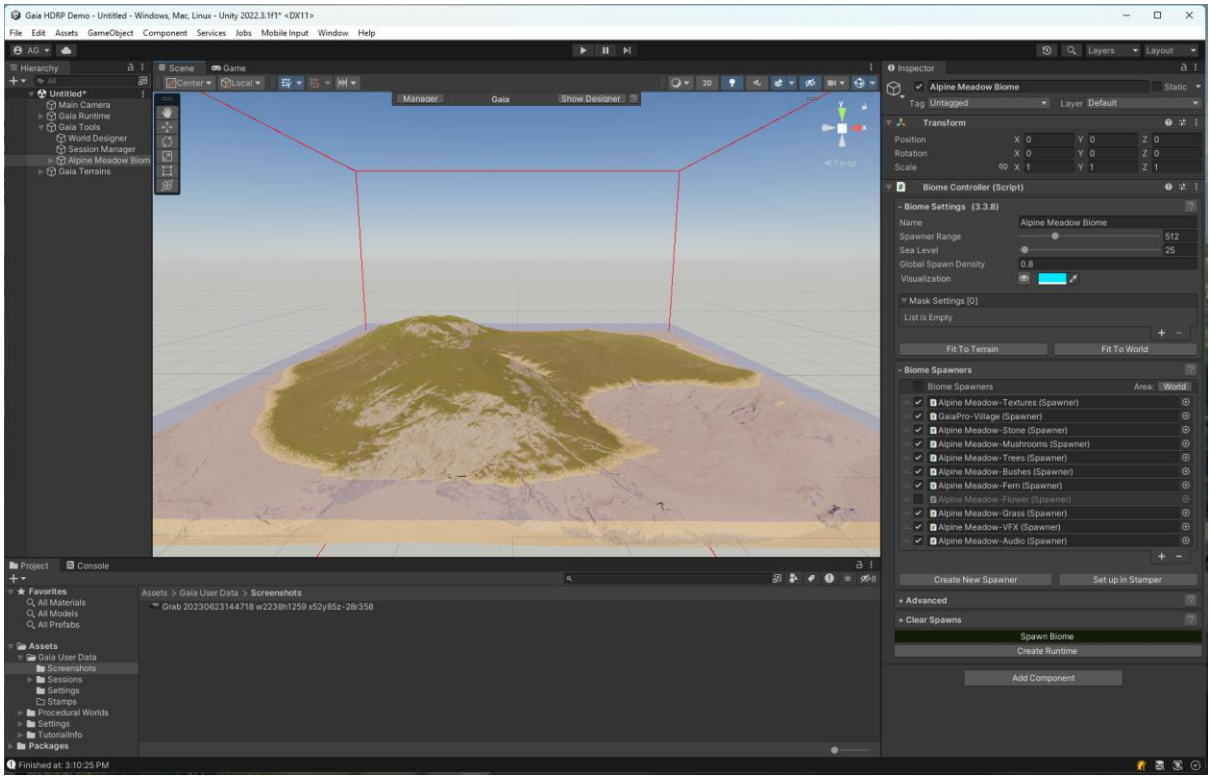
3. The terrain shape is randomized, so your terrain will look different. The easiest way to use the world designer is to click the “Randomize All” Button. Clicking this will cause a new terrain will be generated.



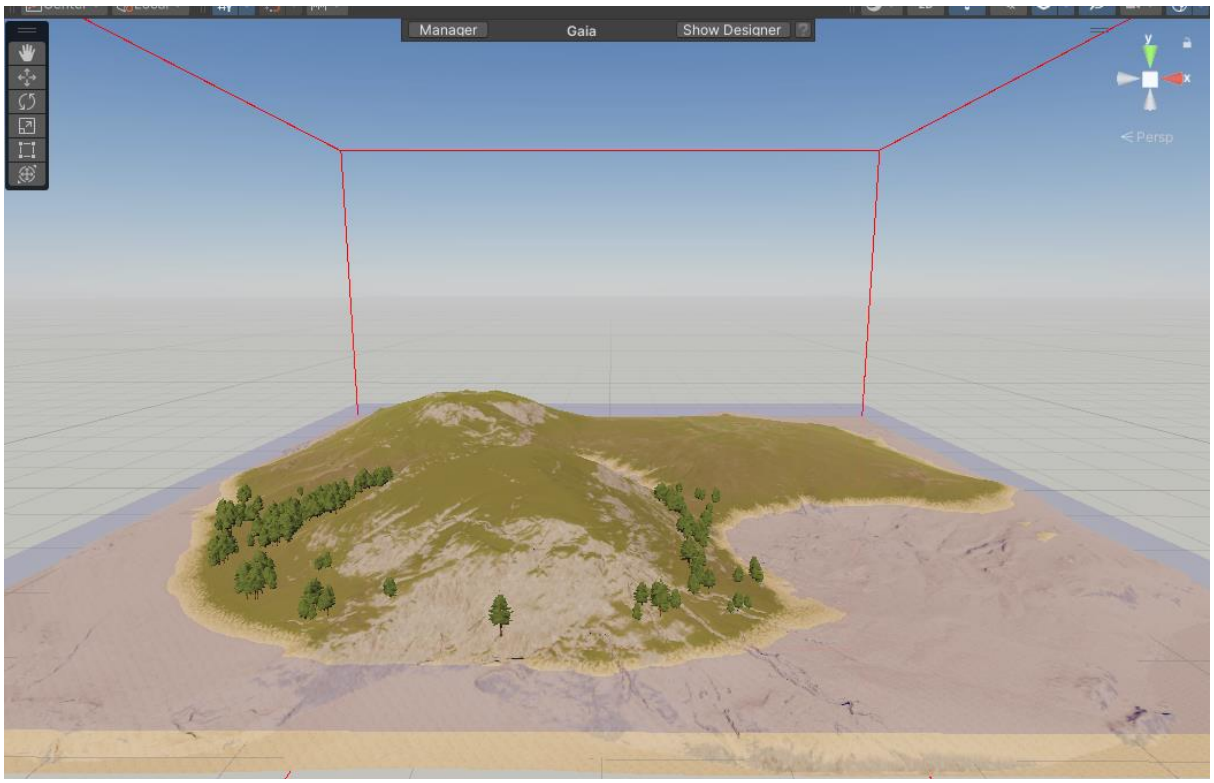
4. When you see a terrain shape that you like, press the “Generate World” button, and confirm the popup.

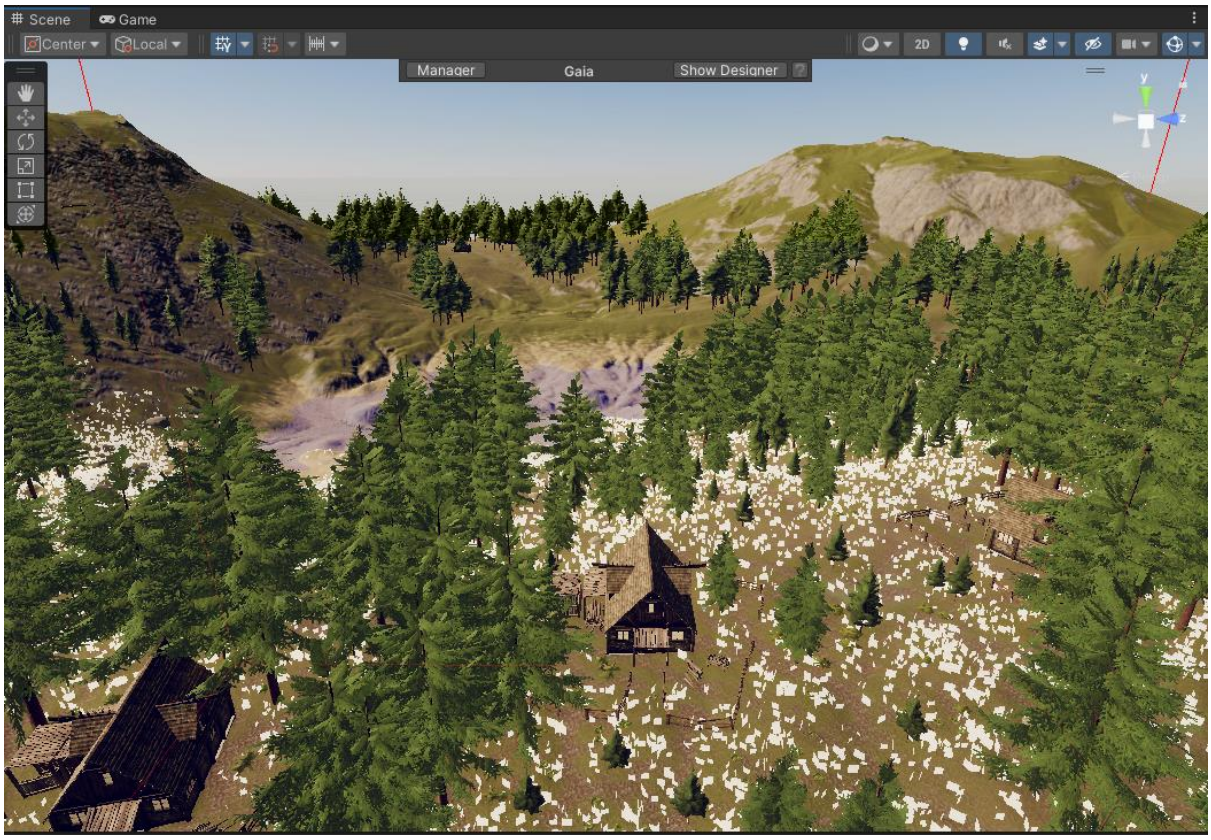


5. Gaia will now take the preview shape and create a unity terrain and spawn the textures from the selected biome:

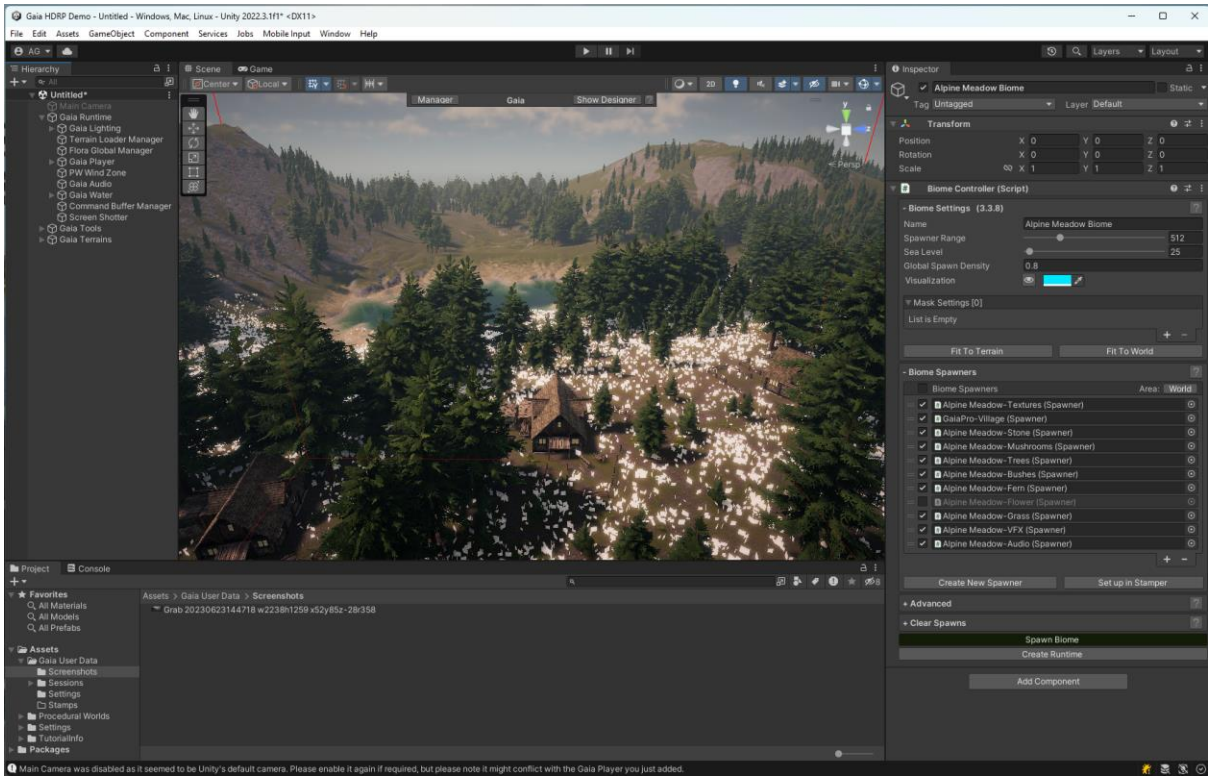


6. From here you can click the Spawn Biome button in the Biome Controller. It seems that it did not do the entire terrain, but this is incorrect. Gaia use layer-based culling in order to improve performance. Moving in closer will show all the content.



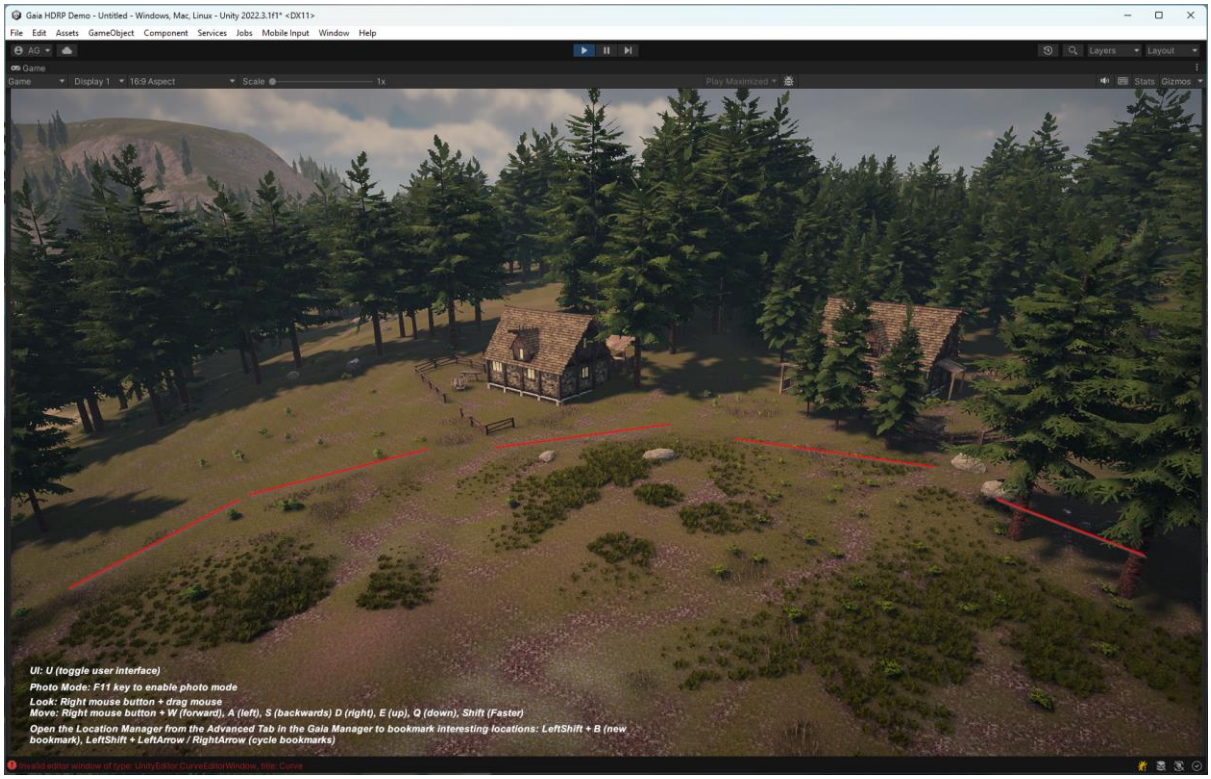


7. Bring the Gaia Manager back and Update your runtime. You can see that the visuals have been updated.

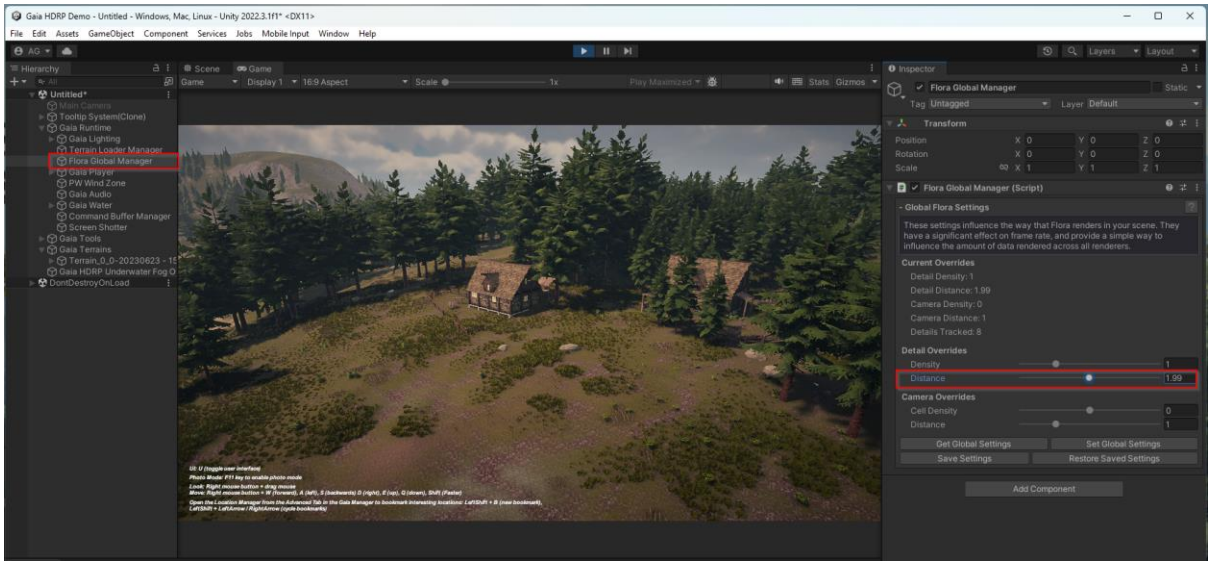


8. Now press play and let's see what Gaia did for us!

   Note how the grass cut off destroys the immersivity of this scene.

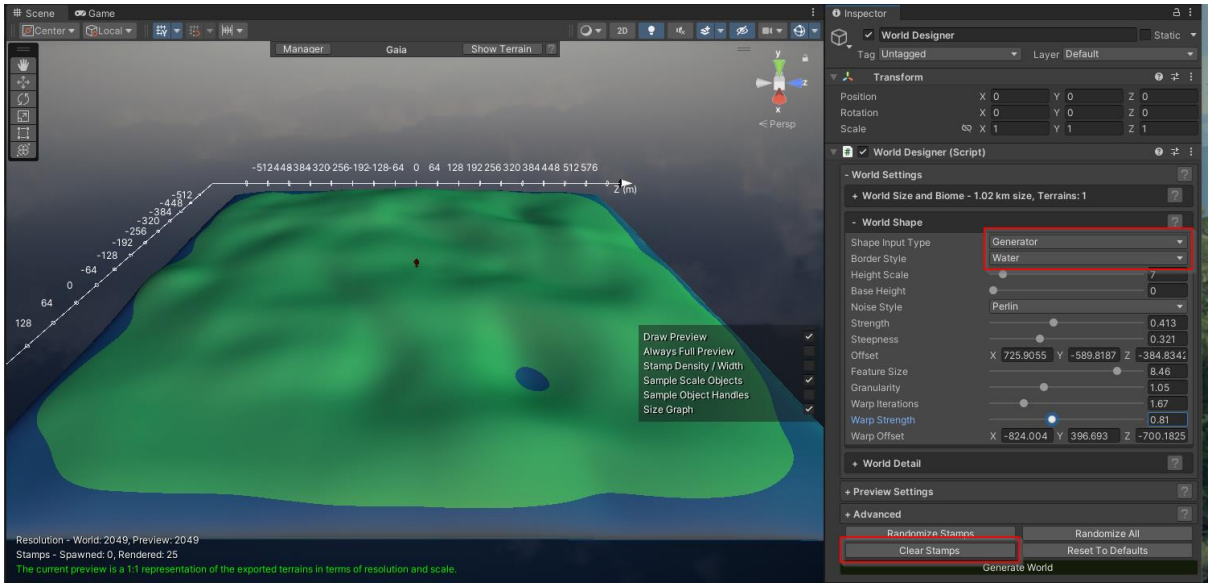


9. This can be updated to create longer draw distances. But grass is expensive to render, so this is a choice you need to consider carefully.



10. Let's explore World Designer in more detail. Create a new scene and choose the World Designer workflow from Gaia Manager.

    Hit the clear stamps button so that we are left with a base terrain. Then open the World Shape panel and select "Generator" and "Water" and adjust the settings that influence the base shape of the terrain.



    The most important settings are:

    Shape Input type – Allows you to switch between generating a shape from Noise (Generator), using an input image or an already existing terrain.

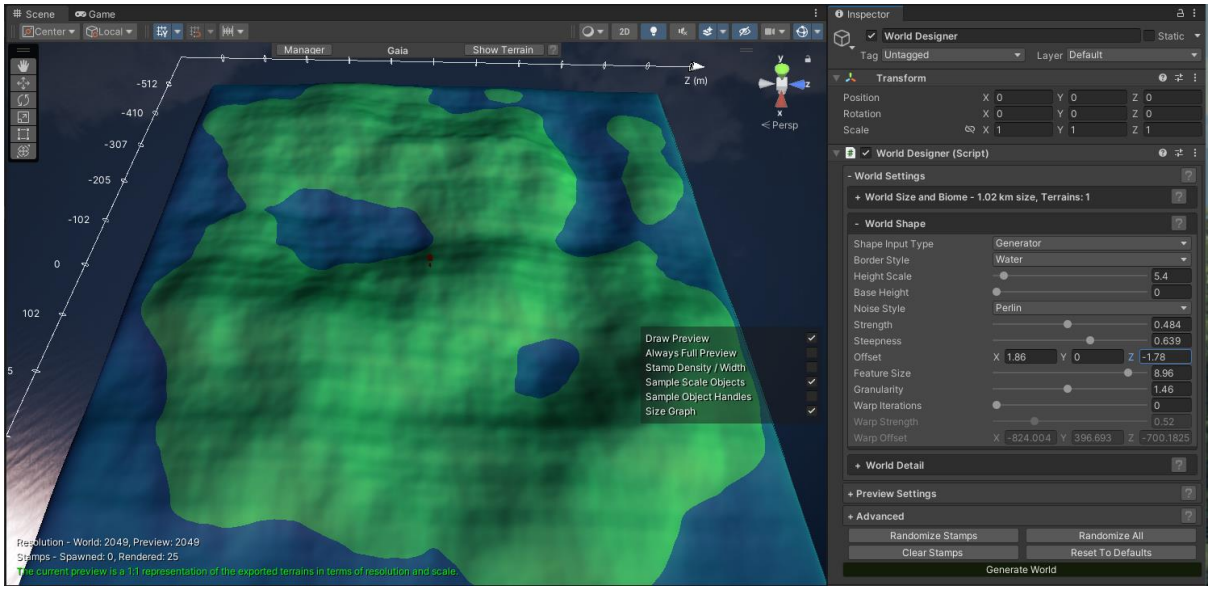
    Border Style – Allows you to force the borders of your world to be Water (to create islands), Mountains or nothing specific.

    Height Scale – Influences the overall height of the base terrain but also of the stamps that are placed on it.

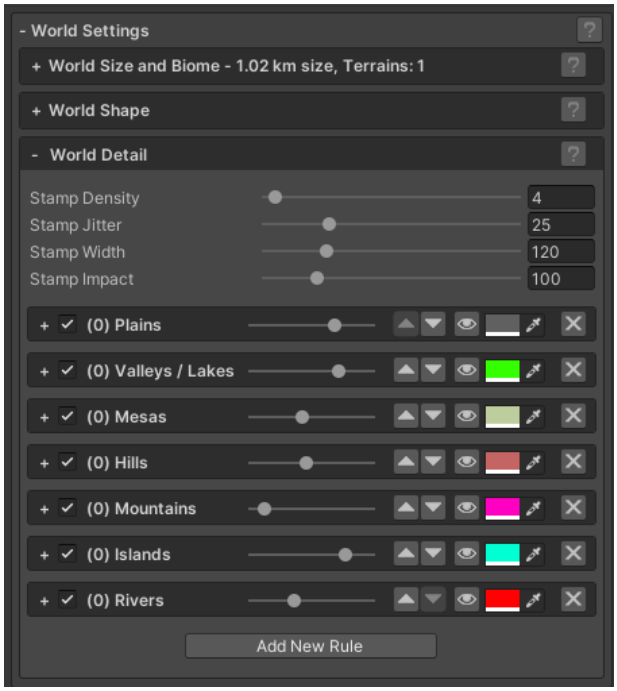
    Base height – lifts the entire shape up on the y-axis.

    You can find more information about all the remaining settings by clicking the "?" icon in the World Shape Panel.

11. Try to create a more interesting base terrain shape that would still be somewhat recognizable when the stamps are spawned.

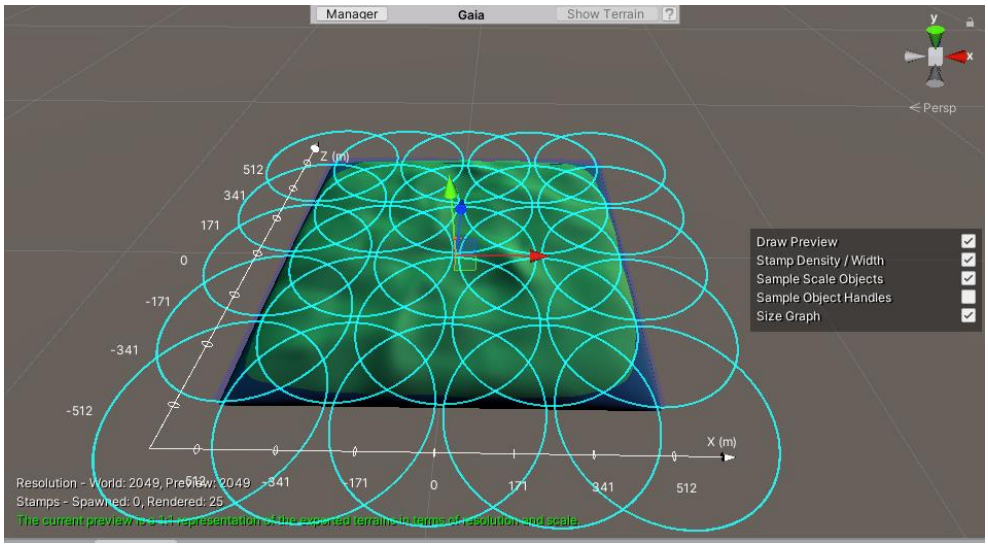


12. Next we will look at the World Detail settings which control the stamp spawning.



There are 4 general settings on the top that apply to the way the stamps are being spawned on the base terrain:

Stamp Density: Controls the number of stamps that will be placed on the terrain. You can drag the slider around to see a preview visualization of the stamp areas (each circle represents one stamp that will be placed). There is also a checkbox in the scene view panel to activate this visualization permanently.



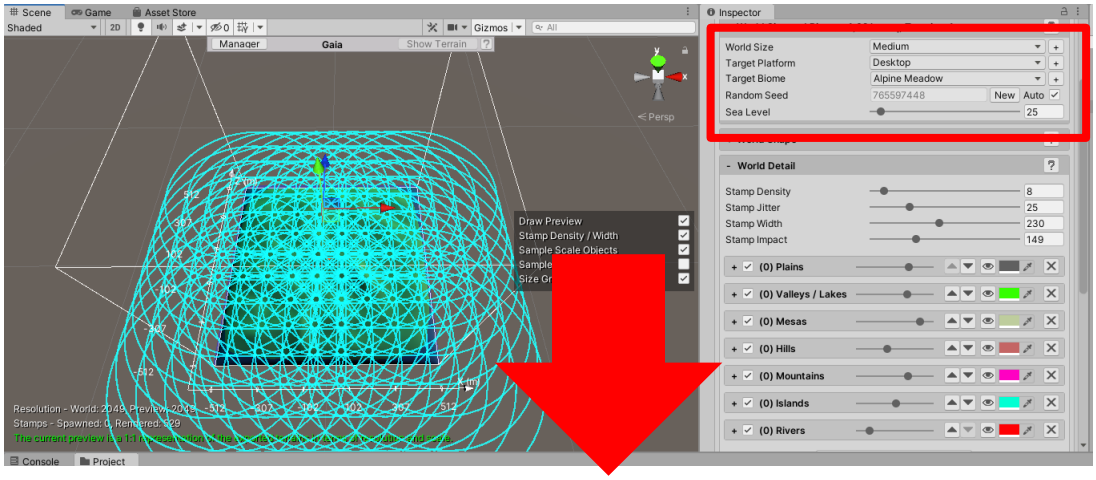
Stamp Jitter – controls the randomness in stamp placement – at a Jitter of 0 the stamps will be placed in a grid-like fashion, at 100 they are shuffled around in position to make that pattern less recognizable.

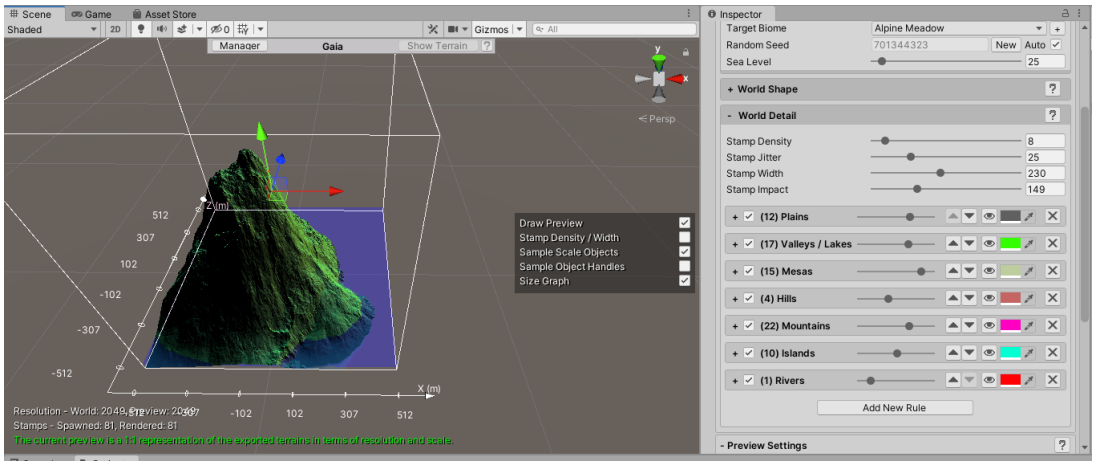
Stamp Width – controls the width of the stamps that are being placed. Again, the visualization in form of the blue circles pops in when you change the value here so you can review the stamp sizes and positioning.

Stamp Impact – Controls how much Impact on the base terrain shape the stamps will have – A high impact means that the imprint of a mountain will be rather high, and the imprint of a valley would be rather deep. High Impact means that the stamp features are more visible which can make the terrain more visually impressive, but it is also possible to overdo it so that the stamps become unnaturally distorted.

These settings can have a huge impact on your final result, and “more” does not necessarily mean “better” for these settings.

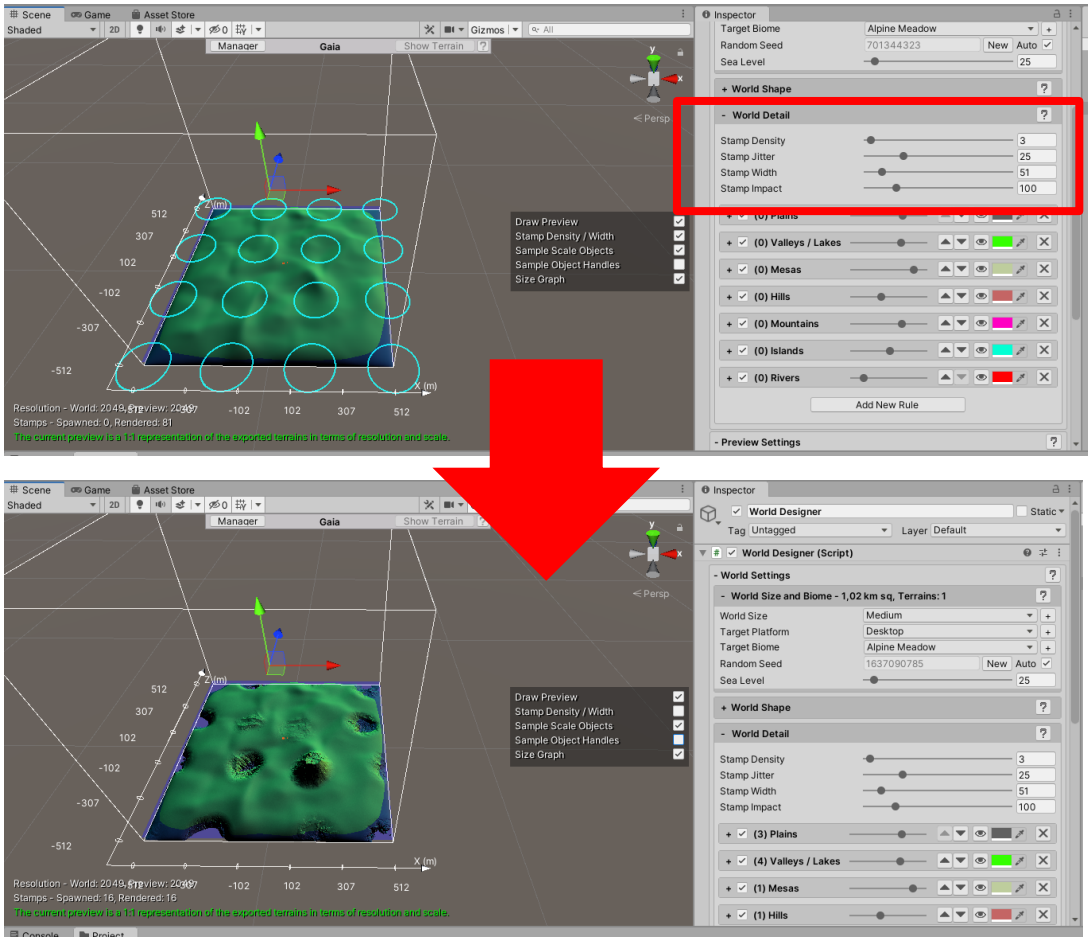
For example, here is a generation result with high stamp density, high width and high impact:





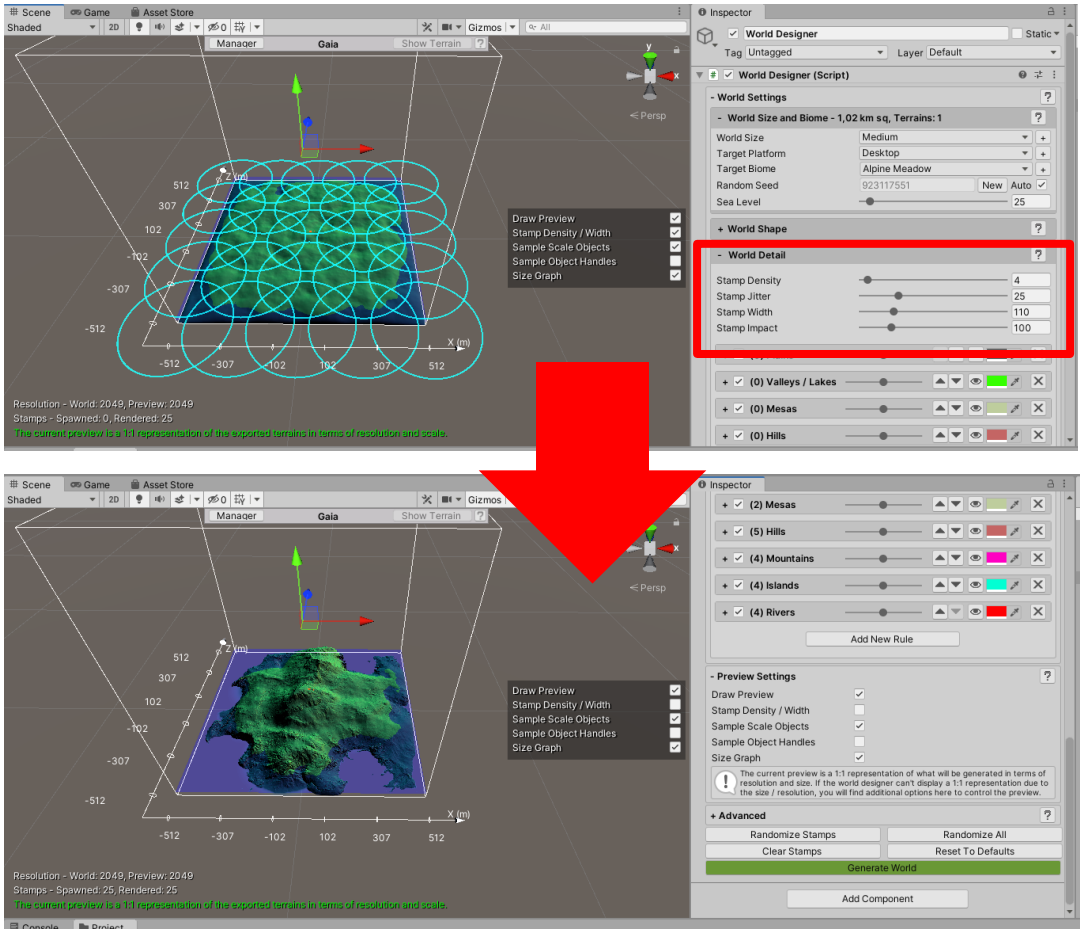
Not a very good result – this happens because too many stamps are placed on top of each other and overlapping multiple times. The result is an unrealistic mountain with barely recognizable features.

The other extreme is too little, too small, and the stamps will not overlap with each other:



Again, not a good result – the featureless base terrain is mostly visible, and the stamps are not connecting to a cohesive landscape.

What you should aim for is that the stamps are overlapping a bit, and that individual stamps have enough room to imprint their own features on the terrain:



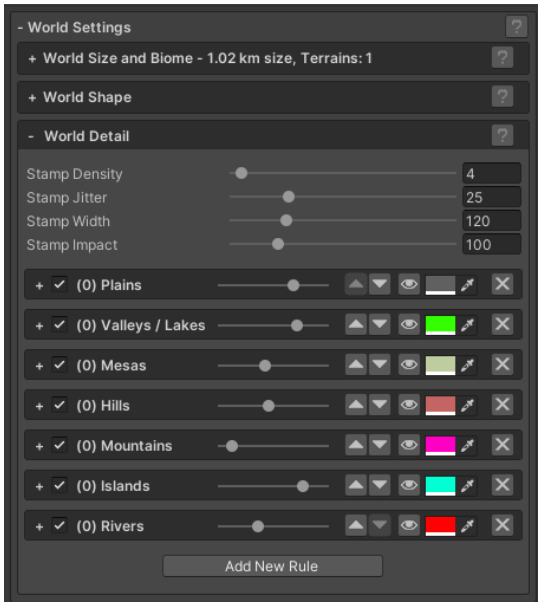
This is a better result – the individual stamps are connected but have still enough "breathing room" to display the actual features of the stamp.

World size, the total available heightmap resolution and scale also play into this.

If you are creating a multi-terrain scene with 10 x 10 terrains with a heightmap resolution of 1024 x 1024 meters each, this is a lot more space, and total heightmap resolution requirement is vastly more than for a single terrain.

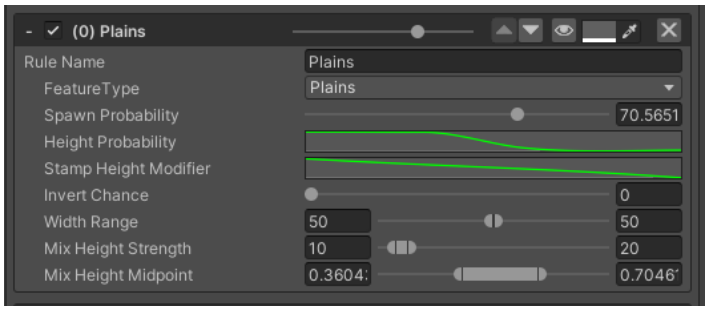
To avoid losing features due to the limitations imposed by lack of stamp resolution, you would use more stamps to fill this space.

13. Following the stamp spawning settings are the individual entries for the different classes of stamps that the world designer can use during generation:



You can activate these features with the checkboxes, and you can change the relative distribution with the sliders (left = less, right = more).

Like the spawn rules in a regular Gaia Spawner, you can unfold each of these rules to display more settings for how and where these stamps will appear on the base terrain:



The feature type is the class of stamp that will be chosen. This selection is linked to the Gaia Stamps directory, and if you add your own stamps, they can be used as well.

The main settings are:

Spawn probability – This is the same slider as in the list display and influences the overall chance that a stamp of this feature type will be selected.

Height probability – how the height of the base terrain will influence the chance of the stamp to appear (left side of the curve = minimum height, right side = maximum height)

Stamp Height Modifier – controls how the underlying height of the base terrain at the spawn spot will influence the height of the spawned stamp. For example, if a mountain

stamp would be drawn for spawning at a beach, it should receive only reduced height to not fully destroy the underlying base terrain shape.

Invert Chance – Chance the stamp will spawn inverted (a valley instead of a mountain)

Width Range – the possible width for the stamp when spawning (100 = one full terrain wide)

Mix Height Strength – Stamps are spawned using the "Mix Height" operation to blend in well with the already existing stamps. This slider controls the minimum and maximum strength for this operation according to the Stamp Height Modifier above)

Mix Height Midpoint – another setting from the "Mix Height" operation. This setting controls whether the features found on the stamp should be elevated above the terrain, or rather should cut down into the terrain.

The more the slider range is to the left, the more this operation will use the stamp to elevate features above the terrain (Which you would want for mountain-like stamps) The more it is set to the left, the more it uses the features in the stamp to lower the terrain (Better for valleys, rivers, lakes).

14. With the base shape and the stamp spawning settings all set up, we can look at the controls for the World Designer that start the stamp spawning process:

"Randomize Stamps" will keep your base shape and will spawn stamps according to the stamp probabilities you set up. This is the button to use to generate a terrain that sticks to the base shape and where you can try out how it will look like e.g., if you decide to increase the mountain probability.

"Randomize All" will create a random base shape and will also randomize the stamp probabilities. This button is suitable if you want a mostly random terrain. (This is the button we used earlier in the guide to create the completely random terrain)

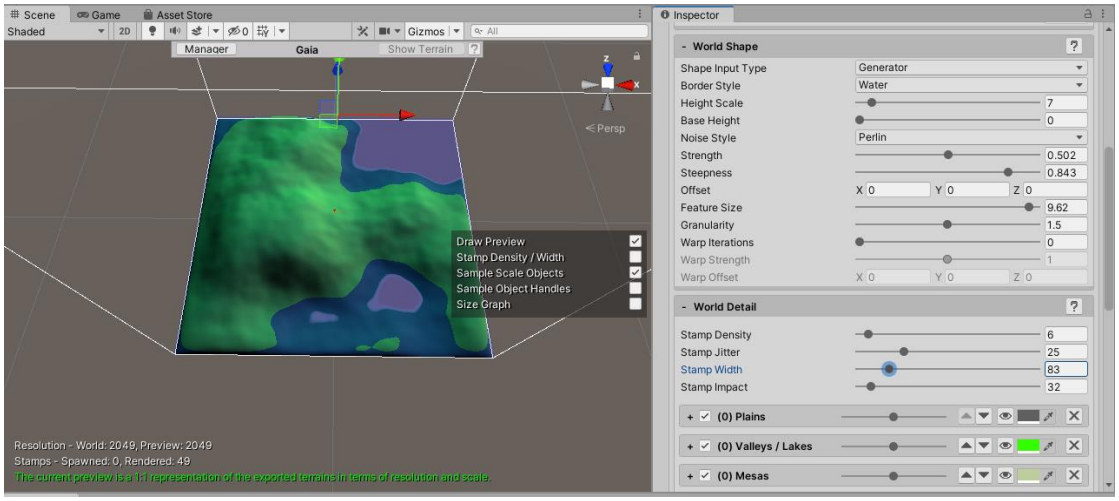
"Clear Stamps" will clear all spawned stamps so you can see the base terrain shape again.

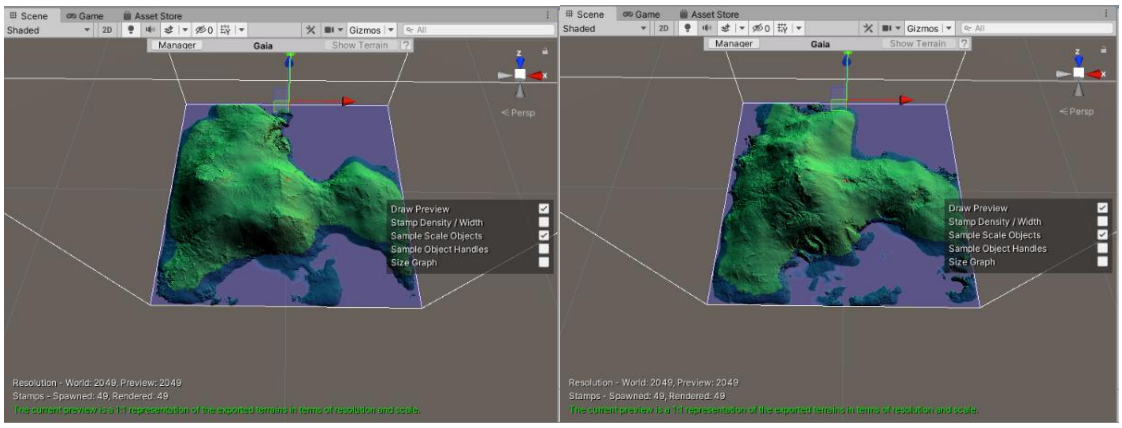
"Reset To Defaults" will reset the Settings to sensible defaults according to your selected World size.

"Generate World" will turn the currently viewed preview into a real unity terrain. After the generation you can treat this terrain like a terrain that you shaped manually with

the Gaia stamper.

15. To complete your terrain generation on a base terrain, click the “Randomize Stamps” button. You will see stamps appear on the base terrain that you created initially.





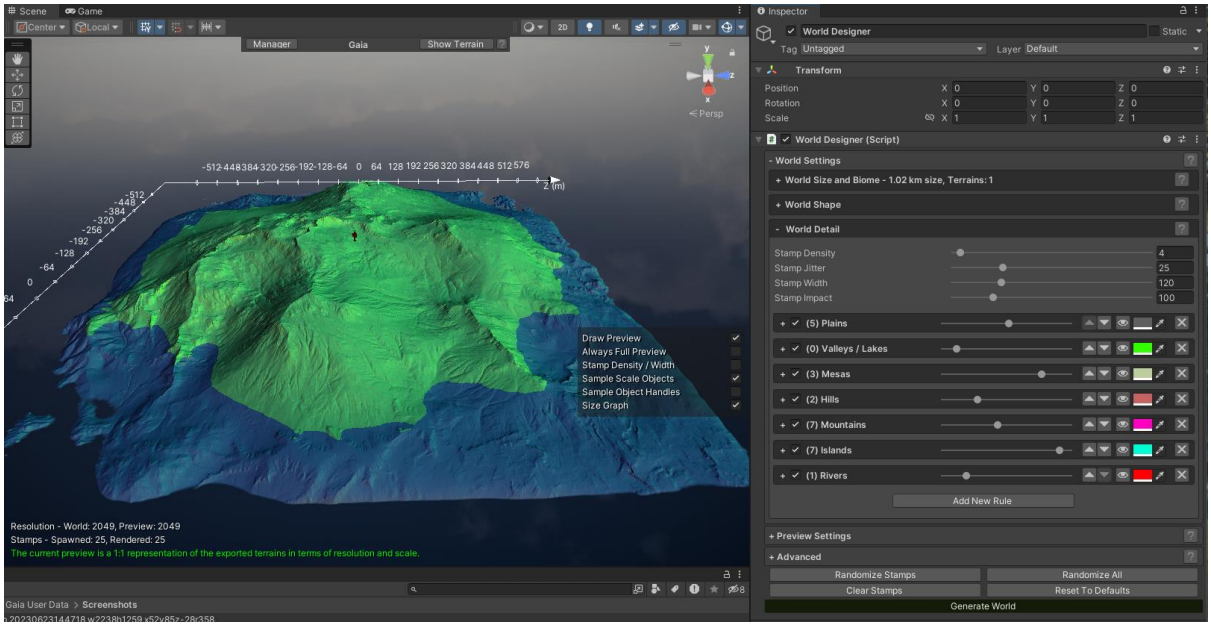
16. The last thing to do when you have a terrain shape you are happy with, is to click the Generate World button. Gaia will warn you that it will remove all existing terrains from the scene to export your new terrains.

    Pro Tip: The settings for the World Designer can be saved and loaded again via the “Advanced” Panel. In this way you can quickly apply the same generation settings in different scenes or projects.

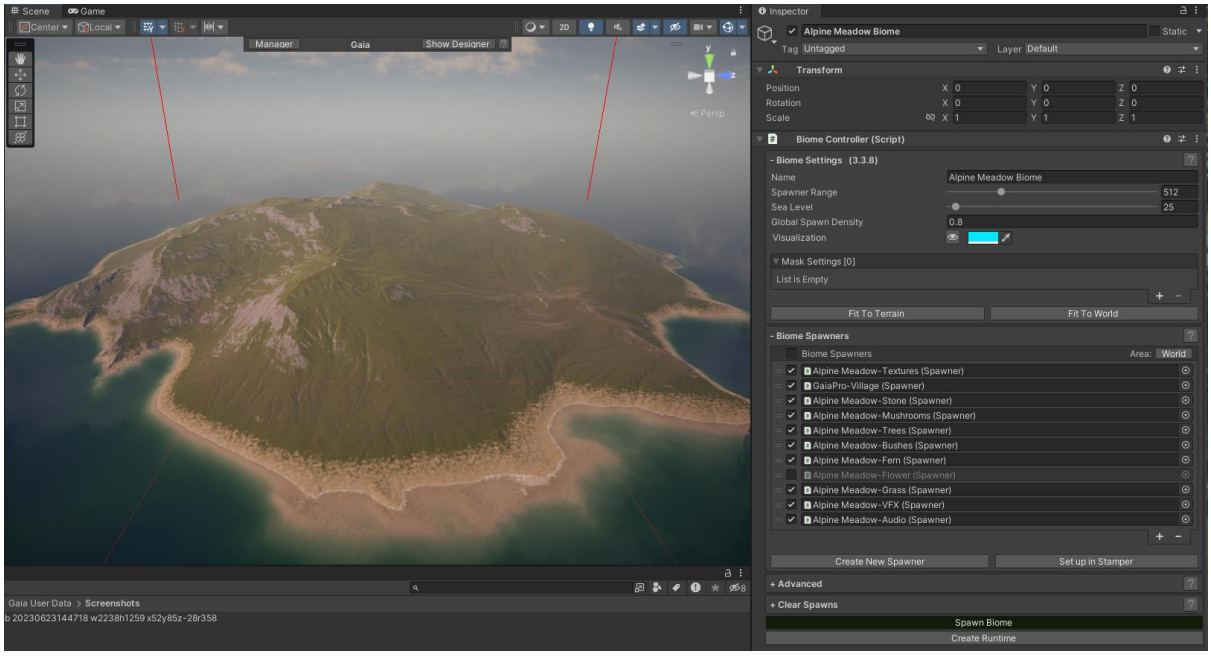
How to create stylized low poly terrains – cool technique

In this mini tutorial I am going to create a terrain. I could be made with any technique you want. Here I will use the world designer.

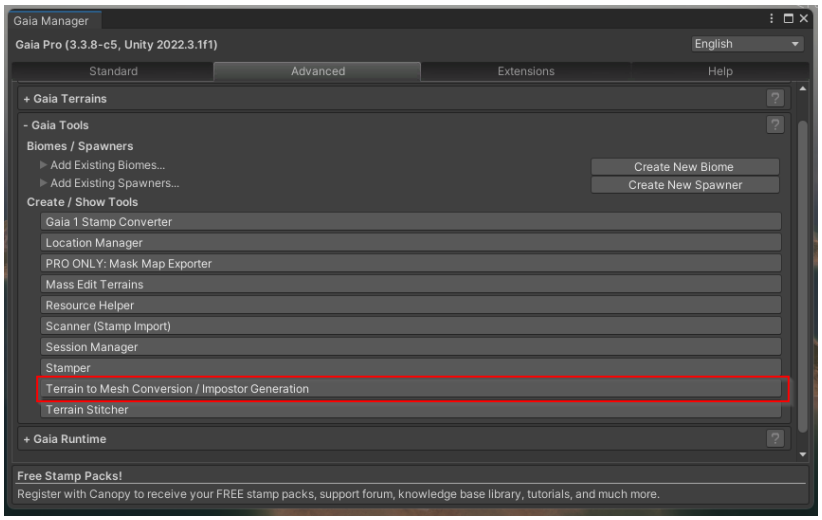
1. A nice randomized terrain.



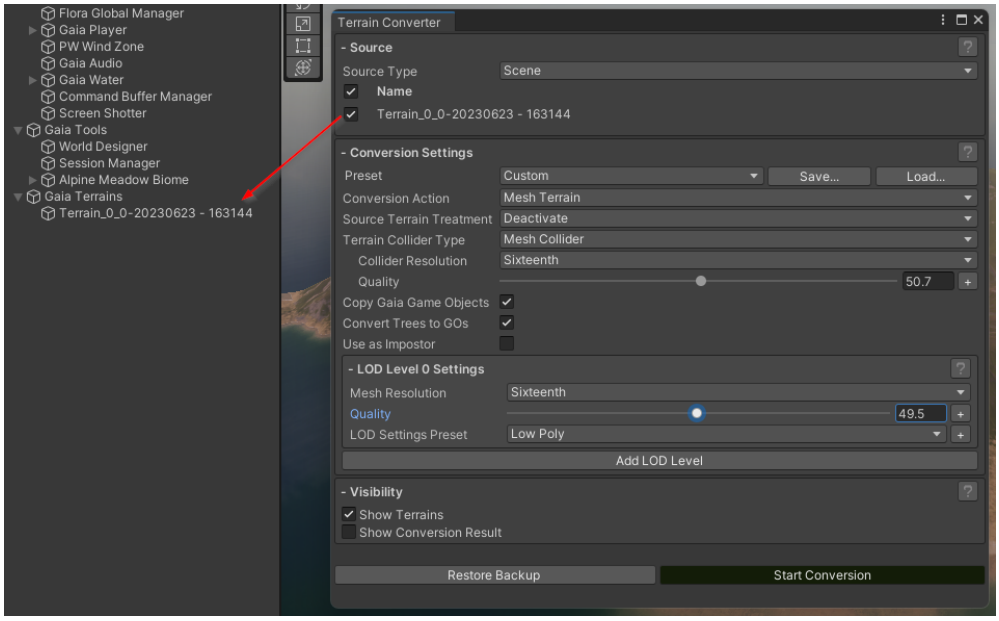
2. Generate my world.



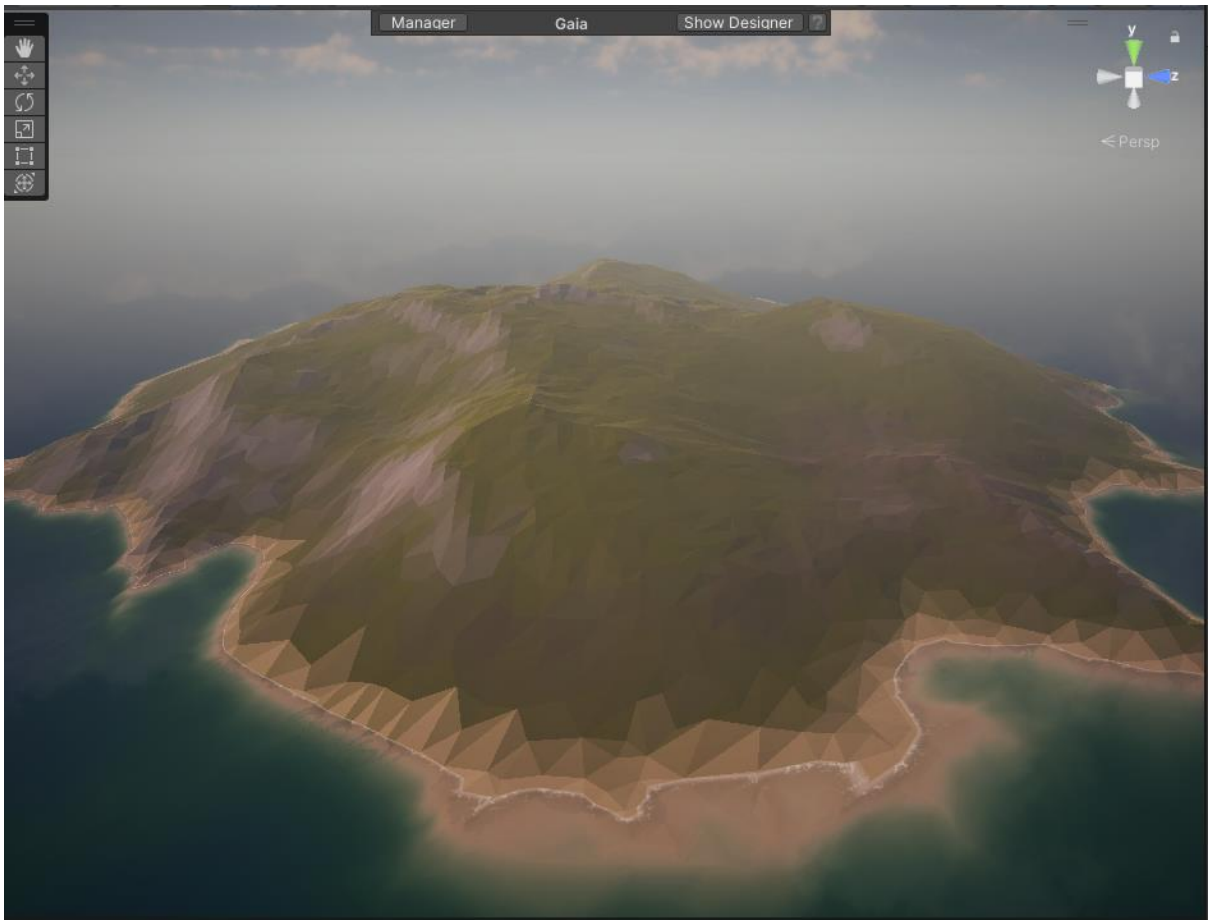
3. Now – let's do some magic! Open the Terrain to Mesh Converter!



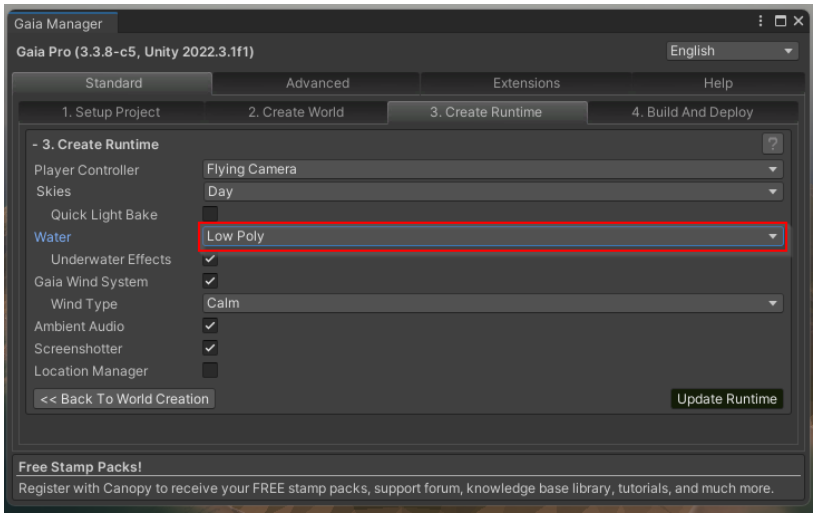
And configure it…



4. And then hit Start Conversion!



5. Super cool… but there is more, lets configure Gaia Runtime to make the water low poly as well.



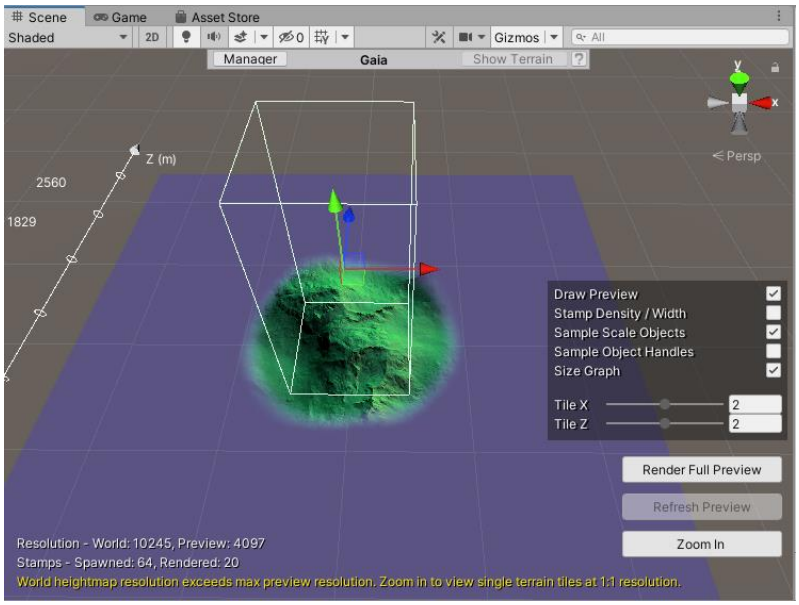
And use the screen shotter. Woot!

Creating larger world sizes in World Designer

In theory there is no size limit in the world designer – if you increase the amount of terrain tiles in the world size settings you could generate very large worlds with it. In reality we are constrained by the limitations of memory and the Unity terrain system.

To assist you when creating large worlds, the world designer displays extra controls in the scene view:

- When working with multiple terrains, the world designer will only display the stamp spawn result on a single terrain tile like so:



  This is done to keep the preview responsive because large terrains with 100's of stamps take time to calculate.

  You can preview other terrain tiles by changing the X/Z tile coordinate in the panel in the scene view, or by dragging the white box cursor around. The preview will update to the new spot after 2 seconds.

  To see the full preview, you click the "Render Full Preview" button. This will take some time but will display a full preview when finished.

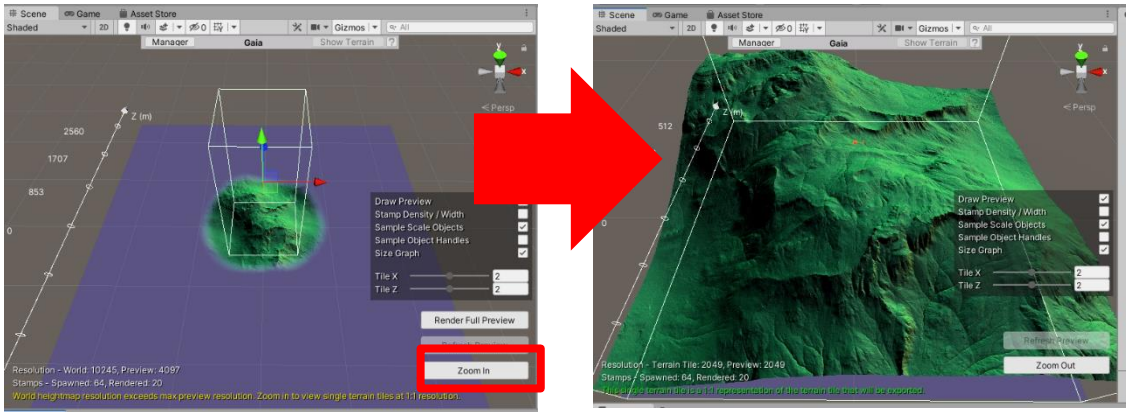
- The preview can only display a total resolution of 4097 heightmap pixels for technical / performance reasons.

  This means that you can create a world that can have a much higher terrain heightmap resolution than what is currently displayed in the preview.

  The scale and size of the preview will still match with what is generated, but you would not see every detail in the preview due to the lower resolution.

  If you want to look at the actual resolution of a single terrain tile, you can do so with the “Zoom In” button.

  This will Zoom in the preview to a single terrain tile which is then rendered at the correct heightmap resolution.



- When looking at the preview, it can be difficult to estimate the scale of the resulting terrain correctly.

  A small world can take in the same amount of screen space than a large world depending on how far you are zoomed in.

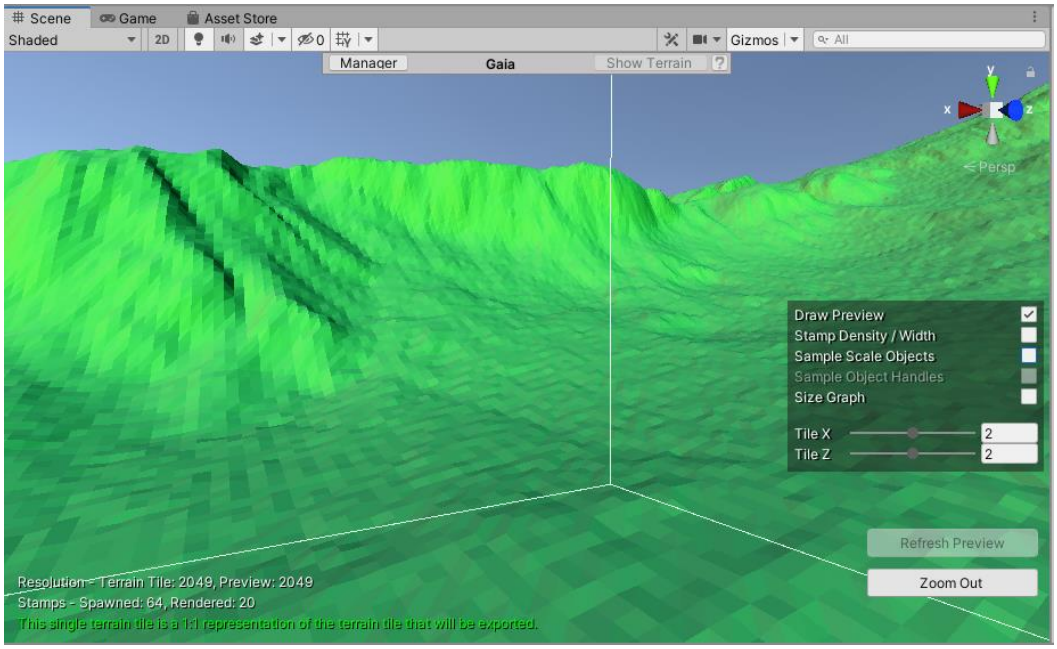
  Then when generating the world you discover that the world offer too little or too much space or your mountains are much smaller than you expected from the perspective of the player.

  To combat this, the world designer features a size graph at the borders of the preview. The numbers printed on here are world space unity units / meters measured from the center of the world at X=0 / Z=0.

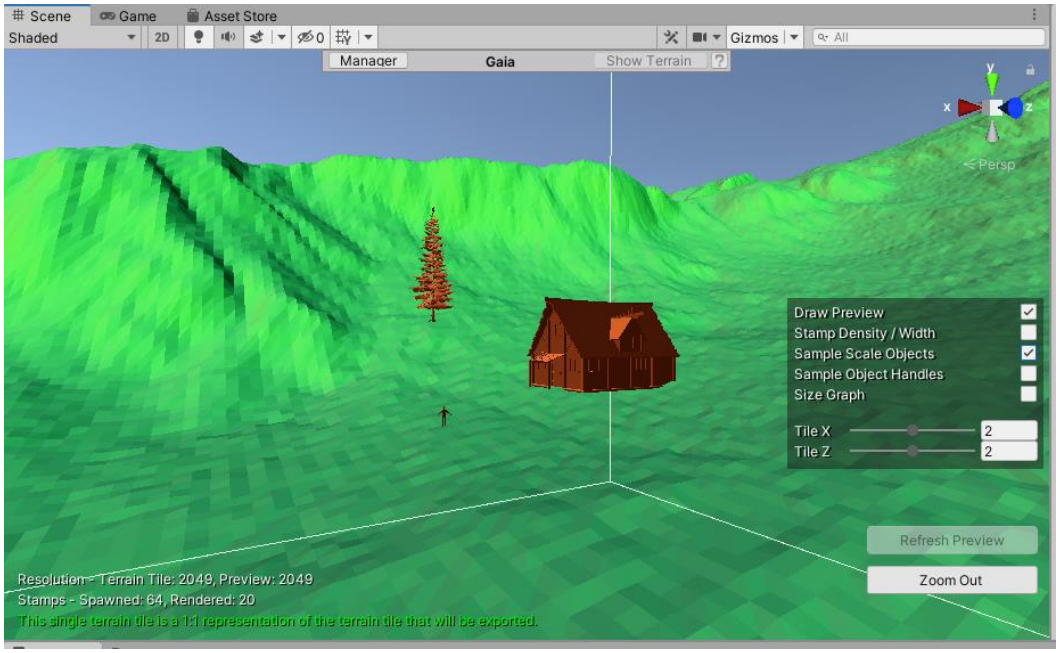
  This helps you to understand how much space there would be in a certain area.

- If you scroll in to the center of the preview, you will also notice that there are a some sample objects being rendered in the scene.

  These help you to estimate the scale of the terrain features. This mountain ridge might seem massive at first glance:



  With the sample scale objects, we can see that the character could scale this ridge quite quickly.



You can activate handles for these objects in the scene view settings panel, this allows you to drag around these objects on the preview to test different locations for scaling.

This concludes the introduction to the World Designer. You can learn more about the world designer in the built-in help features of Gaia, including the link to the online manual page for the World Designer.

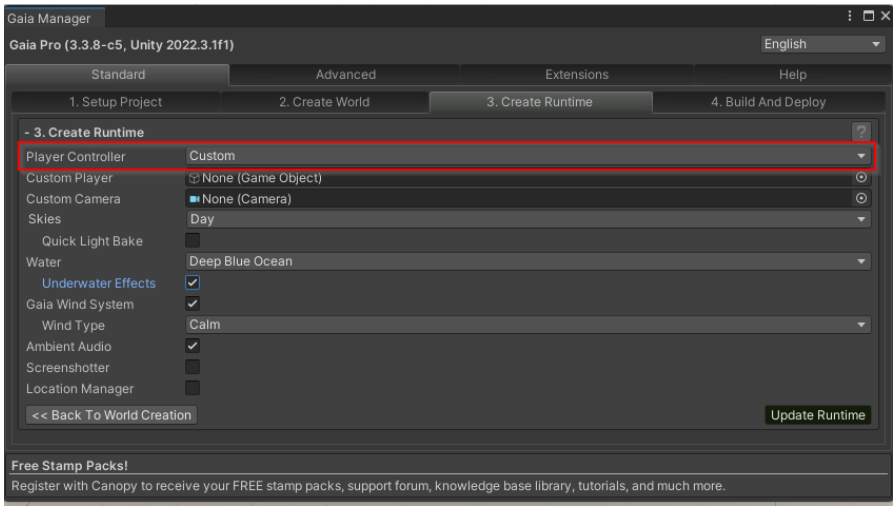
How Gaia organizes your scene hierarchy

When you create a world Gaia adds Gaia Tools, Gaia Runtime, and Gaia Terrains to your scene hierarchy.

- Gaia Tools are the tools that uses to modify your scene. You can delete them before you make your final build, and add them back again as needed from the Advanced Tab.

- Gaia Runtime contains the helpers that Gaia uses at runtime for lighting, streaming, culling etc. You should remove these only if you understand what you are doing. If you do delete them, they can be added back in Create Runtime on the Standard Tab.

  Please note: Some of the tools provided with Gaia need to understand where other systems are to operate correctly. In the example below we are using our own custom player controller, but we still want to use Gaia water and Ambient audio. Make sure you fill these settings in correctly to ensure that the Gaia runtime operates as expected.



- Gaia Terrains is where Gaia puts the environment it is generating for you. If you have Gaia Pro and enable streaming, then Gaia will create each terrain in a separate streamable scene for you and manage the process of loading and culling these scenes at runtime.

    - Tip: You can use the Terrain Mesh Exporter in the Advanced tab to create terrain impostors for large streaming scenes. Gaia will display these in the distance rather than the original terrains, and this can have a significant impact on performance.

Customizing Biomes and Spawners

You probably noticed during the creation of your first worlds with Gaia, that tools like a biome controller and spawners are added to your scene:

- A Spawner is a tool that spawns resources on your terrain, including terrain textures, trees, terrain details (grass) and objects.

  Each resource is represented by a "Spawn Rule" in the spawner that determines what is spawned and where it is spawned to.

- Multiple spawners can be grouped into a biome so that a set of matching assets can be spawned together.

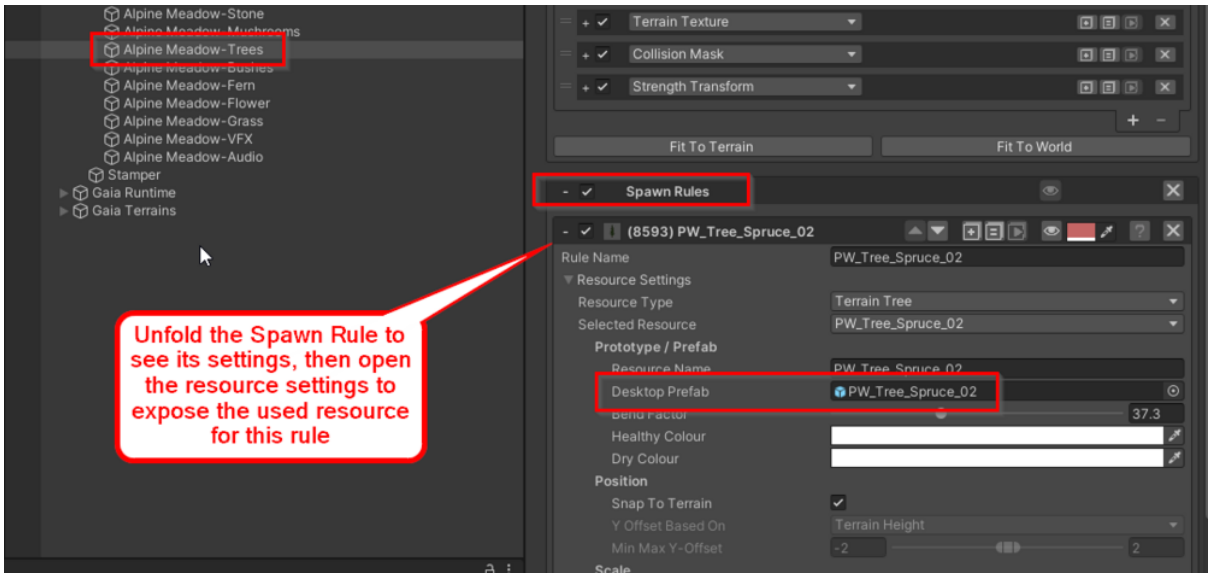
  The biome controller is the tool that collects spawners and makes them spawn together at command. It is possible to spawn this set across the entire world, or in a restricted area of your world so you can have multiple biomes in your world.

You do not need to stick to the art assets that come with Gaia / Gaia Pro. You can fully customize the biomes, and / or create your own biome from scratch.

Swapping out art assets

To swap out art assets on an existing spawner, select the spawner and check for the "Spawn Rules" section.

Each spawn rule represents one resource that is being spawned on the terrain. By opening the resource settings, you can see the prefab / texture etc. that is used in this rule.



You can swap out the used asset by selecting a different prefab / texture etc. Gaia will automatically swap out the resource on the terrain and use the new asset now in this scene.

Changes that you make this way will only affect your current scene, but it is possible to save the spawner settings into a file (see under Advanced: Save & Load in the spawner) so you can re-use the settings in other scenes.

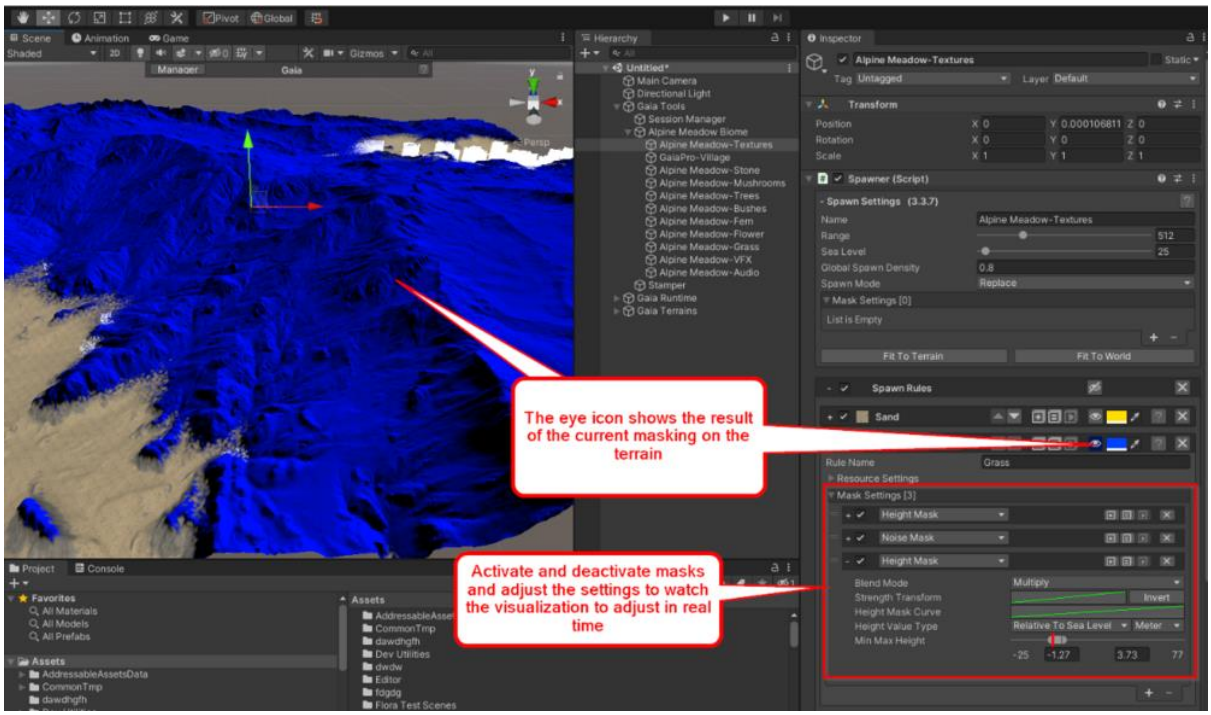
Customizing where assets spawn

To influence where Art Assets spawn on the terrain, you need to get familiar with the Mask System in Gaia. By default, an unmasked spawn rule will just spawn anywhere on the terrain. This means that a tree spawned by this rule would appear under water, over water, on steep slopes, etc.

By adding masks to the spawn rules, you can combine multiple restrictions to spawn your assets in a more logical fashion, e.g. adding a height mask ("Do only spawn over water") with a slope mask ("Do only spawn on flat areas") to get better results for your spawning.

It is possible to set masks on the spawner or at the biome level as well to influence multiple rules with a single mask.

To edit a spawn rule's mask, open the spawn rule and look at the mask settings. If you click the eye icon, you can see a visualization of the currently active masks for this rule:



You can then add or remove masks to get the spawn rule to spawn where you want it to.

Remember there might also be masks on top of the spawner or in the biome controller that could also influence the spawn rule.

For a full description of the available masks, their effects and their settings please see this article: Introduction to masks

Building a Biome from scratch

You can build new biomes and spawner from scratch and use them in other projects and scenes. We created a tutorial series for this that goes both in the technical details as well as some design aspects of creating a full biome.

Please see this video tutorial series if you are interested in building your own biome:

Biomes and Spawners - Intro and Installation

Biomes and Spawners - Texture Spawners

Biomes and Spawners - Game Object Spawners

Biomes And Spawners - Trees and Grass, Biome Creation

Handy Techniques

In this section we share some handy techniques to help you get the best out of Gaia. It's worth a quick read, as their impact on your game can be significant.

Use Biomes to create your own look and feel

In Gaia, stampers modify the shape of a terrain, and spawners fill it with content.

We encourage you to learn from Gaia's spawners and then either modify them by swapping our assets out with yours, or by creating your own.

Spawners are components that contain sets of assets and rules that choose where and how they will be placed in a scene.

There are two major systems. The first one chooses where on your terrain your spawner can spawn, and the second one determines if that location is ok or 'fit' to be spawned on.

Collections of spawners are called Biomes. The downside of this system is that it is deep, and can take some time to set up, but the upside is that once you have done this you can apply that Biome in a replicable way to any terrain to create a given look, and this saves a lot of time.

To learn more about this, read the section on Customizing Biomes and Spawners on Canopy.

Use Perspective and impostors to create space

It is difficult to create massive worlds in Unity because the terrain system does not scale.

The problem is that as soon as Unity is displaying more than a few terrain tiles, your frame rates will plummet.

In Gaia Pro, we mitigate this by creating low poly mesh-based impostor terrains with streaming and culling.

However, even then, massive draw distances inherently mean that the engine needs to do more work, and this will impact your performance.

The solution is to cheat and create the illusion of space by using scale and perspective!

In this example on a relatively small terrain, we created a sense of vastness by putting a mountain range in the distance and adding some haze.

To do this we added a bunch of stamps on the far side and shrunk them to make them seem distant.

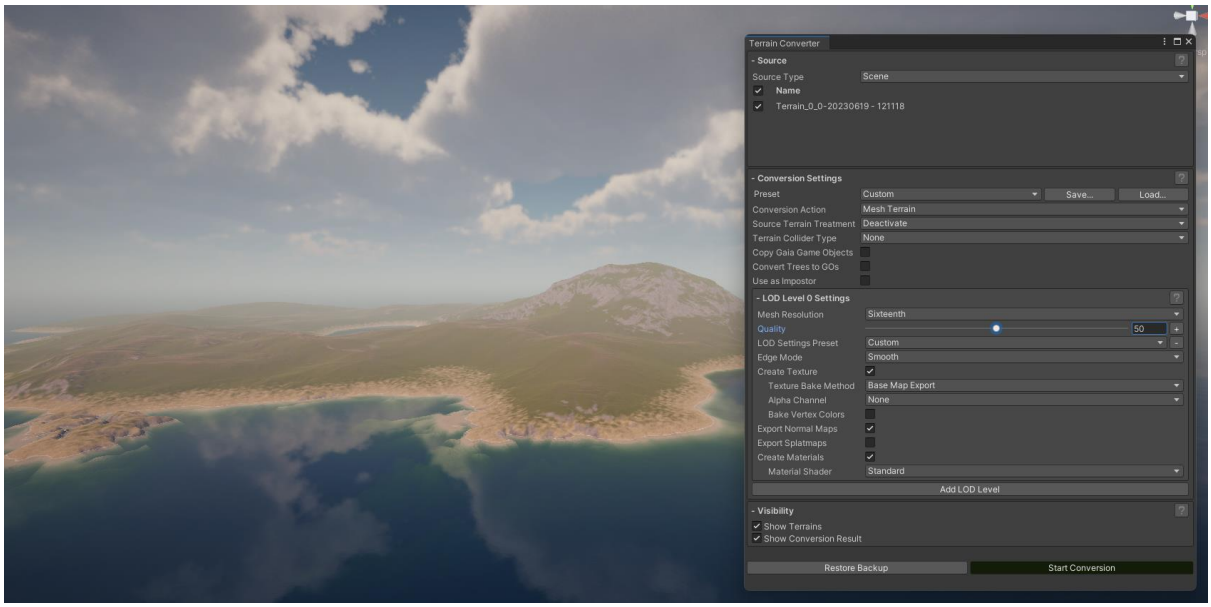
When doing this, be sure to remove trees or other assets in the distance that could break the illusion unless you also shrink those as well.

We naturally perceive the world around us based on what we have experienced. In this example, as there is nothing to tell us different, we assume this is a large environment.

Another good technique is to create islands with Gaia and use the Terrain mesh conversion system convert it to a low poly mesh impostor.

Then save that as a prefab, and bring it them in as game objects, and shrink them and place them in the distance off your coast. Make sure your remove the original terrain from your prefab!

You can experiment with the export settings to fit the export within your performance profile.



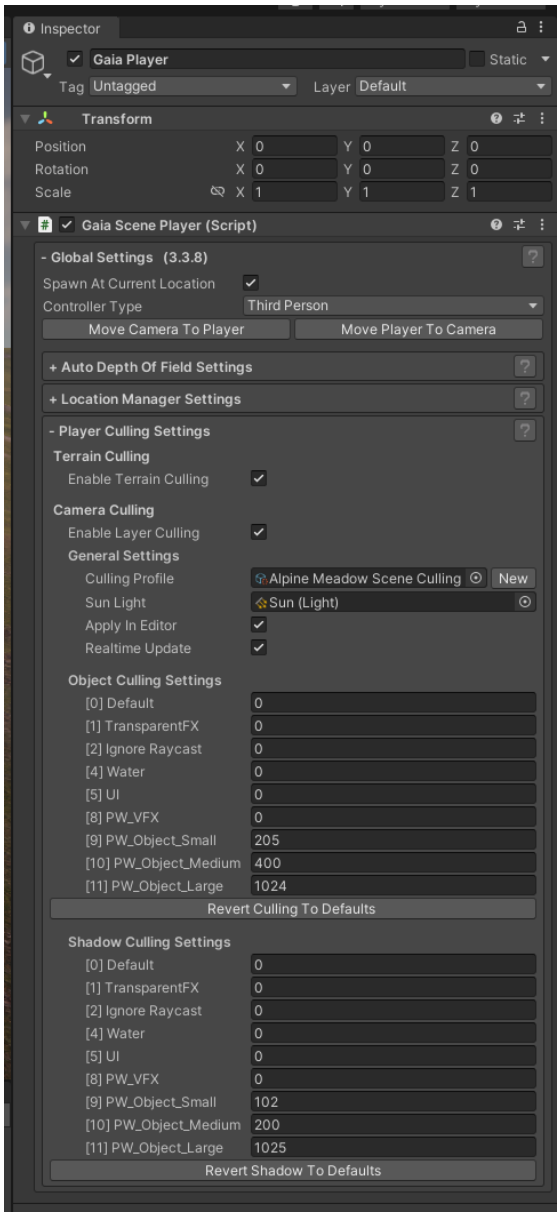
Use culling, streaming and light baking to increase performance

The fundamental truth of game development is that the bigger the world, the more you spawn, the heavier it is, the slower it will render, and slow frame rates break immersion.

Our customers use Gaia to make popular games in VR, on mobile, desktop, and console, but as with all things, every game requires optimization to make it run well.

You need to balance the asset render cost, visual density, draw distances, and the size of your environment against your target hardware and audience.

One of the main approaches to improving performance is to not render the content in the first place. You can achieve this with a combination of clever level design and technology.



Layer based culling

Gaia spawns content into layers, and the following script is automatically added to the players that are spawned into the scene by Gaia's optional runtime system.

The layers are based on object size, and are into PW_Object_Small, PW_Object_Medium, and PW_Object_Large based on the object size.

The culling distance for these objects can be controlled per layer. The idea here is to send less drawcalls the GPU by displaying less objects.

You can update these settings yourself. There is always a tradeoff between the amount of content and the visual fidelity, and this changes from scene to scene.

Terrain culling, streaming and impostor meshes

Gaia Pro helps to manage performance on larger worlds by breaking each tile up into a separate scene and using the Unity scene streaming system to stream them in only when needed. This system also culls the terrain (hides it), when it is not in view so that it does not consume resources.

Another optional feature is the terrain mesh impostor system in Gaia Pro. In this process, each terrains scene is saved in two scenes. One contains the original terrain, with vegetation etc, and the other is saved in a separate scene as a low poly mesh. Gaia will then load the low fidelity mesh based terrains in the distance instead of the high fidelity unity terrain. This faster to load and render.

You can learn more about this on Canopy.

Occlusion culling

A low tech, but useful approach is to use the Unity occlusion culling system, and strategically placed natural barriers such as hills and mountains to minimise what gets rendered.

This system should be used with caution, as while this removes load from the GPU, it increases load on the CPU.

You can mitigate this by merging meshes into groups. Our Scene Optimizer system does this and can provide significant performance benefits in scenes with many game objects.

Light baking

Lightmaps are important as they store the information than the Unity GI (global illumination) system needs to light your scene properly.

Gaia offers the “Quick Bake” option in the Runtime tab which will populate the basic lighting settings for the scene so that the ambient light in the scene will be correct.

You can have both baked and real time lightmapping in your scene also known as mixed lighting. To learn more about lighting in general, please visit these links:

https://unity3d.com/de/learn/tutorials/topics/graphics/choosing-lighting-technique

Use Github to protect your work

Source control can be tedious, until you need it, which you will, then you will wish you had it. In addition to saving your work, it becomes a handy way of trying ideas out, and saving them for later on a different branch.

You can get free accounts at github.com, and you can get a free git client here. Another good git client is called Fork and you can get it here. I prefer the more visual nature of Fork.

You need to make sure that you install LFS (large file storage) support with you git client in order to use it effectively. Then there are two special files you should be aware of: .gitignore and .gitattributes.
.gitignore tells git which files and directories to ignore for the upload / sync in the repository
.gitattibutes tells git how to treat files based on their file endings (including which files types are to be considered large binary files)

We have included samples of .gitignore and .gitattributes here for you to use as a base.

Then create and copy the contents of the following .gitignore and .gitattributes into their respective files root of your Unity directory. At this point git should now treat your repository correctly.

.gitignore

Create an empty .gitignore file in the root of your Unity project directory. The copy this into it and check it in to your repository.

The files and folders mentioned in this file will be ignored for the synchronization in the repository. This can help to keep the size of the repository down and reduce upload / download times. Please note that you do not need to upload the entirety of the Gaia installation into your repository. Normally it should be enough to upload the Gaia User Data folder as it contains your actual output that you created with Gaia. If you need to restore the Gaia installation folder you can do so by re-installing Gaia instead.

```
#
# Get latest from https://github.com/github/gitignore/blob/main/Unity.gitignore
#
/[Ll]ibrary/
/[Tt]emp/
/[Oo]bj/
/[Bb]uild/
/[Bb]uilds/
/[Ll]ogs/
/[Uu]ser[Ss]ettings/
```

```
# MemoryCaptures can get excessive in size.
# They also could contain extremely sensitive data
/[Mm]emoryCaptures/

# Recordings can get excessive in size
/[Rr]ecordings/

# Uncomment this line if you wish to ignore the asset store tools plugin
# /[Aa]ssets/AssetStoreTools*

# Autogenerated Jetbrains Rider plugin
/[Aa]ssets/Plugins/Editor/JetBrains*

# Visual Studio cache directory
.vs/

# Gradle cache directory
.gradle/

# Autogenerated VS/MD/Consulo solution and project files
ExportedObj/
.consulo/
*.csproj
*.unityproj
*.sln
*.suo
*.tmp
*.user
*.userprefs
*.pidb
*.booproj
*.svd
*.pdb
*.mdb
*.opendb
*.VC.db

# Unity3D generated meta files
```

```
*.pidb.meta
*.pdb.meta
*.mdb.meta

# Unity3D generated file on crash reports
sysinfo.txt

# Builds
*.apk
*.aab
*.unitypackage
*.app

# Crashlytics generated file
crashlytics-build.properties

# Packed Addressables
/[Aa]ssets/[Aa]ddressable[Aa]ssets[Dd]ata/*/*.bin*

# Temporary auto-generated Android Assets
/[Aa]ssets/[Ss]treamingAssets/aa.meta
/[Aa]ssets/[Ss]treamingAssets/aa/*

# Procedural Worlds Assets
/[Aa]ssets/Procedural Worlds/*
```

.gitattributes

Create an empty .gitattibutes file in the root of your Unity project directory. The copy this into it and check it in to your repository.

Files with these defined file types will be stored as binary blobs by git. This is not only faster and more efficient, it also gets around the github file size limit. Add new file binary file types as needed.

```
### Standard
## git-lfs ##
*.3dm filter=lfs diff=lfs merge=lfs -text
*.a filter=lfs diff=lfs merge=lfs -text
*.ai filter=lfs diff=lfs merge=lfs -text
```

```
*.aif filter=lfs diff=lfs merge=lfs -text
*.asset filter=lfs diff=lfs merge=lfs -text
*.blend filter=lfs diff=lfs merge=lfs -text
*.block filter=lfs diff=lfs merge=lfs -text
*.bytes filter=lfs diff=lfs merge=lfs -text
*.cfl filter=lfs diff=lfs merge=lfs -text
*.dae filter=lfs diff=lfs merge=lfs -text
*.dll filter=lfs diff=lfs merge=lfs -text
*.docx filter=lfs diff=lfs merge=lfs -text
*.exr filter=lfs diff=lfs merge=lfs -text
*.fbx filter=lfs diff=lfs merge=lfs -text
*.gif filter=lfs diff=lfs merge=lfs -text
*.glb filter=lfs diff=lfs merge=lfs -text
*.gltf filter=lfs diff=lfs merge=lfs -text
*.hdr filter=lfs diff=lfs merge=lfs -text
*.jpeg filter=lfs diff=lfs merge=lfs -text
*.jpg filter=lfs diff=lfs merge=lfs -text
*.lxo filter=lfs diff=lfs merge=lfs -text
*.max filter=lfs diff=lfs merge=lfs -text
*.mov filter=lfs diff=lfs merge=lfs -text
*.mp3 filter=lfs diff=lfs merge=lfs -text
*.mp4 filter=lfs diff=lfs merge=lfs -text
*.obj filter=lfs diff=lfs merge=lfs -text
*.ogg filter=lfs diff=lfs merge=lfs -text
*.pdf filter=lfs diff=lfs merge=lfs -text
*.pdf filter=lfs diff=lfs merge=lfs -text
*.png filter=lfs diff=lfs merge=lfs -text
*.psd filter=lfs diff=lfs merge=lfs -text
*.pwcfg filter=lfs diff=lfs merge=lfs -text
*.rar filter=lfs diff=lfs merge=lfs -text
*.reason filter=lfs diff=lfs merge=lfs -text
*.rns filter=lfs diff=lfs merge=lfs -text
*.tga filter=lfs diff=lfs merge=lfs -text
*.ttf filter=lfs diff=lfs merge=lfs -text
*.u3d filter=lfs diff=lfs merge=lfs -text
*.unity filter=lfs diff=lfs merge=lfs -text
*.unitypackage filter=lfs diff=lfs merge=lfs -text
*.usd filter=lfs diff=lfs merge=lfs -text
*.usdc filter=lfs diff=lfs merge=lfs -text
```

```
*.usdz filter=lfs diff=lfs merge=lfs -text
*.vsdx filter=lfs diff=lfs merge=lfs -text
*.wav filter=lfs diff=lfs merge=lfs -text
*.zip filter=lfs diff=lfs merge=lfs -text
```