



GAIA

By Procedural Worlds

QUICK START GUIDE

Gaia enables the rapid and precise creation of beautiful worlds.

Contents

Contents.....	1
Introduction	3
What can I create with Gaia?	4
Inline help, library, and support forums	6
Additional products and services	7
Setup.....	8
Migrating from earlier Gaia versions.....	15
Workflows.....	16
How Gaia organizes the scene hierarchy.....	22
Create a terrain using the stamp-based workflow (manual generation)	23
Create a terrain using the world designer workflow (random generation)	52
Create really large worlds with world designer	66
Create a stylized low poly terrain for mobile and VR	70
Storm: AAA worlds with massive scale and performance!	73
Customizing Biomes and Spawners.....	74
Swapping out art assets	74
Customizing where assets spawn	75
Building a Biome from scratch.....	76
Terrain streaming and impostors for large worlds (Gaia Pro).....	77
Things to consider before creating a vast world.....	77
How to enable terrain loading	78
Updating your loading setup (add/remove terrains to load)	79
Converting already existing worlds from/to terrain loading	80
Using Gaia tools to load terrains	83
Creating a custom loader	85
Using the scene view loading range.....	85
Using the terrain loader manager & scene view buttons	86
Using multiple loading workflows at the same time.....	88
Runtime loading / adding your own loaders.....	89
Creating impostor terrains	91
Preventing the player from falling through the terrain	92

Terrain loader manager	93
General settings panel	94
Scene view panel	96
Terrain loaders panel	98
Terrains panel	99
Floating point fix panel	102
Handy Techniques.....	103
Using your custom player/camera.....	103
Use Biomes to create a custom look and feel.....	104
Use the Poly Mask to control biome or stamp placement	105
Use Perspective and terrain impostors to create space.....	117
Use culling, streaming, and light baking to increase performance	119
Use Audio and VFX management (Gaia Pro)	122
Use Github to protect your work	124

Introduction

Thank you for purchasing Gaia.

Gaia is a set of assets, tools, and processes for creating beautiful 3D worlds. Quality environments contribute to your game's success by enhancing realism, visual storytelling, immersion, engagement, and aesthetic appeal.

We make world-building easy for newcomers and flexible for pros, freeing you up to create engaging player experiences that lead to positive word-of-mouth, critical acclaim, and higher sales for your game!

In a nutshell:

- Gaia workflows start with Gaia Manager. Gaia Manager allows you to choose your desired operation 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 can be blended to create any terrain you want.
- Terrain Population is done via Spawners and Biomes. Biomes are spawners containing assets and the rules needed to apply those assets to your scene. You can create your unique biomes or use ours as you please.
- Runtime Systems are controlled via Gaia Runtime. They include skies, lighting, water, audio, culling and streaming, and player controls. These optional systems are provided as installable modules to make it easy and fast to test scenes.
- Ad hoc Tools are accessed via the Advanced Tab in Gaia Manager. Some notable tools are a Scanner to create new stamps, a Stitcher to stitch terrains together, and a Terrain-to-mesh converter to light weight environments for mobile and VR.

Please go to [Canopy](#) for a deeper dive, including [tutorials](#), support [forums](#), your [free stamp packs](#), and more products.

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 terrain, populate it with one or more biomes, and then set dress it to make it interesting and relevant to your game.

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

Gaia worlds are used on desktops, mobile phones, and VR. However, your environment must be created with the limitations of the target platform in mind. The sample assets supplied with Gaia are well-suited for desktops. However, they would be too heavy for mobile and VR and would need to be substituted for lower-poly assets.

Your levels will also need additional work to tell your unique story. Set dressing is adding additional assets, towns, buildings, roads, paths, and rivers. Gaia's stable mate [GeNa](#) can help with this.





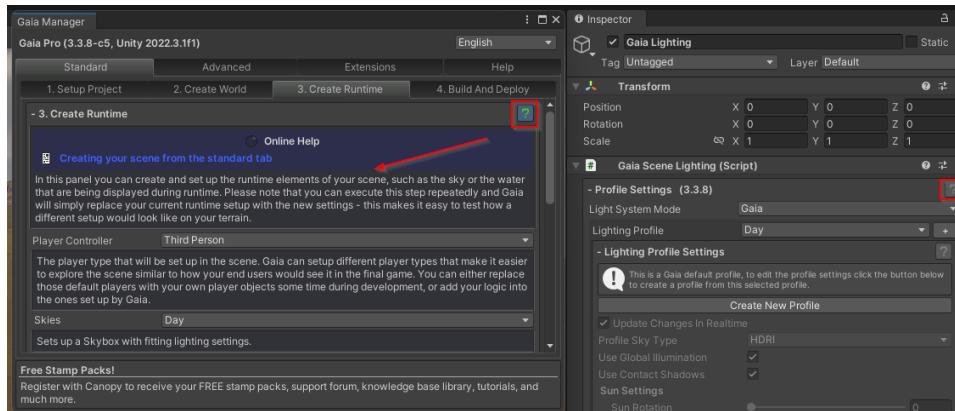
Gaia by Procedural Worlds

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 this opens and closes the help system, which can also link to web pages with more detailed information.



Canopy Library

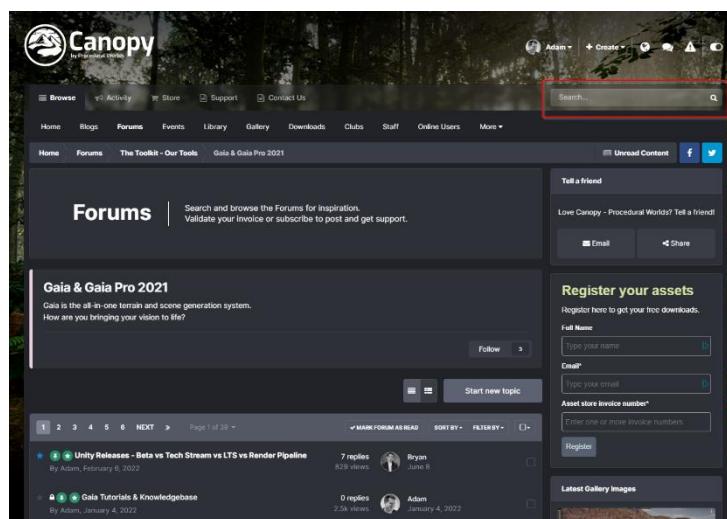
The Gaia section in the Canopy Library stores our latest documents and video tutorials. Click [here](#) to view it. You can also access this via the Help Tab in Gaia Manager.

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.

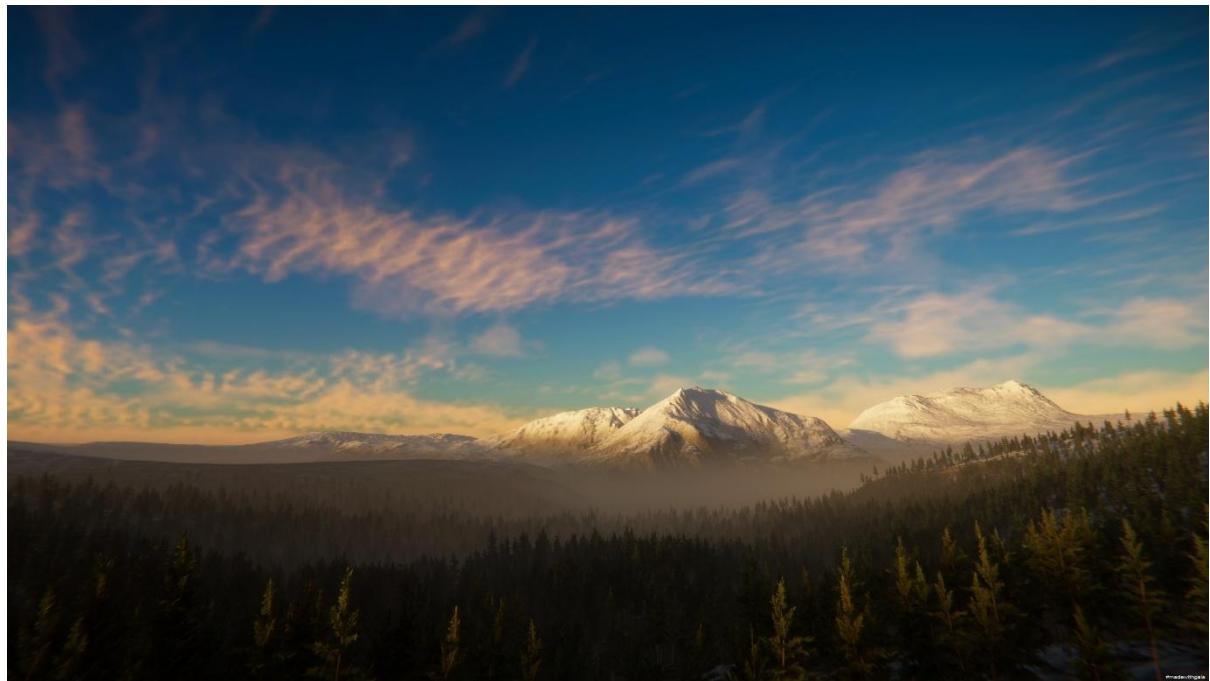
If you are unable to find the solution you are looking for, then register for free and leave a post in the forum. Video or screen shots are best so we have the information needed to help you.

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



Additional products and services

Storm for massive AAA worlds



Check out the section on Storm later in this document.

Canopy for product and subscription services

We have over fifty assets, 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 can access all our non-enterprise products at substantially cheaper rates than when you purchase them outright.

Custom solutions & professional services

We create tools and offer high-end professional services. Some companies we have worked with include Wargaming.net, Unity, Peloton, BMW, and Google.

If your project could benefit from our unique expertise in procedural generation, world-building at scale, and advanced rendering, don't hesitate to contact us.

Setup

Version Differences:

This guide covers “regular” Gaia and Gaia Pro VS.

Gaia and Gaia Pro VS are essentially the same systems; however, Gaia Pro VS adds additional utilities, operations, and biomes.

Some of the more significant enhancements in Gaia Pro include:

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

If you have Gaia and want to upgrade to Gaia Pro, we have removed 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 with at least 32 GB RAM. 64 GB is better. A fast SSD will also speed your process up substantially, as Unity is very disk-intensive.
- Make sure your GPU is relatively recent and has at least 6GB VRAM. Gaia extensively uses the GPU to do its magic. If your GPU does not have enough VRAM, you will experience crashes.
- Make sure your graphics drivers are up to date. Old drivers are a common cause of crashes.
- Make sure that automatic light baking is turned off in the Unity editor. This system has a long history of causing crashes when working with terrain.
- Stick to Unity's LTS releases. Unity considers everything else 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 applicable settings for this later in this document.

Installation Directories:

Gaia is installed into the Procedural Worlds directory. In here, you can find

\Procedural Worlds

\Frameworks - Common frameworks across all products

\Packages – Cache - Contains the uninstalled installation source package files for Gaia and additional modules

\Packages – Install - Contains the installed Gaia application and the installation of additional modules

\Gaia User Data - User-generated sessions and settings

The Gaia User Data directory is where we store global settings and Sessions. It contains the actual output or result of your work created with Gaia.

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 helpful as they store the steps used to create a terrain and can be used to re-create it later.

Installation Tips:

Before using Gaia, please ensure that it is correctly configured for your project.

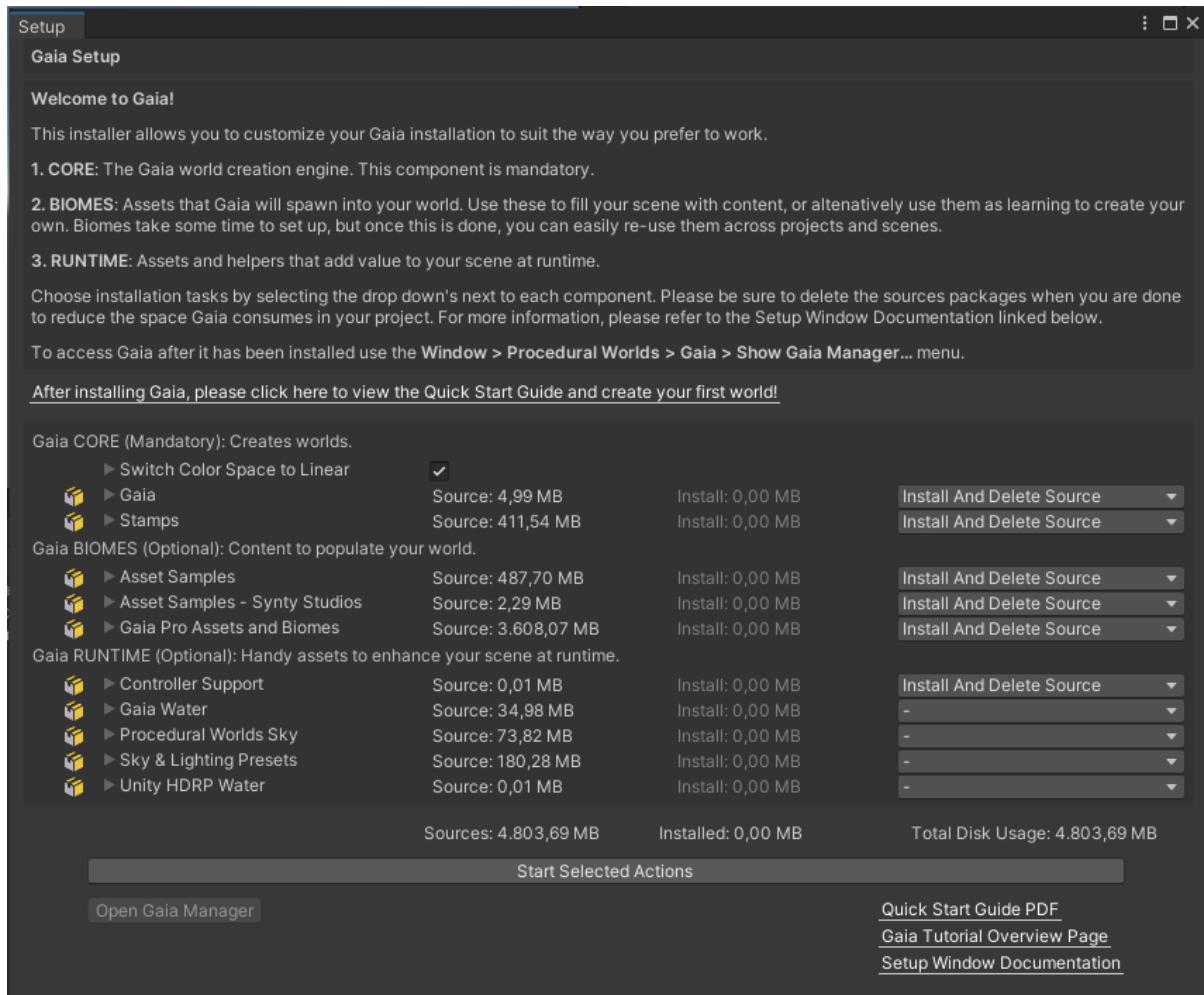
While these instructions may seem long, most of the text here is informational; the process is just a few clicks.

Create a new project in Unity or open the project that you want to use Gaia in.

Install Gaia from [the Package Manager](#) under Window > Package Manager.

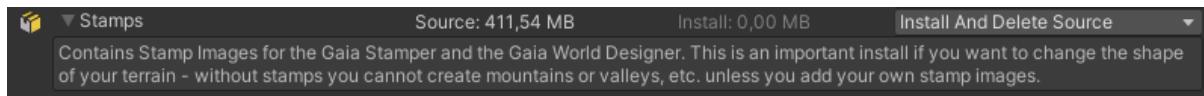
If you purchased Gaia from Canopy, you can download a .zip file from the Canopy website download area. Unzip the file, and install the .unitypackage via Assets > Import Package > Custom Package... in the Unity editor.

After installing the Gaia Package, you will see the setup window itself:



Gaia consists of multiple modules, each with its own installation package. To minimize disk space, build size, and processing time in Unity, you can choose which modules to install on a project-by-project basis.

Unfold the package with the small triangle at the beginning of each line to learn what the package does:



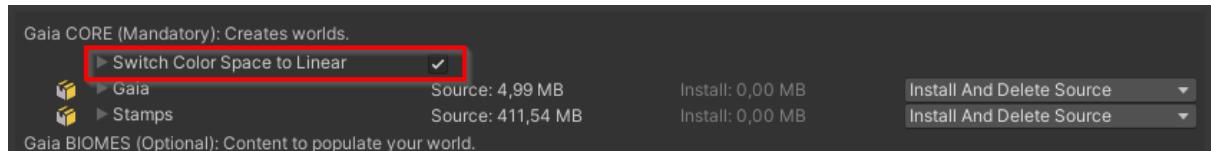
You can open this the Setup window at any time via Window > Procedural Worlds > Setup... to install/uninstall additional components as you see fit.

It is also possible to delete the installer package to save disk space. Gaia will remember your last choice, so when a Gaia update arrives, updating already installed packages only requires a single click.

Select the packages you would like to install by setting the dropdown on the right-hand side to "Install". If you are unsure about the package selection, the default preset should be fine to get you started. Ensure the core "Gaia" package is selected; otherwise, you cannot use

Gaia.

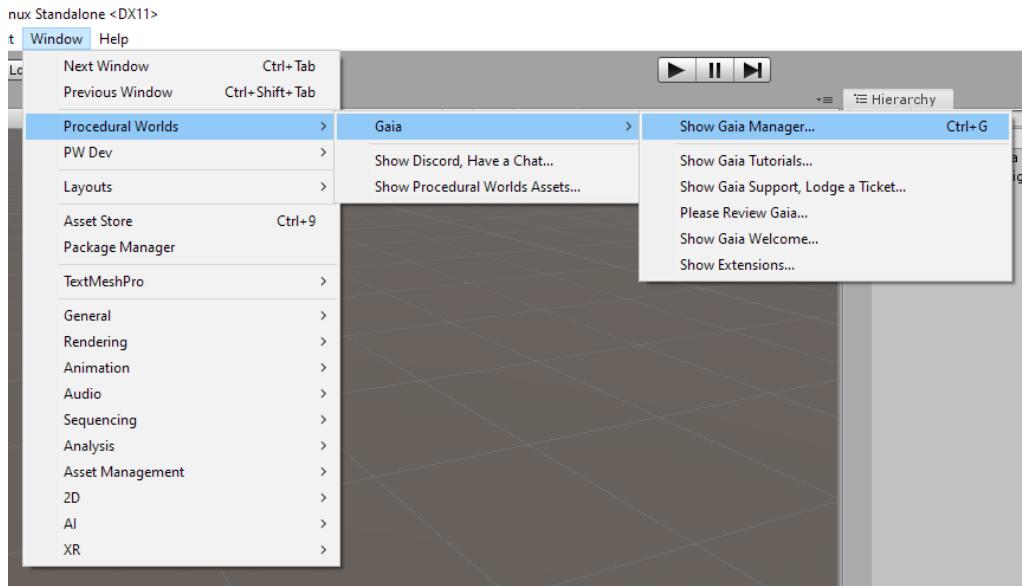
Another setting to be aware of is the “Switch Color Space to Linear” setting on top of the package list:



You will see this setting only if your project is currently NOT configured to use [Linear Color Space](#). For most projects, Linear is the better choice, so Gaia offers to switch your project to Linear BEFORE installation begins. This will save time by avoiding a second import process if you switch later.

Click the “Start” button to begin the installation.

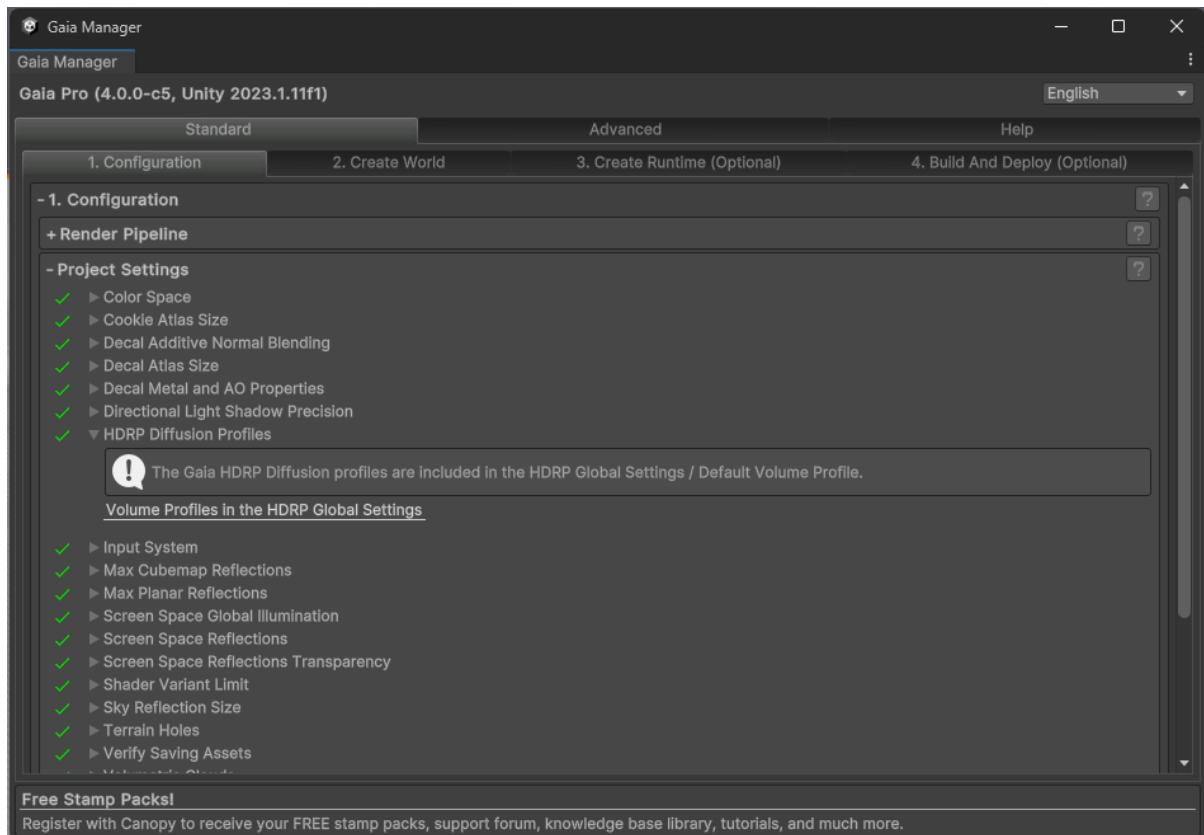
After installing Gaia, you can open the Gaia Manager Window from the Window Menu or by pressing Control + G:



If the Gaia Manager Menu entry does not appear, you have a compilation issue with your project. Please check your console for messages that might prevent the successful compilation of your project. In a fresh project, this will not happen, but in a larger project, these errors are often caused by conflicts with poorly coded assets. If you are stuck with a compilation error you can't resolve, please contact support. Ensure you provide the error, Unity version, Gaia version, and the pipeline you are using.

The Gaia Manager's Configuration tab will open automatically if your project requires further configuration decisions.

The Project Settings list shows which configurations have been detected. You can click on the Fix button to let Gaia automatically address them or on the Ignore button to ignore them.



NOTE: The list of fixes will depend on the render pipeline used. Most configuration issues are not a true error, but instead, informed guidance that can help your project to run better.

For example, Gaia will warn you if post-processing is not installed in the built-in render pipeline. But if you decide against using post-processing in your project, you do not need to "Fix" this, but can click "Ignore" instead to hide the suggestion.

Every suggestion has a link to the Unity setting in question so that you can make informed decisions about the configuration of your project.

If there are no issues (left) to fix, then you can start working with Gaia.

To sum up:

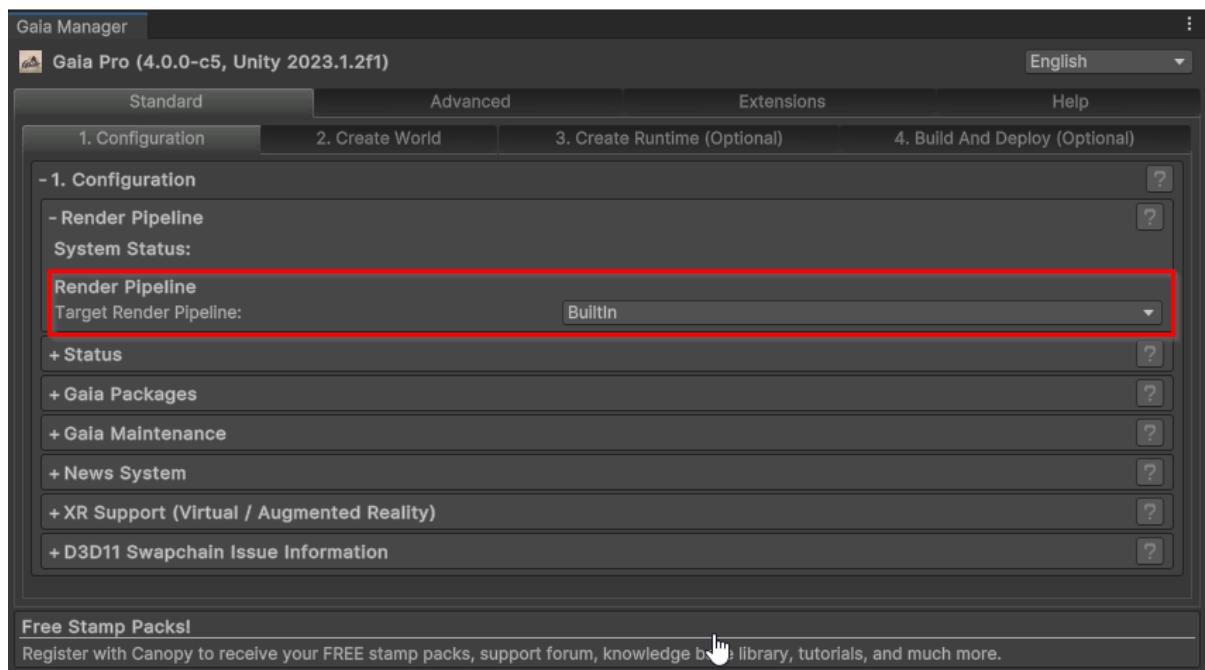
1. Import the Gaia package;
2. Choose the modules you want to install in the Setup window;
3. Open Gaia Manager and check for potential configuration issues.

OPTIONAL:

Gaia comes with its own water and vegetation shaders which also support the [Unity scripted rendering pipelines](#) i.e. URP and HDRP.

If you want to use one of these Pipelines, you must set up Gaia for that specific pipeline. If you want to use Unity's built-in rendering, you are already done setting up Gaia.

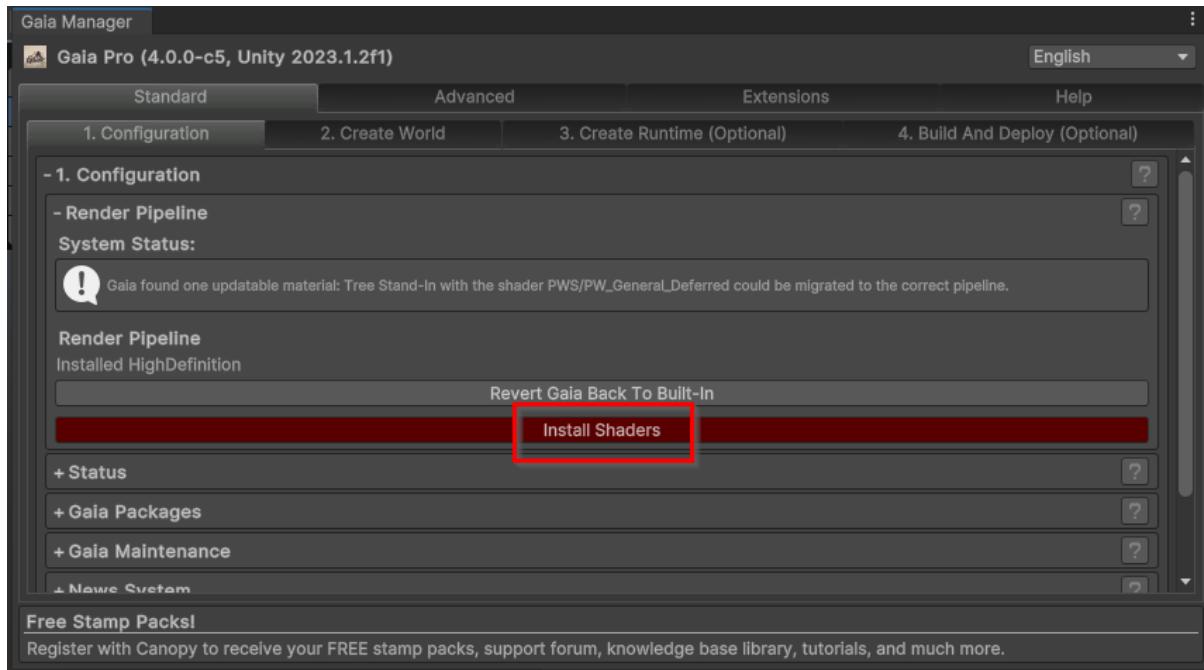
Supporting these pipelines can be challenging for asset store developers as we need to ensure that features like water use the correct shader for the current pipeline. To make this easier for you, we have mostly automated this process in the Configuration Tab in the Gaia Manager:



In the Render panel, you need to do only two things:

- A) Select the pipeline you want to use and click the button to "upgrade Gaia to this pipeline." This will change the Gaia tools and functions to the respective pipeline. This process can also be reverted later.

B) After configuring the rendering pipeline, click the “Install Shaders” button. This will install the shaders for the current pipeline. If the correct shaders are already installed, this button will not appear.



The pipeline setup process is now done.

Please note: The Unity-recommended scriptable render pipeline (SRP) is now URP, and in future releases, URP and HDRP will be merged into a single, compatible API.

All materials you use beyond the Gaia vegetation items and the water must be compatible with your target pipeline. Gaia cannot set up materials from other asset packs for you.

When you start building a scene in one pipeline and then switch to another, you might need to re-apply Gaia runtime modules such as lighting or water because these usually contain elements specific to that pipeline.

When switching pipelines, it is possible to revert to built-in rendering later and then switch to another pipeline again.

We STRONGLY recommend backing up your project if you are switching pipelines, as the different versioning of the pipeline API's can cause all sorts of problems unless all the assets in your project support them.

Migrating from earlier Gaia versions

You should be able to open projects / scenes made with Gaia 2023 / Gaia Pro 2023 with Gaia for Unity 6 / Gaia Pro VS respectively without issues.

Gaia for Unity 6 / Gaia Pro VS are incompatible with the 2021 versions, but you can migrate scenes created with Gaia 2021 into Gaia for Unity 6 / Gaia Pro VS.

Please visit this page to learn how to migrate your scenes from Gaia 2021:

https://canopy.procedural-worlds.com/library/tools/gaia-pro-2021/written-articles/30_installation_getting_started/migrating-from-gaia-2021-to-gaia-2023-r160/

Please note that this was originally written for migrating scenes from the 2021 versions of Gaia to 2023, but the same steps / principles would apply here.

Workflows

Gaia offers two “workflows” when creating a new world 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.

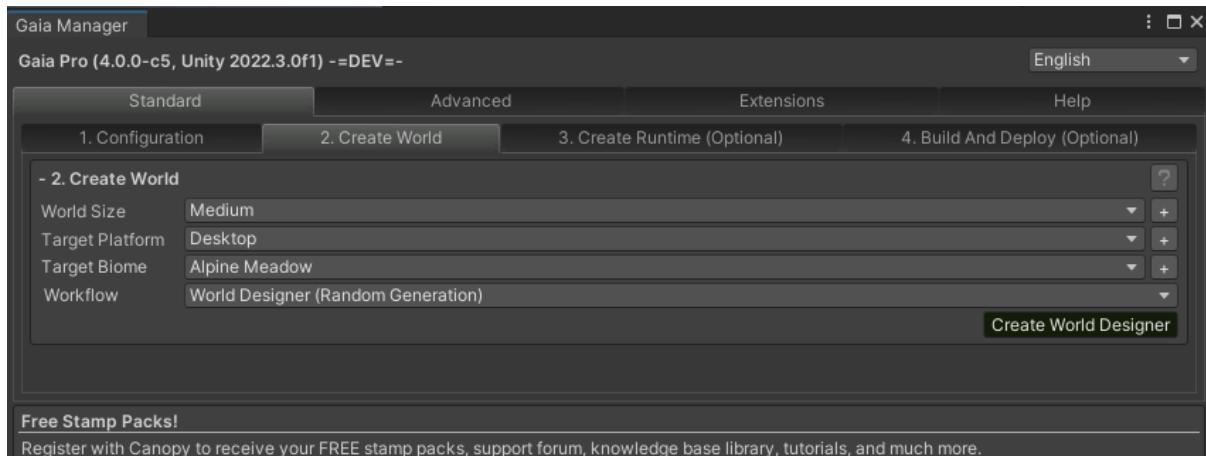
Gaia Manager

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.
- *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. Configuration:

- 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.

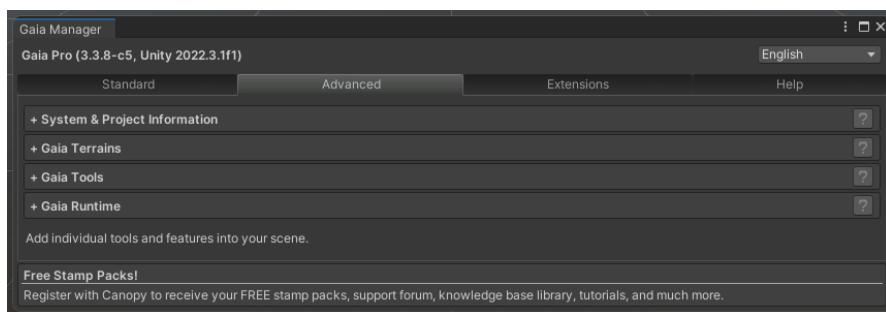
3. Create Runtime (Optional):

- This step automates your scene's runtime setup. It provides handy configuration for things like your player controller, skies, and water and is completely optional. Note that most runtime functionality needs to be installed from the Setup Window before it appears here!

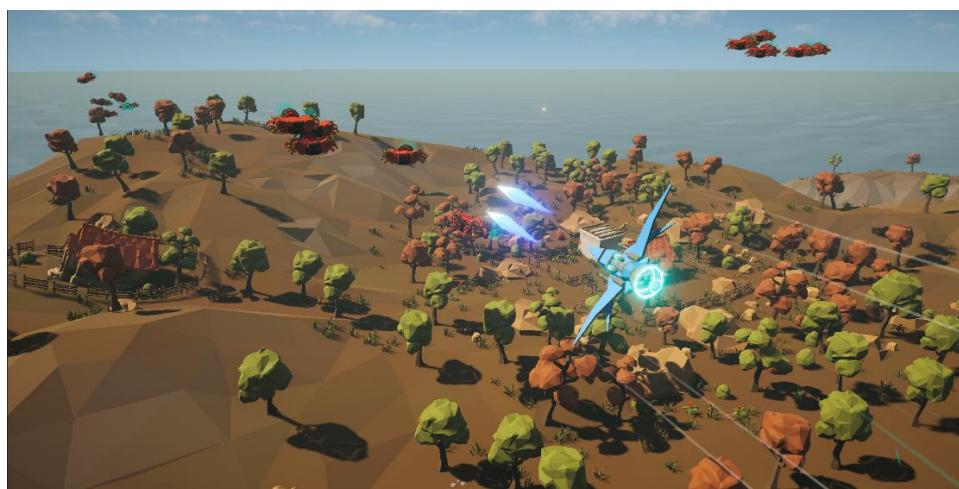
4. Build and Deploy (Optional):

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

Advanced Tab



The Advanced Tab provides access to individual tools and utilities you can use when needed.



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 should be considered for mobile and VR-based games.

The biome shown here is the Synty biome, and the gameplay comes from our Rails Shooter Pack on the Asset Store.

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, back up 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 the operations Gaia performs on your terrain. You can ‘play it back’ in fresh scenes to re-create the terrain and enable and disable playback steps 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 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 infinite 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.

Most of the runtime components can be installed as separate modules, so you can install only the components you want into your project to keep the file size low.

Help Tab

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

How Gaia organizes the scene hierarchy

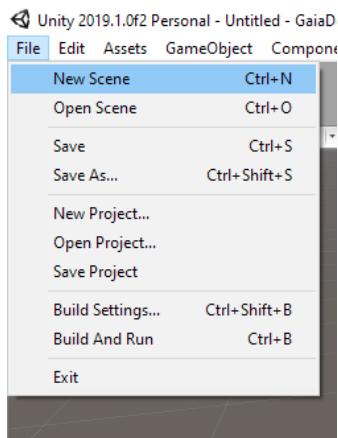
When you create a world, Gaia adds Gaia Tools, Gaia Runtime, and Gaia Terrain objects at the top level in your scene hierarchy.

- Gaia Tools are the tools that are used 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 helpers and runtime modules that must be present during the scene's runtime. Most of these are added from the "Create Runtime" tab in the Gaia Manager and can also be removed.
- Gaia Terrains is where Gaia puts the environment it generates 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, which can significantly impact performance. Learn more in the Terrain streaming section.

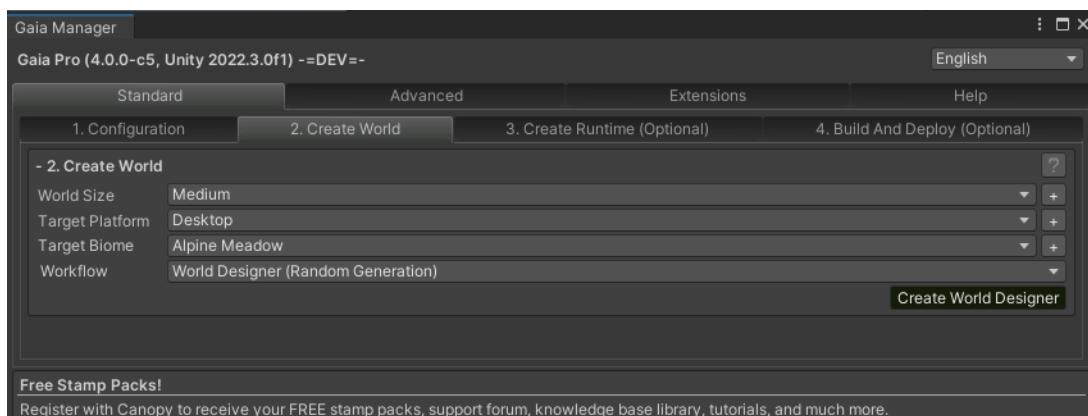
Create a terrain using the stamp-based workflow (manual generation)

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

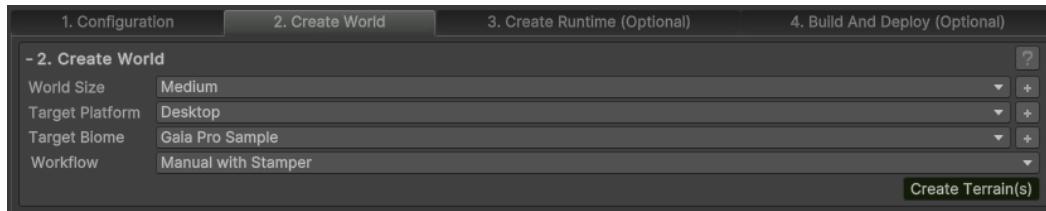
1. Create a new scene, File -> New Scene



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



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

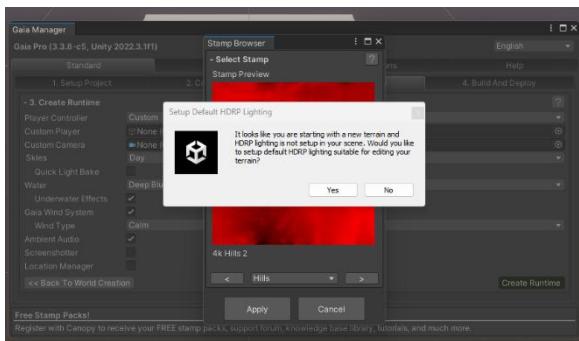


- World Size is the size of your world. For now, leave this at the default setting.
- Target Platform is what you are targeting your world to run on. Gaia will use this to guide how it sets up your scene.
- Target Biome is the Biome that will apply to your world. Gaia Pro provides more biomes to use, and you can 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, 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.

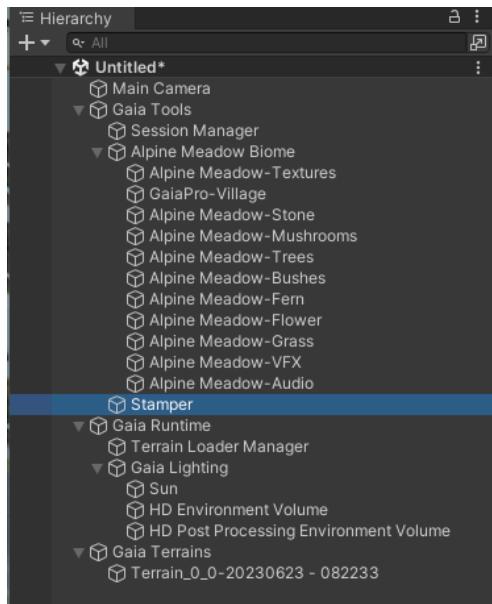
4. Select the “Manual with Stamper” workflow, then click on “Create Terrain(s)” to create the terrain and set up a stamper tool.

Important: Depending on your Gaia version and which additional modules you have installed, you will have different options in the Biome selection dropdown. The screenshots in this tutorial were made with the “Alpine Meadow Biome” part of Gaia Pro, but you can choose the “Gaia Pro Sample Biome” if you do not own the Pro version. The biome selection will not influence the overall workflow but only which textures, assets, etc., will be applied to your terrains.



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

5. Gaia just did a lot of work for you! Let's unpack this by looking 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 to your scene, and the Stamper is used to shape your terrain.

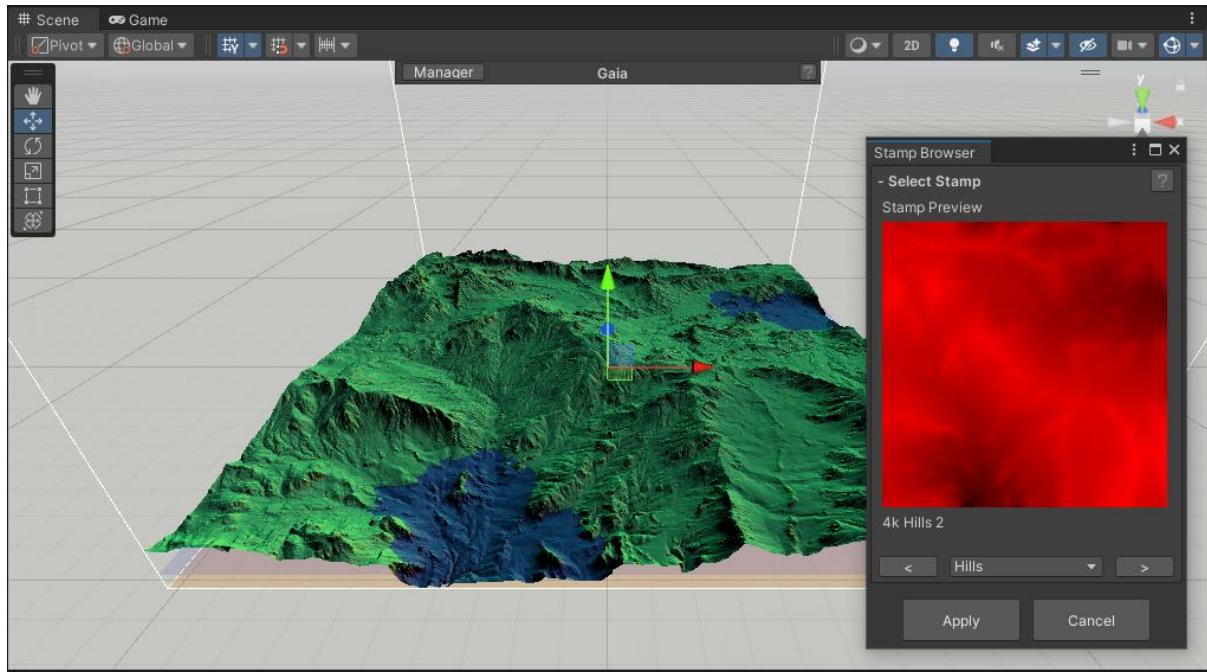
Gaia Runtime

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

Gaia Terrains

- This stores the terrains that Gaia created and added to your scene.

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



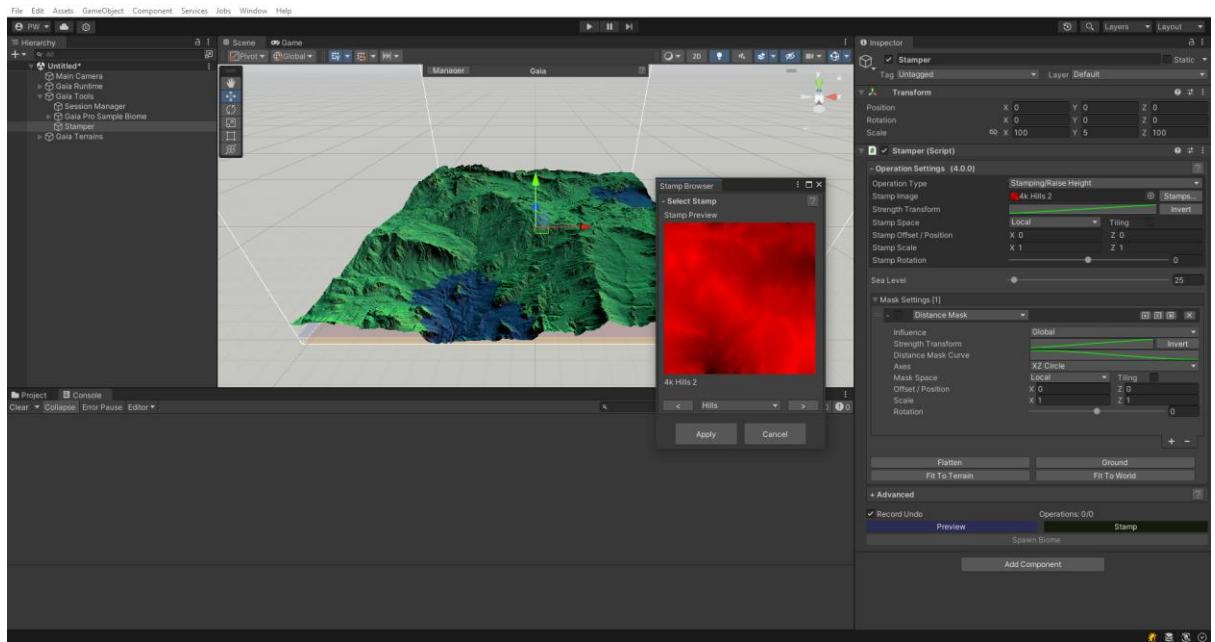
The blue-greenish image in the scene view is a low-fidelity preview of the terrain shape we are about to create. You can see the terrain we created under it.

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

Important: If you did not install the stamp package as part of the setup process, you will not see any stamps in this window. In this case, you can now go to Window > Procedural Worlds > Setup... to install the stamp package. You can refresh the stamp browser by closing it and clicking the "Stamps..." button in the stamper.

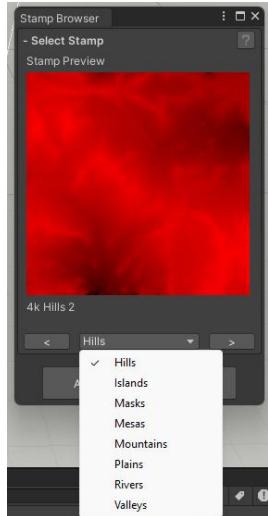
For simplicity, close Gaia Manager for now so that we can focus on the stamper.

- 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.

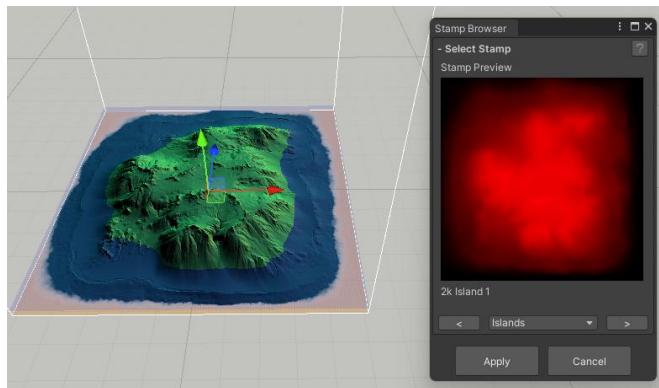


The Stamper is a tool for applying stamps to your scene. It shows a low-fidelity mesh preview in real-time.

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



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

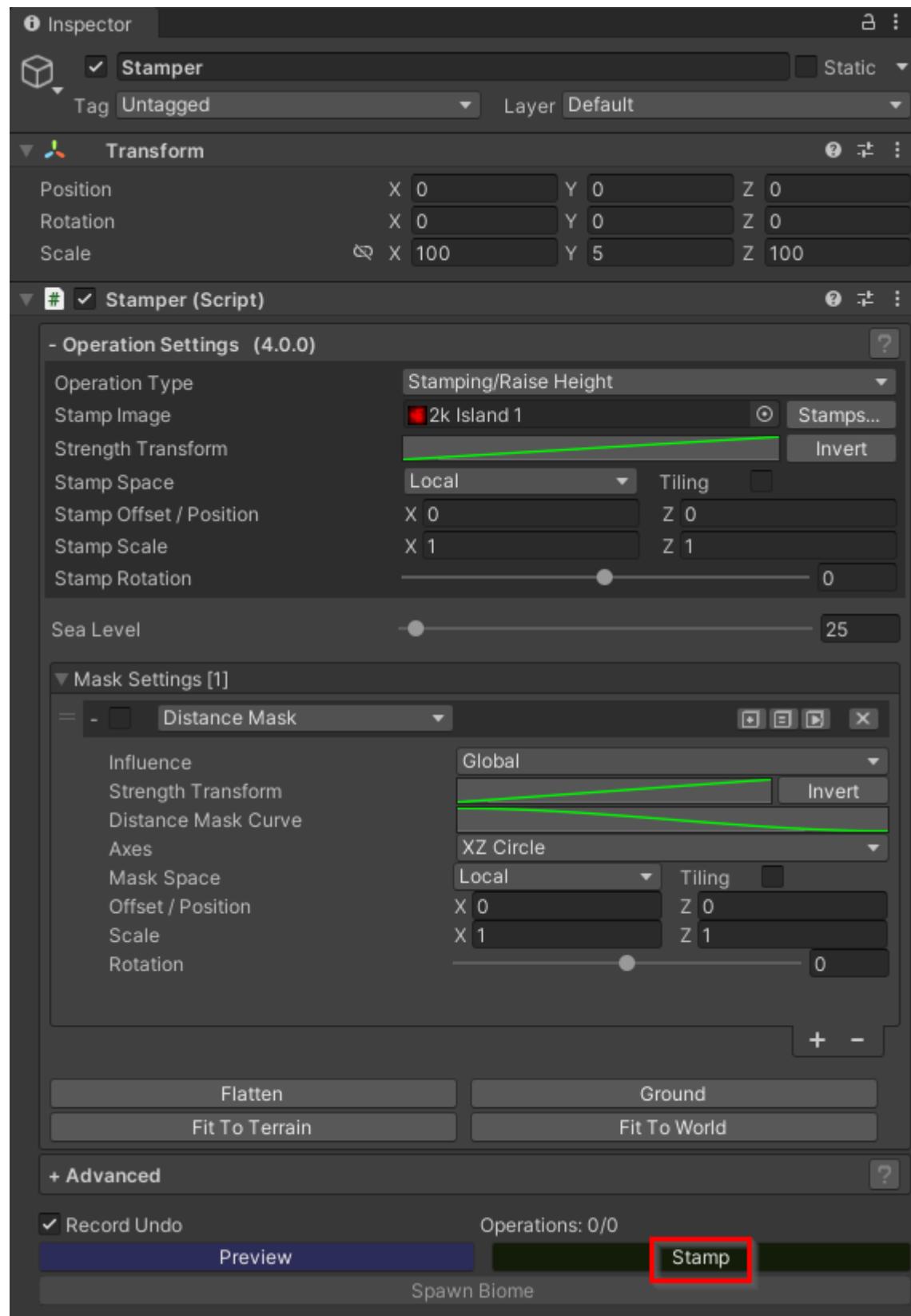


The preview updates, and you can see that the stamp's edges would now be underwater.

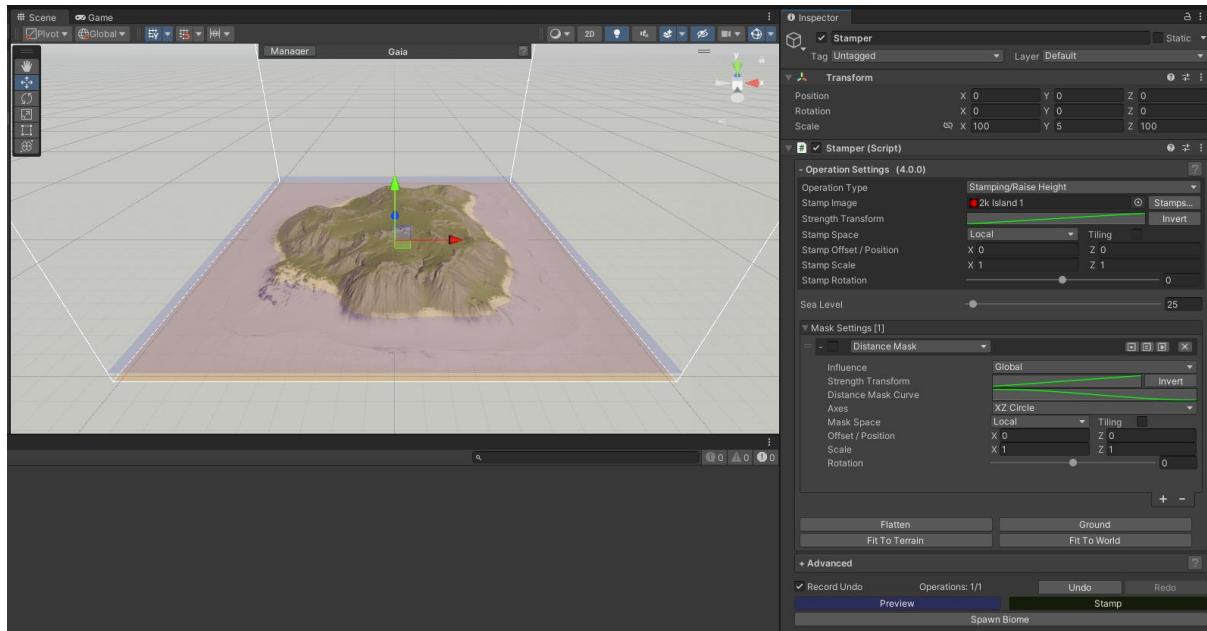
The lighter section of the stamp preview represents high points on the terrain, and darker areas represent low points on the generated terrain. You can see this reflected in the preview.

Click the Apply button to select that stamp.

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

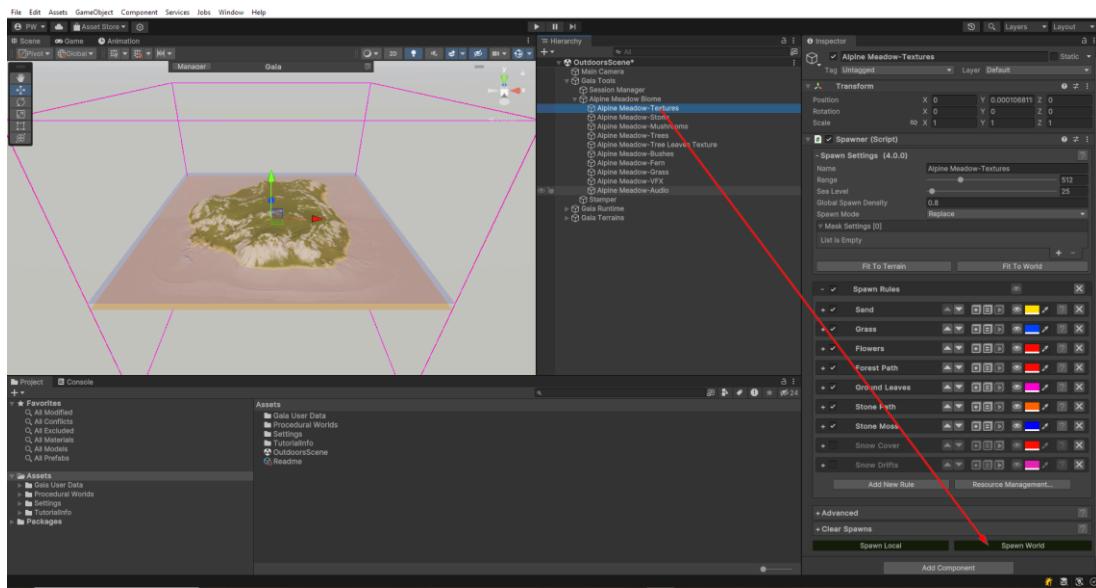


10. Gaia has now applied the stamp into your terrain and textured it as well!



So what just happened?

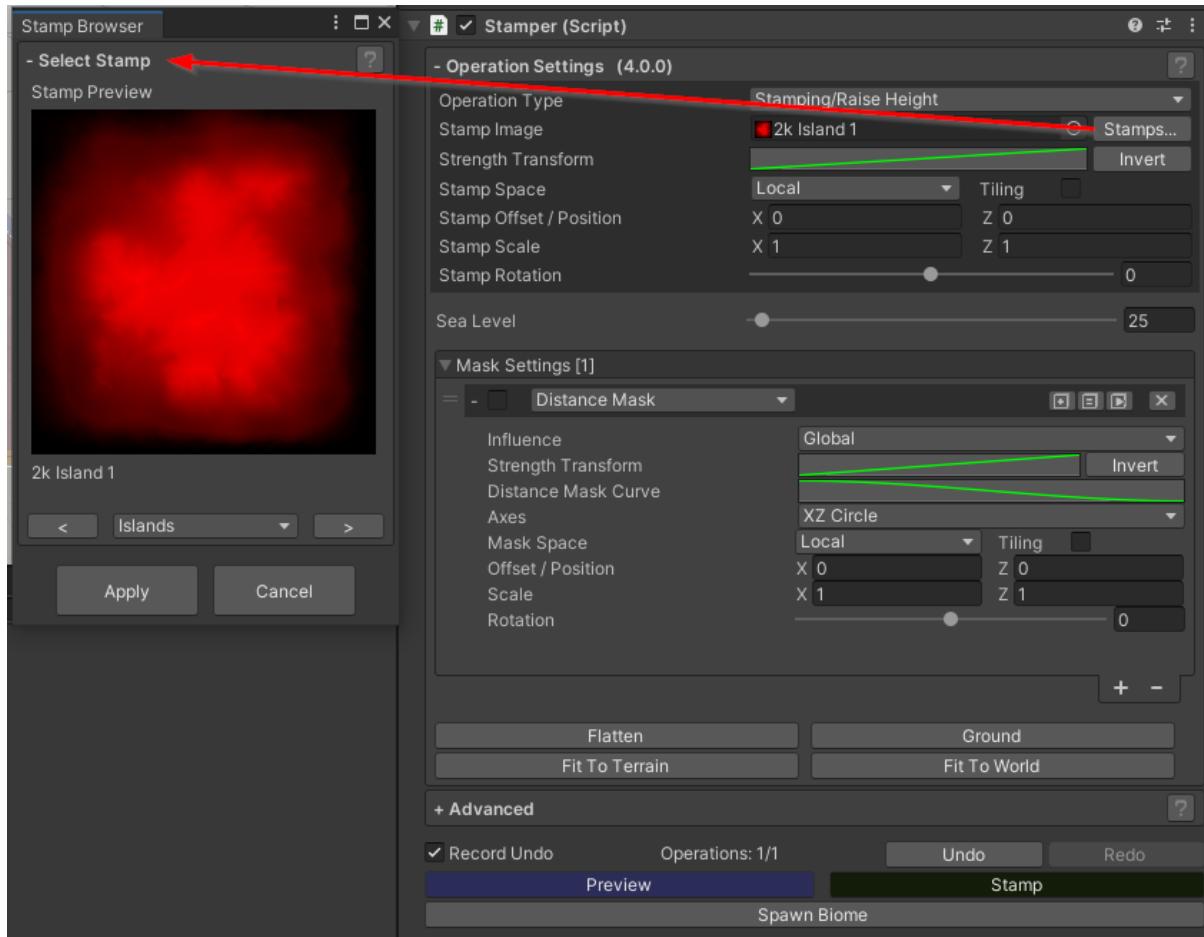
Gaia used the Stampers “Stamping / Raise Height” Operation to apply that stamp to the scene and then called the Alpine Meadows – Textures spawner in the Alpine Meadow Biome to texture it for you.



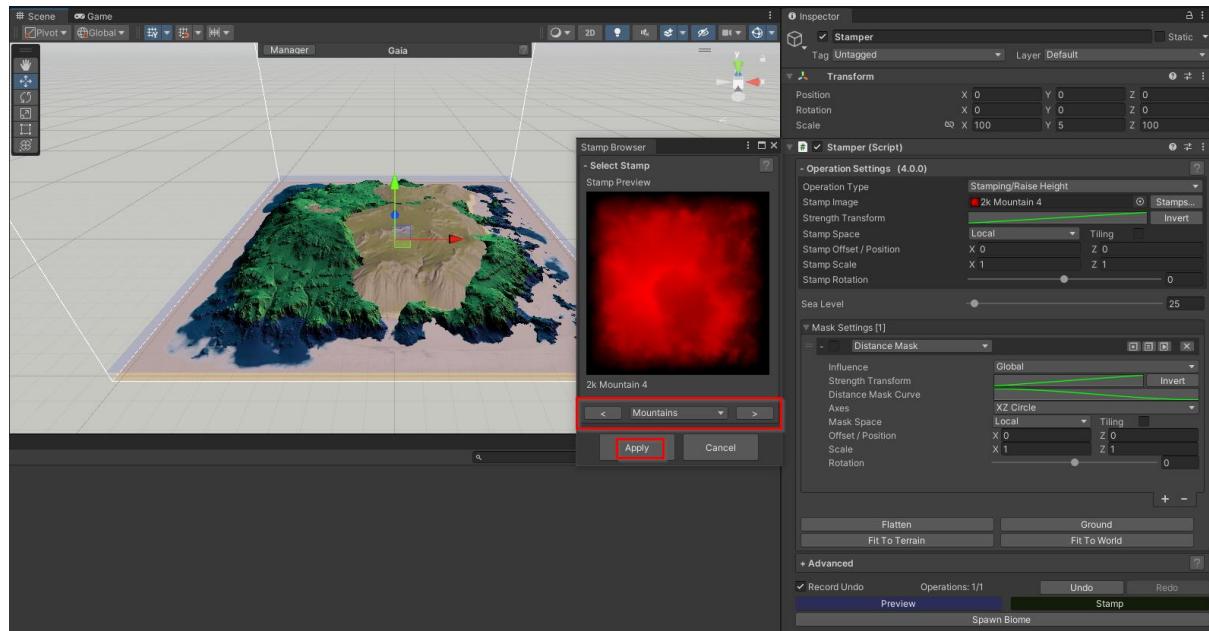
Auto texturing is a handy shortcut that gives you a sense of how your scene will eventually look. As you become more proficient with Gaia over time, you can customize these Biomes or create new ones to create your look.

Let's add another stamp to customize your scene further.

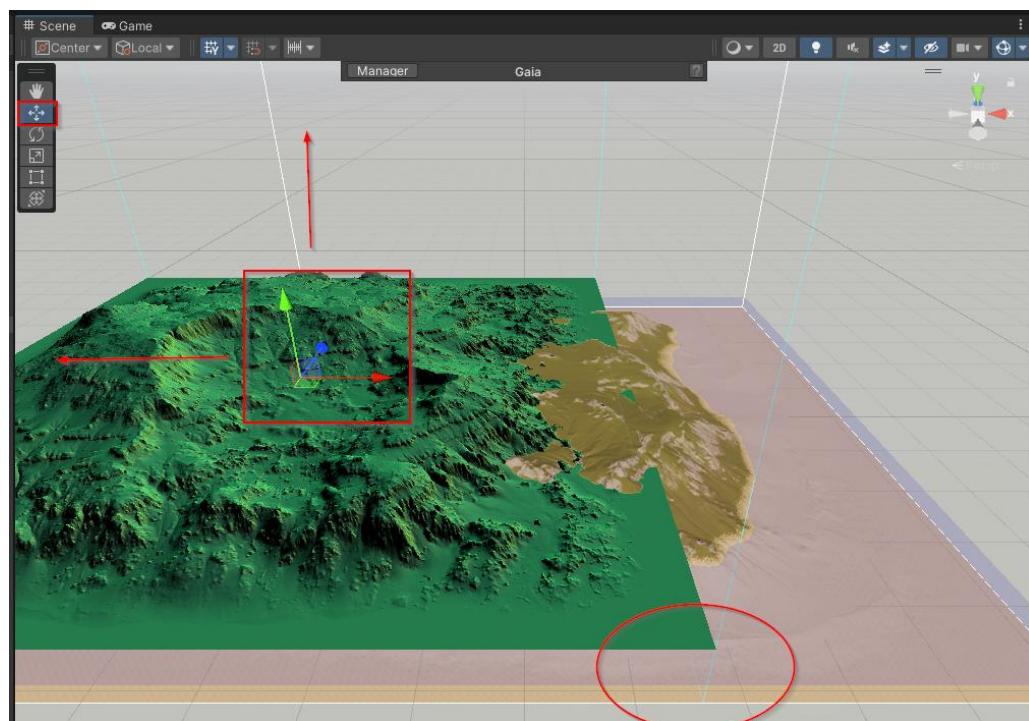
Ensure your Stamper is selected in the hierarchy, and click on the Stamps button to open the Stamp browser.



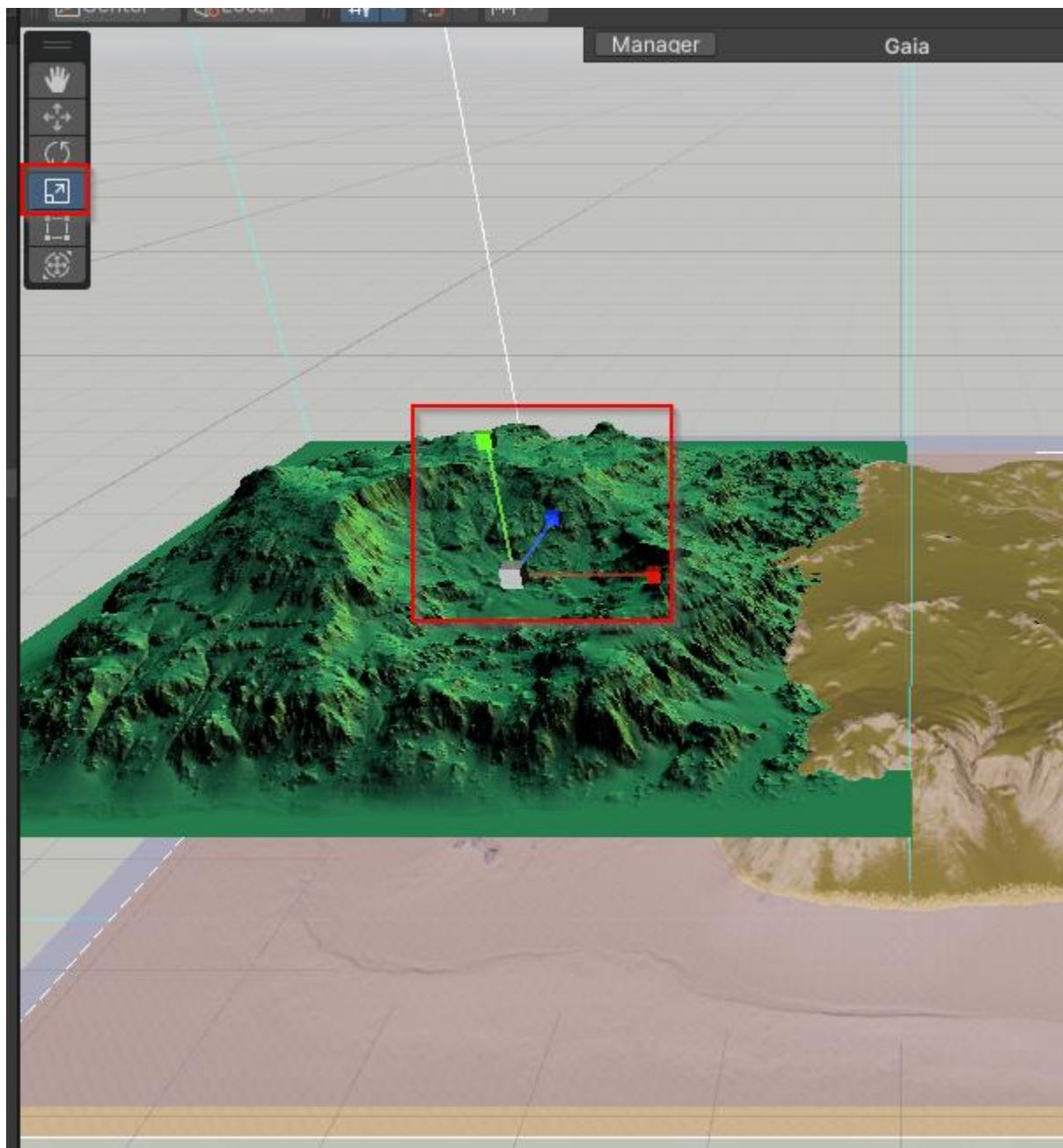
Browse to Mountains, and hit the arrow buttons to select 2k Mountain 4. Notice how the blue/green preview updates in the background. Hit the Apply button to choose it.



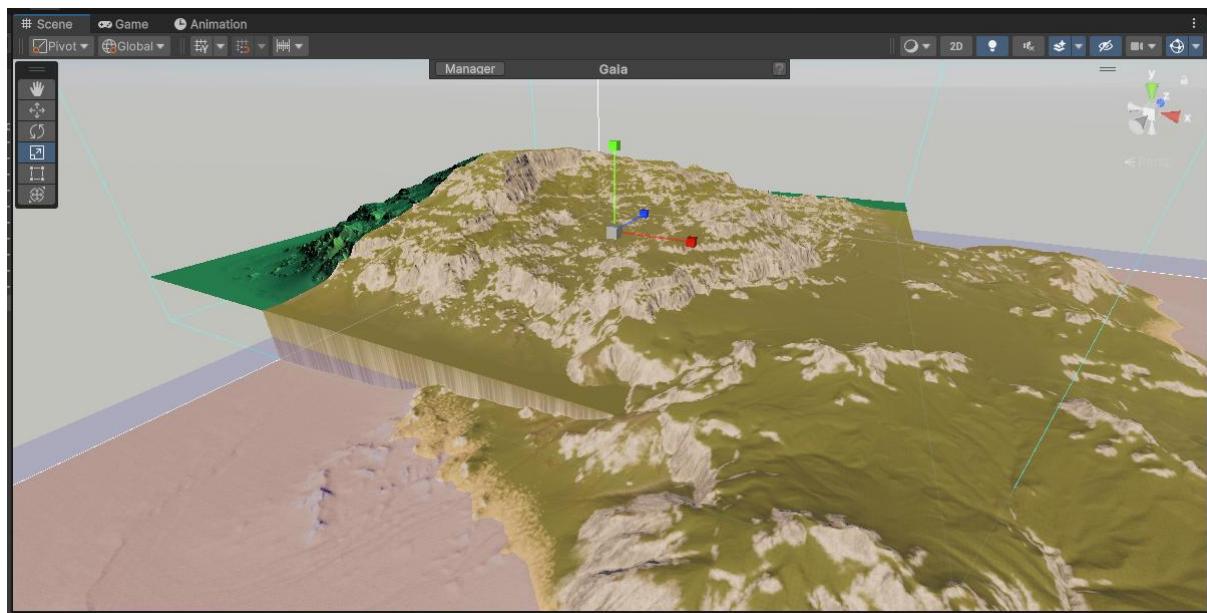
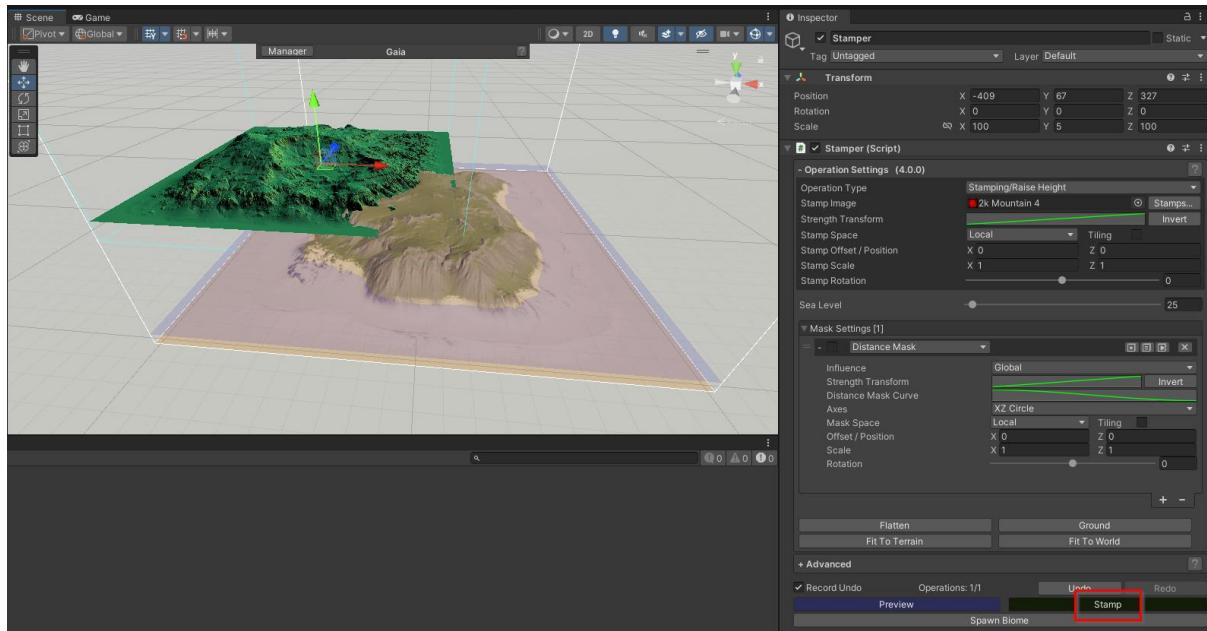
Make sure that the Mover tool is selected. Then, lift the Stamp preview and drag it to the left. Notice how the stamp is sitting well above the underlying terrain.



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



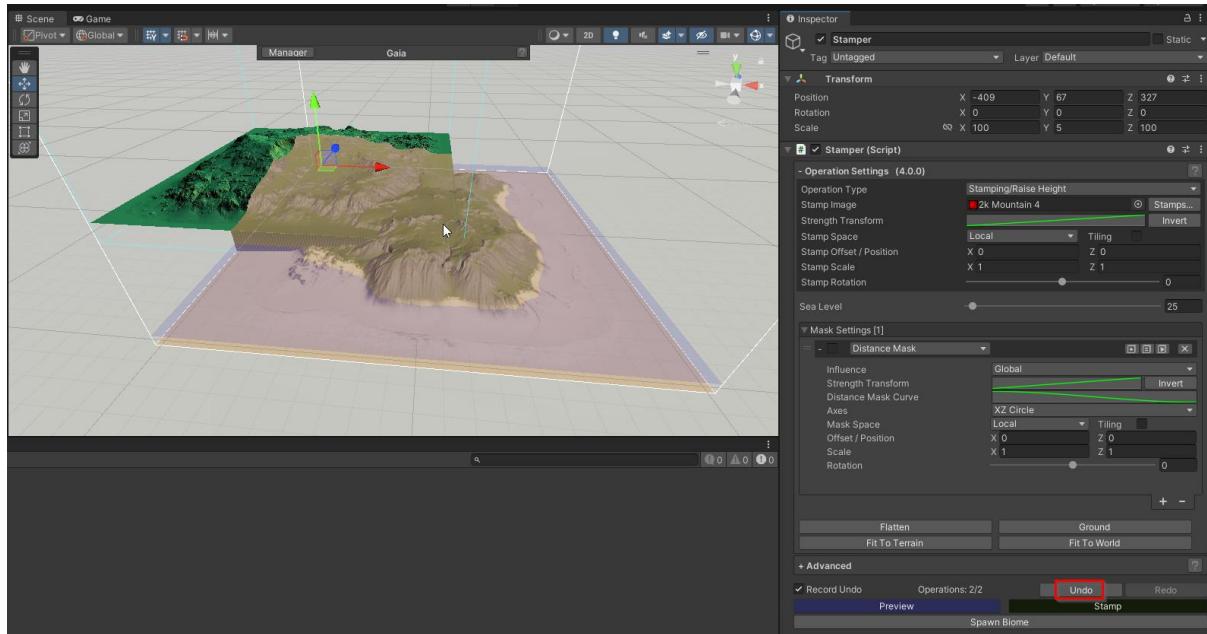
And now hit the stamp button.



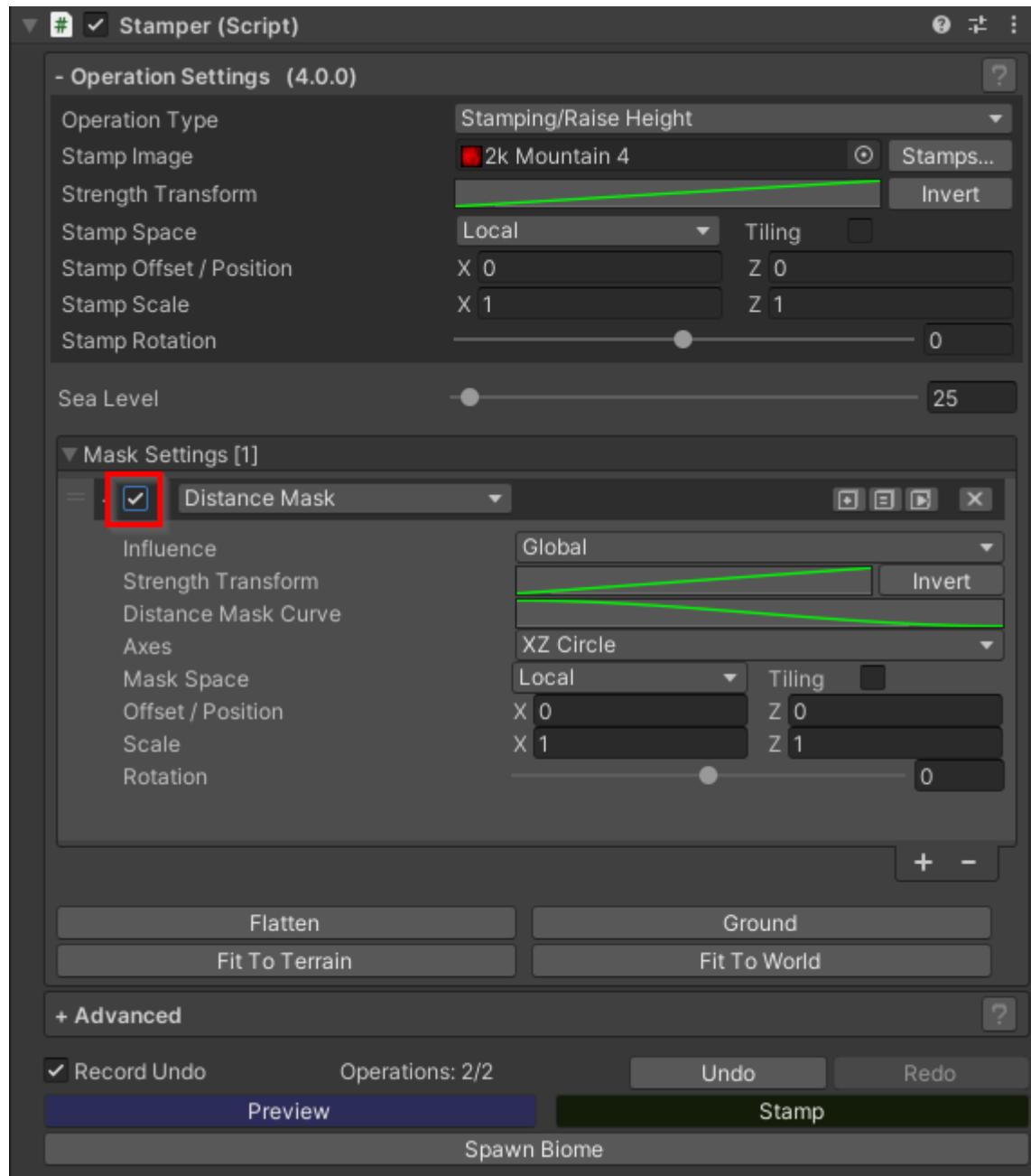
Awesome. Gaia added and textured the stamp, but.. Houston, we have a problem! An ugly big step exists between the existing terrain and the new stamp.

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

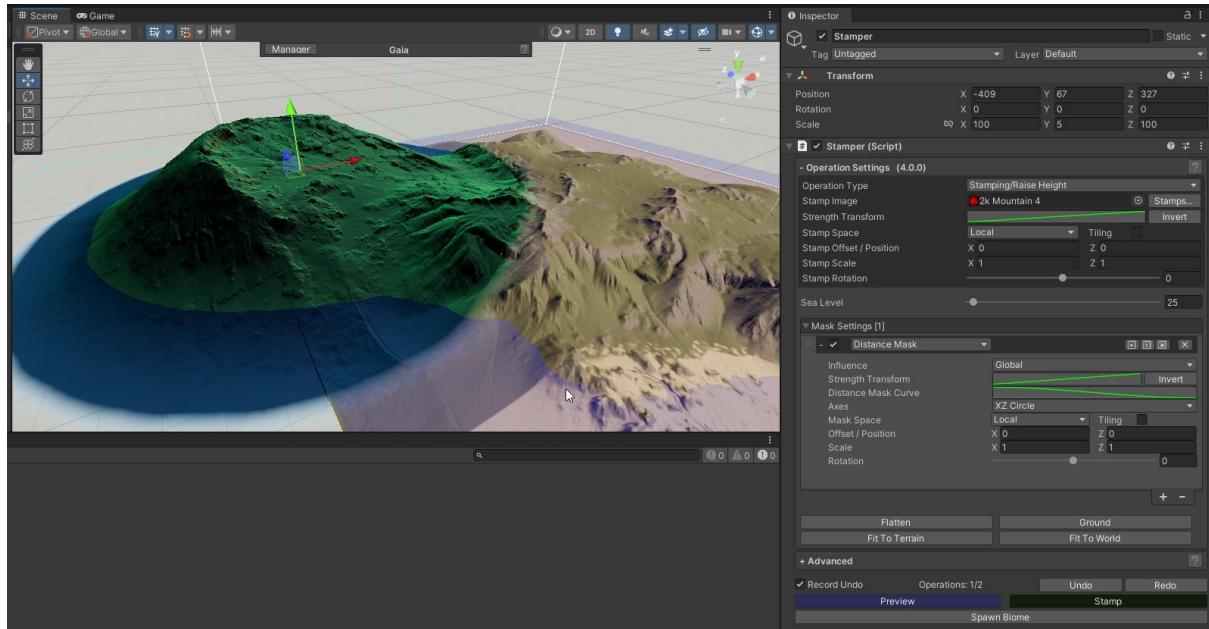
Warning: The Undo list will be lost if you hit play!



11. Now, let's use a mask to fix this issue! Gaia has a potent masking system and you can use these to get many sorts of effects. By default, the stamper is already set up with a distance mask to help us fix this issue. You can find it in the Mask Settings of the Stamper and activate it with this checkbox:



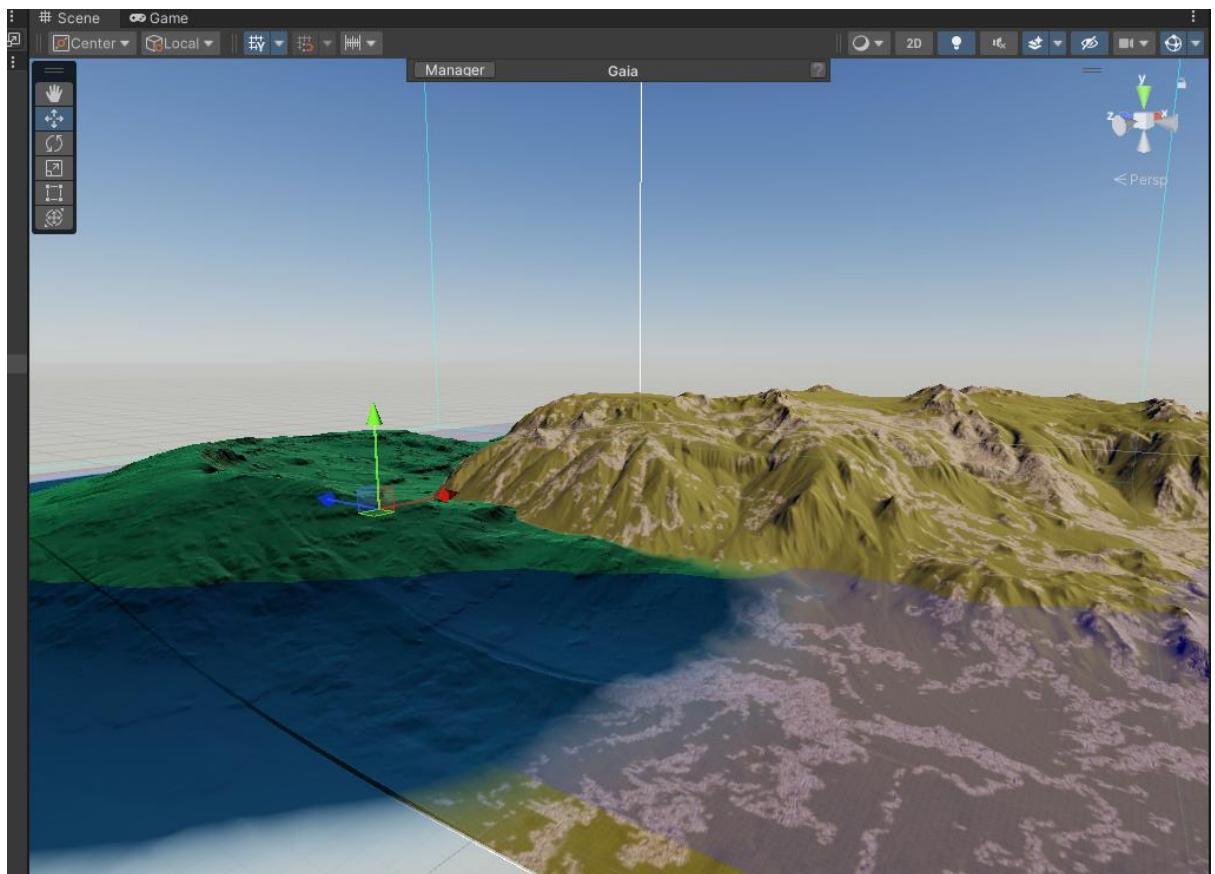
The distance mask fades out the stamp towards the border of the stamper. With the default settings in this mask, the stamp will be blended out in a circle shape towards the border of the stamp. You can already see how there is a better transition to the surrounding terrain:



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

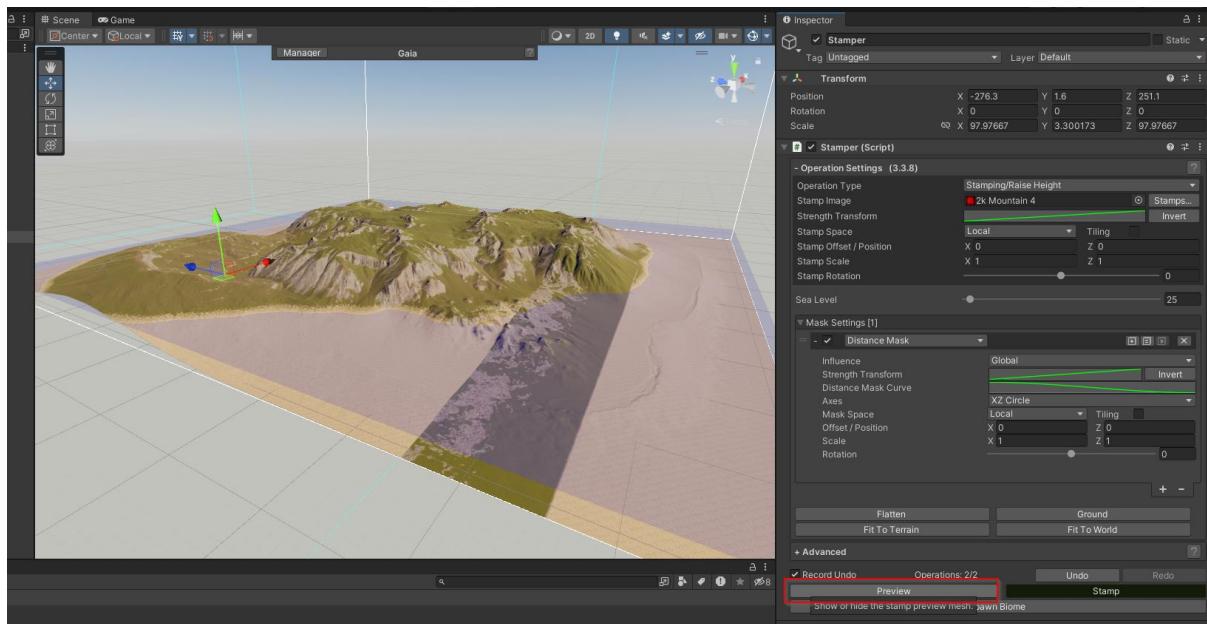
12. Use the Mover and Scaler tools to adjust the stamp's position and scale. If you accidentally unselect the stamper, just select it again in the hierarchy to get the preview back. You can see how the Distance mask blends the stamp nicely into my scene.

When you are ready, hit the Stamp button!



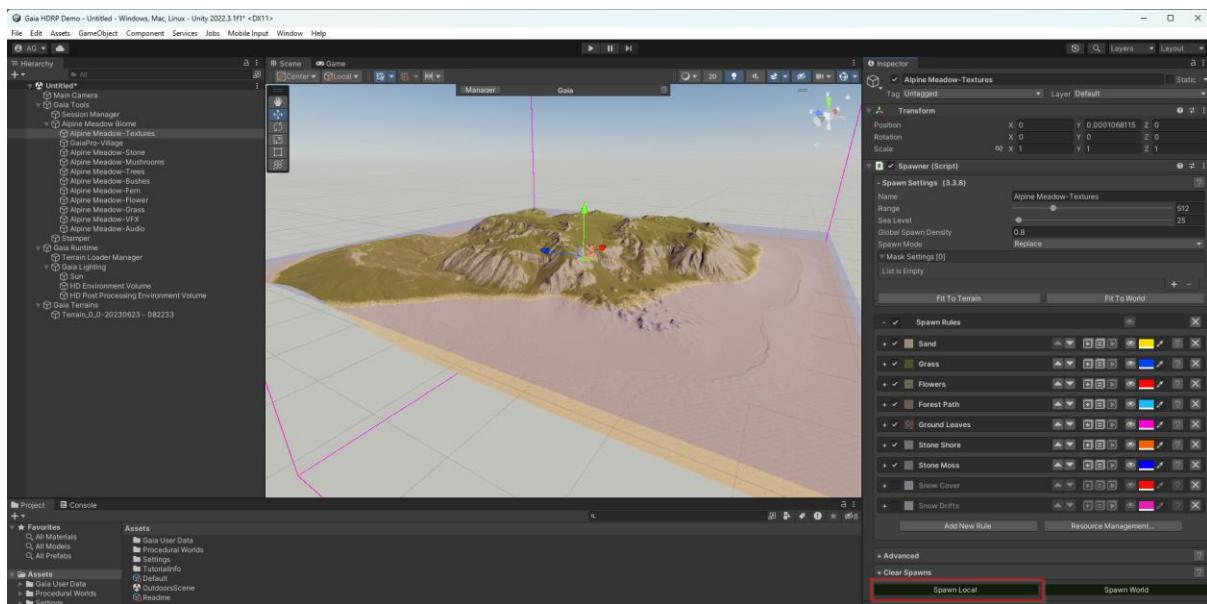
Tip: You can also use the rotation tool to rotate the stamp!

13. 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.

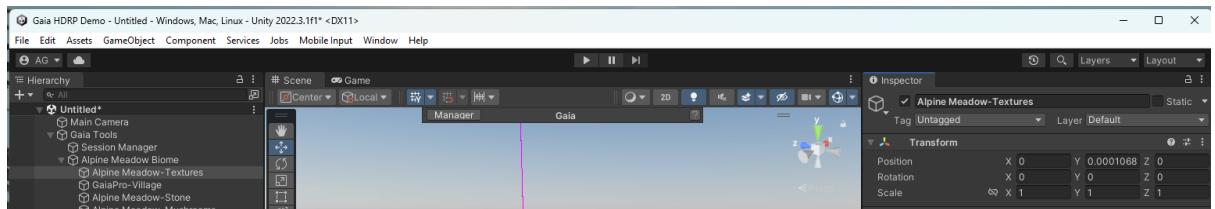
14. To fix this, click on the Alpine Meadow-Texels object and hit the Spawn Local button.



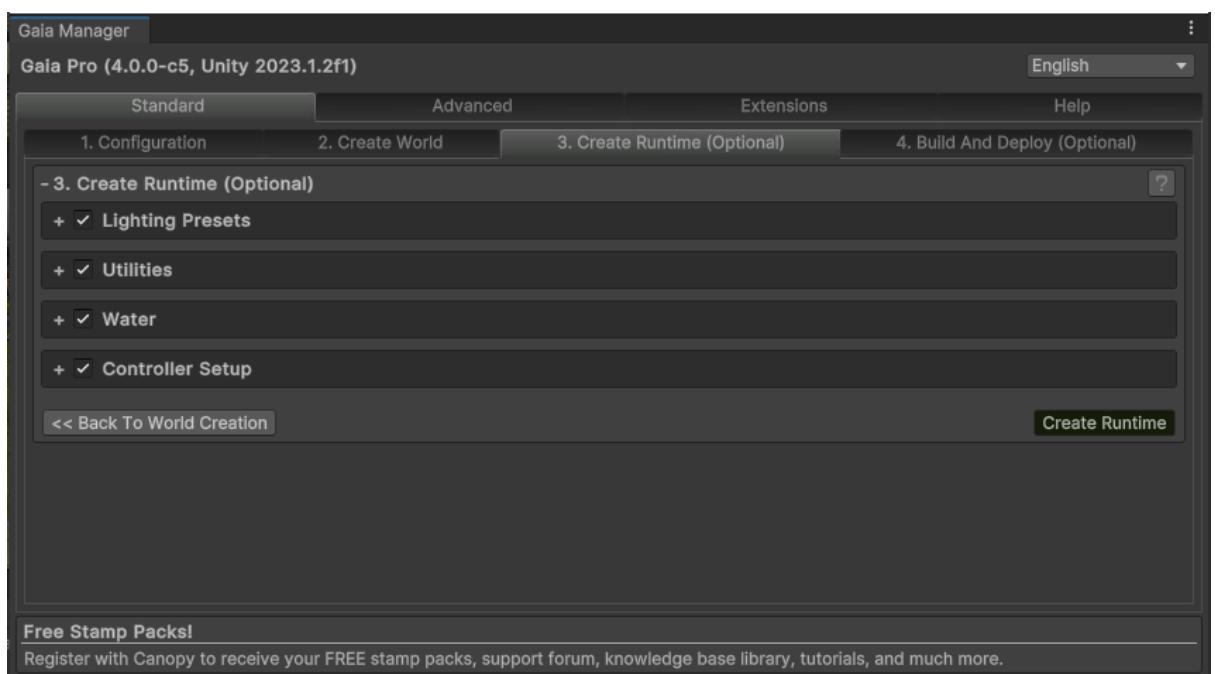
Nice. Now, we have re-textured the terrain, and it looks pretty good!

15. Let's understand how this looks 'in-game'.

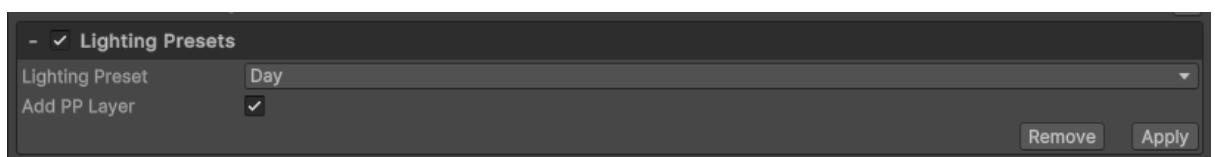
Click the Manager button at the top of your Scene view to open Gaia Manager.



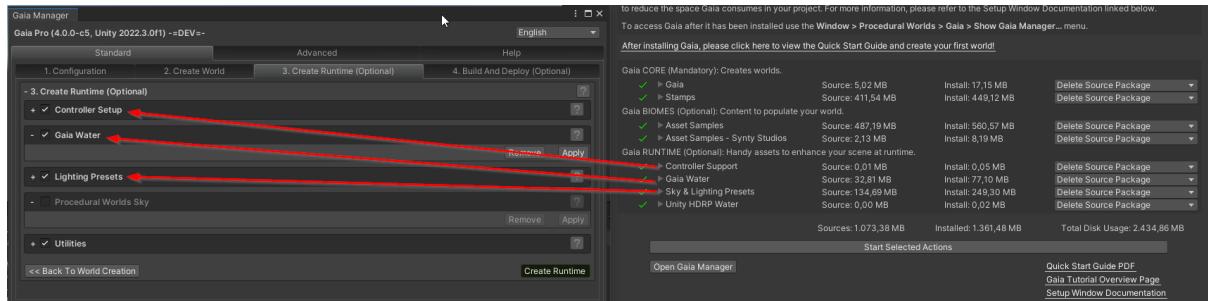
It should automatically select the runtime tab since you already executed the first two steps of the scene creation process.



This tab shows you the available runtime elements, such as Lighting or Water, that you can add to your scene. Unlike the Gaia Tools, these elements are intended to remain in your final product. You can look at the available modules and choose what to add to your scene. It is possible to include/exclude modules with the checkbox in front of their name. Modules can have additional settings you can modify before bringing them into the scene. Click the small "+" before the name to show these options.



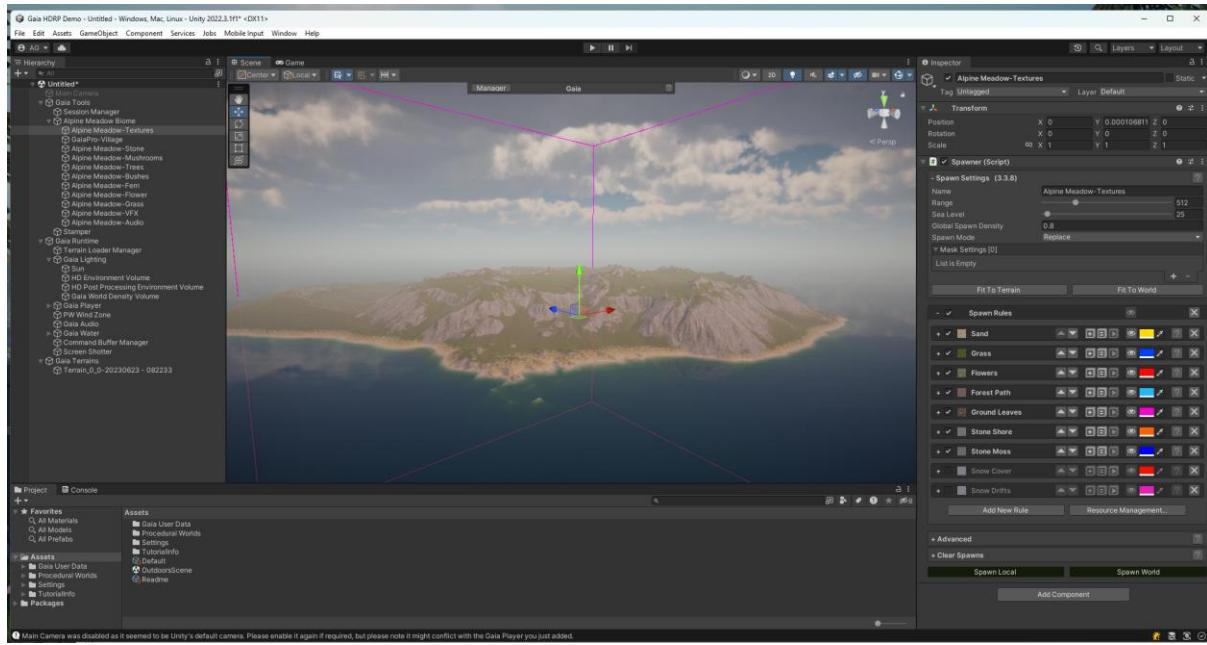
If you are missing modules, note that you can install them from the Setup Window via Window > Procedural Worlds > Setup...



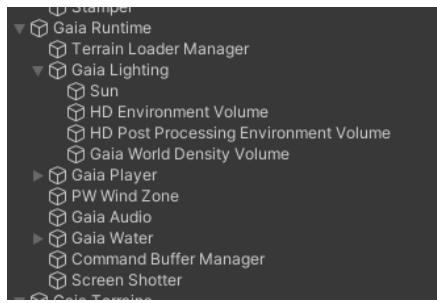
For the tutorial, it is recommended that you install the water and lighting preset modules in the project, as they make a huge visual impact on the scene. You should also have the “Controller Setup” package installed to explore the scene during runtime.

Click on “Create Runtime” to add the elements to the scene.

16. Our scene now has skies, water, post-fx, audio fx, a screenshotter, and a player controller!



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!



This approach makes it easy to prototype and check its scale for new scenes. You can remove the runtime later.

NOTE: For sizeable multi-scene environments, you will still need the terrain loader to manage terrain streaming.

17. Hit Play and enjoy your scene!

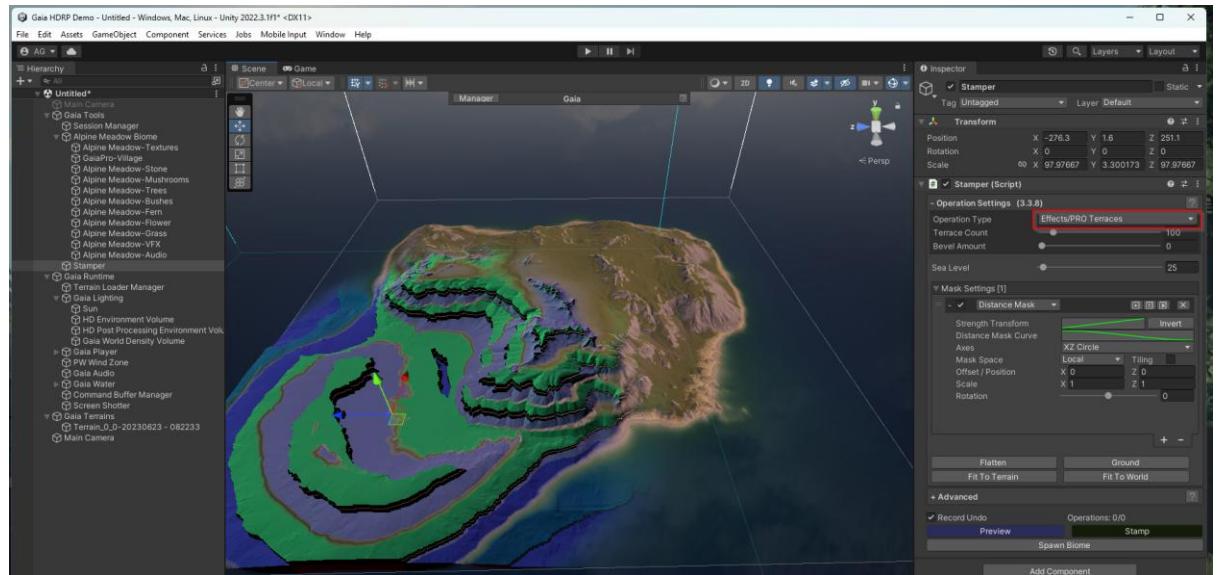
Notice that we created a runtime user interface at the bottom left of your screen. Read this to learn how to control the Fly Camera we added to your scene.



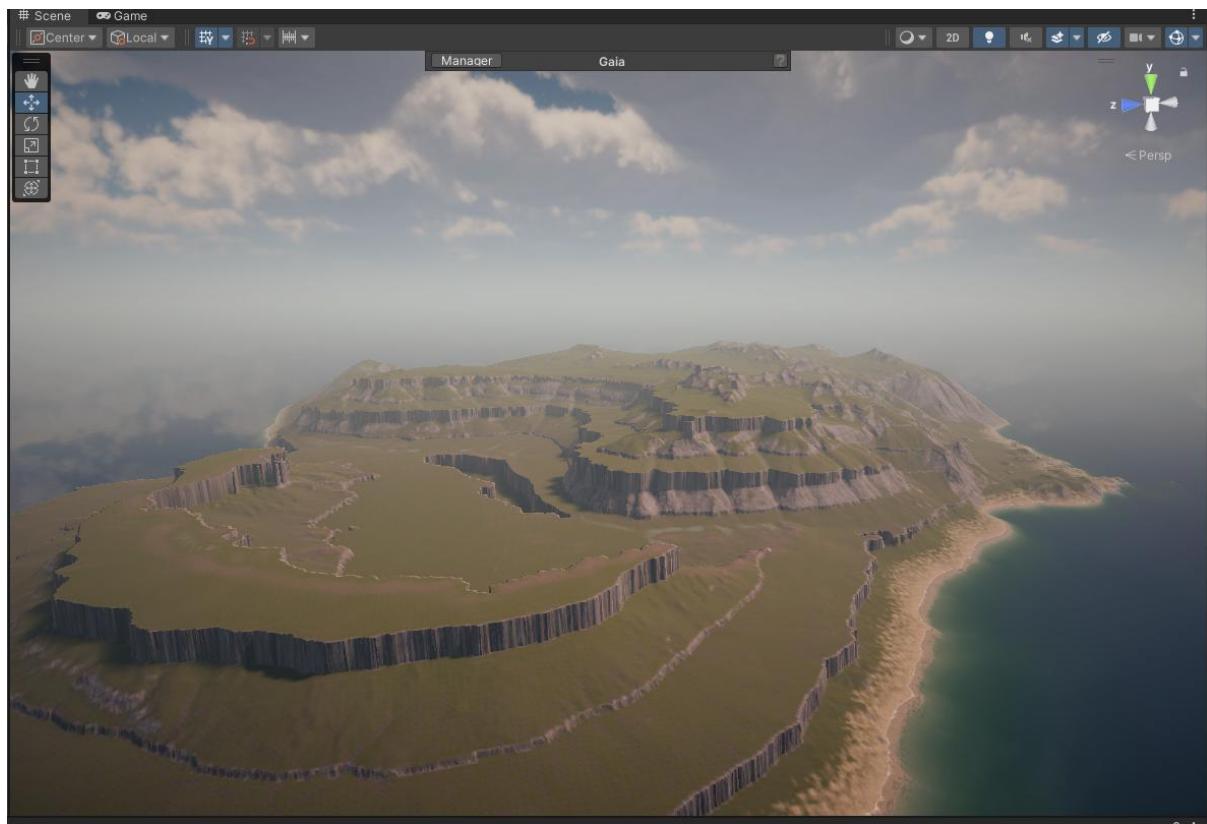
18. Ok, last demonstration of the stamper before we finish this world.

Choose one of the Effects Operations. In this case, I am going to choose Effects / PRO Terraces, 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 control its area of effect, and you can also influence this with masking.

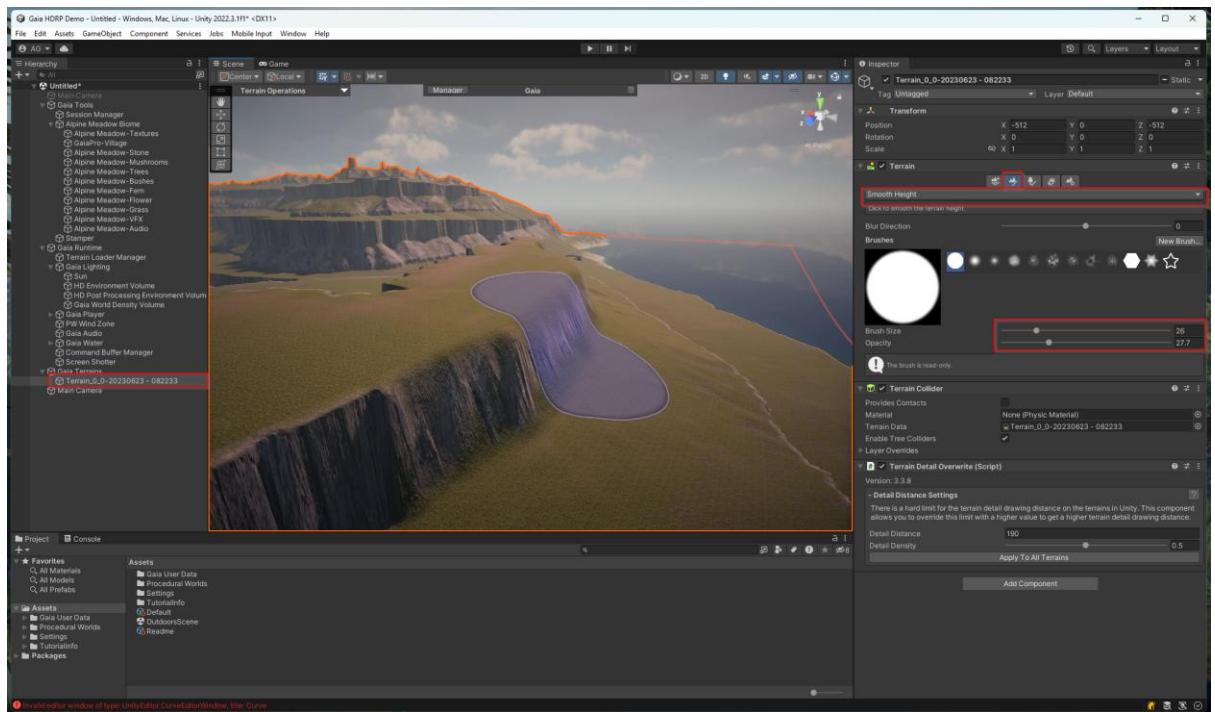


19. Experiment with your settings and then hit the Stamp button.



20. 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](#)

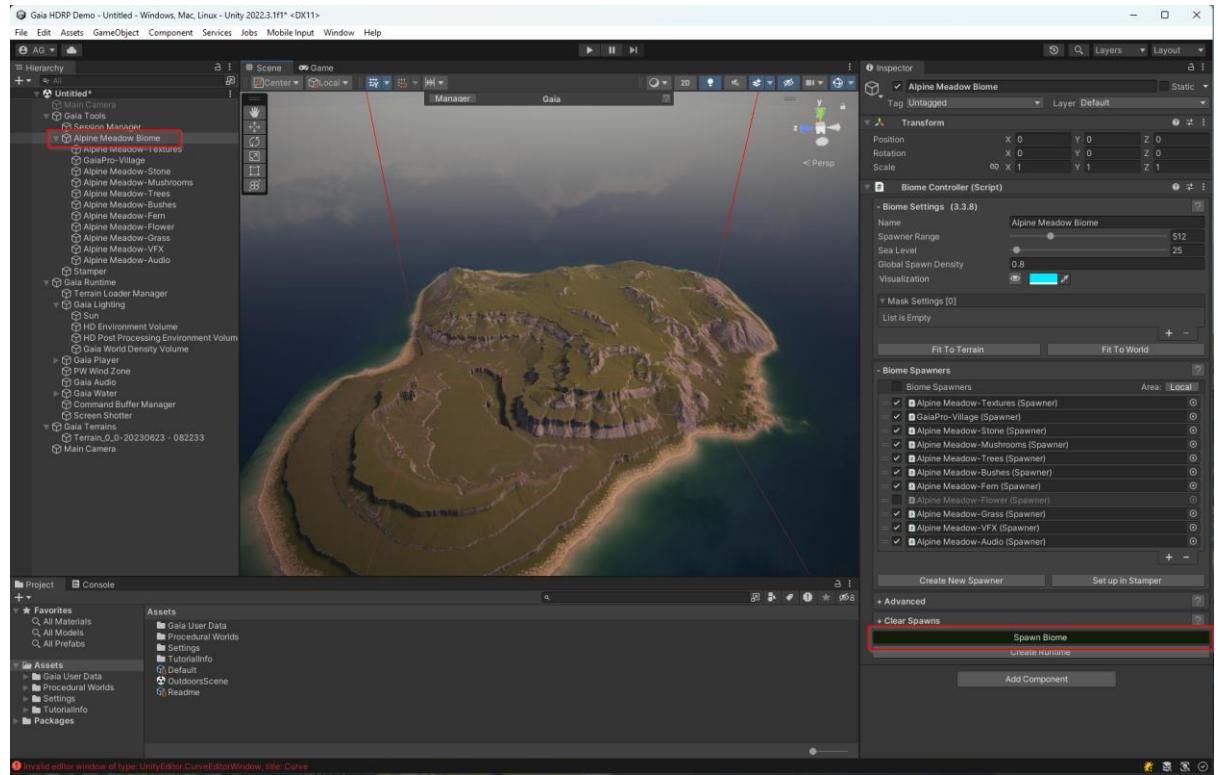
[How to mix and blend stamps](#)

[Introduction to masks](#)

21. Lets spawn the biome!

Select the Biome (which you chose earlier when creating the terrain), and then hit the Spawn Biome button!

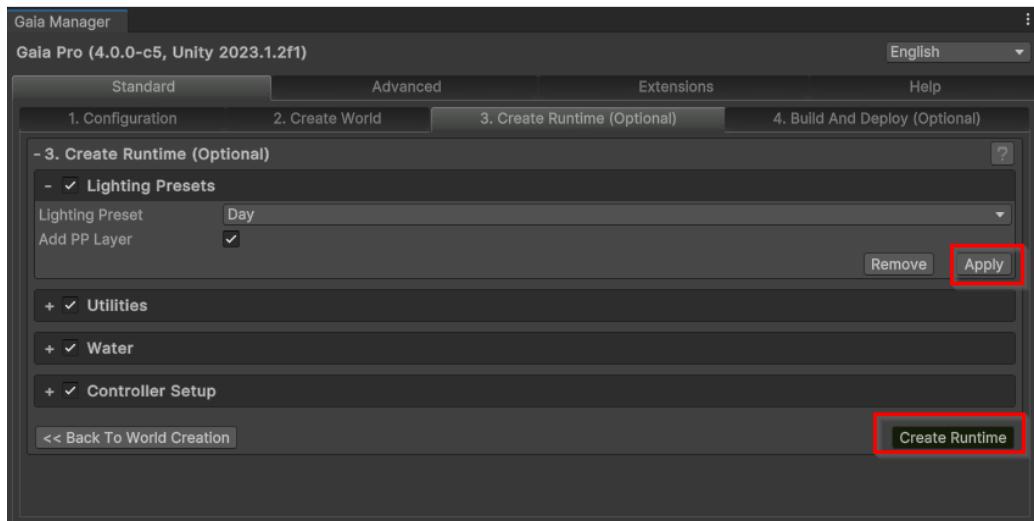
Depending on your machine's speed, you will need to wait a bit. On my machine, with this demo, it took about 2 seconds.



22. And now hit play and go exploring!



23. To change the game's appearance, stop the game and re-visit the runtime tab in the Gaia Manager. You can pick a different Lighting preset here, e.g., "Morning."



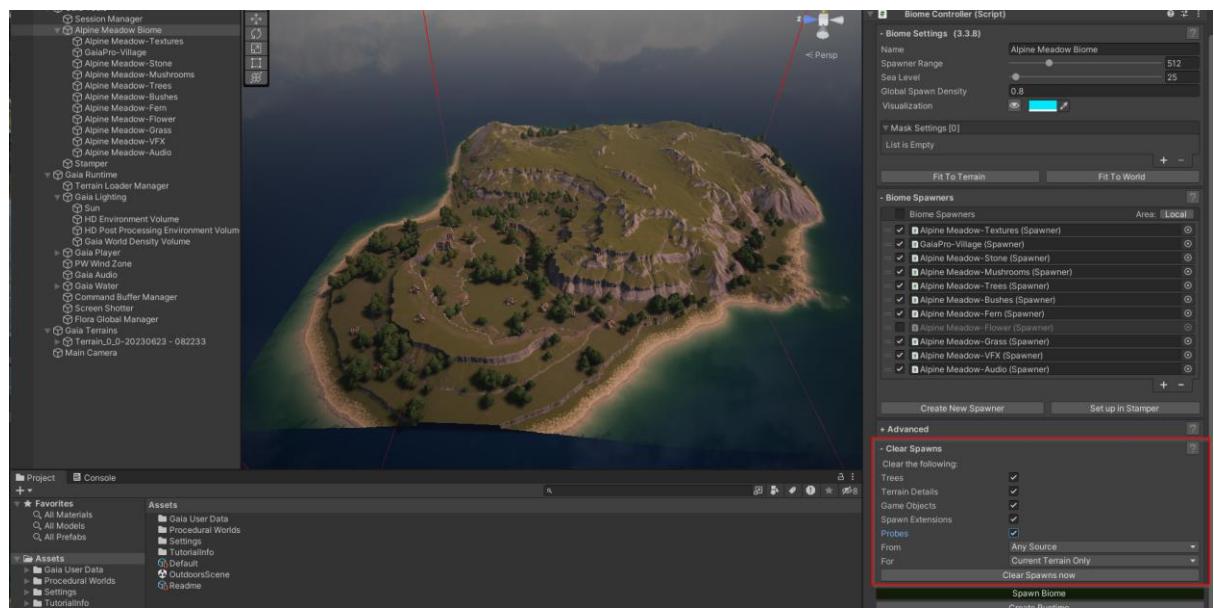
24. You can choose to re-apply individual modules or the entire runtime setup. Here is how your scene might look with Morning Lighting:



25. 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.

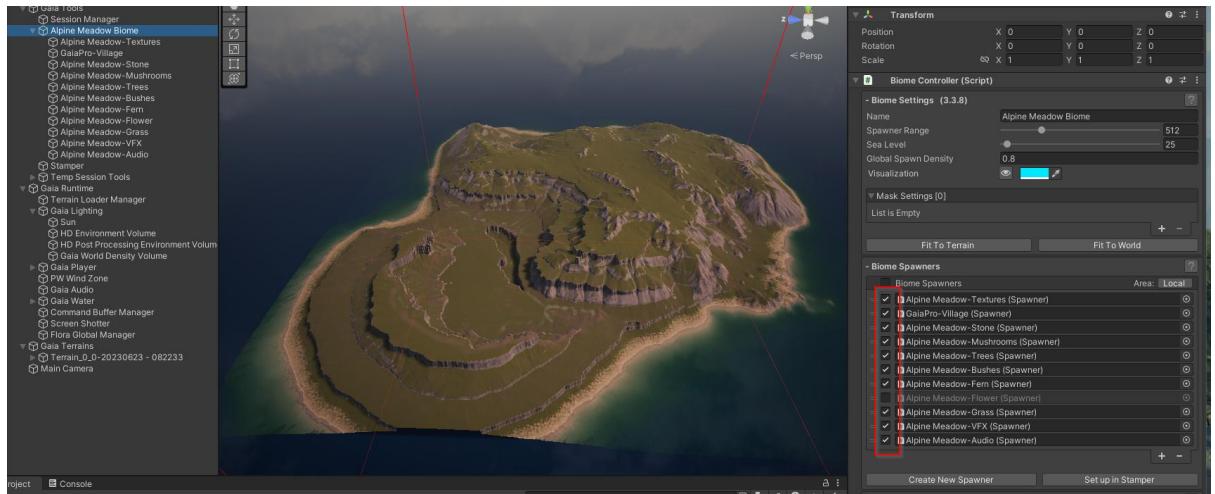
Select the object types you want removed and hit the Clear Spawns button. Then, you can use the stamper to refine your world.

You can rerun the Biome at any time.

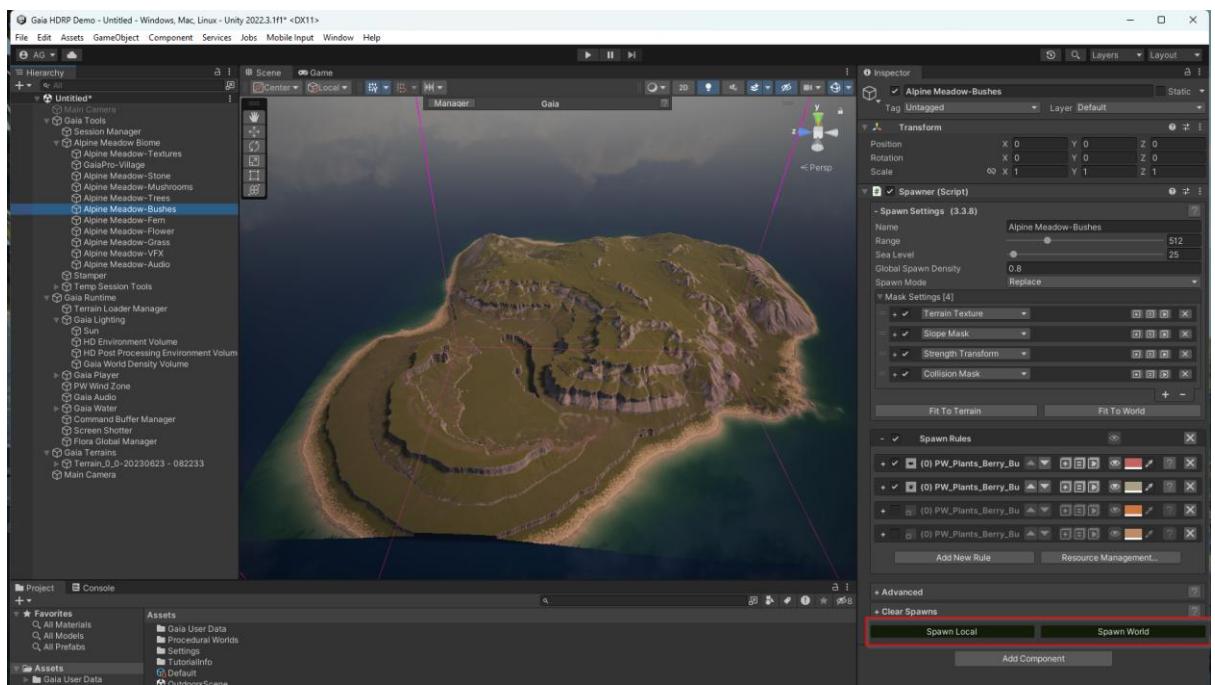


Warning: The biome system will overwrite what is in your scene so please treat it with care. If you have done some manual texturing or vegetation placement, it will be lost!

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



Or even 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.

This concludes the Gaia QuickStart Guide for the manual workflow using the Gaia Stamper. Below is a guide detailing the World Designer (Random Terrain Generation) workflow.

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

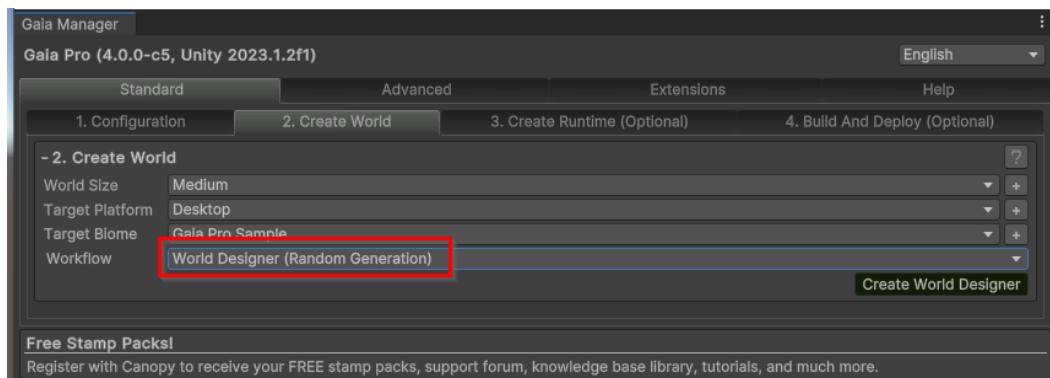
The previous section explained how to create a terrain manually using the Stamper.

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

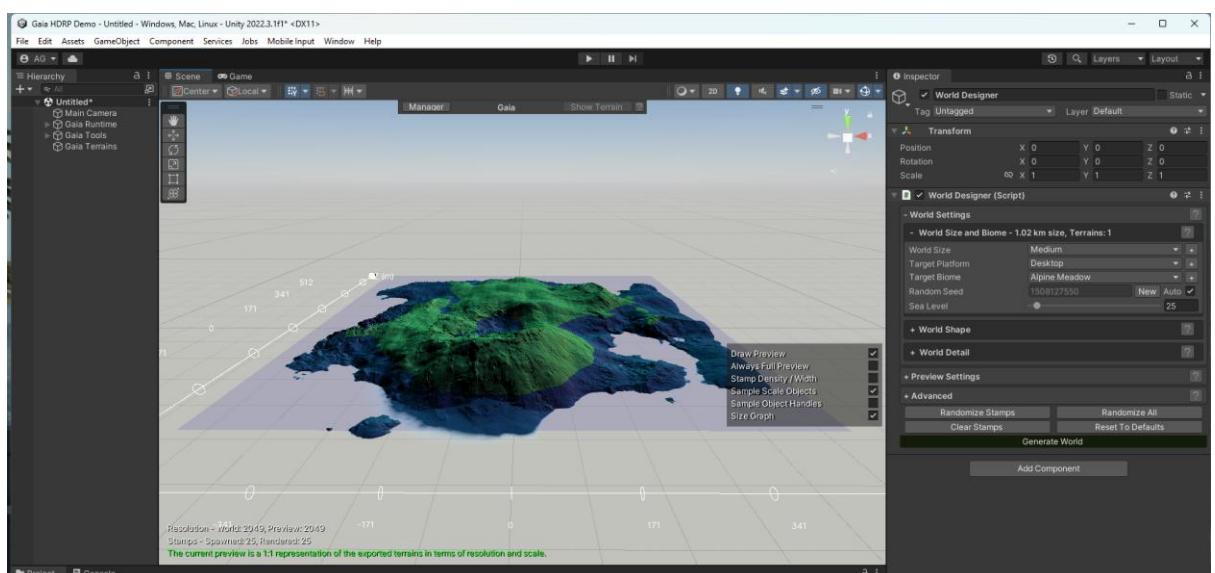
It's a great way to iterate on environments, especially larger ones, rapidly. After they are generated, you can manually refine them with a Stamper.

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

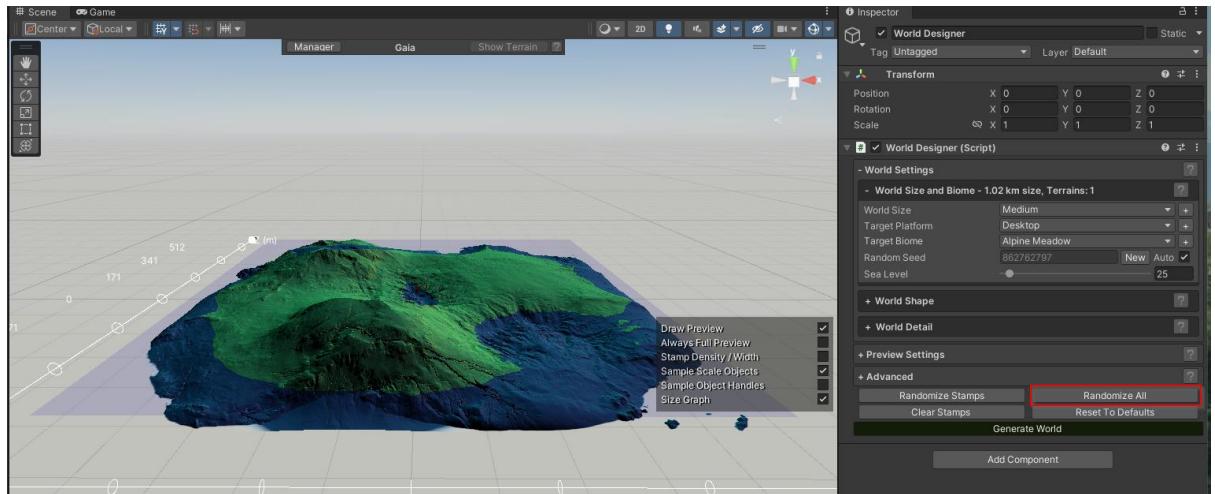
1. Open a new scene and bring up the Gaia Manager again. The default settings will be fine, but this time we will switch the workflow to "World Designer (Random Generation)"



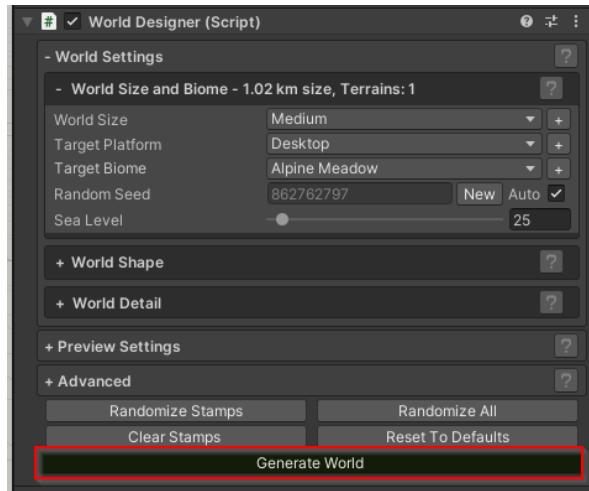
2. Click the "Create World Designer" button. Gaia will open the world designer tool and show you a terrain preview that matches the world size.



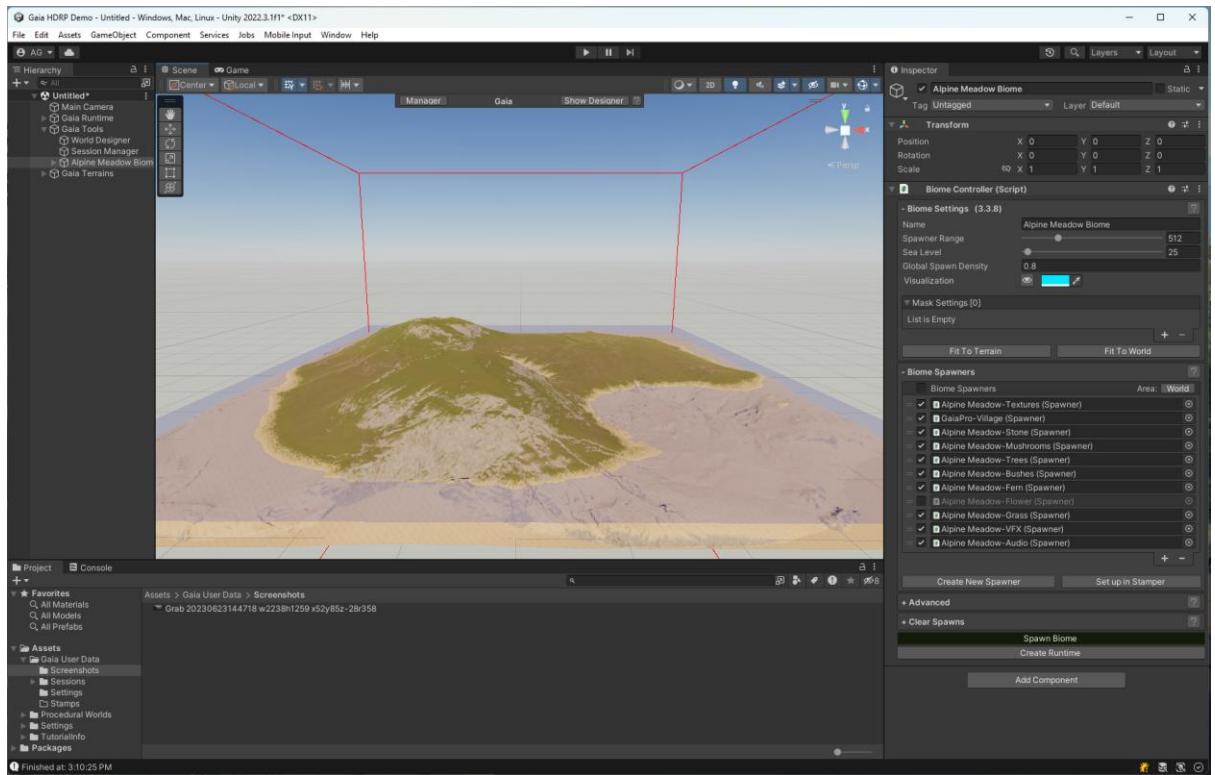
- The terrain shape is randomized, so your terrain will look different. The easiest way to use the world designer is to click the “Randomize All” Button. Clicking this will generate new terrain.



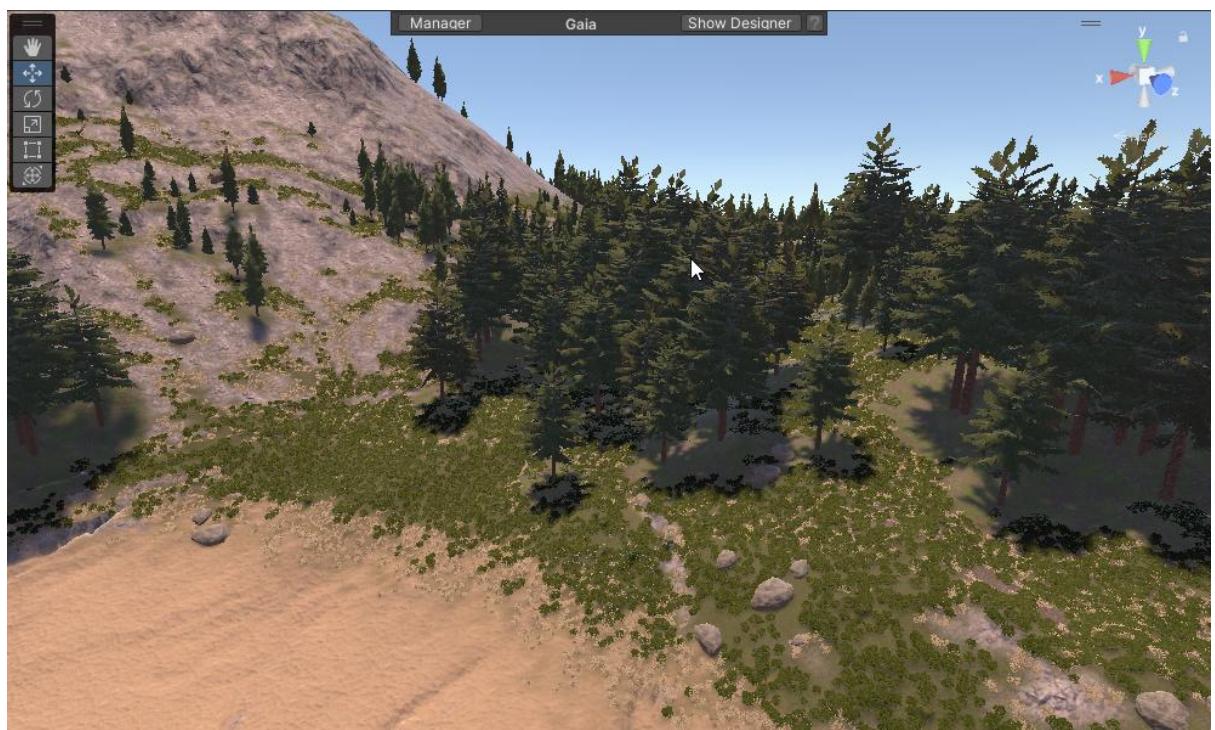
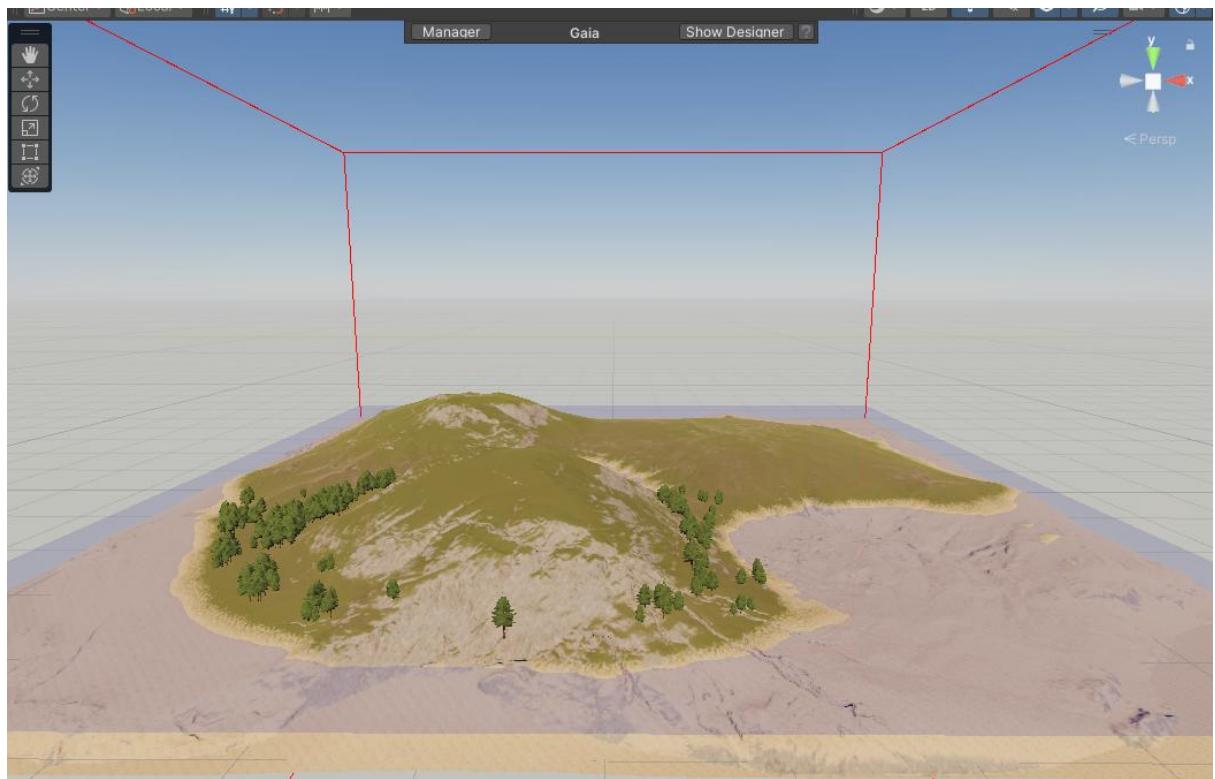
- When you see a terrain shape you like, press the “Generate World” button and confirm the popup.



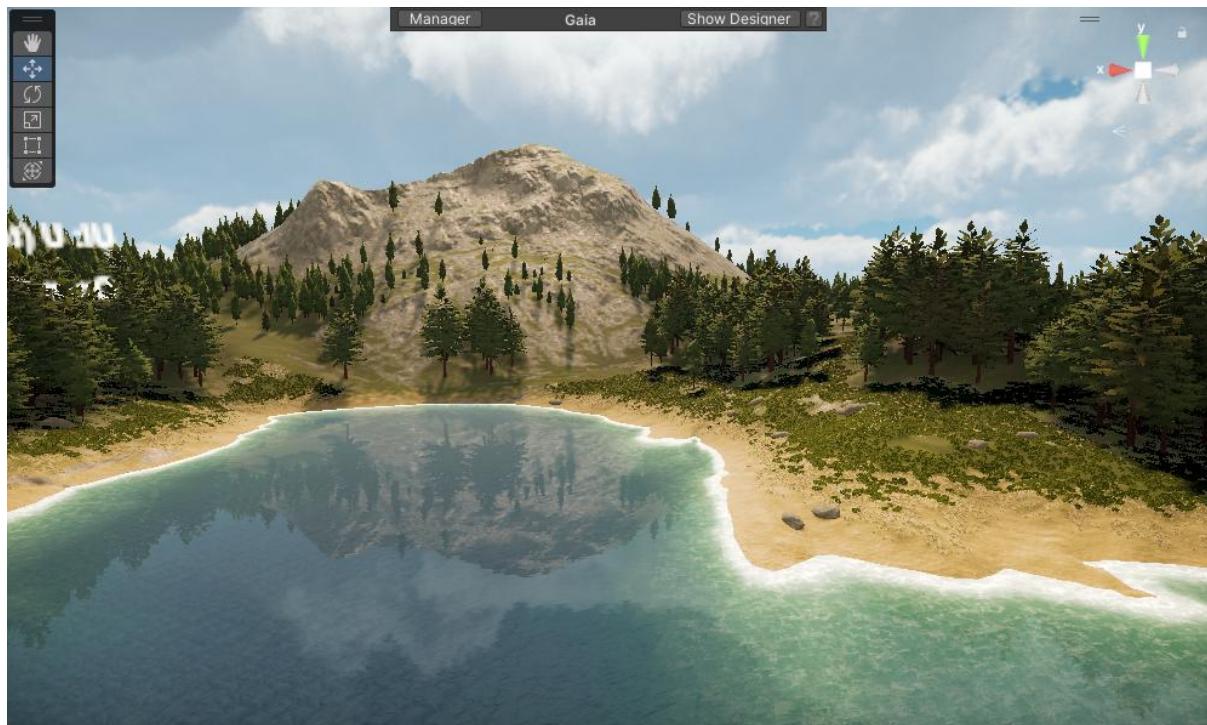
5. Gaia will now take the preview shape create a unity terrain and spawn the textures from the selected biome:



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 uses layer-based culling to improve performance. Moving in closer will show all the content.



7. Bring the Gaia Manager back and Update your runtime. The visuals have been updated.

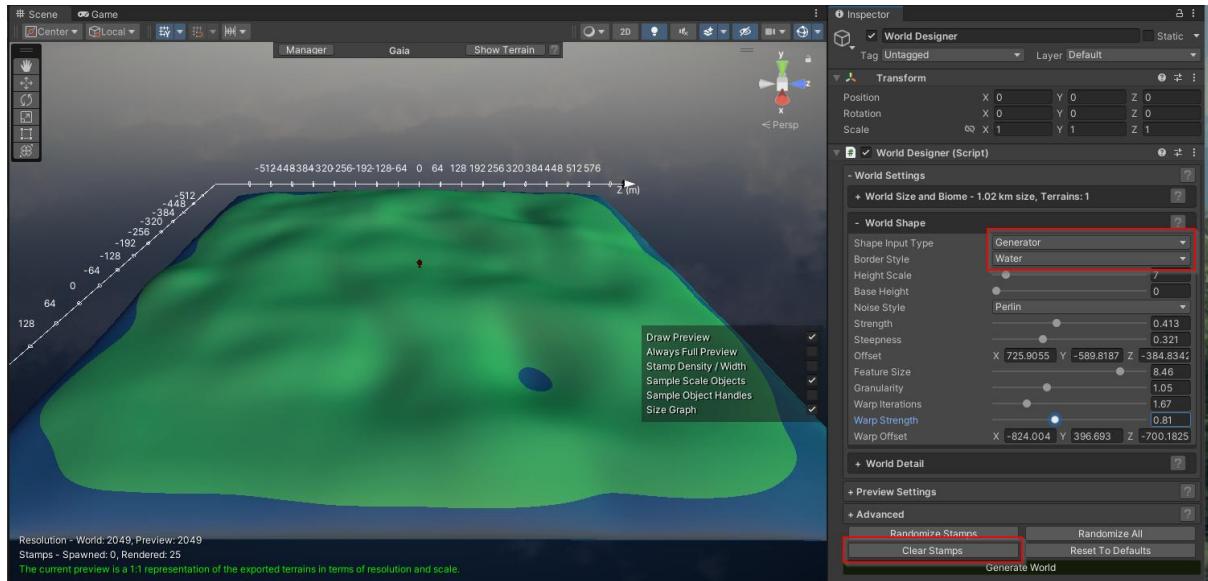


8. Now press play, and let's see what Gaia did for us!



9. 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 to leave us with a base terrain. Then open the World Shape panel, 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 existing terrain.

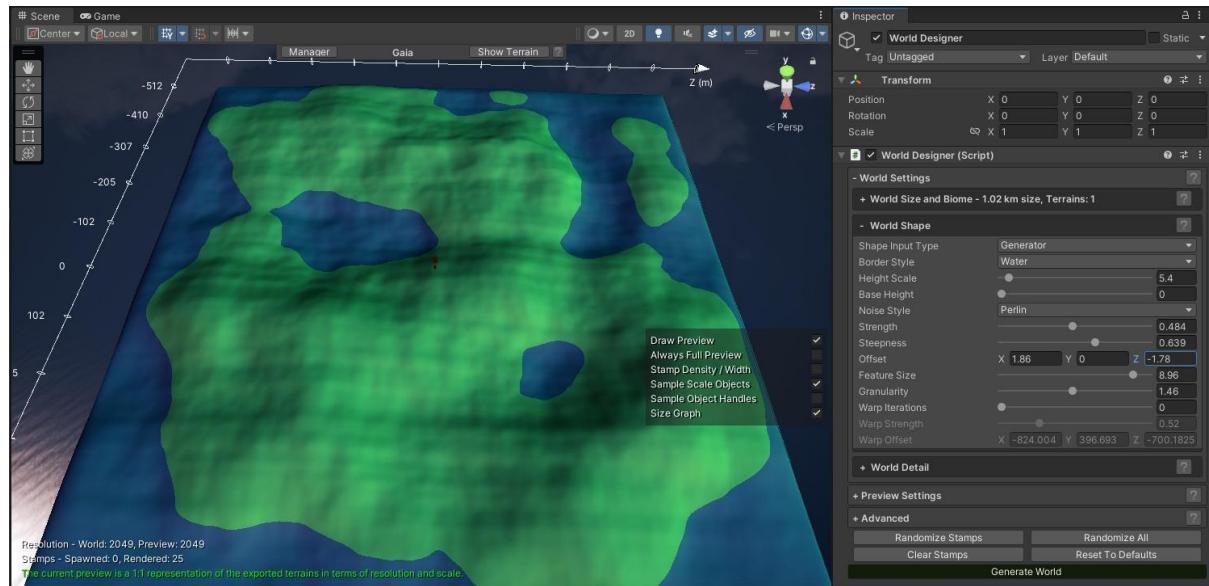
Border Style – Allows you to force the borders of your world to be Water (to create islands), Mountains or nothing specific.

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

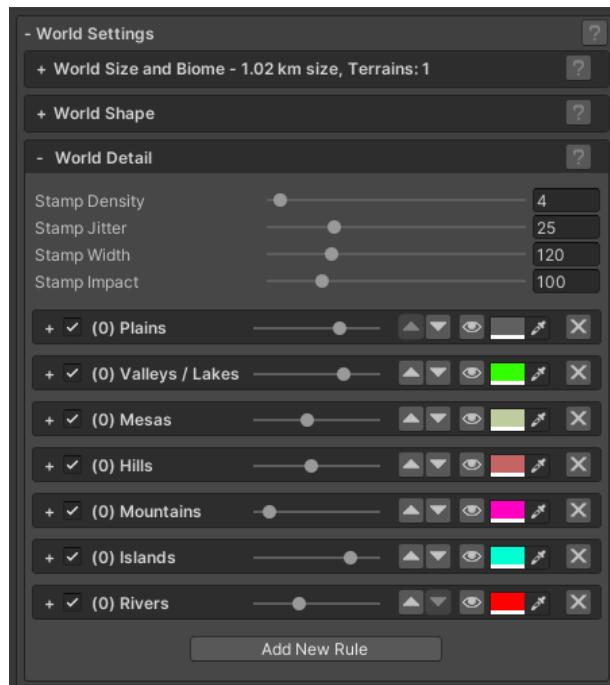
Base height – lifts the entire shape on the y-axis.

Clicking the "?" icon in the World Shape Panel will give you more information about all the remaining settings.

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

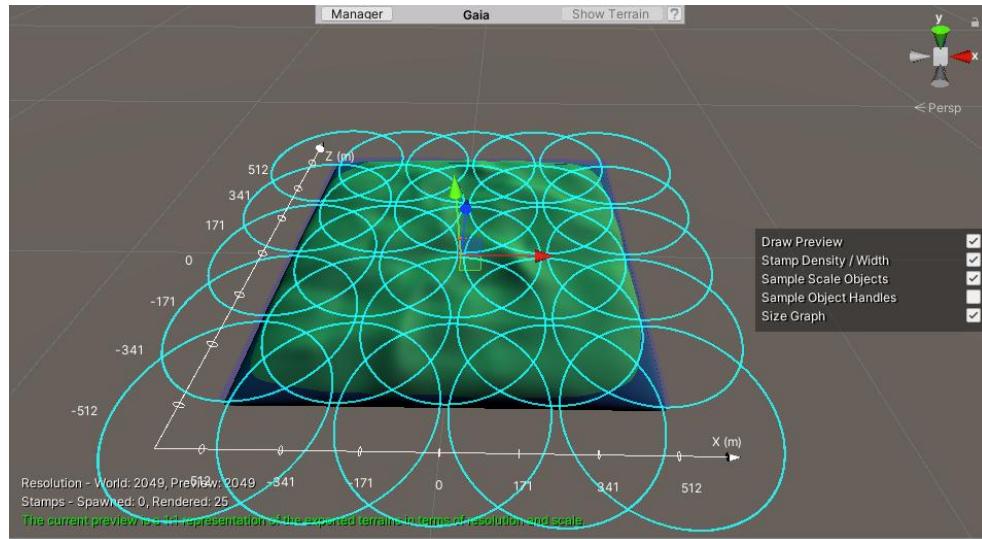


11. Next, we will look at the World Detail settings, which control the stamp spawning.



There are four 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 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.



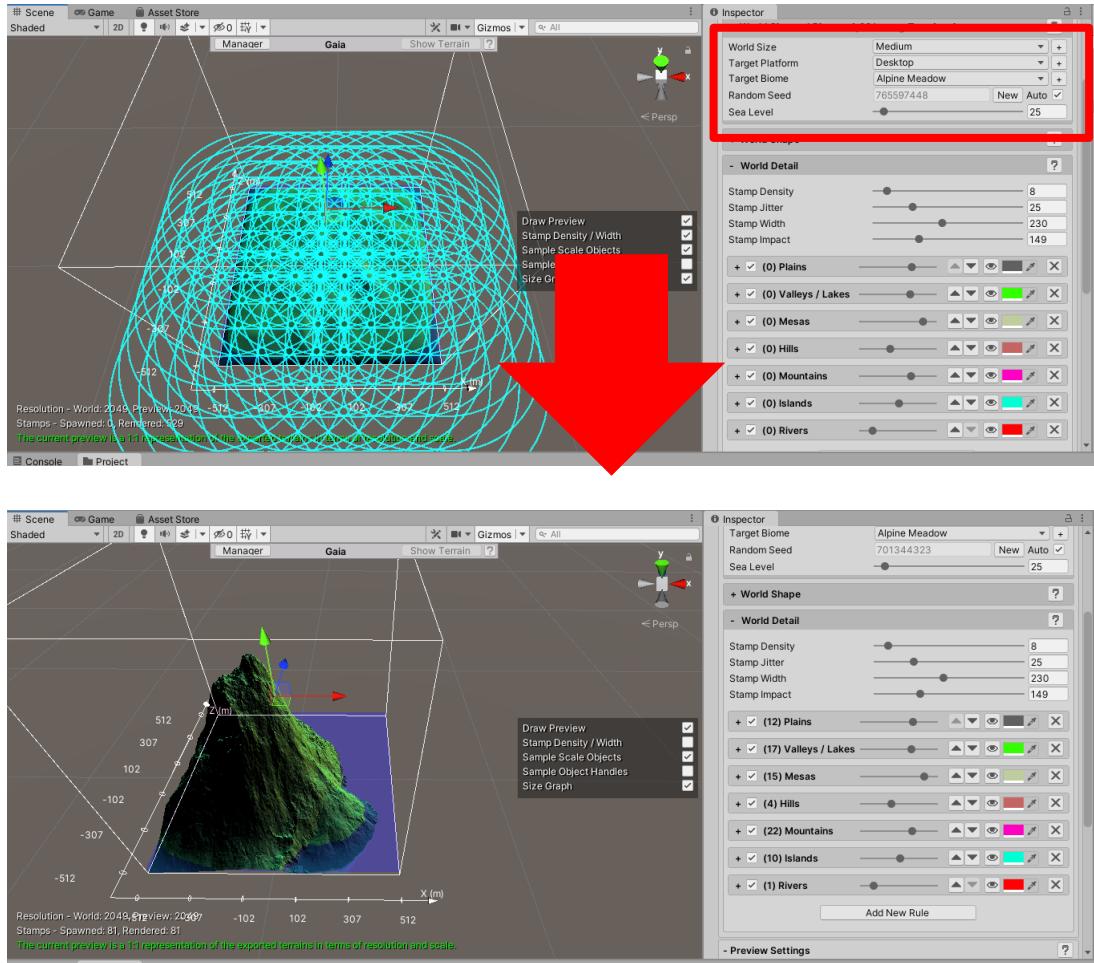
Stamp Jitter – controls the randomness in stamp placement – at a Jitter of 0 the stamps will be placed in a grid-like fashion, at 100 they are shuffled around in position to make that pattern less recognizable.

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.

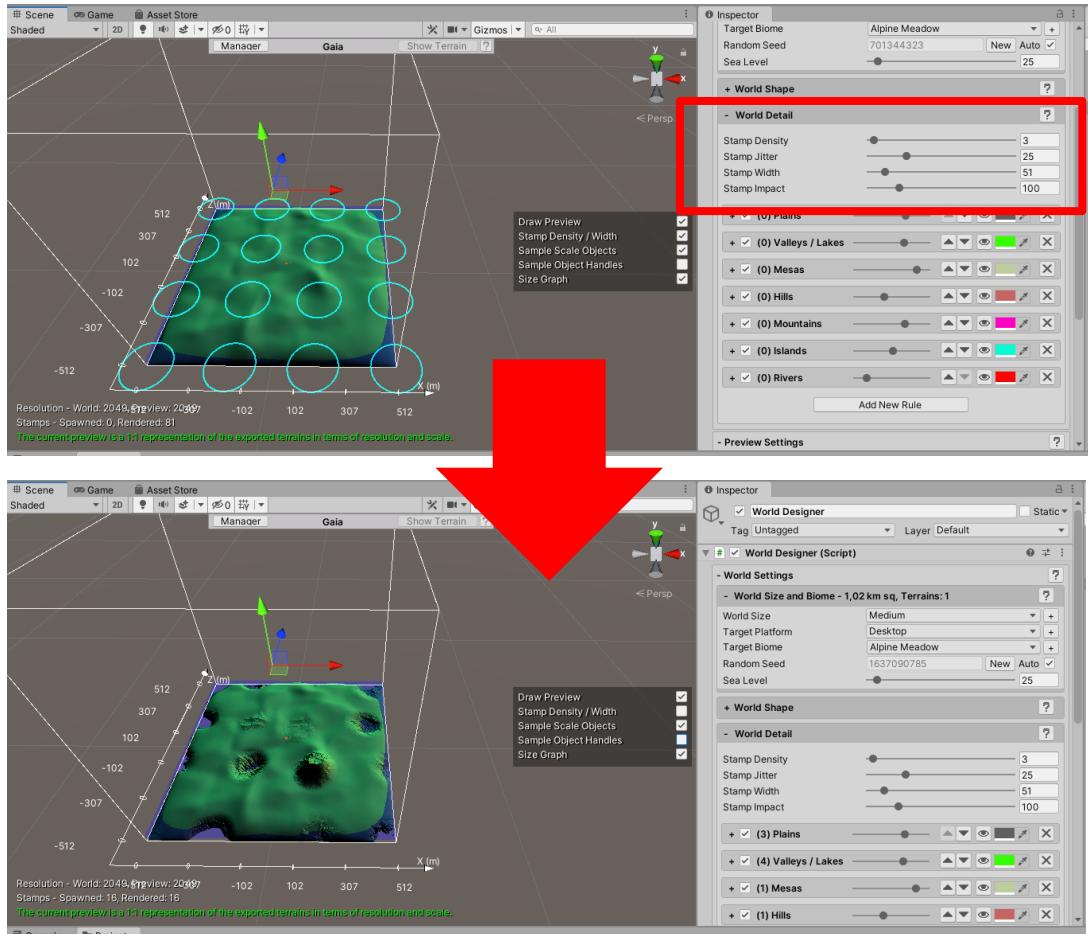
These settings can greatly impact your final result, and “more” does not necessarily mean “better” for these settings.

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



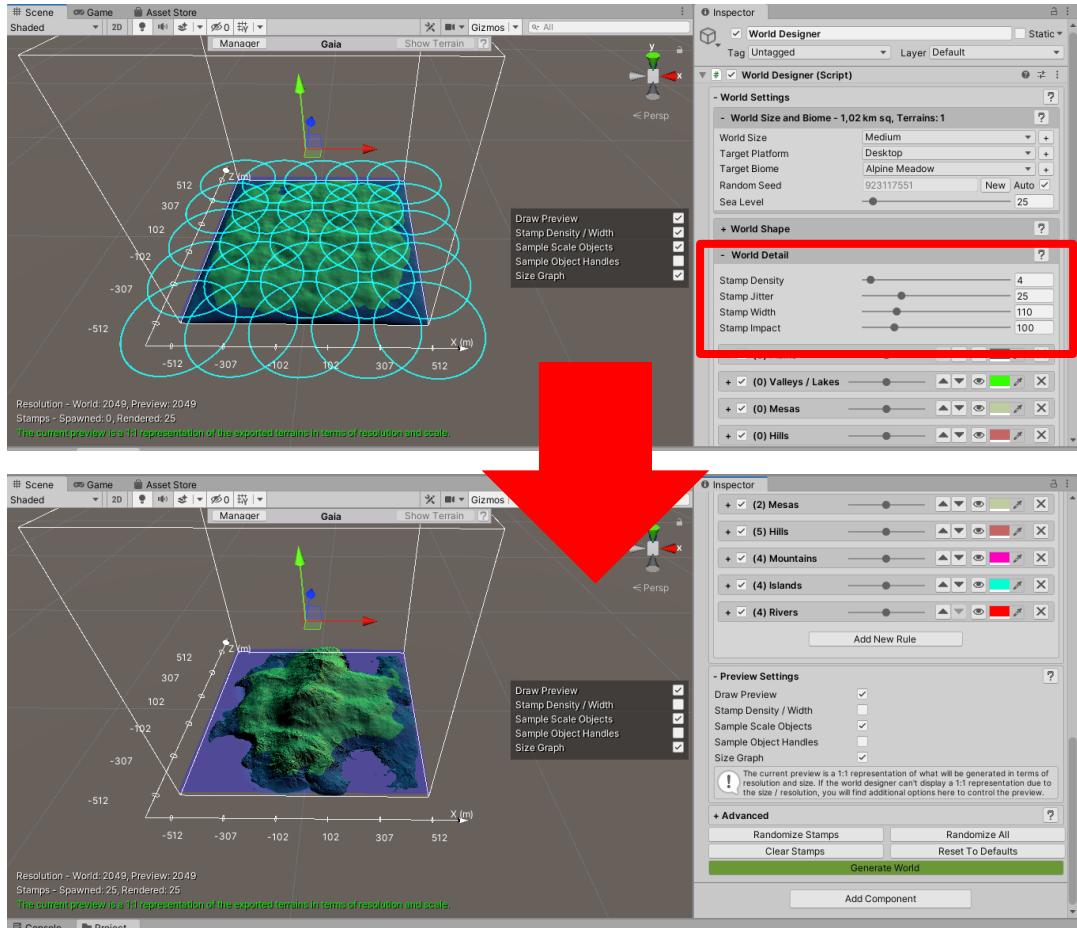
This is not a very good result. Too many stamps are placed on top of each other and overlap multiple times, resulting in an unrealistic mountain with barely recognizable features.

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



Again, this is not a good result—the featureless base terrain is mostly visible, and the stamps do not connect 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.

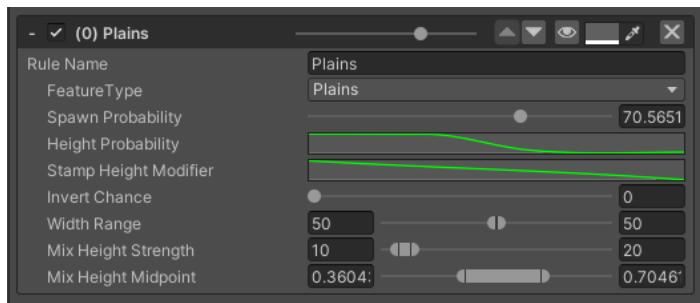
To avoid losing features due to the limitations imposed by lack of stamp resolution, you would use more stamps to fill this space.

12. 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).

13. 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)

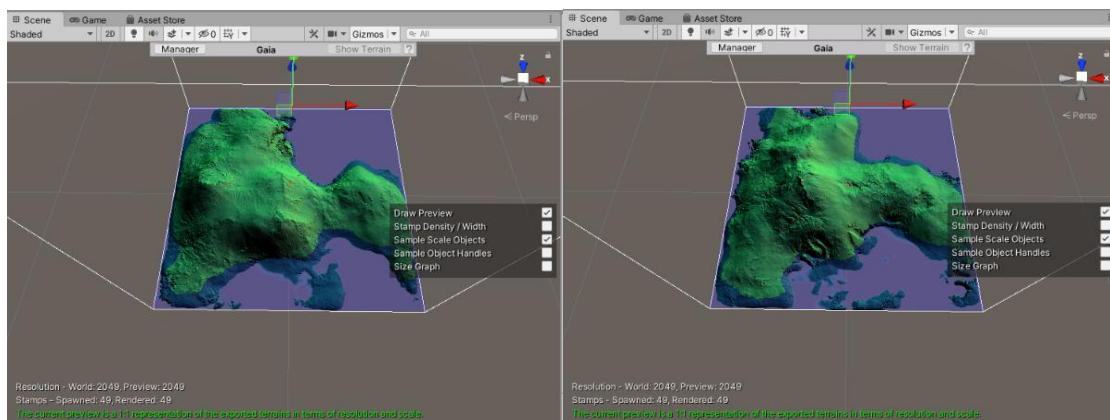
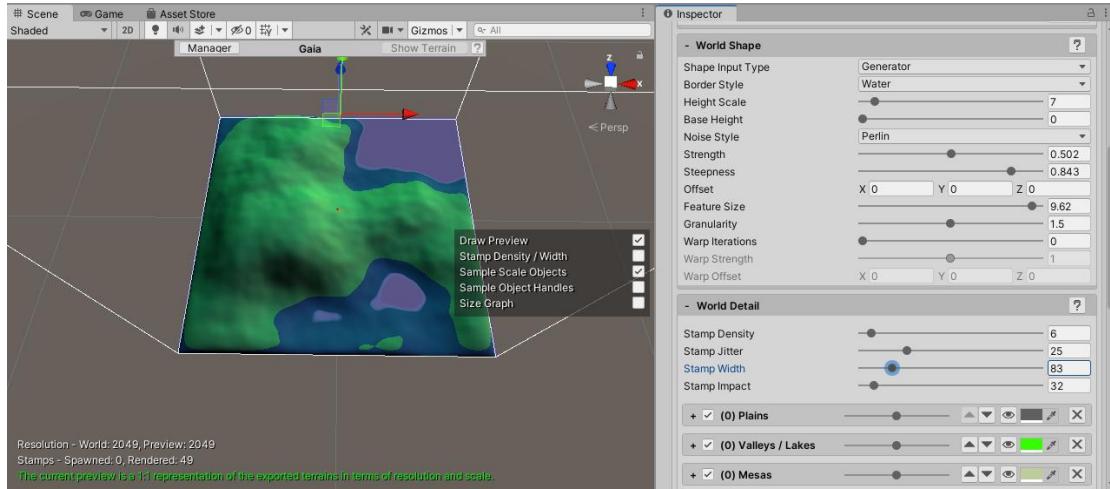
“Clear Stamps” will clear all spawned stamps so you can see the base terrain shape again.

“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.

14. 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.



15. 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.

Create really large worlds with world designer

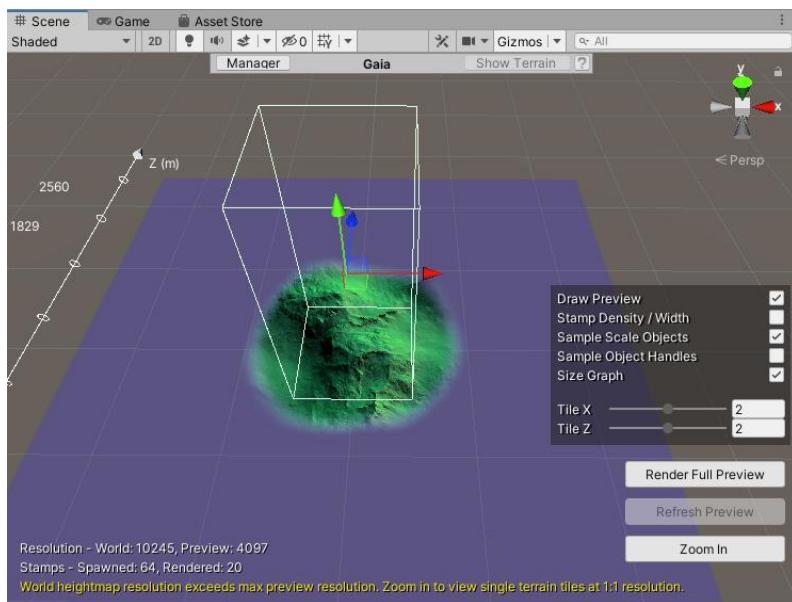
In theory, the world designer has no size limit on what it can generate, and increasing the number of terrain tiles in the world size settings will generate vast worlds.

In practice, however, we are constrained by the Unity terrain system's size, memory, and performance limitations. Unity terrain is resource-intensive and slow when scaling beyond a few kilometers.

Gaia Pro supports this via its streaming system. It loads, unloads, and culls terrains as needed, and it has an impostor system for larger draw distances. See the terrain streaming section later in this document for more details.

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 scene view panel or dragging the white box cursor around. The preview will update to the new spot after 2 seconds.

You click the “Render Full Preview” button to see the full preview. This will take some time, but a full preview will be displayed when it is finished.

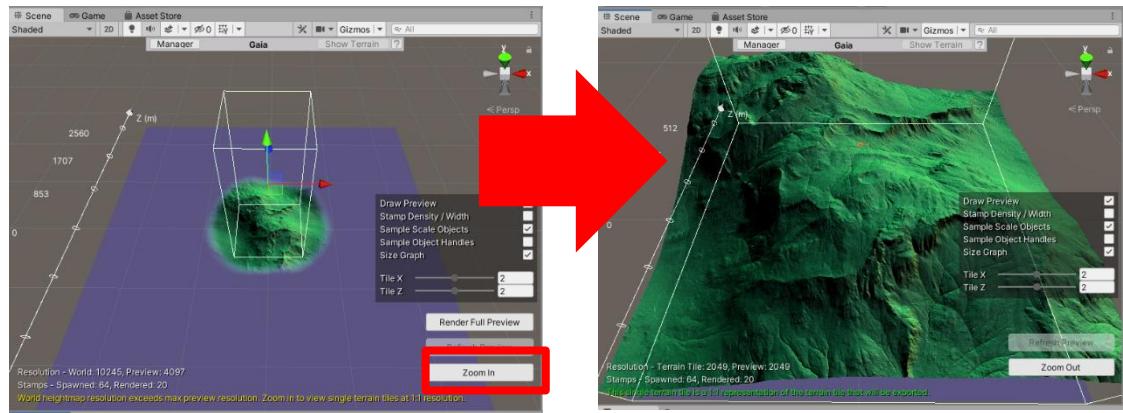
- The preview can only display a total resolution of 4097 heightmap pixels for technical / performance reasons.

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

The scale and size of the preview will still match those generated, but due to the lower resolution, you will not see every detail.

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, estimating the scale of the resulting terrain can be difficult.

Depending on how far you zoom in, a small world can take up the same amount of screen space as a large world.

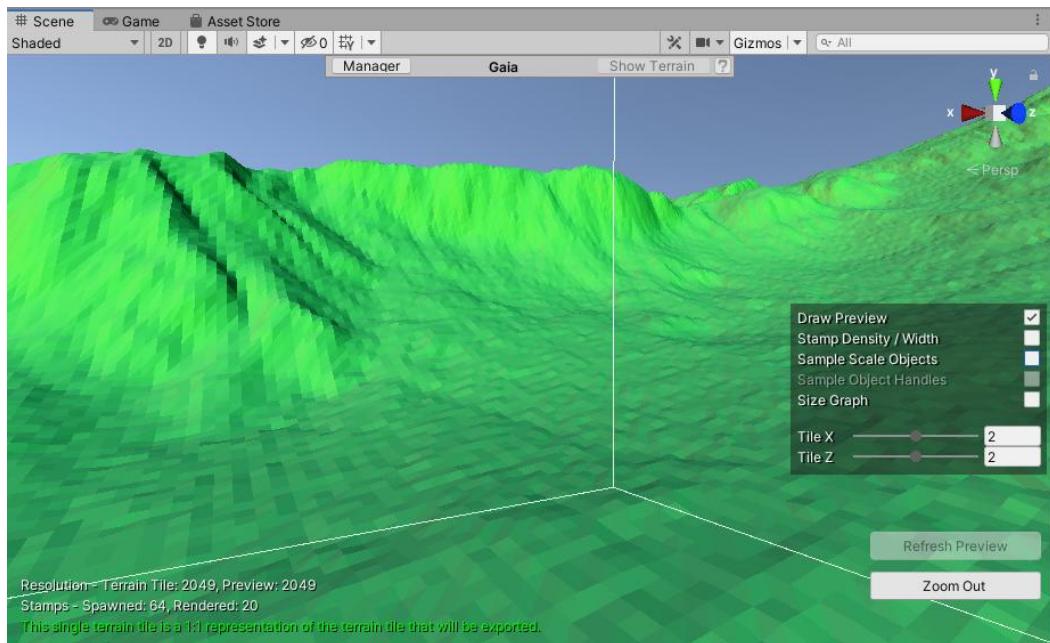
Then, when generating the world, you discover that it offers too little or too much space or your mountains are much smaller than you expected from the player's perspective.

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.

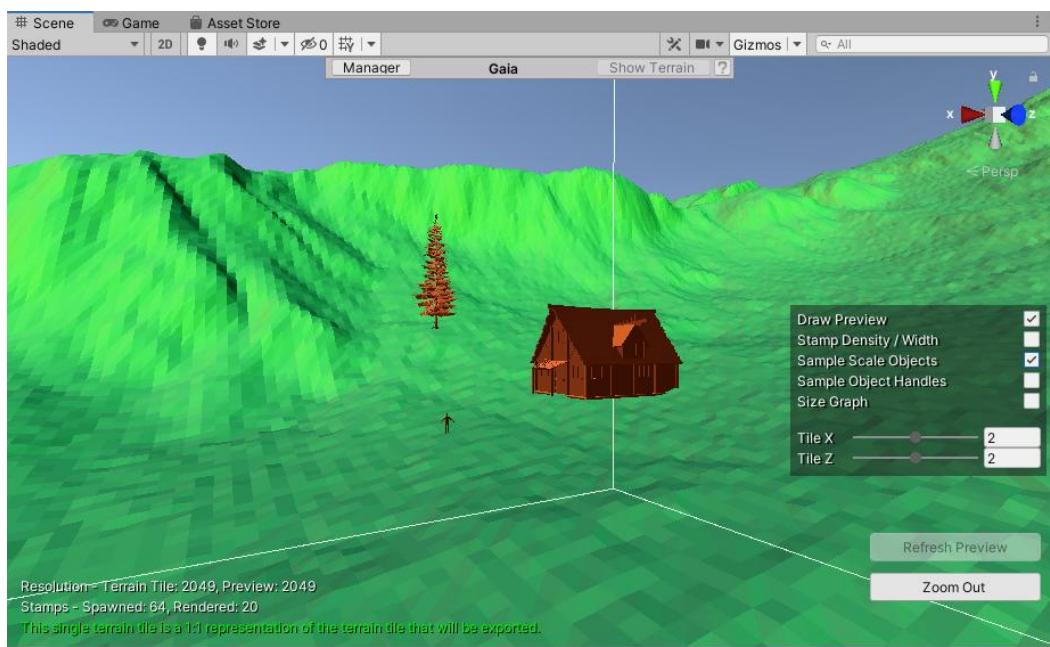
This helps you to understand how much space there is in a particular area.

- If you scroll into the center of the preview, you will also notice that some sample objects are 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.



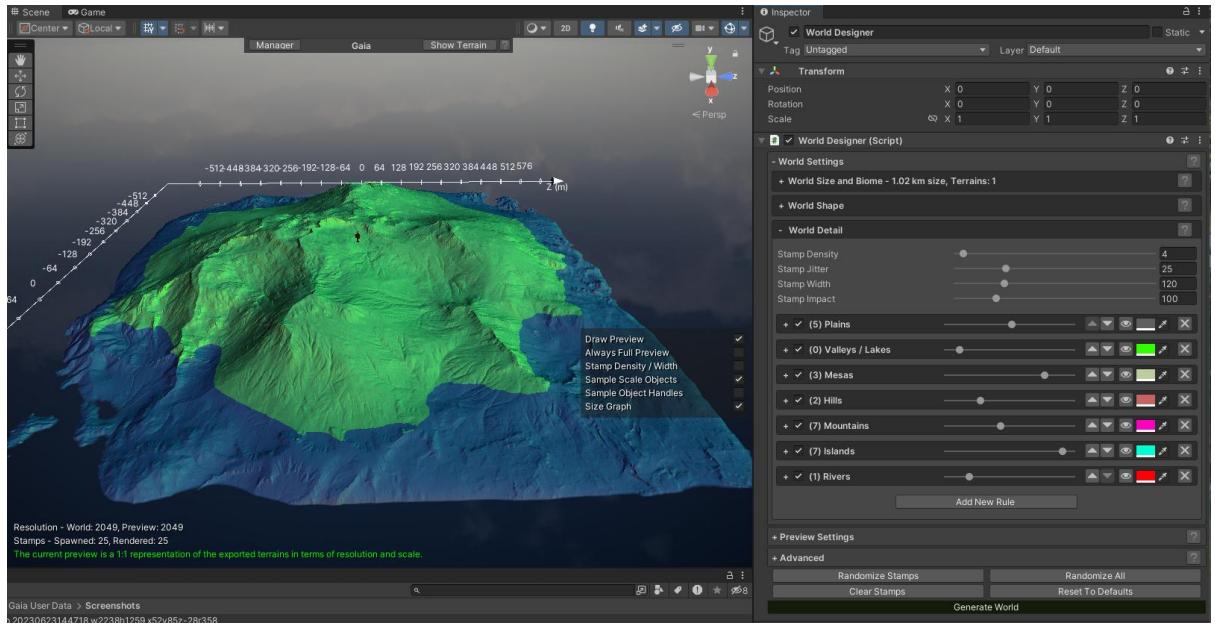
You can activate handles for these objects in the scene view settings panel, this allows you to drag around these objects on the preview to test different locations for scaling.

This concludes with the introduction to the World Designer. You can learn more about it in Gaia's built-in help features, including the link to the online manual page.

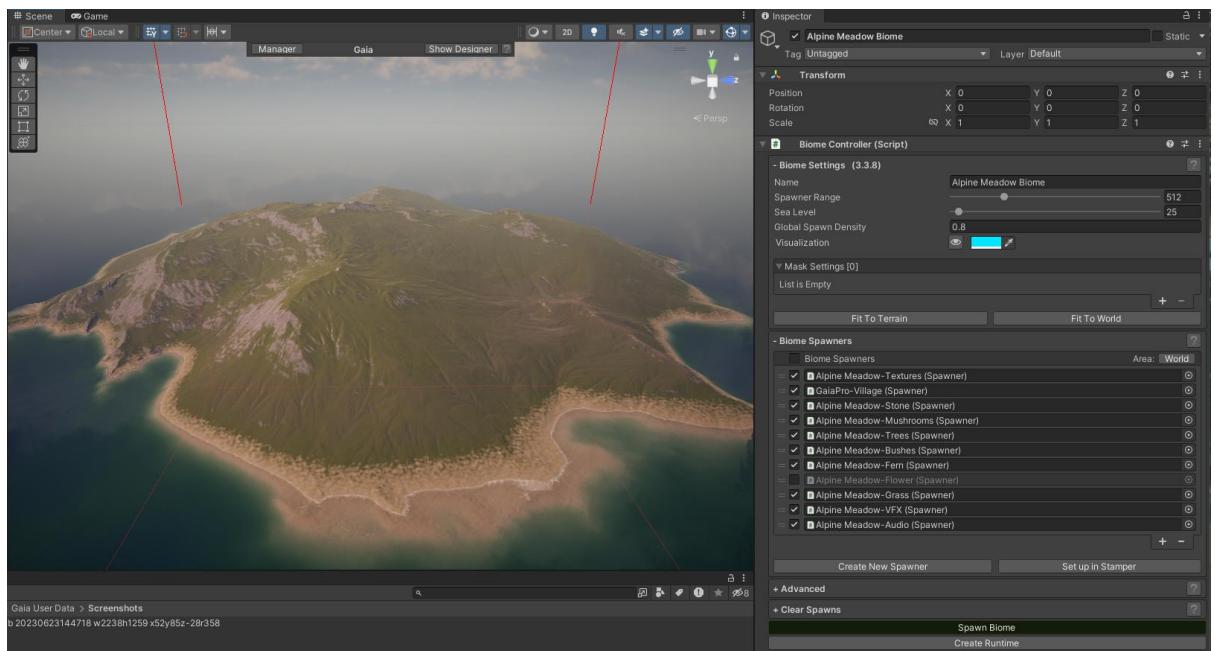
Create a stylized low poly terrain for mobile and VR

In this mini tutorial, I am going to create a terrain. You can use any technique you want, but here, I will use the world designer.

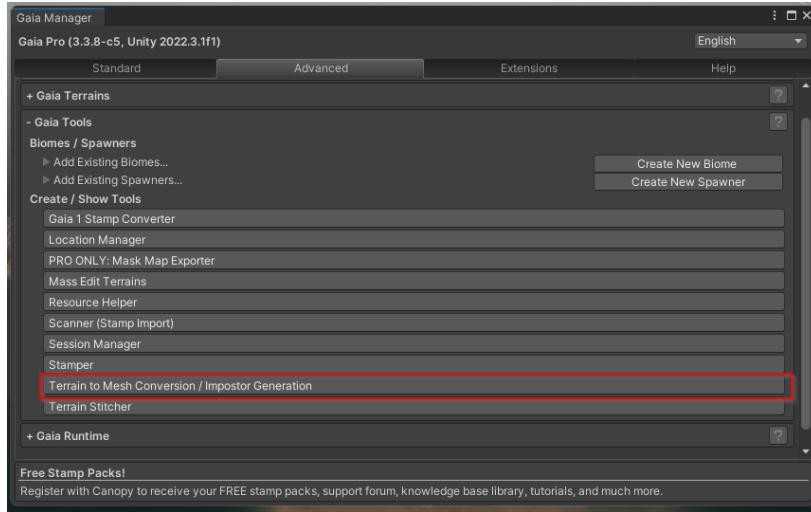
1. A nice randomized terrain.



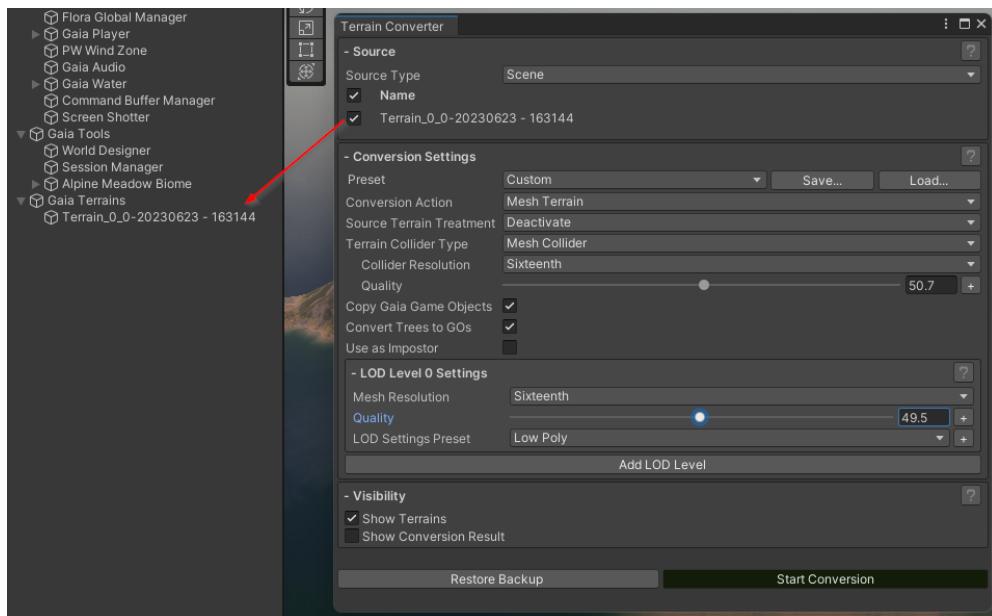
2. Generate my world.



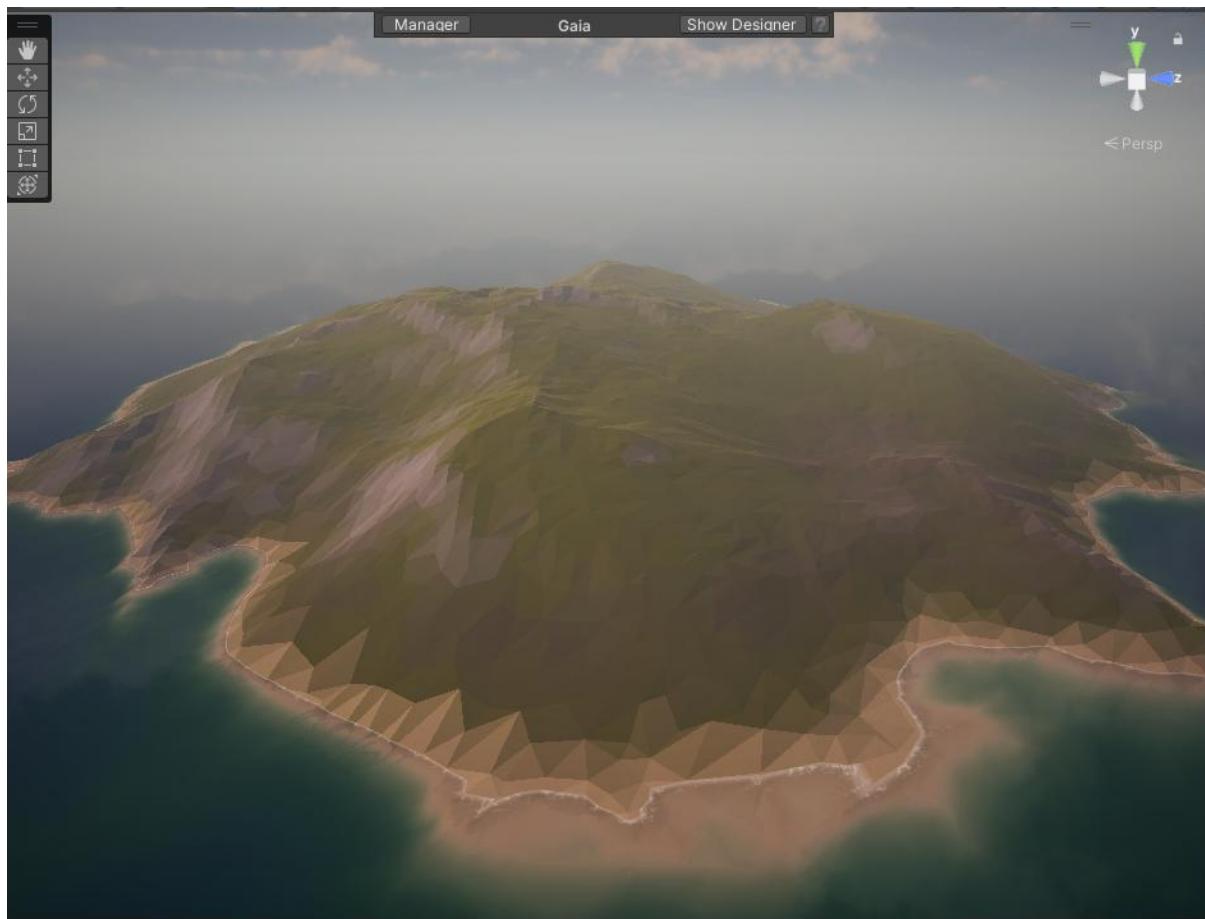
3. Now – let's do some magic! Open the Terrain to Mesh Converter!



And configure it...



4. And then hit Start Conversion!



5. Super cool! You successfully converted your terrain into a low-poly scene! This is an entire separate asset worth of work right here!

Storm: AAA worlds with massive scale and performance!

While beyond the scope of Gaia, Gaia is compatible with Storm, and if you want remarkably better performance and quality on a massive scale, you should check it out.

[Storm](#) is a professional tool that supports all pipelines and delivers draw distances and frame rate improvements of up to 10x on mobile and desktop.

Storm works hand in hand with Gaia to offer both natural and built environments at design time and runtime.

The terrain system offers an advanced shading system and a virtual texturing system that enables AAA terrains to be delivered with fixed performance costs.

The building system enables you to construct buildings, cities, and dungeons and to render them in the blink of an eye.

The vegetation system enables tuneable vegetation rendering at massive draw distances and densities.

The entire system is treated as one accelerated whole – and designed to run across devices and platforms.



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.

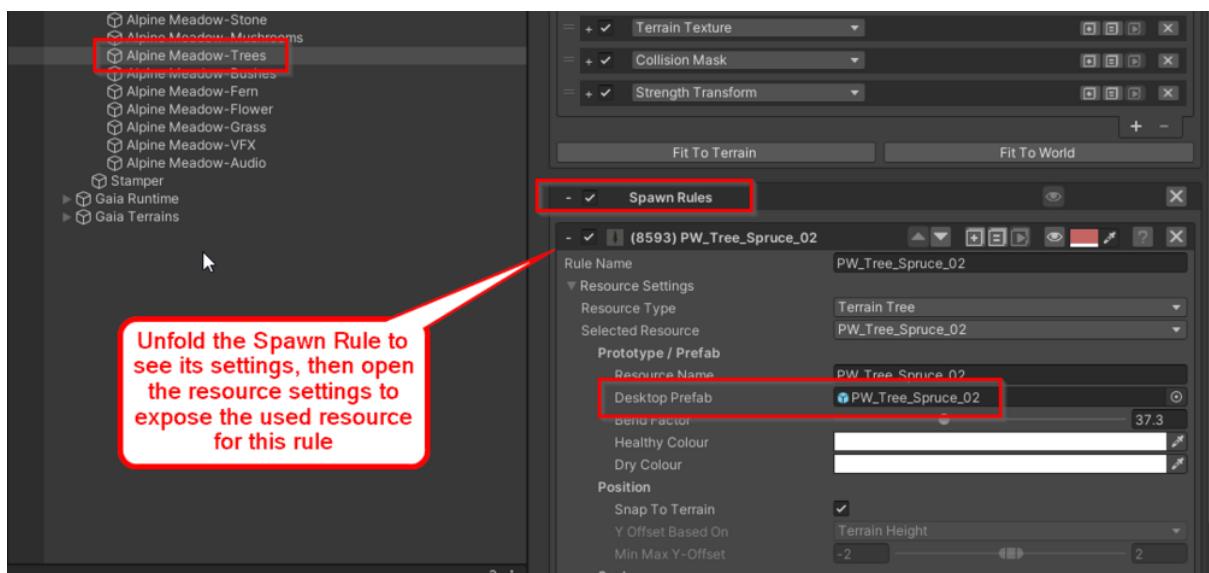
The biome controller is the tool that collects spawners and makes them spawn together at command. It is possible to spawn this set across the entire world, or in a restricted area of your world so you can have multiple biomes in your world.

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.

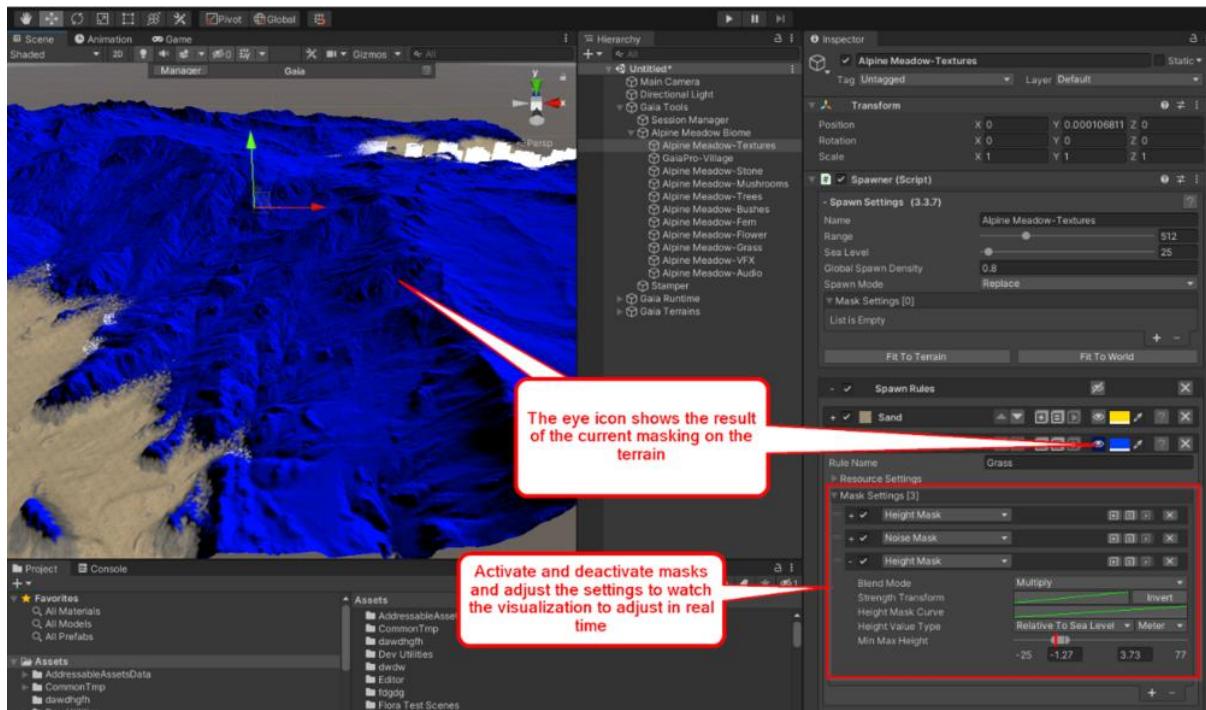
Customizing where assets spawn

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 underwater, over water, on steep slopes, etc.

By adding masks to the spawn rules, you can combine multiple restrictions to spawn your assets more logically, 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 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 where you want it to.

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

For a complete 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 spawners from scratch and use them in other projects and scenes. We created a tutorial series for this that covers 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 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](#)

Terrain streaming and impostors for large worlds (Gaia Pro)

Terrains can be created in 3 different ways in Gaia:

- A single terrain covering the desired target area
- Multiple terrains covering the desired target area
- Multiple terrains stored in separate scenes cover the desired target area streamed in and out of memory as needed.

Having a single terrain in your scene is the simplest, fastest, and most convenient way to handle terrain for sizes up to 2km sq.

However, as the terrain size grows, you run into issues with the terrain heightmap/control texture/detail resolution and performance issues.

The best approach is to use terrains ranging in size from 256m to 1024m sq. and stream them in and out of memory as needed based on their distance from the player.

The Gaia Pro terrain streaming solution supports this automatically.

Please note: Due to the overhead of the editor system, loading scenes is significantly faster in a build than in the editor. You will encounter delays and hiccups when loading a scene. Loading performance should only be measured when running a build. Gaia provides a thin wrapper over the Unity scene streaming system.

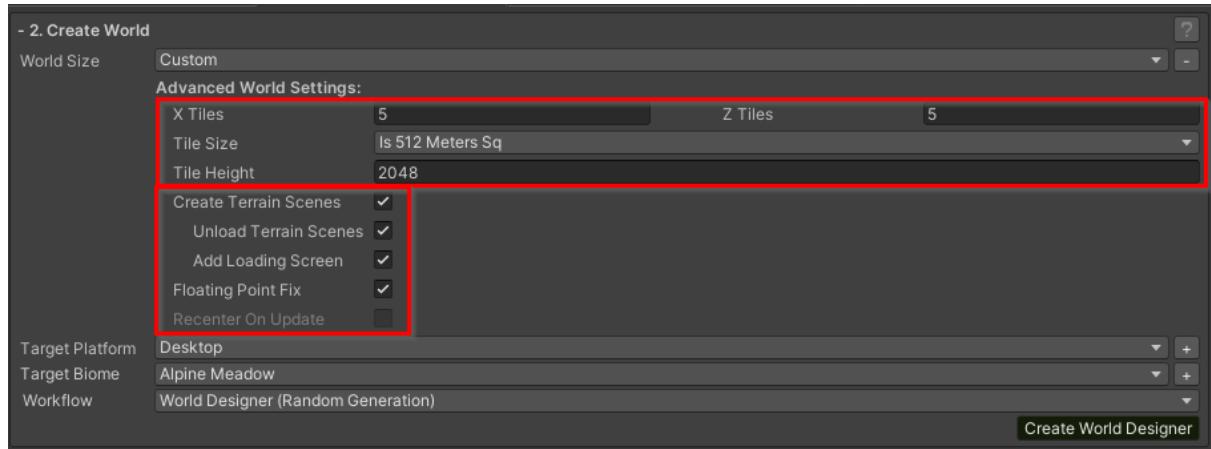
Things to consider before creating a vast world

While Gaia makes it easy to create a large game world, please consider the following:

- Using terrain streaming adds complexity to your game. Your code must handle parts of the world being unloaded and loaded as the player moves through it.
- Increasing the world size exponentially increases the time required for spawning textures & assets on the terrain, up to a point where it will take hours or days to generate your world.
- Unity still needs to load the individual scenes in and out of memory. Depending on the scene's content, the scene-loading process can become a significant performance bottleneck.
- Depending on your game type, the world still needs to be filled with interesting gameplay content, and a 25 x 25-kilometer world consists of 625 x 1 km sq terrain tiles. A level designer can easily spend an entire day in just one small part of one terrain, placing towns, enemy camps, loot, etc. Is this size realistic for you and your team?
- Many AAA games are much smaller than you think.

How to enable terrain loading

This feature, which is available in Gaia Pro (but not Gaia) is pretty simple: Just set up the amount/size of terrain tiles you want to create during world creation and activate the following checkboxes for terrain loading:



- Create Terrain Scenes - Will create the terrains in separate unity scene files
- Unload Terrain Scenes - Will unload these terrain scenes right after creation (recommended when creating huge worlds)
- Floating Point Fix - Enables a workaround that helps with issues regarding floating point precision in the Unity Engine. For more documentation, please see here: [Using the Floating Point Fix in Gaia Pro](#)

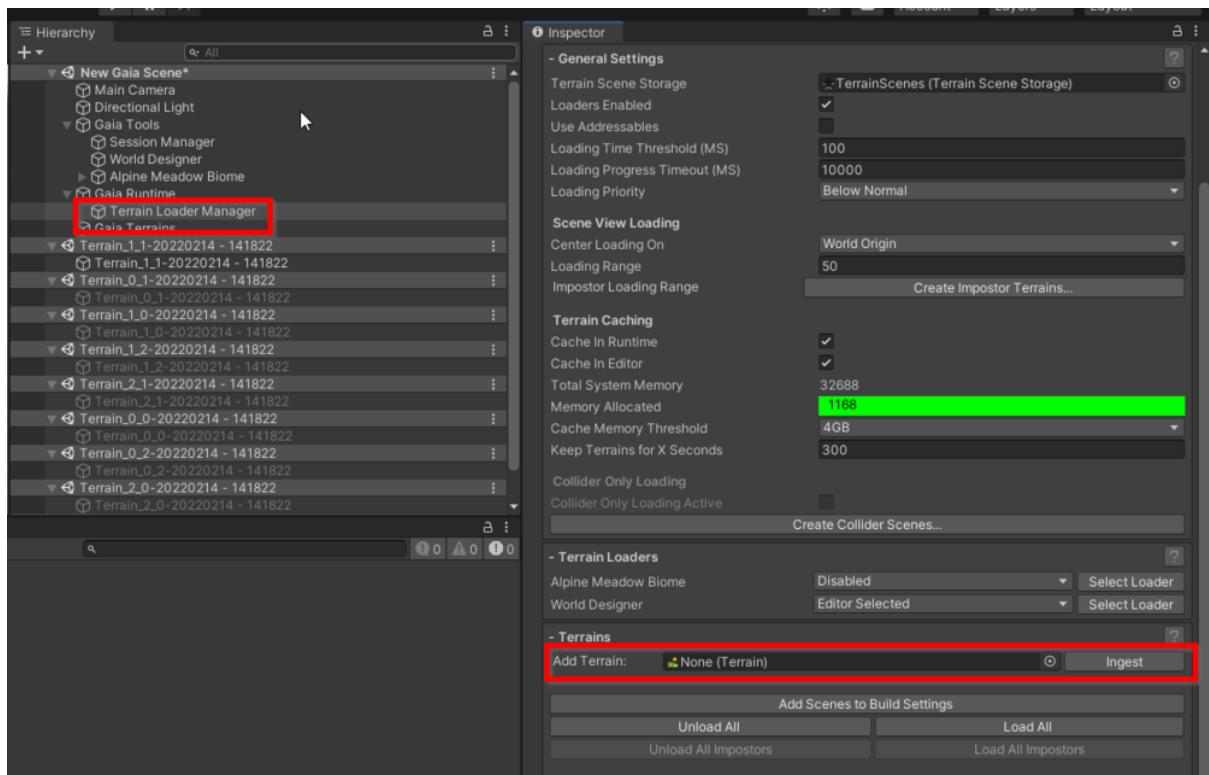
By activating those checkboxes, your Gaia Tools and the player will be configured for terrain streaming. You can then continue to create your terrains as you would with a single terrain. Unity will prompt you to save the scene if you have not already - this is required from the technical side; Gaia can't create additional scenes if your "master scene" has not been saved yet.

Updating your loading setup (add/remove terrains to load)

You might find yourself in a situation where you want to change terrain loading later in development. You might want to add or remove single terrains, or you might want to convert a non-loading set of multiple terrains into terrain loading, or vice versa. For this, you can do the following:

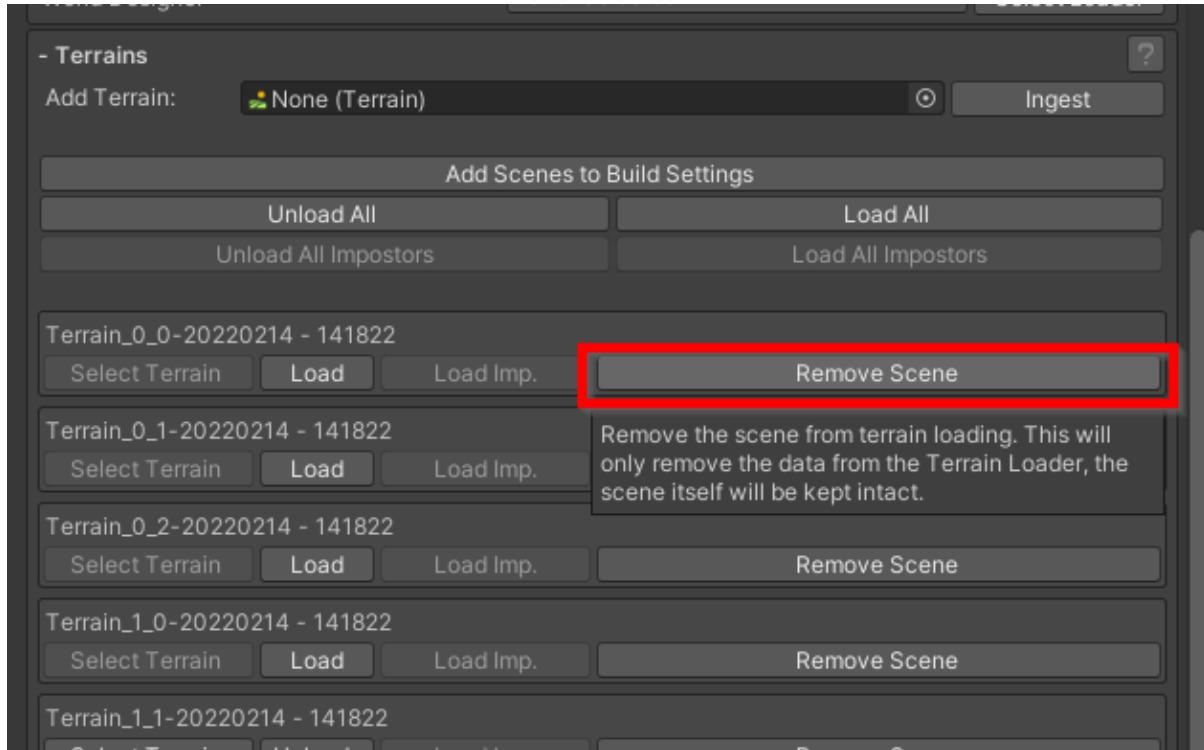
Single Terrains:

You can use the "Add Terrain" tool in the Terrain Loader Manager to add single terrain to a terrain loading setup.



Add the single terrain from the scene to the reference slot and click "Ingest" to add the terrain into the terrain loading logic.

You can remove single terrains from terrain loading with the "Remove Scene" button in the list of terrains in the Terrains panel:



Note that this will only remove the terrain from the loading mechanism. The terrain itself will not be deleted from the project; it will still sit in the session's terrain scenes folder, so you can access it from there and put it elsewhere. If you intend to keep the terrain for later use, you should put it somewhere else as it might get overwritten, e.g., if you decide to re-create the entire world from the world designer.

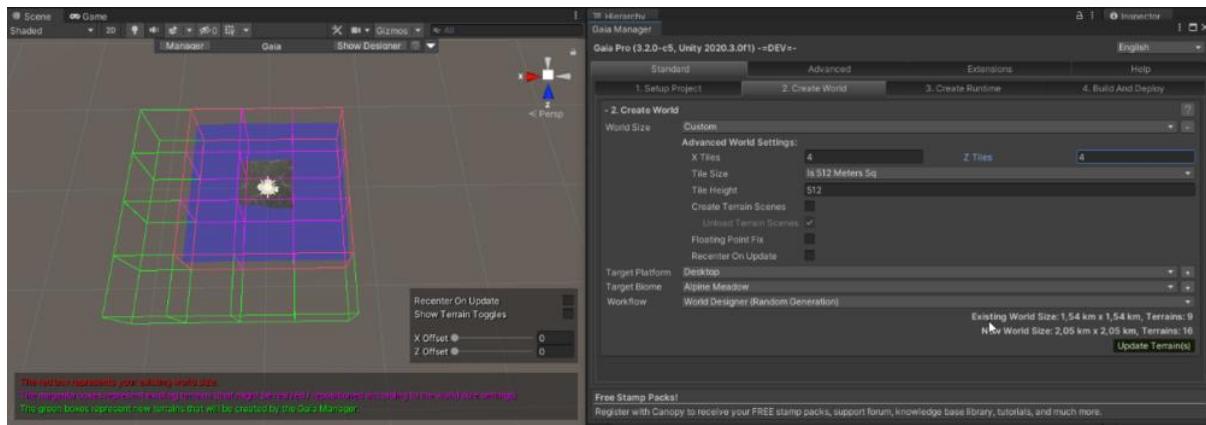
Converting already existing worlds from/to terrain loading

Warning: Before attempting anything in the following section, please back up your project first—the wrong settings applied here can break your scene!

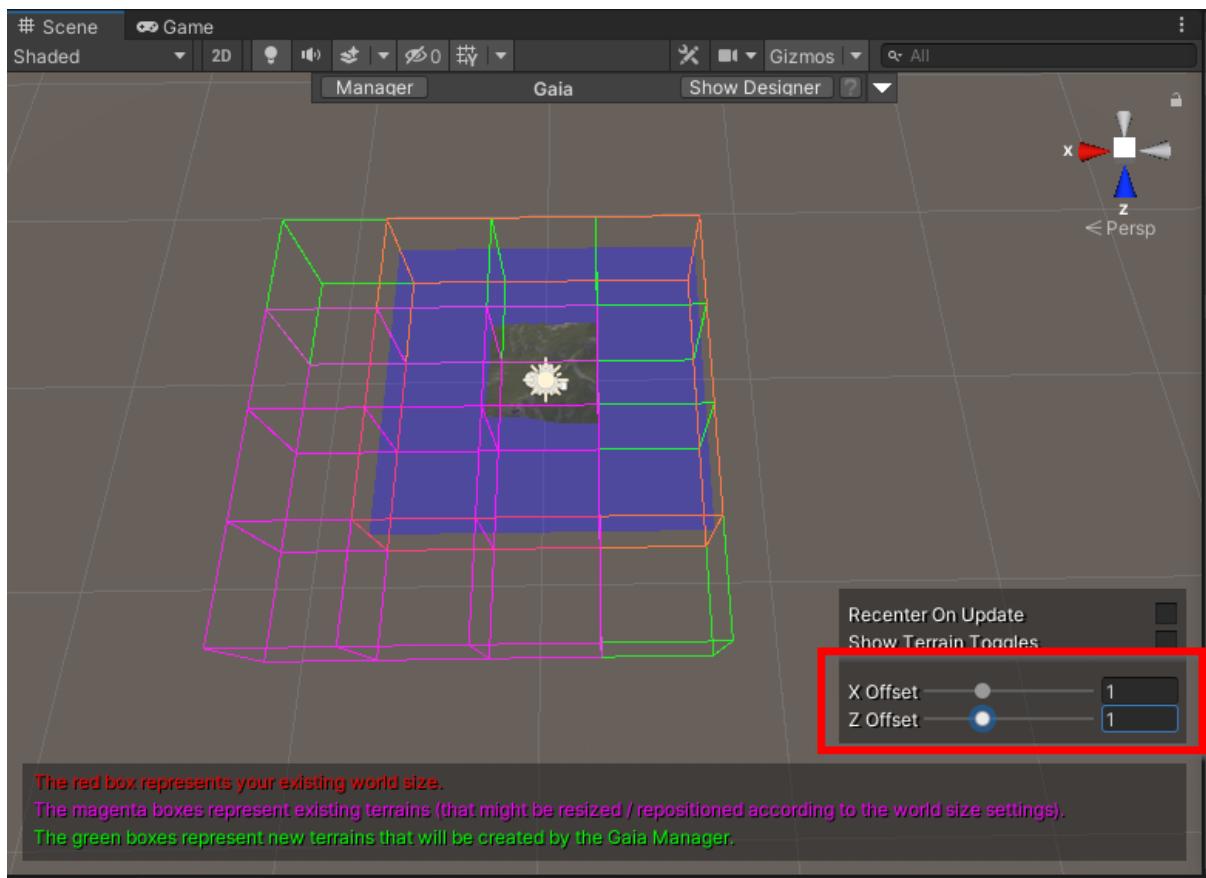
If you have an existing world that does NOT utilize terrain loading yet, or you have many terrains you want to add/remove, you can use the Gaia Manager to change your scene setup.

Navigate to the "Create Terrain" tab again, and look at the world creation settings. The settings that you enter here can be used to update your current world. This means converting an existing world from/to terrain loading by checking/unchecking the "Create Terrain Scenes" option. Doing so will add/remove the terrain loading from the scene. It is also possible to add/remove new rows and columns of terrains to the loading setup; these will be displayed as green boxes in the scene view.

Here is an example of how it would look like going from 3x3 loaded terrains to 4x4:

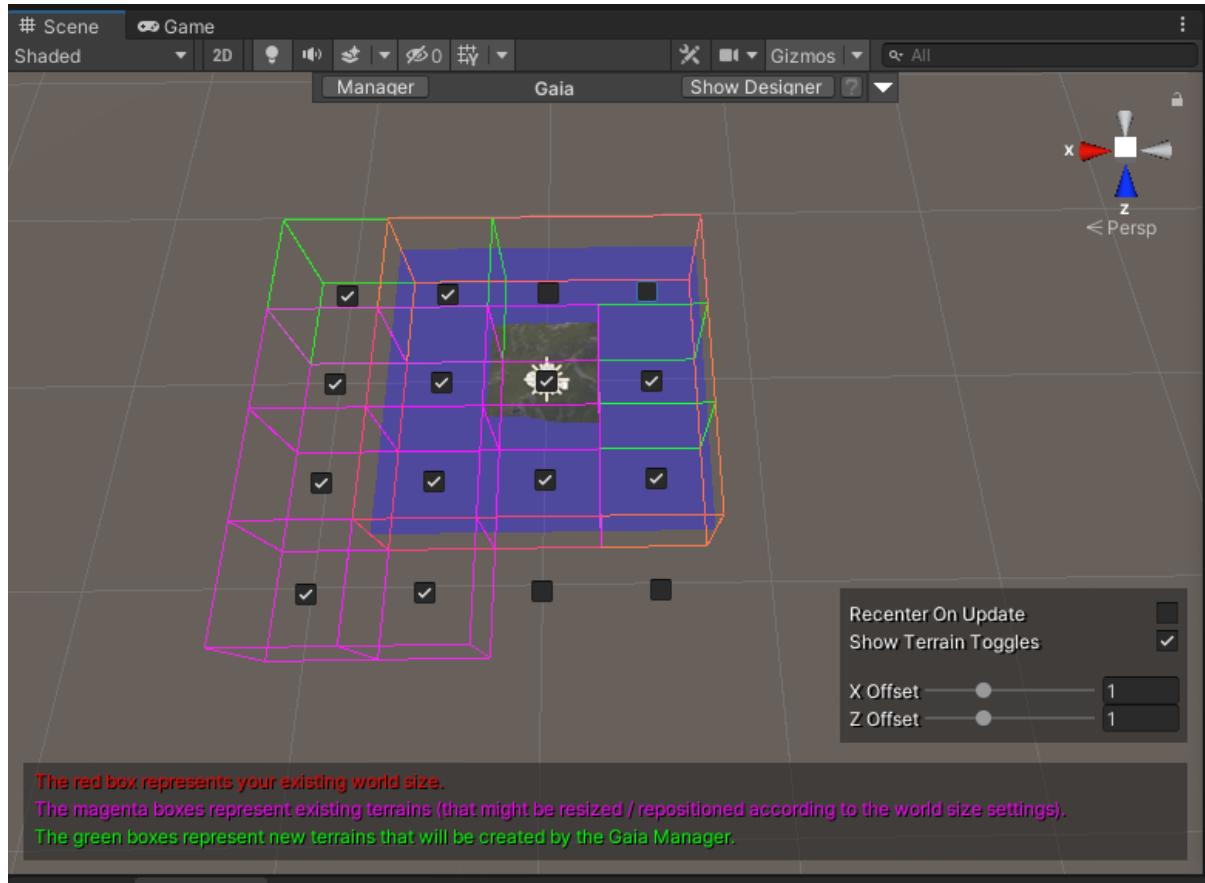


If you want the terrains added to the other borders instead, you can use the "X Offset" and "Z Offset" options in the scene view. This controls where your original terrains (purple) will be located after the update and where the new terrains (green) will be added.



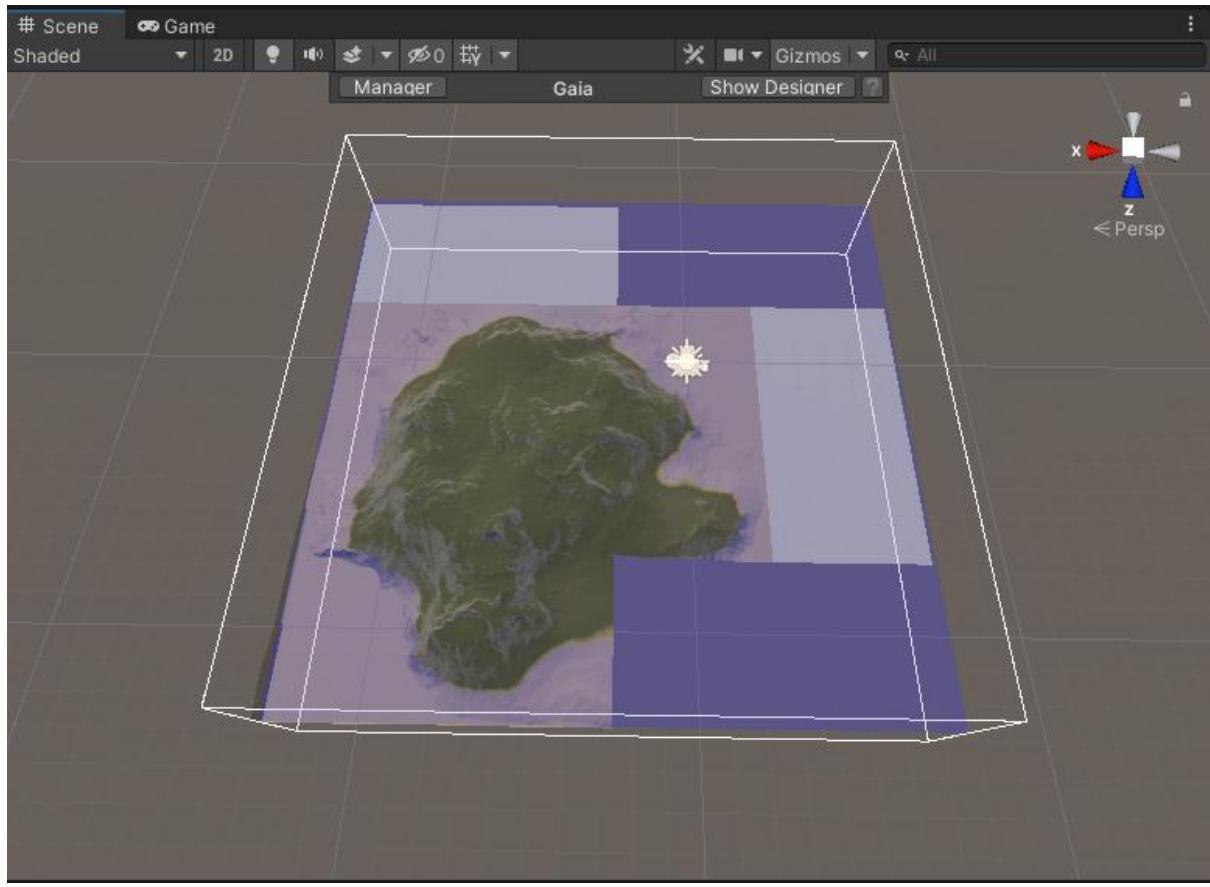
The "Recenter on Update" option will recenter your entire world so that its center sits at X=0, Z=0 again after the terrains were added / removed.

When using the "Show Terrain Toggles" option, you can choose which Terrains you want to keep when updating. This allows you to create irregularly shaped setups as well:



The terrains from the above example after updating. Note how the existing terrains were kept, and new, flat terrains were added.

The "unchecked" terrains were thrown out in the update:



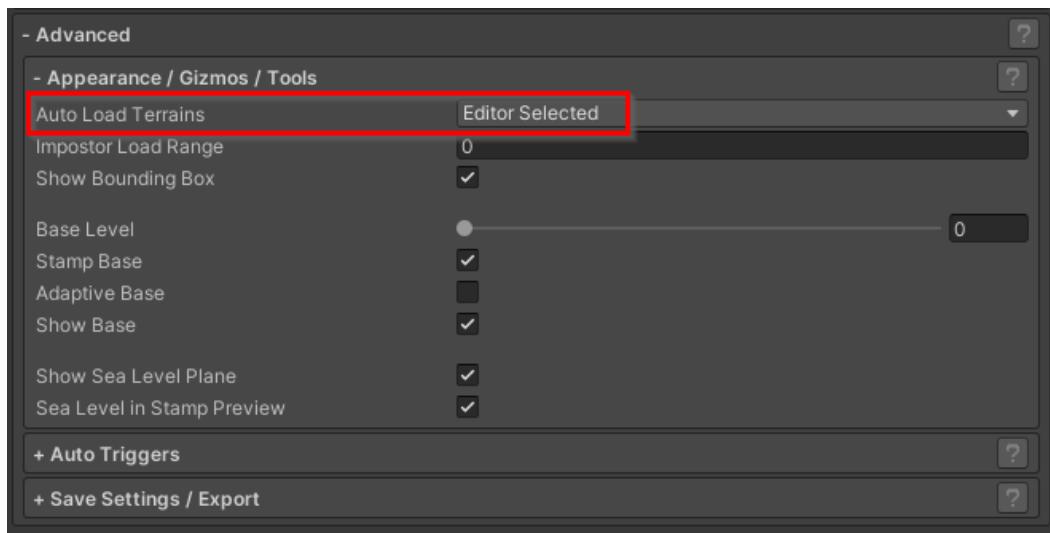
Controlling terrain loading during design time

Once Terrain Loading is set up, you can interact with it in different ways to load terrains in and out at will. For example, you can let the system load terrains in and out following the scene view camera. Another approach is to selectively load three specific terrains and lock them in so you can focus on those three terrains. This section explains the different ways you can load terrains during design time.

Using Gaia tools to load terrains

When creating your scene while terrain loading is active, most Gaia Tools are set up to recognize this automatically and load terrains within their range of influence. For example, the stamper (usually the first tool you will use) will automatically load in terrain scenes in its range of operation. The same is true with spawners. You should notice terrains loading in and out in the scene as you move those tools around.

In the advanced options, you can change the loading behavior for these tools:

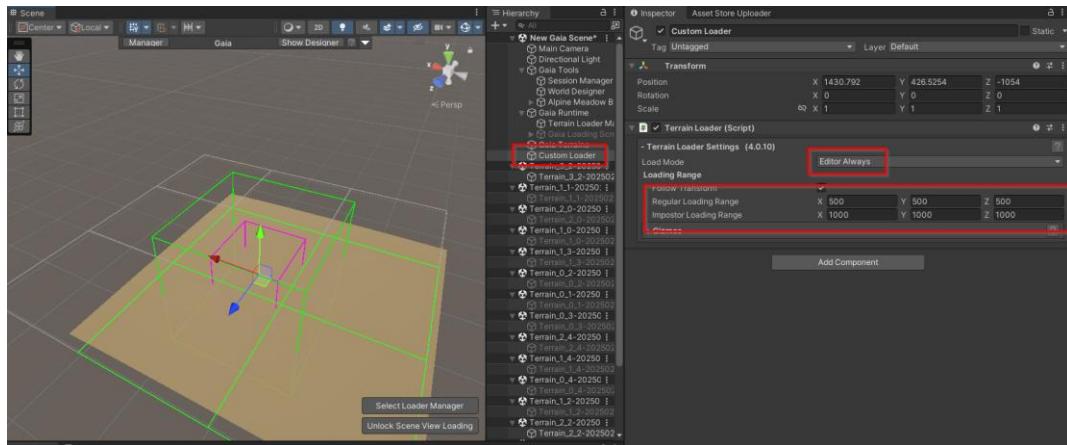


The different load modes for those tools are:

- Disabled - will not load terrains at all
- Editor Selected - will load terrains if the tool is selected in the Scene Hierarchy / Inspector
- Editor Always - will keep terrains loaded even when not currently selected
- Runtime Always - will load terrains during runtime (usually used on game objects like the player rather than tools)

Creating a custom loader

You can turn any game object into a custom loader for design-time purposes by attaching the “Terrain Loader” component. This will give you similar options to Gaia Tools, and you can set up a loading range for regular terrains and impostor terrains.



By setting the load mode to “Editor Always” the terrains “touched” by the loading range will always stay loaded in, and you can just move the game object around in the scene view to load terrains at that spot.

Using the scene view loading range

Independently from the Gaia tools, there is also a general loading range in the Gaia Scene View Panel on the top of the scene view:



The Loading Range defines another area for loading terrains in the scene view that is independent of the individual tools. If unsure how large this area is, activate “Show Range” to show a gizmo in the scene view.

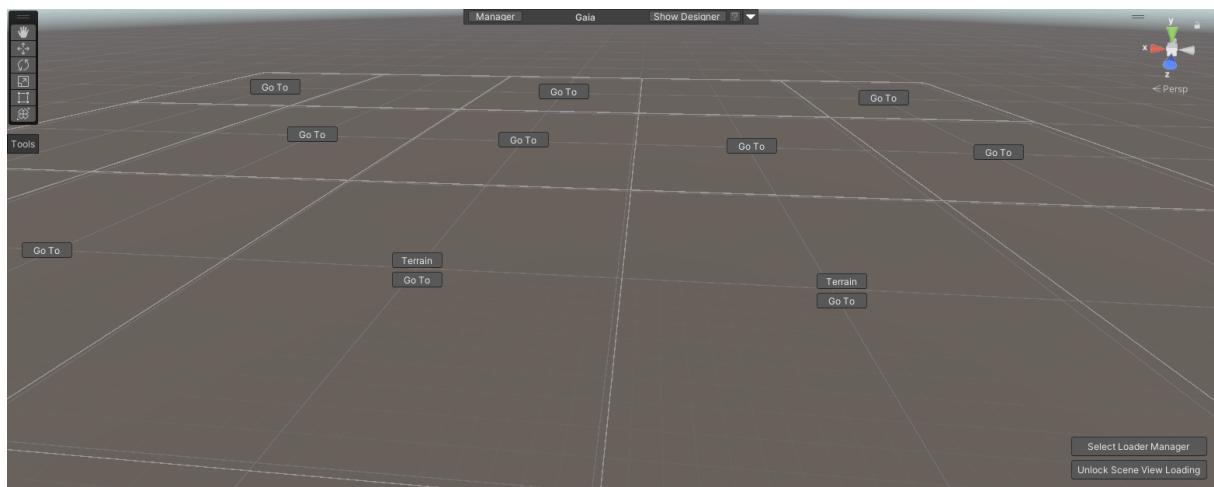
You can switch the loading range to work with the "World Origin" (which is whatever your scene is being centered on, usually X=0, Y=0, Z=0) or with the "Scene View Camera".

The latter will apply the loading range around the scene view camera, which can be useful if you want to navigate the scene while the terrain loads around you. Please follow [this link for more information about the other options in the Scene View Panel.](#)

Using the terrain loader manager & scene view buttons

Finally you can also load individual terrains or all terrains from the Terrain Loader Manager. You can find the Terrain Loader Manager under "Gaia Runtime" and it has a "Terrains" panel that lists all terrains with their current load state and offers options to load/unload individual terrains or all terrains simultaneously. Please see the section "Terrain Loader Manager" below for more information on all the settings/buttons available in the Terrain Loader Manager.

While the Terrain Loader Manager is selected, you will notice that buttons appear in your scene view that allow you to load terrains in and out at the position of the terrains:



These buttons adapt to the distance of the camera and the current state of the terrain. If the terrains are far away, those buttons will disappear for readability / performance, while the terrains closer to the camera will have all buttons available.

The "Go To" button quickly zooms the scene view to the terrain.

The button above the "Go To" button controls the load state and changes according to the current load state of the terrain:

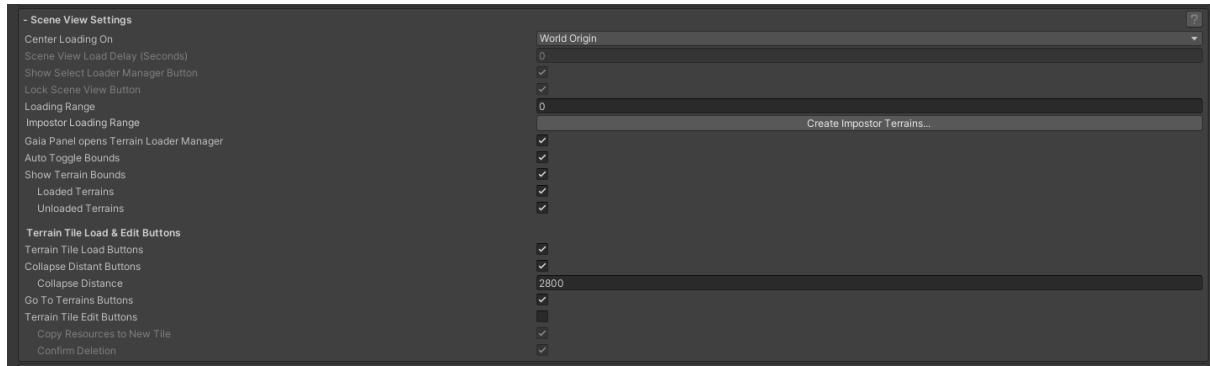
"Terrain": will load in the "regular" terrain at this position.

"Impostor": will switch to the Impostor terrain instead.

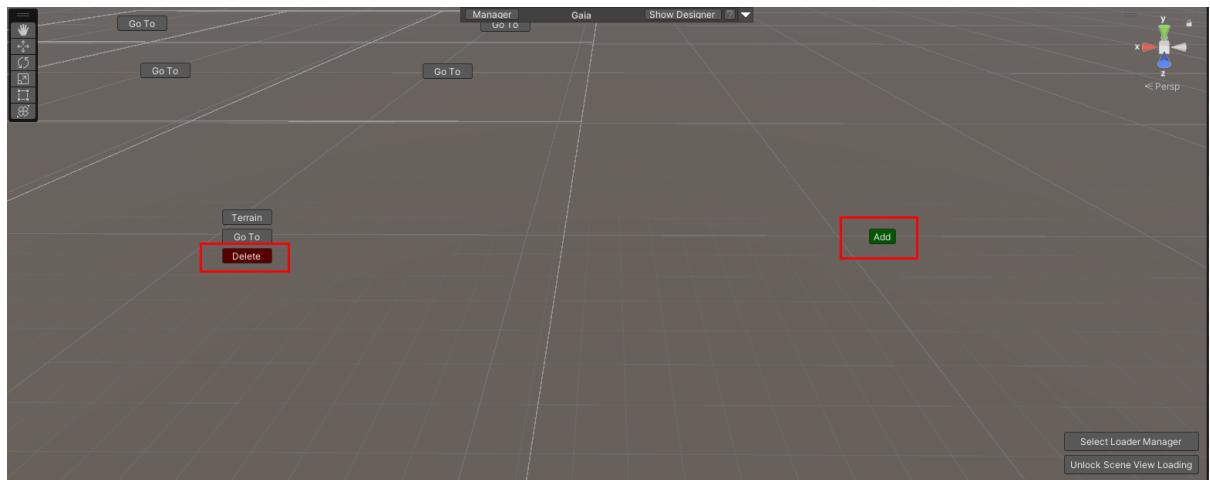
"Unload": will unload this terrain again.

By pressing this button repeatedly, you can cycle between the different states.

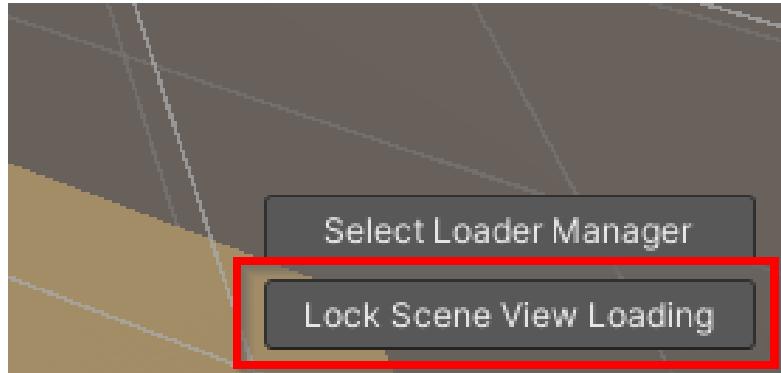
You can configure the behavior of these buttons in the Terrain Loader Manager's "Scene View Settings."



If the options for "Terrain Tile Edit Buttons" are active, even more buttons will become available that allow you to add / and remove terrains via those buttons as well.



If you use the Scene View Camera loading together with the scene view loading, you might find it irritating that terrains load in and out while you move the scene view when you are trying to “pin” a couple of specific terrains with the scene view buttons. To combat this, you can use the “lock scene view loading” button in the lower right corner of the scene view.

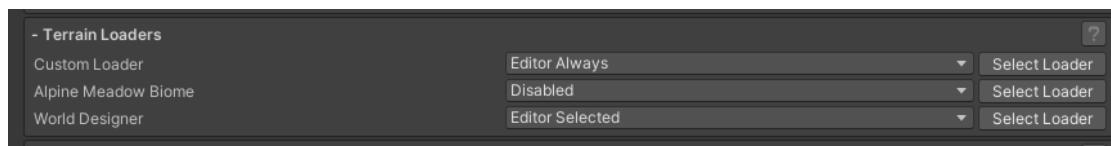


Using multiple loading workflows at the same time.

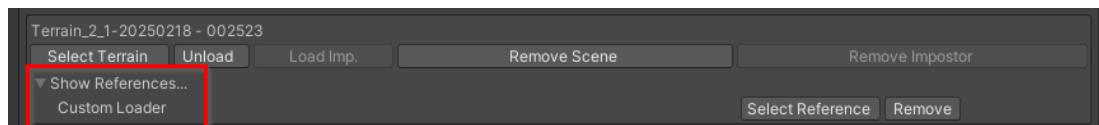
As explained above, it is possible to mix and match the different loading workflows. For example, you could create your own custom loading game object, use the scene view panel on top of the scene view, and also load in terrains based on the scene view buttons.

Note that while this is very flexible, it is also possible to create contradictory setups. For example, when you tell a Gaia Stamper to load terrains on its own and then use the scene view loading buttons to unload them, those terrains would pop right back at the moment the Stamper moves, as it would re-request them to be loaded.

The terrain loader manager lists all active loaders in the “Terrain Loader” section.



The “Terrains” section allows you to review which loader is referencing a terrain.

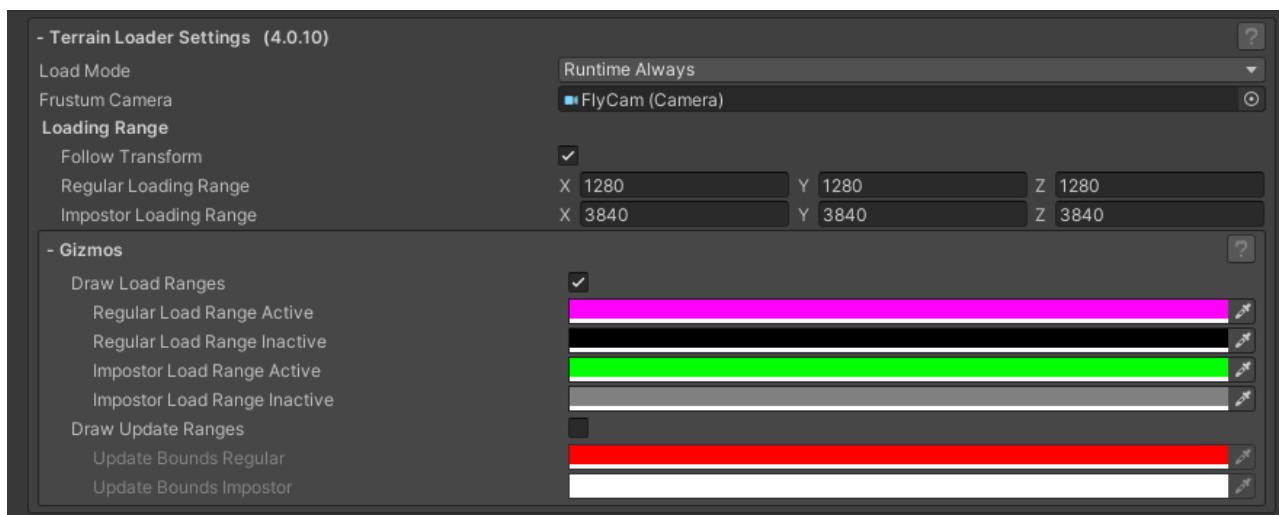


This helps analyze which loaders are currently active and why a specific terrain is currently loaded in or not.

Runtime loading / adding your own loaders

Please note: Loading scenes in Unity is significantly faster in a stand-alone build. When you run a terrain-loading scene in the editor, you are more likely to encounter delays and hiccups when loading a new scene. Please judge the runtime performance only by running the project in a build. What happens in the editor is largely irrelevant.

Terrain Loading during runtime is controlled similarly to the design time tools. To make an object load in terrains around itself, you can attach the "Gaia Terrain Loader" component to it. Gaia does this automatically for the player object in a scene where terrain loading is used, but you can set up additional Terrain Loader components on any object you like. The component has the following settings:



Load Mode	<p>The load mode applied to this object. The Load Modes are the same as for the regular Gaia Tools:</p> <p>Disabled - will not load terrains at all;</p> <p>Editor Selected - will load terrains as long as the tool is selected in the Scene Hierarchy / Inspector;</p> <p>Editor Always - will keep terrains loaded even when not currently selected;</p> <p>Runtime Always - will load terrains during runtime (usually used on game objects like the player rather than tools).</p> <p>When used on a runtime object, you usually would want this to be "Runtime Always".</p>
Frustum Camera	If a camera is assigned here, the loader will load terrains in the frustum of the camera (terrains that will be visible when loaded) first rather than the other terrains ones that are not inside the

	frustum. Those will be loaded after all the terrains in the frustum have been processed.
Refresh Rate Settings	When the Loading Mode is set to Runtime and the Terrain Loader Manager is NOT set to "Assume Grid Layout," 4 settings control the refresh rate for terrain loading checks. These settings are not relevant anymore if "Assume Grid Layout" is enabled in the Terrain Loader Manager and are therefore hidden then.
Min Refresh Distance	The minimum distance for controlling the refresh rate.
Max Refresh Distance	The maximum distance is used to control the refresh rate.
Min Refresh MS	This is the refresh rate used for terrains at or below the minimum distance. The refresh rate for any larger distance will be interpolated according to the maximum distance.
Max Refresh MS	This refresh rate is used for terrains at or above the maximum distance. The refresh rate for any smaller distance will be interpolated according to the maximum distance.
Loading Range Settings	The Loading Range is determined by a bounding box that determines every terrain that is touched by this box will be loaded automatically during runtime. When the "Follow Transform" checkbox is activated, the box's center will be the transform position of the Game Object. If not, you can enter a different point in world space for the center. You can set up the range of the box in the XYZ dimensions as well. The box is displayed as a black Gizmo in scene view so you can review the range settings accordingly
Gizmos Panel	It allows you to customize the color of the various box gizmos that the terrain loader draws. You have the option to show loading ranges, update ranges, and choose the color for them. "Update Ranges" are the ranges within the terrain loader that can move until another loading update happens. This is only relevant if "Assume Grid Layout" is active in the Terrain Loader Manager.

Creating impostor terrains

Depending on the loading range you set up around your player, you will run into the issue that the number of terrains you are loading around the player is creating too much of a performance hit for the game. Every terrain and the game objects on it incur a memory and culling cost that significantly slows your frame rate.

One way to mitigate this is to use impostor terrains. Impostor Terrains are simplified meshes that roughly resemble the full terrain object. They are low resolution, cheap to render, and designed only to be viewed in the distance, where the player would not be able to tell the difference.

As the player approaches the terrain tile in question, Gaia swaps the Impostor Terrain for the original high-fidelity terrain to preserve the illusion that the world is larger than it is.

All loading controls in Gaia have two loading ranges: a "Regular" loading range for the full terrains and the "Impostor" loading range within Impostor Terrains.

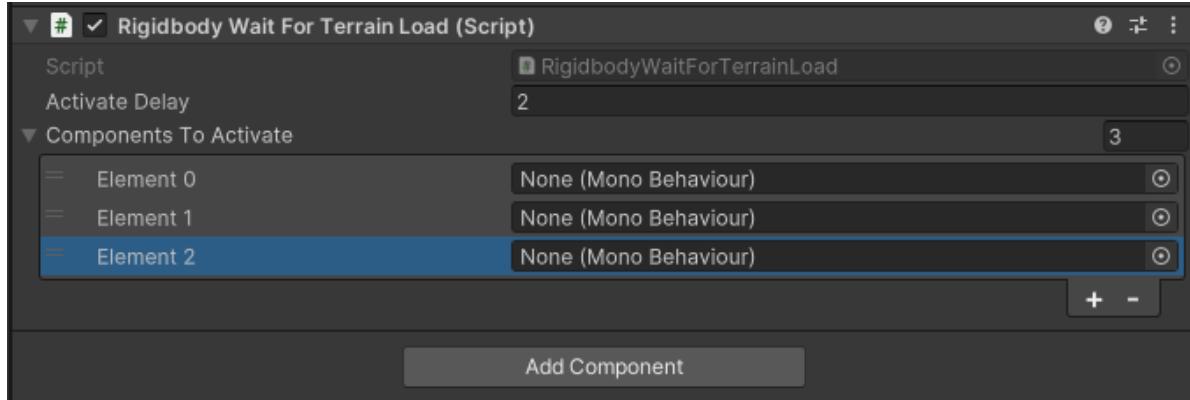
An example setup could load regular terrains to 2000 meters and impostor terrains to 5000 meters, giving an overall view distance of 5000 meters. This can improve performance considerably.

Generating the Impostor Terrains is a mostly automated process that can be started from the Terrain Loader Manager or the Gaia Scene view Panel. This will open the "[Terrain Mesh Exporter](#)" (Gaia Pro 2021) or the "[Terrain Converter](#)" (Gaia Pro 2023 / VS) tool that allows you to create the Impostor Terrains for each terrain tile of your setup.

Preventing the player from falling through the terrain

A common problem with terrain streaming is that the player character/camera might fall through the terrain at the scene start since the terrain takes a few milliseconds to load in the scene, which is enough for the player character to fall below the terrain collider.

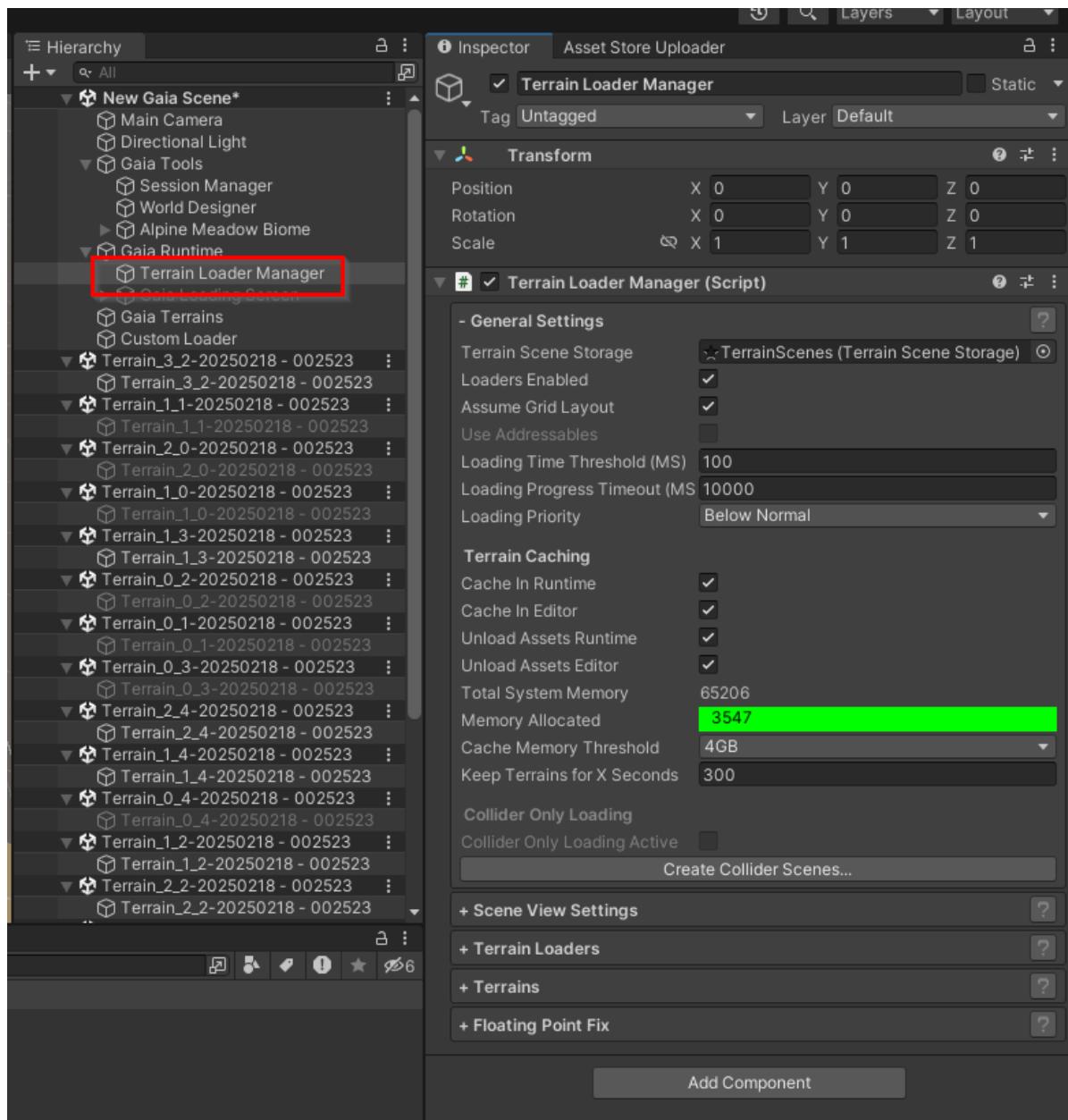
You can prevent this with custom scripting, but a small helper script is included with Gaia that helps with this problem: You can attach the component "Rigidbody Wait For Terrain Load" to the game object with the Rigidbody that is affected by gravity.



This component will turn off the gravity on the Rigidbody at scene start and only activate it after the "Activate Delay" when the terrain below the character has been loaded in. Additionally, you can set up one or more components that should be activated together with gravity. This is entirely optional and can be used, to activate player controls together with the gravity on the player.

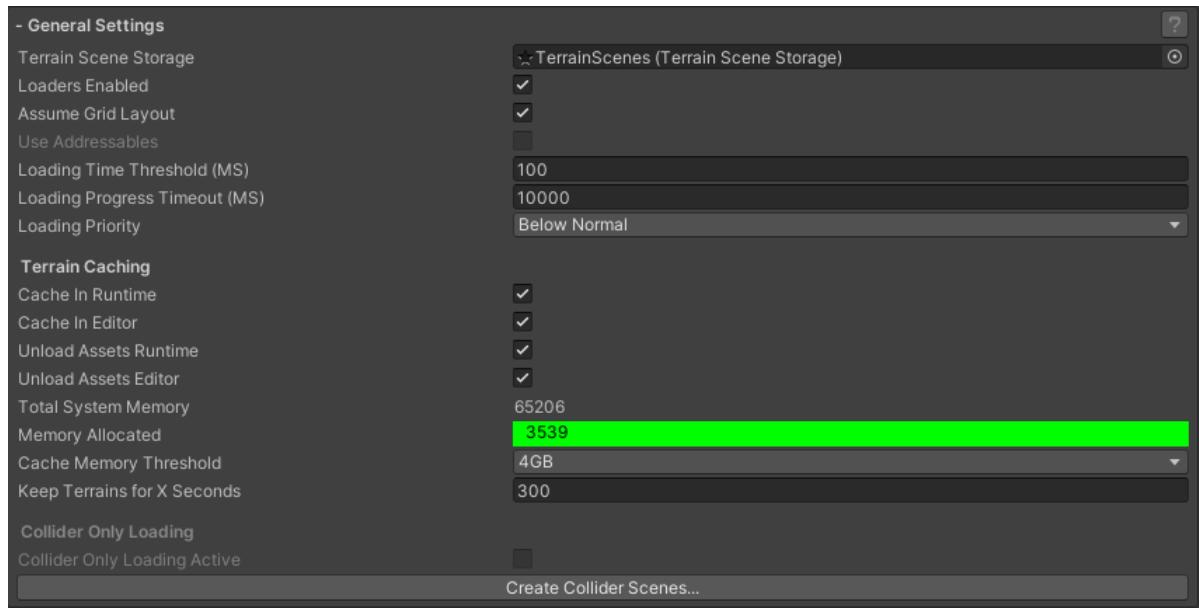
Terrain loader manager

When you have many tools or different runtime loaders in the scene, it can become difficult to determine whether a certain terrain is currently being loaded (or not). Under "Gaia Runtime" in the scene hierarchy, you can find a "Terrain Loader Manager" Game Object that displays the Terrain Loader Manager when selected:



The Terrain Loader Manager contains additional settings for terrain loading but also gives you an overview of the loaders in your scene and a complete list of terrain scenes and their current load state.

General settings panel



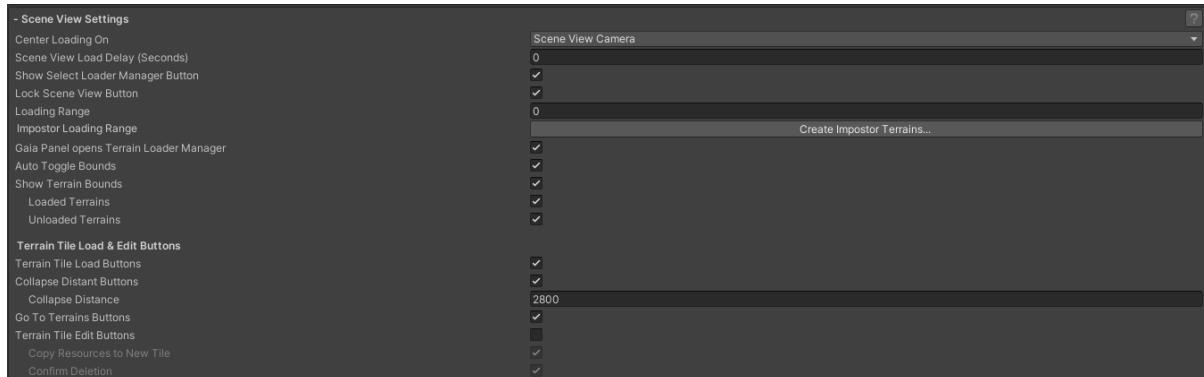
The following settings are accessible via the General Settings Panel:

Terrain Scene Storage	A reference to the terrain scene storage data Object. This is an Object that is created by Gaia initially upon terrain creation which holds data about the position and size of the different terrain scenes. You normally would not need to adjust this in any way, but you can hook up a different terrain scene storage here if you need to.
Loaders Enabled	Enables / Disables Terrain Loading altogether. You should only turn that off if you would want terrain loading to stop completely, e.g. if you wanted to do some process / workflow where you would not want Gaia to interfere with its terrain loading.

Use Addressables	Use the Unity Addressable System to load the terrains from. This requires that you have the Unity Addressable package installed in the project, and that you set up the terrain scenes / impostor scenes to be organized in addressable groups.
Loading Time Threshold (MS)	A threshold in milliseconds before Gaia will attempt to load another terrain scene in - this prevents loading spikes during runtime as it avoids multiple terrains being loaded at the exact same time. With the threshold in Place, they are rather being loaded one after another, which evens out the workload across a small timespan rather than starting to load 10+ terrains in the exact same moment.
Loading Progress Timeout (MS)	Threshold in milliseconds until the load progress tracking will time out. The Terrain Loader Manager offers events that a programmer can subscribe to in their own scripts to measure loading progress in their own code, e.g. to create a custom loading screen for your game.
Terrain Caching	"Terrain Caching" means a terrain will rather be deactivated than fully unloaded when it is not needed anymore. AS soon as the terrain is needed again, the deactivated terrain will be activated again. Caching Terrain saves performance on frequent loading / unloading of the same terrains, but costs memory (RAM).
Cache In Runtime	Whether Gaia is allowed to cache terrains during runtime / in a standalone build.
Cache In Editor	Whether Gaia is allowed to cache terrains during design time in the editor.
Total System Memory	Read-only value for the total available system memory in Megabyte.
Memory Allocated	Read-only value for the currently used system memory in Megabyte. This includes the overhead of the unity editor. The value is printed in green as long as it is below the memory threshold (see below) and red if it is above, indicating that caching will stop until memory is freed up again.
Cache Memory Threshold	Defines a maximum amount of memory the unity / standalone build process is allowed to occupy. If the allocated memory passes this threshold, Gaia will stop caching terrains and instead fully unload them to save system memory.
Keep Terrains for X Seconds	Defines how long a cached terrain will be kept until it is automatically unloaded and thus removed from memory,

Collider Only Loading	"Collider Only Loading" is a special mode that loads only collision information for the terrain scenes. This collision information needs to be created from the terrain mesh exporter first before this mode can be activated. This is intended to be used in server builds only, where the server would not need to render the scene, but would still require the collision information to be loadable. This mode will only be useful for special technical reasons, but will not give you any advantages otherwise.
Collider Only Loading Active	Whether collider loading is active or not. When activated, Gaia will only load in special collider scenes and the regular terrain will not be visible anymore.
Deactivate Runtime Components	When collider loading is active, you will additionally get options to deactivate certain runtime components of Gaia. This is again only intended for special server builds Of your Gaia scene that do not render the content
Deactivate Player	Deactivates the Gaia Player.
Deactivate Lighting	Deactivates the Gaia Lighting System.
Deactivate Audio	Deactivates the Gaia Audio System.
Deactivate Weather	Deactivates the Gaia Weather System.
Deactivate Water	Deactivates the Gaia Water.
Deactivate Screenshoter	Deactivate the Gaia Screenshoter Tool.

Scene view panel



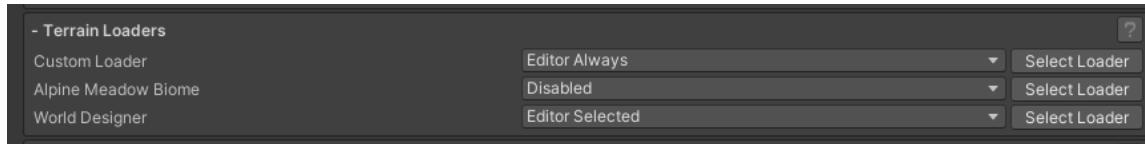
The terrain loader manager can draw many gizmos to visualize the terrains loading in the scene view. The following options are available to control this:

Center Scene View Loading On	Controls if you want the general loading of the scene view to be centered around the scene view camera or the world origin at 0,0,0
Scene View Load Delay	The delay in seconds until the scene view loading updates. Setting a delay can be useful if you want to navigate with the scene view camera without terrains loading without the terrain loading interrupting the movement of the scene view camera.

Show Select Loader Manager Button	Toggles a button in the lower right corner of the scene view to select the Terrain Loader Manager. This allows you to quickly see the terrain loading buttons or access other terrain loading settings.
Lock Scene View Button	Toggles a button to lock the Scene View Loading – if the loading is currently centered on the Scene View Camera, this button will stop the loading activity from moving the scene view camera. This helps to “pin” specific terrains for loading without the loading of the scene view camera interfering.
Loading Range	The Loading Range for “regular” terrains around the Scene View Camera / World Origin
Impostor Loading Range	The Loading Range for “Impostor” terrains around the Scene View Camera / World Origin. If Impostors have not been created yet, a “Create Impostor Terrains...” button will be offered that opens the Terrain Converter Window.
Gaia Panel opens Terrain Loader Manager	This option automatically selects the Terrain Loader Manager whenever the Scene View Panel on top is unfolded.
Auto Toggle Bounds	This option will automatically switch on and off the terrain bounds when the terrain loader manager is selected. If this is off, your manual selection of “Show Terrain Bounds” below will be used instead.
Show Terrain Bounds	Draws rectangles for the terrain positions as gizmos in the scene view. This makes it easier to see the location / layout of your world when no terrains are loaded in.
Loaded Terrains	Show Bounds for loaded terrains.
Unloaded Terrains	Show Bounds for unloaded terrains
Terrain Tile Load and Edit Buttons	This section lists options for the small terrain-specific buttons to load / unload and edit terrains when the terrain loader manager is selected.
Terrain Tile Load Buttons	Displays a button for each terrain to cycle between the different load states (Terrain, Impostor, Unloaded)
Collapse Distant Buttons	Collapses Distant Buttons for better readability of the scene view. The further away the terrains are from the camera, the less buttons will be displayed for those.

Collapse Distance	Controls at which distance from the scene view camera the buttons start collapsing.
Go To Terrains Buttons	Displays a button for each terrain to move the scene view quickly to that terrains location. Can help with navigating the world in large worlds.
Terrain Tile Edit Buttons	Activates Buttons to Edit the terrain loading layout. You can add new terrains at the edge of your grid, and (permanently) remove existing ones.
Copy Resources To New Tile	If you want to copy the resources (textures, trees, etc. automatically from the neighbor terrain to the newly created terrain that was added via the "Add" button.
Confirm Deletion	When this setting is on, the deletion of terrains with the "Delete" button needs to be confirmed.

Terrain loaders panel

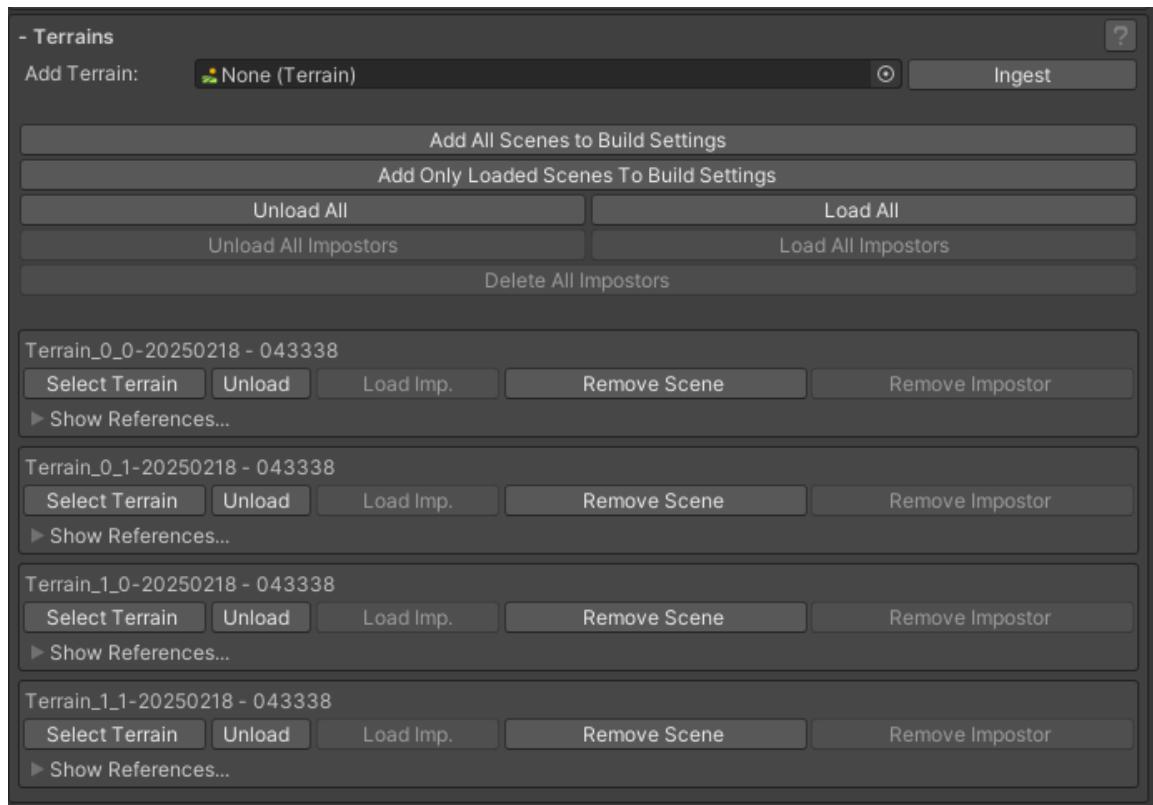


In the "Terrain Loaders" panel, you can find a list of all objects with a terrain loading component. The dropdown tells you which mode these loaders are currently operating.

You can use this list to analyze which objects are responsible for loading scenes and change the loading mode here directly to stop unwanted loading of terrains. You can create your own loader object by adding the Gaia Terrain Loader component to any game object. (see "Runtime Loading / Adding your own Loaders" above).

The "Select Loader" button will select the object in question and will shortly highlight the loading settings (if it is one of the Gaia tools).

Terrains panel



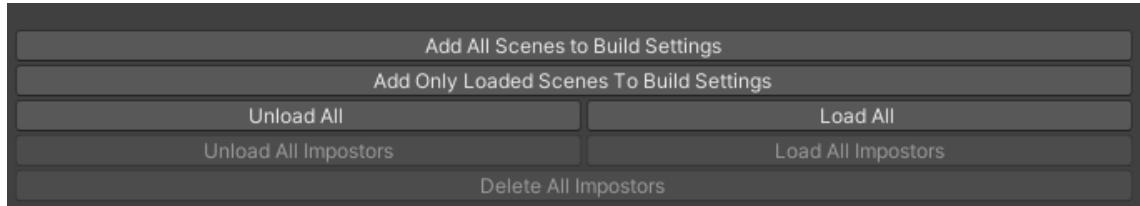
In the Terrains Panel, you can add or remove terrain scenes from loading and ensure that all scenes are part of the build settings. Additionally, it contains a list of all terrain scenes with an overview of the load state and which object is currently referencing (=requesting) this scene.

At the top you can add another terrain to terrain loading:



You need to have the terrain in your main scene, drag and drop it from the scene hierarchy into this reference slot, and click the "Ingest" button. This will take the terrain, put it into a new terrain scene that is loadable by Gaia, and add the required information to the terrain scene storage.

Then there is a block of general buttons that affect all terrains:



Add All Scenes to Build Settings: This will add the scenes associated with the terrains to the project build settings. This is usually done when Gaia creates the scenes initially, but if the build settings/scene setup has changed, it might be required to perform this again. This button will also check if your main scene is part of the build settings and whether it is on top of the loading order.

Add Only Loaded Scenes To Build Settings: This option adds only the currently loaded terrains to the build settings. This can help reduce the build size when you only want to test a portion of the world. Of course, only those terrains that were added to the build will work correctly for loading.

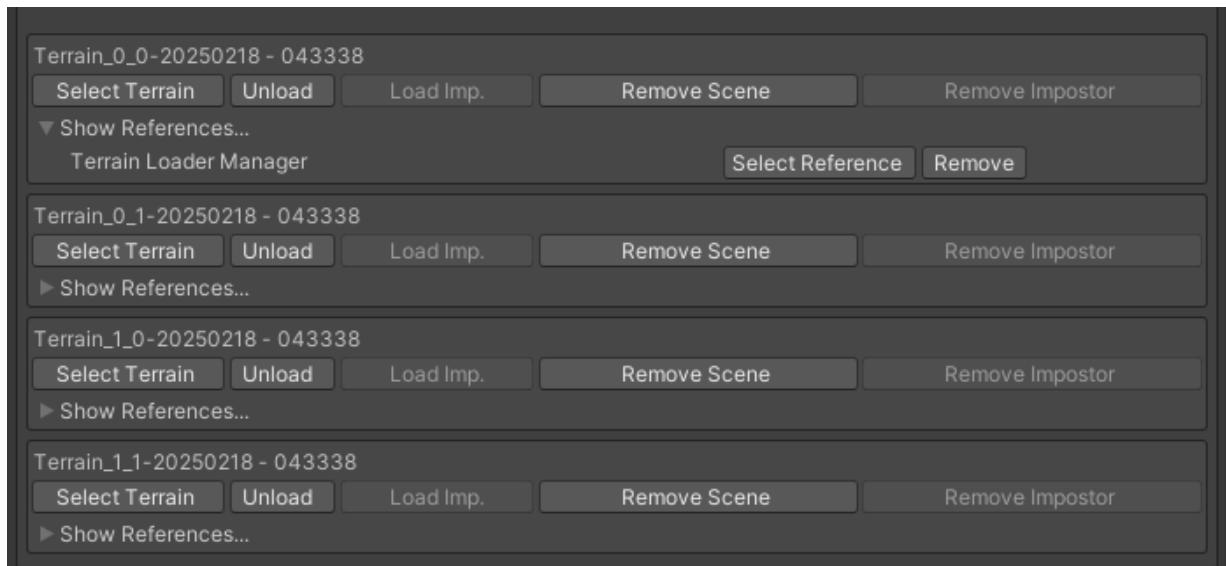
Load All: Loads all terrain scenes at once. Warning: In a fully populated large world with hundreds of terrains, this can severely reduce the editor's performance or lead to crashing.

Unload All: This function unloads all terrain scenes at once. If there are still loader objects active in the scene, terrains might be loaded back in by those loaders immediately after.

Load All Impostors: Loads in all impostor scenes at once. Warning: While impostor terrains are not as heavy as the complete unity terrains, they might still slow down or crash your editor if they are loaded in all at once together.

Unload All Impostors: Unloads all impostor terrain scenes at once. If there are still loader objects active in the scene, there might be impostor terrains loaded back in by those loaders immediately after.

Below the buttons, you can find a list of all available terrain scenes.



You can choose to load/unload those scenes manually using the respective buttons. When a terrain scene is loaded in, you can see the references to this terrain scene. A "Reference" means an object requests to load this terrain.

If the terrain scene has at least one reference remaining, it will stay loaded in the scene. The references created by the Gaia Panel on top of the scene view will show up as "Terrain Loader Manager" in this view.

You can choose to select the referencing object or remove the reference. When you remove a reference, but the corresponding loader is still active, the reference might be recreated immediately afterward.

Similar information is shown for the impostor terrain for this terrain scene (if it exists). The "Remove Scene" button permanently removes the terrain from Terrain Loading; if you want to unload the terrain only, click "Unload."

You can use the information displayed in the Terrain Loaders and Terrains Panel to analyze why a certain terrain is being loaded right now and quickly adjust the loaders in your scene to best suit your current task when editing the scene.

Floating point fix panel

The Floating Point Fix Panel allows you to deactivate/activate Gaia's Floating Point Fix solution:



When active, this will automatically shift the entire world during gameplay whenever the player moves too far away from 0,0,0. This shift keeps positioning information small and prevents issues with floating point precision calculations in 3D Engines such as Unity.

For more information on the floating point fix, please see [Using the Floating Point Fix in Gaia Pro](#)

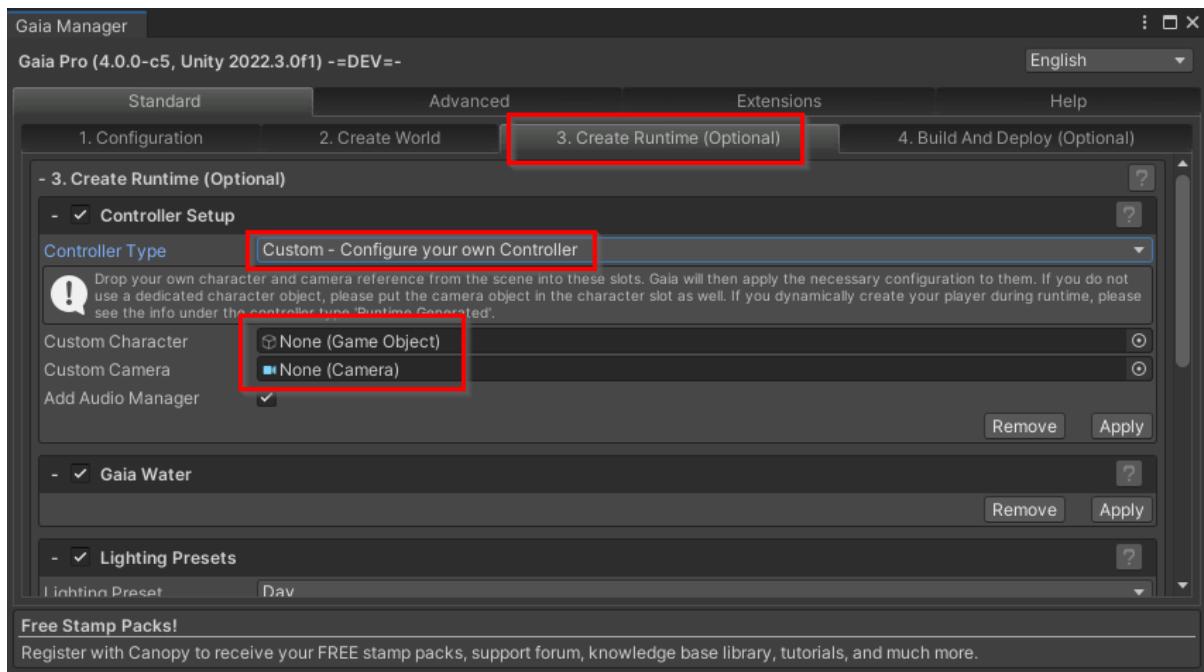
Handy Techniques

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.

Using your custom player/camera

Many of Gaia's systems, especially the runtime components, require knowing what your main camera is in the scene and what object represents the player. For example, the Gaia water object needs to know the main camera to display underwater effects for that camera correctly.

When you set up one of Gaia's controllers, this is done automatically for you, but what do you do when you want to run your custom controller? If your controller is part of the scene during design time, please check the "Custom Controller" option inside the Controller Setup Runtime Component:



This option allows you to name your character and camera, and when you click the Apply button, Gaia will send those to all required systems.

If you spawn your Character / Camera during runtime, you can use the API function `GaiaAPI.SetRuntimePlayerAndCamera` to perform this step from within a script.

This allows you to register your dynamically spawned player from code with Gaia's systems.

Use Biomes to create a custom look and feel

In Gaia, stampers modify the shape of a terrain, and spawners fill it with content. It is convenient to use the spawners that come with Gaia and call it a day, but you will always get better results if you start to customize or build your spawners according to the needs of your project.

This manual's "Customizing Biomes and Spawners" section is a good starting point.

Use the Poly Mask to control biome or stamp placement

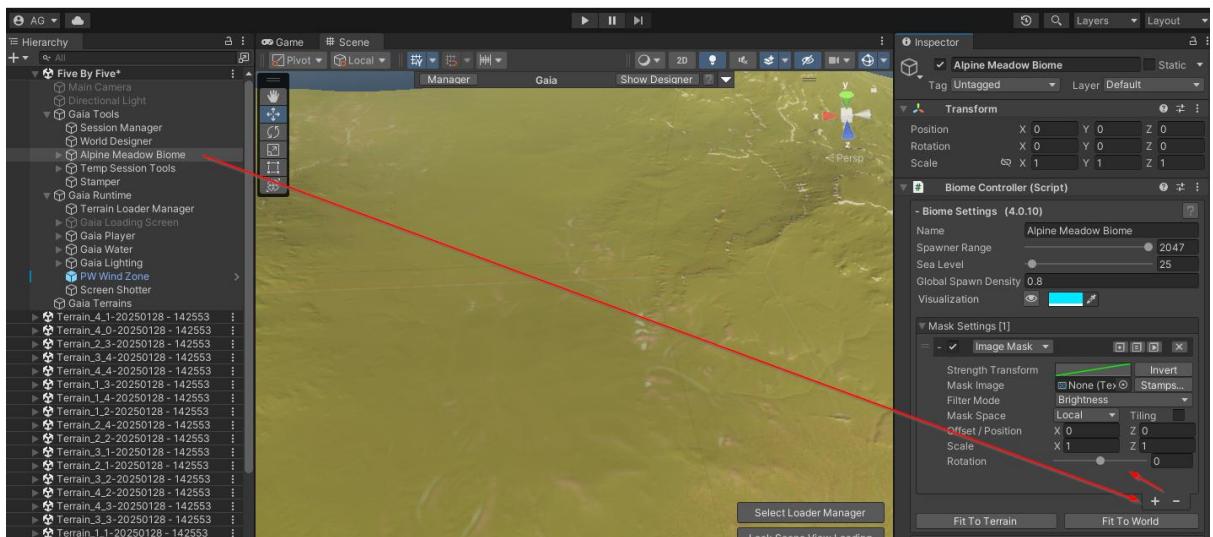
The masking system in Gaia works in essentially the same way, regardless of whether it is being used in a stamper or a spawner.

The Poly Mask system is a new system for Gaia Pro 4.0.10 onwards that allows you to draw masks directly onto your terrain. One of the benefits of this system is that you can move these masks as your environment evolves and then re-run your spawn.

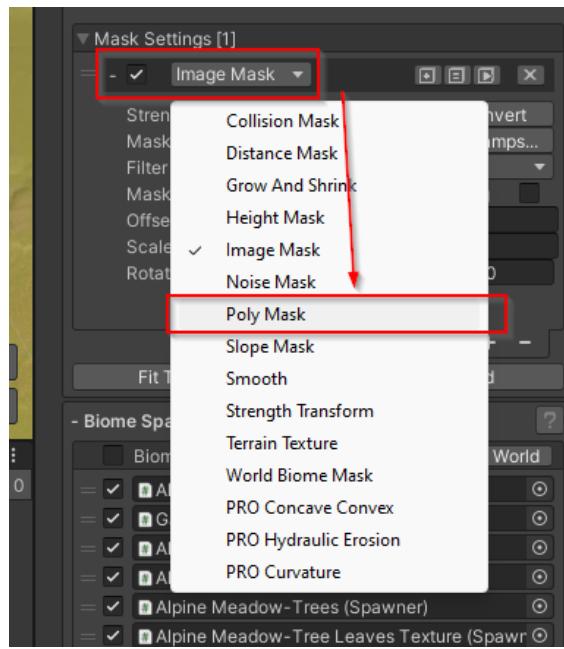
In this example, I will add a Poly Mask to my biome. Because it is added to the biome itself, its effect will also be applied to the individual spawners. You could as easily add it to individual spawners or even sub-components of spawners.

One thing to be aware of is that Biomes are generic and designed to be applied to any scene, whereas a Poly Mask is scene-specific. Practically, you would add it to the spawner in your scene rather than the more generic settings in your biome.

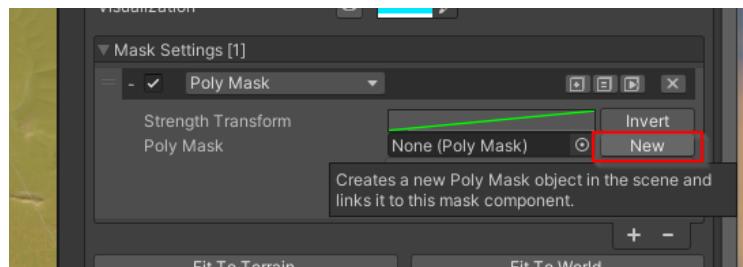
1. Create your scene and add a biome to it.
2. Select the top-level biome component and add a mask to it.



3. Change the type of mask to Poly Mask



4. Click the New button to create one in your scene



5. Select the Poly Mask in the scene hierarchy



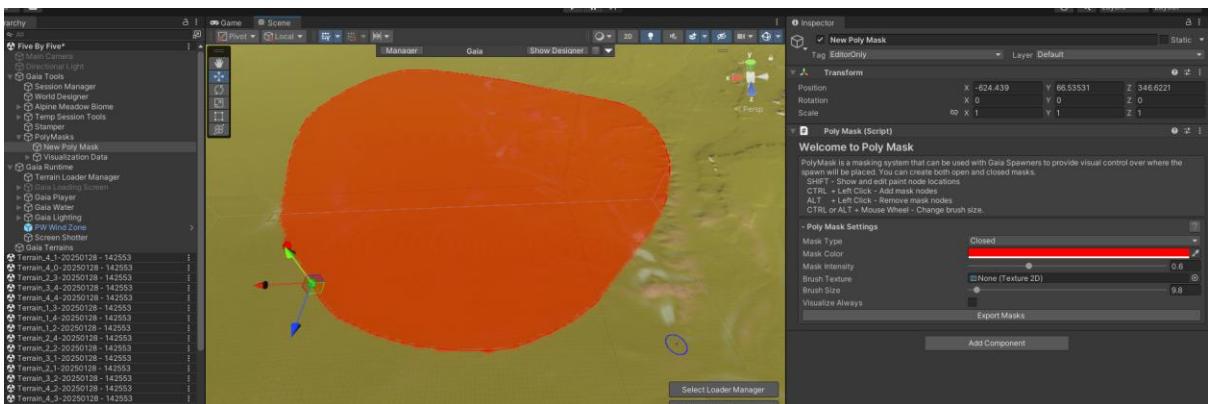
6. Pay attention to the instructions, and read how to add them into your scene



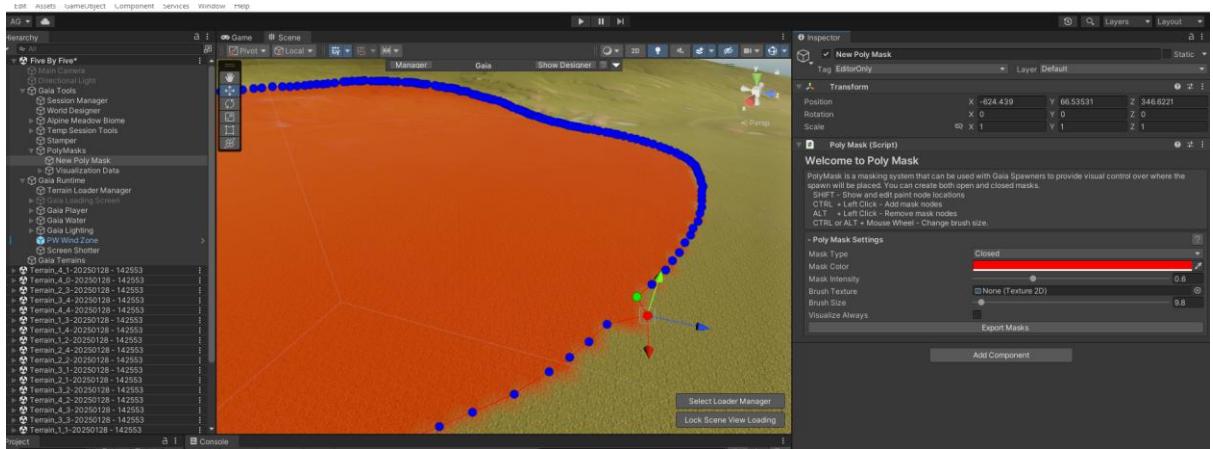
7. Hit the Ctrl button and move the mask over the terrain. You can use the mouse wheel to increase or decrease the size of the mask



8. While holding the CTRL key down, drag your mask around over the terrain to create a new mask:



9. Hit the SHIFT button and notice how the individual control points are highlighted. You can click these to drag them around.

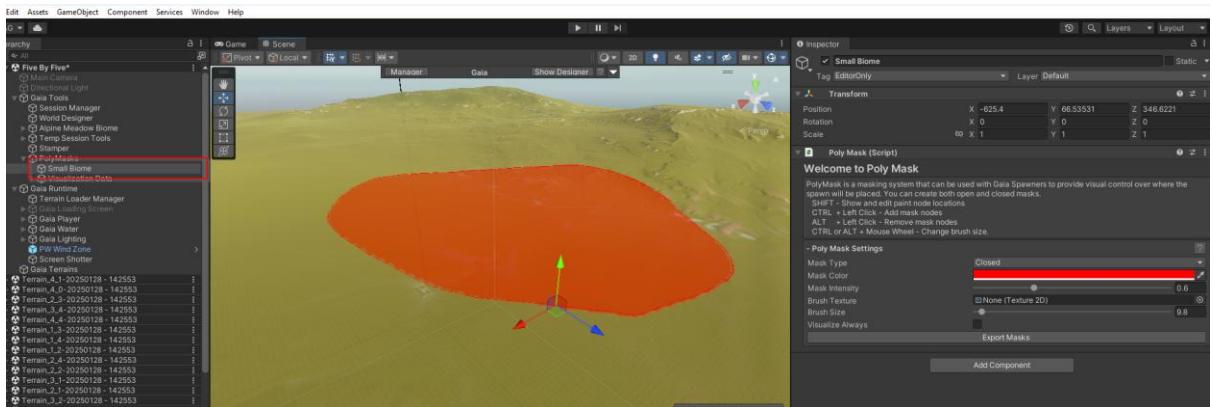


10. Hit the ALT button and drag the mouse over the control points to delete them.

(my screenshot software was unable to handle this)

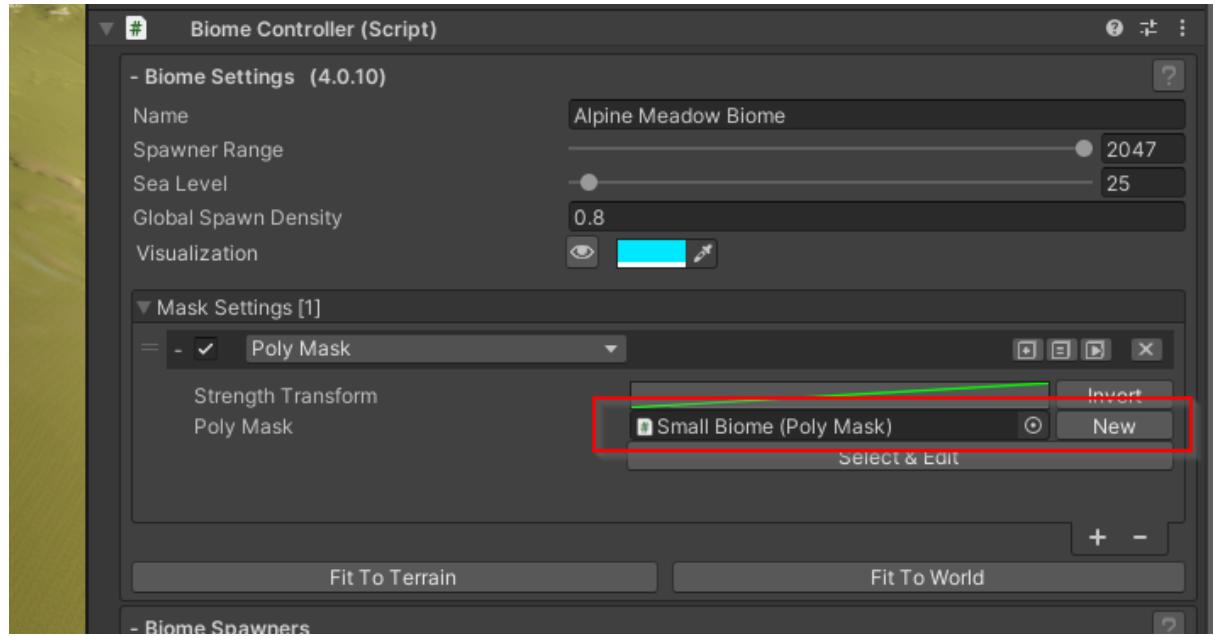
11. Select a control point, hold the CTRL button, and click once to add an individual control point.

12. Select your Poly Mask and name it in a way that signifies what it does.

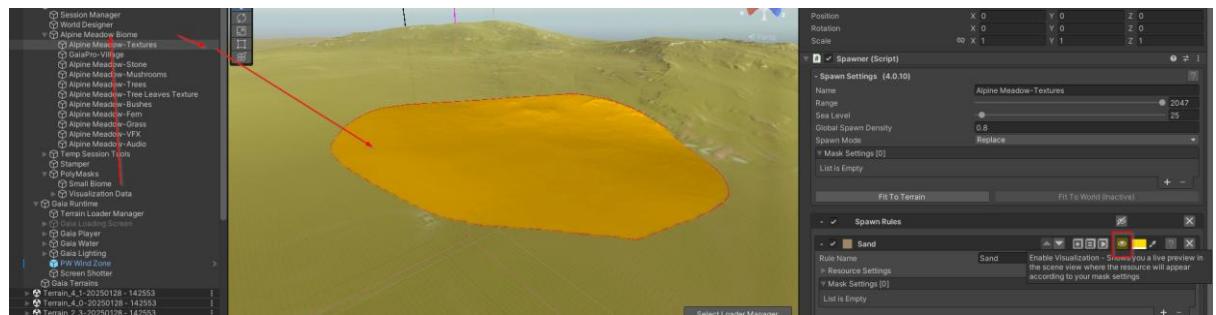


13. Note – you can apply the usual Unity object operations to a Poly Mask, such as moving, rotating, and scaling it, and all the internal control points will adapt accordingly.

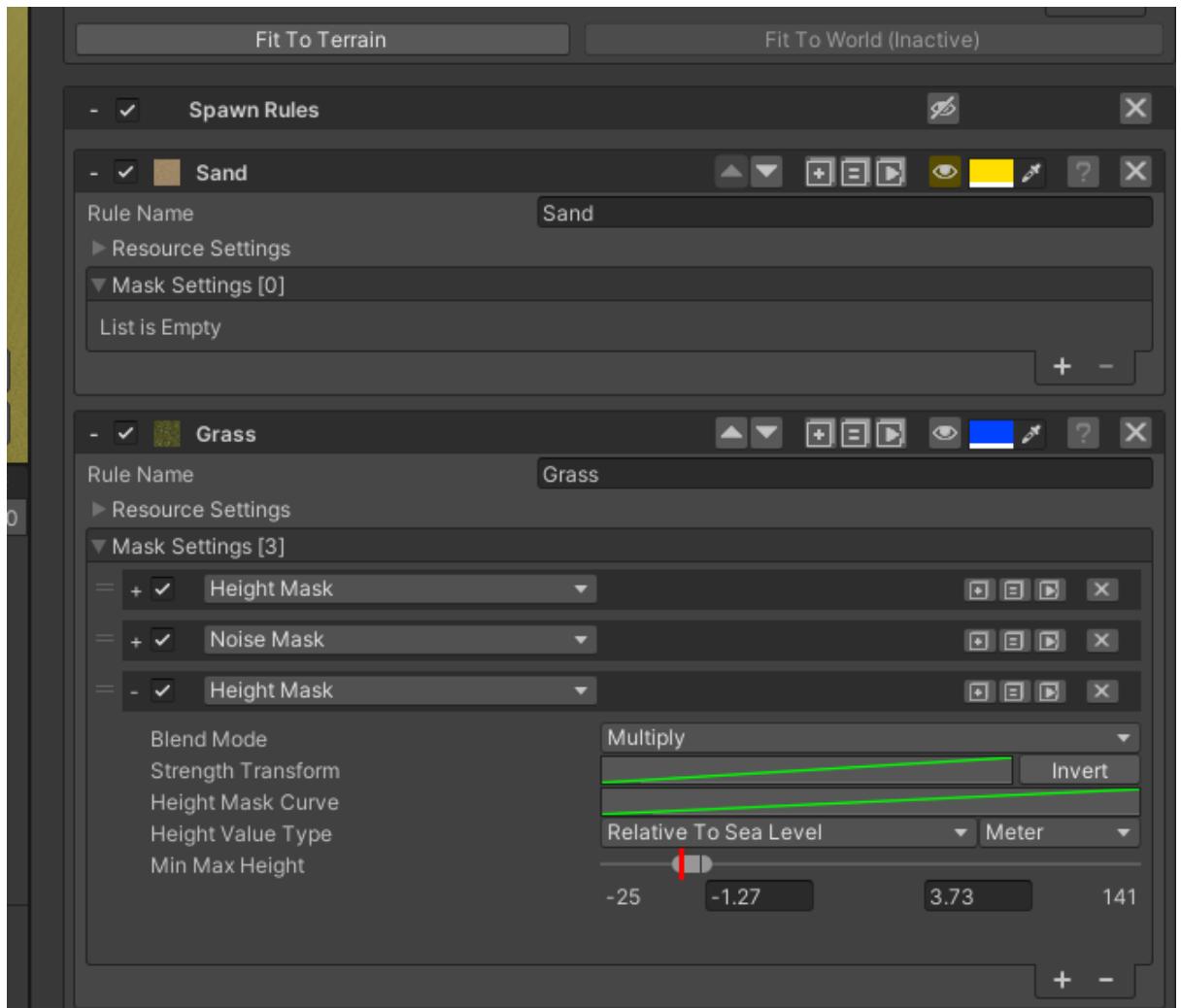
14. If you select the biome again, you will notice that the Poly Mask name has also been updated.



15. If you select the sand texture in the textures spawner and then turn on the visualizer, you will notice that it has been constrained to the mask you defined on the biome earlier. And if you were to move the poly mask independently, this would be automatically picked up on your next spawn.

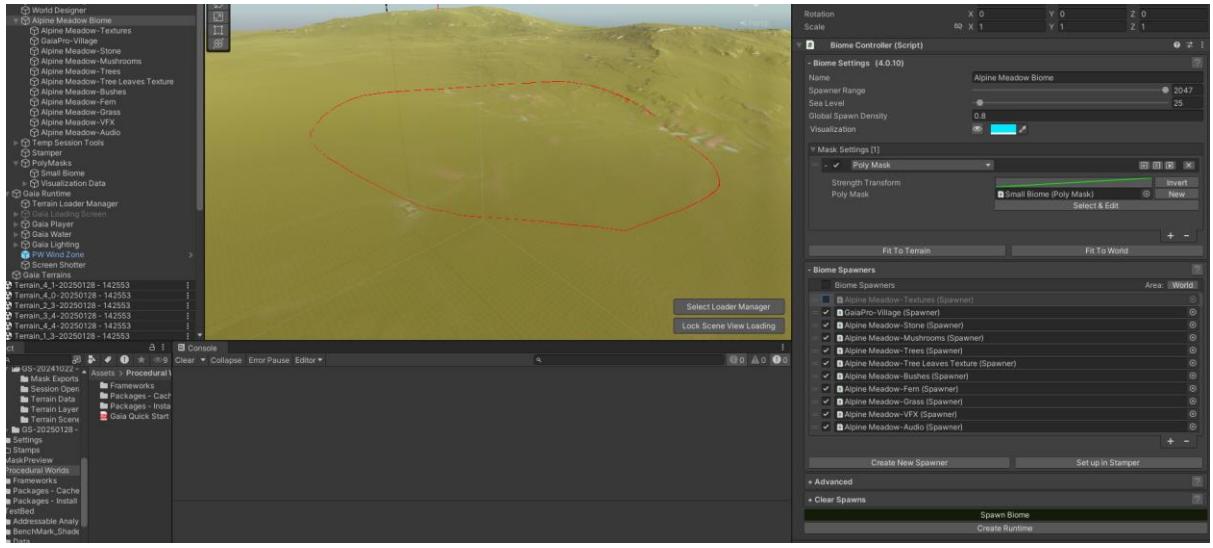


16. I chose the sand texture for a reason. The texturing system is like a paintbrush. Each layer is painted over the last one, and where that paint goes is based on the mask settings for that spawn rule. The sand mask is empty, which means it will spawn everywhere, whereas the grass mask will spawn grass afterward based on height and noise.

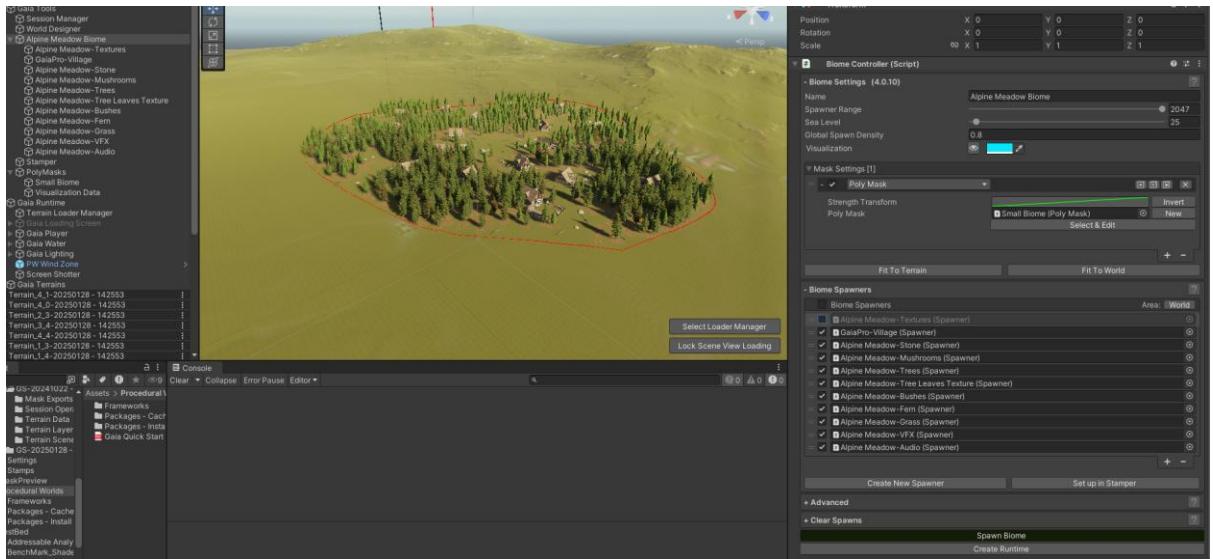


17. If mixing biomes, it is often a good idea not to spawn the sand / first layer, as it is used to clear what was there before. It's your call, and I encourage you to experiment in a clean scene until you understand how it all hangs together.

18. In this example, I am going to disable the texture spawner all together, and just spawn everything else:



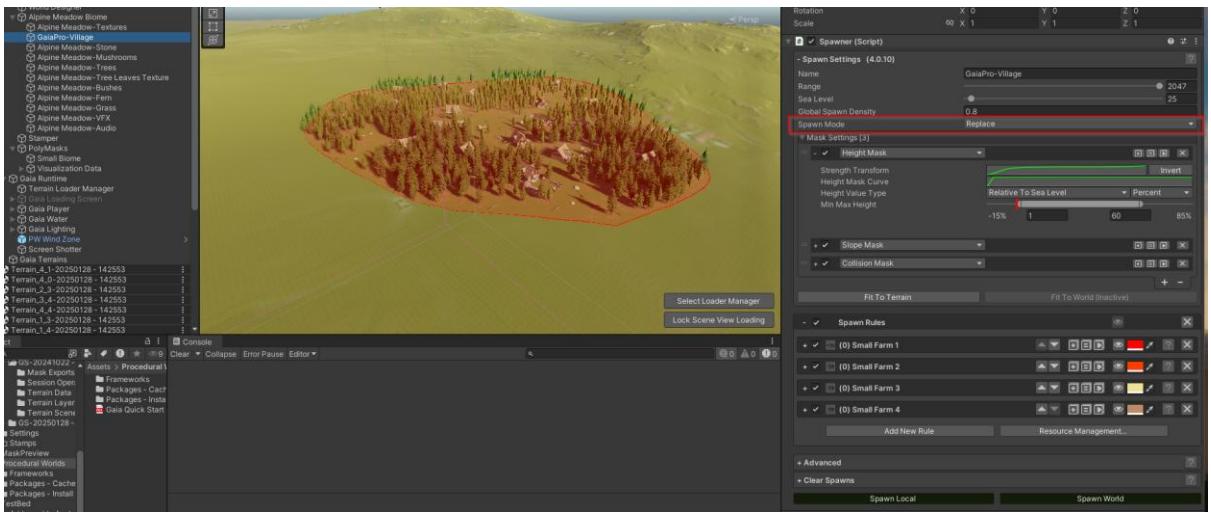
19. And there we have it!



20. If you want to monitor the design layout of your scene, you can visualize the mask constantly and change its intensity.



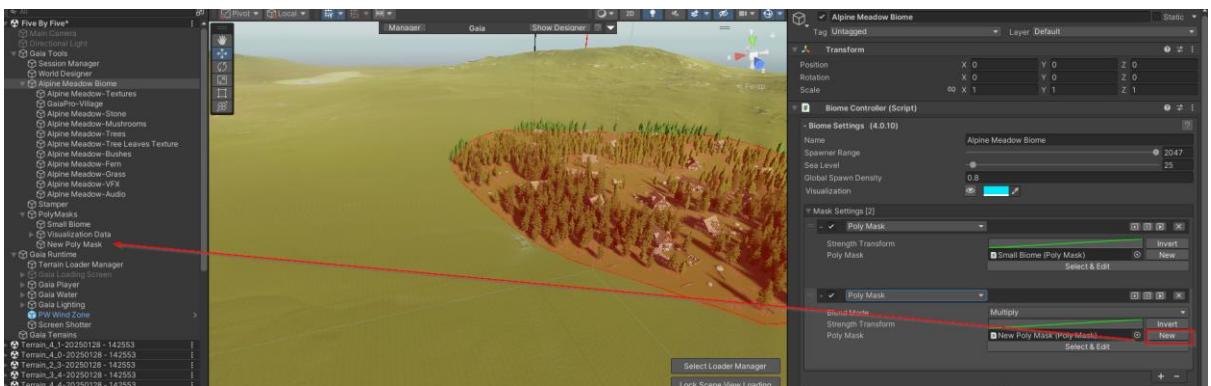
21. WARNING: Biomes were initially designed to run as a single entity over an entire world, and they assume that if you are spawning again, it is okay to delete what was there before and then replace it. You can change your Spawn Mode to “Add” if you want to add rather than replace the content. Replacement is generally fine, as it will spawn the biome on all the masks that have been assigned to the biome, but it can be problematic if you are mixing biomes in your scene, and these biomes share the same assets, as it will remove them from the other masked areas when it spawns.



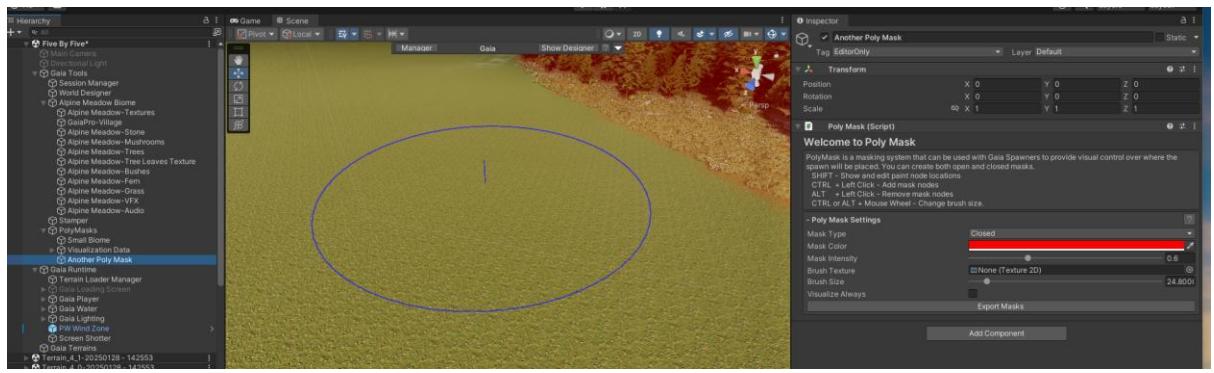
Poly Mask Example Two

In the previous example, I used a closed Poly Mask to mask out a large space. In this example, I will use an open Poly Mask with some stamps (but this could be any texture) to create something more organic.

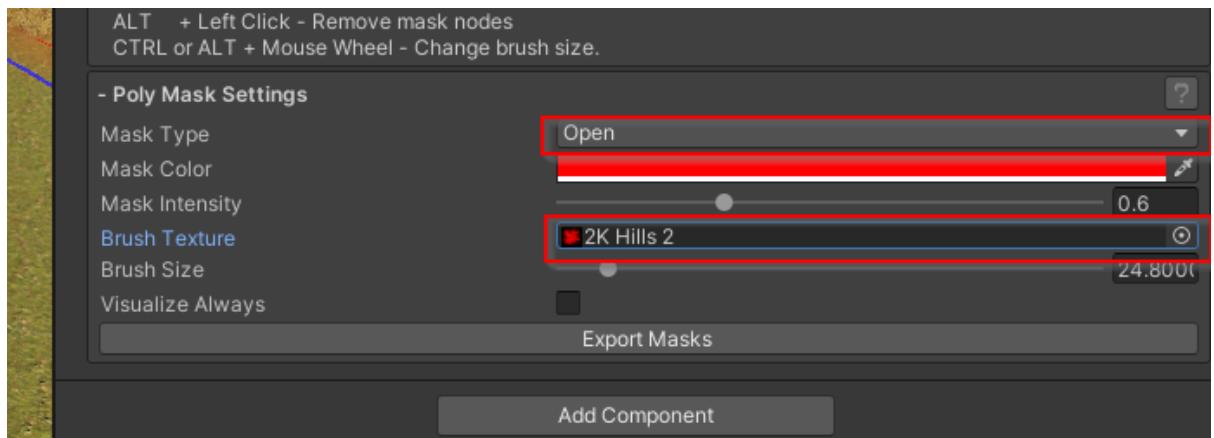
1. Add another Poly Mask to your previous scene onto the biome.



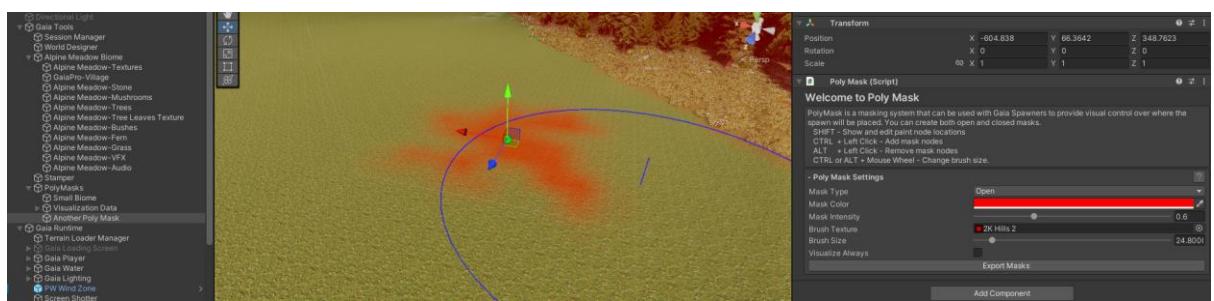
2. Use the mouse wheel to make it quite large



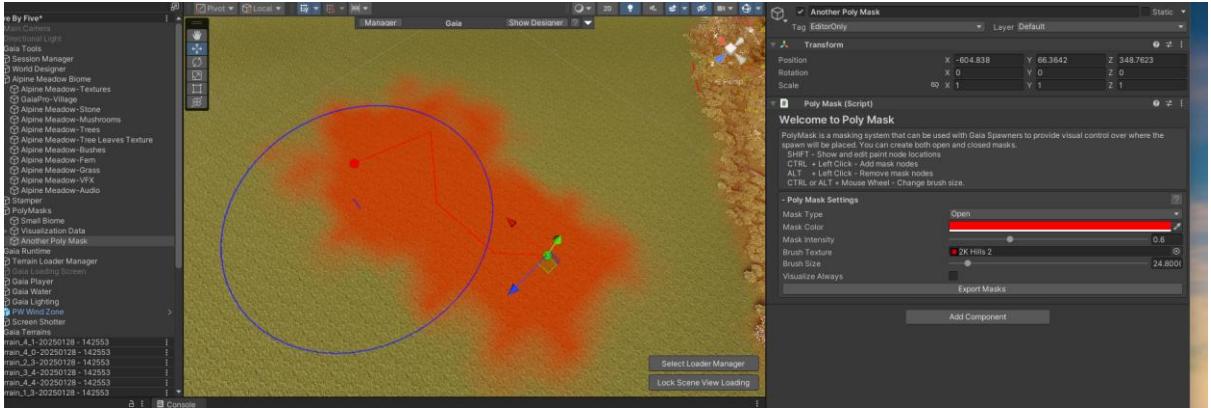
3. Make it open and add a stamp to it (it could be any mask texture – stamps happen to work very well with it due to their nicely blended edges).



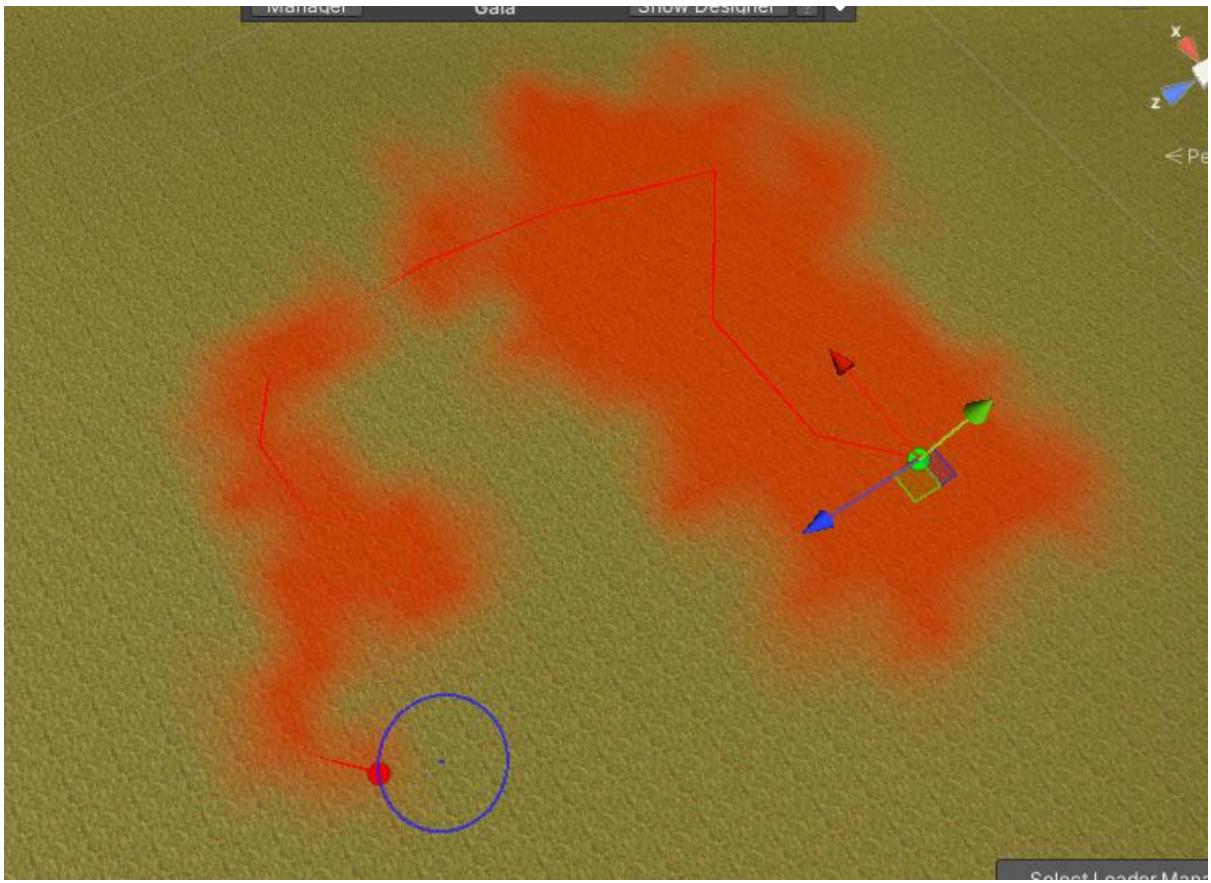
4. Left click once and observe how the mask is being visualized



5. Left click several more times to make a more organic shape

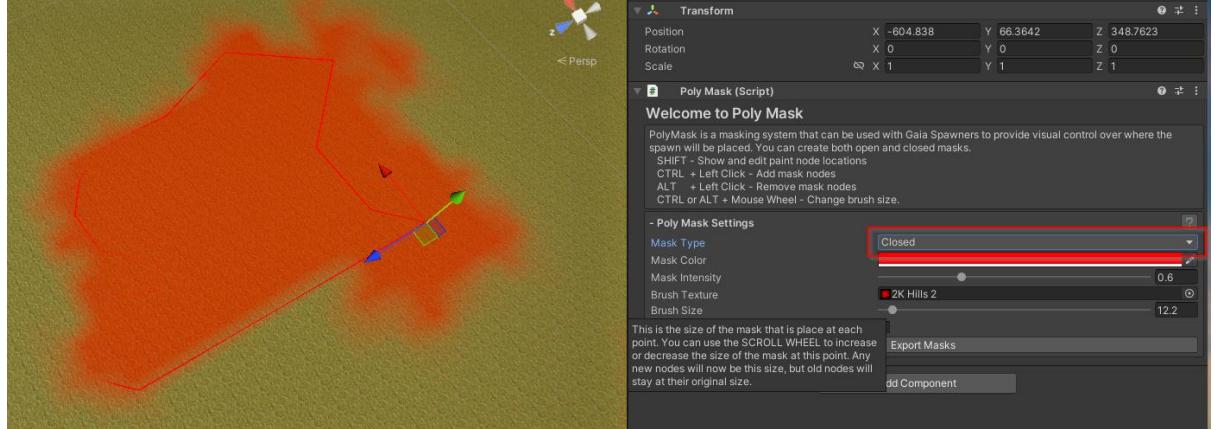


6. Use the scroll wheel to make the brush size smaller, to get more control, and add more mask points.

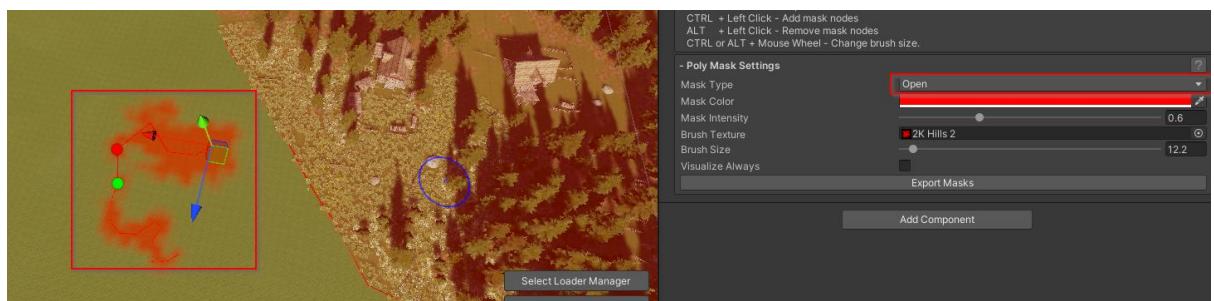


7. Use the SHIFT key to visualize the points. Select them and drag them around. Use the ALT key to remove them.

8. New mask points will always be added between the Green and the Red visualization dots. Select a different point if you want to preserve the integrity of the control points in case you want to close the mask again.
9. Close the mask and note how the stamps break up the outline.



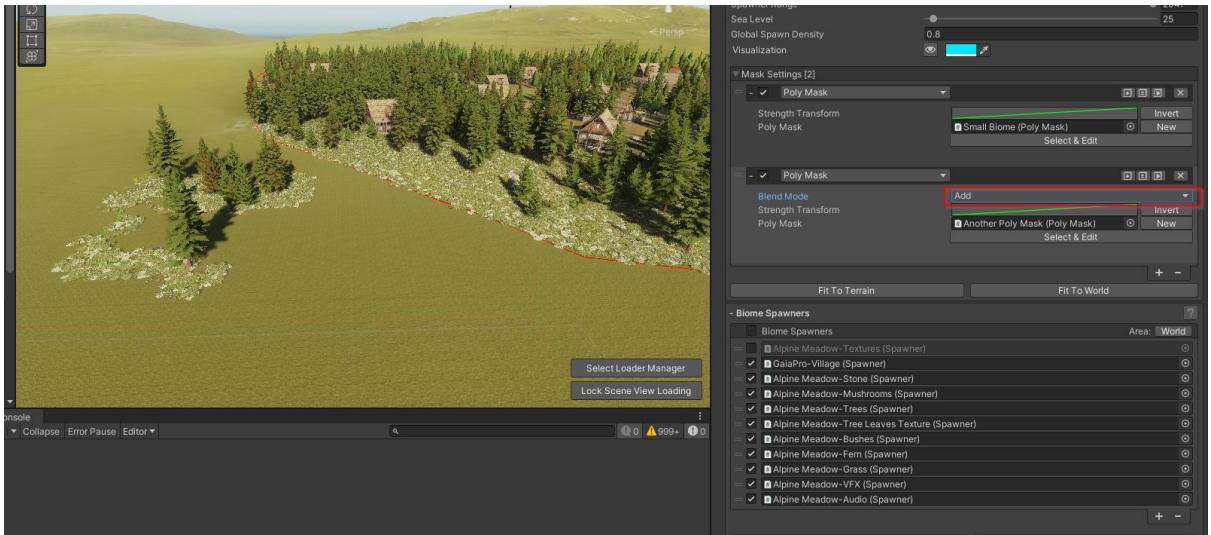
10. Open it again. Notice that this right next to the last mask we created.



11. Select a new color and select Visualize Always to more clearly show the mask, especially in proximity to the other much larger mask.



12. Select the biome, and make sure that the blend mode is set to add instead of multiply. And then click spawn and enjoy your result. NOTE: Gaia will load and unload all the scenes on large streaming environments as the masks are applied. Please be patient.



Use Perspective and terrain impostors to create space

Creating massive worlds in Unity is difficult because the terrain system does not scale.

The problem is that your frame rates will plummet once Unity displays more than a few terrain tiles.

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

(NOTE: We solved this problem with [Storm](#). Contact us to learn more!)

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

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



In this example, on relatively small terrain, we created a sense of vastness by placing 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.

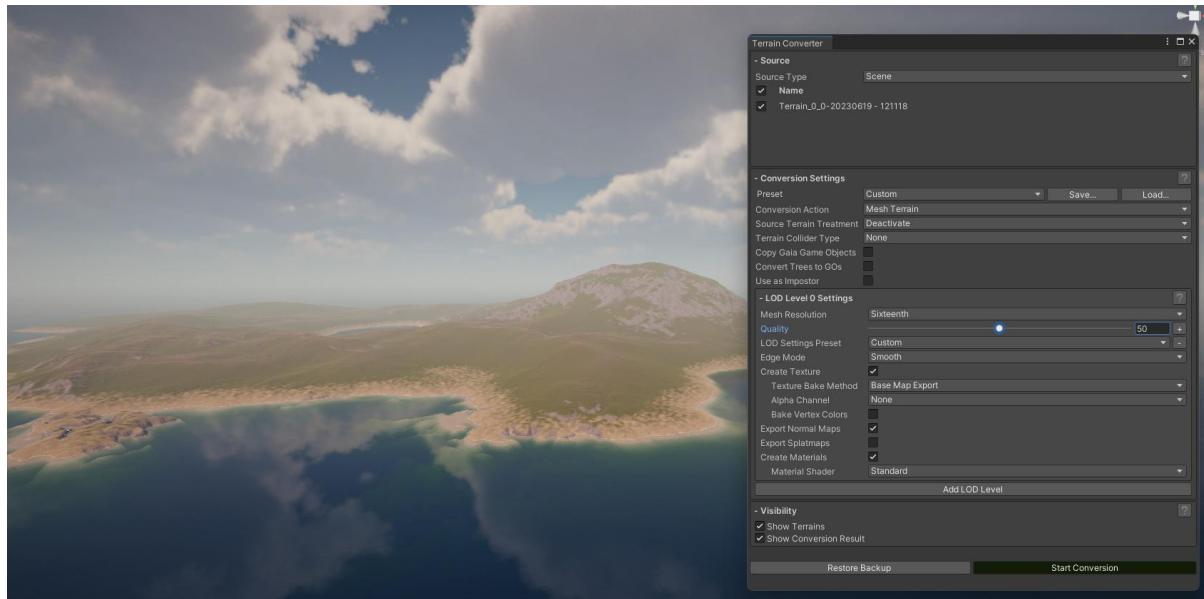
When doing this, remove trees or other assets in the distance on hills or mountains that could break the illusion unless you also shrink those.

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

Another good technique is to create islands with Gaia and use the Terrain mesh conversion system to convert them to low-poly mesh impostors.

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

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



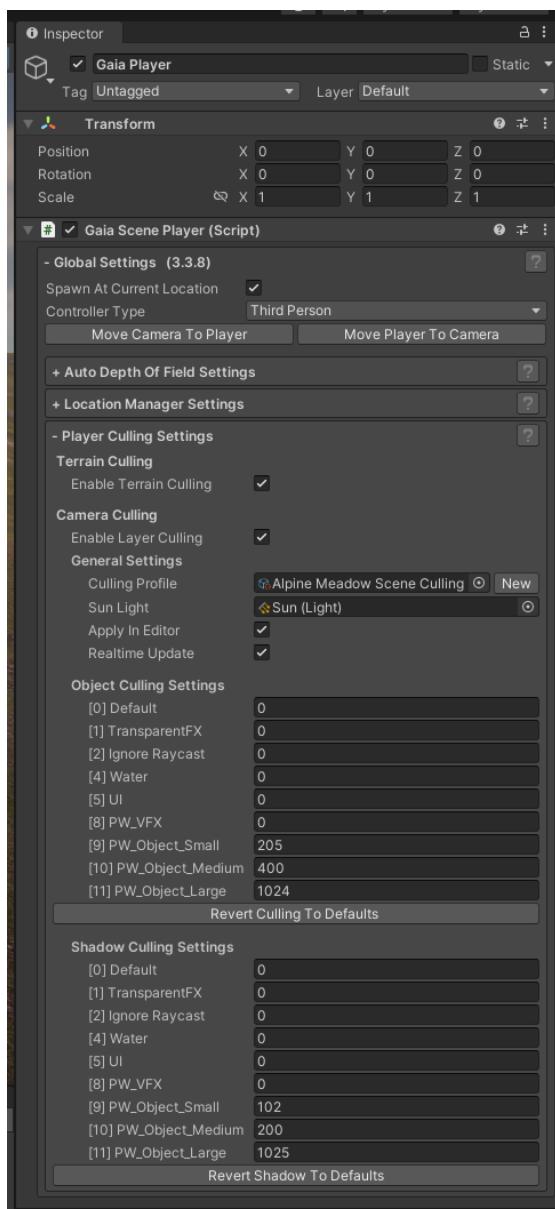
Use culling, streaming, and light baking to increase performance

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

Our customers use Gaia to create popular games in VR, on mobile, desktop, and console, but as with everything, every game requires optimization to 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 main approach to improving performance is to avoid rendering the content in the first place. This can be achieved 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 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. By displaying fewer objects, the idea is to send fewer draw calls to the GPU.

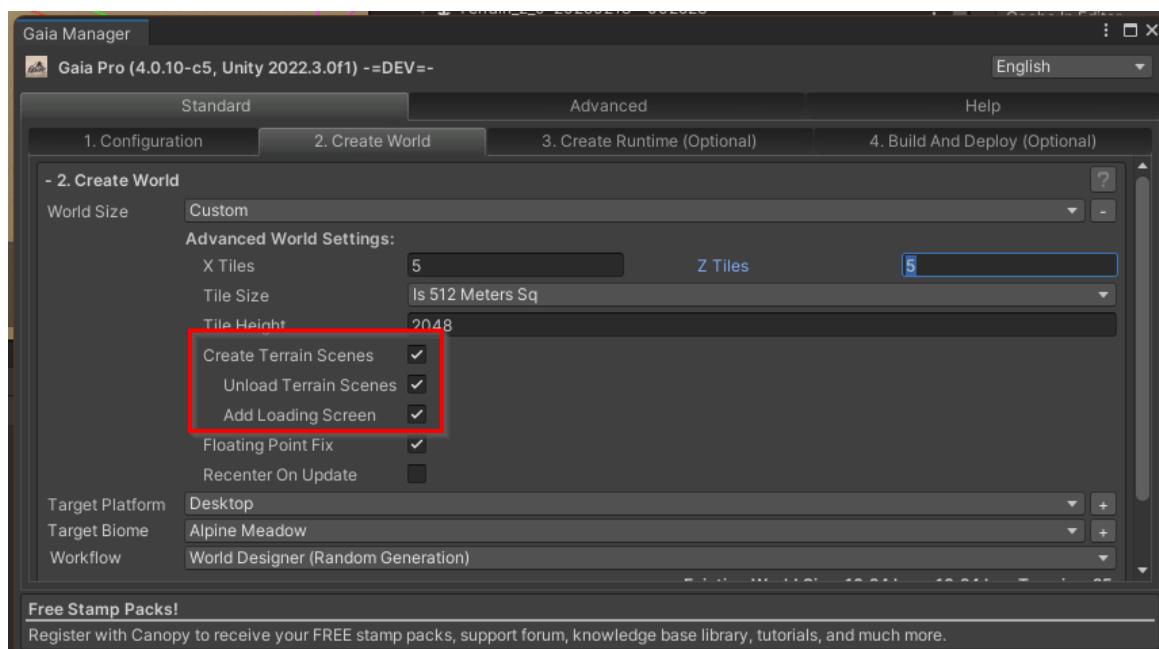
You can update these settings yourself. The tradeoff between the amount of content and the visual fidelity changes from scene to scene.

Terrain 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 additive scene system to stream them in only when needed.

Having a single terrain in your scene is the simplest and most convenient way to handle terrains in your scene. However at certain world sizes you start to run into issues with the terrain heightmap / control texture / detail resolution, or you run into performance issues when all of your game world is being loaded in the scene at the same time. When you use multiple terrains you have the advantage that you can use higher terrain resolution values (since multiple terrains are used to cover the same area). With terrain loading from multiple terrain scenes you can additionally unload terrains distant to the player to save some performance during runtime.

Activating terrain loading in Gaia Pro is fairly simple: Just set up the amount / size of terrain tiles you want to create during world creation, and activate the following checkboxes for terrain loading:



Another optional feature is the terrain mesh impostor system in Gaia Pro. In this process, each terrain 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 terrain in the distance instead of the high-fidelity unity terrain. This is 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 is rendered.

This system should be used with caution, as while this removes load from the GPU, it increases the 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 essential as they store the information that the Unity GI (global illumination) system needs to light your scene correctly.

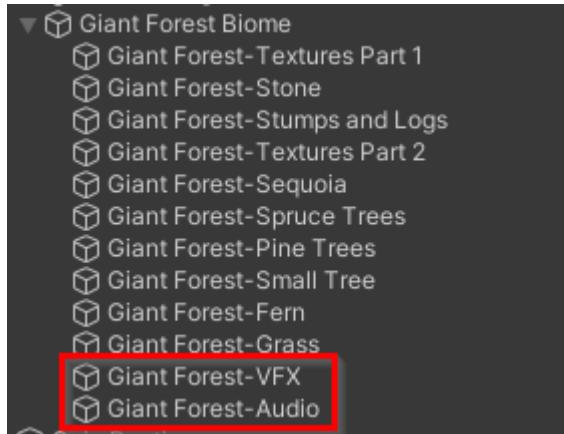
Gaia offers the “Quick Bake” option in the Runtime tab, which populates the basic lighting settings for the scene so that the ambient light is correct.

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>

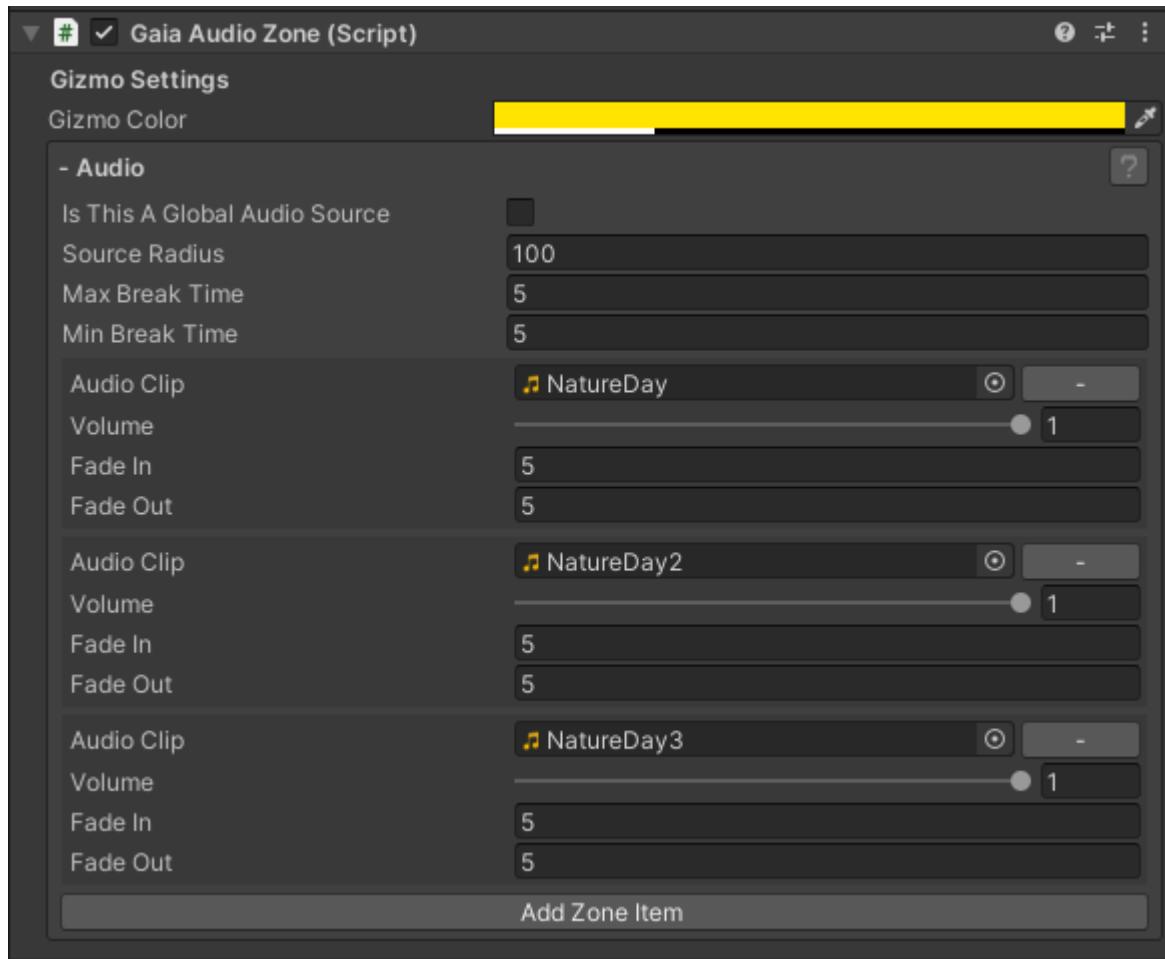
Use Audio and VFX management (Gaia Pro)

If you take a closer look at the spawners included in Gaia Pro, you will notice that some of those also spawn Audio sources and particle effects on the terrain:



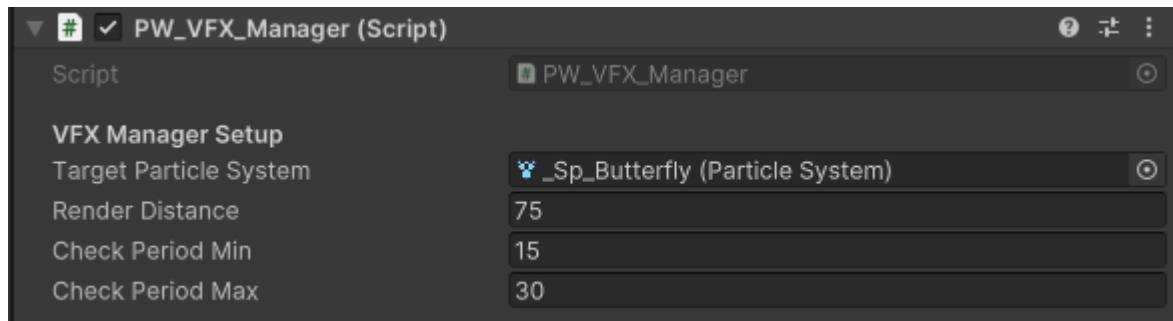
If you look closer into the resources these spawners add to the terrain, you will find that they place audio sources and particle effects on the terrain. Both are optimized only to be active when the player is near. You can harness the same systems to bring particle systems and audio effects to your scene in certain areas.

Place the Gaia Audio Zone script on the prefab that hosts the audio source to spawn optimized audio sources. It allows you to play back different, randomized audio samples from the same source.



Make sure you also got the Gaia Audio Manager script on your camera. There is an option to add it in the controller setup component, if you create your own player you would need to add it manually.

Likewise, you can add the PW_VFX_Manager script to your particle systems to make them play back only when the player is near.



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 in 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.

In order to use your git client effectively, you need to make sure that you install LFS (large file services) support. Then, you need a special file called .gitattributes to tell git which file types are to be considered large binary files.

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

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

.gitignore

```
#  
# 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
*.boopproj
*.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 `.gitattributes` file in the root of your Unity project directory. Then 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
```