

# Pathfinder Web

version 3.4.4

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# Pathfinder User Manual

Pathfinder is a cloud application developed by [Gilytics](#), used for the planning and routing of linear infrastructures like powerlines, underground cables, pipelines, roads, railways, as well as optimal placement of solar plants and other location-dependent facilities.

This user manual focuses on powerline routing, but a similar approach can be followed with other infrastructures.

Download a [PDF version](#) of this manual.

If you are currently a Pathfinder user, you may want to check what is new in version 3.4.4.

This manual will guide you the processes of using the software.

- Introduction to Pathfinder
- Create projects
- Add data
- Project viewer
- Set up a scenario
- Manage scenarios
- Run processes
- Analyze results
- Use comments
- Export results
- User profile and resources
- Use Cases

You can also find help on managing your account and enabling advanced features.

- Manage company users
- Set advanced options
- Run geoprocesses
- Information on data security

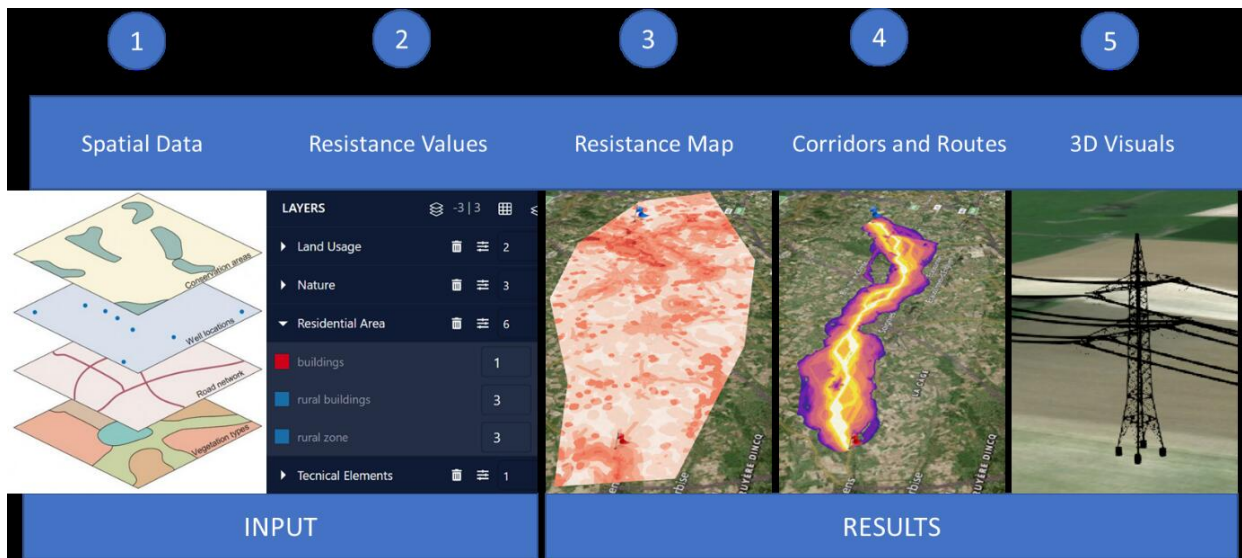
The left navigation area provides quick links to all the content.

## Introduction to Pathfinder

Pathfinder is a decision support system which implements a proven methodology to optimize the location and routing of infrastructure elements taking into account spatial and cost constraints.

## The Pathfinder methodology

The following diagram describes the typical steps followed with Pathfinder.



1. In a first step, relevant Spatial Data, representing important land features for the routing, are identified and imported into the application. A project is created for a specific study area.
2. Then, spatial data layers are assigned parameters representing their suitability of being crossed or hosting the infrastructure (e.g. power plants, power lines). These parameters are called Resistance Values and take into account regulations, constraints and other planning constraints. The resistance values define how suitable an area (forest, residential area, water bodies etc.) is for the location of the infrastructure (e.g. being crossed by powerlines and their pylons). Multiple scenarios can be defined with different resistance values and weights.
3. Based on these scenarios, Pathfinder runs a multi-criteria decision analysis (MCDA) to calculate the Resistance Map for the entire planning area.
4. The Resistance Map is the basis for Pathfinder to identify automatically possible optimal sites, corridors and paths within the planning area.
5. Additionally, 3D Visualizations and various forms of analytics and cost calculation can be used for discussion, decision making, stakeholder engagement and reporting purposes. The optimal paths and analysis results can be then exported to be used in other software.

## Where to start?

First, understand the different user roles and their permissions. You can find out your user role in the profile page.

Start using Pathfinder by opening an existing sample project or creating a new one.

You can also follow our [tutorial videos](#).

*Disclaimer:* the scenarios depicted in this manual do not represent actual customer projects or infrastructure proposals, and are presented for demonstration purposes only.

For more help, please use the help chat in the application, or [contact Gilytics](#).

## What's New in Version 3.4.4

In addition to other improvements and bug fixes, these are the main new features of the latest Pathfinder release:

- PDF manual
- Multipoint routing geoprocess
- Pipeline optimization geoprocess

- Specify dimensions in optimal site geoprocess
- More control on Forbidden behavior in Explore
- Upload project thumbnail

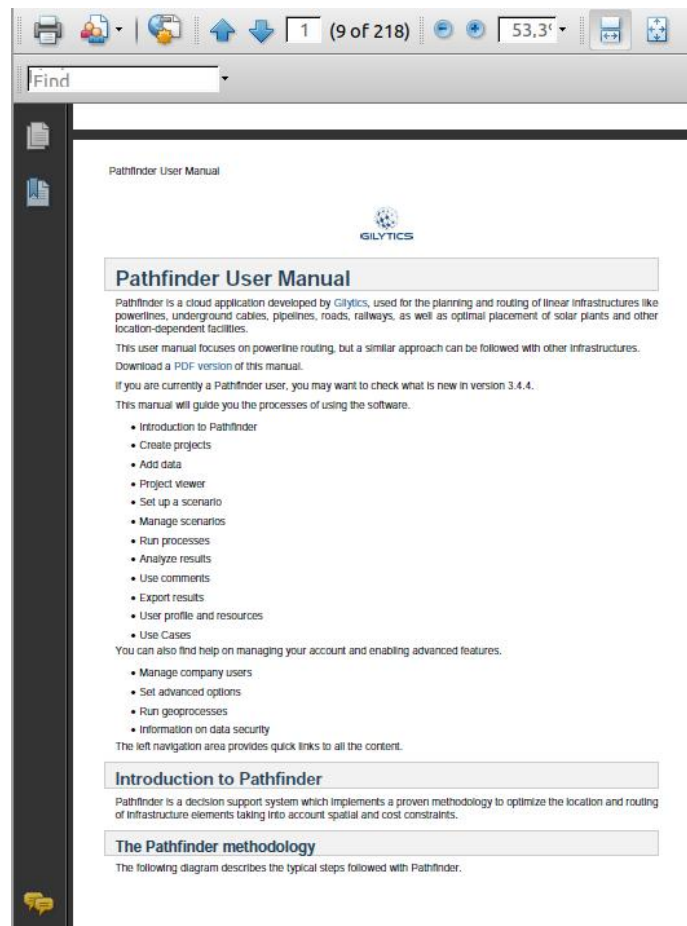
Previous releases:

- [What's new in Pathfinder 3.4.3](#)
- [What's new in Pathfinder 3.4.2](#)
- [What's new in Pathfinder 3.4.1](#)
- [What's new in Pathfinder 3.4](#)
- [What's new in Pathfinder 3.3](#)
- [What's new in Pathfinder 3.2](#)
- [What's new in Pathfinder 3.1](#)

## PDF manual

Starting with this version, a [PDF version](#) of the online manual can be downloaded from the index page.

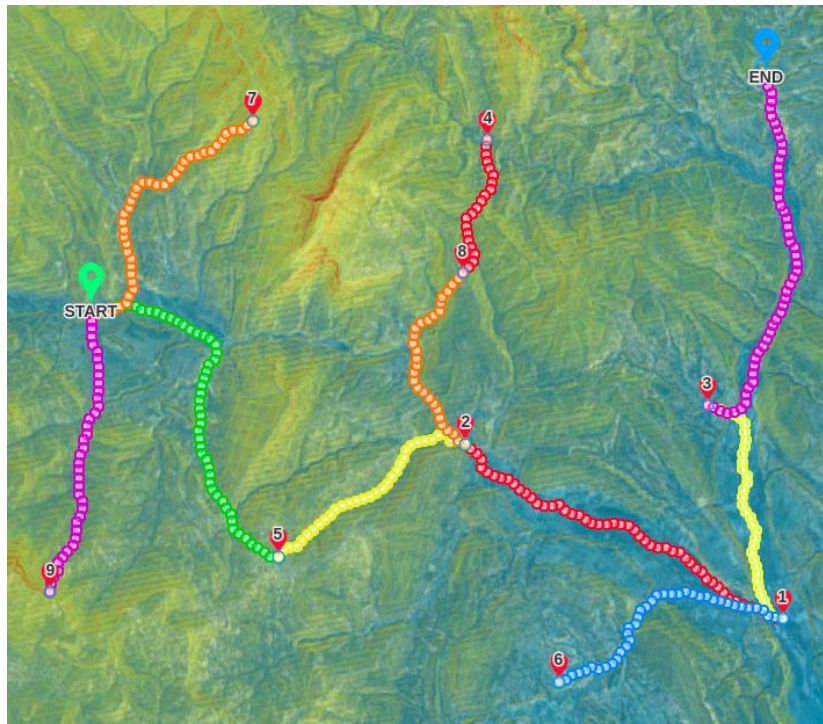
Please consider the environmental impact before printing this document.



## Multipoint routing geoprocess

A new geoprocess has been added to perform multipoint routing, meaning that Pathfinder will automatically find the most optimal combination of paths to join a number of unsorted locations. Both existing connections and excluded connections can be specified.

This geoprocess can be used, for instance, in grid expansion studies and connecting multiple wind turbines with feeder lines.



## Note

As with other geoprocesses, this one may not be activated in your company automatically. Check with Gilytics if you want to use it.

## Pipeline optimization geoprocess

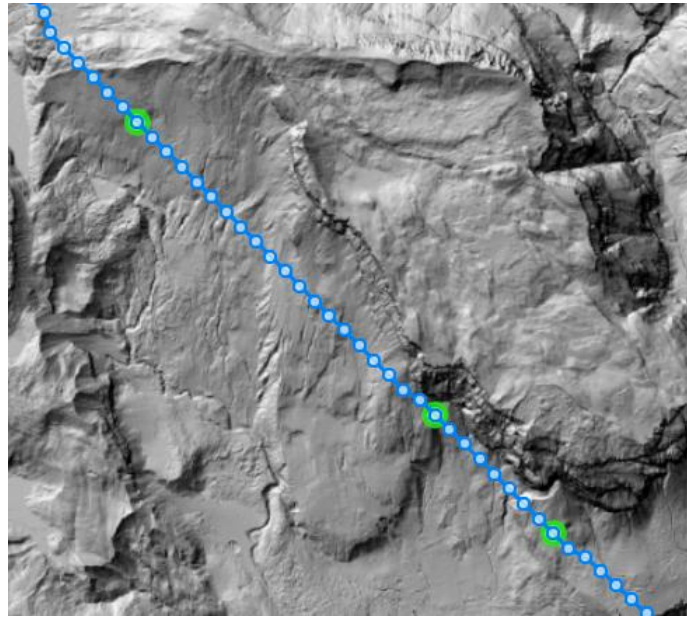
Gilytics has developed a specific geoprocess for pipeline optimization.

### Geoprocessing Tools

GEOPROCESS	RESULTS
Select Geoprocess	Pipeline Optimization
Select OPTIMAL_PATH	
[PATH] Basic (A)	
Path to calculate viewshed from each of its points	
Fluid properties	
Monetary costs	
Pipeline characteristics	
Pipeline sizes	
Pumps parameters	
Solver parameters	

This geoprocess can be used to optimize the pipeline infrastructure with a cost perspective and display the resulting pump and pressure reduction stations in Pathfinder.





This geoprocess requires expert knowledge. For more information about using it, check with Gilytics.

## Specify dimensions in optimal site geoprocess

The optimal siting geoprocess, used to find optimal locations for substations, power plants, etc., now allows the specification of the width and height of a precise rectangular area:

Force dimensions ^

<b>Select FORCE_RECT_WIDTH</b>	<b>Select FORCE_RECT_HEIGHT</b>
400	200
Force site width (m)	Force site height (m)

**Select FORCE\_RECT\_DIMENSIONS**

force\_rect\_dimensions

Force site to be rectangles with specified width and height.



Don't forget to *activate the checkbox* to apply these parameters.

## Forbidden value in Explore algorithm

Unlike other routing algorithms, the Explore algorithm doesn't apply the forbidden (FB value) constraint strictly. Because of the way the algorithm works, assigning to FB areas an "infinite" resistance (as the other algorithms do), would create problems in the optimization.

For this reason, the Explore algorithm internally assigns a high (but finite) resistance value to the FB areas. As a result, solutions calculated using Explore might still cross these areas, and this may be fine (for instance, crossing a river when it's not too wide).

Now, in the Explore configuration within each scenario, users have control on which resistance value is used by Explore in FB areas and, therefore, they can control how strictly these areas are avoided. The larger this resistance value is compared to the overall resistance map, the more strict the FB constraint will be.

### Routing Algorithm Configuration

Edge weight ?	0.4
Angle weight ?	0
Corridor width ?	1
<b>Resistance of FB areas ?</b>	<b>100</b>
<small>Resistance to be applied internally in Forbidden areas</small>	
Number of paths ?	5

Reset to default

CANCEL

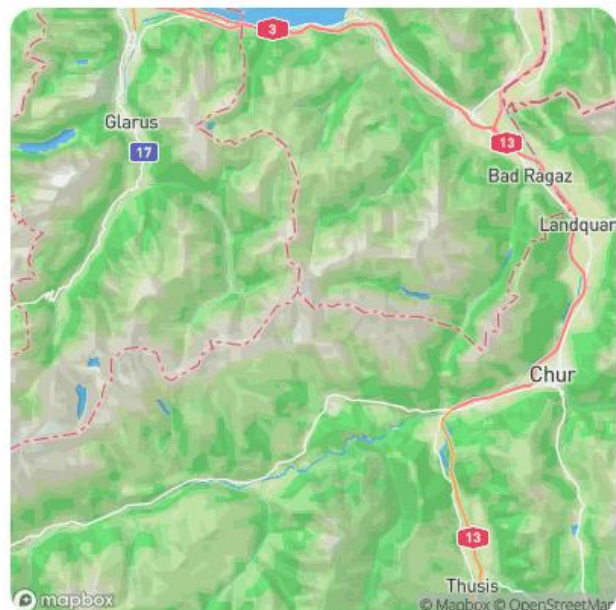
SAVE

## Upload project thumbnail

The project information dialog now shows the thumbnail for the project:

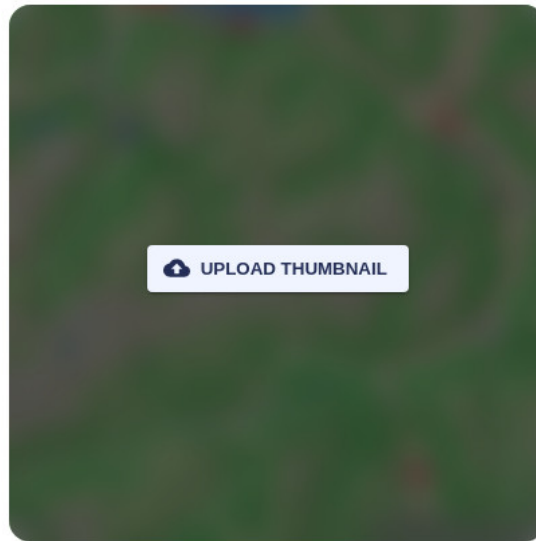
### Project Information

Project: **Switzerland tunnels**  
 Owner: **Sal\_Bay**  
 Date created: **2/21/2022, 3:21:39 PM**  
 Layers: **54**  
 Scenarios: **17**  
 Raster height: **3387**  
 Raster width: **5030**  
 Raster resolution (m): **10**  
 Area (m2): **1344644977**  
 Estimated Project size (bytes): **3679907760**  
 Estimated Raster size (bytes): **68146440**  
 Srid name: **WGS 84 / UTM zone 32N**  
 Srid: **32632**



## Pathfinder projects

To change the thumbnail from the default map, hover the mouse on the image and select a new one from your local disk.



---

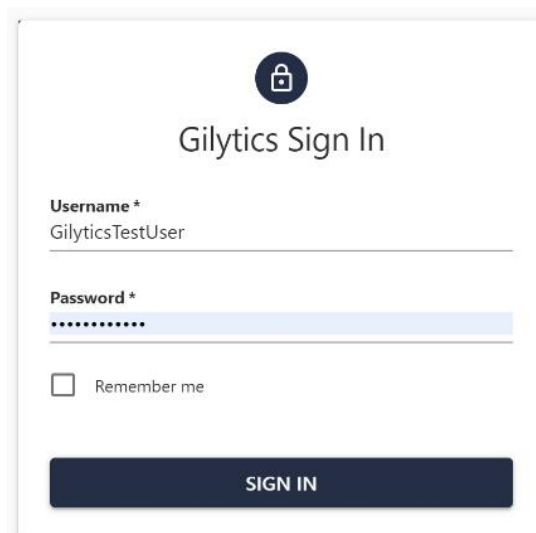
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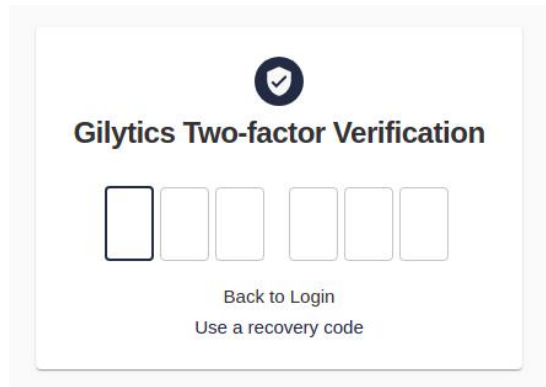
## Pathfinder projects

### Login

To get started, enter your username and password in the Pathfinder login window.



If you have enabled Two Factor Authentication, an additional step will require you to enter the 6-digit code generated at this time by the registered authentication app:



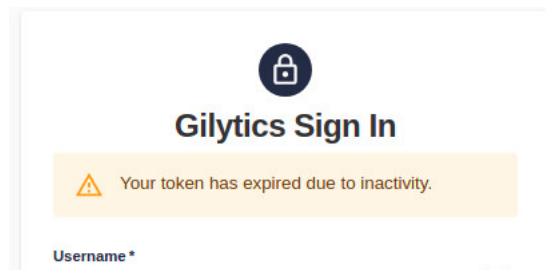
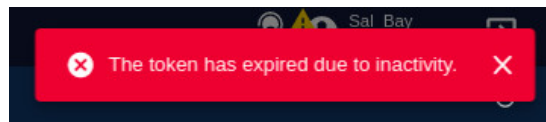
## Note

Depending on your user profile, you may have different permissions in Pathfinder.

## Automatic logout

To improve Pathfinder security, an automatic logout is performed when the user has been inactive for a long period (30 minutes). This prevents inappropriate accesses if you leave a session open.

When you return to Pathfinder after a long period of inactivity you will briefly see a notification of token expiration and then the application will show the login page.



## Note

*Inactivity* means that the user does not perform any read or write operation in Pathfinder, such as opening a project, adding data, change the visibility of a result or data element, changing any properties, running processes... Simply selecting the Pathfinder tab in the web browser or navigating in the map do not count as activity.

Contact Gilytics if you want to change the default inactivity period.

## Note

If you see a refresh loop in the login page after the automatic logout, just close the web browser tab and open a new one to log in.

## Open a project

Once logged in, you will see the list of existing projects in the Pathfinder account. In free trial accounts, you will find here the predefined projects to test the application. In other cases, this list may be initially empty.

The screenshot shows the Pathfinder web interface. At the top, there is a dark navigation bar with the Gilytics logo and the words 'PROJECT' and 'HELP'. Below this, the main content area is titled 'Latest Projects' and features a search bar. A grid of nine project tiles is displayed, each showing a satellite map of a region in Spain with a red line indicating a project path. The tiles are labeled 'Lorena Test' followed by a number (1, 2, 3, 4, 5, 6, 7, 10, 10). To the right of the grid, a 'Welcome to Pathfinder!' message is displayed, followed by the text 'Open an existing project or create a new project' and a prominent blue button labeled 'NEW PROJECT'.

Each company can choose a **default permission system** based on roles (in this case all company users have access to all projects) or a **per-project permission system**. Gilytics will configure the system your company prefers. If a per-project mode is configured, company administrators decide which users have access to each project.

### Note

Projects which are not accessible to a user will not be visible in the project list.

To open an existing project, just click on the tile with its name.

## Create a new project

### Note

Users who are not administrators can't create new projects. Ask your administrator to do so.

For this section, you can follow the first of our [tutorial videos](#):

To create a project, use the *New Project* button on the page, or the menu command with the same name under the top *Projects* menu. In both cases, the New Project Wizard will open.

## Create New Project

### Project name \*

Name

---

### Description

Description

---

### Categories \*

Category name

---

Add more categories (optional)

Add category

Default



## Basic properties

In the first step of the wizard, users must set these project properties:

- The **name** of the project.
- An optional **description** of the project, which will be displayed in the Project Information dialog.
- Initial project **categories**. Each project must have at least one category. A default one (“General”) will already be created. The user can create more by typing category names and clicking on the *Add category* button.

Categories are used for grouping layers with similar attributes or themes (for example, protected areas, existing infrastructures, physical medium, social data, etc.). Later, you can create new categories or move layers from one category to another.

Once you have set all the properties, click on *Next* to go to the next step.

## Project area, resolution and points

In this step, users define the Project Area. This is the region where the simulations are performed. You can set it in two ways:

- Drawing the area by hand.
- Importing the area from a file.



## Project area



### Draw the project area

If you want to draw the project area by hand, click on the *Draw Area* tile. The map view will appear.

Click on the *Draw Area* button and select which geometry you want to draw (Circle, Rectangle or Polygon). For Circle and Rectangle areas, you need to click first, drag the mouse and click a second time. For the Polygon area, click on multiple locations to define the area and then double-click to enter the last point.

You also have the specify the *project resolution*. This resolution will be used to build the resistance map and the corridors, and affect the precision of the optimized route points. Depending on the size of the project area, there might be a limit on how small the resolution can be.



## Note

You might get a warning message stating that the size is too large for the given resolution. You will also see a message below the resolution value. In this case, draw a smaller area or increase the resolution size in meters until the error message disappears.

Raster resolution in meters:

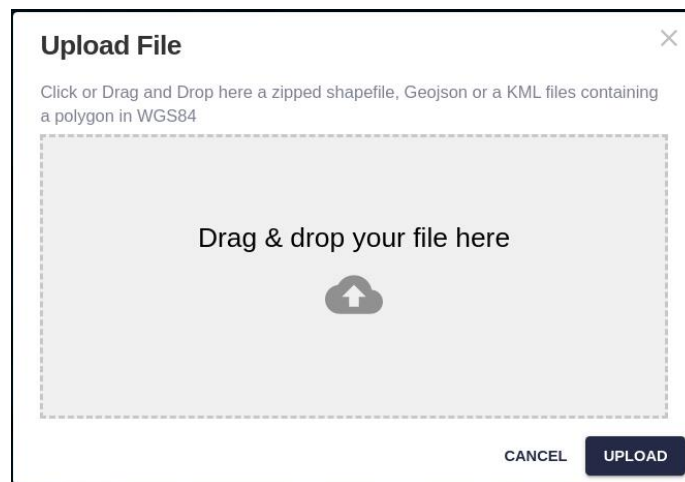
Max raster size reached, please reduce area or increase raster resolution

## Import the project area

If the project area is already defined in a file containing *geographic coordinates* in longitude and latitude (WGS84 or EPSG:3426 coordinate system), you can import this file by clicking on the *Import Area* tile or in the Import button next to the *Draw Area* button:



In both cases, a dialog will open where you can drag the file from a file browser, or click and browse to select it from your computer. The accepted formats are GeoJSON, KML and Shapefile (compressed as .zip).



## Project points

After the project area is defined, you can also specify the Start and End points for the routing calculations. These can also be set or changed later for the project, using the *Project/Edit Project Points* menu option.

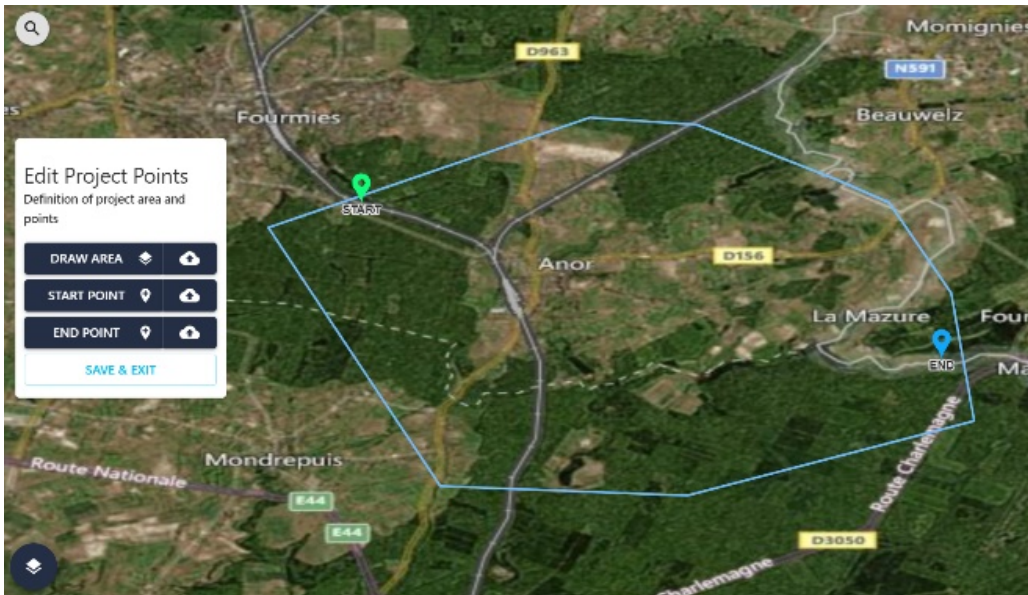
Start and End points can be changed for each scenario as well.

Like the project area, Start and End points can be specified manually on the map, or imported from a file *containing a single point in WGS84 coordinates*. You can choose these options by clicking on the named button or in the cloud import button.



After the points are drawn or imported, they appear as pins on the map.





Finally, click on *Save and Exit* to finish the editing and return to the wizard.

### Adding initial layers

In the next page of the wizard, the user can add some layers to the project based on **datasets** shared by all Pathfinder users (like OpenStreetMap data) or by the company members.

If you user has administration permission, he/she can add more datasets later. We can also add layers to the project after it is created, so this step is optional. If you want to add some initial layers now, see how to define them.



### Add New Layers

Select the base datasets to create the layer(s). Only base datasets available in your project area are shown. If there is none, first import the datasets.

UPLOADED OSM WFS Search Datasets + ADD RING

Name	Filter	Category	Buffer Ring		Ring Width				Distance
			Single	Multi	Buffer 1	Buffer 2	Buffer 3	Buffer 4	
<input type="checkbox"/> elena-cv-test 433 dem		Default							
<input type="checkbox"/> elena-cv-test 433 slope		Default							
<input type="checkbox"/> ESP rails	SET	Default	<input checked="" type="radio"/>	<input type="radio"/>	[m]				
<input type="checkbox"/> ESP roads	SET	Default	<input checked="" type="radio"/>	<input type="radio"/>	[m]				

CANCEL BACK COPY FROM ANOTHER PROJECT PROCESS

Users can also bring layers, their rings and categories from an existing project by using the corresponding button:

COPY FROM ANOTHER PROJECT

After clicking this button, the user can choose an existing project to copy the layers, rings and categories from:

## Select project to copy settings from

- probando
- Project\_Manuel
- Rafael Test
- Rok test 7

An information dialog will appear then to confirm:

## Select Project

You're about to select **Project\_Manuel** project. You will copy all buffer settings and categories from this project.

CANCEL SELECT

When the process is completed, a dialog will show the list of the copied categories and layers:

## Import buffers from Project\_Manuel

The following categories and layer configuration have been added to the project:

### Infrastructures

- geonode:ES\_Oil\_Gas\_Pipelines
- geonode:ES Power Lines (<100kV-150kV)
- geonode:ES\_VC\_A\_Railway

### Settlements

- geonode:ES\_Archaeological\_Sites
- geonode:ES\_CV\_High\_cultural\_value
- ms:clasificacion

### Hidrology

- geonode:ES\_Lakes
- geonode:ES\_VC\_Rivers
- geonode:ES\_VC\_Sea

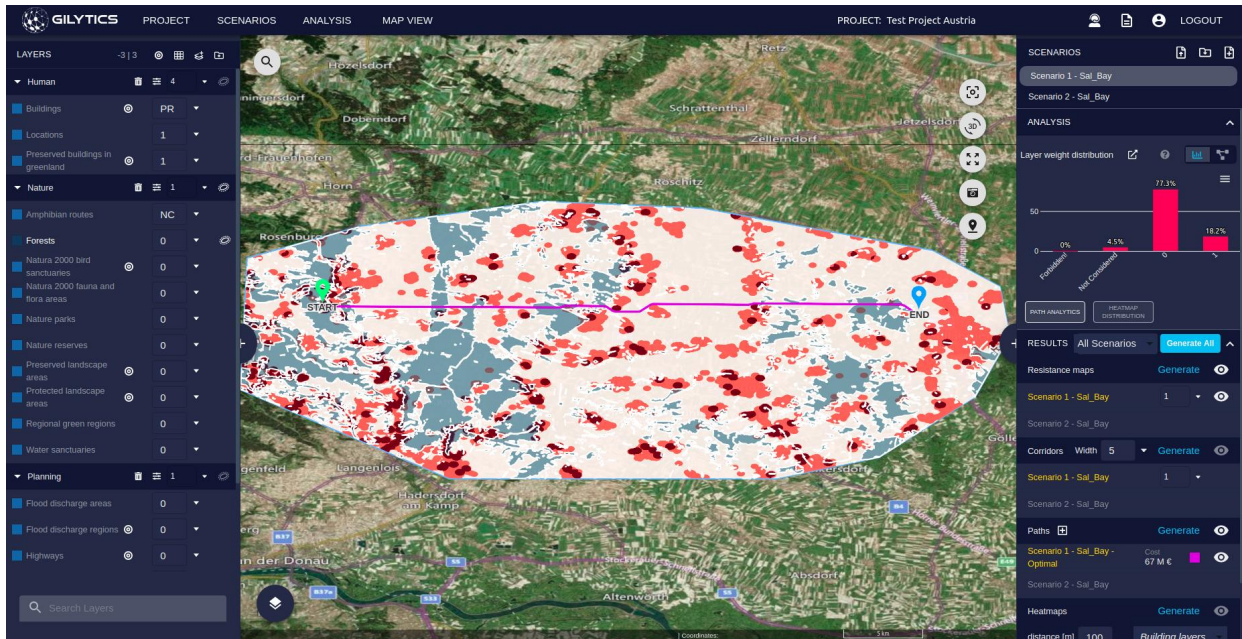
### Terrain

- Flat\_terrain\_Manuel\_20
- geonode:ES\_CV\_Clay
- geonode:ES\_VC\_Agricultural\_Land\_Use
- geonode:ES\_VC\_Forest
- project\_manuel\_432\_dem
- project\_manuel\_432\_slope
- Didges\_Manuel\_20

CONTINUE

After selecting some layers (or none), press the *Process* button. The Project Viewer will appear.

## Pathfinder projects

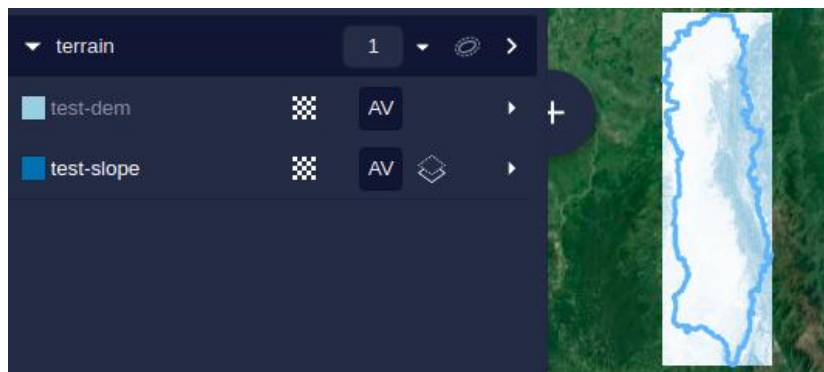


Data may need some time to be processed. You can track the data preparation progress in the Process Log. After this, you can explore or add more data to your Pathfinder project.

## Default raster layers

When a project is created, a **digital elevation model** and a **slope map** are automatically created for your study area from open data sources and added to the project as default layers.

The default Slope Map provides slope in *degrees*.



These layers use public data providing a 30m resolution elevation model for the whole globe. If you wish, you can upload your own DEM and slope raster data for the project.

## Project information

The project information can be accessed from the Project menu:



PROJECT

New Project

Open Project

Delete Project

Edit Project Points

Import Datasets

Add New Layer

Add New Category

Layer Preprocessing

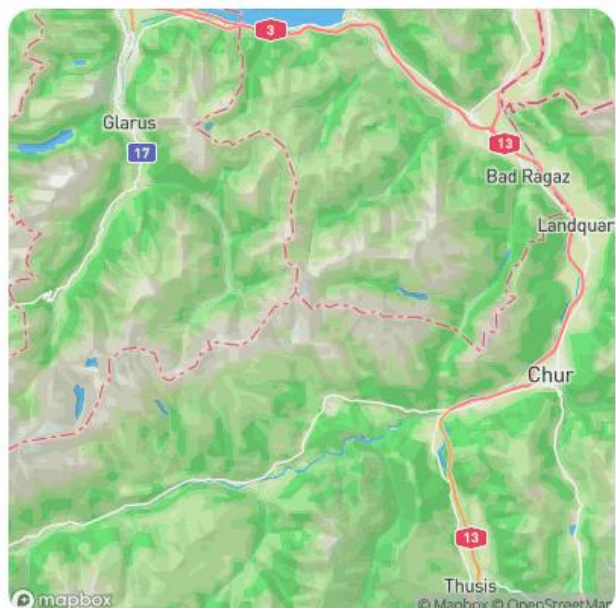
Project Information

The Project Information dialog shows:

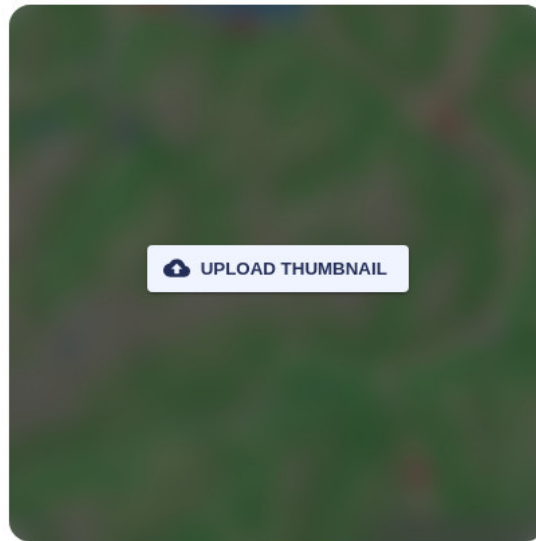
- The project's *owner*: the user who created the project (it can also be assigned by a company administrator).
- The project's *creation date*
- The number of *layers* and *scenarios* used by the project. Its layers are the same for all users, but the scenarios may vary.
- Raster *width, height, resolution and area*. These parameters give information about the extent, size and scale of the project. The larger the raster width and height of the project, the longer its layers and results will take to process.
- Internal *coordinate system* name and ID. All data in Pathfinder is internally projected to a [UTM coordinate system](#). Its UTM zone and [EPSG ID](#) are provided here. When the path results are exported, a copy is saved in this coordinate system.
- The project *thumbnail*, which is also shown in the Projects page of Pathfinder.
- The project *description*, if entered when it was created, appears below the thumbnail.

## Project Information

Project: **Switzerland tunnels**  
 Owner: **Sal\_Bay**  
 Date created: **2/21/2022, 3:21:39 PM**  
 Layers: **54**  
 Scenarios: **17**  
 Raster height: **3387**  
 Raster width: **5030**  
 Raster resolution (m): **10**  
 Area (m2): **1344644977**  
 Estimated Project size (bytes): **3679907760**  
 Estimated Raster size (bytes): **68146440**  
 Srid name: **WGS 84 / UTM zone 32N**  
 Srid: **32632**

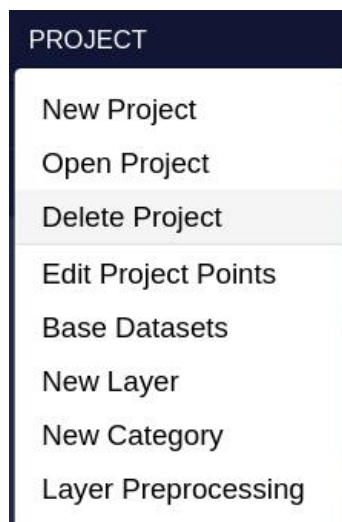


To change the thumbnail from the default map, hover the mouse on the image and click on the button to select a new one from your local disk.



## Delete a project

Some Pathfinder licenses may have a limit on the number of projects, or a limit on the data storage used. You can remove projects from the cloud by using the *Delete project* menu option:



A warning will be displayed before deleting the project.

### Delete Project

You are about to delete the aaa test delete project. **This can't be undone!** All data will be deleted.

NO

YES

Keep in mind that, if you delete the project, its simulations results will also be removed. It is advisable to export the project results before deleting it.

### Note

Users who are not administrators can't delete projects. Ask your administrator to do so.

*Disclaimer:* the scenarios depicted in this manual do not represent actual customer projects or infrastructure proposals, and are presented for demonstration purposes only.

For more help, please use the help chat in the application, or [contact Gilytics](#).

## Adding Data

In order to optimize the location of the infrastructures, Pathfinder needs spatial information about the suitability of different locations. This geospatial information is collected from multiple datasets in *vector* form (*features*) and *raster* (*image*) form.

Check out our recommended steps to prepare data for Pathfinder.

### Note

Users who are not admin/staff can't add data. Ask your administrator to do it for you.

## Base Datasets and Project Layers

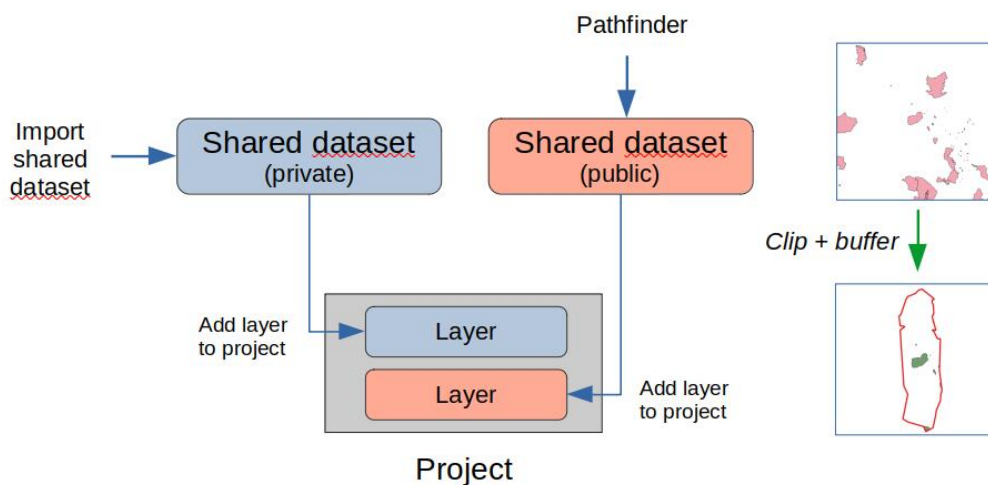
Pathfinder works with vector and raster data at two levels:

- **Base datasets:** These contain the original data which can be used in different projects. For instance, we may have a “protected areas” dataset or a land cover raster for the whole country that we want to use for different study areas (different projects).

The base datasets can be:

- *Public datasets:* They are setup by Gilytics for all Pathfinder users. An example are the [OpenStreetMap \(OSM\)](#) datasets for the whole world.
- *Private datasets:* They are uploaded or connected from remote services by Pathfinder users, and are available to all members of your organization.
- **Project layers:** Data from the base datasets are added to a project in the form of a *layer*, clipped to the *area* of the project.

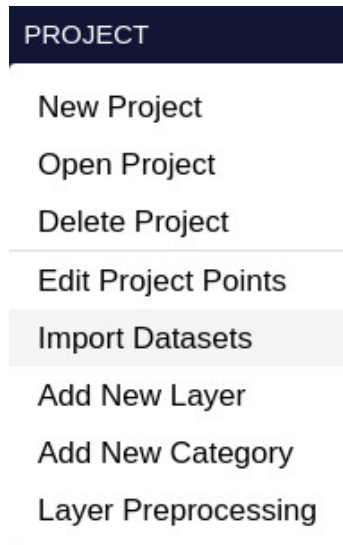
Therefore, data can be added to a project only by creating layers from the base datasets, either public or private.



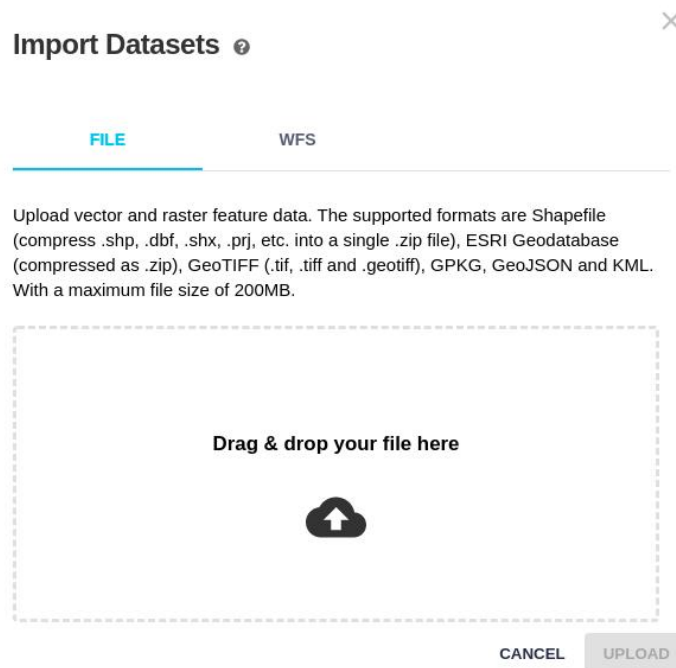
## Adding Base Datasets

For this section, you can follow one of our [tutorial videos](#):

To add private base datasets to be used within your organization and projects, use the *Project/Import Datasets* menu option.



The *Import Datasets* dialog will open:



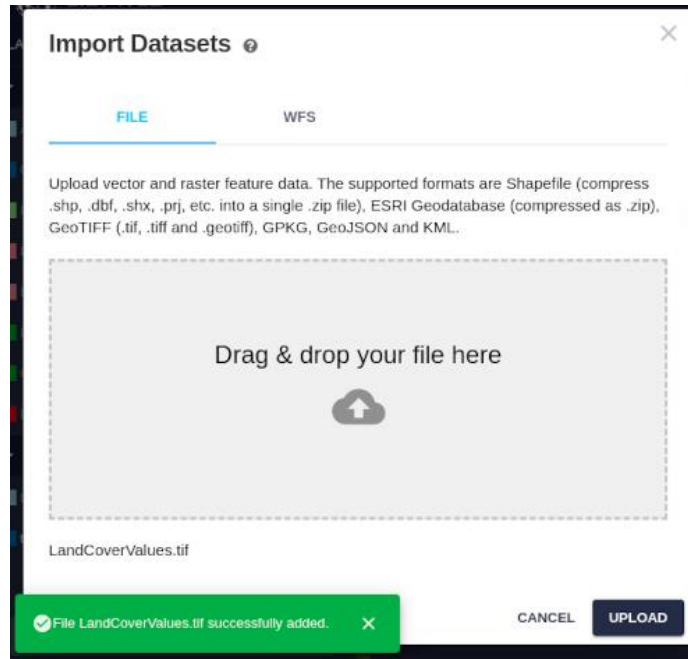
From the user profile it is possible to list the datasets already available and also add new ones.

## Add the Files

By default, the **File** tab is selected in the *Import Datasets* dialog. The supported formats are

- Vector data: shapefile (all files compressed in a single .zip), ESRI Geodatabase (zip), GPKG, GeoJSON and KML.
- Raster data: GeoTIFF files (.tif, .tiff, .geotiff).

You can drag and drop, or select, the data files. Multiple files are supported. They should appear in the list below the drop area before they can be uploaded. If a format is not supported, an alert message will be visible and the file will not be listed.



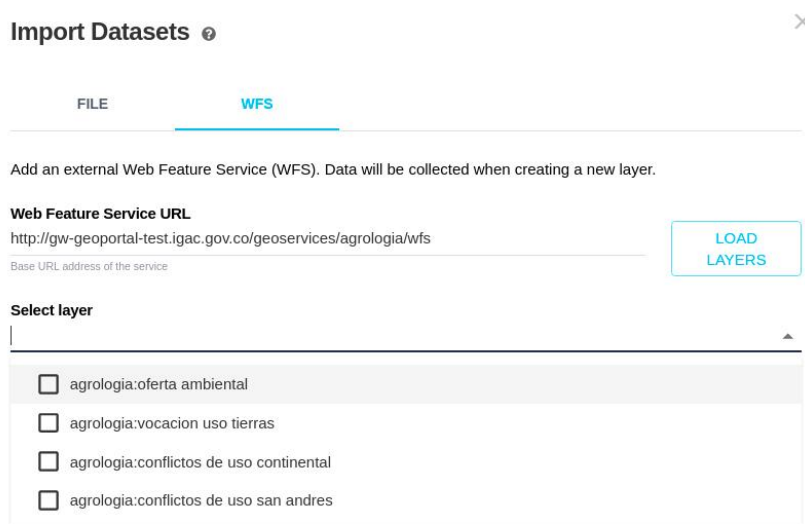
After you click on the *Upload* button, the new datasets will be uploaded and stored in the Pathfinder database. You can follow the progress in the Process Log popup window:



## Add WFS Services

Another option to add vector data to Pathfinder is to use a [Web Feature Service](#). Some organizations publish data in this form.

Select the **WFS** tab in the *Import Dataset* dialog, and enter the URL of the service you want to access. Then click on the *Load Layers* button to get a list of the available datasets:



You can type some text to search available layers by name:



**Select layer**  
area

---

A

AreaNoZ

C

CH Grundwasserschutzareale

CH swissTLM3D Verkehrsareal

Click on the layer list names to select which datasets you want to create from the WFS service:

**Select layer**

---

agrologia:oferta ambiental

agrologia:vocacion uso tierras

agrologia:conflictos de uso continental

agrologia:conflictos de uso san andres

After you click on the *Upload* button, you should see a confirmation that the base dataset was created:

**Select layer**  
1 layer selected

---

**agrologia:oferta\_ambiental** ✓ Completed

When you are done adding datasets, click on **Cancel** to close the dialog.

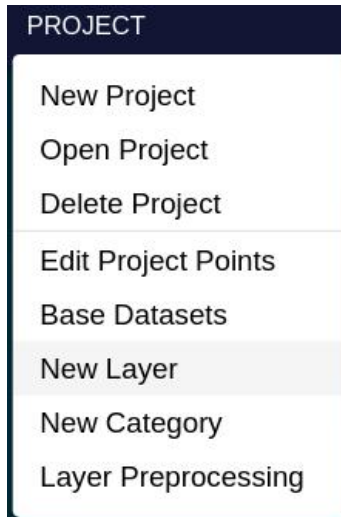
## Adding Layers to a Project

After creating and opening a project, you can add layers to it in the project viewer.

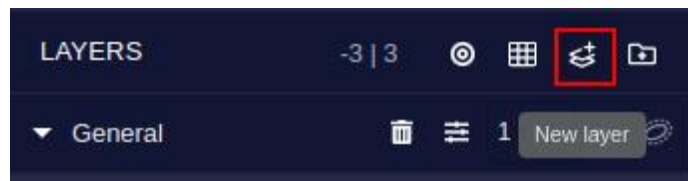
### Note

*Base datasets are not visible in the project until they are added as one or more layers.*

To add a new layer, use the *Project/New Layer* menu option:



You can also use the *New layer* icon button in the LAYERS header of the left panel:



In both cases, the *Add New Layer dialog* will become visible:

### Add New Layer

UPLOADED OSM WFS INCLUDED Search Datasets + ADD RING

Name	Filter	Category	Buffer Ring		Ring Width				Distance
			Single	Multi	Buffer 1	Buffer 2	Buffer 3	Buffer 4	
<input checked="" type="checkbox"/> Natura2000 end2019 epsg3035	SET	General	<input type="radio"/>	<input checked="" type="radio"/>	100	200	[m]	[m]	
<input type="checkbox"/> area	SET	General	<input checked="" type="radio"/>	<input type="radio"/>	50				
<input type="checkbox"/> buildings clipped	SET	General	<input checked="" type="radio"/>	<input type="radio"/>	100				
<input type="checkbox"/> cables	SET	General	<input checked="" type="radio"/>	<input type="radio"/>	25				
<input type="checkbox"/> rasters/building-classes 66/DEM.tif		General							
<input type="checkbox"/> rasters/building-classes 66/SLOPE.tif		General							
<input type="checkbox"/> swissTLM3D TLM GEBAEUDE FOOTP RINT	SET	General	<input checked="" type="radio"/>	<input type="radio"/>	[m]				

COPY BUFFER SETTINGS FROM ANOTHER PROJECT Rows per page 10 1-7 of 7

If a raster with multiple bands has been imported, the user will be able to add them separately as layers in the project.

## Add New Layers

Select the base datasets to create the layer(s). Only base datasets are

UPLOADED	OSM	WCS
<div style="border: 1px solid #ccc; padding: 5px;"> <div style="background-color: #f0f0f0; padding: 2px 5px;"><input type="checkbox"/> Name</div> <div style="padding: 2px 5px;"><input checked="" type="checkbox"/> clipped image-BAND0</div> <div style="padding: 2px 5px;"><input checked="" type="checkbox"/> clipped image-BAND1</div> <div style="padding: 2px 5px;"><input checked="" type="checkbox"/> clipped image-BAND2</div> </div>		

Default	1		
<input checked="" type="checkbox"/> clipped image-BAND0	<input checked="" type="checkbox"/>	AV	<input type="checkbox"/>
<input checked="" type="checkbox"/> clipped image-BAND1	<input checked="" type="checkbox"/>	AV	<input type="checkbox"/>
<input checked="" type="checkbox"/> clipped image-BAND2	<input checked="" type="checkbox"/>	AV	<input type="checkbox"/>

### Configuring the Layers

The *Add New Layer dialog* will show all datasets (public and private) available to create project layers. You can use the checkboxes to select one or more of these datasets to create new layers.

#### Note

Only the base datasets whose extension intersects the project area are listed. If a base dataset is already used by other project layer, it will appear under the “Included” tab.

Even if the base dataset extension includes the project area, it may happen that it does not include any data in this area.

Use the *Search Layers* input to quickly find the dataset you are interested. For instance, search for “forest” to quickly find the OSM Forest dataset.

#### Add New Layer

UPLOADED	OSM	WFS	INCLUDED	SEARCH	ADD RING
<input type="checkbox"/> Name	Filter	Category	Buffer Ring Single Multi	Ring Width Buffer 1 Buffer 2 Buffer 3 Buffer 4	Distance
<input type="checkbox"/> cables	SET	General	<input checked="" type="radio"/> <input type="radio"/>	[m]	

COPY BUFFER SETTINGS FROM ANOTHER PROJECT

Rows per page 10 1-7 of 7

The layer configuration includes these options (raster layers only require the Category):

- For vector layers, set a **filter** to specify the objects to be used in the layer, based on attributes or field values. If no filter is specified, all features from the base dataset in the project area will be used.

## Adding Data

First click on the Set button in the Filter column. Then, in the filter dialog, select the attribute containing the property you are interested, as well as the operator (=, <, ...) and the value to compare. Multiple filters can be combined by using Add Filter, as in the following example.

**Filter Baselayer**

OBJEKTART = Offenes Gebaeude

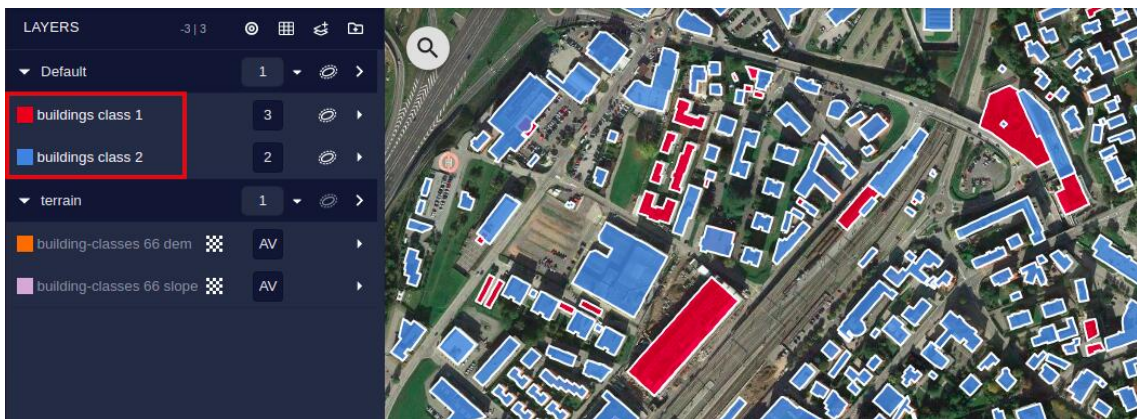
OR

OBJEKTART = Im Bau

+ ADD FILTER

CANCEL APPLY

By repeating this process on the same base dataset, you can easily create layers with different objects from the original data.



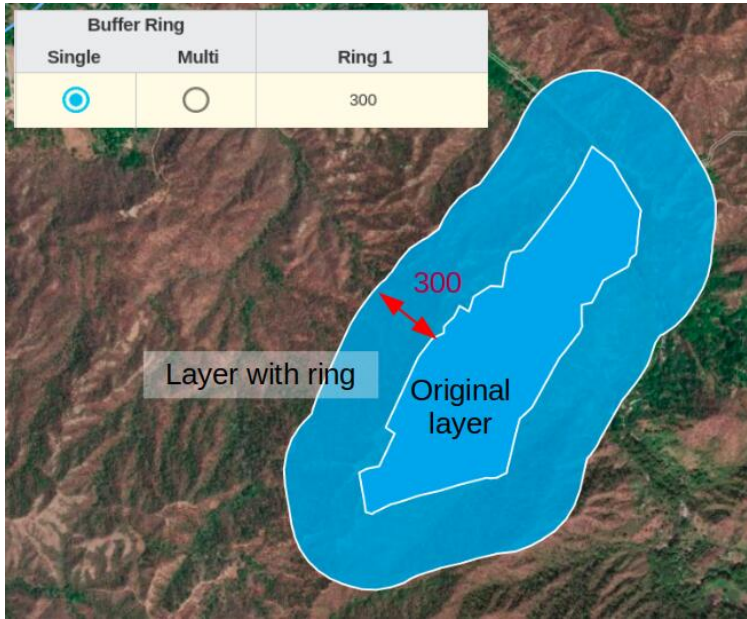
- Select the name of the **category** (the group the layer will belong to) in the dropdown of the column *Category*. Categories are important to tune the relative weight of different layer groups in the optimization scenarios. The name and members of categories can be changed later.
- Select the **buffering** option: *single or multiple* buffer rings.

Buffer Ring

Single Multi

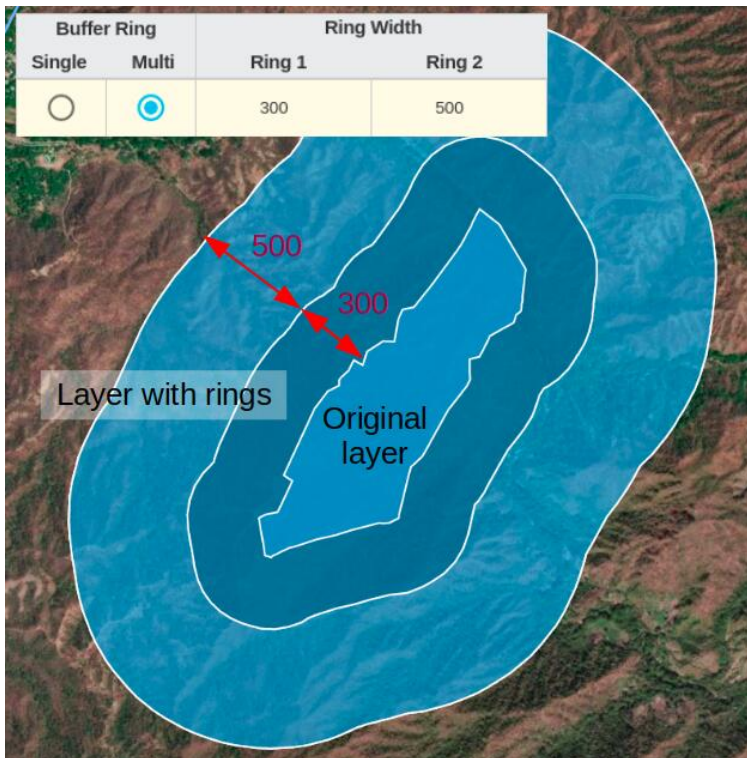
*Buffer rings* are used to extend the area of influence beyond the original dataset boundaries or locations.

- In the *single ring* mode, the original data boundary or location is extended by a certain distance or *ring width*:



- In the *multi ring* mode, the original data are extended with multiple rings at different distances, so we can set different resistances or cost to each of these areas. Normally, the first ring will have a higher resistance, and more distant rings will have progressively lower resistance.

The user specifies the *width* of each ring, and the distances are added (e.g. if widths are 100, 200, 300, the distances to the original will be 100, 300, 600...):



By default, up to four rings can be defined. Click on the *Add Ring* button if you want more rings:

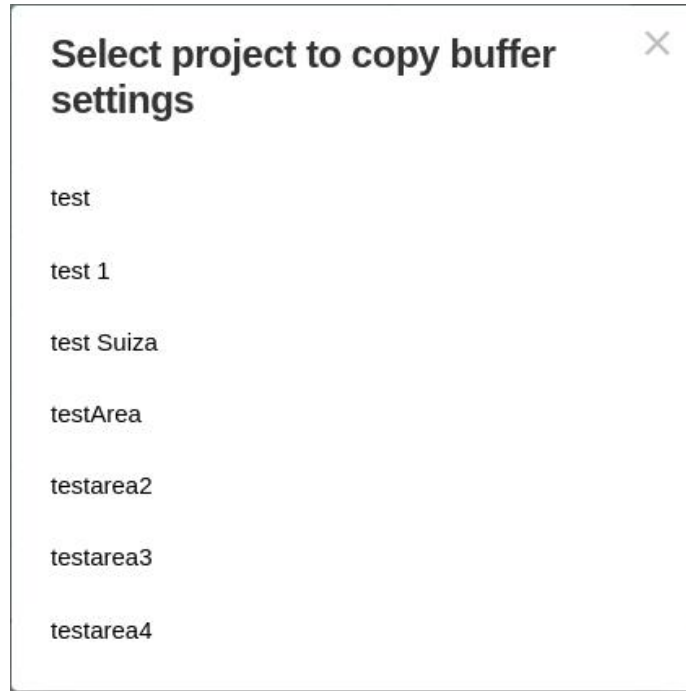


If you have a project containing correct settings for the layers, you can copy them to the current project, by clicking on the *Copy Buffer Settings from Project* button:

**COPY BUFFER SETTINGS FROM PROJECT**



When the selection dialog pops up, select the project you want to copy the settings from:



After the layer configuration is finished, click on the *Process Layers* button at the bottom right.

You can follow the progress of layer preprocessing in the Process Log:



After the process is completed, the new layers will be visible in the Left Panel of Pathfinder.

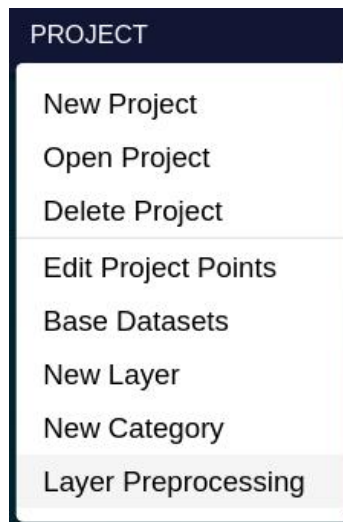
## Changing the Layer Configuration

The layer configuration can be changed at any time while working in the project. This is typically needed to change the layer filter, the number of rings or their widths.

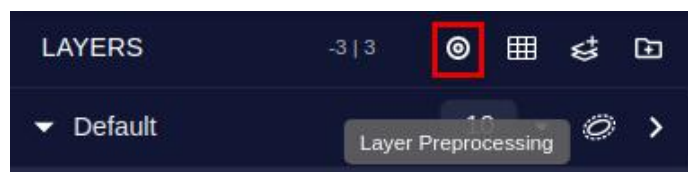
### Note

*Only the project owner (the user who created the project) and the administrators of the company can change the layer configuration.*

Layer configuration changes require the layers to be processed again from the base data. To access the configuration properties at any time, use the *Project/Layer Preprocessing* menu option:



You can also access it from the corresponding icon in the *Layers* panel on the left:



The window displayed with a table of the project layers is very similar to the Add New Layer dialog we have seen. After changing the properties of one or more layers, they get automatically selected, so when the user clicks on the *Process Selected* button, these layers will be reprocessed:

### Layer Preprocessing

+ ADD RING
PROCESS SELECTED

Name	Filter	Category	Buffer Ring		Ring Width		Distance
			Single	Multi	Buffer 1	Buffer 2	
<input checked="" type="checkbox"/> buildings class 1	EDIT	General	<input type="radio"/>	<input checked="" type="radio"/>	50	100	
<input checked="" type="checkbox"/> buildings class 2	EDIT	General	<input type="radio"/>	<input checked="" type="radio"/>	50	100	
<input type="checkbox"/> building-classes 66 dem		Terreno					
<input type="checkbox"/> building-classes 66 slope		Terreno					

Check the process log to see when the layer processing ends and you can verify visually the results.

*Disclaimer:* the scenarios depicted in this manual do not represent actual customer projects or infrastructure proposals, and are presented for demonstration purposes only.

For more help, please use the help chat in the application, or [contact Gilytics](#).

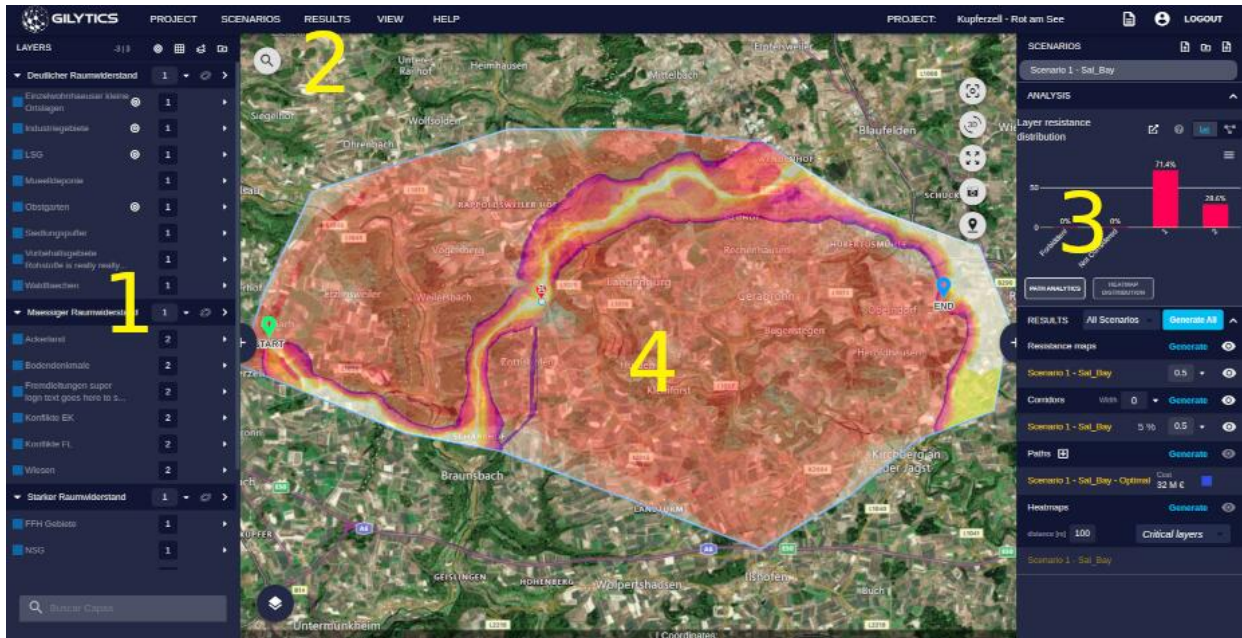
## Project Viewer

We have seen how to create a project and add data layers to it. Before performing an analysis based on these data layers, we need to understand how to organize and explore the data in the Project Viewer.

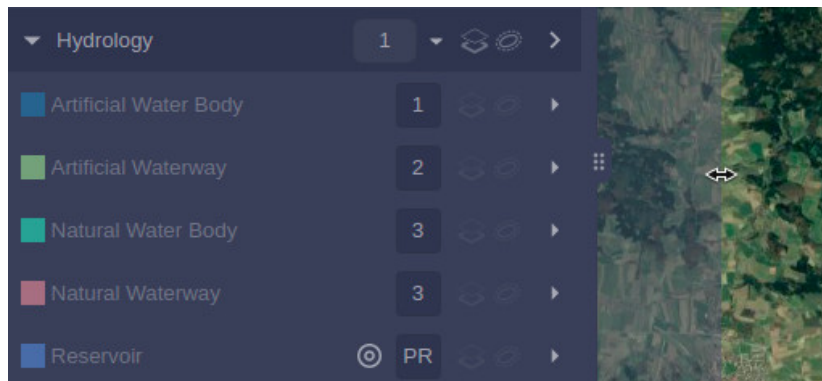
### Project Viewer Sections

The interface of Pathfinder consists of four major components:

- The left panel (1) lists the **layers** added to the project, grouped by **category**.
- The top menu (2) includes commands to modify the **project** and its **scenarios**, calculate and export the analysis **results**, and access the application **configuration**.
- The right panel (3) has specific sections to manage scenarios and their results.
- The central view (4) offers an interactive **2D map or 3D view** of the data and the results.



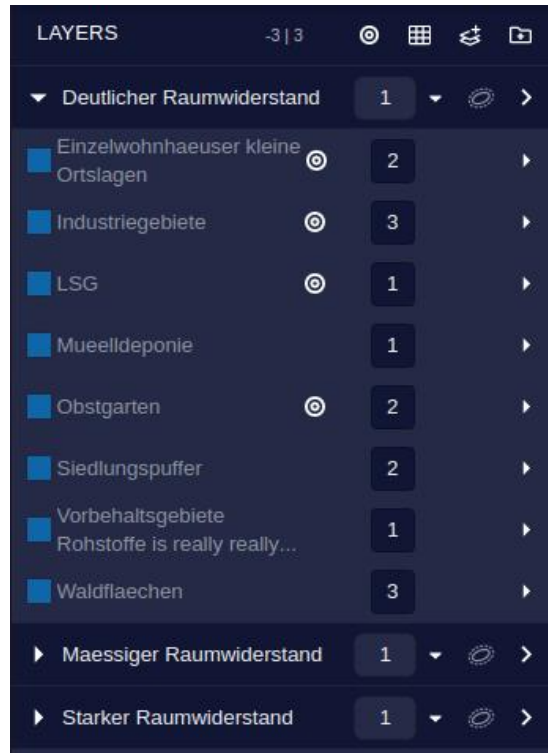
Side panels (sections 1 and 3) can be hidden and reopened by clicking on their pull handles, and their width changed by dragging sideways from the handle:



## Organize Data

Data layers are listed in the left panel, grouped by their **category**. The category is assigned when a layer is added to the project, but it can be changed later.





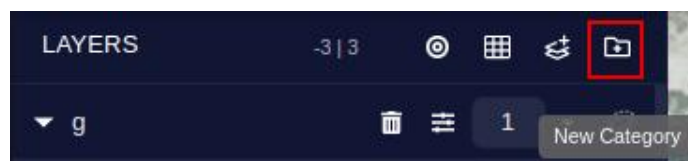
The role of categories is to group layers which share a common theme (for instance, existing infrastructures, physical environment, land property, etc.) so the user can adjust their weight (importance) in the analysis scenario.

### Note

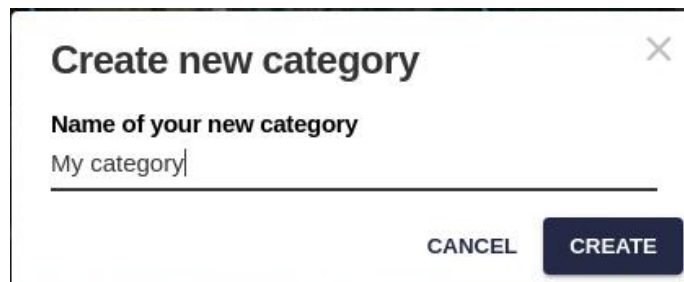
Users who are not admin/staff can't create, modify or delete categories or their layer list. Ask your administrator to do it for you.

### Create New Category

A new category can be created from the *Project/New Category* menu option and also from the corresponding button in the Layers panel header.

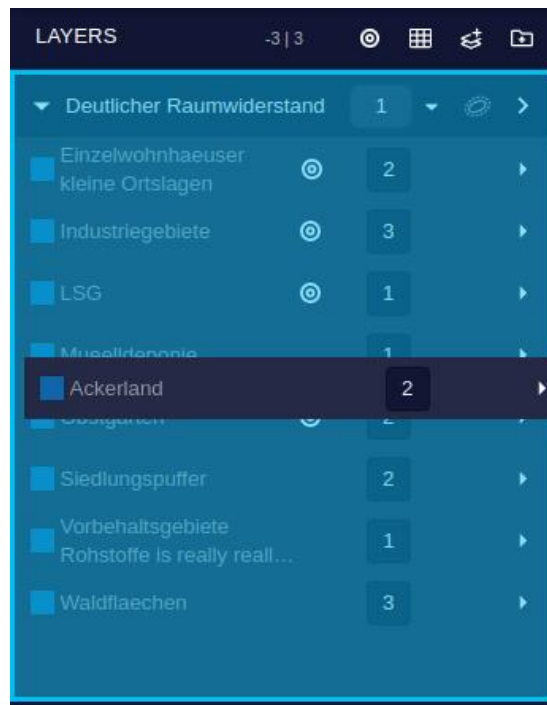


The category name is assigned in the following dialog:

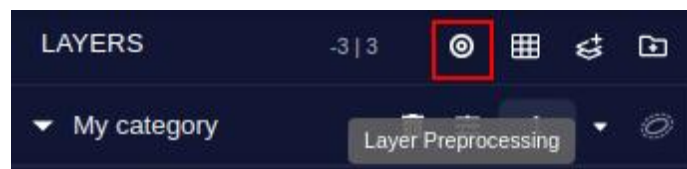


### Change Layer Category

Layers can be moved to a different category by clicking on them and dragging them to a different group.

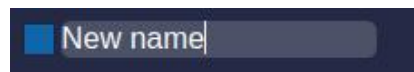


The category of a layer can also be changed in the *Layer Preprocessing* dialog, which opens from the Project menu or from the button in the Layers panel header.



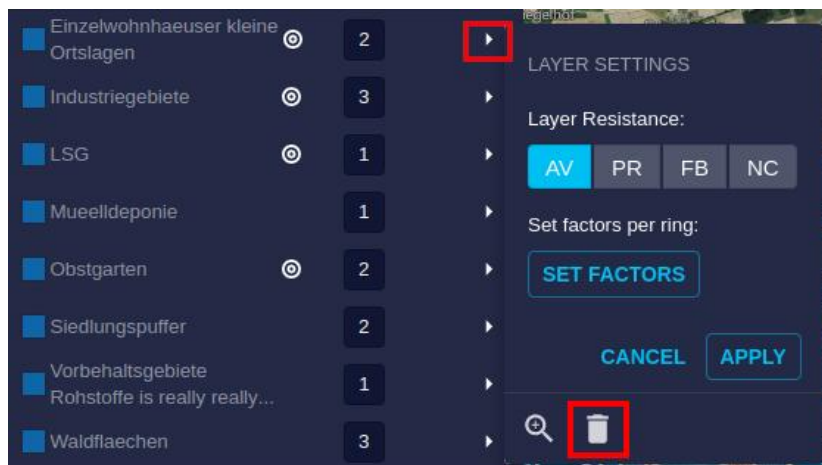
## Change Names

To change the name of a category or layer, double-click on its name, type the modified name and *hit Enter*, or click outside the Layers panel to cancel the change.



## Delete a Layer

A layer can be removed by using the *Delete* button in its side panel. First, open the side panel to the right of the layer item, and then click on the Delete button:



A dialog will prompt the user to confirm the operation:

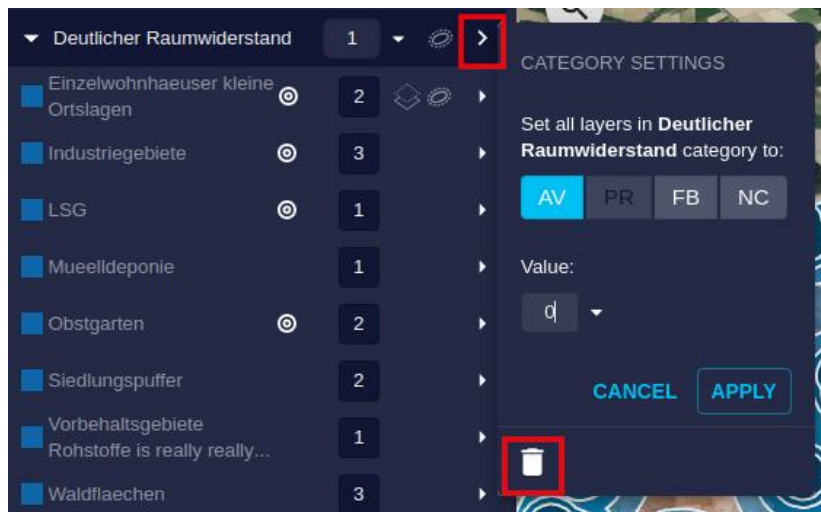


## Note

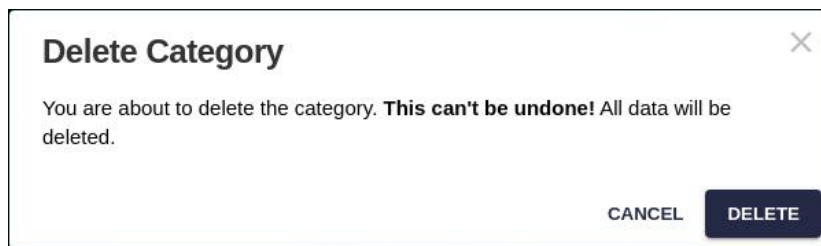
*If a layer is removed from the project, it can be recreated from the base data without the need to upload it again.*

## Delete a Category

Like the layers, a category can be removed from the project by using the *Delete* button in its side panel.



A dialog will prompt the user to confirm the operation:



## Note

*If a category is removed, all the layers it contains will also be removed from the project.*

## Explore Data

The main view of Pathfinder is used to explore data added to the project and the results of the analysis processes. In order to display a layer in the view, it must be made visible.

## Layer Visibility

A layer can be displayed in two ways:

- **Original layer:** Displays the original vector features of the layer without buffering. Use the first visibility button:



This is the only visibility option available for *raster layers*:



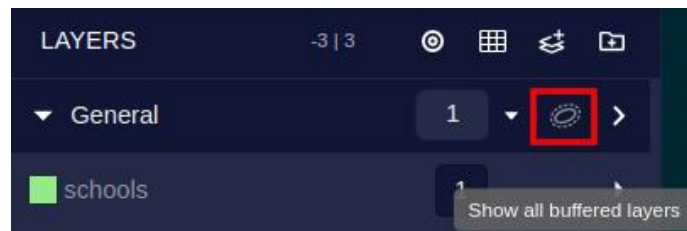
- **Buffered layer:** Available for vector data. It displays the features with buffering, showing one or multiple rings depending on the layer configuration. For multiple rings, different transparency values are applied. Use the second visibility button to switch this mode on:



The following image shows the difference between the original (left) and the buffered displays (right):



The visibility of *all buffered layers in a category* can be changed at once with the button located in the category header, identical to the layers'.



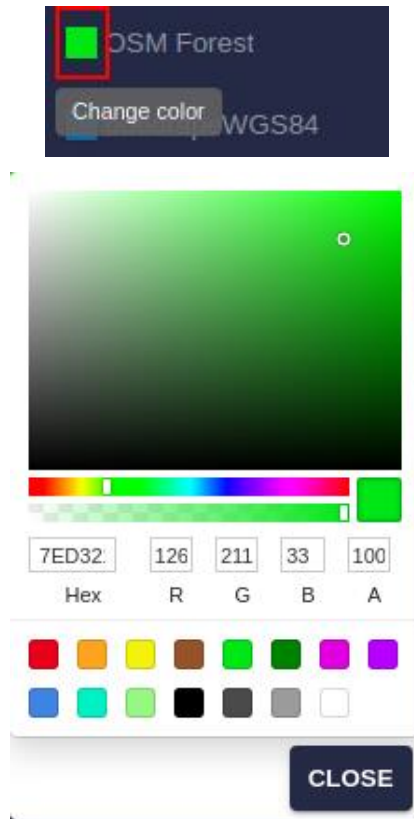
## Note

Since raster layers do not have a buffered version, the toggle to display all buffered layers does not affect them.

## Layer Color

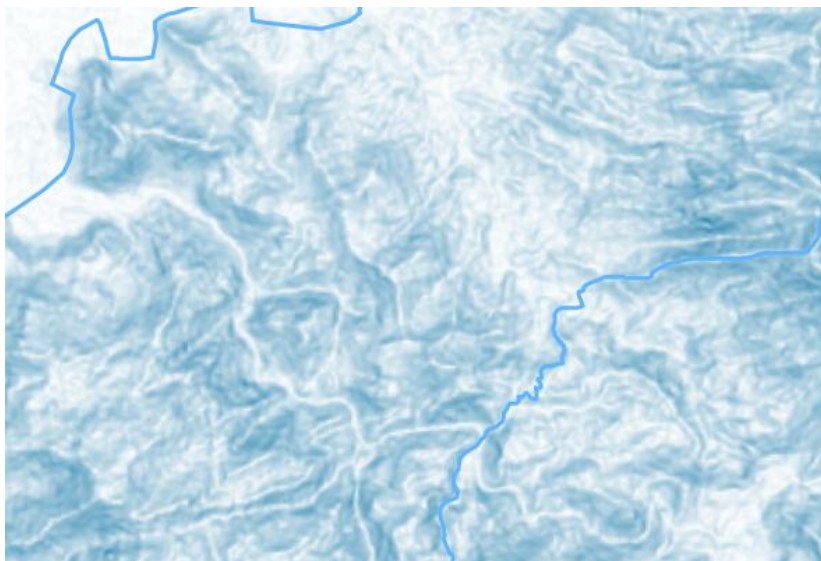
To better understand the information provided by different layers in the view, a different color can be assigned to each layer.

Click on the colored square next to the layer name to open the color picker.



You can also control the *transparency* of the color by using the transparency slider in the color picker typing an opacity value in the A field (0 means fully transparent, 100 completely opaque). Transparency is only applied to the Map view.

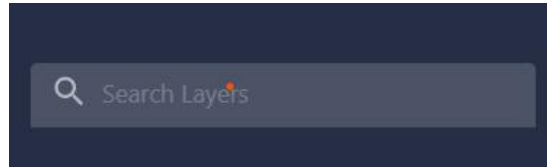
When applied to a **raster layer**, the color is displayed lighter for smaller values in the raster and darker for larger values, as in this slope example:





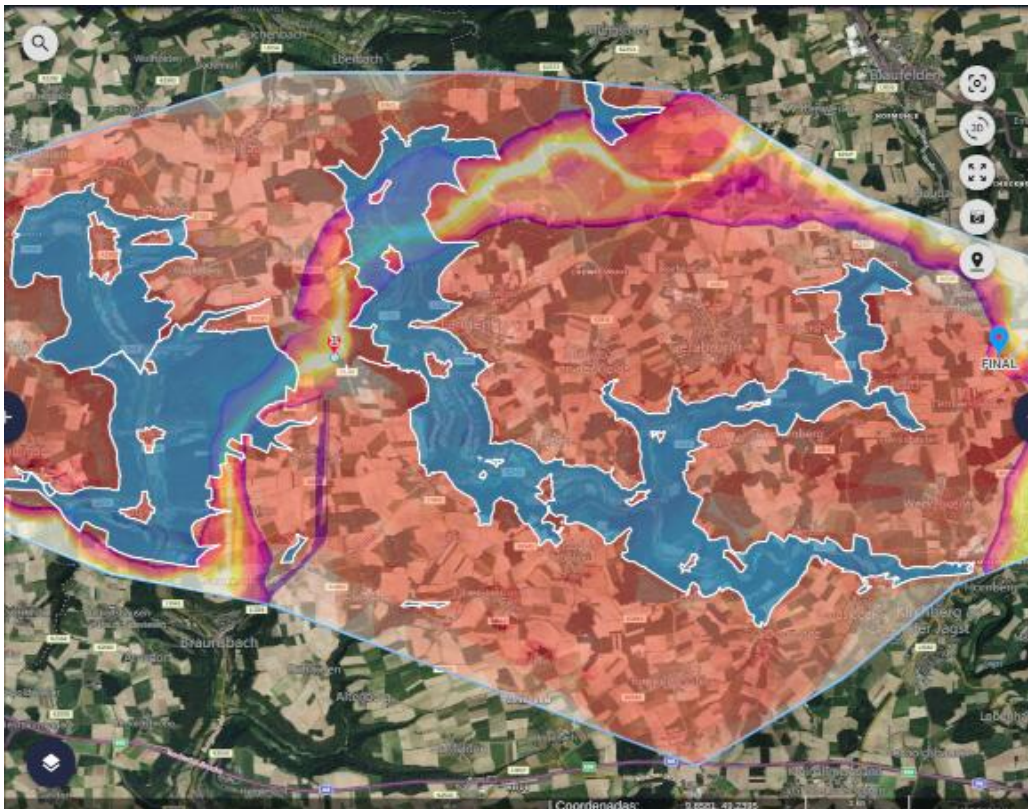
## Search Layers

If your project has many layers, it may be difficult to find quickly the one you want to edit. To quickly find layers by name, use the Layer Search field at the bottom of the Layers panel. Type one or more characters, and only the layers whose name includes the typed text will be shown in the panel:



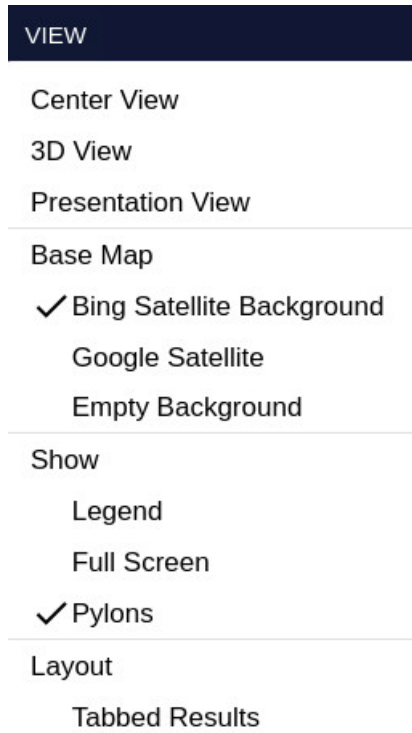
## Map View

Data and results are displayed in the central view. By default, this shows an interactive 2D Map, but most its options and tools are common to the 3D View. These tools can be found in the View menu and also as floating buttons on either view.



The **View Menu** provides direct access to view options. For the 2D Map, these are:





- **Center View:** zooms the view to the data extent.
- **Switch to 3D View** (or back to 2D): it will use a 3D globe to display the data and results, including a realistic display of the pylons and cables, which can also be interactively moved by the user.
- **Presentation View:** switches to a view mode with limited interaction capabilities, for public presentations.
- **Base Map:** lets the user choose which map service to use as a background reference image.
- **Show** options, including:
  - *Legend:* toggles on/off the color ramp legend to interpret Resistance Maps and Corridors.



- *Full Screen:* toggles on/off the full screen mode (F11 key can also be used).
- *Pylon:* shows or hides the visualization of pylons

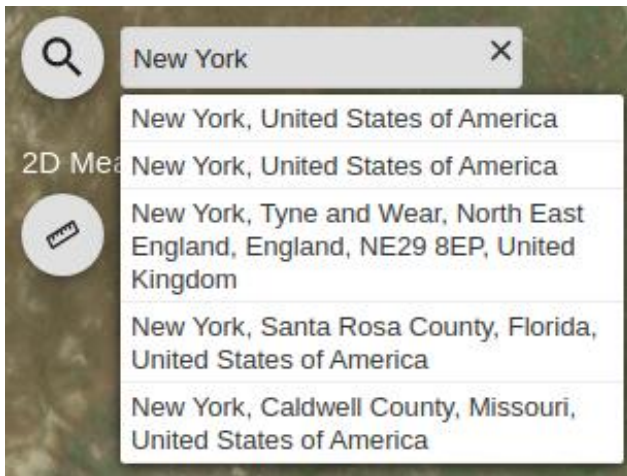
## Tools

This menu contains tools to operate on both the Map view and the 3D view:

TOOLS

- Identify Point
- Search Location
- Measurement Tools
- Pylons Tools
- Screenshot
- StreetView

- *Identify Point*: lets the user find out what the resistance values at a certain location on the view. It is described in the analysis page.
- *Search Location*: find a place by typing its name. A list of matching places will be offered from which the user can pick one to zoom to:



- *Measurement Tools*: opens the measurement toolset on the view. This toolset includes *distance, area and elevation* measurement tools. *Note that the elevation values returned by this tool are Ellipsoidal Height values, not Orthometric Height (above sea level).*



- *Pylon tools*: it opens the pylon toolset on the view. This toolset includes tools to move and get info about individual pylons. The 3D version has an additional tool to detect conflicts between cables and terrain.

To move a path point, activate the Move tool, and click and drag on one of the yellow circles appearing around the points.



Right click to finish the editing operation and accept the changes if you want to keep them.

- *Screenshot*: captures an image of the view and saves it to local disk.
- *Streetview*: very convenient to check the situation on the ground. See below.

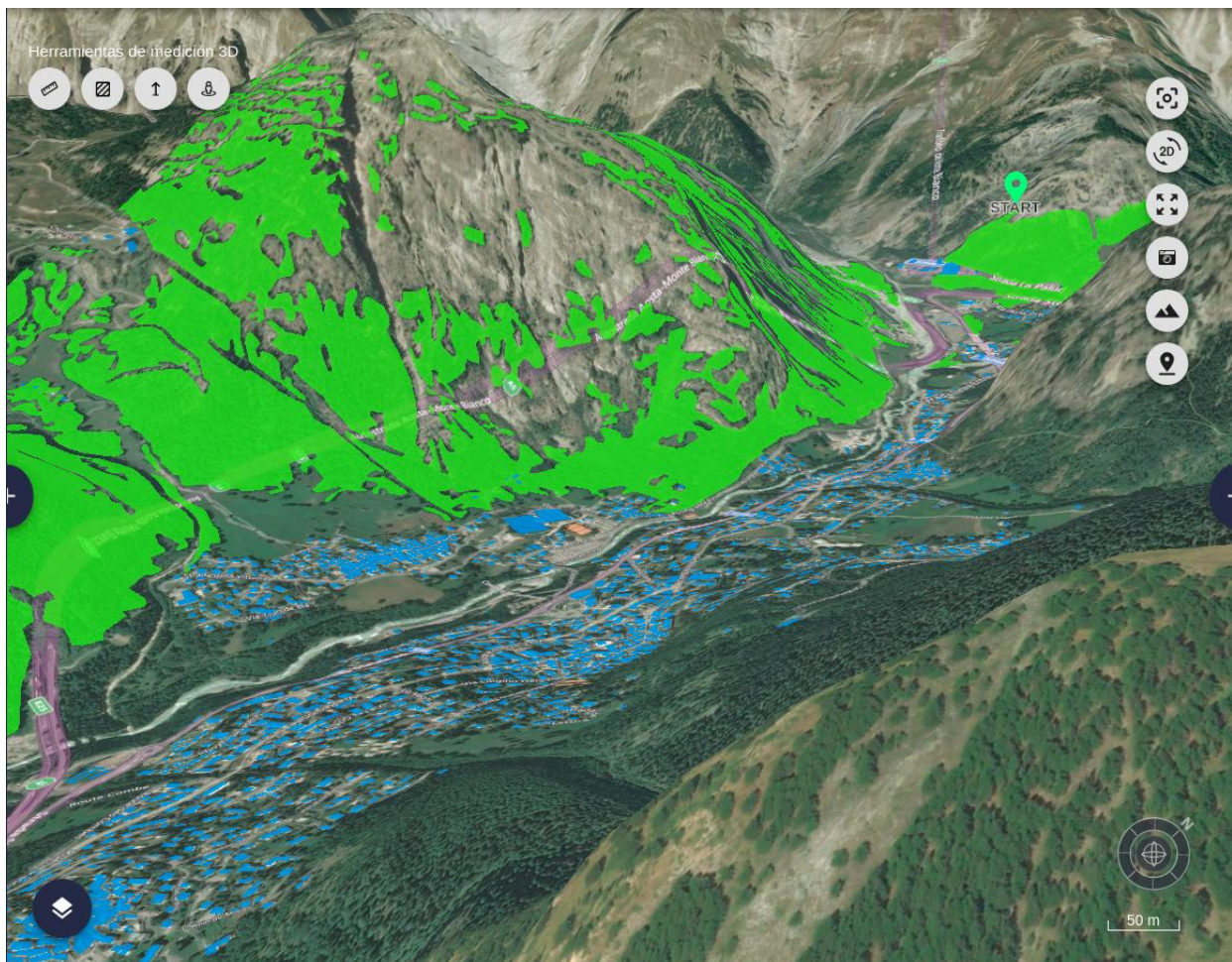
## Navigation

Use the *left mouse/trackpad button* to click and drag on the 2D Map view, so you can move around.

To zoom in and out, use the *mouse wheel* or drag up and down with *two fingers on the trackpad*.

## 3D View

By clicking on the *View/3D View* menu option or on the 3D tool button on the 2D Map, the view can switch to a 3D perspective of the project area.



In this view we have some additional View menu options:



- *Add 3D Assets*: allows users to add custom 3D assets to the view.
- Additional **View/Show** options are:
  - *Buildings*: toggles on/off the display of world buildings.



- *Terrain*: toggles on/off the elevation data. *Note that switching off the terrain may lead to some objects “floating” above the zero elevation plane.*
- *Underground*: turns on/off the underground mode with a semi-transparent surface and underground navigation.



To check how the *Pylon Tools* work in 3D, see the analysis page.

## Navigation

Same as in the 2D Map view, use the *left mouse/trackpad button* to **pan**, and **zoom** in and out with the *mouse wheel* or with *two fingers on the trackpad*.

In addition, you can **rotate the view** with the middle mouse button (or pressing the wheel), or by pressing the *Ctrl* key while using the left mouse.

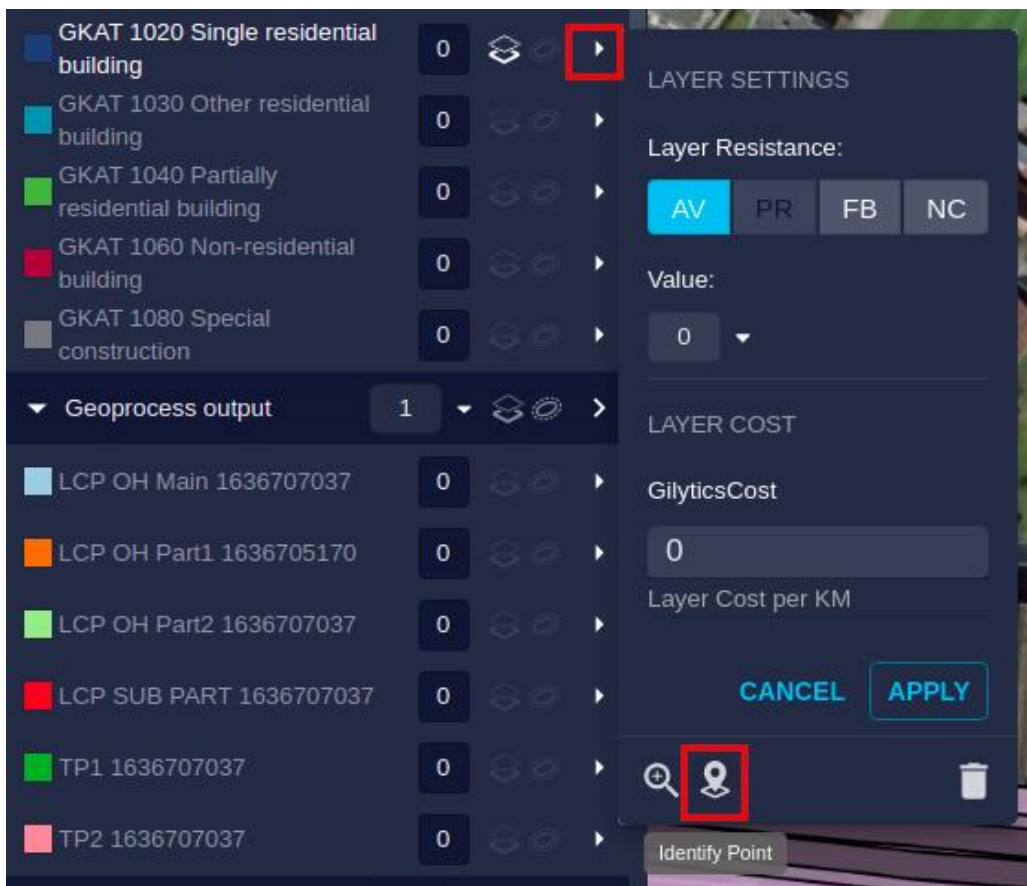
There is also a **compass** in the bottom right corner of the 3D View, which you can use to know the orientation of the 3D view and navigate around.



## Identify and edit feature attributes

Checking the attributes of geographic elements might be important to classify the input data into layers to assign different resistance values.

To identify the attributes of objects in a specific layer, use the Identify icon in that layer's settings panel:



The cursor will change into a blue dot. Click on an object of the selected layer:



After clicking, if one or more features are found in the selected location, their IDs and attributes will be shown in the Identify dialog:

### Identify attributes for Base Dataset for layer GKAT\_1020\_Single\_residential\_building

To modify an attribute, edit the corresponding value and press enter.

#### Feature 1500855

<b>OBJECTID_1</b> 3568	<b>GWR_MADD_G</b> 3064022.0
<b>GWR_MADD_1</b> 2023.0	<b>GWR_MADD_2</b> None
<b>GWR_MADD_5</b> 901.0	<b>GWR_MADD_6</b> 1004.0
<b>GWR_MADD_7</b> 1020.0	<b>GWR_MADD_8</b> 1122.0
<b>GWR_MADD_9</b> 1990.0	<b>GWR_MAD_24</b> Volketswil

The features values can then be **edited** for uploaded and WFS layers, but not for OpenStreetMap layers. Type the value you want and then click *Enter*. When you do so and the change is performed, a green checkbox will appear next to it.

**GWR\_MADD\_2**

### Note

Attribute editing has important consequences:

- The affected layers must be processed again so the attribute change takes effect in the elements included in the layer. Also, the resistance map and other results must also be recalculated.
- Attribute value changes affect the base dataset from which layers in different project may take their data, so all the projects using the modified data will change if their layers are reprocessed. This may be specially dangerous when editing WFS layers. A lot of projects and users may depend on the service data, so be careful with these changes and notify affected users.



## StreetView tool

Sometimes it is convenient to check the situation on the ground to verify the constraints provided by the data sources. Some elements like existing lines, buildings, etc. might be different than we expected, or we might need to check their type or precise location.

The Street View by Google comes in handy to do these quick checks. Just click on a street or road where StreetView is available (unfortunately, the available areas are not displayed).

### TOOLS

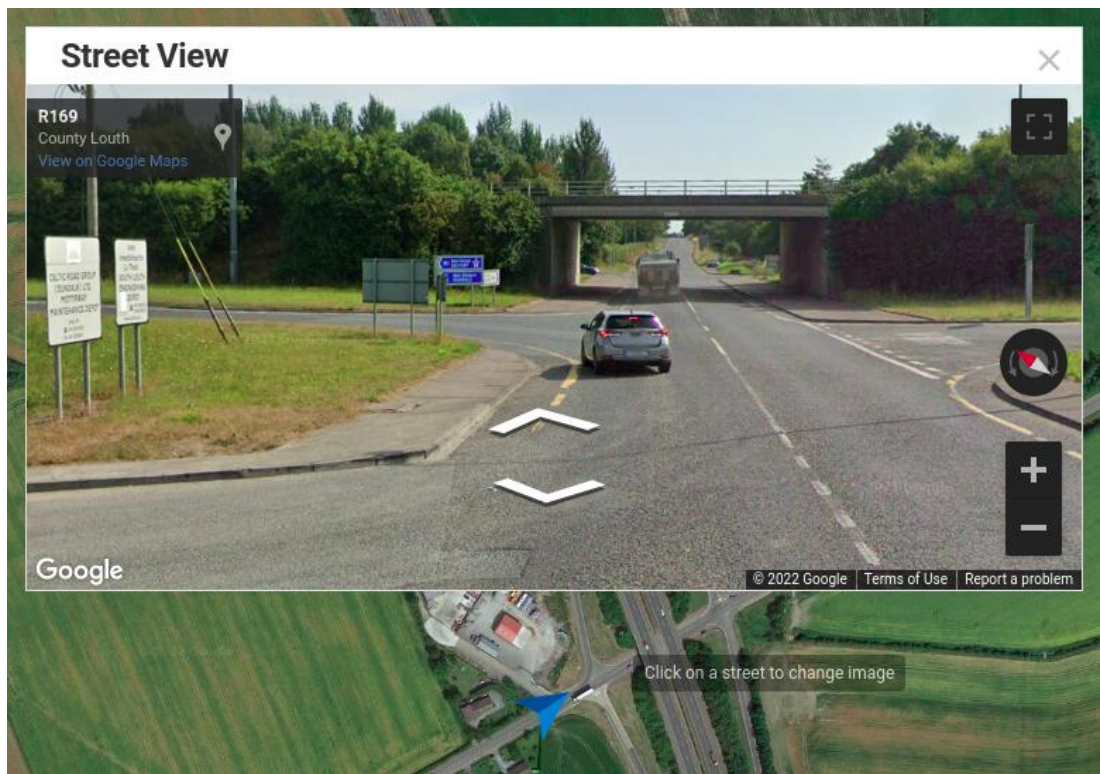
Identify Point

Search Location

Measurement Tools

Screenshot

StreetView



This tools works in both the 2D and 3D views.

## Presentation view

This option in the View menu can be used to simplify the project viewer interface for public presentation purposes.



Its effect is to hide some user interface elements like the right panel, menus and layer resistance information. Touch-based interaction in Pathfinder has also been improved to ease the use of this kind of displays.

VIEW

Center View

3D View

Presentation View

To exit this mode, press the key combination `<Ctrl> + <Alt> + P`.

---

*Disclaimer:* the scenarios depicted in this manual do not represent actual customer projects or infrastructure proposals, and are presented for demonstration purposes only.

For more help, please use the help chat in the application, or [contact Gilytics](#).

## Setting Up a Scenario

After creating a project and adding data to it, we are ready to define the constraints which affect the location or route of our infrastructure. These constraints are encapsulated in the concept of **Scenario**.

### Note

Users with an administrator or editor role can define new scenarios or modify their existing ones. However, *viewer* users can only access shared scenarios. They can't create new ones or modify any of them.

In this section, you can follow one of our [tutorial videos](#):

## Scenario Variables

A scenario includes the following variable elements:

- **Layer-driven constraints:**

- **Resistance values** assigned to layers. They define the relative importance of each data element in determining the cost/benefit of the infrastructure being located or passing through or near each location, even preventing that possibility.
- **Weights** assigned to each category. These values multiply the resistances of the layers in each category. They are used to quickly change the relative importance of layer groups sharing a common theme.

For instance, in one scenario, the environmental constraints may be considered more important, so the weight of the “Environment” category can be increased without changing the resistance of each of its layers.

- **Key points:**

- As an option, each scenario may have its own **Start and End points** which, if defined, are used instead of the project points. A possible application is to create scenarios considering different connection points.
- Optional **intermediate points**. The user can define an ordered list of intermediate points to force the infrastructure path to pass through specific locations in a given order.

- **Path/pylon options:**

- **Routing algorithm** and its options. There are different algorithms to calculate the route, each one with its own options.
- **Cost calculation** parameters. A monetary cost calculation will be performed for the output paths, and each scenario can use different cost factors.
- **Pylon type** and **pylon distance range**. The user can choose the pylon model to be used in each scenario, as well as the minimum and maximum separation between pylons.

These elements are described in more detail below.

### Note

*Separate scenarios are automatically created for each user, so the values set by one user are not automatically shared by others. If you want to share scenarios with other users, check managing scenarios.*

## Layer-Driven Constraints

Pathfinder’s optimization method calculates a cost or resistance value for each spatial location. The primary source for this cost is the information provided by the layers in the project. Each layer has one or more (one per ring) **resistance values**. Depending on the selected MCDA formula, each layer value will be multiplied by its **category weight**.

### Note

*Layer resistances have a default value 0, and all category weights have an initial value of 1, so the default cost is uniformly zero and the infrastructure location or path is not constrained. It is necessary to set resistance values to get meaningful analysis results.*

## Assigning Simple Resistances

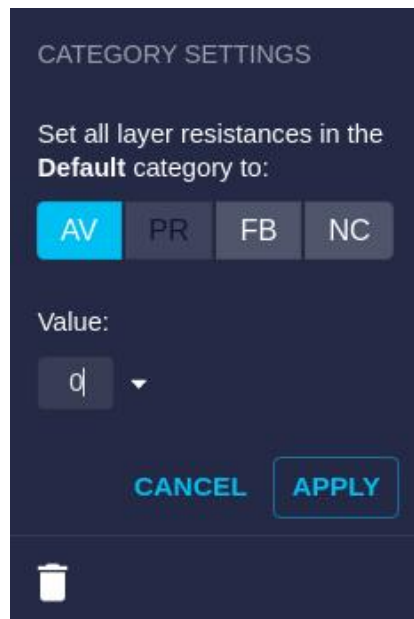
The simplest way to introduce data-based constraints is to assign an **integer resistance** value. By default, this value is limited to the (-3, +3) range, +3 being the highest resistance. We will see later how to change this range.

Resistance	Explanation
NC	Zone is <b>not considered</b>
-3	Zone is <b>very suitable</b>
-2	Zone is <b>largely suitable</b>
-1	Zone is <b>suitable</b>
+1	Zone is <b>unsuitable</b>
+2	Zone is <b>largely unsuitable</b>
+3	Zone is <b>very unsuitable</b>
FB	Zone is <b>forbidden</b> (value 9'999)

When a vector layer is in the default **Assigned Value (AV)** mode, the resistance value can be assigned with the input field next to the layer's name:



For convenience, we may want to quickly *set the same resistance value for all layers in a category*. We can do so by using the category's side panel:



In addition to an integer value, we can use two **special resistance values**:

- **Forbidden (FB)**: this value forces the area defined by the layer to be excluded from the infrastructure location. In other words, the infrastructure is not allowed to be in or intersect this area. See more details in the algorithm section.
- **Not Considered (NC)**: this setting disables the layer in the analysis without removing it (maybe because it is considered in a different scenario).

The same options, plus the **Per Ring (PR)** option for vector layers (see next section), can be set individually for each layer in its side panel.

## Note

*Forbidden values (FB) are not recommended for long linear elements like highways or rivers, because this may constrain too much the optimal path we are seeking. Use a large resistance value instead. It's okay to use FB for localized areas or elements like water bodies, populated areas, etc..*

## Note

*Not Considered (NC) values are used when including reference data in the project, like administrative boundaries, which do not intervene in the optimization but are useful for visualization.*

## Vector Layers: Ring Resistances

In vector layers, we can use rings to define the influence of objects beyond their original boundaries. For instance, we probably don't want the infrastructure to pass through a protected area, but we also want to discourage construction in the surroundings.

On the other hand, while we want to avoid building too close to a highway, it may be good to build near it, because of easier access and reduced transportation cost.

We have already seen how to define the number and width of rings when we add project layers or change their configuration, but how are resistances assigned to each ring?

First, we must select the **Per Ring (PR)** option (available if the layer has more than one ring). Then the user can set to each ring a resistance value or the Forbidden value.

The screenshot shows a dark-themed dialog box titled "LAYER SETTINGS". Under "Layer Resistance:", there are four buttons: "AV", "PR" (highlighted in blue), "FB", and "NC". Below this, "Set resistances per ring:" is followed by three rows. Each row has a label (Ring 0, Ring 1, Ring 2), a numeric input field, a dropdown arrow, and a checkbox labeled "Forbidden".

Ring	Value	Forbidden
Ring 0:	0	<input checked="" type="checkbox"/>
Ring 1:	3	<input type="checkbox"/>
Ring 2:	1	<input type="checkbox"/>

When more than three rings are defined, a separate dialog is be used. Click on the "Set Resistances" button to open it.

This screenshot is identical to the previous one, but with a blue button labeled "SET RESISTANCES" highlighted at the bottom of the dialog box.



## Set resistance values for Cobertura\_Bosques

Set a numeric resistance value or forbidden for each ring

Ring 1	0m	Ring 2	50m	Ring 3	100m	Ring 4	200m
		3		2		1	
<input checked="" type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	
Forbidden		Forbidden		Forbidden		Forbidden	

CLOSE

APPLY

## Raster Layers: Resistance Modes

Raster layers provide an integer or floating point value for each pixel. We have different options to decide which resistance corresponds to each of those values. As with vector layers, the side panel can be used to specify this correspondence.

Raster resistances can be specified in four different modes:

- **Table of assigned values (AV):** The user sets a *default resistance value*, which will be used when no other rules applies, and by clicking on the Edit Values button a dialog can be opened to assign specific resistances to individual raster values.

For instance, if our raster contains an integer code for *land cover* categories (e.g. data from the [Copernicus Global Land Cover](#)), the user will assign a resistance to each integer value:

LAYER SETTINGS

Layer Resistance:

AV RNG LNR NC

Default resistance:

q ▾

Set resistances:

EDIT VALUES

CANCEL APPLY

## Assign values to land\_cover\_clip

Set all non-assigned values to:

Raster

(min. 20 - max. 126)

Resistance

+ ADD VALUE

0	0	<input checked="" type="checkbox"/> Forbidden	
1	3	<input type="checkbox"/> Forbidden	
2	2	<input type="checkbox"/> Forbidden	

CLOSE

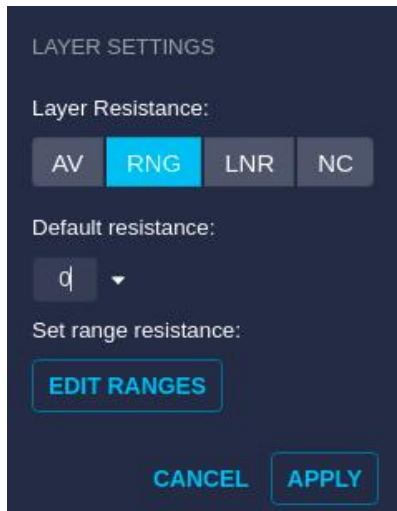
APPLY

After editing the values, don't forget to click on Apply in both panels to make the changes effective.



- **Value ranges (RNG):** The user also sets a *default resistance value*, which will be used when no other rules applies. By clicking on the Edit Ranges button a dialog can be opened to assign specific resistances to ranges of raster values.

For instance, if we want to assign resistance according to DEM elevation of slope, the user can set values for different ranges:



### Range resistance for india-raster\_65\_dem

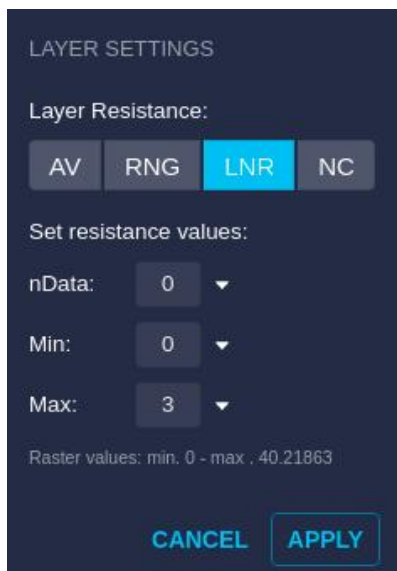
Set all non-assigned values to:

From <small>(min. -35 - max. 347)</small>	To	Resistance		ADD RANGE
<input type="text" value="1001"/>	<input type="text" value="5000"/>	<input type="text" value="0"/> <input checked="" type="checkbox"/> Forbidden		
<input type="text" value="800"/>	<input type="text" value="1000"/>	<input type="text" value="3"/> <input type="checkbox"/> Forbidden		
<input type="text" value="500"/>	<input type="text" value="799"/>	<input type="text" value="1"/> <input type="checkbox"/> Forbidden		

- **Linear value interpolation (LNR):** In this case, the user sets a *no data value* to be applied where the raster does not provide a numeric value, and then a resistance to be used for the minimum raster value and another resistance assigned to the maximum raster value (the minimum and maximum values are displayed at the bottom of the panel). The resistance for intermediate values will be interpolated from the maximum and minimum.

For instance, if we want to assign a linear resistance according to the slope value, we can set up maximum and minimum values to be applied on the slope raster:

## Setting Up a Scenario



- **Not considered (NC):** As with vector data, we use this mode when the raster data must not be used in route calculations, only for display purposes.

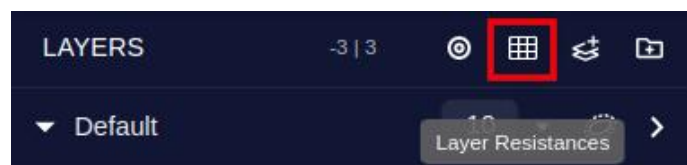
### Layer Resistances Table

To change many layer resistance values quickly in the scenario, it may be more convenient to use a table view.

The *Layer Resistances* dialog with such table can be opened from the *Scenario/Layer Resistances* menu option:



And also from the icon in the Layers panel:



From both, the Layer Resistances window will open:

## Layer Resistances

Change the layer resistances in your scenarios. These changes do not affect other users.

Scenario 1 - Sal\_Bay Search Layers IMPORT SCENARIO FILE EXPORT

VECTOR RASTER

Name	Mode	Res. Value [-3, 3]	Resistance Values [-3, 3]		
		Ring 1	Ring 2	Ring 3	Ring 4
OSM Railways	Per Ring Value ▾	<input checked="" type="checkbox"/> FB	3 <input type="checkbox"/> FB	1 <input type="checkbox"/> FB	
rt areaffcc s	Not Considered ▾				
rt estacionfcc p	Assign Value ▾	3	0	0	0
rt nodoffcc p	Forbidden ▾				

This table view allows the user to change quickly the assignation mode for each layer and the resistance values (including the Forbidden option) for each ring.

### Note

*The current interval of possible resistance values is shown in the table header ([-3, 3] in the example). It is also visible in the Layers header, in the left panel of the project viewer.*

In the case of **raster data**, the corresponding tab table allows changing the resistance assignation mode and, through the Edit button, assigning resistance values using the same popup dialog we have seen earlier.

## Layer Resistances

Change the layer resistances in your scenarios. These changes do not affect other users.

Scenario 2 - Fast Search Layers IMPORT SCENARIO FILE EXPORT

VECTOR RASTER

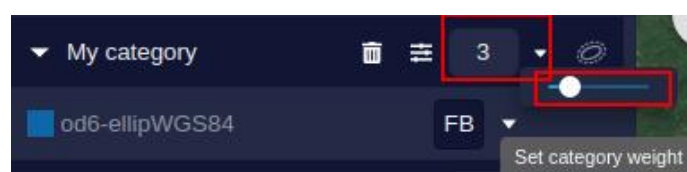
Name	Mode	Edit Resistances
ResistanceMap	Linear ▾	EDIT
salva-austria 218 dem	Ranges ▾	EDIT
salva-austria 218 slope	Not Considered ▾	EDIT

## Assigning Category Weights

After deciding on the role and relative importance of layers within a category, the scenario configuration also allows the user to change the relative importance of different categories.

We can create different simulation scenarios by modifying the category weights.

By default, an *absolute scale* is applied for the category weights. This means each category has an integer weight from 1 to 10, which multiplies the resistencia values of its layers. This weight is assigned with the input box or slider in the category's header:



Other category weight assignation options are possible. See the section about Advanced Options below.

## Importing Resistances and Weights

Instead of using the Pathfinder UI to assign layer resistances and category weights, for a large project it may be more convenient to import the scenario configuration from a file.

This importing can be done with the “Import scenario file” button in the resistance table (see images above).

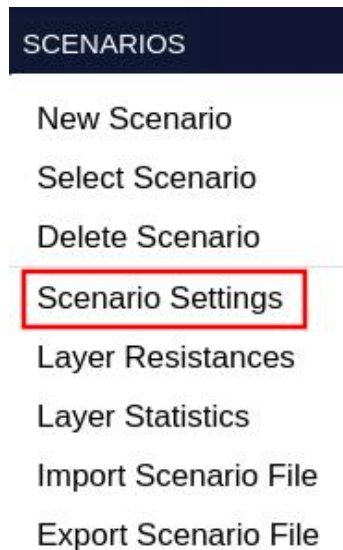
## Advanced Options

In addition to the layer resistance and category weights, each scenario has advanced options defining how those constraints are applied to generate results.

To access the advanced settings, select the scenario in the right panel and click on the Settings button near its name:



Alternatively, you can select the scenario and open the settings for the active one with the *Scenarios* menu:



The scenario settings panel is divided in three different tabs: General, Points and Paths & Pylons:



## Note

*After changing any scenario settings, do not forget to click on the button to apply the settings, located at the bottom of the panel. Otherwise, the changes may have no effect.*

## MCDA Model

The MultiCriteria Decision Analysis (MCDA) performed by Pathfinder calculates a final resistance value for each location in the project area. To do so, it combines the layer resistances and category weights according to a formula which can be customized for specific clients or regional standards.

If multiple MCDAs are available for your company, you can select one in the General options of the Scenario Settings:

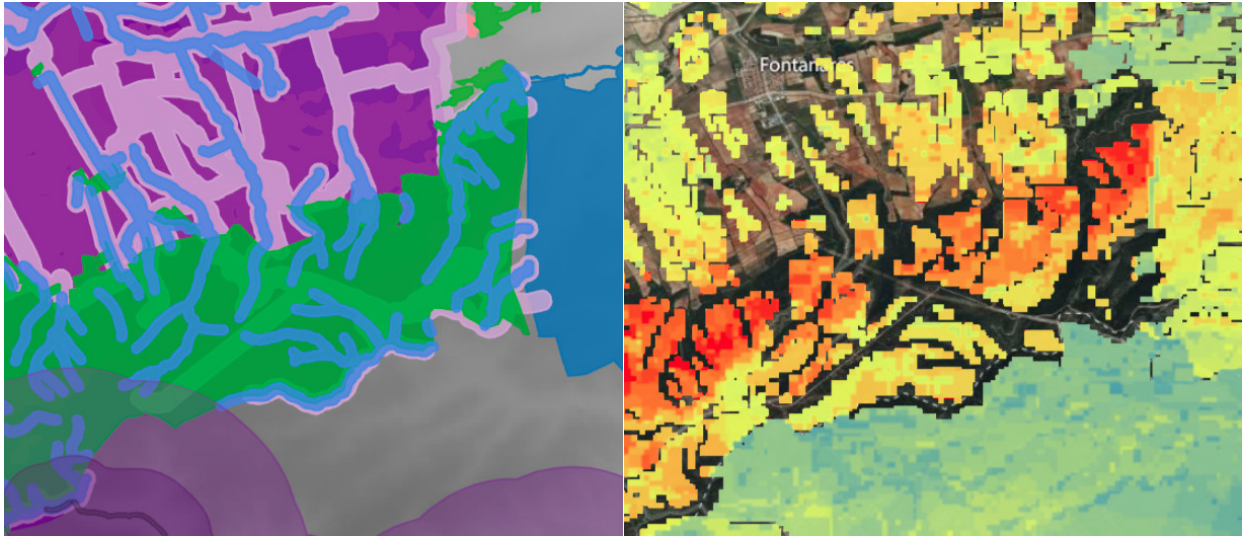


## How do MCDAs work?

MCDAs combine the resistance values at each location in the project area to create a Resistance Map that will be used in the calculation of corridors and paths.

## Setting Up a Scenario

The following image shows on the left the layers as constraints in the study area, and on the right the resistance map resulting from the MCDA calculation on the layer resistances.



All MCDAs give preference to **FB values**. A forbidden value in any layer at a certain location will force a FB value in the resistance map, which will appear transparent on the map.

The default **Gilytics MCDA** operates by:

- Finding the resistance contribution of each layer at each location. This contribution depends on the layer's resistance mode.
- Calculating each category's total contribution by adding its layers contributions.
- If defined, applying a cap value to the category contribution.
- Adding all category contributions to calculate the final value.

The Identify tool can be used to verify how the MCDA calculation is done. For example, the next image shows how all layer contributions are combined together in an example with Gilytics MCDA, adding them to calculate the final resistance (13).

### Identify

Point coordinates: 38.77561 -0.73940

Calculated resistance: 13



In this case, most layers belong to categories with the default weight (1), so their contributions remain unchanged. However, the layers “Areas delimited by territorial planning”, “Natural reserve without planning” and “Strategic forest



## Setting Up a Scenario

floor of PATFOR” belong to category “01 Protected areas”, with a weight of 2, so we can see in the chart that their contributions are multiplied by 2.



Compare this with the **Maximum Resistance MCDA**, used as standard by some customers. In this case, no category weight is applied to modify the layers contributions.

The resulting combined resistance will be *the highest positive value + the lowest negative value* (if any of these two sets does not exist, the corresponding value is 0). In the location of the previous example, we can see now that the category weight of 2 is ignored, and the final resistance value is:

- Max = highest positive value = 3
- Min = lowest negative value = -2
- Total = Max + Min = 1

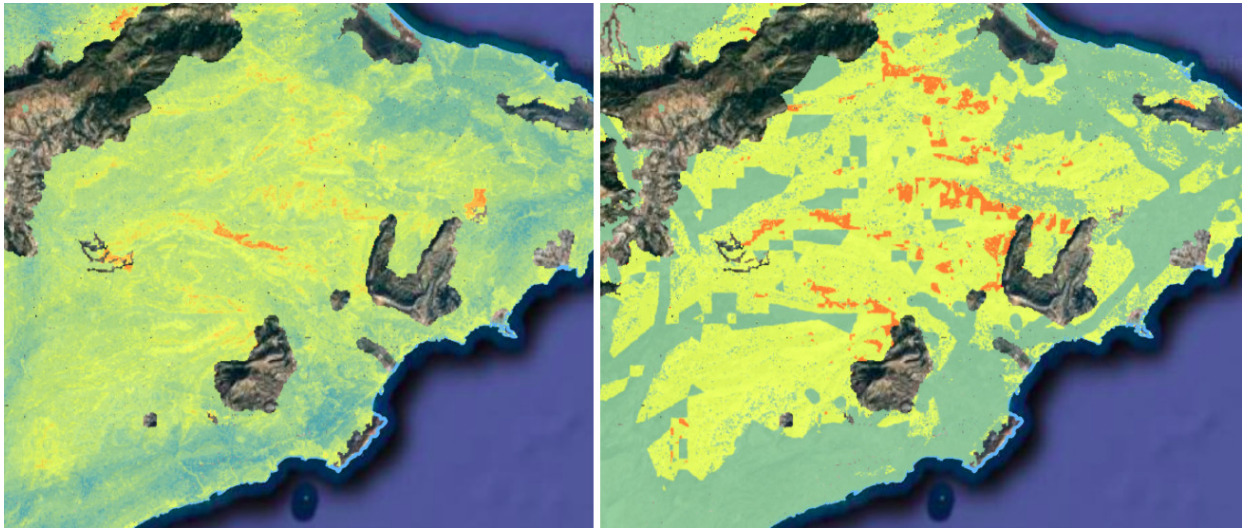
### Identify

Point coordinates: 38.77540 -0.73886

Calculated resistance: 1



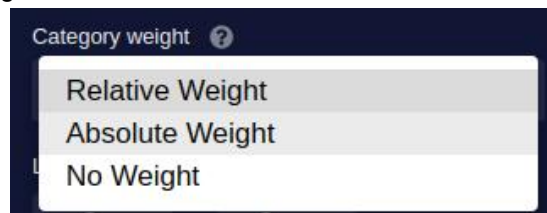
The following picture shows the difference between the resistance map calculated with the default Gilytics MCDA (on the left) and the one calculated with the Maximum Resistance MCDA (on the right), which generates a more simplified map.



### Category Weight Mode

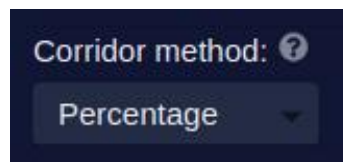
In the General section, the user can change the method to assign category weights:

- **Absolute Weight** (default): each category has a value from 1 to 10.
- **Relative Weight**: values from 1 to 100 are used. The values of all categories must add up to 100, since they are interpreted as relative percentages.
- **No Weight**: the category weights will be assumed to be all the same and not visible in the user interface.



### Corridor Method

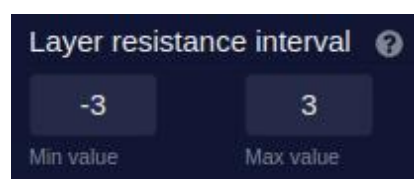
The corridor calculation method (percentage or percentile) can also be selected from the Scenario Settings:



### Layer Resistance Interval

In the scenario settings panel, we can also find the **Layer Resistance Interval**, the minimum and maximum integer values which can be set as layer resistances.

The interval limits can be changed. For instance, instead of the default (-3, +3) range, the user may prefer to use values from 0 to 10.



## Note

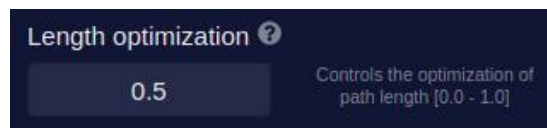
If you need more precision in layer resistances, instead of decimal values (1.2, 3.4, etc., out of 4) use a larger integer range (12, 34, etc., out of 40).

## Note

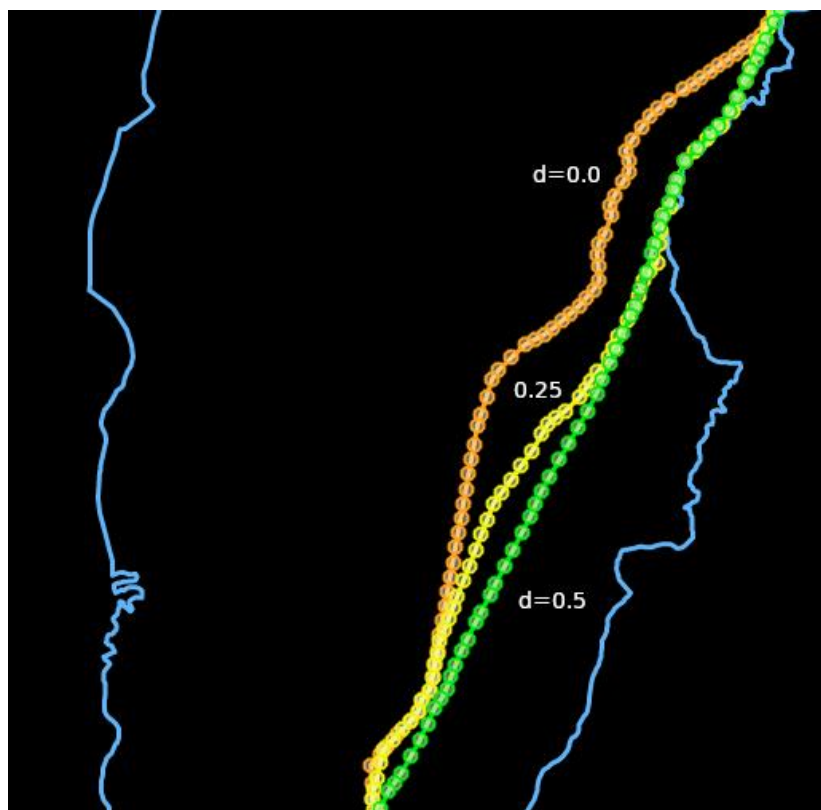
When importing scenarios from files, be aware that the resistance values will be limited to the current resistance interval, so values outside the interval will be capped. To avoid this, first extend the interval range and then import the file.

## Path Length Optimization

This is an important new feature introduced in version 3.1. It lets users choose a value between 0.0 and 1.0 to assign more or less weight to the path length, so it can be optimized together with other resistance/cost factors in the scenario.



The minimum value of 0.0 disables the explicit length optimization (although in general the length tends to be optimized when the area has defined resistances). Higher values, up to 1.0, create shorter and smoother paths:

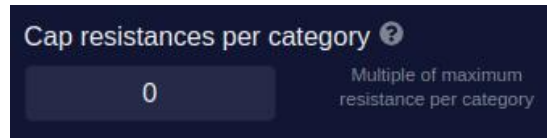


## Cap Value

One problem users may find is that adding new layers to a category makes that category too important in the overall assessment, while it would be better than the effective importance of the category remains the same even if new layers are added in it.

## Setting Up a Scenario

A solution is to set a maximum value of total resistance for each category. If this value is zero (the default), no maximum is applied.



The **effective resistance cap** is the value entered in this field *multiplied by the maximum layer resistance interval*. For instance, if the maximum resistance value is +3 and the cap value is set to 2, the effective resistance cap is 6. In other words, the Cap Value set in the UI represents how many layer contributions with the maximum resistance are considered as a limit for the category total.

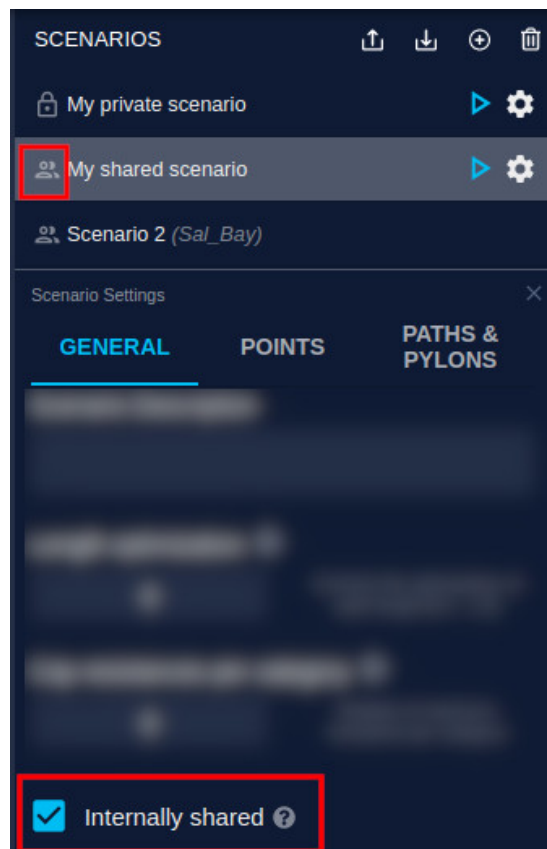
The effective resistance cap will be applied in the Resistance Map calculation to limit the final resistance in each cell. The result is to “flatten” the maximum contribution of each category.

### Note

*The cap value setting is used by the default MCDA model, but it may not apply to other models.*

## Shared Scenario

Activate this option so other users in your company can see your scenario when they open the project.



Other users will be able to open it and display your parameters and results, but not modify them.

## Add Scenario



CREATE NEW

SHARED

IMPORT SCENARIO

Selected scenarios will appear in the Scenarios Panel.

Scenario 1 - Lorena	Lorena	<input checked="" type="checkbox"/>
---------------------	--------	-------------------------------------

CANCEL

CREATE

## Scenario Analytics

We may have many layers and categories in each scenario, so it is convenient to use graphical representations to quickly see the distribution of resistances and compare it among different scenarios.

By using the *Scenario/Layer Statistics* menu, users can display the resistance analysis charts:

### SCENARIOS

New Scenario

Select Scenario

Delete Scenario

Scenario Settings

Layer Resistances

Layer Statistics

Import Scenario File

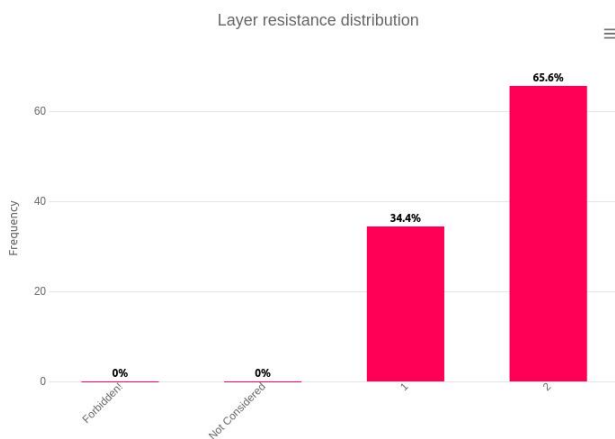
Export Scenario File

### Layer Statistics

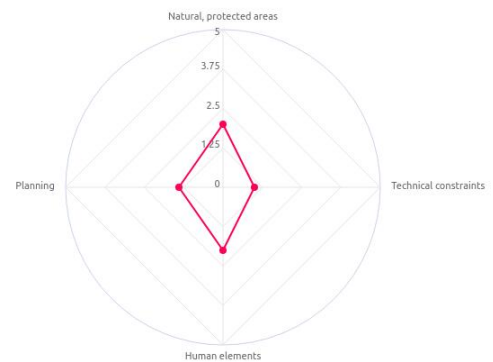
COMPARE WITH SCENARIOS

All Scenarios

Scenario 1 - Sal\_Bay



Average layer resistance per category



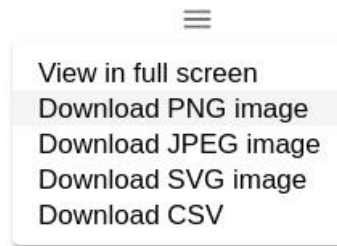
Note that:



## Setting Up a Scenario

- The category weight does not affect the average resistance value shown in the charts.
- Average values are represented in absolute values without sign, so a negative average appears in the same position (as important) as a positive average.

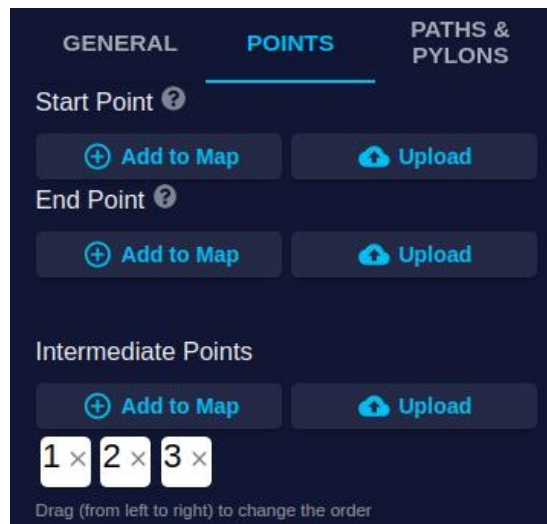
These charts can be exported as a CSV table or as image files to create reports.



The scenario management page describes how to export the scenario settings to a spreadsheet for further numerical and graphical analysis.

## Key Points

The Points tab of the scenario settings panel allows users to constrain the infrastructure path by using key points.

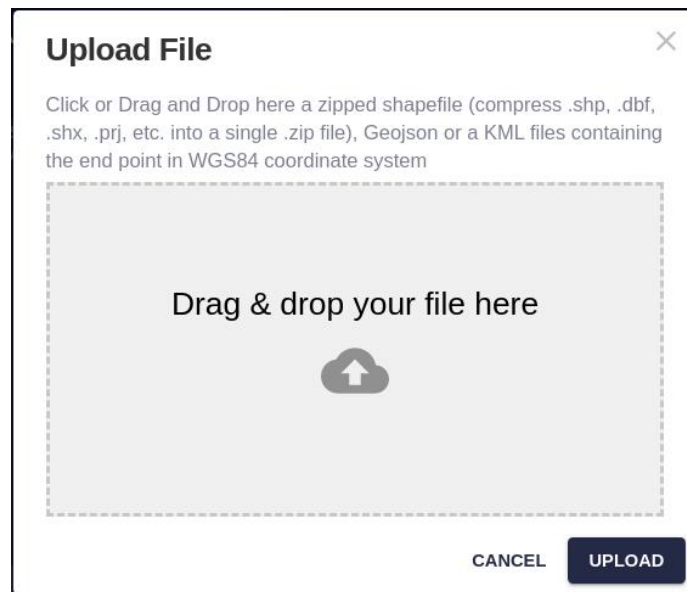


## Start and End Points

The Start and End points defined for the project can be changed for each scenario. If they are not defined in the scenario, the project points are used.

To place interactively the Start or End point on the View, click on the "Add to Map" button and then choose a location on the View.

The Start and End points can also be imported from a file by clicking on the "Upload" button:



The Start and End points specification begs the question: would the routing results be the same if we swap the initial and destination points? In other words, is the routing calculation **reversible**? The answer depends on the routing algorithm:

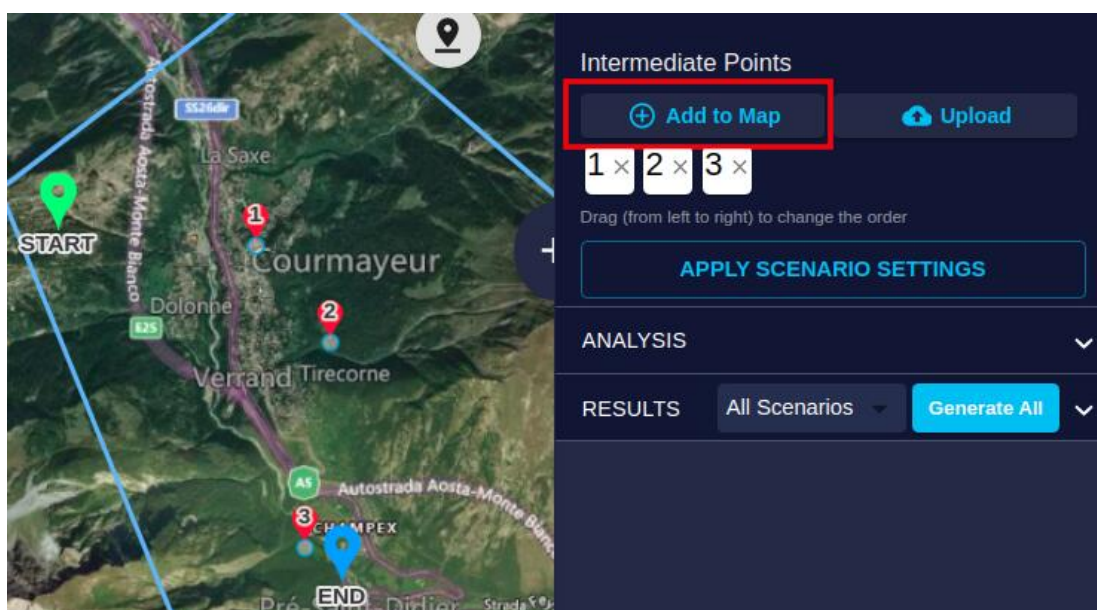
- In the Fast routing algorithm, the corridor doesn't change when the points are reversed and the path may differ only very slightly in specific points.
- In the Pylon Spotting algorithm, the corridor doesn't change, but some minor sections of the path might be different because of the order of the pylon evaluation. However, the overall route remains very similar.
- In the Explore algorithm, because of the randomness intrinsic to this algorithm, the paths obtained can be different when reversing the order. Because the corridor is based on multiple path results, it will probably also change. However, overall, the solutions should be quite consistent.

## Intermediate Points

An option only available for scenarios is the definition of intermediate points to be used in the path calculation.

The user can click on the "Add to Map" button to add one or more intermediate points to a sorted numbered list. Click again on the button to disable it.

The list of points can also be uploaded from a georeferenced data file.



The path will be built from the Start point, going through the intermediate points in the defined sequence and finishing at the End point.

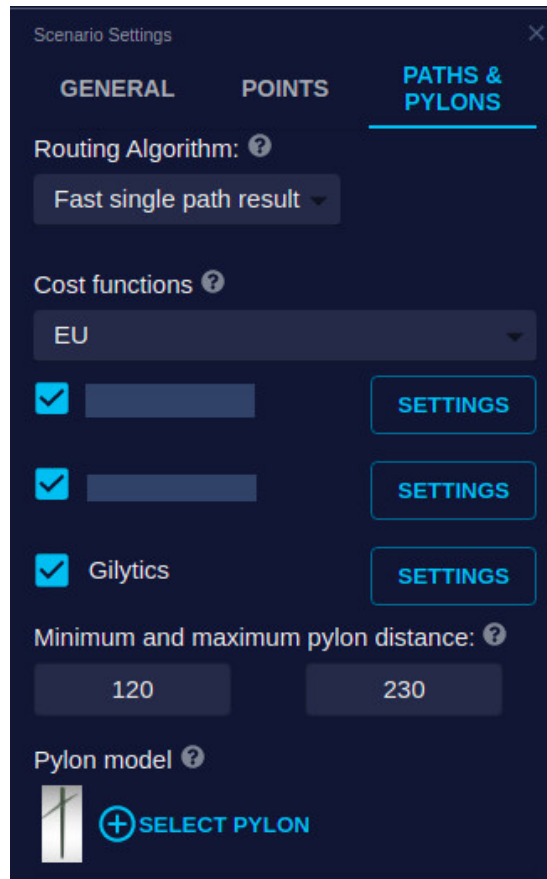
## Setting Up a Scenario

To *delete* an intermediate point, click on the “X” inside its corresponding box.

To *change the order* of intermediate points, click on a box and drag it *to the right*. Note the change in numbering on the view.

## Path and Pylon Options

The third tab of the scenario settings panel allows users to change options related to the path routing and the pylons used in the case of power lines.



## Routing Algorithm

Depending on your company license, more than one routing algorithm may be available. In the dropdown list, you can select which of the available algorithms will be used in the scenario, taking into account that the choice may affect the performance of the routing process as well as the results.



## Pylon Spotting Parameters

When a pylon spotting algorithm is selected, the user can use a Configure button to specify parameters controlling angles and the route behavior when crossing forbidden areas.



### Routing Algorithm Configuration

Edge weight ?	<input type="text" value="0.4"/>
Angle weight ?	<input type="text" value="0"/>
Max. direction deviation ?	<input type="text" value="90"/>
Maximum angle ?	<input type="text" value="180"/>
Angle cost function ?	<input type="text" value="linear"/>
FB crossing allowed ?	<input checked="" type="checkbox"/>

[Reset to default](#) [CANCEL](#) [SAVE](#)

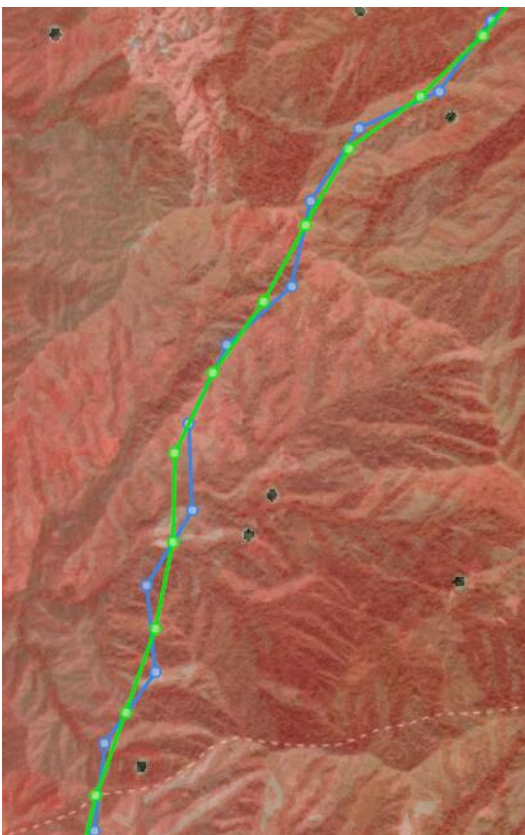
- *Edge weight* (0.0 to 1.0): relative importance of the path line resistance compared to the resistance at pylon locations. A value of 0.0 means that only the resistance at the pylon locations are important for the route optimization, 0.5 means both are equally important and if 1.0 is set, only the values along the line are important. The results can be significantly different:

## Setting Up a Scenario



- *Angle weight* (0.0 to 1.0): relative importance of the angle minimization compared to the resistance minimization. A value of 0.0 means that the angle minimization is not considered, 1.0 implies that only angle minimization is considered. Note that, even with angle optimization, some angles may be large, since the optimization affects the total sum of the angles.

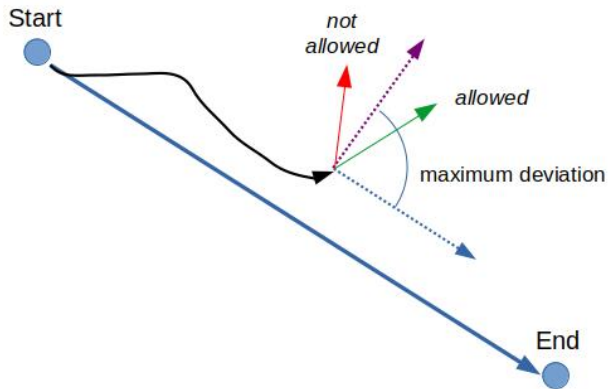
In the following image, the green path has been calculated with an angle weight  $> 0$ , compared with the blue path where angle weight = 0.



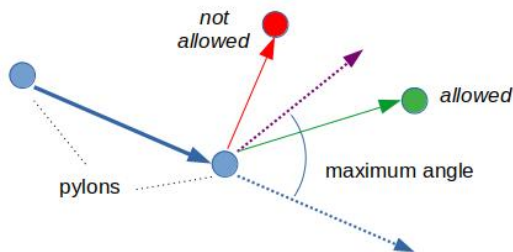


## Setting Up a Scenario

- *Max direction deviation*: how much the path can deviate from the straight line going from Start to End. The default (and the maximum value) is 90 degrees. In the pylon spotting algorithms, the route can not “go backwards”.

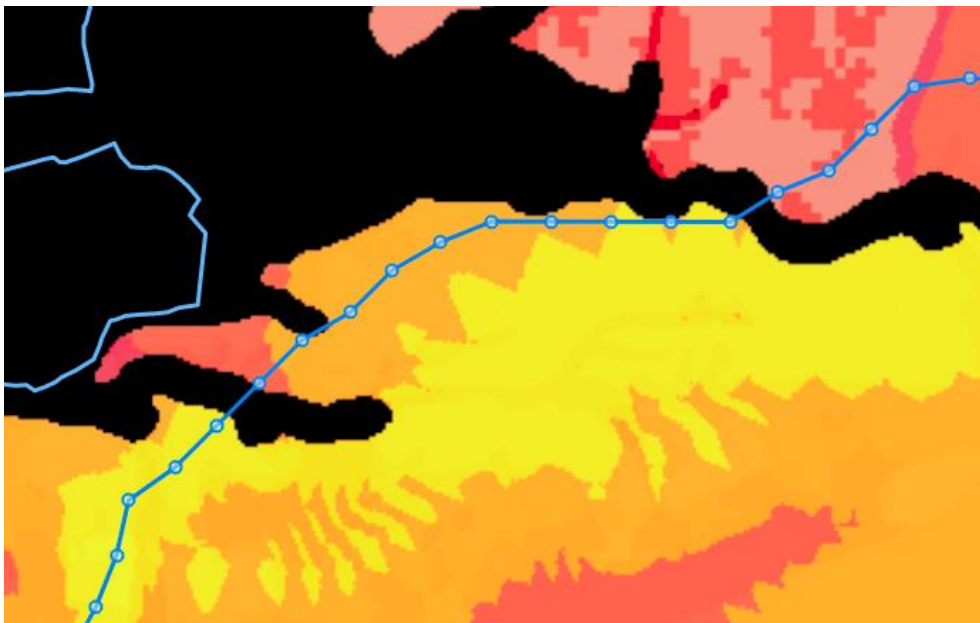


- *Max angle*: maximum angle between previous and following cables at any pylon. The default is 180 degrees, which means any turning angle is possible.

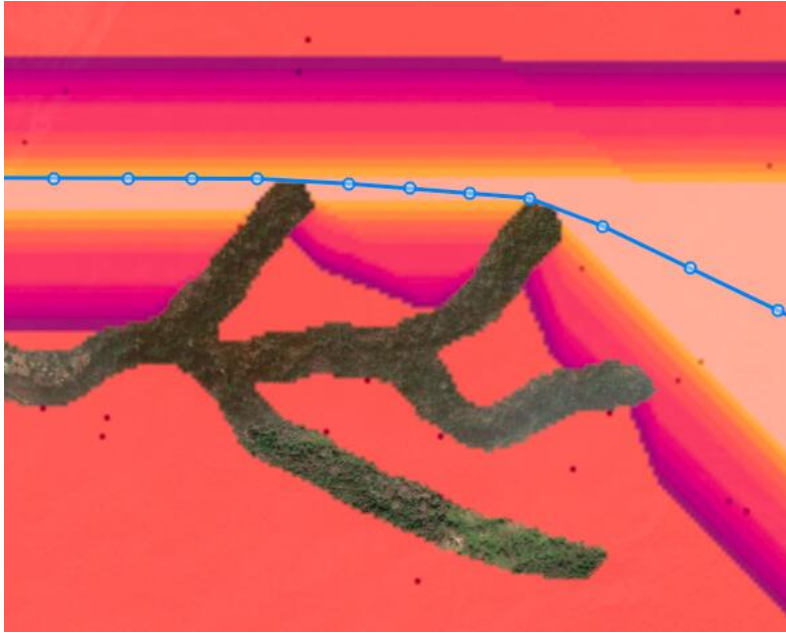


- *Angle cost function*: for the angle optimization, we can choose to calculate the cost of large angles with a linear or discrete function. You can usually keep the default setting.
- *Between points allowed*: this option lets the path cross over forbidden areas as long as the pylons are not placed on them.

This is the behavior when this option is **enabled** (also the behavior of other algorithms which don't have this option). The FB areas are black in this example:



However, if this option is **off**, the path will not be able to cross forbidden areas at all. This choice might be safer to avoid problem areas like building surroundings, but *it may prevent the algorithm from finding a solution*. The FB areas are transparent in this example:



### Explore Parameters

The Explore routing algorithm also has advanced configuration parameters:

#### Routing Algorithm Configuration ✕

Edge weight <span>?</span>	0.4
Angle weight <span>?</span>	0
Corridor width <span>?</span>	1
Resistance of FB areas <span>?</span>	100
Number of paths <span>?</span>	5

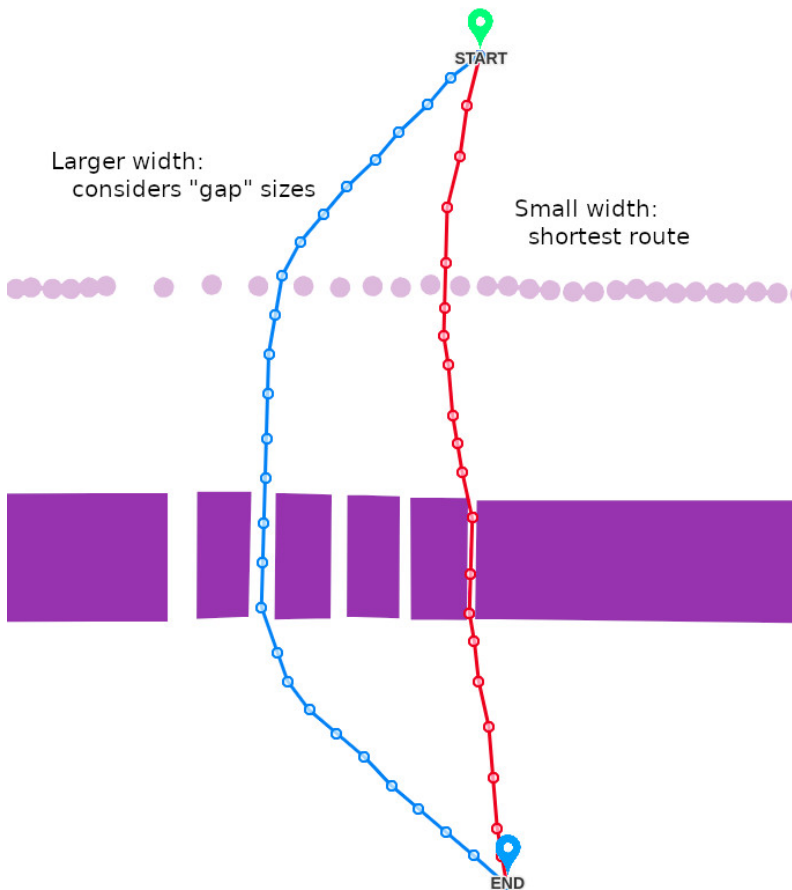
Reset to default CANCEL SAVE

- *Edge weight* and *Angle weight* have the same meaning as in the pylon spotting settings (see above).
- *Corridor width*:

Regular routing optimizes only the resistance along the line itself, so we can find high-resistance areas close to the line and the algorithm will not try to avoid them. This can be addressed by setting up rings around all the objects we need to avoid, but a simpler solution is to define a *width* for the resistance evaluation.

This width is specified in meters, so it should be a multiple of the project resolution. If the width is smaller, it is considered to be the project resolution.

Typically, this width can be used to find paths leaving a certain safety gap between high-resistance elements like buildings or highly protected areas, so even if there is a shorter route, the algorithm will choose one that requires a certain safety gap defined by the width.



Note that it is not guaranteed that the calculated paths skip narrow gaps completely, because the algorithm *optimizes* the total resistance. A specific gap may have a small weight in the total resistance and crossing it still might be the best solution overall.

To maximize compliance with the gap constraint, the layers representing areas to avoid *should have a very high resistance compared to other areas*. See also the next property.

- **Resistance of FB areas:** Unlike other routing algorithms, the Explore algorithm doesn't apply the forbidden (FB value) constraint strictly. Because of the way the algorithm works, assigning to FB areas an "infinite" resistance (as the other algorithms do), would create problems in the optimization.

For this reason, the Explore algorithm internally assigns a high (but finite) resistance value to the FB areas. As a result, solutions calculated using Explore might still cross these areas, and this may be fine (for instance, crossing a river when it's not too wide).

With this option, the user has control on which resistance value is used by Explore in FB areas and, therefore, he/she can control how strictly these areas are avoided. The larger this resistance value compared to the overall resistance map, the more strict the FB constraint will be.

- **Number of paths:** with the Explore algorithm it is possible to choose the number of paths to generate, between 1 and 8.

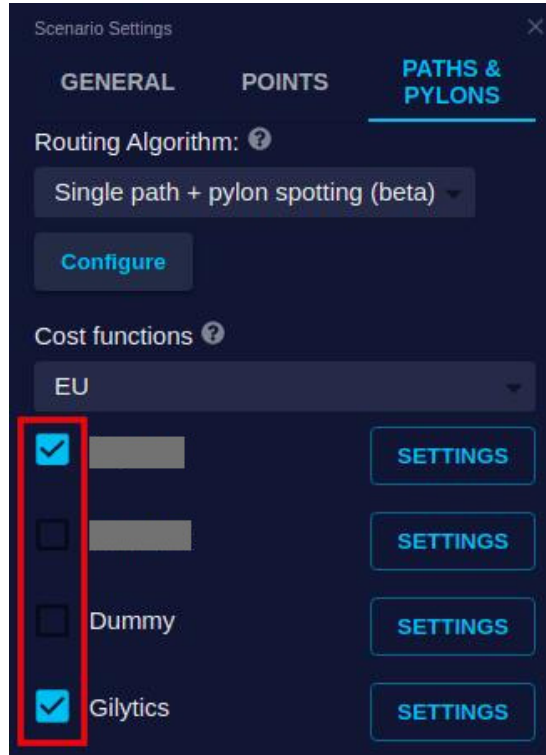


## Cost Models

In order to evaluate how good each potential path is, Pathfinder can use multiple cost models to calculate monetary CAPEX (construction) or OPEX (operation) costs, and also other costs like CO2 footprint or environmental impact.

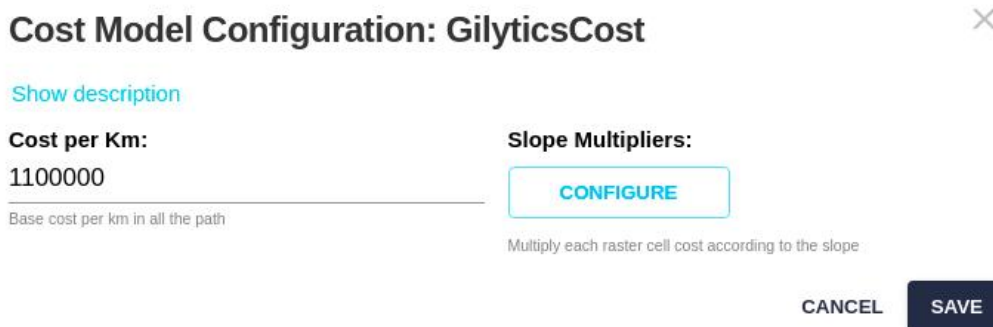
The *Gilytics* cost model will be active by default, but your organization may have other cost models available. Contact a Gilytics representative if you have specific cost estimation needs.

You can change the *currency* used in the cost estimations and then activate one or more of the available cost models, so they are automatically executed for each new or modified path in your scenario. Different scenarios may have different cost models activated.

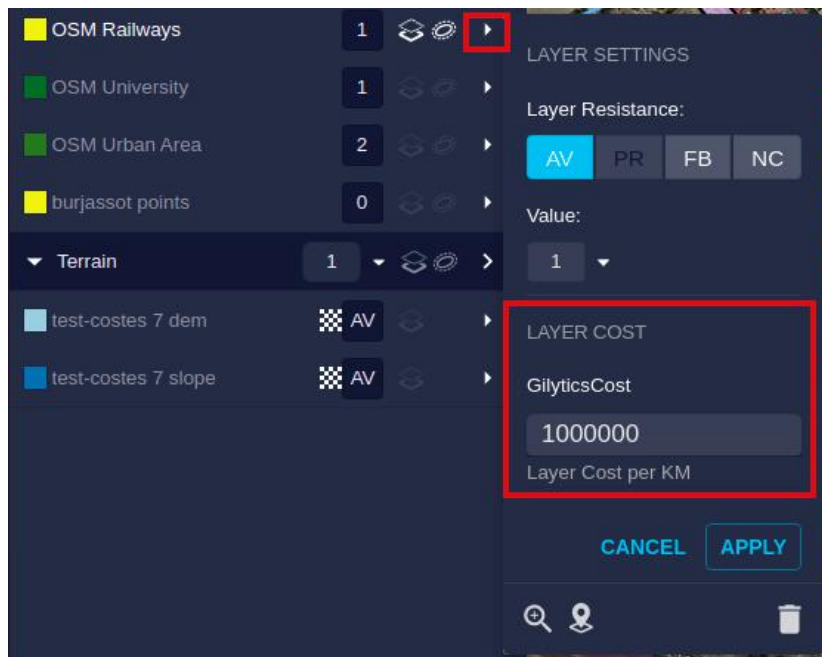


Each cost model will have a **global configuration panel**. Click on the *Settings* button next to a cost model to configure it.

For instance, the Gilytics cost model has global parameters to specify the price per kilometer and the multiplication factors related to slope.

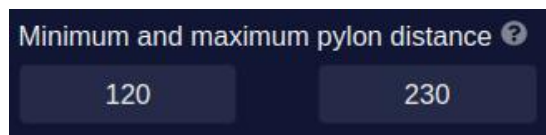


In addition, some cost models will have specific **cost parameters for each layer**. In this case, the right layer panel will contain input fields to set these costs for each cost estimation model:



## Pylon Options

The user can specify the minimum and maximum **separation** between pylons.



Pylons will be placed automatically by the algorithm, but can also be manually adjusted by users in the 3D view after the path is calculated.

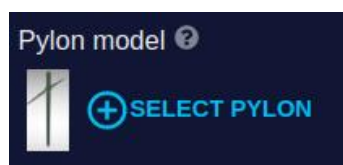
### Note

The minimum and maximum pylon distances should be **larger than the project resolution**, especially in the Explore algorithm. The minimum distance has no effect in this routing algorithm. The distance range applied by the Explore algorithm will be actually from  $max\_distance/2$  to  $max\_distance$ .

### Note






For the pylon spotting algorithms, it is recommended that the maximum and minimum distance values are close. In this way, the algorithm will run faster and use less memory. A large range may exhaust the algorithm memory.

The scenario settings show the **type of pylon** selected for the simulation. This type can be changed by clicking on the *Select Pylon* button and choosing the right model from the dialog:



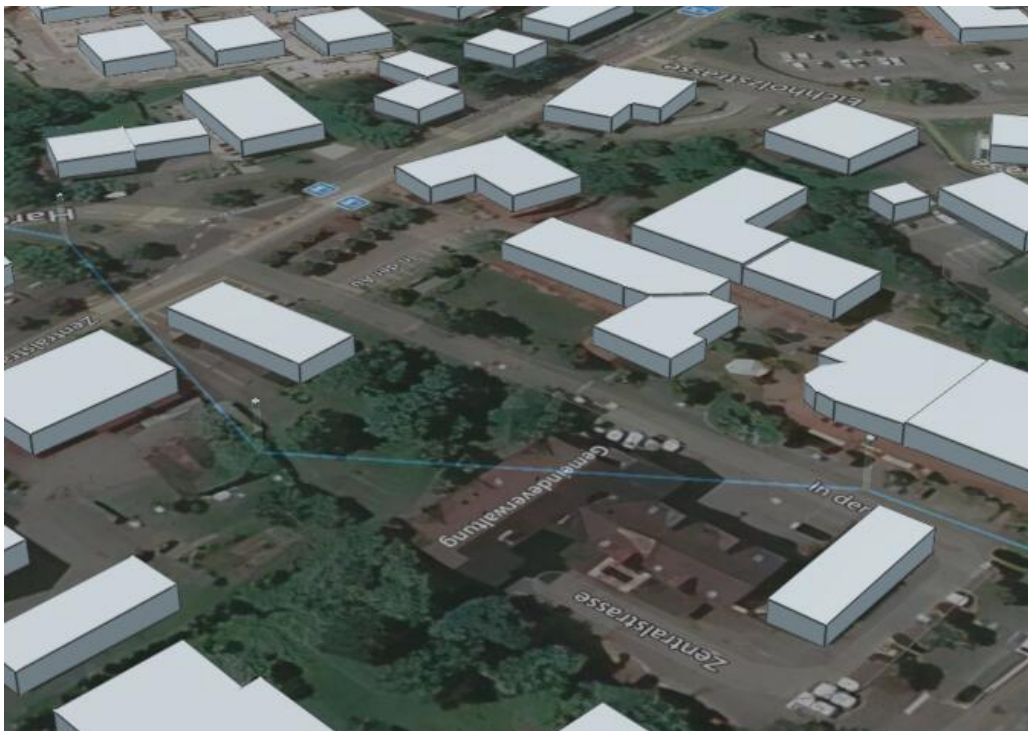


### Select Model ✕

Model Name	Wires Count	Graphics	
Single T, MV, steel tube	2		<input type="button" value="SELECT"/>
cat LayerDouble T, HV, lattice tower	6		<input type="button" value="SELECT"/>
Triple T, HV, lattice tower	6		<input type="button" value="SELECT"/>
Double T, MV, steel tube	4		<input type="button" value="SELECT"/>
Underground	1		<input type="button" value="SELECT"/>

It is possible to add custom pylon models if needed.

Notice that one of the default pylon types is named **Underground**, meaning that it will generate routes located under the surface, like earth cables.



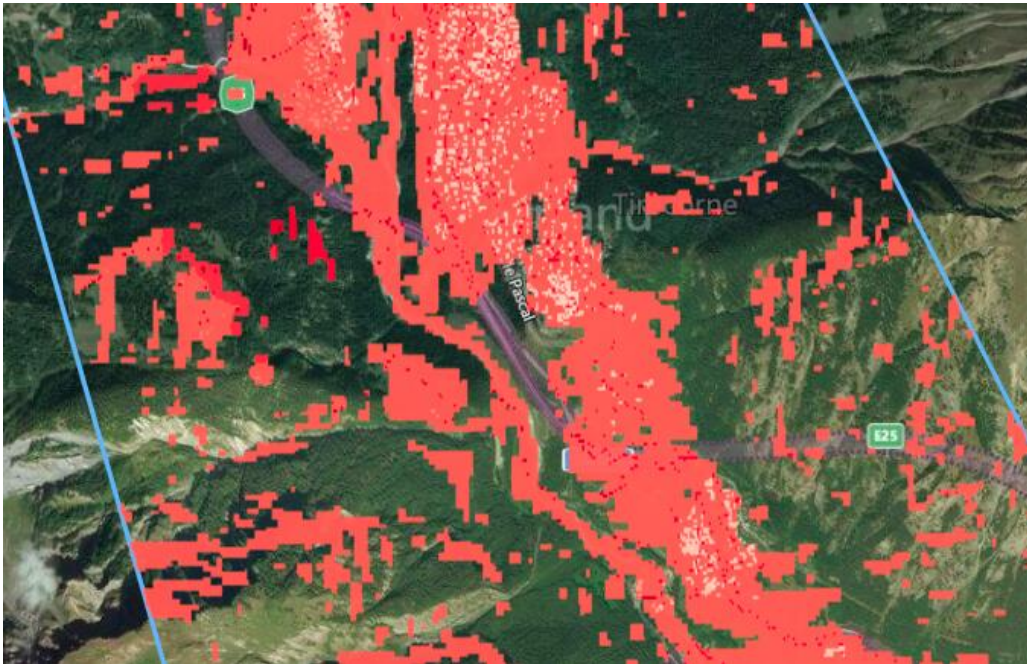
If you use this option in 3D, you will need to switch the view mode to Underground, so the lines are visible and it becomes possible to navigate below the surface.

### Slope Resistance

Because of the new **support for raster data**, this option has been discontinued. Slope and Digital Elevation Model rasters are now visible in the Layers panel and can be used to setup resistances which depend on the slope or the elevation of the terrain.

Typically, you may want to add some resistance for large values of slope, and certain ranges or elevation (to avoid mountains and flooding areas, for instance). This is easy to do with the raster resistance settings.

This is an example, exaggerated for demonstration purposes, of resistances ranges based on the slope, including forbidden values (transparent) for a high slope:



In the analysis section we will see how to identify the effect of slope and other layers' resistances at a specific location and along a path.

---

*Disclaimer:* the scenarios depicted in this manual do not represent actual customer projects or infrastructure proposals, and are presented for demonstration purposes only.

For more help, please use the help chat in the application, or [contact Gilytics](#).

## Multiple Scenarios

We have seen how to setup the parameters of one scenario in the project, defining the constraints for the route optimization calculation.

However, the users normally create multiple scenarios with different parameters to compare the results of different criteria or different start/end points.

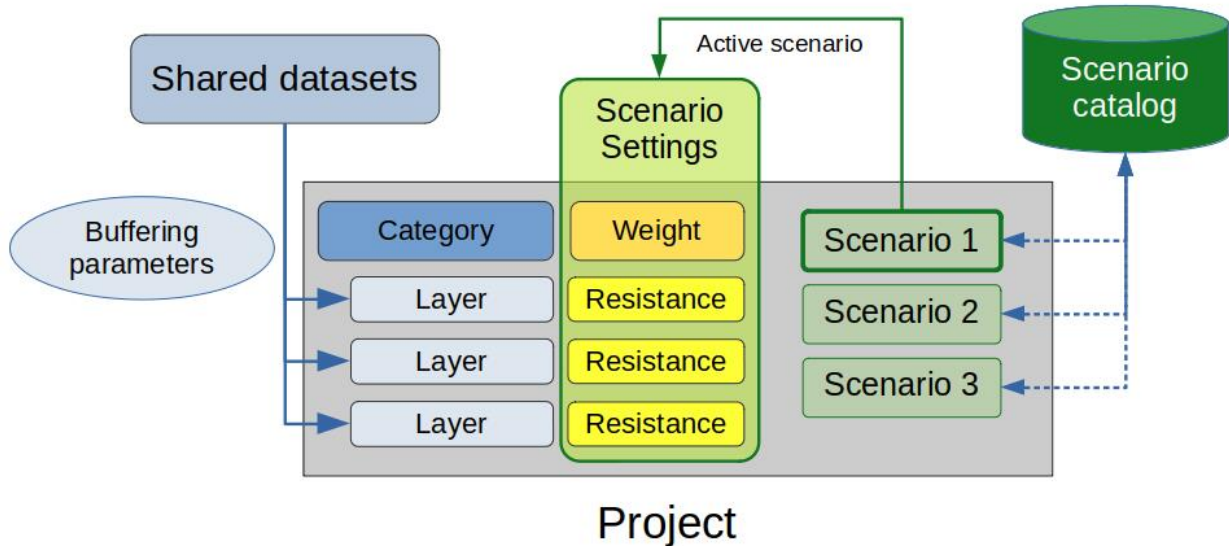
### Note

Users with an administrator or editor rol can define new scenarios or modify their existing ones. However, *viewer* users can only access shared scenarios. They can't create new ones or modify any of them.

## Scenarios and Projects

Each scenario in the project contains an assignation of resistances to the project layers and weights for the categories where layers are grouped. In addition, the scenario contains other settings like key points, cost calculation factors, etc.

A project may contain *multiple scenarios*, each of them with different settings, but only one of them is the **active scenario**. Changes applied to layer resistances, category weights and other settings, as well as the result calculations and analysis charts, all operate on the active scenario.



Because it may be interesting to keep scenario settings to be reused in multiple projects sharing the same layers and categories (for instance, projects for different areas in the same country), scenarios can be stored or copied to be reused.

**Note**

Scenarios are independent and private to each user, unless they are copied or shared.

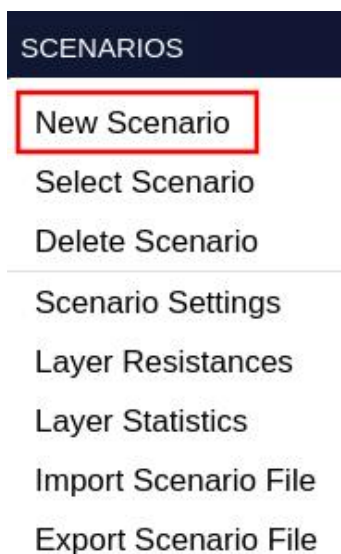
**Managing Scenarios**

**Create New Scenario**

Except in the case of viewer users, there is always one default scenario in the project.

However, if we are a viewer user or we want to try multiple scenarios with different settings, we need to explicitly add more scenarios to our project.

A new scenario can be created or imported by using the *Scenario/New Scenario* menu option.



It can also be created by using the corresponding button in the Right Panel header.



In either case, the Add Scenario dialog will popup.

This dialog offers three ways to add a new scenario to the project:

- By copying settings from the active scenario:

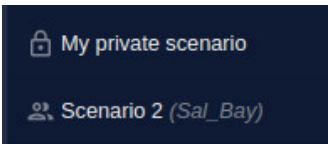
A screenshot of the "Add Scenario" dialog box. It has a title bar with a close button (X). Below the title are three tabs: "CREATE NEW" (selected with a blue underline), "SHARED", and "IMPORT SCENARIO". There are two text input fields: "Scenario Name" and "Scenario Description". At the bottom right, there are two buttons: "CANCEL" and "CREATE".

- By selecting one or more shared scenarios defined by other users for this project:

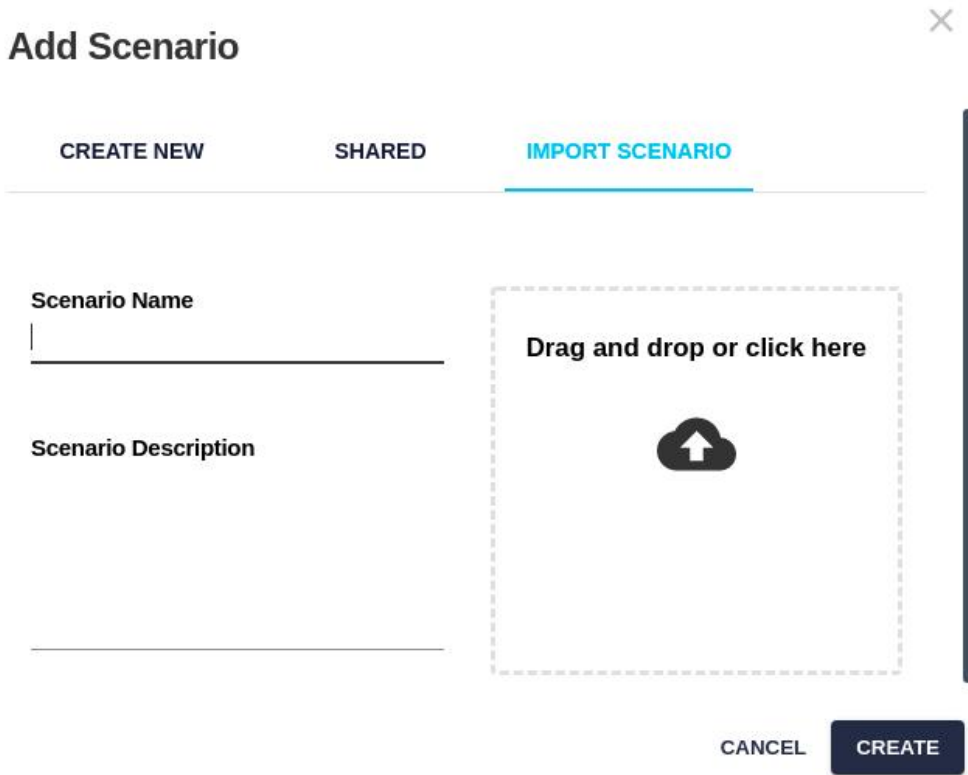
This is the only option available to viewer users. Shared scenarios can not be modified (except for their owner), but are useful to present results prepared by someone else.

A screenshot of the "Add Scenario" dialog box. It has a title bar with a close button (X). Below the title are three tabs: "CREATE NEW", "SHARED" (selected with a blue underline), and "IMPORT SCENARIO". Below the tabs, it says "Selected scenarios will appear in the Scenarios Panel." There is a list of scenarios with columns for the scenario name, the owner's name, and a checkbox. One scenario is listed: "Scenario 1 - Lorena" with owner "Lorena" and a checked checkbox. At the bottom right, there are two buttons: "CANCEL" and "CREATE".

Shared scenarios added to the project are indicated by a special "team" icon and the name of the owner between parenthesis:



- By importing a saved scenario file:



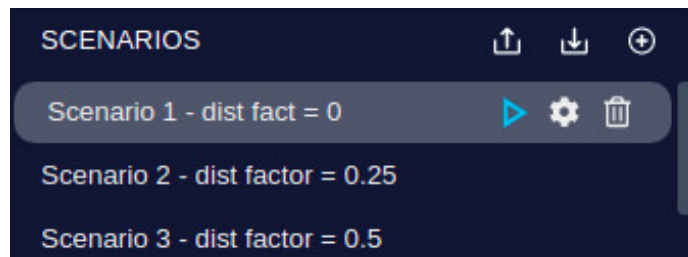
### Note

*The new scenario will become the new active escenario.*

### Select the Active Scenario

As mentioned, any changes in the layer resistance assignation, category weights and other settings, or the result calculations, operate on the active scenario, which is highlighted in the Scenario Selector and also in the Results section of the Right Panel with a different color.

To change the active scenario, the user can pick it directly in the Scenario Selector:



Or use the *Scenario/Select Scenario* menu option:



SCENARIOS

New Scenario

Select Scenario

Delete Scenario

Scenario Settings

Layer Resistances

Layer Statistics

Import Scenario File

Export Scenario File

And pick the scenario from the following dialog:



### Rename scenario

To change the name of a scenario, double click on it and type the new name, finishing with the Enter key.

New scenario name|

### Delete Scenario

Scenarios can be removed from the project if we discard them as a viable option or have no more use for them.

The removal can be invoked from the top menu:

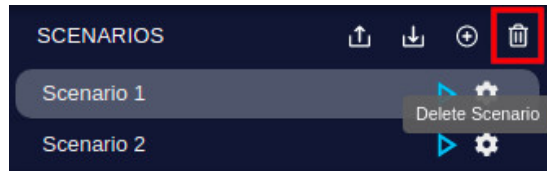
SCENARIOS

- New Scenario
- Select Scenario
- Delete Scenario
- Scenario Settings
- Layer Resistances
- Layer Statistics
- Import Scenario File
- Export Scenario File

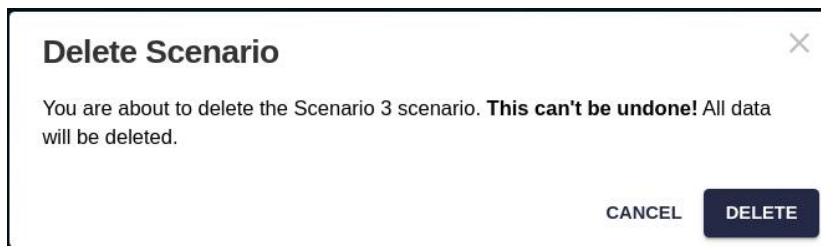
In both cases, a dialog will appear to select which scenario to remove from the project:



Direct removal is possible by clicking on the trash icon in the Scenario Selector:



In both cases, a confirmation dialog will pop up:



**Note**

*As with other delete operations in Pathfinder, scenario removal cannot be undone. The Results associated to the deleted scenario will be removed permanently.*

**Reusing and Sharing Scenarios**

Because users and organizations invest time and effort in defining the scenario parameters (resistances, costs), it makes sense to reuse them as much as possible in different projects and scenarios belonging to different users.

## Multiple Scenarios

Another reason for sharing scenarios is to allow other users to see our results without the need to recalculate them in their own scenarios, for instance, for public discussion purposes. Viewer users can only access shared scenarios created by other users, and will not be able to modify them.

There are three options to share scenarios, which we detail below:

- Save them in the *Scenario Catalog*, so they are visible to all users of the company, who can import them from the catalog.

### Note

This method can be used to share scenario settings in the same project and *among different projects*, as long as the projects have layers created from the same base datasets and use the same ring settings. Otherwise, the results of importing the scenario from the catalog might not be correct.

- Save them to *Scenario Files* which can be imported later.

### Note

This method is meant to be used as a backup for scenario settings, or to share scenario settings among different users of the same project.

- Mark the scenario as *shared* in a project so other users can open it and display the results, but not change it.

### Note

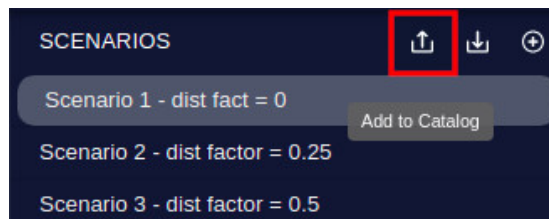
This method also works only in the same project.

## Scenario Catalog

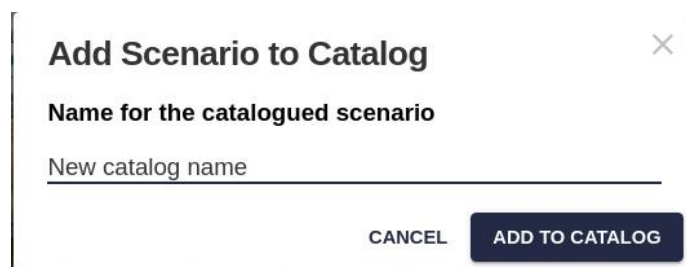
In some cases it may be convenient to *reuse the same scenario in different projects*. For instance, if our company operates in different areas of the same country, using the same base datasets and constraints, it's a good idea to save the scenario settings to be assigned later to other projects.

It is common that different public organizations have their own route analysis methodology and constraint preferences. In that case, it is convenient to store specific scenarios for each one to reuse in multiple projects.

The active scenario can be **saved** from the corresponding Scenario header button:



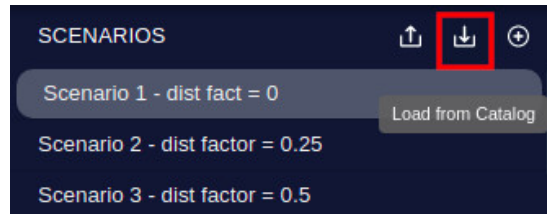
And give it a name in the catalog:

A dialog box titled "Add Scenario to Catalog" with a close button (X) in the top right corner. Below the title, there is a label "Name for the catalogued scenario" followed by a text input field containing the placeholder text "New catalog name". At the bottom of the dialog, there are two buttons: "CANCEL" and "ADD TO CATALOG".

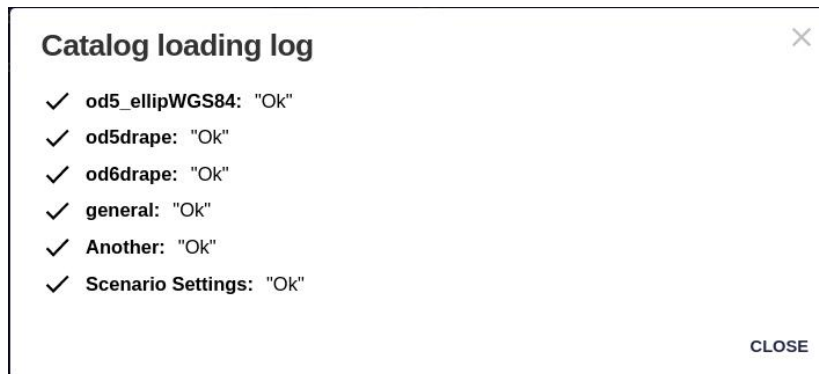
Another button in the Scenario header allows us to **load** a scenario from the catalog.

## Note

Beware that the current scenario values and settings will be overwritten in this operation. Create a new scenario or save the settings in the catalog or as an external file if you need to preserve them.



After loading the new scenario, a dialog will confirm which settings could be applied successfully to the project. *It is possible that some layers, categories or settings were not applied (e.g. resistances for layers which do not exist in the current project):*



It is not required for the current project to have the same layers/categories than the scenario we load from the catalog. Those layers/categories which exist in both the project and the scenario will be assigned the saved values.

## Note

*The Scenario Catalog is shared with all members of your company.*

## Importing and Exporting Scenarios

Another way to share and backup scenario settings is by using the file export and import options of Pathfinder.

This feature is more limited than the Scenario Catalog, because it is used only to **backup or share scenarios of a specific project**. It can be used to *store safety copies* of our user scenario parameters (in case we modify something and we want to revert to a previous state) or to *share a scenario with other company user working in the same project*.

To **export** the active scenario settings, use the top menu option:

SCENARIOS

- New Scenario
- Select Scenario
- Delete Scenario
- Scenario Settings
- Layer Resistances
- Layer Statistics
- Import Scenario File
- Export Scenario File

A *JSON text file* will be downloaded, and it can easily be viewed in text editors:

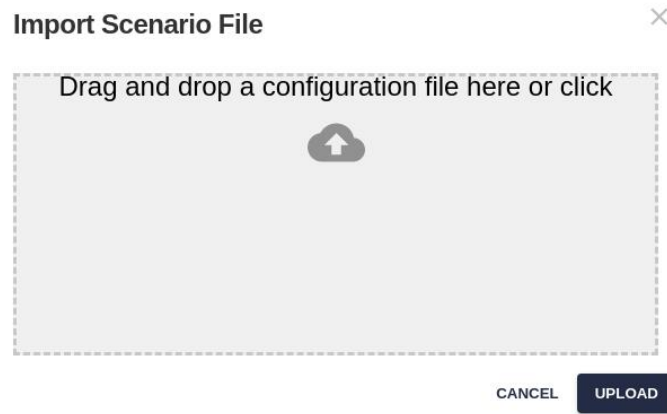
```
"max_direction_deviation": 1.57,  
"mcda_class_model": "GilyticsMCDA",  
"mcda_dist_weight_factor": 0,  
"path_price_per_km": 8270,  
"price_currency": "EUR",  
"pylon": 1,  
"pylon_max_m": 600,  
"pylon_min_m": 300,  
"routing_model": "GilyticsFastRouting",  
"threshold_multiplier": 0  
},  
"layers": [  
  {  
    "layer": 16,  
    "name": "CercaniaAeropuerto",  
    "resistance_value": 10,  
    "rfactors": {  
      "resistance_factors": [  
        100  
      ],  
      "ring_ids": [  
        1  
      ]  
    }  
  },  
]
```

Scenarios can be **imported** from files in the same format:

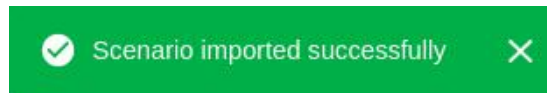
SCENARIOS

- New Scenario
- Select Scenario
- Delete Scenario
- Scenario Settings
- Layer Resistances
- Layer Statistics
- Import Scenario File
- Export Scenario File





A message will report when the importing is completed.



### Note

*Unlike loading scenarios from the catalog, loading a scenario from the external file requires the same project configuration. The layers and categories in the project must be the same as when the file was saved, including the ring configuration of layers.*

### Note

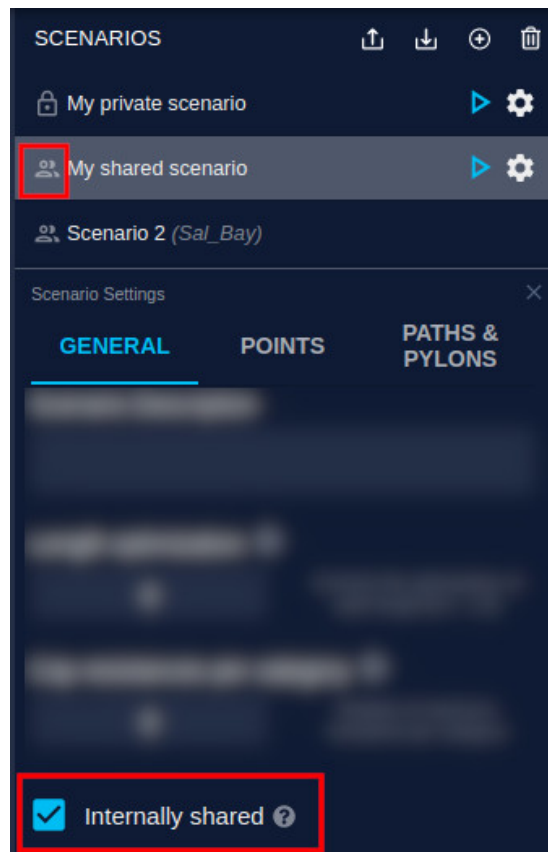
*Same as when loading a scenario from the catalog, importing it from a file will not create a new scenario, but overwrite the active one.*

As described above, we can also import directly a saved scenario file when we create a new scenario.

## Defining Shared Scenarios

By default, scenarios are private. All users of a project share the same layers (with their filters and rings), but they have different scenarios with their own resistance values, scenario settings and results.

If we want to provide view-only access to one scenario, so other users of the same project (assuming they have permission to access the project) can see its parameters and results (without being able to modify them) we just need to set a special flag in the scenario settings to change its type to *shared*:



Notice that, when we do this, the icon at the left of the scenario name changes from a “lock” (private) to a “team” (shared).

After doing this, other users can add this shared scenario when they open the same project.

## Note

Comments may only be visible to other members of your organization if their scenario is shared.

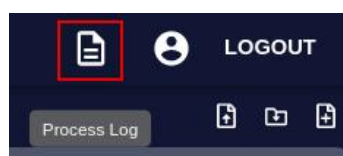
*Disclaimer:* the scenarios depicted in this manual do not represent actual customer projects or infrastructure proposals, and are presented for demonstration purposes only.

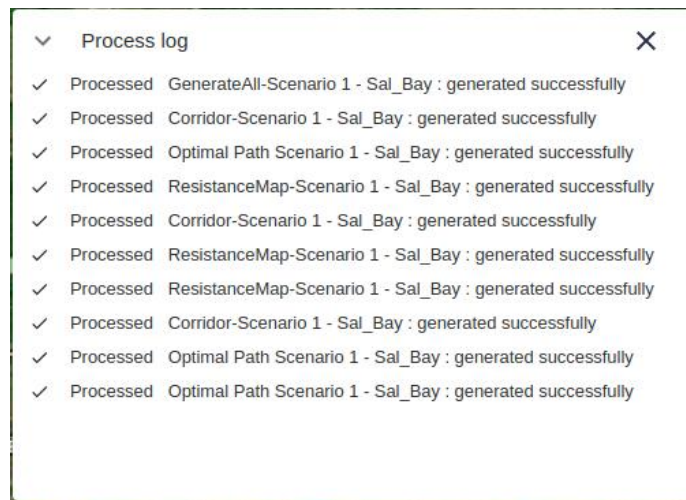
For more help, please use the help chat in the application, or [contact Gilytics](#).

## Running Processes

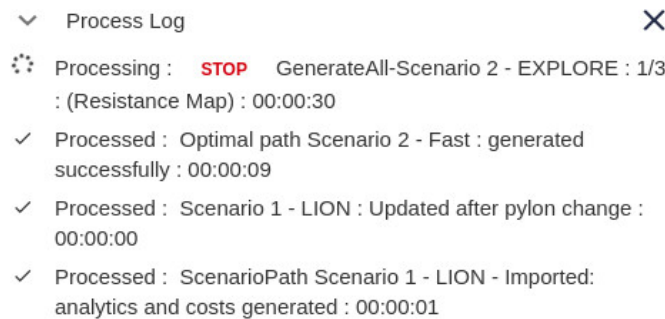
The Pathfinder cloud infrastructure runs processes to perform different data preparation and calculation tasks.

The user can open the **Process Log** to check the status of these tasks at any time:





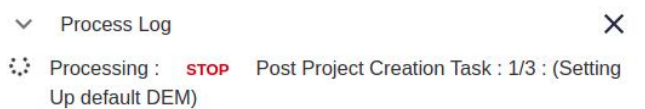
Estimating the **duration of a process** in Pathfinder is nearly impossible because of the many factors involved, including how many other processes there are, but the Process Log shows the time it's taking for each process to complete, so the users have an approximate estimation of how long it will take to run it again in similar conditions.



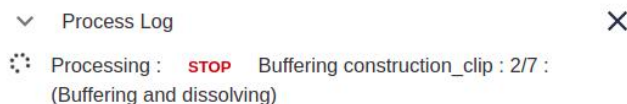
## Data Preparation Processes

These processes are run automatically by the application:

- When a *project* is created, a process is executed to prepare the *Digital Elevation Model (DEM)*, *Slope Map* and other information relative to the project area.



- When a *layer* is added to the project from a base dataset, or its ring/buffer options are changed, a process is executed to *clip and buffer* the data and prepare it for display and analysis.



### Note

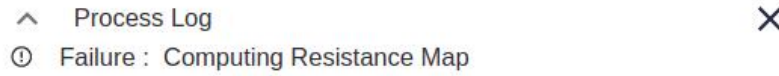
*It will not be possible to add layers to the project until its post project creation process ends.*

## Stop a Process

In some cases, a process can be running much longer than expected, or we wish to stop it in order to change some parameters and run it again. The Process Log shows a “Stop” button we can use to cancel the process.



After the process stops it will be displayed as “Failure”, but without the red color indicating a problem, and it can be executed again.



## Note

*It is not advisable to stop the project post-creation process calculating the terrain variables. If this process is canceled, it becomes impossible to add layers to the project and we will need to recreate it.*

## Scenario Analysis Processes

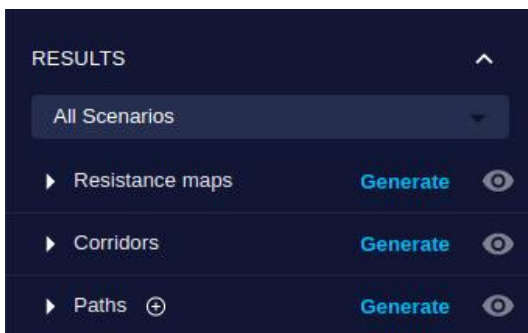
Pathfinder can generate multiple **analysis deliverables** based on the active scenario parameters, to provide information about the optimal location and effects of the infrastructure placement.

These results are generated in sequence. Each one is needed to calculate the following ones.

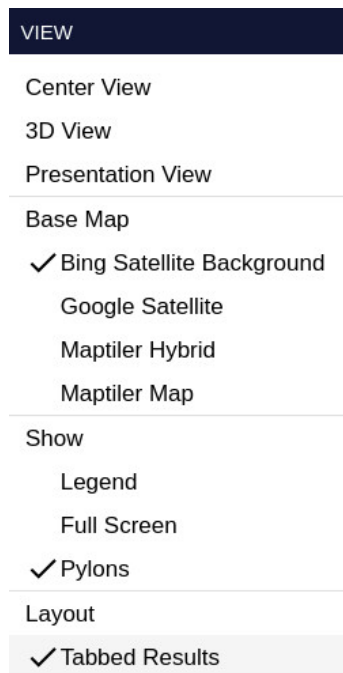
To run the generation processes and access the available results, use the **Results Panel**, in the right section of the Project Viewer.

The panel is comprised of *three sections* corresponding to each processing step: Resistance Map, Corridor and Paths.

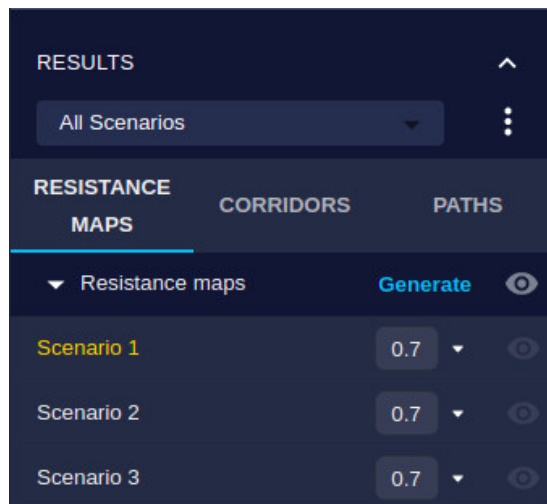
To expand/collapse each section’s items corresponding to different scenarios, click on the section header bar.



Instead of showing the Resistance Maps, Corridor and Paths stacked on top of each other, users can also split them in separate **tabs** by using the corresponding option in the View menu:



In this mode, each tab will show only one type of result, leaving room to view and manage more items.



**Note**

Viewer users can not run scenario analysis processes, but they can add shared scenarios to see results generated by other users.

**Resistance Map**

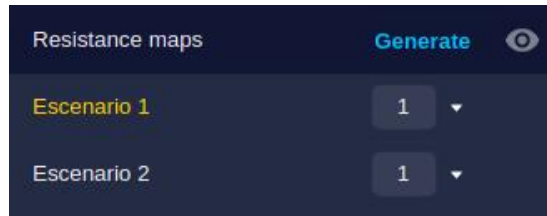
In this section, you can follow one of our [tutorial videos](#):

The first result to be calculated from the Scenario parameters is the Resistance Map, a sum of the resistances of layers added to the project, multiplied by the corresponding category weights.

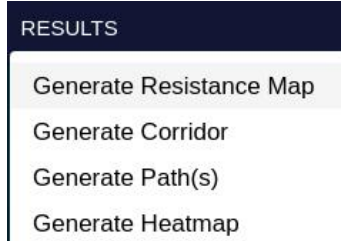
The Resistance Map can be used to calculate corridors or optimal paths (see below), but also in **Site Analysis** to determine the most optimal areas to locate an infrastructure like a power plant or substation.

To generate the Resistance Map (RM), click on the **Generate** button in the section header. Notice the active scenario name highlighted. The RM will be calculated for this scenario:





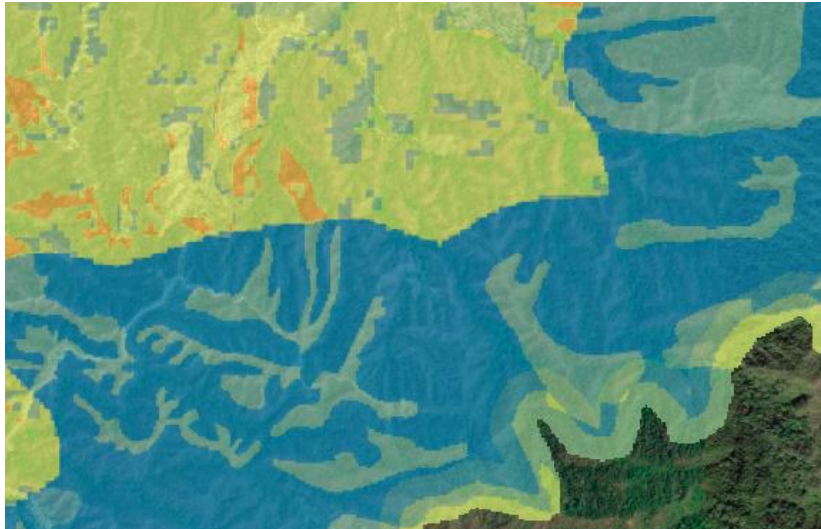
This process can also be invoked from the top menu option “Results/Generate Resistance Map”:



A new process is created and displayed in the Log:

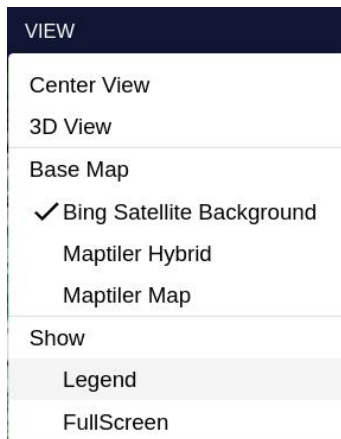


When the process is finished, the RM is displayed on the View:



Note that areas with *Forbidden values* look transparent (bottom right area), so the background map is clearly visible.

To interpret the resistance map colors, you can open the **Legend** with the *View/Legend* menu option:



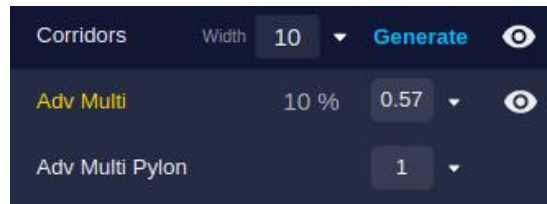
The yellow and reddish colors (see top color ramp) mean higher resistance values, while green and blue colors represent smaller values:



## Corridor Map

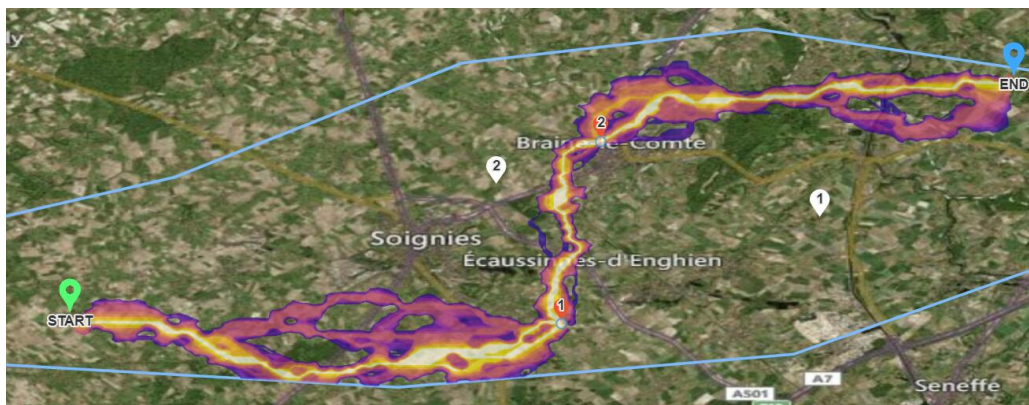
The Corridor Map displays possible paths from the Start to the End point which have an accumulated resistance near the optimum path, so in addition to hinting where this will be located, it also shows possible alternative routes.

The alternatives considered in the corridor map are defined by a percentage value, the *width* of the corridor.



As with the Resistance Map, the process to create the Corridor Map can be invoked with the *Results/Generate Corridor* menu option or with the *Generate* button in the Corridor Section of the Results panel.

After the process to generate the Corridor Map is completed, it will be displayed in the View:

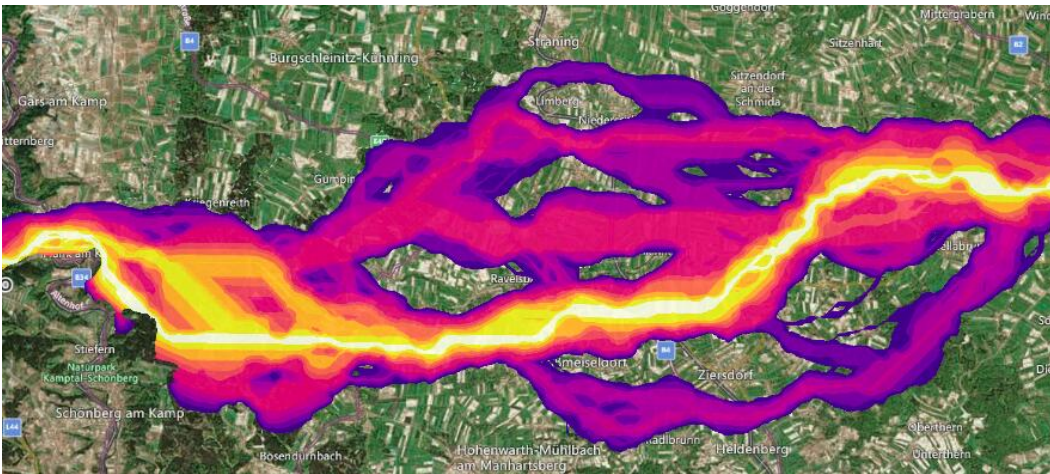


The *Legend* shows the interpretation of the Corridor Map colors: more yellow means lower resistance and more blue means higher resistance. Areas with a resistance higher than the percentage threshold are shown as transparent.

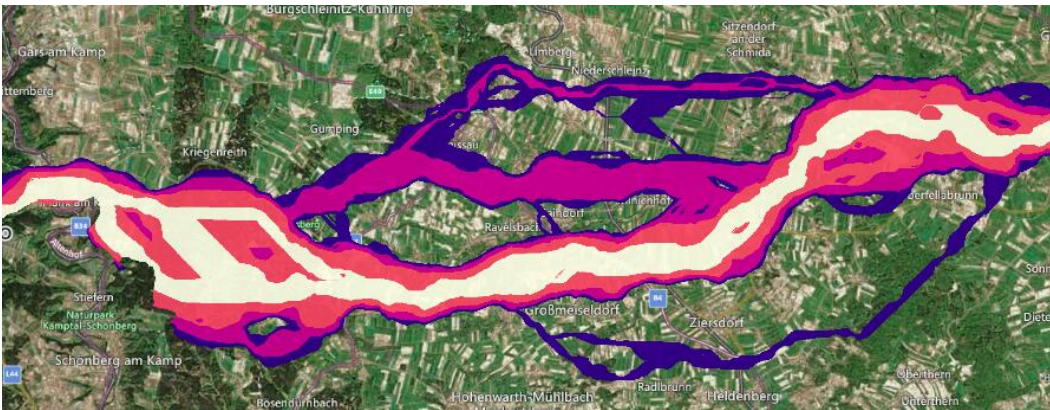
*What is the meaning of the corridor width?* It depends on the corridor method selected in the Scenario Configuration.

- The default option (*percentage*) calculates the corridor map as those areas crossed by routes whose resistance is limited by a percentage of the optimal resistance. As an example, if the total resistance of the optimal path is 1200 and the width is 10%, the corridor map will show paths with a resistance lower than  $1200 + 10\% \text{ de } 1200 (120) = 1320$ .

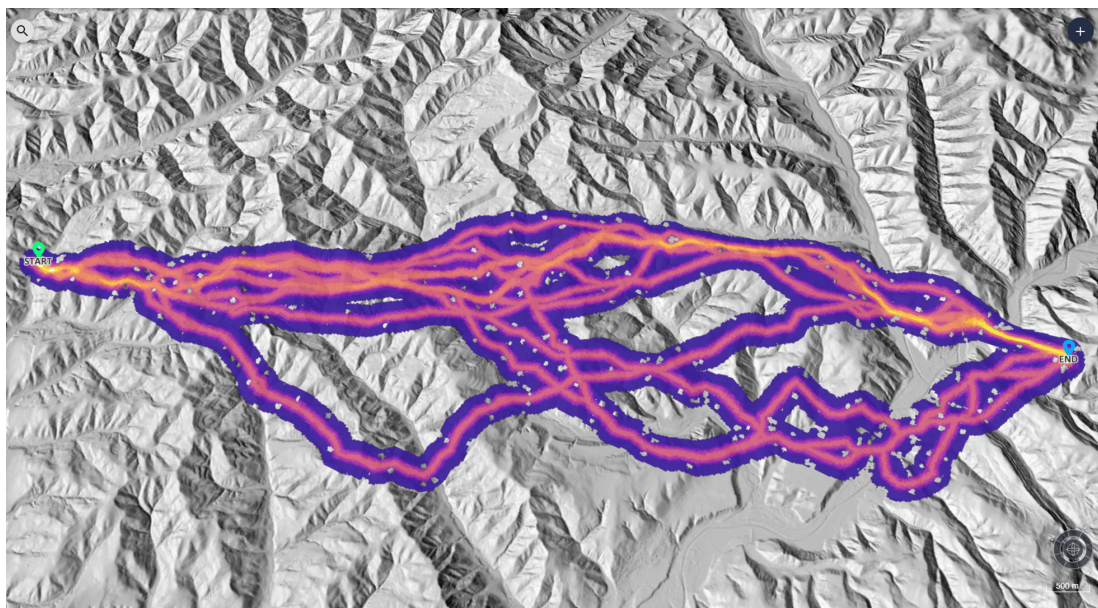




- The *percentile* option calculates the limit as a percentile of the resistance values, so a width of 10 will display the 10% of points with a resistance above the optimal one, and it will show a subdivision of this range in four categories. For instance, a width of 10 will use different colors for points with values above 0% to 2.5%, between 2.5% and 5.0%, 5.0% to 7.5% and 7.5% to 10%.



However, in the case of the Corridor Map associated to the Explore routing algorithm, the corridor width is used to control the spatial influence of the routers combined to make the corridor, regardless of the selected corridor method:



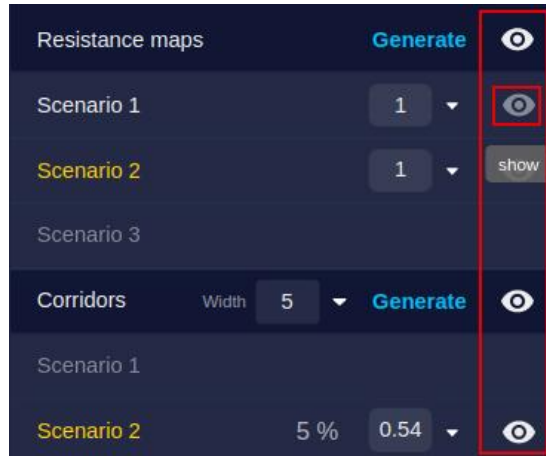
**Note**

*You might get a failure message if the Start or End points are inside a Forbidden area.*

## Visibility and Transparency

As we create multiple results of different types, or for different scenarios, we probably need to control their visibility to focus on the information we need.

The “eye” icons on the right side of the Results panel can be used to *show or hide* results already calculated:



In addition, the *opacity* input or slider can be used to make a result more or less transparent and therefore control the way it is overlaid on top of the base map and other results and project layers.



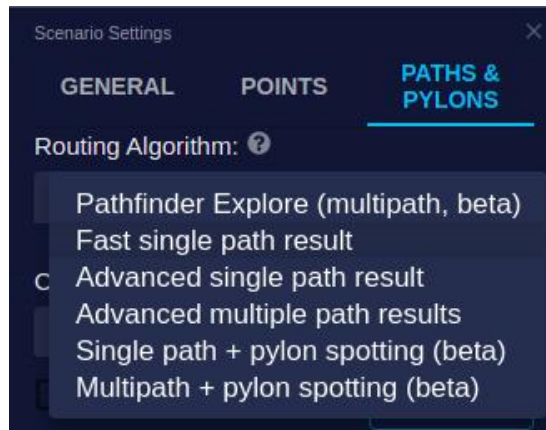
## Optimal Paths

The ultimate goal of Pathfinder is to find the optimum routes for a linear infrastructure between the Start and End points (possibly passing through some intermediate locations).

## Algorithm Selection

Pathfinder offers a default fast routing algorithm to perform this calculation. Depending on your company license, you may also have access to other routing algorithms.

The routing method can be selected in the *Path and Pylons* section of the *Scenario Settings* in the Right Panel:



Some methods may generate *multiple path candidates*. They may also differ in the way *pylons are positioned*. For more information, see the section about routing algorithms.



## Path Calculation

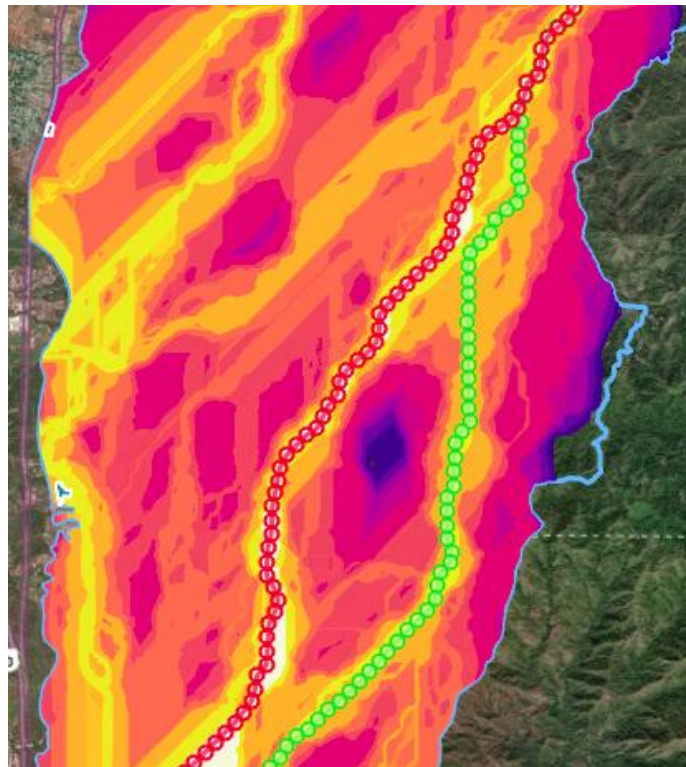
To calculate one or more optimal paths on the active scenario parameters, using the selected algorithm, click on the *Generate* button:



Or use the *Results/Generate Path* menu option:



After the calculation process is completed, the path line or lines will appear in the View.



## Importing Paths

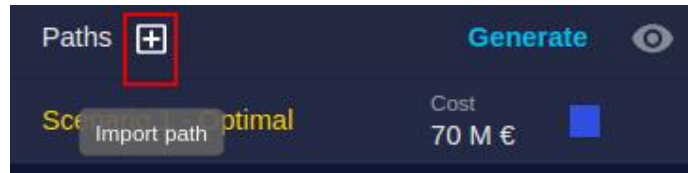
In addition to the paths calculated by Pathfinder, external paths created from other tools can be imported to perform the analysis of possible alternatives.

### Note

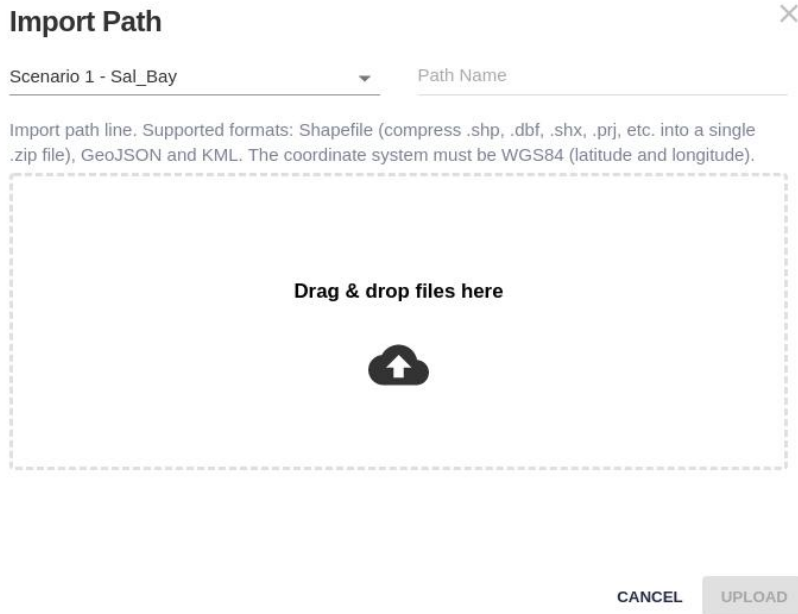
*Path files to be imported must include a single polyline in the WGS84 (EPSG:4326) coordinate system (latitude and longitude).*

To import a path, click on the button in the Paths panel:





Select the scenario where the path will be inserted, and type its name. Then, drag and drop the path file on the dialog:

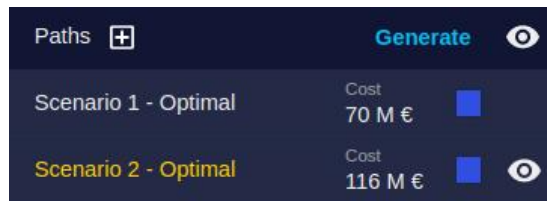


The imported path will be shown in the Paths panel and displayed in the View. Its statistics and cost are also evaluated.

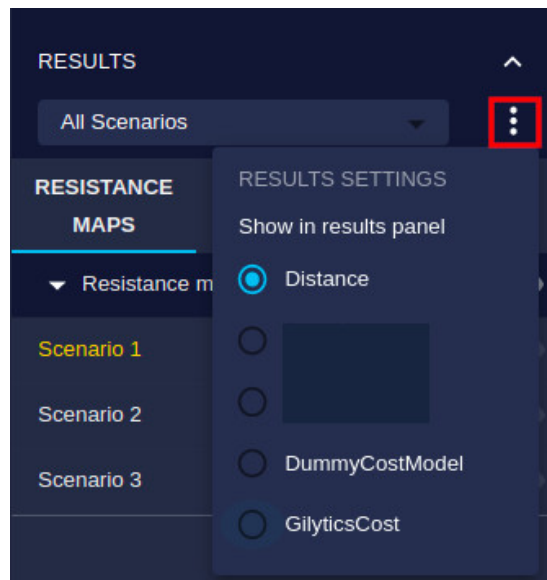
## Monetary Cost and Other Indicators

If one or more cost calculation models are activated in the scenario settings, these models are applied to the optimal paths when calculated.

The calculated value of the first cost model is displayed next to each path name:



The user can select to display instead a different cost model result, or the path distance.



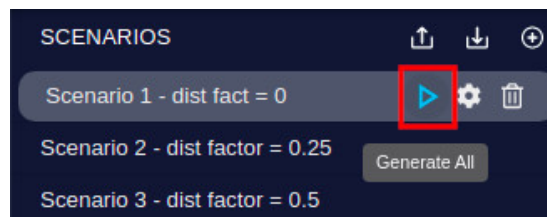
The path costs will be automatically updated if the user edits the path using the pylon tools in the 3D View.

When an external path is imported, its cost calculation is done automatically.

A detailed path cost report can be used to review the details of the cost estimations. This report can be open by clicking on the numeric cost value displayed for each path.

## Generate All Results

Instead of generating the Resistance Map, Corridor and Path(s) one by one for the active scenario, the user can choose to generate all automatically in sequence. This can be done by using the *Generate All* button corresponding to the scenario.

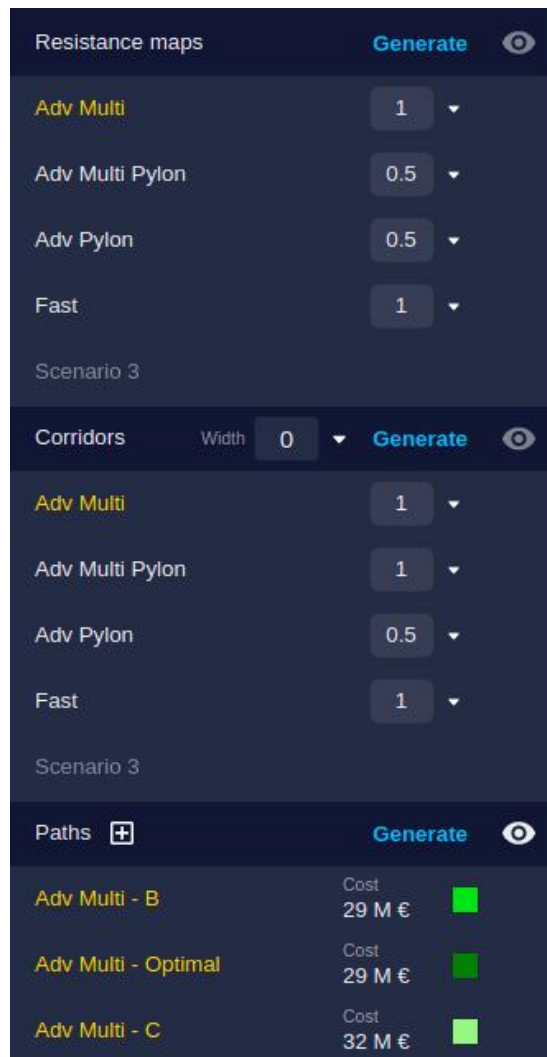


Notice that all the results are generated in a single process. The results will become all visible after the process is completed.

## Comparing Scenarios

A key feature of Pathfinder is the ability to compare the results of different scenarios.

By default, the list of results includes all of them, for each scenario. The results for the active scenario are highlighted in orange:



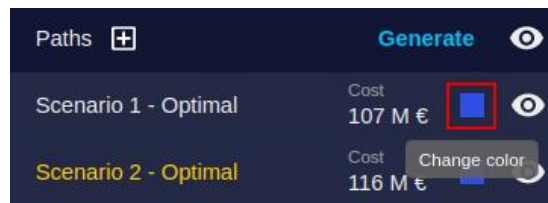
As we saw for corridors, each result can be made visible or invisible by switching on and off the eye icon to the right, and also assign an *opacity* value from 0 to 1, so multiple results can be overlaid for visual comparison:



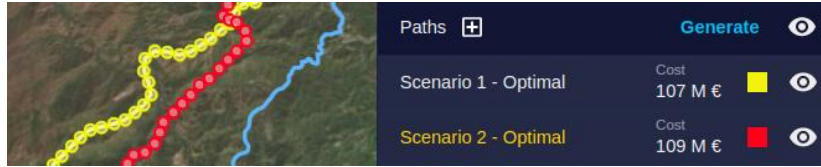
## Path Comparison

A key result of Pathfinder is the comparison of optimal paths for different scenarios and also against imported paths. The monetary *cost estimations* for all paths can be easily compared by checking the figures shown next to each path name.

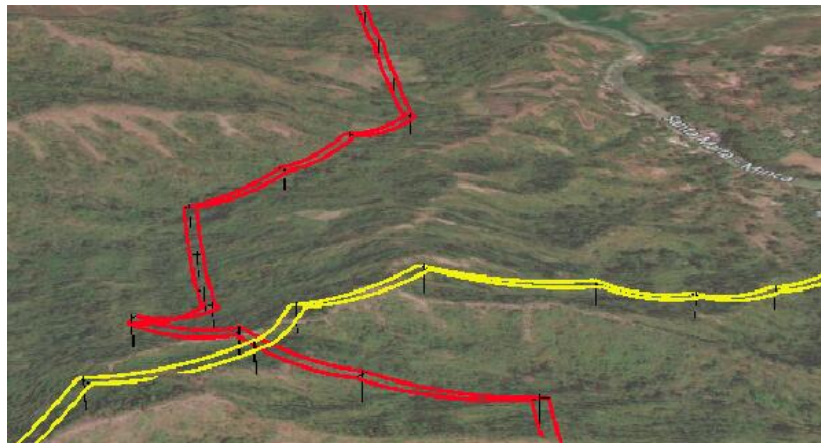
To identify each path more clearly in the View, the user can click on the color square next to each path name and assign different colors to each one:



The Map View will show the routes with the assigned colors:



This visual comparison can also be done in the 3D View.

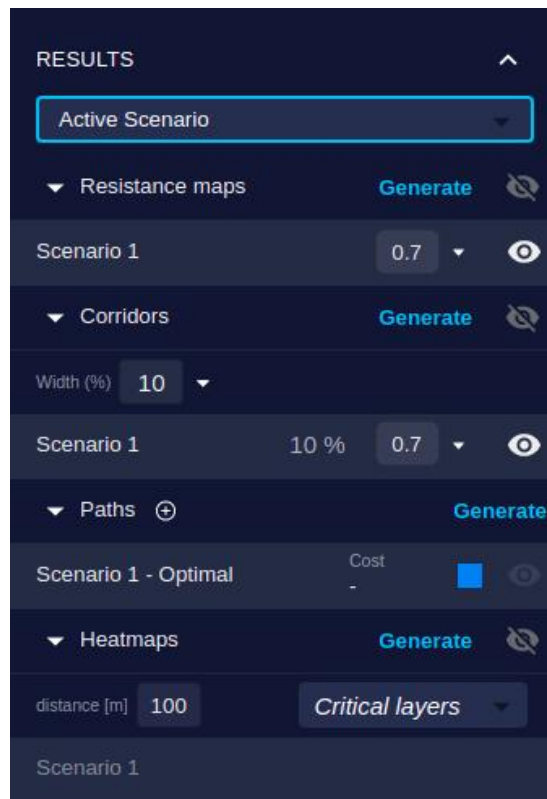


Path comparison can also be done quantitatively in terms of:

- *Monetary cost*, by using the Path Cost report.
- *Layer coverage*, in the Path Analytics page.
- *Elevation profile*, with the Vertical Profile chart.
- *Resistance profile*, in the Path Resistance chart.

## Single Scenario Results

If the user wants to focus on the results of the active scenario, this can be done by using the *Active scenario* option in the Results header bar. When this option is selected, only the results for the active scenario will be presented:



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*Disclaimer:* the scenarios depicted in this manual do not represent actual customer projects or infrastructure proposals, and are presented for demonstration purposes only.

For more help, please use the help chat in the application, or [contact Gilytics](#).

## Analyzing Results

After generating the project results, the next step is to analyze them and check if they match our expectations, and possibly modify the scenario or create new ones to study different alternatives.

This is typically an iterative process:

- Define the scenario with constraints and cost factors
- Generate the results
- Analyze the results
- Modify the scenario and/or create new ones

After we are satisfied with the results, at least with a preliminary version, we can export them.

## Analyze Resistance Maps

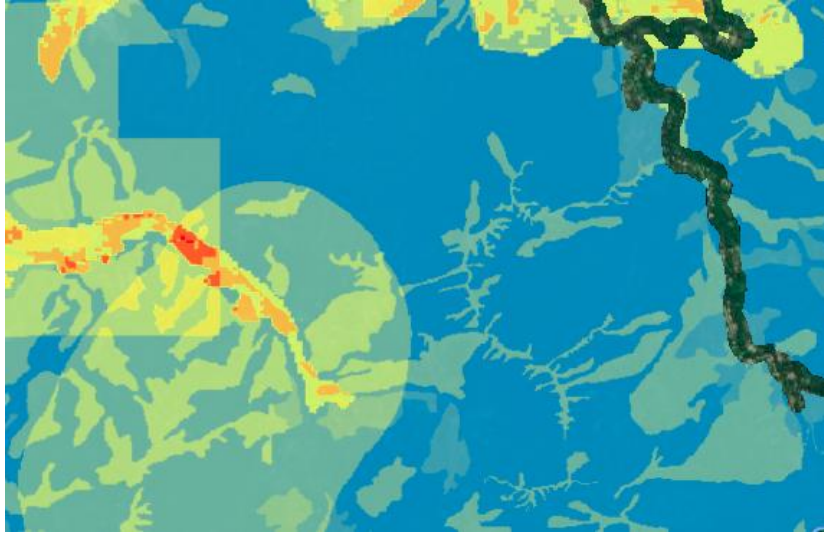
Some aspects of the Resistance Map to consider:

- Areas with *Forbidden* values should look transparent, regardless of the value of other layers in those locations.
- The more red the color (farther from blue), the higher the resistance. The visible resistance includes the multiplicative effect of the category weights.
- Colors are assigned starting with blue for the lowest resistance. If you add a new smaller resistance value in the scenario configuration (e.g. a very negative number), this may make other values look more red even if they haven't changed.



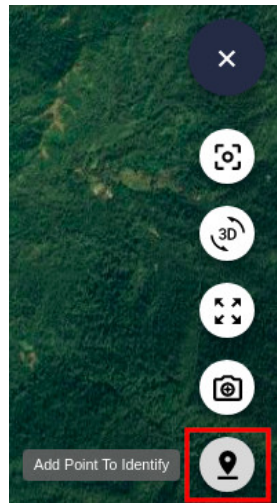
## Analyzing Results

The blue/green areas in the Resistance Map show preferred locations for the infrastructure, but the overall path will be calculated to optimize the total resistance along the route, so it may cross some higher resistance areas.

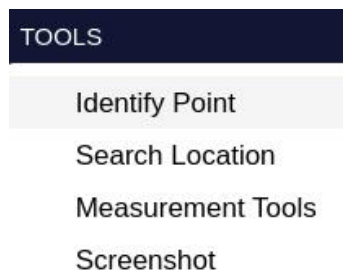


### Identify Tool

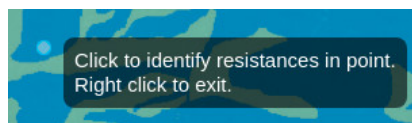
This tool can be activated from the 2D or 3D View toolbar:



And also from the *Tools* menu:



When the tool is activated, the cursor will change to prompt the user to pick a location:



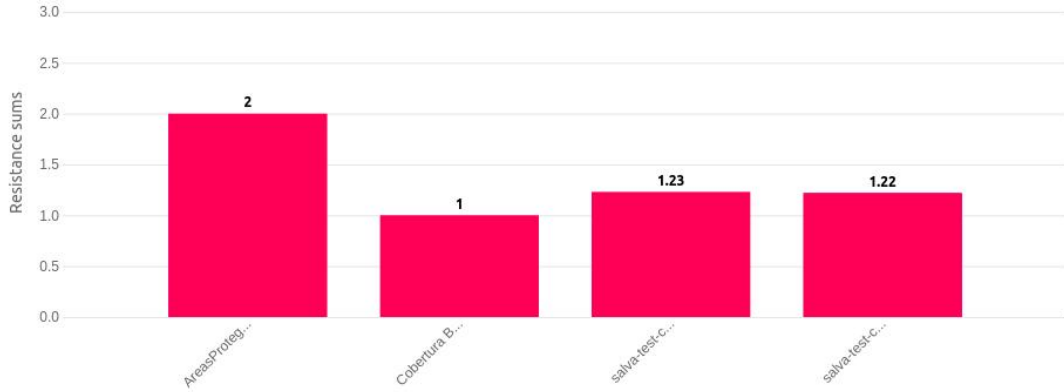
After picking a point, a dialog will appear showing the geographic coordinates and resistance values in the selected location (data may take a few seconds to pop up, depending on the number of layers):

## Identify



Point coordinates: 11.18484 -74.15076

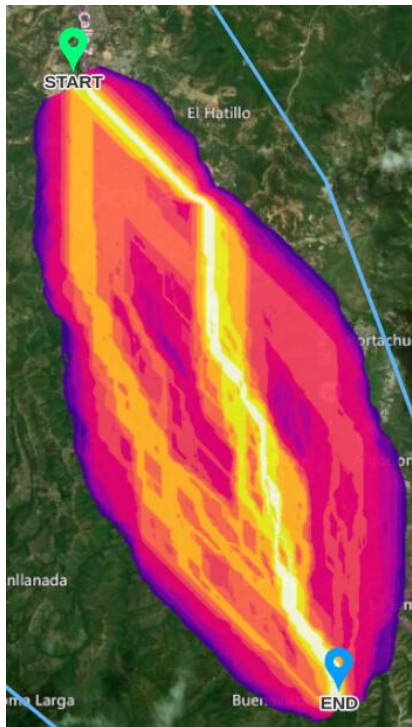
Calculated resistance: 5.45 ?



Category	Layer name	Calculated resistance
Default	AreasProtegidas 2 (0m)	2
	Cobertura_Bosques (0m)	1
Terrain	salva-test-cost-compare-with-prod_240_dem (rst=129.00)	1.23
	salva-test-cost-compare-with-prod_240_slope (rst=5.84)	1.22

## Analyze Corridors

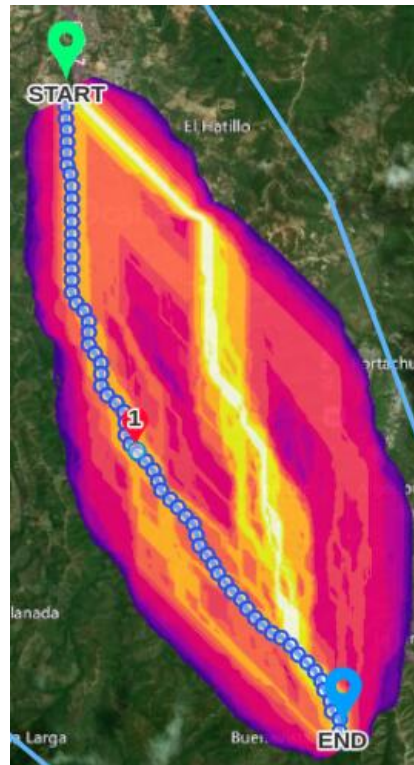
The Corridor Map shows in bright yellow hues the areas where an optimal path is most likely to pass through. This provides a quick overview of routing options:



For instance, in the previous image we see a clear optimal track on the right side, but also a possible alternative track on the left.

## Analyzing Results

According to the corridor map, the left alternative will have a higher resistance, but we might still force our solution to pass through this area by adding one or more intermediate points on it.



## Analyze Paths

The most important results of Pathfinder are probably the optimal paths which can be used as routes for our infrastructure, so it is essential to understand how to analyze its fitness and compare different options.

There are several key factors we can analyze separately to support the decision about the best route:

- Impact and compliance of each path with the Scenario constraints
- Vertical profile of each path
- Resistance along each path
- Estimated monetary cost

In this section, you can follow one of our [tutorial videos](#):

## Analyze Constraints

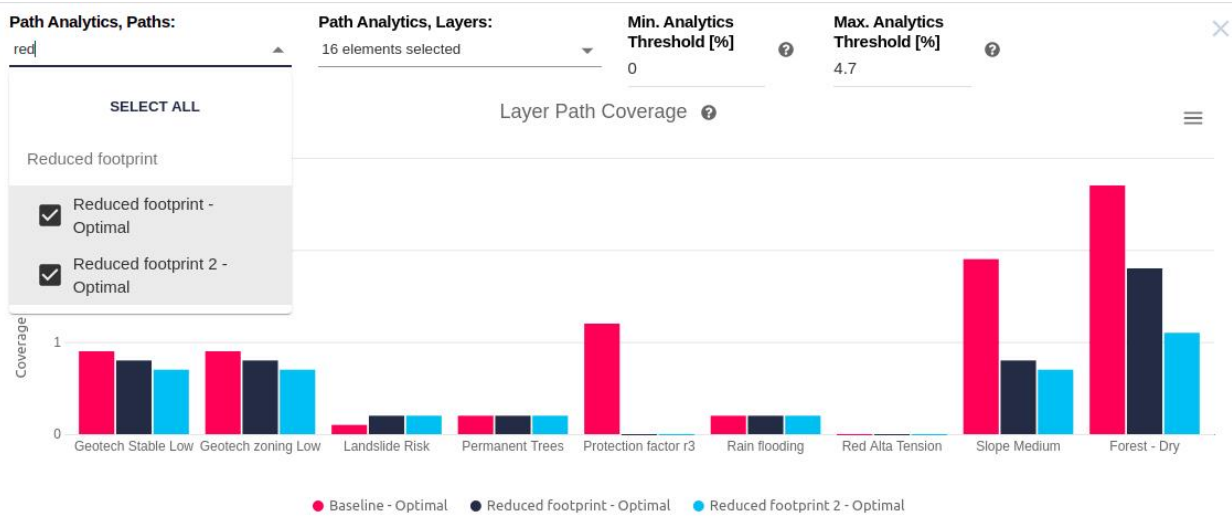
To access the path analytics, we can use the menu option in *Results*:

- RESULTS
- Generate Resistance Map
- Generate Corridor
- Generate Path(s)
- Generate Heatmap
- Geoprocessing Tools
- Path Analytics
- Path Profiles
- Path Resistances
- Path Cost
- Pylon Report
- Heatmap Distribution

At the top of the analytics window, we'll find selectors to choose the content of the chart:

- The *scenarios* to compare
- The *layers* to include in the comparison
- The *minimum percentage threshold* for layers to include (if we are not interested in layers with low coverage)
- The *maximum percentage threshold* for layers to include (if we prefer to ignore layers with a high coverage)

Below the selectors there is a first chart showing the percentage and length of the path as it crosses the selected layers *regardless of their category*.



If the chart includes too many layers, we can change the thresholds or select only those layers we are interested in.

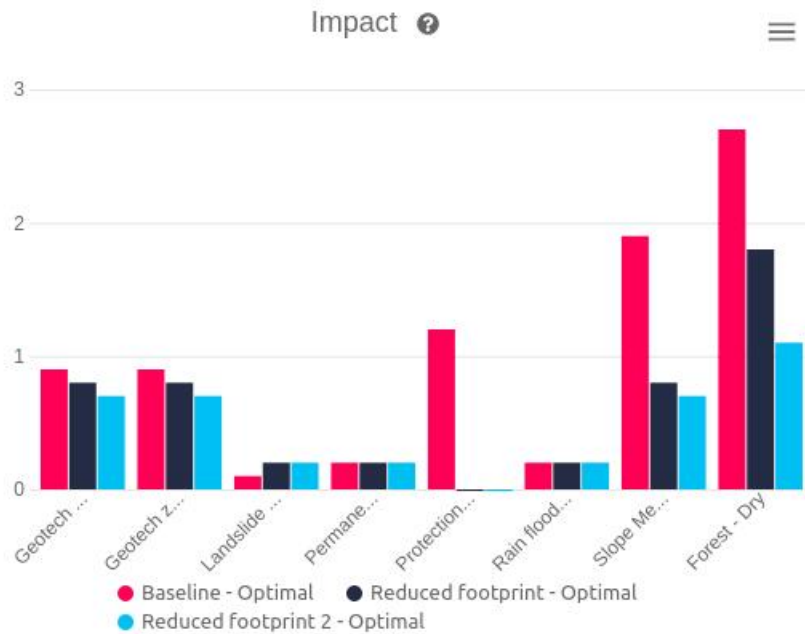
Below the summary chart we can see the **total length of the selected paths**:

Path length for Baseline - Optimal: **29.8 Km** (5 Layers not visible in chart)

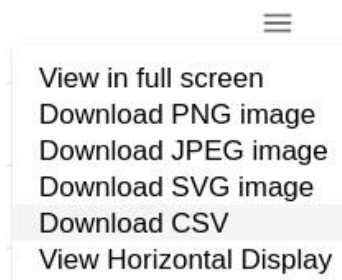
Path length for Reduced footprint - Optimal: **30.2 Km** (5 Layers not visible in chart)

Path length for Reduced footprint 2 - Optimal: **30.6 Km** (5 Layers not visible in chart)

In the bottom sections, the same information is shown *for each category*, so we can focus on the impact of the paths in each layer group:



The Path Analytics chart, as all Pathfinder charts, it can be **exported** as an image file or CSV (spreadsheet) file by using the top right corner menu:



The exported CSV can be open in spreadsheet software like Microsoft Excel or LibreOffice Calc to create custom calculations and charts:

Layer	Coverage Distance (km)	Coverage Percentage
Forest - Dry	2.72716206033571	9.14282496951136
Geotech Stable Low	0.882649961436455	2.95908857934393
Geotech Stable Medium	2.90821846268165	9.74981749860755
Geotech zoning High	2.90821846268165	9.74981749860755
Geotech zoning Low	0.882649961436455	2.95908857934393
Landslide Risk	0.101844226319591	0.341433297616607
Permanent Trees	0.192372427492561	0.644929562164702
Protection factor r3	1.24476276612833	4.17307363753631
Rain flooding	0.158424352052697	0.531118462959166
Red Alta Tension	0.011316025146621	0.037937033068512
Slope Medium	1.92372427492561	6.44929562164702

In some cases, like after removing a layer from the project, the path analytics may need to be *refreshed*.

In these cases, a warning message will appear at the top of the page together with a link to recalculate the analytics:

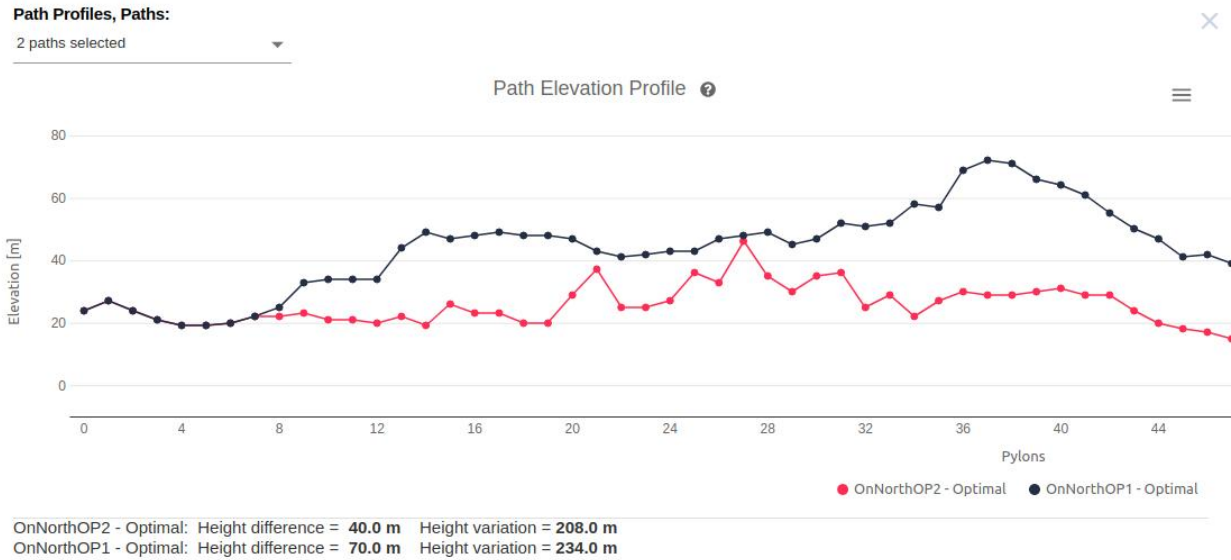
**Path Analytics, Paths:** 1 element selected  
**Path Analytics, Layers:** 73 elements selected  
The path analysis is not up to date and must be re-calculated [CALCULATE PATH ANALYTICS](#)



## Vertical Profile

This chart shows the variation of the elevation along the path. Multiple paths can be selected in order to compare their profiles.

Note that the elevation values are shown as altitude above sea level (geoidal elevation). Also, note that the elevation values are shown at the pylon locations. Different paths may have different number of pylons, so some lines may extend further on the right side of the chart.

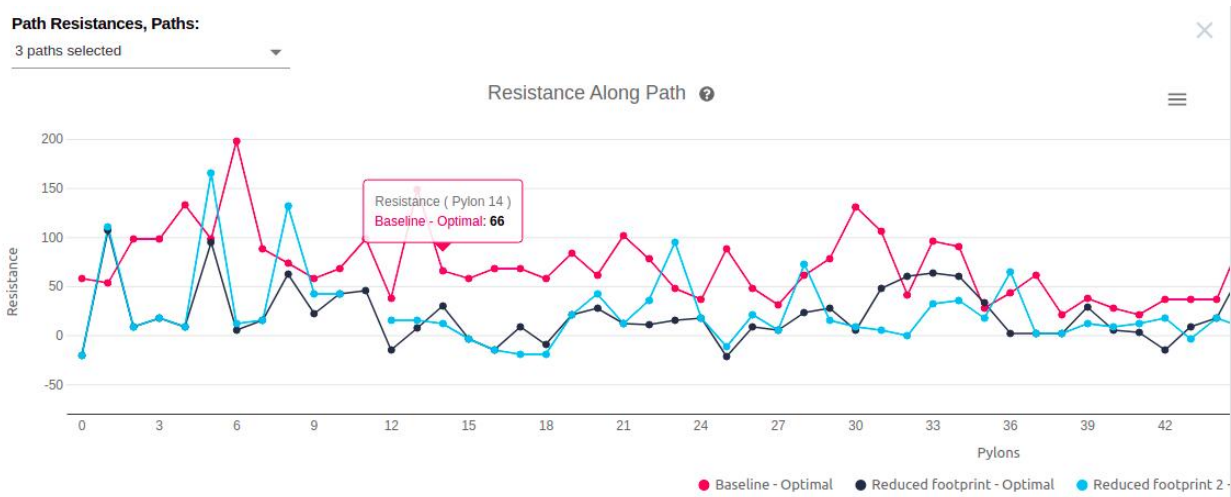


Below the line chart, these statistics are shown:

- **Height difference:** Shows the difference between the maximum elevation of the profile and the minimum elevation.
- **Height variation:** Shows the summation of height differences for all line sections (each section measured between two pylons), that is, the total variation of height when the line goes either up or down from start to end.

## Resistance Profile

The resistance profile chart shows the variation of the resistance (cost) along the paths. Again, multiple paths can be selected to compare the impact of each alternative and decide which one is more optimal.



Resistance values are shown for each pylon along the routes. Because the number of pylons will vary among the paths, lines can extend more or less on the right side.

## Analyze Cost

The path cost analysis can be accessed from the menu option in *Results*:

- RESULTS
- Generate Resistance Map
- Generate Corridor
- Generate Path(s)
- Generate Heatmap

---

- Geoprocessing Tools
- Path Analytics
- Path Profiles
- Path Resistances
- Path Cost
- Heatmap Distribution

This report can also be opened simply by clicking on the path cost number in the Results panel:



Both will open the Path Cost report window:

### Monetary cost ✕

Scenario 1 A ▼

Select path

GilyticsCost

**Total Cost: €2,684,104.86**

**Sople Multipliers:** From 0 to 1: x1

From 1 to 3: x2

From 3 to 10: x2

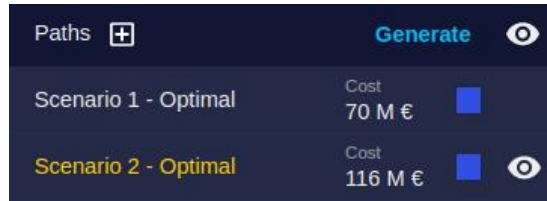
From 11 to 100: x3

name	Crossed path length	Price per km	Slope cell coverage	Final price
Full Base Path	1,961	€1,100,000.00	0 - 1: 0% 1 - 3: 46.3% 3 - 10: 52.5% 11 - 100: 1.1%	€2,157,759.89
OSM Agricultural	106.03	€1,000.00	0 - 1: 0% 1 - 3: 30% 3 - 10: 70% 11 - 100: 0%	€212.06
OSM Farmland	53.02	€2,000.00	0 - 1: 0% 1 - 3: 60% 3 - 10: 40% 11 - 100: 0%	€212.06

Note that, because it is possible to have multiple cost models activated in one scenario:

- The user can choose which cost model results to show in the table. Each model results with contain a different cost breakdown (different cost items or categories) defined in the model.

- The path cost figure shown in the Results panel corresponds to the first active model in the scenario:

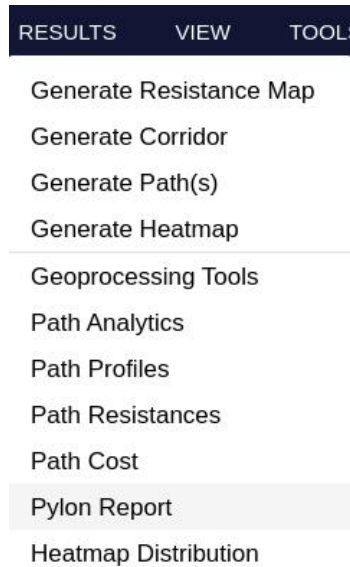


Paths	Cost	Generate
Scenario 1 - Optimal	70 M €	<input type="checkbox"/>
Scenario 2 - Optimal	116 M €	<input checked="" type="checkbox"/>

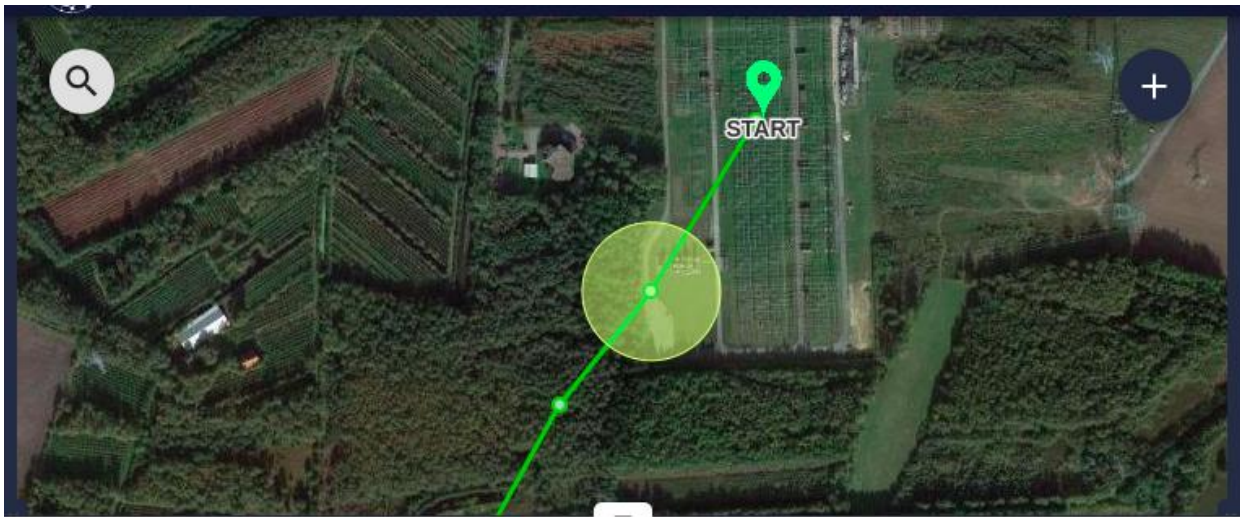
See the Scenario Settings section on how to define the cost model parameters.

## Pylon Report

In many cases, it is useful to display or export a list of the path pylons or anchor points. This can be done by using the pylon report, which displays a table of all the pylons or points created for each path, with their location and other properties.



From the table of the report, we can locate any pylon just by clicking on its table row. The map will zoom to it and highlight it with a yellow circle.



### Pylon Report

Scenario 2 - EXPLORE B

[DOWNLOAD CSV](#)

Select path

Number	Longitude	Latitude	Elevation	Distance to Next (m)	Angle
0	9.50156621	53.54271128	26	174.9	0.0
1	9.50019239	53.54136881	36	128.1	7.7
2	9.49897480	53.54047507	29	125.3	10.0
3	9.49805796	53.53949019	23	148.7	9.0
4	9.49728887	53.53823505	25	116.6	11.3
5	9.49637316	53.53734003	24	177.2	14.6

As with other charts and reports, it can be **exported** to a CSV file.

This table is also available in the printed report, for each scenario (see next section):

## REPORT GENERATOR ?

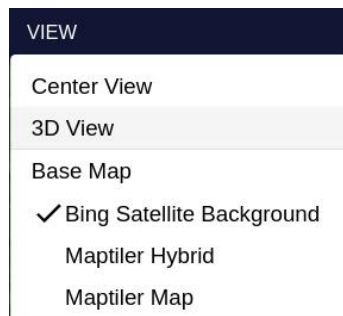
### Scenario 1 - Pylon Report - Optimal Path

Number	Longitude	Latitude	Elevation	Distance to Next (m)	Angle
0	-0.41943243	39.51257420	34	149.8	0.0
1	-0.41800931	39.51335163	40	228.2	60.0
2	-0.41560120	39.51248904	48	225.4	10.4
3	-0.41306372	39.51198310	46	211.9	4.7
4	-0.41063571	39.51165933	39	127.8	43.2
5	-0.40974032	39.51074044	43	190.9	45.3
6	-0.40754121	39.51051160	43	202.2	38.9
7	-0.40553085	39.51145555	32	190.9	38.9
8	-0.40333174	39.51122664	25	211.9	2.1
9	-0.40090381	39.51090266	26	220.7	2.9

## 3D Inspection and Editing

The 3D View provides all visualization capabilities of the Map View and, in addition, it supports a better visual analysis of the results.

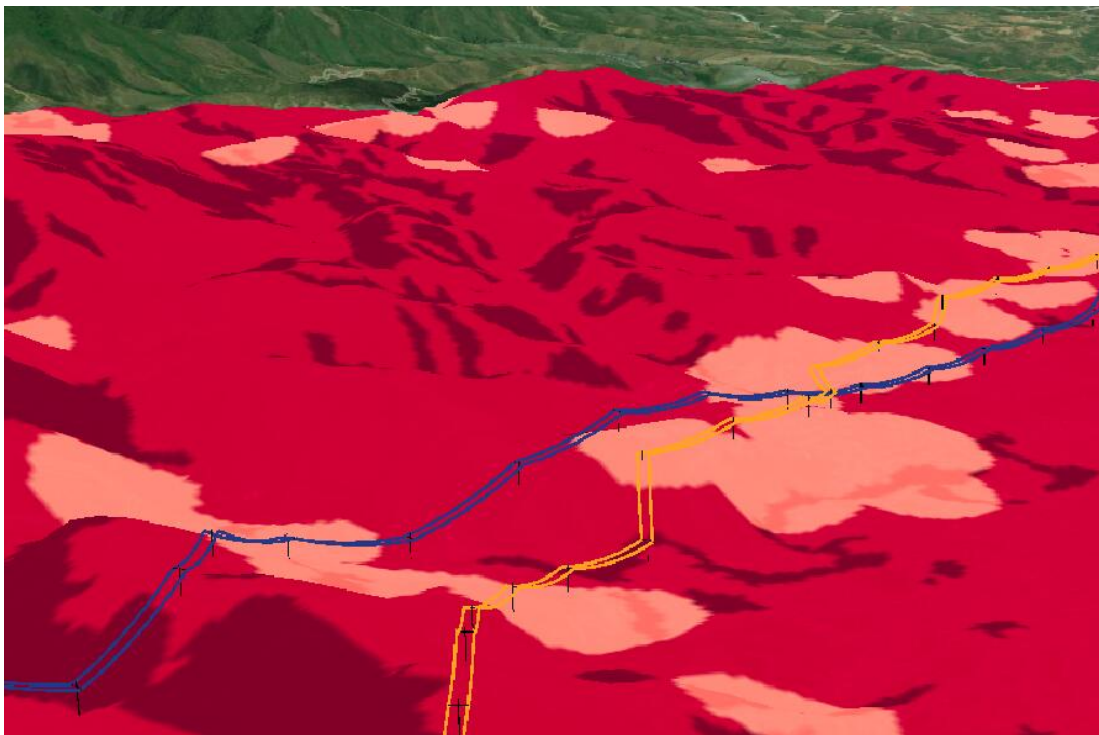
To enable the 3D View, use the *View/3D View* menu option:



or click on the 3D View view toolbar button:



Data layers and results can be displayed in the same way as the Map View, appearing as draped on the terrain. In this example, we can see the resistance map with two proposed routes:



The visualization of the *paths* in 3D is more detailed, since we can see the 3D shape of pylons and the cables in their context:

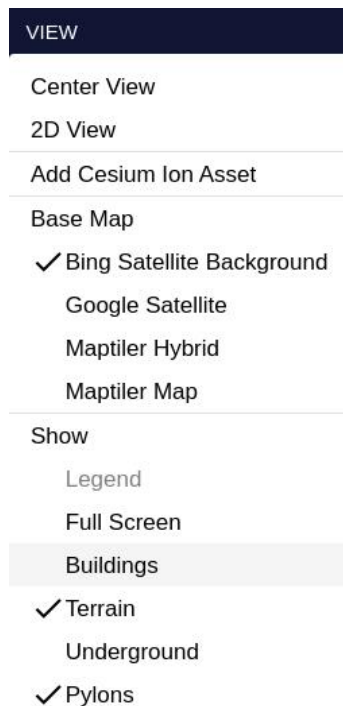




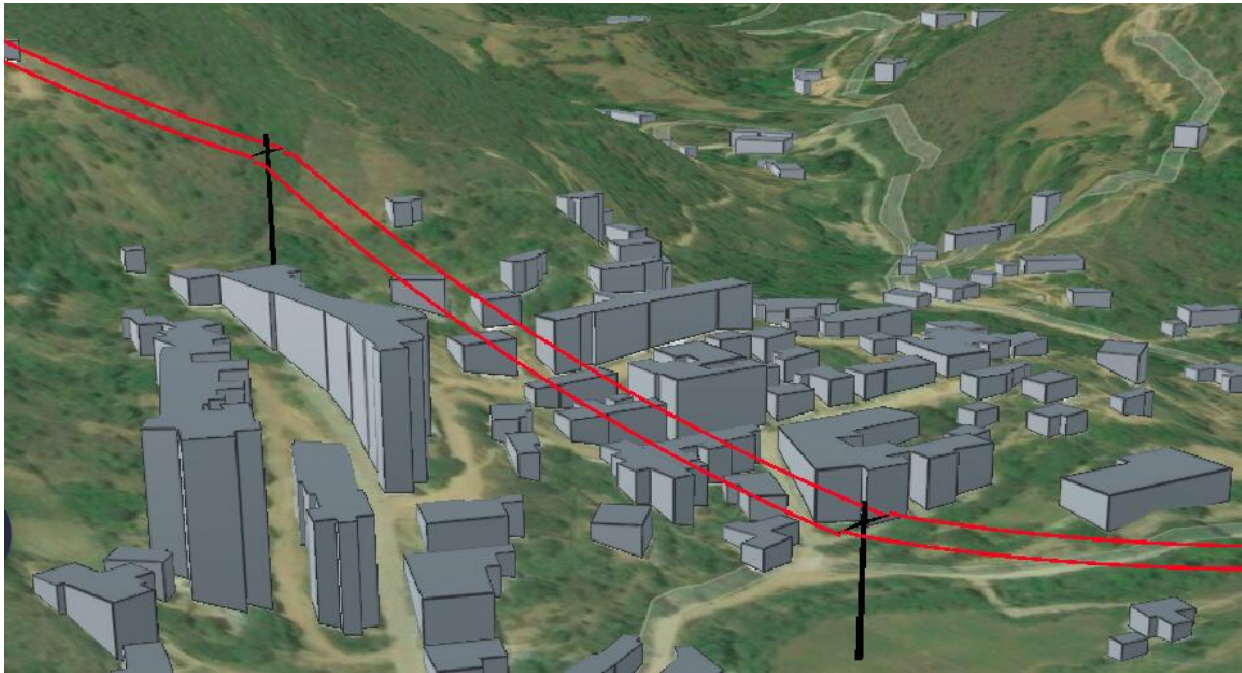
## Showing 3D Buildings

In the 3D View we can add a **global buildings dataset** which provides a good reference of constructions near the path, and what is the visual impact of the proposed infrastructure.

To show the 3D buildings, use the *View/Show/Buildings* menu option:



When enabled 3D building data will be streamed and added to the view. Notice that some constructions may not be present in this global dataset:



## Integrating 3D Assets

The integration of external reference data can help providing important information of the current environment, or future construction plans that need to be taken into account.

Pathfinder can easily integrate any 3D data published to the [Cesium Ion server](#), which is free up to a certain storage level. Sample data is provided for each of the types supported, and users can add their own assets by specifying the correct IDs.

### Add a 3D Cesium Ion Server Asset

**Account access token**

eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVC

Copy access token from <https://cesium.com/ion/tokens>

**Asset ID**

171354

Get asset ID from <https://cesium.com/ion/assets/>

**Asset type**

3D Tiles with objects (buildings...) ▾

TRY EXAMPLE

Check asset type in <https://cesium.com/ion/assets/>

CANCEL

ADD

This video shows how the integration operates.

In the dialog, first paste the *Cesium Ion account token*. You can access it from [your Cesium Ion page](#) or it may be given by an external data provider.

Second, type or paste the 3D *asset ID* number, which can be found in [your assets page](#) or given by an external data provider.

Third, you need to select the *type of asset*, which you can also check in the Cesium Ion server, and click on the Add button.

To try our samples:

- Select the type of asset you wish to test.
- Click on the Try Example button, which will fill the token and ID fields for you.



## Analyzing Results

- Click on the Add button.

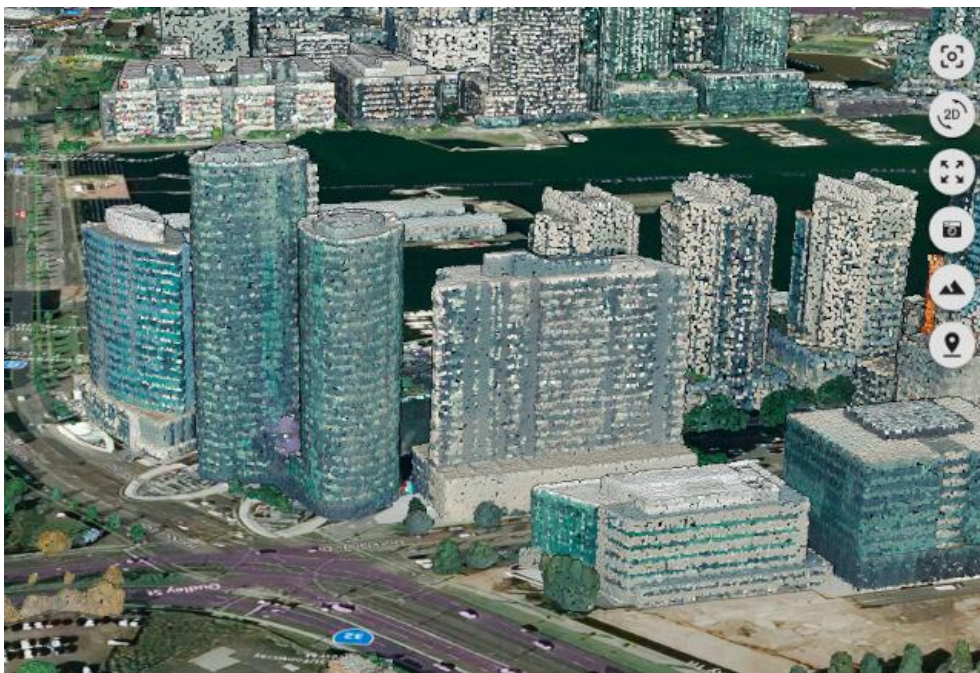
You may need to wait some time for the asset to be downloaded and displayed.

Samples of the 3D assets supported are:

- 3D Tiles with objects (e.g. buildings imported from CityGML)



- 3D Tiles with colored point clouds

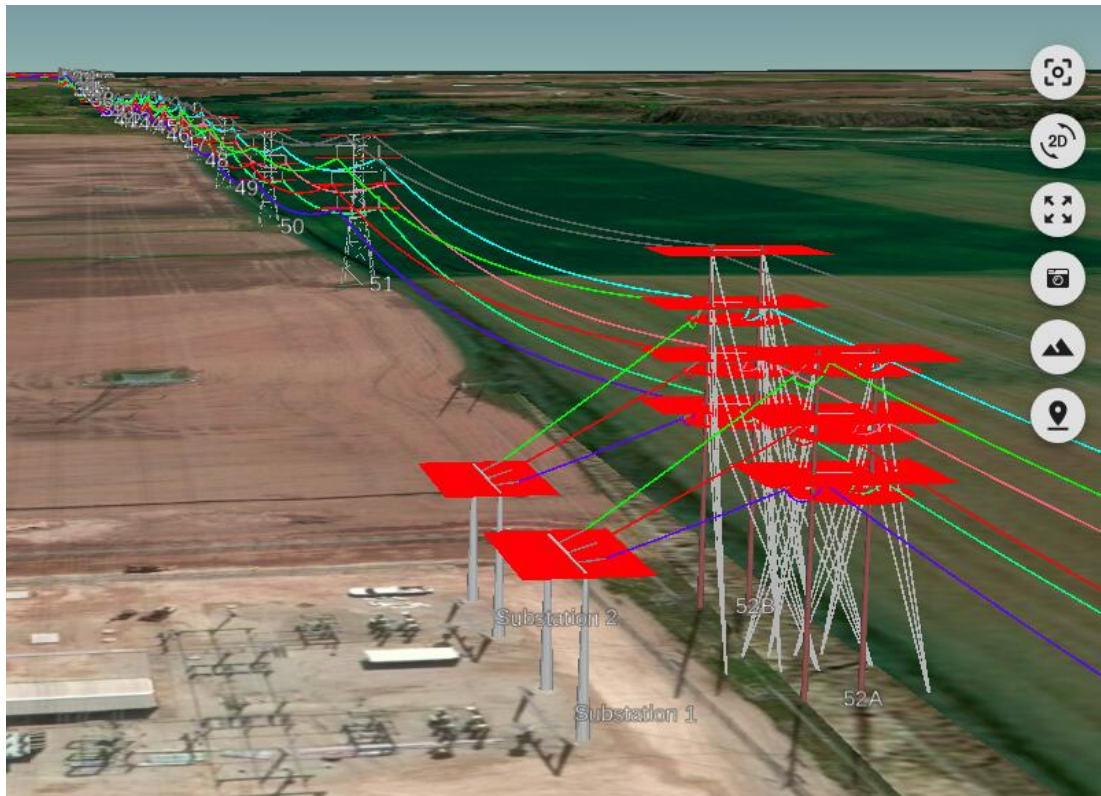


- 3D Tiles with classified point clouds





- KML/KMZ models (for instance, used in the integration with PLS-CADD)



- Geographic features (GeoJSON) with or without elevation. For instance, we can import underground utility data:





- Custom terrain data (e.g. bathymetry for off-shore routing)



## Underground Visualization

Our model may contain imported underground assets as well as earth cables or other subterranean lines generated by Pathfinder. In order to display and explore these assets properly, we have to enable the Underground viewing option in the 3D View menu.

This option has two effects:

- It makes the terrain surface semi-transparent, so we can see the objects below.
- It allows the viewing point to rotate or move under the surface, so we can explore these objects closer.

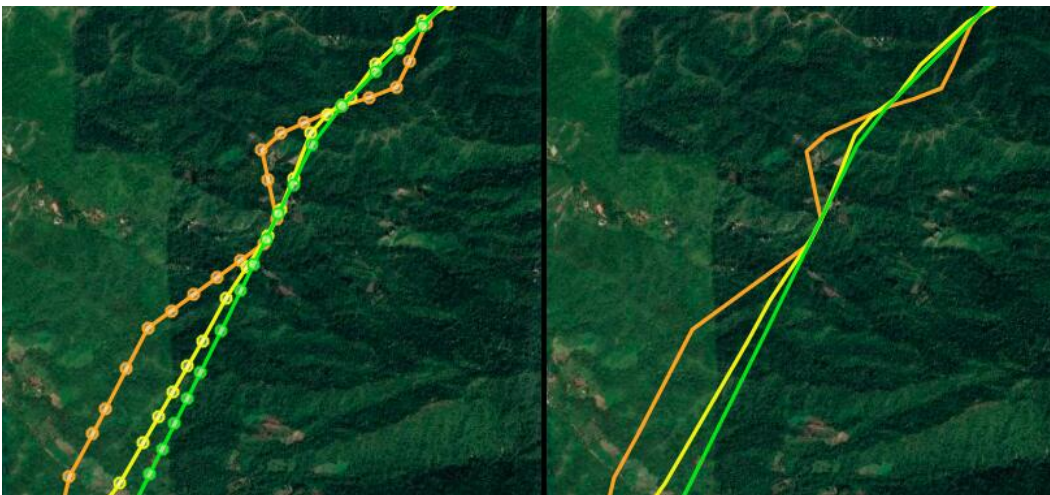




### Pylon Visualization

In some cases, the paths calculated by Pathfinder should not be displayed in 3D using pylons or underground supporting structures, but as lines following the surface. Think, for instance, of pipelines, roads or other linear infrastructures.

The Show/Pylon toggle in the View menu can be used to hide the pylon structures in both the Map and the 3D View:





## Pylon Tools

The infrastructure path and the position of pylons is calculated by the selected routing algorithm. However, the user can manually adjust both by using the *Pylon Tools* in the 3D View.

To activate these tools, use the corresponding Tools menu option:

TOOLS

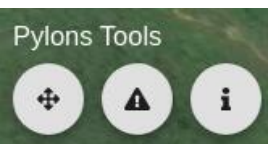
Identify Point

Measurement Tools

Pylons Tools

Screenshot

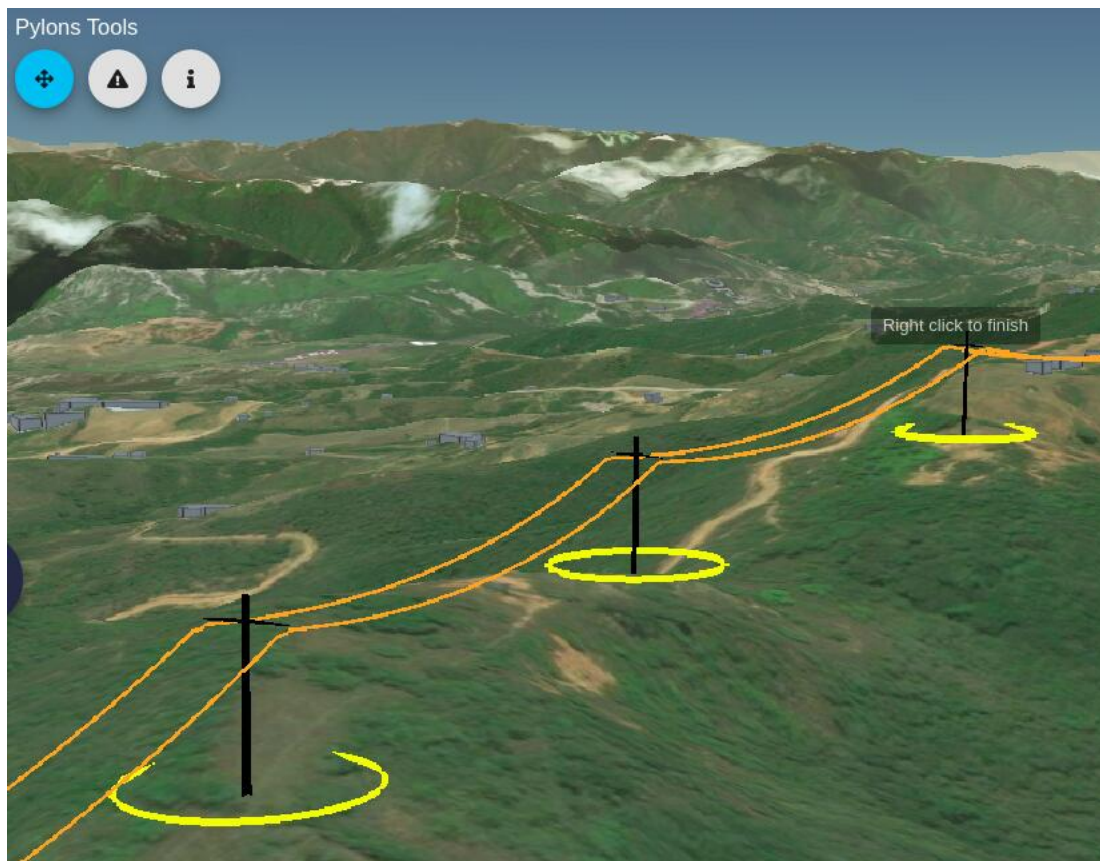
Once activated, the *Pylon Toolbar* will be visible:



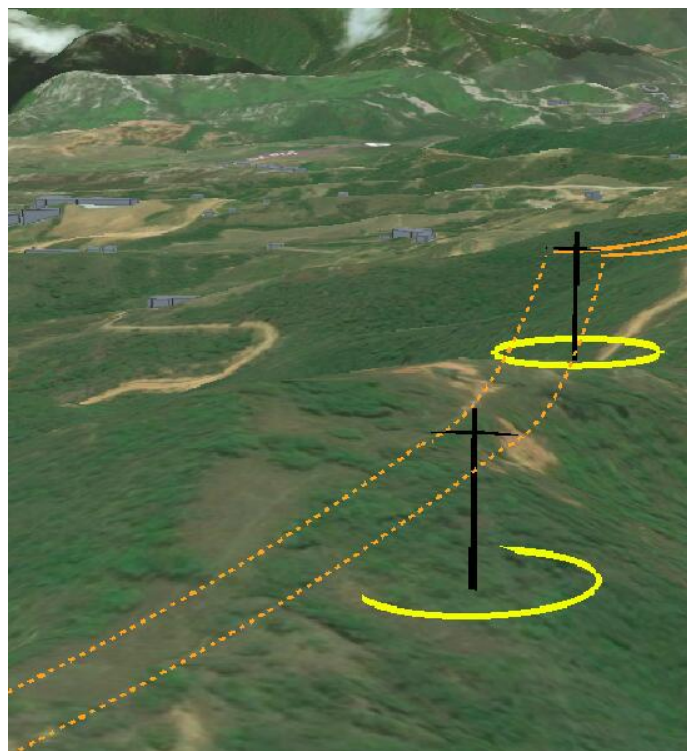
## Path Editing

Click on the *Move* tool to enable editing. Yellow handlers will become visible at the pylons' locations:

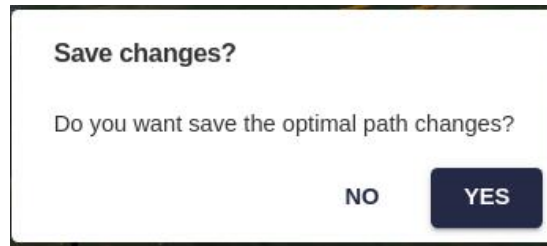




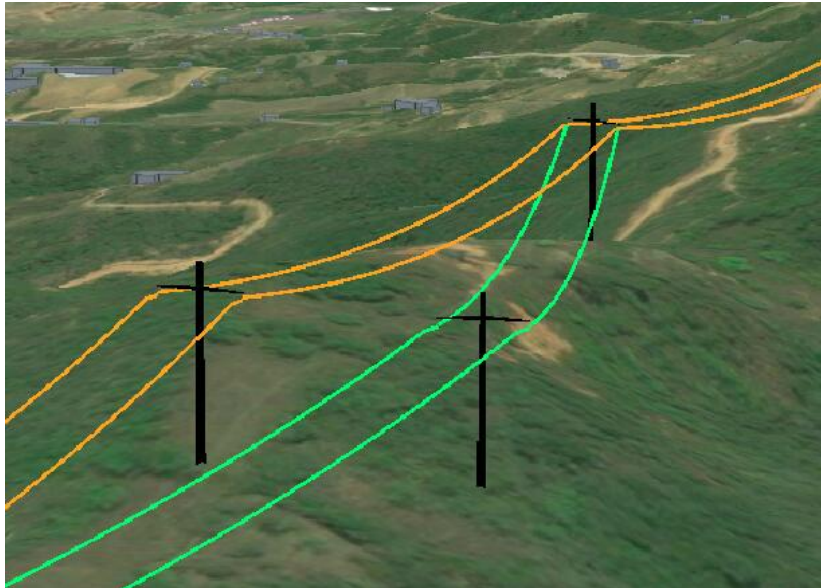
The user can move the pylons by clicking and dragging their handlers. After doing so, the cables will become dotted lines to show that the path section has been edited:








**To close and validate the edit** press the right mouse button and accept the confirmation:



After the editing is accepted, a *new path* is created with the modifications, so it can be compared to the original.



The new modified path is also shown in the Results panel. Note that the Path Analytics and Path Cost will be automatically calculated for the modified route:

Scenario 2 - Optimal	Cost 12 M €		
Scenario 2 - modified 	Cost 12 M €		

## Clash Analysis

The *cable warnings* tool automatically checks the segments along the path where the cables may be too close to the ground.

After the tool is invoked, a list of warnings will appear and problematic segments are displayed in red.

By clicking on each warning line, the user can zoom to the location of the potential problem.



Pylons Tools

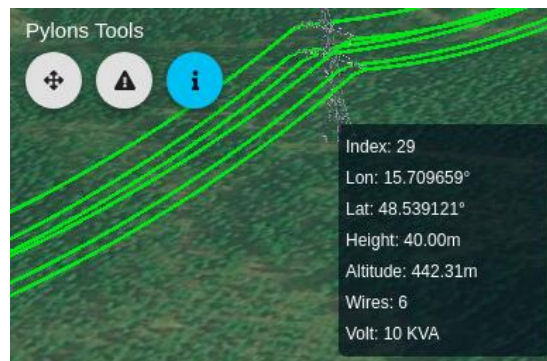
Cable Errors

Wire	Lenght	Altitude to ground
#4, wire 0	73.48	14.74
#5, wire 0	64.81	14.56
#8, wire 0	54.67	14.17
#9, wire 0	69.51	13.99
#14, wire 0	71.96	14.08
#16, wire 0	94.85	14.30
#18, wire 0	42.54	14.61
#22, wire 0	94.65	14.23
#23, wire 0	55.57	14.82
#25, wire 0	67.53	14.93
#26, wire 0	33.07	14.87
#28, wire 0	54.22	14.75
#29, wire 0	76.83	14.24

The screenshot shows a 3D aerial view of a power line project. The power lines are represented by green and red lines. A table titled 'Cable Errors' is overlaid on the left side of the view, listing various wires and their corresponding lengths and altitudes to the ground. The interface includes a 'Pylons Tools' header with three icons: a crosshair, a warning triangle, and an information 'i' icon.

## Pylon Information

Finally, the *Info* tool lets user get additional information about specific pylons, like its geographical location, elevation and pylon type parameters:



Pylons Tools

Index: 29  
Lon: 15.709659°  
Lat: 48.539121°  
Height: 40.00m  
Altitude: 442.31m  
Wires: 6  
Volt: 10 KVA

The screenshot shows a 3D aerial view of a power line project. The power lines are represented by green lines. A tooltip is displayed over a pylon, providing detailed information about it. The tooltip includes the pylon index, longitude, latitude, height, altitude, number of wires, and voltage. The interface includes a 'Pylons Tools' header with three icons: a crosshair, a warning triangle, and an information 'i' icon.

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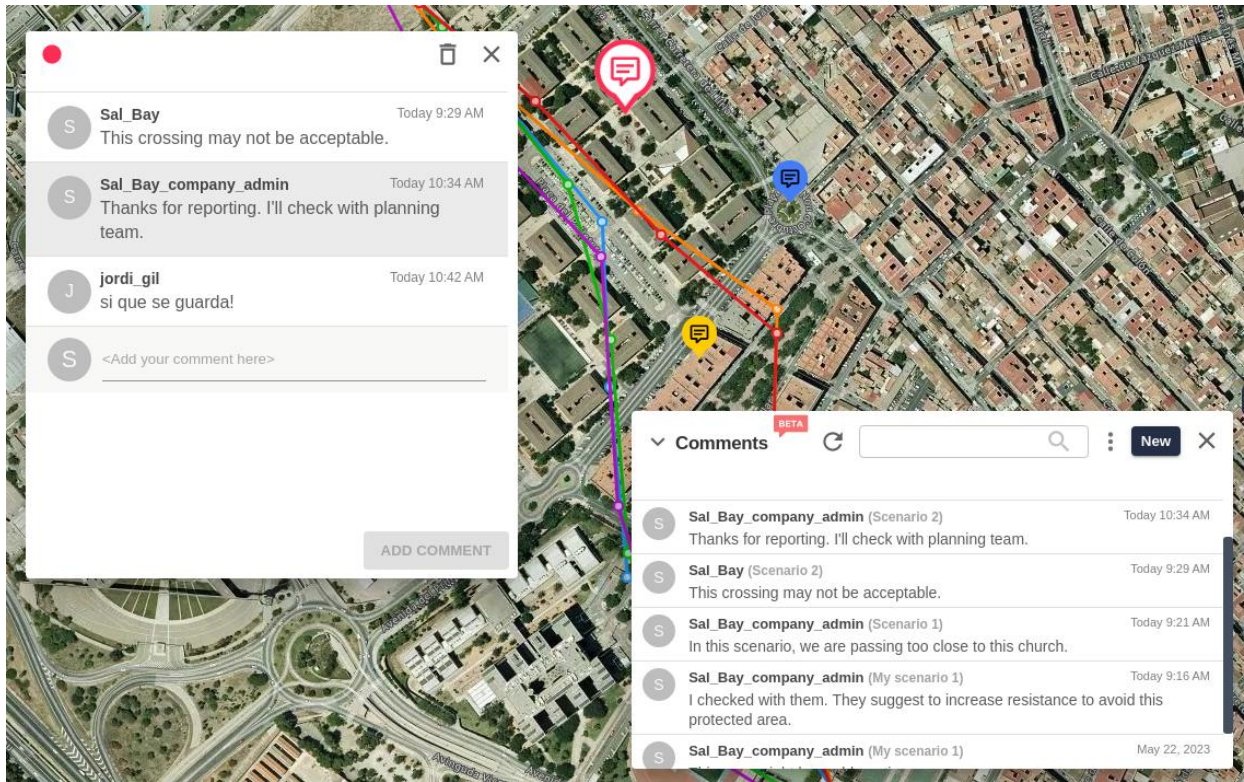
For more help, please use the help chat in the application, or [contact Gilytics](#).

## Georeferenced comments

The ability to add and share georeferenced comments to Pathfinder can be used for a variety of applications, such as collaborative planning, stakeholder engagement, public consultation, inspection and field tasks management.

Next releases will add more options to Pathfinder's commenting system.





## Comment manager

To access the Comment Manager dialog and display the comments as icons on the map, click on the icon in Pathfinder's top bar:



Initially, the comment manager will be empty.

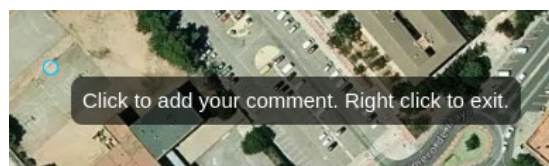


### Note

The comment thread markers on the map will not be visible if the Comment Manager is not open.

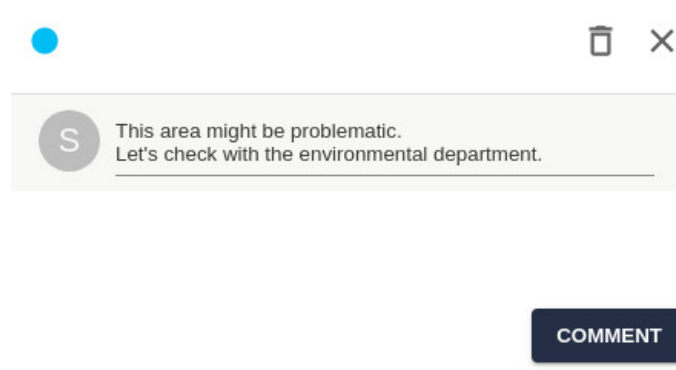
## Adding comments

To add new comment threads in a specific location, click on the New button of the Comment Manager. The cursor will change to a blue circle:

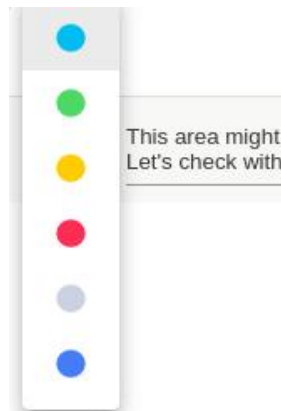


After clicking on the comment location, the comment thread dialog will appear and we can type the initial comment:

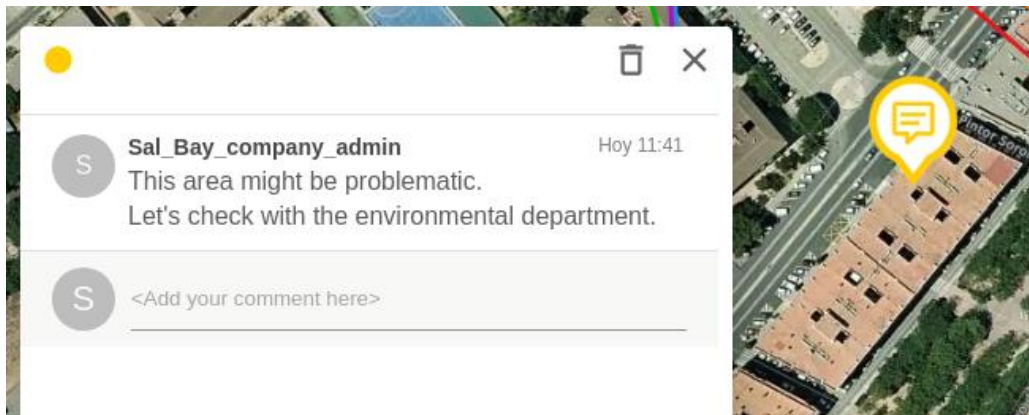
## Georeferenced comments



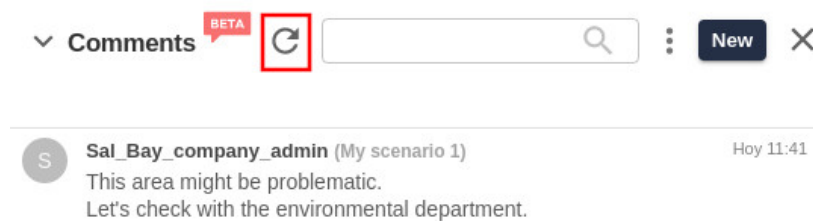
We can also assign a color to the comment thread, so it is used in its map marker. This color can be used to represent the comment's priority, topic or status.



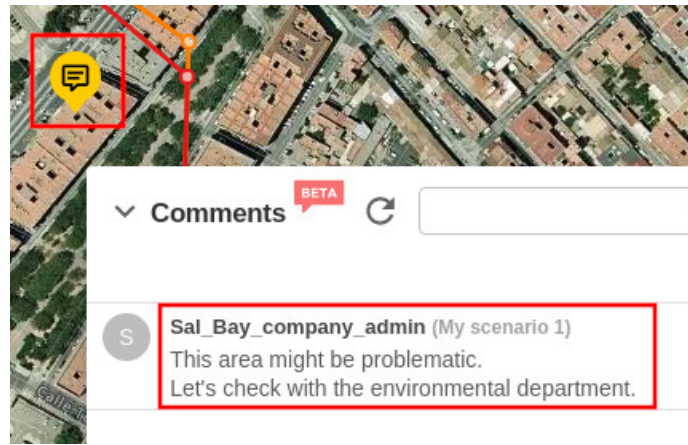
The marker showing the location of the new comment thread will be visible on the map:



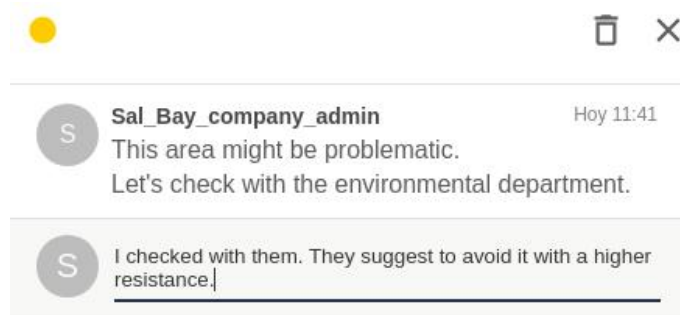
The new comment will also be visible in the Comment Manager when we click the Refresh button:



New comments can also be added to an existing thread. To do so, open the thread by clicking on the map marker or in the Comment Manager.



The comment thread dialog will open and we can add a new comment below the previous ones:



## Comments in multiple scenarios

When we add a comment thread, it is always assigned to the current scenario, since each scenario may have different results with different implications to discuss.

The Comment Manager offers the option to see all the comment threads in the project, or only the ones in the current scenario. To change this option, click on the three-dot icon and use the filter menu:



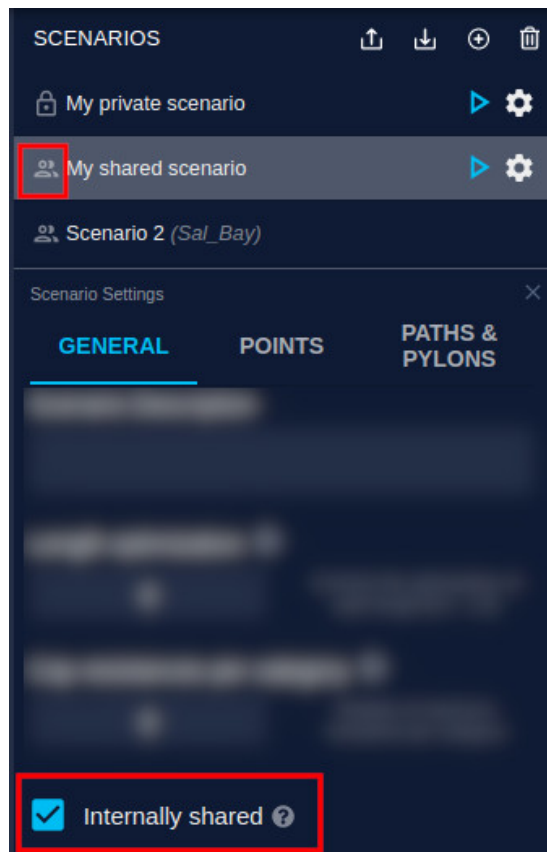
### Note

If you don't see the comments you made in previous sessions, remember to select the right scenario or use the "project" filter.

## Sharing comments

Comments become much more useful when we can share them with other users, see their shared scenarios with comments and add our own. Since comment threads are associated to scenarios, this means we need to use shared scenarios.

To make the comment threads in our scenario visible to other company users with access to the project, we have to enable it as "internally shared".

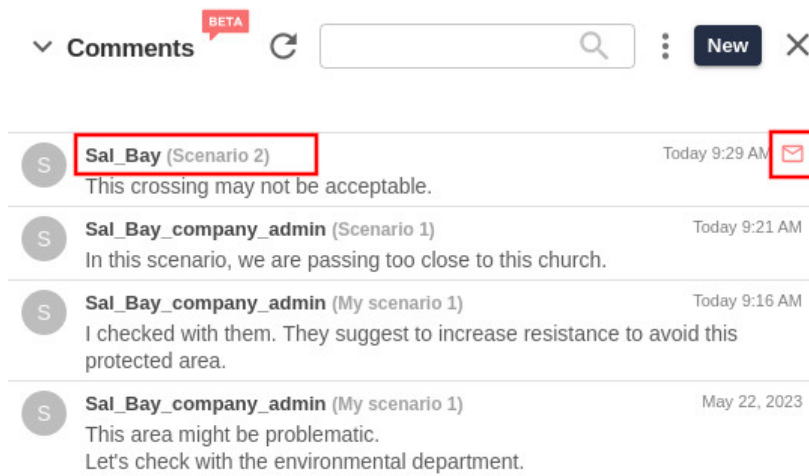


## Note

Comments which are not in a shared scenario will not be visible to other members of your organization. Comments belong to a specific project and can only be seen when accessing that project.

Conversely, to access comment threads created in scenarios owned by other users, we need to add to the project their shared scenario.

When we do this, the shared scenario becomes visible in the project's list of scenarios, and its comments can be seen in the Comment Manager. Note the unread mail icon in these unopened comments.

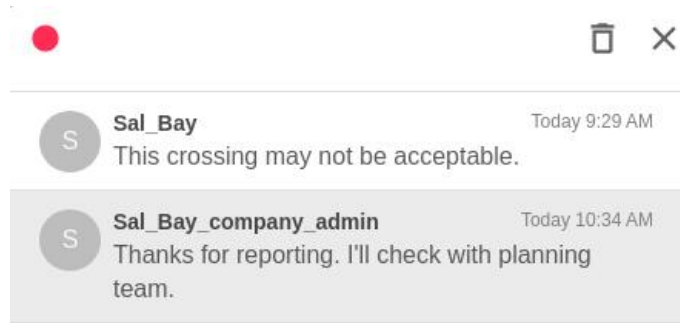


The comment threads from the shared scenarios are also visible on the map with the others if the “project” filter is active:





We can also add comments to threads created and shared by other users, so we can collaborate together.



## Searching comments

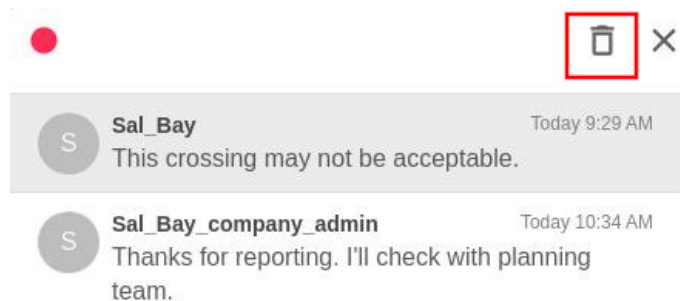
The Comment Manager has a search box to find comments by text. After hitting Enter, the search will be performed and the found text highlighted.



We can also type a user name to see only the comments made by that user. Click on the red X button on the right side of the search box to clear the results.

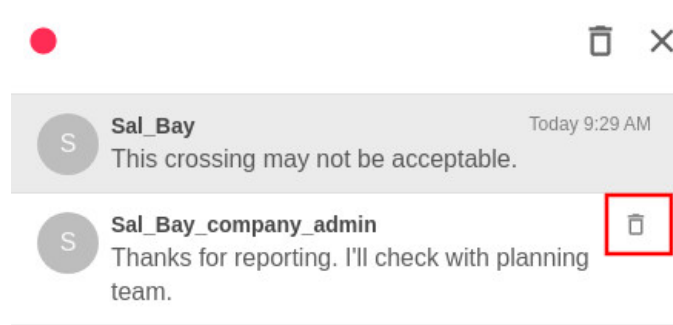
## Deleting comments

We can delete a whole comment thread, if we are its owner/creator.



It is also possible to delete a specific comment we made. When the cursor hovers over it, click on the Delete icon.





## Note

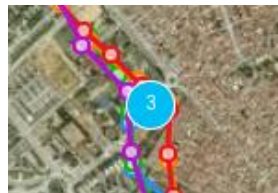
Pathfinder will show an error message if we try to remove another user's comment or thread.

## Zooming to comments

To zoom to a specific comment thread location, click on any of its comments in the Comment Manager. The map will center in the thread location, its marker will be highlighted and the corresponding comment thread dialog will open up.



If we zoom out of an area with multiple comment thread markers, they will group into a single circle with the number of threads under it. We can click on the numbered icon to zoom to a group and expand it.



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For more help, please use the help chat in the application, or [contact Gilytics](#).

## Exporting Data and Results

After processing the scenarios and analyzing the results, a common task is to export them as files, so they can be used to create reports, perform further analysis in other software, sent deliverables to customers, or back our data up elsewhere.

Users may also want to export input layer data, in case the original data is lost or the buffered version is useful elsewhere.

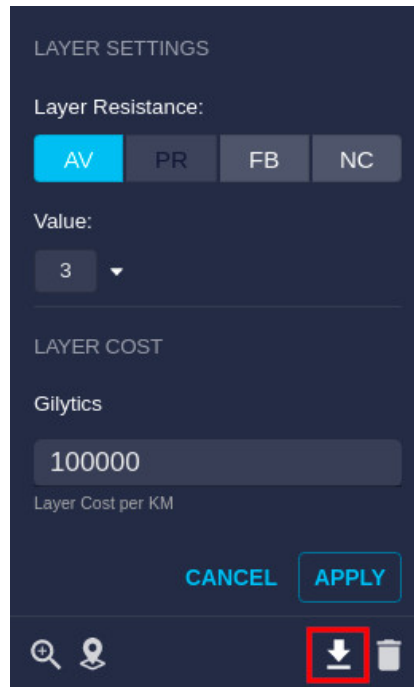
## Exporting Data

It is possible to export all the data in a base dataset by using the administration tools.

## Exporting Data and Results

However, in most practical cases it may be more convenient to export the raster or vector layer data *only for the project area*.

This command can be found in the layer's side panel.



When clicked, it will download a zipped **Geopackage file** containing:

- For vector layers, a “original” and a “buffered” version of the data.
- For raster layers, a single raster with the data in the project area.

### Note

The download button will only be active for layers processed after this feature was introduced. To allow downloading of existing layers, an administrator user must open the Project / Layer Preprocessing panel, select the layer, reprocess it and then reload the project. The download button should now be enabled.

## Exporting Results

The Results of the *active scenario* (the calculated Resistance Map, Corridor Map and Path(s)), can be exported with the *Results / Export Scenario Results* menu option:

**RESULTS**

- Generate Resistance Map
- Generate Corridor
- Generate Path(s)
- Generate Heatmap

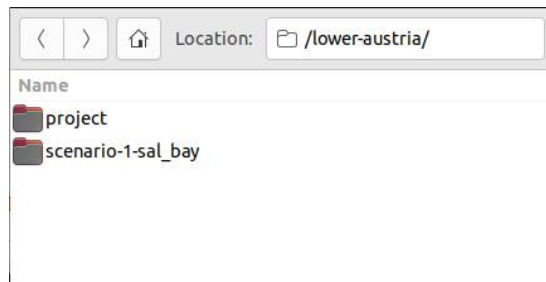
---

- Geoprocessing Tools
- Path Analytics
- Path Profiles
- Path Resistances
- Path Cost
- Pylon Report
- Heatmap Distribution

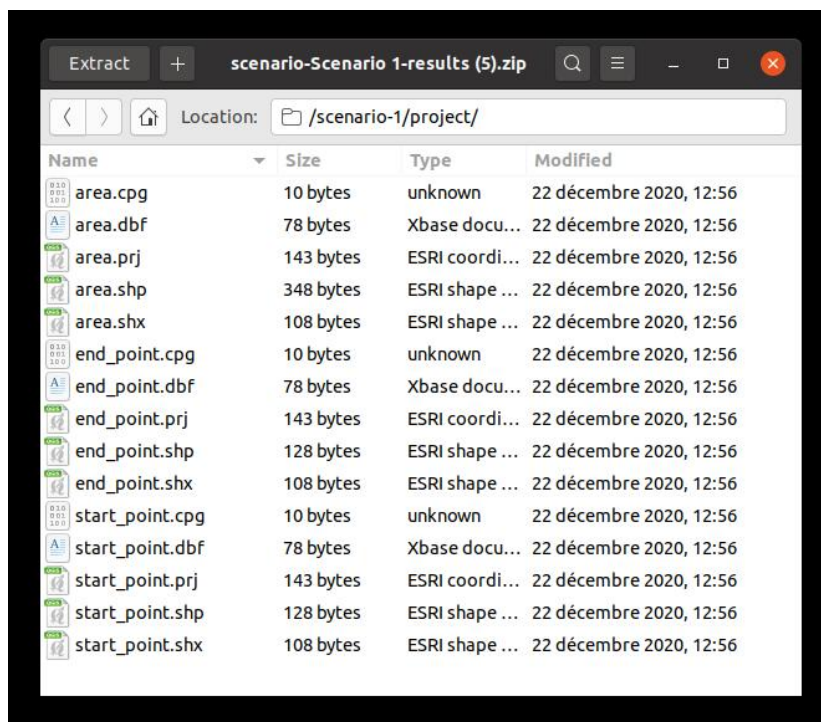
---

- Import Path
- Export Scenario Results**
- Export All Results
- Print Project Report

This command will create and download a **ZIP file** containing:

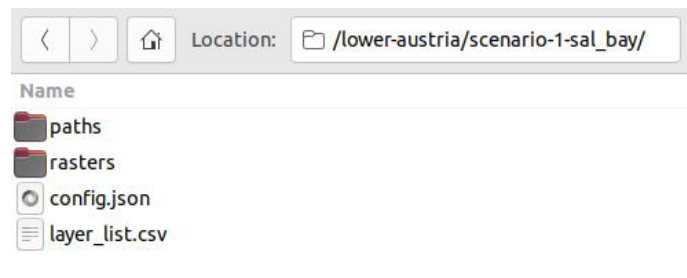


*Project* folder with the Area, Start Point and End Point in Shapefile format.

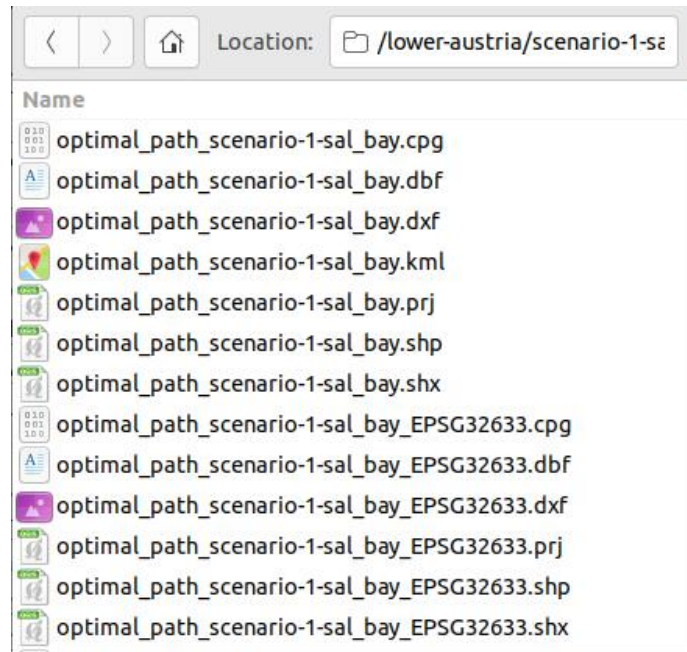


*Scenario folders* (one for each exported scenario), which in turn contains:

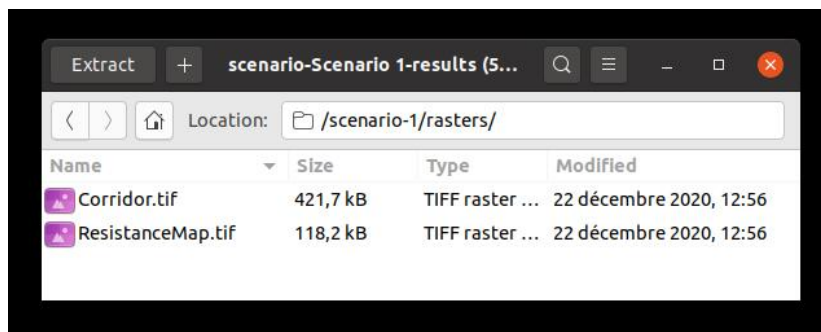
## Exporting Data and Results



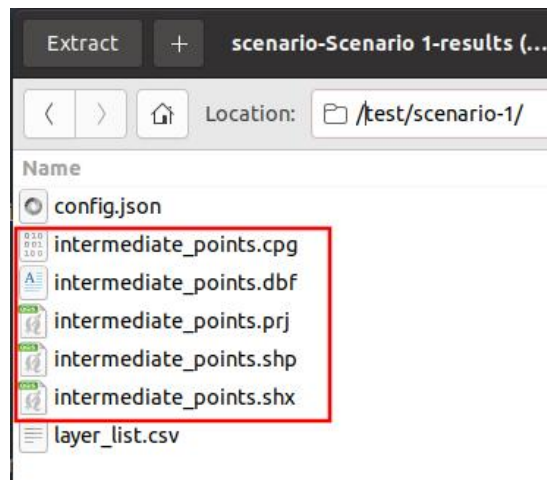
*Paths* folder containing the calculated optimal paths in Shapefile, KML and DXF formats. Shapefiles are provided in *UTM coordinate system* as well (note the files with EPSG32??? in their names), so some software packages like PLS-CADD can import these results:



*Rasters* folder with the Resistance and Corridor maps in GeoTIFF format, which can be used in Geographical Information Systems:



*Intermediate points* (if any) used in the scenario:

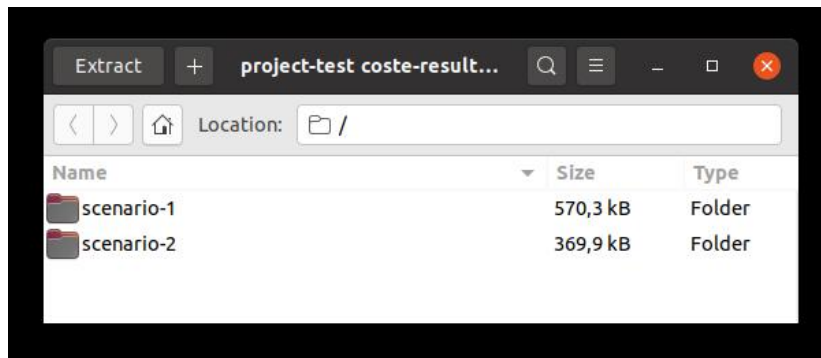


Scenario configuration file, in JSON format. It is identical to the file exported from the menu.

CSV (spreadsheet) file with the list of layers used in the scenario.

Similarly, the results of *all the scenarios* contained in our Project can be exported at once by using the *Results / Export All Results* menu option.

In this case, the generated ZIP file contains separate folder for each scenario, each one with the same data described above.



## Integration with PLS-CADD

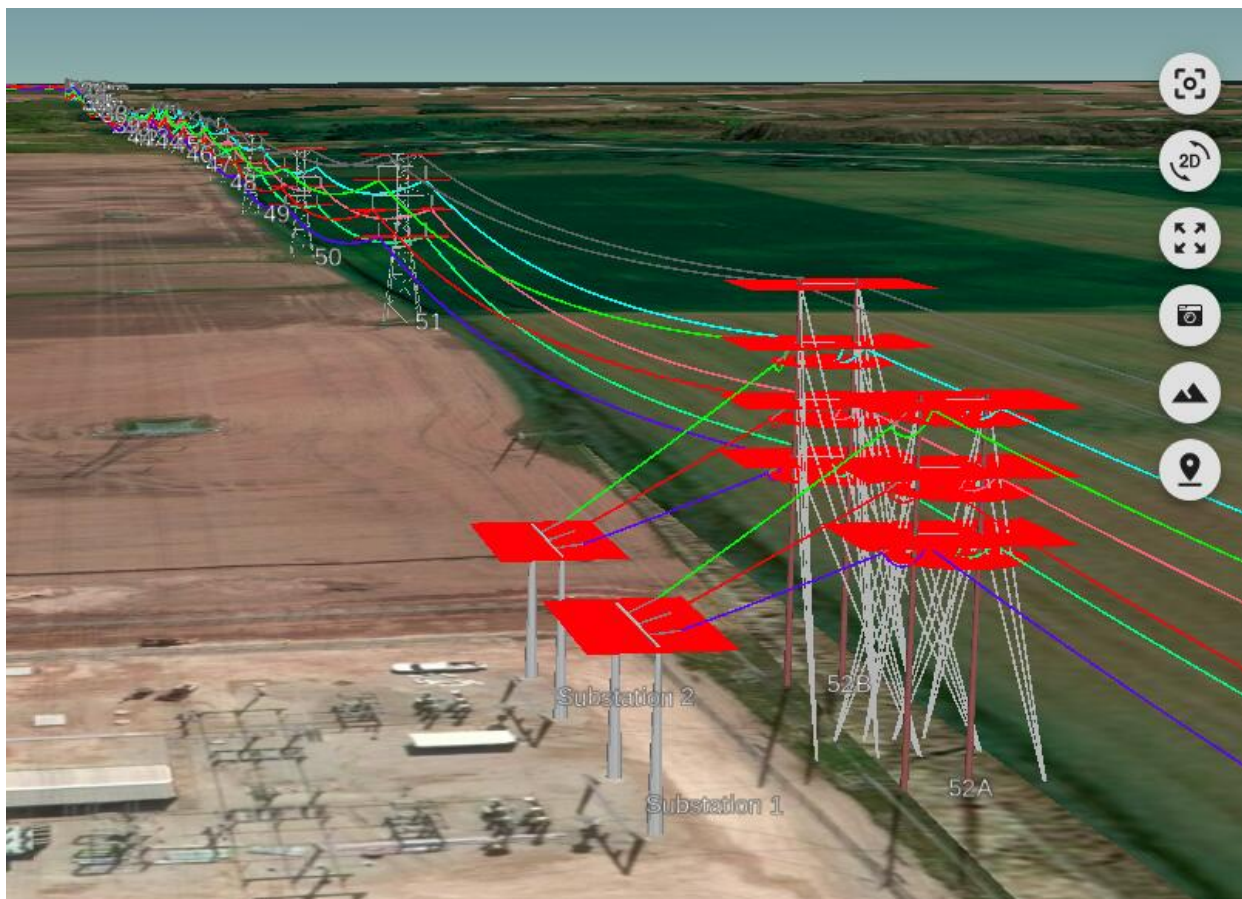
PLS-CADD is a software product from [Power Line Systems](#) which focuses on structural and geometric design of power lines. Is it widely used to complete the detailed design of a transmission line, based on terrain and other survey data.

Typically, Pathfinder is used in previous design iterations focused on environmental, regulatory and other geographic constraints, as well as community and stakeholder feedback. Once the decision about the overall route is done from alternatives provided and evaluated in Pathfinder, the route can be exported and used in PLS-CADD to finish the details of the design.

Integrated workflows with Pathfinder and PLS-CADD are possible with:

- Path export in UTM coordinates, so they can be imported in PLS-CADD.
- Detailed KML export of Pathfinder routes, so they can be compared in Google Earth with the KMZ exported from PLS-CADD.
- Importing of detailed PLS-CADD design in KMZ as a Cesium asset:





This video shows the different data exchange options between Pathfinder and PLS-CADD:

## Exporting Analysis Graphics

As we have seen, resistance distribution graphics and path analysis graphics are very useful to compare the parameters and results of different scenarios. These graphics can be used to generate documentation and reports.

The data represented in these charts can be exported as:

- An *image* in PNG, JPEG or SVG format.
- A *text file* in CSV format, which can be used in spreadsheet software.

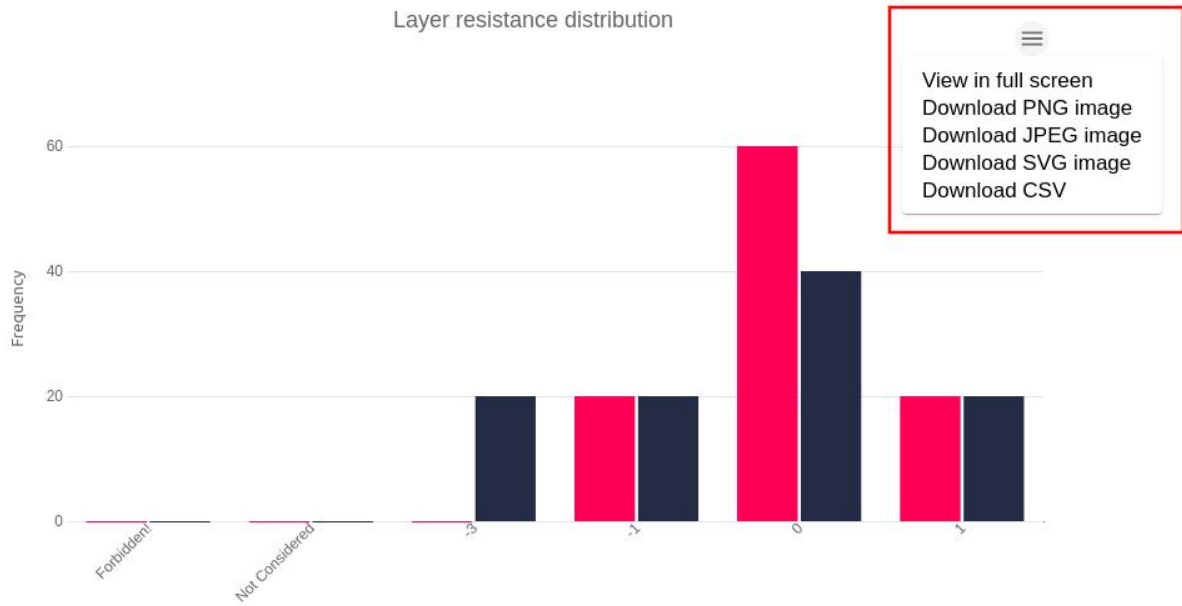
## Layer Statistics

COMPARE WITH SCENARIOS

All Scenarios

Scenario 1

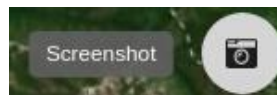
Scenario 2



The exported data can then be included in documents or reports.

## Exporting Views

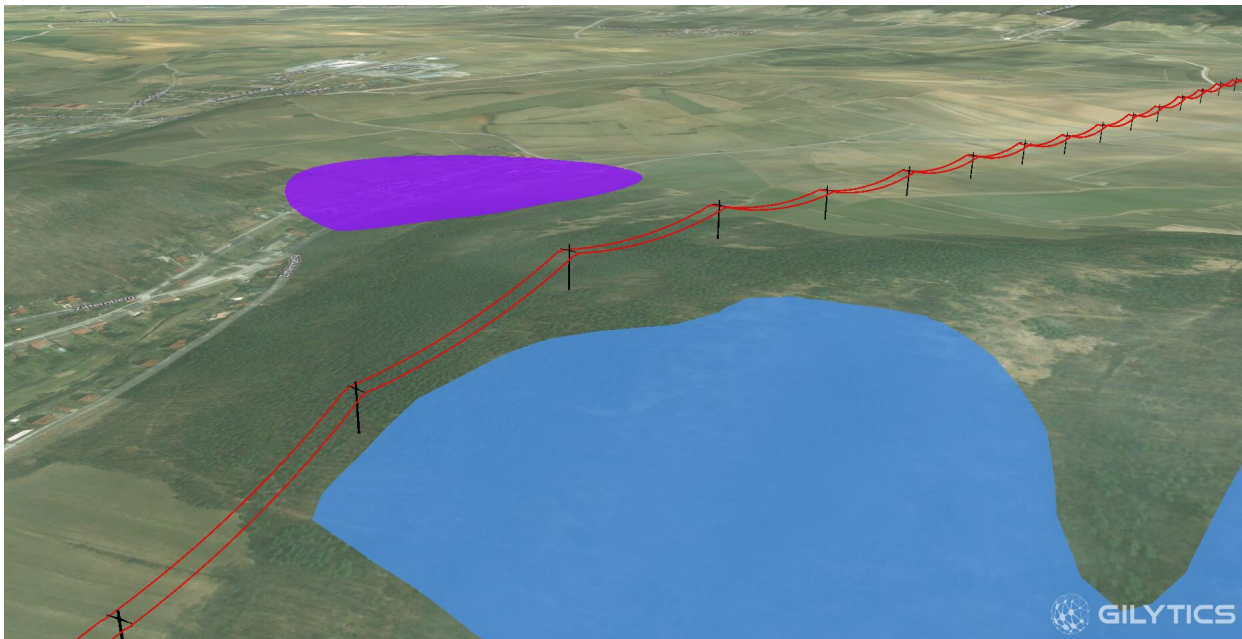
Images of the Map and 3D views can also be exported, using the *Screenshot tool* located on the view itself:



Or using the *Tools / Screenshot* top menu option:



In both cases, a PNG image file is downloaded with a full view without the tool icons.



As with the Analysis Graphics images, these can also be used in reports and documentation.

## Automated Reporting

In addition to manually exporting results and analysis charts, users can also generate and print a fully automated report with all the project highlights, to help in the analysis of scenario alternatives in the decision making process.

This function is available in the Results menu:

### RESULTS

Generate Resistance Map

Generate Corridor

Generate Path(s)

Generate Heatmap

Geoprocessing Tools

Path Analytics

Path Profiles

Path Resistances

Path Cost

Heatmap Distribution

Import Path

Export Scenario Results

Export All Results

Print Project Report

After this option is invoked, a window will open showing a Report Preview and a side panel to customize its content:



REPORT GENERATOR

Report Elements

SIMPLE REPORT

Project

- Project Data
- Path Cost Summary
- Layers List
- Layer Path Coverage
- Path Profiles
- Path Resistances

Scenario

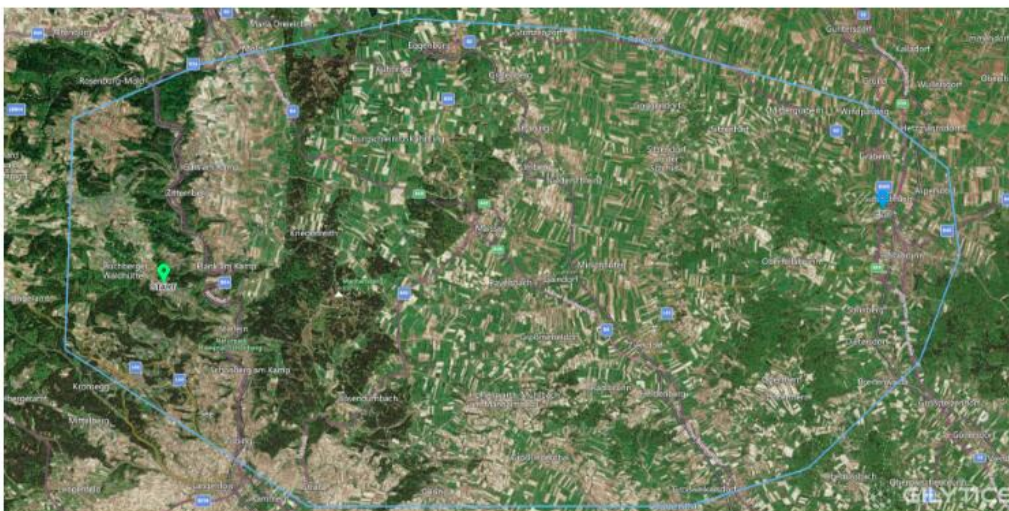
CLOSE PRINT

## Report Content

The report contains two main sections:

- **Project data**
  - **Project information**
    - Map of the project area
    - Start and end point coordinates
    - Project stats (number of layers, categories, scenarios)
    - Summary table with costs of each path
    - Layer list, including category and buffer configuration

### Lower Austria Project Data



Start Point	End Point	Nº of Layers	Nº of Categories
15.648134, 48.549579	16.067247, 48.577717	36	5
Nº of Scenarios			
2			

## REPORT GENERATOR

### Path Cost Summary

Path	Path length (km)	(EUR)	Gilytics (EUR)
 Scenario 1 A	1.96	1,226,200	2,684,104.86
 Scenario 2 A	1.84	1,137,800	2,605,282.02

- **Path analytics**

- Path options summary: table with lengths and costs
- Layer coverage chart for all scenarios
- Vertical profile chart for all scenarios
- Resistance profile chart for all scenarios

- **Scenario data**

- **Scenario information**

- Map of the scenario area
- Start and end point coordinates (if defined)
- Scenario stats (number of paths, optimal path cost)
- Scenario settings
- Category weights
- Layer resistances

- **Path analytics**

- Layer coverage chart
- Optimal route costs
- Vertical profile chart for all scenarios
- Resistance profile chart for all scenarios



REPORT GENERATOR Scenario 1 - Path Cost - Optimal Path - 

Variable (EUR)	Computed Value (EUR)	Base Cost (EUR)	Total Cost (EUR)
TM. Pylons with angle less than WINK°	8	15,000	120,000
AM. Pylons with angle bigger than WINK°	2	19,000	38,000
Number of sag lines	2	--	--
Km of sag lines	3.92	125,000	490,000
Km of line	1.96	295,000	578,200
Total			1,226,200
<b>TOTAL COST</b>			<b>1,226,200</b>

## Scenario 1 - Path Cost - Optimal Path - Gilytics

name (EUR)	Crossed path length (EUR)	Price per km (EUR)	Slope cell coverage (EUR)	Final price (EUR)
Full Base Path	1,961	1,100,000	0 - 1: 0% 1 - 3: 46.3% 3 - 10: 52.5% 11 - 100: 1.1%	2,157,759.89
OSM Agricultural	106.03	1,000	0 - 1: 0% 1 - 3: 30% 3 - 10: 70% 11 - 100: 0%	212.06
OSM Farmland	53.02	2,000	0 - 1: 0% 1 - 3: 60% 3 - 10: 40% 11 - 100: 0%	212.06
OSM Highways	21.21	2,000,000	0 - 1: 0% 1 - 3: 100% 3 - 10: 0% 11 - 100: 0%	84,825.94
OSM Railways	21.21	1,000,000	0 - 1: 0% 1 - 3: 100% 3 - 10: 0% 11 - 100: 0%	42,412.97
OSM Urban Area	996.7	200,000	0 - 1: 0% 1 - 3: 47.8% 3 - 10: 50% 11 - 100: 2.2%	398,681.93
<b>TOTAL COST</b>				<b>2,684,104.86</b>

The selector in the right panel can be used to check off the elements we don't want to include in the report.

We might see a *warning message* if some results are missing, but this does not prevent the rest of the information to be printed:

- There is no optimal path for scenario: **Scenario 1 - dist fact = 0**

**Report Elements**

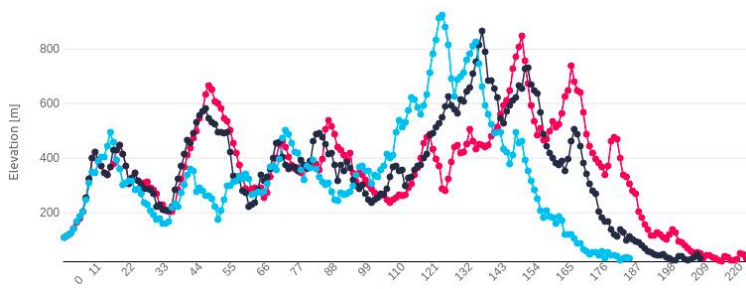
12 elements selected

**Chart Customization**

Because charts can include different paths, the Report Preview allows users to customize its content. To do so, click on the Tool icon next to the chart and select which paths to include in it:

## Exporting Data and Results

### Project - Path Profiles



### Project - Path Profiles

- Scenario 2 - dist factor = 0.25 - Optimal
- Scenario 3 - dist factor = 0.5 - Optimal
- Scenario 4 - dist factor = 1.0 - Optimal

After selecting the paths, click on the Apply button below the selector to refresh the chart.

## Print / Export

After customizing the report content, we click on the Print button to open the browser's print dialog.

From this dialog we can typically export the report to a PDF file, or send it to a printer:

**Salva test** GILYTICS

**Table of Contents**

**Project**

- Project Data
- Path Cost Summary
- Layers List
- Layer Path Coverage
- Path Profiles
- Path Resistances

**Scenario 1 - dist fact = 0**

- Scenario Data
- Scenario Settings
- Category Weights
- Layer Resistances
- Layer Path Coverage
- Path Cost

**Scenario 2 - dist factor = 0.25**

- Scenario Data
- Scenario Settings
- Category Weights
- Layer Resistances
- Layer Path Coverage
- Path Cost

**Scenario 3 - dist factor = 0.5**

- Scenario Data
- Scenario Settings
- Category Weights
- Layer Resistances
- Layer Path Coverage
- Path Cost

**Scenario 4 - dist factor = 1.0**

- Scenario Data
- Scenario Settings
- Category Weights
- Layer Resistances
- Layer Path Coverage
- Path Cost

**Print** 23 pages

Destination: Save as PDF (selected), Epson-Stylus-Office-BX525WD, Save as PDF, See more...

Pages: [ ]

Layout: Portrait

More settings

Paper size: Letter

Pages per sheet: 1

Margins: Default

Scale: Default

Options:  Headers and footers,  Background graphics

Print using system dialog... (Ctrl+Shift+P)

Cancel Save

## Note

When setting the printing options, make sure the Header and Footer printing are disabled, so no additional texts (like the page URL) appears in the report.

## Running Geoprocesses

Geoprocesses are spatial computations done with the company datasets in the cloud server to extract additional information not provided in the regular Pathfinder interface. These processes are typically defined to serve advanced needs of specific customers, so they are not available for all companies.

If your company requires access to a geoprocess which is not available to you, [contact Gilytics](#).

### Note

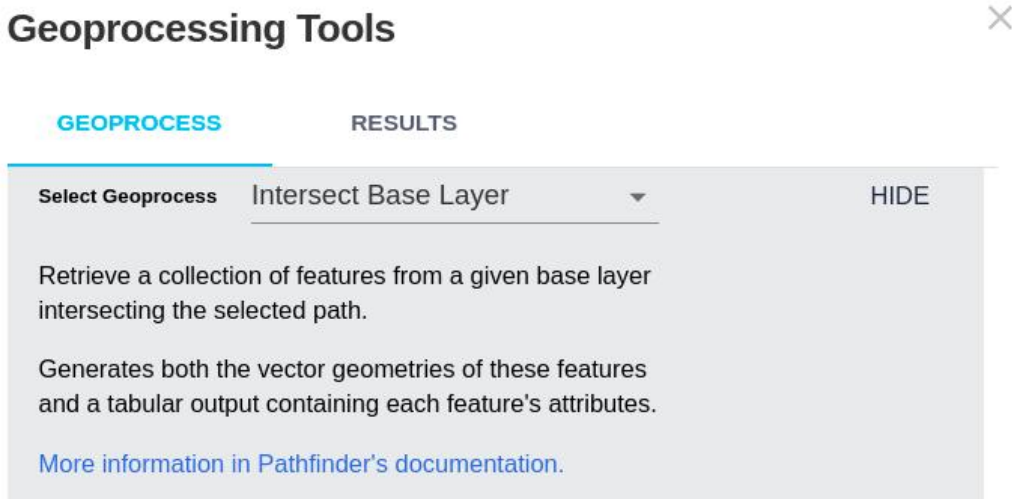
Viewer users can not run geoprocesses, but they can add shared scenarios to see results generated by other users.

## Access to Geoprocesses

If one or more geoprocesses has been enabled for your company, you can access them from the *Results/Geoprocessing Tools* menu:



When the geoprocessing dialog opens, you can select the geoprocess you would like to run. You can click on the “More” button for information about what each geoprocess does.



When a geoprocess is selected, some options will be displayed below. The specific options shown depend on the geoprocess.

Note that the geoprocess description also includes the outputs which will be generated, in this case the intersected geometries and a table with their attributes.

After selecting the input options, click on the “Process” button and check the process status in the log until it is completed:



## Note

The actual names of geoprocesses may vary, since they can be exposed with different names for each company.

## List of Geoprocesses

This is the list of commonly available geoprocesses:

- **Siting**
  - Optimal siting
  - Resistance map classification
- **Intersection**
  - Base dataset intersection
  - Number of crossings
- **Corridors**
  - Export subcorridor
  - Corridor (buffered path) coverage
  - Corridor merge
  - Corridor map classification
- **Rasters**
  - Visual impact from observers
  - Visual impact from route
  - Raster classification
- **Routing**
  - Hybrid OH-EC planning
  - Combined OH + Tunnel routing
  - Combined OH + EC routing
  - Multipoint routing
- **Other analyses**
  - Resistance along path
  - Hilltop and ridge detection
  - Ridge detection (geomorphon)
  - Clusterize layer
  - Pipeline optimization

## Optimal Siting

In addition to routing analysis, Pathfinder is often used to determine optimal locations for infrastructures using a limited area, like power plants or electric substations.

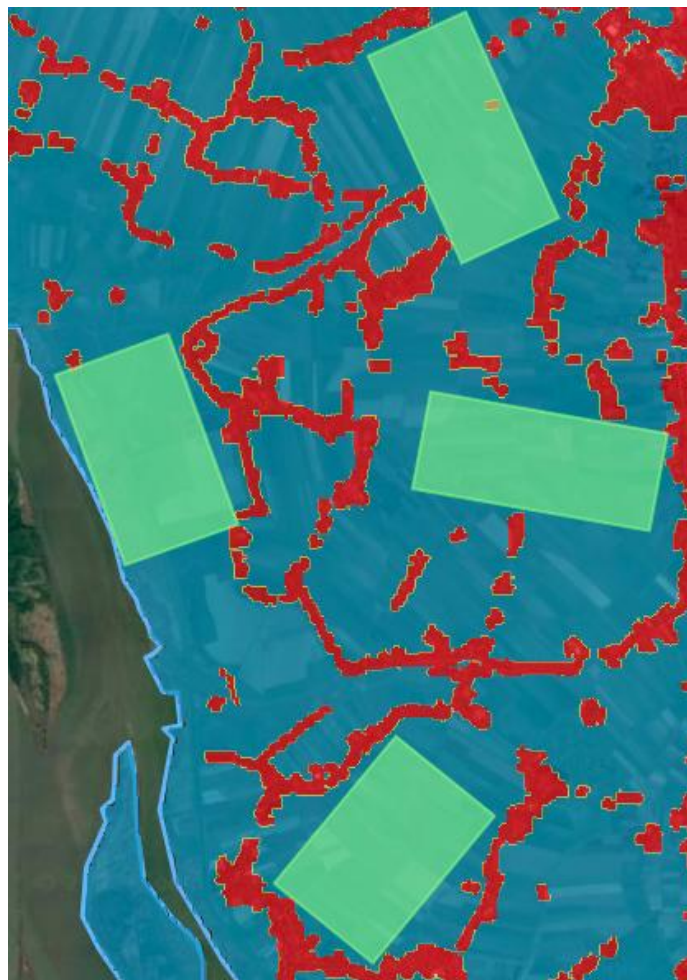
Resistance maps can be used as a *suitability map* to locate the infrastructure, with smaller values representing more suitable locations.

This geoprocess automatically finds site candidates which optimize the sum of resistance map values (therefore, are more suitable to locate the infrastructure), given the desired area in square meters and the preferred shape (square, rectangle, circle or ellipse).

## Geoprocessing Tools

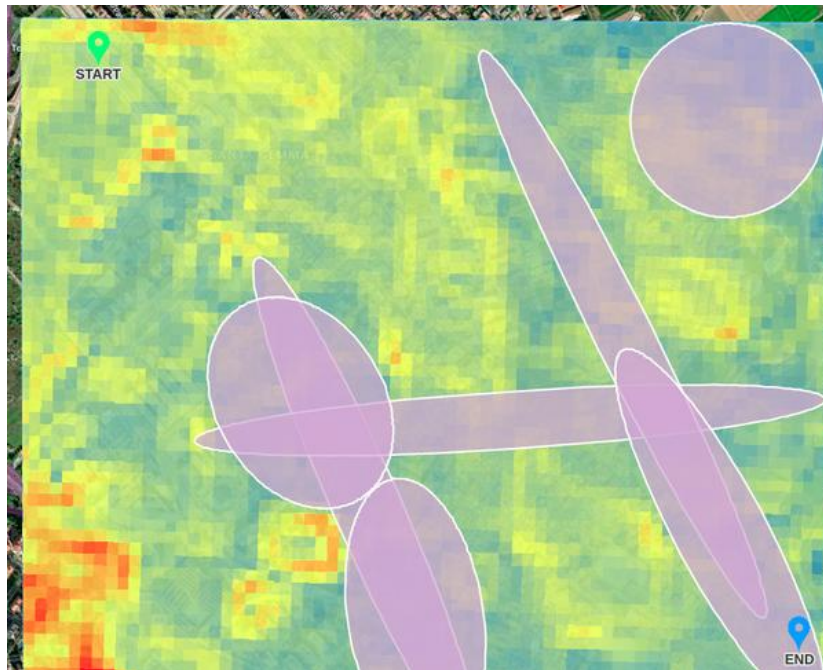
GEOPROCESS		RESULTS	
Select Geoprocess		Optimal sites	
<b>Select SITING_SCENARIO</b>		<b>Select SITE_AREA</b>	
[project] Explore	▼	10000	
Scenario with a calculated resistance map		Desired area for sites (square m.)	
<b>Select SITE_SHAPE</b>		<b>Select NUM_SITES</b>	
Rectangle	▼	16	
Choose the shape of the site		Number of site results	

In this example, optimal rectangular areas are found fitting low-resistance zones:



Similarly, in this example, optimal elliptical areas of the desired size are found on the Resistance Map.





This geoprocess also allows the specification a fixed-size rectangular area, so all the solutions found will have the required width and height in meters. Don't forget to *activate the checkbox* to apply these parameters.

Force dimensions ^

<b>Select FORCE_RECT_WIDTH</b>	<b>Select FORCE_RECT_HEIGHT</b>
<input type="text" value="400"/>	<input type="text" value="200"/>
Force site width (m)	Force site height (m)

**Select FORCE\_RECT\_DIMENSIONS**

force\_rect\_dimensions  
Force site to be rectangles with specified width and height.



As in other geoprocesses, the resulting sites can be exported to a GIS file, and also added to the Pathfinder project.

### Raster classification geoprocess

It allows users to divide a raster area in different classes depending on the pixel value, outputting a list of datasets, one for each class, which can then be exported or added to the project.

## Geoprocessing Tools

✕

GEOPROCESS
RESULTS

Select Geoprocess
Suitability classes from raster map
MORE

**Select SUITABILITY\_MAP**

[RM] Scenario 1 - Sal\_Bay ✕ ▼

---

Raster map representing suitability (resistance map or corridor map).

**Select NUM\_CLASSES**

5

---

Number of classes to divide the map.

**Select CLASS\_BREAK\_METHOD**

Per value ▼

---

Choose the method to divide in classes.

The user can select:

- The raster to classify. It can be a resistance map (marked as [RM]), corridor ([COR]), project raster like the DEM or Slope, or a layer raster.
- The number of classes to create.
- The method to divide the raster area.
  - *Per value* divides the raster in classes so that each class covers the same value interval (i.e. if raster values range from 100 to 200 and we select 4 classes, each class will cover 1/4 of the range: class 1 will cover values from 100 to 124, class 2 from 125 to 149, etc.)
  - *Per area* divides the raster in N classes so that each class covers approximately 1/N of the total area.

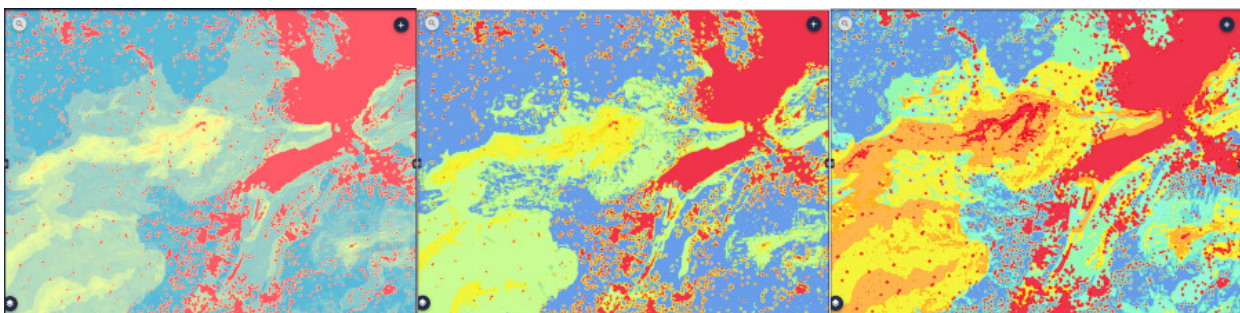
There are three main uses for this process:

### Calculate suitability zones from a Resistance Map

In an optimal siting analysis (for instance, finding best locations for photovoltaic plants, wind farms or electric substations) a resistance map is calculated, reflecting the overall suitability based on the project layers and their resistances.

A convenient way to present the siting process results is to extract a number of classes from the resistance map raster, representing more to less suitable areas.

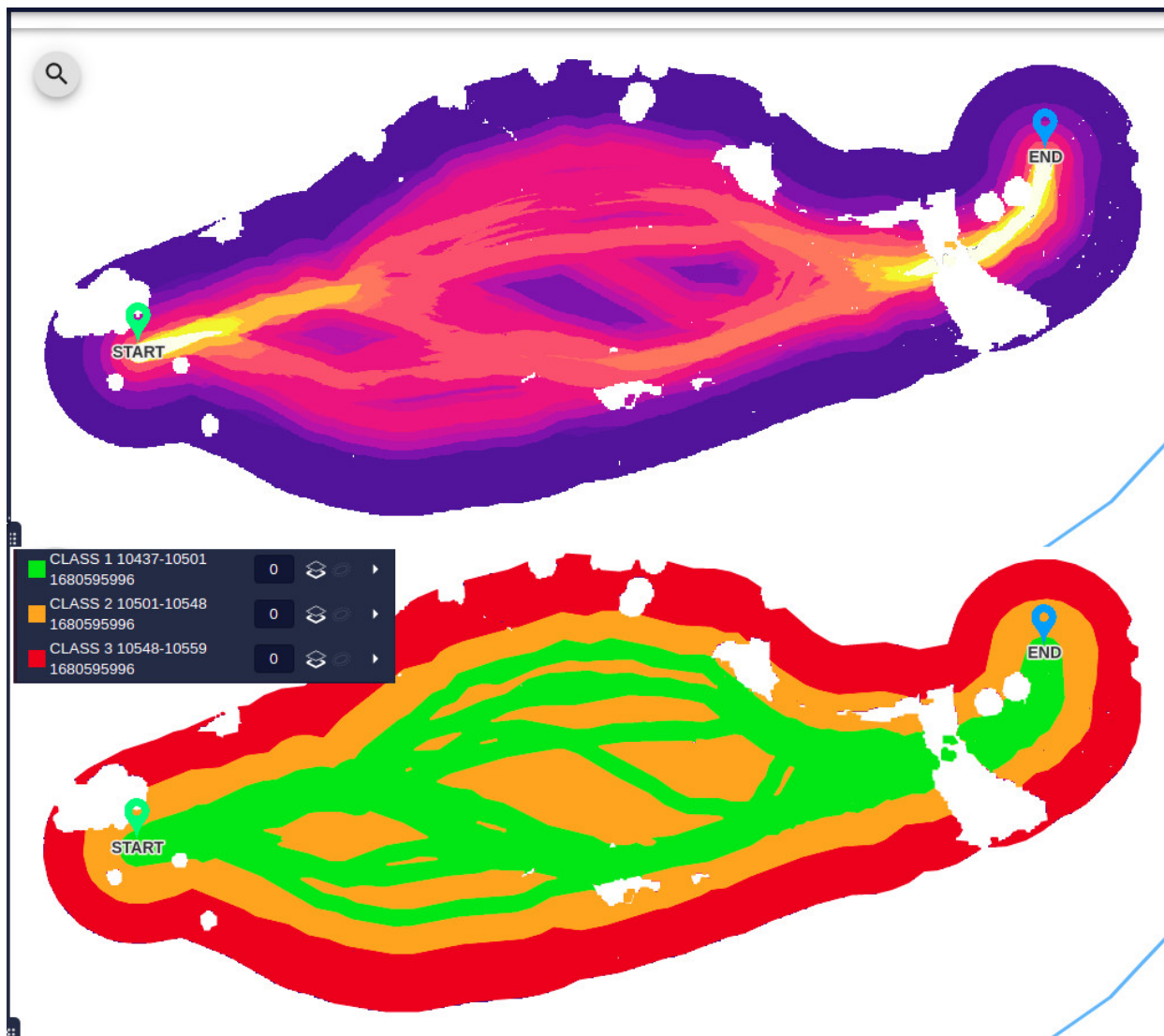
The following image shows the original resistance map on the left, the result of the classification per value in five classes (center) and the classification per area (right).



### Divide a corridor map into classes

When a corridor map is calculated, users can select its width in terms of value or percentile. We can then further analyze and share the corridor by dividing it into vectorized classes near or farther from the optimal value.

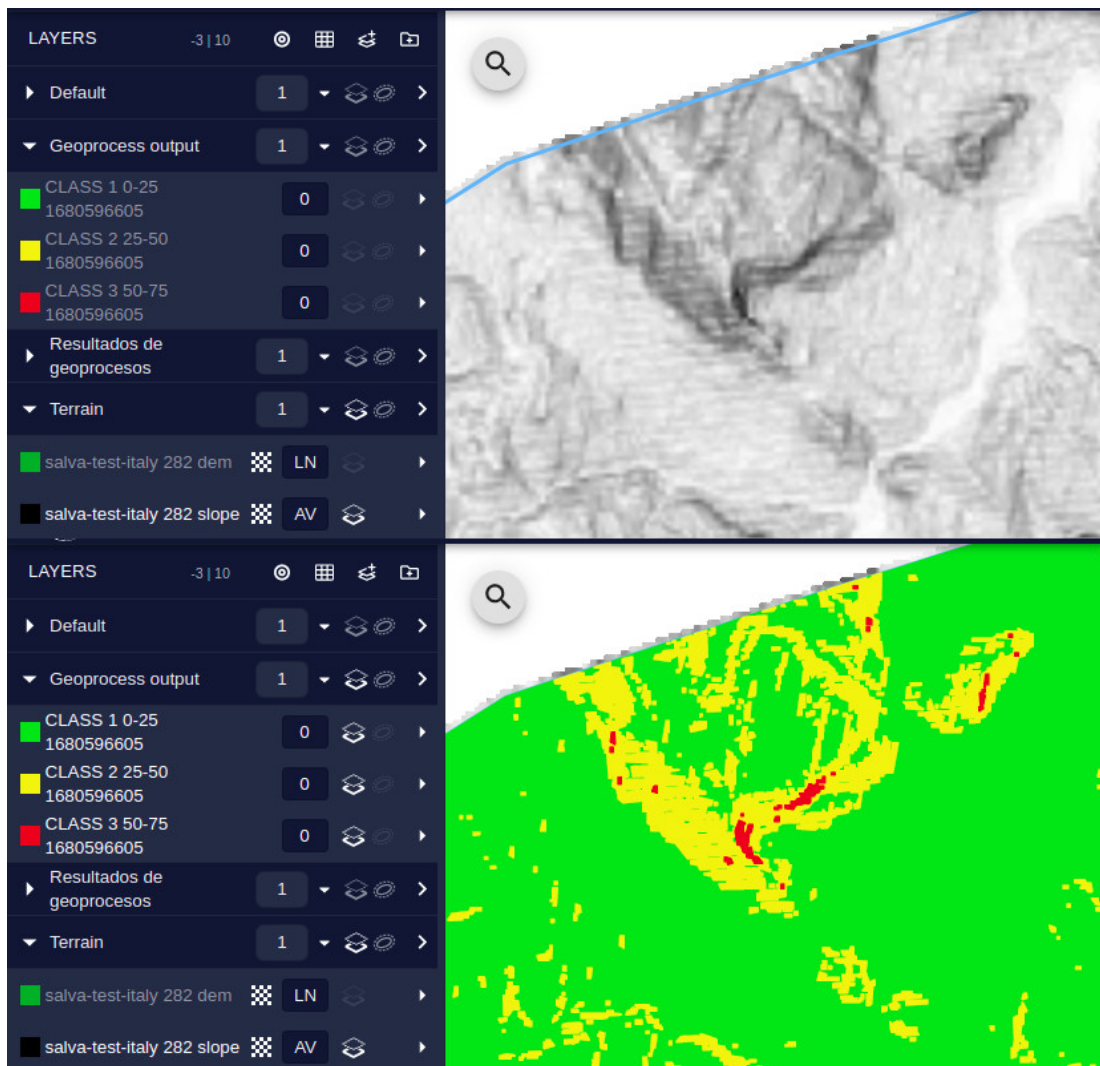
The following image shows the original corridor on top, and the result of classifying it into three classes and adding them as new layers in the project (below).



### Extract classes from a project or layer raster

The geoprocess can also be used to classify one of the default project rasters (DEM or Slope), or any other raster added as a layer in the project.

In the image below, we can see the original slope map (top) and the result of classifying it into three classes based on the value.



### Base Layer Features Intersecting Path

A common geoprocessing task is to find the objects crossing or near the calculated route. This geoprocess can be used to evaluate the impact of the proposed path on protected areas or find which properties are affected.

To execute it, we must select the base dataset (Base Layer) to intersect, the path already calculated in our project and the buffer distance: how close to the path can be the features to be considered "intersected".



### Geoprocessing Tools ✕

GEOPROCESS
RESULTS

Select Geoprocess
Base Layer Features Intersecting Path ▼
MORE

**Select BASE\_LAYER**

[base layer] Vineyards ▼

The Baselayer to get features from

**Select OPTIMAL\_PATH**

[PATH] Scenario 1 (A-Modified) ▼

The Optimal path to intersect with

**Select BUFFER**

100

Buffer to apply if required

**Output**

Name	Description	Type
VECTOR_OUTPUT	Features intersecting the given path with buffer	vector
TABLE_OUTPUT	Table with attributes of each intersected feature	tabular data

After running the geoprocess, we get the *geometries* of the intersected elements, which we can export, add as a layer in the project or display on the map, and a *table* with their attributes, which can be downloaded, for instance, to obtain IDs or names of the elements.

### Geoprocessing Tools ✕

GEOPROCESS
RESULTS

IntersectedBaselayer 2023-09-04 13:13:38

VECTOR\_OUTPUT

🗺️ SHOW ON MAP

📁 TO LAYER

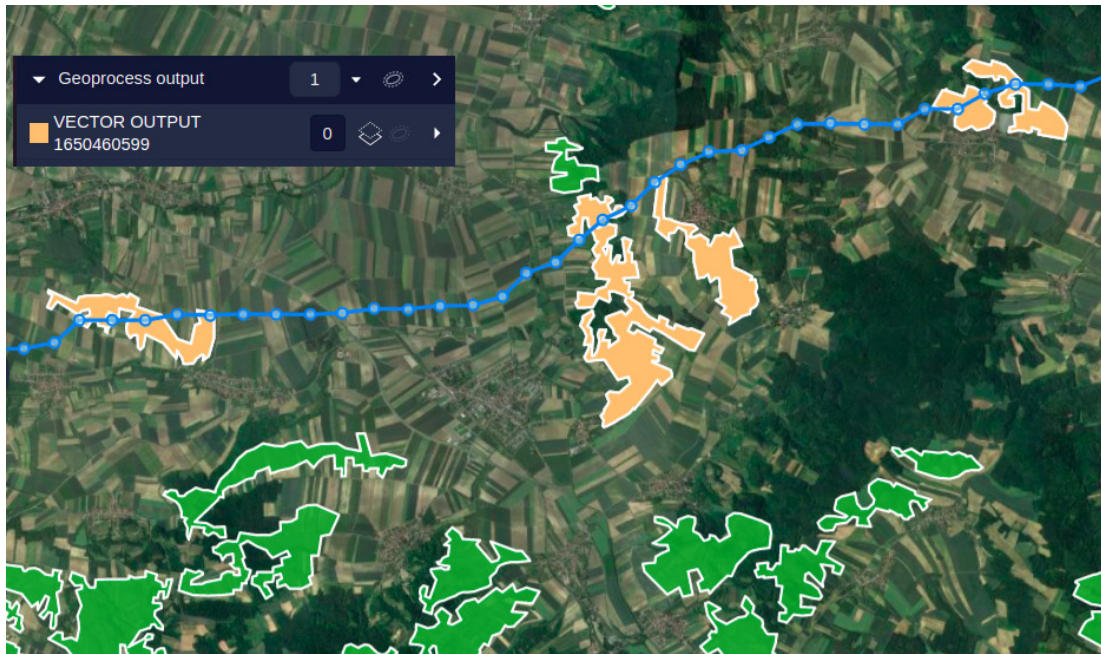
☁️ DOWNLOAD ▼

TABLE\_OUTPUT

☁️ DOWNLOAD

In this case, if we select to add the result as a layer, we will find the intersected features under the “Geoprocess output” category:





### Path Number of Crossings

In some cases, it is important to know how many times the candidate routes cross certain layers (railways, protected areas, etc.), since this may incur in additional costs or restrictions.

This geoprocess provides the number of intersections between selected paths and layers:

**Geoprocessing Tools** ×

**GEOPROCESS**      **RESULTS**

Select Geoprocess: **Path Number of Crossings** MORE

**Select PATHS**

- [PATH] Scenario 1 (A)
- [PATH] Scenario 1 (B)
- [PATH] Scenario 1 (C)
- [PATH] Scenario 1 (D)
- [PATH] Scenario 1 (E)

**Select LAYERS**

1950 1949 ▼

Layers to perform analysis on

Name	Description	Type
INTERSECTION_ANALYSIS	Table with number of intersections for each Layer	tabular data

After running the geoprocess, we get a *table* in CSV format, showing how many times each path intersects each of the selected layers:

Layer Name	B	C	A
ArcGIS_238_AreasProtec_BosqueSeco_Protec	34	26	32
ArcGIS_238_AreasProtec_REAA	11	9	13

### Export Sub Corridor

The corridor map shows the areas closer to an optimal path. *No data* (transparent) areas show where the cost is too high or forbidden.

This geoprocess allows users to extract the valid corridor area near a calculated path (given a maximum distance), or extract the whole valid corridor area if the *full corridor flag* is selected.

In order to use this geoprocess, typically the user would select a corridor map from the project or an imported raster layer.

## Geoprocessing Tools

GEOPROCESS
RESULTS

---

Select Geoprocess
Export Sub Corridor
MORE

**Select CORRIDOR**

[layer raster.] CorridorAustria

A Raster File Path containing a valid corridor

**Select OPTIMAL\_PATH**

[PATH] Scenario 1 - LION (Imported)

Path within this corridor. Scenario Path ID

**Select BUFFER\_M**

0

BUFFER in METERS for the new corridor

**Select FULL\_CORRIDOR\_FLAG**

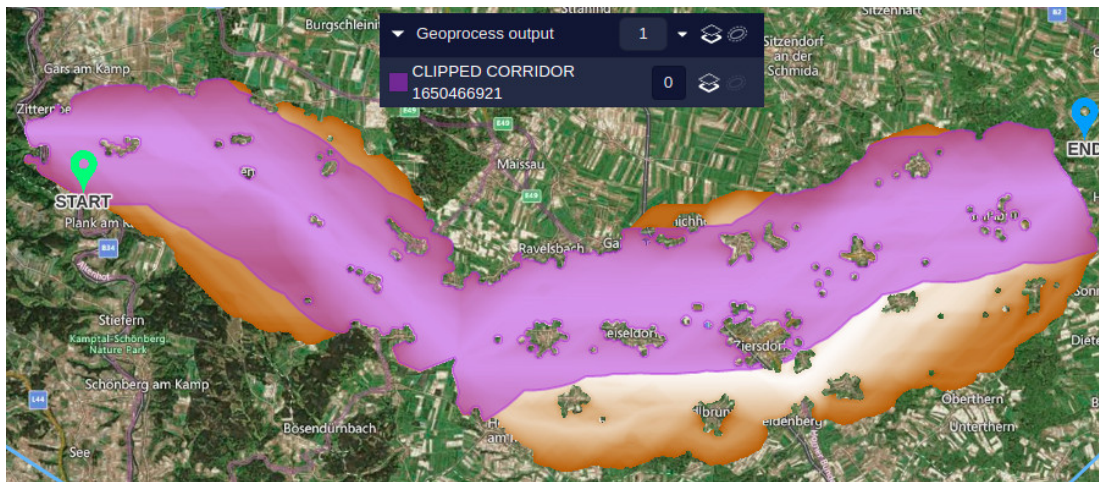
full\_corridor\_flag

Instead of buffering around the path, export the whole corridor

**Output**

Name	Description	Type
CLIPPED_CORRIDOR	Generated corridor	vector

The result is a polygon geometry containing the valid corridor area, and maybe holes where the corridor is not valid:



### Buffered Path Layer Coverage

In some cases users are interested in knowing the *area* affected by the route across different layers, assuming the path is expanded or buffered by certain width. For instance, if a path is crossing a forest layer, and vegetation must be trimmed near the route, the user may want to calculate the total area to be trimmed.

To do this, the user can select the path, the corridor width or buffer, and the layers whose coverage must be calculated:

## Geoprocessing Tools



**GEOPROCESS**      RESULTS

---

Select Geoprocess: Buffered Path Layer Coverage      MORE

---

Select PATH: [PATH] Scenario 1 (A)      Select BUFFER\_M: 200  
Path to perform analytics on      BUFFER in METERS for the new corridor

---

Select LAYERS

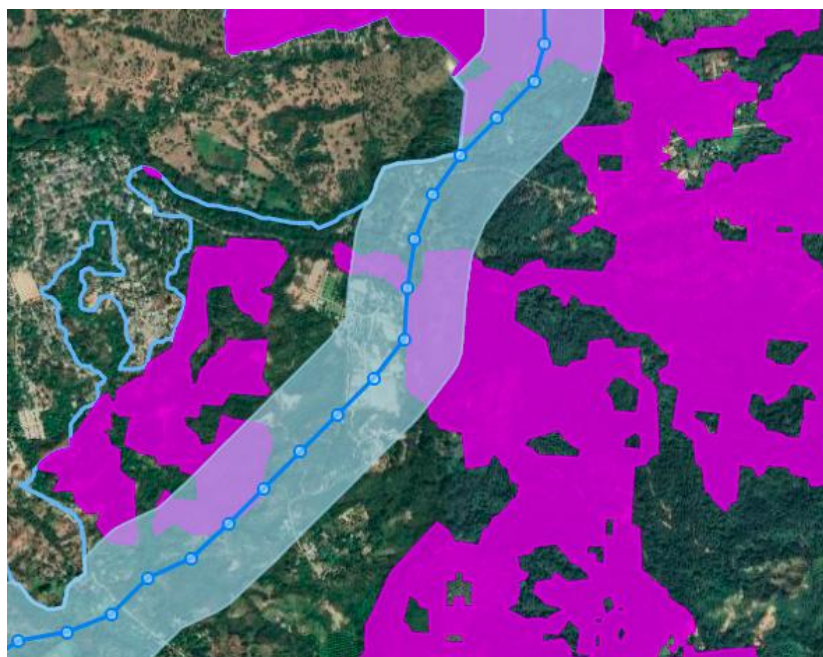
- [layer] ArcGIS\_238\_AreasProtec\_BosqueSeco\_Protec
- [layer] ArcGIS\_238\_AreasProtec\_REAA
- [layer] ArcGIS\_238\_N11W075.hgt

---

Output

Name	Description	Type
CORRIDOR_ANALYSIS	Sub Corridor coverage in square meters for each layer	tabular data
BUFFERED_PATH	Polygon with the buffered path used	vector

The resulting corridor can be exported or displayed as a vector layer:



The areas covered on the selected layers (in square meters) can be exported to a CSV table:

Layer Name	Area Coverage
ArcGIS_238_AreasProtec_BosqueSeco_Protec	2582527.46
ArcGIS_238_AreasProtec_REAA	2455846.28

Note that Pathfinder's path analytics chart provides instead a *linear coverage*: the lengths and percentages of the path along different layers in the project.

### Corridor merge and export

This is implemented to merge multiple corridor maps and extract a portion of the merged corridor based on value. Multiple scenario corridors can be selected to be merged, and a minimum value percentage (usually 0, to include the corridor centers) and a maximum value percentage can be selected.

## Geoprocessing Tools



GEOPROCESS
RESULTS

Select Geoprocess
Merge and Export Corridors
MORE

**Select MIN\_WIDTH\_PERCENTAGE**

0

Inner width percentage [0 - 100]

**Select MAX\_WIDTH\_PERCENTAGE**

25

Outer width percentage (0 - 100]

**Select CORRIDORS**

[project] Scenario pylon

[project] Scenario 1

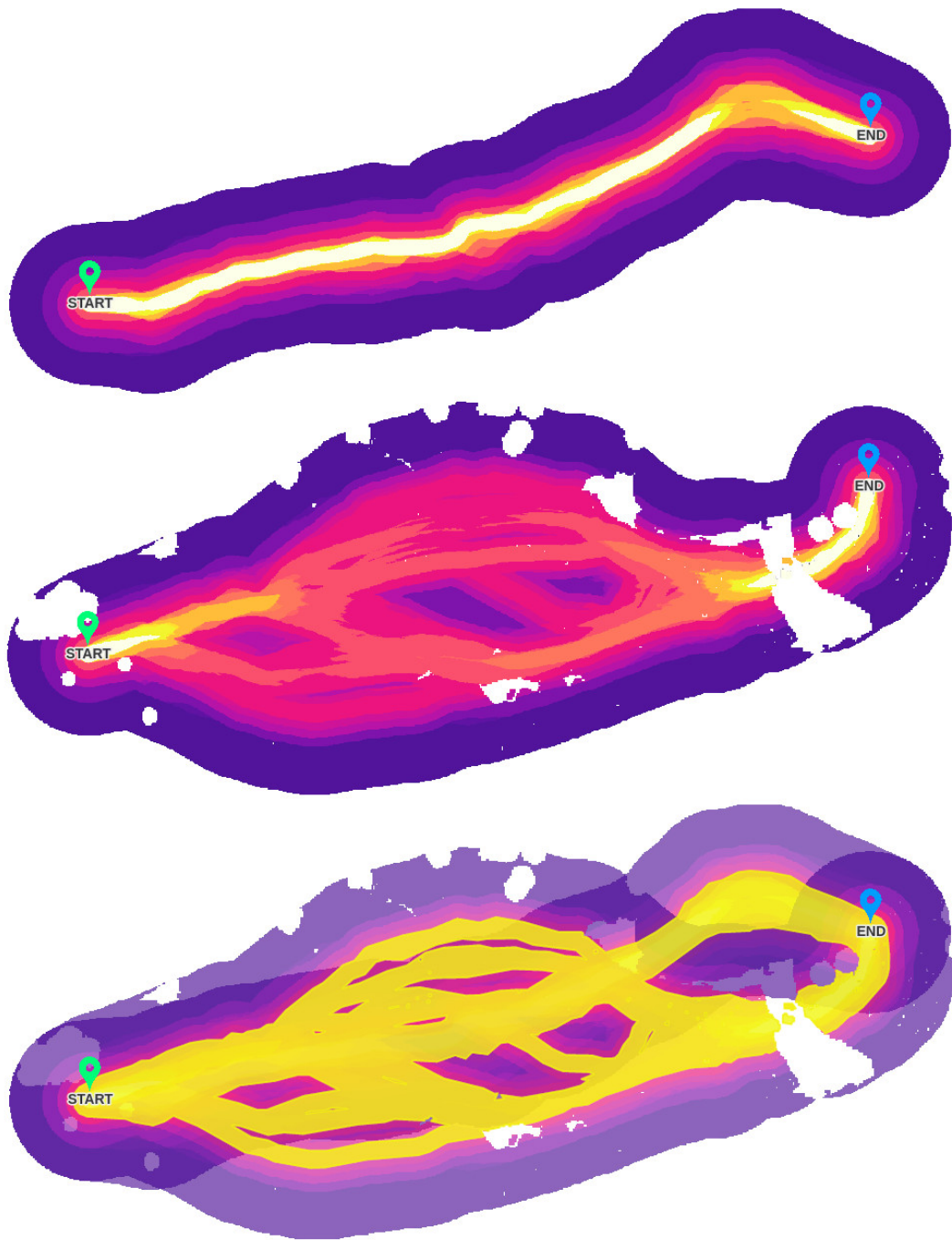
List of corridors to merge and export

**Output**

Name	Description	Type
MERGED_CORRIDOR	Generated corridor	vector

The following image shows an example with two corridors (top and center). Their 50% lower ranges are merged into a single polygonal area, shown in yellow color in the bottom part.





### Visual Impact from Observers

Geoprocesses can also generate raster data. An example are the visibility analysis processes, which work on a digital elevation model (the DEM automatically generated in the project can be used):

This geoprocess calculates a raster whose pixel values represent the number of objects in the layer that can view that location.



## Geoprocessing Tools ×

GEOPROCESS
RESULTS

Select Geoprocess
Visual Impact from observers
MORE

**Select ELEVATION\_RASTER**

[project] DEM
▼

DEM (Digital Elevation Model) or DSM (Digital Surface Model).

**Select OBSERVER\_LAYER**

[layer orig.] AreasProtegidas\_Humedal
▼

Observation point layer. If polygon or line, takes centroid.

**Select OBSERVER\_HEIGHT**

2
▼

Observer height for each observer point in meters.

**Select TARGET\_HEIGHT**

40
▼

Height of observation target (like a pylon) in meters.

**Select VIEW\_DISTANCE**

2000
▼

Maximum view distance for each point in meters.

**Select DECAY\_FUNCTION**

Linear
▼

Visual Impact decay function to be used.

**Select CURVATURE**

RESET
▼

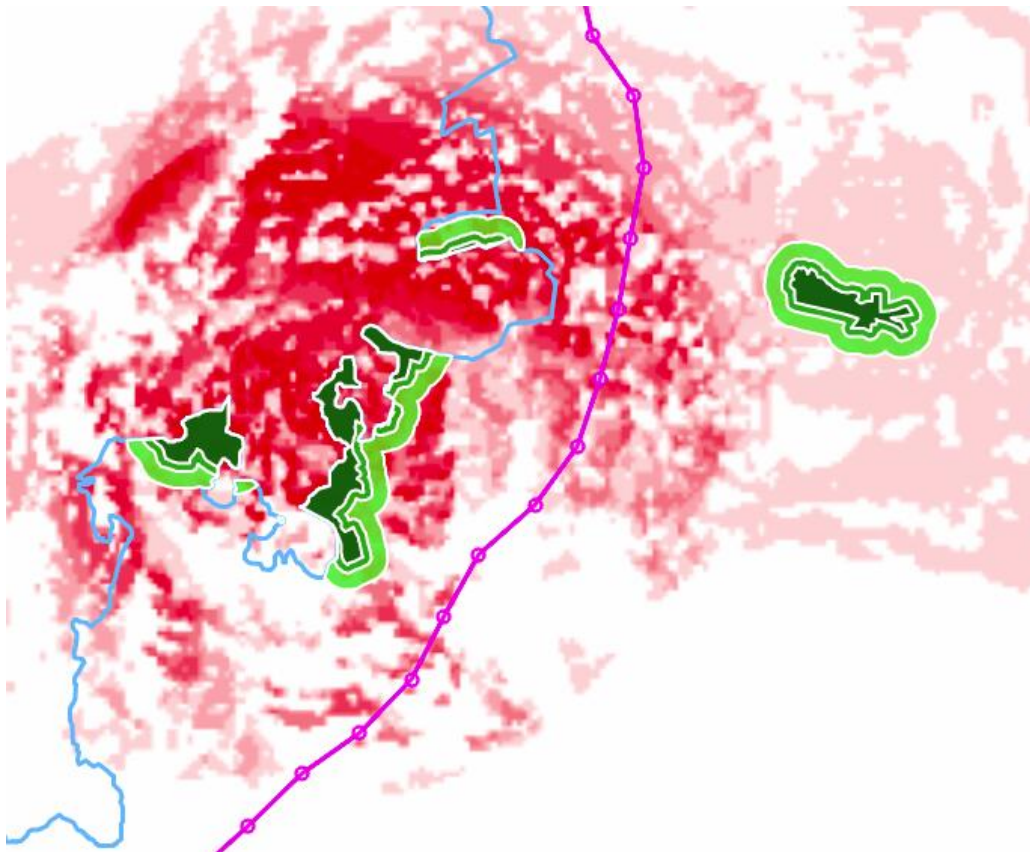
**Select ALGORITHM**

CLOSE
PROCESS

The following image shows an example. In this case, we have some recreation areas (green polygons) whose scenery visibility we would like to protect. After running the process, we generate a raster. The value of each pixel indicates how many of the areas can see it.

By adding this raster result as a project layer, we can display it with color shades (red in this case) whose intensity matches the visibility values, that is, darker red shades mean those points are visible from a greater number of recreation areas.

We can now compare this viewshed with the path location (purple colored line) to check its impact.



After calculating the viewshed and adding it as a layer, we can assign it some resistance and then recalculate the results to make the route avoid the most highly visible areas.

### Note

The cost of this geoprocess is proportional to the number of objects in the layer. We must avoid layers containing a large number of objects (like buildings), because the process would take a long time to complete. It is possible to use the clustering geoprocess or another grouping method to reduce the number of objects before running it.

## Viewshed (GRASS GIS)

This geoprocess calculates a raster whose pixels are yes/no values marking the area visible from the selected route.

**Geoprocessing Tools** ×

**GEOPROCESS**      RESULTS

Select Geoprocess      Viewshed (GRASS GIS)      MORE

**Select DEM\_RASTER**  
[project] DEM  
DEM Raster File (Digital Elevation Model)

**Select OPTIMAL\_PATH**  
[PATH] Scenario 1 (A)  
Path to calculate viewshed from each of its points

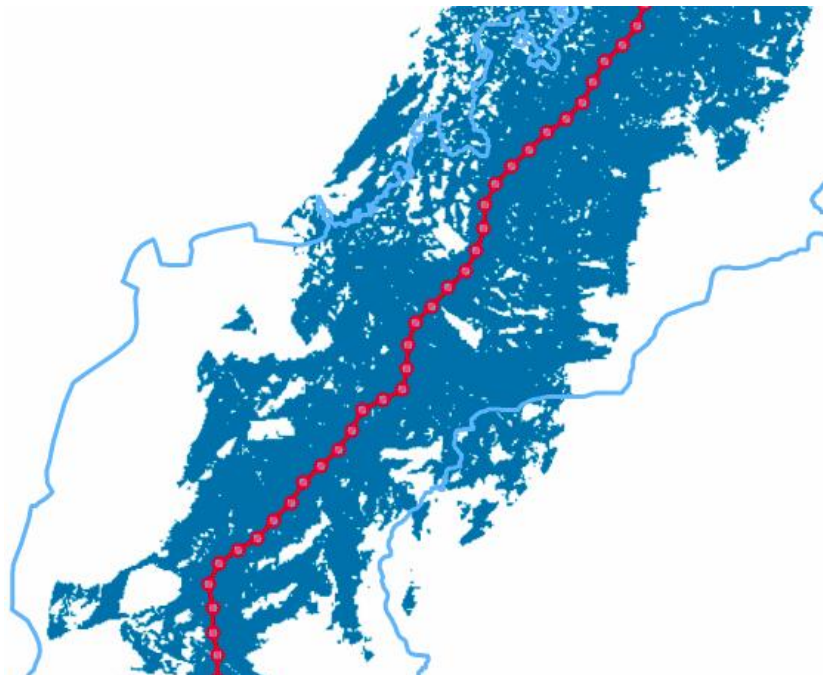
**Select VIEW\_DISTANCE**  
2000  
View distance for each point in meters (-1 for infinite)

**Select VIEW\_HEIGHT**  
28  
View height above ground level for each point in meters

**Select TARGET\_HEIGHT\_OFFSET**  
0  
Offset for target elevation above the ground

**Select REFRACTION\_COEFF**  
0.14286  
Refraction coefficient used

In this case the raster only has two shades: visible or not visible.



With this result, we can easily check which areas and elements are affected by the line, visible to them.

**Note**

This geoprocess is faster than the Visual Impact.

**Hybrid Planning**

More and more, combining multiple infrastructure modes or technologies to plan a single route is becoming an important requirement. For instance, it may be necessary to find an optimal powerline path which combines overhead and underground (earth cable) sections.

The *hybrid planning geoprocess* addresses this routing problem. Its requirements are:

- The area where underground cables are preferred, the *critical area*, must be defined in a project layer.
- One scenario must define the *overhead constraints*, but in such a way that the overhead line crosses the critical area. This section will be then substituted by an underground route.
- The second scenario (subscenario) must define the *underground cable constraints*.
- The Start point must be located outside the critical area. The End point can be either in or out this area.

### Geoprocessing Tools ✕

GEOPROCESS
RESULTS

Select Geoprocess
Hybrid planning (Schito) ▼
MORE

**Select MAIN\_SCENARIO**

[project] SB - Overhead ▼

Main Scenario for the Overhead line

**Select SUB\_SCENARIO**

[project] SB - Underground ▼

Secondary scenario for the hybrid routing

**Select CRITICAL\_AREAS**

[layer] Building\_zones ▼

Critical Areas that could be run through the Sub Scenario

**Select TRANSITION\_AREAS**

[layer] Building\_zones ▼

Areas where it is possible to perform a line transition

**Select CA\_USE\_BUFFERED**

ca\_use\_buffered

Use buffered data for the Critical Areas input

**Select TA\_USE\_BUFFERED**

ta\_use\_buffered

Use buffered data for the Transition Areas input

**Select BUFFER\_WIDTH**

100

Distance to join close pipes

**Select GI\_THRESHOLD**

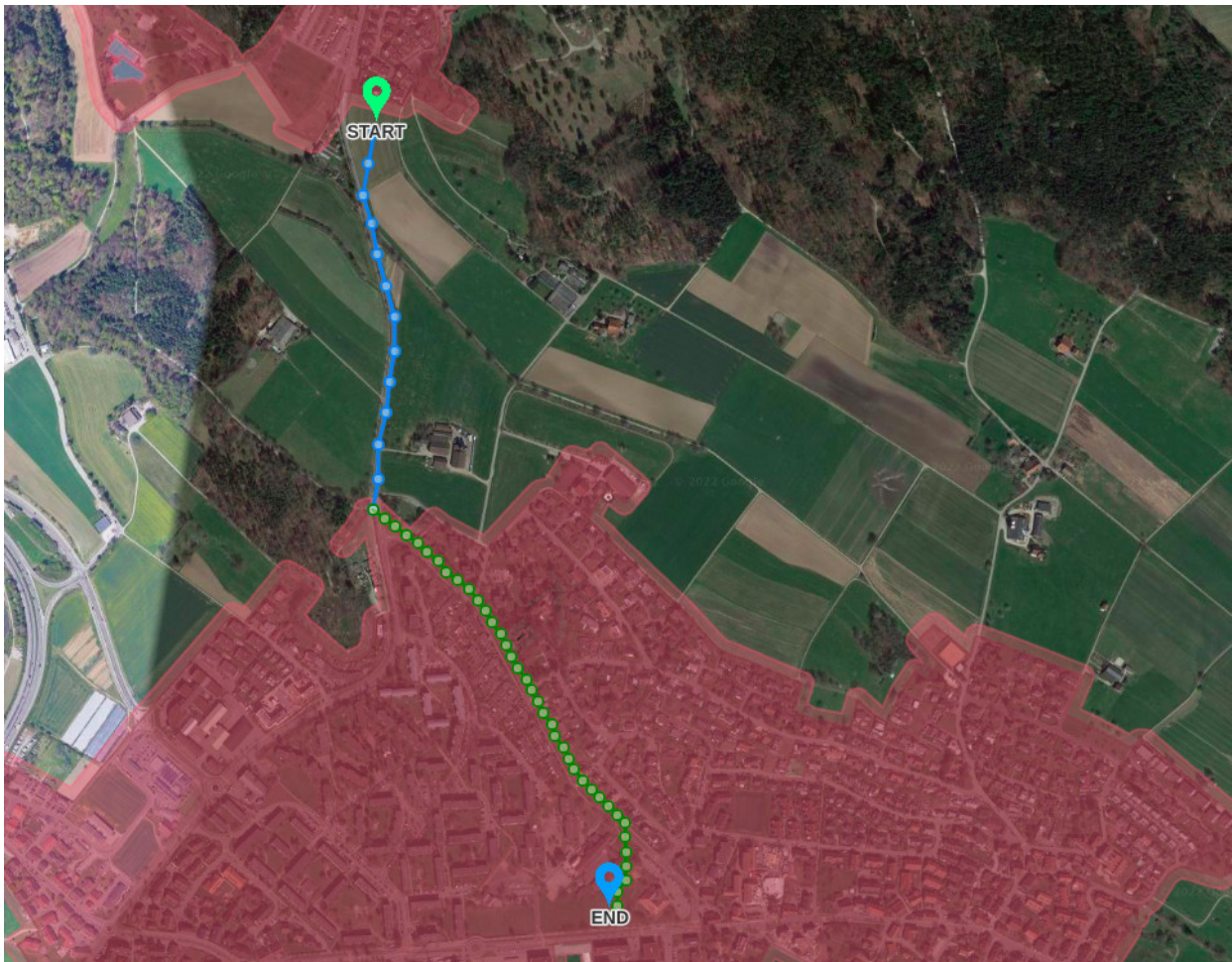
0.00004

Getis Ord value threshold to cluster

RESET
CLOSE
PROCESS

This image shows an example of results, with a blue overhead section and a green underground section. Critical areas are displayed in a transparent red:





## Note

This geoprocess will be deprecated. Use the Combined Routing for Tunneling instead. See below.

## Combined Routing (Tunneling)

Similarly, in some countries it is important to combine overhead powerlines with tunnel segments. The *tunnel planning geoprocess* has been implemented to do so by using a custom version of the Pathfinder Explore algorithm.

This geoprocess uses *three different scenarios*, one for the conventional technology (typically overhead), a second one with the constraints defining the tunnel sections (usually should have a smaller resistance/cost than overhead for a high elevation, surface protected areas, type of geology, etc.), and a third scenario defining the cost of locating the tunnel entrance (usually must be away from populated areas, but not too far from transportation networks).

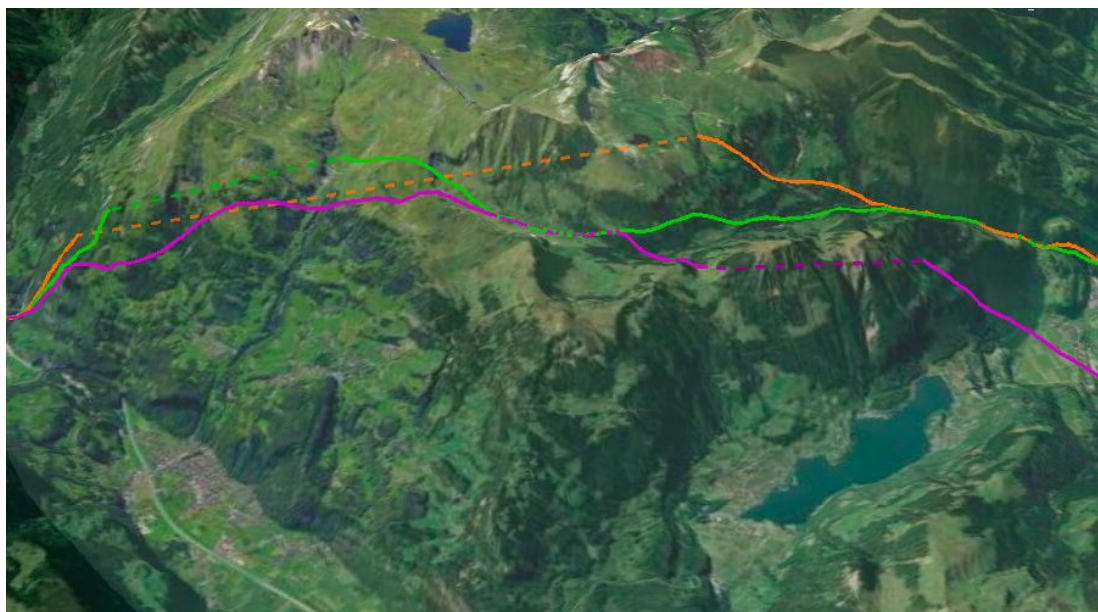
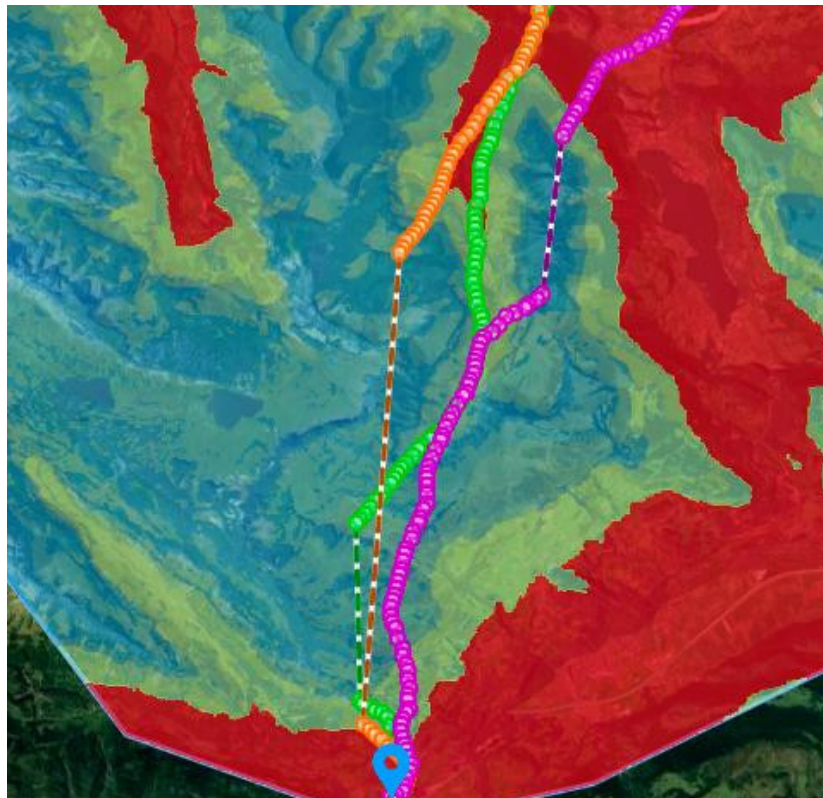
The geoprocess includes tunnel-specific constraints like maximum and minimum slope, and a maximum and minimum length for the tunnel sections.

## Geoprocessing Tools

GEOPROCESS		RESULTS	
Select Geoprocess		Combined routing	
<b>Select OVERHEAD_SCENARIO</b> [project] Overhead <small>Scenario for the overhead lines</small>		<b>Select TUNNEL_SCENARIO</b> [project] Tunnel <small>Scenario for the tunnel section</small>	
<b>Select ENTRANCE_SCENARIO</b> [project] Tunnel entrance <small>Scenario for tunnel entrance selection</small>		<b>Select ELEVATION_MODEL</b> [layer] DEM <small>Layer with elevation</small>	
Output Options			
Tunneling Parameters			
<b>Select MIN_TUNNEL_LENGTH</b> 300 <small>Minimum length of tunnel (m)</small>		<b>Select MAX_TUNNEL_LENGTH</b> 10000 <small>Maximum length of tunnel (m)</small>	
<b>Select MIN_TUNNEL_SLOPE</b> 2 <small>Minimum tunnel slope (percentage)</small>		<b>Select MAX_TUNNEL_SLOPE</b> 15 <small>Maximum tunnel slope (percentage)</small>	

The results can be displayed in the 2D and 3D views, where the tunnel sections are marked with dashed lines.





This video shows how to use the geoprocess to get combined routes with tunnels:

### Combined routing (OH + EC)

This geoprocess is used to find the best overall routes combining overhead and earth cable sections.

Although earth (underground) cabling is more expensive, it might be necessary in certain areas (e.g. populated areas), so a combined route is necessary.

Same as with the tunneling geoprocess, the user needs to create first **two separate scenarios** with the constraints for the overhead and earth cable sections, calculate their resistance maps, and provide some parameters like the number, maximum and minimum length of the earth cable sections.

## Geoprocessing Tools

**GEOPROCESS**      RESULTS

Select Geoprocess      Combined routing OH + EC

---

**Select OVERHEAD\_SCENARIO**      **Select EARTH\_CABLE\_SCENARIO**

[project] Overhead      [project] Earth cables

---

Scenario for the overhead lines      Scenario for the earth cables section

---

Earth Cable Parameters

<b>Select MIN_EC_LENGTH</b>	<b>Select MAX_EC_LENGTH</b>
300	10000
Minimum length of EC section (m)	Maximum length of EC section (m)

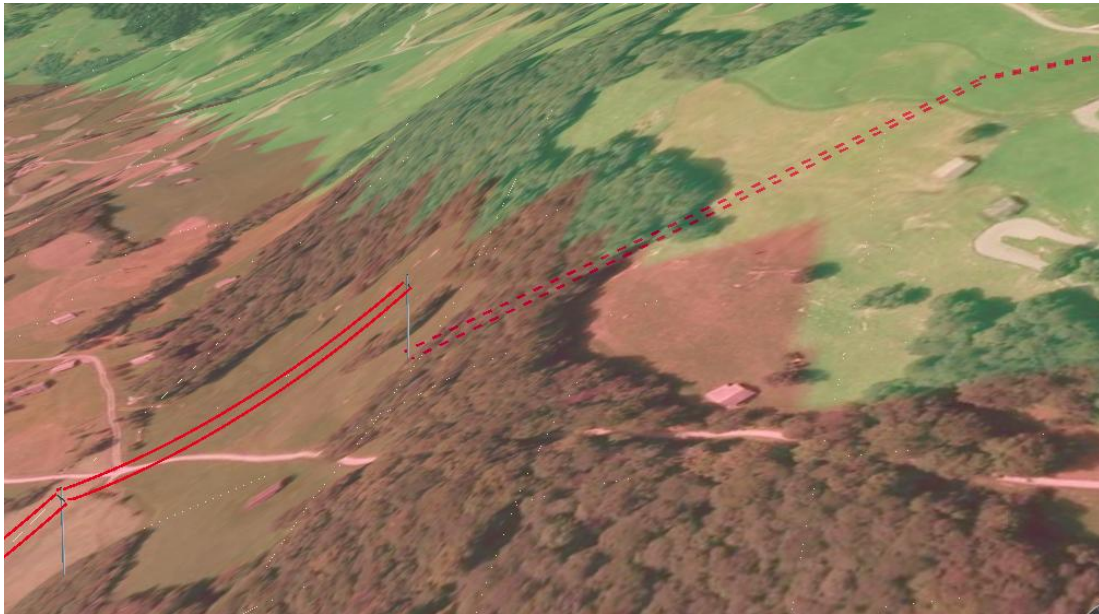
---

<b>Select WEIGHT_EC_RESISTANCES</b>	<b>Select MIN_OVERHEAD_LENGTH</b>
1	1000
Weight factor for EC resistances [0.0 - 1.0]	Minimum length of overhead section (m)

The results can be seen in the map and 3D views, with the earth cable sections visible as dashed lines.





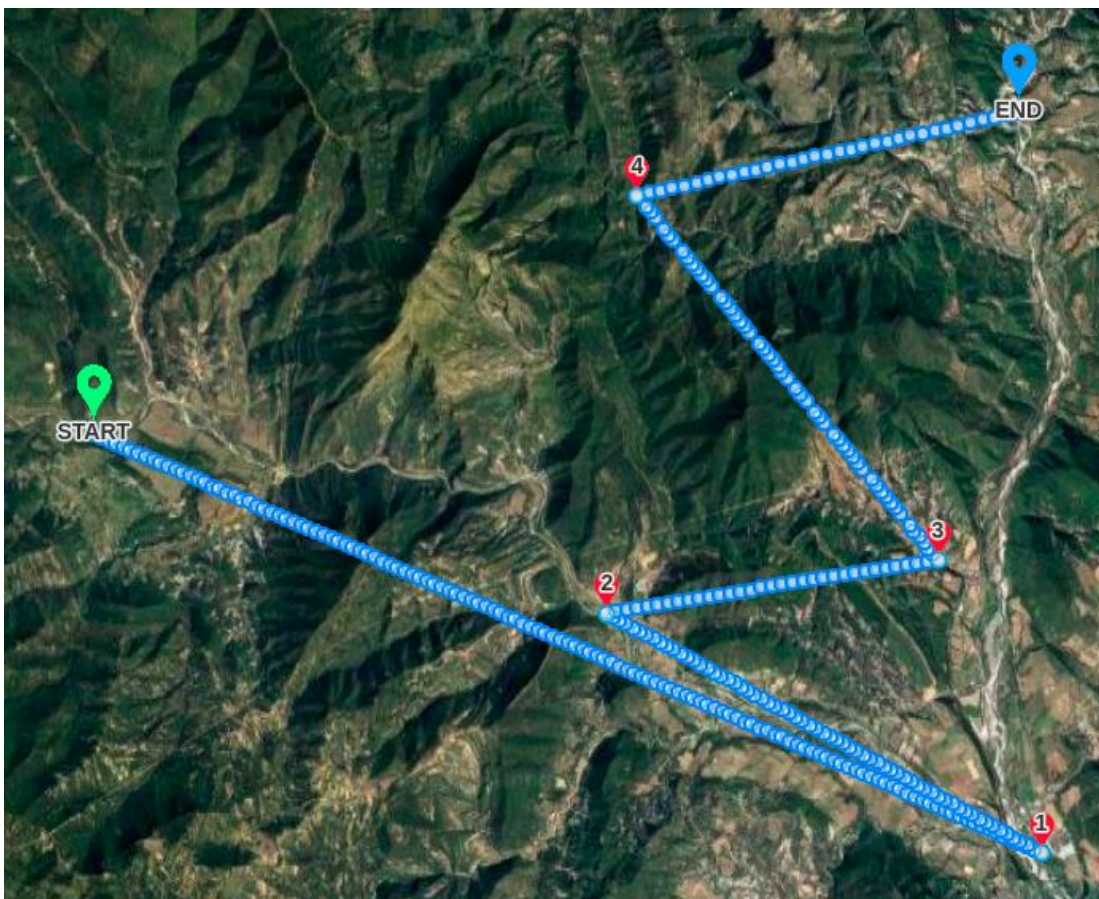


### Note

The algorithm decides to pick either OH or EC sections depending on their relative resistance in each area, so earth cables will be chosen only where the resistance is smaller than the OH lines. The “Weight EC Resistances” parameter can be used to lower the overall resistance of EC and therefore, make EC segments more likely.

### Multipoint Routing

Regular route calculation proceeds from the Start point to the End point, going through the optional Intermediate points of the scenario in strict order, as seen in the following image:

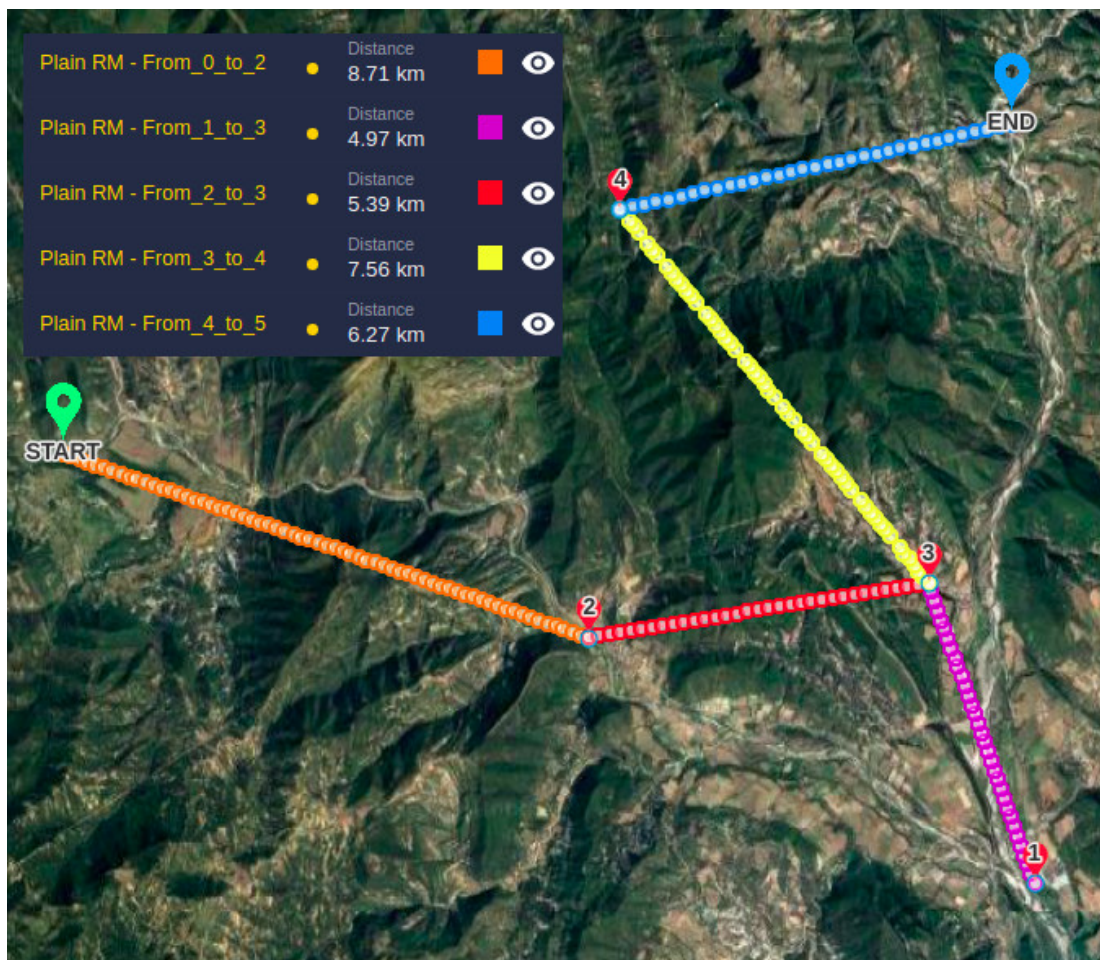




## Running Geoprocesses

For some use cases, like connecting multiple wind turbines with feeder lines or performing power grid extension analysis, we want to find a way to connect multiple points with paths that result in a minimum total resistance, that is, in the most optimal way.

In this case, the result of the previous scenario may look like this, where each “edge” (link between two points) appears as a separate path in the scenario results:



Notice that the name of each path shows which points the route section is connecting.

Points are **indexed** in this way:

- The *Start point* (if defined) has index 0.
- If Start is defined, the *Intermediate points* have the same index as it appears on the map (1, 2...). If Start is not defined in the project or the scenario, the Intermediate points are indexed starting with 0, one less than the number it appears on the map.
- The *End point* (if defined) has the last index value (5 in the example above).

To use the geoprocess:

- Define or import in the scenario as Intermediate points any additional points (other than the Start and End points) that must be connected.
- Make sure *the resistance map is already calculated* in your scenario.
- Select the Multipoint Routing geoprocess in the dialog open from geoprocessing tools menu, and select the scenario:

## Geoprocessing Tools

**GEOPROCESS**      RESULTS

Select Geoprocess      Multipoint routing      MORE

Select SCENARIO  
[project] Plain RM  
Scenario with routing constraints and points

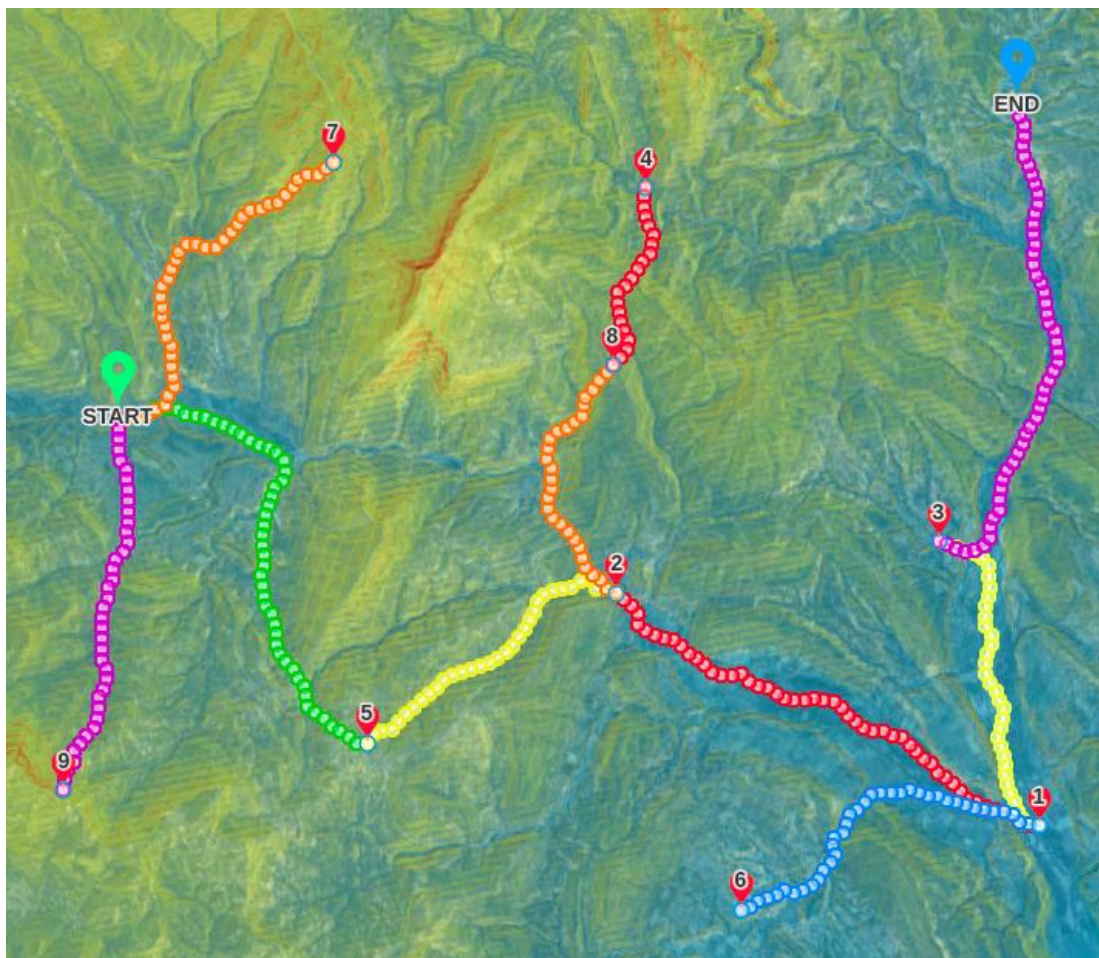
Select EXCLUDE\_LINKS  
[]  
List of links to be excluded, in this format [[0, 4], [2, 3]...].

Select ASSUMED\_LINKS  
[]  
Links to be assumed as existing, in this format [[0, 4], [2, 3]...].

### Note

Because this geoprocess calculates different combination of routes, it may take quite longer to complete than a usual routing process.

The geoprocess will automatically choose the best combination of paths to connect all the points, based on the scenarios's resistance map.





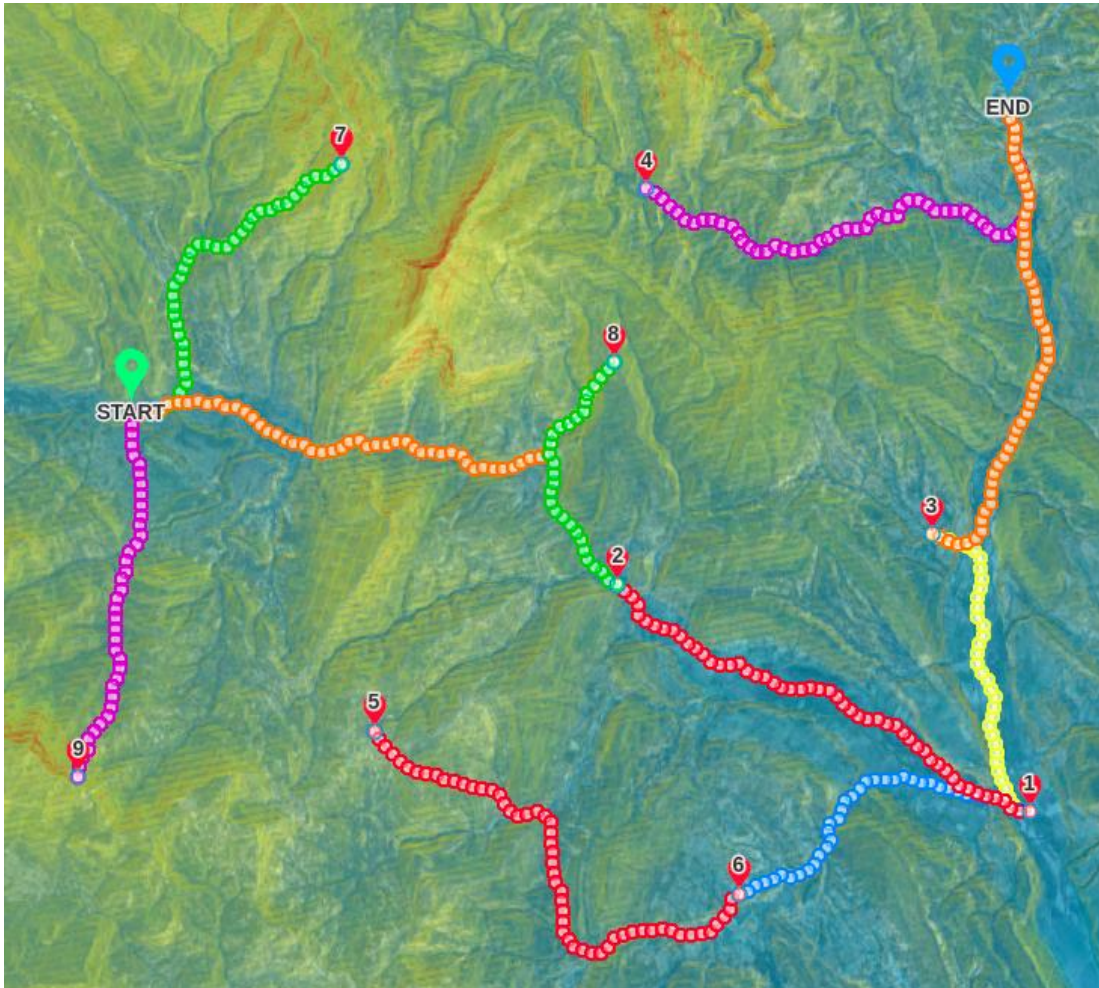
Optionally, we can **exclude specific connections**. Imagine that in the previous example we don't want point 2 to be connected to point 5, and neither point 4 to point 8. When we run the geoprocess, we can use the EXCLUDE\_LINKS field to specify this constraint as a list of pairs, using the indexing system we described above: [ [ 2, 5 ], [ 4, 8 ] ]

Select EXCLUDE\_LINKS

[ [ 2, 5 ], [ 4, 8 ] ]

List of links to be excluded, in this format [[0, 4], [2, 3]...].

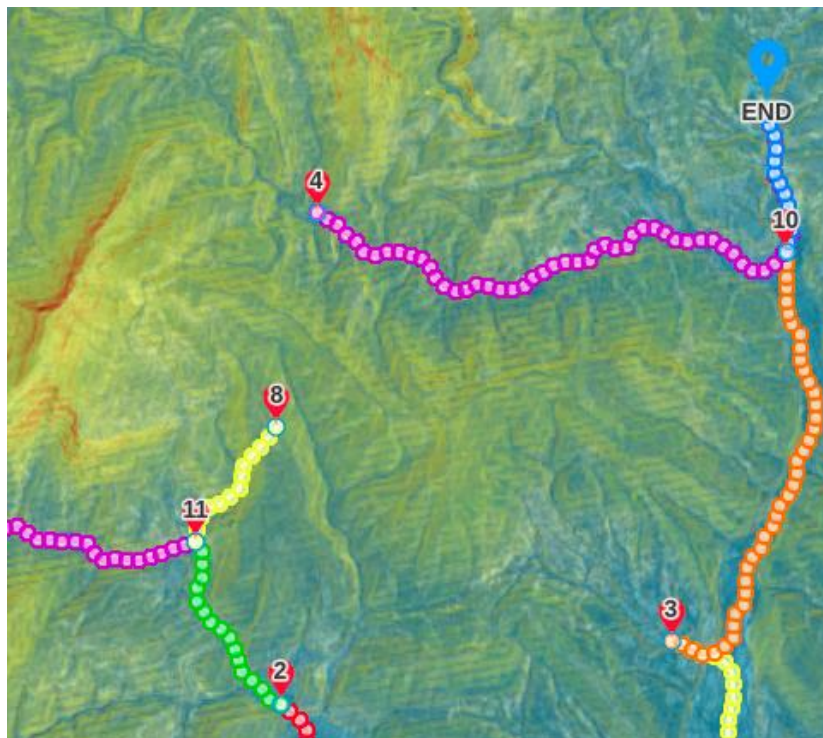
This time, the optimal connection tree will not contain the excluded edges:



If we look at these last results, they suggest ways we could reduce the cost by sharing some sections in the final design and adding **intermediate distribution points** (marked as red circles in the image).



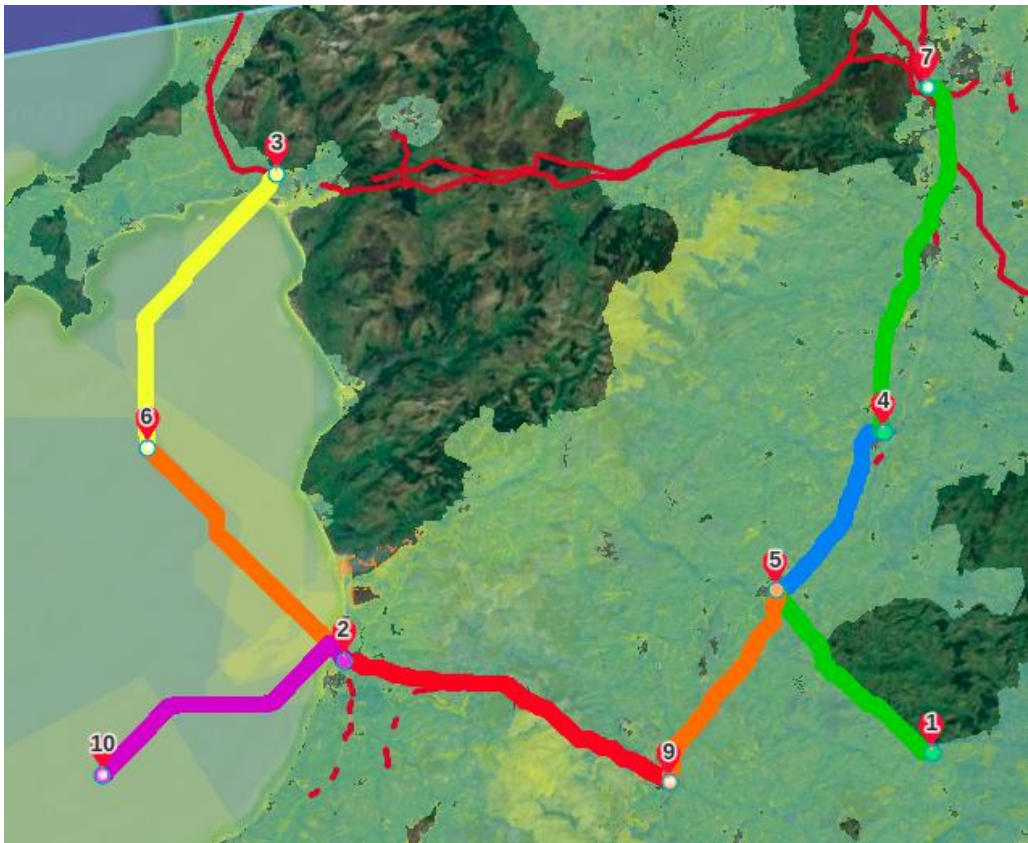
In fact, we can add these points as new intermediate points and run again the geoprocess to obtain new links in a more optimal network:



Another option available in this geoprocess is to **assume existing connections**. For instance, if we are studying potential expansions of a powerline grid to reach new areas or connect existing substations, we can assume certain paths already exist and use them in this expansion without the need to calculate them. For this purpose, we can use the ASSUMED\_LINKS field, specifying the edges with the same format as the excluded ones.

For instance, in the following example we are connecting points 1 to 10, with this initial result:





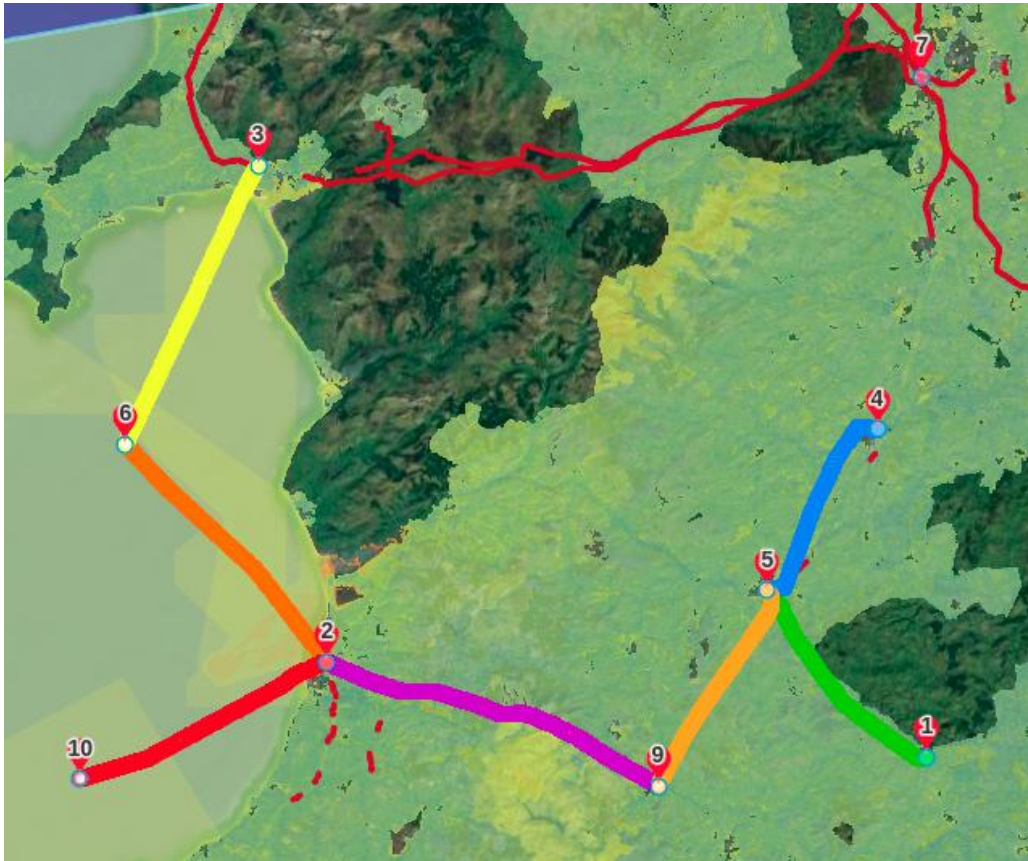
However, since points 3 and 8 are already linked by a powerline, we can decide to use it in our planning. In this case, because there is no Start point, the indices for these points are 2 and 7, so we specify the assumed edge as [2, 7]:

**Select ASSUMED\_LINKS**

[[2,6]]

Links to be assumed as existing, in this format [[0, 4], [2, 3]...].

When we use this existing connecting, the result changes to:



We see that there is no need now of a new path between 4 and 7, so it has disappeared, since 7 is already connected to the grid and there is a more optimal way to reach point 4.

### Path Resistance Analysis

In addition to the resistance profile chart, this geoprocess provides statistics about the total value and the variation of the resistance (taken from the resistance map) along the selected path. It is a convenient way to compare the “cost” of the paths calculated with similar constraints. It is also useful to estimate the resistance of a path in a different scenario from the one used to calculate it.

Note that the resistance values reported here will not include the angle cost and other constraints applied in advanced algorithms.

The path and the scenario are selected as input:

## Geoprocessing Tools ×

GEOPROCESS
RESULTS

Select Geoprocess
Path Resistance Analysis
MORE

**Select OPTIMAL\_PATHS**

- [PATH] SB - Overhead (A)
- [PATH] SB - Underground-tmp (A)
- [PATH] SB - Overhead no FB (OH Part 1)
- [PATH] SB - Overhead no FB (OH Part 2)
- [PATH] SB - Overhead no FB (A)
- [PATH] SB - Overhead no FB-tmp (A)

**Select RESISTANCE\_MAP**

[RM] SB - Overhead

Resistance map to use for analysis.

Name	Description	Type
PATH_ANALYSIS	Generated path analysis	tabular data

The Results tab will show a button to download the table with the stats:

## Geoprocessing Tools

GEOPROCESS
RESULTS

PathResistance 2022-02-14 09:53:59

PATH\_ANALYSIS DOWNLOAD

Path Name	n	null_cells	cells	min	max	range	sum
Path SB - Overhead (A)	870	1346876	1347746	-5	17	22	3444.71

### Note

Strictly speaking, the resistance values of two paths are only comparable when they belong to the same scenario (or two scenarios with the same layer resistances), and use the same algorithm, since different algorithms may calculate the total resistance with different methods.

## Hilltops and Ridges from DEM

Pathfinder creates automatically a digital elevation model (DEM) for the project area. This DEM can be used to automatically detect terrain features like ridges and hilltops.

This geoprocess calculates the main ridge lines and hilltops, using some parameters set by the user:

- *Minimum ridge length*: minimum length of ridges in meters. This parameter is used to avoid generating ridges that are too small.
- *Minimum distance between hilltops*: similarly, we want to avoid hilltops that are too close, so we can specify a minimum distance in meters.
- *Hilltop cluster threshold*: with this parameter we can ignore groups of nearby hilltops.

As with other geoprocesses, getting the right results might take some trial and error.

## Geoprocessing Tools

GEOPROCESS
RESULTS

Select Geoprocess
Hilltops and Ridges from DEM ▼
MORE

**Select DEM**

[project] DEM ▼

Digital Elevation Model

**Select MINIMUM\_RIDGE\_POLYGON\_LENGTH**

2000

Minimum ridge line polygon length in srid units

**Select MINIMUM\_DISTANCE\_INTER\_HILLTOPS**

1000

Minimum distance separating hilltops

**Select CLUSTERS\_THRESHOLD**

2

Number of clusters to ignore to filter out hilltops

As a result, we obtain separate layers with the ridge lines and hilltop points, which we can download or add as a layer to the project:





Once these results are added to the project, we can use buffered rings and resistance values to avoid ridges and hilltops in the routing.

## Ridges (geomorphon)

This geoprocess follows a different approach, using [an image processing technique](#) to calculate the ridge lines.

These are the input options:

### Geoprocessing Tools

GEOPROCESS RESULTS

Select Geoprocess Ridges (geomorphon) MORE

Select DEM\_LAYER [project] DEM Layer with Digital elevation model

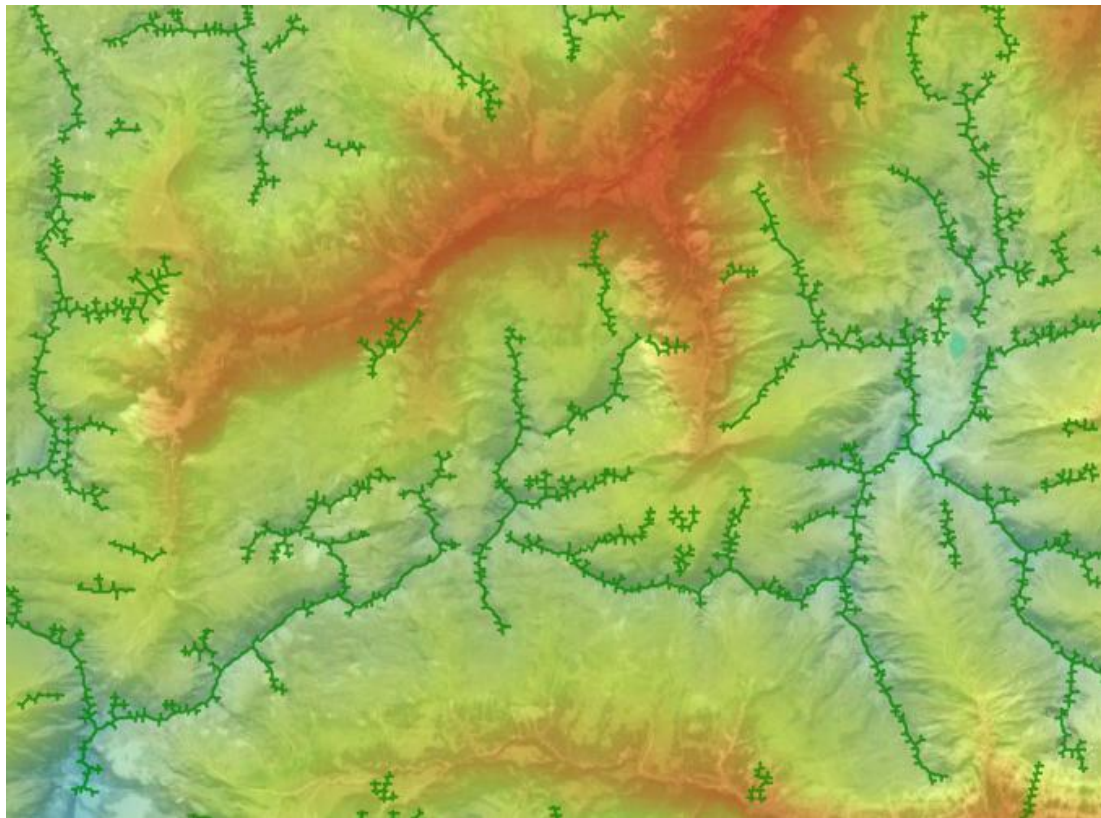
Select SEARCH\_RADIUS 3 Search radius input for geomorphon (in meters)

Select FLATNESS\_THRESHOLD 5 Flatens threshold (in degrees).

Select AREA\_THRESHOLD 5 Ridges area size threshold (in hectares).

Select ALTITUDE\_THRESHOLD 300 Minimum ridge height (in meters)

These are the ridge lines (green) seen on the terrain:



## Clusterize Layer

This geoprocess can be used to group together elements into larger shapes, for instance, to find building groups representing populated areas.

The geoprocess has some parameters to specify the amount of objects to include in each group and the maximum separation distance in a group.

### Geoprocessing Tools



**GEOPROCESS**

RESULTS

Select Geoprocess

Clusterize Layer



MORE

Select **INPUT\_LAYER**

[layer orig.] GKAT 1040 Gebäude mit tei... ▾

Layer to clusterize

Select **MIN\_TO\_CLUSTER**

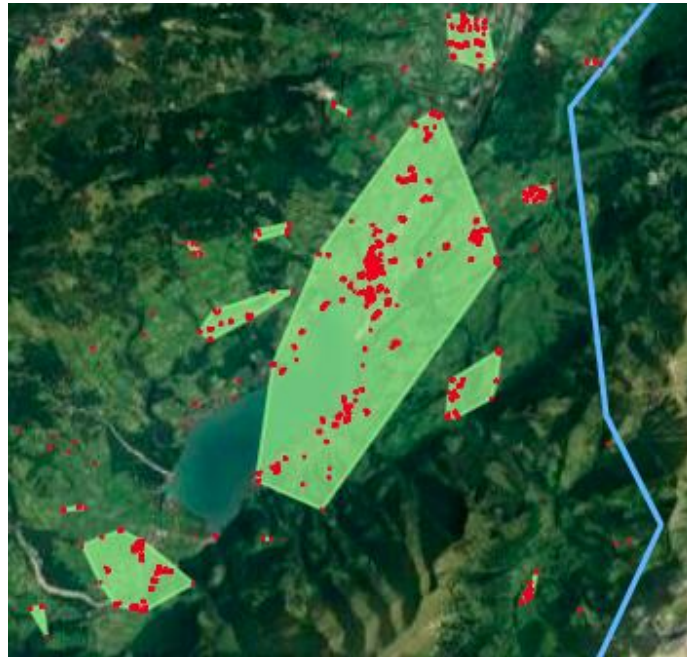
3

Minimum number of points to create a cluster. Should be higher than 3.

Select **DISTANCE**

0

Maximum distance to neighbours. 0 for estimate.



## Pipeline optimization

This is a complex geoprocess that optimizes the design of an oil, gas or hydrogen pipeline given design constraints and costs, including pipe elements and pumping or pressure reduction stations, given a path calculated or imported into Pathfinder.

This geoprocess implements the methodology described in [this article](#).

## Geoprocessing Tools

GEOPROCESS	RESULTS
Select Geoprocess	Pipeline Optimization
<b>Select OPTIMAL_PATH</b>	
[PATH] Basic (A)	
Path to calculate viewshed from each of its points	
Fluid properties	
Monetary costs	
Pipeline characteristics	
Pipeline sizes	
Pumps parameters	
Solver parameters	

It generates multiple outputs, including the geographical location of the stations, the pressure variation and the total cost.

## Running Geoprocesses

### Output

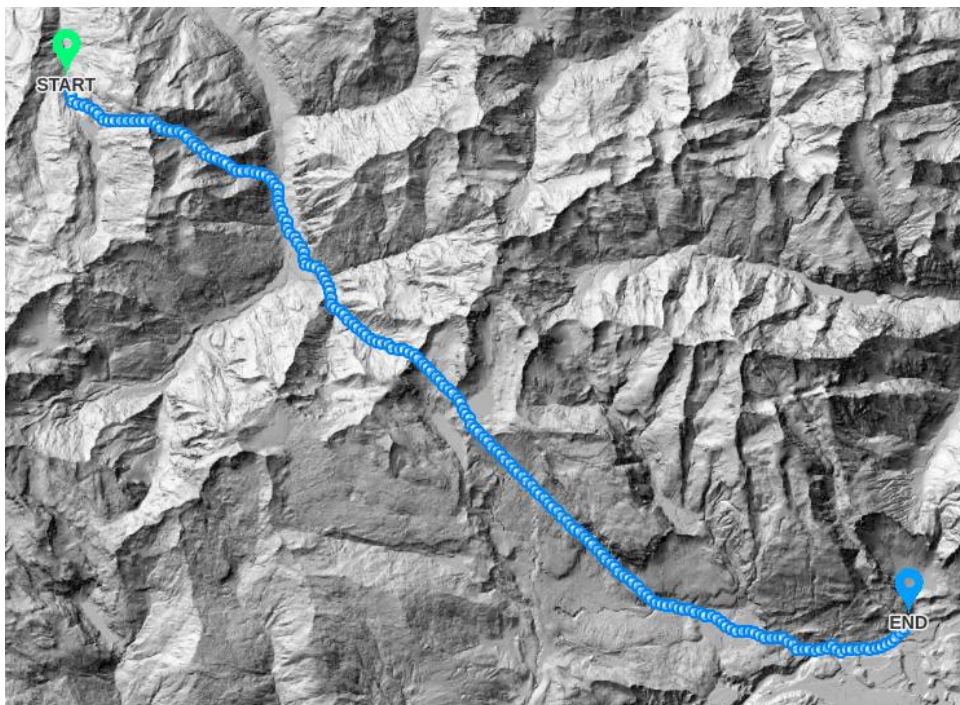
Name	Description	Type
PUMP_STATIONS	Location of the pump stations	vector
PRESSURE_REDUCTION_STATIONS	Location of the pressure reduction stations	vector
PRESSURE_TABLE	Calculated pressure at each node of the pipeline	tabular data
SIZES_TABLE	Optimal sizes for each node of the pipeline	tabular data
PIPELINE_COST	Resulting cost	floating point (number)

Among its parameters, different pipe section sizes and costs can be specified. For instance, if two types of pipe sections are available, its specification looks like this:

Pipeline sizes ^

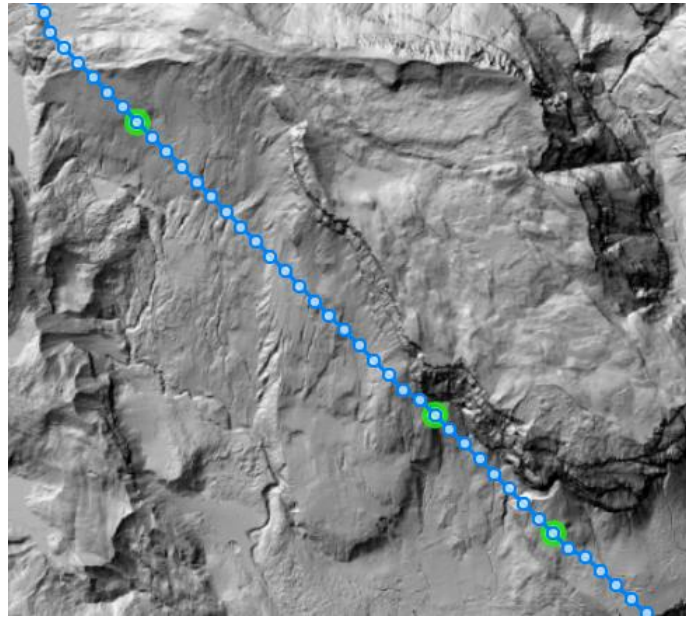
<b>Select PIPELINE_SIZES</b> 400; 250 <small>Diameters, separated by semicolons, of each available pipeline, in mm.</small>	<b>Select DESIGN_PRESSURES</b> 1000; 800 <small>Design pressures, separated by semicolons, of each available pipeline, in meters.</small>
<b>Select PRICES</b> 400; 310 <small>Prices, separated by semicolons, of each available pipeline, in currency unit/1000 meters.</small>	

Let's take, for instance, this path calculated in Pathfinder:



As part of the result, we get the location of the stations, which can be added as layers in Pathfinder:





This geoprocess requires expert knowledge. For more information about using it, check with Gilytics.

## Geoprocessing Results

After the geoprocess is completed, open again the Geoprocessing dialog and switch to the “Results” tab of the Geoprocessing Tools dialog to access the output data.

The results will still be available in this dialog if you reopen the project later on.

### Geoprocessing Tools

✕

GEOPROCESS
RESULTS

SuitabilityClasses 2023-09-04 13:34:04

CLASS_1 100-233	<input type="button" value="SHOW ON MAP"/>	<input type="button" value="TO LAYER"/>	<input type="button" value="DOWNLOAD"/>
CLASS_2 233-367	<input type="button" value="SHOW ON MAP"/>	<input type="button" value="TO LAYER"/>	<input type="button" value="DOWNLOAD"/>

Depending on the geoprocess, different types of output may be available:

- **Table output:** it can be saved to local disk by clicking on the “Download” button

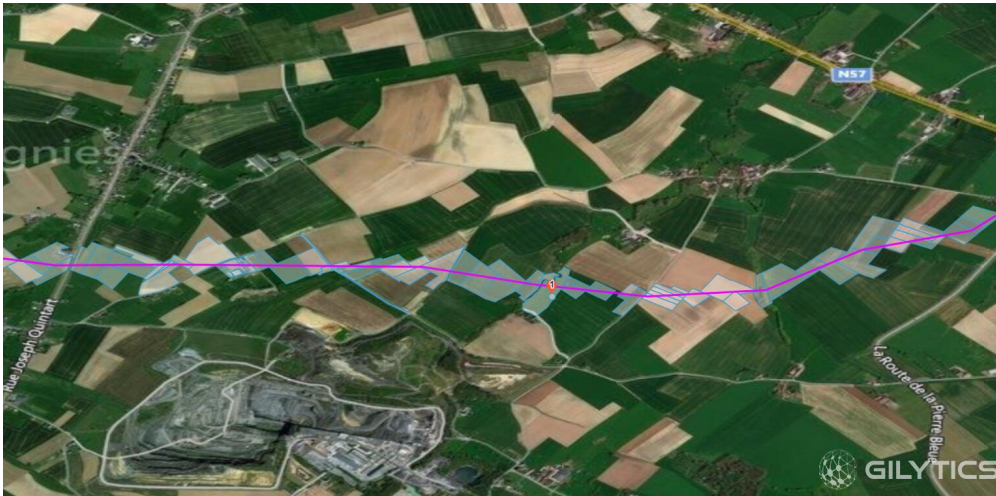
For instance, in the case of the “Intersect Layer” geoprocess, the table contains the list of features intersected by the path, with their geometries:

	A	B	C	D
1	cat	fid	wkt	
2	1	110	POLYGON	((6.9497913 45.7901691, 6.9497538 45.7902027, 6.9494694
3	1	111	POLYGON	((6.9501185 45.7899895, 6.9500166 45.7901018, 6.9497913
4	1	108	POLYGON	((6.9494641 45.7890095, 6.9497269 45.7892265, 6.9499415
5	1	56	POLYGON	((6.9598952 45.7881304, 6.9601983 45.7880818, 6.9606999
6	1	173	POLYGON	((6.9825199 45.7552339, 6.9835392 45.7560752, 6.9841058
7	1	175	POLYGON	((6.9583315 45.7947211, 6.9586801 45.7946052, 6.9587928
8	1	116	POLYGON	((6.94658415959193 45.7884378014736, 6.9472071389772,
9	1	107	POLYGON	((6.9556278 45.7886953, 6.9558102 45.7885868, 6.9561535
10	1	148	POLYGON	((6.94747464514546 45.7862530744839, 6.9504930443630,

- **Vector output:** geoprocesses also generate spatial data in the form of points, lines or polygons. This output can be:

- *Downloaded* in a GIS-compatible format (GeoJSON, GeoPackage).
- *Displayed* on the map by clicking on the “Show on Map” button. Notice that in this case the results do not appear as an item in the Layers panel, but they will be visible on the Map view.

For instance, in the case of the “Intersect Layer” geoprocess, we can see on the Map the intersected objects:

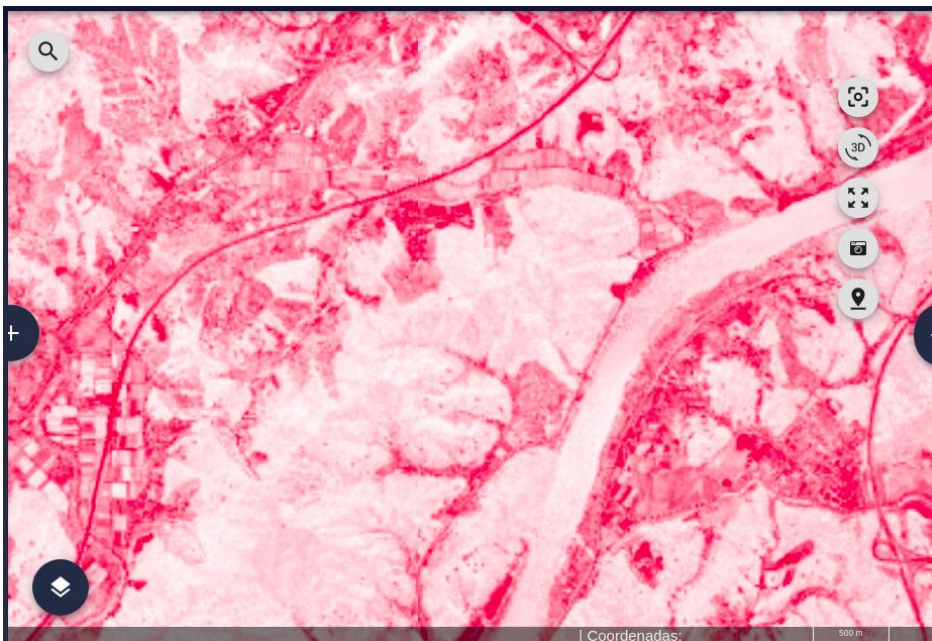


Click again on the “Show on Map” button to hide the results.

- *Added as a layer* by clicking on the “To Layer” button. In this case the resulting data will be added to the project under a “Geoprocess Results” group, and they can be used in the scenarios as any other layer.
- *Raster output*: it can also be:
  - *Downloaded* as a TIF file to be used in a GIS or CAD software.
  - *Added as a raster layer* to the project. For instance, in the case of the viewshed geoprocesses we described earlier, they would appear as a new layer:



After switching the visualization on, these layers are displayed on the view:



- *Number output*: when the result is a single number. In this case, the value is printed directly in the results dialog:

## Geoprocessing Tools ×

GEOPROCESS	RESULTS
Capex2023-09-04 13:39:10	
COST_TABLE	<a href="#">DOWNLOAD</a>
COST	41370

### Note

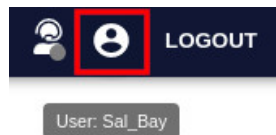
The last hundred geoprocessing results are kept for each user and they should be available in this tab. If they need to be preserved, it is recommended to download the result files or add them as layers in the project to make sure they are not eventually deleted.

*Disclaimer:* the scenarios depicted in this manual do not represent actual customer projects or infrastructure proposals, and are presented for demonstration purposes only.

For more help, please use the help chat in the application, or [contact Gilytics](#).

## User Profile and Assets

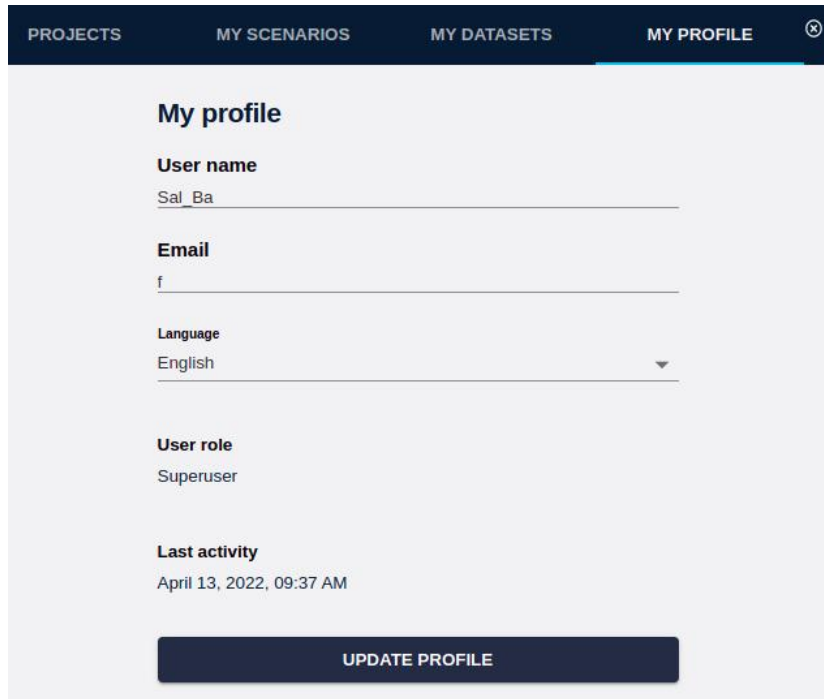
Users can access their profile information and data assets in the Account section. To do so, click on the user icon at the top bar:



### Profile

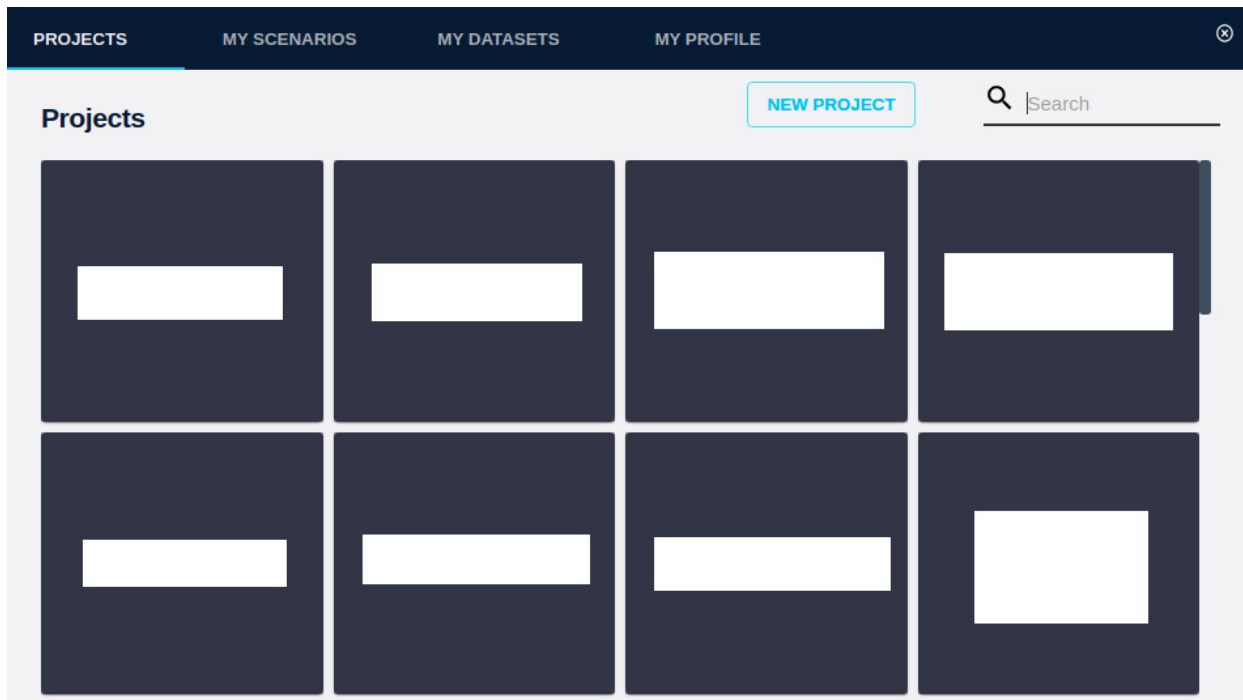
By default, the Profile tab will be selected, showing the user account data.

- *Account name* and *email*: they can only be changed in the administration page.
- *Language*: English, Spanish and German languages are available for the user interface, and the first two for the user manual. The language option can be changed in this tab.
- *User role*: the type of user can only be changed in the administration page.
- *Last activity*: shows the date of the last user login.



## Projects

In the same page, users can select the Projects tab to see a list of projects accessible to them within their company, and open a selected one or create a new one.



In order to delete a project, it is necessary to open it first and then use the delete menu option to remove it.

## Scenarios

The Scenarios tab shows a searchable list of all the user scenarios. Remember that each user has his/her own scenarios, which are not shared with other users.



PROJECTS				MY SCENARIOS		MY DATASETS		MY PROFILE	
<b>My Scenarios</b>									
Search: tun									
Scenario ↑	Project				Download				
combi TUN	Test		CSV	Scenario results					
TUN	Combined tunnels		CSV	Scenario results					
Tunnels	Jordi Test		CSV	Scenario results					
TUN	test tunnels new		CSV	Scenario results					
TUN	Test tunnels		CSV	Scenario results					
TUN2	test tunnels new		CSV	Scenario results					
<b>Projects</b>									
Combined tunnels			Download All Project Results						
Jordi GA bug			Download All Project Results						
Jordi hybrid			Download All Project Results						
Jordi Test			Download All Project Results						

With the links on the right, the scenario description files (JSON) can be downloaded, as well as the results calculated in the scenario (Resistance Map, Corridor, Paths).

The same page shows the list of project with links to download the full set of scenario results.

## Shared Datasets

The *My Datasets* tab shows the list of current private shared datasets available in your organization, which can be used to create project layers. The panel offers this information:

- Which *projects* use this dataset? (So, if the dataset is not used any more, it can be deleted).
- What is the *upload date* of the data? (If the data is old, it may require a new update).
- What is the *number of features* in the dataset? (For vector data)

GILYTICS									
PROJECT		TOOLS		HELP		LOGOUT			
PROJECTS									
MY SCENARIOS									
MY DATASETS									
MY PROFILE									
IMPORT DATASETS									
Search									
Dataset ↑	Projects		Upload date	Type	Features	Delete			
HILLTOPS_1645708793			07/04/2022, 03:48 PM	File (Vector)	1128	Delete			
HILLTOPS_1646847515	Lorena Test4		07/04/2022, 03:48 PM	File (Vector)	35	Delete			
HILLTOPS_1648809184			07/04/2022, 03:48 PM	File (Vector)	99	Delete			
HILLTOPS_1652355869	Switzerland tunnels		07/04/2022, 03:48 PM	File (Vector)	64	Delete			
HILLTOPS_1652874941	Switzerland tunnels		07/04/2022, 03:48 PM	File (Vector)	154	Delete			
HILLTOPS_1654167433	Lorena Test 9		07/04/2022, 03:48 PM	File (Vector)	66	Delete			
HILLTOPS_1657877994	Lorena Test 10 Lorena Test 10		07/15/2022, 09:40 AM	File (Vector)	32	Delete			
hi_presa_I_ES080			07/04/2022, 03:48 PM	File (Vector)	891	Delete			
hi_presa_s_ES080			07/04/2022, 03:48 PM	File (Vector)	110	Delete			
hi_rednodo_p_ES080			07/04/2022, 03:48 PM	File (Vector)	67773	Delete			

To add more datasets, click on *Import Datasets*.



It is also possible to remove them by using the trash icon in each row.

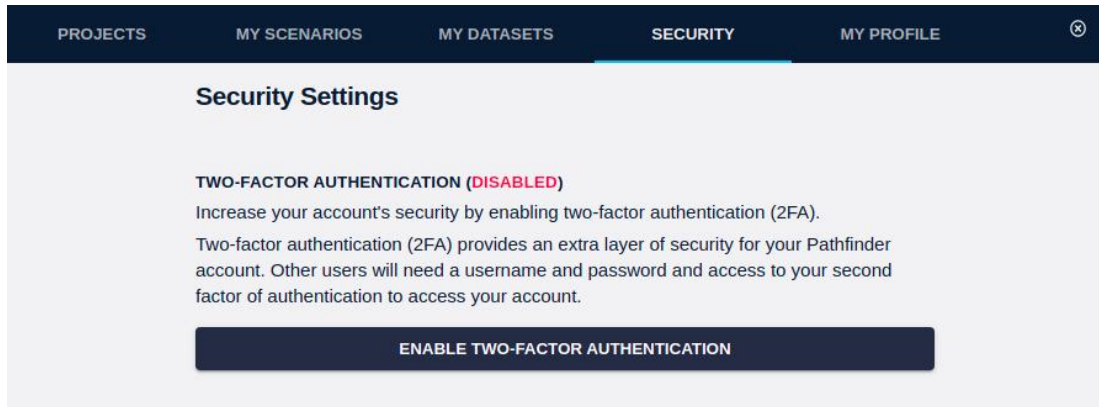
## Note

*Be careful when deleting shared datasets, because these data can not be recovered later and, in addition, maybe some layers use them from different projects, even from other users.*

## Two Factor Authentication

To improve access control, individual users can now activate a Two Factor Authentication login process, which will add an additional verification step with a registered mobile device.


You can find this new option in the *Security* tab of your User Profile.



When clicking on the Enable TFA button, the page will show a form with a QR code. Authenticator apps in your mobile device (like Google Authenticator, Microsoft Authenticator, etc. You need to install one if you don't already have it) can register Pathfinder by scanning this code.

PROJECTS MY SCENARIOS MY DATASETS SECURITY MY PROFILE

### Security Settings



#### Register Two-Factor Authenticator

Use a one-time password authenticator app on your mobile device or computer to enable two-factor authentication (2FA).

We recommend using cloud-based authenticator applications that can restore access if you lose your hardware device.

Can't scan the code? To add the entry manually, provide the following details to the application on your phone:

*Issuer:* **GilyticsPathfinder**

*Account:* **Sal\_Bay**

*Key:* [REDACTED]

*Time based:* **Yes** | *Algorithm:* **SHA1** | *Period:* **30** | *Digits:* **6**

#### Final step

To finish the enrollment process, please enter the pin from your app in the field below and click the button to proceed with the device registration

Your Password  
[REDACTED]

Verification Pin  
[REDACTED]

**REGISTER TWO-FACTOR APP**

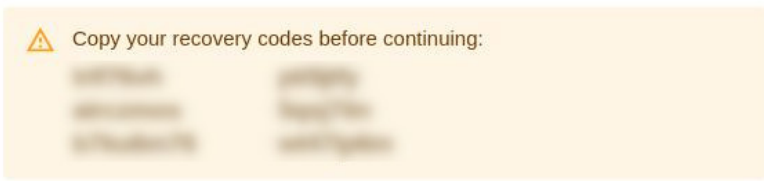
The authenticator app will then provide a 6-digit code that you should enter in the “Verification PIN” input box to complete the activation by clicking on the Register Two-Factor App button.

**Don't forget** to save in a secure place (like a password manager) your recovery codes, which will be needed in case you need to recover access.

### Two-factor recovery codes

If you lose access to your two-factor authentication credentials, you can use your recovery codes, to regain access to your account.

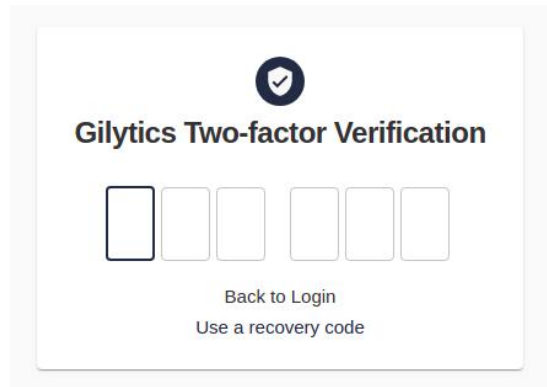
⚠ Copy your recovery codes before continuing:



Treat your recovery codes with the same level of attention as you would do with your password.

**CONTINUE**

After the activation, when a user logs in, an additional step will require him/her to enter the 6-digit code generated at that time by the registered authentication app:



## Note

Two Factor Authentication (TFA) in Pathfinder is not available for Single Sign On users, since in that case authentication is done by their own company service, which may already include TFA.

---

*Disclaimer:* the scenarios depicted in this manual do not represent actual customer projects or infrastructure proposals, and are presented for demonstration purposes only.

For more help, please use the help chat in the application, or [contact Gilytics](#).

## User Management

Pathfinder provides an easily manageable set of user profiles, basically, admin/staff users and non-staff users.

## Note

Only administrator users can access the [administration site](#).

## Administration Site

Before performing any administration tasks, the admin user must **login** into the [administration site](#) with the credentials provided by Gilytics:



## User Management

After logging in, the user will see the administration index page:

### Site administration

CATALOGS	
<a href="#">PylonPrices</a>	<a href="#">+ Add</a> <a href="#">✎ Change</a>
<a href="#">SlopeMultipliers</a>	<a href="#">+ Add</a> <a href="#">✎ Change</a>

DB_REPOSITORY	
<a href="#">BaseLayers</a>	<a href="#">+ Add</a> <a href="#">✎ Change</a>
<a href="#">BaseLayers WFS</a>	<a href="#">+ Add</a> <a href="#">✎ Change</a>

MCDA	
<b>Categories</b>	
<b>Category configs</b>	
<b>Corridors</b>	
<b>Generation infos</b>	
<b>Layer configs</b>	
<a href="#">Layers</a>	<a href="#">✎ Change</a>
<a href="#">Projects</a>	<a href="#">✎ Change</a>
<a href="#">Pylons</a>	<a href="#">+ Add</a> <a href="#">✎ Change</a>
<a href="#">Scenarios</a>	<a href="#">✎ Change</a>

The *Users* section is located lower in the page:

USERS	
<a href="#">DailyUserActivities</a>	<a href="#">👁 View</a>
<a href="#">Users</a>	<a href="#">✎ Change</a>

When the admin user clicks on the [Users](#) link, the list of current users in the company is displayed:

Select user to change

🔍

Action:   0 of 28 selected

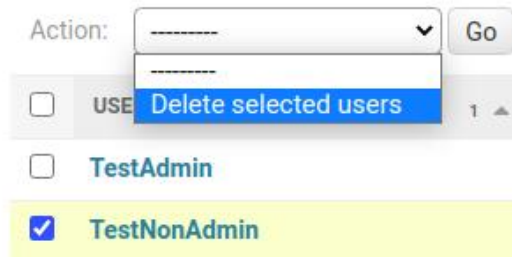
<input type="checkbox"/>	USERNAME	EMAIL ADDRESS	USER TYPE	LAST LOGIN
<input type="checkbox"/>	<a href="#">...</a>	<a href="#">...</a>	Company Administrator (Project and Scenario creator)	Sept. 7, 2021, 4:58 p.m.
<input type="checkbox"/>	<a href="#">...</a>	<a href="#">...</a>	Superuser (Reserved to Gilytics)	Dec. 13, 2021, 10:17 a.m.
<input type="checkbox"/>	<a href="#">...</a>	<a href="#">...</a>	Editor (Scenario Creator)	Jan. 20, 2021, 10:47 a.m.

The **User Type** column shows which is the user profile (SuperUser –only for Gilytics–, Administrator, Editor or Viewer).

The **Last Login** column displays the date of the last login. In this way, when we create users we can make sure later that they have actually accessed successfully the application.

## Remove Users

Users can be removed by selecting them with the left checkbox and then selecting the “Delete” action.



However, *it is recommended to deactivate the users instead of deleting them*, to avoid any problem accessing projects these users may have created.

## Edit User Options

By clicking on a user name, we can access a page to change his/her options:

Change user

**Ana\_Flasker**

**Username:**   
Required. 150 characters or fewer. Letters, digits and @/./+/-/\_ only.

**Password:** **algorithm:** pbkdf2\_sha256 **iterations:** 320000 **salt:** K3t0zO\*\*\*\*\*  
Raw passwords are not stored, so there is no way to see this user's password

**Email address:**

**Company:** DUMMY\_COMPANY

**User type:**   
Type of user

**Extra**

**Active**  
Designates whether this user should be treated as active. Unselect this instead of deleting accounts.

**Trial Account**  
Designates that this user is a trial user and should be deactivated after a trial period

Editable properties include:

- *User name*
- *Email address* for notifications
- *User type* among the defined profiles
- *Activation status*. As mentioned, it is preferable to deactivate a user rather than delete him/her.
- *Trial account*. This option is used to deactivate automatically the account after 15 days.

## Reset User Password

Users can reset their passwords when they forget them, but the admin user can also explicitly set new passwords for users, by clicking on the **password reset link**:

Password:

**algorithm:** pbkdf2\_sha256 **iterations:** 150000 **salt:** awGLKk\*\*\*\*\* **hash:**  
xxZcHv\*\*\*\*\*

Raw passwords are not stored, so there is no way to see this user's password, but you can change the password using [this form](#)

This page will be displayed to perform the password reset:

Change password: TestNonAdmin

Enter a new password for the user **TestNonAdmin**.

**Password:**

Your password can't be too similar to your other personal information.

Your password must contain at least 8 characters.

Your password can't be a commonly used password.

Your password can't be entirely numeric.

**Password (again):**

Enter the same password as before, for verification.

CHANGE PASSWORD

## Add New Users

To add new users, go to the [Users section](#) and click on the *Add User* button:

Home > Users > Users

Select user to change [ADD USER +](#)

**FILTER**

By staff status

All

A form will be displayed to fill in the User Name (which can be changed later if necessary) and the password:

Home > Users > Users > Add user

### Add user

First, enter a username and password. Then, you'll be able to edit more user options.

**Username:**   
Required. 150 characters or fewer. Letters, digits and @/./+/-/\_ only.

**Password:**

**Password (again):**

*Note that the user name must not contain spaces or punctuation characters.*

Click on “Save and continue editing”. The next page is identical to the user editing form we have seen before. After clicking on the “Save” button, the new user will be available in the company list.

## Check User Activity

Next to the Users link, the administrator can find a link to check the [daily user activity](#):

USERS	
<a href="#">DailyUserActivities</a>	<a href="#">View</a>
<a href="#">Users</a>	<a href="#">Change</a>

In this page, the admin can see the earliest and latest user activity each day.

Home > Users > DailyUserActivities

Select DailyUserActivity to view

Action:   0 of 41 selected

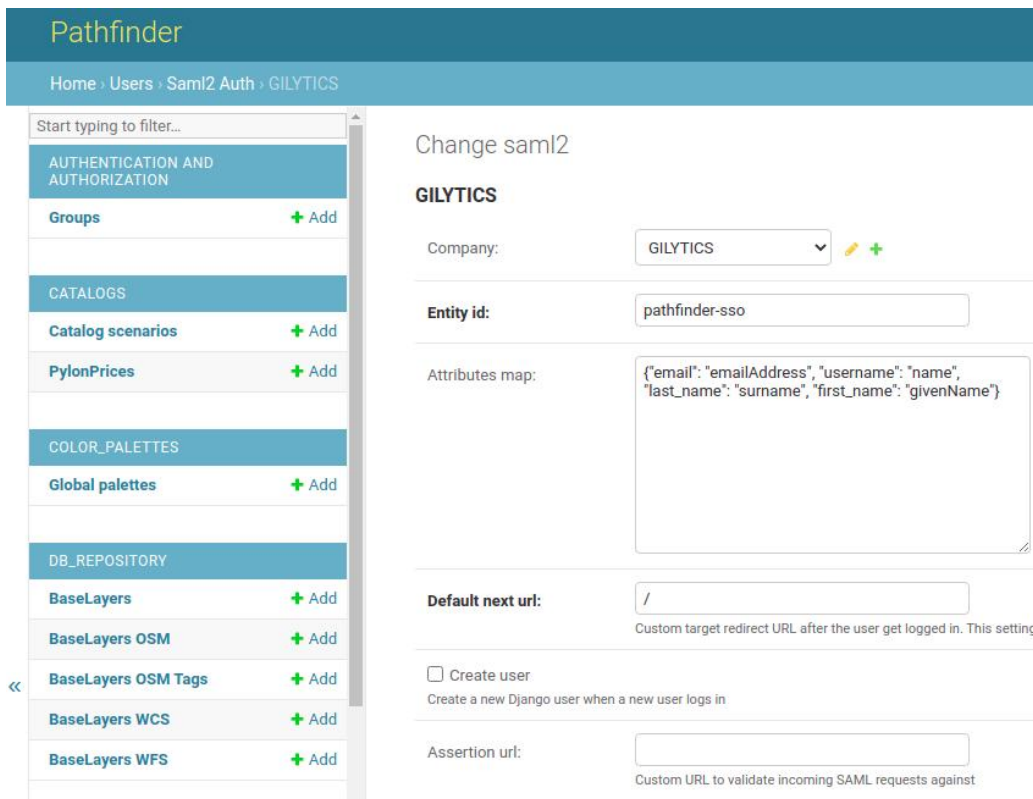
<input type="checkbox"/>	USER	DATE	FIRST ACTIVITY TIMESTAMP	LAST ACTIVITY TIMESTAMP
<input type="checkbox"/>	<a href="#">TestAdmin</a>	Feb. 5, 2021	Feb. 5, 2021, 12:19 p.m.	Feb. 5, 2021, 12:19 p.m.
<input type="checkbox"/>	<a href="#">salva</a>	Feb. 5, 2021	Feb. 5, 2021, 8:51 a.m.	Feb. 5, 2021, 12:18 p.m.
<input type="checkbox"/>	<a href="#">salva</a>	Feb. 4, 2021	Feb. 4, 2021, 10:56 a.m.	Feb. 4, 2021, 3:51 p.m.
<input type="checkbox"/>	<a href="#">salva</a>	Feb. 3, 2021	Feb. 3, 2021, 8:47 a.m.	Feb. 3, 2021, 3:55 p.m.

## Single Sign-On

Authentication using :doc: [SAML 2.0 <https://en.wikipedia.org/wiki/SAML\\_2.0>](https://en.wikipedia.org/wiki/SAML_2.0) is now supported in Pathfinder. This enables users to enter Pathfinder through their company’s login.

This feature, as well as the integration of Pathfinder activity log into another company’s own event management system, can be provided upon request by Gilytics if there is a compatible service available.





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For more help, please use the help chat in the application, or [contact Gilytics](#).

## Setting Advanced Options

### Note

This section does not apply to users who are not administrators/staff. The functions described in this section are only accessible to administrators/staff.

To access the advanced options setup, the administrator users must login to the [administration site](#).

## Manage Company Data

In general, it is advisable to let users manage the projects, data, layers, etc. from the Pathfinder application. However, in some cases, if access is somehow impossible, the administrator can directly access the corresponding data objects.

In some cases, direct access to project and data properties is required to set some advanced options.

The MCDA (MultiCriteria Decision Analysis) section of the admin page contains links to manage the data objects (disabled links are only accessible to Gilytics staff):

MCDA	
Categories	
Category configs	
Corridors	
Generation infos	
Layer configs	
Layers	Change
Projects	Change
Pylons	Add  Change
Scenarios	Change

## Projects

Go to the [Projects](#) link to see the list of projects created by members of the company.

In this page, the administrator can see who is the *owner* of each project, and how many *scenarios* have been created within it (maybe by different users).

It is also possible to remove projects by selecting them with the checkbox and using the action “Delete selected Projects”:

Home > Mcda > Projects



Select Project to change

Action:   1 of 8 selected

<input type="checkbox"/>		OWNER	SCENARIO COUNT
<input type="checkbox"/>	<b>test warning 2</b>	salva	1
<input checked="" type="checkbox"/>	<b>test warning</b>	salva	1
<input type="checkbox"/>	<b>test coste</b>	salva	2

By clicking on the project name we can access a page showing some of its properties, like the area and start/end points:

### Change Project

Owner:   


---

Name:

---

Status:

---

Area: 

Some properties which may be useful to change are:

- The project *owner*. This user (or users) has full permissions to modify the project or remove it. The administrator can change who is the owner or add multiple owners.
- The project *name*.
- The project *thumbnail*, the small preview image that will be displayed in the Pathfinder project list page.

Thumbnail:  thumb.png

Click on the “Choose File” button and browse for an appropriate image in your local disk, which you may have captured from the Pathfinder view. *Note that the size of the thumbnail image can not be larger than 512x512 pixels.*

When Gilytics activates for your company the *per-project authorization mode*, administrators can select here **which users have access to it**:

Per project permissions:

- Alberto
- Sal\_Bay\_viewer
- Ramon
- RamonCardena2021
- Elena\_R



When this project company's permission mode is per project, this field selects the users that can view and edit this project

Don't forget to click on “Save” to keep the changes.

### Note

*Do not remove or change properties like the project area or project points. Doing so may result in the project corruption.*

## Base Layers

*Base Layers* is the internal name for the base datasets which users can add to the company's shared database.

*WFS Base Layers* are base layers added from a Web Feature Service, from which data is accessed remotely, not actually stored in the DB.

The configuration of base layers is accessible from the [DB\\_Repository](#) section of the admin page:

The [Base Layers](#) link opens a page listing all the uploaded datasets with their feature counts and owners:

<input type="checkbox"/>	NAME	FEATURE COUNT	OWNER	COMPANY
<input type="checkbox"/>	Construccion_P	1346694	salva	GILYTICS
<input type="checkbox"/>	Suscept_Incendios_Muy_Alta	160	salva	GILYTICS
<input type="checkbox"/>	construction_clip	17498	salva	GILYTICS
<input type="checkbox"/>	orientation	163	salva	GILYTICS

As with other objects, we can select them and use the Delete action to remove them. However, *this removal must be done carefully, because projects using removed base layers will fail to process layers created from them, for instance, if ring widths are changed.*

Some **WFS services** do not support standard features correctly and they need some special configuration.

To help with one of the most common issues, a checkbox has been added to disable the spatial filter in the base layer WFS configuration if the server fails to return any features for a specific layer.

Please try to disable this option if you find this kind of problem, or contact Gilytics for support.

```

{"GDAL": {}, "URLPARAMS": {"SERVICE": "WFS",
"request": "GetFeature", "version": "2.0.0",
"typeNames": "bfm_sch_Schutzgebiet:Naturparke"}}
    
```

Advanced options for a WFS, split in two sets  
 \* GDAL -> for options to set as GDALCONFIG options  
 \* URLPARAMS -> for extra URL parameters to pass to the url

Spatial filter enabled  
 Disable the Spatial Filter. Some servers do not support it



## Layers for each base layer

Administrators can now easily see which layers are using each base dataset and access their properties:

Select BaseLayer to view

Q  Search

Action:  Go 0 of 25 selected

<input type="checkbox"/>	ID	NAME	FEATURE COUNT	OWNER	COMPANY	NUMBER OF LAYERS
<input type="checkbox"/>	1265	VIEWSHED_RASTER_1649774816	-	Lorena	GILYTICS	2
<input type="checkbox"/>	1267	VIEWSHED_RASTER_1649775102	-	Lorena	GILYTICS	2
<input type="checkbox"/>	1307	VIEWSHED_RASTER_1650375970	-	Lorena	GILYTICS	0

Select Layer to change

Q  Search 2 results (1587 total)

Action:  Go 0 of 2 selected

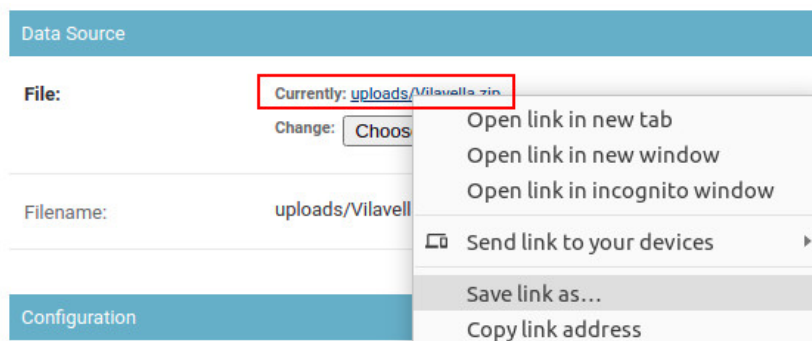
<input type="checkbox"/>	ID	LTYPE	NAME	PROJECT
<input type="checkbox"/>	2722	Raster	VISUAL_IMPACT_RASTER_1657877908	Lorena Test 10
<input type="checkbox"/>	2617	Raster	VISUAL_IMPACT_RASTER_1657877908	_Lorena_Test 10_

2 Layers

## Download data source

An important addition in the base layer management is the possibility to download the original data used to create it, both for vector as well as raster datasets.

This option lets company administrators access and recover the data from Pathfinder in case the original has been lost.



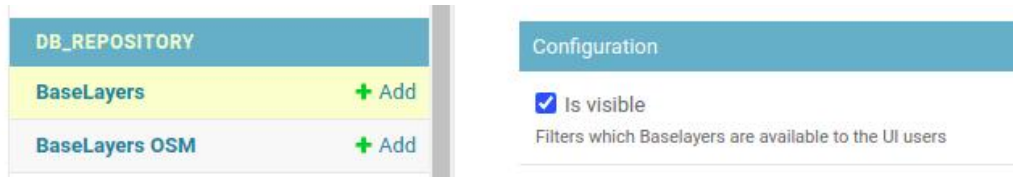
To download the data of a specific project, it is more convenient to use the layer download feature in Pathfinder.

## Invisible base layers

Base layers also have now a flag that can be set to hide them from users. This is used by Pathfinder to make invisible “internal data” like the DEM and Slope maps generated automatically for each project, but it can also be used by company admins.

## Setting Advanced Options

Invisible base layers will still work in existing projects using them, but users won't be able to add them as layers into new projects.



## WFS sources

The [Base Layers WFS](#) link opens a similar page listing the WFS-based base layers. The same limitations and recommendations apply to the management of this type of base layers.

This is how a typical WFS configuration looks like:

### Change BaseLayer WFS

**Name:**

**Url:**

**Layer name:**

**Advanced ops:**

```
{"GDAL": {}, "URLPARAMS": {}}
```

Advanced options for a WFS, split in two sets  
\* GDAL -> for options to set as GDALCONFIG options  
\* URLPARAMS -> for extra URL parameters to pass to the url

## Note

*Usually, it is not advisable to modify Base Layer properties. Both base datasets and base WFS data connections can be added from the Pathfinder user interface.*

## Layers

In the [Layers](#) link, the administrator can see the list of layers added to any of the company's projects. In addition to the layer type and name, the category is shown.

## Setting Advanced Options

ID	LTYPE	NAME	CATEGORY
929	Vector	ch.swisstopo.swissnames3d_feature_poly	Base Data (Swiss beauty)
1708	Vector	geonode:swissTLM3D_TLM_GEBAEUDE_FOOTPRINT	General (Salva test Suiza FB)
919	Vector	osm_Swiss_forests	Base Data (Swiss beauty)
920	Vector	osm_Swiss_industrial	Base Data (Swiss beauty)
922	Vector	osm_Swiss_meadows	Base Data (Swiss beauty)
923	Vector	osm_Swiss_natural	Base Data (Swiss beauty)
921	Vector	osm_Swiss_residential	Base Data (Swiss beauty)
1916	Raster	swiss-beauty_76_dem	terrain (Swiss beauty)
1917	Raster	swiss-beauty_76_slope	terrain (Swiss beauty)

Each layer has its own information page, showing the type, the base layer it has been created from, as well as its ring configuration and its filter in the case of vector data.

Change Layer

Category: Base Data (Swiss beauty)

Name: ch.swisstopo.swissnames3d

Ltype: Vector

Baselayer ref.: BaselayerWFS - ch.swisstopo.swissnames3d\_feature\_poly

Buffer settings: {"ring\_widths": [1], "resistance\_factors": [100]}

Baselayer filter:

To filter baselayers by attribute

Errors: -

As mentioned regarding base layers, *it is not advisable to modify these properties in the admin pages. These pages should be used mostly to access information, and only in exceptional cases to modify the configuration with advice from Gilytics technical support staff.*

## Scenarios

The [Scenarios](#) link provides access to the list of all scenarios defined in the company, indicating the project and user who owns each one. Remember that different users will have different scenarios defined in the same project.

Home · Mcda · Scenarios

Select Scenario to change

Action:

0 of 12 selected

<input type="checkbox"/>	NAME	PROJECT	OWNER
<input type="checkbox"/>	Scenario 1	test war3	salva
<input type="checkbox"/>	Scenario 1	test warning 2	salva
<input type="checkbox"/>	Scenario 1	test warning	salva

Scenarios can be deleted here, if for some reason it is not possible to remove them from the Pathfinder application. By clicking on each scenario's name, the administrator can access its settings, the same fields shown in the Pathfinder scenario settings user interface in the Right Panel. This admin page can be used as an alternative way to edit these settings, but it is recommended to do so from the user interface, so that any side effect of these changes is handled properly.

**Settings**

**Resistance alpha:**   
Opacity of the image

**Corridor alpha:**   
Opacity of the image

**Heatmap alpha:**   
Opacity of the heatmap

---

**SCENARIO CONFIGS**

Scenario config: Scenario 1

Category values setting:

**Layer min resistance:**

**Layer max resistance:**



**Layer weight values:**

Layer weight enabled

**Threshold multiplier:**

**Pylon min m:**   
Minimum accepted distance between pylons

**Pylon max m:**   
Maximum accepted distance between pylons

**Pylon:**     
The pylon to use for this project

**Path price per km:**

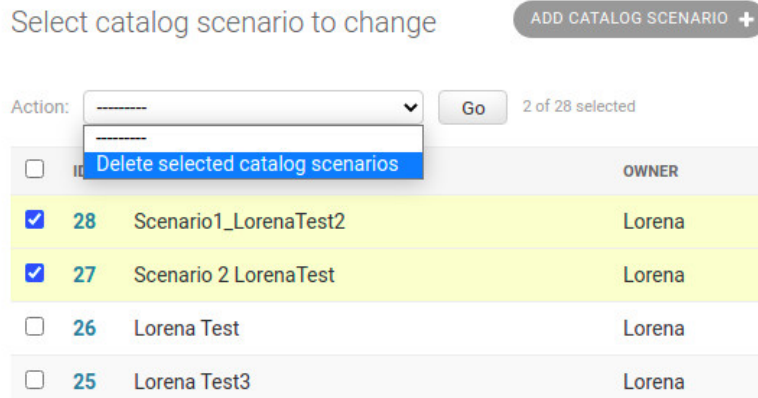


## Scenario Catalog

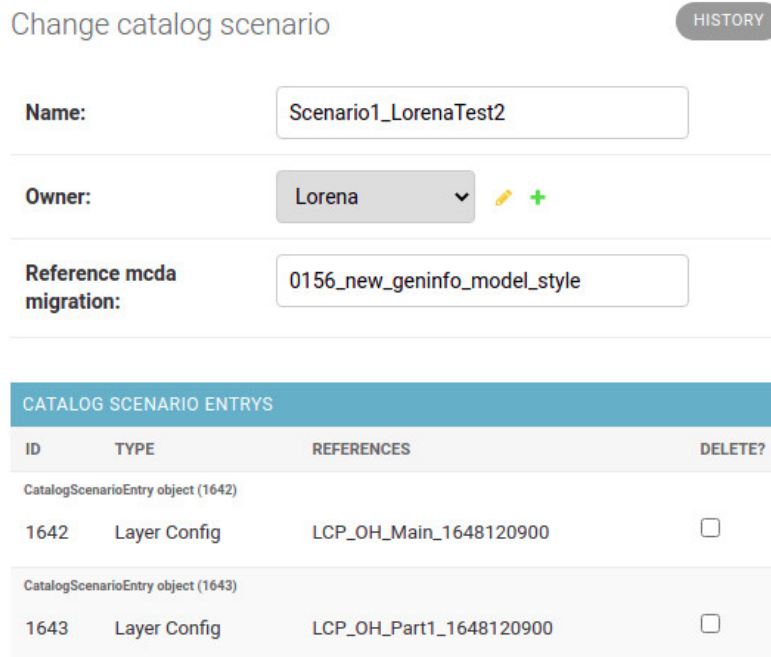
Users can save scenario configurations in the scenario catalog. Currently, the Pathfinder application does not include UI components to modify or remove the entries in this catalog, but this can be done in the administration pages.



In this section, we'll see the list of all scenarios saved in our company catalog. We can select and remove those we don't need any more.



In addition, we can select a specific catalog entry and check the list of layer configurations stored in it. We can also remove individual layer configurations from the catalog entry:



## Pylons

The [Pylons](#) link provides access to the list of all pylon models available to use in the company scenarios.

Home › Mcda › Pylons

Select pylon to change

Action:   0 of 7 selected

- PYLON
- Underground
- T-Pylon-conductors
- T-Pylon
- Double T, MV, steel tube
- Triple T, HV, lattice tower
- cat LayerDouble T, HV, lattice tower
- Single T, MV, steel tube

7 pylons

Here, the properties of default pylons are visible, but can not be changed.

Home › Mcda › Pylons › Double T, MV, steel tube

View pylon HISTORY

Name:	Double T, MV, steel tube
Thumbnail:	<a href="#">mcda_thumbnails/towerFour.png</a>
Model 3d:	<a href="#">mcda_3d/towerFour.glb</a>
Model json:	
Metadata:	<pre>{'volt': '10 KVA', 'lines': [[23.62, 3.6], [27.0, 2.8], [23.62, -3.6], [27.0, -2.8]], 'wires': 4, 'height': 28, 'sag_arc_radius': 4000, 'minimum_distance_to_ground': 15}</pre> <p>JSON with the pylon metadata</p>
Owner:	-

But the company admin can add custom pylons with the “Add Pylon” button.

Home › Mcda › Pylons › Add pylon

### Add pylon

**Name:**

---

**Thumbnail:**  No file chosen

---

**Model 3d:**  No file chosen

---

**Model json:**  No file chosen

---

**Metadata:**

```
{'volt': '10 KVA', 'lines': [[38.7, 12.0], [28.84, 8.4],
[28.84, 15.15], [38.7, -12.0], [28.84, -8.4], [28.84,
-15.15]], 'wires': 6, 'height': 40, 'sag_arc_radius':
4000, 'minimum_distance_to_ground': 15}
```

JSON with the pylon metadata

In this page, these properties must be specified:

- Name of the new pylon, as it will be shown in Pathfinder
- Thumbnail image to be displayed in Pathfinder, no larger than 512x512 pixels
- Model 3D file in [glTF/glb format](#)
- Model JSON. Only needed for Augmented Reality applications
- Metadata. This is a JSON object containing some required properties
  - `volt`: voltage information to be displayed
  - `lines`: height and lateral position coordinates for all cables in meters from the center of the model's base
  - `wires`: number of cables
  - `height`: pylon height to be displayed (the real world size of the model will be given by the 3D model file, which must use meter units)
  - `sag_arc_radius`: radius of the cable curve
  - `minimum_distance_to_ground`: in meters, for clash detection

If you need help creating custom pylons, let us know.

---

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For more help, please use the help chat in the application, or [contact Gilytics](#).

## Use Cases

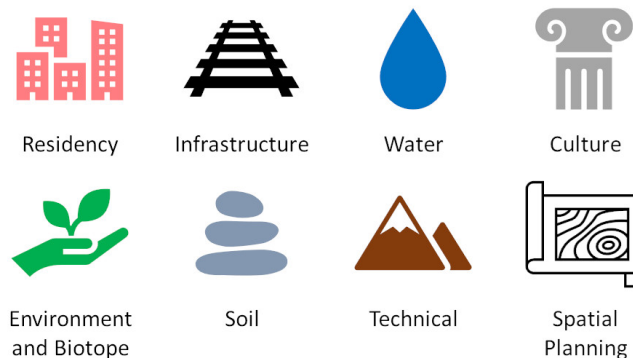
In previous sections it was explained how to create a new project and set up its initial configuration.

For more information, please check [Pathfinder projects](#) and [Adding Data](#).

Every project created may vary according to the following **factors**:

1. The client segment: a distribution system operator (**DSO**), a Transmission System Operator (**TSO**), energy companies, utilities, etc.
2. The linear infrastructure type: **overhead lines**, **underground cables**, or a combination of these two, called **hybrid planning**, tunneling, etc.

And for each type of project, GIS data must be collected and classified under the following **categories**, for instance:



In the following sections, some use cases representative of real situations are presented, using different combinations of client and infrastructure types, specific types of data required for each project, resistance value settings to define planning rules, as well as the restrictions and settings of each scenario.

### Transmission System Operator: High Voltage Overhead Line (HV-OH)

A TSO is in general a public company in charge of managing and monitoring the transmission of electricity from large generation plants over the high voltage grid to regional or local electricity distribution operators. In these large-scale infrastructure projects, usually overhead lines are the main technology used and the route lengths can be up to hundreds of kilometres.

To plan and design new routes, engineers and planners must consider multiple land features which have an impact on the routing process depending on their suitability of being crossed by infrastructure. These elements are represented by spatial data, or geodata, to which resistance values are assigned.

Below some land features typically considered in a project for an OH line project of a TSO: the classification of “high”, “mid” and “low” correspond typically to the resistance of those elements to be crossed by HV power lines or, conversely, the impact that HV power lines have on such elements.

HIGH	MID	LOW
<ul style="list-style-type: none"> <li>Urban areas and residential</li> <li>Territory and environment</li> <li>Heritage</li> </ul>	<ul style="list-style-type: none"> <li>Forestry and rivers</li> <li>Railroads</li> <li>Geography Risks</li> </ul>	<ul style="list-style-type: none"> <li>Mobility and Transport</li> <li>Renewable Energies</li> <li>Agriculture</li> </ul>

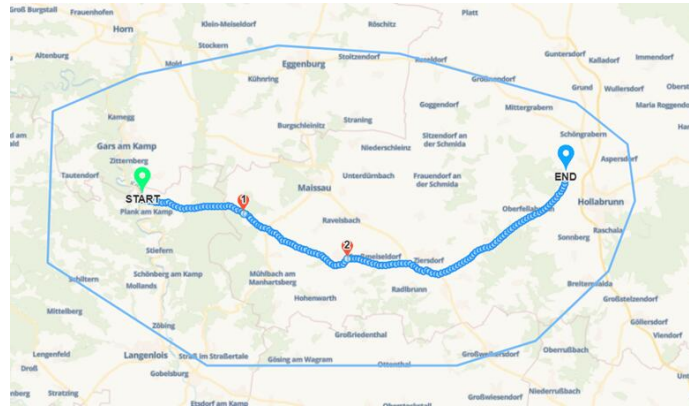
- It is forbidden to build powerlines close to urban areas, settlements or heritage areas, as the impact of constructing towers near those areas will be high. Therefore, a high resistance value is applied to these elements.
- On the other hand, large linear infrastructure that can be included in Mobility and Transport (e.g. highways, railways) can be used to bundle power lines with existing infrastructure, so the resistance values of these layers will be lower or set in a way that the algorithm interprets them as preferred corridors to exploit.

### High Voltage Overhead line project (HV-OH): scenario settings

#### Project Area

In Pathfinder, users can define the project area, the spatial resolution of the raster used to discretize it, the start and end points of the route. The points can be changed in each scenario if users wish to try different alternative start and end points. For more detail, check the section Project area, resolution and points.

It is possible to add Intermediate Points to force a route to go through certain relevant locations. In HV OH lines projects, intermediate points are usually used to spot substations that must be crossed or any other mandatory crossing point.



## Planning principals

**a) Project Data:** Once the project area is set up, spatial data layers need to be added, assigned to different categories and classified as mentioned above. Also read more here: Base Datasets and Project Layers. The table below shows examples of spatial layers used in HV-OH projects and their typical categories.

Category	Layer Name
Residential/Urban Areas	Residential areas
	Industry and commercial
	Leisure and recreation
Infrastructure	Highways
	Substations
	Airports
Water	Small Rivers
	Lakes
	Flood risk

## b) Layer Settings:

Once the data layer are imported into categories, then buffer rings and resistance values can be applied to layers. For this task, check the section Configuring the Layers.

- **Buffer rings:** In HV-OH projects, large buffer rings around buildings and urban areas are usually applied.



Name	Filter	Category	Buffer Ring		
			Single	Multi	Ring 1
<input type="checkbox"/> Buildings OSM	SET	03 Land use planning	<input checked="" type="radio"/>	<input type="radio"/>	150

- **Resistance Values:** depending on the relative importance of each data layer, resistance values are assigned to prevent or favour the route passing through different layers. Forbidden resistance value can be also applied in order to prevent a route to cross a specific layer:



Category	Layer Name	Resistance Value
Residential/Urban Areas	Residential areas	Forbidden
	Industry and commercial	3
	Leisure and recreation	2
Infrastructure	Highways	3
	Substations	-3
	Airports	Forbidden
Water	Big Rivers	-2
	Lakes	Forbidden
	Flood risk areas	1

**c) Additional settings:**

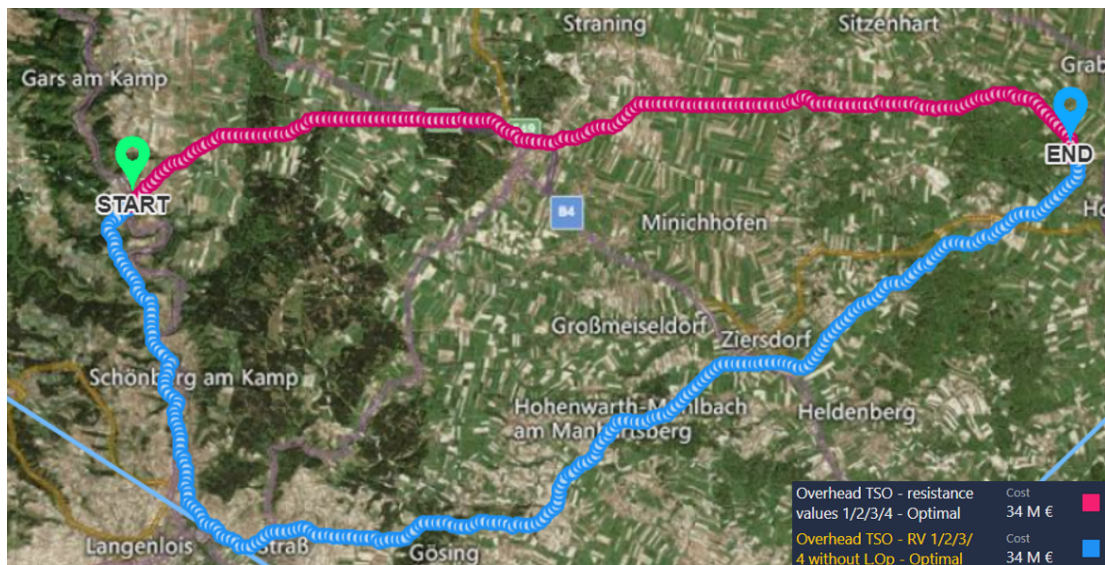
- **Bundling** : We create buffer rings around the infrastructure we want the route to bundle with. The first buffer ring, corresponding to the lanes of the infrastructure for example will have a very high resistance value and the second buffer ring will have a very low resistance value.



**d) Length optimization:**

Route length is an important cost factor, so Pathfinder provides different ways to reduce it. See the section on length optimization.

In the image below, we use the length optimization factor with a value of 0.8 (red path) and 0.0 (blue path).



*Disclaimer:* the scenarios depicted in this manual do not represent actual customer projects or infrastructure proposals, and are presented for demonstration purposes only.

For more help, please use the help chat in the application, or [contact Gilytics](#).

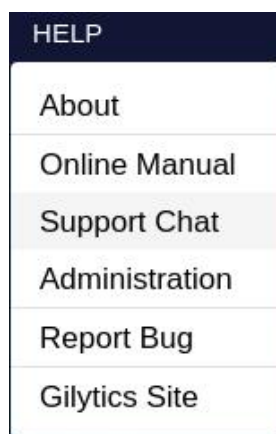
## Tech Support and FAQ

What to do when you have a problem or request?

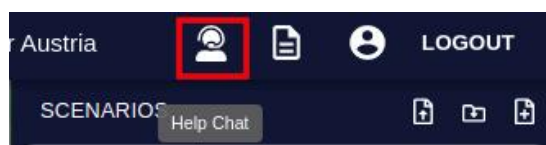
First, we recommend you to take a look at our question list below. If you don't find the answer to your question, use the support chat or report the problem from Pathfinder itself, so it goes directly into our issue management system.

## Support Chat

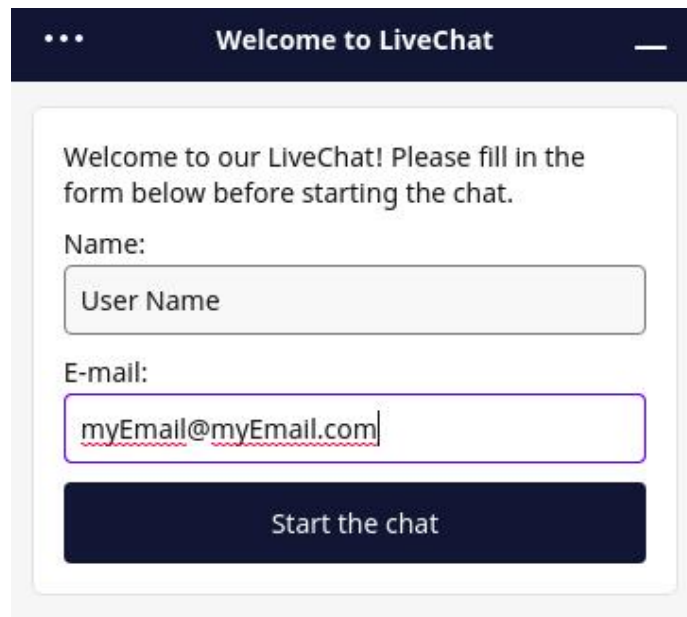
You can find the support chat link in the Help menu:



And you can also open it from the button in the top bar:



The chat dialog will open. Please provide a user name and email, and click on "Start the chat":



... Welcome to LiveChat —

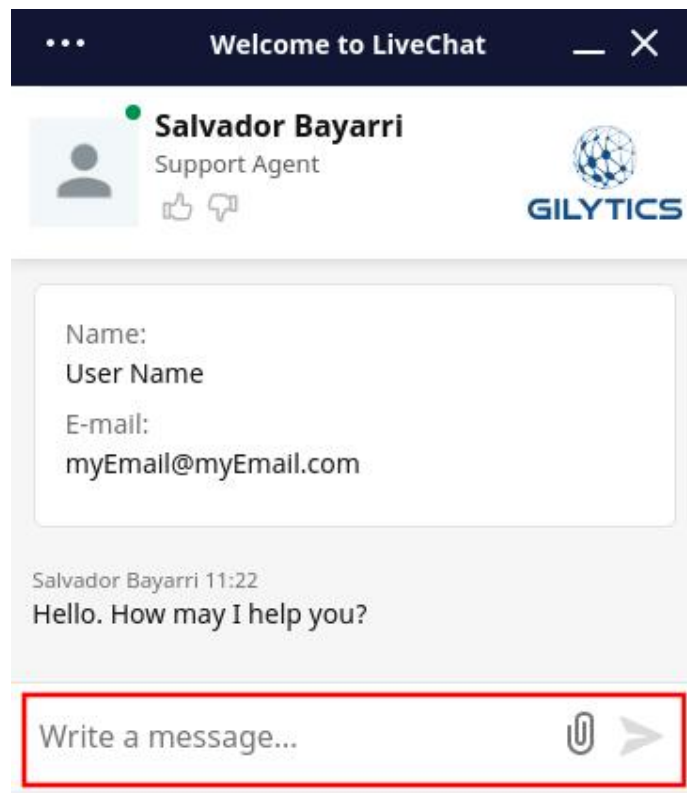
Welcome to our LiveChat! Please fill in the form below before starting the chat.

Name:



E-mail:


Start the chat

Then, type your message and attach sample data or screenshots related to your problem or question.



... Welcome to LiveChat — X



 **Salvador Bayarri**  
Support Agent  




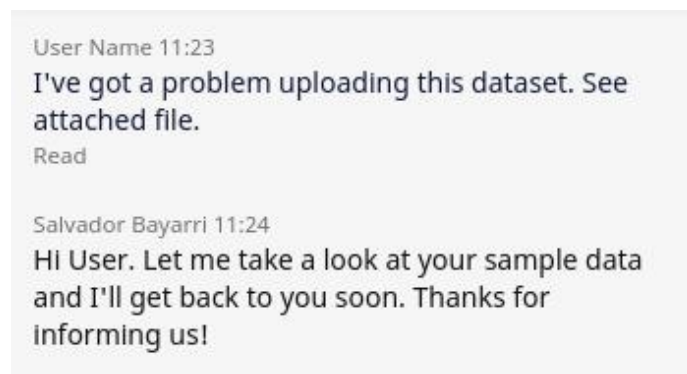
Name:  
User Name

E-mail:  
myEmail@myEmail.com

Salvador Bayarri 11:22  
Hello. How may I help you?

Write a message...  

A tech support associate will respond to you as soon as possible.



User Name 11:23  
I've got a problem uploading this dataset. See attached file.  
Read

Salvador Bayarri 11:24  
Hi User. Let me take a look at your sample data and I'll get back to you soon. Thanks for informing us!

## Note

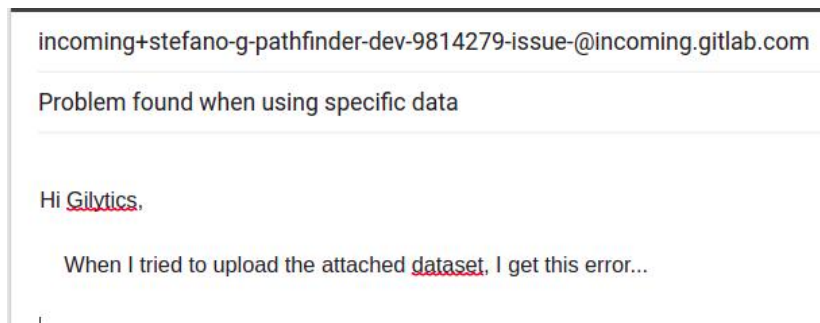
If you have an Ad Block or Privacy Web browser extension active for the Pathfinder site, it may prevent the application from showing the chat window. If the chat button is not visible, disable these extensions for Pathfinder.

## Report a Bug

If you find a problem with the software, you can report it directly to us, using this menu option:



Your default email application will open to send an email to our internal issue tracking system.



To make your report email more effective, please:

- Describe the steps you follow to find the problem
- Attach an image or video capture
- If the problem is data-specific, attach some sample data to reproduce the issue

## Common Questions

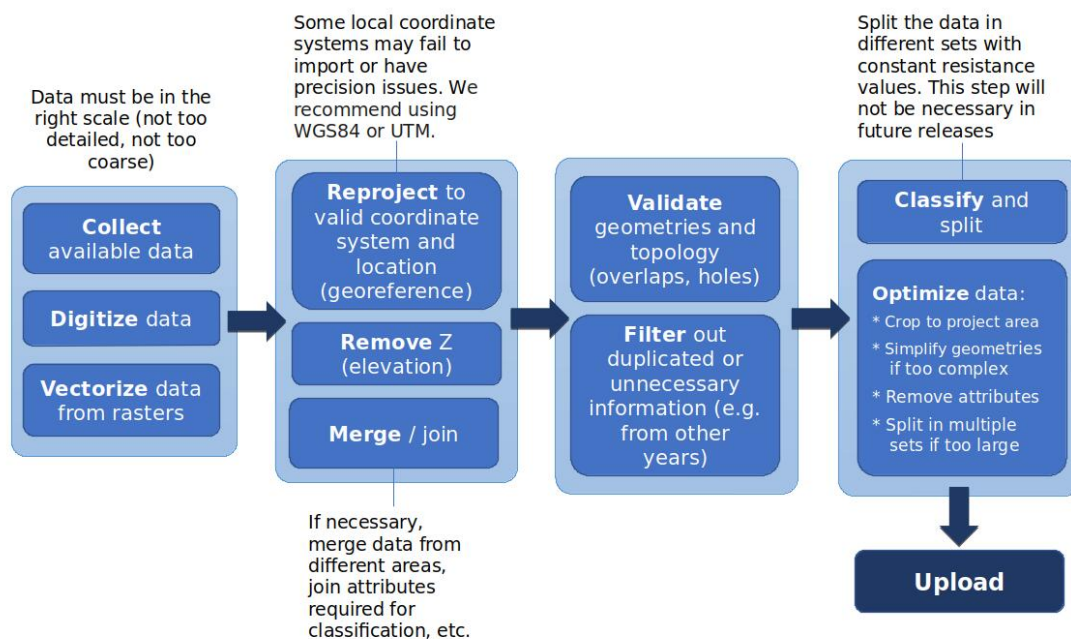
- How to prepare data for Pathfinder?
- I get a login error. What should I do?
- I can't find my original data. ¿Is it possible to download them from Pathfinder?
- How can I create a project thumbnail?
- What is the maximum area size (or minimum resolution value) I can use?
- What is the source of elevation data (digital terrain model) of Pathfinder?
- Things get very slow when adding large datasets. What can I do?
- I don't see the base datasets listed when I try to add a new layer
- The calculated path is too long. How can I reduce its length?



- We use our own pylon/structures models. How can they be added to Pathfinder?
- I would like to setup my own background image
- I don't see the support chat button or dialog
- How to impose a 90-degree crossing over linear features?
- How to force the path to follow linear features like roads or existing transmission lines?
- How can I avoid the path from crossing forbidden areas between pylons?
- I get an error about points being in a forbidden area. What should I do?
- The path generation fails to calculate a path. Why?
- I don't see the same algorithms and geoprocesses shown in the manual. Where are they?
- I've changed the rings or resistances in the project/scenario, but the path doesn't change when I recalculate it.
- Sometimes the map view is split, with a lower white area and there is no way to restore it.

## Data Preparation

A common question asks how to prepare data to be used in Pathfinder. This figure summarizes the criteria and most frequent steps for preparing vector data.



If your organization needs help to prepare data, check our data preparation services.

## Login Failure

If you login into Pathfinder from a different computer, or after a long time, you might get this error message:



In this case, just click on the “Logout” button in the right corner of the top bar, and log in again.

If you have problems logging with the “Remember me” option on, check this option off before logging.

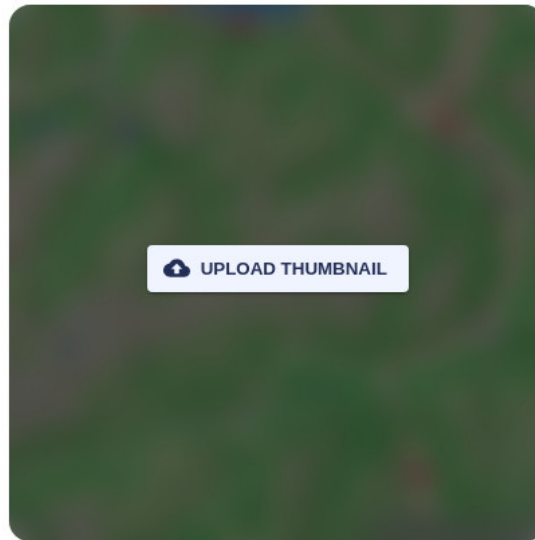
## Recover original data

You can download the original vector or raster data uploaded to create a base dataset, by using the Admin tool.



## Project Thumbnail

If you wonder how to change the default project thumbnail visible in the landing page, you can do so in the Project Information dialog.



## Maximum Area/Resolution

In principle, a project may have any area size. However, the product of the area by the resolution is limited to certain number. By default, the limit is 5,000.

This means that at 10m resolution you can only work with an area that is 50x50 Kms.

If you need to work with a larger area, you will also need to increase the size of the resolution value. For instance, you can work with a 500x500 Kms area, but increasing the resolution size to 100m.

Gilytics support can increase the maximum size number to 16,000. However, this may slow down your data processes and cause failures for large datasets. If you still want us to increase this size, let us know.

## Changing Project Area or Resolution

Sorry, it's not possible to change the project area or its resolution after it has been created. The reason for this is that important internal data like the digital elevation model and slope are setup after the project creation and affect its layers.

If you need to modify the project area or resolution, do this:

- Save the scenarios in your current project to the Scenario Catalog.
- Create the new project.
- In the new project wizard, or in the Add New Layers dialog, click on "Copy from another project" and select the original project:

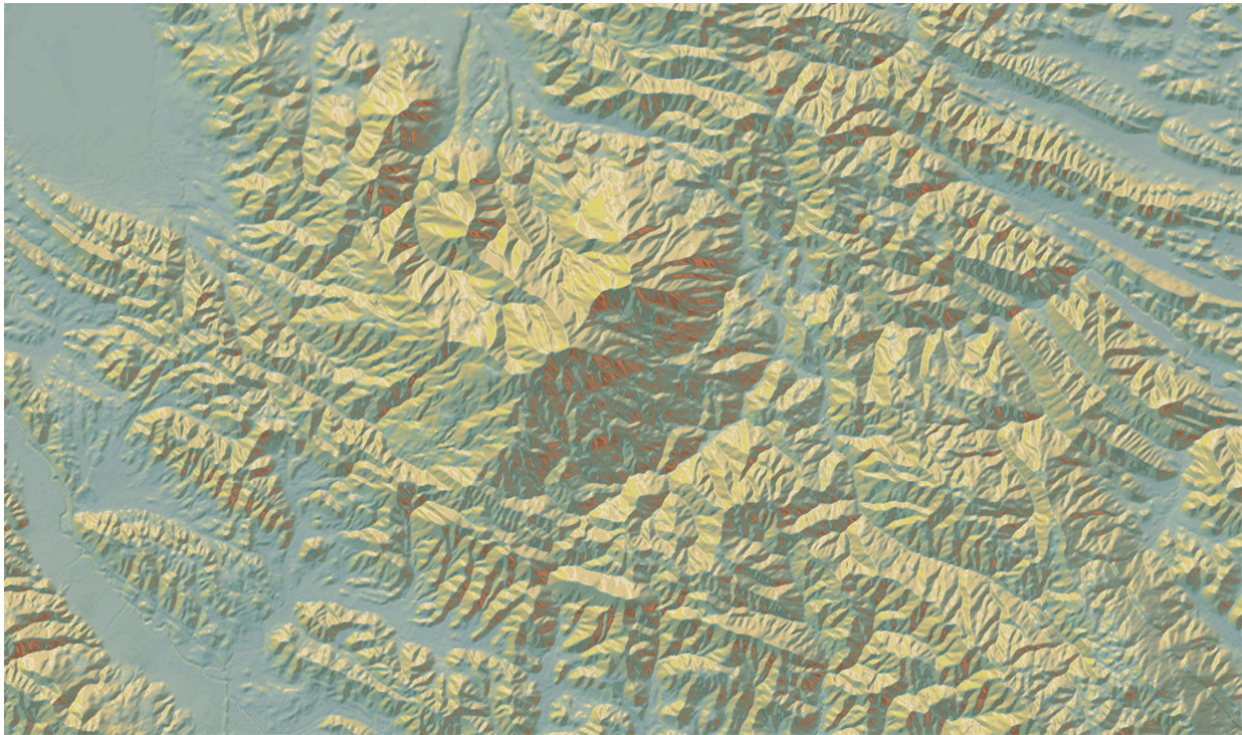
COPY FROM ANOTHER PROJECT

- After the layers are processed, create the scenarios and import them from the ones you saved in the Scenario Catalog.
- Remove the original project if you don't need it anymore.

## Elevation Sources

A digital elevation model layer is automatically added to Pathfinder projects when they are created. This layer uses data from the [Tilezen Terrain Tiles](#) hosted by AWS. This data service is mostly based on the [Global SRTM terrain data](#).

This dataset is geoid-corrected, meaning that its values represent height above the sea level.



On the other hand, the [Cesium World Terrain Layer](#) is used in Pathfinder's 3D View. Its resolution varies quite a lot from a few meters to one kilometer depending on the region. This elevation source provides ellipsoidal values, meaning elevation about the average global ellipsoid, so the elevation values at sea level are not necessarily zero.

However, these elevation values are only used for 3D visualization and do not affect the data products generated by Pathfinder.



## Maximum Data Size

Some processes may have problems, taking a long time, even failing, for large datasets (with many features, or very complex geometries).

If you try to upload data (e.g. a zipped Shapefile) *larger than 50 MB*, we recommend you to simplify it or split it into multiple datasets using GIS software, so all the processing will be faster.

## Base Datasets not Listed

After uploading a base dataset, the user needs to create layers from the company datasets. However, it may happen that the datasets are not listed in the “Uploaded” tab. Why?

### Add New Layer

UPLOADED											OSM	WFS	INCLUDED	Search Datasets	+ ADD RING
Name	Filter	Category	Buffer Ring		Ring Width				Distance						
			Single	Multi	Buffer 1	Buffer 2	Buffer 3	Buffer 4							
<input checked="" type="checkbox"/> Natura2000 end2019 epsg3035	SET	General	<input type="radio"/>	<input checked="" type="radio"/>	100	200	[m]	[m]							
<input type="checkbox"/> area	SET	General	<input checked="" type="radio"/>	<input type="radio"/>	50										
<input type="checkbox"/> buildings clipped	SET	General	<input checked="" type="radio"/>	<input type="radio"/>	100										
<input type="checkbox"/> cables	SET	General	<input checked="" type="radio"/>	<input type="radio"/>	25										
<input type="checkbox"/> rasters/building-classes 66/DEM.tif		General													
<input type="checkbox"/> rasters/building-classes 66/SLOPE.tif		General													
<input type="checkbox"/> swissTLM3D TLM GEBAEUDE FOOTPRINT	SET	General	<input checked="" type="radio"/>	<input type="radio"/>	[m]										

COPY BUFFER SETTINGS FROM ANOTHER PROJECT

Rows per page 10 1-7 of 7

- The dataset might already be used by some other layer in the project. In this case, look for it in the “Included” tab.
- The dataset does not have a valid extent (may be empty) or its extent does not intersect our project area. This may happen if the coordinate system was incorrectly assigned in the original data source, or because some other data processing issues.

To check that the extent of an uploaded base dataset seems correct, take a look at the base layers admin page.

**DB\_REPOSITORY**

- BaseLayers + Add
- BaseLayers OSM + Add
- BaseLayers OSM Tags + Add
- BaseLayers WCS + Add
- BaseLayers WFS + Add
- WFS Custom overrides per servers + Add

**DEPLOY\_CONFIG**

- Minimum desired workers + Add

**GEOPROCESSING**

- Available GeoProcesses + Add

**GIS data**

Feature count: 269

---

Srid: 4326

---

**Extent:**

## Optimize Route Length

The length of a route is an important cost factor, so it is usually convenient to reduce it as much as possible.

The user can **manually** shorten the path length by reduce the relative resistance differences between layers (make their differences less important) while keeping approximately the same relative absolute values.

For instance, if layers have initial resistance values like 2, 3 and 4, scaling up these values to 20, 30 and 40 will make no difference: the resulting path will stay the same. What we can do is to use values like 22, 23 and 24; or 32, 33 and 34, which reduce the relative difference between the layers.



This scaling is done **automatically** by using the length optimization factor in the scenario settings. The higher the value of this factor (near 1.0), the smoother and more straight the path will be, at the expense of other optimization criteria.

Also, you can consider using an advanced algorithm with pylon spotting and set an angle weight to make the path smoother.

## Custom Pylons

The company administrator can add custom pylons to Pathfinder, but we can also do it for you.

To do so, we need:

- A 3D model of the pylon, best in [glTF/glb format](#), but it can be in 3DS, OBJ, FBX or other 3D file format.
- The real height in meters of the pylon.

## Custom Background Image

It is possible to use your own image or tiled Web Map Service as background map in the 2D and 3D views.

Contact us and we will help you to set it up.

## Chat Not Visible

As mentioned earlier, if you have an Ad Block or Privacy Web browser extension active for the Pathfinder site, it may prevent the application from showing the chat window.

If the chat button is not visible, disable these extensions for Pathfinder.

Also, the chat will not be visible if you did not accept the use of cookies, which are needed by this feature.

## 90-Degree Crossings

A common constraint for routing is to favor 90-degree crossings of other linear infrastructures like highways or transmission lines.

The routing model of Pathfinder is designed so this constraint is applied automatically, just by:

- Creating a ring or buffer on the linear elements for which we want to optimize the crossings
- Set a relatively high resistance to the layer containing the linear elements

With these conditions, the routing algorithm will try to minimize the length over the linear feature, and therefore, will cross it near 90-degree angles, unless other constraints are given more priority (for instance, reducing the route length).



## Note

*The larger the buffer or ring distance around the lines compared to the project resolution, the better the 90-degree angle will be approximated. For instance, if your project resolution is 10 meters, a buffer of 100m or 150m will induce more precise perpendicular crossings than a buffer of 30 or 40 meters.*

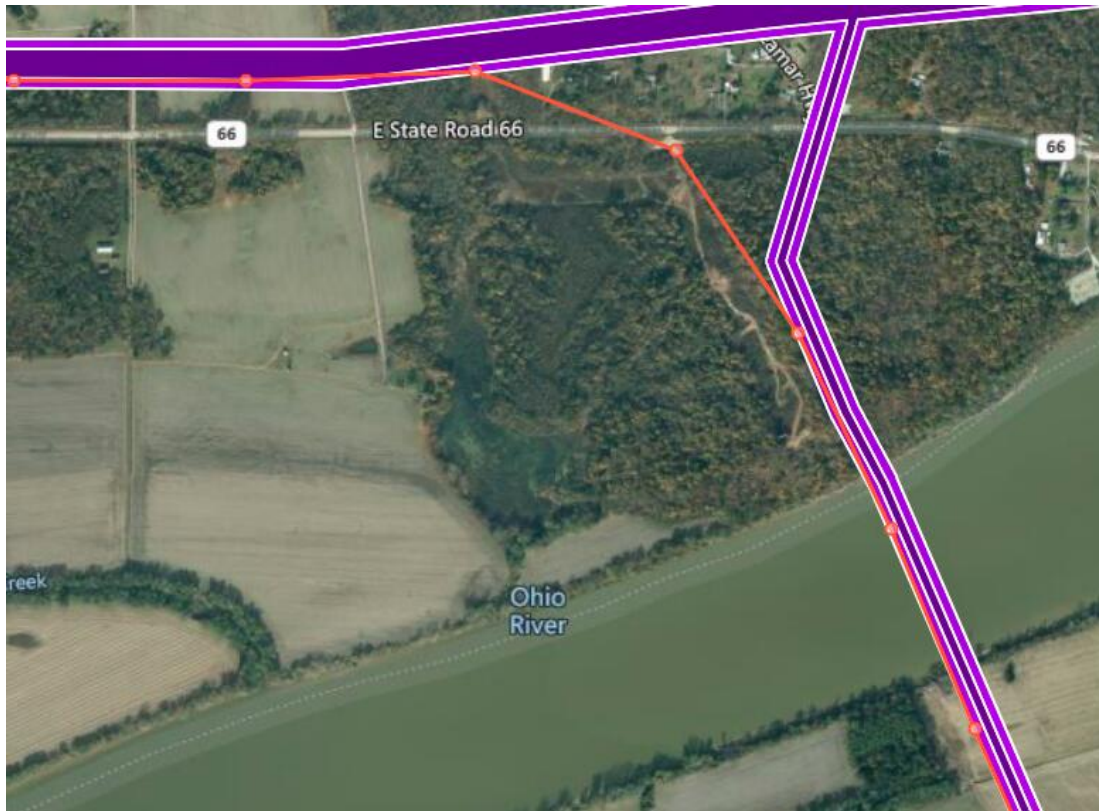
## Bundling with Existing Lines

In some cases, we would like the route to run close to existing roads or transmission lines, reducing the right of way, and the cost of construction and maintenance.

We can use per-ring resistances to achieve this “bundling” effect. Usually, we should set a high resistance close to the lines we don’t want to cross too often, but we can also set a negative or small resistance in a second or third ring, at the right distances, to favor routes which are not too far from the existing lines.

This image shows the bundling effect achieved by applying this technique:





### Prevent Crossing Forbidden Areas

If you need to prevent strictly the path from crossing forbidden areas, you must use the algorithms including pylon spotting, disabling the “between points allowed” choice in the advanced options.

### Points in Forbidden Areas

When calculating a corridor, it may fail with the following message in the Process Log:

```
Process Log
Failure : Point in Forbidden area
```

The problem here is that the Start, End or intermediate points of the path lies within a forbidden area, so a route is not possible.

You must either:

- Change the FB value of the layer the points is in to a high-resistance value
- Move the problem point out of the forbidden area

### Failure with Forbidden Areas

Algorithms may fail to find a path when large or long forbidden areas are defined, or they generate unexpected results.

For this reason, and because of the strong restrictions they impose, it is recommended to limit the use of forbidden areas, especially for large linear features like highways or rivers.

### Algorithms or geoprocesses not visible

Some of the Pathfinder calculations (MCDAs, routing algorithms, geoprocesses) may not be available by default to all companies.

Check with Gilytics if you need to use some of these calculation options and they are not visible to you.

## The path(s) doesn't change after modifying parameters

Some changes require recalculating the Resistance Map and Corridor so that they affect the routing and therefore the path is correctly recalculated.

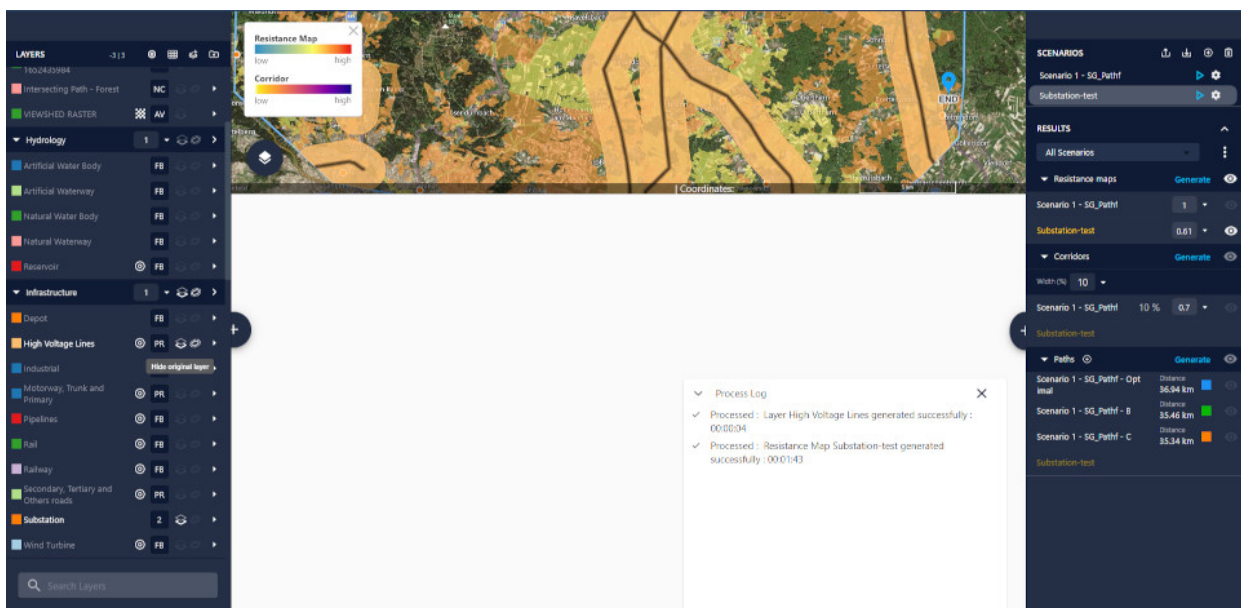
So if you change:

- The layer rings
- The layer resistances
- The MCDA or other scenario options like the length optimization factor

you will need to *recalculate the Resistance Map and Corridor* again so those changes are reflected in the routing. You can force this recalculation by using the Generate All button in the scenario.

## The map view is split with a white bottom

Sometimes, when using the layer side panel to edit a layer's resistance options, the map view may be split in two and there is no apparent way to restore it.



Unfortunately, this issue happens randomly and it has proved difficult to fix. If this happens, you can restore the normal map by reloading the Pathfinder web page and the project, or using one of the Generate buttons.

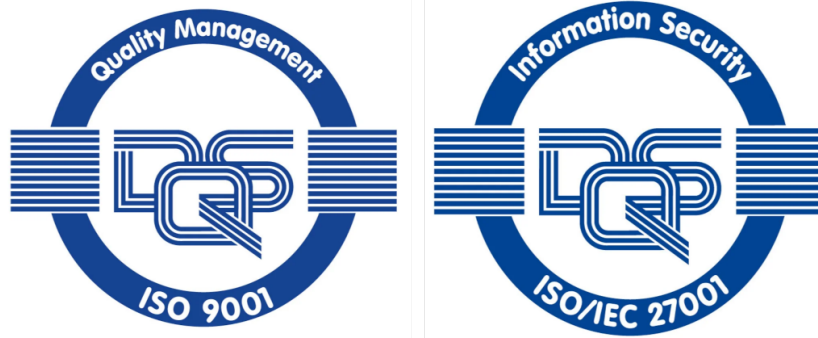
*Disclaimer:* the scenarios depicted in this manual do not represent actual customer projects or infrastructure proposals, and are presented for demonstration purposes only.

For more help, please use the help chat in the application, or [contact Gilytics](#).

## Data Security

Gilytics is aware that our customers use sensitive information, and we take all possible measures to guarantee that all data is secure in our cloud infrastructure.

Gilytics has been certified in the ISO 9001 (Quality Management) and ISO 27001 (Information Security) standards.



This document describes the flow of information in the Pathfinder application and how data is protected throughout the system.

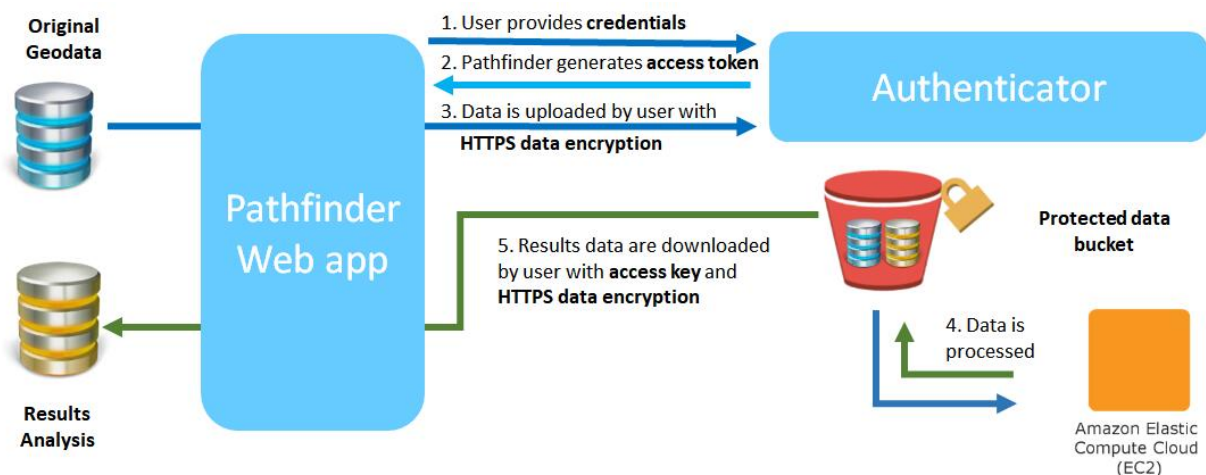
## Overview

Pathfinder is a **cloud application**, a model which has many advantages for customers:

- The application can be used remotely from any computer
- There is no need to install and manage local software or databases
- Also, no need to update to use new features, which are automatically available
- Automatic access to latest fixes and improvements
- It's easy to manage projects in an organization with multiple concurrent users
- A single version of the application makes easier to get fast and precise technical support

The **data flow** in Pathfinder is the following:

- Users provide their unique credentials (name and password) to authenticate and receive the authorization to access the system according to their company membership and role.
- Users upload geodata to our cloud server from the Pathfinder Web application, using an encrypted data transmission protocol.
- Data is stored in the highly secure and protected cloud storage.
- Data is processed to be displayed in the Map and 3D views and analyzed to find optimal paths and locations.
- User downloads the analysis results and reports from the cloud, again using an encrypted transmission protocol.
- User removes the project data when he/she wishes, and all data and trace is removed from the cloud.



Let's examine each of these steps to understand how the data is protected:

## Pathfinder Authentication

The first step to guarantee security is to check that the user is who he/she claims to be. This is done with an authentication protocol. Pathfinder uses its [Django REST authenticator](#) component to check the (encrypted) user credentials (name and password) and create a unique *token* or key that can be used to secure the communication during the work session.

For more secure access control, Pathfinder supports Two Factor Authentication which can be activated by each user.

Work sessions are closed automatically after an inactivity period, preventing unwanted access.

Companies who wish to use their own authentication method can do so by using our support for **Single Sign On**.

## Pathfinder Authorization

Your company's Pathfinder administrator manages the list of users and their permissions. Only messages from users previously authenticated, carrying the right token, are accepted by the Pathfinder server. No operation is possible in the server, including listing projects and layers, accessing data, or processing it, if the administrator has not provided [authorization](#) to the user or the user has not authenticated (logged in).

Administrators can restrict access to projects for specific users by enabling this option in the admin page.

## Encrypted Data Transmission

Authenticated and authorized users can proceed to upload or download data. During the uploading and downloading processes, data is divided in packets and codified in a binary form, but these packets could potentially be inspected by external systems. To prevent this, modern Web applications use the [HTTPS protocol](#) (instead of the old plain HTTP protocol). When you connect to Pathfinder, you will see (if you copy the Web address in your Web browser) that it starts with the "https" keyword.

This protocol uses [Transport Layer Security](#), so the data transmitted is encrypted with a secret key that only the user's Web browser knows for each session. The cloud server provides this cryptographic key before the data is transmitted.

## Cloud Data Storage Security

What about access to the server's storage system? Today's cloud storage systems have features and best practices which protect data and applications better than standard corporate data centers, so probably your data is safer in our cloud provider, Amazon Web Services, than in your office computer.

Configuration and Spatial Data are stored in AWS RDS database system, and temporary files for data visualization are stored in Amazon S3, but all this information is only accessible through the secured HTTPS REST API.

Pathfinder uses [cloud database encryption](#) to keep data protected even if a physical access to the database would occur.

## Protection from External Threats

Pathfinder protects its servers using [AWS GuardDuty](#) for threat detection.

In addition, continuous automated vulnerability testing is performed to detect potential weaknesses in third party and own components.

## AWS Infrastructure

Amazon Web Services considers security as its first priority and provides many [technologies and practices](#) to ensure it, from [data privacy controls](#) to [data center physical safety](#), being [compliant with security standards](#) and protocols.

All the Pathfinder infrastructure and data is currently located in the AWS eu-west-1 region (Ireland).

*Disclaimer:* the scenarios depicted in this manual do not represent actual customer projects or infrastructure proposals, and are presented for demonstration purposes only.

For more help, please use the help chat in the application, or [contact Gilytics](#).

## Additional Services

Gilytics provides training and support services to help our customer make the most of their Pathfinder licenses. Additional services are provided for a fee.

## Pilot Projects

If you are not sure how Pathfinder will help your organization or need to validate the methodology before moving to a subscription license, the best way is to see the software in practice by using it in a real or prototype project and comparing this process with your existing workflows to check the time savings, transparency, quantitative analysis and other advantages of Pathfinder.

## Data Services

If you need support for collecting data in your area or prepare it to be used in Pathfinder, let us know. We have an expert team of Geographical Information Systems specialists and a growing repository of data.

### Explore Layers

Upload Layers

The screenshot shows the 'Explore Layers' interface. On the left, there is a 'Selection' panel with a 'Create a Map' button and a 'Filters' section. The filters include 'TEXT', 'KEYWORDS', 'TYPE', 'CATEGORIES', 'RESPONSIBLE', and 'GROUPS'. The 'TYPE' filter is expanded, showing 'Raster Layer' (9) and 'Vector Layer' (617). The main area displays '626 Layers found' and a list of layers. Two layers are highlighted: 'ES\_VC\_Sea' and 'ES\_VC\_Forest'. Each layer entry includes a map thumbnail, a title, a description ('No abstract provided'), and metadata (user, date, views, shares, stars, and a 'Create a Map' button).

## Analysis Services

Gilytics' expert team can also setup special analysis scenarios, calculate and discuss the results with you and your stakeholders.

Also, some processes can be run for you in batch mode to automate multiple scenarios.



## Sensitivity Analysis

The goal of this analysis is to find routing corridors which are robust: they don't change much when different resistance parameters are used in the different layers. The process involves running automatically the routing calculation with different parameter combinations.

A configuration page let's Gilytics configure and run this analysis by using two scenarios defining the minimum and maximum resistance values to test for each layer. An optimized parallel processing infrastructure is used to execute all variations in a reasonable time.

### Sensitivity Analysis 1667984687 for [REDACTED].

#### General Information

Item	Value
Expected Paths	19683
Task Id	
Task Status	PENDING REVIEW BY USER
Start Time	None
Estimated End Time	Waiting for the first iteration...
End Time	None

#### Layer Information

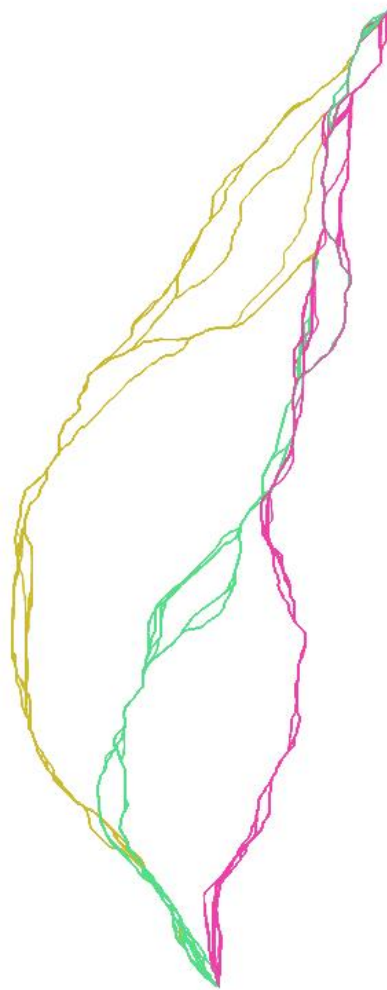
Layer	Resistance Configuration
108 109 110.1 Line Infrastructure	[[80, 60, 0, -20], [80, 60, 0, -10], [80, 60, 0, 0]]
301/2/3 Grundwasserschutzzonen All	[0, 50, 100]
201 BLN	[0, 50, 100]
203 Infrastrukturfreie Landschaftsgebiete	[0, 20, 40]
113.1 An und Abflugbereich	[0, 40, 80]
105 Arbeitszonen 106 Eingeschränkte Bauzonen	[0, 40, 80]
211 Bodenbedeckung Wald	[0, 30, 60]
209 Geotope	[0, 20, 40]
208 Moorlandschaften	[0, 50, 100]

#### Cost Estimation

Number of parallel tasks:  Workers in machine:  Path task time:

Item	Value
Rough Runtime Estimation (Assumes 200 parallel tasks, 30 seconds per task)	0 days, 0 hours. 49 minutes
Rough Price Estimation (Assumes a price per hour of 0.428 per machine and 101 running)	35.4523635 \$

The results are provided as a raster map showing all generated paths superimposed, and also as a dataset with all the paths (which can be several thousands) in vector format.



## Customization Services

Do you use a specific MCDA formula to combine the scenario resistances or have a cost calculation model to be integrated in Pathfinder? Do you have special infrastructure siting or routing constraints? Do you need a custom geoprocess to calculate additional results?

Gilytics can create custom components, integrated in Pathfinder, to fulfil your requirements.

## Annexes

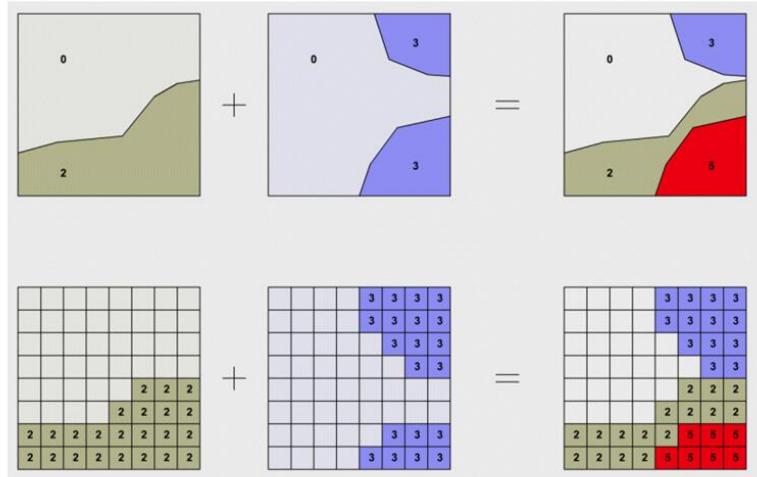
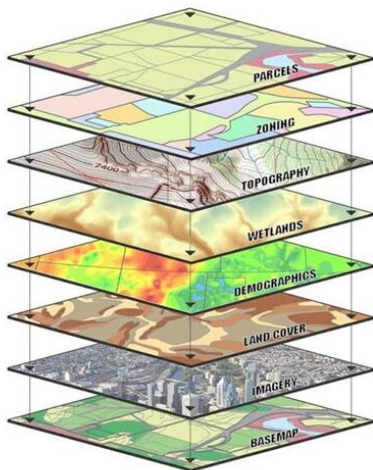
These are documents with additional information, referenced by some of the main pages:

- About Pathfinder algorithms
- About the process log
- Features per user role

## Routing Algorithms

At the core of Pathfinder is a routing engine which calculates optimal paths given the constraints of the scenario.

Before using a routing algorithm, Pathfinder needs to create a Resistance Map, where all the layer resistances are combined into a single image. The resolution of this image is given by the project resolution.



<https://storymaps.arcgis.com/stories/b60b7399f6944bca86d1be6616c178cf>

[http://www.gitta.info/Suitability/en/html/BoolOverlay\\_learningObject1.html](http://www.gitta.info/Suitability/en/html/BoolOverlay_learningObject1.html)

Image source: Geography, Remote Sensing and GIS lesson – LyfSkill, Universität zu Köln.

## The Routing Problem

The goal of all routing algorithms is to find paths traversing the resistance map from the Start point to the End point (possibly with some intermediate points), so that the sum of all the resistances along the way is minimized.

The results of the routing algorithms are:

- A corridor map raster summarizing where optimal paths might be located.
- One or more polygonal lines describing the optimal paths.

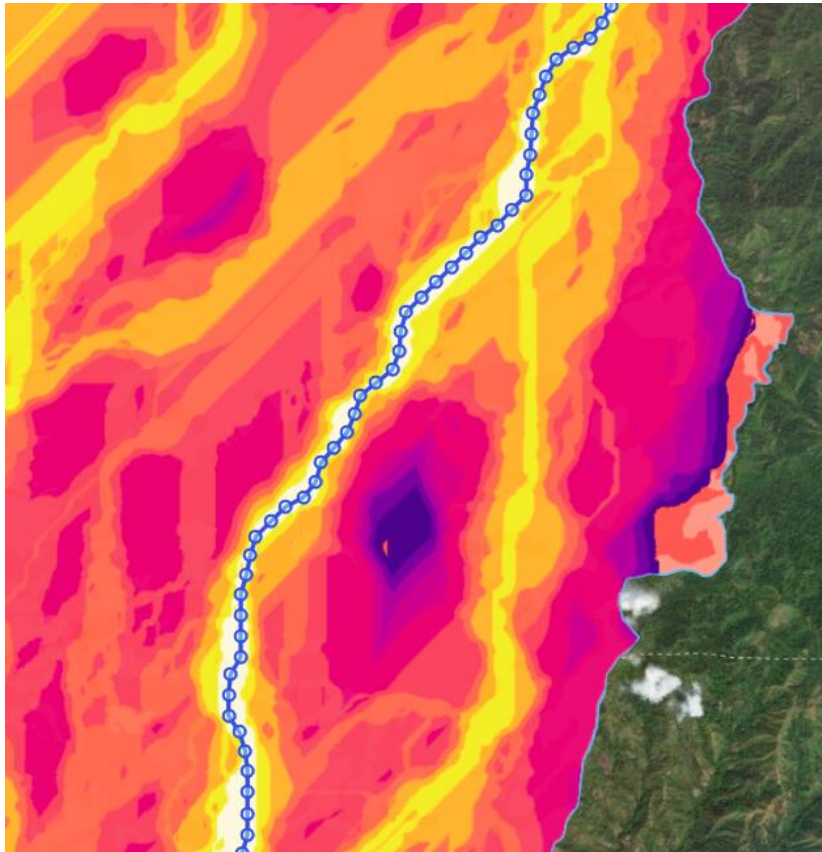
## Algorithm Choices

Depending on your company license, more than one routing algorithm may be available. In the scenario settings panel it is possible to choose the algorithm among the available ones.



## Fast Single Path

This is the default option and the fastest to compute. It generates a single optimal path per scenario by finding the least resistance route in the corridor map, therefore, crossing the lightest areas in that map.

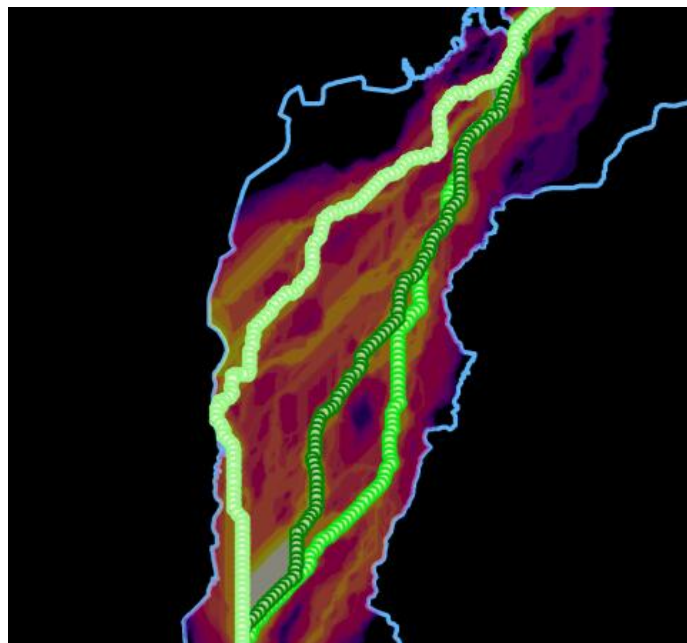


### Advanced Single Path

This option is equivalent to the previous Fast Single Path and it probably will not be available for most customers. It's only used for testing.

### Advanced Multiple Paths

This version of the algorithm generates multiple possible paths which are local resistance optima. The resulting paths are significantly different between them and can be used to analyze alternative routing solutions.



In this case, multiple paths are shown in the *Results/Path* section of the right panel, each one with its own cost estimation, and can be colored and displayed separately.

Adv Multi - B	Cost 29 M €	■
Adv Multi - Optimal	Cost 29 M €	■
Adv Multi - C	Cost 32 M €	■

### Pylon Optimization (Beta)

The advanced single and multiple path routing algorithms have additional versions which optimize the pylon/tower location and angles for power transmission applications, so that pylons are actually placed in least-resistance locations and large angles are avoided.

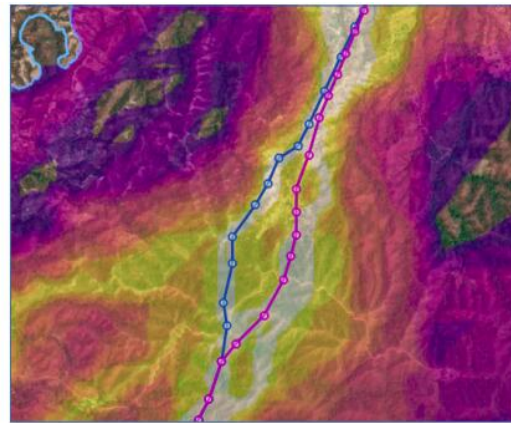
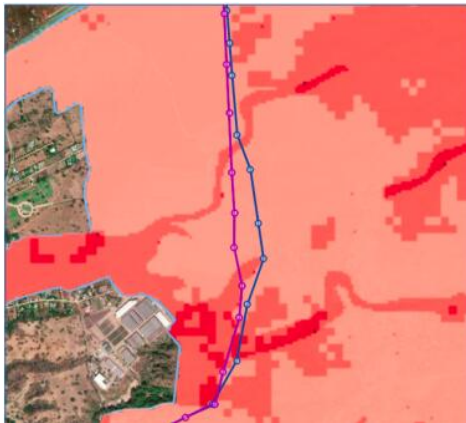
With these algorithms we can configure options to achieve the desired effect:

- Balance the relative importance of the edge resistance compared to the resistance at pylon locations.
- Balance the relative importance of the angle minimization compared to the resistance minimization.
- Control how much the path can deviate from the straight line going from Start to End.
- Set a *maximum angle* between previous and following wires at any pylon.
- Allow jumps over forbidden areas.

### Note

*The default settings may disable the angle optimization. If you want to use this feature check with your administrator that appropriate options are set in the algorithm configuration.*

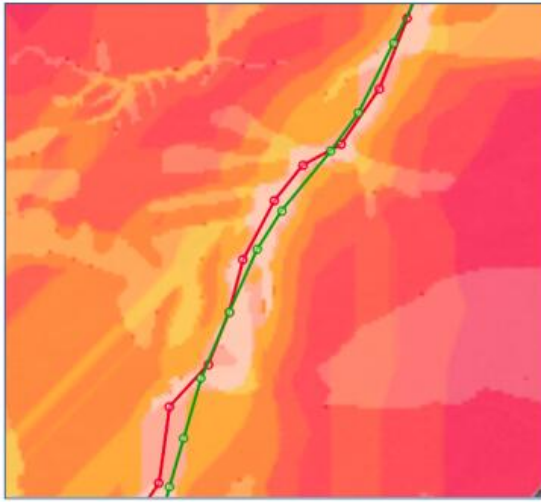
As an example, compare these results (the parameters must be set in the pylon siting options):



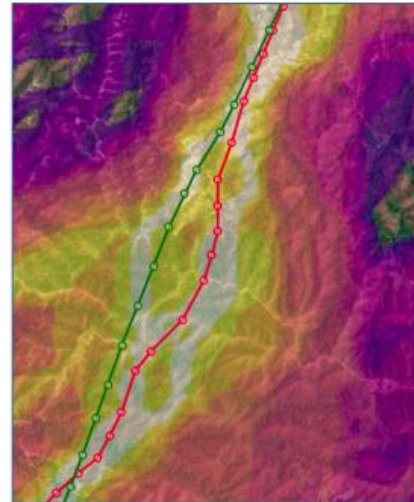
Only path resistance  
considered  
(Edge weight = 1.0)

Both path and pylon  
resistances  
considered  
(Edge weight = 0.75)





**No optimization**  
(Angle Weight = 0, No Max Angle)



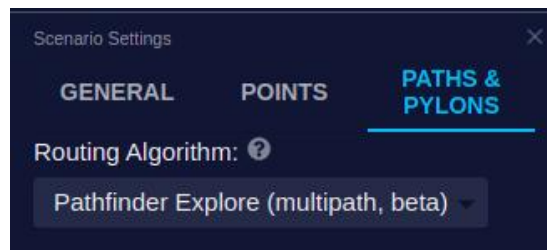
**Angle optimization**  
(Angle Weight = 0.5, Max Angle LG = 10 degrees)

## Note

*Because of the additional resources required to run this algorithm, it may fail in large projects. We recommend to reduce as much as possible the difference between the minimum and maximum pylon distances.*

## Pathfinder Explore algorithm (Beta)

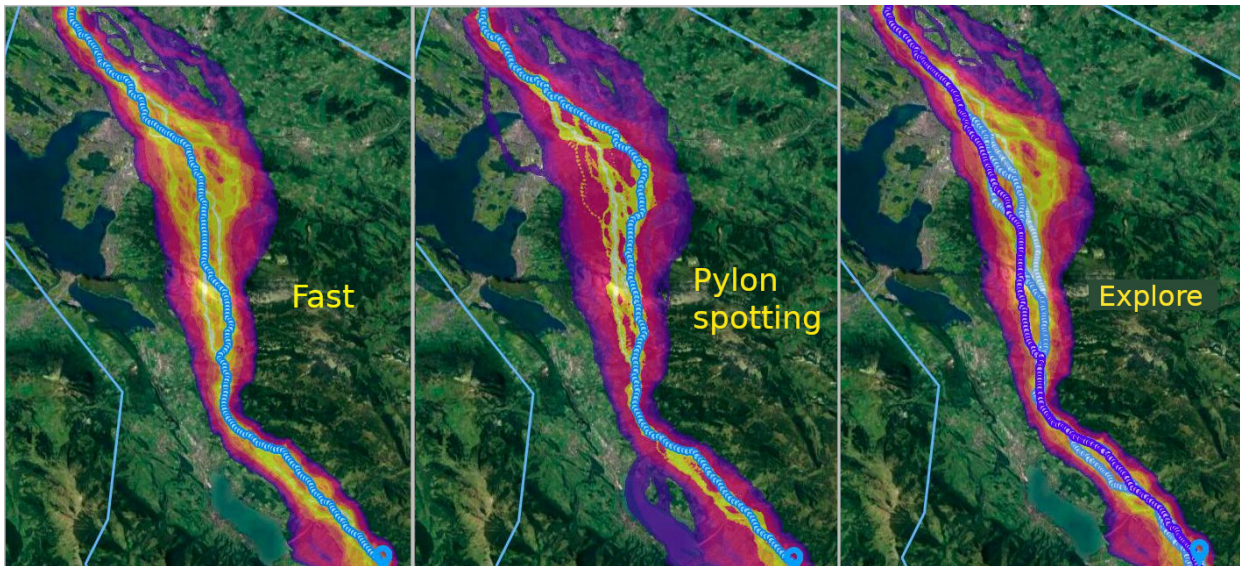
Pathfinder 3.2 includes a new multipath algorithm which can be used like the standard routing algorithms, and also to solve specific problems like combined overhead-tunnel routing (see below).



Some advantages of this algorithm are:

- Small **memory footprint** and great performance with large areas.
- Generation of many **alternative routes**. By default this number is six, but in some cases (see the Tunneling geoprocess) can be configured.
- Extensible with complex geometric and multi-map **constraints**. Because the resistance evaluation (cost function) is clearly separated from the algorithm engine, the Explore algorithm can be extended to take into account specific geometric criteria (e.g. slope limits or advanced crossings constraints) and to use multiple resistance maps as input, describing alternate costs for different technologies used, so the most appropriate can be chosen for each route segment.

Compare the results of the Fast, Pylon Spotting and Explore algorithms.

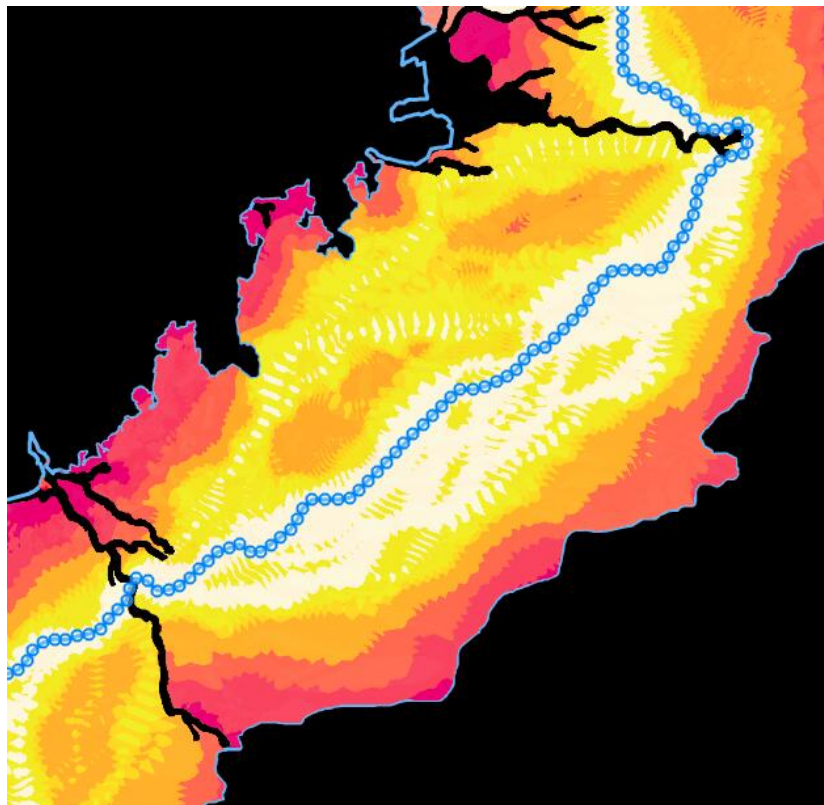


You are welcome to try this new routing method and give us your feedback.

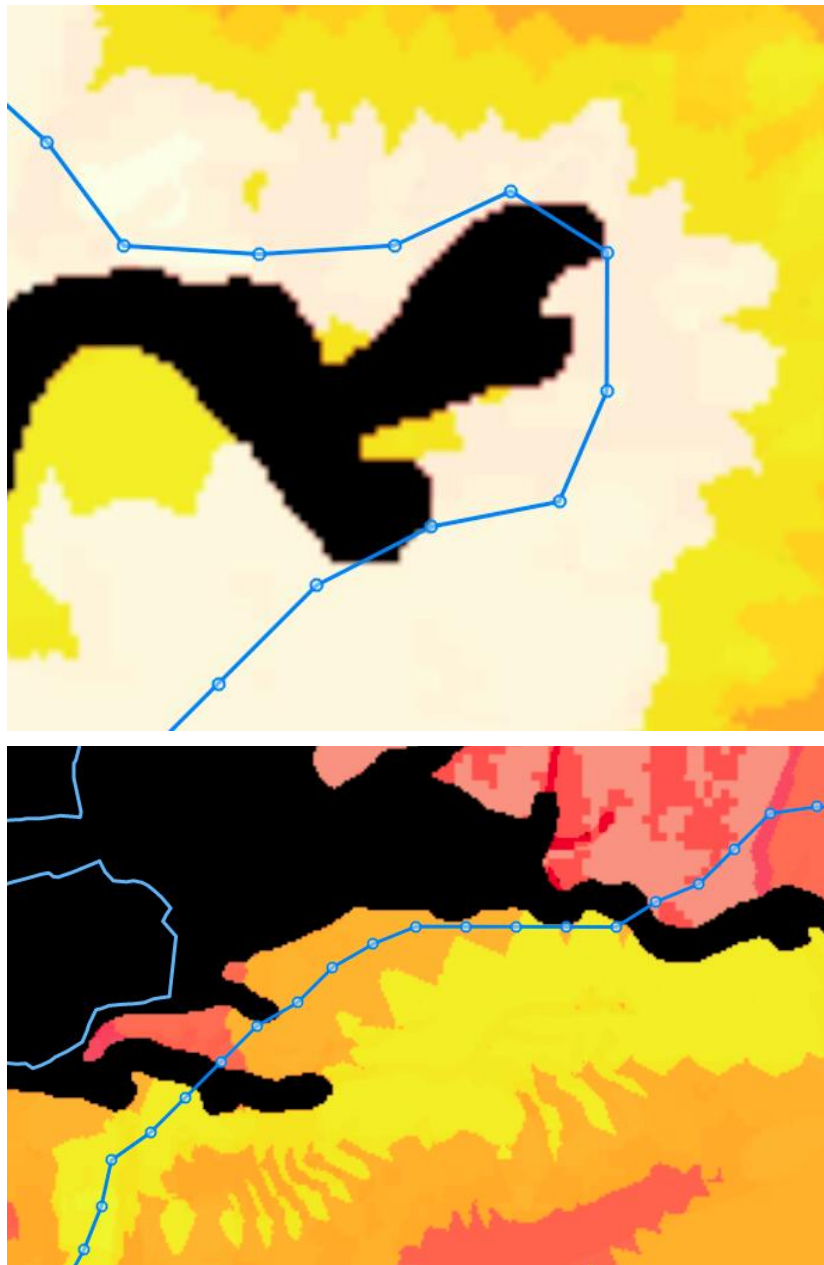
### Forbidden Areas

The use of Forbidden areas is an important feature of Pathfinder's optimization algorithms. However, they must be used carefully, because the strong constraints they impose on the path search.

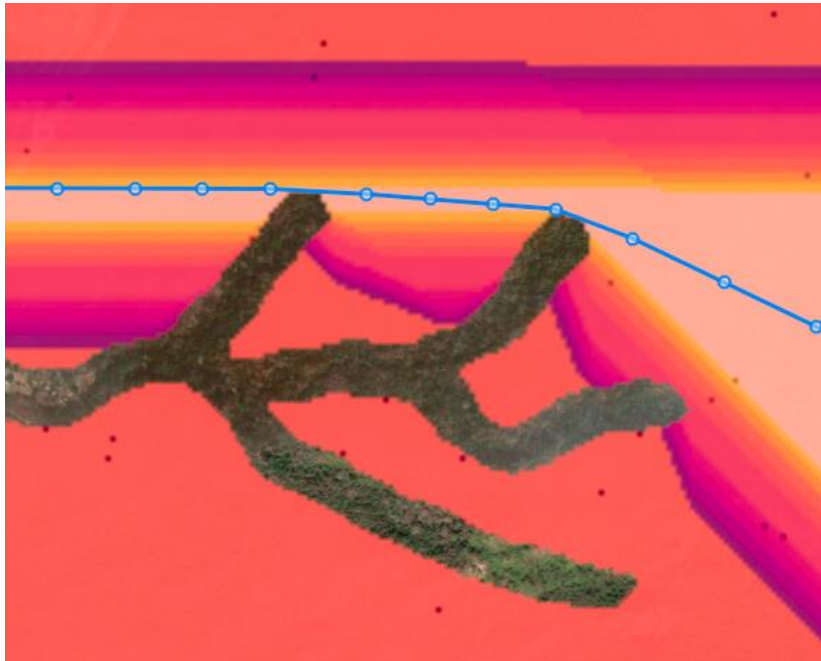
As we can see in the next images, algorithms will avoid forbidden areas (see North detour), unless there is no other choice than crossing them to find a path (see South area).



Usually, the path may cross a forbidden area, as long as the pylons are located outside:



**If we need to prevent strictly the path from crossing forbidden areas, we must use the algorithms including pylon spotting, disabling the “between points allowed” choice in the advanced options.**



**Note**

*Advanced algorithms with pylon spotting (in beta) may fail when trying to find an optimal path with forbidden areas. Sudden turns are not handled well.*

**Note**

*It is recommended to avoid forbidden areas for large linear features like highways, rivers, etc. Use a large resistance value instead.*

**Pros and Cons**

The following table summarizes some of the pros and cons of using each algorithm:

**Algorithm comparison**

Algorithm	Performance	Optimizations	Suggested for
Gilytics fast	Fast, quite lean.	Total resistance. Avoids FB areas but “cuts corners”.	Quick results, strict bundling, single solution per scenario.
Pylon spotting	Slow, memory limitations with large projects.	Total resistance. Pylon location. Angle constraints. FB constraints.	Precise pylon constraints in smaller projects.
Explore	Fast and lean.	Total resistance. Relaxed pylon, angle and FB constraints. “Corridor width” option.	Large projects. Multiple path options. Used by combined routing geoprocesses.

Regarding the reversibility of the results when swapping the Start and End points, see this note.



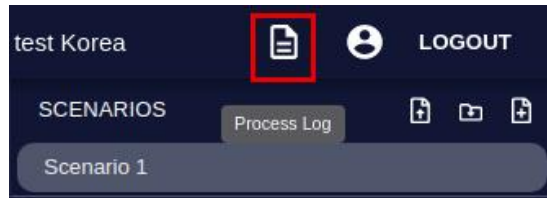
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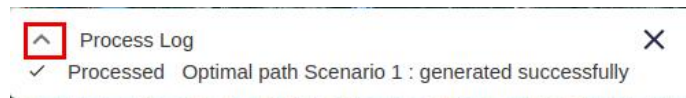
## Process Log

The Process Log shows messages related to process execution, which actually happens in the cloud server.

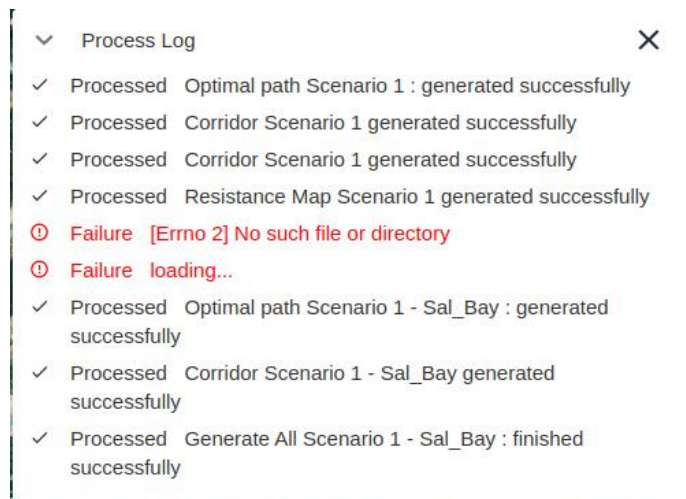
This popup window will open automatically when certain tasks are executed, and it can also be opened at any time by clicking on the “Process Log” button in the top bar:



The log popup initially opens in a minimized state showing only the last message, but it can be expanded by using the left top icon:

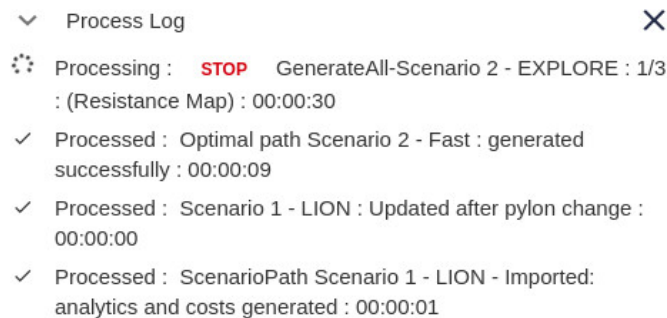


Which results in:



The log window can be minimized again or closed.

Estimating the **duration of a process** in Pathfinder is nearly impossible because of the many factors involved, including how many other processes there are, but the Process Log shows the time it's taking for each process to complete, so the users have an approximate estimation of how long it will take to run it again in similar conditions.



## Data Preparation Processes

These processes are run automatically by the application:



- When a *project* is created, a process is executed to prepare the *Digital Elevation Model (DEM)*, *Slope Map* and other information relative to the project area.



- When a *layer* is added to the project from a base dataset, or its ring/buffer options are changed, a process is executed to *clip and buffer* the data and prepare it for display and analysis.

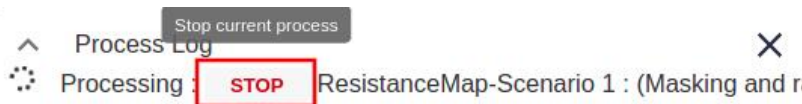


**Note**

*It will not be possible to add layers to the project until its post project creation process ends.*

**Stop a Process**

In some cases, a process can be running much longer than expected, or we wish to stop it in order to change some parameters and run it again. The Process Log shows a “Stop” button we can use to cancel the process.



After the process stops it will be displayed as “Failure”, but without the red color indicating a problem, and it can be executed again.



**Note**

*It is not advisable to stop the project post-creation process calculating the terrain variables. If this process is canceled, it becomes impossible to add layers to the project and we will need to recreate it.*

**User Profiles**

Pathfinder provides an easily manageable set of user profiles:

- Company administrators
- Scenario editors
- Viewers

**Admin/Staff Users**

The administrator users can:

- Login into the [administration site](#).
- Create and manage company users and their roles.
- Configure advanced properties and manage the company’s projects, datasets, layers and scenarios.

- Create projects. Other roles cannot create new projects or change their data.
- Add data to the company base datasets.
- Add layers to projects and configure them.

However, the administrators **can not** change some company options, including:

- Available routing algorithms.
- Available geoprocesses.
- Maximum analysis area size.

When a license is purchased, Gilytics will setup at least one administration user in your organization.

## Scenario Editors

The scenario editors can:

- Open projects created and configured by administrators
- Create, modify and delete scenarios in those projects
- Run processes to create resistance maps, corridors and paths, and run available geoprocesses
- Export reports and scenario results

The editor users **can not** perform administration tasks like:

- Create projects
- Add datasets to the company and add layers to projects
- Change categories or change layer configuration (rings)
- Access the administration site

## Viewers

Viewer users can see the data and results of projects configured by administrators and editors.

They are able to:

- Open projects (when they have permission)
- Add shared scenarios to them
- Explore the data and analysis results, including statistics. They can change locally their visibility and colors.
- Print reports
- Download the results

## Free Trial Users

Any user role can be provided temporarily by Gilytics as a trial user. These users are active for a limited period, normally 15 days.

In most cases, free trial users have the editor role, so they can test existing demo projects creating their own scenarios and performing analysis processes.

## Functions per User

The following table details which features are available for each user profile:

**Features per user profile**

Function	Action	Administrators	Editors	Viewers
Project	Open an Existing Project	Yes	Yes	Yes

	Create Project	Yes	No	No
	Rename Project	Yes	No	No
	Delete an Existing Project	Yes	No	No
	Assign/Update Project Name	Yes	No	No
	Draw/Import Project Area	Yes	No	No
	Draw/Import Start & End Points	Yes	No	No
	Add/Import/Delete Layers to a Project	Yes	No	No
	Change the Layer Configuration: Layer Preprocessing	Yes	No	No
	Organize Data: group layers by Category	Yes	No	No
	Create/Delete Category	Yes	No	No
	Change Layer Category	Yes	No	No
	Change Category Name	Yes	No	No
View	Search Layers	Yes	Yes	Yes
	Change Base Map in Project View	Yes	Yes	Yes
	Identify Point Tool	Yes	Yes	Yes
	Search Location Tool	Yes	Yes	Yes
	Measurement Tool	Yes	Yes	Yes
	Screenshot Tool	Yes	Yes	Yes
	Change Project View to 3D View	Yes	Yes	Yes
Scenario	Create Scenario	Yes	Yes	No
	Import/Export Scenario	Yes	Yes	Shared only
	Rename Scenario	Yes	Yes	No
	Delete a Scenario	Yes	Yes	No
	Change Layer Visibility/Color	Yes	Yes	Yes
	Assign/Import Layer Resistance Values	Yes	Yes	No
	Assign/Import Category Weights	Yes	Yes	No
	Change Scenario Settings (General, Points, Paths & Pylons)	Yes	Yes	No
	Access Scenario Layer Statistics	Yes	Yes	Yes
	Configure Cost Parameters	Yes	Yes	Yes
Process	Run Scenario Analysis Process	Yes	Yes	No
	Stop Scenario Analysis Process	Yes	Yes	No
	Generate Resistance Map	Yes	Yes	No
	Generate Corridor Map	Yes	Yes	No
	Generate Optimal Path	Yes	Yes	No
	Import Path for Comparison	Yes	Yes	No
	Access Path Analytics	Yes	Yes	Yes
	Change to 3D View	Yes	Yes	Yes

	Integrate 3D Data published to the Cesium Ion Server	Yes	Yes	Yes
	Access Underground Visualization	Yes	Yes	Yes
	Pylon Visualization	Yes	Yes	Yes
	Access Pylon Tools	Yes	Yes	Changes won't be saved
	Clash Analysis	Yes	Yes	Yes
	Export Scenario Results	Yes	Yes	Yes
	Export All Results	Yes	Yes	Yes
	Print Project Report	Yes	Yes	Yes
	Exporting Analysis Graphics	Yes	Yes	Yes
	Exporting Views	Yes	Yes	Yes
	Access to Routing Algorithms	Yes	Yes (*)	No
	Access to Geoprocesses	Yes	Yes (*)	No
Manage Company	Access Administration Site	Yes	No	No
	Add Base Datasets to an Organization	Yes	No	No
	Change Scenario Settings in the Admin. Site (Not Recommended)	Yes	No	No
	Change available routing algorithms	No	No	No
	Change available Geoprocesses	No	No	No
	Add Custom Pylons	Yes	No	No
Manage Users	Create other company administration users	Yes	No	No
	Create and manage non-admin users for the company	Yes	No	No
	Reset User Password	Yes	No	No
	Check User Activity	Yes	No	No

(\*) Trial users provided by Gilytics may have restricted access to algorithms and geoprocesses.

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