1. App Tutorial: Prepare TOPKAPI Model

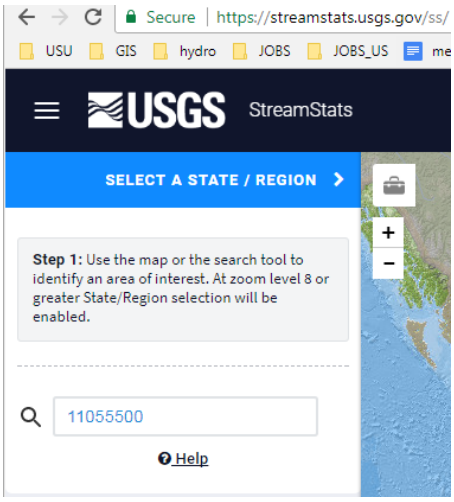
This tutorial provides step by step guidance for using the HydroTop app to prepare input-files for TOPNET. The steps given correspond to the Plunge River, the alternative use case mentioned in the text to demonstrate app's TOPKAPI modeling functionality.

Log on to the app's home page (http://appsdev.hydroshare.org/apps/hydrotop). If you are prompted to enter your HydroShare account, and to authorize the app to access your HydroShare account, please do so. As of this writing, the app is hosted by the HydroShare's development app portal, but this could change in the future.

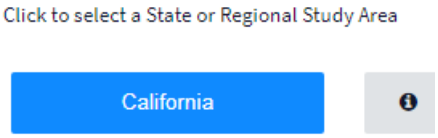
We are interested in modeling a watershed called Plunge that drains to the USGS gage 11055500 in south west California. We will need to know the position of the outlet, and the domain containing the watershed. Assuming we have the required information, lets proceed. The next section shows the procedure to get the model domain accurately using streamstats, which is the recommended method to define the model domain. You can skip the following section (*Get bounding box GeoJSON from Streamstat*) and go to *App Input* section if you already have a file describing the bounding box, or if you only want the App tutorial.

Get bounding box GeoJSON from Streamstat

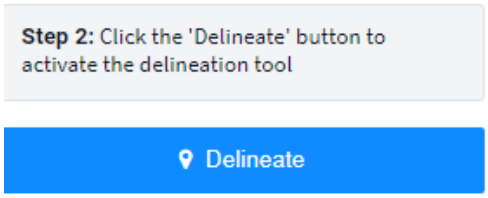
There are three ways to enter the domain, drawing on the map, explicitly typing them, or uploading supported file. In this tutorial, we will use a combination of the two. First, we will get a GeoJSON file for our watershed to accurately describe our model domain. For this, go to https://streamstats.usgs.gov/ss/, and enter the USGS gage id 11055500 in the search box field to the left of the screen.



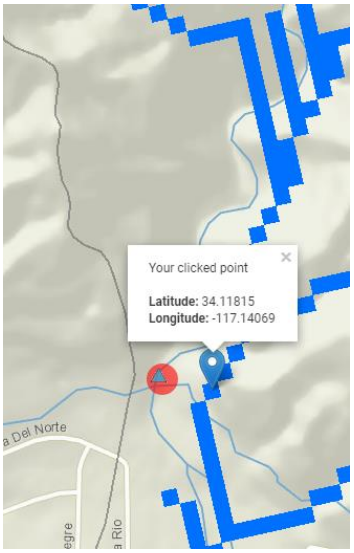
A button to confirm the location is California pops up. Click on it to confirm.



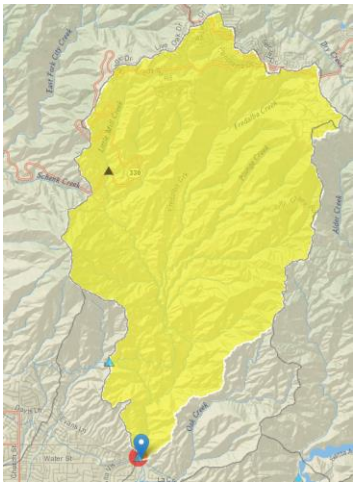
We want to delineate watershed for our USGS gage, so click on Delineate button to do so.



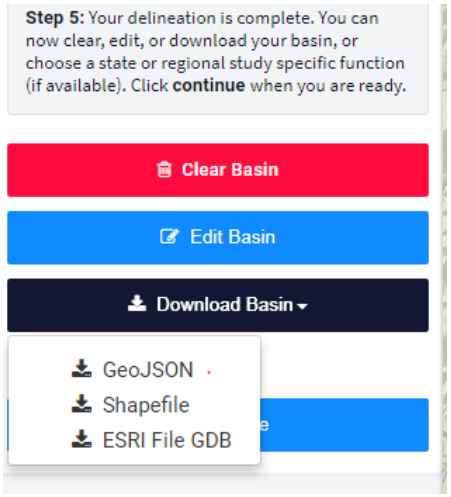
Now click on the stream location on the map, very close to the USGS gage location.



After waiting a few second, you should see the watershed getting delineated.

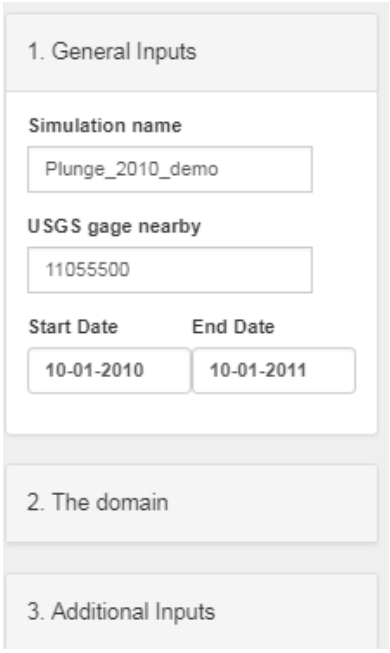


Now, head back to the left of the screen, and choose **Download Basin → GeoJSON**



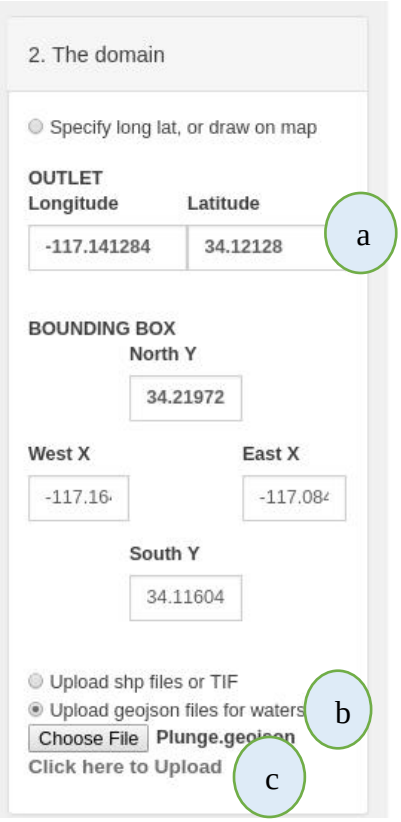
App Inputs

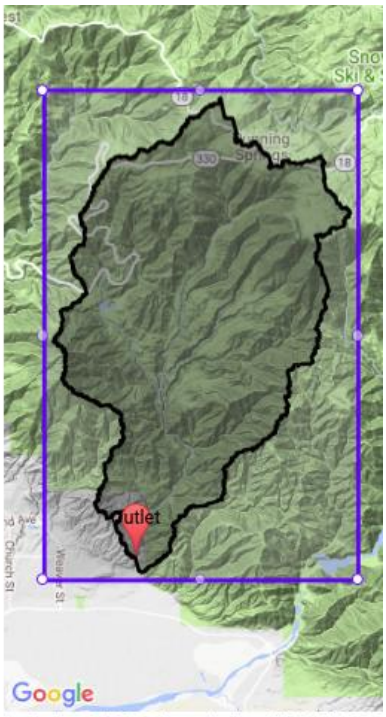
Switch back to the app's homepage. In the app navigation section to the top left of screen, click and expand the tab '**1. General Inputs**', and type in the simulation name, and start and end date of the simulation. In this example, we will do 2010 water year.



Expand '**The Domain**' section, and type in the latitude and longitude of the outlet, which is the location of USGS gage, as 34.12128 and -117.141284 respectively (Figure ..,

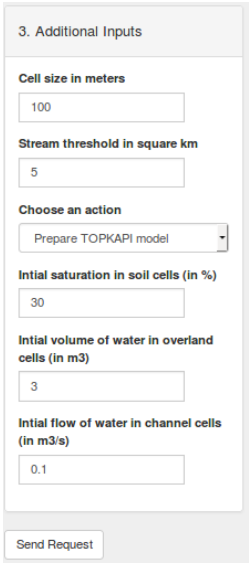
a). This should bring the outlet marker on the map to our point of interest. On the same section, check the "**Upload GeoJSON file for watershed**" button → **upload the GeoJSON** file you just downloaded → Click '**upload file**' button.





The map section should be updated with the watershed map and the bounding box surrounding the watershed. Also, the coordinates for the bounding box at the values at the navigation pane also should update accordingly.

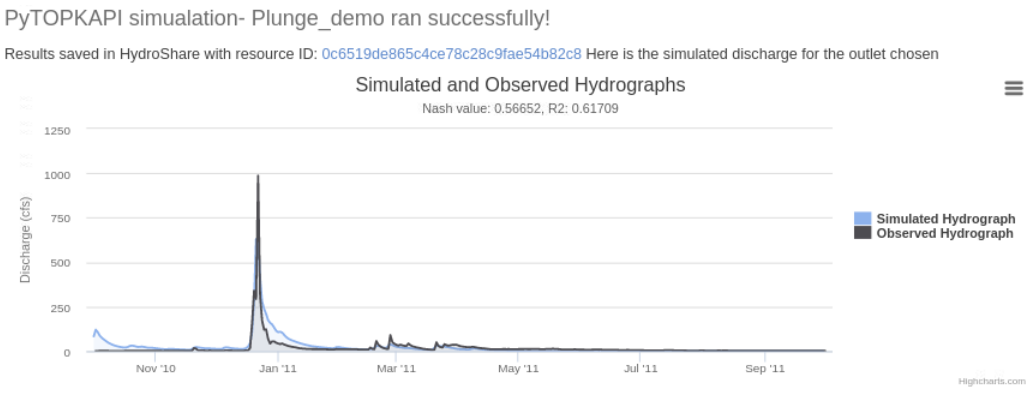
Now, head over to the navigation pane, click and expand the tab the third tab-'**3. Additional Inputs'**, complete the form as shown in the figure below.



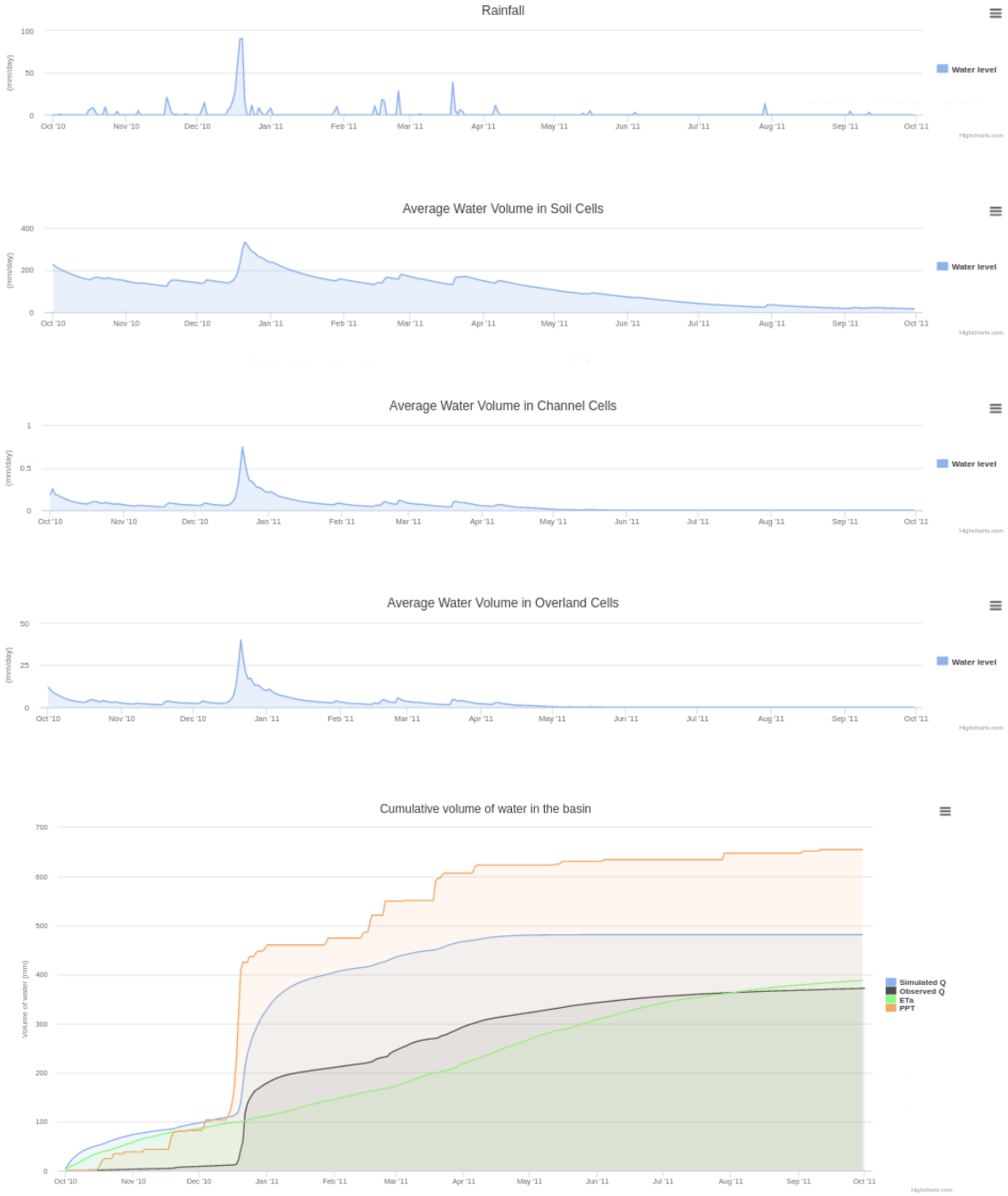
This is all the inputs required to create a TOPKAPI model. With the inputs completed, go ahead and click '**Send Request**' button. It will be few minutes for the app to do its work and return result. So make sure you don't close the page. If you accidentally closed it, that will be fine too. The model-instance will be saved in your HydroShare account so you will not lose the progress.

Results

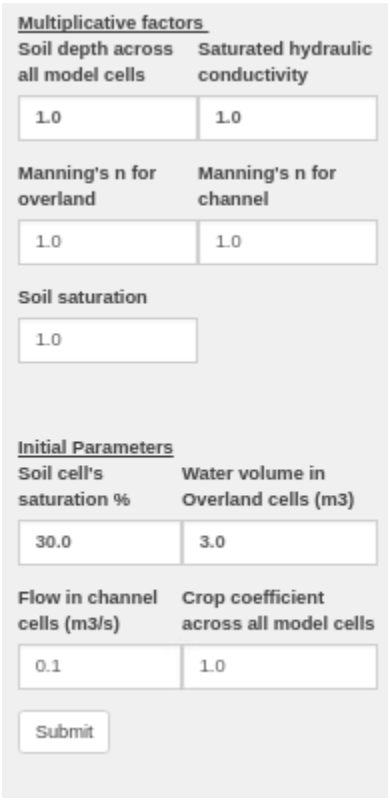
After a few minutes, you should get results (as shown in the figure below), which are the time series plots of the simulated and observed hydrograph. The plot also mentions a NSE value of 0.57, and an R^2 value of 0.62 for the two hydrographs.



There are also other time series plots displayed as shown in the figure below, like rainfall (Fig (a)), volume of water in soil (Fig (b)), channel (Fig (c)) and overland (Fig (d)) cells and actual ET(Fig (e)),. Additionally, a cumulative graphs of volume of water in the basin (Fig (f)).



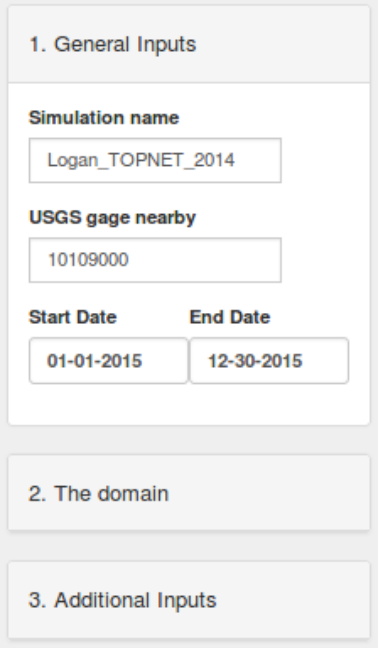
The initial values used for the model are displayed in the left section of the app, which is shown in the figure below:



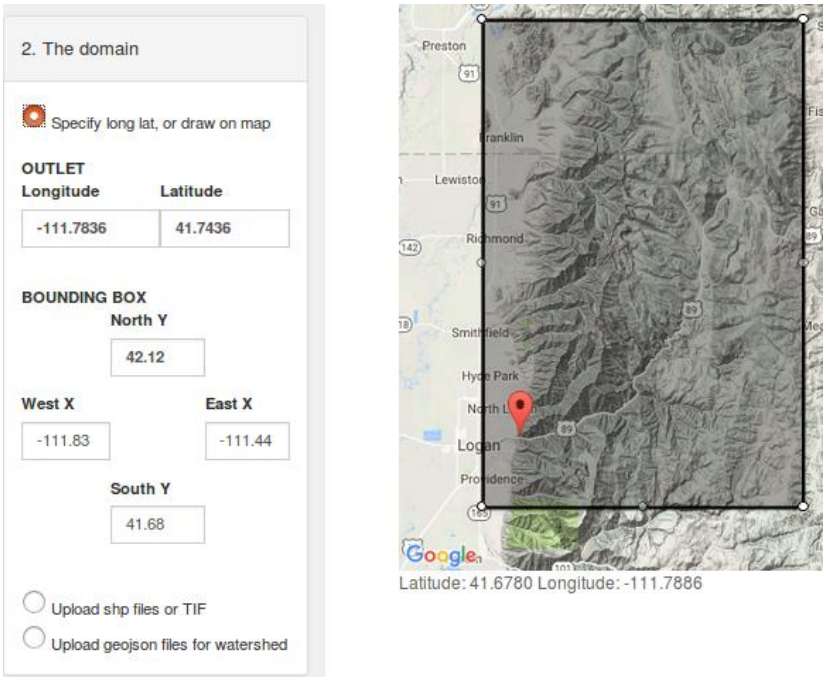
2. App Tutorial: Prepare TOPNET Input Files

This tutorial provides step by step guidance for using the HydroTop app to prepare input-files for TOPNET. The steps given correspond to the Logan River use case for TOPNET input files creation described in the text.

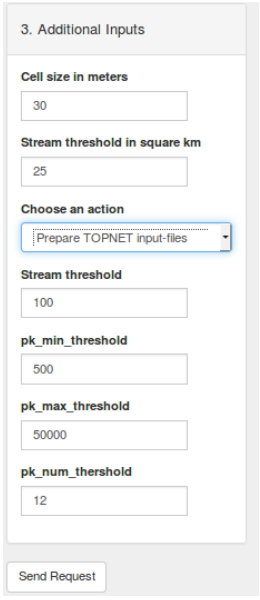
To start, log on to http://appsdev.hydroshare.org/apps/hydrotop, the app's home page. In the *app navigation* section to the top left of screen, click and expand the tab '**1. General Inputs**', and type in the simulation name, and start and end date of the simulation. In this example, we will do 2015 calendar year.



Expand '**The Domain**' section and click '**Specify long lat'** radio button. Type in the latitude and longitude of the outlet, which is the location of USGS gage 10109000, as 41.7436 and -111.7836 respectively. This should bring the outlet marker on the map to our point of interest. On the same section, enter the bounding box coordinates for North Y, East X, South Y and West X as 42.12, -111.44, 41.68, and -111.83 respectively.



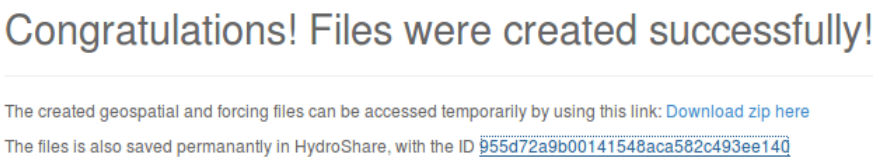
The map section should be updated with the watershed map and the bounding box surrounding the watershed. Now, head over to the navigation pane, click and expand the tab the third tab-'**3. Additional Inputs' → 'Prepare TOPNET input-files**', and complete the expanded form for TOPNET inputs as shown in the figure below.



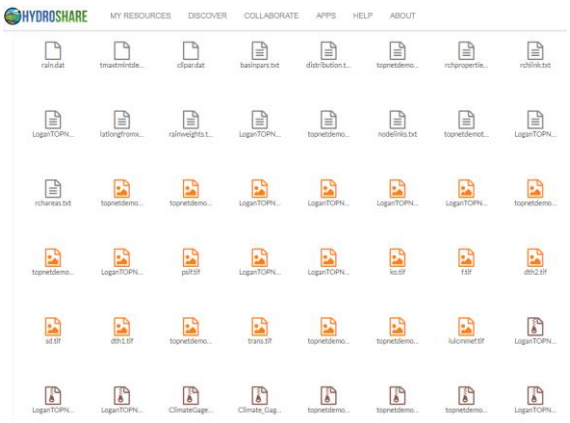
This is all the inputs required to create input files for TOPNET model. With the inputs completed, go ahead and click '**Send Request'** button. It will be few minutes for the app to do its work and return result.

Results

After a few minutes, you should get the prompt (as shown in the figure below), saying the files were created successfully. This page will have a temporary link to the zipped file that contains all the files for you to download immediately. Also, you will have a link to HydroShare where the file is permanently stored. The results of this analysis can be found in HydroShare, and has been made public and available at https://www.hydroshare.org/resource/955d72a9b00141548aca582c493ee140/



Snippet of files shaved in HydroShare is a shown in the figure below.

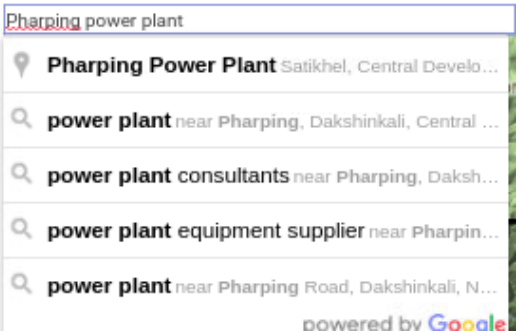


3. App Tutorial: Perform Terrain Analysis

This tutorial provides step by step guidance for using the HydroTop app to perform terrain analysis. The steps given correspond to the terrain analysis for the Bagmati River in Kathmandu, Nepal use case.

To start, log on to the app's home page (http://appsdev.hydroshare.org/apps/hydrotop). The outlet location, and the extent of the area that includes the watershed are required as inputs. Assuming we have the required information, lets proceed.

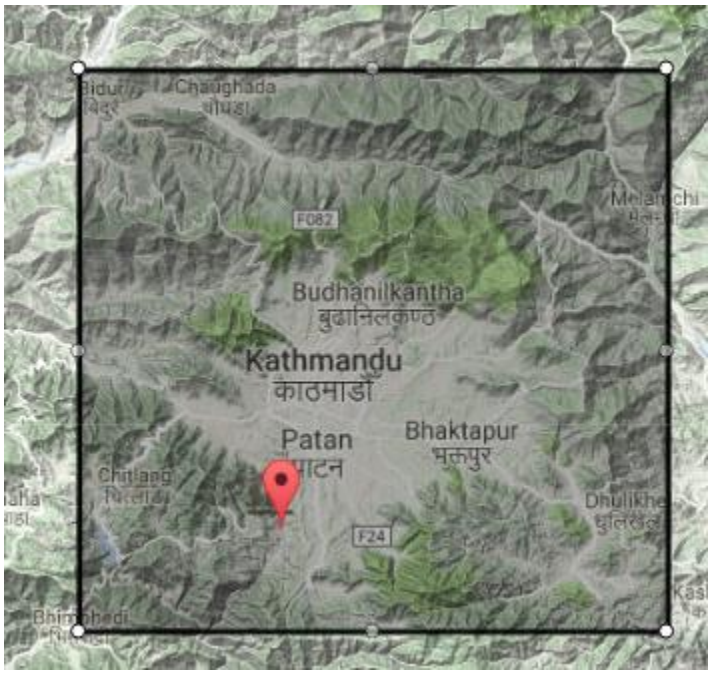
To quickly go to our desired location, type in 'Pharping Power Plant' in the search box located at the top-left of the map element.



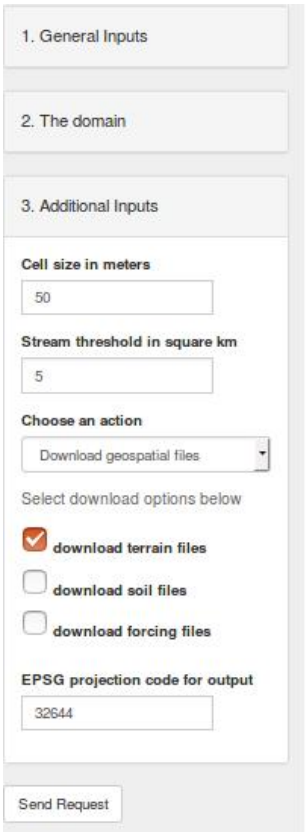
Now, click on this icon at the top-center of the map element,  and draw the outlet point on the Bagmati River.

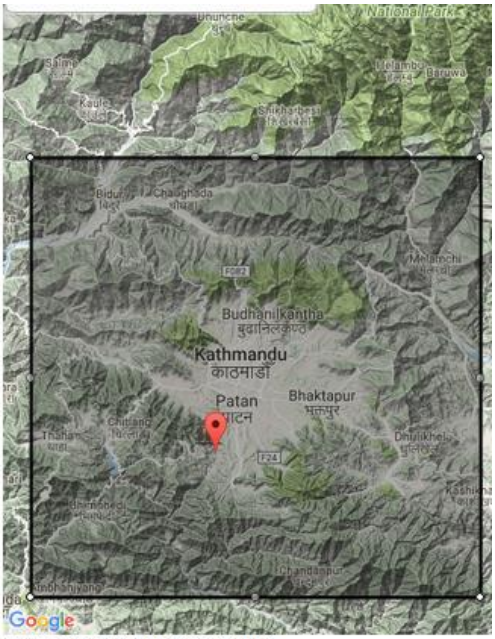
Now zoom out until you see 5km in the scale at the bottom-right of the map 

. Draw a rectangle that completely surrounds the valley using the 'rectangle draw' toolbar from the top- center of the screen.



In the app navigation section, type in the name of the simulation as 'BagmatiRiver-Kathmandu' or any other name that you would want to give. This name will be used in HydroShare to name the resources. You can ignore the other inputs in the tabs '1. General Inputs' and '2. Domain'. Now head over to the additional input tab and fill the form as shown in the figure below. Because this area is outside US, only 'downloading terrain files' option will work, which should be checked by default when you chose 'Download geospatial files' in the 'Chose an action' menu.





This is all the inputs required to create perform terrain analysis. With the inputs completed, go ahead and click 'Send Request' button. It will be few minutes for the app to do its work and return result. So make sure you don't close the page. Again, if you accidentally closed it, that will be fine too. The files will be saved in your HydroShare account so you will not lose the progress.

Results

After a few minutes, you should get results page displayed, which will have a temporary link to the zipped file that contains all the files for you to download immediately. Also, you will have a link to HydroShare where the file is permanently stored. The results of this analysis can be found in HydroShare, and has been made public. If you want to

check it out, here is the link: https://www.hydroshare.org/resource/ebda23b9e6054f5d8e6dc1ddb1594d26