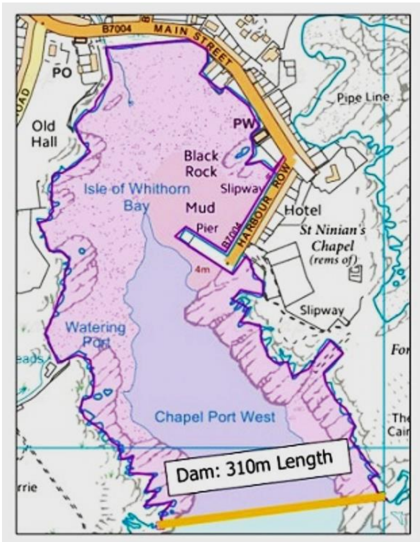
Isle of Whithorn Tidal Barrier

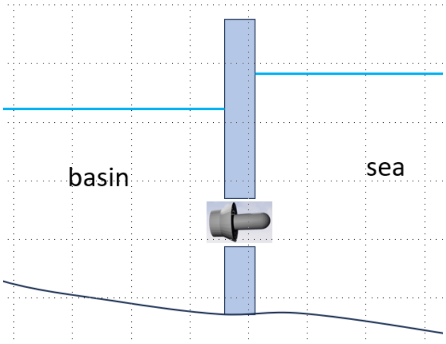
Background. This was a proposed project to alleviate flooding around a bay, details at the link below. The idea was to build a barrage across the inlet to the bay with a pipe to let some water in and out. The water height variation in the bay is less than the sea height variation due to the pipe. Also, a generator was to be placed inside the pipe. This would produce power on the ebb tide only (when water flows out of the basin).

A big question is how to choose the diameter of the pipe, since this will influence both the basin water height variation, and also the power generated. This is a main part of this study.

There is one important technical factor. The turbine will only generate power if there is a minimum water difference between basin and sea. This minimum 'head' is coded as the parameter **hmin**.

https://www.esru.strath.ac.uk/EandE/Web_sites/14-15/Tidal_barrage/turbine.html





Files and Levels
Level **Whithorn** from the **MainMenu** then the actor **MAS22_Tidal_Basin**

Octave Script **Whithorn_Data** which plots power and basin max water height as a function of turbine hole diameter.

Parameters (Independent Variables) available

pipe diam Diameter of the turbine pipe (m)
sea High Water maximum height of the tide
sea Low Water minimum height of the tide
hmin Minimum basin – sea water height difference ('head') for the turbine to operate.

Dependent Variables to observe:

HUD
sea height
basin height
power

Octave file (as function of time)
sea height, basin height, power

Getting Started

Orientation. Run with the default parameters for 40 to 50 seconds and generate the Octave plots or sea height, basin height and power. Note the differences between sea and basin heights. Also look at when power is being generated, can you deduce from the basin height graph the direction of water flow when this is happening?

Study 1 Effect of pipe diameter. This is the most important design parameter for the barrage. It influences both the maximum basin height and the power produced. The default value is 2m. You should investigate values smaller and larger than this. Watch out for any flooding around the edges of the basin, the front part of the jetty has a height 5m and the rear part 6m.

Other Ideas

1. You could investigate the effect of **hmin** on power generated. This is the minimum head needed for the turbine to operate. This would lead to the best choice of turbine to use.

2. You could investigate how the pipe diameter affects the *time* for the basis to fill or empty. To do this edit the script **MAS22_System.ini** (which you will find in the **Saved/Config**) folder. Change the **forcingTypeStr** to the option **"Constant".** Then run the simulation and after some time decrease the parameter **sea High Water** from 5.3 to something like 2.0. Wait a bit and then look at the Octave plot, perhaps make a snip. Repeat for a few values of **pipe diam** and compare your snips.

Hints for Roundup

Reflect on the amount of power produced, could this provide enough power for the 300 or so people living nearby?

Have you discovered any 'trade-off' in dependent variables as you change a parameter? What does this mean?

Can you estimate the cost of building a concrete barrage (some Googling required)? How many years would it take for this cost to be recovered from generated electricity?

Can you foresee any social impacts of such a project (outside its intended goals)? Think positive and negative aspects of the barrier structure.

Domestic electrical energy consumption per household per year (2023) is 2700 kWh, which means an average continuous power draw of 2700/(365*24) = 0.31kW.

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