**Introduction:**

For our project, we will be utilizing the Daily Streamflow by Watershed, 15-minute Precipitation by Watershed, and Total Daily Precipitation by Watershed datasets provided by the Hubbard Brook Experimental Forest. Our client wishes to have an app that produces visualizations and analyzes trends for specific watersheds in the Hubbard Brook Experimental Forest. Our client wants the app to graph water flow, precipitation, time, and possible baseflow for a watershed. In addition, the app should also be able to perform trend and storm analysis, 30-day rolling averages, and enhanced viewing of the data to allow the user to choose specific months of the year to look at.

This data is collected two ways, the flow data comes from weirs placed at the bottom of the watershed so flow can be collected for the entire span of the watershed. The data we are using is also the daily flow which is measured in mm/day. The precipitation data is also measured daily but is extrapolated from water gages. They do this by using a weighted average where the gage closest to the watershed is what is treated as the precipitation measurement for that watershed. This data is also measured in millimeters per day, which means that both datasets have the same unit. That means for conversions we want to do (like to cfs) it would be very easy as both datasets go through the same conversion.

**App Mockup:**

Our app has a bunch of features that we want to include, and quite a few that we could include later depending on our progress. The first is our goal is to allow for the input of other datasets beyond the one provided to us by Hubbard Brook. Second, we want a way to graph precip, flow, and baseflow on the same graph that also allows for zooming in on the graph. We want to allow for trend analysis including 30 day rolling averages, or a given length of time. We want to allow for editing the tables, or downloading the data that we are using. And we likely want to do this in a format with multiple pages that can be accessed by the user. This allows for each page to have a separate focus, for example a page for the trend analysis, a page for the datasets and inputting your own data, and the main page of the precip and flow graph. This would allow for the app to feel less cluttered and the user to be able to explore the data in a more fluid way.

**Existing apps with similar functionality:**

There are a few apps we’ve seen that do work similar to what we are aiming for. The first one is Dr. Gannon’s water balance app, this app talks about storage, outputs, and precipitation and creates graphs for all of them. I think that is similar to what we want to do. This is done by running a model behind the scenes that uses precip in millimeters and temperature in Celsius for each month. Another example takes in a precipitation dataset, and uses that to create graphs, but it requires flow in cfs and a very specific template for it to work. Dr. Gannon has another example which is a discharge app for Hubbard Brook this is really similar to what we want, the graph shows discharge, precip, and supposed to have baseflow as well. sHystreamflow is used to map streamflow data, precipitation, and monthly discharge, it also has statistics for your selected data range, I think this could be helpful, especially with 30-day rolling averages. Lastly is the EcohydRology app, this is a package that is shut down, but we can use the code they created to extract baseflow for our own baseflow line to add to our graphs.

**Expected issues:**

Given the scale of the app we are trying to build, we have identified some potential issues that may come up during the development phase. In the Total Daily Precipitation by Watershed dataset, we are unsure if snowfall is included in the precipitation value. We don’t know how this will affect the streamflow of the watersheds as the snow will not melt and contribute to the flow immediately. Another issue is that since we are in the early stages of designing our app, we aren’t quite sure of how we want the graphs to function. We are still trying to figure out how multiple graphs will interact with each other and how they will be displayed on the app. Similarly, we will also need to figure out how to tackle having multiple datasets being used in the app as once. We could potentially combine all the datasets into one, but having one very large dataset could lead to a higher chance of encountering issues or difficulty finding specific data. Another key issue is user input in the app. We want to make sure that nothing will break when the user goes in and changes some variables, so we will have to incorporate a good amount of redundancy into the code of our app. The final potential issue is linear models with dates. The dates in the datasets are given as year-month-day so we will have to separate them out in order for the user to look at individual days, weeks, or months.

**Links to data:**

Daily Streamflow by Watershed: <https://portal.edirepository.org/nis/mapbrowse?packageid=knb-lter-hbr.2.14>)

15-minute Precipitation by Watershed: <https://portal.edirepository.org/nis/mapbrowse?packageid=knb-lter-hbr.278.5>

Total Daily Precipitation by Watershed: <https://portal.edirepository.org/nis/mapbrowse?packageid=knb-lter-hbr.14.19>

Links to other Apps:

Gannon’s app: <https://cuahsi.shinyapps.io/WaterBalance/>

GRWAT package in R: automatic hydrograph separation and hydrological time series analysis: <https://cran.r-project.org/web/packages/grwat/grwat.pdf>

https://github.com/tsamsonov/grwat

<https://sccwrp.shinyapps.io/rainfall_flow_analysis/> (Predicts flow based on rainfall inputs

<https://jpgannon.github.io/discharge_app.html>

<https://owrc.github.io/shinyapps-manual/>

A graph showing the number of days and months

AI-generated content may be incorrect.