Hydrological Analysis of Post-Fire Responses within the Little Creek Watershed of Swanton Pacific Ranch

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Background

- Various factors such as climate change, forest densification, etc. can be associated with:
  - → longer, more severe wildfire seasons
  - → more burned area (Dennison et al., 2014; Pausas & Keeley, 2021; Radeloff et al., 2005)

- Subsequently, fires can impact:
  - → water supplies, water quality
  - → **<u>flooding, changes in peak flows</u>**
  - → terrestrial and aquatic ecosystems (Niemeyer et al., 2020)
  - → increased likelihood of hazardous and deadly debris flows (Esposito et al., 2019; Nalbantis & Lymperopoulos, 2012).

(Wellman, 2018)

General Theory of Post-Fire Hydrology

- **Less vegetation**
  - → Reduced evapotranspiration and interception
  - → More water passing through
- **Burning/volatization of material**
  - → Reduced soil infiltration
  - → Also boosts water repellency
- **Ultimately…**
  - → More runoff & erosion

(Hallema et al., 2017; Ebel & Moody, 2013).

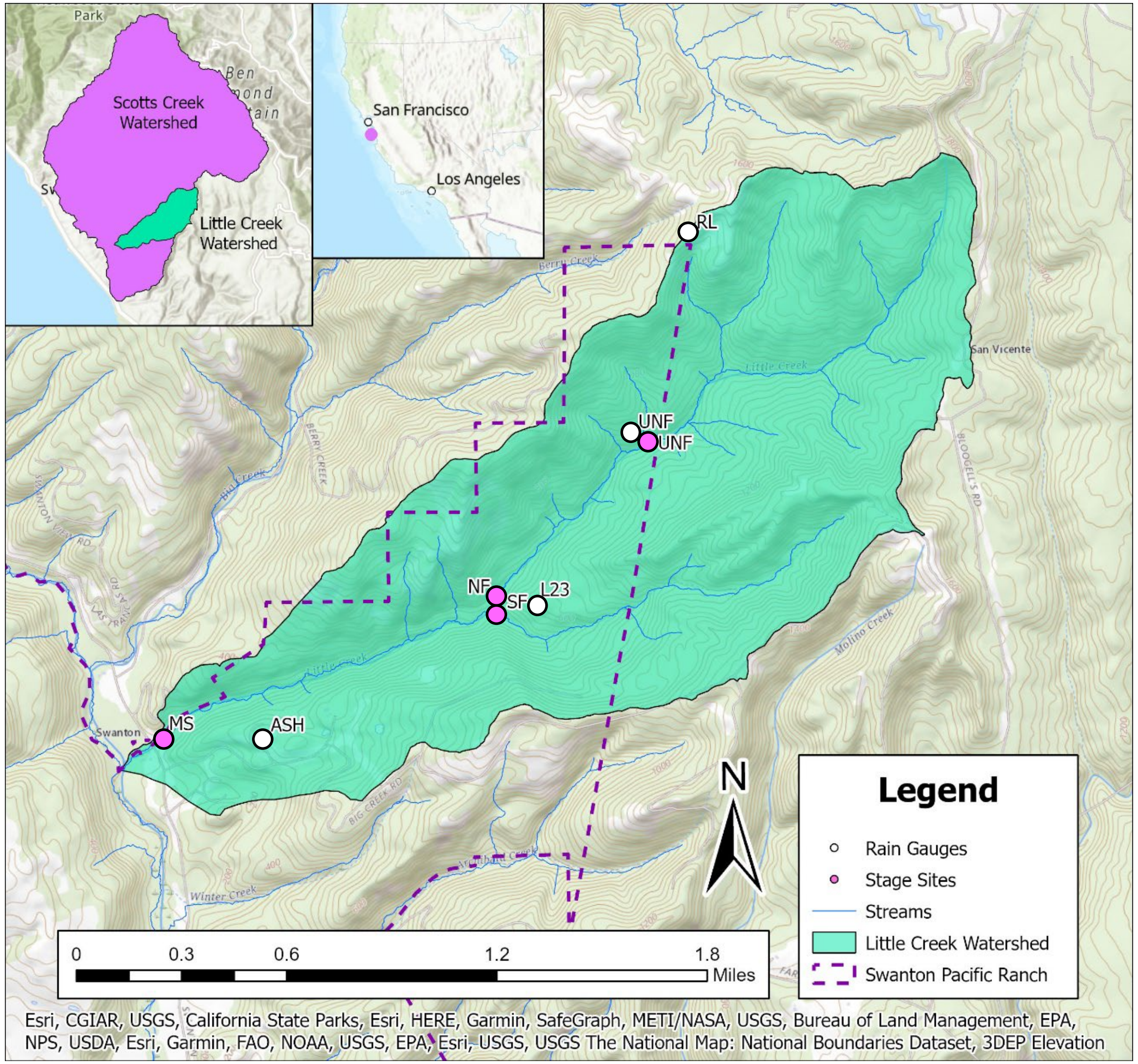
Problem Statement

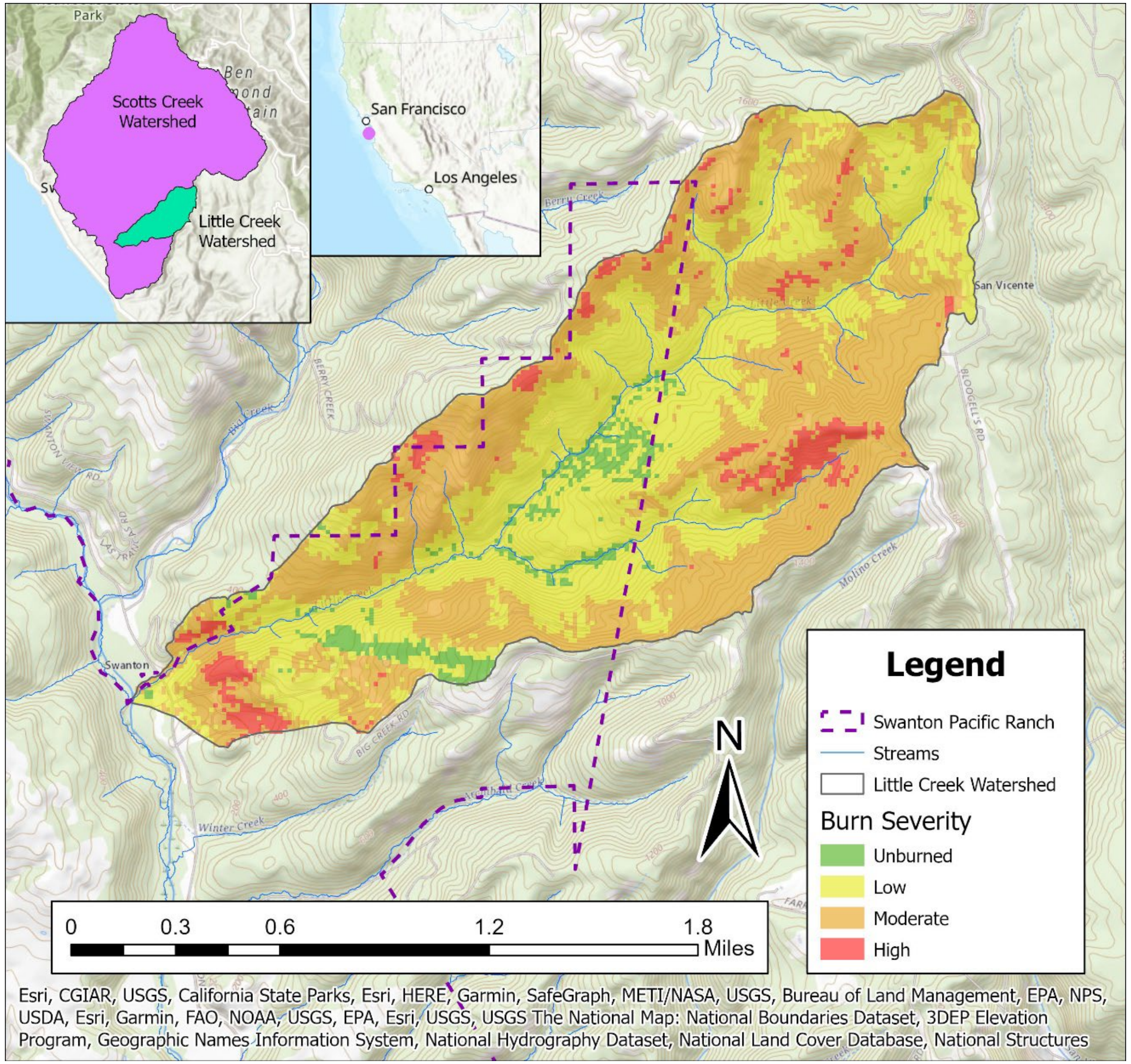
- The measurable extent to which fires affect the hydrology of a watershed has proven difficult. Some challenges include:
  - limited research efforts,
  - lack of available data (Seibert et al., 2010),
  - and short research timespans (Moody et al., 2013)
- Fire agencies need reliable data for accurate predictions to make decisions (Chen et al., 2013).
- Knowledge gaps also arise in addressing postfire hydrology for coastal-redwood forests.

Objective

- Evaluate the hydrological responses of the Little Creek watershed for hydrologic years (HY) 2021 through 2024 after exposure to the 2020 CZU Lightning Complex Fire.
- Specific sub-goals include:
  - Develop rating curves based on stage and streamflow data.
  - Develop a time series of streamflow and rainfall, and a compilation of storm events.
  - Analyze the pre- versus post-fire storm volume and peak flows via linear regression analysis
  - Make post-fire runoff predictions from commonly used post-fire assessments.
  - Compare the post-fire runoff predictions to the actual post-fire runoff calculations.

Study Location





Procedure

- Data Collection – rainfall, stage, and streamflow
    - Additionally calculate API (soil moisture indicator)

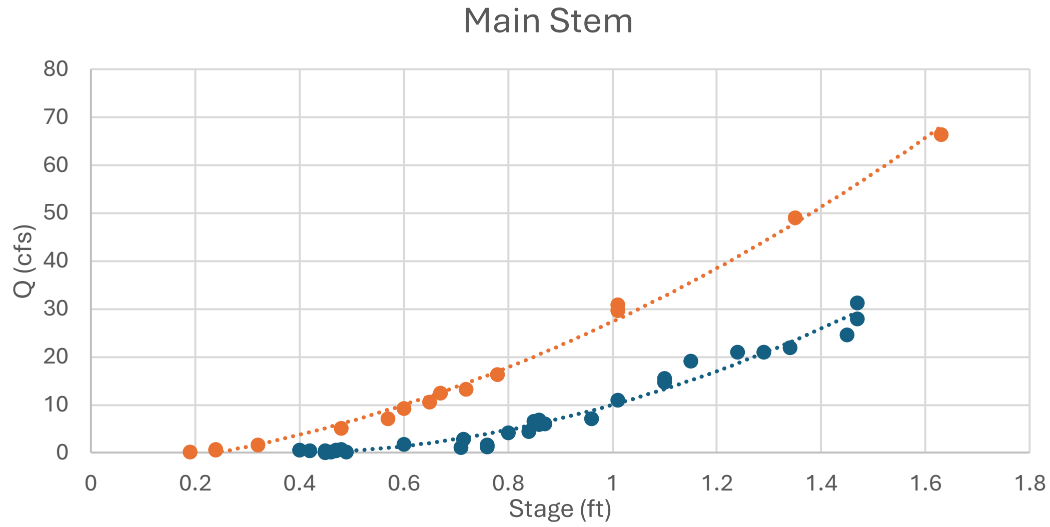
Rainfall

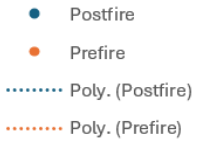
Stage

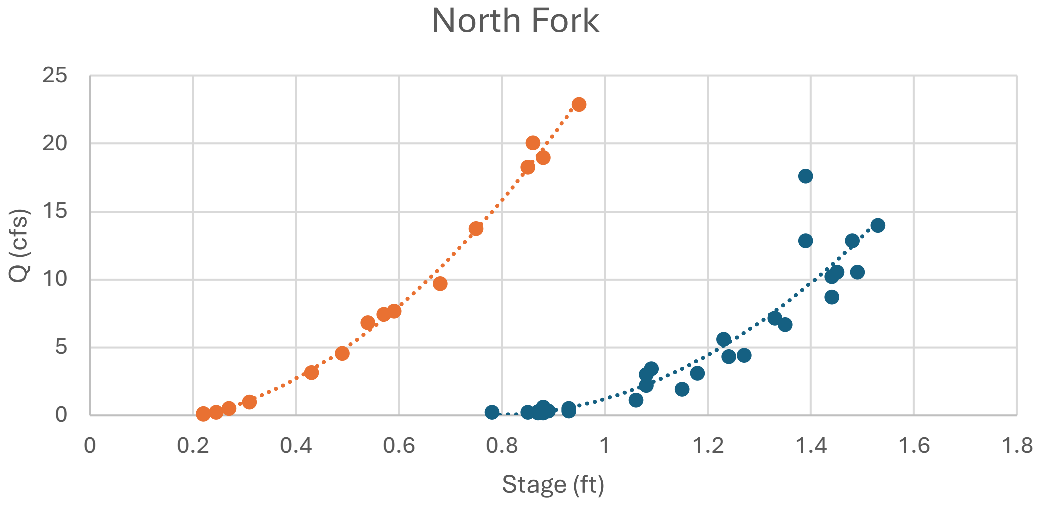
Streamflow

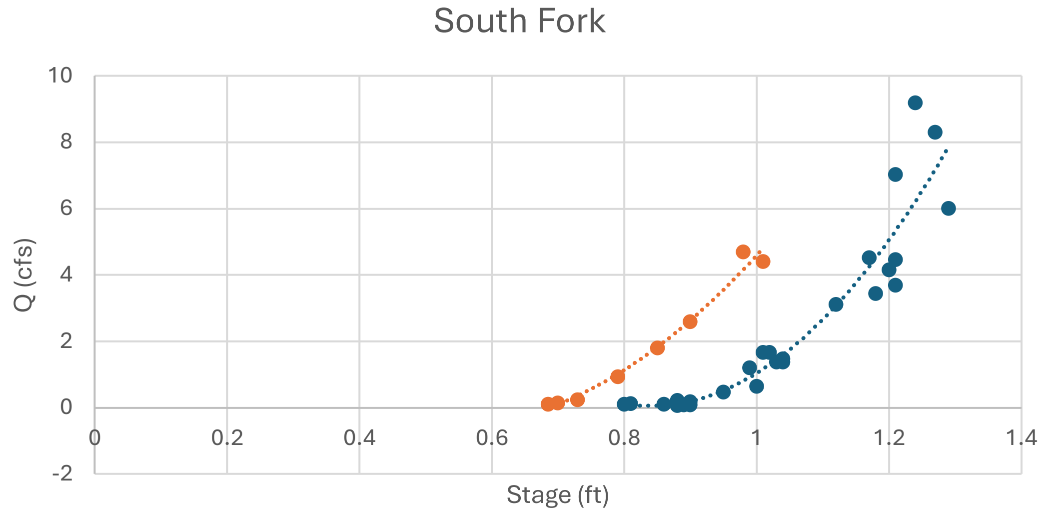
Procedure

- Rating curves plotted
  - → these curves relate stage to streamflow
  - → were used to convert stage data into a continuous time series of streamflow









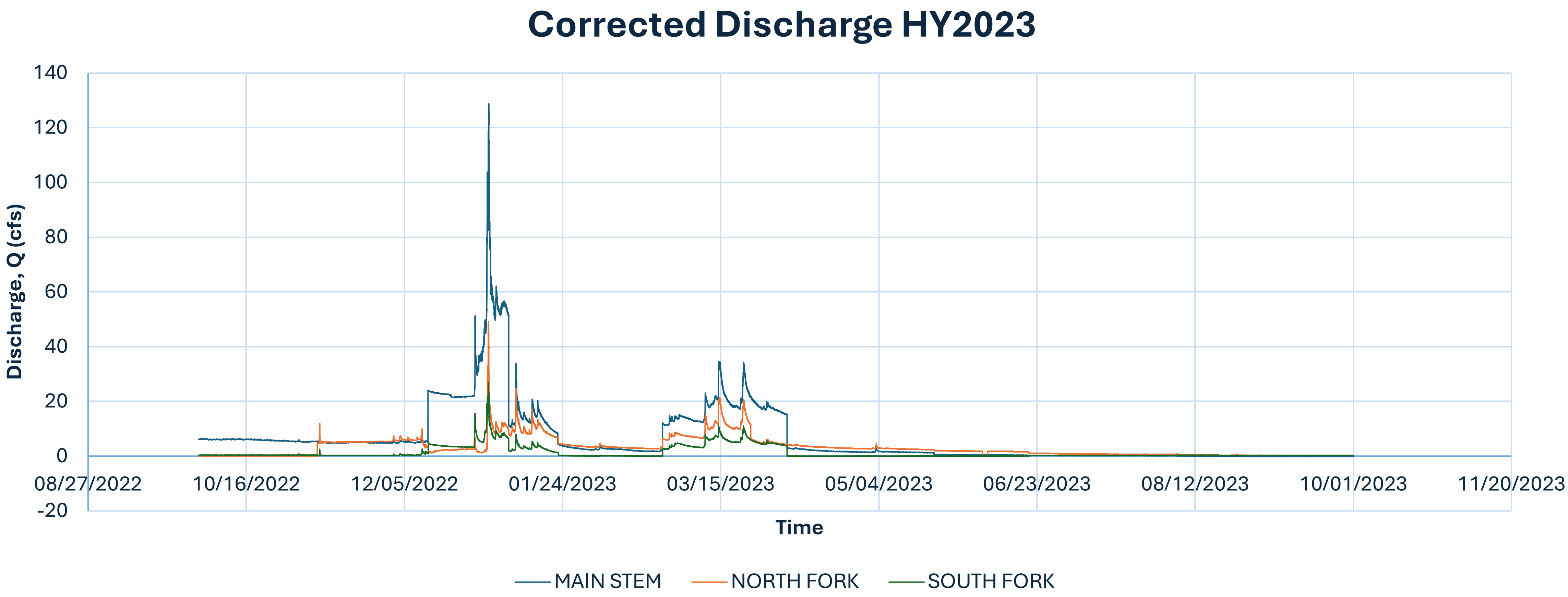
Procedure

- Identify and separate events on the hydrographs into “storms”
  - Use baseflow recession rates to determine end of storm events

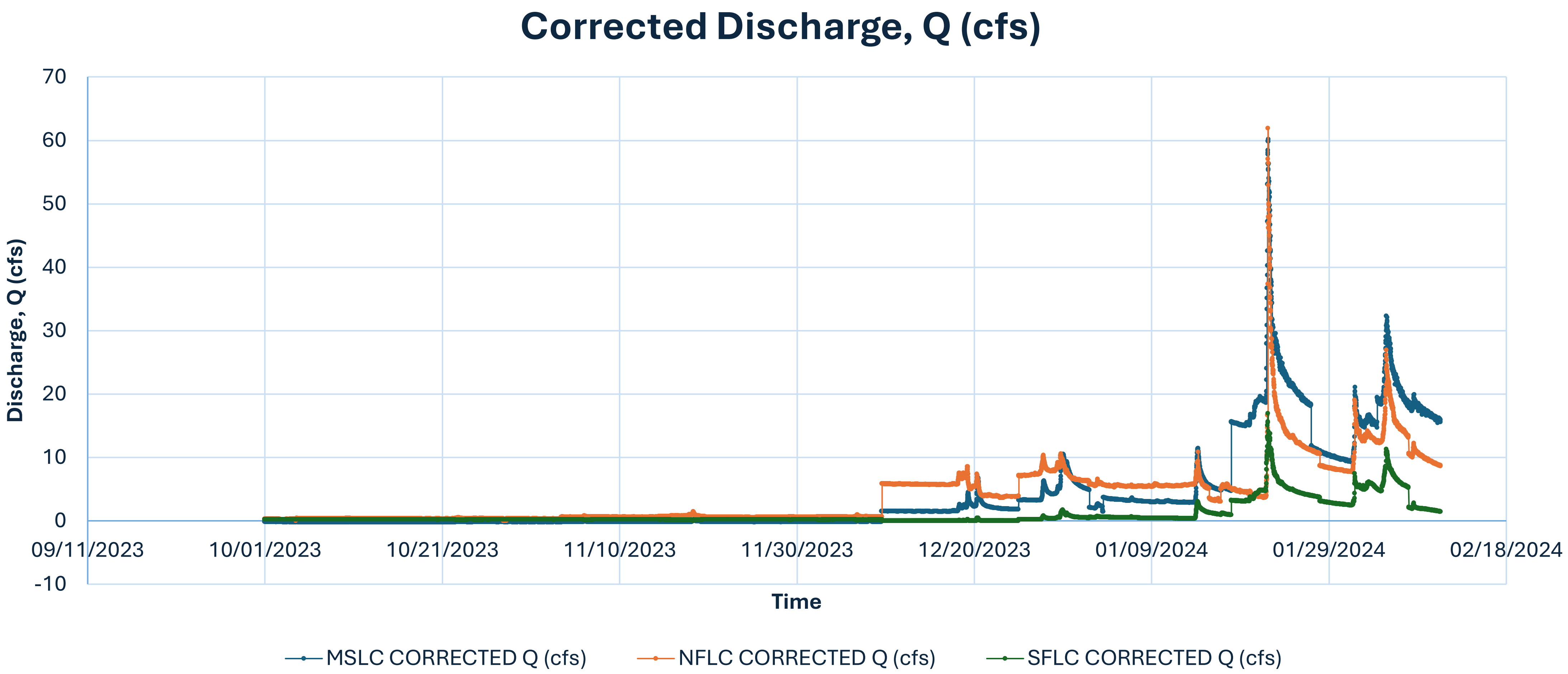
- Gather peak-flow and total storm volume from the events

- Compare post-fire data (2023-2024) to pre-fire calculations, which are estimated from a statistical regression equation from 2001-2008 data, Dupuis, 2022.

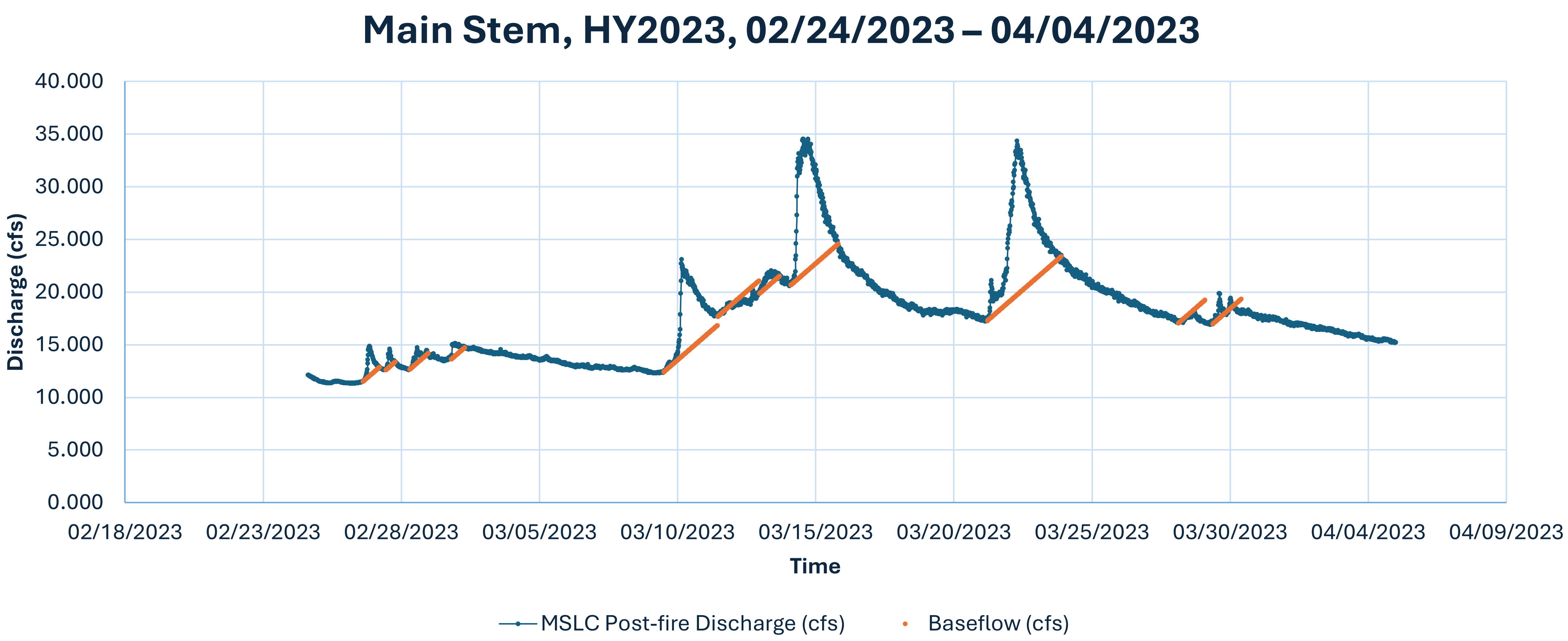
Concurrent Results (HY2023)



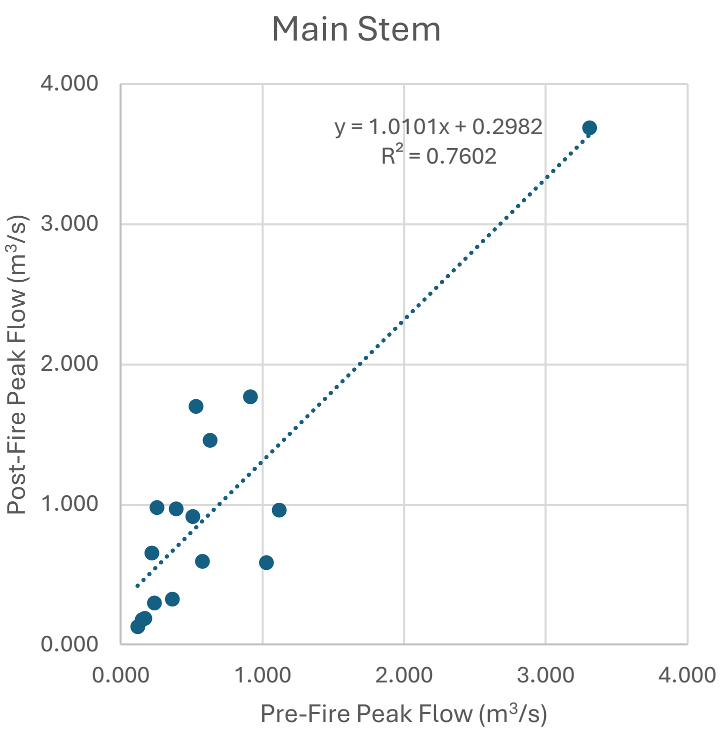
Concurrent Results (HY2024)

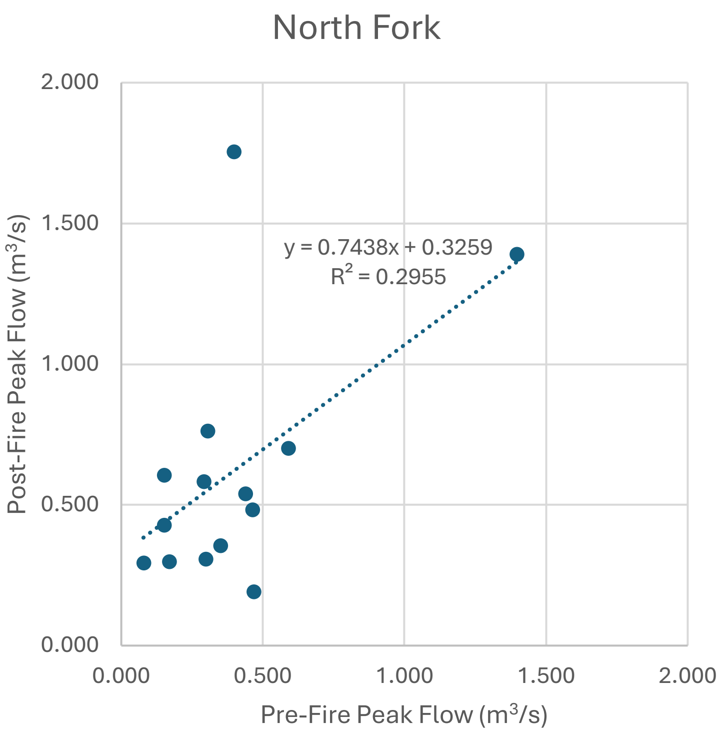


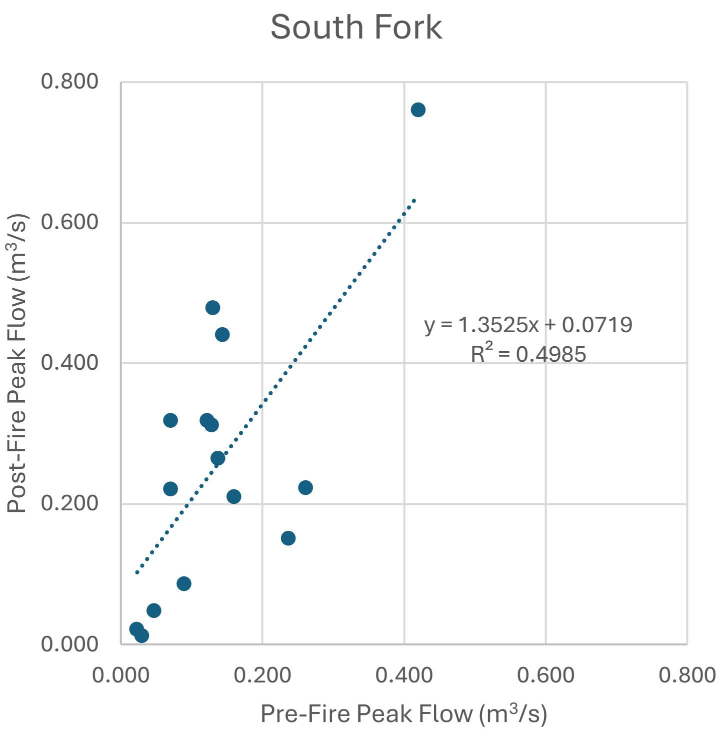
Sample Storm Separation



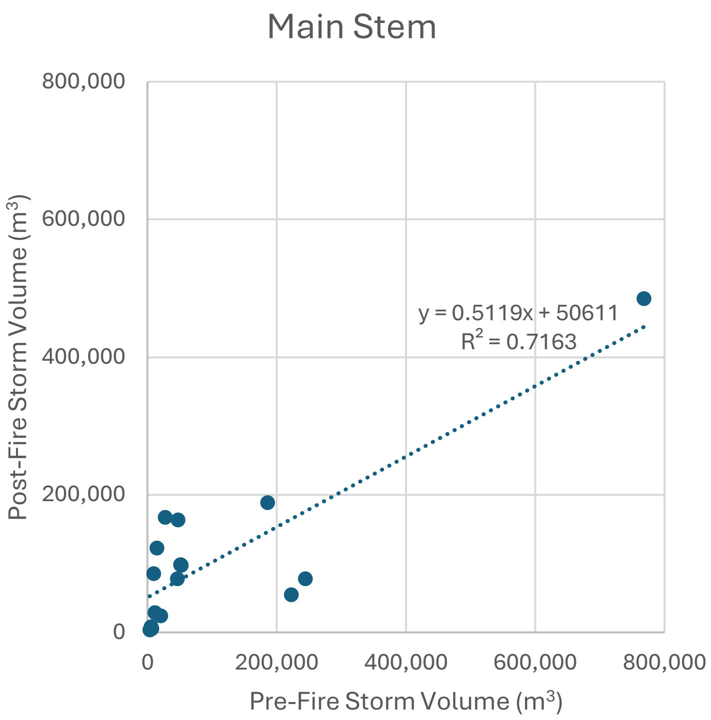
Preliminary Results: Pre- versus Post-Fire Peak Flows

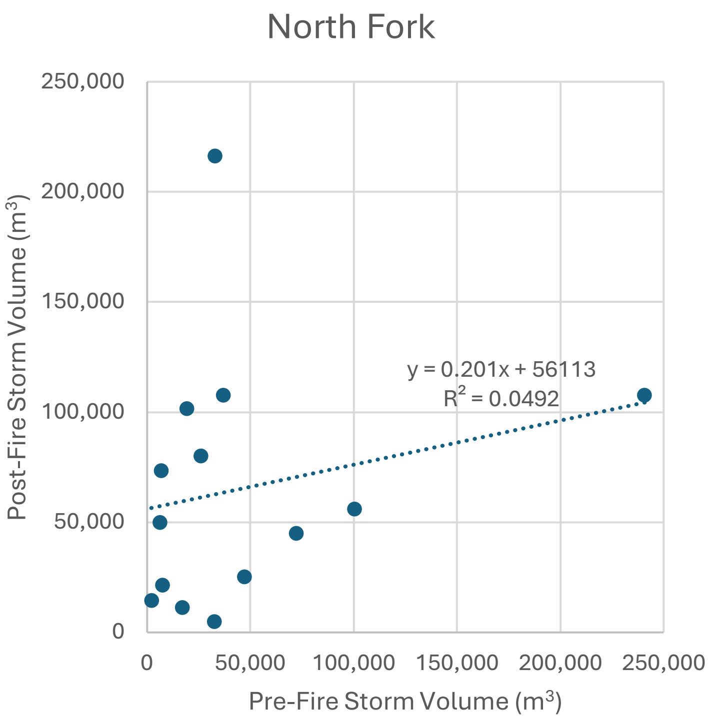


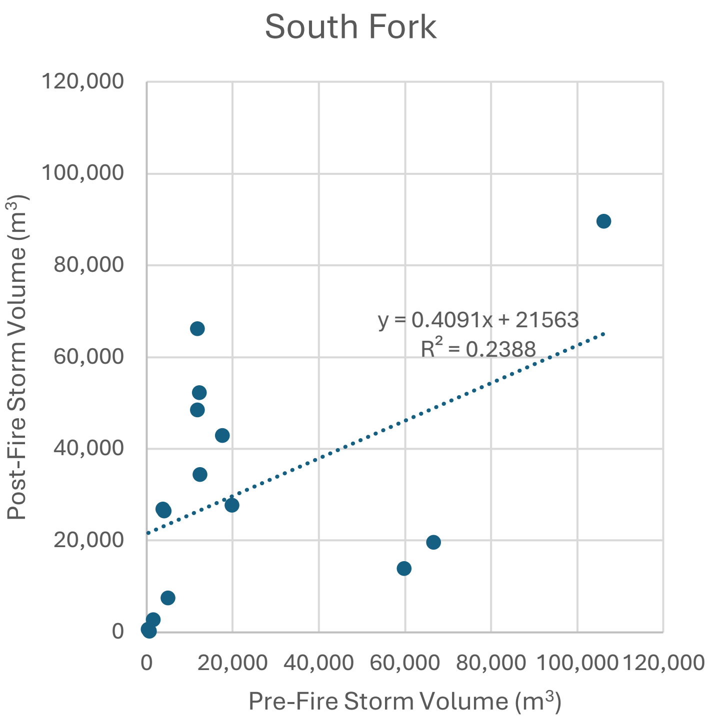




Preliminary Results: Pre- versus Post-Fire Storm Volumes







Next Steps

- Analyze the pre- versus post-fire storm volume and peak flows via linear regression analysis
- Use Little-Creek data to improve commonly used post-fire flood-assessment estimates

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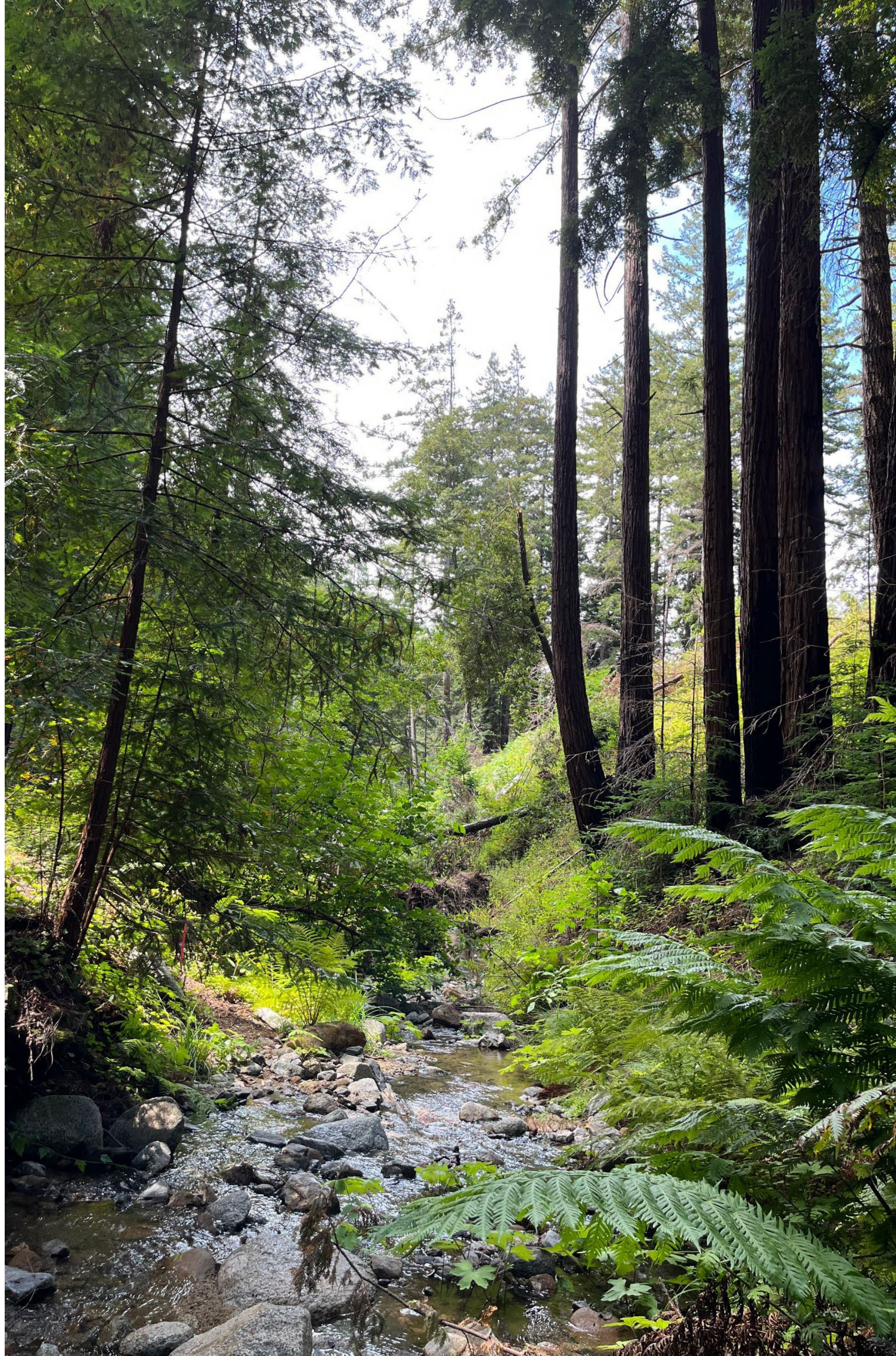

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