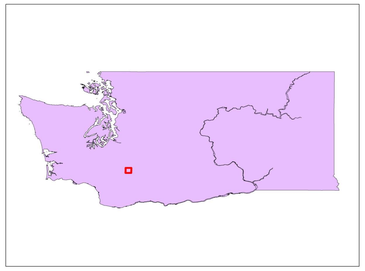

# The Annual Surface and Ground Water Nutrient Budget of Spirit Lake, Mount Saint Helens, WA

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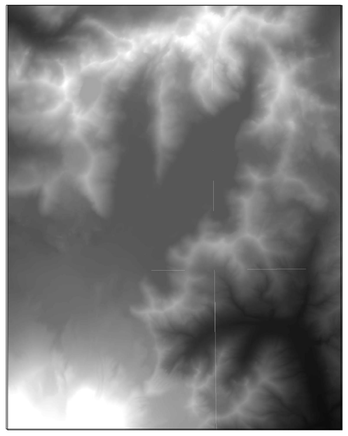
## Purpose:

**This project stems from an effort to create a nutrient budget for Spirit Lake to better understand the enhanced primary production taking place with in the shallow shorelines of the South end of the lake. Research done at Spirit Lake takes place in the summer months, spanning from June to September. According to the USGS lake level data the average flow of the summer months is a good representation for the annual flow. However only accessible, running streams are sampled. To better understand the nutrient budget of the Spirit Lake Watershed, it is useful to model the total annual Surface Water flows and nutrient loads.**

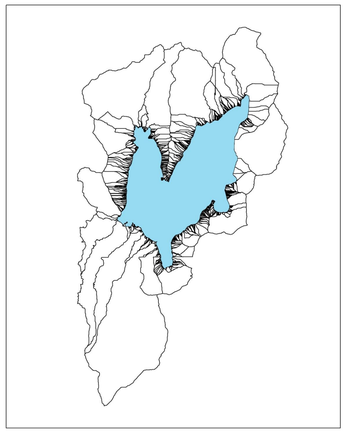
**•If Surface Water flow is proportional to drainage basin area, then flow can be modeled by basin area.**

## Objective:

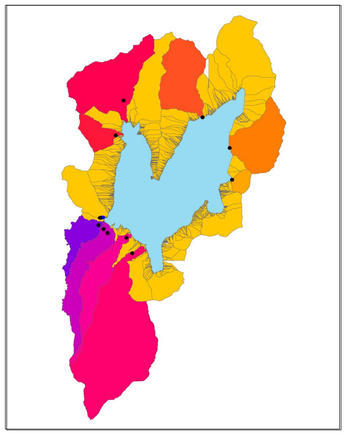
**To develop drainage basin areas to annualize total flow and nutrient loads.**



Mosaic DEM



Drainage Basins



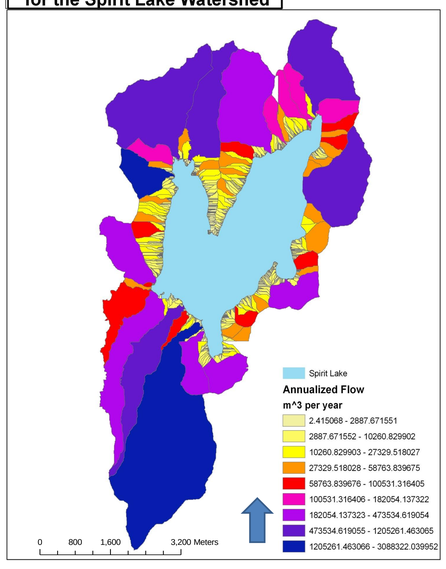
Sample Points and Sampled Basins

## Methods:

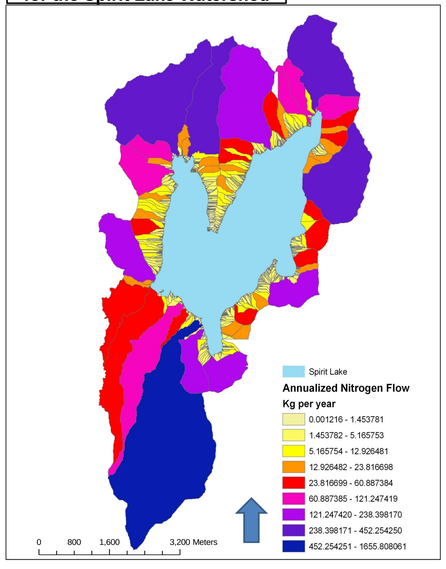
• A Flow Direction layer was created by imputing a surface raster of the Spirit Lake Watershed area.
•Drainage Basins were then created by imputing the Flow Direction layer.
•Select by Location was utilized to extract only the basins flowing into Spirit Lake.
•To gage accuracy, the Flow Accumulation tool was used revealing streams.
•Collected data points matched up with created stream locations.
•Measured flow data and sampled nutrient data for each sampled stream was averaged.
•A calibration curves were created (ex. basin area vs. average stream flow), outliers were discounted and the resulting formula was applied to the remaining un-sampled basins.
• Calibration curves were created for nutrient loads, outliers were discounted and the resulting formula was applied to the remaining basins.
•A Plant Cover raster layer was imported, and made into a polygon layer.
•From the Plant Cover data and basin area, percent plant cover was mapped.

## Results:

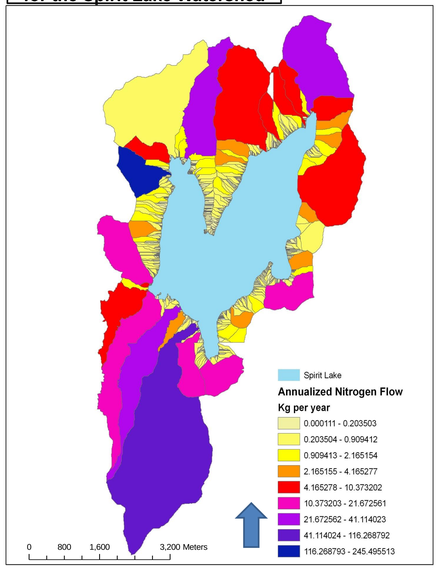
**Annualized Surface Water Flow for the Spirit Lake Watershed**



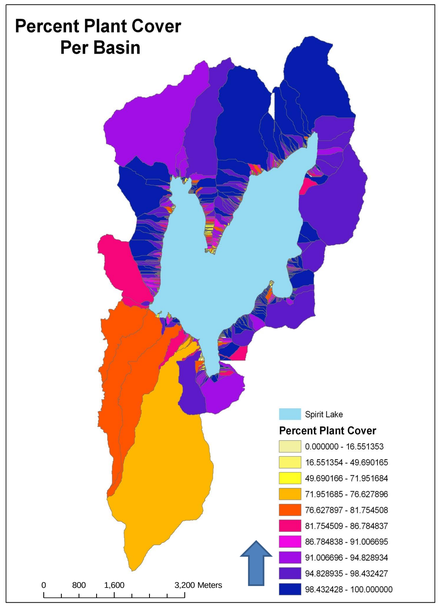

**Annualized Nitrogen Flow for the Spirit Lake Watershed**




**Annualized Phosphorus Flow for the Spirit Lake Watershed**




**Percent Plant Cover Per Basin**




## Discussion:

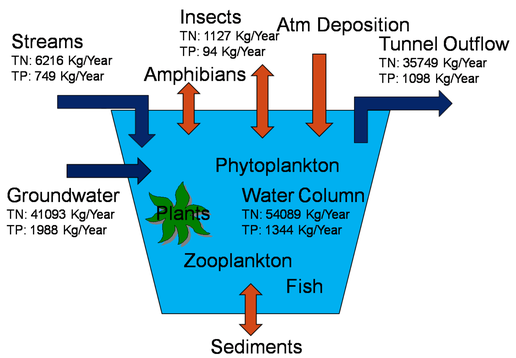
•Nutrient inflows are greater than outflows and this difference maybe similar to what is held in the lake.
•Differences could be attributed to sediments, plants, amphibians, insects…..
•There is a relationship between plant cover and nutrient load per basin.

**Assumptions:**

•Average Summer Surface Water Flows and Nutrient Concentrations are a good representation of yearly flow.
•Ground Water Nutrient Concentration are homogeneous with in the watershed. South Shoreline data is representative of the watershed.

## Future Work:

•Collect a more complete set of Surface Water flows.
• Insert wells in more locations
•Find a formula to calculate Ground Water Flow from well head measurements.
•Find the absorption rate plant groups and apply plants uptake to nutrient load.

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