**Problem Statement Formation**

Can key predictors of chlorophyll-a concentrations be identified at Cherry Creek and can the algal population in the reservoir be reduced to a chlorophyll-a concentration of less than 18 μg/L through management of these key water quality parameters?

**Context**

Cherry Creek reservoir in Denver, CO has a popular swim beach and is the state's most visited state park. As an urban lake receiving flow from populated and agricultural areas in its watershed, the reservoir is highly eutrophic and suffers from high turbidity, algal growth, and occasional closure of the reservoir due to harmful algal blooms. The Colorado Water Quality Control Commission has established a growing season (July through September) concentration standard of 18 μg/L chlorophyll-a, which is a surrogate for algal populations, to be obtained four out of five years. The Cherry Creek Basin Water Quality Authority (CCBWQA) was established to manage the Cherry Creek Reservoir and research has been conducted on the reservoir and its watershed since the mid 1990s. Chlorophyll-a concentrations have fluctuated throughout the years and have been over 18 μg/L in eight of the past 10 years. In order to further investigate the issues, Cherry Creek reservoir data will be combined with water quality data from lakes across the country to develop a model for the major water quality parameters, including chlorophyll-a. This model will be used to determine which parameters could be altered to reduce the chlorophyll-a concentrations in the reservoir. Management recommendations will be made to the CCBWQA.

**Criteria for Success**

Identify the key water quality parameters that predict chlorophyll-a concentrations in Cherry Creek Reservoir and model how changes in these parameters can reduce chlorophyll-a concentrations to less than 18 μg/L.

**Scope of Solution Space**

Water quality data collected at Cherry Creek reservoir will be combined with lakes data from across the country. Analysis will be centered around predicting different response variables using statistics, machine learning, and domain knowledge. Firstly, water quality parameters with the most influence on chlorophyll-a concentration will be identified in Cherry Creek reservoir. Secondly, chlorophyll-a concentrations will be predicted at Cherry Creek Reservoir given data from lakes across the US. Although every lake is different, each has comparable parameters in terms of pH, conductivity, temperature, etc. Lastly, chlorophyll-a concentrations will be forecasted given changes in oher water quality parameters. With this information, recommendations will be provided to the CCBWQA for actions to reduce chlorophyll-a concentrations, as well as predicted future concentrations when implementing management recommendations.

Deliverables to the client will include a presentation including a slidedeck, a project report with management recommendations, and GitHub repository containing developed model.

**Constraints**

Data cleaning will be difficult and time consuming. A large number of parameters were assessed but they were likely not consistent across all lakes. As a result, many parameters will need to be removed from the dataset. The Cherry Creek dataset and the national lake datasets are structured differently and combining them will be difficult. Samples greater than three meters in depth will need to be removed from the data. This will likely be uncommon. Paired water quality data may not have occurred on the exact same day and will need to be paired by week or month. Lastly, data should ideally be limited to the growing season (July through September). Sufficient data may not be available to do so.

**Stakeholders**

The Cherry Creek Basin Water Quality Authority (CCBWQA)

Technical Advisory Committee (TAC)

Erin Stewart - Water Quality Monitoring Consultant with LRE Water

**Data Sources**

Dataset: <https://ccbwqportal.lre-up.com/data-access/query-and-download>

Data to download (2016 sampling events):

Location: Surface, Reservoir, Groundwater, Weather

Locations: All sites. Some sites will have very little data and need to be filtered out.

Parameters: All Flow, Weather, Nutrients, Biological, Chemical WQ, Physical WQ. Some parameters were filtered infrequently and need to be filtered out.

Flow conditions: All

Dates: All

Dataset: <https://www.waterqualitydata.us/#advanced=true>

Data to download:

Sample media: Water

Characteristic Group: Algae, Physical, Nutrients

Data sources: All