Problem Statement

1. Evaluate the long-term trends for salinity in wastewater and recycled water

2. Assess how periodic droughts and various conservation measures may influence these trends

3. Primary Research Questions:
   a. What portion of the increment from use (IFU) can be attributed to water conservation measures?
   b. If trends of conservation measures continue, what portion of the IFU can be attributed to water conservation measures
Problem Statement

- Increment from use (IFU) typically ranges from 200 to 250 mg/L.
- IFU can drive effluent TDS above the discharge limit.
- How much of IFU is due to conservation measures?
Increase in TDS from MSLs from Indoor Use

1980 Indoor Water Use (77 gcpd)
2016 Indoor Water Use (52 gcpd)

Increment from Use TDS (mg/L)

Indoor Water Use (gpcd)

- Salt Load = 0.17 pounds per capita per day
- Salt Load = 0.15 pounds per capita per day

Based on mineral pickup in water due to domestic use of 300 mg/l TDS and 60 mg/l hardness. SOURCE: State Water Pollution Control Board Publication No.9, 1954 (18).
Regression Tree Analysis for Influent TDS

- Indicates important explanatory variables:
  - Population (POP)
  - Source TDS (STDS)
  - Source Flow (SFLOW)
Principal Component Analysis

PCA indicates an initial EMWD multiple regression model:

- \( \text{ITDS} \sim \text{POP} + \text{STDS} + \text{SFLOW} + \text{PMDI} + \text{IFLOW} \)

Backward stepping from the initial model resulted in removal of first SFLOW and second PMDI:

- \( \text{ITDS} \sim \text{POP} + \text{STDS} + \text{IFLOW} \)
EMWD Multiple Regression Analysis

- **Variables:**
  - STDS: Source TDS
  - IGPCD: Influent per capita water use

- **R -squared = 0.979**

- **Relative Importance**
  - STDS: 88.2
  - IGPCD: 11.8
EMWD Multiple Regression Analysis

• Variables:
  – STDS: Source TDS
  – IGPCD: Influent per capita water use
• C_gpcd: Constant water use of 66 gpcd (no conservation)
  – IFU Difference: ~18mg/L
IEUA Multiple Regression Analysis

- Variables:
  - STDS: Source TDS
  - IGPCD: Influent per capita water use

- R-squared = 0.75

- Relative Importance
  - STDS: 67.2
  - IGPCD: 32.8
IEUA Multiple Regression Analysis

• Variables:
  – STDS: Source TDS
  – IGPCD: Influent per capita water use
• C_gpcd: Constant water use of 95 gpcd (no conservation)
  – IFU Difference: ~20mg/L
Source Flow
Drought Index
% SPW Allocation
State Mandate

Local Conservation
State Mandate
Technology enhancements

Seasonal trends

Influent TDS

Source TDS

Long term conservation trends

Indoor per capita water use

Effluent TDS

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Summary

• Unintended consequences from water conservation measures
  – lower water quality (higher TDS)
  – less quantity of recycled water
  – less revenue
  – infrastructure O&M

• Observation data from groups of sewering agencies rather than individual WWTP is more reliable due to the following factors
  – Population (city boundaries, sewershed boundaries)
  – Operations can divert flows from plant to plant
Summary

• Drought impacts both source water quality and an agency’s source(s) of supply.
• “...drought, and the conservation strategies that are often enacted in response to it, both likely limit the role reuse may play in improving local water supply reliability.”