



# **Global Warming:**

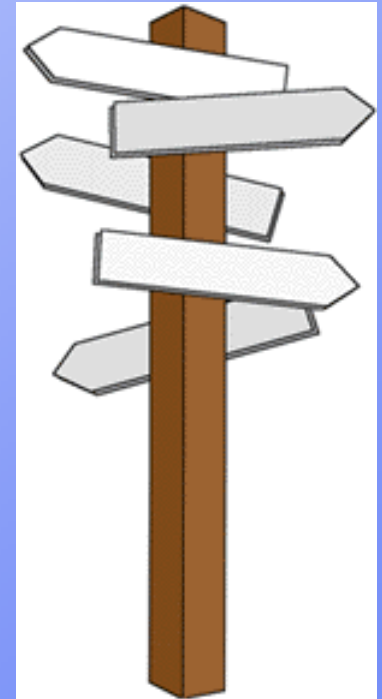
## **Heating up the Debate on Northwest Hydropower**

February 8, 2006

Portland, Oregon

# Where are we going?

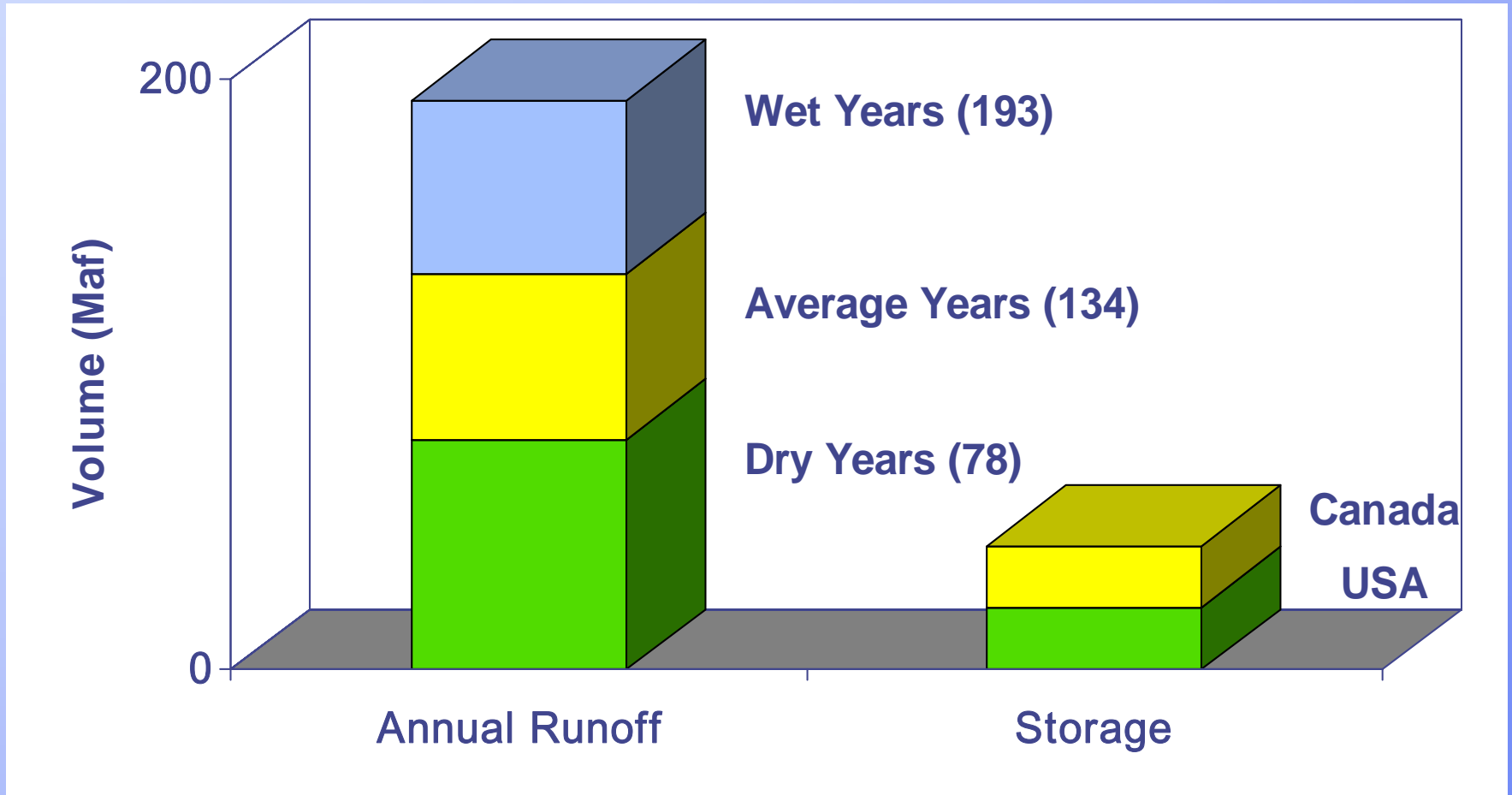
1. The Hydroelectric System
2. Current operations
3. Global Warming Impacts
4. Mitigating Actions
5. Proposal – Adaptive Management



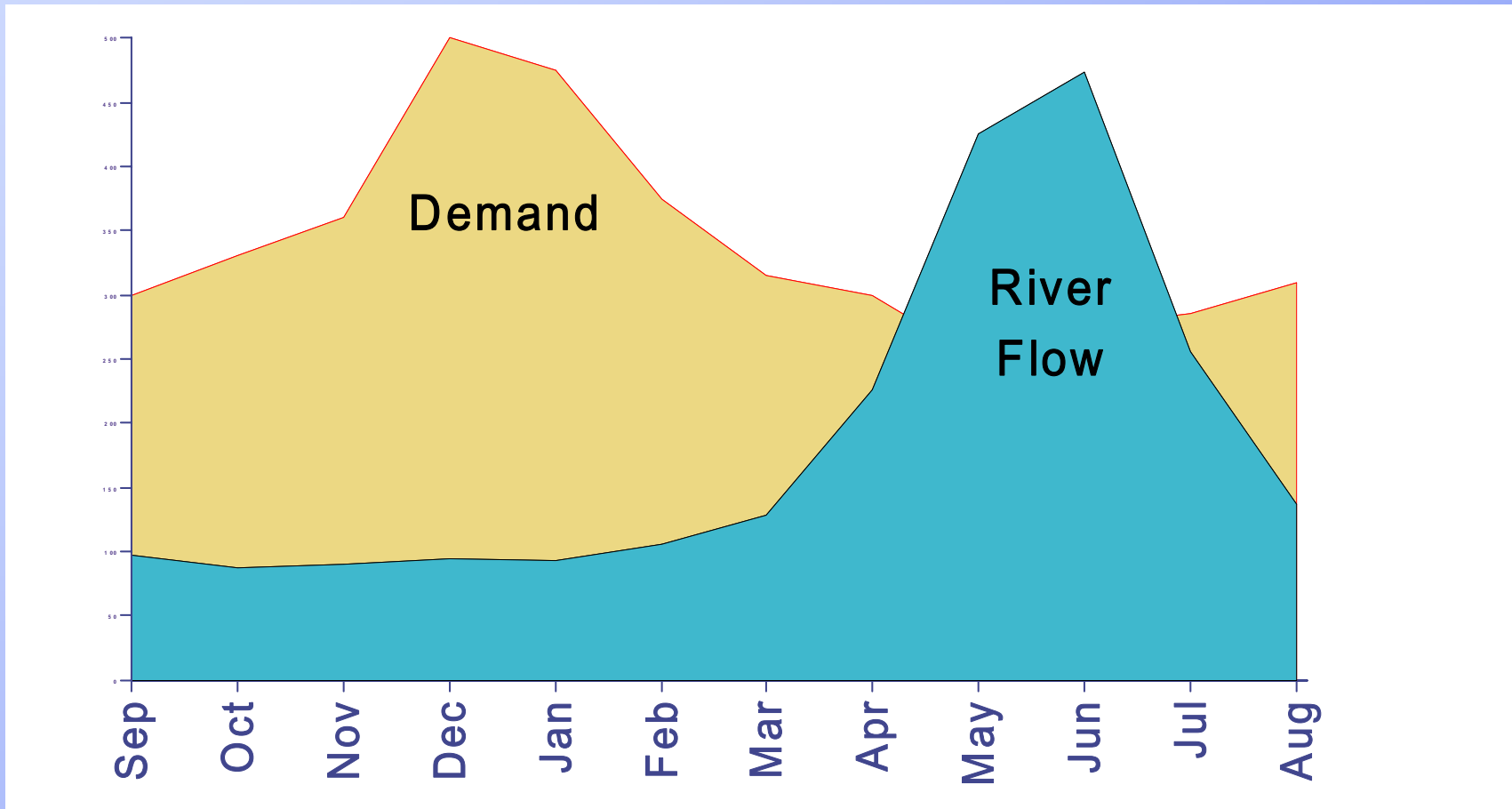
# Columbia River Hydroelectric System



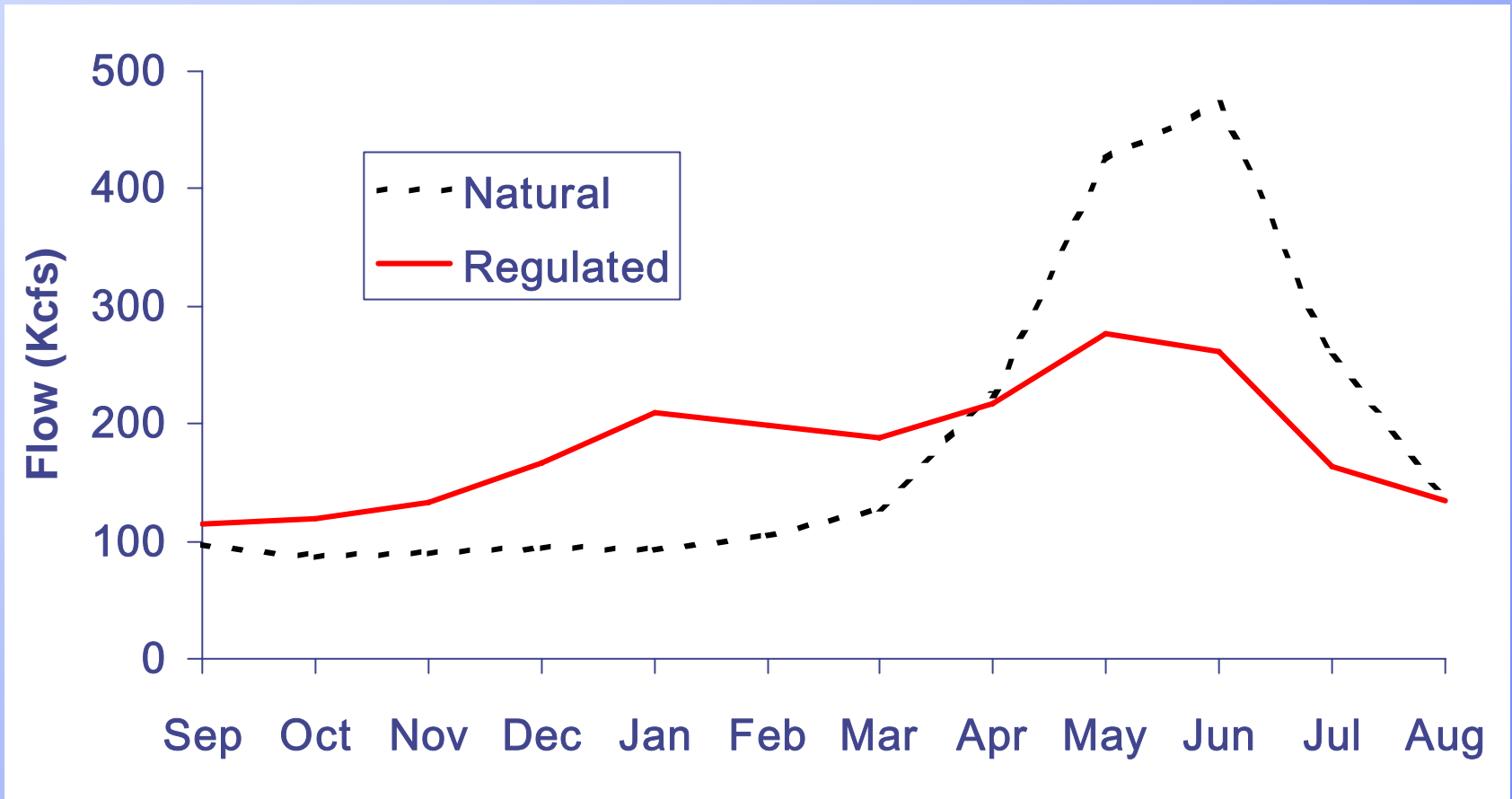
# Reservoirs hold 30% of the Average Runoff Volume



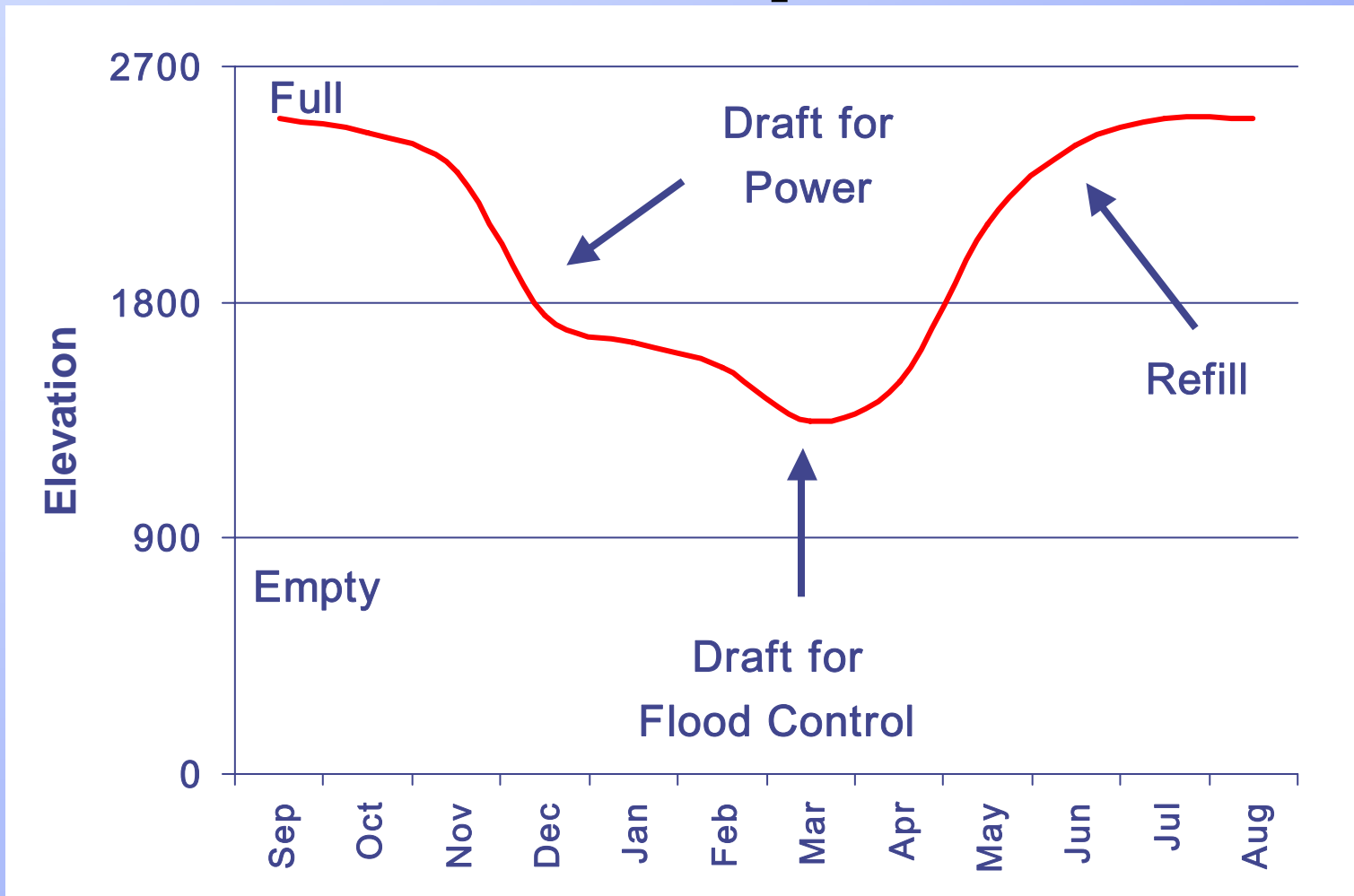
# River Flows and Electricity Demand peak in different months



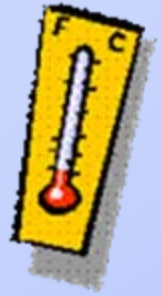
# Using Reservoir Storage to change the shape of River Flows



# 2. Current Operations



# 3. Global Warming Impacts

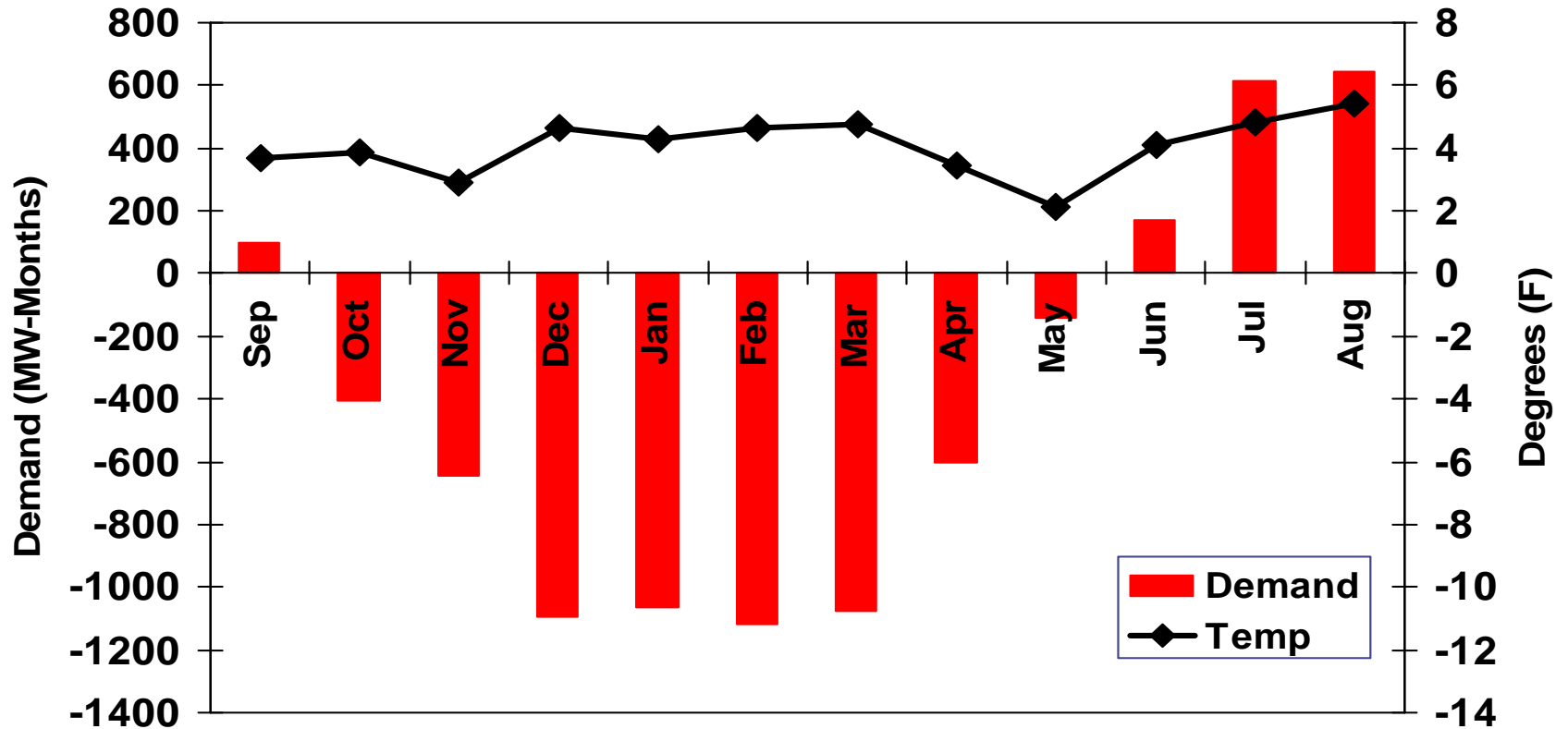


Temperature → Demand

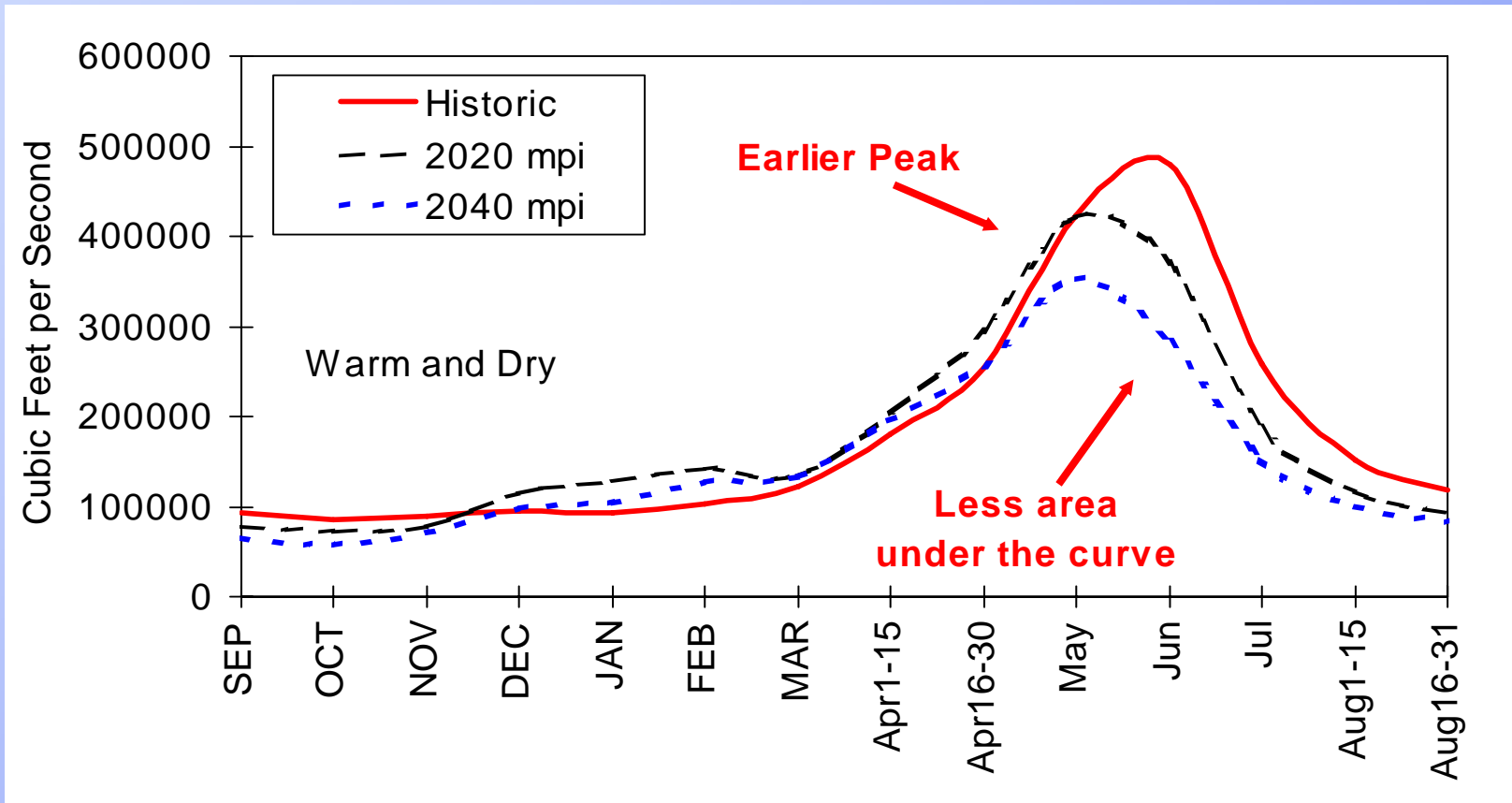


Precipitation → River flows

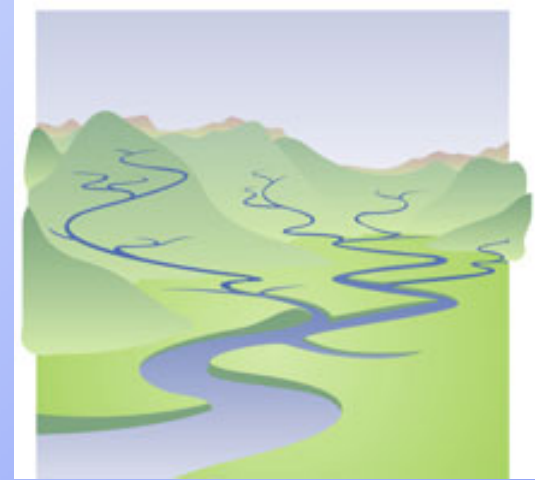
# Temperature → Demand



# Precipitation → River Flows





# River Flows



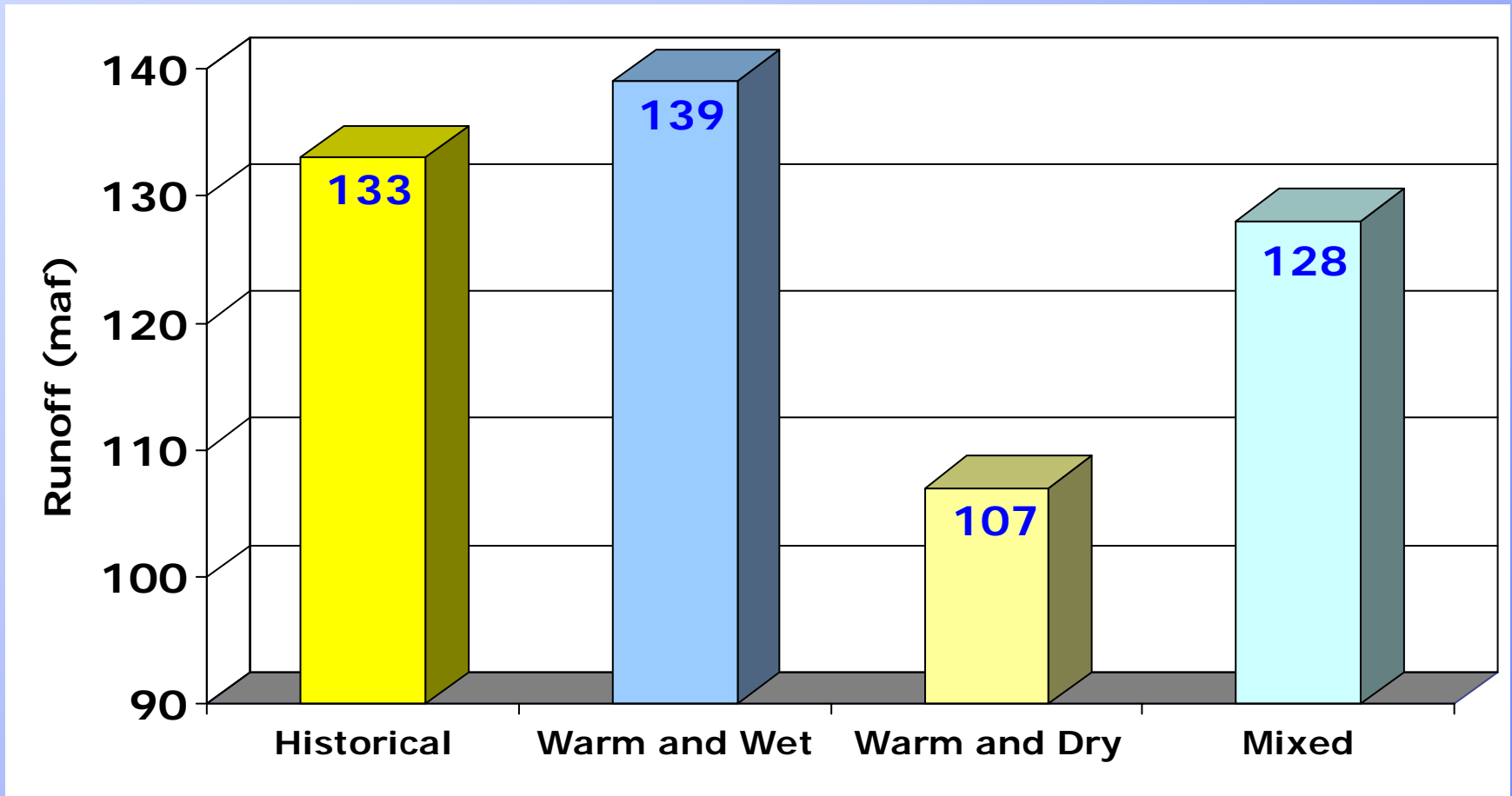
- **Winter** – More rain (less snow)  
higher river flows
- **Summer** – Less snowpack  
lower river flows

# Power System

- **Winter** – **Better**  
less demand  
more hydro generation  

- **Summer** – **Worse**  
more demand  
less hydro generation  


# Runoff Volume

## Fuel for the Hydroelectric System



# Energy and Cost

Scenario	Annual Energy (aMW)	Annual Benefit (Millions)
Warm/Wet	300	\$170
Mixed	-500	- \$160
Warm/Dry	-2000	- \$730



# Fish

➤ **Winter** –



**Neutral**  
more flow

➤ **Summer** –

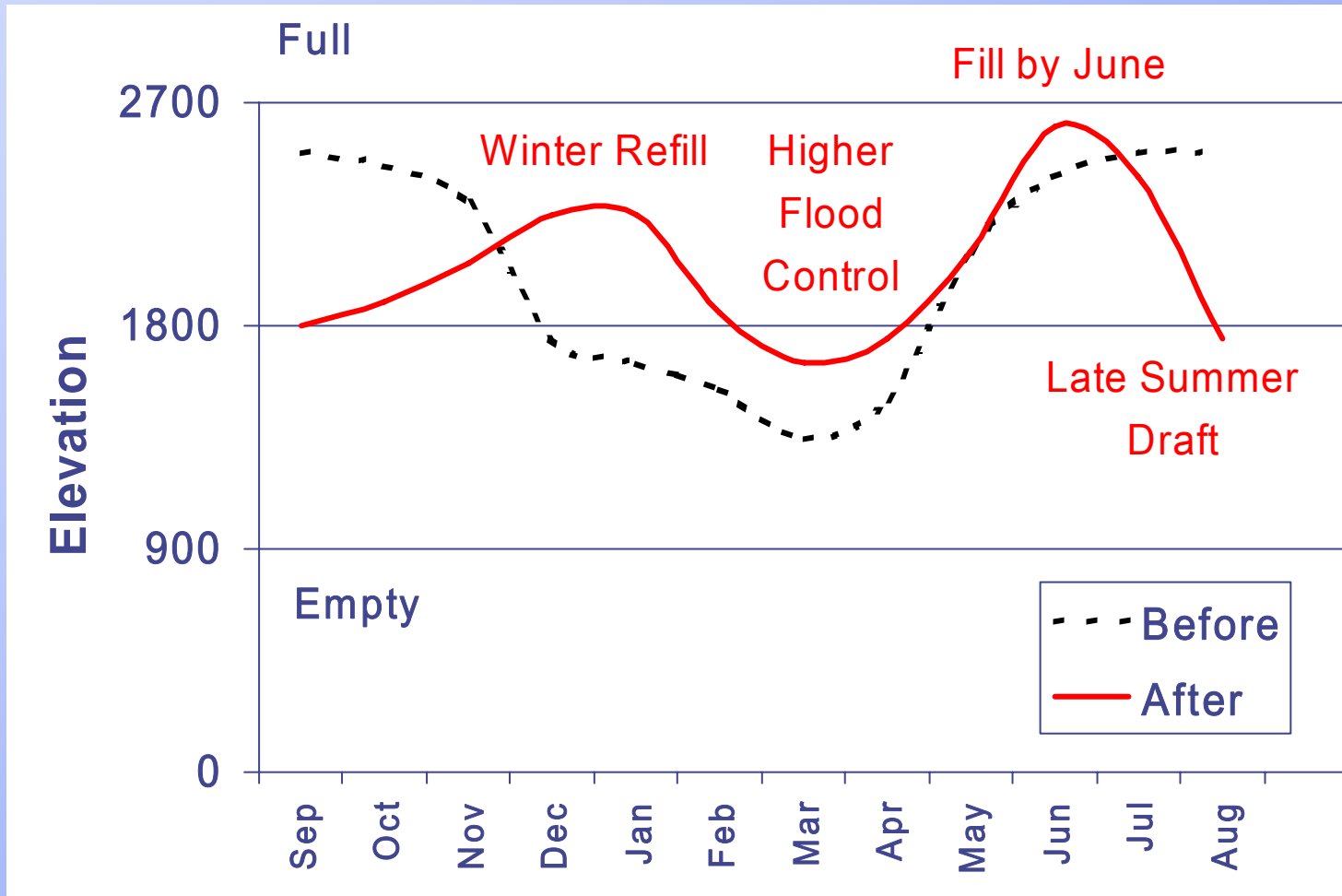


**Worse**  
less flow  
higher water temps

# 4. Mitigating Actions


1. Fill by June
2. Lower draft in summer
3. More Canadian water
4. Winter refill
5. Non-hydro replacement resources

# Changes in Reservoir Operation



# 5. Proposal

## Adaptive Management

- No “bright line”
- Operations  Forecasts
- Mitigating actions built in
- Calls for better forecasting



# Examples

- **Already being done**
  - Flood control
- **Could be done**
  - End-of-summer drafting limits
  - Resource expansion strategies should include GW uncertainty