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Adaptive Management Strategies for Integrated Water Resource Management in Uncertain Future Climate

PNWS-AWWA Symposium

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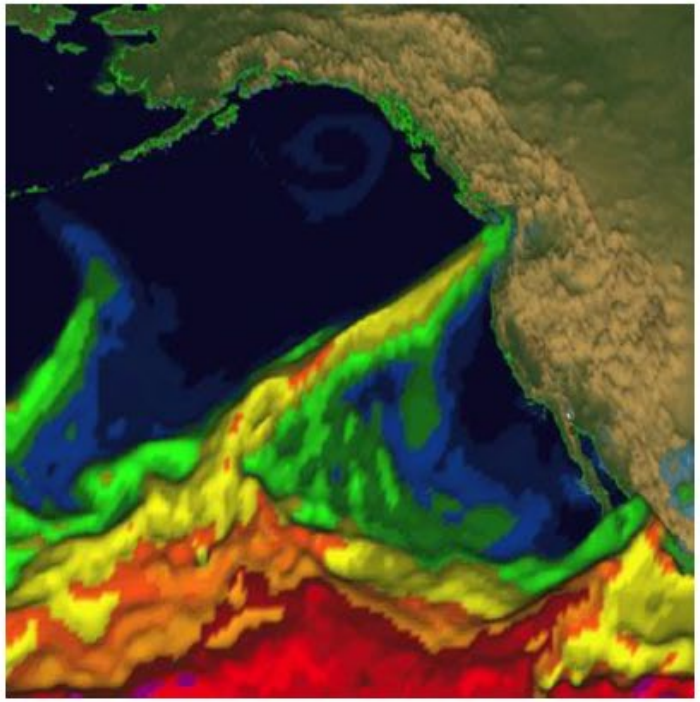
Jacobs Climate Resiliency – Our Goals

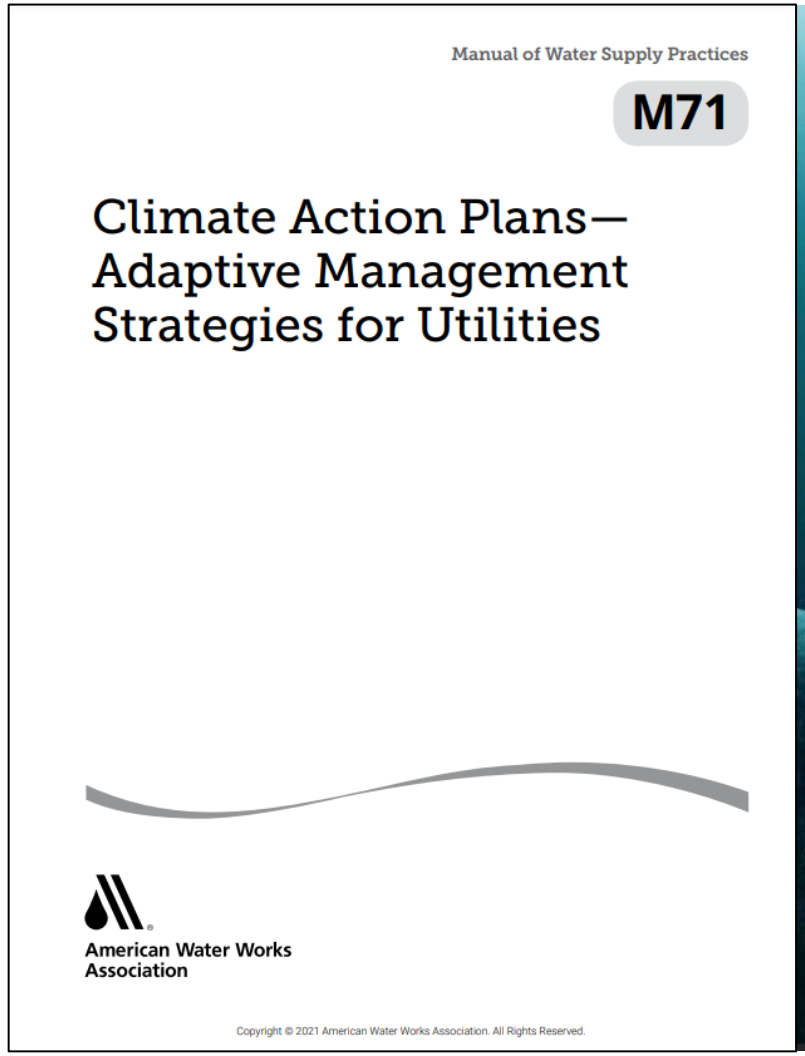
Supporting clients to improve understanding, apply climate science, assess climate risks, and develop adaptation strategies to create more resilient communities and systems.



Adaptive Management Themes

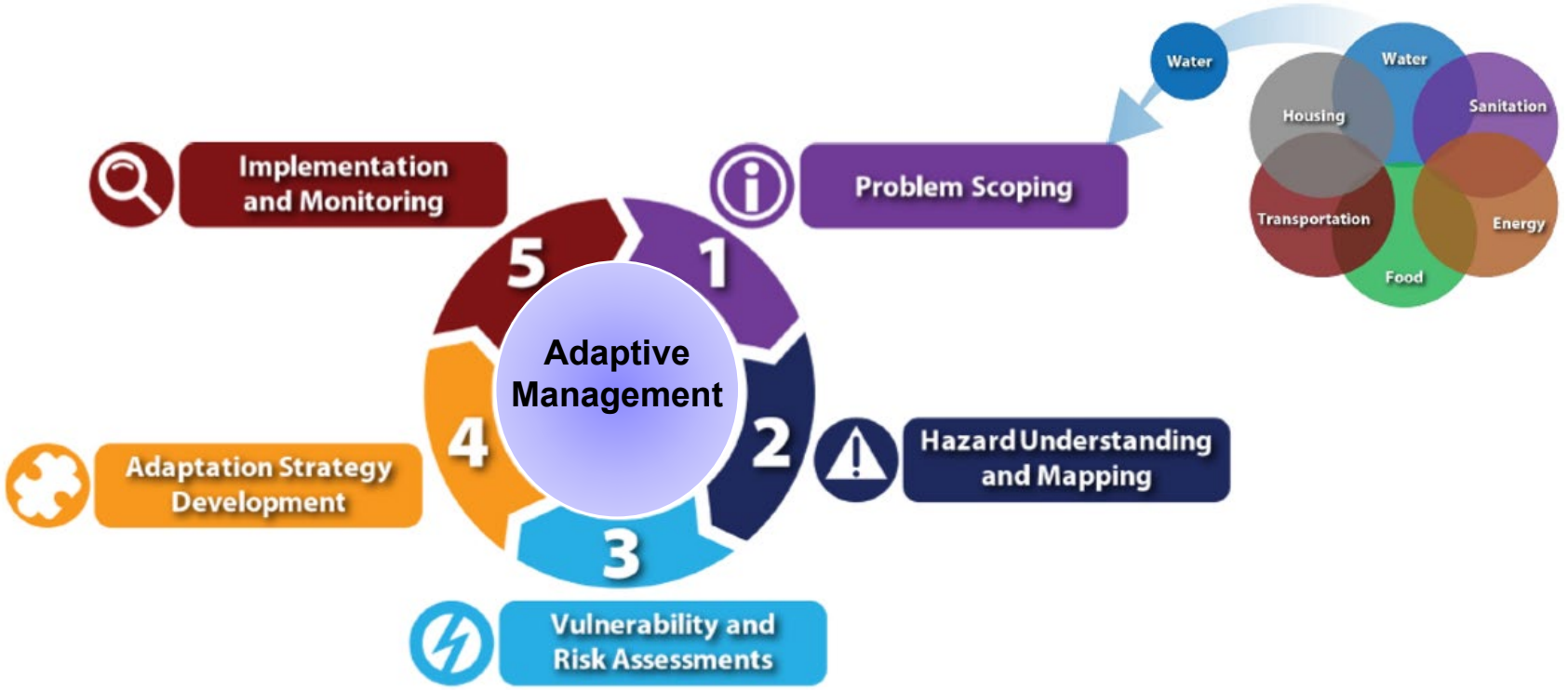
- Adaptive Management Framework
- Scenario Planning to Envision Futures and Understand
  Performance
- System Vulnerability and Risk Assessments
- Alternatives Development and Evaluation
- Portfolio Approaches to Achieve Strategies
- Adaptive Implementation Pathways
- Inclusive, but Deliberate Decision Making

- Case study discussed in this presentation:
  Portland Water Bureau's 2020 Preliminary Supply System Management Plan (**SSMP**)



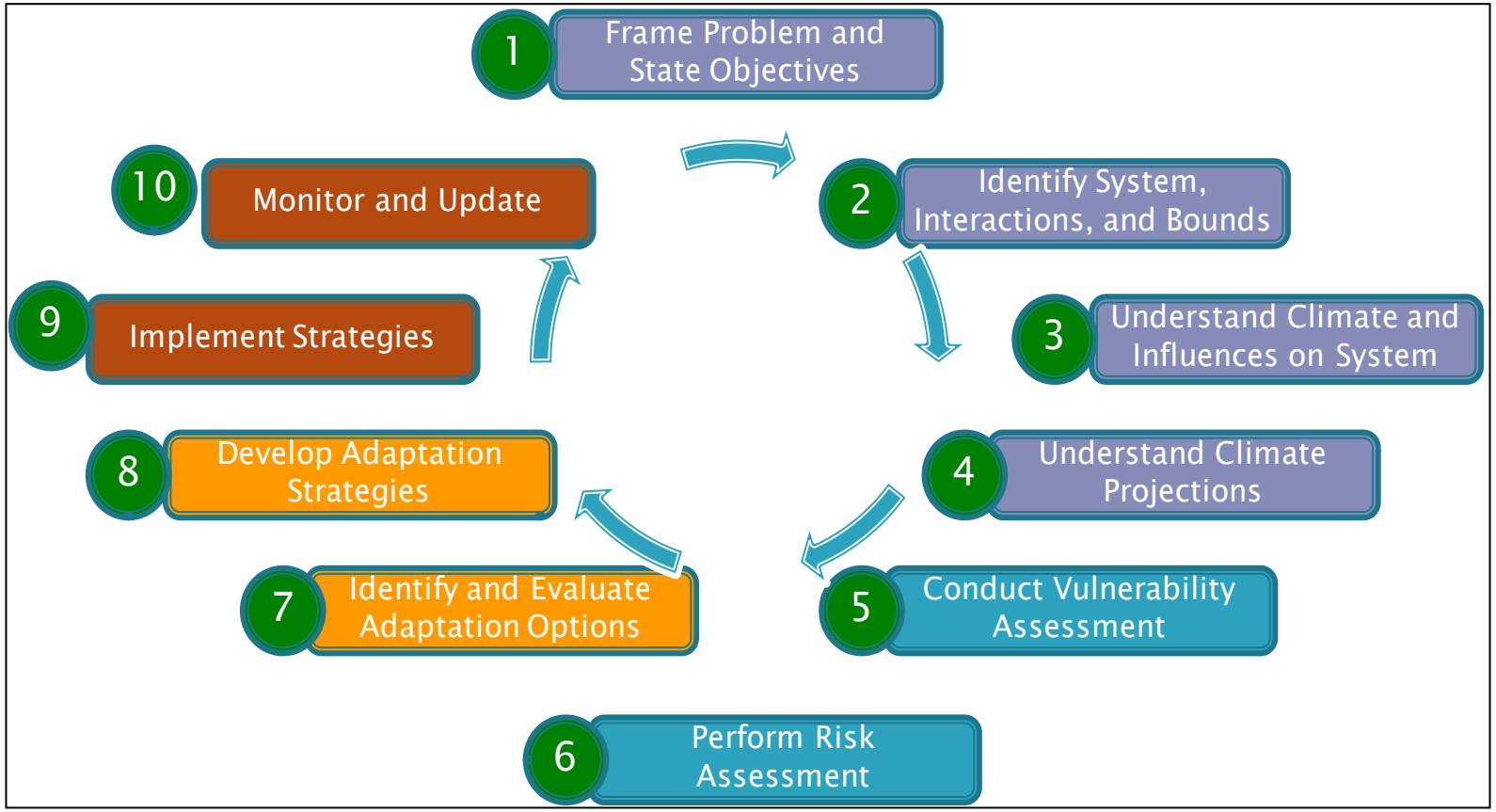
Adaptive Management Framework

What is adaptive management?



- Integrative Approach
- Iterative Decision-Making Process
- Continuous monitoring of the results
- Involves assessment of risks and uncertainties
- Results in effective resources management

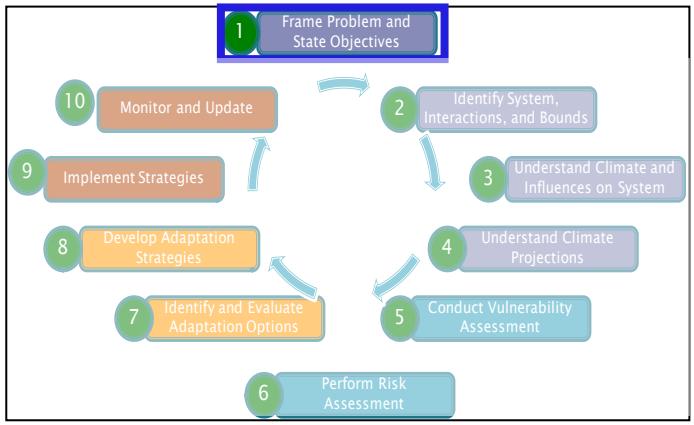
Adaptive Strategies in Uncertain Climate



Holistic methodology of climate risk assessment to support smart strategies for more resilient infrastructure and systems

CH2M Best Practice for Incorporating Climate Change in Infrastructure Planning, 2015

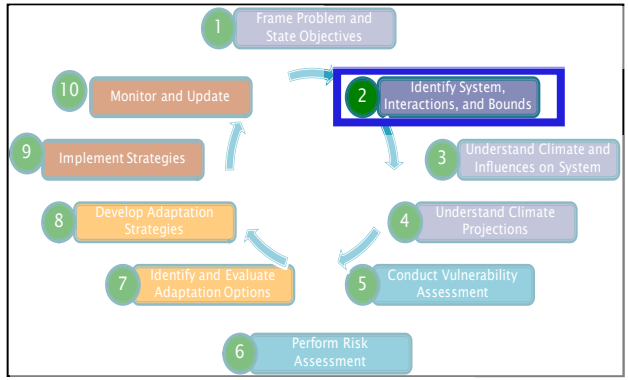
Step 1 Problem and Objectives Statement



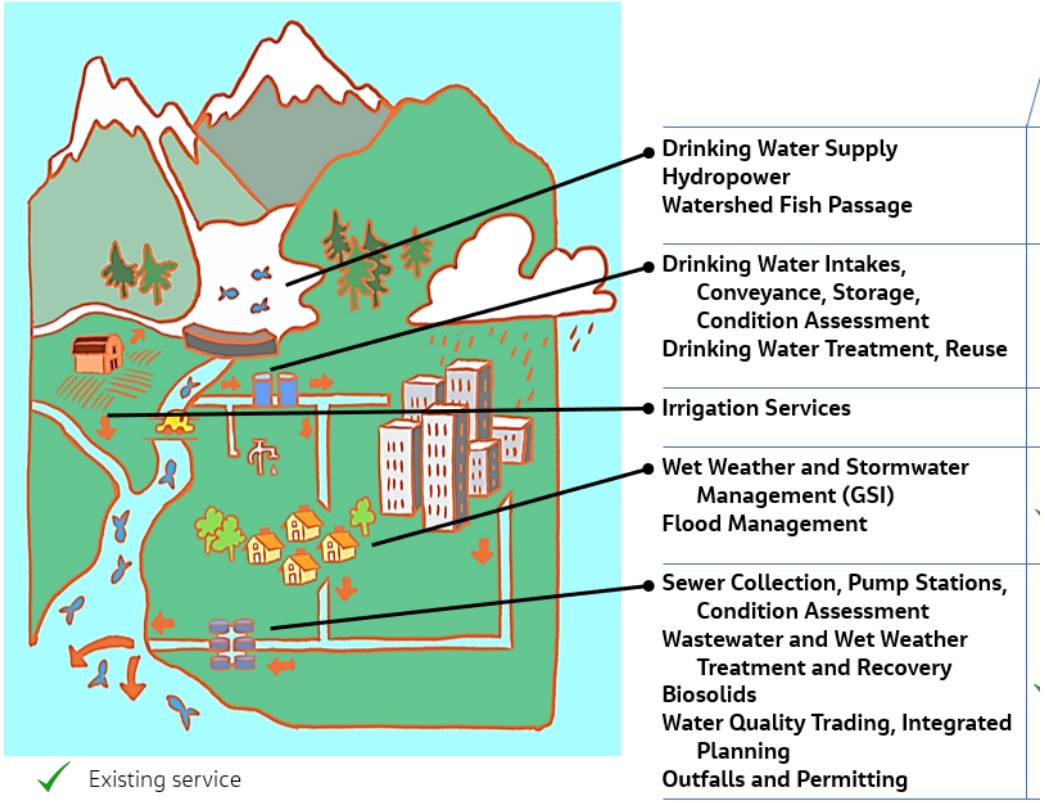
- What is the analysis question?
- What is the planning horizon?
- What are the expected outcomes?
- What types of decisions will be made from study?
- How will decision-makers handle uncertainty?

Poll Question #1

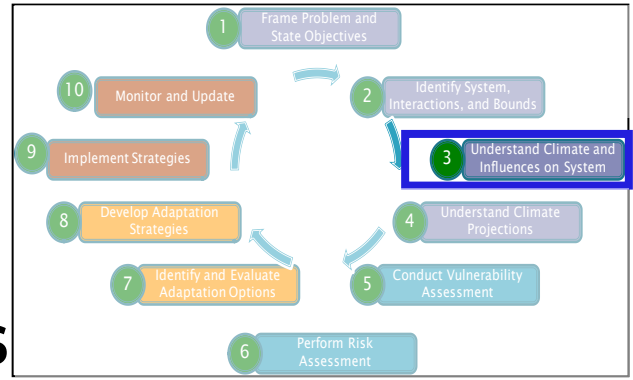
Step 2 Identify System Components and Interactions



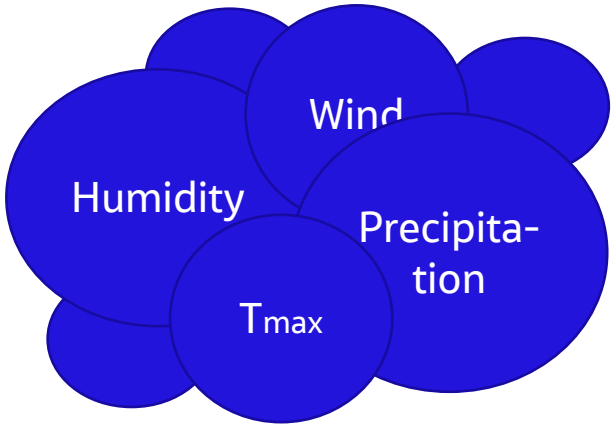
- Identify the **system** to be evaluated
- Identify **components** of system
- How do components and other systems **interact**?
- Think broadly and **integrated**, ensure buy-in



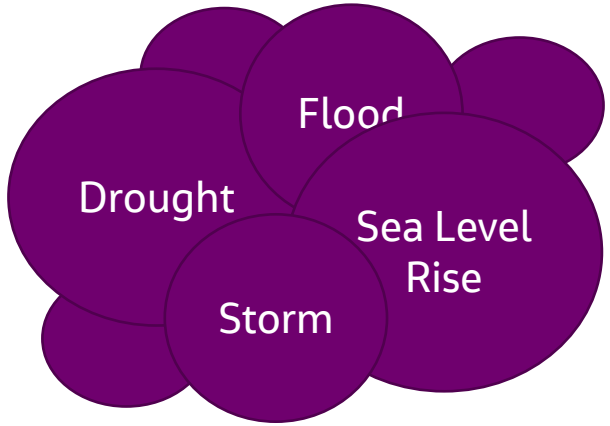
Step 3 Understand Climate and Climate Influences on System



Climate variables

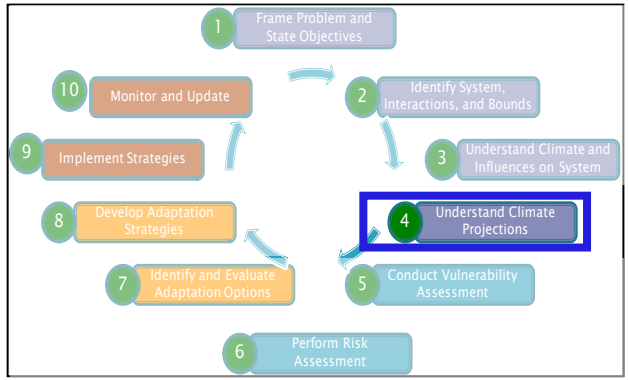


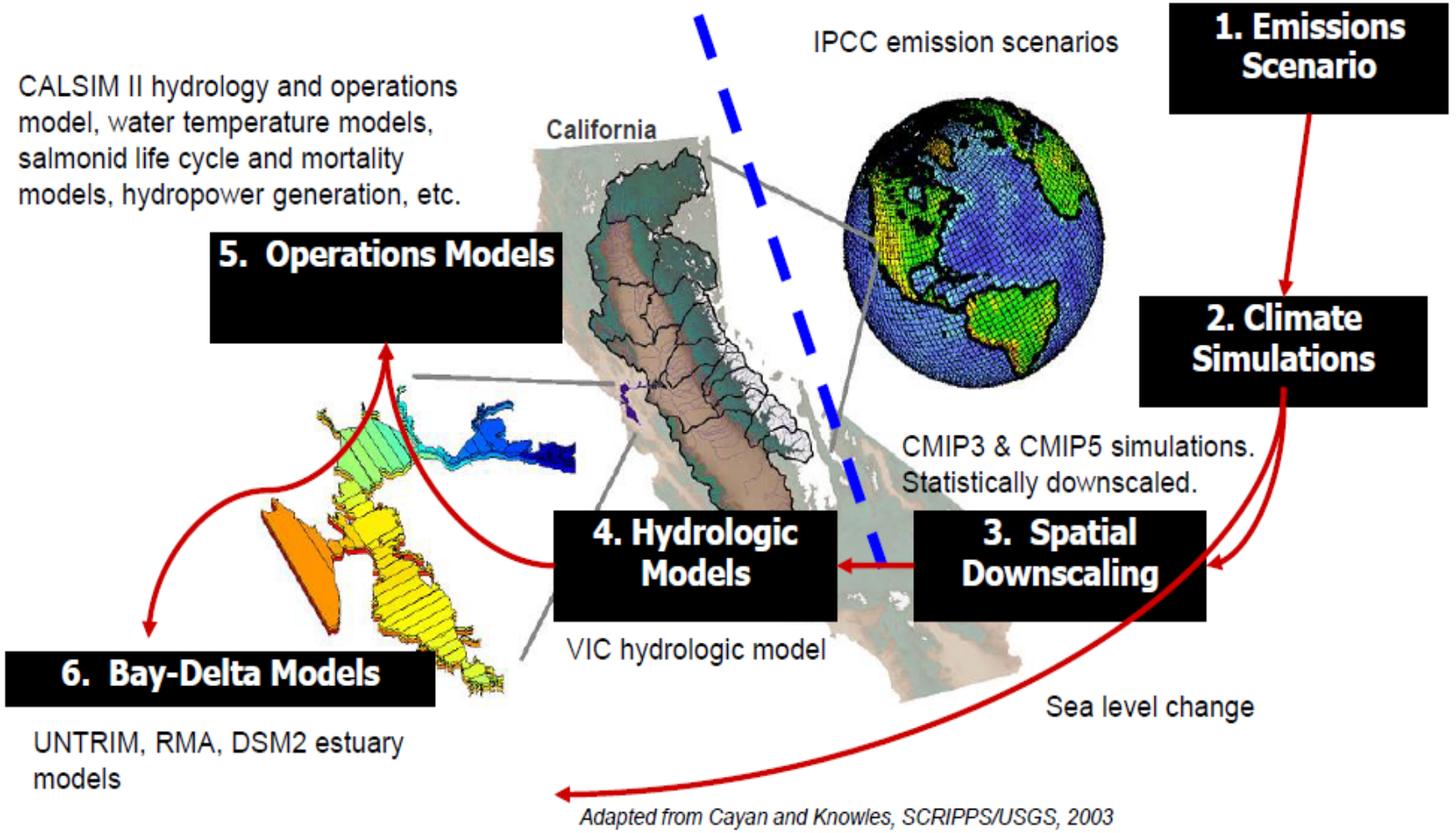
Climate influencing factors



Impact of climate variables on water system risks

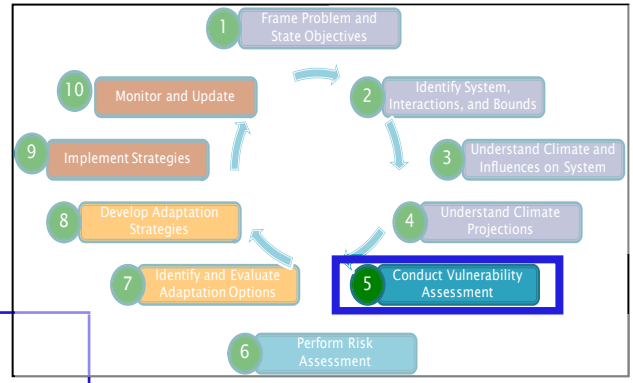
Step 4 Understand Climate Projections





Adapted from Cayan and Knowles, SCRIPPS/USGS, 2003

Step 5 Conduct Vulnerability Assessment



- Develop Performance Metrics and Thresholds
- Develop System Relevant Climate Scenarios
- Perform Qualitative Assessment
- Perform Quantitative Assessment

Step 6 Perform Risk Assessment

- Risk Definition
- Assess Consequences
- Assess Likelihood
- Assess, Rate and Prioritize Risk

Step 6 Perform Risk Assessment

Risk = f(Consequence + Likelihood)

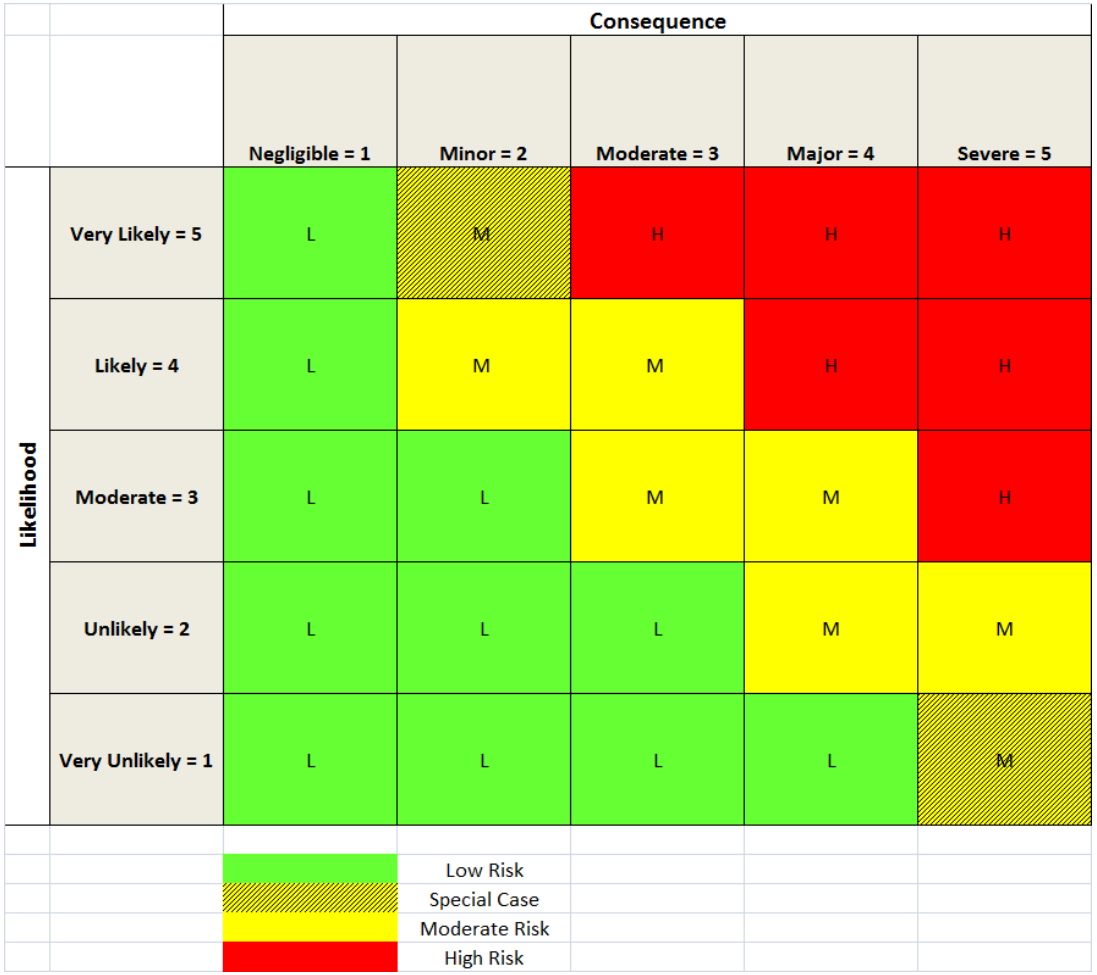
Consequence

- ❑ System Function
- ❑ Social
- ❑ Governance
- ❑ Financial

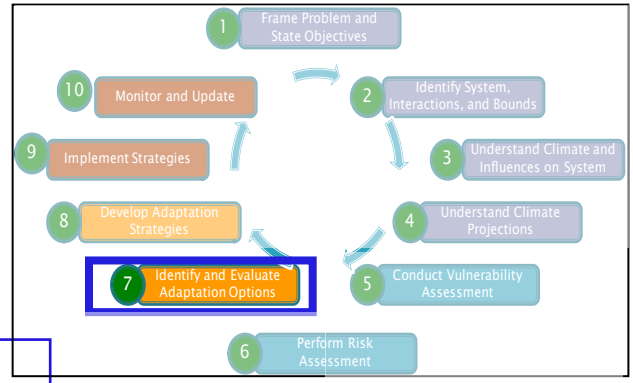
Likelihood

- ❑ Based on degree of confidence climate projections

Vulnerability = Sensitivity x Adaptive Capacity

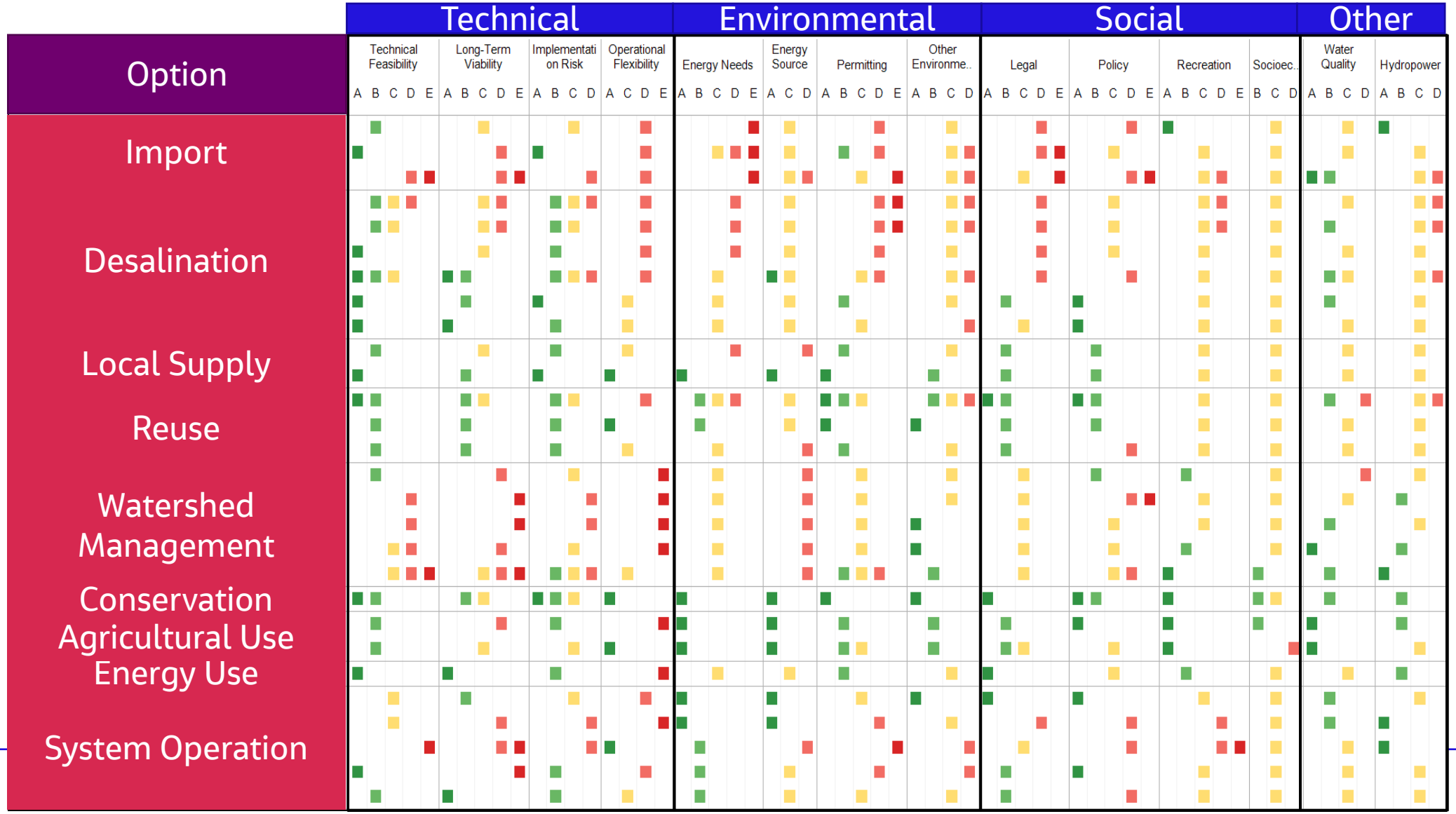


Step 7 Identify and Evaluate Adaptation Options



- Identify Adaptation Options
- Develop Evaluation Criteria
- Evaluate Options
- Prioritize and Select Options
- Determine Effectiveness of Selected Options

Step 7 Identify and Evaluate Adaptation Options



Step 8 Develop Adaptation Strategies and Plan

Types of Adaptation Options

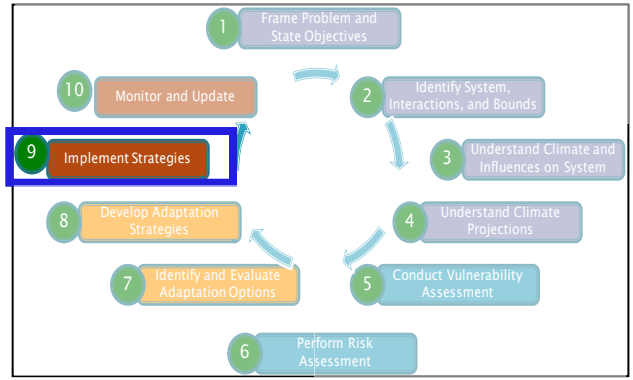
- Early, Low Regret Actions
- Long Term, Robust Actions
- Long Term, Contingent Actions

Adaptation Plan

- Science and System Analysis Tool Strategy
- Adaptation Implementation Strategy
- Monitoring and Update Strategy
- Funding Strategy
- Regional Partnership & Leadership Strategy
- Public Awareness and Outreach Strategy

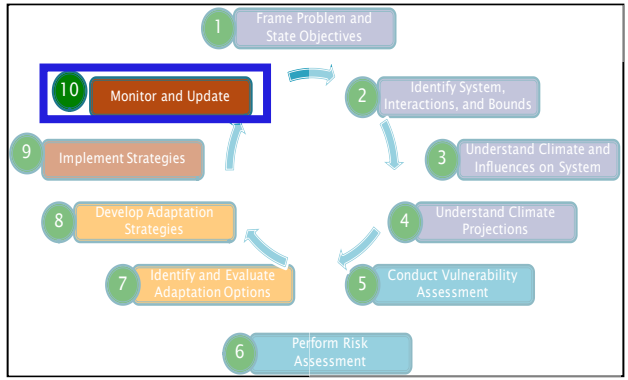
Poll Question #2

Step 9 Implement Adaptation Strategy

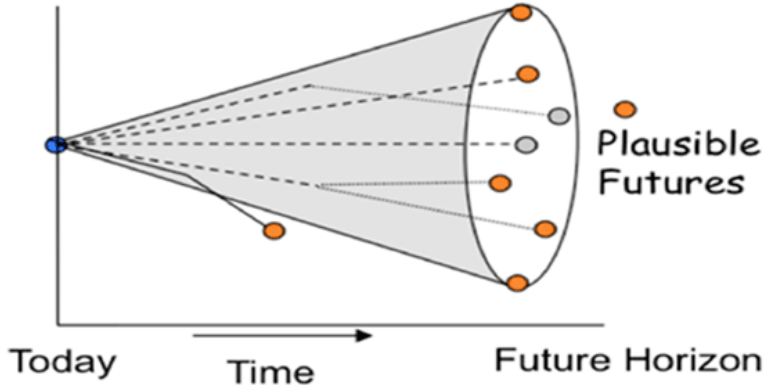


- Ensure that implementation of the selected option is consistent with that for which the risk reduction was evaluated
- Include mechanisms that track the actual implementation of the adaptation options

Step 10 Monitor and Update

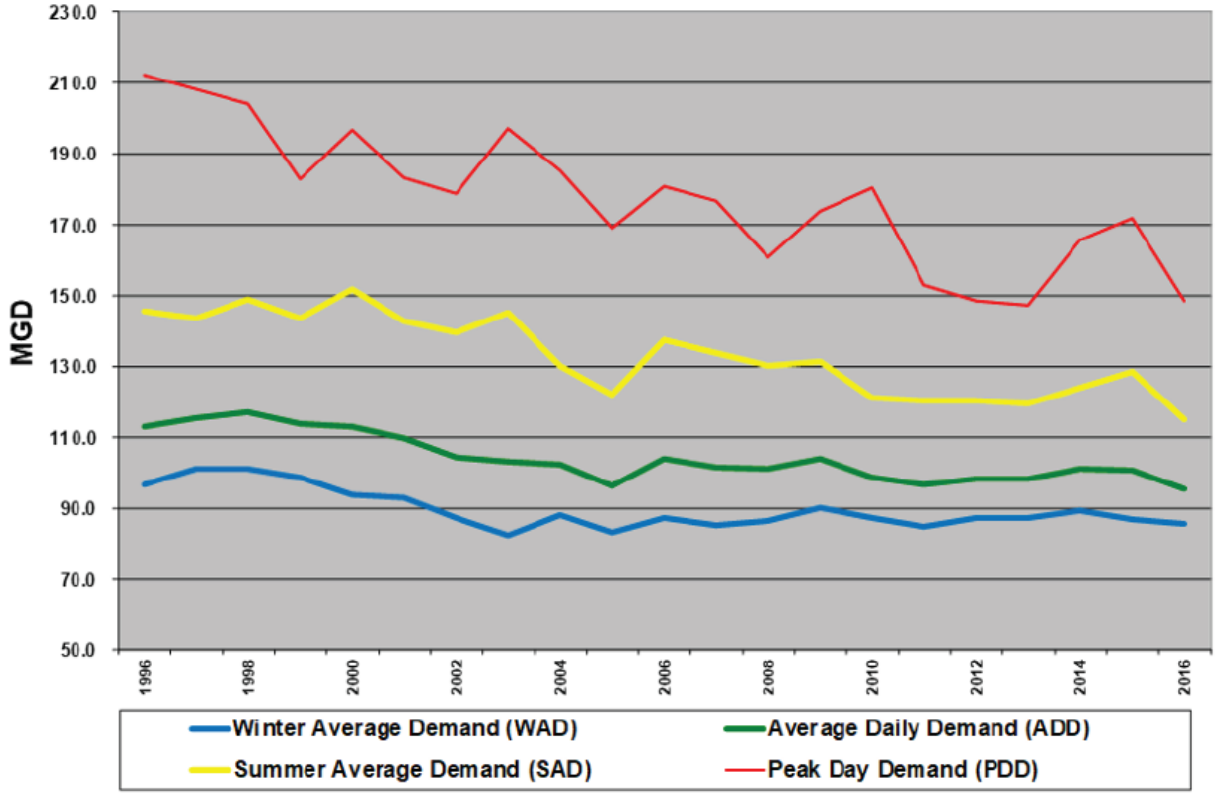


- Develop Monitoring Metrics
- Monitor for Status and Changes
- Integrate with Other Plans
- Update Periodically



Portland Water Bureau Draft Supply System Management Plan (2020)

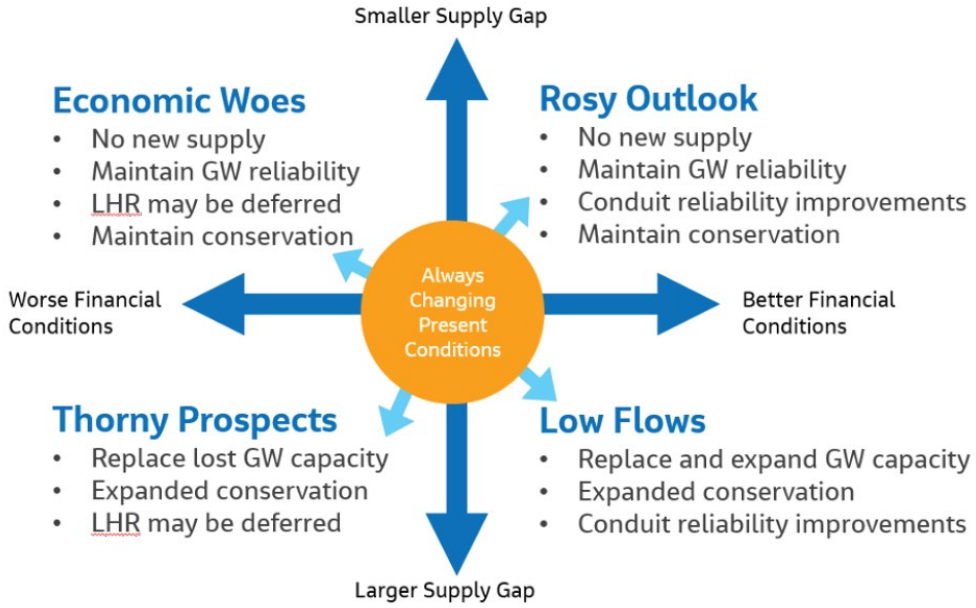
Previous SSMP 20 years ago expected demands to increase. How demands actualized:



Scenario Development

Economic stress, lower supply stress

Economic stress, higher supply stress



Business as usual, lower supply stress

Business as usual, higher supply stress

Incorporate Climate Uncertainty

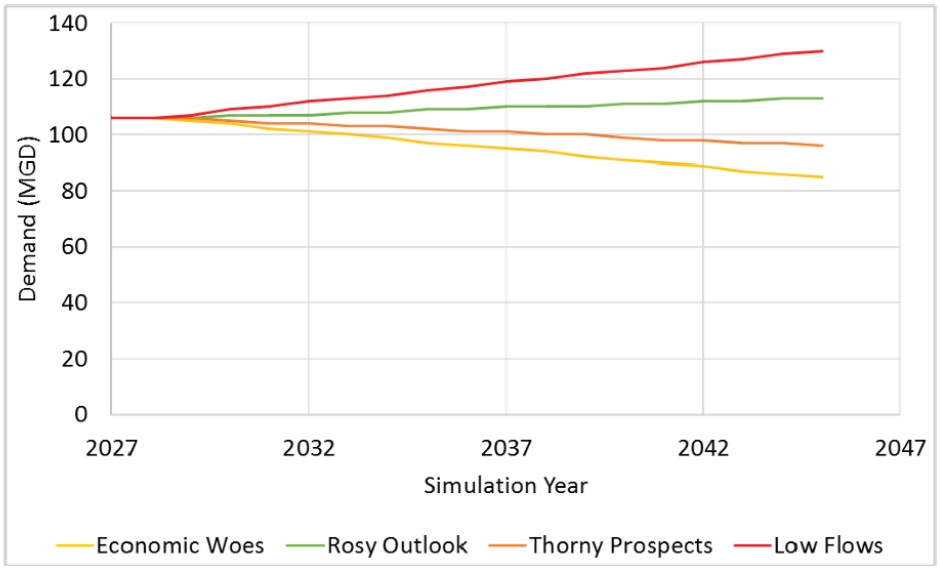


Table 1: 2025 results for reservoir storage, drawdown and groundwater use for 143 of the 150 simulations.

	Simulated Minimum Reservoir Storage Without GW Use	Simulated Drawdown Start Dates	Simulated Drawdown End Dates	Simulated Drawdown Duration	Simulated Refill Completion Dates	Projected Need for Summer GW Augmentation
Supply stress simulations ~17% (25) of 150	0.2 BG to -6.0 BG	April 19 to June 9	September 3 to November 14	128 to 186 days	October 29 to December 24	3.0 BG to 8.0 BG
Moderate GW use simulations 48% (72) of 150	4.1 BG to -0.7 BG	May 12 to July 15	September 6 to November 27	92 to 178 days	October 7 to December 26	0.1 BG to 2.9 BG
Non-stress simulations ~31% (46) of 150	7.8 BG to 2.6 BG	May 27 to September 25	August 27 to November 28	49 to 152 days	September 13 to December 26	0 BG

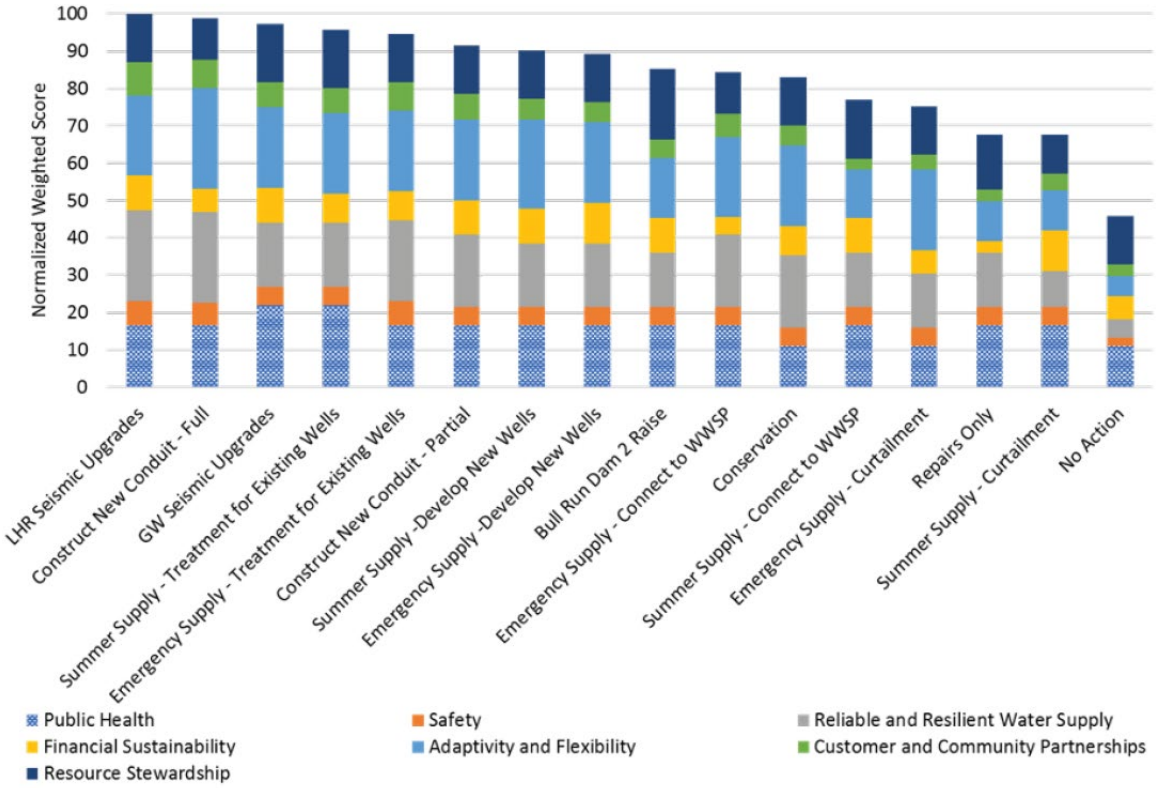
Adaptation Options to address relevant risks

Table ES-6. **Plausible Actions by Category**

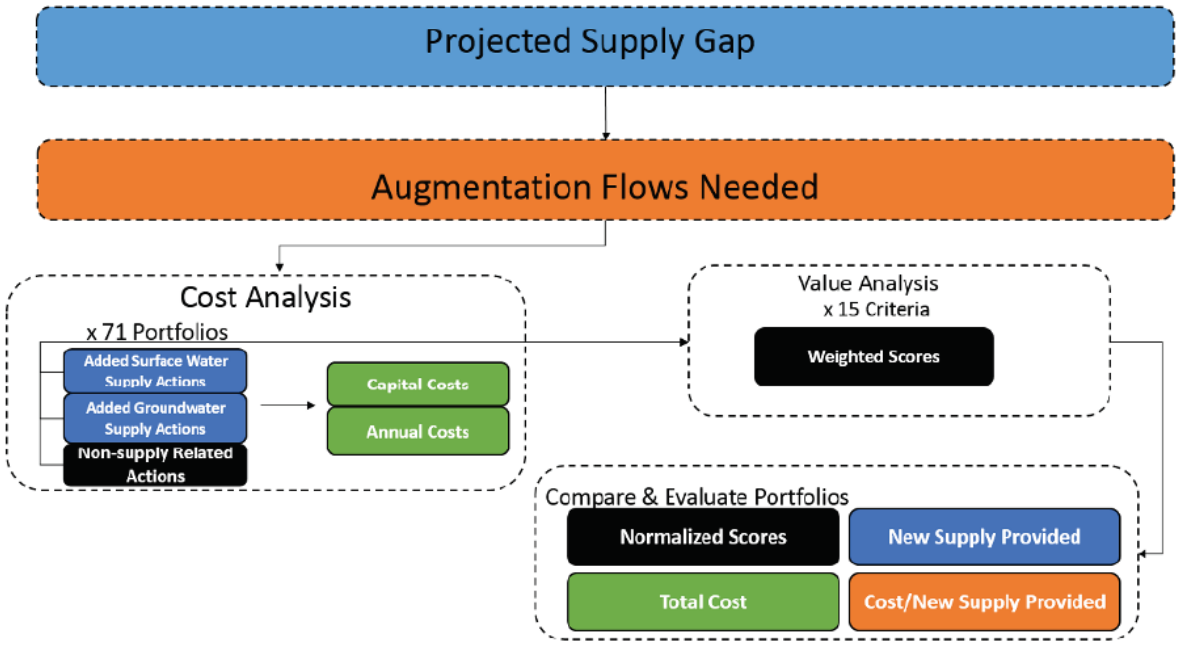
Conduits	Seismic Resilience	Summer Supply	Emergency Supply Needs
Repairs only Construct new conduit - full (Headworks to Powell Butte) Construct new conduit - partial (Headworks to Hudson Intertie) Least hazardous route seismic upgrades	No Seismic Action* Groundwater seismic upgrades	Curtailment Enhanced Conservation Bull Run Dam 2 Raise Develop new wells Treatment for existing wells	Curtailment Enhanced Conservation Bull Run Dam 2 Raise Develop new wells Treatment for existing wells

Only category where No Action is plausible; for the other categories, one of the actions must be implemented in at least one of the future scenarios.

Using various combinations of the 15 plausible actions described above, PWB developed portfolios for evaluation. For example, a portfolio could consist of the actions *Repairs Only, LHR Seismic Upgrades, Summer Supply Curtailment, and Emergency Supply Curtailment.*



Portfolio Evaluation: Reliability, Scoring and Cost Analysis



Efficiency Frontier

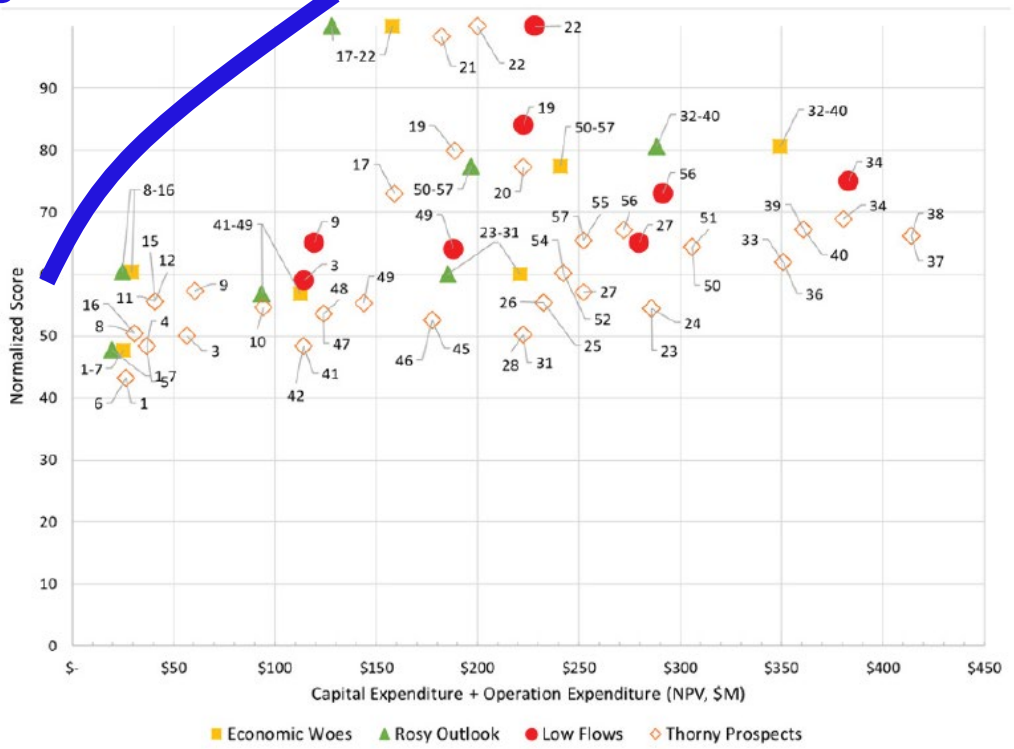


Figure 7-2. Successful Portfolio Performance with Efficient Frontier
Labels correspond to the portfolio numbers.

Scenario-Dependent and Base Supply (Scenario-Independent) Actions

Scenario Independent Actions

System Component	Action
Groundwater	Groundwater System Actions
Conduit	Conduit System Actions
Bull Run	Bull Run Surface Supply System Actions
Conservation	Demand Management Actions

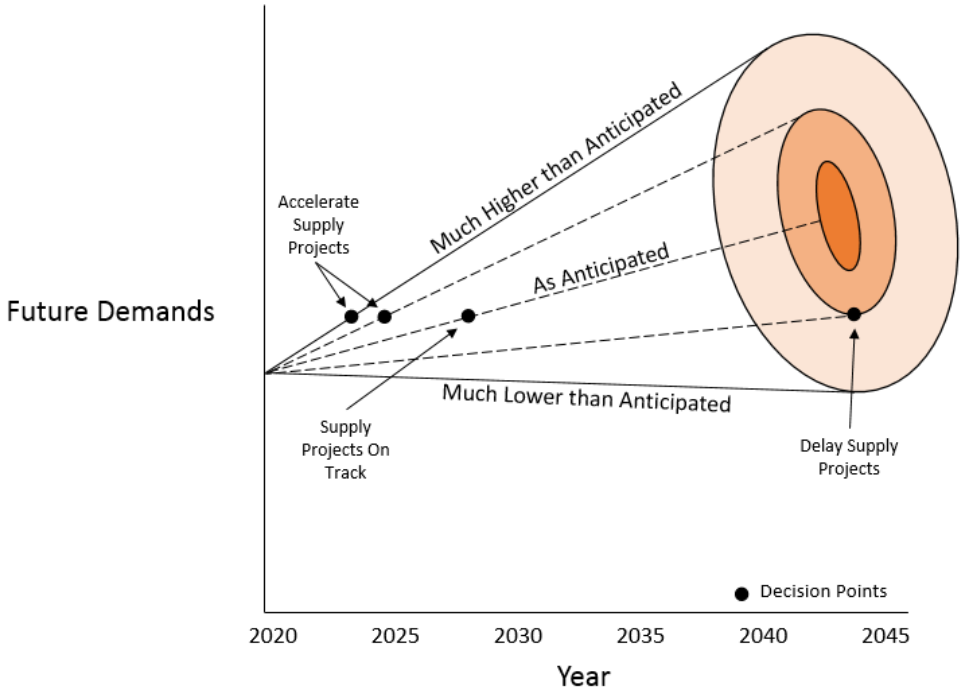
Scenario Dependent Actions

Scenario-Dependent Action	Near-Term Next Steps	Lead Time to Full Implementation
Groundwater System Actions	Plan studies to conduct	3 to 5 years
Demand Management Actions	Plan studies to conduct	3 to 5 years
Conduit System Actions	Construction	10 to 15 years
Bull Run Surface Supply System Actions	Plan studies to conduct	10 to 15 years

Long-term options preserve and to prioritize in specific scenarios

To integrate into near-term CIPs

Adaptive Management Cycle

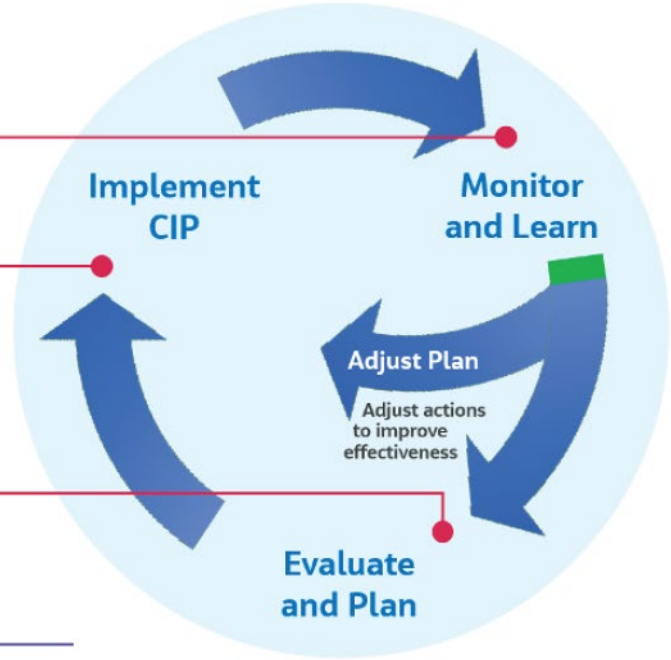


Overview of adaptive management cycle

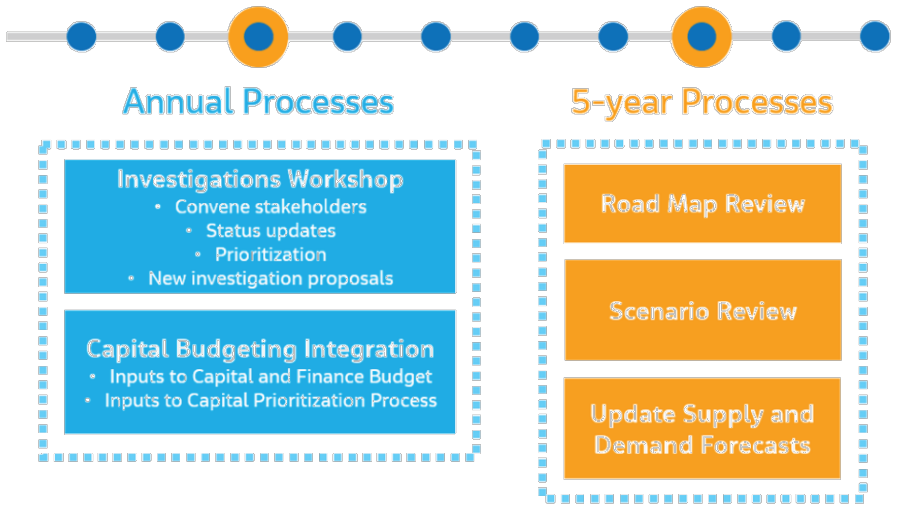
Have supply, demand and economic conditions changed?
What metrics need to be considered?
Do indicators point towards a need to adjust the base plan?

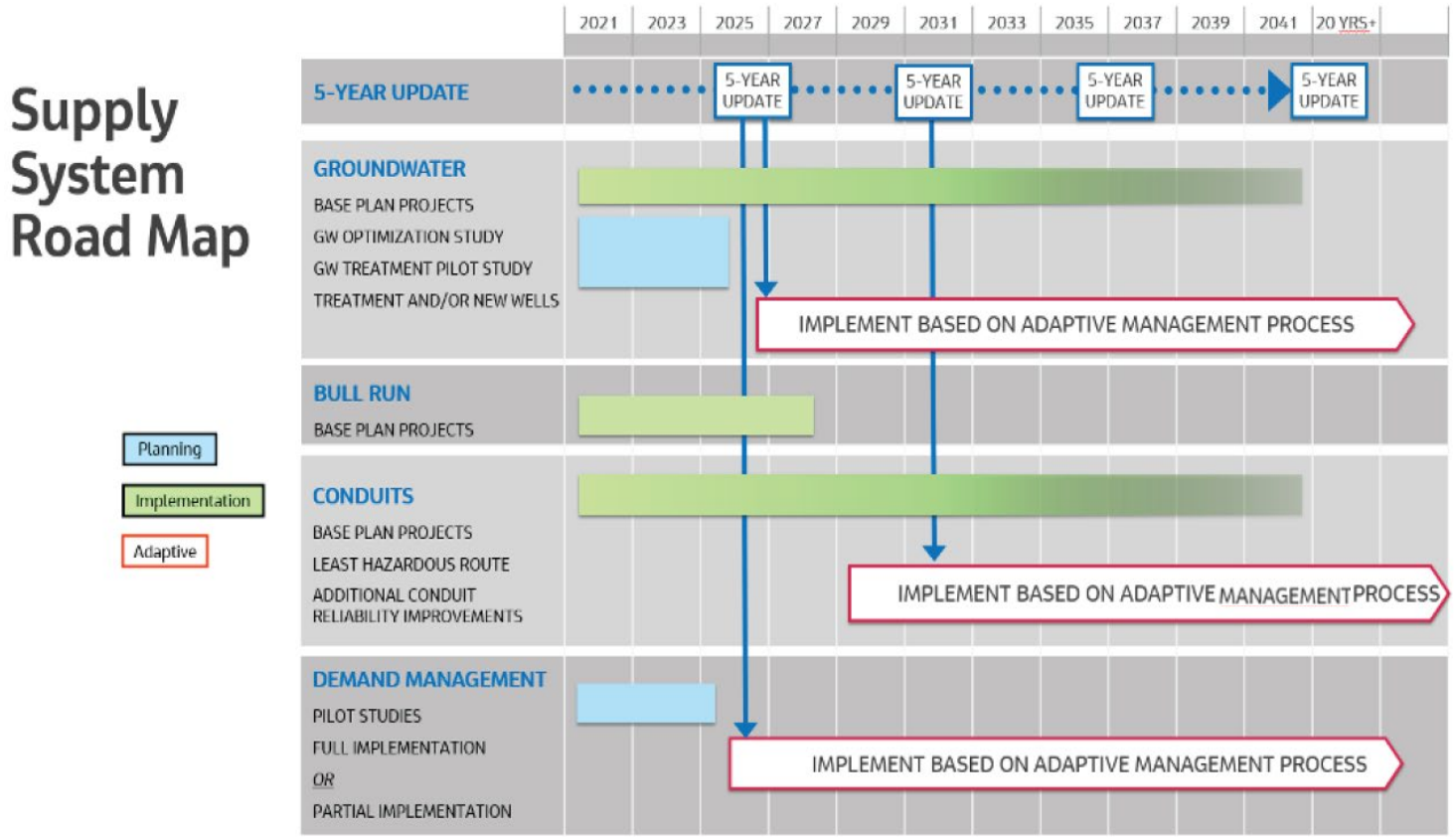
Implement projects included in CIP.
Conduct studies identified during planning phase.

Develop the Base Supply Plan and long-range "options" to preserve.
Prioritize projects that provide the most benefit to the greatest needs identified by indicators.
Identify studies that need to be conducted in order to implement projects.



Portland Water Bureau Supply System Management Plan (2020)





Thank you

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