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SUSTAINABLE
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A FRAMEWORK FOR WATER UTILITIES TO PERFORM LONG-TERM WATER SUPPLY PLANNING INCORPORATING CONCEPTS OF INTEGRATION, RELIABILITY AND SUSTAINABILITY

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Water Research Foundation Project 4615 - Framework for Evaluating Alternative Water Supplies: Balancing Cost with Resilience, Reliability and Sustainability

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26. *Colorado Springs Utilities, CO*

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Research Premise and Objective

- <u>Our Premise</u> – Water supply planning will be more sustainable when it considers risk-based concepts such as risk, reliability and resilience in addition to cost in the decision-making process

- <u>Our Objective</u> – Prepare a practical Framework usable by utilities to incorporate concepts of reliability, resilience and sustainability in addition to cost in their planning processes

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Water Supply Planning Evolution

Traditional Planning

- Supply projects
- Firm yield
- Single future
- Deterministic
- Low complexity

Traditional IWRM

- Supply management
- Demand management
- Firm yield
- Single future
- Deterministic
- Moderate complexity

Next-Generation IWRM

- Planning under uncertainty
- Multiple Futures
- Climate Variability
- Adaptive Planning
- Probabilistic
- High complexity

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Research Approach

TECHNICAL APPROACH

TASK 1: Identify and Assess Water Supply Evaluation Planning Tools

TASK 2: Define an Integrated, Reliable, Resilient, Sustainable Water Supply

TASK 3: Conduct Case Studies

TASK 4: Convene Workshop

TASK 5: Develop Framework

TASK 6: Prepare Reports and Presentation

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Classical Definitions

- Reliability - the probability that the water supply system is in a satisfactory state, answering the question “how often”
- Resilience - the probability that a time period when the water supply system is in an unsatisfactory state is followed by a time period when the water supply system is in the satisfactory state, answering the question “how long”
- Sustainability - the ability of the water supply system to meet goals for long-term viability, triple bottom line performance and other organizational objectives

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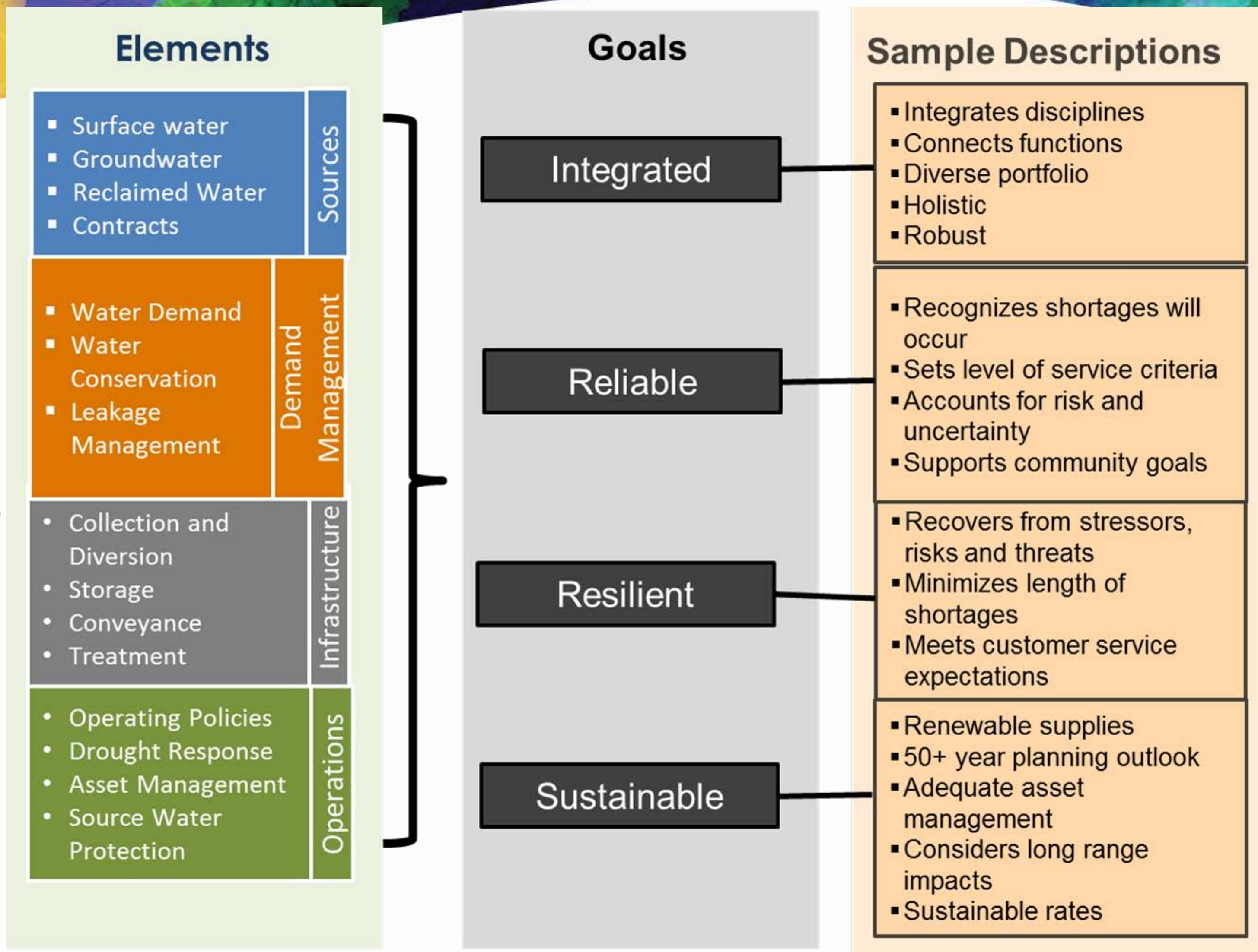
Description of a Sustainable Water Supply



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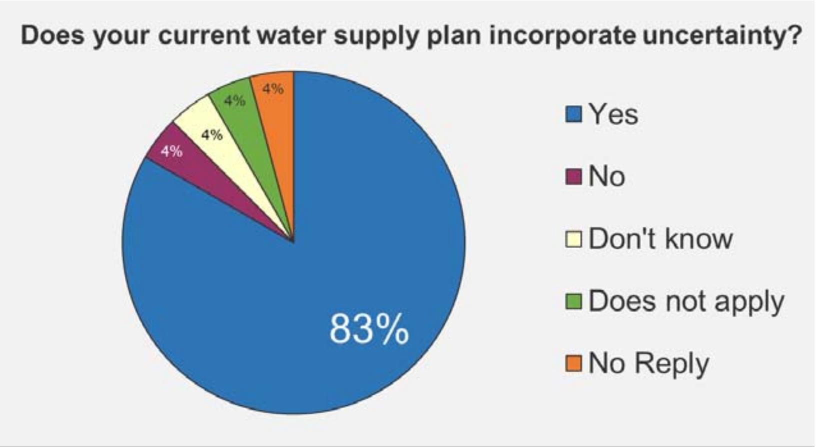
Survey Process

- Survey sent to the WRF 4615 participating utilities
- Survey published in the WRF newsletter
- Survey sent to selected utilities
- Effort to reach smaller communities
- Received 27 responses



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Case Study Utilities

Region	State	Utility	Location	Customers	Main Water Sources
Southwest	CA	Metropolitan Water District of SoCal	Coastal	>1M	100% - Surface
		East Bay Municipal Utility District	Coastal	>1M	98% - Surface 2% - Reclaimed
		City of San Diego	Coastal	>1M	96% - Surface 3.8% - Reclaimed 0.2% -Groundwater
Mountain	CO	Colorado Springs Utilities	Inland	100K-500K	Surface
		Denver Water	Inland	>1M	97% - Surface 3% - Reclaimed
Northwest	OR	Portland	Inland	500K-1M	Surface
South Central	TX	Tarrant Regional Water District	Inland	>1M	97% - Surface 3% - Reclaimed
Southeast	FL	Tampa Bay Water	Coastal	>1M	33% - Surface 65% - Groundwater 2% - Desalinated
		West Palm Beach	Coastal	100K-500K	Mostly Surface

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Research Findings and Lessons Learned – General Planning

- There are no consistent accepted definitions for reliability, resilience or sustainability
- We need improved methods of informing policy makers and stakeholders of these new planning strategies
- The greatest focus is on 20-25 year planning horizon
- Understanding your system is critical

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Research Findings and Lessons Learned – General Planning

- Non-technical factors (e.g., State regulations, local politics, external stakeholders) can strongly impact planning approaches
- Utilities concerned with water scarcity have different issues than those concerned with water quality
- Commit to continuity - select a process and stick with it through future updates

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Research Findings and Lessons Learned – General Planning

- Planning is iterative – you don't have to do everything the first time
- You will learn much about your organization and system in the process – that will a valuable outcome of the planning activity

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Research Findings and Lessons Learned – Addressing Risk and Uncertainty

- Concepts of sustainability and uncertainty are currently being widely used in water supply planning, especially by large utilities
- Utilities use a wide variety of level of service goals and decision-making approaches to assess system performance and make decisions
- Uncertainty is most frequently addressed through use of different future scenarios

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Research Findings and Lessons Learned – Addressing Risk and Uncertainty

- Climate change is often addressed in a simplified fashion (e.g., reduce streamflow by an assumed percentage, resequence historical flows)

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Research Findings and Lessons Learned – Modeling

- There are no industry-wide standards for modeling or decision support systems
- Model approaches vary substantially but nearly always represent a major time and cost commitment
- Stay focused – only model and analyze what you need
- Traditional simulation models are starting to be combined with optimization routines

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Research Findings and Lessons Learned

"It's gonna be messy." – Leon Basdekas, Black and Veatch, formerly Colorado Springs Utilities, CO

"In preparing for battle I have always found that plans are useless but planning is indispensable." – Dwight D. Eisenhower

"Everyone has a plan 'til they get punched in the mouth." – Mike Tyson

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Framework Goals

- Provide guidance and a process, not make specific recommendations
- Provide examples from case studies and research
- Provide a practical guidance manual for practicing water supply planners

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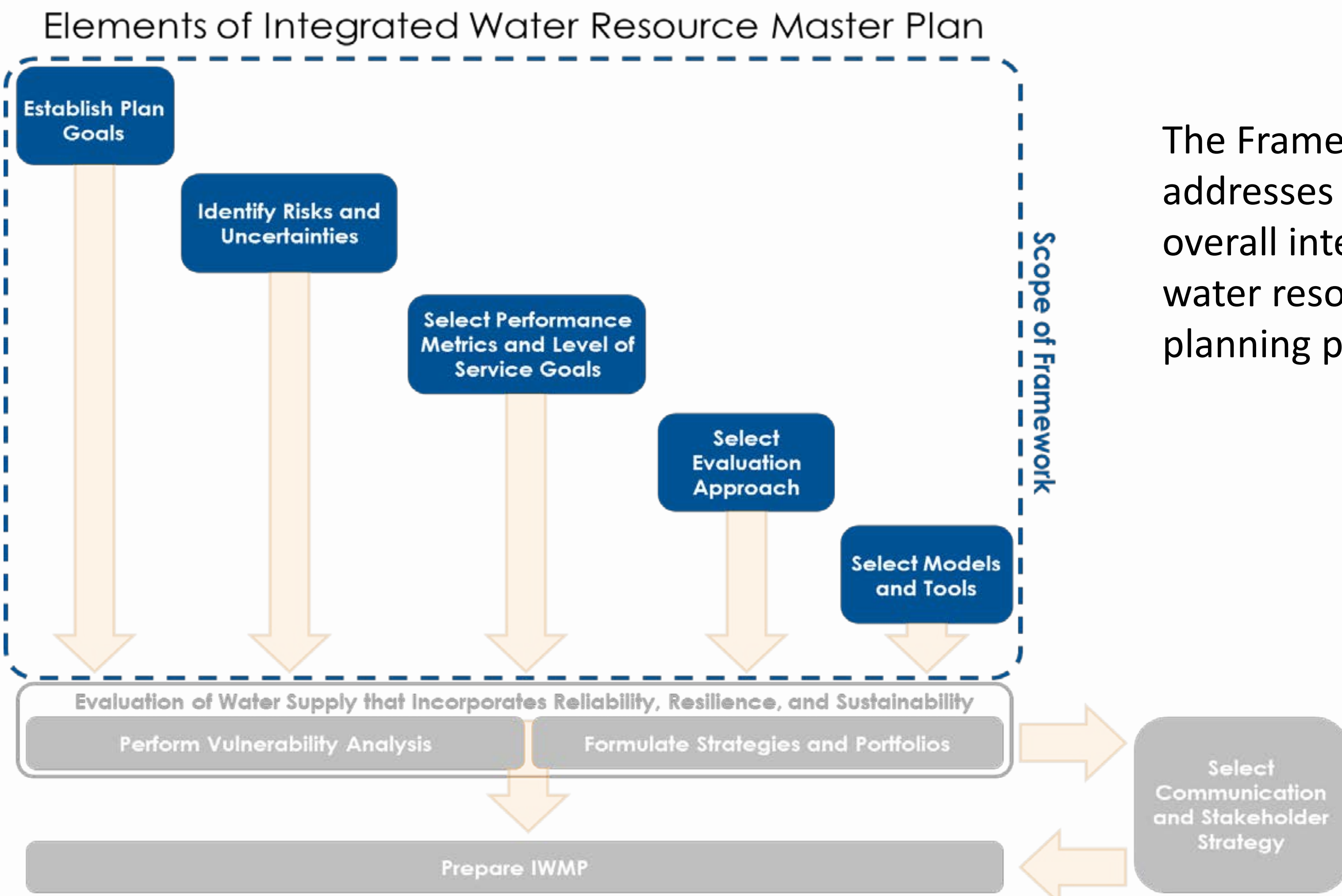
Overview of Framework



The Framework addresses part of the overall integrated water resources planning process

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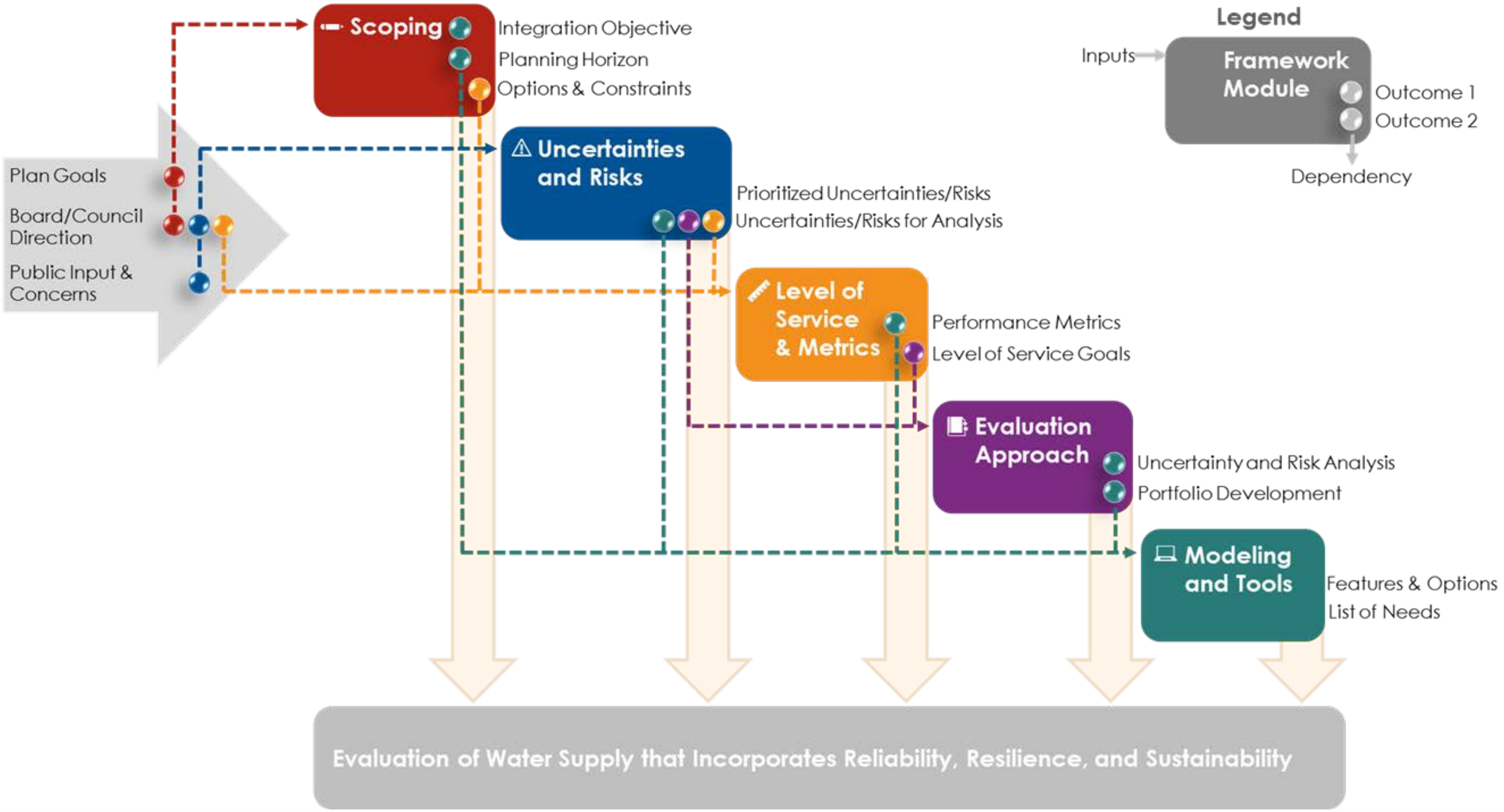
Water Supply Evaluation Framework Modules and Dependencies



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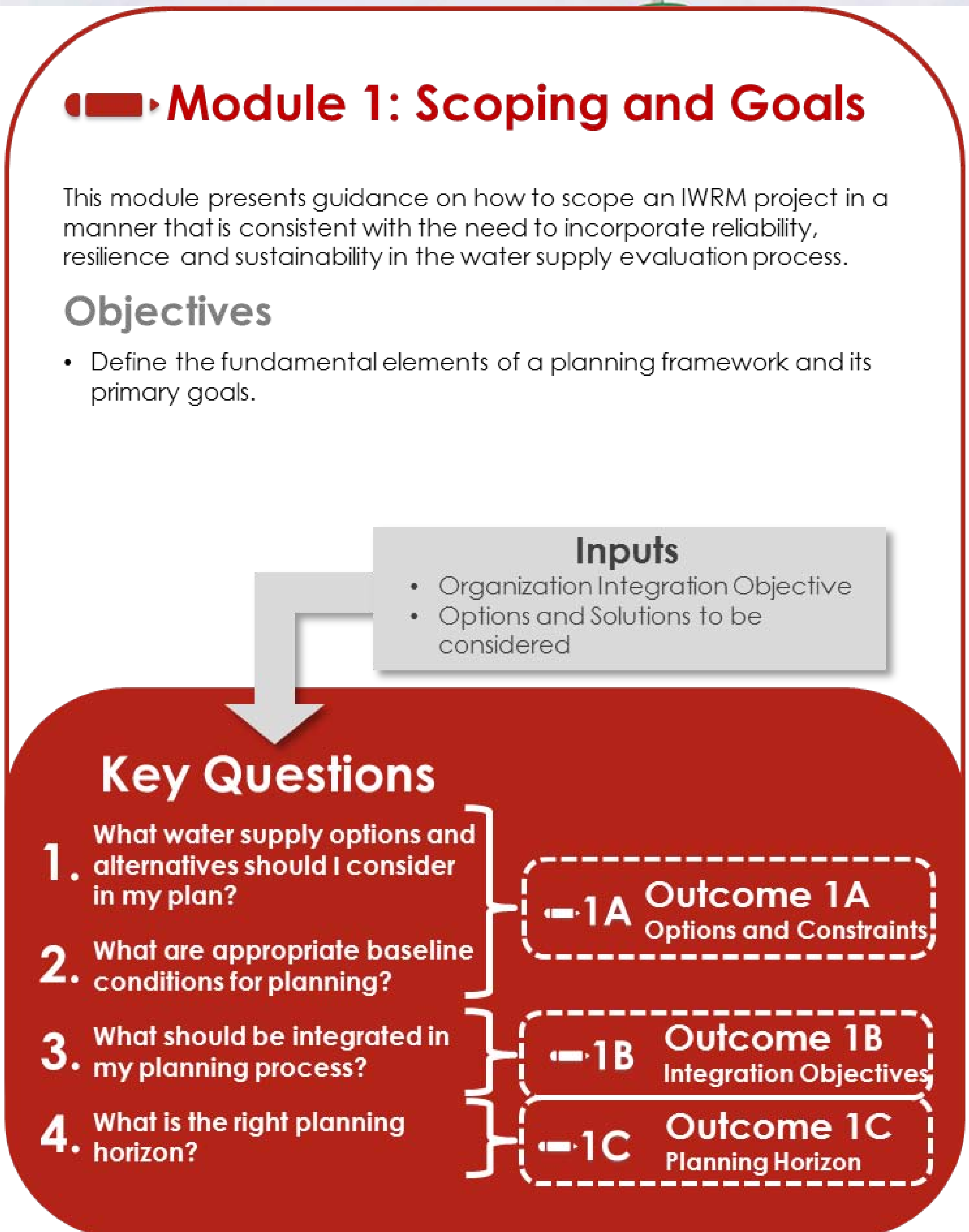
Module 1: Scoping and Goals

This module presents guidance on how to scope an IWRM project in a manner that is consistent with the need to incorporate reliability, resilience and sustainability in the water supply evaluation process.

Objectives

- Define the fundamental elements of a planning framework and its primary goals.

Each module is organized around a set of key questions leading the user to specific outcomes

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Example Guidance for Scoping and Goals

Factors Driving Goals

- Demand Growth
- Organization Goals
- Political Goals
- Regional Opportunities
- State Guidance
- Past Droughts or Failures

Factors Driving Process

- Past Planning Methods
- Scheduled Update
- System Features
- Technical Issues

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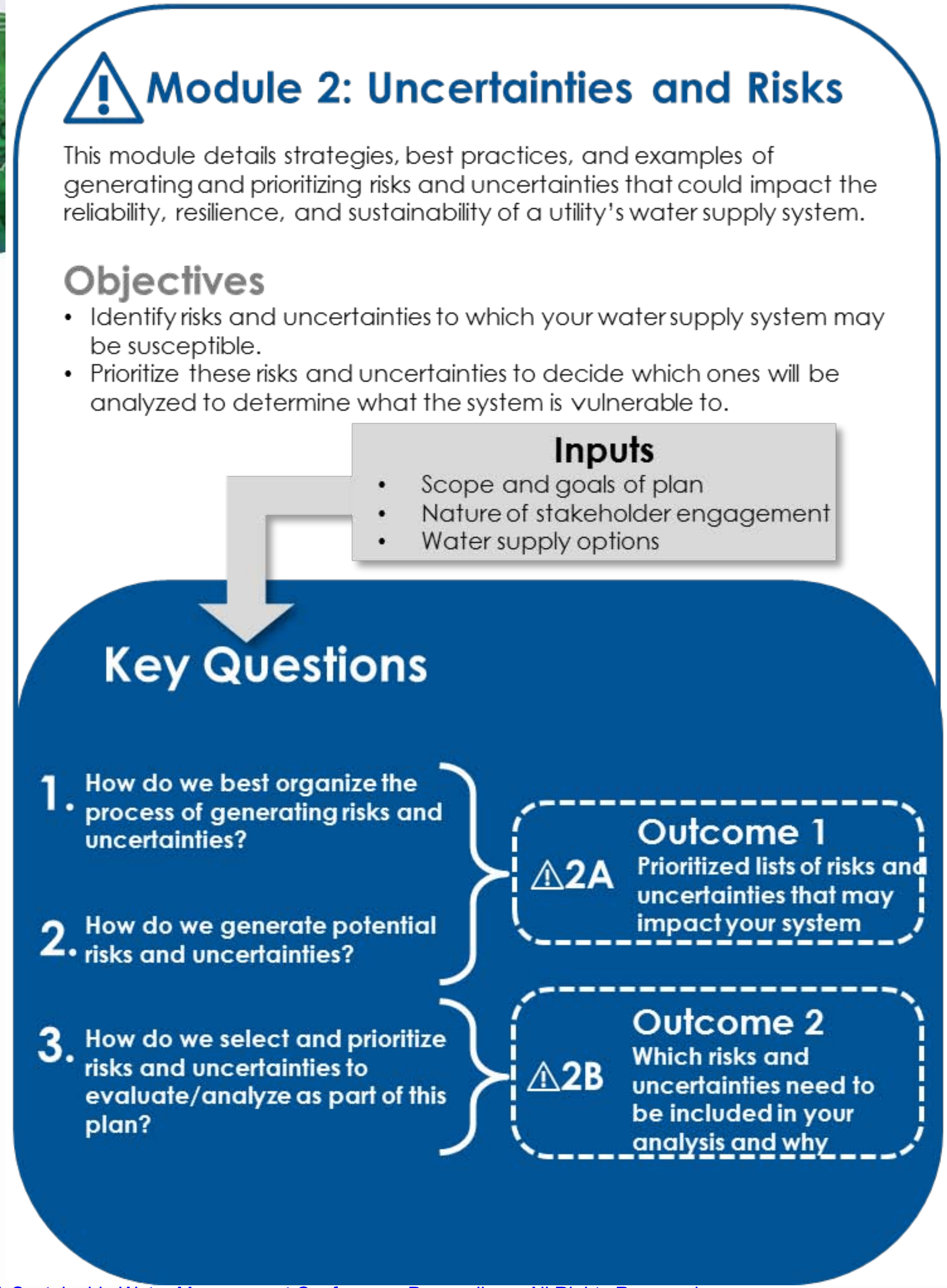
- Risk based planning is fundamental to new approaches
- Risk – threat to water supply system performance
- Uncertainty – a “known unknown”



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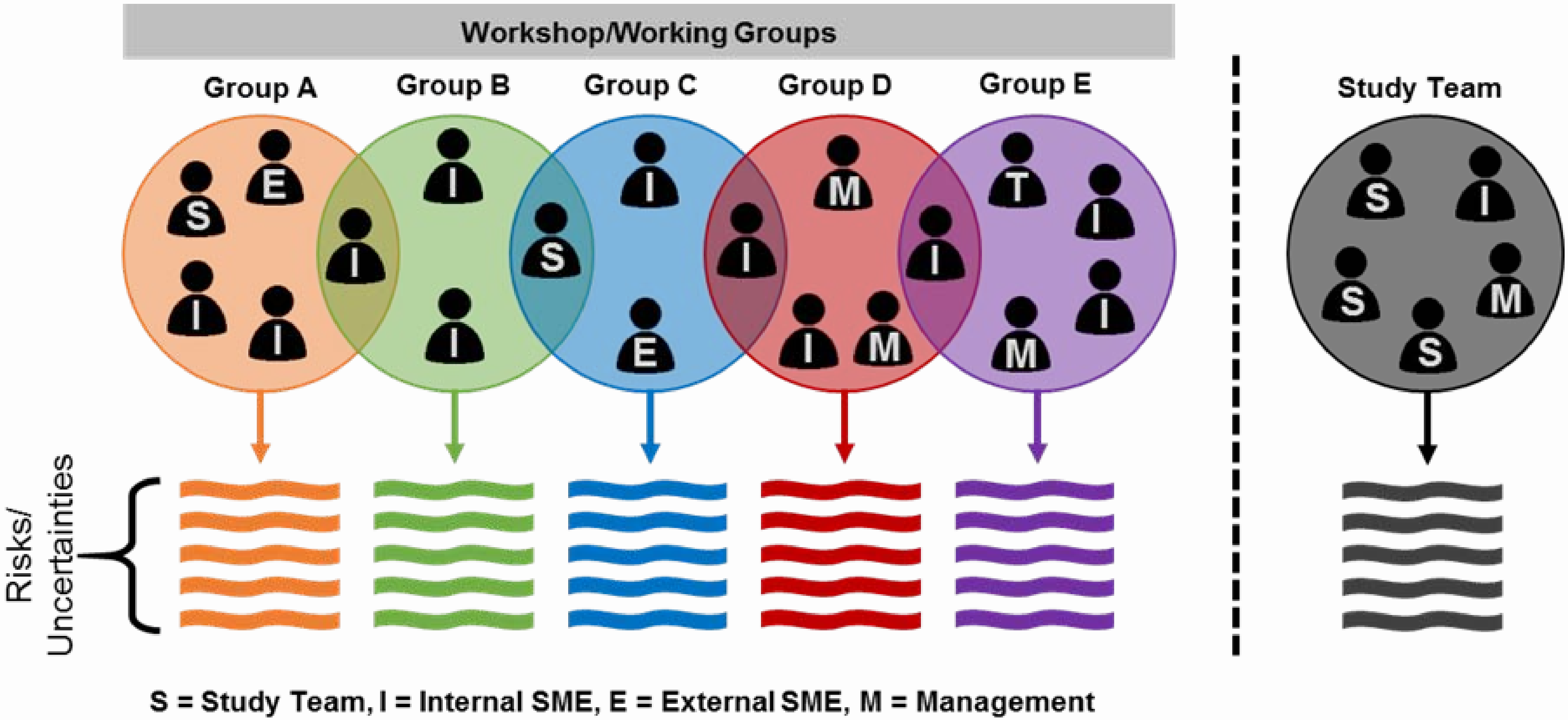
Risk/Uncertainty Identification Methods



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Risk and Uncertainty Categories

- **Demand Uncertainties** - population growth, economic conditions, conservation effectiveness, demand hardening
- **Hydrology Uncertainties** – drought, climate change, change in rain-snow mix
- **Environmental Uncertainties** - wildfire, sea level rise, water quality degradation
- **Regulatory Uncertainties** – increased environmental permitting, constrained water administration
- **Infrastructure Uncertainties** – aging infrastructure, failures

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1

Generate initial list of risks and uncertainties by thinking about the water supply system in a bottom-up or top-down approach

Bottom-Up

List all the events that could have a negative impact on the water supply system, stepping through the various elements. This approach is effective when the theme is an aspect of the water supply system (e.g. supply, conveyance, demands)

Top-Down

List all the events that could occur around a theme and map them to the water supply system. This approach is effective when the theme could impact multiple aspects of the water supply system (e.g. environmental, climate, political).

2

Contextualize the initial list by categorizing around themes based on what is important to your utility. Identify if there are any categories that are not well represented by the initial list and if it is realistic.

3

Focus on categories that are not well represented by the initial list and attempt to fill them in.

4

List assumptions made by your organization in relation to the water supply system. Generate risks and uncertainties around those assumptions being incorrect.

Examples

- Population will always increase
- There is an ultimate demand we can quantify
- Past hydrology is indicative of future hydrology
- Customers will always use water the way they use it today
- We need to meet all our customers demand all the time

Comprehensive list of potential risks and uncertainties

A key strategy: Question your assumptions

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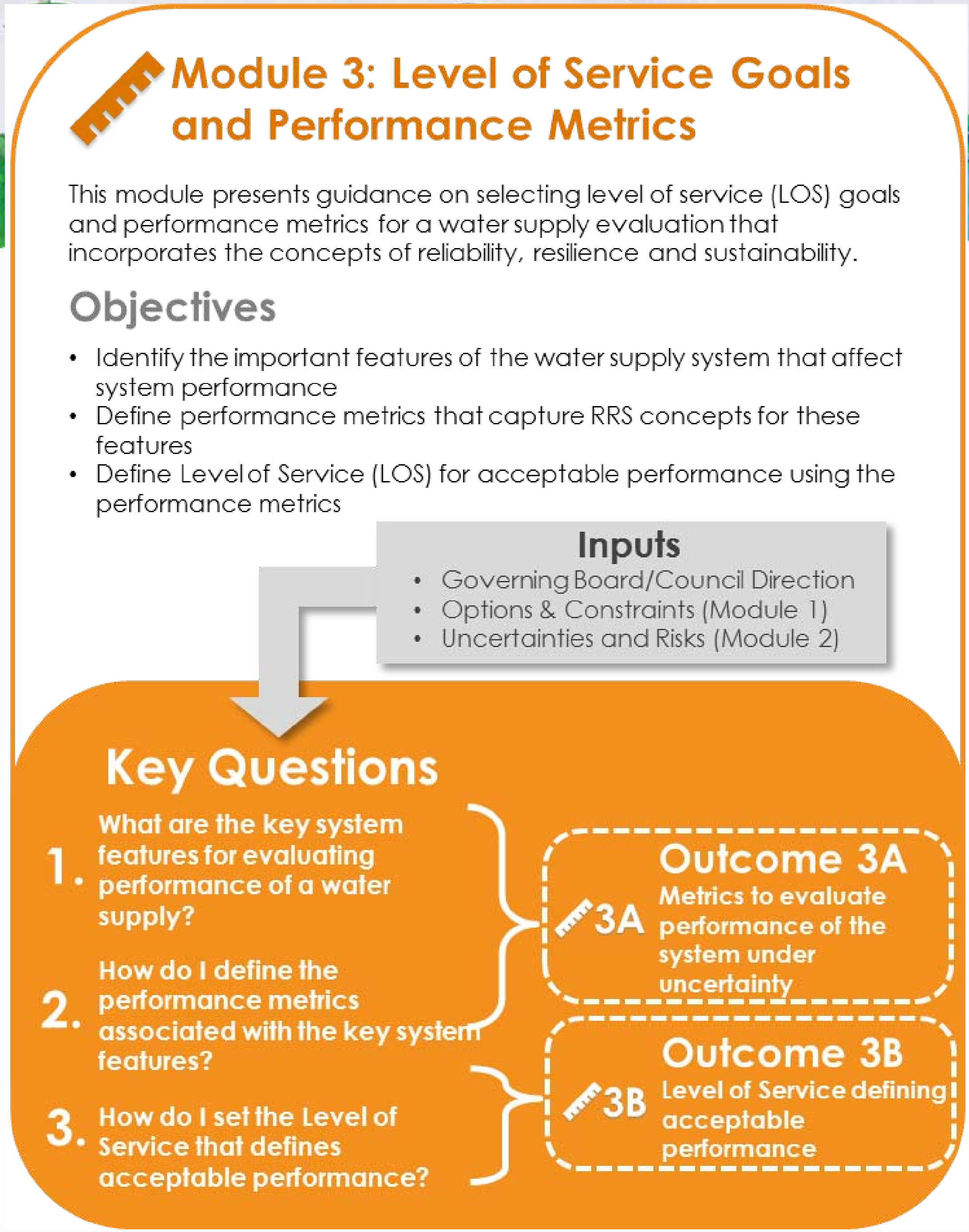
- Metric – quantifiable measure of system performance
- Level of service goal – value of a metric defining acceptable system performance



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Water Utility	Level of Service Goals
Colorado Springs Utilities	• Maintain 1.5 Years of Demand (YOD) in storage 90% of years • Outdoor watering restrictions in at most 10% of years (90% reliability) • Maintain 1.0 YOD in storage 100% of years • Meet indoor demands in 100% of years
Denver Water	• Outdoor watering restrictions in at most 10% of years (90% reliability) • Outdoor watering bans in at most 1% of years (99% reliability) • Meet indoor demands in 100% of years
East Bay Municipal Utility District	• Meet 85% of total demand in 100% of years
Metropolitan Water District of Southern California	• Meet commitments to wholesale customers 100% of years for “foreseeable conditions” • Maintain 1 million acre-ft in storage, trigger mandatory restrictions if storage falls below this number (no reliability attached)
Portland Water Bureau	• Meet average day demand throughout a 500-year drought event
City of San Diego	• Meet demands 100% of the time, but allowing for restrictions
Tampa Bay Water	• Meet full demands 95% of the time • Always maintain 90 days of demand in storage • Meet contractual pressure requirements for members 100% of time
Tarrant Regional Water Utility	• 100% reliability in supply transmission system • 100% reliability in meeting primary customer demands
West Palm Beach	• Minimum operational targets for Lake Okeechobee and Grassy Lake Elevation

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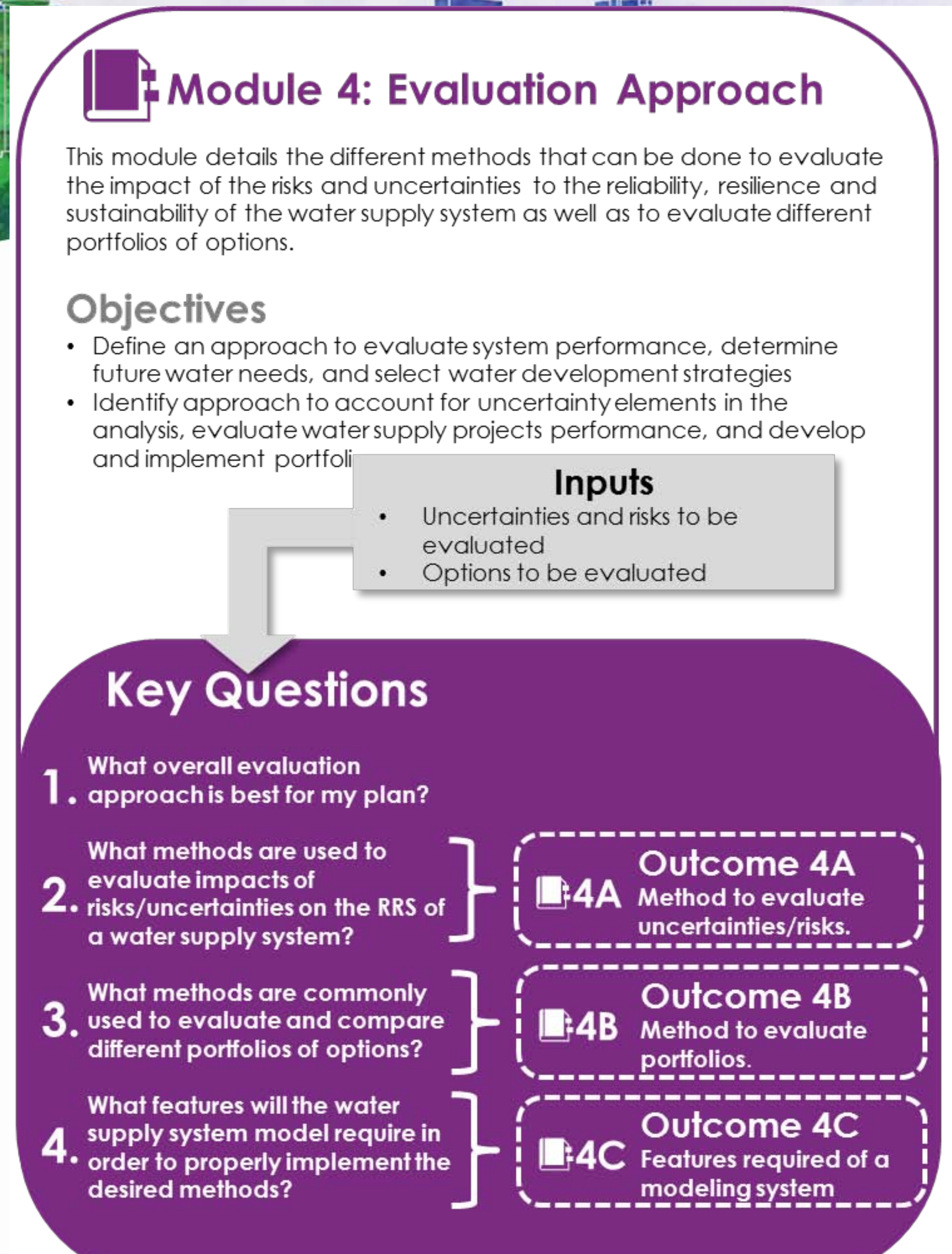
- Approach to evaluate system performance and evaluation potential portfolios
- Two main categories:
  - Scenarios – top down
  - Robustness – bottom up



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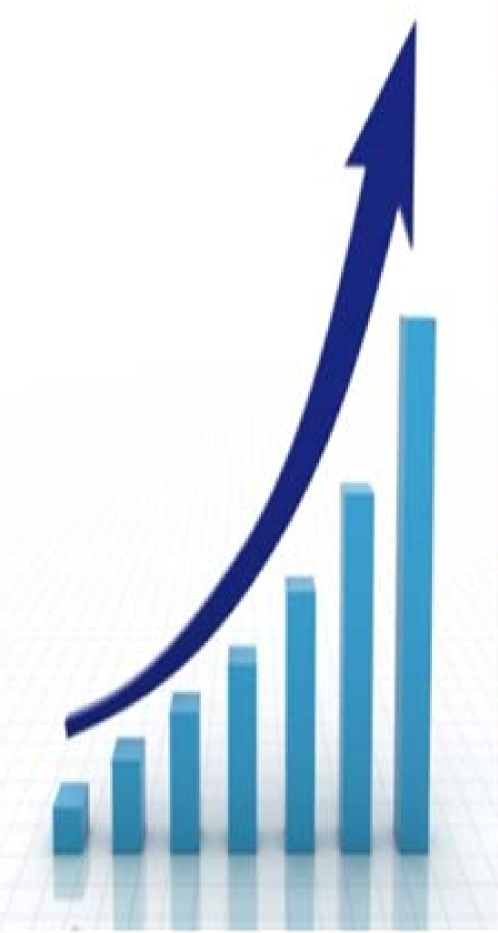
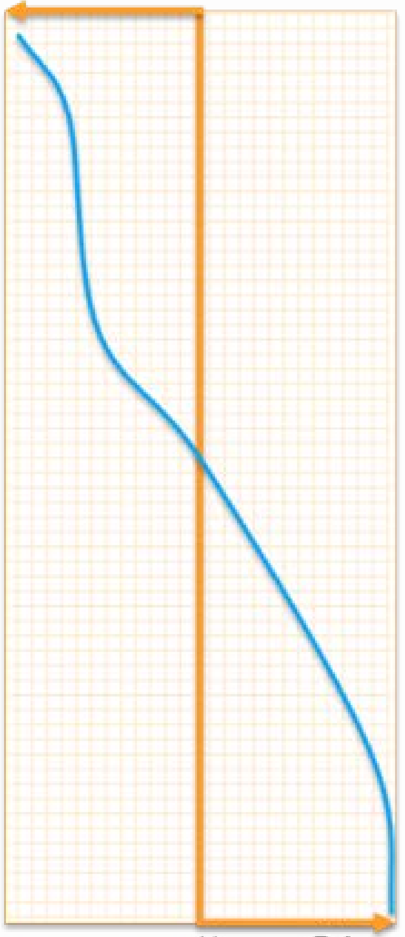
Number of Futures	Approaches	 Vs. 
	Full Combinatorial Exploratory Search Probabilistic (monte carlo) Latin Hypercube Sampling Selected Stressed System Story Lines Discrete Scenarios Scenarios Bookends	

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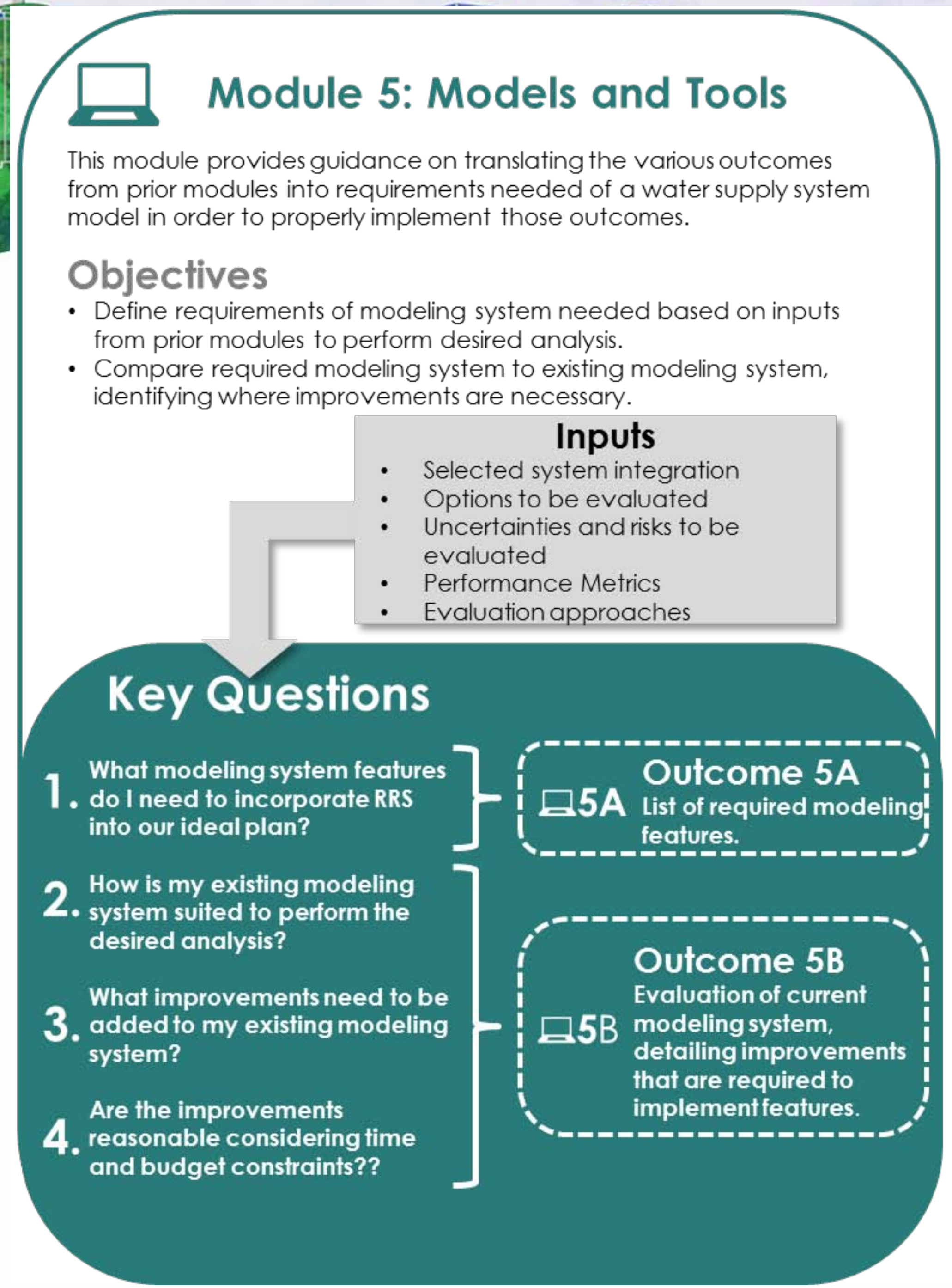
- Simulation and optimization models
- Alternative evaluation models



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Guidance for Model Selection

- Existing model?
- Budget to develop new model?
- Staff and knowledge to prepare model?
- Complex system?
- Need to simulate climate futures?
- Use optimization?
- Open source or proprietary?
- **Select Suitable Model Approach**

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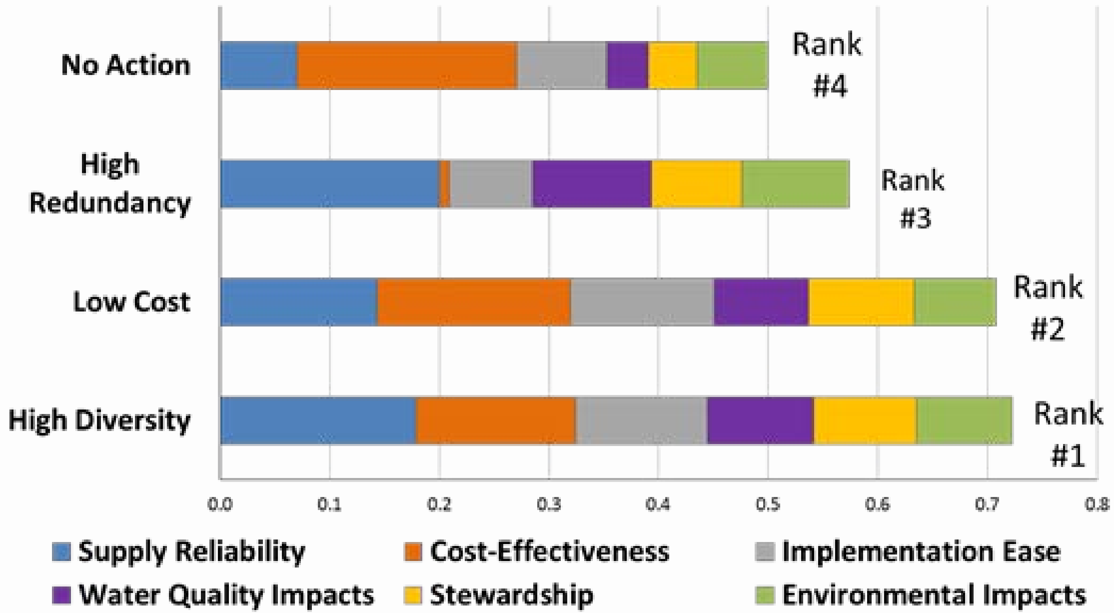
Guidance for Alternative Evaluation

- Multi-criteria methods
- Add reliability, resilience and sustainability criteria to traditional triple-bottom-line criteria



Example from West Palm Beach, FL

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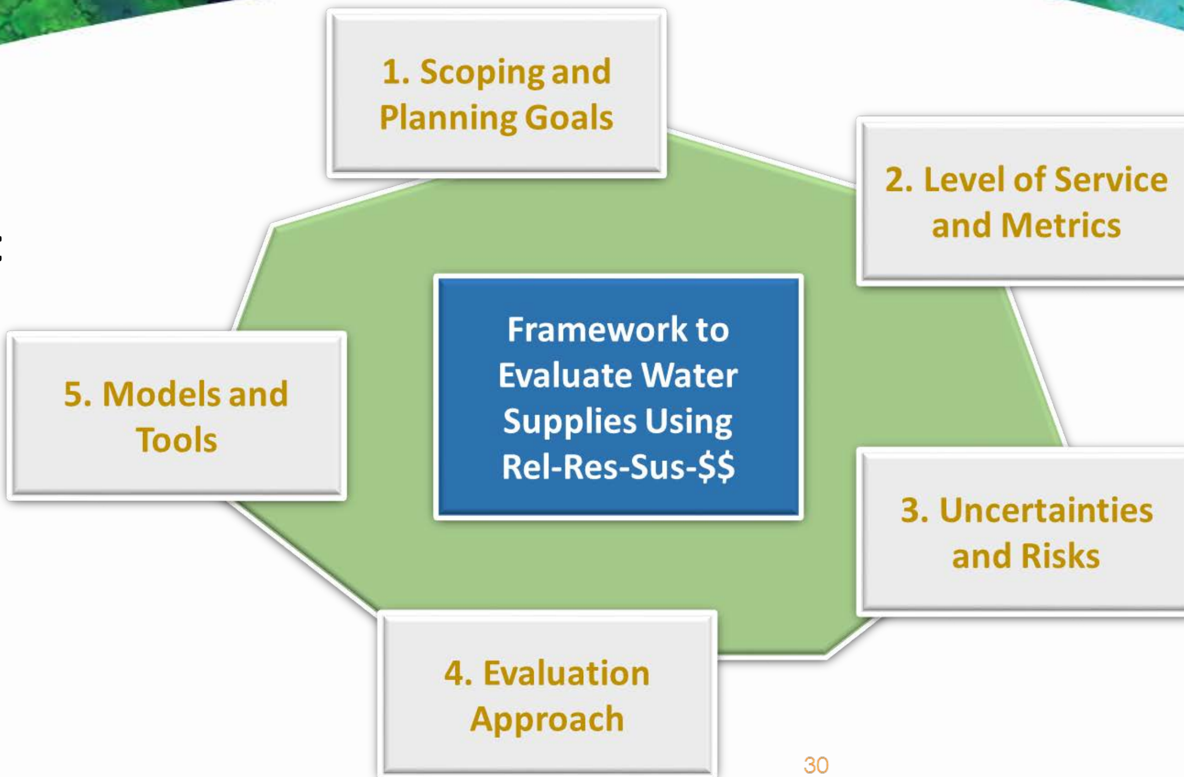
WRF 4615 Framework Report

- Guidance Manual
- Literature Review
- Survey Results
- Case Study Summaries



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Questions and Comments

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