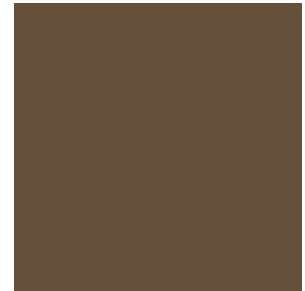
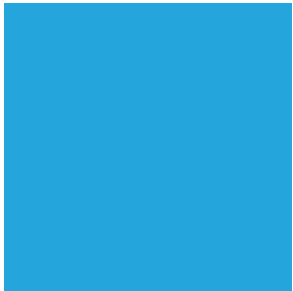


Can We Grow Water Smart?

Statewide Water Planning



Poudre River Forum 2018

Greg Johnson

February 2, 2018



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Can we grow water smart?



And...



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And... Change & Uncertainty Prevail



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Drought is Unavoidable - Balance is Essential



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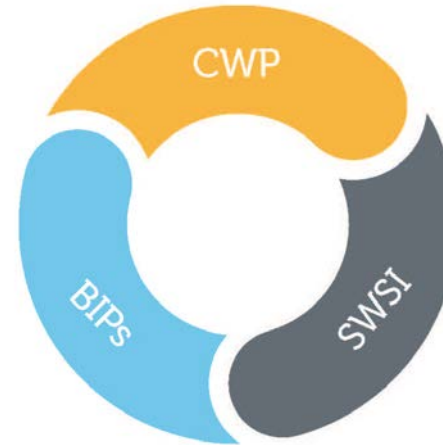
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What is the State doing?

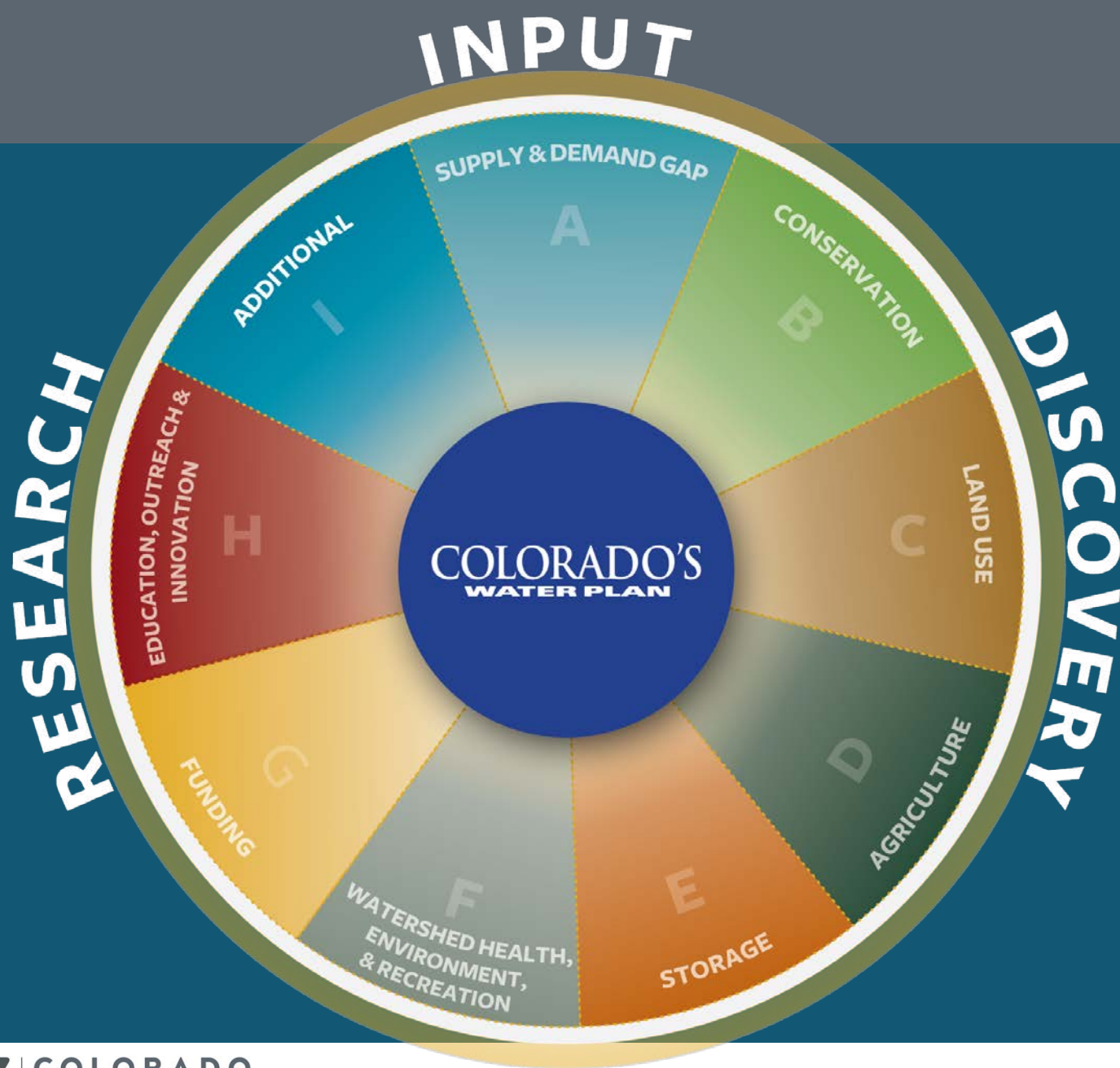
The Recent Evolution of CWCB's Water Planning



COLORADO'S
WATER PLAN



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Department of Natural Resources

An aerial photograph of a Colorado town, likely Aspen, showing a mix of residential and commercial buildings, a winding river, and surrounding mountains under a blue sky with scattered clouds. The image is used as a background for the top half of the slide.

INTEGRATING WATER-SAVING ACTIONS

AND LAND USE
PLANNING.

Conservation

Colorado's Water Plan sets a measurable objective to achieve 400,000 acre-feet of municipal and industrial water conservation by 2050.

Land use

Colorado's Water Plan sets a measurable objective that by 2025, 75 percent of Coloradans will live in communities that have incorporated water-saving actions into land-use planning.



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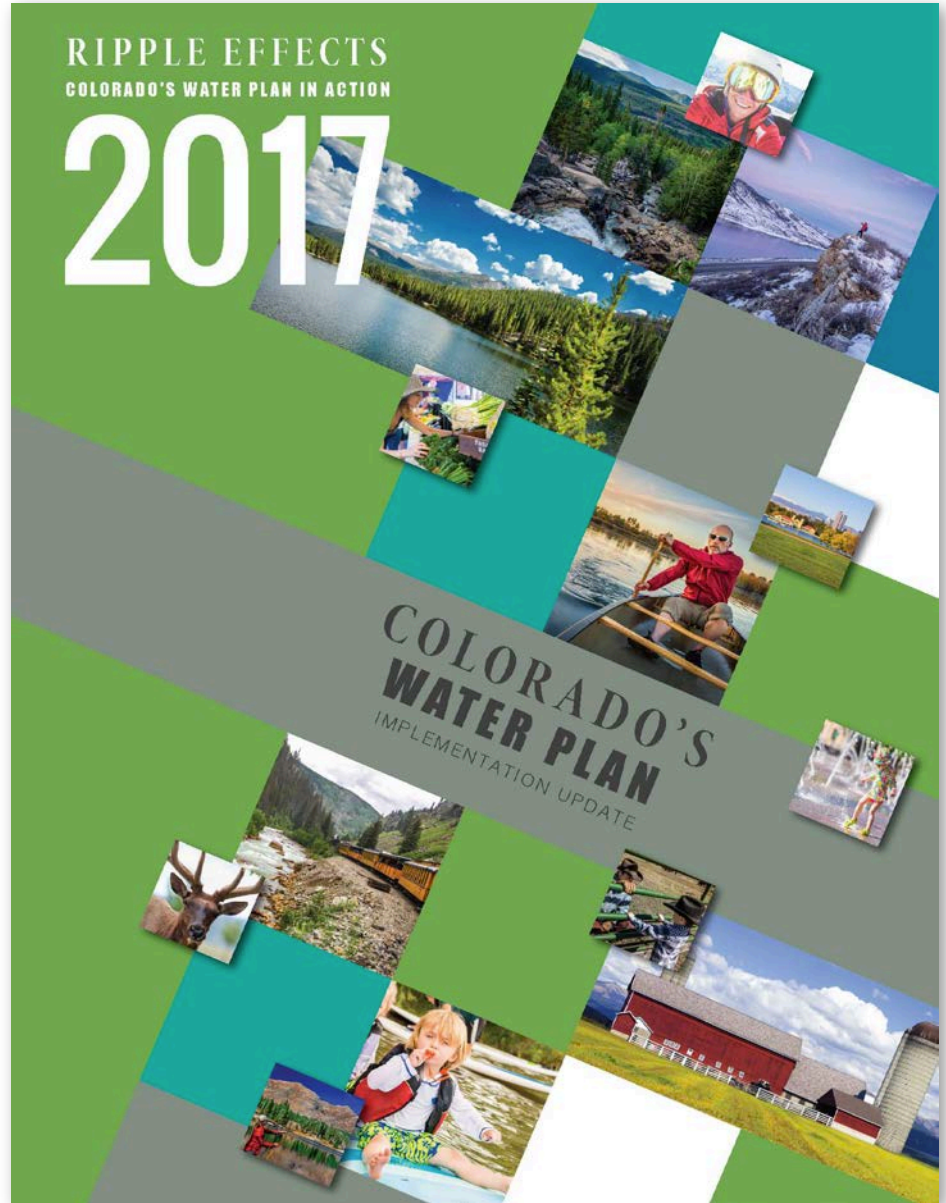
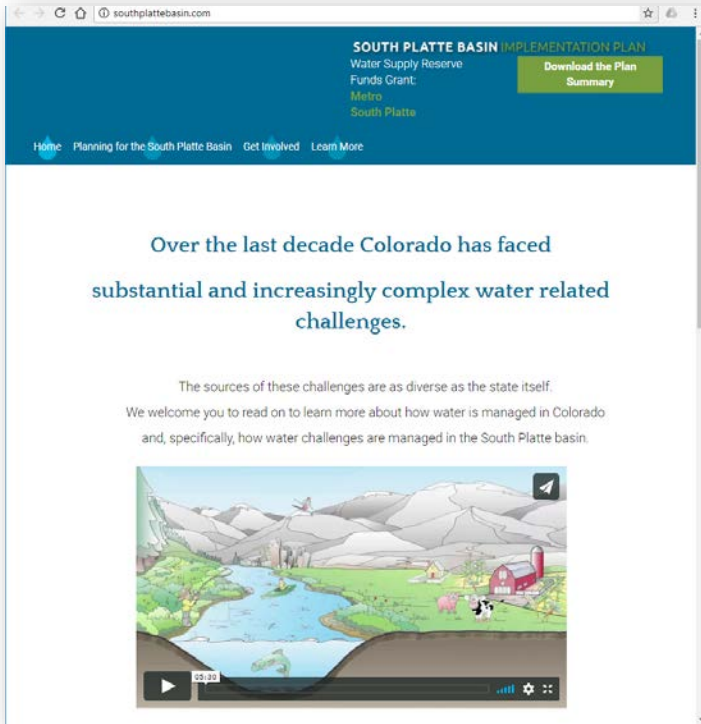
C. Land Use

- ❖ **Integrate Land Use and Water Planning:** Initiate the use of local land use tools, where appropriate, to reduce water demands for municipalities, and the need to urbanize agricultural lands.

CRITICAL LAND USE ACTION	SECTION	PARTNERS	TYPE
1 Through voluntary trainings for local governments, encourage the incorporation of best management practices in land use for water demand management, water efficiency, and water conservation.	6.3.3	CWCB, DOLA, stakeholders	Programmatic



Water Plan Today: **Implementation**



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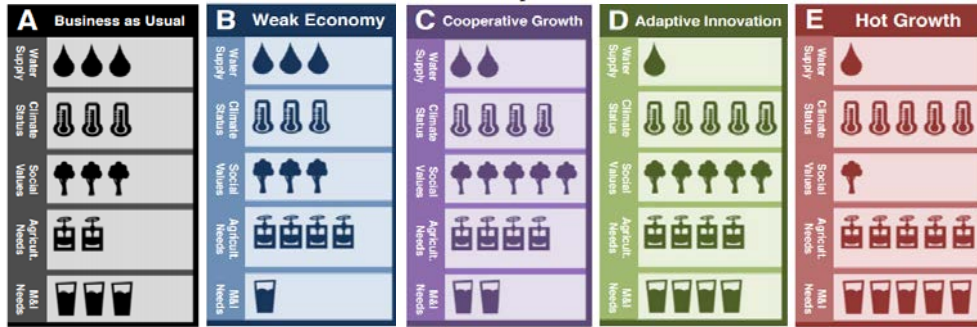
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SWSI Update: Purpose

1. Consistent statewide framework for examining future water supply and demand
2. Tools and data for Roundtables to update Basin Plans & develop local solutions to identified gaps



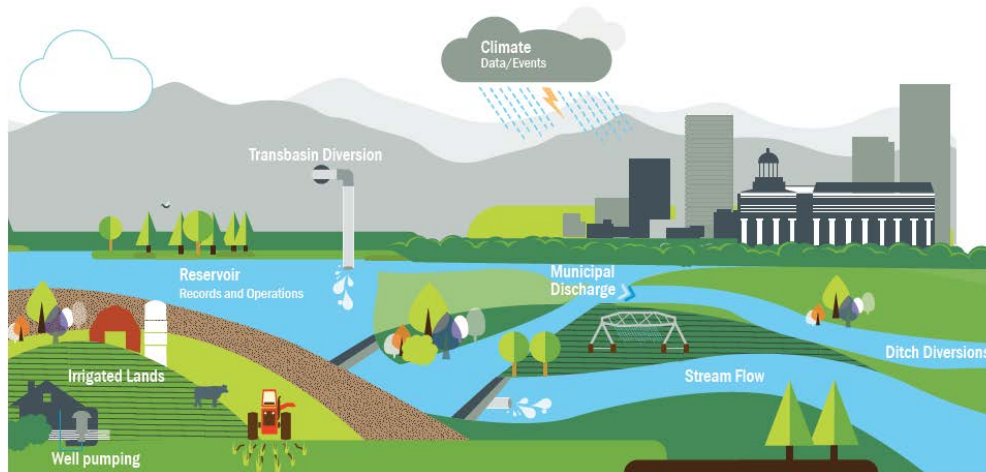
SWSI Update: **New Approach**



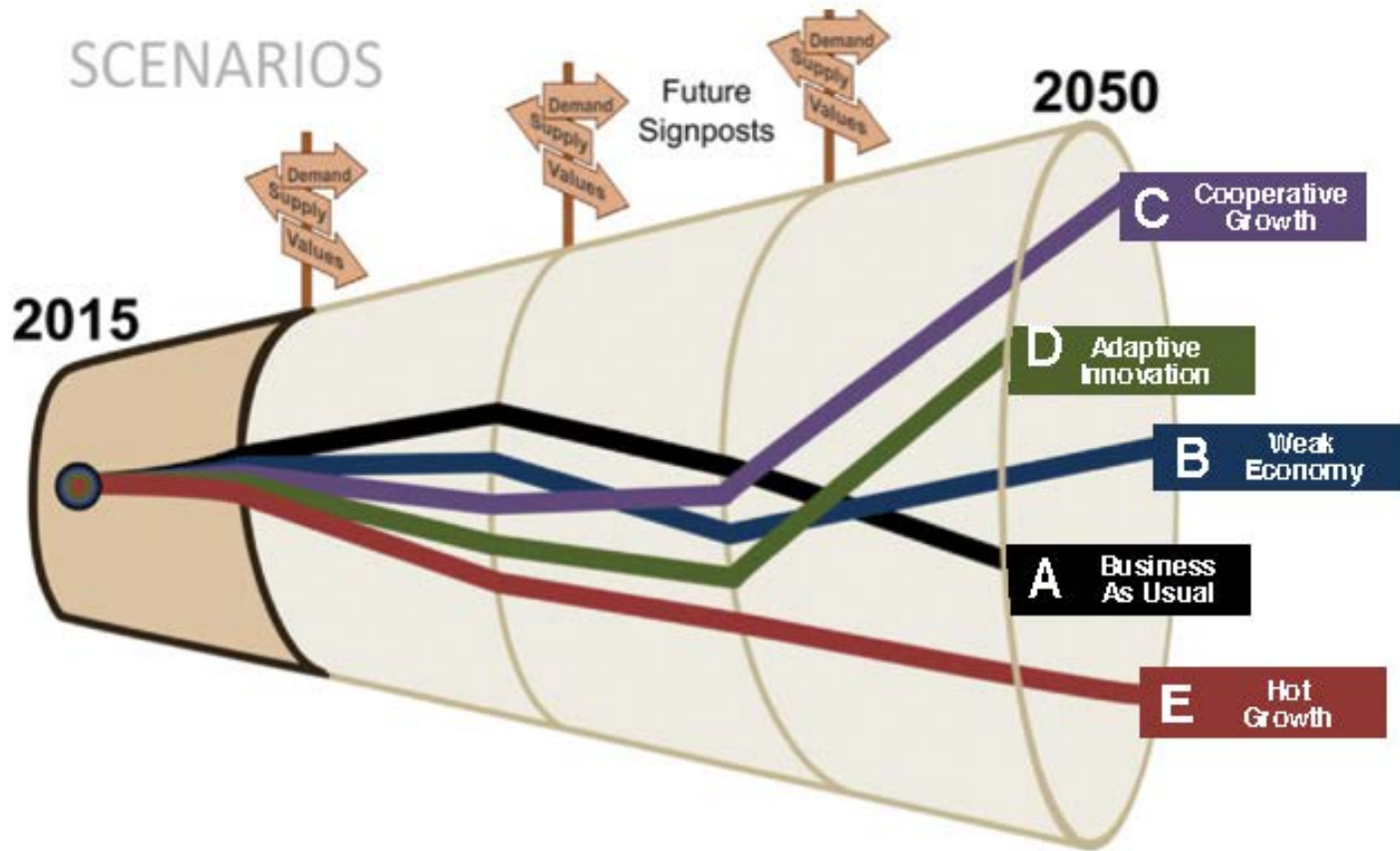
Scenario
Planning

+

Hydrologic
Modeling



SWSI Update: Scenario Planning



SWSI Update: M&I Drivers & Parameters

Key Driver	Water Demand Parameter	Parameter Adjustment by Scenario				
		Business as Usual	Weak Economy	Cooperative Growth	Adaptive Innovation	Hot Growth
Land Use & Associated Population Growth	Population	SDO	Low	Adjusted SDO	Adjusted High	High
Economic Growth	Indoor and Outdoor gpcd	~	-	~	~	++
Climate Conditions	Outdoor gpcd	Current	Current	In-between	Hot and dry	Hot and dry
Regulations & Technology Change	Indoor and Outdoor gpcd	~	+	--	--	+
Social Values Changes	Indoor and Outdoor gpcd	~	~	--	--	-

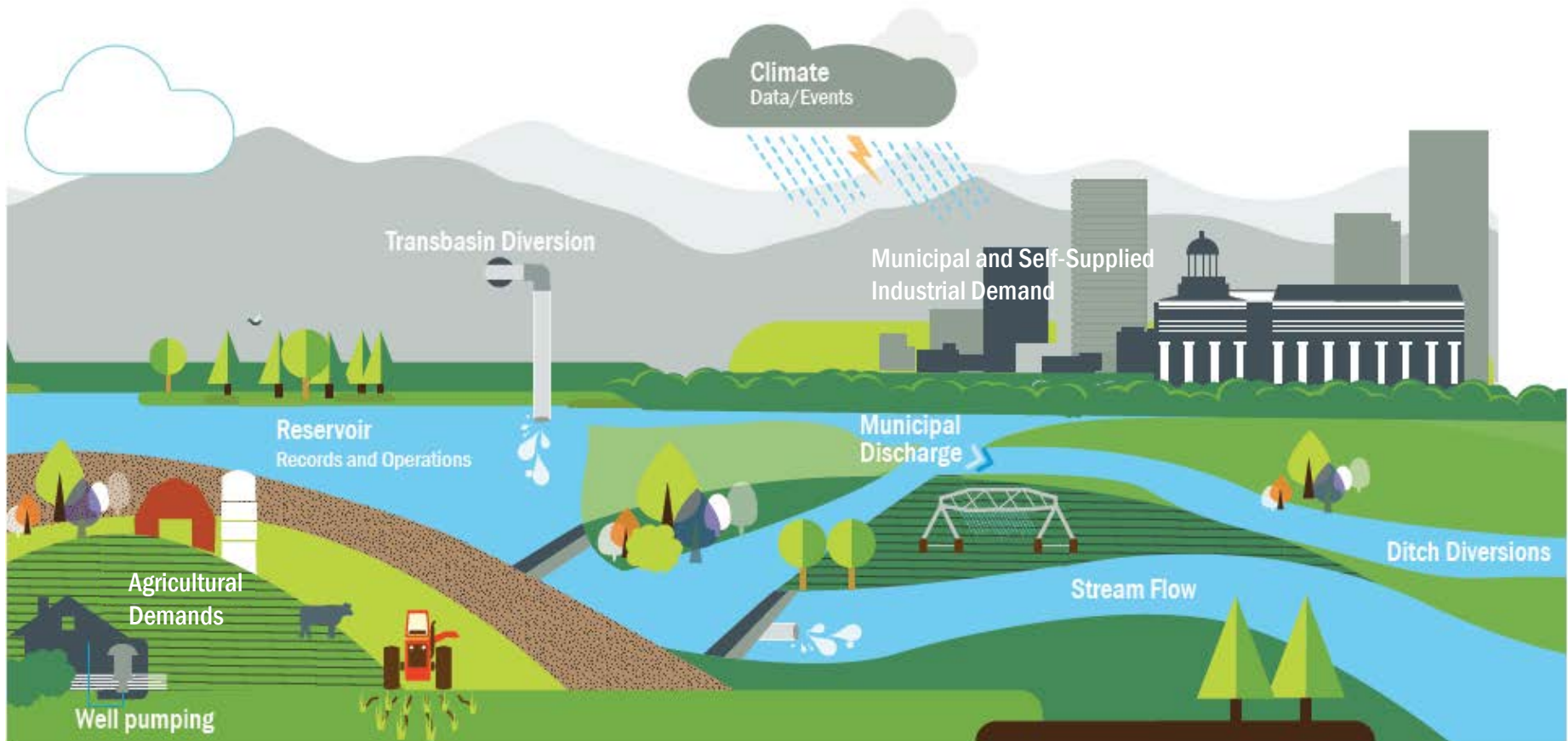


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SWSI: Hydrologic Modeling Overview



(Source: Brown and Caldwell)

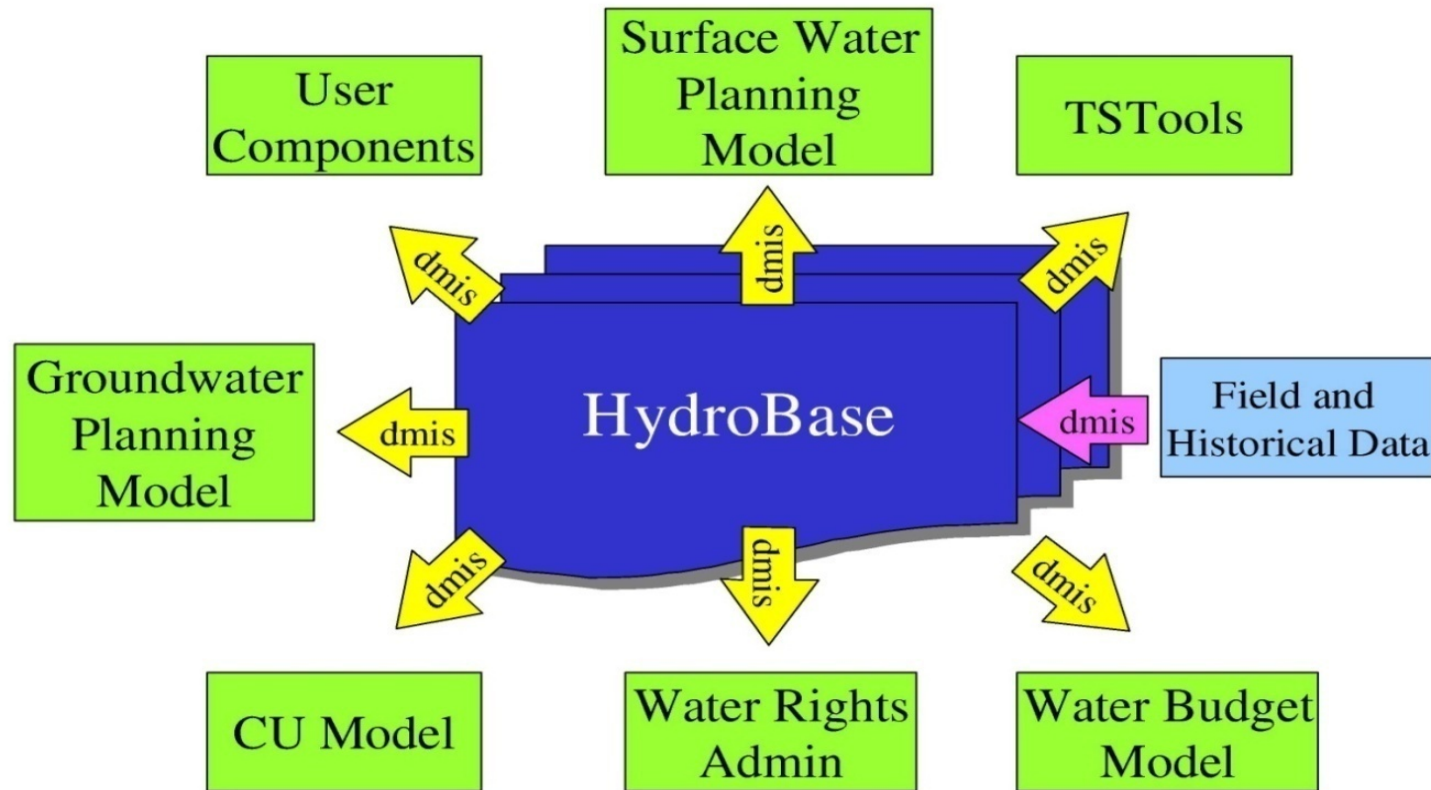


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SWSI Modeling: Data-Centered Approach

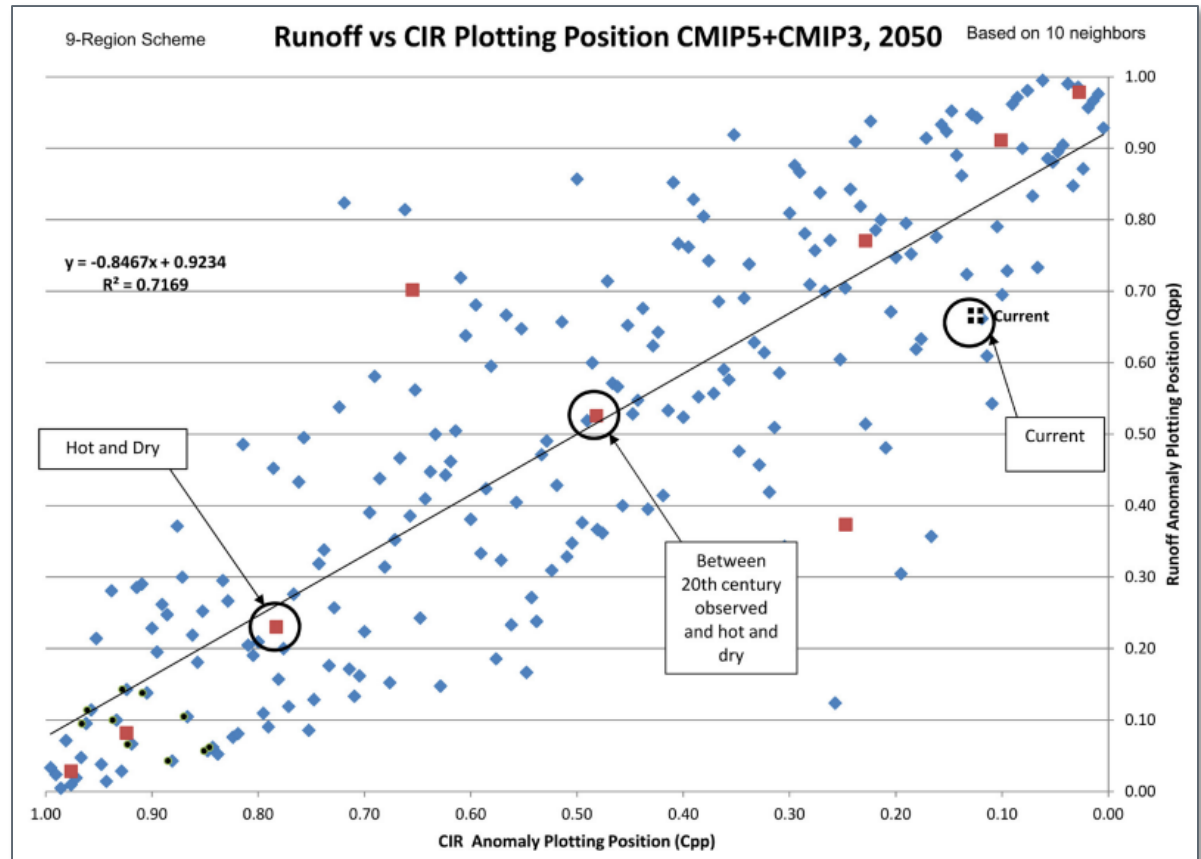


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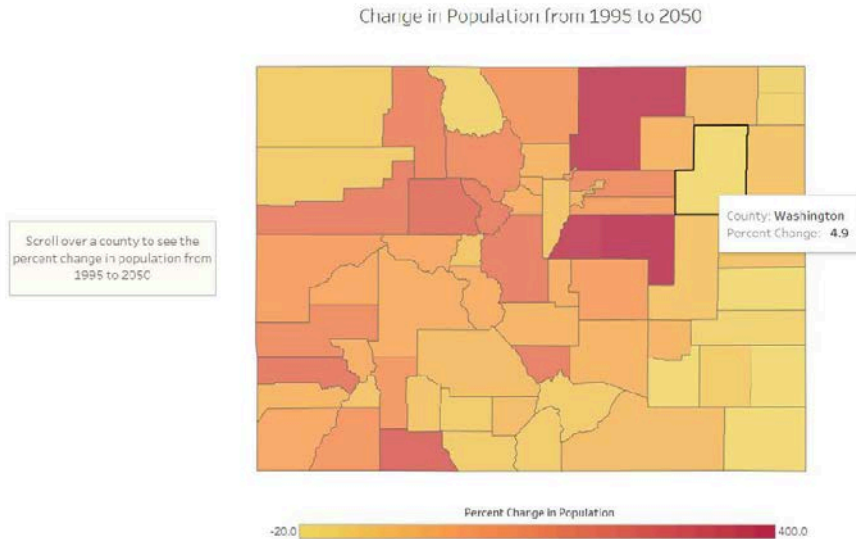


Data Example: Future Water Flows

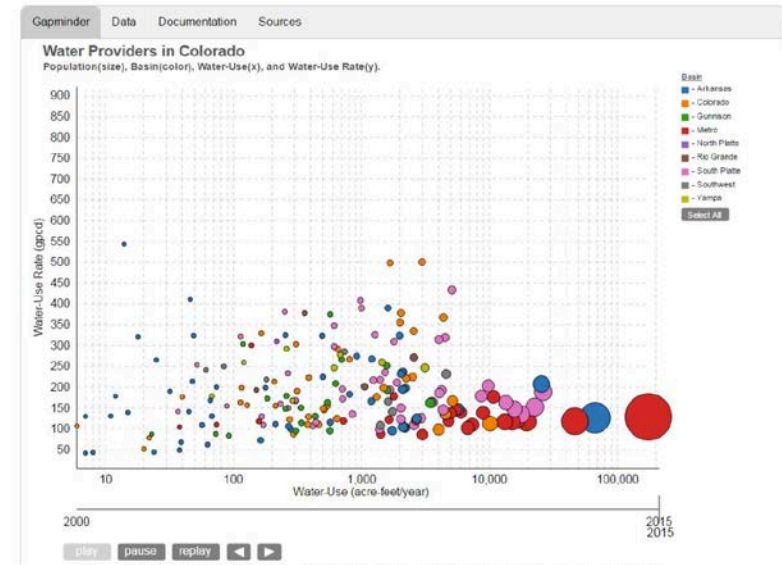
Based on past analyses, three natural streamflow data sets are available for use in the hydrologic modeling



SWSI Update: Tools



Visualization of County Population Growth, using Tableau Software



Gapminder Illustrating Urban Water Use Efficiency, using D3.js Library



FACT SHEET Agricultural Diversion Demand

The fact sheet summarizes the methodologies used to estimate agricultural diversion demand in the SWIS Update.

Previous Methodology:

Water demands and shortages for irrigated crops at the field level were estimated in 2010. Irrigation water requirement, water supply estimated consumptive use, and crop water shortage were estimated and aggregated at a basin level.

Updated Methodology:

In the SWIS Update, crop water demands will again be estimated. In addition, the new diversion or pumping necessary to meet crop water demands will also be estimated. Total agricultural water demands will account for consumptive needs at the field level plus the conveyance losses or pumping efficiencies. As a result, agricultural demands (and gaps) will be higher than in SWIS 2010.

Why did we make this change?

- Allow us to use planning models to analyze planning scenarios from Colorado's Water Plan.
- Provide information and tools for basin roundtables to use in analyzing "what if" scenarios and for evaluating effectiveness of future projects.
- Provide consistency with estimates of municipal and industrial demands.

Calculation Process for Current Agricultural Water Demands



JANUARY 2018 | AGRICULTURAL DIVERSION DEMAND FACT SHEET

FACT SHEET Municipal and Self-Supplied Industrial Demand Methodology

This fact sheet summarizes methodologies used to estimate municipal and self-supplied industrial demand in the SWIS Update.

Overview of Municipal Demand Methodology

Agricultural demands for the SWIS Update will be calculated using the methodology similar to SWIS 2010 but will utilize Planning Scenarios and will use enhanced input data. Enhanced input include data from 1991 reporting data, Water Efficiency Plans, and Basin Implementation Plans. The basic equation for estimating municipal demand considers population, water efficiency plans, and basin implementation plans. The equation is as follows: $\text{Municipal Demand} = \text{Population} \times \text{Per Capita Water Use} \times \text{Water Efficiency Factor}$.

For the SWIS Update, five scenarios:

1. **Baseline**: Five scenarios, county-level population estimates for 2020 will be developed along with consumptive, per capita water use rates.

Population Driver

Baseline	Water	Conservative	Adaptive	Hot
Low	Low	Low	Low	Low
Current	Current	Current	Current	Current
High	High	High	High	High

Climate Conditions: Current, Hot and dry, Hot and dry, Hot and dry, Hot and dry.

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FACT SHEET Finance Methodology

This fact sheet summarizes project cost estimating tool that will be developed as a part of the SWIS Update.

As Colorado's Water Plan is implemented, it is critical that the overall cost of proposed projects and methods to understand and presented in a way that enables easy comparison (i.e., apples to apples). However, only 10 percent of the projects and methods listed in Basin Implementation Plans included cost estimates.

Previous iterations of SWIS have incorporated existing mechanisms developed for strategy and cost analysis and portfolio comparison. The goal of the finance component of the SWIS Update is to build on previous SWIS cost estimation methodologies and develop an accessible and user-friendly tool for Basin Roundtables to use in developing high-level cost estimates of projects and methods.

The Environmental and Recreation component of the SWIS Update will focus on the development of a cost estimating tool with two modules:

1. Projects Module
2. Costing Module

The Projects Module

The Projects Module represents either an entire water project or a component of a large-scale, complex project. It includes an overview of the tool and allows the user to modify global inputs such as project yield, peaking factors, cost index, and life cycle and annual cost.

The type of projects proposed in Basin Implementation Plans will be pre-coded into the Projects Module, and the user will be able to customize the parameters associated with that project to reflect specific design and physical characteristics. The output from the Projects Module becomes input to the Costing Module.



JANUARY 2018 | FINANCE METHODOLOGY FACT SHEET

FACT SHEET Scenario Planning & Gap Analysis

This fact sheet summarizes new approaches and planning concepts that are being adopted for the SWIS Update. Information describing proposed methodologies for specific areas of study (for example, quantification of municipal or agricultural water demands) can be found in other fact sheets in this set.

Scenario Planning

Scenario planning allows us to assess how driving forces to build multiple, plausible future (or "scenario") in contrast, scenario analysis is a more targeted approach designed to explore future conditions. The approach involves the future in looking at the past, scenario planning, the SWIS and stakeholders to identify and account for key drivers and uncertainties, while the planning process, scenario analysis can be used to assess future water needs depending upon future conditions.

Gap Analysis

In previous iterations of SWIS, the gap analysis considered new municipal and self-supplied industrial (surface) water needs and anticipated gaps from identified projects and increases (drops) in the year 2050. A range of 2050 water gaps were calculated by using high and low baseline water demands combined with higher and lower assumptions regarding the 2050 agricultural water demands. All calculations were defined at the field level in the difference between the irrigation water requirement and water supply limited consumptive use (SWIS 2010), this difference was treated as a "negative" rather than a "gap".

For the SWIS Update, the gap will be defined somewhat differently. For the purposes of the SWIS Update, a "gap" means when legally and physically available water supplies cannot meet demand. The "gap" is the difference between demand and water supply. The gap will be a hydrologic gap and will not consider identified projects and increases (drops) in the year 2050. The model that uses this information to allocate water will be developed based on their appropriation. The output of the modeling and analysis will be a range of gaps for SWIS and agricultural water needs, normal, and dry conditions. The graphics below illustrate the gap analysis process.



JANUARY 2018 | SCENARIO PLANNING & GAP ANALYSIS FACT SHEET

FACT SHEET Environmental and Recreation Methodology

This fact sheet summarizes methodologies that will be implemented during the SWIS Update for the Environmental and Recreation component.

The Environmental and Recreation component

During the SWIS 2010 process, Basin Roundtables identified projects and methods required to meet the nonconsumptive needs identified as part of their Heads Assessment and future development projects. In 2010, CWRB developed a survey to collect information on existing or planned nonconsumptive projects, methods and needs. In addition, CWRB facilitated numerous meetings to gather additional data from stakeholders.

1. Environmental and Recreation Database Update
2. Environmental and Recreation Flow Tool

Environmental and Recreation Database Update

A database was developed in 2010, known as the "Nonconsumptive Needs Database" to help manage the nonconsumptive data received by Basin Roundtables and other stakeholders. The database included information related to nonconsumptive activities, projects, and protections. Significant focus of the SWIS Update will be enhancing the Nonconsumptive Needs Database (more than it is being renamed the "Environmental and Recreation Database" in the SWIS Update). The update of the Environmental and Recreation Database (ERDB) will include the following components:

Overall and	Actual outcome
Enhanced Technical Foundation	SWIS Update process will be consistent and streamlined to add efficiency and improve data quality. The Source Water Basin Framework will be implemented as a common spatial unit to provide consistency.
Engaging and Meaningful User Experience	Event-based template for data entry will be developed, which will improve uniformity of data and efficiency. Standard reports will be developed to increase transparency of data while-in-use. An on-line mapping tool will be developed to increase ease of use and enable visualization of database content. User feedback will be collected to enhance improvements.
Integration into Colorado Water Planning Process	Database content will be reviewed and segmented to include project identification, project description, data, etc., which will be more useful and meaningful for planning purposes.

JANUARY 2018 | ENVIRONMENTAL AND RECREATION METHODOLOGY FACT SHEET

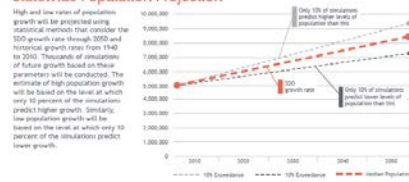
FACT SHEET Population Projection Methodology

This fact sheet summarizes methodologies that will be implemented during the SWIS Update to project population growth to the year 2050 for each Planning Scenario.

Population projections

Population projections, by basin and for the state as a whole, are the primary driver in the municipal and industrial demand projections being developed for the SWIS Update. In this Update, population projections will be developed for each of the Planning Scenarios described in Colorado's Water Plan. The projections will then be used to estimate municipal and industrial demands for each Planning Scenario and will also influence agricultural water demands as the other hydrologic component to expand onto lands currently used for agricultural purposes. Projections of future population have been a key component of past SWIS iterations. Prior population projections conducted by the State Demography Office (SDO) covered the period 2005 to 2035. In past SWIS iterations, a complex process was used to extend the population projections to the year 2050. The process included developing economic forecasts for the state and each county, estimating future labor demands, comparing future labor demands to labor supply, and estimating net immigration to balance labor markets throughout the state. In addition, high and low growth scenarios were developed.

Statewide Population Projection



JANUARY 2018 | POPULATION PROJECTION METHODOLOGY FACT SHEET

FACT SHEET SWIS Update Overview

This fact sheet provides an overview of the context, process, and features of the current updates to the Statewide Water Supply Initiative (SWSI).

Context

The current SWIS Update is the first iteration of SWIS to be conducted in the context of Colorado's Water Plan (CWP) and the Basin Implementation Plans (BIPs) that were developed in Colorado's eight major river basins. The iterations of SWIS included components (such as portfolio of projects and methods to meet future gaps) that are now available to the SWIS Update process. As a result, the SWIS Update will be a technically focused effort to develop analysis tools and data sets that will be useful to the basin roundtables, water managers, and the public for analyzing and evaluating projects. The SWIS Update results will provide more detailed information to help guide basin roundtable as they update their BIPs, which in turn will serve as the backbone for the current update to CWP.

Features of the SWIS Update

The SWIS Update addresses a wide variety of new questions, principles, and tools.

New Questions	New Processes	New Tools
The SWIS Update will estimate future available water supply and gaps under the five different planning scenarios described in CWP. Previous iterations of SWIS were conducted prior to CWP and therefore did not consider the constraints. The planning scenario incorporates water supply and demand drivers associated with the potential effects of climate change, population growth, and many other factors.	In their BIPs, the basin roundtables cataloged various projects and methods to mitigate future water supply gaps. The SWIS Update focuses on developing tools and more detailed datasets to help the basin roundtables update their portfolios and of projects and methods for meeting future water needs in a targeted manner with forthcoming updates to their BIPs.	New analysis tools and data sets have been developed during the last iteration of SWIS. Consumptive use and surface water allocation models are now available in most river basins. Municipal water demand and conservation data is available via CWS reporting. The availability of these new tools and data sets allow for a more robust approach to assessing future water availability and gaps.

JANUARY 2018 | SWIS UPDATE OVERVIEW METHODOLOGY FACT SHEET



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Water Management

[Water Efficiency](#)[Drought](#)[Flood](#)[Water Supply Planning](#)[SWSI Update](#)[SWSI 2010](#)[Colorado's Water Supply Needs](#)[The Water Supply Gap](#)

Statewide Water Supply Initiative - Update

The ongoing SWSI update will serve two primary purposes:

- Provide a consistent statewide framework for examining future water supply and demand under different scenarios
- Provide tools and data for Basin Roundtables to use in updating their Basin Implementation Plans (BIPs) and developing detailed local solutions to identified gaps.

Since this is the first time that SWSI is completed in the context of Colorado's Water Plan (CWP) and the Basin Implementation Plans (BIP), this SWSI update will be different from previous versions. SWSI 2010 was a relatively straightforward update of the original SWSI 2004 analysis, and did not focus on methodology refinement. In addition to complementing CWP and the BIPS, this SWSI update will also include a number of new approaches and additions, such as quantifying a scenario planning approach, providing a more detailed and scientifically rigorous



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