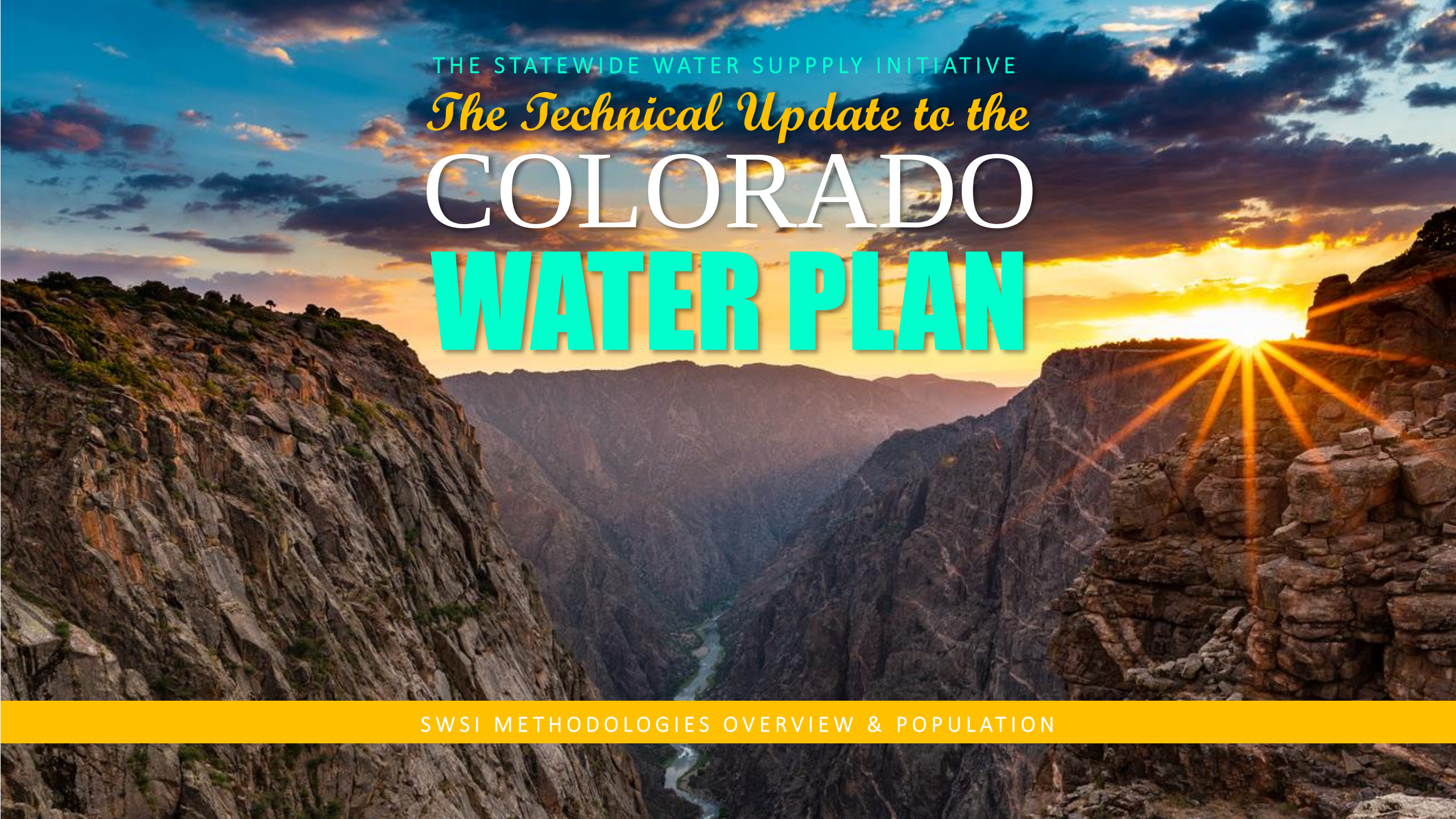

THE STATEWIDE WATER SUPPPLY INITIATIVE
The Technical Update to the
COLORADO
WATER PLAN
SWSI METHODOLOGIES OVERVIEW & POPULATION

PRESENTATION

AGENDA

- Background / SWSI / Rebranding
- Methodologies/ Fact Sheets / New Resources
- Population/ New Projections /Implications

ANALYSIS
HISTORY

2000

2004 SWSI 1

2005 Water for the 21st Century Act

2007 SWSI 2

2010 SWSI 2010

2015 Basin Implementation Plans

2015 Colorado Water Plan

2015 SWSI Update Initiated

2016 Ripple Effects

2018 Basin Implementation Plan Updates Initiated

2019 Water Plan Technical Analysis (i.e. SWSI) Launches

ANALYSIS UPDATE

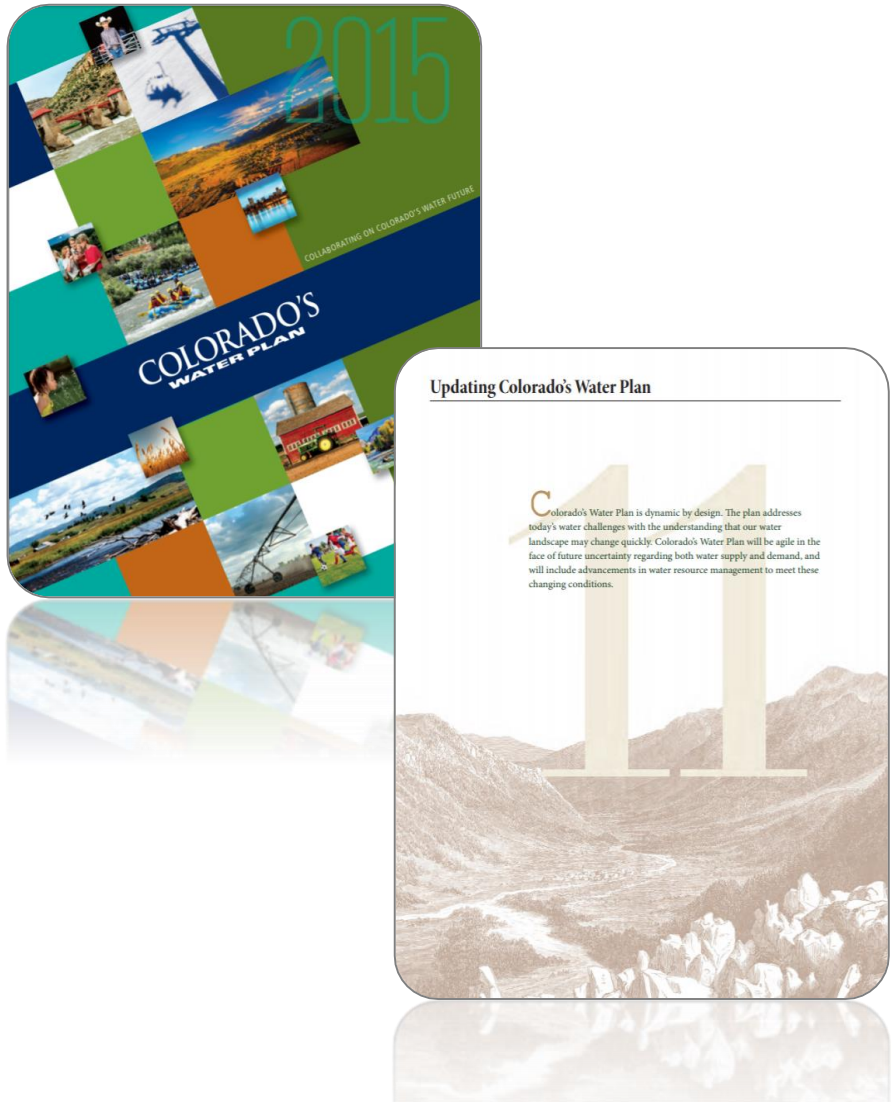


TABLE 11-1 CYCLICAL PLANNING PROCESS PROPOSED BY THE CWCB

Product	Year Initiated
Basin Implementation Plans	2013
Colorado's Water Plan	2013
Statewide Water Supply Initiative	2016
Basin Implementation Plans	2018
Colorado's Water Plan	2020
Statewide Water Supply Initiative	2022

ACTIONS

1. The CWCB will work with other state agencies, the basin roundtables, and the people of Colorado to update Colorado's Water Plan, beginning no later than 2020.
2. The CWCB will develop guidelines for Basin Roundtable WSRA grants to help facilitate the implementation of the BIPs.

UPDATING THE WATER PLAN

A ANALYSIS + PLANNING PHASE

B BASIN INTEGRATION PHASE

C COMPREHENSIVE UPDATE PHASE

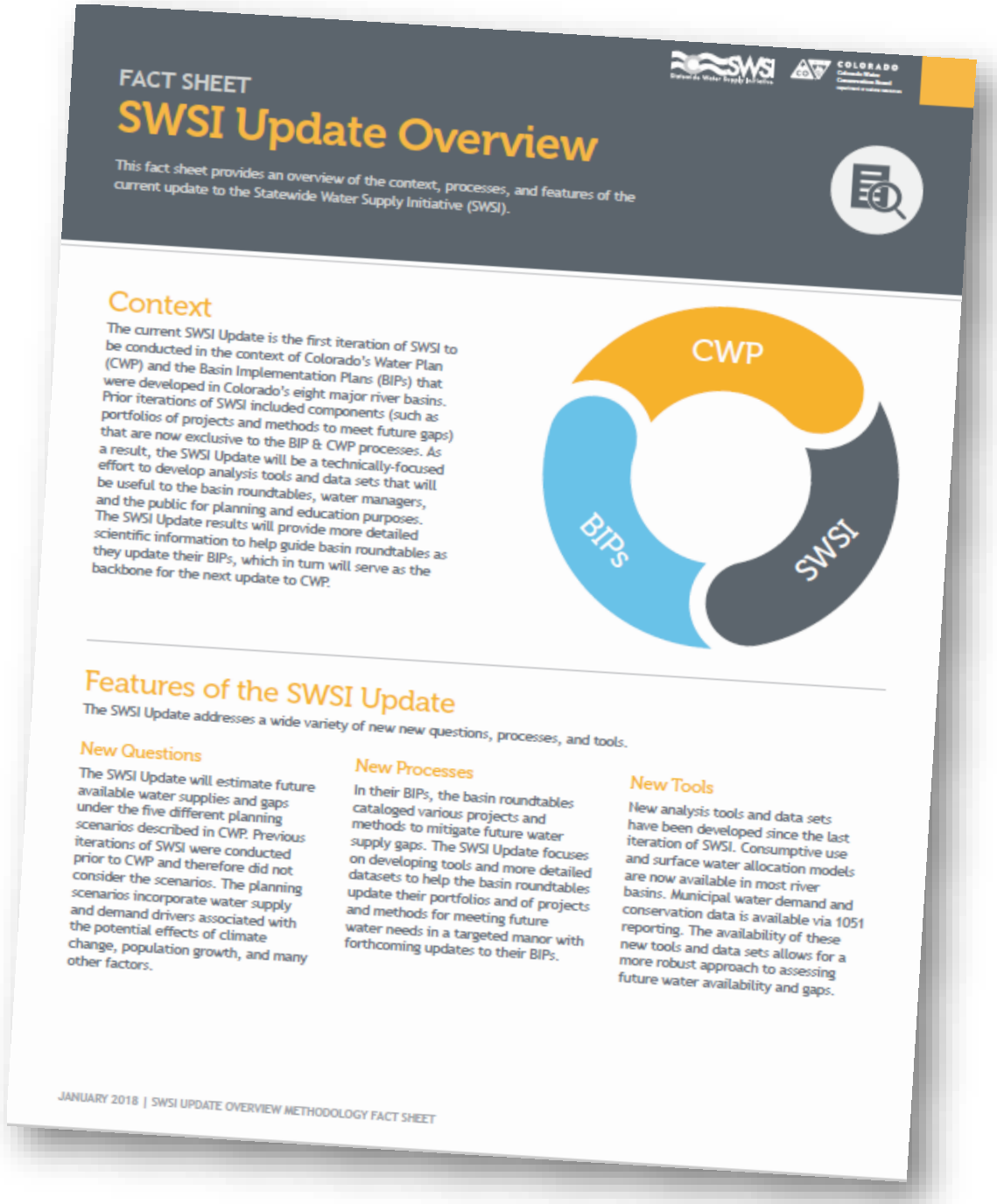
SWSI UPDATE OVERVIEW

METHODOLOGY

SWSI update goals:

A **consistent statewide framework** for examining future water supply and demand scenarios.

Tools and data for roundtables to update their basin plans (e.g. identify local solutions).



FACT SHEET

SWSI Update Overview

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

Context

The current SWSI Update is the first iteration of SWSI 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. Prior iterations of SWSI included components (such as portfolios of projects and methods to meet future gaps) that are now exclusive to the BIP & CWP processes. As a result, the SWSI 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 planning and education purposes. The SWSI Update results will provide more detailed scientific information to help guide basin roundtables as they update their BIPs, which in turn will serve as the backbone for the next update to CWP.

CWP

BIPs

SWSI

Features of the SWSI Update

The SWSI Update addresses a wide variety of new new questions, processes, and tools.

New Questions

The SWSI Update will estimate future available water supplies and gaps under the five different planning scenarios described in CWP. Previous iterations of SWSI were conducted prior to CWP and therefore did not consider the scenarios. The planning scenarios incorporate water supply and demand drivers associated with the potential effects of climate change, population growth, and many other factors.

New Processes

In their BIPs, the basin roundtables cataloged various projects and methods to mitigate future water supply gaps. The SWSI 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 manor with forthcoming updates to their BIPs.

New Tools

New analysis tools and data sets have been developed since the last iteration of SWSI. Consumptive use and surface water allocation models are now available in most river basins. Municipal water demand and conservation data is available via 1051 reporting. The availability of these new tools and data sets allows for a more robust approach to assessing future water availability and gaps.

JANUARY 2018 | SWSI UPDATE OVERVIEW METHODOLOGY FACT SHEET

NEW APPROACH

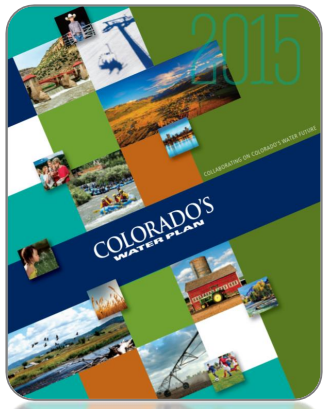
- SCENARIO PLANNING
- STATE MOD (MODELING)
- INCLUDES CLIMATE
- HB-1051 DATA
- GREATER AG ANALYSIS
- NO IPPs INCLUDED
  (Identified Projects & Process)
- LEVERAGES TAGs
  (Technical Advisory Groups)

NEW OUTPUTS

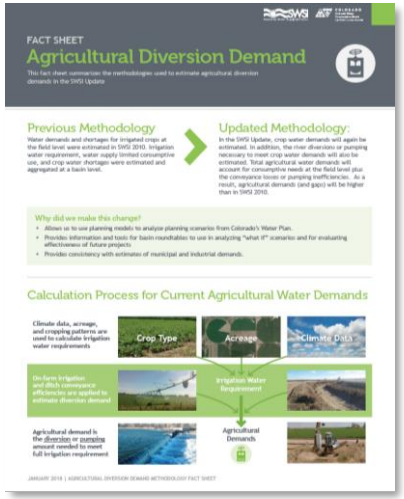
- DATA FOR EACH SCENARIO
- TOOLBOX W/ OPEN DATA
- DOCUMENTED DECISIONS
- COSTING TOOL + FLOW TOOL
- DATA VISUALIZTION
- STREAMLINED REPORTING
- USES WORKING GROUP INPUT

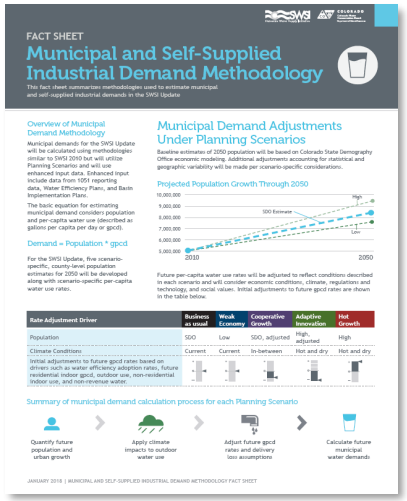
NEW PROCESS

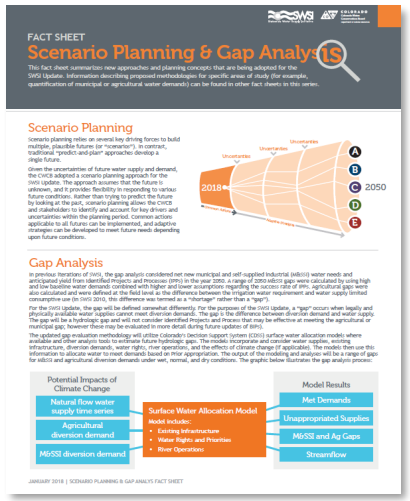
- AIMS FOR TRANSPARENCY
- INTEGRATED WITH BASINS
- COLLABORATIVE + ITTERATIVE
- BUILDS TOWARDS CWP UPDATE
  (Colorado Water Plan)

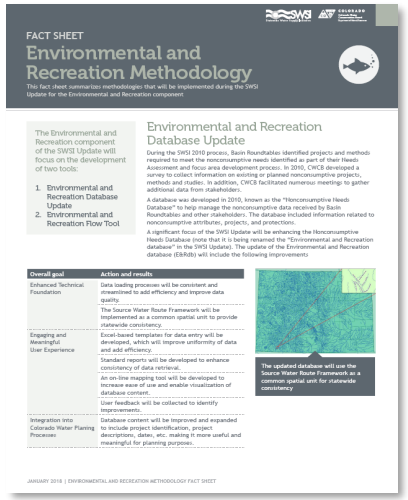


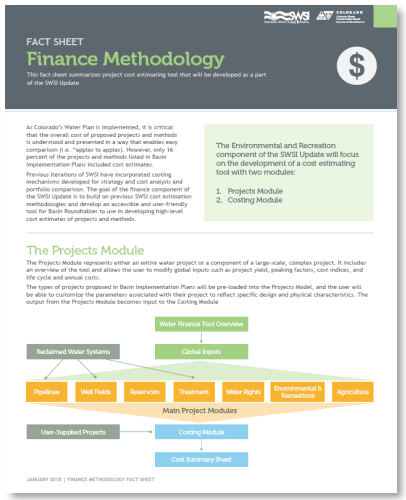
FACT SHEETS

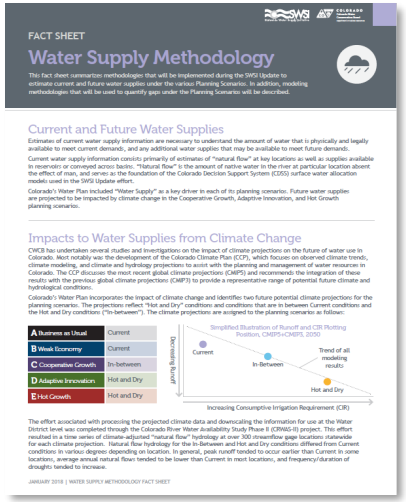


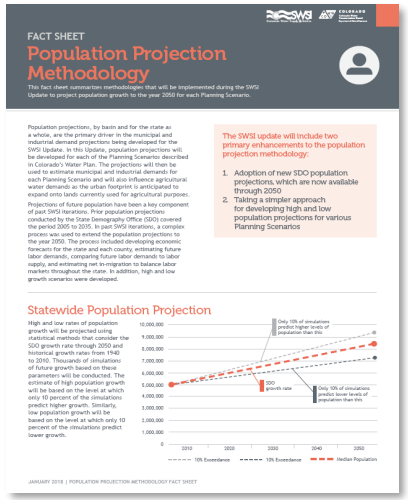


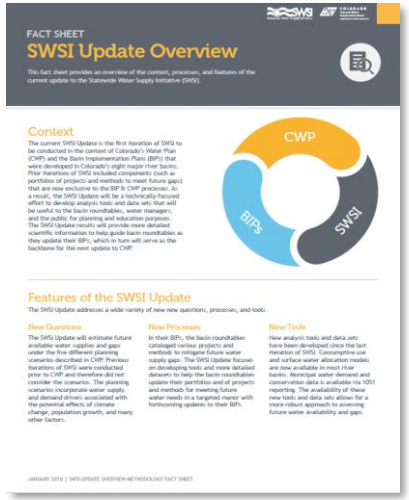












Visit, **www.cwcb.state.co.us** to learn more.

TAG REVIEW

PROCESS

4 TAGs were formed in 2017 to review different focus areas.

4 Focus Areas:

- **Agriculture,**
- **Environment & Recreation**
- **Municipal & Self-Supplied Industrial Demands**
- **Planning Scenarios**

60 TAG Participants: included subject matter experts from each basin.

2 TAGs meetings for each topic to review and discuss methodologies.

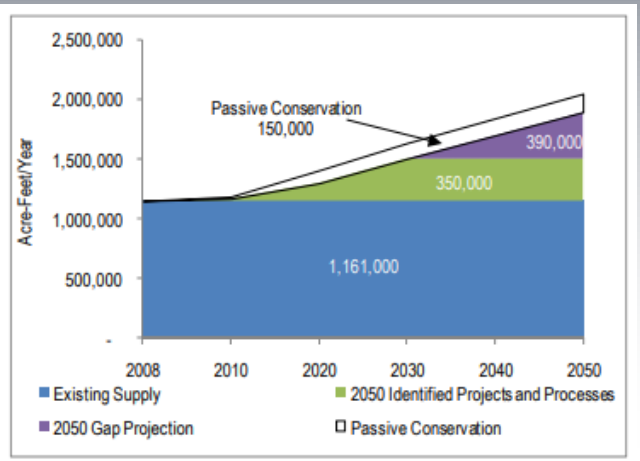
New Stakeholder-Driven Methodologies

2050 Demand Projections

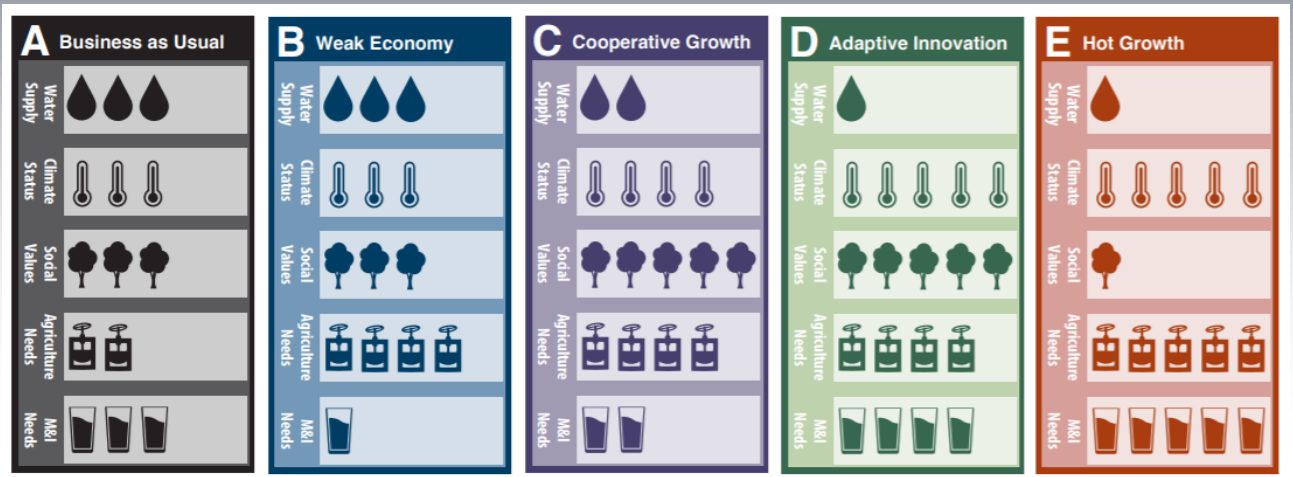
- IPPs

_____

= 2050 M&I Gap



- **Hydrologic Modeling**
- **Municipal Modeling**
- **Agricultural Modeling**
- **Environmental Modeling**
- **Scenario Planning Across Major Drivers**



SCENARIO & GAP
METHODOLOGY

FACT SHEET

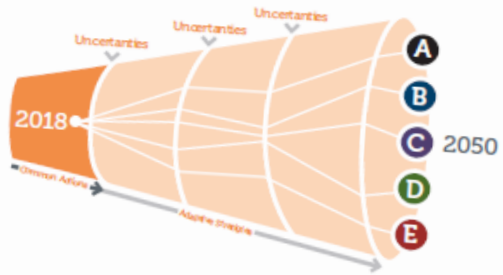
Scenario Planning & Gap Analysis

This fact sheet summarizes new approaches and planning concepts that are being adopted for the SWSI 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 series.

Scenario Planning

Scenario planning relies on several key driving forces to build multiple, plausible futures (or "scenarios"). In contrast, traditional "predict-and-plan" approaches develop a single future.

Given the uncertainties of future water supply and demand, the CWCB adopted a scenario planning approach for the SWSI Update. The approach assumes that the future is unknown, and it provides flexibility in responding to various future conditions. Rather than trying to predict the future by looking at the past, scenario planning allows the CWCB and stakeholders to identify and account for key drivers and uncertainties within the planning period. Common actions applicable to all futures can be implemented, and adaptive strategies can be developed to meet future needs depending upon future conditions.

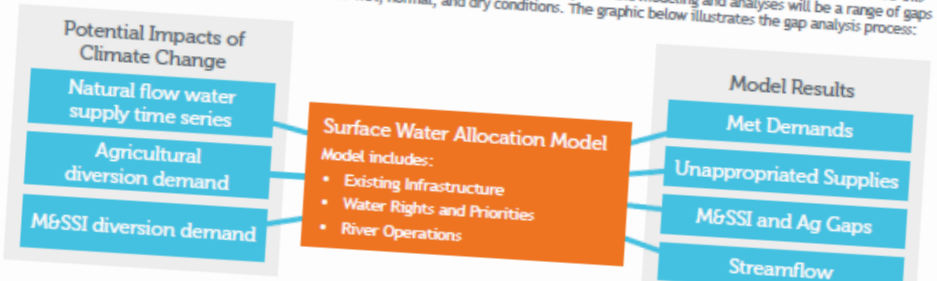


Gap Analysis

In previous iterations of SWSI, the gap analysis considered net new municipal and self-supplied industrial (M&SSI) water needs and anticipated yield from Identified Projects and Processes (IPPs) in the year 2050. A range of 2050 M&SSI gaps were calculated by using high and low baseline water demands combined with higher and lower assumptions regarding the success rate of IPPs. Agricultural gaps were also calculated and were defined at the field level as the difference between the irrigation water requirement and water supply limited consumptive use (in SWSI 2010, this difference was termed as a "shortage" rather than a "gap").

For the SWSI Update, the gap will be defined somewhat differently. For the purposes of the SWSI Update, a "gap" occurs when legally and physically available water supplies cannot meet diversion demands. The gap is the difference between diversion demand and water supply. The gap will be a hydrologic gap and will not consider Identified Projects and Process that may be effective at meeting the agricultural or municipal gap; however these may be evaluated in more detail during future updates of BIPs).

The updated gap evaluation methodology will utilize Colorado's Decision Support System (CDSS) surface water allocation models where available and other analysis tools to estimate future hydrologic gaps. The models incorporate and consider water supplies, existing infrastructure, diversion demands, water rights, river operations, and the effects of climate change (if applicable). The models then use this information to allocate water to meet demands based on Prior Appropriation. The output of the modeling and analyses will be a range of gaps for M&SSI and agricultural diversion demands under wet, normal, and dry conditions. The graphic below illustrates the gap analysis process:



WATER SUPPLY PLANNING

METHODOLOGY

FACT SHEET

Water Supply Methodology

This fact sheet summarizes methodologies that will be implemented during the SWSI Update to estimate current and future water supplies under the various Planning Scenarios. In addition, modeling methodologies that will be used to quantify gaps under the Planning Scenarios will be described.

Current and Future Water Supplies

Estimates of current water supply information are necessary to understand the amount of water that is physically and legally available to meet current demands, and any additional water supplies that may be available to meet future demands.

Current water supply information consists primarily of estimates of "natural flow" at key locations as well as supplies available in reservoirs or conveyed across basins. "Natural flow" is the amount of native water in the river at particular location absent the effect of man, and serves as the foundation of the Colorado Decision Support System (CDSS) surface water allocation models used in the SWSI Update effort.

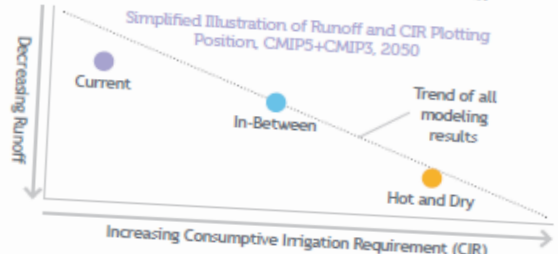
Colorado's Water Plan included "Water Supply" as a key driver in each of its planning scenarios. Future water supplies are projected to be impacted by climate change in the Cooperative Growth, Adaptive Innovation, and Hot Growth planning scenarios.

Impacts to Water Supplies from Climate Change

CWCB has undertaken several studies and investigations on the impact of climate projections on the future of water use in Colorado. Most notably was the development of the Colorado Climate Plan (CCP), which focuses on observed climate trends, climate modeling, and climate and hydrology projections to assist with the planning and management of water resources in Colorado. The CCP discusses the most recent global climate projections (CMIP5) and recommends the integration of these results with the previous global climate projections (CMIP3) to provide a representative range of potential future climate and hydrological conditions.

Colorado's Water Plan incorporates the impact of climate change and identifies two future potential climate projections for the planning scenarios. The projections reflect "Hot and Dry" conditions and conditions that are in between Current conditions and the Hot and Dry conditions ("In-between"). The climate projections are assigned to the planning scenarios as follows:

A Business as Usual	Current
B Weak Economy	Current
C Cooperative Growth	In-between
D Adaptive Innovation	Hot and Dry
E Hot Growth	Hot and Dry



The effort associated with processing the projected climate data and downscaling the information for use at the Water District level was completed through the Colorado River Water Availability Study Phase II (CRWAS-II) project. This effort resulted in a time series of climate-adjusted "natural flow" hydrology at over 300 streamflow gage locations statewide for each climate projection. Natural flow hydrology for the In-Between and Hot and Dry conditions differed from Current conditions in various degrees depending on location. In general, peak runoff tended to occur earlier than Current in some locations, average annual natural flows tended to be lower than Current in most locations, and frequency/duration of droughts tended to increase.

BASIN MODELING

MUNICIPAL & SSI
METHODOLOGY

FACT SHEET

Municipal and Self-Supplied Industrial Demand Methodology

This fact sheet summarizes methodologies used to estimate municipal and self-supplied industrial demands in the SWSI Update

Overview of Municipal Demand Methodology

Municipal demands for the SWSI Update will be calculated using methodologies similar to SWSI 2010 but will utilize Planning Scenarios and will use enhanced input data. Enhanced input include data from 1051 reporting data, Water Efficiency Plans, and Basin Implementation Plans.

The basic equation for estimating municipal demand considers population and per-capita water use (described as gallons per capita per day or gpcd).

Demand = Population * gpcd

For the SWSI Update, five scenario-specific, county-level population estimates for 2050 will be developed along with scenario-specific per-capita water use rates.

Municipal Demand Adjustments Under Planning Scenarios

Baseline estimates of 2050 population will be based on Colorado State Demography Office economic modeling. Additional adjustments accounting for statistical and geographic variability will be made per scenario-specific considerations.

Projected Population Growth Through 2050

Future per-capita water use rates will be adjusted to reflect conditions described in each scenario and will consider economic conditions, climate, regulations and technology, and social values. Initial adjustments to future gpcd rates are shown in the table below.

Rate Adjustment Driver	Business as usual	Weak Economy	Cooperative Growth	Adaptive Innovation	Hot Growth
Population	SDO	Low	SDO, adjusted	High, adjusted	High
Climate Conditions	Current	Current	In-between	Hot and dry	Hot and dry
Initial adjustments to future gpcd rates based on drivers such as water efficiency adoption rates, future residential indoor gpcd, outdoor use, non-residential indoor use, and non-revenue water.					

Summary of municipal demand calculation process for each Planning Scenario

Quantify future population and urban growth

Apply climate impacts to outdoor water use

Adjust future gpcd rates and delivery loss assumptions

Calculate future municipal water demands

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AGRICULTURAL METHODOLOGY

FACT SHEET

Agricultural Diversion Demand

This fact sheet summarizes the methodologies used to estimate agricultural diversion demands in the SWSI Update

Previous Methodology

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

Updated Methodology:

In the SWSI Update, crop water demands will again be estimated. In addition, the river diversions 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 inefficiencies. As a result, agricultural demands (and gaps) will be higher than in SWSI 2010.

Why did we make this change?

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

Calculation Process for Current Agricultural Water Demands

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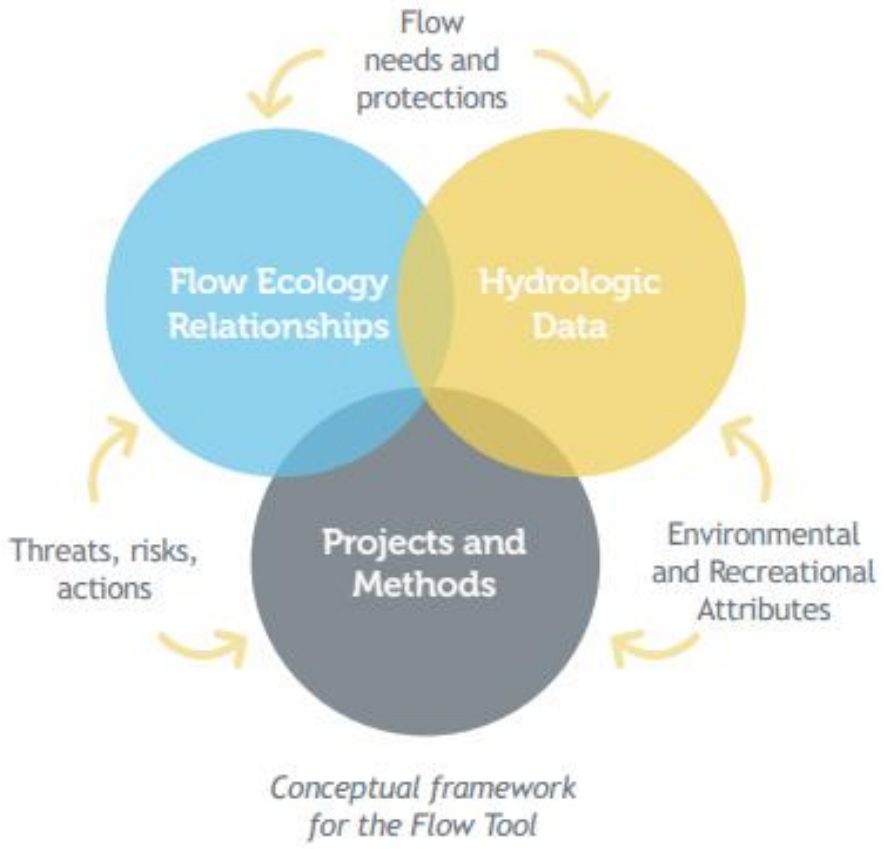
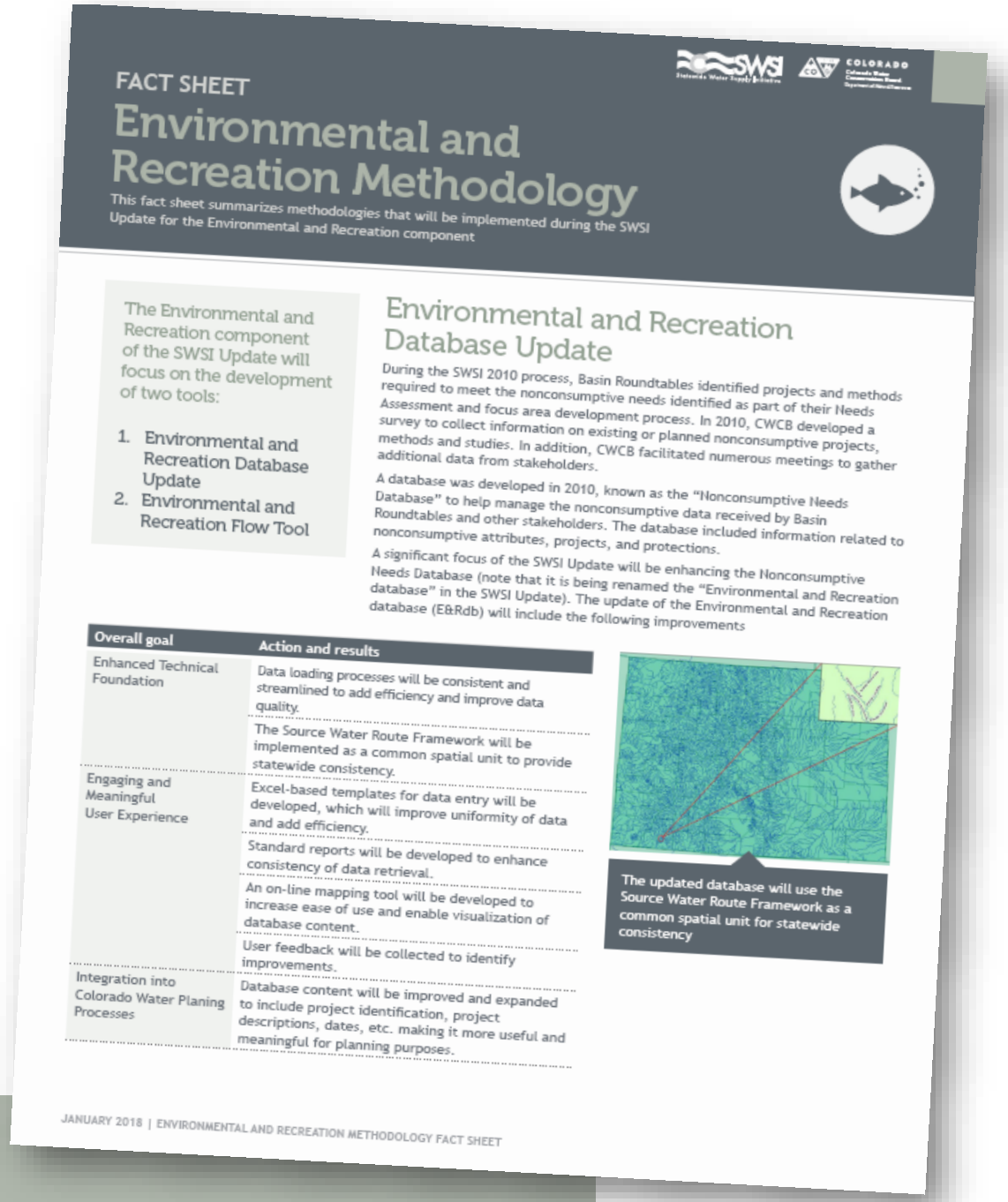
ENVIRONMENTAL & REC

METHODOLOGY



Conceptual framework for the Flow Tool



FACT SHEET

Environmental and Recreation Methodology

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

The Environmental and Recreation component of the SWSI Update will focus on the development of two tools:

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

Environmental and Recreation Database Update

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

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 attributes, projects, and protections.

A significant focus of the SWSI Update will be enhancing the Nonconsumptive Needs Database (note that it is being renamed the "Environmental and Recreation database" in the SWSI Update). The update of the Environmental and Recreation database (E&Rdb) will include the following improvements

Overall goal	Action and results
Enhanced Technical Foundation	Data loading processes will be consistent and streamlined to add efficiency and improve data quality.
	The Source Water Route Framework will be implemented as a common spatial unit to provide statewide consistency.
Engaging and Meaningful User Experience	Excel-based templates for data entry will be developed, which will improve uniformity of data and add efficiency.
	Standard reports will be developed to enhance consistency of data retrieval.
	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 identify improvements.
Integration into Colorado Water Planing Processes	Database content will be improved and expanded to include project identification, project descriptions, dates, etc. making it more useful and meaningful for planning purposes.

The updated database will use the Source Water Route Framework as a common spatial unit for statewide consistency

JANUARY 2018 | ENVIRONMENTAL AND RECREATION METHODOLOGY FACT SHEET

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COSTING TOOL

FACT SHEET

Finance Methodology

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

As Colorado's Water Plan is implemented, it is critical that the overall cost of proposed projects and methods is understood and presented in a way that enables easy comparison (i.e. "apples to apples). However, only 16 percent of the projects and methods listed in Basin Implementation Plans included cost estimates.

Previous iterations of SWSI have incorporated costing mechanisms developed for strategy and cost analysis and portfolio comparison. The goal of the finance component of the SWSI Update is to build on previous SWSI 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.

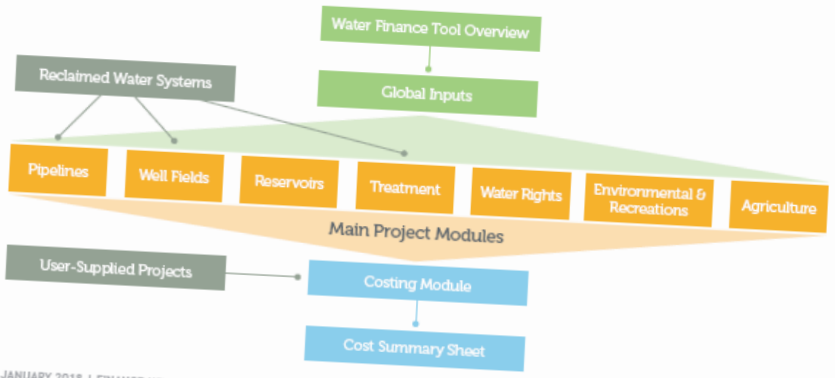
The Environmental and Recreation component of the SWSI Update will focus on the development of a cost estimating tool with two modules:

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 indices, and life cycle and annual costs.

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



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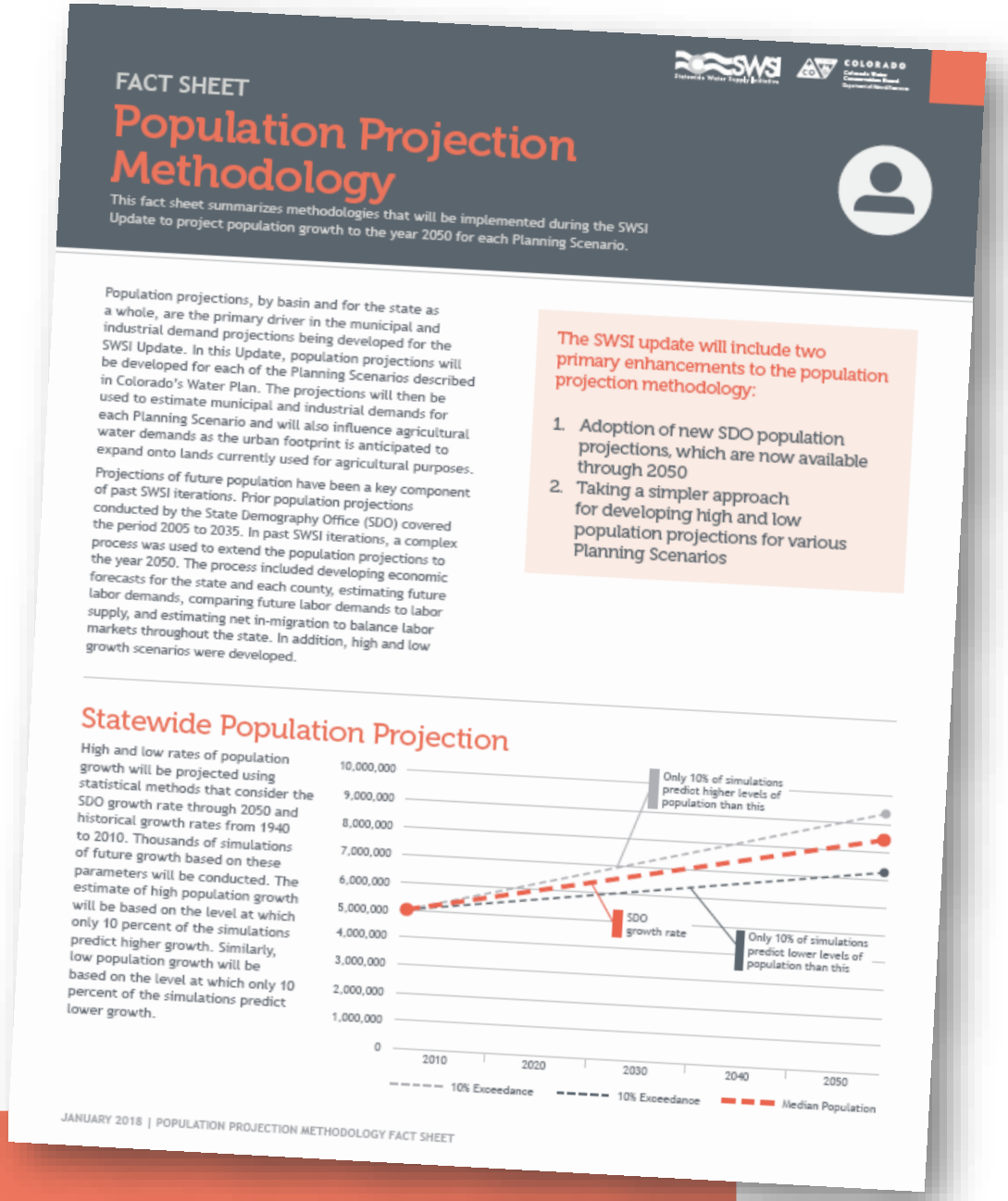
POPULATION PROJECTION

METHODOLOGY



FACT SHEET

Population Projection Methodology

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

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 SWSI 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 urban footprint is anticipated to expand onto lands currently used for agricultural purposes.

Projections of future population have been a key component of past SWSI iterations. Prior population projections conducted by the State Demography Office (SDO) covered the period 2005 to 2035. In past SWSI 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 in-migration to balance labor markets throughout the state. In addition, high and low growth scenarios were developed.

The SWSI update will include two primary enhancements to the population projection methodology:

1. Adoption of new SDO population projections, which are now available through 2050
2. Taking a simpler approach for developing high and low population projections for various Planning Scenarios

Statewide Population Projection

High and low rates of population growth will be projected using statistical methods that consider the SDO growth rate through 2050 and historical growth rates from 1940 to 2010. Thousands of simulations of future growth based on these parameters will be conducted. The estimate of high population growth will be based on the level at which only 10 percent of the simulations predict higher growth. Similarly, low population growth will be based on the level at which only 10 percent of the simulations predict lower growth.

JANUARY 2018 | POPULATION PROJECTION METHODOLOGY FACT SHEET

Presentation by

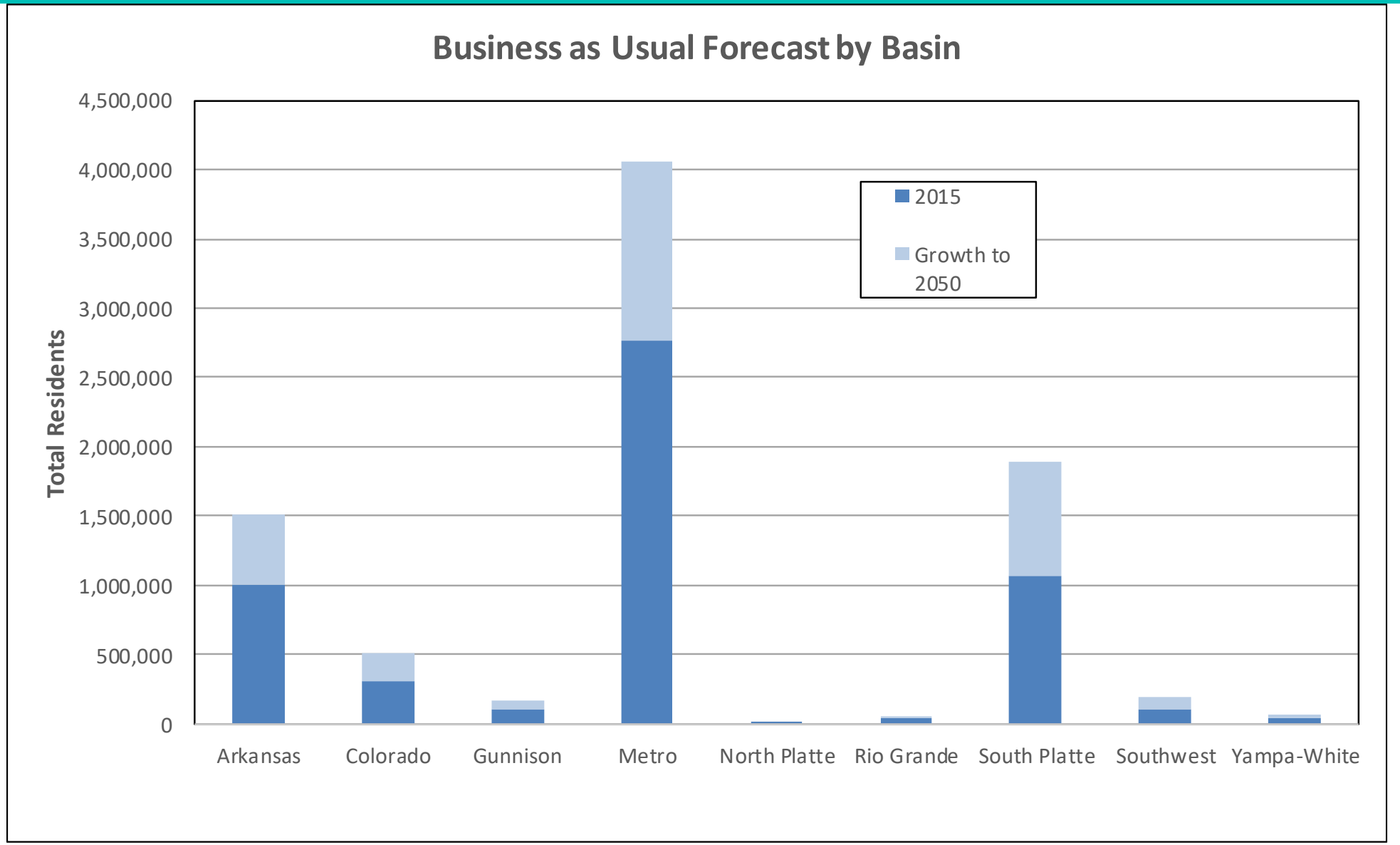
Doug Jeavons

Managing Director

What's Changed since SWSI 2010?

- Role of the SDO in the projections
  - **SWSI 2010 population projections started from the SDO's 2008 projections. The most recent SDO projections envision slower statewide growth than was projected ten years ago.**
  - At the time of SWSI 2010, the SDO only projected Colorado's population through 2035. SWSI team assumptions about post-2035 growth provided the basis for medium, high and low growth scenarios.
  - **Current SDO projections extend through 2050 and provide the Business as Usual population projections.**
  - **The SDO was more actively involved in the population projections for the Technical Update -- discussing, reviewing and approving the methodological approach and the results.**
- Revised approach to considering faster or slower future growth
- Population scenarios aligned with the five Water Plan scenarios

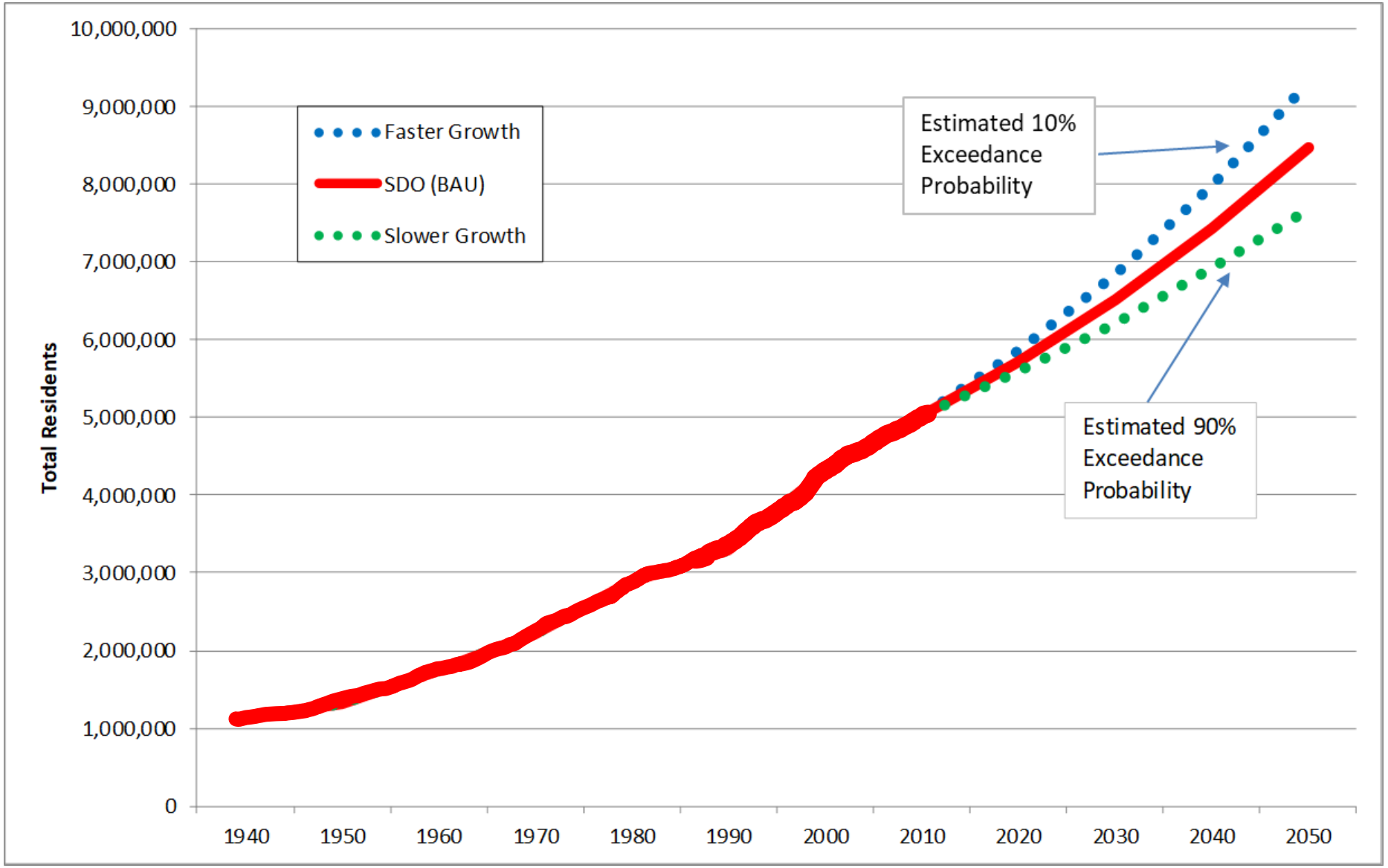
Business As Usual (SDO) Forecast by Basin



Revised Approach to Considering Faster or Slower Future Growth

- SWSI 2010 Approach
  - Many specific assumptions by the SWSI team regarding post-2035 economic growth by sector and location provided the basis for medium, high and low population growth scenarios.
- Technical Update Approach
  - All scenarios start from, and reflect potential variance from, the BAU (SDO) projections
  - Faster or slower growth in other scenarios based on probabilistic analysis of potential variance from SDO's projections based on historical population growth variability by location. Basins that have historically "boomed" and "busted" more dramatically have wider spread between faster and slower growth projections.
  - This approach is simpler than SWSI 2010 and doesn't require many assumptions by the analysts. Avoids picking "winners and losers." The new approach also provides information on relative likelihood of the different growth levels.

Potential Faster or Slower Growth in the Statewide Population Projections



Population Forecasts Based on Water Plan Scenario Descriptions

- **Business as Usual**
  - "Recent trends continue into the future. Few unanticipated events occur"
- **Weak Economy**
  - "The world's economy struggles, and the state's economy is slow to improve. Population growth is lower than currently projected"
- **Cooperative Growth**
  - "Population growth is consistent with current forecasts. Mass transportation planning concentrates more development in urban centers and mountain resort communities"

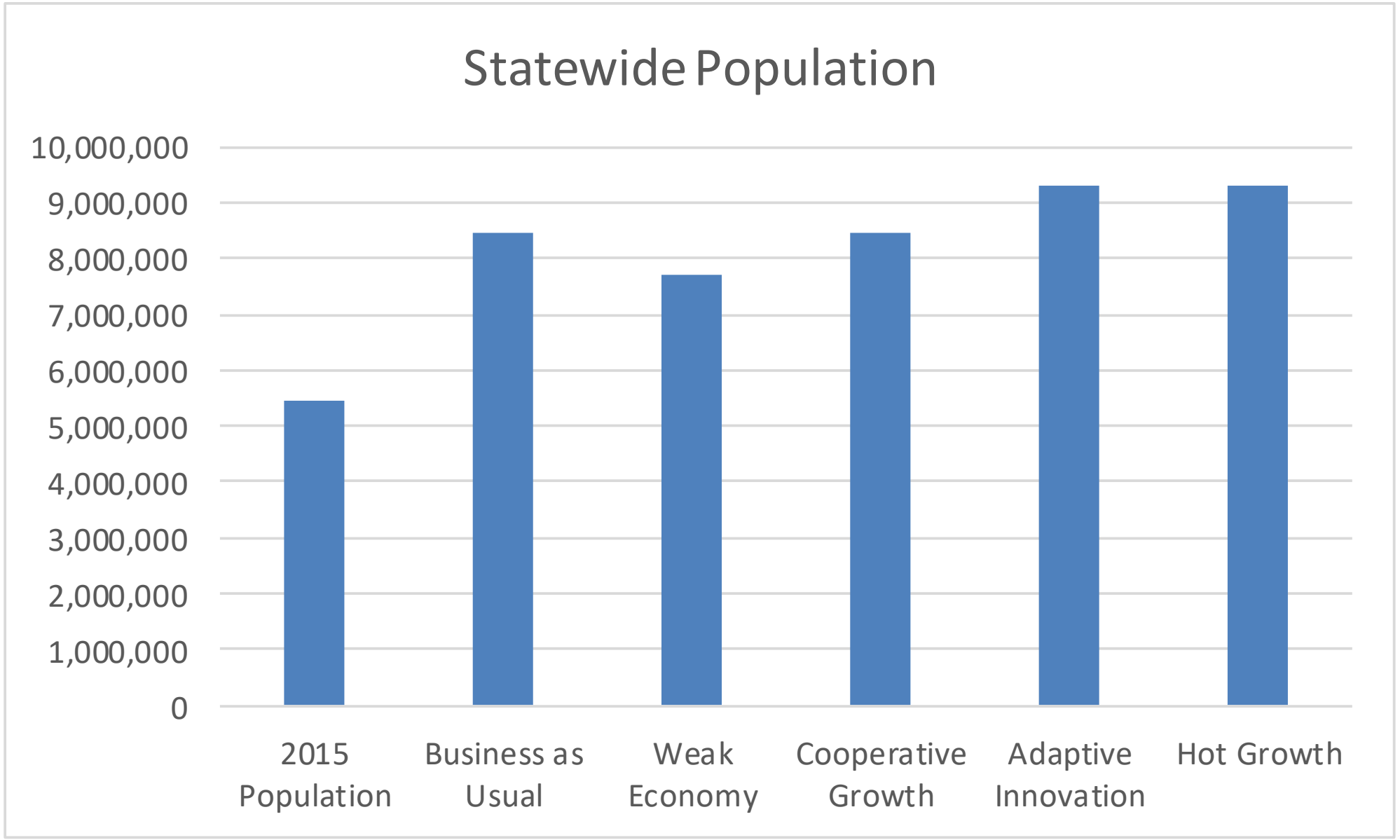
Scenario Descriptions are shown in the Colorado Water Plan, Chapter 6.

Population Forecasts Based on Water Plan Scenario Descriptions

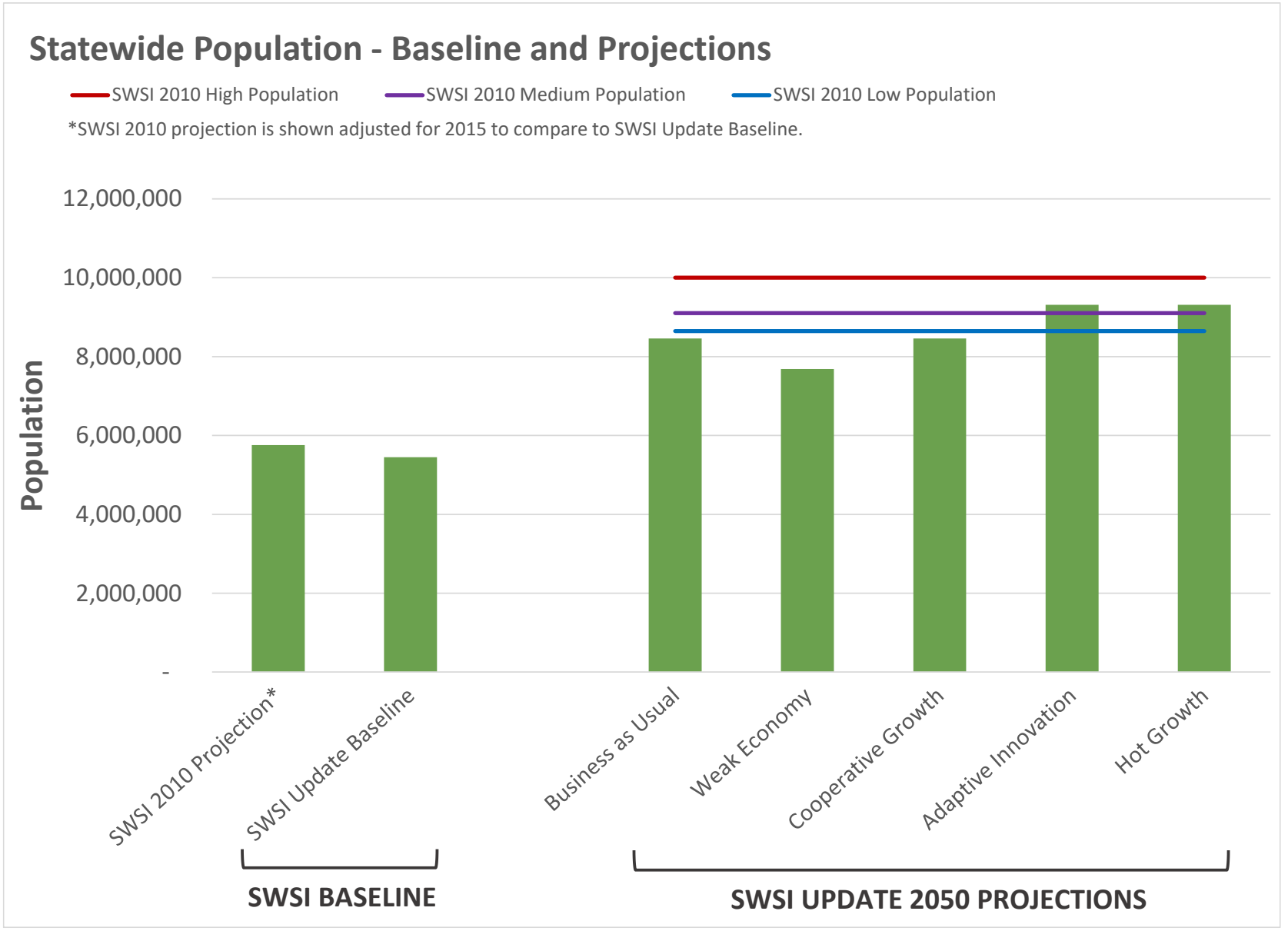
- **Adaptive Innovation**
  - "Relatively cooler weather in Colorado (due to its higher elevation) and the high-tech job market cause population to grow faster than currently projected … More compact urban development occurs through innovations in mass transit"
- **Hot Growth**
  - "A vibrant economy fuels population growth and development throughout the state… A much warmer global climate brings more people to Colorado "

Scenario Descriptions are shown in the Colorado Water Plan, Chapter 6.

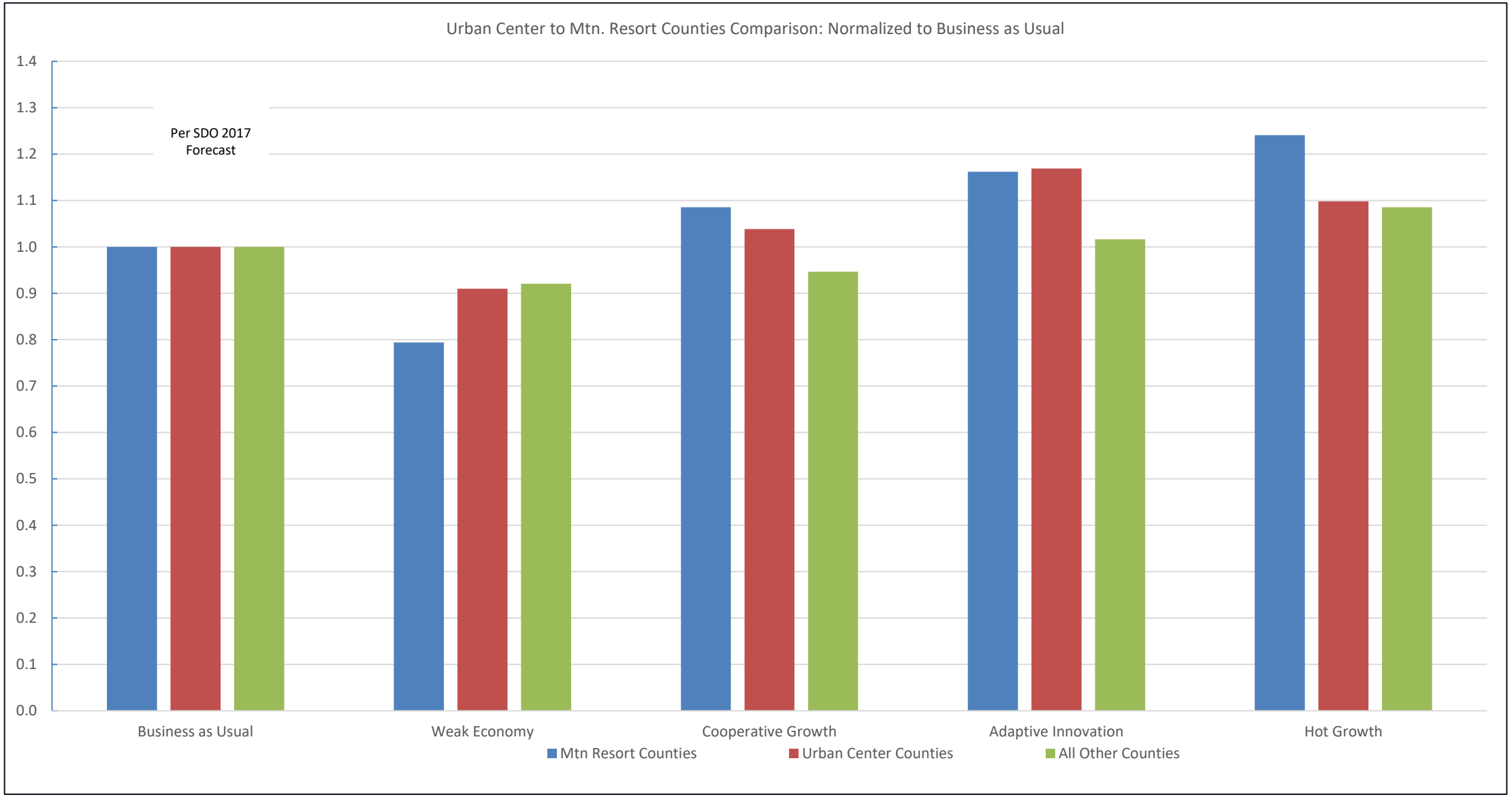
Statewide Population by Water Plan Scenario



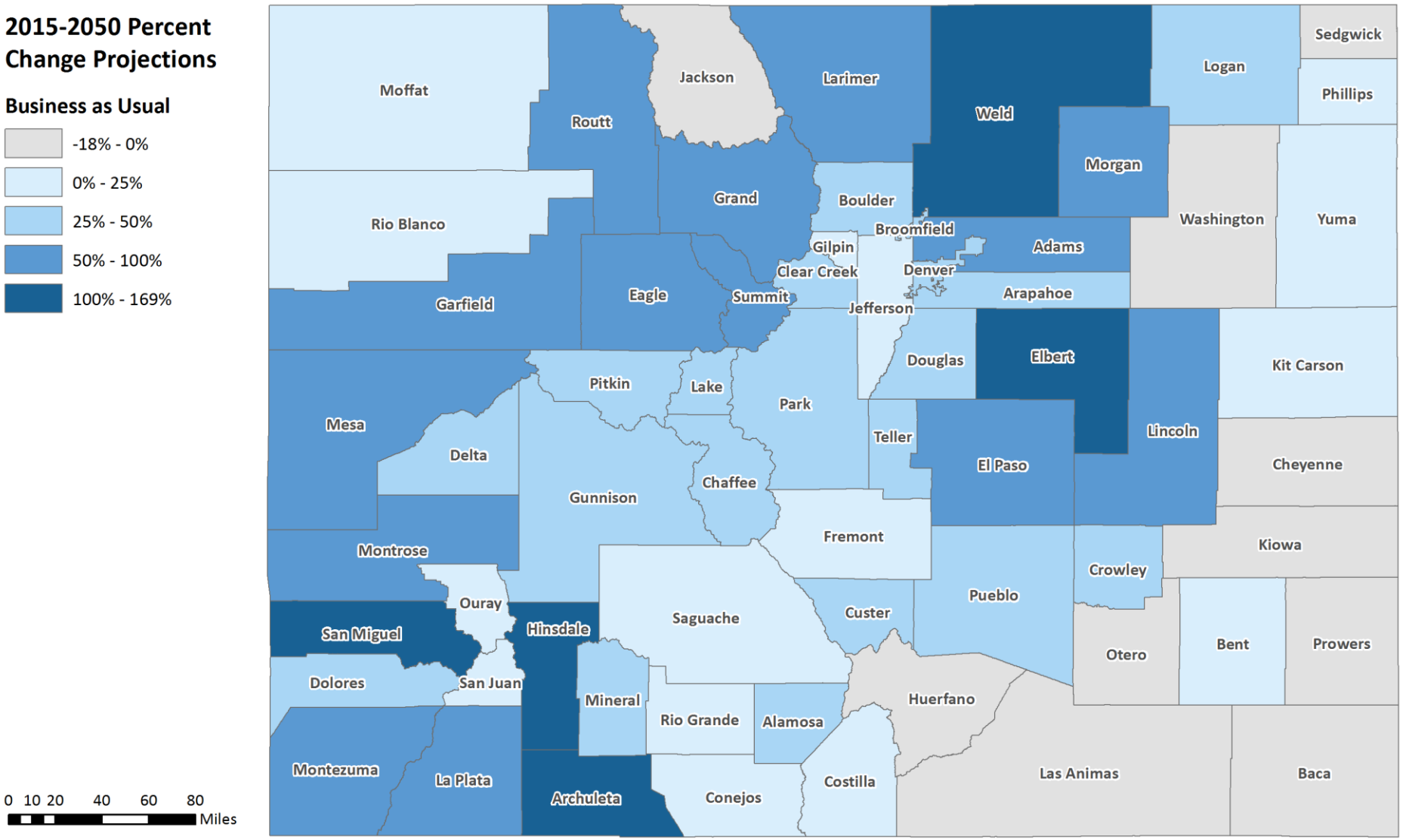
Comparison to SWSI 2010 Projections



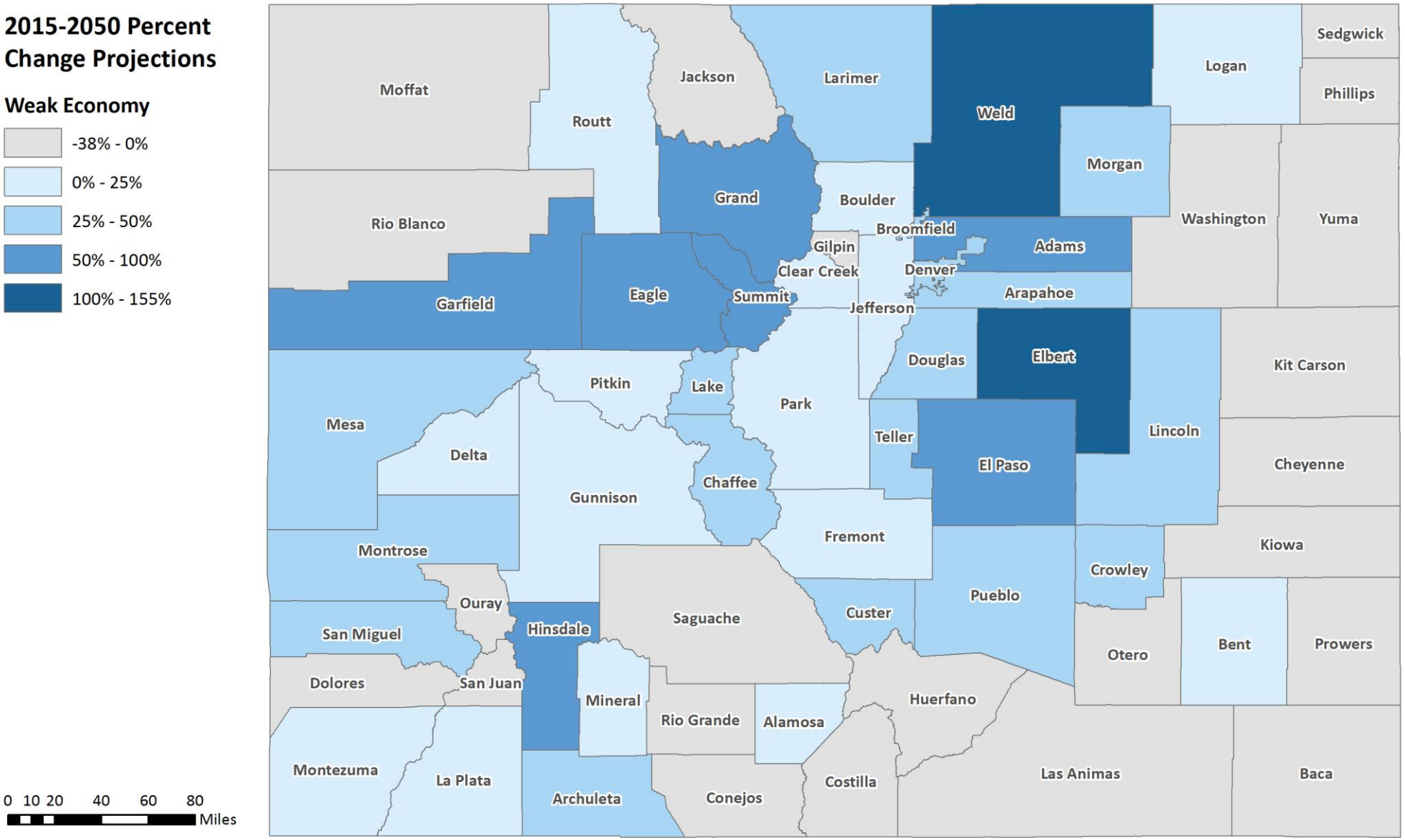
Geographic Comparisons by Water Plan Scenario



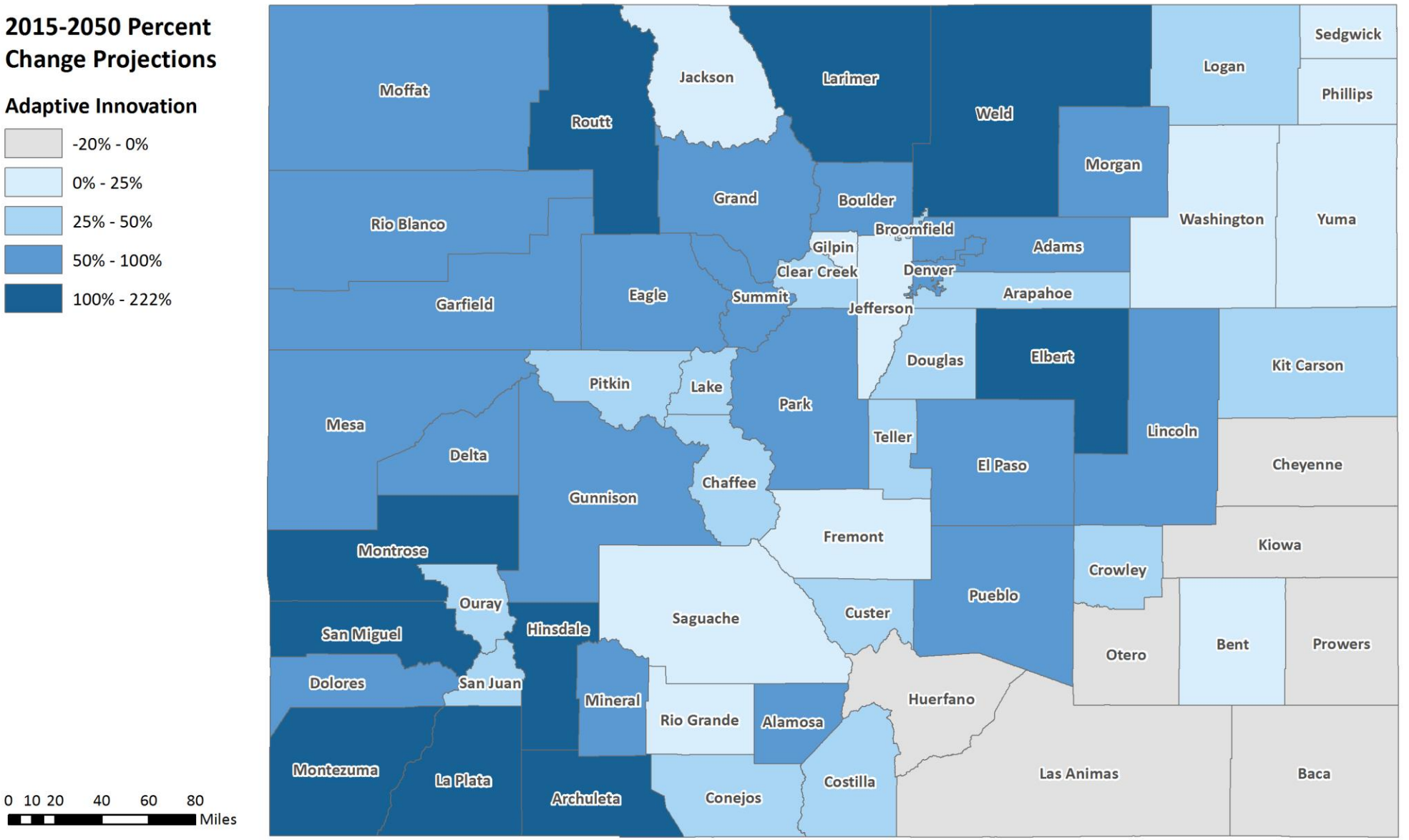
Growth by County in Business as Usual Projections



Growth by County in Weak Economy Projections

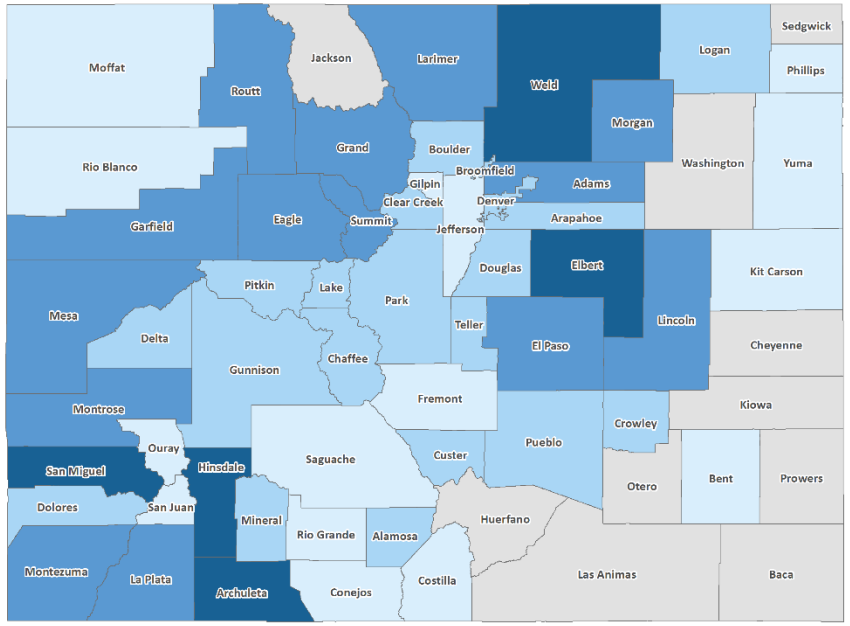


Growth by County in Adaptive Innovation Projections

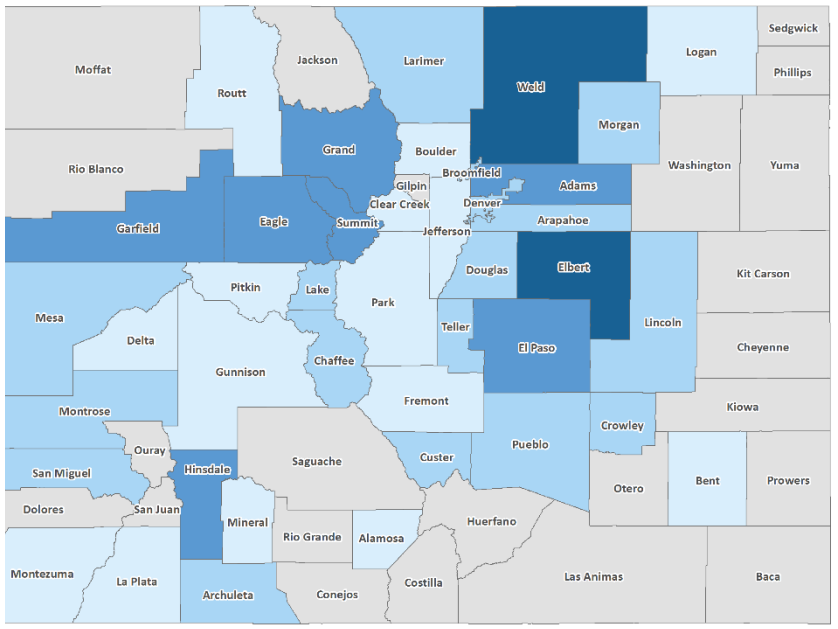


Growth by County Across Three of the Five Scenarios

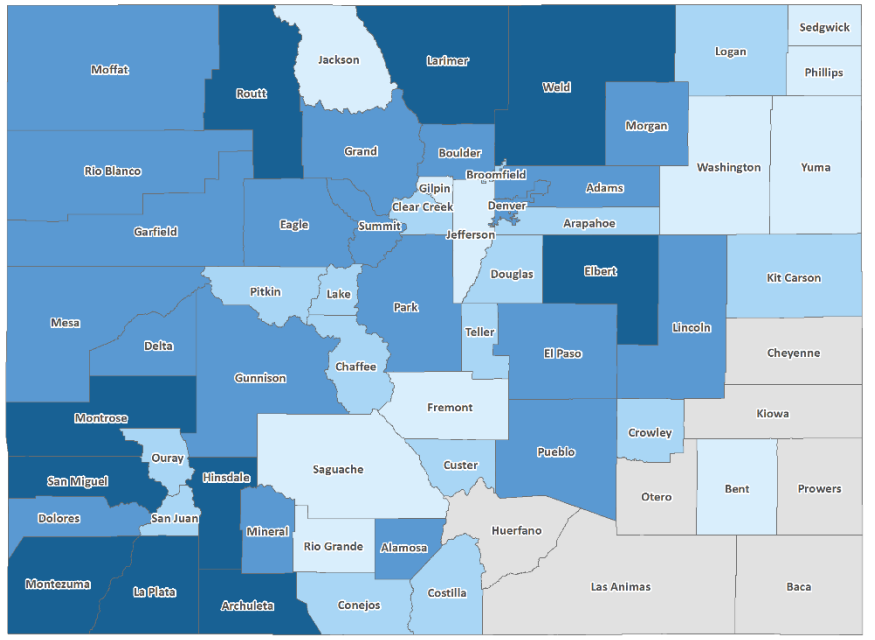
Business As Usual



Weak Economy



Adaptive Innovation



- Below 0%
- 0% - 25%
- 25% - 50%
- 50% - 100%
- Over 100%

Summary

1. The Technical Update incorporates new population projections

   - Projections more closely tied to official forecasts from SDO
   - Alternative forecasts based on Water Plan scenario descriptions and probabilistic analysis of potential faster or slower growth

2. Population is one key driver of M&I demand projections

   - Others include water use efficiency and future climate

3. Population growth also informs estimates of urbanization and loss of irrigated lands

TECHNICAL WEBINARS

- **February 19** SWSI Methodologies Overview and Population Data
- **March 19** Municipal and Industrial Data & Methodologies
- **April 23** Agricultural Data & Methodologies
- **May 21** Environmental Data & Methodologies
- **June 25** SWSI Tools & Next Steps

SIGN-UP FOR WEBINARS

WEBINARS

COLORADO'S WATER PLAN

COLLABORATING ON COLORADO'S WATER FUTURE

Home | The Plan | The Basins | The Supply Analysis | Implementation | Learn More

The Supply Analysis › Quick Guides

Quick Guides

POPULATION

Population projections in the technical update are one of the major drivers of future water use. The scenario planning analysis update utilizes State Demography Office projections from 2017 (for comparison 2018 projections can be found here). The updated, detailed Technical Memorandum can be found here. Images below include both the methodology fact sheet and analysis insights.

CHECK-IN ON UPDATES

WEBSITE

COLORADO'S WATER PLAN

COLLABORATING ON COLORADO'S WATER FUTURE

Home | The Plan | The Basins | Supply Study | Implementation | Learn More

Implementation › 2019 Implementation Working Group

2019 Implementation Working Group

IMPLEMENTATION WORKING GROUP

An Implementation Working Group has been organized to help CWCB staff fine tune practical guidance following the Statewide Water Supply Initiative (SWSI) findings and Basin Implementation Plan updates. The group participants include representatives from each basin and some IBCC members. Group outputs will be updated under this page as they are developed. Roundtables will be updated by working group representatives according to their normal meeting schedule.

CHECK-IN ON WORKING GROUP EFFORTS

OUTPUTS

SEPTEMBER 25 + 26 2019

SUMMIT


THOUGHTS, COMMENTS OR
QUESTIONS?
CO
COLORADO