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# APPENDIX B - NARRATIVE TO NUMBERS

Table 4: Business as Usual Scenario Hydrologic Modeling Inputs

Relevant Scenario Narrative Language		Key Driver	Water Demand Model Parameter	Input Adjustment (~no adjustment, --- large decrease, - moderate decrease, - small decrease, + small increase, ++ moderate increase, +++ large increase)
M&SI Demands	By 2050, Colorado's population is close to 9 million people. Single family homes dominate, but there is a slow increase of denser developments in large urban areas. Municipal water conservation efforts slowly increase.	Land Use & Associated Population Growth	Population	~ Per SDO Office Forecast
	The economy goes through regular economic cycles but grows over time.	Economic Growth	Indoor and Outdoor gpcd	~ Economic conditions have similar to historical impact on water use
	The climate is similar to the observed conditions of the 20th century. Municipal water conservation efforts slowly increase.	Climate Conditions	Outdoor gpcd	~ Water use not significantly impacted by climate change
	Social values and regulations remain the same. Regulations are not well coordinated and create increasing uncertainty for local planners and water managers.	Regulations & Technology Change	Indoor and Outdoor gpcd	~ Regulations / technology does not change historic water use
	Social values and regulations remain the same. Willingness to pay for social and environmental mitigation of new water development slowly increases.	Social Values Changes	Indoor and Outdoor gpcd	~ Social values <b>do not change</b> historic water use behaviors
	Transfer of water from agriculture to urban uses continues. Efforts to mitigate the effects of the transfers slowly increase. Large portions of agricultural land around cities are developed by 2050.	Land Use Changes	Acres of Crops	- - Irrigated agricultural land within and adjacent to city boundaries is converted to housing except in counties with no projected growth
Agricultural Demands	The climate is similar to the observed conditions of the 20th century.	Climate Conditions	Crop Consumptive Use	~ Similar to recent past
	Agricultural economics continue to be viable, but agricultural water use continues to decline.	Technology Changes	Irrigation Efficiency	~ Similar to recent past
	Social values and regulations remain the same.	Social Values Changes	Crop Types	~ Similar to recent past
	The climate is similar to the observed conditions of the 20th century.	-	Stream Flows	20 <sup>th</sup> century observed
Hydrologic	-	-	Demands	Business as Usual Scenario Demands



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Table 5: Weak Economy Scenario Hydrologic Modeling Inputs

	Relevant Scenario Narrative Language	Key Driver	Water Demand Model Parameter	Input Adjustment (~no adjustment, --- large decrease, -- moderate decrease, - small decrease, + small increase, ++ moderate increase, +++ large increase)
W&SSI Demands	Population growth is lower than currently projected, slowing the conversion of agricultural land to housing.	Land Use & Associated Population Growth	Population	- Rural areas have less population decline than SDO forecast & urban areas have less growth than SDO forecast
	The world's economy struggles, and the state's economy is slow to improve. Many sectors of the state's economy, including most water users and water dependent businesses, begin to struggle financially.	Economic Growth	Indoor and Outdoor gpcd	- Poor economy limits water purchases
	Greenhouse gas emissions do not grow as much as currently projected and the climate is similar to the observed conditions of the 20th century.	Climate Conditions	Outdoor gpcd	~ Water use not significantly impact by climate change
	Regulations are not well coordinated and create increasing uncertainty for local planners and water managers. The maintenance of infrastructure, including water facilities, becomes difficult to fund. There is little change in social values, levels of water conservation, urban land use patterns, and environmental regulations.	Regulations & Technology Change	Indoor and Outdoor gpcd	~ Poor economy results in reduced maintenance & increased leakage
	There is little change in social values, levels of water conservation, urban land use patterns, and environmental regulations.	Social Values Changes	Indoor and Outdoor gpcd	~ Social values <b>do not</b> change historic water use behaviors
Agricultural Demands	Population growth is lower than currently projected, slowing the conversion of agricultural land to housing. There is little change in social values, levels of water conservation, urban land use patterns, and environmental regulations.	Land Use Changes	Acres of Crops	- Irrigated agricultural land within and adjacent to city boundaries is converted to housing except in counties with no projected growth
	Greenhouse gas emissions do not grow as much as currently projected and the climate is similar to the observed conditions of the 20th century.	Climate Conditions	Crop Consumptive Use	~ Similar to recent past
	There is little change in social values, levels of water conservation, urban land use patterns, and environmental regulations.	Technology Changes	Irrigation Efficiency	~ Similar to recent past
	There is little change in social values, levels of water conservation, urban land use patterns, and environmental regulations.	Social Values Changes	Crop Types	~ Similar to recent past
Hydrologic Modeling Inputs	Greenhouse gas emissions do not grow as much as currently projected and the climate is similar to the observed conditions of the 20th century.	-	Stream Flows	20 <sup>th</sup> century observed
	-	-	Demands	Weak Economy Scenario Demands

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Table 6: Cooperative Growth Scenario Hydrologic Modeling Inputs

Relevant Scenario Narrative Language		Key Driver	Water Demand Model Parameter	Input Adjustment (~no adjustment, --- large decrease, -- moderate decrease, - small decrease, + small increase, ++ moderate increase, +++ large increase)
M&SSSI Demands	Population growth is consistent with current forecasts. Mass transportation planning concentrates more development in urban centers and in mountain resort communities, thereby slowing the loss of agricultural land and reducing the strain on natural resources compared to traditional development.	Land Use & Associated Population Growth	Population	~ Overall urban and rural growth per SDO forecast, but more population in urban areas than suburban areas.
	Broad alliances form to provide for more integrated and efficient planning and development. Eco-tourism thrives.	Economic Growth	Indoor and Outdoor gpcd	~ Economic conditions have similar to historic impact on water use
	There is a moderate warming of the climate, which results in increased water use in all sectors, in turn affecting stream flows and supplies.	Climate Conditions	Outdoor gpcd	+ Moderate warming results in slight increase of outdoor water use
	Coloradans embrace water and energy conservation. New water-saving technologies emerge. Water-development controls are more restrictive and require both high water-use efficiency and environmental and recreation benefits. Environmental regulations are more protective, and include efforts to re-operate water supply projects to reduce effects.	Regulations & Technology Change	Indoor and Outdoor gpcd	- - Water saving technology advancements occur and are required
	Environmental stewardship becomes the norm. Coloradans embrace water and energy conservation. Demand for more water-efficient foods reduces water use. This dynamic reinforces the social value of widespread water efficiency and increased environmental protection.	Social Values Changes	Indoor and Outdoor gpcd	- - Increased conservation behaviors
Agricultural Demands	Population growth is consistent with current forecasts. Mass transportation planning concentrates more development in urban centers and in mountain resort communities, thereby slowing the loss of agricultural land and reducing the strain on natural resources compared to traditional development.	Land Use Changes	Acres of Crops	- Irrigated agricultural land within and adjacent to city boundaries is converted to housing but less dry-up occurs from agricultural water transfers
	There is a moderate warming of the climate, which results in increased water use in all sectors, in turn affecting stream flows and supplies.	Climate Conditions	Crop Consumptive Use	+ Moderate warming
	Coloradans embrace water and energy conservation. New water-saving technologies emerge. Water-development controls are more restrictive and require both high water-use efficiency and environmental and recreation benefits.	Technology Changes	Irrigation Efficiency	~ Agriculture maintains current trends in efficiency improvements
			Crop Types	-
	Environmental stewardship becomes the norm. Coloradans embrace water and energy conservation. Demand for more water-efficient foods reduces water use. This dynamic reinforces the social value of widespread water efficiency and increased environmental protection.	Social Values Changes		Similar to recent past
Hydrologic Modeling Inputs	There is a moderate warming of the climate, which results in increased water use in all sectors, in turn affecting stream flows and supplies.	-	Stream Flows	In-between 20 <sup>th</sup> century observed and hot and dry
		-	Demands	Cooperative Growth Scenario Demands



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Table 7: Adaptive Innovation Scenario Hydrologic Modeling Inputs

	Relevant Scenario Narrative Language	Key Driver	Water Demand Model Parameter	Input Adjustment (-no adjustment, --- large decrease, -- moderate decrease, - small decrease, + small increase, ++ moderate increase, +++ large increase)
M&SSI Demands	The 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 food is bought locally, increasing local food prices and reducing the loss of agricultural land to urban development. More compact urban development occurs through innovations in mass transit.	Land Use & Associated Population Growth	Population	+
				More population growth than forecasted by SDO with greatest growth in urban areas
	Renewable and clean energy become dominant. Colorado is a research hub and has a strong economy. The warmer climate reduces global food production increasing the market for local agriculture and food imports to Colorado	Economic Growth	Indoor and Outdoor gpcd	~
				Economic conditions have similar to historic impact on water use
	A much warmer climate causes major environmental problems globally and locally.	Climate Conditions	Outdoor gpcd	++
				Significant warming results in increased outdoor water use
Agricultural Demands	Technological innovation becomes the dominant solution. Strong investments in research lead to breakthrough efficiencies in the use of natural resources, including water. The warmer climate increases demand for irrigation water in agriculture and municipal uses, but innovative technology mitigates the increased demand. The regulations are well defined and permitting outcomes are predictable and expedited.	Regulations & Technology Change	Indoor and Outdoor gpcd	- -
				Water saving technology advancements occur and are required
	Social attitudes shift to a shared responsibility to address problems	Social Values Changes	Indoor and Outdoor gpcd	- -
				Increased conservation behaviors
	More food is bought locally, increasing local food prices and reducing the loss of agricultural land to urban development.	Land Use Changes	Acres of Crops	-
				Irrigated agricultural land within and adjacent to city boundaries is converted to housing but less dry-up occurs from agricultural water transfers
Hydrologic Modeling Inputs	A much warmer climate causes major environmental problems globally and locally.	Climate Conditions	Crop Consumptive Use	++
				Much warmer
	The warmer climate increases demand for irrigation water in agriculture and municipal uses, but innovative technology mitigates the increased demand.	Technology Changes	Irrigation Efficiency	+
				New technologies increase efficiency
	The warmer climate reduces global food production increasing the market for local agriculture and food imports to Colorado. More food is bought locally, increasing local food prices and reducing the loss of agricultural land to urban development.	Social Values Changes	Crop Types	-
				Demand for locally grown foods allows for investment in new irrigation efficiency technologies and crops. Increased temperatures and drier conditions lead to crop hybrids that consume less water.
	A much warmer climate causes major environmental problems globally and locally. Droughts and floods become more extreme.	-	Stream Flows	Hot and dry
		-	Demands	Adaptive Innovation Scenario Demands

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Table 8: Hot Growth Scenario Hydrologic Modeling Inputs

	Relevant Scenario Narrative Language	Key Driver	Water Demand Model Parameter	Input Adjustment (~no adjustment, --- large decrease, -- moderate decrease, - small decrease, + small increase, ++ moderate increase, +++ large increase)
M&SSJ Demands	A vibrant economy fuels population growth and development throughout the state. Families prefer low-density housing and many seek rural properties, ranchettes, and mountain living. Agricultural and other open lands are rapidly developed. A much warmer global climate brings more people to Colorado with its relatively cooler climate.	Land Use & Associated Population Growth	Population	+
				More population growth than forecasted by SDO with growth in both urban and suburban areas
	A vibrant economy fuels population growth and development throughout the state. Worldwide demand for agricultural products rises, greatly increasing food prices. Fossil fuel is the dominant energy source, and there is large production of oil shale, coal, natural gas, and oil in the state.	Economic Growth	Indoor and Outdoor gpcd	++
				Increased oil and gas production increases water use
	Hot and dry conditions lead to a decline in stream flows and water supplies. A much warmer global climate brings more people to Colorado with its relatively cooler climate.	Climate Conditions	Outdoor gpcd	++
				Significant warming results in increased outdoor water use
Agricultural Demands	Regulations are relaxed in favor of flexibility to promote and pursue business development.	Regulations & Technology Change	Indoor and Outdoor gpcd	+
				Regulations are relaxed in favor of business
	Regulations are relaxed in favor of flexibility to promote and pursue business development.	Social Values Changes	Indoor and Outdoor gpcd	~
				Social values do not change historic water use behaviors
	Agricultural and other open lands are rapidly developed.	Land Use Changes	Acres of Crops	---
				More agricultural land near cities and in rural areas is converted to housing and more irrigated land is dried up for agricultural water transfers
Hydrologic Modeling Inputs	Hot and dry conditions lead to a decline in stream flows and water supplies. A much warmer global climate brings more people to Colorado with its relatively cooler climate. A hotter climate decreases global food production. Worldwide demand for agricultural products rises, greatly increasing food prices.	Climate Conditions	Crop Consumptive Use	++
				Much warmer
	Regulations are relaxed in favor of flexibility to promote and pursue business development.	Technology Changes	Irrigation Efficiency	~
				Similar to recent past
	Agricultural and other open lands are rapidly developed.	Social Values Changes	Crop Types	~
				Similar to recent past
Hydrologic Modeling Inputs	Hot and dry conditions lead to a decline in stream flows and water supplies. Droughts and floods become more extreme.	-	Stream Flows	Hot and dry
		-	Demands	Hot Growth Scenario Demands





# APPENDIX C - CONSULTANT TEAM

Technical Update to the Colorado Water Plan Consultant Teams		
Prime Consultant	Subconsultants	Subconsultant Responsibilities
Brown and Caldwell	CDR Associates	Facilitation (if needed)
	HDR Engineering, Inc.	Facilitation and public relations assistance (if needed), technical advisors related to general water resources
	Lynker Technologies, Inc.	Technical advisors related to general water resources and climate change
CDM Smith	The Nature Conservancy	Technical advisors related to environmental and recreational needs, gaps, etc.
Jacobs	BBC Research & Consulting	Research and calculations related to population estimates and water-related values
	ELEMENT Water Consulting	Research and calculations related to municipal and self-supplied industrial water demands and water conservation
	The Open Water Foundation	IPP information development
	Southwest Water Resource Consulting	Technical advisors related to planning scenarios
	Wilson Water Group	Research and calculations related to water supplies, projects and methods, and gap analyses



# APPENDIX D - TECHNICAL ADVISORY GROUP (TAG) & IMPLEMENTATION WORKING GROUP (IWG) PARTICIPANTS

Technical Advisory Group Participant List (July 2017)			
NAME	BASIN	ORGANIZATION	TAG
Laurina Kaatz	Metro	Denver Water	Planning Scenario
Joe Frank	South Platte	Lower South Platte WCD	Planning Scenario
Frank Kugel	Gunnison	Upper Gunnison WCD	Planning Scenario
Steve Harris	Southwest	Harris Water Engineering	Planning Scenario
Cary Denison	Gunnison	Trout Unlimited, Gunnison Basin	Planning Scenario
Jim Hall	South Platte	Northern Water Conservancy District	Planning Scenario
Heather Dutton	Rio Grande	San Luis Valley WCD	Planning Scenario
Kevin McBride	Yampa/White	Upper Yampa WCD	Planning Scenario
Jim Broderick	Arkansas	Southeastern WCD	Planning Scenario
John Currier	Colorado	Colorado River WCD	Planning Scenario
David Graf	Gunnison, CO & SW	Colorado Parks and Wildlife	Planning Scenario
Ken Neubecker	Colorado (Enviro Rep)	American Rivers	Environmental & Recreational
Cary Denison	Gunnison (Enviro Rep)	Trout Unlimited	Environmental & Recreational
David Nickum	Metro (Enviro Rep)	Trout Unlimited	Environmental & Recreational
Barbara Vasquez	North Platte (Enviro Rep)	At-large	Environmental & Recreational
Rio de la Vista	Rio Grande (Enviro Rep)	Rio Grande Headwaters Land Trust	Environmental & Recreational
Jason Roudebush	South Platte	Ducks Unlimited	Environmental & Recreational
SeEtta Moss	Arkansas (Rec Rep)	Arkansas Basin Roundtable	Environmental & Recreational
Tim Hunter	Southwest (Rec Rep)	At-large	Environmental & Recreational
Geoff Blakeslee	Yampa White (Enviro Rep)	The Nature Conservancy	Environmental & Recreational
Kent Vertrees	Yampa White (Rec Rep)	Steamboat Powdercats	Environmental & Recreational
Pete Conovitz	Statewide	Colorado Parks and Wildlife	Environmental & Recreational
Mickey O'Hara	Statewide	Colorado Water Trust	Environmental & Recreational
Laura Belanger	Statewide	Western Resource Advocates	Environmental & Recreational
Tammy Allen	Statewide	CDPHE	Environmental & Recreational
Matt Rice	Statewide	American Rivers	Environmental & Recreational
Nathan Fey	Statewide	American Whitewater	Environmental & Recreational
Greg Fisher	Metro	Denver Water	Municipal & Industrial
Lyle Whitney	Metro	Aurora Water	Municipal & Industrial
Rick Marsicek	Metro	South Metro Water Supply Authority	Municipal & Industrial
Liesl Hans	South Platte	City of Fort Collins	Municipal & Industrial
Katie Melander	South Platte	Northern Water	Municipal & Industrial
Ben Moline	South Platte	Molson Coors	Municipal & Industrial
Scott Winter	Arkansas	Colorado Springs Utilities	Municipal & Industrial
Alan Ward	Arkansas	Pueblo Water	Municipal & Industrial



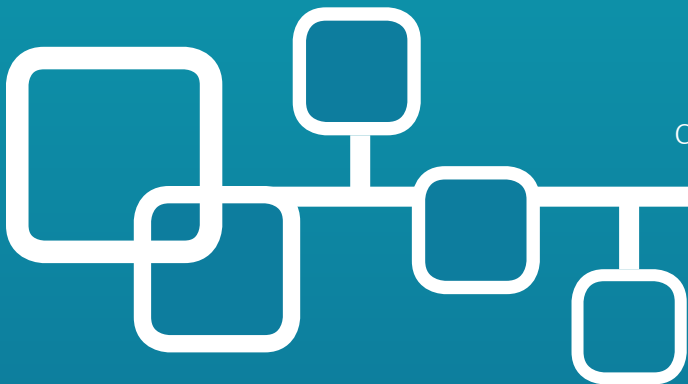


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Technical Advisory Group Participant List (July 2017), continued			
NAME	BASIN	ORGANIZATION	TAG
Maureen Egan	Colorado	Eagle River Water San. Dist.	Municipal & Industrial
Rick Brinkman	Gunnison & Colorado	City of Grand Junction	Municipal & Industrial
Jackie Brown	Yampa/White	Tri State	Municipal & Industrial
Ann Bunting	Rio Grande	Town of Crestone	Municipal & Industrial
Ed Tolin	Southwest	La Plata Archuleta Water District	Municipal & Industrial
Richard Belt	Statewide	Xcel Energy	Municipal & Industrial
Jorge Figueroa	Statewide	Western Resource Advocates	Municipal & Industrial
Kelley Thompson	Statewide	Colorado DWR	Agriculture
Perry Cabot	Statewide	CSU Extension	Agriculture
Cindy Lair	Statewide	Colorado Dept of Agriculture	Agriculture
Tom Trout	Statewide	USDA	Agriculture
Terry Fankhauser	Statewide	Colorado Cattlemen's Association	Agriculture
Eric Wilkinson	South Platte	Northern Water	Agriculture
Mark Sponslor	South Platte	Colorado Corn	Agriculture
Jim Yahn	South Platte	South Platte Roundtable	Agriculture
Joe Frank	South Platte	South Platte Roundtable	Agriculture
T. Wright Dickinson	Yampa/White	Yampa Roundtable	Agriculture
Mary Brown	Yampa/White	Yampa Roundtable	Agriculture
Ty Wattenberg	North Platte	North Platte Roundtable	Agriculture
Travis Smith	Rio Grande	Rio Grande Roundtable	Agriculture
Ken Curtis	Southwest	Southwest Roundtable	Agriculture
Terry Scanga	Arkansas	Arkansas Roundtable	Agriculture
Jack Goble	Arkansas	Arkansas Roundtable	Agriculture
Paul Bruchez	Colorado	Colorado Roundtable	Agriculture
Frank Kugel	Gunnison	Gunnison Roundtable	Agriculture

# APPENDIX D *CONTINUED*

Implementation Working Group Participant List (January 2019)	
NAME	BASIN
Terry Scanga	Arkansas
Amber Shanklin	Arkansas
Abby Ortega	Arkansas
Jim Pokrandt	Colorado
Ken Neubecker	Colorado
Mike Wageck	Colorado
Joanne Fagan	Gunnison
Frank Kugel	Gunnison
Cary Denison	Gunnison
Lisa Darling	Metro
Casey Davenport	Metro
Rick Marsicek	Metro
Curran Trick	North Platte
Kent Crowder	North Platte
Barbara Vasquez	North Platte
Ty Wattenberg	North Platte
Heather Dutton	Rio Grande
Emma Reesor	Rio Grande
Daniel Boyes	Rio Grande
Judy Lopez	Rio Grande
Sean Cronin	South
Lisa McVicker	South
Mike Shimmin	South
Mely Whiting	Southwest
Philip Johnson	Southwest
Karen Guglielmone	Southwest
Kevin McBride	Yampa
Alden Brink	Yampa
Jackie Brown	Yampa
Kelly Romero-Heaney	Yampa



COLLABORATING ON COLORADO'S WATER FUTURE