Appendix B

Basin Roundtable Portfolio and Trade-off Documentation

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Memorandum

To: *Todd Doherty, CWCB*

From: *Nicole Rowan, CDM*

Date: *February 9, 2012*

Subject: *Portfolio and Trade-off Tool Analysis for Arkansas Basin*

The Arkansas Basin held workshop on the Portfolio and Trade-off Tool on 12/14/2011. The purpose of the workshop was to develop preliminary portfolios for meeting Colorado's future M&I water needs. During the workshop, the attendees developed three portfolios that were to be reviewed by the full Arkansas Roundtable in future meetings. At the Arkansas Basin's January and February 2012 roundtable meetings, the roundtable discussed the workshop attendees efforts in preparation for the March 1, 2012 Basin Roundtable Summit. During the February 2012 meeting the roundtable agreed that the roundtable should present the three scenarios developed during the December 2011 workshop plus two additional portfolios that were developed during the February 2012 meeting. The original three portfolios assumed that as demands increase more active conservation savings would be applied to the M&I gap. The five portfolios represent the "four extremes" or "four corners "of potential demand and supply scenarios and one medium demand/medium supply portfolio. The roundtable is very interested in the dialogue that will occur at the Basin Roundtable Summit regarding these portfolios and plans to revisit their portfolios after the summit prior to the Interbasin Compact Committee's June 2012 meeting.

This memorandum summarizes the portfolios developed by the roundtable to date and provides a summary of feedback from roundtable members that they would like shared with other roundtables across the state at the summit.

Summary of Scenarios

Following are the scenarios that were developed during the December 2011 workshop:

- Scenario 1: Low Demand/Low Supply Scenario. Any conservation savings achieved would be needed for M&I system reliability/risk management. No Colorado River System water available for the East Slope and limited amount for the West Slope.

- Scenario 2: Medium Demands/Medium Supply Scenario. Some conservation savings could be applied to the M&I Gap. 50,000 AFY of Colorado River System Water available for the East Slope and 150,000 AFY for the West Slope.

- Scenario 3: High Demands/High Supply Scenario. More conservation savings could be applied to the M&I Gap. 150,000 AFY of Colorado River System Water available for the East Slope and 200,000 for the West Slope.

Assumptions

The following assumptions were held constant for the above portfolios:

- Oil shale demands were turned "on" in the tool. These demands include oil shale development (oil shale demands for medium scenario are ~50,000 AFY and for high scenario ~113,000 AFY).

- Replacement of Front Range non-tributary groundwater was turned "on" in the tool (~34,000 AFY).

- Arkansas Identified Projects and Process (IPPs) will deliver ~86% of their potential yield in the future.

- Reuse ratio of 1.5 for all reusable supplies on the East Slope.

The dialogue during the February roundtable meeting affirmed the assumptions and approach fo the December workshop. To explore the direct and indirect impacts of potentially extreme conditions, namely High Municipal Demand coupled with the lowest supply conditions. And Low Demand plus significant New Supply volume, the roundtable models two additional scenarios. The development of these scenarios were intended to provide stimulus for the discussion at the Roundtable Summit. Following are the two additional scenarios that were developed during the February 2012 roundtable meeting:

- Scenario 4: High Demands/Low Supply Scenario. Less conservation savings would be applied to the M&I gap to represent a worst case scenario. No Colorado River System water available for the East Slope and 25,000 AFY for the West Slope.

- Scenario 5: Low Demands/High Supply. Less conservation savings would be applied to the M&I gap as there is high Colorado River System water available for development. 250,000 AFY of Colorado River System water available for the East Slope and none for the West Slope. For this Scenario, the Replacement of Front Range non-tributary groundwater was turned “off.”

Results

Results are shown in Table 1 through 6 below. Table 1 describes each scenario and its results. Tables 2 through 6 present the information graphically. A key output examined by other roundtables is the amount of irrigated acres potentially lost in the South Platte basin. Approximately 20 percent of the South Platte's irrigated acres will be lost to IPPs and urbanization onto irrigated lands. Therefore, 20 percent of irrigated acre dry-up in the South

Platte Basin and 5 percent in the Arkansas Basin is considered low in the scenarios presented below.

Basin Roundtable Member Comments

As part of the portfolio and trade-off tool exercise in the Arkansas Basin, the following roundtable members noted the following:

Reeves Brown: M&I and Agricultural needs to have equal representation and this should be reflected in future efforts by the state when examining our water future.

Tom Verquer: As an alternative water supply consideration for the whole state, we need to look into water losses from phreatophytes like cottonwood and willows. Historical photos show much less phreatophytes in 1900-1930 than now.

Dan Henrichs: Using an excessively low consumptive use number in the ag transfer options portion of the Portfolio and Trade-off Tool overstates the amount of acres needed to be transferred to M&I needs to meet the gap.

Tom Young: The scenarios we have to deal with are High demand and Low Supply. We will always have the high demand for the present water supply about 2 years of 10 we will have an ample supply. The other scenarios are only wishful thinking. They haven't happened in the recent past or will they happen in the future. Until we import an outside supply anything we come up with is a wild dream. If the lower 3 states would develop a source other than the Colorado River then we could develop all of our allotted supply. This is not apt to happen any time soon. At present the Colorado River is delivering with present flow 2,000,000 AF Per year and more in time of peak flow. The Green River is doing about the same. The San Juan and Dolores somewhat less. During the irrigating season the San Juan and D0lores are deficit rivers and draw from their storages.

Colorado Springs Utilities:

- The Portfolio Tool scenarios developed by the Arkansas Basin Roundtable demonstrate the paramount importance of high success rates and successful implementation of the Identified Projects and Processes (IPPs). The Portfolio Tool shows that the “water supply gaps” on local, basinwide and statewide levels may be too great to overcome if the IPPs are not successful.

- Development of certain IPPs, particularly those which focus on more effectively managing/using reusable water supplies may be effective at addressing the water supply gap on a local basis. However, the basin-wide effect of these projects may be to simply “redistribute” the gap, as excess reusable return flows which others had come to rely on (particularly lower in the basin) are no longer be available at the locations, amounts, or times certain users have become accustomed to, as the “owner” of these reusable return flows is now using and reusing these supplies more effectively in their systems.

- We support the use of a reuse ratio of 1.5 for reusable water supplies on the Front Range. It is important to note, however, that reuse ratios are specific to each water user and are dependent on factors such as basin geography and hydrology, location of water system infrastructure, existing and future river exchange potential, composition of water rights portfolio, and other considerations. We expect reuse ratios for future supplies to be less than existing supplies due to reductions in exchange potential that will exist on Front Range rivers and streams as water development continues.

- The relationship between conservation and reuse should be examined more closely to evaluate the potential conflicts or "friction" that may exist between these two portfolio solutions. As conservation levels increase, less fully consumable, reusable water enters the system. This results in a corresponding decrease in the amount of "feed water" that is available for subsequent reuse, either through exchange or by reuse projects. This may create a negative, self perpetuating cycle which adversely affects total system yield and reduces reuse ratios. We suspect that some of these impacts could be offset by other supply strategies such as greater system-wide storage; however, additional investigation is warranted.

- We believe there is validity to arguments made by many that conservation is more a demand reduction tool than a water supply strategy which generates new, "wet" water. The Porfolio Tool currently treats water conservation as a source of supply, rather than as a demand reduction tool.

- We remain concerned about the amount of conservation savings that can reasonably be applied to the "gap". This is primarily due to the fact that the Portfolio Tool treats all of the savings that have occurred since the 2002 drought as permanent, and then applies all of these savings to the existing water supply gap. Furthermore, the Portfolio Tool assumes that all passive conservation savings are applied to the gap, which may not be the case. We believe it is important to be conservative about the conservation savings that can be achieved moving forward, and the amounts that can realistically be applied to the gap for future planning purposes.

- Meeting the goals of the "medium conservation strategy" described in the portfolios above for certain customer types/use categories will require that the savings achieved through behavioral changes since the 2002 drought become permanent, that regulations and technological changes will be implemented to achieve additional conservation savings (e.g., regulations requiring 1.28 gpf or 1.0 gpf toilets), and that utilities will continue to offer programs to achieve active conservation savings.

- For the Portfolio Tool scenarios described above, "Colorado River System Water" refers specifically to the "New Supply Development" strategy. It is important to remember that many of the existing IPPs rely on a transmountain water supply component that is not considered "new supply development" in the context of these discussions.

- There is a distinction, which at some point must be acknowledged in the Portfolio Tool, between the amount of water needed from West Slope and agricultural sources to fill the M&I gap, and the actual amount of water delivered through municipal distribution systems from such sources. The Portfolio Tool does not currently address the losses that occur between the point of diversion and the point of delivery in the municipal water distribution system, which may result in an underestimation of the actual amount of water required to fill the M&I water supply gap.

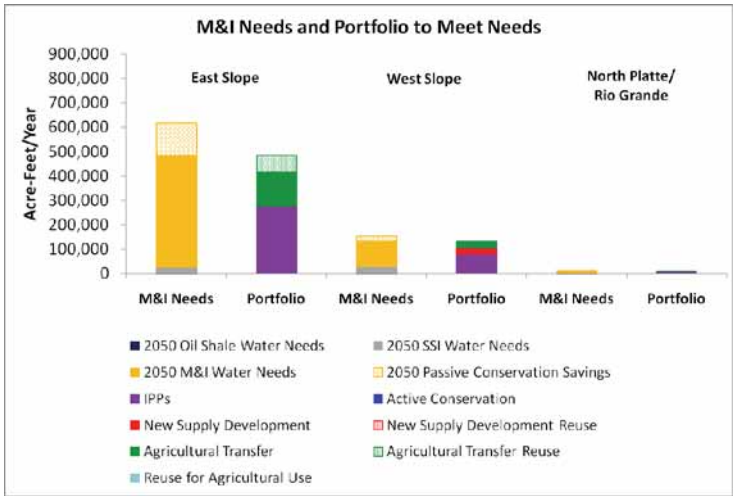
Table 1 Summary of Scenario Results

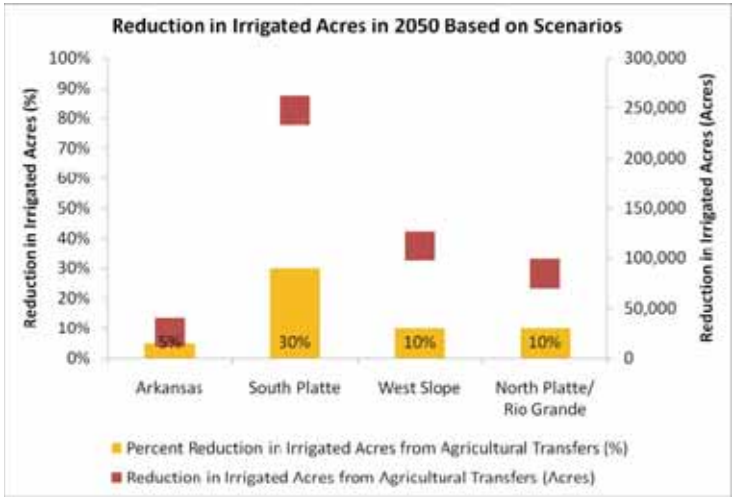
Portfolio Element	Scenario 1: Low Demand/Low Supply	Scenario 2: Medium Demands/Medium Supply	Scenario 3: High Demands/High Supply
IPPs	86% Yield Arkansas Basin	86% Yield Arkansas Basin	86% Yield Arkansas Basin
Conservation/Reuse	Low Conservation Strategy/0% applied to the M&I gap; 1.5 Reuse Factor	Medium Conservation Strategy/25% applied to the M&I gap; 1.5 Reuse Factor	Medium Conservation Strategy/50% applied to the M&I gap. 1.5 Reuse Factor
New Colorado River System Assumptions	25,000 AFY to West Slope; 0 AFY to East Slope	150,000 AFY to West Slope; 50,000 AFY to East Slope	200,000 AFY to West Slope; 150,000 AFY to East Slope
New Colorado River System and New Agricultural Transfer Results	25,000 AFY new Colorado River System water and 27,000 AFY new agricultural transfers for West Slope; 0 AFY new Colorado River System water and 140,000 AFY new agricultural transfers for the East Slope.	121,000 AFY new Colorado River System water and no new agricultural transfers for West Slope; 50,000 AFY new Colorado River System water and 78,000 AFY new agricultural transfers for East Slope. For West Slope, IPP and conservation levels are high enough that not all designated supplies are needed.	196,000 AFY new Colorado River System water and no new agricultural transfers for West Slope; 150,000 AFY new Colorado River System water and no new agricultural transfers for East Slope. For West Slope, IPP and conservation levels are high enough that not all designated supplies are needed.
Ag Transfers and Urbanization – Irrigated Acres Results	10% of West Slope acres (112,000 acres), 30% of South Platte acres (248,000), 5% of Arkansas acres (26,000).	10% of West Slope acres (94,000 acres), 25% of South Platte acres (214,000), 5% of Arkansas acres (21,000).	10% of West Slope acres (113,000 acres), 20% of South Platte acres (182,000), 5% of Arkansas acres (12,000).
Other Portfolio Trade-off Results	90% of South Platte acres and 20% of Arkansas acres needed for fallowing program; Decrease in South Platte flows (8% at state line).	70% of South Platte acres and 15% of Arkansas acres needed for fallowing program; Decrease in South Platte flows (10% at state line); Transbasin diversion would trigger FWS consultation and environmental flow metrics indicate the full 50,000 AFY could be developed in the Blue River, Gunnison River, Yampa River, and Green River.	5% of South Platte acres and 10% of Arkansas acres needed for fallowing program; Slight decrease in South Platte flows (4% at state line); Transbasin diversion would trigger FWS consultation and environmental flow metrics indicate the full 150,000 AFY could be developed in the Gunnison River, Yampa River, and Green River.

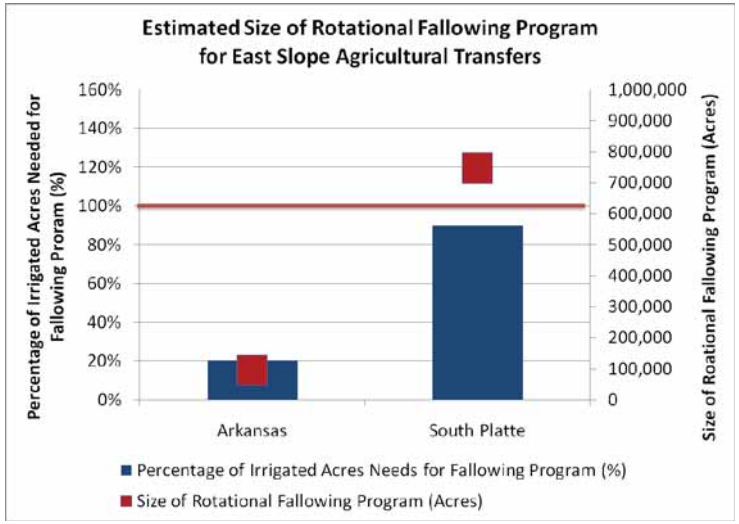
Table 1 Summary of Scenario Results (con't)

Portfolio Element	Scenario 4: High Demand/Low Supply	Scenario 5 Low Demand/High Supply
IPPs	86% Yield Arkansas Basin	86% Yield Arkansas Basin
Conservation/Reuse	Low Conservation Strategy/0% applied to the M&I gap; 1.5 Reuse Factor	Low Conservation Strategy/0% applied to the M&I gap; 1.5 Reuse Factor
New Colorado River System Assumptions	25,000 AFY to West Slope; 0 AFY to East Slope	0 AFY to West Slope; 250,000 AFY to East Slope
New Colorado River System and New Agricultural Transfer Results	25,000 AFY new Colorado River System water and 111,000 AFY new agricultural transfers for West Slope; 0 AFY new Colorado River System water and 173,000 AFY new agricultural transfers for the East Slope.	0 AFY new Colorado River System water and 53,000 AFY new agricultural transfers for West Slope; 175,000 AFY new Colorado River System water and 0 AFY new agricultural transfers for East Slope.
Ag Transfers and Urbanization – Irrigated Acres Results	10% of West Slope acres (112,000 acres), 30% of South Platte acres (285,000), 10% of Arkansas acres (34,000).	15% of West Slope acres (138,000 acres), 15% of South Platte acres (136,000), 0% of Arkansas acres.
Other Portfolio Trade-off Results	105% of South Platte acres and 30% of Arkansas acres needed for fallowing program; Decrease in South Platte flows (9% at state line).	35% of South Platte acres and 5% of Arkansas acres needed for fallowing program; Increase in South Platte flows (11% at state line); Transbasin diversion would trigger FWS consultation and environmental flow metrics indicate the full 250,000 AFY could be developed in the Blue River, Gunnison River, Yampa River, and Green River.

Table 2 Scenario 1 – Low Demands/Low Supply







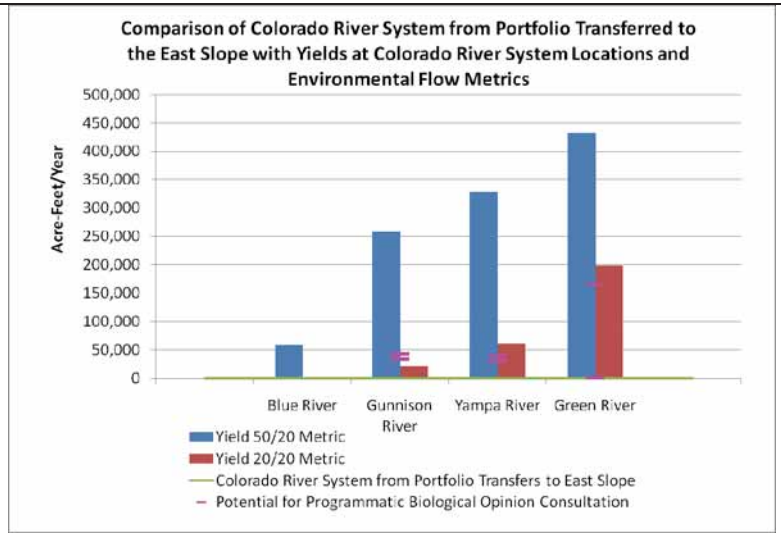
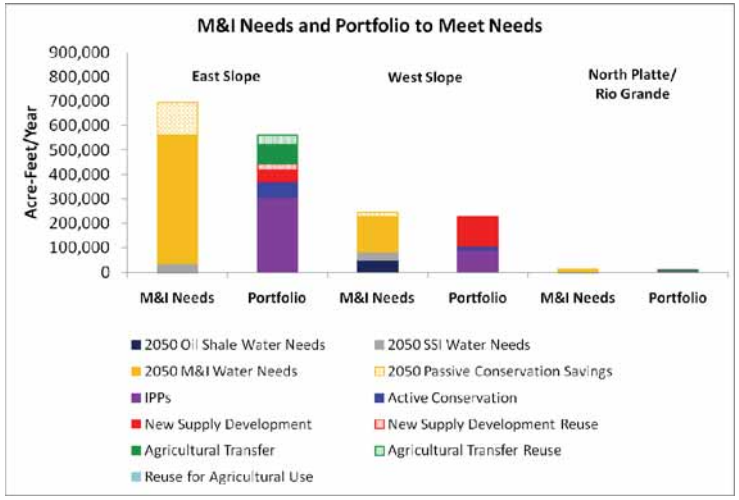
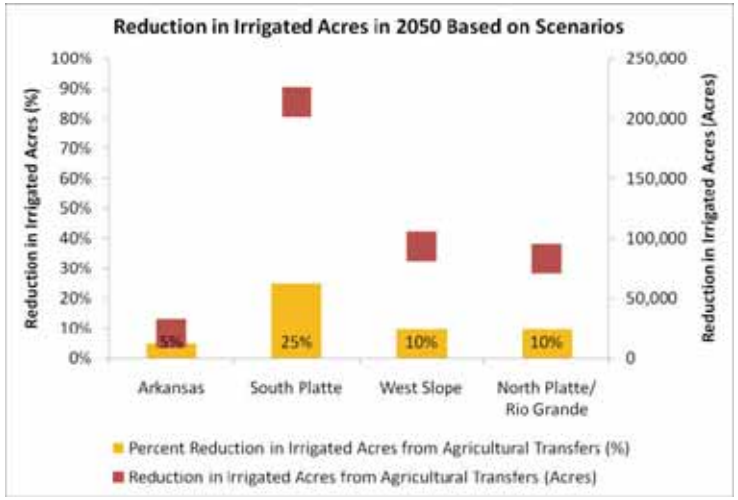
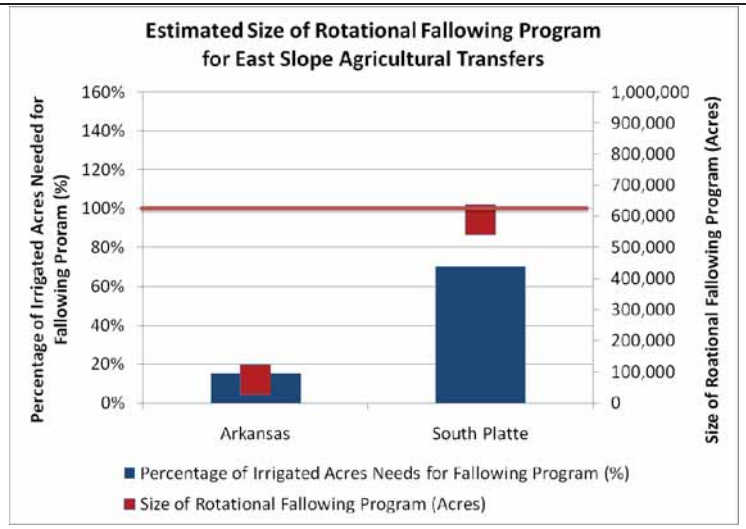


Table 3 Scenario 2 - Medium Demands/Medium Supply







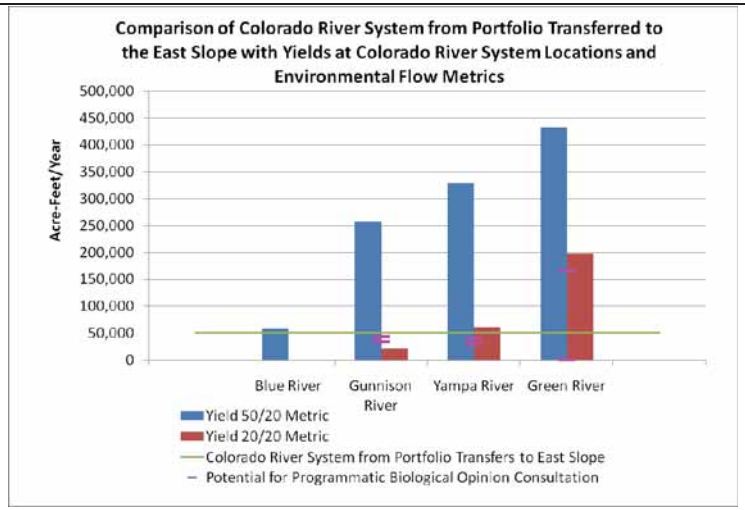
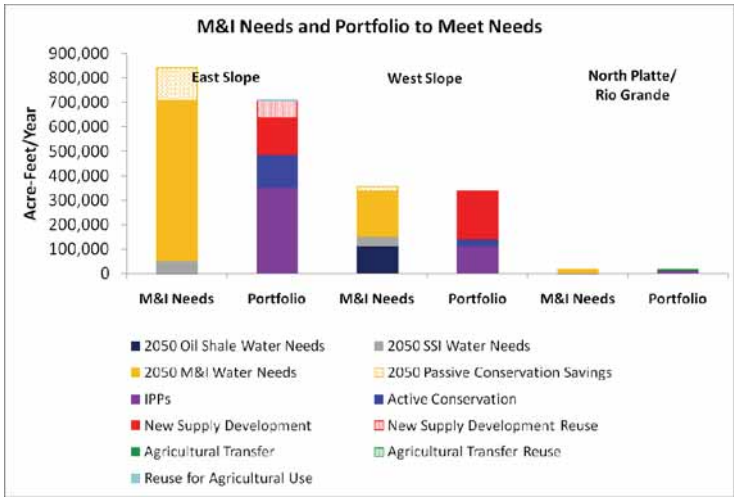
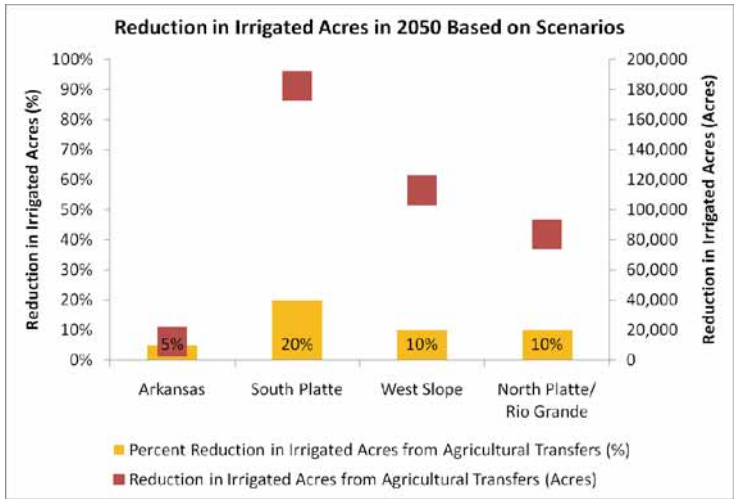
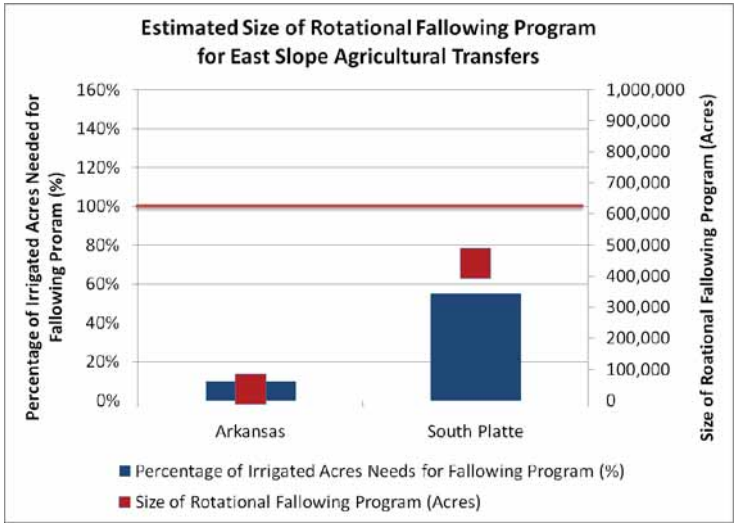


Table 4 Scenario 3: High Demands/High Supply







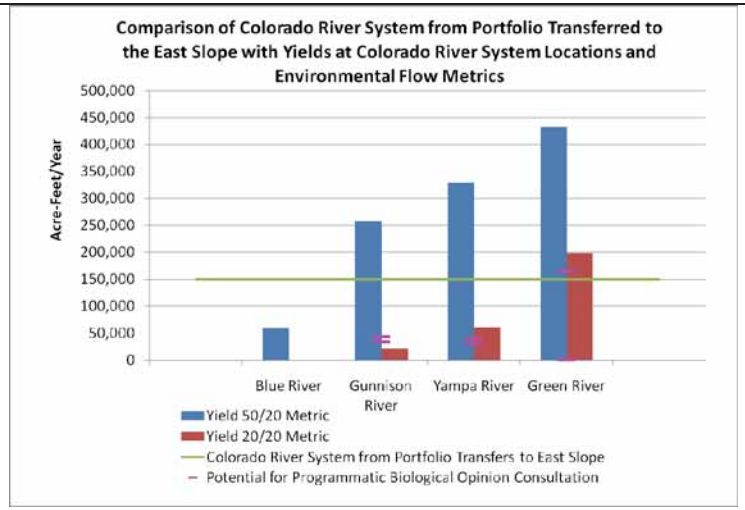
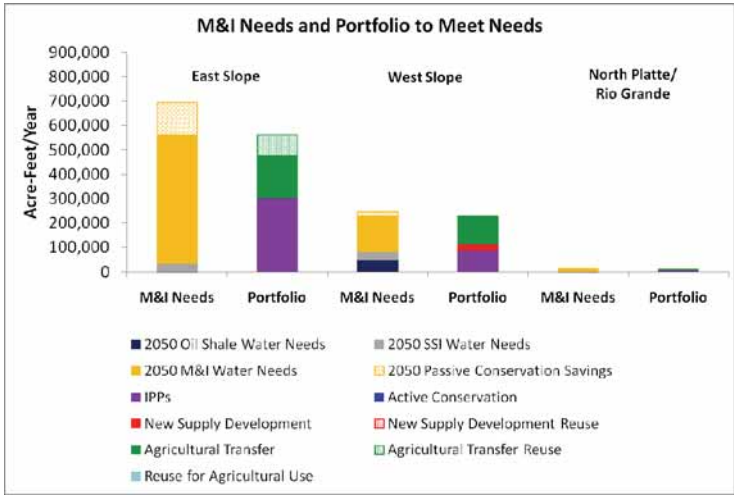
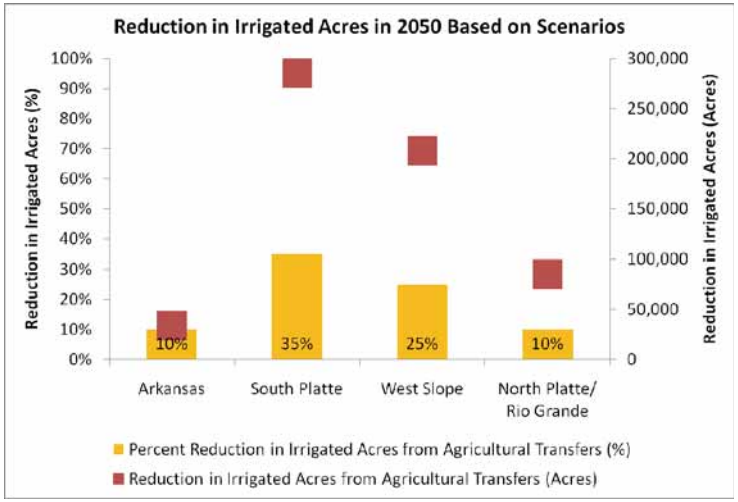
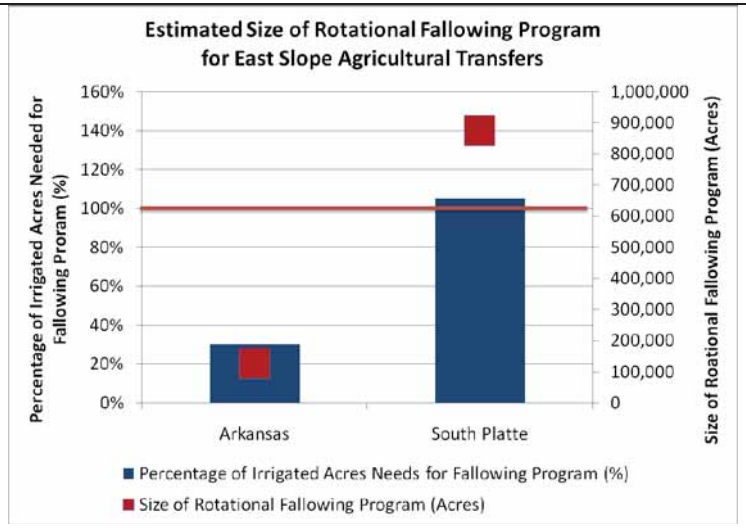


Table 5 Scenario 4: High Demands/Low Supply







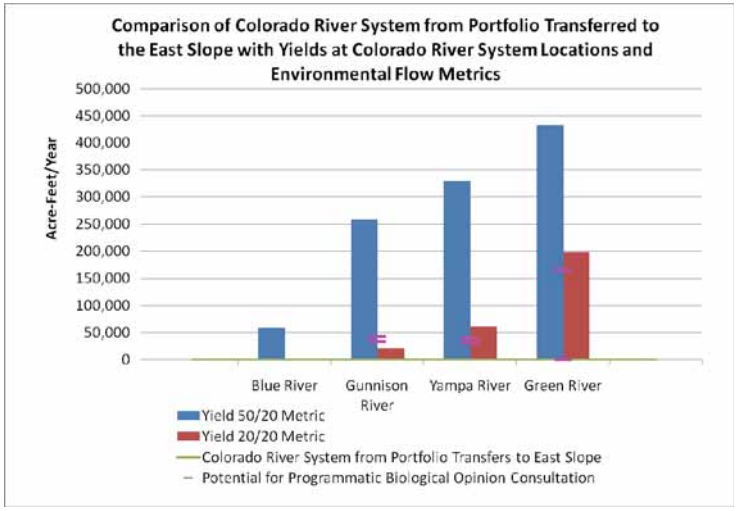
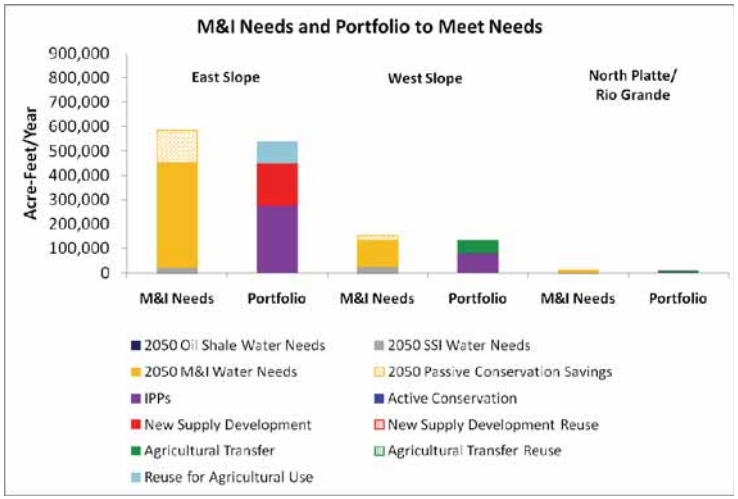
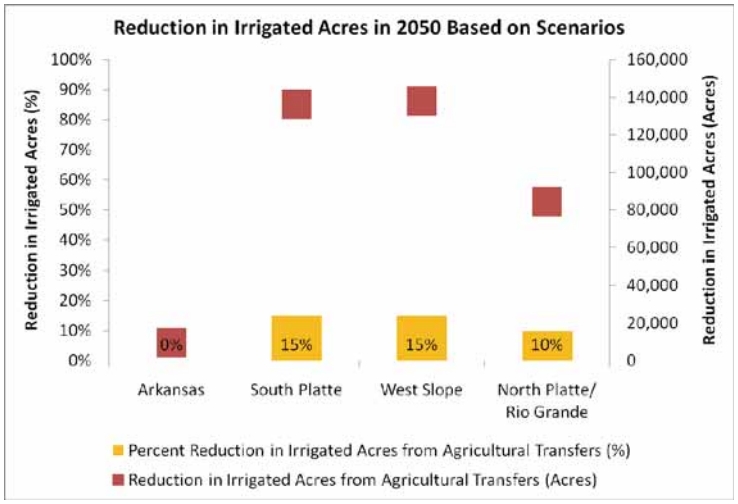
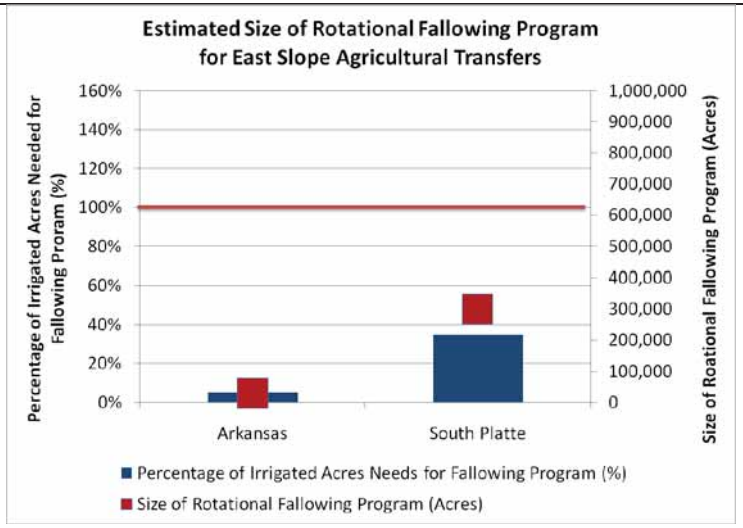
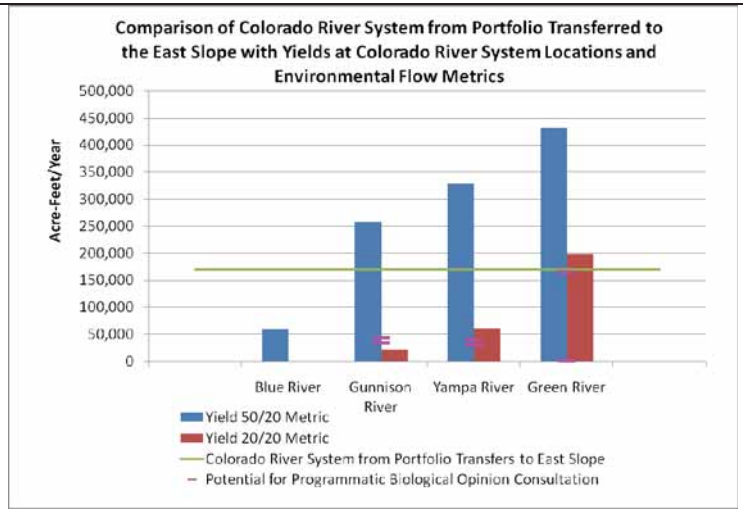


Table 5 Scenario 4: High Demands/Low Supply









Colorado BRT Portfolio Summary for the High Demand - Low Supply Scenario

1. Define demand levels in 2050

<<Check the appropriate boxes to determine your demand scenario>>

☐ Low ☐ Mid ☑ High

☑ Oil Shale ON

☑ Replace of nontrib groundwater ON in South Metro & Northern El Paso County

2. Define IPP success levels by basin and by project type

<<Change the grey percentages>>

Basin	Ag Transfer	Reuse	Existing Supplies	In-Basin Project	Transbasin	In-Basin Firming	Total	Total % Success
Arkansas	11,000	32,000	2,500	37,000	11,000	7,300	**100,000**	**91%**
% Success	90%	90%	100%	90%	90%	90%	**91,000**	
Colorado	8,000	540	28,000	15,000	0	19,000	**71,000**	**92%**
% Success	90%	90%	100%	85%	90%	85%	**65,000**	
Gunnison	550	0	1,700	15,000	0	900	**18,000**	**94%**
% Success	90%	90%	100%	90%	90%	90%	**17,000**	
Metro	33,000	21,000	86,000	39,000	18,000	1,400	**200,000**	**80%**
% Success	50%	90%	100%	50%	80%	50%	**160,000**	
North Platte	0	0	290	0	0	0	**290**	**100%**
% Success	90%	90%	100%	90%	90%	90%	**290**	
Rio Grande	0	0	4,300	0	0	4,300	**8,600**	**93%**
% Success	90%	90%	100%	90%	90%	85%	**8,000**	
South Platte	20,000	7,300	30,000	39,000	21,000	26,000	**140,000**	**69%**
% Success	50%	90%	100%	100%	80%	50%	**120,000**	
Southwest	0	0	7,300	13,000	0	0	**20,000**	**75%**
% Success	100%	100%	100%	60%	100%	100%	**15,000**	
Yampa Whit	0	0	4,900	9,000	0	0	**14,000**	**93%**
% Success	100%	100%	100%	85%	100%	100%	**13,000**	

3. Define conservation level & how much can be applied to the gap

☐ Low ☐ Mid ☑ High

What % can reliably meet new demand each year?

☐ 0% ☐ 10% ☐ 20% ☐ 30% ☐ 40% ☐ 50% ☑ 60% ☐ 70% ☐ 80% ☐ 90% ☐ 100%

If there are any variances by basin, please indicate those here: _____

4. Define amount of new supply & ag transfer water for West & East Slopes

Amount of West Slope New Supply available for the West Slope: **0 AF**

Amount of West Slope New Supply available for the East Slope: **0 AF**

The remainder will be met through agricultural transfers **(30% SP ag: 244,000 acres; 35% WS ag: 300,000 acres)**

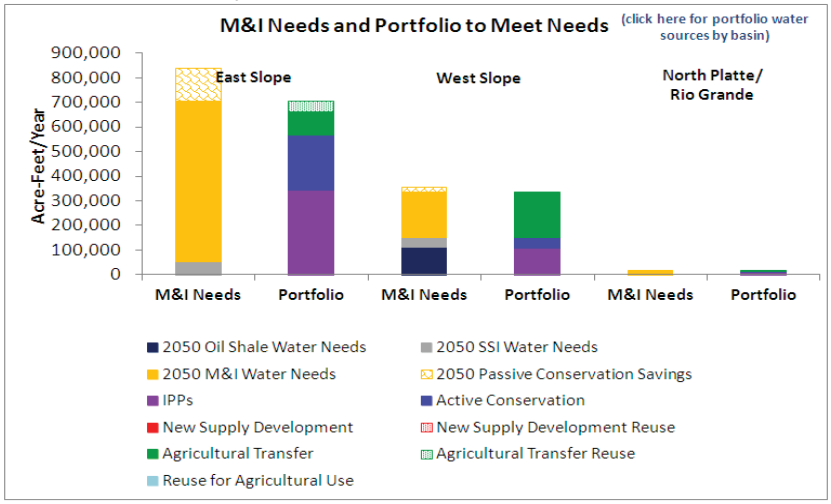
5. If desired, define percent of water that can be reused (Currently @ 30-50%)

What percent of 2050 consumable water diversions reused on East Slope?

☐ 0% ☐ 10% ☐ 20% ☐ 30% ☐ 40% ☑ 50% ☐ 60% ☐ 70% ☐ 80% ☐ 90% ☐ 100%

reuse factor of 1.5 represented by 100% of direct reuse in the tool

Portfolio & Trade-Off Summary

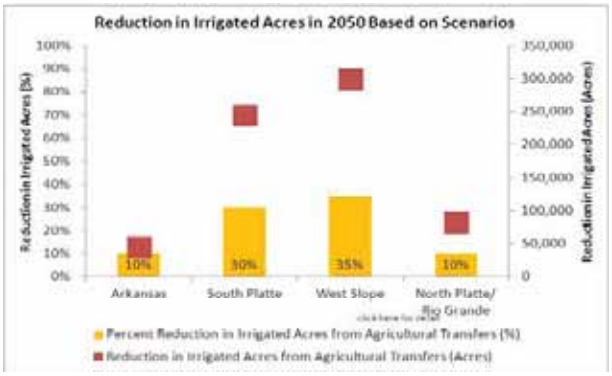


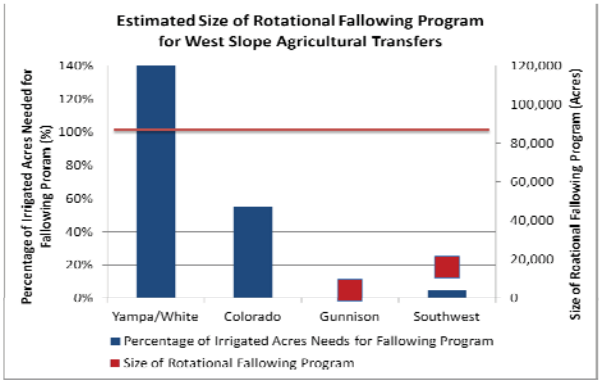
The selected portfolio represents a worste case scenario. Impacts to agriculture are severe, with more than 100% of the Yampa and White river basins irrigated agricultural needed to meet the high demands in their basin. A rotational fallowing program is not practicable on either the East or West Slopes. Agriculture and/or enviornmental flows in the South Platte are also significantly impacted.

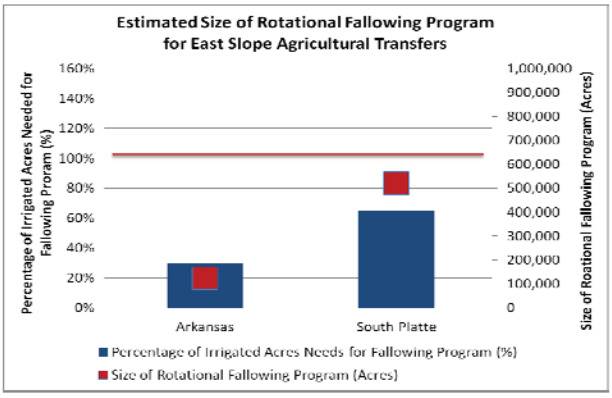
Impacts to nonconsumptive needs, especially riparian, may be significant, but the tool does not capture these.

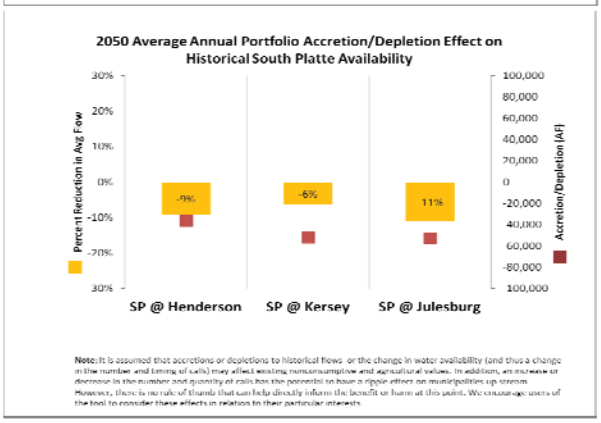
IPP success is higher for the Metro basin because it assumes the WIndy Gap and Moffat are 80% successful

Although impacts are severe, the increase of conservation lessens the impact on SP agriculture.









Colorado BRT Portfolio Summary for the High Demand - Mid Supply Scenario with 100% Conservation Demonstrated

1. Define demand levels in 2050

<<Check the appropriate boxes to determine your demand scenario>>

☐ Low ☑ Mid ☐ High

☑ Oil Shale ON

☑ Replace of nontrib groundwater ON in South Metro & Northern El Paso County

2. Define IPP success levels by basin and by project type

<<Change the grey percentages>>

Basin	Ag Transfer	Reuse	Existing Supplies	In-Basin Project	Transbasin	In-Basin Firming	Total	Total % Success
Arkansas	11,000	32,000	2,500	37,000	11,000	7,300	100,000	91%
% Success	90%	90%	100%	90%	90%	90%	91,000	
Colorado	8,000	540	28,000	15,000	0	19,000	71,000	92%
% Success	90%	90%	100%	85%	90%	85%	65,000	
Gunnison	550	0	1,700	15,000	0	900	18,000	94%
% Success	90%	90%	100%	90%	90%	90%	17,000	
Metro	33,000	21,000	86,000	39,000	18,000	1,400	200,000	80%
% Success	50%	90%	100%	50%	80%	50%	160,000	
North Platte	0	0	290	0	0	0	290	100%
% Success	90%	90%	100%	90%	90%	90%	290	
Rio Grande	0	0	4,300	0	0	4,300	8,600	93%
% Success	90%	90%	100%	90%	90%	85%	8,000	
South Platte	20,000	7,300	30,000	39,000	21,000	26,000	140,000	69%
% Success	50%	90%	100%	100%	80%	50%	120,000	
Southwest	0	0	7,300	13,000	0	0	20,000	75%
% Success	100%	100%	100%	60%	100%	100%	15,000	
Yampa Whit	0	0	4,900	9,000	0	0	14,000	93%
% Success	100%	100%	100%	85%	100%	100%	13,000	

3. Define conservation level & how much can be applied to the gap

☐ Low ☐ Mid ☑ High

What % can reliably meet new demand each year?

☐ 0% ☐ 10% ☐ 20% ☐ 30% ☐ 40% ☐ 50% ☐ 60% ☐ 70% ☐ 80% ☐ 90% ☑ 100%

If there are any variances by basin, please indicate those here: _____

4. Define amount of new supply & ag transfer water for West & East Slopes

Amount of West Slope New Supply available for the West Slope: **150,000 AF**

Amount of West Slope New Supply available for the East Slope: **0**

The remainder will be met through agricultural transfers **(20% SP ag: 179,000 acres; 10% WS ag: 82,000 acres)**

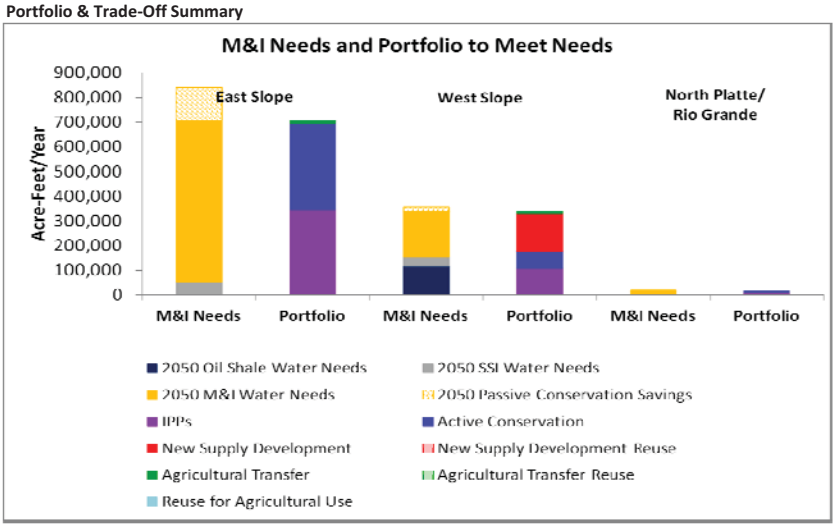
5. If desired, define percent of water that can be reused (Currently @ 30-50%)

What percent of 2050 consumable water diversions reused on East Slope?

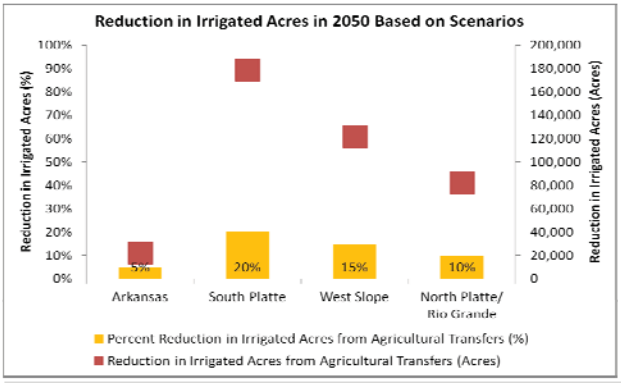
☐ 0% ☐ 10% ☐ 20% ☐ 30% ☐ 40% ☑ 50% ☐ 60% ☐ 70% ☐ 80% ☐ 90% ☐ 100%

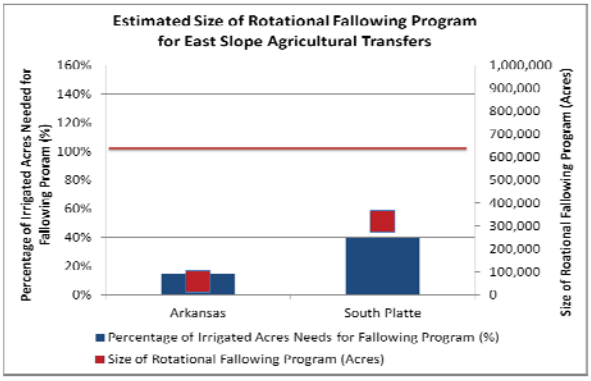
reuse factor of 1.5 represented by 100% of direct reuse in the tool

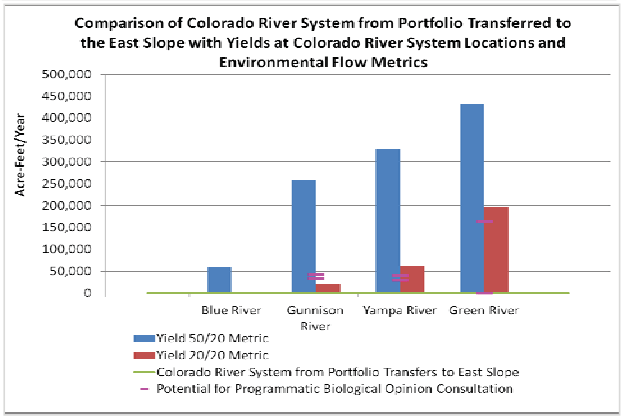
Portfolio & Trade-Off Summary

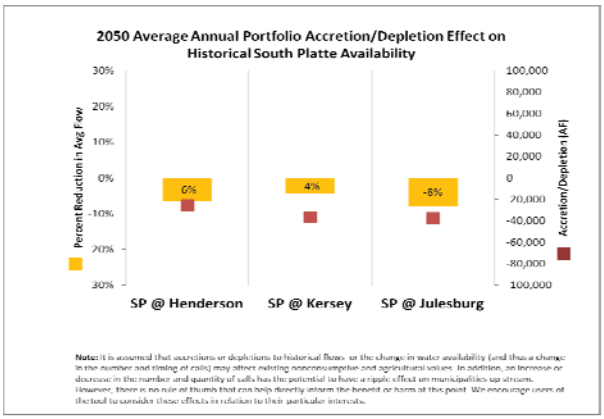


The selected portfolio demonstrates the impact if 100% conservation could be achieved. While the roundtable recognizes that this is not feasible, the results are illustrative on the postivie impact conservation could have. The portfolio assumes a that there is only additional water available for West Slope uses, and no additional transbasin water. West Slope nonconsumptive needs are met with less risk, however East Slope agriculture, and perhaps West Slope agriculture as a result, could be signficantly affected.









Colorado BRT Portfolio Summary for the Mid Demand - High Supply Scenario

1. Define demand levels in 2050

<<Check the appropriate boxes to determine your demand scenario>>

☐ Low ☑ Mid ☐ High

☑ Oil Shale ON

☑ Replace of nontrib groundwater ON in South Metro & Northern El Paso County

2. Define IPP success levels by basin and by project type

<<Change the grey percentages>>

Basin	Ag Transfer	Reuse	Existing Supplies	In-Basin Project	Transbasin	In-Basin Firming	Total	Total % Success
Arkansas	11,000	32,000	2,500	37,000	11,000	7,300	100,000	91%
% Success	90%	90%	100%	90%	90%	90%	91,000	
Colorado	8,000	540	28,000	15,000	0	19,000	71,000	92%
% Success	90%	90%	100%	85%	90%	85%	65,000	
Gunnison	550	0	1,700	15,000	0	900	18,000	94%
% Success	90%	90%	100%	90%	90%	90%	17,000	
Metro	33,000	21,000	86,000	39,000	18,000	1,400	200,000	80%
% Success	50%	90%	100%	50%	80%	50%	160,000	
North Platte	0	0	290	0	0	0	290	100%
% Success	90%	90%	100%	90%	90%	90%	290	
Rio Grande	0	0	4,300	0	0	4,300	8,600	93%
% Success	90%	90%	100%	90%	90%	85%	8,000	
South Platte	20,000	7,300	30,000	39,000	21,000	26,000	140,000	69%
% Success	50%	90%	100%	100%	80%	50%	120,000	
Southwest	0	0	7,300	13,000	0	0	20,000	75%
% Success	100%	100%	100%	60%	100%	100%	15,000	
Yampa Whit	0	0	4,900	9,000	0	0	14,000	93%
% Success	100%	100%	100%	85%	100%	100%	13,000	

3. Define conservation level & how much can be applied to the gap

☐ Low ☐ Mid ☑ High

What % can reliably meet new demand each year?

☐ 0% ☐ 10% ☐ 20% ☐ 30% ☐ 40% ☐ 50% ☑ 60% ☐ 70% ☐ 80% ☐ 90% ☐ 100%

If there are any variances by basin, please indicate those here: _____

4. Define amount of new supply & ag transfer water for West & East Slopes

Amount of West Slope New Supply available for the West Slope: **150,000 AF**

Amount of West Slope New Supply available for the East Slope: **168,000 AF (only 40,000 AF needed with high conservation)**

The remainder will be met through agricultural transfers **(20% SP ag: 147,000 acres; 10% WS ag: 82,000 acres)**

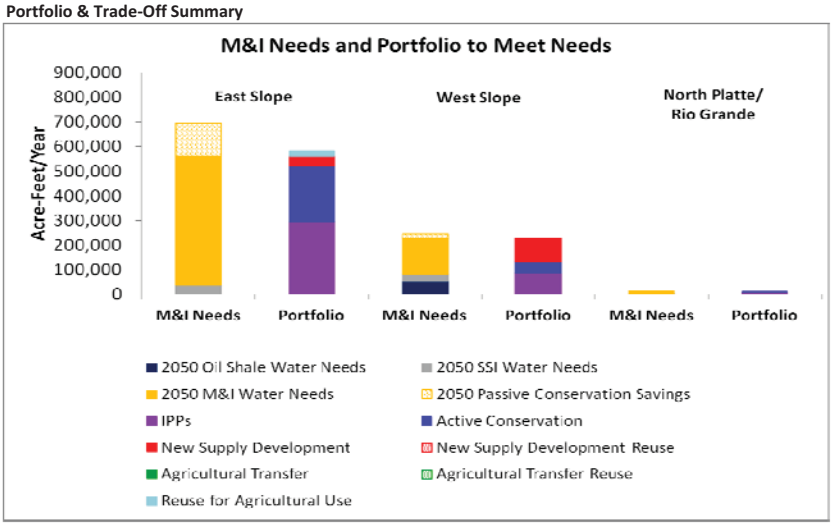
5. If desired, define percent of water that can be reused (Currently @ 30-50%)

What percent of 2050 consumable water diversions reused on East Slope?

☐ 0% ☐ 10% ☐ 20% ☐ 30% ☐ 40% ☑ 50% ☐ 60% ☐ 70% ☐ 80% ☐ 90% ☐ 100%

reuse factor of 1.5 represented by 100% of direct reuse in the tool

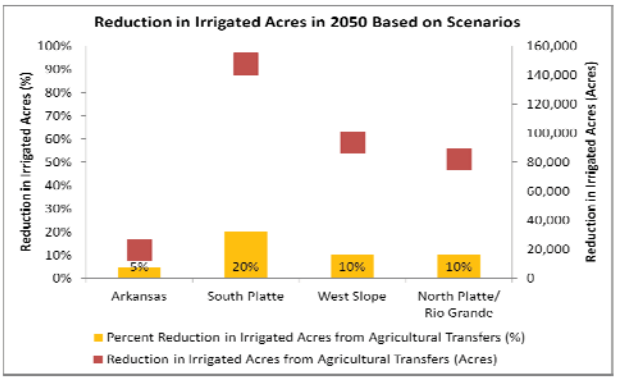
Portfolio & Trade-Off Summary

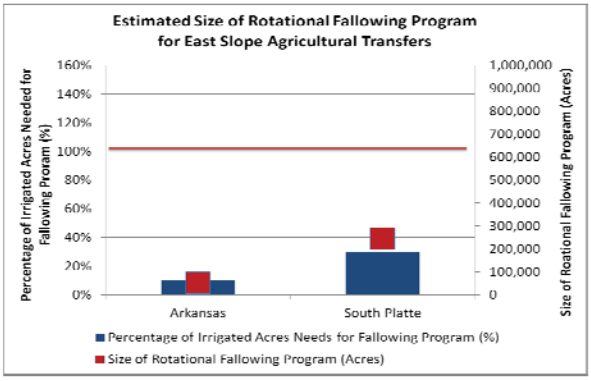


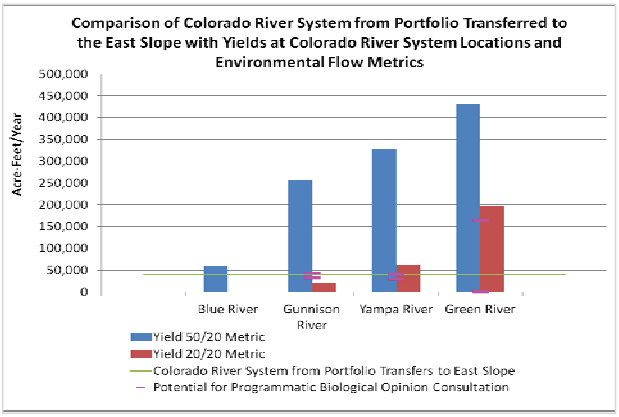
The selected portfolio assumes a high supply scenario. While the level of transbasin diversions was allowed to go up to 168,000 AF, with high conservation only about 40,000 AF was needed, and some of the reuse water could be used to meet some of the agricultural shortages. The level of transbasin diversions is within the PBO ranges, however such use does not also account for in basin use and the combined total would likely trigger consultation with the Fish and WIldlife Service on the Gunnison or Yampa. There may be additional environmental concerns for any given project.

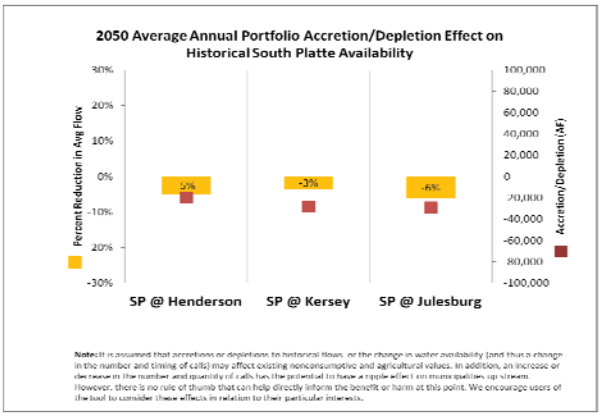
The roundtable indicated that they would consider additional trans basin waters if agricultural loss still allowed for west slope agriculture to be viable, however IPPs and urbanization still dry up a significant number of acres.

IPP success is higher for the Metro basin because it assumes 80% success for WIndy Gap and Moffat.









Colorado BRT Portfolio Summary for the Mid Demand - Mid Supply Scenario

1. Define demand levels in 2050

<<Check the appropriate boxes to determine your demand scenario>>

☐ Low ☑ Mid ☐ High

☑ Oil Shale ON

☑ Replace of nontrib groundwater ON in South Metro & Northern El Paso County

2. Define IPP success levels by basin and by project type

<<Change the grey percentages>>

Basin	Ag Transfer	Reuse	Existing Supplies	In-Basin Project	Transbasin	In-Basin Firming	Total	Total % Success
Arkansas	11,000	32,000	2,500	37,000	11,000	7,300	**100,000**	**91%**
% Success	90%	90%	100%	90%	90%	90%	**91,000**	
Colorado	8,000	540	28,000	15,000	0	19,000	**71,000**	**92%**
% Success	90%	90%	100%	85%	90%	85%	**65,000**	
Gunnison	550	0	1,700	15,000	0	900	**18,000**	**94%**
% Success	90%	90%	100%	90%	90%	90%	**17,000**	
Metro	33,000	21,000	86,000	39,000	18,000	1,400	**200,000**	**80%**
% Success	50%	90%	100%	50%	80%	50%	**160,000**	
North Platte	0	0	290	0	0	0	**290**	**100%**
% Success	90%	90%	100%	90%	90%	90%	**290**	
Rio Grande	0	0	4,300	0	0	4,300	**8,600**	**93%**
% Success	90%	90%	100%	90%	90%	85%	**8,000**	
South Platte	20,000	7,300	30,000	39,000	21,000	26,000	**140,000**	**69%**
% Success	50%	90%	100%	100%	80%	50%	**120,000**	
Southwest	0	0	7,300	13,000	0	0	**20,000**	**75%**
% Success	100%	100%	100%	60%	100%	100%	**15,000**	
Yampa Whit	0	0	4,900	9,000	0	0	**14,000**	**93%**
% Success	100%	100%	100%	85%	100%	100%	**13,000**	

3. Define conservation level & how much can be applied to the gap

☐ Low ☐ Mid ☑ High

What % can reliably meet new demand each year?

☐ 0% ☐ 10% ☐ 20% ☐ 30% ☐ 40% ☐ 50% ☑ 60% ☐ 70% ☐ 80% ☐ 90% ☐ 100%

If there are any variances by basin, please indicate those here: _____

4. Define amount of new supply & ag transfer water for West & East Slopes

Amount of West Slope New Supply available for the West Slope: **150,000 AF**

Amount of West Slope New Supply available for the East Slope: **0**

The remainder will be met through agricultural transfers **(20% SP ag: 172,000 acres; 10% WS ag: 82,000 acres)**

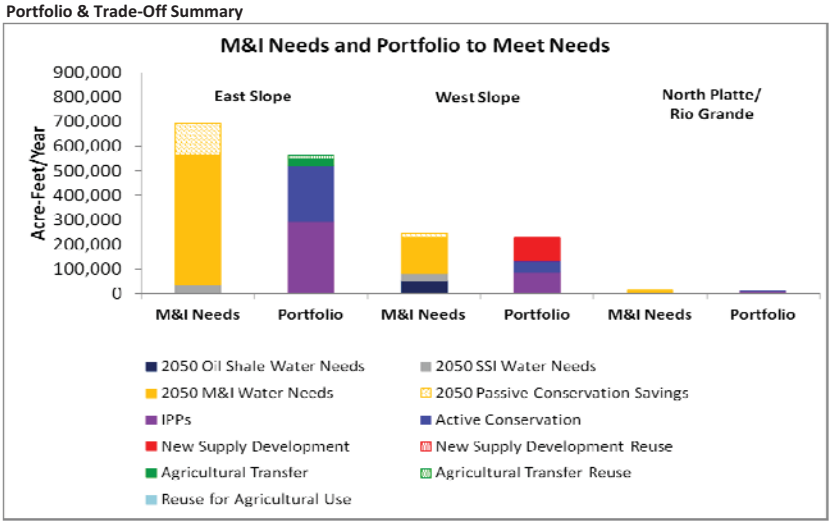
5. If desired, define percent of water that can be reused (Currently @ 30-50%)

What percent of 2050 consumable water diversions reused on East Slope?

☐ 0% ☐ 10% ☐ 20% ☐ 30% ☐ 40% ☑ 50% ☐ 60% ☐ 70% ☐ 80% ☐ 90% ☐ 100%

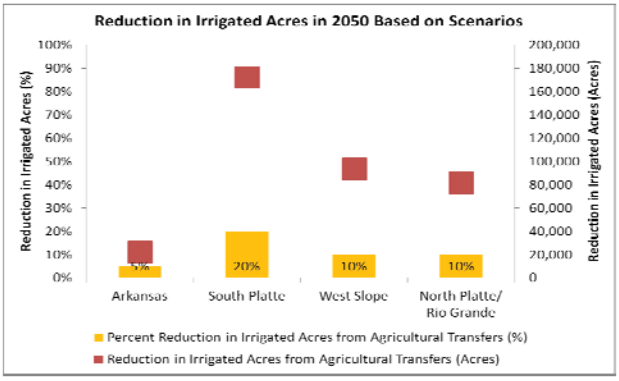
reuse factor of 1.5 represented by 100% of direct reuse in the tool

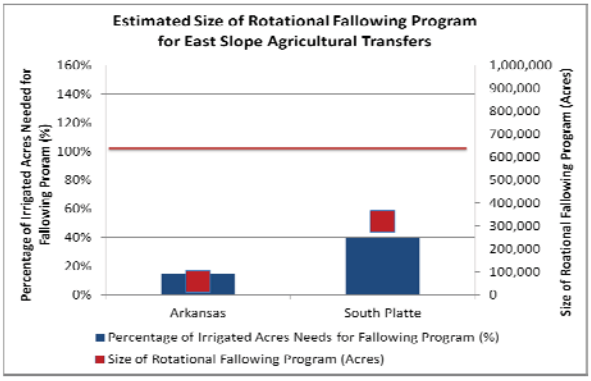
Portfolio & Trade-Off Summary

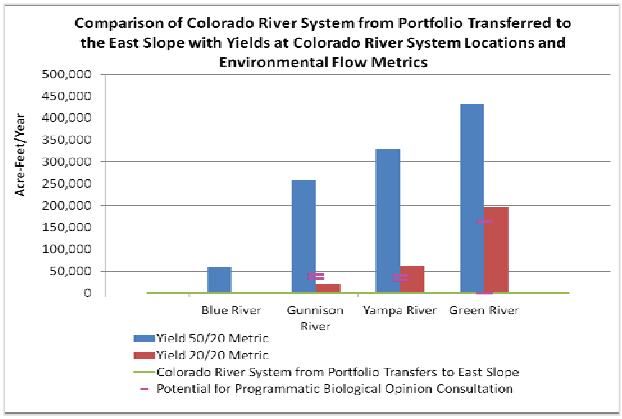


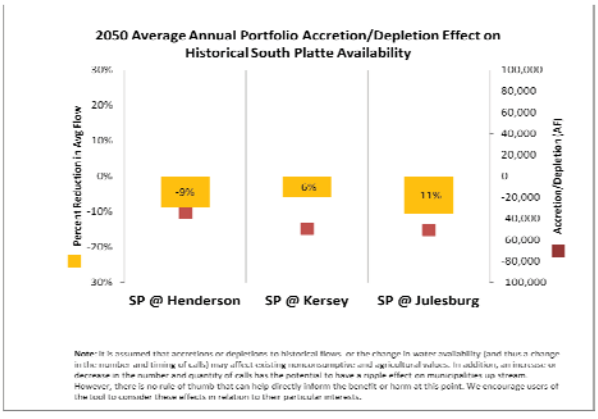
The selected portfolio assumes a that there is only additional water available for West Slope uses, and no additional transbasin water. West Slope nonconsumptive needs are met with less risk, however East Slope agriculture, and perhaps West Slope agriculture as a result, could be signficantly affected.

Furthermore, impacts to the Southe Platte River are significant.









Memorandum

To: *Todd Doherty, CWCB*

From: *Nicole Rowan, CDM Smith*
Susan Morea, CDM Smith

Date: *February 9, 2012*

Subject: *Portfolio and Trade-off Tool Analysis for Gunnison Basin*

During the Gunnison Basin Roundtable's December 5, 2011 Meeting, three potential portfolios were discussed. This memo describes the assumptions and results for each of the three portfolios. The assumptions and results presented below were discussed and refined during the December 16, 2011 conference call with Gunnison Basin Roundtable members. On January 9, 2012, roundtable representatives reviewed the December 21, 2011 memo describing all of the scenarios and portfolios developed by the roundtable to date. The purpose of this memo is to describe the scenarios and portfolios that were at the Gunnison Basin Roundtables February 6, 2012 meeting and the decision of what portfolios to include in the discussion at the March 1, 2012 Basin Roundtable Summit.

Summary of Scenarios

At the February 6, 2012 Basin Roundtable Meeting, the Gunnison Basin Roundtable reviewed the 10 portfolios developed to date and decided that the following portfolios should be included in the Basin Roundtable Summit: 3, 4b, 5 and 6b. All ten portfolios are included in this memorandum. In addition to the four scenarios above, the roundtable recommends an addition to the portfolio tool that shows flow changes at the state line and what the ten year running average would be for each scenario for risk assessment reasons. Also attached to this memorandum is a paper developed by Gunnison Basin Roundtable member Bill Trampe on risk management.

Following are the scenarios discussed at the December 5, 2011 meeting:

- Scenario 1: Medium Demands/High Colorado River System Supply –Colorado River System could be utilized by West and East slope.
- Scenario 2: Medium Demands/West Slope Colorado River System Supply – Colorado River System could be utilized by West Slope only.

- Scenario 3: High Demands/Low Supply – represents a worst case scenario where no Colorado River System supplies are available for the West or East Slope.

A summary of west slope medium and high M&I demands are shown in Table 1 below. These demands include oil shale development (oil shale demands for medium scenario are ~50,000 AFY and for high scenario ~113,000 AFY). For all scenarios and portfolios developed to date, the Gunnison Basin Roundtable has included future oil shale demands. These demands also include passive conservation.

Table 1 2050 New M&I Demands for the West slope

Basin	M&I Demands – Medium (Acre-Feet/Year)	M&I Demands – High (Acre-Feet/Year)
Colorado	87,000	120,000
Gunnison	19,000	22,000
Southwest	24,000	30,000
Yampa/White	93,000	170,000
TOTAL	**223,000**	**342,000**

The following additional scenarios were developed during the December 16, 2011 conference call:

- Scenarios 4a and 4b: low demands with 0 AFY and 80,000 AFY Colorado River System development for the East Slope.

- Scenario 5: climate change scenario with medium demands and 80,000 AFY Colorado River System development for the East Slope.

- Scenario 6a, 6b, and 6c: medium demands and high conservation strategy with 25%, 36% and 50% of active conservation savings applied to the M&I Gap.

- Scenario: examines high demands and Flaming Gorge potential development of 165,000 Colorado River System.

Assumptions

The assumptions below will be refined during the December 16, 2011 conference call. The following portfolio elements were held constant for the scenarios described above:

- Oil shale demands and replacement of Front Range non-tributary groundwater (~34,000 AFY) were turned "on" in the tool.

- Gunnison Basin Identified Projects and Process (IPPs) will deliver 91 percent of their potential yield in the future. The specific IPPs for the Gunnison Basin the portfolio tool are presented in Table 2 below. For Colorado's other basins, the IPP success rate was based on

recommendations for each roundtable and to date the Gunnison Basin Roundtable has not changed another roundtables IPP success rate.

Table 2 Specific IPPs Included in Portfolio and Trade-off Tool for the Gunnison Basin

Index	Project	Yield (Acre-Feet/Year)	Yield Success Rate	Yield Success (Acre-Feet/Year)
1	Upper Gunnison River WCD/Hinsdale County Commissioners - Lake San Cristobal water development	950	90%	855
2	Tri-County WCD - Project 7	12,000	90%	10,800
3	Upper Gunnison River WCD - Augmentation plan for non-agricultural purposes using Aspinall Unit	500	90%	450
4	Augmentation storage for Mt. Crested Butte (400 AF)	400	90%	9360
5	Other Gunnison Ag Transfer Projects -Mesa County	430	90%	387
6	Other Gunnison Growth into Existing Water Rights Projects -Mesa County	1,300	100%	1,300
	Total	15,580	91%	14,152

Results

Results are presented in Table 3 through Table 13 below. Table 3 describes each scenario and its results. Tables 4 through 13 present the information graphically. A key output examined by other roundtables is the amount of irrigated acres potentially lost in the South Platte basin. Approximately 20 percent of the South Platte's irrigated acres will be lost to IPPs and urbanization onto irrigated lands. Therefore, 20 percent of irrigated acre dry-up in the South Platte Basin is considered low in the scenarios presented below.

In the scenarios presented below, it is assumed that a varying percentage of conservation savings are applied to the gap. The Metro Basin Roundtable is currently examining what levels of conservation savings could be available for new growth for the Denver Metro area. When this information becomes available, it may need to be considered by the Gunnison Basin Roundtable. The draft information from this analysis was presented at the November 2011 IBCC meeting and preliminary results indicate a small amount of conserved water may be available to meet the gap. The Metro Basin has developed four preliminary portfolios and three of the four portfolios assigned no conservation savings to the gap. Their fourth preliminary portfolio, which focuses on high future demands, applied 36 percent of conservation savings to the gap. The Metro Basin has assumed that an achievable level of conservation savings are a decrease from their current demands of 155 gallons per capita per day to 129 gallons per capita per day. In their analysis, they have assumed that savings achieved since the 2002 drought will remain permanent and that passive conservation savings will be applied to the gap (75,000 acre-feet/year for Metro Basin). Because the Metro's fourth portfolio is the high demand portfolio more savings are applied to the gap because the 129 gallons per capita per day demand is applied to a higher population.

Table 3 Summary of Scenario Results

Portfolio Element	Scenario 1: Medium Demands/High Colorado River System Supply	Scenario 2: Medium Demands/West Slope Colorado River System Supply	Scenario 3: High Demands/Low Supply
IPPs	91% Yield Gunnison Basin	91% Yield Gunnison Basin	91% Yield Gunnison Basin
Conservation/Reuse	Medium Conservation Strategy/ 50% applied to the M&I gap; 1.5 Reuse Factor	Medium Conservation Strategy/ 50% applied to the M&I gap; 1.5 Reuse Factor	Medium Conservation Strategy/ 50% applied to the M&I gap. 1.5 Reuse Factor
New Colorado River System Assumptions	140,000 AFY to West Slope; 100,000 AFY to East Slope	140,000 AFY to West Slope; 0 AFY to East Slope	0 AFY to West Slope; 0 AFY to East Slope
New Colorado River System and New Agricultural Transfer Results	110,000 AFY new Colorado River System water and no new agricultural transfers for West Slope; 100,000 AFY new Colorado River System water and no new agricultural transfers for East Slope. For West Slope, IPP and conservation levels are high enough that not all designated supplies are needed.	110,000 AFY new Colorado River System water and no new agricultural transfers for West Slope; 0 AFY new Colorado River System water and 81,000 AFY new agricultural transfers for East Slope. For West Slope, IPP and conservation levels are high enough that not all designated supplies are needed.	0 AFY new Colorado River System water and 199,000 AFY new agricultural transfers for West Slope; 0 AFY new Colorado River System water and 144,000 AFY new agricultural transfers for East Slope. East Slope agricultural transfers are reduced due to reuse of consumptive use transfer.
Ag Transfers and Urbanization – Irrigated Acres Results	10% of West Slope acres (94,000 acres), 20% of South Platte acres (154,000)	10% of West Slope acres (94,000 acres), 25% of South Platte acres (218,000)	35% of West Slope acres (316,000%); 35% of East Slope acres (292,000)
Other Portfolio Trade-off Results	40% of South Platte acres and 15% of Arkansas acres needed for fallowing program; Slight decrease in South Platte flows (2% at state line); Transbasin diversion would trigger FWS consultation and environmental flow metrics indicate the full 100,000 AFY could be developed in the Gunnison River, Yampa River, and Green River.	75% of South Platte acres and 30% of Arkansas acres needed for fallowing program; Decrease in South Platte flows (9% at state line)	100% of South Platte acres and 55% of Arkansas acres needed for fallowing program; Decrease in South Platte flows (10% at state line)

Table 3 Summary of Scenario Results (con't)

Portfolio Element	Scenario 4a: Low Demands/No East Slope Colorado River System Supply	Scenario 4b: Low Demands/80,000 AFY East Slope Colorado River System Supply	Scenario 5: Climate Change Scenario (Medium Demands with 1.2 Factor Increase)
IPPs	91% Yield Gunnison Basin	91% Yield Gunnison Basin	91% Yield Gunnison Basin
Conservation/Reuse	Medium Conservation Strategy/ 50% applied to the M&I gap; 1.5 Reuse Factor	Medium Conservation Strategy/ 50% applied to the M&I gap; 1.5 Reuse Factor	Medium Conservation Strategy/ 50% applied to the M&I gap. 1.5 Reuse Factor
New Colorado River System Assumptions	140,000 AFY to West Slope; No new supplies to the East Slope	140,000 AFY to West Slope; 80,000 AFY to East Slope	140,000 AFY to West Slope; 80,000 AFY to East Slope
New Colorado River System and New Agricultural Transfer Results	23,000 AFY new Colorado River System water and no new agricultural transfers for West Slope; no new Colorado River System water and 48,000 AFY new agricultural transfers for East Slope. For West Slope, IPP and conservation levels are high enough that not all designated supplies are needed.	23,000 AFY new Colorado River System water and no new agricultural transfers for West Slope; 80,000 AFY new Colorado River System water and 0 AFY new agricultural transfers for East Slope. For West Slope, IPP and conservation levels are high enough that not all designated supplies are needed.	140,000 AFY new Colorado River System water and 16,000 AFY new agricultural transfers for West Slope; 80,000 AFY new Colorado River System water and 89,000 AFY new agricultural transfers for East Slope.
Ag Transfers and Urbanization – Irrigated Acres Results	10% of West Slope acres (84,000 acres), 20% of South Platte acres (181,000)	10% of West Slope acres (84,000 acres), 15% of South Platte acres (136,000)	10% of West Slope acres (110,000%); 25% of East Slope acres (223,000)
Other Portfolio Trade-off Results	60% of South Platte acres and 20% of Arkansas acres needed for fallowing program; Decrease in South Platte flows (9% at state line).	35% of South Platte acres and 15% of Arkansas acres needed for fallowing program; Very slight decrease in South Platte flows (1% at state line). Transbasin diversion would trigger FWS consultation and environmental flow metrics indicate the full 80,000 AFY could be developed in the Gunnison River, Yampa River, and Green River.	75% of South Platte acres and 35% of Arkansas acres needed for fallowing program; Decrease in South Platte flows (7% at state line). Transbasin diversion would trigger FWS consultation and environmental flow metrics indicate the full 80,000 AFY could be developed in the Gunnison River, Yampa River, and Green River.

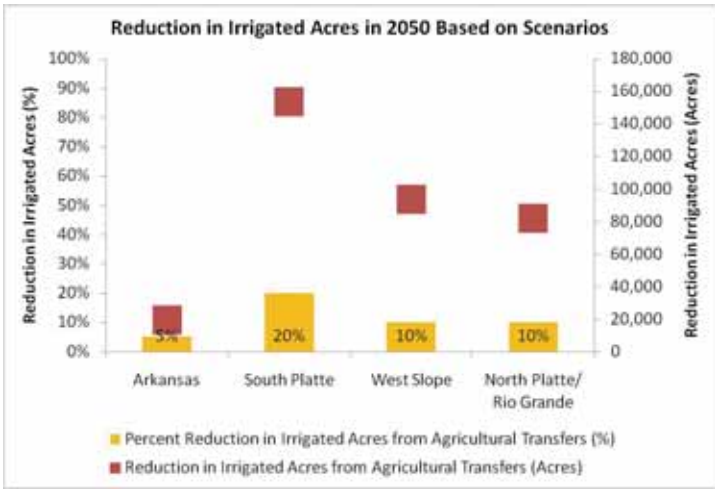
Table 3 Summary of Scenario Results (con't)

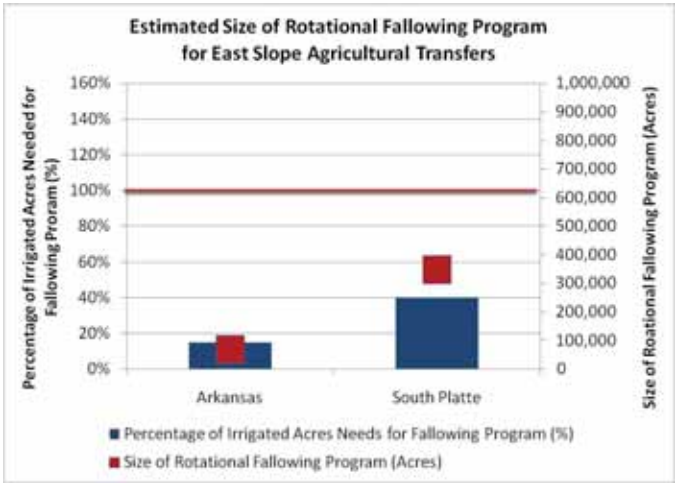
Portfolio Element	Scenario 6a: Medium Demands/High Conservation Strategy (25% applied to Gap)	Scenario 6b: Medium Demands/High Conservation Strategy (36% applied to Gap)	Scenario 6c: Medium Demands/High Conservation Strategy (50% applied to Gap)
IPPs	91% Yield Gunnison Basin	91% Yield Gunnison Basin	91% Yield Gunnison Basin
Conservation/Reuse	High Conservation Strategy/ 25% applied to the M&I gap; 1.5 Reuse Factor	High Conservation Strategy/ 36% applied to the M&I gap; 1.5 Reuse Factor	High Conservation Strategy/ 50% applied to the M&I gap. 1.5 Reuse Factor
New Colorado River System Assumptions	140,000 AFY to West Slope; 100,000 AFY to the East Slope	140,000 AFY to West Slope; 100,000 AFY to the East Slope	140,000 AFY to West Slope; 100,000 AFY to the East Slope
New Colorado River System and New Agricultural Transfer Results	119,000 AFY new Colorado River System water and no new agricultural transfers for West Slope; 100,000 AFY new Colorado River System water and 3,000 AFY new agricultural transfers for East Slope. For West Slope, IPP and conservation levels are high enough that not all designated supplies are needed.	111,000 AFY new Colorado River System water and no new agricultural transfers for West Slope; 100,000 AFY new Colorado River System water and no new agricultural transfers for East Slope. For West Slope, IPP and conservation levels are high enough that not all designated supplies are needed.	99,000 AFY new Colorado River System water and no new agricultural transfers for West Slope; 66,000 AFY new Colorado River System water and no new agricultural transfers for East Slope. For West Slope and East Slope, IPP and conservation levels are high enough that not all designated supplies are needed.
Ag Transfers and Urbanization – Irrigated Acres Results	10% of West Slope acres (94,000 acres), 20% of South Platte acres (159,000)	10% of West Slope acres (94,000 acres), 20% of South Platte acres (154,000)	10% of West Slope acres (110,000%); 20% of East Slope acres (154,000)
Other Portfolio Trade-off Results	45% of South Platte acres and 15% of Arkansas acres needed for fallowing program; Decrease in South Platte flows (12% at state line). Transbasin diversion would trigger FWS consultation and environmental flow metrics indicate the full 100,000 AFY could be developed in the Gunnison River, Yampa River, and Green River.	40% of South Platte acres and 15% of Arkansas acres needed for fallowing program; Decrease in South Platte flows (6% at state line). Transbasin diversion would trigger FWS consultation and environmental flow metrics indicate the full 80,000 AFY could be developed in the Gunnison River, Yampa River, and Green River.	40% of South Platte acres and 15% of Arkansas acres needed for fallowing program; Decrease in South Platte flows (5% at state line). Transbasin diversion would trigger FWS consultation and environmental flow metrics indicate the full 66,000 AFY could be developed in the Gunnison River, Yampa River, and Green River.

Table 3 Summary of Scenario Results (con't)

Portfolio Element	Scenario 7: High Demands/High Colorado River Development
IPPs	91% Yield Gunnison Basin
Conservation/Reuse	Medium Conservation Strategy/35% applied to the M&I gap; 1.5 Reuse Factor
New Colorado River System Assumptions	210,000 AFY to West Slope; 165,000 AFY to the East Slope
New Colorado River System and New Agricultural Transfer Results	208,000 AFY new Colorado River System water and no new agricultural transfers for West Slope; 165,000 AFY new Colorado River System water and 6,000 AFY new agricultural transfers for East Slope. For West Slope, IPP and conservation levels are high enough that not all designated supplies are needed.
Ag Transfers and Urbanization – Irrigated Acres Results	10% of West Slope acres (112,000 acres), 20% of South Platte acres (187,000)
Other Portfolio Trade-off Results	55% of South Platte acres and 25% of Arkansas acres needed for fallowing program; Decrease in South Platte flows (5% at state line). Transbasin diversion would trigger FWS consultation and environmental flow metrics indicate the full 165,000 AFY could be developed in the Gunnison River, Yampa River, and Green River.

Table 4 Graphically Summary of Scenario 1: Medium Demands/High Colorado River System Supply





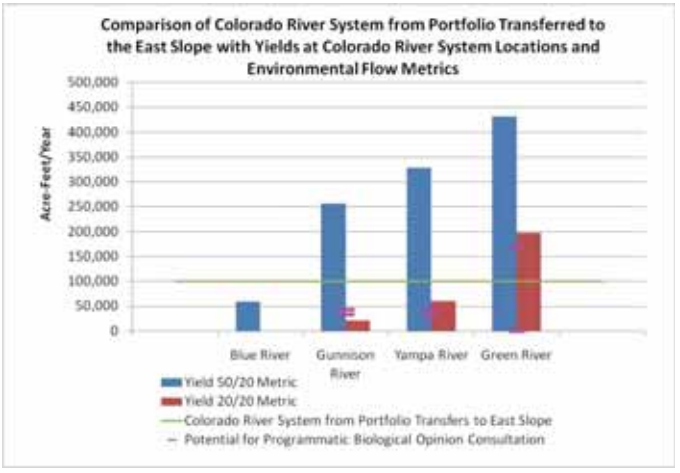
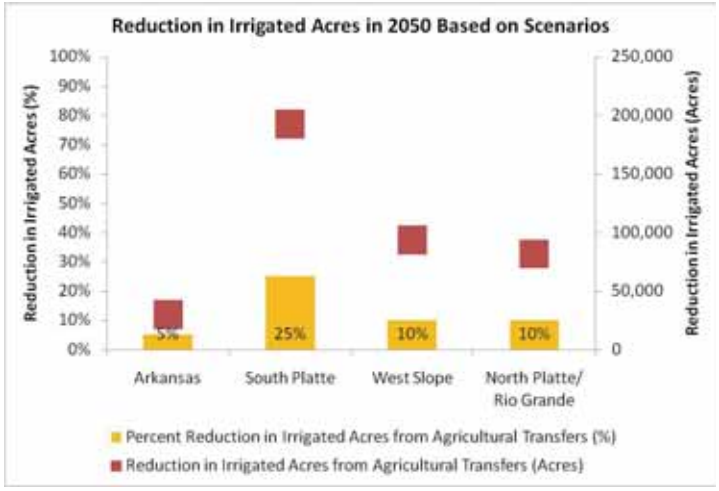
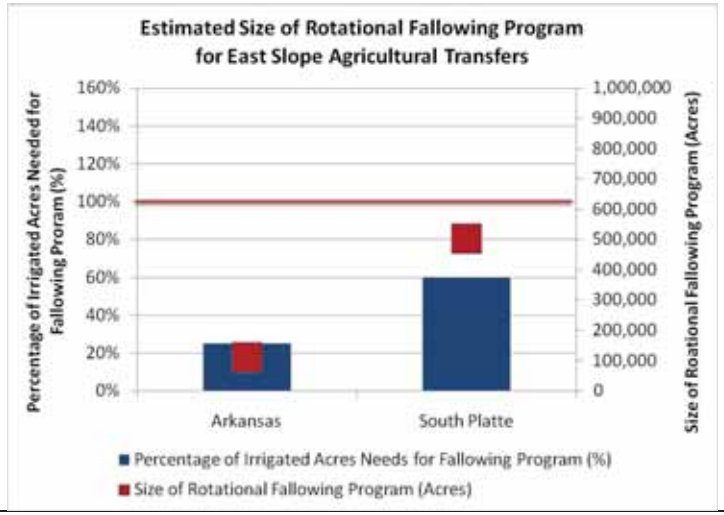


Table 5 Graphical Summary of Scenario 2: Medium Demands/West Slope Colorado River System Supply





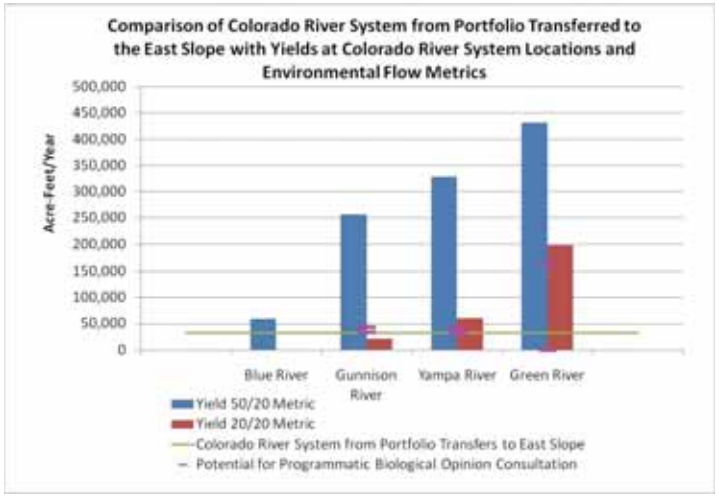
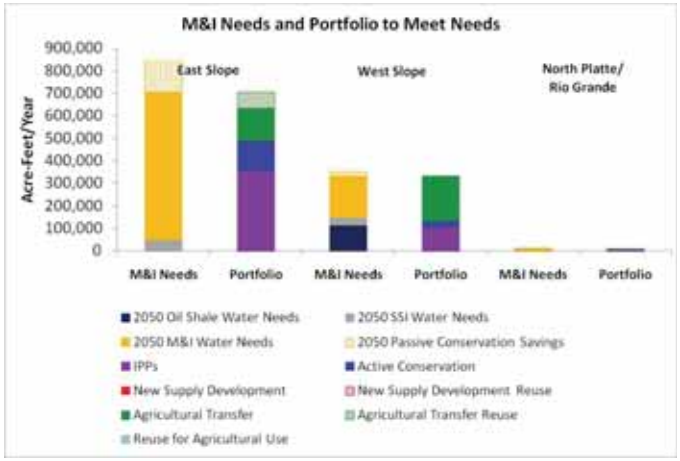
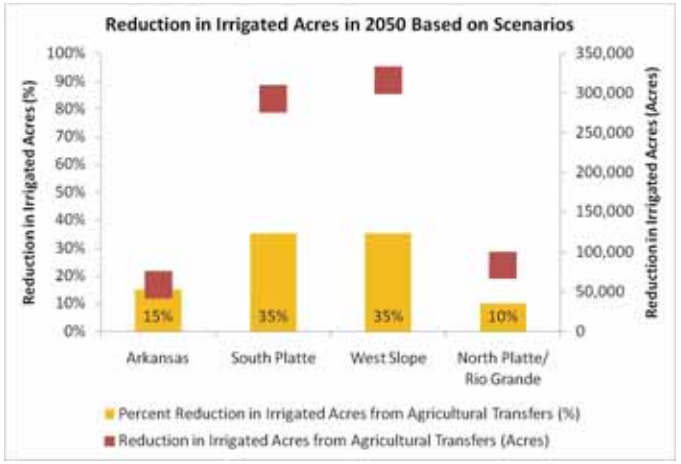
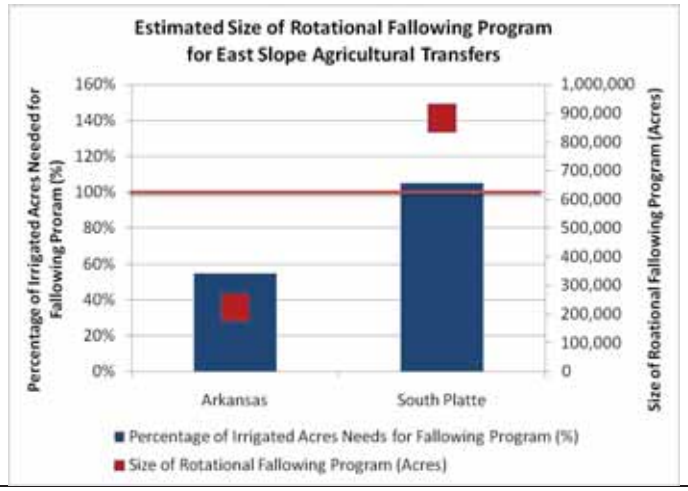


Table 6 Graphical Summary of Scenario 3 High Demands/Low Supply







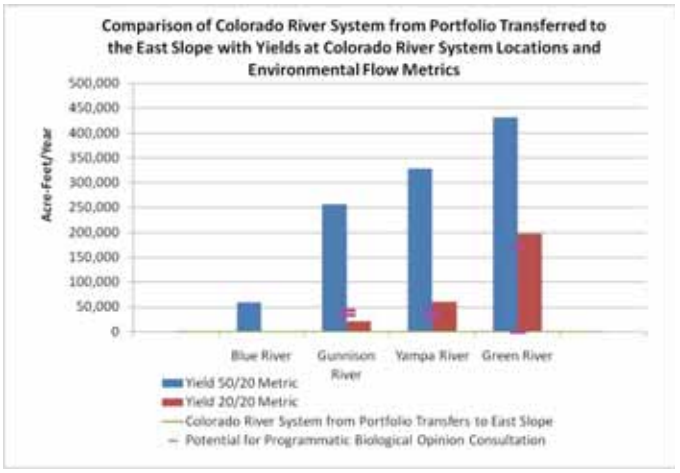
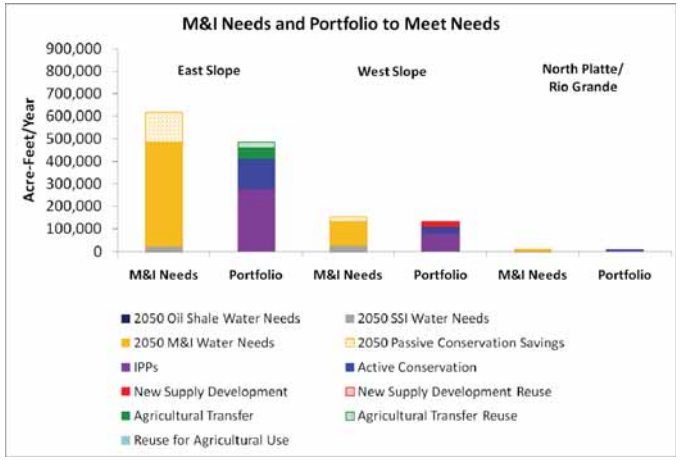
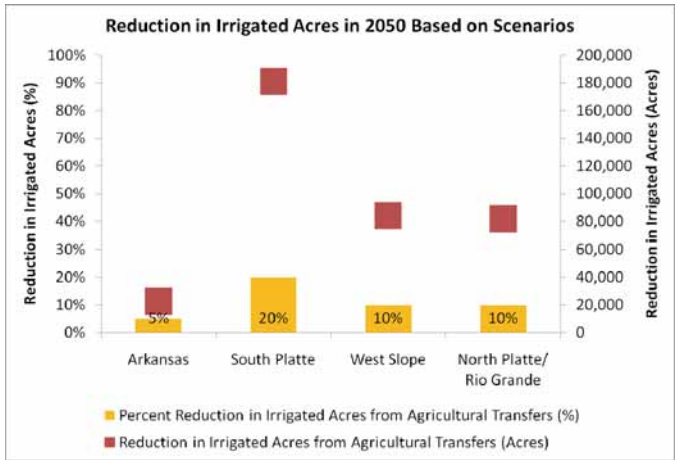
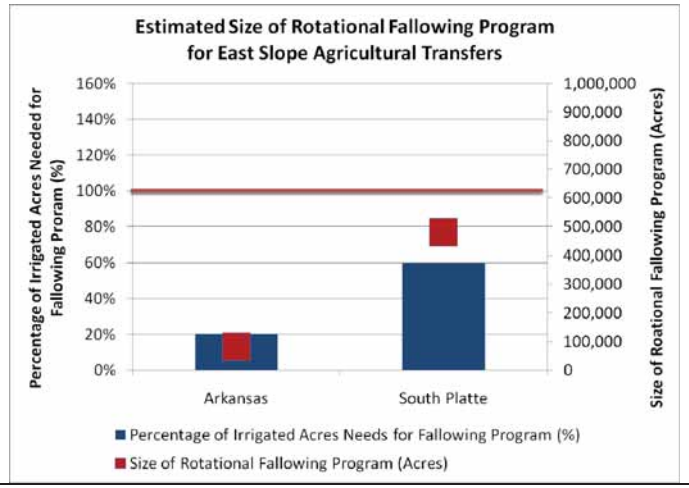


Table 7 Graphical Summary of Scenario 4a Low Demands/No East Slope Colorado River System Supply







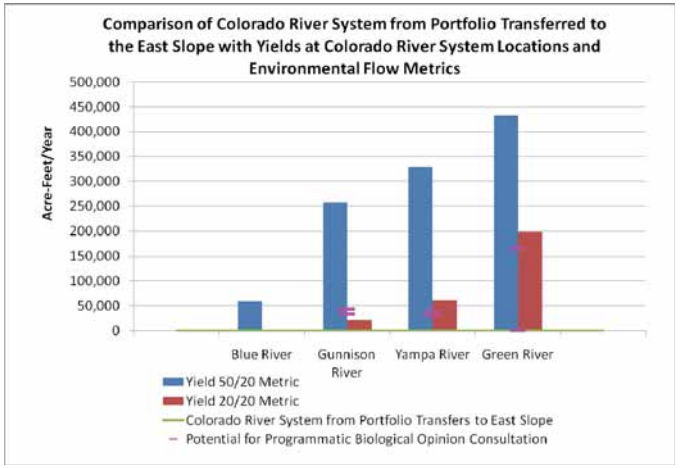
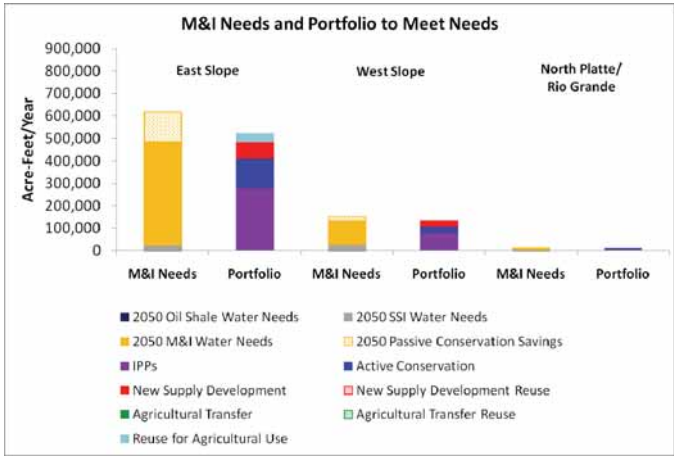
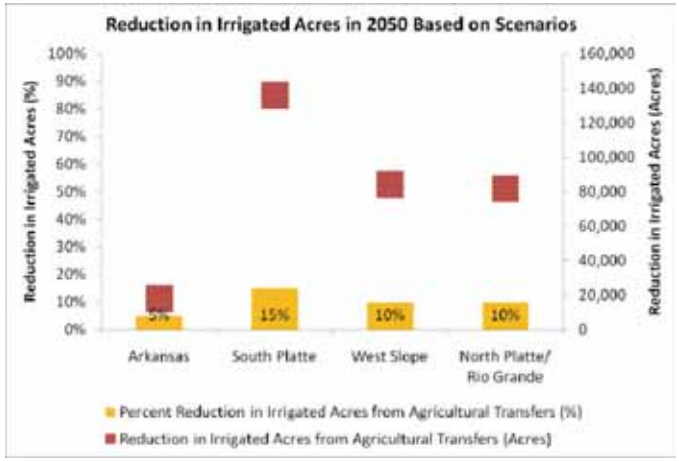
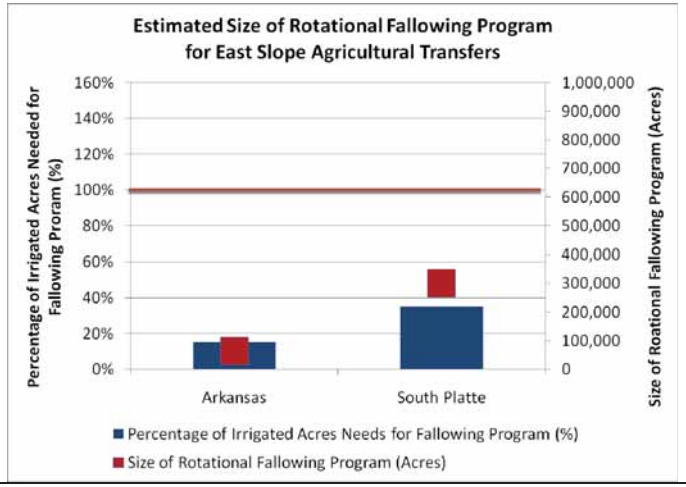


Table 8 Graphical Summary of Scenario 4b Low Demands/80,000 AFY East Slope Colorado River System Supply







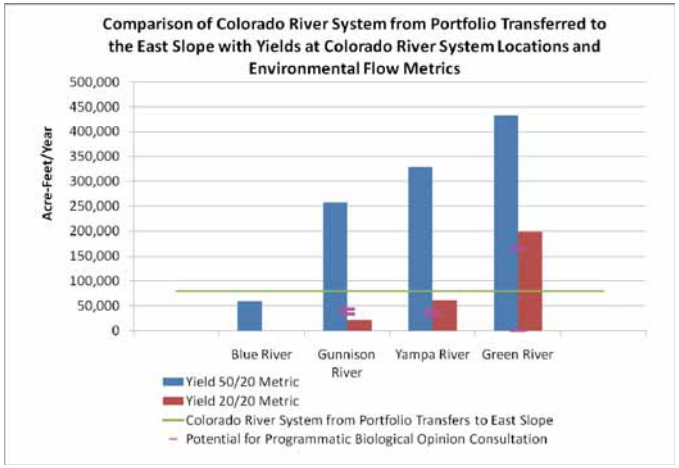
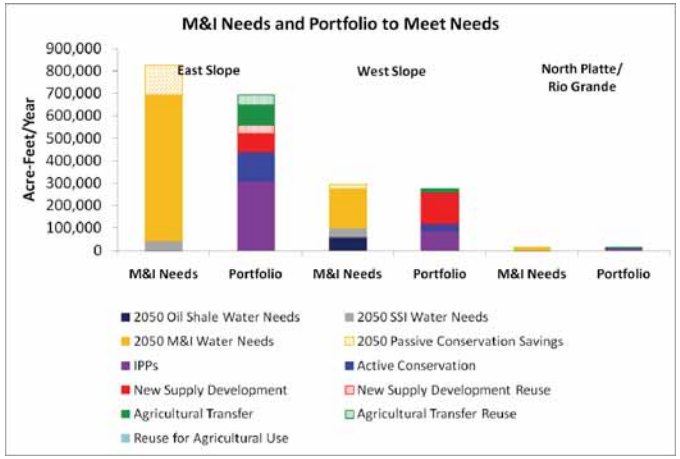
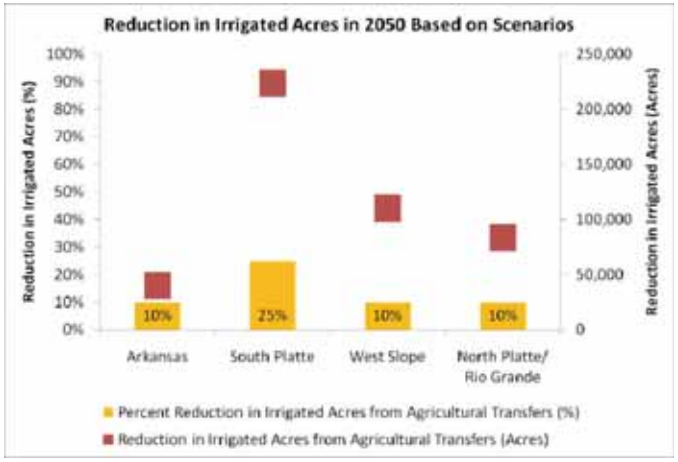
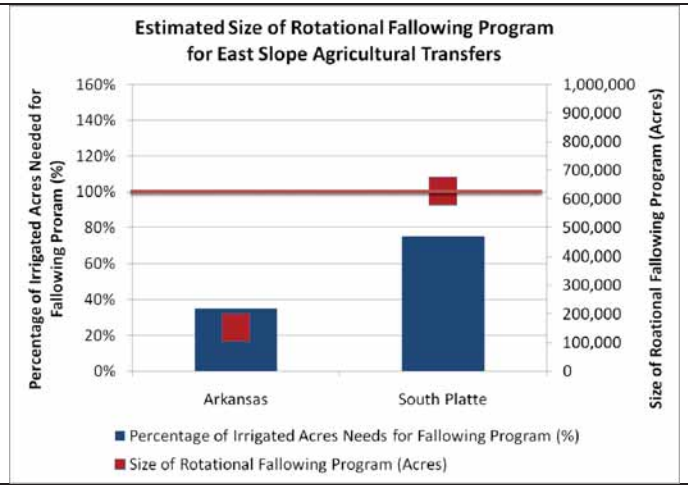


Table 9 Graphical Summary of Scenario 5 Climate Change Scenario (Medium Demands with 1.2 Factor Increase)







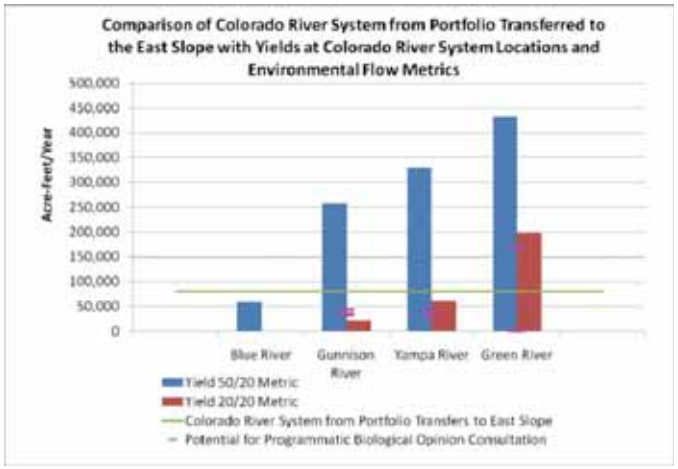
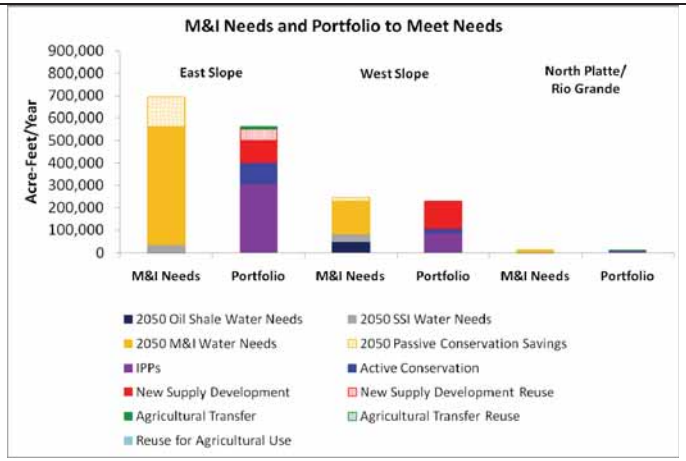
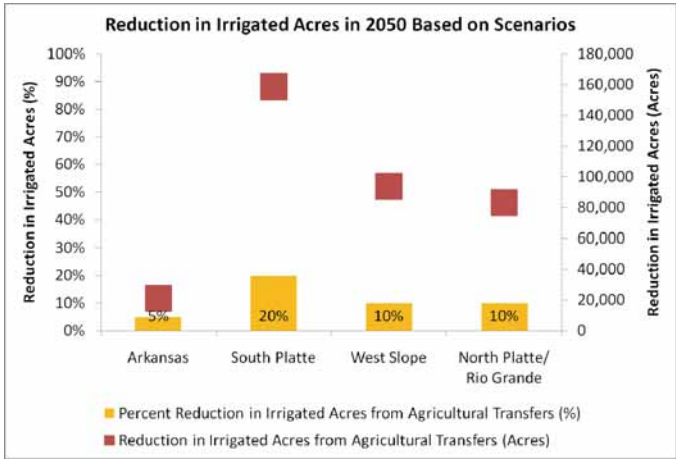
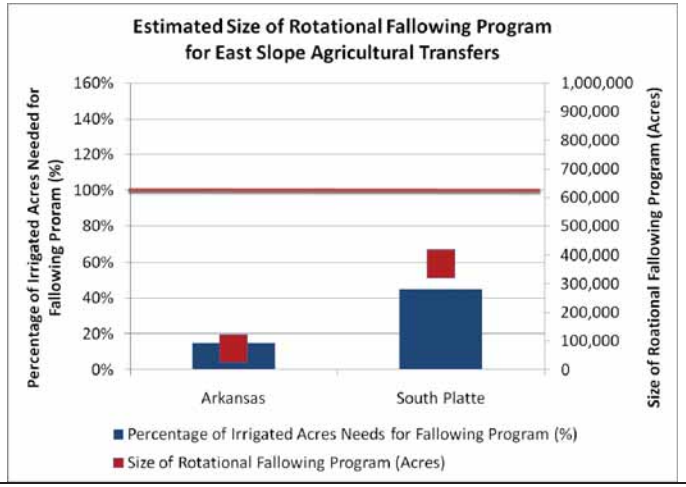


Table 10 Graphical Summary of Scenario 6a Medium Demands/High Conservation Strategy (25% applied to Gap)







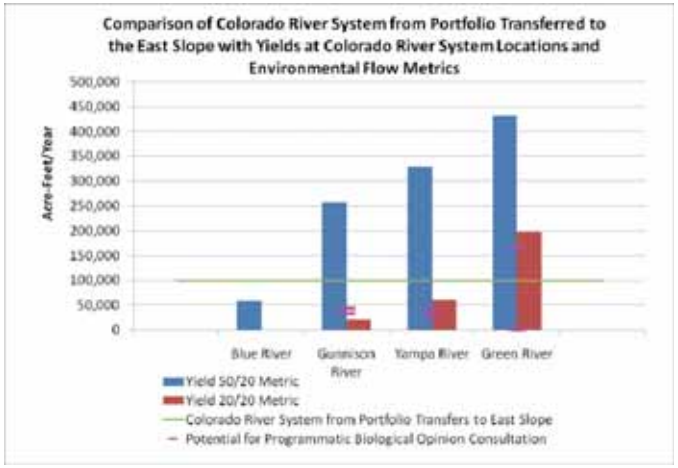
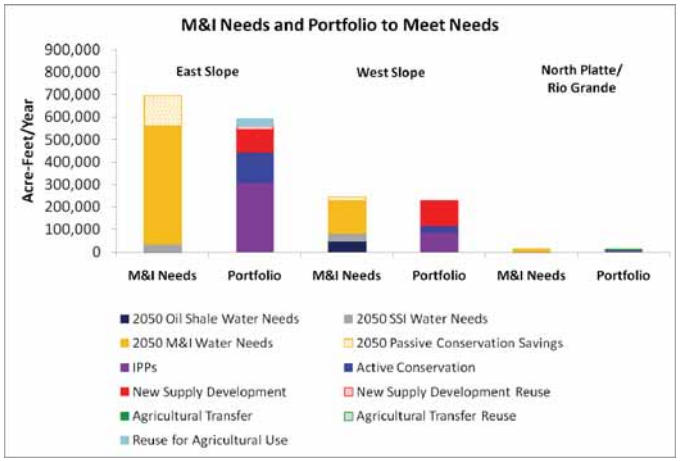
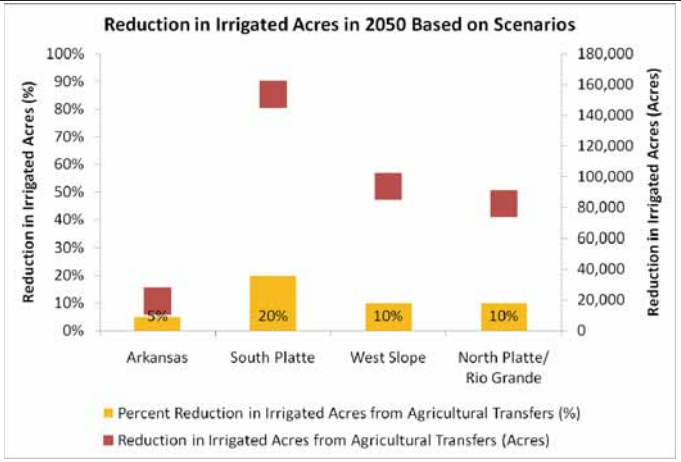
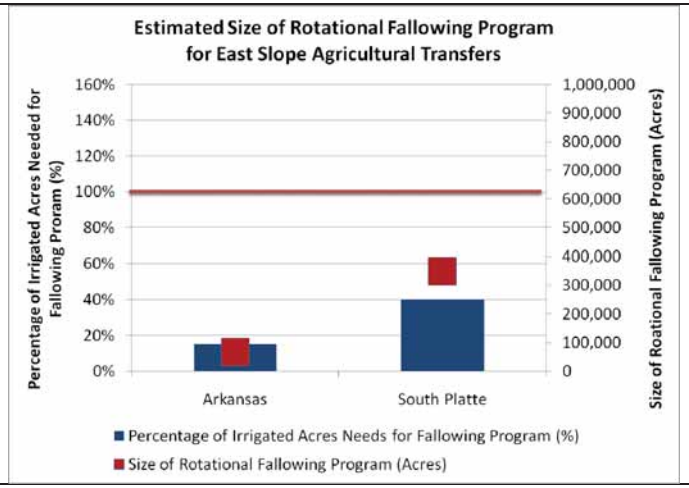


Table 11 Graphical Summary of Scenario 6b Medium Demands/High Conservation Strategy (36% applied to Gap)







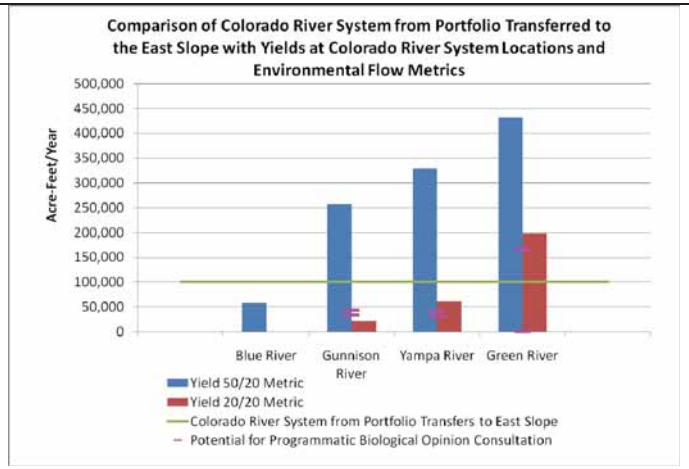
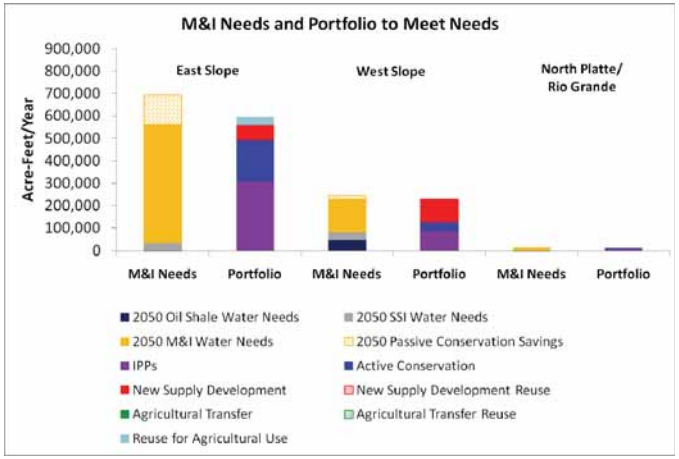
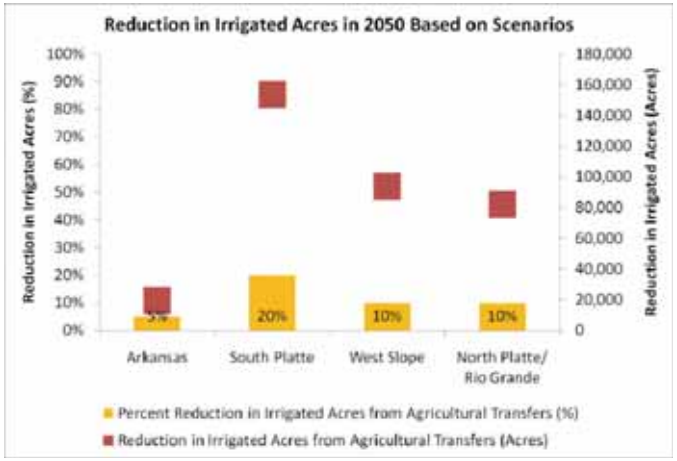
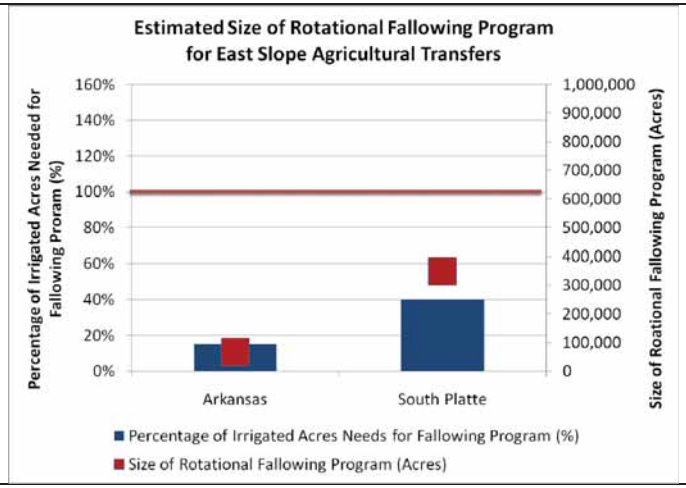


Table 12 Graphical Summary of Scenario 6c Medium Demands/High Conservation Strategy (50% applied to Gap)







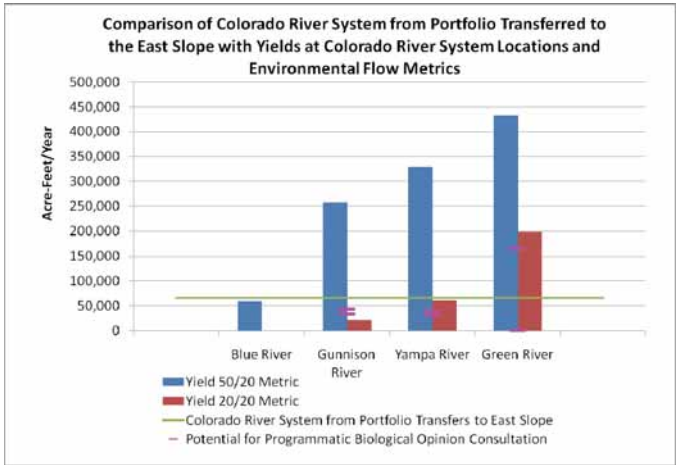
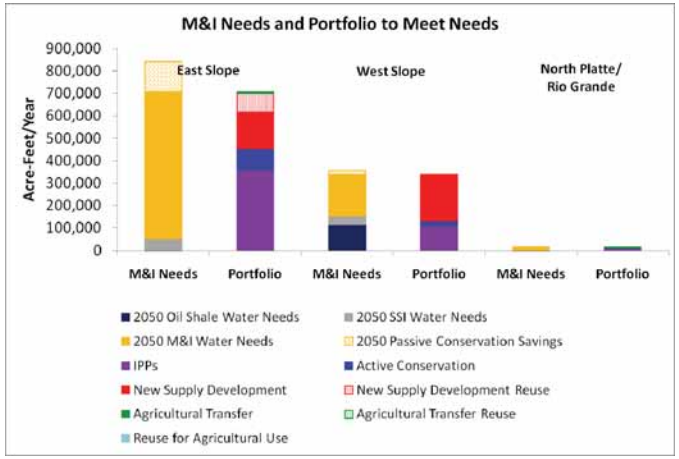
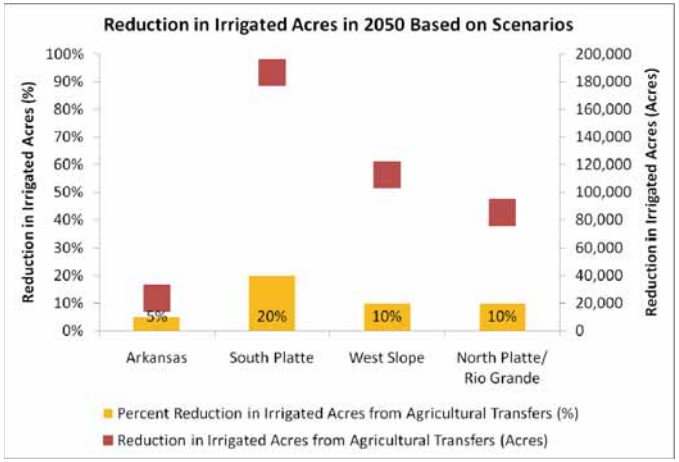
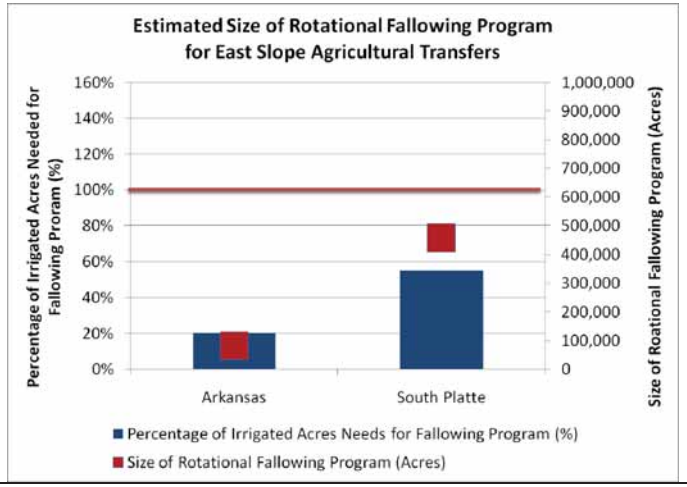
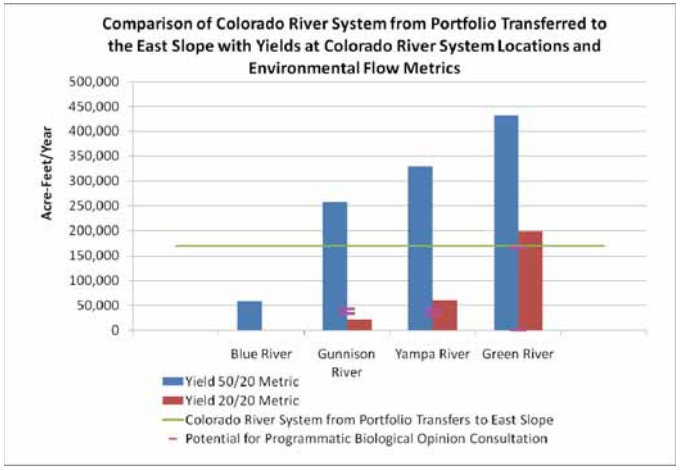


Table 13 Graphical Summary of Scenario 7 High Demands/High Colorado River Development









How to think about Risk Management on water supply development

Bill Trampe, a member of the Gunnison Roundtable and the IBCC, will be presenting this paper to the Gunnison Roundtable concerning steps and triggers related to the risk management of Colorado River system water development and the need to forestall a compact call.

It would be a companion document to their portfolio tool submissions and it informs the hoped-for thinking and scoping going into Phase II of the Colorado River Water Availability Study.

The Gunnison Basin Roundtable submission of Portfolio Tool Scenarios are accompanied by this outline of the basic concepts of our ideas concerning procedures or a process to employ risk management in order to avoid a Colorado River Compact Curtailment. It is our belief that any identified scenario or scenario grouping identified by the IBCC, CWCB or any other entity using the information generated by the HB 1177 process must consider risk assessment and risk management tools in combination with the portfolio tool output in water planning for the future.

We understand that other Roundtables will have different risk assessment concerns and priorities, and they should be considered, but above all for the benefit of the State, Colorado's entitlement under the Law Of The River should never be over developed nor should we leave water in the river that we have a right to develop. The Gunnison Basin Roundtable has participated in this five year water planning effort in order to communicate our concerns for our own basin as well as concerns that all citizens of the State should have. And we have attempted to identify methods to employ that will assure the citizens of Colorado a future lifestyle that is not entirely unlike what we enjoy today. It is with that spirit that we submit these ideas.

Risk Assessment of water development of the Colorado River for the citizens of the State can be managed in two different views as seen in the eyes of the GBRT.

1. How do we deal with a Compact Curtailment under full Compact entitlement development?
2. How do we manage development and use of Colorado River water to prevent a Compact Curtailment, while allowing for full development of Colorado's entitlement?

The GBRT is of the opinion that time, resources, and total commitment be made to accomplish the number two position.

At the November IBCC Meeting the New Supply Sub-Committee presented their report to the IBCC. In that report there is much discussion about risk assessment and risk management. On pages 5,6and 7 of that report under Next Steps/ Questions is a list of eight questions about methods and process in developing Colorado River water. That list identifies what we think are tools to use in creating a process or procedure to monitor Colorado River water delivery to the State Boundary and to identify a group of trigger points of storage in the CRSPA Units based upon the Law Of The River in the lower basin and in the upper basin. Those trigger points would be used as an early warning system to preventing a Compact Curtailment. It may require a number of such triggers, each indicating a worsening of delivery conditions.

Prioritizations of the tools or methods used to help in meeting the needs created by hitting the respective triggers will be the most difficult part of the process. We also present our ideas of how the junior-junior water right scenario might be applied to this situation. We understand that it is controversial, but for discussion purposes, the GBRT makes the following effort to create an example.

Trigger Level One: First Level Warning.

The State of Colorado has identified newly developed storage in place for this purpose. It does not take a great amount to cover this warning. Approximately (X) combined with a positive hydrology forecast for the next year.

Trigger Level Two: The difference may be poor hydrology forecast.
The same storage as above would be used with some level of reduced consumptive water use. Some level of water bank input might alleviate the problem.

Trigger Level Three: The situation continues to worsen because of poor hydrology and Colorado has new water rights consuming Colorado River water. These junior water rights are causing Colorado to consume more than our entitlement on a given year or maybe the last three years. The trigger will be satisfied by using the storage and water bank identified in trigger two plus 25% reduction in consumption by those junior-junior water right holders. The junior-junior water right holders might be front range entities and/or they might be west slope entities. After one or two years of observing this trigger and meeting the requirements, the hydrology improves and deliveries at the State Boundary allow junior-junior rights uses to return to the situation characterized by the trigger level indicated by the deliveries.

Trigger Level Four: The situation has continued to worsen beyond that in level three. This level of problem may force market conditions to start to play a greater role in solving the problem. Lease fallowing on both sides of the mountains above the amount that participated in the water bank might come into play. But, a given set of conditions for meeting the trigger have to be structured. State storage and all water bank participation would be used. Junior-junior consumptive use would be reduced 50%. The GBRT recognizes that there will be market driven actions, that we have not identified, come into play. The GBRT would implore that condemnation or total buy and dry scenarios would not be employed at this level of shortage. Again as hydrology improves, if it does, everything returns to normal.

Trigger Level Five: This condition will be identified for our purposes as the last resort to prevent a Compact Curtailment from occurring. It would most likely require that all junior-junior rights would need to be curtailed and much of the agricultural water would go to domestic uses on a fallowing basis. The ag. water would be leased only on a temporary basis so that as hydrology and adaptation of water use changed water would return to agriculture. It is our belief that at some point in the future that water will be as important for food production as it will be for showers. Preventing a curtailment in this scenario is better than allowing it to occur because the opportunity to return to "normal" is easier than trying to recover from the effects of dealing with Compact Curtailment.

Under some trigger level the market for further Colorado River water development has lost it's appeal and other market forces really start to exert pressure on change of uses of existing water rights all over the State, but we think that between will thought out storage scenarios to obtain as much benefit as possible from big hydrology events and using the ten year running average situation of the 1922 compact, and using a risk management

process something like what we have described, that Colorado should be able to develop it's entire Compact Entitlement.

Example 2 of trigger response

Trigger Level one: The State would be responding to a situation of severe drought over a number of years. The State identified storage and water bank participation will satisfy the situation.

Trigger Level two: Some number of junior-junior water rights are now diverting and have been for some number of years. Hydrology may be marginal and the forecast is not good. The junior- junior rights are curtailed some percentage or are administer according to priority. For example one right is for east slope use and one is for west slope use, both rights are curtailed 25%. If that allows the system to get back in balance we can expect to return to normal operations. If there are a large number of junior-junior rights diverting those rights would be curtailed in priority until the system is back in balance. Most likely the first situation would involve large volume diversions and the second situation would involve a larger numbers of small diversions.

Trigger Level three : The situation continues to worsen because of hydrology. Those junior-junior diverters are further restricted to 50%, if the situation involves large diverters. If a large number of small diverters are creating the situation then they will be administer totally out of priority and other of the tools will be used to balance the system. Lease fallowing and strict conservation could temporarily be implemented.

Trigger Level four: The situation reaches a critical point, and we have no choice but to curtail all junior-junior rights, understanding that the market will be creating many other potentially negative factors. But it appears to us that recovery from this situation would be far superior to recovery from a full compact curtailment. In our opinion, recovery from curtailment is nearly impossible for agriculture. We think ag water will all be purchased for municipal protection from curtailment. In that scenario junior –junior appropriation will continue to the very point of curtailment, without control. Because of the ten year running average with normal hydrology to declining hydrology when curtailment occurs those entities depending upon the junior-junior rights will be forced to replace them permanently, thus the buy out or condemnation of large amounts of ag water. It appears to us that a curtailment will be in place for a number of years unless an abnormal hydrologic event would occur. Therefore another reason ag water would be demanded for an extended period of time even if municipal providers were willing to lease water back to agriculture. The longer water is away from ag the less likely agriculture is to maintain a viable infrastructure and economic survival.

Portfolios for the Metro Roundtable

DRAFT 11/14/2011

Portfolio Number	2050 DEMAND PROJECTIONS: Existing Demand (2008 level of 155 gpcd)	Future Demand (from 2012 to 2050)		Safety Factor	Climate Factor	Total Demand	SUPPLY STRATEGIES TO MEET DEMAND: Existing Supply	Identified Projects and Processes	New Supply: Conservation	New Supply: New Water	New Supply: Reuse of New Water		Total Supply	
	kaf/yr	level	kaf/yr	factor	factor	kaf/yr	kaf/yr	kaf/yr	kaf/yr	kaf/yr	factor	kaf/yr	kaf/yr	tool calc.
1	2	3	4	6	7	8	9	10	11	12	13	14	15	
1	**437**	**Low**	**261**	**1.1**	**1.0**	**767**	**437**	**120**	**75**	**85**	**0.6**	**51**	**768**	**255**
2	**437**	**Medium**	**282**	**1.1**	**1.0**	**791**	**437**	**140**	**75**	**87**	**0.6**	**52**	**791**	**279**
3	**437**	**High**	**350**	**1.1**	**1.0**	**866**	**437**	**170**	**75**	**115**	**0.6**	**69**	**866**	**354**
4	**437**	**High**	**350**	**1.0**	**1.3**	**1023**	**437**	**170**	**111**	**191**	**0.6**	**115**	**1023**	**511**

Explanation

To investigate a range of future conditions, portfolios where prepared for low, medium and high demand plus high demand and a warmer climate.
IPPs, Conservation and Reuse set to maximum levels considered achievable. The remainder of the gap met with new water.
These portfolios are for the metro "basin" only. No attempt was made to do the planning for other basin roundtables.

Conservation Table

		2008	2050			
			Low	Medium	High	High (+10% demand)
Conservation Potential	population (1000's)	2,513	4,018	4,144	4,534	4,534
	Demand at 191 gpcd (kaf)	538	860	887	970	1,067
	Demand at 155 gpcd (kaf)	437	698	719	787	866
	Conservation demand of 129 gpcd (kaf)	n/a	581	599	655	721
	2000-2008 Conservation savings(191-155) (kaf)	101	162	167	183	201
	2008-2050 Conservation savings (155-129) (kaf)		117	121	132	145
	2000-2050 Total Conservation Savings (191-129) (kaf)		279	288	315	346
	Estimate of 2008-2050 Passive (kaf)		75	75	75	75
Conservation Applied To Gap	2000-2008 Conservation applied to meet new demand (SWSI assumes 100%)		162	167	183	201
	Passive Conservation applied to meet new demand (SWSI assumes 100%)		75	75	75	75
	2008-2050 Active conservation applied to meet new demand		0	0	0	36
	Total 2008-2050 Conservation applied to new demand (Column 11 Entry above)		75	75	75	111
	Total 2000-2050 conservation applied to meet new demand		237	242	258	312
	% of total conservation applied to meet New Demand		85%	84%	82%	90%
	Active conservation savings for Drought reserve*		42	46	57	35

*Reserved savings helps buffer against uncertainties in durability of savings and to help offset increased severity and frequency of drought restrictions.

Column	**Notes**
2	From SWSI 2010. See conservation memo on how the Tool subtracts 100 kaf of conservation.
3	Selected from Tool.
4	Demand from Tool plus the passive conservation estimates.
5	This column was deleted from the table. Need to adjust column numbers.
6	Typical safety factor used in water utility because of inability to predict demand and supply. The factor is applied to existing and new demand. 1.10 factor equals a 10% increase in demand estimate.
7	1.0 factor means a static climate. 1.3 factor roughly derived from 5 degree F temperature increase with no change in precipitation causing roughly a 10% increase in demand (existing and new)to meet ET requirements of landscaping and a roughly 20% decrease supply (existing and new) due to increased water evaporation, plant transpiration, snow sublimation, etc. This is in the mid range of temperate projections for Metro area watersheds. Many variations could be considered.
8	Equals colums (1+4)*6*7
9	Assumed equal to demand. Apparently any supply in excess of demand is counted as an IPP which means no safety factor on existing demand is allowed in the Tool.
10	From Tool. Assumes 75% IPP success except 100% for "Existing IPPs". Tool increases Exisiting IPPs with demand.
11	See conservation table and memo.
12	Composite of new water developed from east and/or west slope as new water and/or ag to urban transfers.
13	Reuse factors considers the losses in water use, including CU from irrigation, and losses in treatment, distribution, stream transit, storage, retreatment, etc. Lack of storage and lack of demand when reuse supply is available (particularly in the winter) is also considered.
14	Equals columns 12*13
15	Should roughly equal total demand. Equals columns 9+10+11+12+14

Recommended Tool improvements

1. Make passive conservation a function of population (not fixed at 75 kaf). Add factor to reduce demand with density.
2. Add ability for the tool user to decide the values for the following: conservation, reuse factor, safety factor, environmental flow metrics , amount of ag transfer in buy and dry, fallowing and dry year leasing. (Tool has too many presumptions embedded and not transparent or adjustable).
3. Display flow impacts to actual flow not pre-development conditions.
4. Display actual new supply diversions.

Updated Metro Roundtable Conservation Strategy

Purpose

The purpose of this memo is to present an estimation of potential future water demand reductions which the Metro Basin Roundtable can reasonably expect[1] by 2050 based on current and future water conservation programs and improved water use efficiencies. In keeping with SWSI and other state water conservation policy efforts, estimated demand reductions relate to three basic processes or influences on water use:

- Passive saving reductions related to the natural replacement of customer water using fixtures and appliances;
- Other changes in water use behaviors (e.g., state legislation, changes in land use, drought impacts, etc.); and
- Active water conservation program impacts related to implementation of water conservation programs sponsored by water utilities and special districts.

Noteworthy is that current water demand is trending downward due to a combination of these three influences. Similarly, future demand reductions will require that water utilities, NGOs, water customers, and state and local officials work together to support and ensure that meaningful, permanent water conservation programs are developed and implemented.

This shared responsibility for future water conservation does not dismiss the important role of water utilities to act as good stewards of the State's water resources. But the work of managing water in Colorado is not solely the responsibility of our water utilities. It requires the cooperation and collaboration between all members of the water community.

Estimations and Limitations

The estimated water demand reductions presented in this memo were developed in a manner consistent with the needs of the IBCC's Portfolio Tool. Additional analysis and evaluations of the estimates provided herein will be developed in the future as more data is collected characterizing the benefits and costs of water conservation. As economic and political climates change, the opportunities for conservation will change as well. Therefore, the Metro Basin water utilities will continually conduct monitoring and verification efforts, through data collection and analysis in the future, which will be used to inform and sharpen future programs and demand reduction estimates.

Water Demand Reductions since 2000

Since the first SWSI report in 2000, water demand in the Metro Basin has declined by approximately 100,000 acre feet.[2] During this time, the basin's daily per capita use (gpcd)

[1] These demand reductions are to be used to assist in characterizing future water supply needs in the Metro Basin using the IBCC portfolio tool and other statewide water supply planning models.

[2] State of Colorado 2050 Municipal & Industrial Water Use Projections, July 2010. Part of the change in per capita use could be errors in reporting, meteorological anomalies, lasting impacts of drought, impacts of utility water conservation programs, as well a temporary reductions in use due to the economic downturn.

has declined from 191 gpcd to 155 gpcd. The Metro basin supplies nearly half of the state's population and conservation has been an integral part of most water utilities water resource management programs as they serve an increasing population and growing economic base.

The 2010 SWSI conservation strategies report identified additional savings opportunities for the next 40 years. According to the study, the Metro basin may be able to save an additional 90,000–225,000 acre feet from the low to the high strategies.[3] Noteworthy is that regardless of the water conservation strategy that is achieved, additional water supply will be needed to meet the 2050 projected water demand as demonstrated in the following table.

Table 1 – Summary of Future Total Water Use Based on Potential 2050 Water Conservation Strategies

Year	2000	2010	2050		
			Low	Medium	High
GPCD	191	155	135	118	106
Total Use (AF)[4]	556,691[5]	451,765[6]	626,653	547,741	492,039

These future water use estimates presented in the CWCB's SWSI 2010 Municipal and Industrial Water Conservation Strategies Report include the impacts and benefits from all three influences on future water demand including passive savings, state and local ordinances, and active water conservation programs conducted by water utilities. This memo attempts to identify water demand reductions that can be reasonably expected based on current trends and programs – independent of new future regulation, substantial changes in land use, and other influences beyond the control of our water providers.

Recommendation

The Metro Basin Roundtable recommends that it pursue conservation programs that would reduce per capita water use from a baseline of 191 gpcd in 2000 to 129 gpcd by 2050. This goal would require that savings achieved since 2000 be maintained and an additional 120,000 acre feet be saved by 2050 including the influences of passive savings.

From the baseline of 191 gpcd in the year 2000, this is a 32 percent reduction in water use for a total of 225,000 acre feet. Metro water providers will have to ensure that the savings achieved through behavioral changes during and after the 2002-2004 drought become permanent, help put regulations in place that will achieve future passive savings, and continue to offer programs to achieve active savings.

Table 2 – Estimate of Future Water Demand Reductions Associated with Active and Passive Water Conservation Impacts

Year	2000	2010	2050
GPCD	191	155	129
Total Use (AF) (based on 2050 medium population)	886,598	719,491	597,758

[3] SWSI 2010 Municipal and Industrial Water Conservation Strategies.
[4] Total water use estimates in 2050 are based on using the medium population estimate of 4,144,000 for the Metro Basin predicted by CWCB for 2050.
[5] Based on 2010 Metro Basin population
[6] Based on 2010 Metro Basin population

Water providers will have to take an active role in continued water savings. Recommended measures include:

- Continue educational, marketing and advertising programs to ensure recent savings become permanent;
- Pursue statewide legislation to require only high-efficient indoor water fixtures can be sold;
- Provide audits and incentives to residential, commercial, industrial and institutional customers to replace inefficient fixture and improve processes;
- Provide targeted audits for inefficient use, both indoors and out;
- Capitalize on an assist with customer's willingness to change landscapes;
- Prepare financially for the future investment by water utilities and their customers to maintain distribution systems and hold water loss rates down as much as practically possible;
- Continually monitor and evaluate conservation programs and pursue new conservation opportunities.

Ultimately, the success in achieving higher levels of conservation will rest on improving technology of water using fixtures and landscapes; the political will to encourage greater efficiency in water use through codes and regulations; and seizing new opportunities to save water as they emerge leveraging partnerships between water utilities, state and local officials, NGOs and our citizenry.

Detailed Estimates

Residential Indoor

Currently the Metro basin is among the lowest in indoor residential use at 44 gpcd; the statewide average is 51 gpcd. The low, medium and high strategies from the 2010 SWSI report are shown in the table below.

Residential Indoor Use (gpcd)

		2050	
Baseline	Low	Medium	High
43.7	40	35	30
	-8%	-20%	-31%

According to the SWSI 2010 reports, 100,000 acre feet could be saved through indoor use from residential and non-residential customers. The estimates suggest that indoor residential use could be driven down to nearly 30 gpcd (the high scenario) through the passive replacement of water fixtures. This is an aggressive projection that will likely need active participation among water providers to be successful.

To illustrate this point, the assumption in the passive savings report is that in 2050 the average flush volume of toilets will be 1.0 gallons per flush (gpf). In 2005 Denver studied its residential customer's use and found that the average flush

volume was 3.14 gpf. There are very few 1.0 gpf toilets in the residential sector right now, and they are not yet widely available at "big box" retailers. This means that a high percentage of toilets would have to be replaced with 1.0 gpf toilets within 40 years. With a replacement rate of 1-4 percent per year, new regulations would have to be put into place within the next five years to reach the projected flush volume.

Recommendation: Medium strategy 20 to 25% savings

Given the aggressive projections of passive savings and the need to enact regulations quickly in order to meet the high strategy, a more realistic goal is the medium strategy. This will still require water providers to actively pursue new ordinances or legislation.

Residential Indoor Use

Measure	Baseline 2010	2050	Reduction
Gpcd	43.7	34.0	9.7
Total AF	202,850	157,824	45,026
% Reduction			-22%

Non-residential Indoor

Non-Residential Indoor Use (gpcd)

	2050		
Baseline	Low	Medium	High
37.5	31.9	28.1	26.3
	-15%	-25%	-30%

There may be fewer opportunities to save water in non-residential indoor use. As the Metro area continues to grow its economy water needs will grow as well. The non-residential customer base is a diverse group of customers that have had varying degrees of success reducing water use. Less is known about this group of customers, as the last Water Research Foundation study was done in the early 1990s.

Many Metro water providers offer programs to improve efficiency in commercial, industrial and institutional water uses. In our experience, increasing business productivity and economic growth can mask achieved efficiencies. As an example, Denver Water's industrial class of customers has reduced their use by only 2 percent since 2000, while the residential class has reduced their use by more than 20 percent. Denver Water has entered into several contracts with industrial customers to improve efficiency. The results have shown the companies using

water more efficiently and productively, but corresponding increases in production have diminished the total water savings.

Recommendation: Low Strategy 15 to 20% savings

Economic growth will continue to be promoted and water use will increase to meet those growing needs. Efficiencies will be gained through replacing bathroom fixtures, changing industrial processes and reducing cycle concentrations on cooling towers. Water providers can offer a variety of programs from audits, education and incentives. Additionally, rules for new developments are being implemented in more and more Metro communities.

Non-residential Indoor Use

Measure	Baseline 2010	2050	Reduction
Gpcd	37.5	31.9	5.6
Total AF	174,070	147,960	26,111
% Reduction			-15%

Outdoor Use

Outdoor Use (gpcd)

	2050		
Baseline	Low	Medium	High
62.8	53.5	48	43.3
	-15%	-24%	-31%

Outdoor use has changed dramatically over the last ten years. The 2002-2004 drought gave a new appreciation for using water for lawns. Many customers have lowered their water use to at or below efficient levels for bluegrass. The Metro area is seeing more and more conversions from bluegrass to low water using landscapes.

There are still opportunities to save water by targeting inefficient users and capitalizing on a willingness to change landscapes. Approximately 20 percent of Denver Water customers use more than 18 gallons per square foot, which is the efficient level of watering bluegrass in our climate. The average use in the Denver Water service area, however, is approximately 16 gallons per square foot. This means that some customers are deficit irrigating and others have converted their landscapes to need less water.

There is some risk of losing outdoor savings. Many Metro providers have seen a sharp decline in outdoor use in the past three years, particularly in its residential sector. Some of this could be due to the economic decline and as it turns around in the coming years, water use could rebound as homeowners recover lawns and landscapes.

Recommendation: Low Strategy 15% savings

There are opportunities in outdoor water use from inefficient watering and conversions to lower water using landscapes. Water providers will have to offer audits, incentives and substantial education to continue to gain savings.

Outdoor Use

Measure	Baseline 2010	2050	Reduction
Gpcd	62.8	53.5	9.3
Total AF	291,510	248,340	43,169
% Reduction			-15%

Water Loss

In the next 40 years, water providers will incur enomous costs to repair and maintain the water infrastructure that currently provides reliable tap water to their customers. The vast majority of water infrastructure in the Metro basin has been built since the 1950s and no water provider has been faced with large replacement and upgrade needs to this point; however as water infrastructure ages, it is likely to require increasingly large repair and maintenance costs.

In addition, water distribution leaks and other water loss (both real and apparent) are expected to increase if proper best management practices are not implemented. Currently, system water loss for water providers in the Metro Basin range from 3 to 15%, averaging about 10%.

Recommendation: Low Strategy – 0 to 15% Savings

Any goal to improve water loss, given what water providers are facing in maintenance costs will involve better management practices, system wide water audits and other third party water accounting reviews. Currently, few water providers utilize these practices; however, it is unlikely that overall systemwide water loss management can reduce losses to less than 7% on average based on the current state of the industry based on joint-industry research. The goal presented below assumes a reduction in the baseline water loss of 10.9% to 8.5 % (or potential demand reduction of 11,140 AF).

Water Loss

Measure	Baseline 2010	2050	Reduction
Gpcd	10.9	9.4	1.5
Total AF	50,596	43,634	6,963
% Reduction			-14%

Historic Savings Calculation

Historic savings from 2000 to 2010 in the Metro basin were calculated using SWSI per capita use figures and population estimates. The 2010 SWSI study shows that daily per capita use went down from 191 to 155[7] in the ten-year period. The SWSI report states that the change could be due to a number of "factors including conservation efforts, behavioral changes from 2002 drought (i.e., a 'drought shadow'), changes in a community's socio-economic conditions, and / or better data.

Denver Water and Aurora have verified with their demand figures that the SWSI demand figures from 2010 look relatively accurate. It may be true that some of the reductions may be temporary for a number of reasons cited above; however, the SWSI portfolio tool is treating all of the changes in demand in the last ten years as permanent savings that will be used to meet the gap in water supply.

The calculation below using SWSI 2010 figures shows that the Metro basin has reduced its use by over 100,000 AF. It is debatable that all of these savings are permanent, but the SWSI portfolio tool is treating them as permanent and applying all of the savings to meeting the supply gap; therefore, this must be included in the calculation of how much of the conservation savings will be used to meet the future supply gap.

Metro Basin 2000-2010 Conservation	2000	2010	Difference
Population		2,602,000	
Daily per capita use	191	155	36
Total annual demand (af)	556,691	451,765	104,926

[7] State of Colorado 2050 Municipal & Industrial Water Use Projections, July 2010, Figure 5-1.

Memorandum

To: *Greg Johnson, CWCB*

From: *Nicole Rowan, CDM*

Date: *December 16, 2011*

Subject: *Portfolio and Trade-off Tool Analysis for Rio Grande Basin*

The Rio Grande Basin held workshop on the Portfolio and Trade-off Tool on 12/13/2011. The purpose of the workshop was to develop preliminary portfolios for meeting Colorado's future M&I water needs. During the workshop, the attendees developed four portfolios that will be review by the full Rio Grande Roundtable in future meetings.

Summary of Scenarios

Following are the scenarios presented in this memo:

- Scenario 1: Medium Demands/Low Conservation Strategy/150,000 AFY Colorado River System Water.
- Scenario 2: Medium Demands/Low Conservation Strategy/300,000 AFY Colorado River System Water
- Scenario 3: Medium Demands/Medium Conservation Strategy/150,000 AFY Colorado River System Water
- Scenario 4: Medium Demands/Medium Conservation Strategy/300,000 AFY Colorado River System Water

Assumptions

The following assumptions were held constant for the above portfolios:

- The medium demand scenario was used for all portfolios.
- Oil shale demands were turned "off" in the tool.
- Replacement of Front Range non-tributary groundwater was turned "on" in the tool.

- Rio Grande Identified Projects and Process (IPPs) will deliver 93% of their potential yield in the future.

- Reuse ratio of 1.6 for all reusable supplies on the East Slope.

Results

Results are shown in Table 1 through 5 below. Table 1 describes each scenario and its results. Tables 2 through 5 present the information graphically. A key output examined by other roundtables is the amount of irrigated acres potentially lost in the South Platte basin. Approximately 20 percent of the South Platte's irrigated acres will be lost to IPPs and urbanization onto irrigated lands. Therefore, 20 percent of irrigated acre dry-up in the South Platte Basin is considered low in the scenarios presented below.

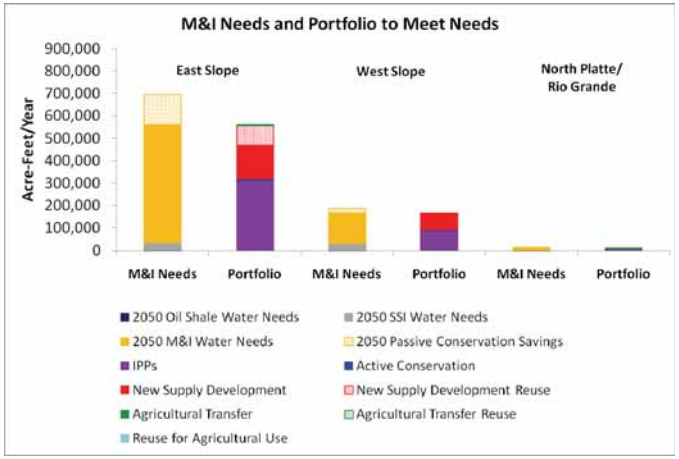
Table 1 Summary of Scenario Results

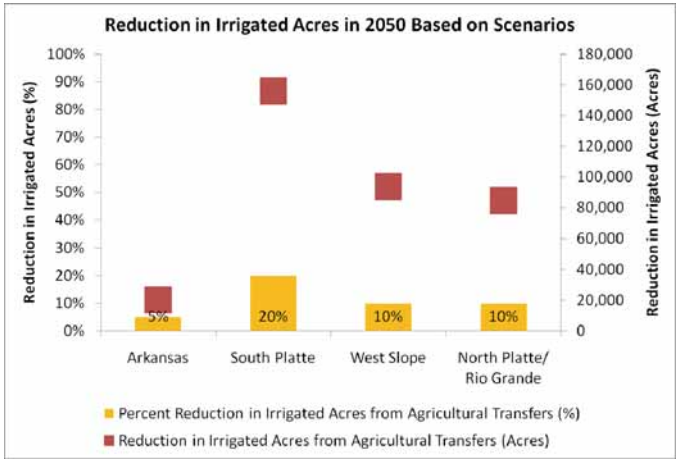
Portfolio Element	Scenario 1: Medium Demands/Low Conservation Strategy/150,000 AFY Colorado River System Water	Scenario 2: Medium Demands/Low Conservation Strategy/300,000 AFY Colorado River System Water	Scenario 3: Medium Demands/Medium Conservation Strategy/150,000 AFY Colorado River System Water	Scenario 4: Medium Demands/Medium Conservation Strategy/300,000 AFY Colorado River System Water
IPPs	93% Yield Rio Grande Basin	93% Yield Rio Grande Basin	93% Yield Rio Grande Basin	93% Yield Rio Grande Basin
Conservation/Reuse	Low Conservation Strategy/ 10% applied to the M&I gap; 1.6 Reuse Factor	Low Conservation Strategy/ 10% applied to the M&I gap; 1.6 Reuse Factor	Medium Conservation Strategy/ 10% applied to the M&I gap. 1.6 Reuse Factor	Medium Conservation Strategy/ 10% applied to the M&I gap. 1.6 Reuse Factor
New Colorado River System Assumptions	75,000 AFY to West Slope; 150,000 AFY to East Slope	75,000 AFY to West Slope; 300,000 AFY to East Slope	75,000 AFY to West Slope; 150,000 AFY to East Slope	75,000 AFY to West Slope; 300,000 AFY to East Slope
New Colorado River System and New Agricultural Transfer Results	73,500 AFY new Colorado River System water and no new agricultural transfers for West Slope; 150,000 AFY new Colorado River System water and very little new agricultural transfers for the East Slope. For West Slope, IPP and conservation levels are high enough that not all designated supplies are needed.	73,500 AFY new Colorado River System water and no new agricultural transfers for West Slope; 242,000 AFY new Colorado River System water and no new agricultural transfers for East Slope. For West Slope, IPP and conservation levels are high enough that now all designated supplies are needed.	71,000 AFY new Colorado River System water and no new agricultural transfers for West Slope; 150,000 AFY new Colorado River System water and no new agricultural transfers for East Slope. For West Slope, IPP and conservation levels are high enough that now all designated supplies are needed.	71,000 AFY new Colorado River System water and no new agricultural transfers for West Slope; 227,500 AFY new Colorado River System water and no new agricultural transfers for East Slope. For West Slope, IPP and conservation levels are high enough that now all designated supplies are needed.
Ag Transfers and Urbanization – Irrigated Acres Results	10% of West Slope acres (94,000 acres), 20% of South Platte acres (156,000), 5% of Arkansas acres (20,000).	10% of West Slope acres (94,000 acres), 20% of South Platte acres (153,500), 5% of Arkansas acres (19,500).	10% of West Slope acres (94,000 acres), 20% of South Platte acres (153,500), 5% of Arkansas acres (19,500).	10% of West Slope acres (94,000 acres), 20% of South Platte acres (153,500), 5% of Arkansas acres (19,500).

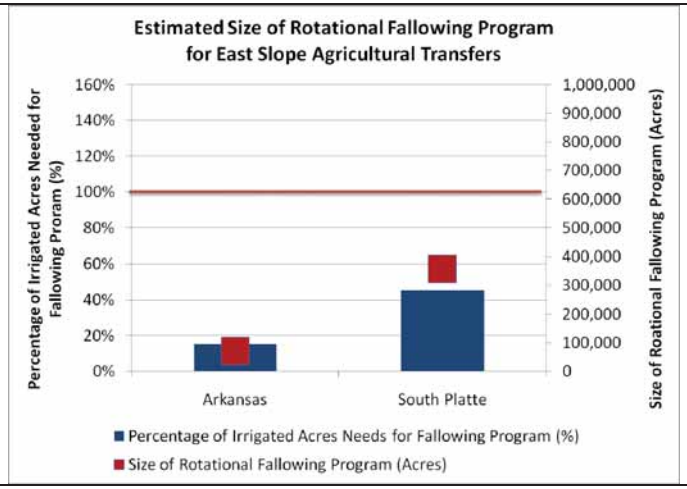
Table 1 Summary of Scenario Results

Portfolio Element	Scenario 1: Medium Demands/Low Conservation Strategy/150,000 AFY Colorado River System Water	Scenario 2: Medium Demands/Low Conservation Strategy/300,000 AFY Colorado River System Water	Scenario 3: Medium Demands/Medium Conservation Strategy/150,000 AFY Colorado River System Water	Scenario 4: Medium Demands/Medium Conservation Strategy/300,000 AFY Colorado River System Water
Other Portfolio Trade-off Results	45% of South Platte acres and 15% of Arkansas acres needed for fallowing program; Slight decrease in South Platte flows (4% at state line); Transbasin diversion would trigger FWS consultation and environmental flow metrics indicate the full 150,000 AFY could be developed in the Gunnison River, Yampa River, and Green River.	40% of South Platte acres and 15% of Arkansas acres needed for fallowing program; Increase in South Platte flows (16% at state line); Transbasin diversion would trigger FWS consultation and environmental flow metrics indicate the full 242,000 AFY could be developed in the Gunnison River, Yampa River, and Green River.	40% of South Platte acres and 15% of Arkansas acres needed for fallowing program; Increase in South Platte flows (16% at state line); Transbasin diversion would trigger FWS consultation and environmental flow metrics indicate the full 242,000 AFY could be developed in the Gunnison River, Yampa River, and Green River.	40% of South Platte acres and 15% of Arkansas acres needed for fallowing program; Increase in South Platte flows (16% at state line); Transbasin diversion would trigger FWS consultation and environmental flow metrics indicate the full 227,000 AFY could be developed in the Gunnison River, Yampa River, and Green River.

Table 2 Scenario 1 - Medium Demands/Low Conservation Strategy/150,000 AFY Colorado River System Water







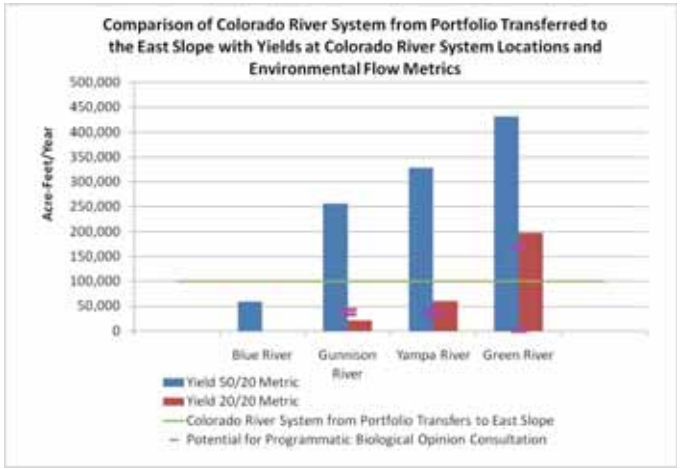
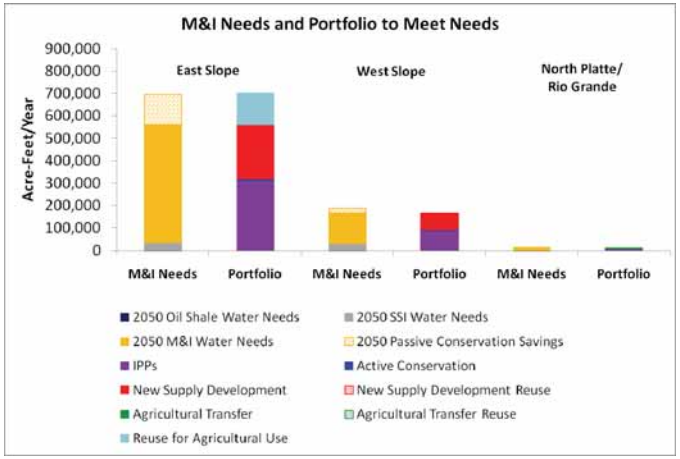
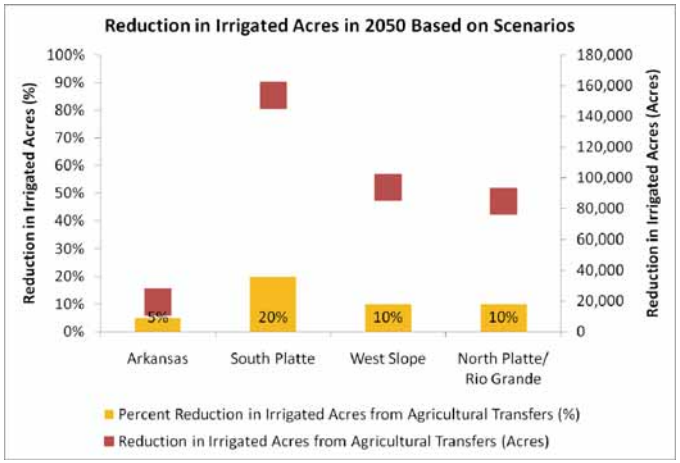
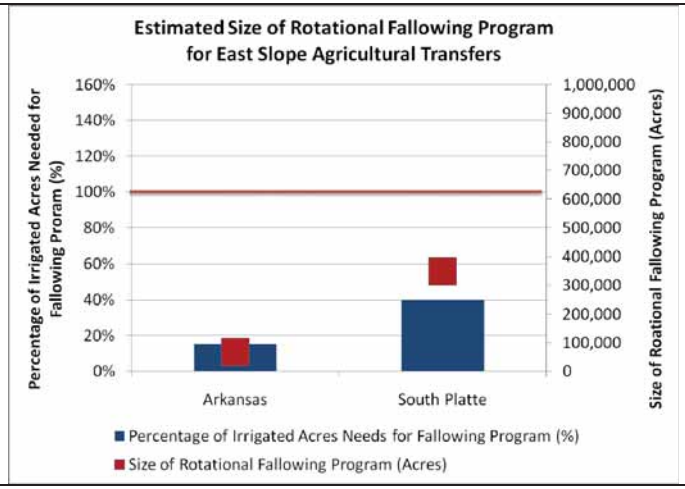


Table 3 Scenario 2 - Medium Demands/Low Conservation Strategy/300,000 AFY Colorado River System Water







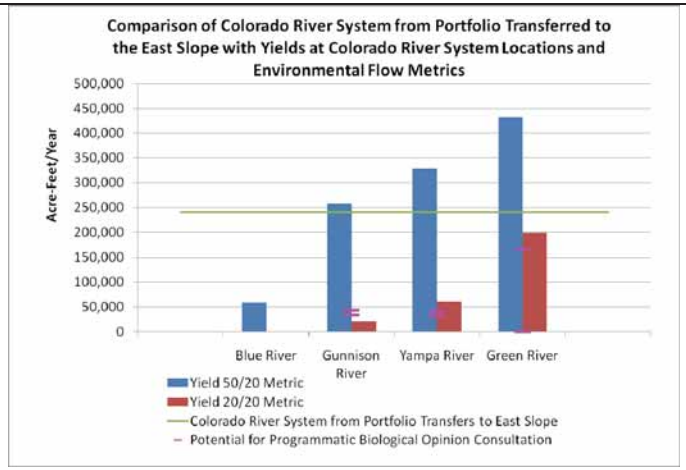
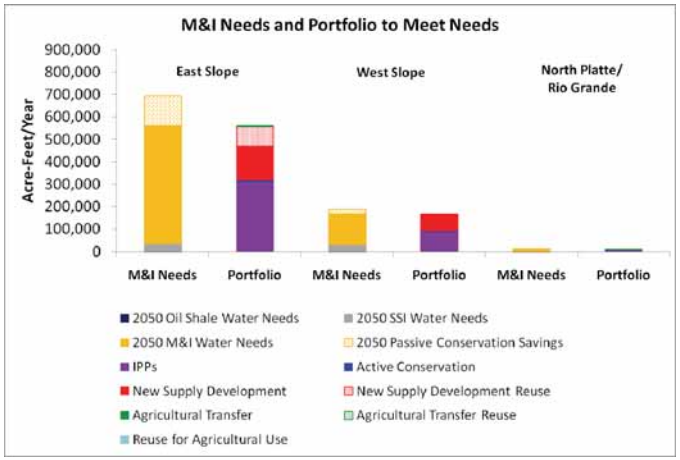
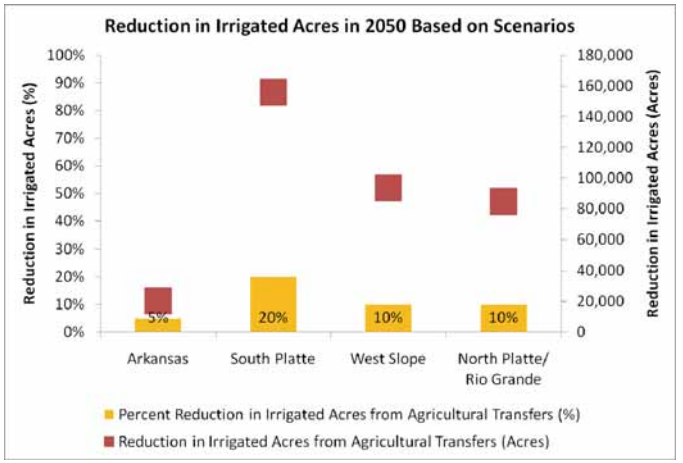
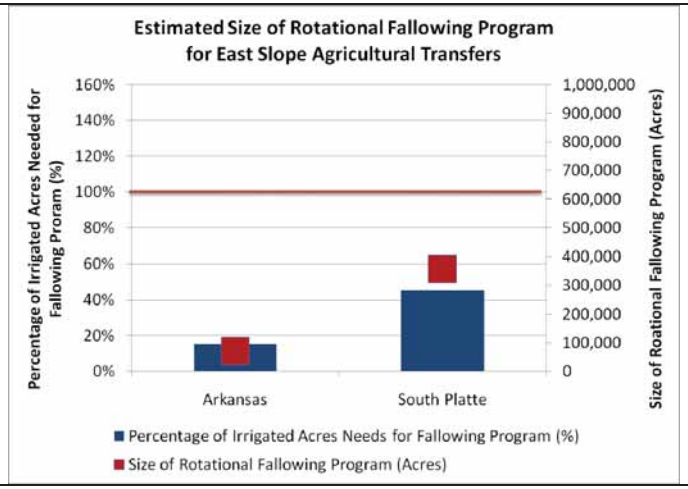


Table 4 Scenario 3: Medium Demands/Medium Conservation Strategy/150,000 AFY Colorado River System Water







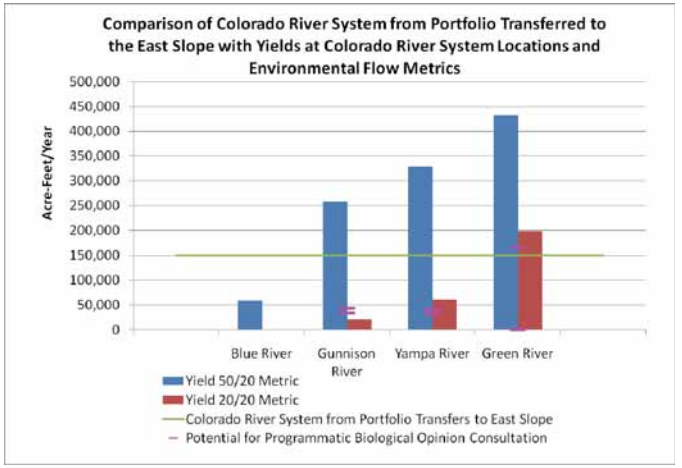
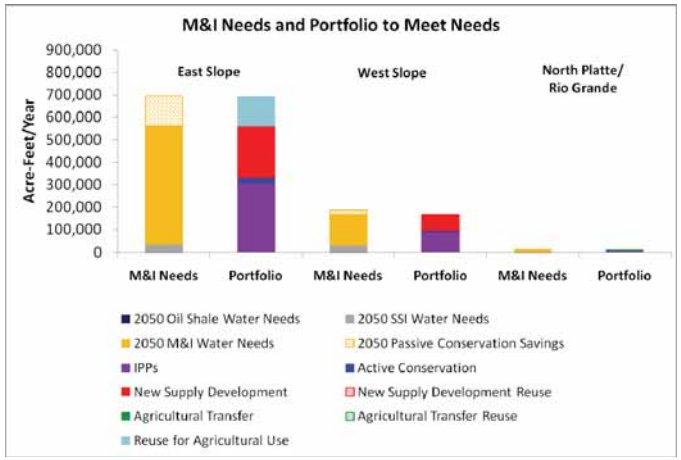
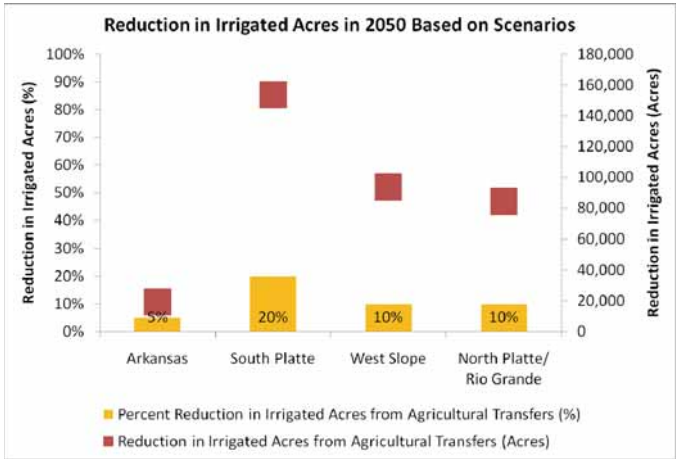
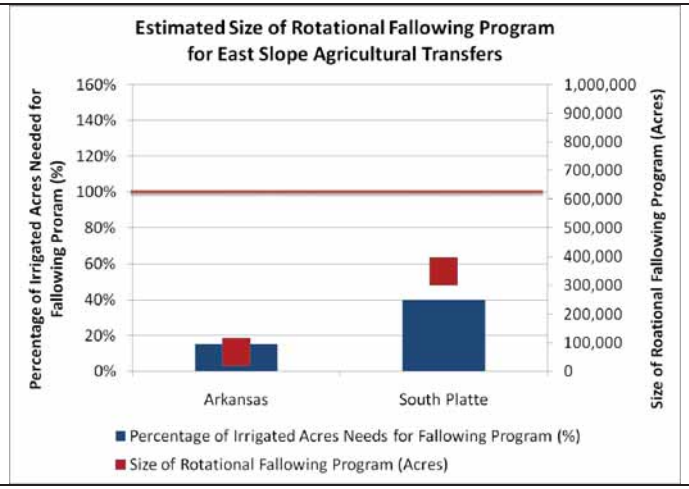
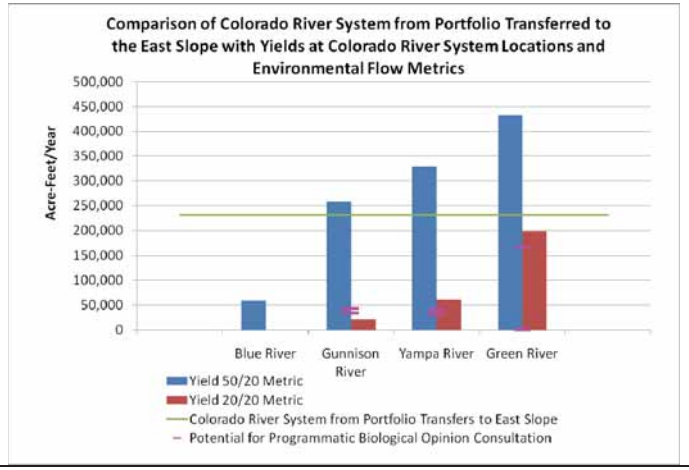


Table 5 Scenario 4 - Medium Demands/Medium Conservation Strategy/300,000 AFY Colorado River System Water









SOUTHWEST BASIN ROUNDTABLE

February 14, 2012

Memo
To: Greg Johnson

From: Steve Harris, IBCC Representative
Mike Preston, Roundtable Chair

Subject: Summary of SWRT January 11, 2012 Evaluation of Scenarios

This memo is an attempt to summarize the results of Southwest Roundtable (SWRT) consideration of multiple scenarios to meet the 2050 Colorado water demand. These results provide an indication of how the SWRT thinks about meeting the 2050 demand. There are many variables to consider and the SWRT preferences may evolve as this discussion unfolds.

BACKGROUND

The Southwest Roundtable (SWRT) conducted a discussion and vote on scenarios at its January 11, 2012 meeting in Durango. The 17 scenarios shown in Table 1 below were developed at a special work session on December 7, 2011 attended by approximately 25 members. The scenarios were developed to attempt to show the sensitivity of the amount of Arkansas and South Platte agriculture land dry up (referenced as Dry Up)compared to certain variables (right hand column).

Other variables were also examined that are listed in the following bullet points and summarized in Table 1 that includes information on the non-consumptive trade-off and the South Platte accretion/depletion trade-off. In addition, during the workshop the attendees identified what portfolios could be compared to one another in the evaluation process. Superscripts representing the three categories of comparable portfolios are included in Table 1. As was discussed at the workshop and as shown in Table 1, the lowest Dry Up percentages that can be achieved in the Arkansas and South Platte basins based on the assumptions presented above are 5% and 19 % respectively. Several of the portfolios in Table 1 reach this level based on the level of active conservation savings applied to the M&I gap and development of additional Colorado River System Supplies.

The variables are:

- 2050 Demand – high, medium, low
- Conservation strategy - high, medium, low
- Amount of Conservation applied to the Gap – 10%, 30%, 50%
- Amount of additional Colorado River Water used on the West Slope – 73,000 AF in all scenarios
- Amount of additional Colorado River Water used on the East Slope – 0, 150,000 AF, 300,000 AF
- Reuse factor – 1.4, 1.6

VOTE ON SCENARIOS

The purpose of the vote at the SWRT meeting was to determine a sense of how the members viewed variables in relation to the amount of Dry Up. The vote was conducted by providing each member with one yellow dot worth 2 points and one red dot worth 1 point. The members could place their dots on one or two scenarios. A total of 84 points were cast. Table 1 immediately below summarizes the points placed on each of the scenarios.

Table 1 Summary of Points for Portfolios Examined by SWRT at

Portfolio	Yellow Dots 2 pts	Red Dots 1 pt	Pts For Each Scenario	M&I Demand Scenario	Conservation Strategy/Percentage Applied to Gap	Colorado River System to West Slope/Colorado River System to East Slope (AF/Yr)	Reuse Ratio for Reusable Supplies	Percentage Irrigated Acres Transferred to M&I Use for Scenario (Arkansas/South Platte)
1a.1[2]	0	0	0	Medium	Medium/10%	73,000/0	1.4	15%/35%
1a.2[2]	8	3	19	Medium	Medium/10%	73,000/150,000	1.4	6%/21%
1a.3[2]	0	0	0	Medium	Medium/10%	73,000/300,000	1.4	5%/19%
1b.1[2]	0	1	1	Medium	Medium/30%	73,000/0	1.4	12%/31%
1b.2[2]	5	9	19	Medium	Medium/30%	73,000/150,000	1.4	5%/19%
1b.3[2]	0	0	0	Medium	Medium/30%	73,000/300,000	1.4	5%/19%
1c.1[1]	1	1	3	Medium	Medium/30%	73,000/0	1.6	11%/30%
1c.2[1]	2	2	6	Medium	Medium/30%	73,000/150,000	1.6	5%/19%
1d.1[1]	0	0	0	Low	Low/30%	73,000/0	1.6	13%/33%
1d.2[1]	0	1	1	Low	Low/30%	73,000/150,000	1.6	5%/19%
2a.1[1]	1	1	3	Medium	High/30%	73,000/0	1.6	10%/28%
2a.2[1]	1	2	4	Medium	High/30%	73,000/150,000	1.6	5%/19%
2b.1[2,3]	8	5	21	Medium	High/50%	73,000/0	1.6	7%/23%
2b.2[2,3]	2	3	7	Medium	High/50%	73,000/150,000	1.6	5%/19%
2c.1[3]	0	0	0	High	High/50%	73,000/0	1.6	12%/31%
2c.2[3]	0	0	0	High	High/50%	73,000/150,000	1.6	6/22%
2d.1[1]	0	0	0	Medium w/ 15% Increase	High/50%	73,000/0	1.6	11%/29%

The preferences of the Roundtable were concentrated on three scenarios, which received 21, 19 and 19 points respectively. All three scenarios were aimed at minimizing Dry Up using different portfolio elements to achieve that outcome. Table 2 on the following page presents the three top rated portfolios, followed by narrative summary and interpretations.

Table 2
Three Top Weighted Scenarios

2b.1	8	5	21	Medium	High/50%	73,000/0	1.6	7%/23%
1a.2	8	3	19	Medium	Medium/10%	73,000/150,000	1.4	6%/21%
1b.2	5	9	19	Medium	Medium/30%	73,000/150,000	1.4	5%/19%

- 2b.1 could be characterized as the "Conservation Portfolio" because it selects "High Conservation" with, 50% going to the gap and a reuse factor of 1.6 and no Colorado River Water going to the gap with Dry Up in the Arkansas and South Platte of 7% and 23% respectively.
- 1a.2. is characterized by 150,000AF of Colorado River Water to the Gap with Medium Conservation, 10% of which is applied to the gap and a reuse factor of 1.4, with Dry Up in the Arkansas and South Platt of 6% and 21% respectively.
- 1b.2 is identical to 1a.2 except that 30% of conservation is going to the gap reducing the Dry Up in the Arkansas and South Platt to 5% and 19% respectively.

Summary Statement: Vote on Scenarios

In summary, 36% of the points in the Roundtable portfolio vote were for the Conservation Portfolio involving no transfer of Colorado River water to the Front Range. 64% of the points in the portfolio voted to allow for the transfer of up to150,000 acre feet of Colorado River water to the Front Range, evenly split between 10% of conservation going to the gap and 30% of conservation going to the gap.

ANALYZING THE VOTE ON THE BASIS OF VARIABLES

Another approach to analyzing the Roundtable scores is to sort results by variables. Sorting the points according to the variables listed above provides an idea of how the SWRT thinks about each one. The points for each variable are shown in parenthesis. This analysis should be viewed as an indication but not be taken literally because Roundtable members did not vote based on variables, but rather based on scenarios.

- 2050 Demand – high (0), medium (83), low (1)
- Conservation strategy – high (35), medium (48), low (1)
- Amount of Conservation applied to the Gap – 10% (19), 30% (37), 50% (28)
- Amount of additional Colorado River Water used on the West Slope – 73,000 AF in all scenarios
- Amount of additional Colorado River Water used on the East Slope – 0 (28), 150,000 AF (56), 300,000 AF (0)
- Reuse factor – 1.4 (39), 1.6 (45)

The analysis of points based on variables by SWRT indicates the following:

- 2050 Demand – The medium estimate should be used.
- Conservation strategy – All members believe at least the medium strategy should be pursued with nearly half also supporting the high strategy.
- Amount of Conservation applied to the Gap – The members spread their points over all three levels of conservation applied to the gap.
- Amount of additional Colorado River Water used on the West Slope – 73,000 AF in all scenarios
- Amount of additional Colorado River Water used on the East Slope – The members supported 150,000 AF of water to the East Slope by a factor of two to one.

- Reuse factor – Support for the two reuse factor amounts was nearly equal.

CONCLUSION

The Southwest Roundtable voting exercise indicates a common interest in reducing Dry Up of front range agricultural lands. The path to this outcome split between those who assert that this result can be achieved with ambitious conservation (36%) and those who assert that up to 150,000 AF of Colorado River Water will need to be transferred to the Front Range (64%). There is enough support for both of these perspectives to warrant ongoing debate, fact finding, and analysis as the Southwest Roundtable continues to participate in the State level dialogue concerning these options. What can be said is that those who participated in the discussion and vote on a wide range of portfolios are better informed about the trade-offs and have taken an initial step towards informed decision making as these issues advance towards some level of statewide consensus.

December 5, 2011

Yampa/White/Green Portfolios:

Members of the roundtable met on December 5th, 2011 to better understand the portfolio and trade off tool and to develop the basin's portfolios. At the January roundtable meeting, members agreed that these portfolios were sufficient to share with other roundtables for discussion purposes.

The group defined two portfolios which share several commonalities represented below. They primarily differ in two respects. The worst case portfolio represents a situation in which there are no new Colorado River supplies are available for development on either the West or East slopes. The second represents a scenario where the historical driest 10 year period amount is available (about 450KAF). To maximize this water availability, a transbasin diversion of 110,000 AF is input in the tool (enough to allow for no new ag transfers on the East Slope) and the addition of 14,000 acres of new agricultural lands were added in the Yampa River Basin.

Portfolio Commonalities:

1) **High M&I demands – 167,700 AF for the Y/W/G (1,209,200 AF Statewide)**
    a. High population growth – 31,000 AF in the Y/W/G area (971,300 AF Statewide)
    b. High self supplied industrial – 32,700 AF in the Y/W/G (90,600 AF Statewide)
    c. Oil shale – 104,000 AF in the White River Basin (113,100 Statewide)
    d. Replacement of E.S. groundwater – (34,200 AF Statewide)
2) **IPP success – 67% in the Yampa/White Basin (left other BRT IPPs alone)**
    This is largely based on some recent Supreme Court rulings that limit some IPPs. Some listed IPPs, like Elkhead and Stagecoach are already complete, while others are far off with a low chance of success.
3) **High conservation strategy with 60% used to meet new demands**
    T. Wright and Jeff Devere discussed with the group that conservation is the crux of what needs to be done. If we don't conserve, then we'll start hammering ag., transferring unsustainable amounts of water from the West Slope to the East, etc. With conservation, we can balance the needs of the state with the needs of agriculture and the environment. The group discussed that what is asked of the East Slope for conservation, the West Slope needs to be prepared to do the same. Setting conservation at low, medium or high is more or less irrelevant to the Y/W/G, but makes a big difference in highly urbanized areas.
4) **East Slope reuse factor = 1.5**
    This is based on what the roundtable has heard so far concerning reuse capacity from East Slope Roundtables and interest in balancing the needs of agriculture downstream.

High Demand / Low Supply Scenario Considerations:

1) **The worst case portfolio** considers the above without any new west slope supplies being available for development for either side of the divide
2) **Impact to agriculture:** Over 100% of the agriculture in the basin would be required to meet new demands. If reuse was employed in the basin, this number could be reduced. (25% of SP ag,

226,000 acres, with 55-75% of SP acres needing to be in a rotational fallowing program to meet those needs)

3) **Impact to east slope environmental values:** Up to 12% depletion at the state line in the SP, which could have significant impact to wetlands and riparian areas needed for migratory, threatened, and endangered birds. Also, endangered fish downstream could be impacted, along with the three states agreement.
4) **Impact to West Slope environmental values:** None calculated, although the drought or climate change scenario that would be necessary to cause no additional supplies available could have a significant impact, especially elsewhere in the Colorado River System, such as the headwaters that already have impacts and expected to have a greater climate change effect.

High Demand / High Supply Scenario Considerations:

1) **The good neighbor portfolio** considers the above, but with enough supplies to meet all West Slope M&I needs plus new agricultural needs in the Yampa Basin (64,000 AF diversion / 24,200 AF CU) and provide 110,000 AF diversion to the East Slope.
2) **Impact to agriculture:** 2% dry-up in the Y/W/G from urbanization (20% dry-up in the SP – 172,000 acres, with some water potentially available from reuse)
3) **Impact to east slope environmental values:** 1-2% depletions in the SP
4) **Impact to West Slope environmental values:** Consultation with the U.S. Fish & Wildlife Service would be triggered if the transbasin diversion was to come out of the Yampa, but it is under the 50% of peak flows / 20% of base flow. Additional work to determine the risk to the environment may be conducted as part of the projects and methods study.

Consumptive Use

The members of the roundtable who attended the workshop wanted to know what the consumptive use of the good neighbor portfolio would be. Table 2 provides a reconnaissance level analysis of this use, indicating that as much as 428KAF of new depletions could occur in the Colorado Basin under this scenario. This represents a range reflective of historical water availability.

Table 1. Reconnaissance CU analysis for High Demand / High Supply Scenario

Basin	Category	Diversion	CU Factor	CU	Notes
White	M&I	14,750	35%	5,163	
White	Energy Development	5,200	100%	5,200	This does not include Oil Shale
White	Oil Shale	104,000	100%	104,000	
Yampa	M&I	10,650	35%	3,728	
Yampa	Ag increase	64,000	35%	22,400	For 14,000 acres of additional irrigation
Yampa	Large Industry	3,400	100%	3,400	
Yampa	Snowmaking	280	0%	-	Steamboat
Yampa	Thermoelectric	23,800	100%	23,800	Data from Xcel Energy, Nov. 2003 RE Hayden Facility and BBGC Yampa Study data for Routt & Moffat Counties
Other WS	M&I IPPs CO River	56,741	35%	19,859	Total IPPs are 93,311 AF. 8,200 from Ag Transfer and Reuse; assume 2/3's of remaining is from Colorado River System
Other WS	New CO River (Oil Shale, SSI, M&I)	34,084	62%	21,257	9,100 Oil Shale (CU=100%); 5,250 SSI (CU=100%); 19,734 M&I (CU=35%)
East Slope	New Transbasin Diversion	110,000	100%	110,000	
ES Total	IPP Transbasin	106,900	100%	106,900	This includes full use of Denver Water's system, Windy Gap Firming, Moffat Expansion, Eagle River MOU, etc.
TOTAL		**533,805**		**425,706**	
Yampa Total		*102,130*		*53,328*	Note this amt compared to PBO/Yampa Plan- ~53,500 AF future depletions b/w CO (30,100 AF) & WY (23,400 AF)
White Total		*123,950*		*114,363*	
Other WS Total		*90,825*		*41,116*	
TOTAL WS		***316,905***		***208,806***	
ES Total		***216,900***		***216,900***	