Technical Memorandum

Basin Roundtable Portfolio and Trade-off Analysis

Introduction and Overview

In May 2011, Interbasin Compact Committee (IBCC) Director John Stulp developed the Colorado Water for the 21st Century Roadmap. The roadmap outlined short-term, mid-term, and long-term actions. One of the short-term actions included the following:

> *To ensure grassroots input in developing statewide solutions, each roundtable will be asked to develop one or more statewide portfolios using the portfolio tool. This should include at least one mid demand/mid supply portfolio, but some roundtables may choose to develop portfolios for other scenarios as well. CWCB will provide technical assistance in this effort, and IBCC members from one or more basins may go to other basins to support portfolio development.*

The purpose of this Technical Memorandum is to summarize the Basin Roundtables' efforts in developing statewide portfolios for meeting Colorado's 2050 Municipal and Industrial (M&I) demands. As part of this task, the Basin Roundtables examined different demand scenarios that were developed as part of the Colorado Water Conservation Board's (CWCB) Statewide Water Supply Initiative (SWSI) 2010. The Basin Roundtables have also identified ranges of Identified Projects and Processes (IPPs), active conservation savings, Colorado River System supplies, and agricultural to M&I transfers that could be utilized to meet various demand scenarios. In addition, the Basin Roundtables have examined trade-offs included in the Portfolio and Trade-off Tool. These trade-offs include irrigated acres reduction, size of a rotational fallowing program, portfolio costs, nonconsumptive metric for the West Slope, and accretion/depletion analysis for the South Platte River.

This memorandum provides:

- An overview of the portfolio and trade-off analysis in the context of scenario planning
- A description of next steps
- A summary of each Basin Roundtable's portfolio development status
- An exploration of the commonalities and differences among the Basin Roundtable Portfolios

Portfolio Development and Scenario Planning Overview

Earlier this month (May 1, 2012), a Colorado Water for the 21st Century Updated Roadmap was provided to the Basin Roundtables, CWCB and IBCC Members. This roadmap was updated based on feedback received at the Basin Roundtable Summit in March 2012. The Updated Roadmap noted that the portfolio exercise resulted in general agreement on the following points:

- We must plan for a variety of possible futures and thus we should continue with scenario planning.
- There are no easy or straightforward solutions, and we need to pursue all types of projects and methods concurrently in order to balance the trade-offs.
- A high success rate for the IPPs statewide is critical to meet our municipal needs.

- Conservation measures should be implemented and monitored to quantify their impact.
- Nonconsumptive needs should be addressed.
- Agricultural shortages should be addressed and agriculture should be preserved.
- Specific solutions need to be identified to address the 2050 water supply gap.

Figure 1 below was included in the Updated Roadmap and summarizes the water supply planning process and schedule. The focus on the next 12 months will include:

- Portfolio Development and Scenario Planning
- Implementation of Consumptive and Nonconsumptive Projects and Methods
- Initiation of SWSI 2016 and the State Water Plan

The remainder of this technical memorandum focused on the portfolio development and scenario planning effort.

Figure 1 Water Supply Planning Process Roadmap Summary and Schedule

Since June 2011, the Basin Roundtables have worked with the Portfolio and Trade-off Tool to develop 33 different portfolios for meeting the state's long-term water supply needs. Basin Roundtable members have developed a broad range of portfolios to address many possible future scenarios. Some of these portfolios explore different potential futures, while others represent a Basin Roundtable's values in how they would meet such a future. These portfolios will be used by the IBCC as a basis for scenario planning.

Per the Updated Roadmap, the IBCC's scenario planning will use the following steps:

- **IBCC Portfolio and Scenario Work:** Starting at the May 31st IBCC meeting, the IBCC will use the Basin Roundtables' portfolio work as they begin to complete scenario planning and adaptive management.
  - The IBCC will first narrow the Basin Roundtables' portfolios into a smaller set of portfolios that addresses a range of different scenarios. Initial metrics will be used to evaluate how these portfolios perform under different scenarios. From this smaller set of portfolios, the IBCC will be able to identify a set of "no regrets" implementation strategies that will be useful in meeting Colorado's water supply needs no matter what future emerges in the year 2050. Implementation of these strategies in the near term will be important.
  - Next, the IBCC will work towards developing adaptive management triggers that will indicate which scenario Colorado is approaching at any given time in the future. Based on the triggers and portfolio work, an adaptive management framework will be developed, which will identify under what conditions a future portfolio and its projects and methods should be pursued. Additional evaluation metrics are an important part of the adaptive management framework to assess portfolios and the specific projects and methods that they may include. Evaluation metrics that will be considered include nonconsumptive needs, supply reliability, agricultural economics, and cost of implementation. In order to apply many of these metrics, additional specificity for how each strategy will be implemented is needed. This is likely to include analysis on a range of projects, methods, and risk management strategies.
- **Roundtable Feedback:** During the summer and fall of 2012, Basin Roundtables will have opportunities to provide feedback on the IBCC's scenario planning work.
- **Continued Cross-Basin Discussions on Statewide Issues:** CWCB and the IBCC will work with Basin Roundtables and constituencies to continue addressing cross-basin issues such as increasing consumptive and nonconsumptive IPP success rates, conservation, alternative agricultural transfer methods, storage, risk management, and the development of new water supplies.

Basin Roundtable Portfolio and Trade-off Results

As discussed above, the Basin Roundtables have been asked to develop one or more statewide portfolios (see **Figure 2**). As part of this effort each Basin Roundtable developed at least one portfolio focusing on mid-level demands and most also developed portfolios for other demand scenarios. In developing portfolios, the Basin Roundtables have explored IPP yield success, the level of active conservation and whether these savings can be used to address the M&I gap, new supply development in the

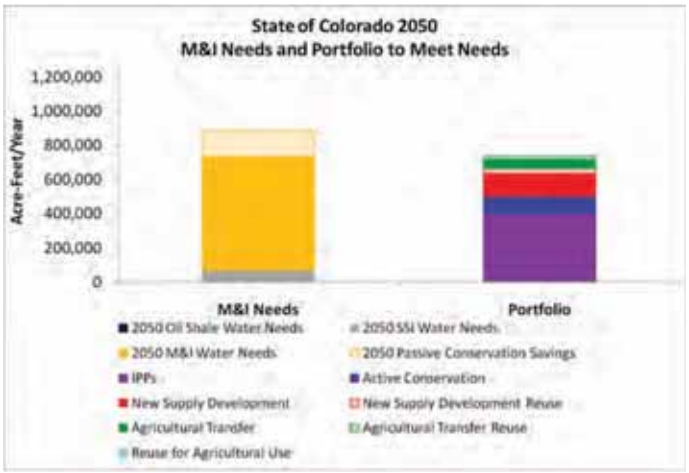


Figure 2 Portfolio and Trade-off Tool Statewide Portfolio Page

Colorado River System, and agricultural transfers. When developing portfolios, the Basin Roundtables have also explored trade-offs associated with each portfolio.

Basin Roundtable Portfolio Status

Table 1 below includes a brief summary of each Basin Roundtable's efforts in developing portfolios for Colorado's future M&I demands. The Basin Roundtables have developed 33 statewide portfolios. A summary of the common elements that have emerged from this effort is included in the next section of this Technical Memorandum. **Appendix A** summarizes the results of the portfolios developed by the Basin Roundtables to date. Some of the Basin Roundtables have developed summary documentation of their efforts and this information is included in **Appendix B** of this memorandum.

Table 1 Status of Basin Roundtable Portfolio Development

Basin Roundtable	Status of Portfolio Development
Arkansas	▪ A roundtable committee developed three initial portfolios for roundtable review. ▪ The roundtable developed two additional portfolios for a total of five portfolios focusing on low demands/low supply, low demands/high supply, mid demand/mid supply, high demand/low supply, and high demand/high supply. ▪ IPP yield success was set at about 80 percent statewide for all portfolios. ▪ The committee's initial portfolios increased conservation savings applied to the gap with increase in M&I demands. ▪ The Colorado River System developed for West and East Slope uses increases based on scenario. ▪ With exception of the high demand/low supply scenario, agricultural transfers were minimized in the Arkansas and South Platte basins. ▪ The roundtable developed a memo (included in Appendix B) that summarized the members' thoughts regarding the portfolio exercise
Colorado	▪ The roundtable held several committee meetings and the roundtable discussed portfolio development at several roundtable meetings. ▪ The roundtable has currently developed three portfolios focusing on mid demand/mid supply, mid demand/high supply, and high demand/low supply. ▪ IPP yield success was set at about 80 percent statewide for all portfolios. ▪ The roundtable assigned the high conservation scenario for all portfolios with 60 percent of active conservation savings applied to the M&I gap for all three portfolios. ▪ The roundtable defined the Colorado River low supply scenario as no use of Colorado River System water for West or East Slope use and the mid-supply scenario as 150,000 acre-feet per year (AFY) for use on the West Slope and no Colorado River water for use on the East Slope. For the high supply scenario, the roundtable assigned 150,000 AFY for use on the West Slope and 168,000 AFY for the East Slope. ▪ With exception of the low supply scenario, agricultural transfers were minimized in the Arkansas and South Platte basins.
Gunnison	▪ A roundtable committee developed 10 portfolios through several webinars. ▪ The roundtable selected four portfolios to be included in the discussion at the Basin Roundtable Summit. The portfolios include a high demand/low supply (worst case scenario), low demands with 80,000 AFY of Colorado River System for East Slope use, climate change scenario (mid demands and 80,000 AFY Colorado River System for East Slope use), and mid demands with high conservation strategy (100,000 AFY Colorado River for East Slope use). All portfolios had 140,000 AFY for West Slope use except the worst case portfolio. ▪ After the summit, the roundtable refined their set of portfolios to three that included a low demand, medium demand and high demand portfolio. ▪ IPP yield success was set at about 80 percent statewide for all portfolios. ▪ For the low demand portfolio, the roundtable used the medium conservation strategy with 50 percent of the savings applied to the M&I gap, for the medium demand scenario they assigned 50 percent of the high conservation strategy savings to the M&I gap, and for the high demand scenario they assigned 60 percent of the high conservation strategy savings to the M&I gap.

Table 1 Status of Basin Roundtable Portfolio Development

Basin Roundtable	Status of Portfolio Development
Metro	▪ The Metro Basin Roundtable's committee developed four portfolios. The portfolios include low demand, mid demand, high demand, and high demand with climate change. ▪ IPP yield success was set at about 80 percent statewide for all portfolios. ▪ The roundtable completed an extensive analysis of conservation savings and used the medium conservation strategy with none of the savings specified in the portfolio tool applied to the gap with exception of the high demand with climate change portfolio. The basin's conservation analysis details the amount of passive savings being used for new growth and also discusses the demand reductions that have occurred since 2000. ▪ The Basin Roundtable utilized a "bookends" approach to define the limits of meeting future demands exclusively with either new supply or agricultural transfers. The first bookend assumes that all the additional supply would be met exclusively from Agricultural Transfers.
North Platte	▪ The roundtable developed one portfolio focusing on mid-supply/mid demand. ▪ IPP yield success was set at about 70 percent statewide. All IPPs in the agricultural transfer category were set to zero percent yield success. ▪ The roundtable's objective in developing the portfolio was to minimize agricultural transfers. ▪ The roundtable used the medium conservation scenario and applied 30 percent of the savings for the Arkansas, Metro, and South Platte basins to the M&I gap. ▪ The roundtable assumed that 300,000 AFY of Colorado River System would be developed for combined West and East Slope uses.
Rio Grande	▪ The Rio Grande Basin conducted a workshop on the portfolio and trade-off tool and the attendees developed four portfolios. ▪ IPP yield success was set at about 80 percent statewide for all portfolios. ▪ All four portfolios are for mid demand and vary the conservation strategy and new supply development for the East Slope between 150,000 and 300,000 AFY. ▪ For all of their portfolios, agricultural transfers were minimized in the Arkansas and South Platte basins.
South Platte	▪ The roundtable discussed portfolio development at several of its roundtable meetings and formed a committee that developed four portfolios. The roundtable developed two mid demand and two high demand portfolios and they varied the amount of Colorado River System development for the East Slope between zero and 175,000 AFY. ▪ IPP yield success was set at about 80 percent statewide for all portfolios. ▪ For all portfolios they utilized the low conservation strategy with 10 percent of the savings being applied to the M&I gap statewide.
Southwest	▪ The Southwest Basin Roundtable conducted a workshop and the workshop attendees developed 17 portfolios. The roundtable conducted a facilitated session on the workshop results and used a dot voting exercise to narrow their portfolios to the three final portfolios. ▪ The results of the facilitated roundtable meeting resulted in three mid demand portfolios. ▪ IPP yield success was set at about 80 percent statewide for all portfolios. ▪ They varied the conservation savings applied to the M&I gap for all portfolios and used the high conservation strategy for one scenario and the medium conservation strategy for two scenarios. ▪ Two portfolios assumed Colorado River System development of 73,000 AFY for the West Slope and 150,000 AFY for the East Slope. The third portfolio assumed 73,000 AFY to the West Slope and 0 AFY to the East Slope. ▪ For all of their portfolios, agricultural transfers were minimized in the Arkansas and South Platte basins.
Yampa-White	▪ The Yampa-White Basin Roundtable formed a committee to develop an initial set of portfolios that were discussed at two basin roundtable meetings. The roundtable identified two portfolios based on this information. ▪ These include two high demand portfolios with one that includes use of the Colorado River System and one that does not. ▪ IPP yield success was set at about 85 percent statewide for all portfolios. ▪ The roundtable utilized the high conservation strategy with 60 percent applied to the M&I gap.

Scenario Summary

As discussed above, the IBCC will use the Basin Roundtables' portfolio work as they begin to complete scenario planning and adaptive management. The IBCC will first narrow the Basin Roundtables' portfolios into a smaller set of portfolios that will be evaluated for range of different scenarios. Metrics will be used to evaluate how these portfolios perform under different scenarios. From this smaller set of portfolios, the IBCC will be able to identify a set of "no regrets" implementation strategies that will be useful in meeting Colorado's water supply needs no matter what future emerges in the year 2050

Table 2 provides a summary of all 33 Basin Roundtable portfolios and an initial draft nonconsumptive portfolio. For each portfolio, the demand scenario is described along with noting whether the portfolio includes oil shale demands and replacement of Front Range nontributary groundwater. The conservation strategy and amount of the active conservation savings applied to the M&I gap is described for each portfolio. Finally, the amount of Colorado River System and agricultural transfer used in each portfolio is summarized.

Table 2 Summary of All Portfolios Developed by the Roundtables and IBCC Nonconsumptive Committee

Basin	Demand Scenario	Oil Shale	Replace Front Range Non-Tributary Groundwater	Identified Projects and Processes (Statewide % of Yield Success)	Conservation			New Supply Development		Agricultural Transfer	
					Strategy	% to meet M&I Demands	Acre-Feet/Year to Meet M&I Demands	West Slope (AFY)	East Slope (AFY)	West Slope (AFY)	East Slope (AFY)
Arkansas	Low	yes	yes	81%	Low	0%	0	25,000	0	27,000	140,000
	Low	no	no	81%	Low	0%	0	0	250,000	52,000	0
	Mid	yes	yes	82%	Medium	25%	83,000	150,000	50,000	0	78,000
	High	yes	yes	83%	Low	0%	0	25,000	0	197,000	237,000
	High	yes	yes	83%	Medium	50%	167,000	200,000	150,000	0	0
Colorado	Mid	yes	yes	78%	High	60%	278,000	150,000	0	0	27,000
	Mid	yes	yes	78%	High	60%	278,000	150,000	168,000	0	0
	High	yes	yes	81%	High	60%	278,000	0	0	183,000	92,000
Gunnison	Low	yes	yes	76%	Medium	50%	167,000	100,000	0	0	105,000
	Mid	yes	yes	77%	High	50%	231,000	100,000	75,000	23,000	32,000
	High	yes	yes	79%	High	60%	278,000	100,000	75,000	135,000	112,000
Metro	Low	yes	yes	80%	Medium	0%	0	200,000	0	0	193,000
		yes	yes	80%	Medium	0%	0	200,000	193,000	0	0
	Mid	yes	yes	81%	Medium	0%	0	200,000	0	0	220,000
		yes	yes	81%	Medium	0%	0	200,000	220,000	0	0
	High	yes	yes	82%	Medium	0%	0	200,000	0	29,000	289,000
		yes	Yes	82%	Medium	0%	0	200,000	289,000	29,000	0
	High	yes	yes	82%	Medium	36%	119,000	200,000	0	8,000	332,000
		yes	yes	82%	Medium	36%	119,000	200,000	332,000	8,000	0
North Platte	Mid	no	Yes	71%	Low	30%	36,000	90,000	210,000	0	0
Rio Grande	Mid	no	Yes	83%	Low	10%	16,000	75,000	150,000	0	3,200
	Mid	no	Yes	83%	Medium	10%	33,000	75,000	150,000	0	0
	Mid	no	Yes	83%	Low	10%	16,000	75,000	300,000	0	0
	Mid	no	Yes	83%	Medium	10%	33,000	75,000	300,000	0	0
South Platte	Mid	yes	Yes	82%	Low	10%	16,000	175,000	0	0	205,000
	Mid	yes	Yes	82%	Low	10%	16,000	175,000	175,000	0	30,000
	High	yes	Yes	83%	Low	10%	16,000	175,000	0	86,000	279,000
	High	yes	yes	83%	Low	10%	16,000	175,000	175,000	86,000	104,000
Southwest	Mid	no	yes	83%	High	50%	231,000	73,000	0	0	42,000
	Mid	no	yes	83%	Medium	10%	33,000	73,000	150,000	0	14,000
	Mid	no	yes	83%	Medium	30%	99,000	73,000	150,000	0	0
Yampa-White	High	yes	yes	85%	High	60%	278,000	0	0	186,000	74,000
	High	yes	yes	85%	High	60%	278,000	263,000	150,000	0	0
NCNA	Mid	no	yes	77%	High	60%	278,000	50,000	0	0	33,000

Basin Roundtable Portfolios Commonalities and Differences

The discussion below includes a summary of the commonalities and differences for each portfolio element based on the work of the nine Basin Roundtables.

M&I Demands

Of the 34 portfolios developed by the roundtables and the nonconsumptive committee, five portfolios were developed using the low demand scenario, 17 using the mid demand scenario, and 12 using the high demand scenario. The major difference between portfolios on the demand side was inclusion of oil shale demands. One-third of the portfolios do not include oil shale demands. The main reasons stated by Basin Roundtables that chose not to include oil shale are: (1) that it is not feasible that oil shale will be developed due to current economic conditions, and (2) that other oil development through the Niobrara and Bakken formations may preclude development of oil shale in Northwest Colorado.

The major commonality among the portfolios is that replacement of Front Range nontributary groundwater should occur in the future. Twenty-nine of the 30 portfolios included this in the M&I demands to be met in the future. The one portfolio that did not include replacing Front Range nontributary groundwater was a high supply portfolio and it was assumed that under the high supply scenario this demand would not have to be replaced as there would be sufficient water supply that nontributary groundwater use would not be needed.

Identified Projects and Processes

The statewide IPP yield success rate used by the Basin Roundtables was relatively consistent at about 80 percent for all 30 portfolios. The exception was the North Platte Basin Roundtable that used an IPP success rate of about 70 percent statewide due to minimizing the amount of IPPs associated with agricultural transfers. All of the Basin Roundtables set their IPP success rate and held it constant for all of the portfolios they examined. Five of the nine Basin Roundtables set their own basin's IPP success rate based on the discussion described in Table 1 and deferred to what other basin's had developed to finalize a statewide success rate. **Table 3** summarizes the IPP success by IPP type as set by each Basin Roundtable. Using the percentages set by the Basin Roundtables results in an 80 percent IPP success rate statewide.

Table 3 IPP Success Rate by Basin and IPP Type

Basin	Agricultural Transfer	Reuse	Existing Supplies	In-Basin Project	Transbasin	In-Basin Firming	Total Success Rate
Arkansas	75%	75%	100%	100%	75%	80%	86%
Colorado	90%	90%	100%	85%	90%	85%	91%
Gunnison	90%	90%	100%	90%	90%	90%	88%
Metro	75%	75%	100%	75%	75%	75%	88%
North Platte	0%	90%	100%	90%	90%	90%	100%
Rio Grande	90%	90%	100%	90%	90%	85%	93%
South Platte	50%	80%	100%	50%	85%	50%	65%
Southwest	100%	100%	100%	80%	100%	100%	88%
Yampa-White	100%	100%	100%	50%	100%	100%	67%

Conservation and Reuse

The Basin Roundtables used all three levels of active conservation (Low = 160,000 AFY, Medium = 330,000 AFY, and High = 460,000 AFY) in their portfolio development. **Figure 3** shows the distribution by conservation strategy and the average amount of conservation savings from each

strategy that the Basin Roundtables assigned to meet the M&I gap. For the low conservation strategy, a lower quantity of water was set aside to meet the M&I gap (13,000 AFY statewide). Most of the portfolios using the medium and high conservation strategies had a higher amount of savings used to meet the M&I gap (57,000 AFY and 268,000 AFY, respectively). The major difference among the portfolios is the amount of conservation savings that could be applied to the M&I gap. The following basins had a portfolio or portfolios that apply a smaller percentage of conservation savings to the M&I gap: Arkansas, Metro, Rio Grande, South Platte, and Southwest. These Basin Roundtables have concerns regarding the reliability of using conserved water for new growth and that using conserved water to meet new demands will impact their drought reserve and system flexibility.

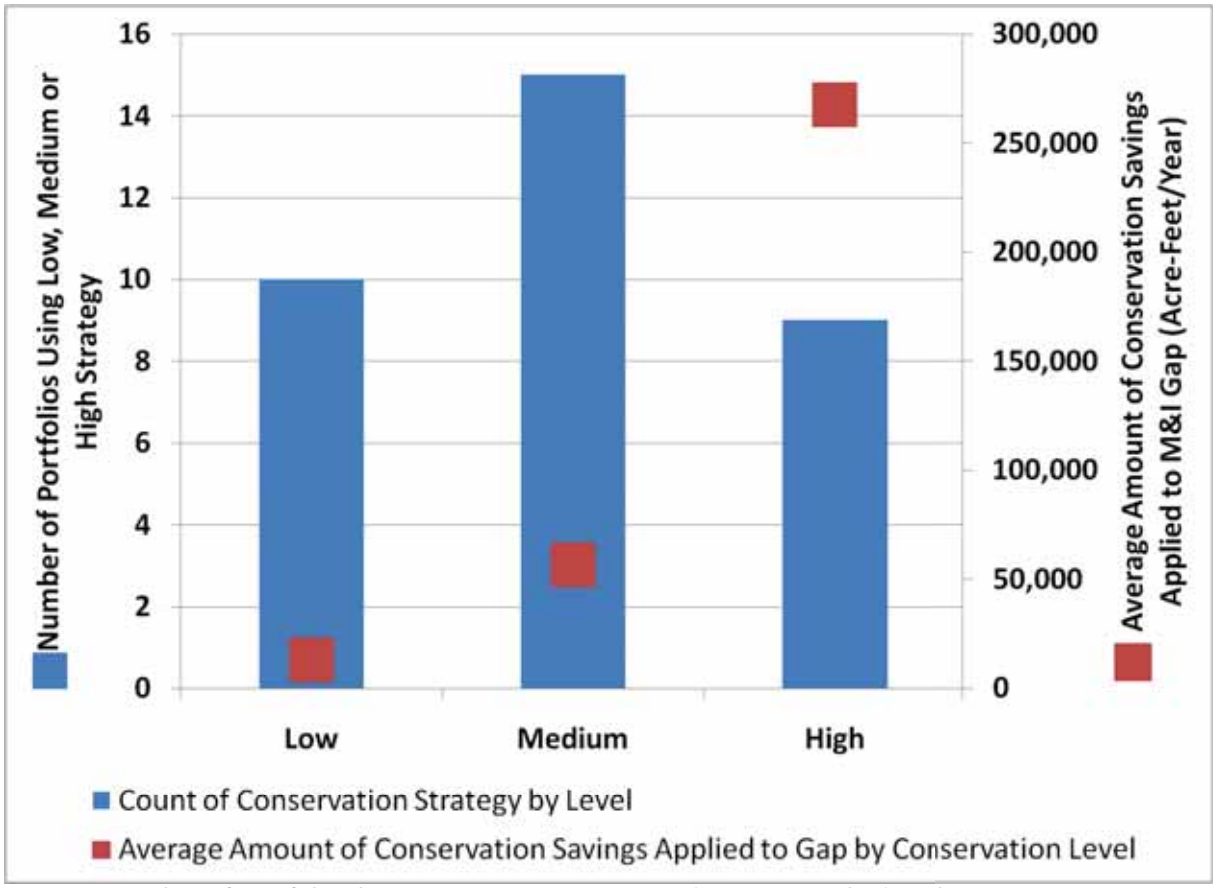


Figure 3 Number of Portfolios by Conservation Strategy and Savings Applied to the M&I Gap

The portfolios developed by the Basin Roundtables also include reuse of any future transbasin supplies and the consumptive use portion of future agricultural transfers. This is included in the portfolio tool as a ratio of reuse that could be achieved by reusing either a transbasin supply or the consumptive use portion of an agricultural transfer. The range of reuse ratios used by the Basin Roundtables is 1.4 to 1.7 with most between 1.5 and 1.6. The initial draft IBCC Nonconsumptive Committee portfolio used a reuse ratio of 1.9.

Colorado River System

The amount of Colorado River System water developed in the portfolios ranges from zero to 532,000 AFY. All of the Basin Roundtables developed at least one portfolio that identified Colorado River System development for West and East Slope use. Overall, more than50 percent of the portfolios

developed by the Basin Roundtables include Colorado River System water development and use by both the West and East Slope as shown in **Figure 4**.

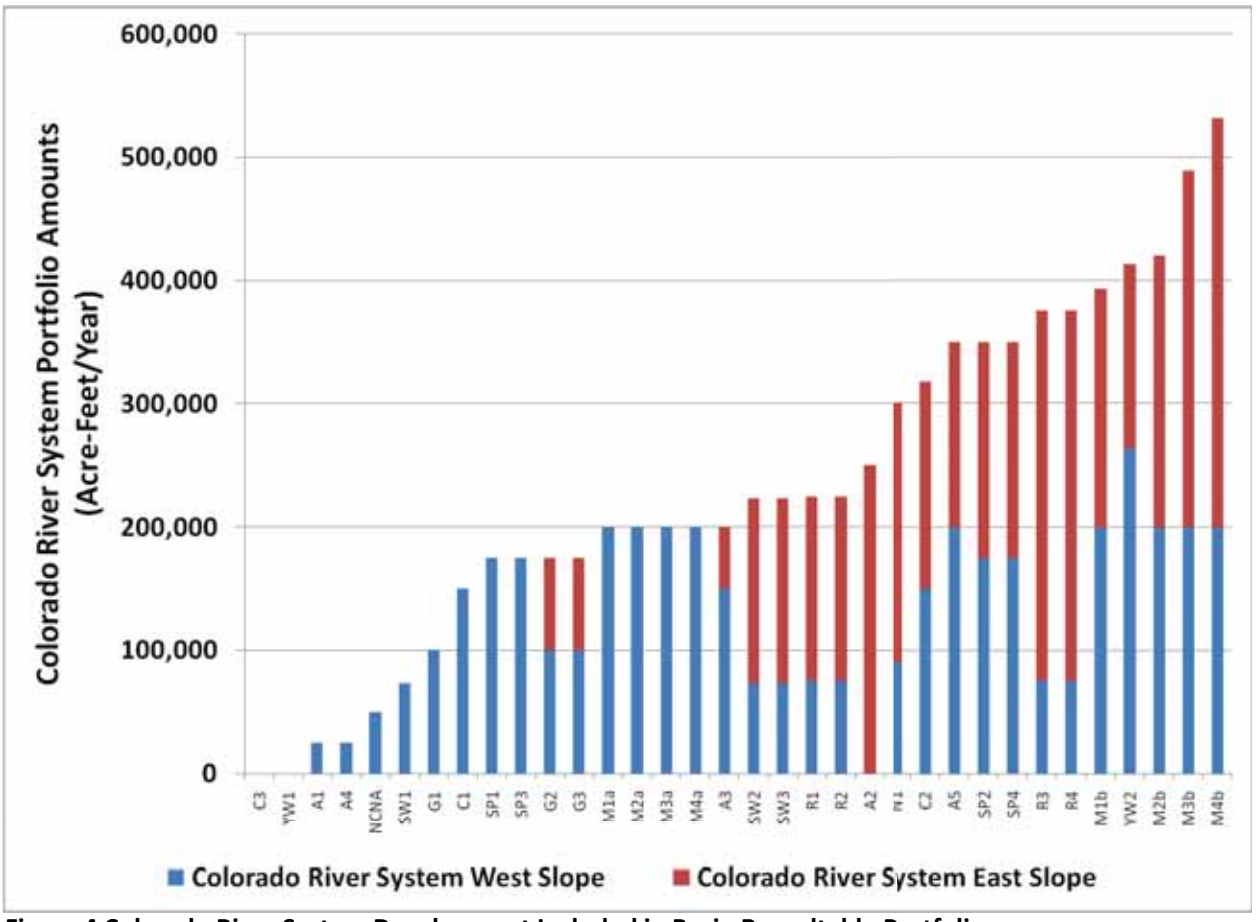


Figure 4 Colorado River System Development Included in Basin Roundtable Portfolios

Agricultural Transfers

As shown in **Figure 5 and Figure 6**, a over half of the portfolios developed by the Basin Roundtables attempted to minimize additional agricultural transfers in the future. Based on results of IPPs analyses and population growth estimates presented in SWSI 2010, approximately 260,000 acres statewide will be lost due to transfers to M&I use or urbanization. Based on the portfolios developed to date, the South Platte could lose from 5 to 40 percent of additional irrigated acres above the 20 percent that is expected to be lost to IPPs and urbanization. The West Slope could lose from 5 to 25 percent of additional irrigated acres more than the 10 percent that is expected to be lost due to IPPs and urbanization. Reducing the impacts to agriculture as a result of meeting Colorado's future M&I water demands was discussed in detail by all of the Basin Roundtables when completing the portfolios exercise.

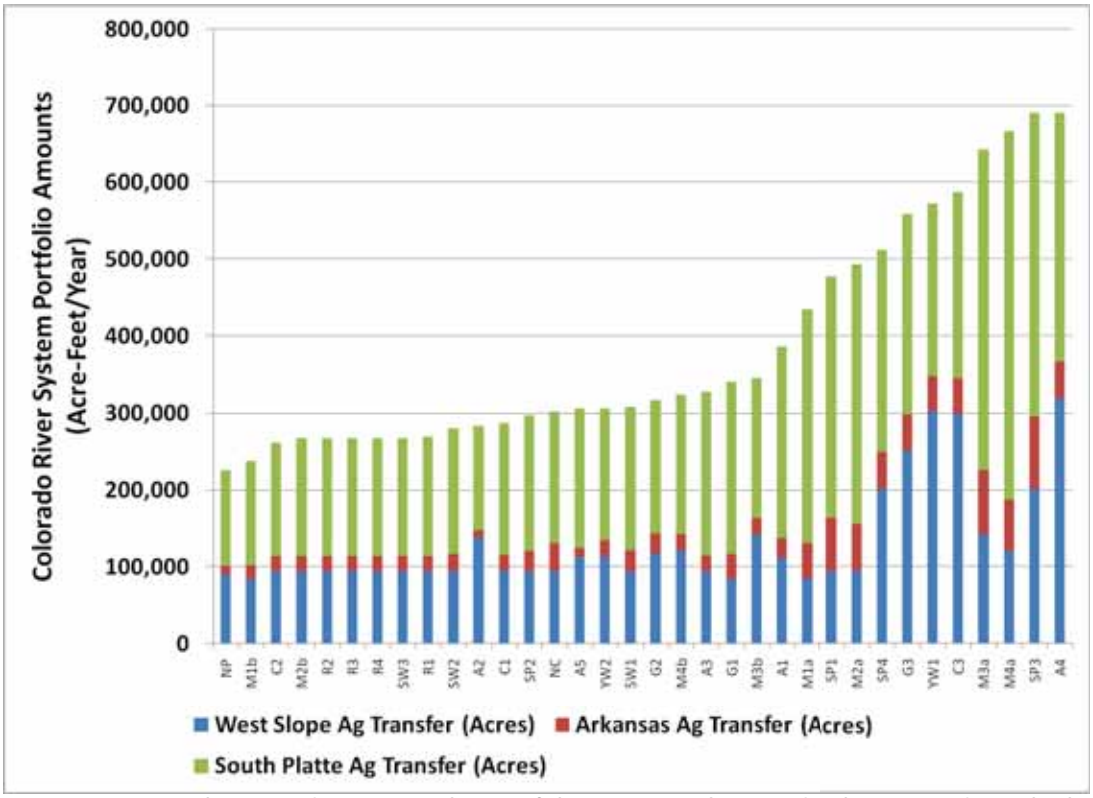


Figure 5 Potential Irrigated Acres Lost by Portfolio on West Slope and Arkansas and South Platte Basins (Acres)

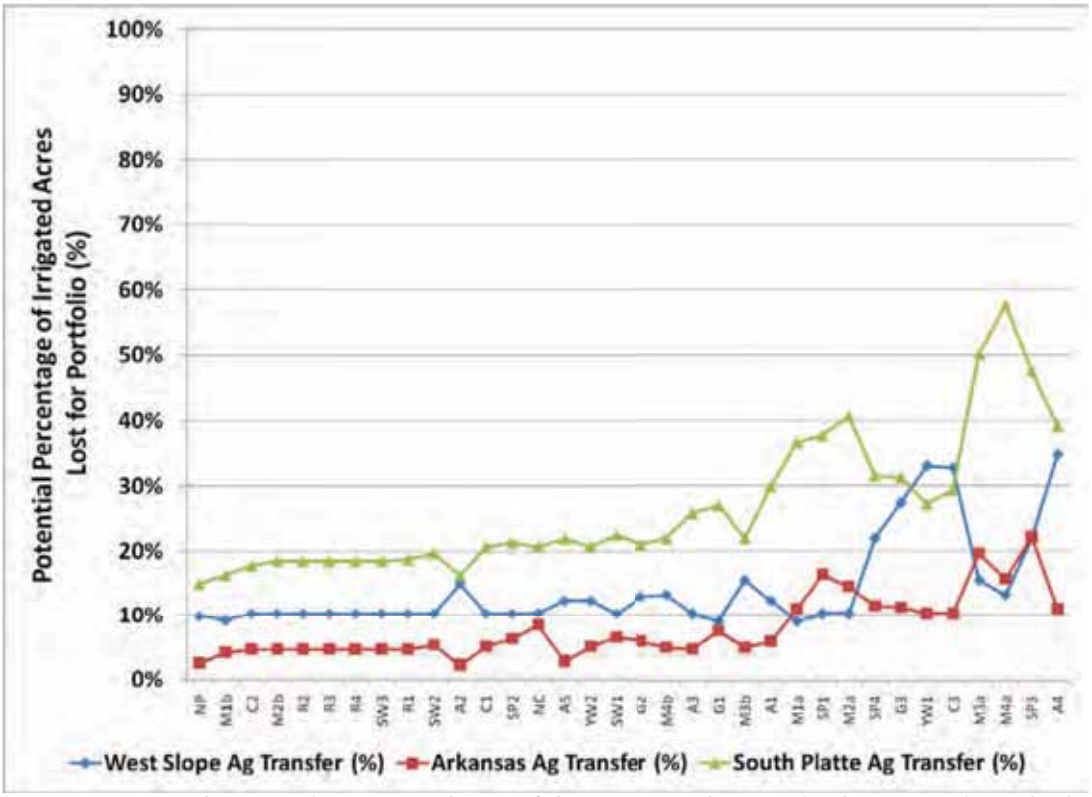


Figure 6 Potential Irrigated Acres Lost by Portfolio on West Slope and Arkansas and South Platte Basins (Percentage)

Trade-Offs

The Basin Roundtables examined all of the trade-offs in the Portfolio and Trade-off Tool when developing their portfolios. The trade-offs identified in the portfolios are summarized in Appendix A. As was discussed above, the trade-offs will be assessed as part of finalizing the scenario planning effort and developing the adaptive management framework as the IBCC develops evaluation metrics. These metrics could include further information on environmental, recreational, agricultural, cost, and M&I reliability.

Appendix A

Basin Roundtable Portfolio and Trade-off Results

This page left intentionally blank.

Table 1 – Summary of Arkansas Basin Roundtable Portfolio Analysis

Portfolio Element	ARK 1	ARK 2	ARK 3	ARK 4	ARK 5
Demand INPUT	Low (620,000 AFY)	Low (590,000 AFY)	Medium (790,000 AFY)	High (1,060,000 AFY)	High (1,060,000 AFY)
Oil Shale INPUT	Yes	No	Yes	Yes	Yes
IPPs INPUT	86% Arkansas IPP yield success.	86% Arkansas IPP yield success.	86% Arkansas IPP yield success.	86% Arkansas IPP yield success.	86% Arkansas IPP yield success.
Active Conservation INPUT	Low Strategy (160,000 AFY). 0% applied to gap. Yield to gap = 0 AFY.	Low Strategy (160,000 AFY). 0% applied to gap. Yield to gap = 0 AFY.	Medium Strategy (330,000 AFY). 25% applied to gap. Yield to gap = 83,000 AFY.	Low Strategy (160,000 AFY). 0% applied to gap. Yield to gap = 0 AFY.	Medium Strategy (330,000 AFY). 50% applied to gap. Yield to gap = 167,000 AFY.
Reuse INPUT	Reuse ratio = 1.5	Reuse ratio = 1.5	Reuse ratio = 1.5	Reuse ratio = 1.5	Reuse ratio = 1.5
New Colo. River Supply INPUT	25,000 AFY to West Slope. 0 AFY to East Slope.	0 AFY to West Slope. 250,000 AFY to East Slope.	150,000 AFY to West Slope. 50,000 AFY to East Slope.	25,000 AFY to West Slope. 0 AFY to East Slope.	200,000 AFY to West Slope. 150,000 AFY to East Slope.
New Colo. River Supply RESULTS	25,000 AFY to West Slope. 0 AFY to East Slope.	0 AFY to West Slope. 175,000 AFY to East Slope.	121,000 AFY to West Slope. 50,000 AFY to East Slope.	25,000 AFY to West Slope. 0 AFY to East Slope.	196,000 AFY to West Slope. 150,000 AFY to East Slope.
New Agricultural Transfer Supply RESULTS	27,000 AFY to West Slope. 140,000 AFY to East Slope.	52,000 AFY to West Slope. 0 AFY to East Slope.	0 AFY to West Slope. 78,000 AFY to East Slope.	197,000 AFY to West Slope. 237,000 AFY to East Slope.	0 AFY to West Slope. 0 AFY to East Slope.
Ag Transfers and Urbanization – Irrigated Acres RESULTS	Arkansas = 5% (26,000 acres). South Platte = 30% (248,000 acres). West Slope = 10% (112,000 acres). North Platte/Rio Grande = 10% (84,000 acres).	Arkansas = 0% (0 acres). South Platte = 15% (136,000 acres). West Slope = 15% (138,000 acres). North Platte/Rio Grande = 10% (84,000 acres).	Arkansas = 5% (21,000 acres). South Platte = 25% (214,000 acres). West Slope = 10% (94,000 acres). North Platte/Rio Grande = 10% (83,000 acres).	Arkansas = 10% (47,000 acres). South Platte = 40% (325,000 acres). West Slope = 35% (319,000 acres). North Platte/Rio Grande = 10% (87,000 acres).	Arkansas = 5% (12,000 acres). South Platte = 20% (182,000 acres). West Slope = 10% (113,000 acres). North Platte/Rio Grande = 10% (84,000 acres).
Other Portfolio Trade-off RESULTS	20% of Arkansas and 90% of South Platte irrigated acres needed for fallowing program. DECREASE in South Platte River flows 8% at state line.	5% of Arkansas and 35% of South Platte irrigated acres needed for fallowing program. INCREASE in South Platte River flows 11% at state line.	15% of Arkansas and 70% of South Platte irrigated acres needed for fallowing program. DECREASE in South Platte River flows 10% at state line.	40% of Arkansas and 120% of South Platte irrigated acres needed for fallowing program. DECREASE in South Platte River flows 10% at state line.	10% of Arkansas and 55% of South Platte irrigated acres needed for fallowing program. DECREASE in South Platte River flows 4% at state line.
Nonconsumptive RESULTS	No transbasin diversion.	Transbasin diversion would trigger FWS consultation. Environmental flow metrics indicate the full 250,000 AFY could be developed in the Gunnison River, Yampa River, and Green River.	Transbasin diversion would trigger FWS consultation. Environmental flow metrics indicate the full 50,000 AFY could be developed in the Blue River, Gunnison River, Yampa River, and Green River.	No transbasin diversion.	Transbasin diversion would trigger FWS consultation. Environmental flow metrics indicate the full 150,000 AFY could be developed in the Gunnison River, Yampa River, and Green River.

Table 2 – Summary of Colorado Basin Roundtable Portfolio Analysis

Portfolio Element	CO 1	CO 2	CO 3
Demand INPUT	Medium (790,000 AFY)	Medium (790,000 AFY)	High (1,060,000 AFY)
Oil Shale INPUT	Yes	Yes	Yes
IPPs INPUT	91% Colorado IPP yield success.	91% Colorado IPP yield success.	92% Colorado IPP yield success.
Active Conservation INPUT	High Strategy (460,000 AFY). 60% applied to gap. Yield to gap = 278,000 AFY.	High Strategy (460,000 AFY). 60% applied to gap. Yield to gap = 278,000 AFY.	High Strategy (460,000 AFY). 60% applied to gap. Yield to gap = 278,000 AFY.
Reuse INPUT	Reuse ratio = 1.5	Reuse ratio = 1.5	Reuse ratio = 1.5
New Colorado River Supply INPUT	150,000 AFY to West Slope. 0 AFY to East Slope.	150,000 AFY to West Slope. 168,000 AFY to East Slope.	0 AFY to West Slope. 0 AFY to East Slope.
New Colorado River Supply RESULTS	93,000 AFY to West Slope. 0 AFY to East Slope.	93,000 AFY to West Slope. 40,000 AFY to East Slope.	0 AFY to West Slope. 0 AFY to East Slope.
New Agricultural Transfer Supply RESULTS	0 AFY to West Slope. 27,000 AFY to East Slope.	0 AFY to West Slope. 0 AFY to East Slope.	183,000 AFY to West Slope. 92,000 AFY to East Slope.
Ag Transfers and Urbanization – Irrigated Acres RESULTS	Arkansas = 5% (22,000 acres). South Platte = 20% (172,000 acres). West Slope = 10% (94,000 acres). North Platte/Rio Grande = 10% (82,000 acres).	Arkansas = 5% (20,000 acres). South Platte = 20% (148,000 acres). West Slope = 10% (94,000 acres). North Platte/Rio Grande = 10% (82,000 acres).	Arkansas = 10% (44,000 acres). South Platte = 30% (244,000 acres). West Slope = 35% (300,000 acres). North Platte/Rio Grande = 10% (82,000 acres).
Other Portfolio Trade-off RESULTS	15% of Arkansas and 40% of South Platte irrigated acres needed for fallowing program. DECREASE in South Platte River flows 11% at state line.	10% of Arkansas and 30% of South Platte irrigated acres needed for fallowing program. DECREASE in South Platte River flows 6% at state line.	30% of Arkansas and 65% of South Platte irrigated acres needed for fallowing program. DECREASE in South Platte River flows 11% at state line.
Nonconsumptive RESULTS	No transbasin diversion.	Transbasin diversion would trigger FWS consultation. Environmental flow metrics indicate the full 168,000 AFY could be developed in the Gunnison River, Yampa River, and Green River. The 40,000 AFY result could also be developed in the Blue River.	No transbasin diversion.

Table 3 – Summary of Gunnison Basin Roundtable Portfolio Analysis

Portfolio Element	GUNN 1	GUNN 2	GUNN 3
Demand INPUT	Low (700,000 AFY)	Medium (880,000 AFY)	High (1,230,000 AFY)
Oil Shale INPUT	Yes	Yes	Yes
IPPs INPUT	92% Gunnison IPP yield success.	88% Gunnison IPP yield success.	94% Gunnison IPP yield success.
Active Conservation INPUT	Medium Strategy (330,000 AFY). 50% applied to gap. Yield to gap = 167,000 AFY.	High Strategy (460,000 AFY). 50% applied to gap. Yield to gap = 231,000 AFY.	High Strategy (460,000 AFY). 60% applied to gap. Yield to gap = 278,000 AFY.
Reuse INPUT	Reuse ratio = 1.5	Reuse ratio = 1.5	Reuse ratio = 1.5
New Colo. River Supply INPUT	100,000 AFY to West Slope. 0 AFY to East Slope.	100,000 AFY to West Slope. 75,000 AFY to East Slope.	100,000 AFY to West Slope. 75,000 AFY to East Slope.
New Colo. River Supply RESULTS	38,000 AFY to West Slope. 0 AFY to East Slope.	100,000 AFY to West Slope. 75,000 AFY to East Slope.	100,000 AFY to West Slope. 75,000 AFY to East Slope.
New Agricultural Transfer Supply RESULTS	0 AFY to West Slope. 105,000 AFY to East Slope.	23,000 AFY to West Slope. 32,000 AFY to East Slope.	135,000 AFY to West Slope. 112,000 AFY to East Slope.
Ag Transfers and Urbanization – Irrigated Acres RESULTS	Arkansas = 10% (33,000 acres). South Platte = 25% (224,000 acres). West Slope = 10% (84,000 acres). North Platte/Rio Grande = 10% (82,000 acres).	Arkansas = 5% (26,000 acres). South Platte = 20% (174,000 acres). West Slope = 15% (118,000 acres). North Platte/Rio Grande = 10% (82,000 acres).	Arkansas = 10% (48,000 acres). South Platte = 30% (260,000 acres). West Slope = 25% (251,000 acres). North Platte/Rio Grande = 10% (84,000 acres).
Other Portfolio Trade-off RESULTS	20% of Arkansas and 60% of South Platte irrigated acres needed for fallowing program. DECREASE in South Platte River flows 10% at state line.	15% of Arkansas and 40% of South Platte irrigated acres needed for fallowing program. DECREASE in South Platte River flows 10% at state line.	30% of Arkansas and 70% of South Platte irrigated acres needed for fallowing program. DECREASE in South Platte River flows 10% at state line.
Nonconsumptive RESULTS	No transbasin diversion.	Transbasin diversion would trigger FWS consultation. Environmental flow metrics indicate the full 75,000 AFY could be developed in the Gunnison River, Yampa River, and Green River.	Transbasin diversion would trigger FWS consultation. Environmental flow metrics indicate the full 75,000 AFY could be developed in the Gunnison River, Yampa River, and Green River.

Table 4 – Summary of Metro Basin Roundtable Portfolio Analysis

Portfolio Element	MET 1a	MET 1b	MET 2a	MET 2b
Demand INPUT	Low (700,000 AFY)	Low (700,000 AFY)	Medium (840,000 AFY)	Medium (840,000 AFY)
Oil Shale INPUT	Yes	Yes	Yes	Yes
IPPs INPUT	86% Metro IPP yield success.	86% Metro IPP yield success.	88% Metro IPP yield success.	88% Metro IPP yield success
Active Conservation INPUT	Medium Strategy (330,000 AFY). 0% applied to gap. Yield to gap = 0 AFY.	Medium Strategy (330,000 AFY). 0% applied to gap. Yield to gap = 0 AFY.	Medium Strategy (330,000 AFY). 0% applied to gap. Yield to gap = 0 AFY.	Medium Strategy (330,000 AFY). 0% applied to gap. Yield to gap = 0 AFY.
Reuse INPUT	Reuse ratio = 1.5	Reuse ratio = 1.5	Reuse ratio = 1.5	Reuse ratio = 1.5
New Colorado River Supply INPUT	200,000 AFY to West Slope. 0 AFY to East Slope.	200,000 AFY to West Slope. 193,000 AFY to East Slope.	200,000 AFY to West Slope. 0 AFY to East Slope.	200,000 AFY to West Slope. 220,000 AFY to East Slope.
New Colorado River Supply RESULTS	54,000 AFY to West Slope. 0 AFY to East Slope.	54,000 AFY to West Slope. 193,000 AFY to East Slope.	138,000 AFY to West Slope. 0 AFY to East Slope.	138,000 AFY to West Slope. 220,000 AFY to East Slope.
New Agricultural Transfer Supply RESULTS	0 AFY to West Slope. 193,000 AFY to East Slope.	0 AFY to West Slope. 0 AFY to East Slope.	0 AFY to West Slope. 220,000 AFY to East Slope.	0 AFY to West Slope. 0 AFY to East Slope.
Ag Transfers and Urbanization – Irrigated Acres RESULTS	Arkansas = 10% (47,000 acres). South Platte = 35% (304,000 acres). West Slope = 10% (84,000 acres). North Platte/Rio Grande = 10% (85,000 acres).	Arkansas = 5% (18,000 acres). South Platte = 15% (136,000 acres). West Slope = 10% (84,000 acres). North Platte/Rio Grande = 10% (85,000 acres).	Arkansas = 15% (62,000 acres). South Platte = 40% (337,000 acres). West Slope = 10% (94,000 acres). North Platte/Rio Grande = 10% (85,000 acres).	Arkansas = 5% (20,000 acres). South Platte = 20% (154,000 acres). West Slope = 10% (94,000 acres). North Platte/Rio Grande = 10% (85,000 acres).
Other Portfolio Trade-off RESULTS	30% of Arkansas and 90% of South Platte irrigated acres needed for fallowing program. DECREASE in South Platte River flows 14% at state line.	10% of Arkansas and 25% of South Platte irrigated acres needed for fallowing program. DECREASE in South Platte River flows 6% at state line.	40% of Arkansas and 100% of South Platte irrigated acres needed for fallowing program. DECREASE in South Platte River flows 14% at state line.	10% of Arkansas and 30% of South Platte irrigated acres needed for fallowing program. DECREASE in South Platte River flows 6% at state line.
Nonconsumptive RESULTS	No transbasin diversion.	Transbasin diversion would trigger FWS consultation. Environmental flow metrics indicate the full 193,000 AFY could be developed in the Gunnison River, Yampa River, and Green River.	No transbasin diversion.	Transbasin diversion would trigger FWS consultation. Environmental flow metrics indicate the full 220,000 AFY could be developed in the Gunnison River, Yampa River, and Green River.

Table 4 – Summary of Metro Basin Roundtable Portfolio Analysis (continued)

Portfolio Element	MET 3a	MET 3b	MET 4a	MET 4b
Demand INPUT	High (1,130,000 AFY)	High (1,130,000 AFY)	High (1,290,000 AFY)	High (1,290,000 AFY)
Oil Shale INPUT	Yes	Yes	Yes	Yes
IPPs INPUT	85% Metro IPP yield success.	85% Metro IPP yield success.	85% Metro IPP yield success.	85% Metro IPP yield success
Active Conservation INPUT	Medium Strategy (330,000 AFY). 0% applied to gap. Yield to gap = 0 AFY.	Medium Strategy (330,000 AFY). 0% applied to gap. Yield to gap = 0 AFY.	Medium Strategy (330,000 AFY). 36% applied to gap. Yield to gap = 119,000 AFY.	Medium Strategy (330,000 AFY). 36% applied to gap. Yield to gap = 119,000 AFY.
Reuse INPUT	Reuse ratio = 1.5	Reuse ratio = 1.5	Reuse ratio = 1.5	Reuse ratio = 1.5
New Colorado River Supply INPUT	200,000 AFY to West Slope. 0 AFY to East Slope.	200,000 AFY to West Slope. 290,000 AFY to East Slope.	200,000 AFY to West Slope. 0 AFY to East Slope.	200,000 AFY to West Slope. 332,000 AFY to East Slope.
New Colorado River Supply RESULTS	200,000 AFY to West Slope. 0 AFY to East Slope.	200,000 AFY to West Slope. 290,000 AFY to East Slope.	200,000 AFY to West Slope. 0 AFY to East Slope.	200,000 AFY to West Slope. 332,000 AFY to East Slope.
New Agricultural Transfer Supply RESULTS	29,000 AFY to West Slope. 278,000 AFY to East Slope.	29,000 AFY to West Slope. 0 AFY to East Slope.	220,000 AFY to West Slope. 332,000 AFY to East Slope.	220,000 AFY to West Slope. 0 AFY to East Slope.
Ag Transfers and Urbanization – Irrigated Acres RESULTS	Arkansas = 20% (84,000 acres). South Platte = 50% (417,000 acres). West Slope = 15% (142,000 acres). North Platte/Rio Grande = 10% (87,000 acres).	Arkansas = 5% (22,000 acres). South Platte = 20% (182,000 acres). West Slope = 15% (142,000 acres). North Platte/Rio Grande = 10% (87,000 acres).	Arkansas = 15% (66,000 acres). South Platte = 60% (479,000 acres). West Slope = 15% (121,000 acres). North Platte/Rio Grande = 10% (85,000 acres).	Arkansas = 5% (22,000 acres). South Platte = 20% (182,000 acres). West Slope = 15% (121,000 acres). North Platte/Rio Grande = 10% (85,000 acres).
Other Portfolio Trade-off RESULTS	55% of Arkansas and 125% of South Platte irrigated acres needed for fallowing program. DECREASE in South Platte River flows 14% at state line.	15% of Arkansas and 40% of South Platte irrigated acres needed for fallowing program. DECREASE in South Platte River flows 4% at state line.	45% of Arkansas and 150% of South Platte irrigated acres needed for fallowing program. DECREASE in South Platte River flows 12% at state line.	15% of Arkansas and 40% of South Platte irrigated acres needed for fallowing program. INCREASE in South Platte River flows 1% at state line.
Nonconsumptive RESULTS	No transbasin diversion.	Transbasin diversion would trigger FWS consultation. Environmental flow metrics indicate the full 290,000 AFY could be developed in the Yampa River and Green River.	No transbasin diversion.	Transbasin diversion would trigger FWS consultation. Environmental flow metrics indicate the full 332,000 AFY could not be developed.

Table 5 – Summary of North Platte Basin Roundtable Portfolio Analysis

Portfolio Element	NP 1
Demand INPUT	Medium (730,000 AFY)
Oil Shale INPUT	No
IPPs INPUT	100% North Platte IPP yield success.
Active Conservation INPUT	Low Strategy (160,000 AFY). 30% applied to gap in Arkansas, Metro, and South Platte. 0% applied to gap in all other basins. Yield to gap = 36,000 AFY.
Reuse INPUT	Reuse ratio = 1.7
New Colorado River Supply INPUT	90,000 AFY to West Slope. 210,000 AFY to East Slope.
New Colorado River Supply RESULTS	82,000 AFY to West Slope. 210,000 AFY to East Slope.
New Agricultural Transfer Supply RESULTS	0 AFY to West Slope. 0 AFY to East Slope.
Ag Transfers and Urbanization – Irrigated Acres RESULTS	Arkansas = 5% (11,000 acres). South Platte = 15% (125,000 acres). West Slope = 10% (90,000 acres). North Platte/Rio Grande = 10% (85,000 acres).
Other Portfolio Trade-off RESULTS	5% of Arkansas and 25% of South Platte irrigated acres needed for fallowing program. INCREASE in South Platte River flows 4% at state line.
Nonconsumptive RESULTS	Transbasin diversion would trigger FWS consultation. Environmental flow metrics indicate the full 210,000 AFY could be developed in the Gunnison River, Yampa River, and Green River.

Table 6 – Summary of Rio Grande Basin Roundtable Portfolio Analysis

Portfolio Element	RIO 1	RIO 2	RIO 3	RIO 4
Demand INPUT	Medium (730,000 AFY)	Medium (730,000 AFY)	Medium (730,000 AFY)	Medium (730,000 AFY)
Oil Shale INPUT	No	No	No	No
IPPs INPUT	93% Rio Grande IPP yield success.	93% Rio Grande IPP yield success.	93% Rio Grande IPP yield success.	93% Rio Grande IPP yield success.
Active Conservation INPUT	Low Strategy (160,000 AFY). 10% applied to gap. Yield to gap = 16,000 AFY.	Medium Strategy (330,000 AFY). 10% applied to gap. Yield to gap = 33,000 AFY.	Low Strategy (160,000 AFY). 10% applied to gap. Yield to gap = 16,000 AFY.	Medium Strategy (330,000 AFY). 10% applied to gap. Yield to gap = 33,000 AFY.
Reuse INPUT	Reuse ratio = 1.6	Reuse ratio = 1.6	Reuse ratio = 1.6	Reuse ratio = 1.6
New Colo. River Supply INPUT	75,000 AFY to West Slope. 150,000 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.	75,000 AFY to West Slope. 300,000 AFY to East Slope.
New Colo. River Supply RESULTS	74,000 AFY to West Slope. 150,000 AFY to East Slope.	71,000 AFY to West Slope. 150,000 AFY to East Slope.	74,000 AFY to West Slope. 242,000 AFY to East Slope.	71,000 AFY to West Slope. 227,000 AFY to East Slope.
New Agricultural Transfer Supply RESULTS	0 AFY to West Slope. 3,200 AFY to East Slope.	0 AFY to West Slope. 0 AFY to East Slope.	0 AFY to West Slope. 0 AFY to East Slope.	0 AFY to West Slope. 0 AFY to East Slope.
Ag Transfers and Urbanization – Irrigated Acres RESULTS	Arkansas = 5% (20,000 acres). South Platte = 20% (156,000 acres). West Slope = 10% (94,000 acres). North Platte/Rio Grande = 10% (85,000 acres).	Arkansas = 5% (20,000 acres). South Platte = 20% (154,000 acres). West Slope = 10% (94,000 acres). North Platte/Rio Grande = 10% (84,000 acres).	Arkansas = 5% (20,000 acres). South Platte = 20% (154,000 acres). West Slope = 10% (94,000 acres). North Platte/Rio Grande = 10% (85,000 acres).	Arkansas = 5% (20,000 acres). South Platte = 20% (154,000 acres). West Slope = 10% (94,000 acres). North Platte Rio Grande = 10% (84,000 acres).
Other Portfolio Trade-off RESULTS	15% of Arkansas and 45% of South Platte irrigated acres needed for fallowing program. DECREASE in South Platte River flows 4% at state line.	15% of Arkansas and 40% of South Platte irrigated acres needed for fallowing program. DECREASE in South Platte River flows 7% at state line.	15% of Arkansas and 40% of South Platte irrigated acres needed for fallowing program. INCREASE in South Platte River flows 16% at state line.	15% of Arkansas and 40% of South Platte irrigated acres needed for fallowing program. INCREASE in South Platte River flows 10% at state line.
Nonconsumptive RESULTS	Transbasin diversion would trigger FWS consultation. Environmental flow metrics indicate the full 150,000 AFY could be developed in the Gunnison River, Yampa River, and Green River.	Transbasin diversion would trigger FWS consultation. Environmental flow metrics indicate the full 150,000 AFY could be developed in the Gunnison River, Yampa River, and Green River.	Transbasin diversion would trigger FWS consultation. Environmental flow metrics indicate the full 300,000 AFY could be developed in the Yampa River, and Green River. The 242,000 AFY result could also be developed in the Gunnison River.	Transbasin diversion would trigger FWS consultation. Environmental flow metrics indicate the full 300,000 AFY could be developed in the Yampa River, and Green River. The 227,000 AFY result could also be developed in the Gunnison River.

Table 7 – Summary of South Platte Basin Roundtable Portfolio Analysis

Portfolio Element	SP 1	SP 2	SP 3	SP 4
Demand INPUT	Medium (880,000 AFY)	Medium (880,000 AFY)	High (1,170,000 AFY)	High (1,170,000 AFY)
Oil Shale INPUT	Yes	Yes	Yes	Yes
IPPs INPUT	65% South Platte IPP yield success.	65% South Platte IPP yield success.	69% South Platte IPP yield success.	69% South Platte IPP yield success.
Active Conservation INPUT	Low Strategy (160,000 AFY). 10% applied to gap. Yield to gap = 16,000 AFY.	Low Strategy (160,000 AFY). 10% applied to gap. Yield to gap = 16,000 AFY.	Low Strategy (160,000 AFY). 10% applied to gap. Yield to gap = 16,000 AFY.	Low Strategy (160,000 AFY). 10% applied to gap. Yield to gap = 16,000 AFY.
Reuse INPUT	Reuse ratio = 1.5	Reuse ratio = 1.5	Reuse ratio = 1.5	Reuse ratio = 1.5
New Colo. River Supply INPUT	175,000 AFY to West Slope. 0 AFY to East Slope.	175,000 AFY to West Slope. 175,000 AFY to East Slope.	175,000 AFY to West Slope. 0 AFY to East Slope.	175,000 AFY to West Slope. 175,000 AFY to East Slope.
New Colo. River Supply RESULTS	159,000 AFY to West Slope. 0 AFY to East Slope.	159,000 AFY to West Slope. 175,000 AFY to East Slope.	175,000 AFY to West Slope. 0 AFY to East Slope.	175,000 AFY to West Slope. 175,000 AFY to East Slope.
New Agricultural Transfer Supply RESULTS	0 AFY to West Slope. 205,000 AFY to East Slope.	0 AFY to West Slope. 30,000 AFY to East Slope.	86,000 AFY to West Slope. 279,000 AFY to East Slope.	86,000 AFY to West Slope. 104,000 AFY to East Slope.
Ag Transfers and Urbanization – Irrigated Acres RESULTS	Arkansas = 15% (70,000 acres). South Platte = 40% (313,000 acres). West Slope = 10% (94,000 acres). North Platte/Rio Grande = 10% (86,000 acres).	Arkansas = 5% (27,000 acres). South Platte = 20% (177,000 acres). West Slope = 10% (94,000 acres). North Platte/Rio Grande = 10% (86,000 acres).	Arkansas = 20% (95,000 acres). South Platte = 50% (395,000 acres). West Slope = 20% (201,000 acres). North Platte/Rio Grande = 10% (88,000 acres).	Arkansas = 10% (49,000 acres). South Platte = 30% (262,000 acres). West Slope = 20% (201,000 acres). North Platte/Rio Grande = 10% (88,000 acres).
Other Portfolio Trade-off RESULTS	65% of Arkansas and 120% of South Platte irrigated acres needed for fallowing program. DECREASE in South Platte River flows 8% at state line.	25% of Arkansas and 55% of South Platte irrigated acres needed for fallowing program. DECREASE in South Platte River flows 2% at state line.	85% of Arkansas and 155% of South Platte irrigated acres needed for fallowing program. DECREASE in South Platte River flows 9% at state line.	45% of Arkansas and 90% of South Platte irrigated acres needed for fallowing program. DECREASE in South Platte River flows 3% at state line.
Nonconsumptive RESULTS	No transbasin diversion.	Transbasin diversion would trigger FWS consultation. Environmental flow metrics indicate the full 175,000 AFY could be developed in the Gunnison River, Yampa River, and Green River.	No transbasin diversion.	Transbasin diversion would trigger FWS consultation. Environmental flow metrics indicate the full 175,000 AFY could be developed in the Gunnison River, Yampa River, and Green River.

Table 8 – Summary of Southwest Basin Roundtable Portfolio Analysis

Portfolio Element	SW 1	SW 2	SW 3
Demand INPUT	Medium (730,000 AFY)	Medium (730,000 AFY)	Medium (730,000 AFY)
Oil Shale INPUT	No	No	No
IPPs INPUT	88% Southwest IPP yield success.	88% Southwest IPP yield success.	88% Southwest IPP yield success.
Active Conservation INPUT	High Strategy (460,000 AFY). 50% applied to gap. Yield to gap = 231,000 AFY.	Medium Strategy (330,000 AFY). 10% applied to gap. Yield to gap = 33,000 AFY.	Medium Strategy (330,000 AFY). 30% applied to gap. Yield to gap = 99,000 AFY.
Reuse INPUT	Reuse ratio = 1.6	Reuse ratio = 1.4	Reuse ratio = 1.4
New Colo. River Supply INPUT	73,000 AFY to West Slope. 0 AFY to East Slope.	73,000 AFY to West Slope. 150,000 AFY to East Slope.	73,000 AFY to West Slope. 150,000 AFY to East Slope.
New Colo. River Supply RESULTS	38,000 AFY to West Slope. 0 AFY to East Slope.	71,000 AFY to West Slope. 150,000 AFY to East Slope.	59,000 AFY to West Slope. 150,000 AFY to East Slope.
New Agricultural Transfer Supply RESULTS	0 AFY to West Slope. 42,000 AFY to East Slope.	0 AFY to West Slope. 14,000 AFY to East Slope.	0 AFY to West Slope. 0 AFY to East Slope.
Ag Transfers and Urbanization – Irrigated Acres RESULTS	Arkansas = 5% (28,000 acres). South Platte = 25% (187,000 acres). West Slope = 10% (94,000 acres). North Platte/Rio Grande = 10% (82,000 acres).	Arkansas = 5% (23,000 acres). South Platte = 20% (164,000 acres). West Slope = 10% (94,000 acres). North Platte/Rio Grande = 10% (84,000 acres).	Arkansas = 5% (20,000 acres). South Platte = 20% (154,000 acres). West Slope = 10% (94,000 acres). North Platte/Rio Grande = 10% (83,000 acres).
Other Portfolio Trade-off RESULTS	25% of Arkansas and 60% of South Platte irrigated acres needed for fallowing program. DECREASE in South Platte River flows 12% at state line.	20% of Arkansas and 45% of South Platte irrigated acres needed for fallowing program. DECREASE in South Platte River flows 5% at state line.	15% of Arkansas and 40% of South Platte irrigated acres needed for fallowing program. INCREASE in South Platte River flows 1% at state line.
Nonconsumptive RESULTS	No transbasin diversion.	Transbasin diversion would trigger FWS consultation. Environmental flow metrics indicate the full 150,000 AFY could be developed in the Gunnison River, Yampa River, and Green River.	Transbasin diversion would trigger FWS consultation. Environmental flow metrics indicate the full 150,000 AFY could be developed in the Gunnison River, Yampa River, and Green River.

Table 9 – Summary of Yampa-White Basin Roundtable Portfolio Analysis

Portfolio Element	YW 1	YW 2
Demand INPUT	High (1,060,000 AFY)	High (1,120,000 AFY)
Oil Shale INPUT	Yes	Yes
IPPs INPUT	67% Yampa-White IPP yield success.	67% Yampa-White IPP yield success.
Active Conservation INPUT	High Strategy (460,000 AFY). 60% applied to gap. Yield to gap = 278,000 AFY.	High Strategy (460,000 AFY). 60% applied to gap. Yield to gap = 278,000 AFY.
Reuse INPUT	Reuse ratio = 1.5	Reuse ratio = 1.5
New Colo. River Supply INPUT	0 AFY to West Slope. 0 AFY to East Slope.	263,000 AFY to West Slope. 150,000 AFY to East Slope.
New Colo. River Supply RESULTS	0 AFY to West Slope. 0 AFY to East Slope.	253,000 AFY to West Slope. 111,000 AFY to East Slope.
New Agricultural Transfer Supply RESULTS	186,000 AFY to West Slope. 74,000 AFY to East Slope.	0 AFY to West Slope. 0 AFY to East Slope.
Ag Transfers and Urbanization – Irrigated Acres RESULTS	Arkansas = 10% (44,000 acres). South Platte = 27% (226,000 acres). West Slope = 33% (303,000 acres). North Platte/Rio Grande = 11% (83,000 acres).	Arkansas = 5% (22,000 acres). South Platte = 21% (172,000 acres). West Slope = 12% (113,000 acres). North Platte/Rio Grande = 11% (83,000 acres).
Other Portfolio Trade-off RESULTS	30% of Arkansas and 55% of South Platte irrigated acres needed for fallowing program. DECREASE in South Platte River flows 12% at state line.	15% of Arkansas and 35% of South Platte irrigated acres needed for fallowing program. DECREASE in South Platte River flows 2% at state line.
Nonconsumptive RESULTS	No transbasin diversion.	Transbasin diversion would trigger FWS consultation. Environmental flow metrics indicate the full 150,000 AFY could be developed in the Gunnison River, Yampa River, and Green River.

Appendix B

Basin Roundtable Portfolio and Trade-off Documentation

This page left intentionally blank.

Memorandum

To: *Todd Doherty, CWCB*

From: *Nicole Rowan, CDM*

Date: *May 9, 2012*

Subject: *Final Input on the Portfolio and Trade-off Tool Analysis for Arkansas Basin*

The Arkansas Basin discussed the elements of the portfolio tool at their meetings of March 7th, April 11th and May 9th with the intention of providing final comments on the tool's elements to the IBCC for their consideration. In March the members determined to retain the five (5) portfolio scenarios, but offer commentary of specific elements. Some of the topics, like conservation or risk management for the Colorado River Compact, were stimulated by the dialogue at the Roundtable Summit of March 1, 2012. To that end, members of the Arkansas Basin Roundtable attend a Joint Roundtable meeting on May 7th in Montrose, CO for a discussion on conservation.

General Roundtable Feedback

Below are the group's insights on the model and its elements. Comments by individual roundtable members follow.

Storage

- Will be needed in the implementation of any of the strategies (IPPs, Conservation, New Supply Development and Agricultural transfers) to meet the gap.
- The Preferred Storage Option Plan (PSOP) prepared by Southeastern Conservancy District has both reoperation (excess capacity) and enlargement of reservoirs (Pueblo Reservoir, Turquoise Reservoir). The precursor to the study also included other storage options which need to be considered, like gravel lakes.
- Alluvial aquifer storage was studied by both CWCB and under a WSRA grant. Further exploration of alluvial aquifer storage is warranted.
- The Basin Roundtable needs to focus on storage to begin their implementation discussions.

- Regional infrastructure will be important to meeting the gap – needs to be throughout the basin. Many of the strategies, like rotating ag fallowing, will depend on regionally available infrastructure for success.

Identified Projects and Process (IPPs)

- The meta-data behind the IPP's indicates that the Arkansas Basin could experience a municipal supply gap as early at the Year 2020.

	With Passive Conservation (High)					LOW GAP SCENARIO IPPs @ 100%	
	2010 Water Needs	2020 Water Needs	2030 Water Needs	2040 Water Needs	2050 Water Needs	IPPs	Information/ Real Gap
	Med	Med	Med	Med	Med	Med	Med
Basin	[AF]	[AF]	[AF]	[AF]	[AF]	[AF]	[AF]
Arkansas Basin	2,858	26,241	64,000	100,620	148,939	94,687	54,252
Eastern Plains	(80)	549	1,381	2,045	2,708	1,797	911
Lower Arkansas	(190)	(161)	164	797	1,431	1,331	100
Southwestern Arkansas	13	801	1,729	2,705	3,681	1,873	1,808
Upper Arkansas	32	4,482	10,003	17,072	22,142	11,853	10,289
Urban Counties	3,083	20,570	50,722	78,000	118,977	77,833	41,144

- The Arkansas has very few identified IPP's, with the balance in the portfolio tool appearing to be generic place holders (e.g. "*Basin Water Rights Firming Other*").

- Infrastructure is a critical component of the IPPs so that water can be transferred to where it is needed. There needs to be regional cooperation on the infrastructure to meet the gap.

Conservation Passive and Active

- Within the portfolio tool, the assumption was "The higher demand and the higher the M&I gap there greater conservation with the ability to place the saved water into storage."

- Risk management should be applied to conservation. A water provider's ability to reduce system demand and daily peak by reduction of lawn watering is an important safety factor for municipal supply. There may be an opportunity to link conservation stages in municipal systems on the Front Range with Colorado River Compact Call risk management.

- To be effective, alternatives like interruptible supply require agreements, storage and infrastructure and should be in place before a drought begins.

New Supply from the Colorado River

- The relationship between Arkansas Basin agriculture and meeting the municipal supply gap on the Front Range indicates that an increment of New Supply from the Colorado River is critical to preserve basin agriculture

- Given the extended lead-time to permit and construct a New Supply project, the time is now to have the dialogue on moving a project forward, hence the Arkansas Basin's support of the Roundtable Project Exploration Committee underway as a potential model for such discussion.

- The Arkansas Basin is a stakeholder in conversations about risk management and precluding a Compact Call.

Oil Shale Development

- The changes in technology related to oil shale development suggest that reserving a significant block of water for future use is unwarranted.

- Conditional water rights held by the energy companies in the Colorado River are senior to many Arkansas trans-basin projects.

Replace Denver Basin Groundwater?

- Replacement of 13,000+ acre-feet of municipal supply constitutes a substantial portion of the gap in the Arkansas Basin and must be included in a portfolio scenario to realistically address the gap.

- The Denver Basin aquifers are the single largest source of high quality drinking water that is drought-proof in Colorado. This source serves 500,000+ of the State's population. If this source of supply is replaced or augmented sooner rather than later, the resource can be managed for drought protection.

Extent of Reuse

- The dialogue about reuse needs to be carefully examined with respect to proposed IPP's. Many current IPP's are reuse projects.

- The 2011 Needs Assessment clearly documents that reuse in one city is not a water supply elsewhere in the basin because the reuse is committed to meeting future supply needs.

- As demand increases reuse needs to increase.

Agricultural Transfers

- This is a critical topic for discussion in the Arkansas Basin.

- Regional cooperation on infrastructure is needed.

- Agricultural transfer should be done in a way to preserve future agricultural activities as much as possible – a sustainable agricultural economy is important to the Arkansas Basin.

Basin Roundtable Member Comments

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

- 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.

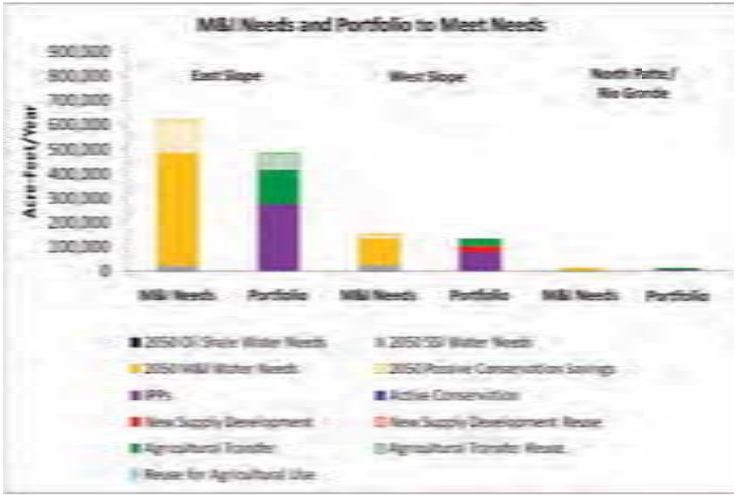
Table 1 Summary of Scenario Results

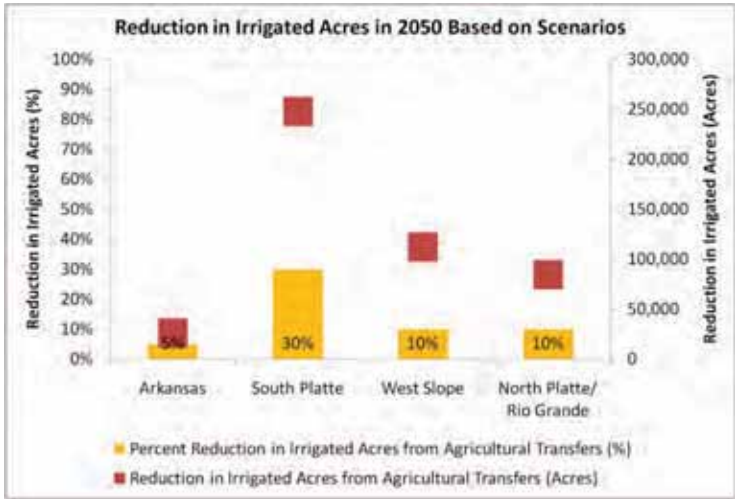
Portfolio Element	Scenario 1: Low Demand/Low Supply	Scenario 2: Medium Demands/Medium Supply	Scenario 3: High Demands/High Supply
IPPs	86% Yield Arkansas Basin	86% Yield Arkansas Basin	86% Yield Arkansas Basin
Conservation/Reuse	Low Conservation Strategy/0% applied to the M&I gap; 1.5 Reuse Factor	Medium 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.

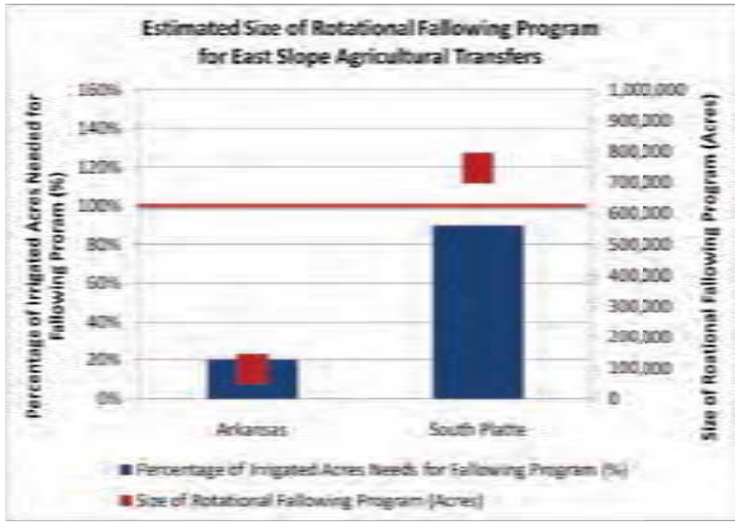
Table 1 Summary of Scenario Results (con't)

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







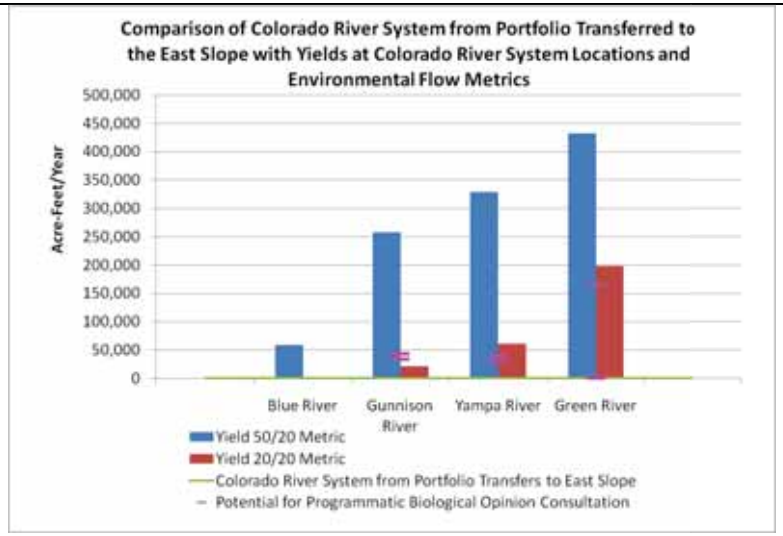
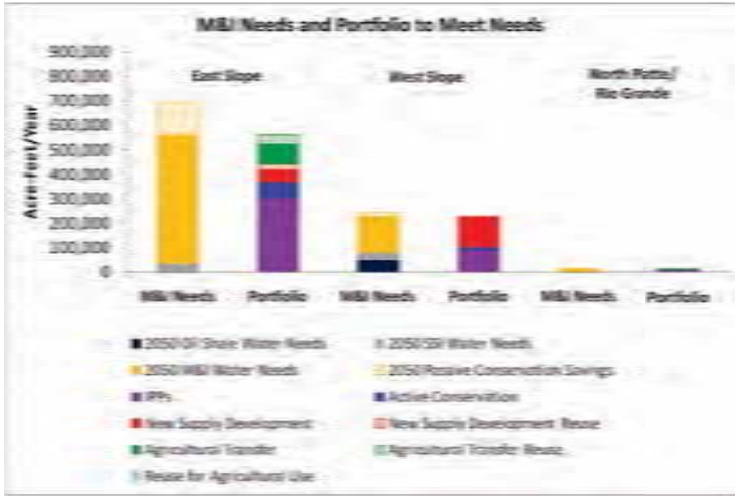
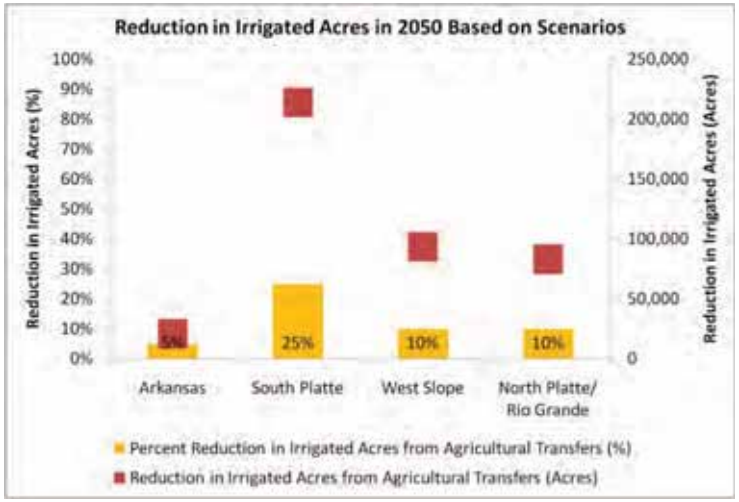
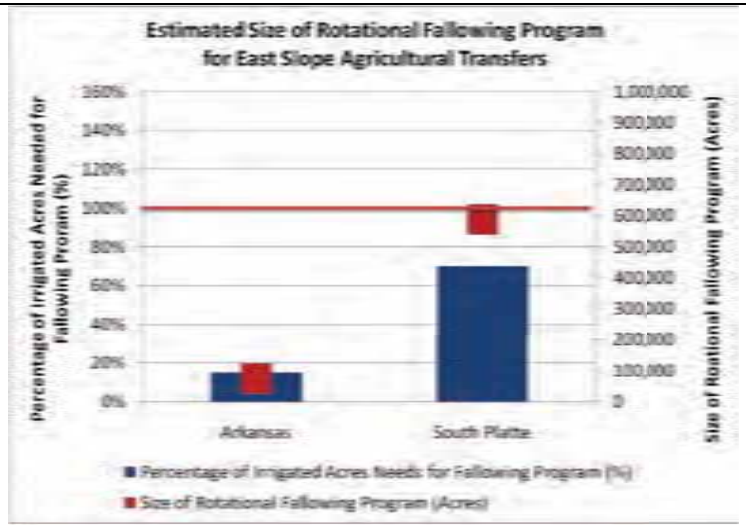


Table 3 Scenario 2 - Medium Demands/Medium Supply







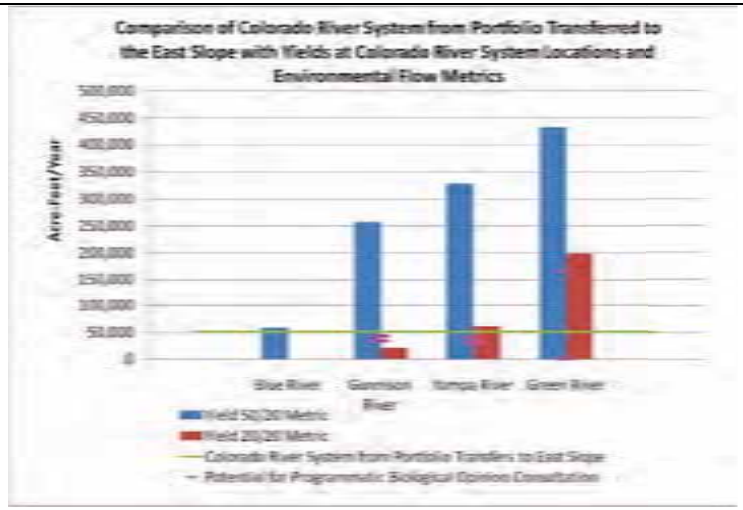
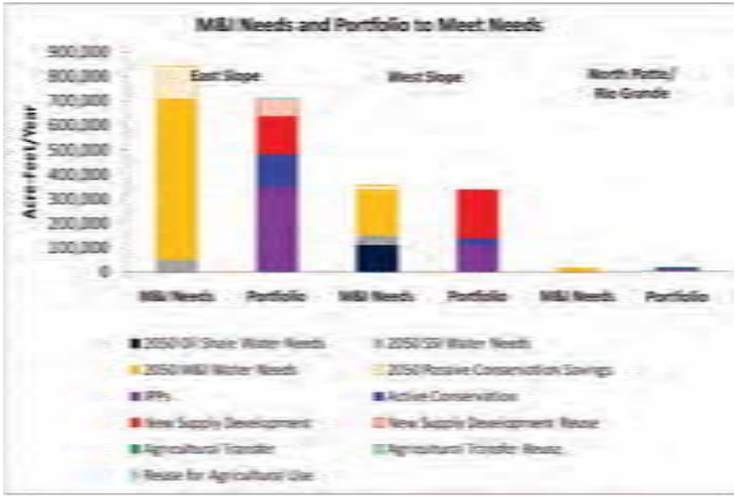
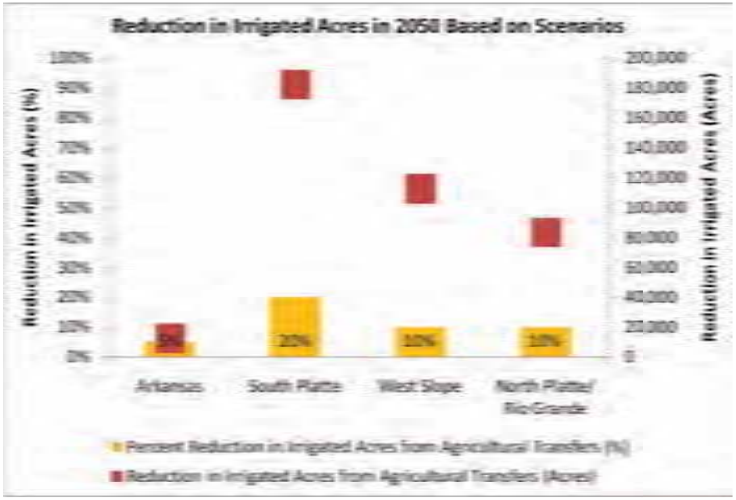
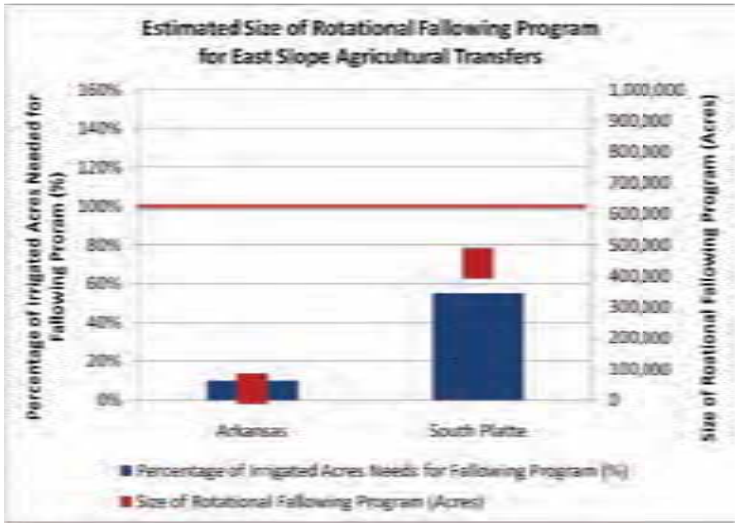


Table 4 Scenario 3: High Demands/High Supply







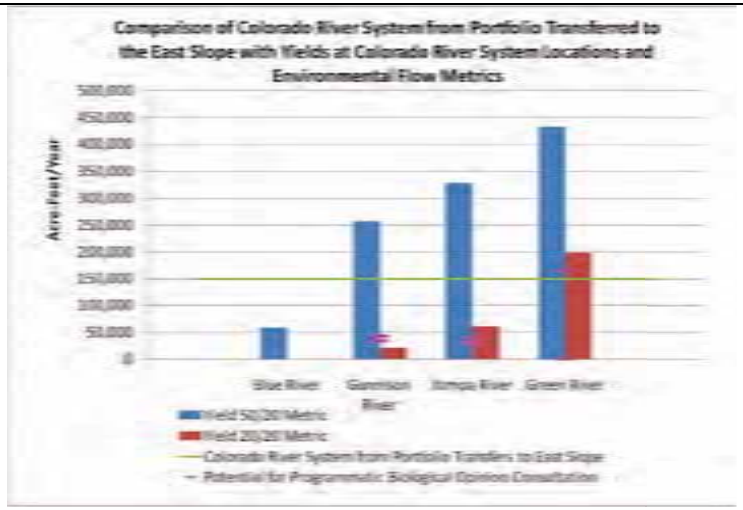
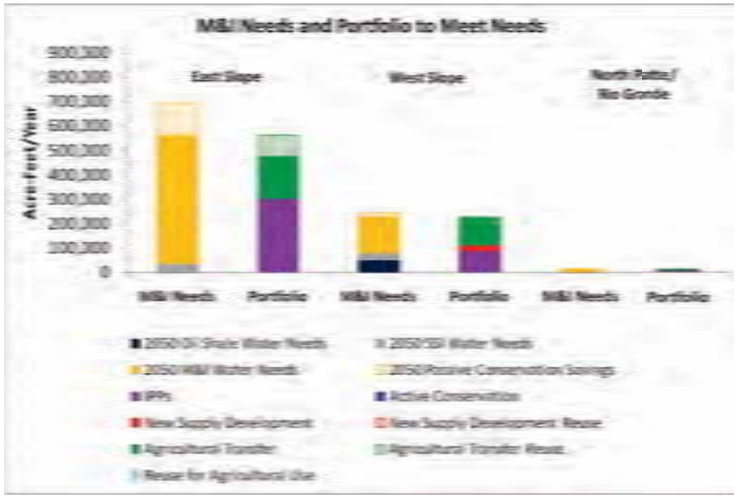
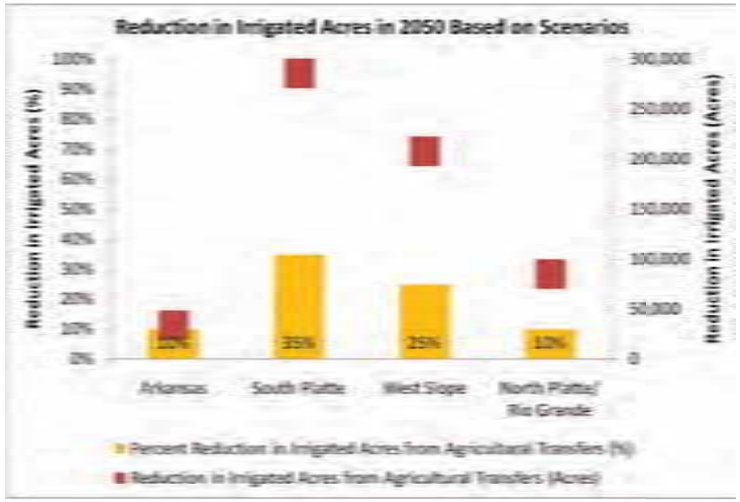
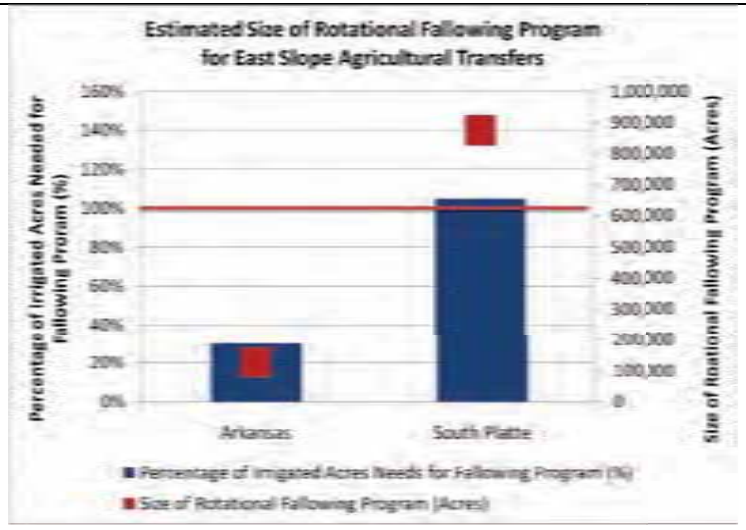


Table 5 Scenario 4: High Demands/Low Supply







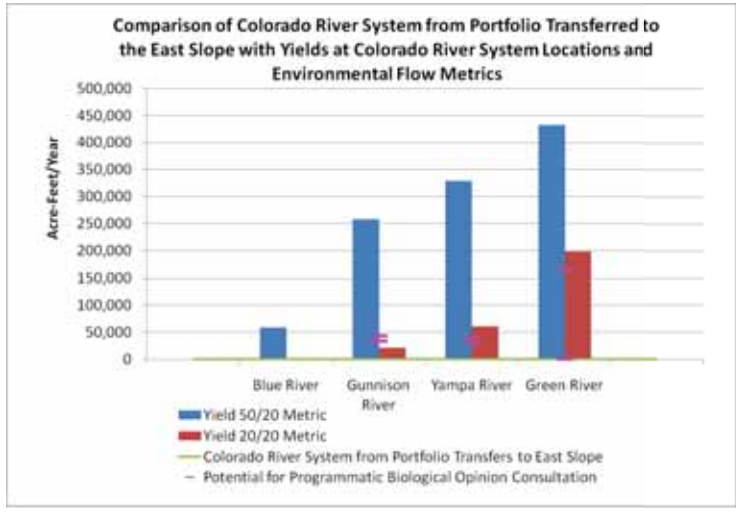
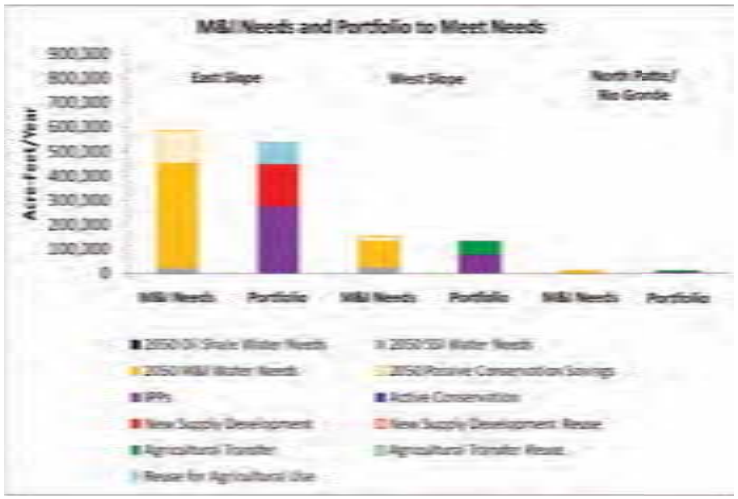
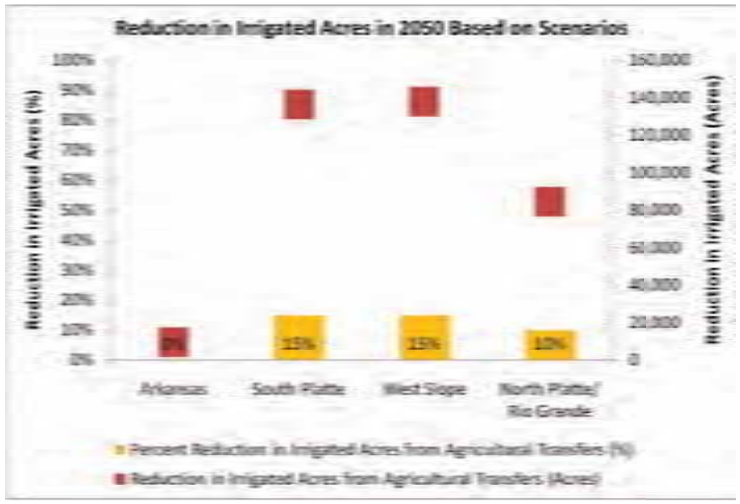
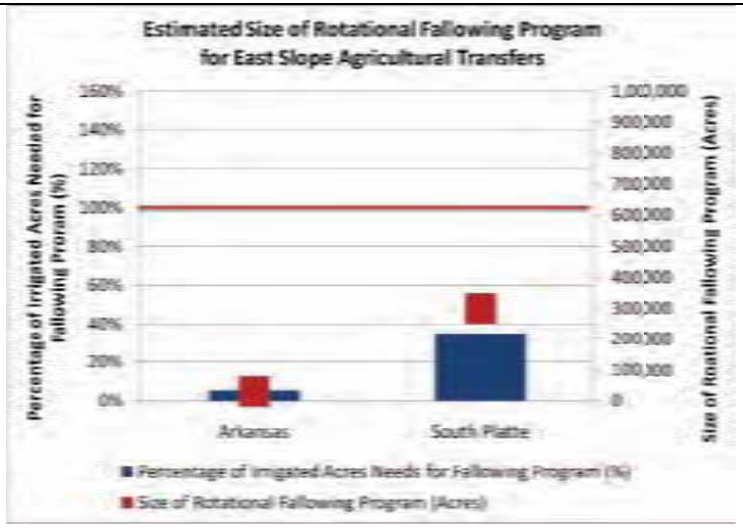
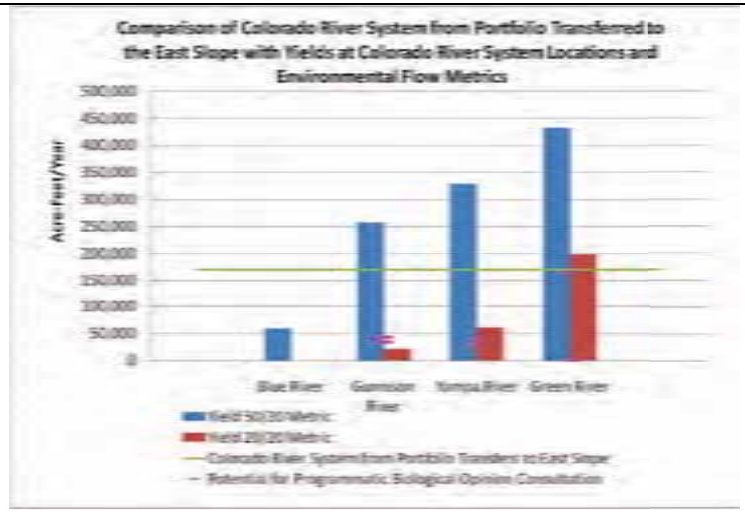


Table 5 Scenario 4: High Demands/Low Supply









Narrative for Colorado Basin Roundtable Portfolio Tool Submissions
5/15/12

The Colorado Basin Roundtable is submitting three versions of its Portfolio Tool to the Inter-Basin Compact Committee. The three versions emphasize high conservation and 60 percent of savings going to help meet the statewide water supply gap projected for 2050. We did one that applied 100 percent to the gap just to see how that would look, but we know it is not possible. But it is intriguing to see that if 100 percent could go to the gap, it almost meets the low end of the range.

In the main, none of our runs represents a panacea. We are not invested in any one run as THE answer. Instead, we tested various levels of supply and demand to see what would happen to agriculture. It seems ag dry-up is always a big number even with the supposition that there could be significant river development. We think that studying high demand and low supply represents a conservative view of the future that could include climate change.

The IBCC will find (if it already does not know) that with river development uncertain and ag dry-up a factor to be minimized, the pressure comes back to success with conservation, reuse and IPP completion.

In each of our runs we believe that oil shale should be turned on and supply allocated to the South Metro area groundwater crisis.

A version of our Portfolio Tool runs hypothesizes that there could be new supply development in the Colorado River. By no means should it be understood that we favor river development in lieu of concerted conservation. But we do agree that potential projects should be studied along with the concepts of risk management, water availability, compact consequences and compact management. We believe that river development should be the last tool pulled out of the box, the not the first one. Conservation can start now. Even if a project were found possible and feasible, it could take 20 years or more to build one. What's more, if we develop what is arguably the last increment of compact water in the Colorado River, by 2050 concerted conservation will be needed anyway.

The IBCC has organized its planning around the four legs of a stool: new supply development, Identified Projects and Processes, conservation and agriculture. Here is what the CBRT is thinking in its Portfolio Tool Development:

Conservation
In our discussions with the Metro Roundtable, we learned that the major utilities are thinking in terms of gallons per capital per day, and that since 2000, usage has declined from 191 gpcd to 155 currently. The Metro Roundtable is only comfortable with the target of 129 gpcd by 2050. We think conservation efforts should be bolder, and must be.

The Metro Roundtable White Paper on conservation says that 129 gpcd is what can be reasonably expected based on current trends and programs – absent new future regulation, substantial changes in land use and other influences beyond the water providers' control.

Herein lays the crux of the conservation matter. The utilities can do better but can only go so far. The IBCC Conservation Committee calls out many ideas to accelerate conservation, and no doubt, they will

require some kind of statewide action. The Colorado Basin Roundtable supports and will help advance initiatives to make conservation a sturdier tool.

Considerations for options with agricultural efficiency and conservation

Agriculture is the state's largest water sector in terms of consumption and diversion – about 10 times more than M&I in terms of consumption. As a roundtable we would like to see something closer to 10 times more the examination than is currently underway on maximizing the profitable consumption of agricultural water and reducing its waste. If done in a prudent manner such improvements would undoubtedly increase opportunities for mutually beneficial use of agricultural water between agriculture and the other water sectors of the state.

Current administration is built on an edifice based in 19th century technology. System loss and resulting return flows are an important consideration and protecting downstream water users who look to these flows from harm is important.

At the same time however these administration and legal structures should not become a roadblock to innovation. Saying that we can't do something or even consider it simply because it might cause a ripple in the existing administrative structure doesn't help. It represents closed mind thinking from deep within the box at a time when we need to be open and start thinking seriously and creatively outside the box.

The needs of rivers and streams are also important and could benefit from creative thinking. In the pre-development past countless beaver ponds and spring floods overtopping banks and inundating riparian areas recharged the alluvial aquifers feeding streams later in the year. That system was replaced in an altered condition by early irrigation technology, transporting water by unlined ditches and flooding fields. This technology also recharged the ground water and late season stream flows. Now irrigation is moving towards greater efficiency, piping and lining ditches and replacing flood irrigation with much more efficient sprinkler and drip delivery systems. Although less water is needed, the same amount is still diverted due to antiquated legal and administration. Much of the unused water returns to the stream at the traditional return point. Little seeps into the ground as it is supposed to for late season return.

We need to develop new ways of providing the recharge water for alluvial aquifers, keep and protect un-needed water in the streams, and still make sure that downstream users are protected too.

We also need to be clear about what type of saving we're generating by improving agricultural efficiency. Colorado being a headwater state, with minimal terminus points - where return flows aren't part of a downstream user's right - has little opportunity to generate new water from agriculture. That is unless consumptive use of water to raise a crop can be lowered - which is being investigated extensively by CSU and others in the form of limited irrigation and rotational fallowing concepts.

Given 21st century technology and innovation there appears to be a great deal we might do to conserve a lot of water from agriculture, both consumptive and non-consumptive while protecting the needs of agriculture and the needs of downstream users. If we have any real hope of preserving agriculture in Colorado, provide for the real needs of rivers and streams and fill the gap both at and well beyond 2050

we will need to attempt just this kind of thinking. We can either tackle the “sacred cows” in a thoughtful, deliberate and fair manner or we can wait until crisis forces us to slaughter them wholesale.

As others have pointed out there are definitely local opportunities to improve instream flow opportunities as demonstrated by the improvements made in Grand Valley Water Users irrigation water delivery system(s) and the increase in flows in the critical reaches of the Colorado mainstem.

In making this distinction it's important to remember the Portfolio Tool is essentially a consumptive use trade off algorithm designed to meet a municipal shortfall. Non-consumptive trade-offs are considered sparingly.

The tool assumes any consumptive use savings from ag would be put toward closing the M&I gap and will not explicitly be available for other uses, non-consumptive or otherwise (including ag itself). Do we want to underline that West Slope irrigators have economic choices for this saved CU beyond selling/leasing to Front Range water providers?

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)**

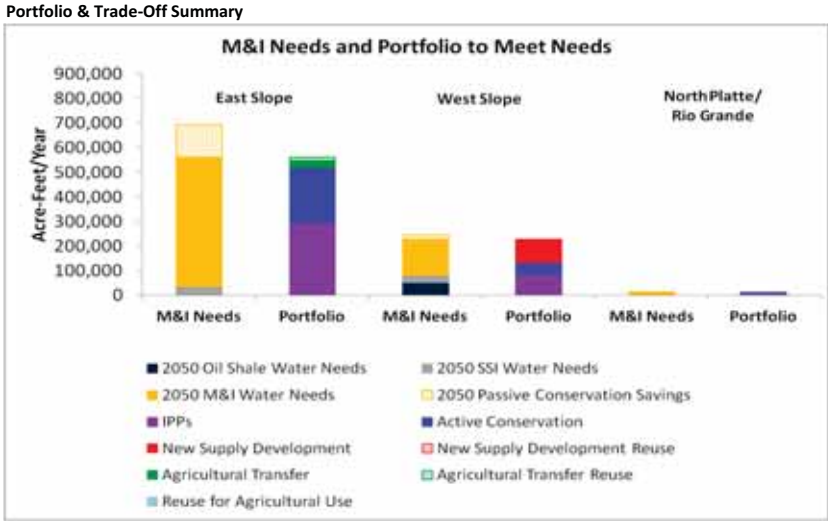
5. If desired, define percent of water that can be reused (Currently @ 30-50%)

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

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

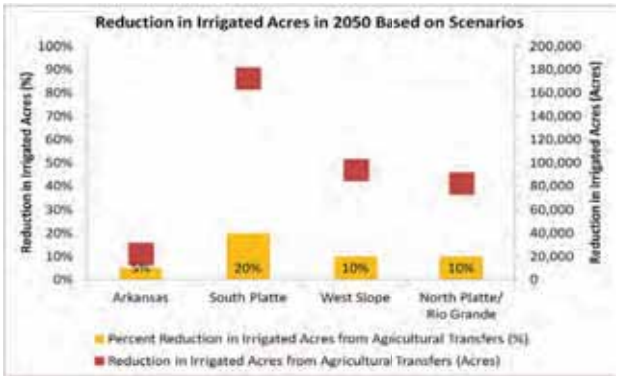
reuse factor of 1.5 represented by 100% of direct reuse in the tool

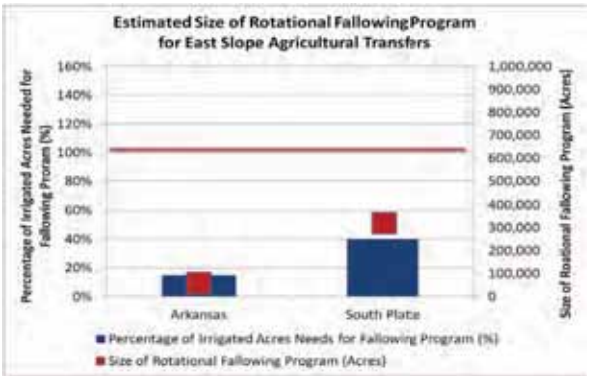
Portfolio & Trade-Off Summary

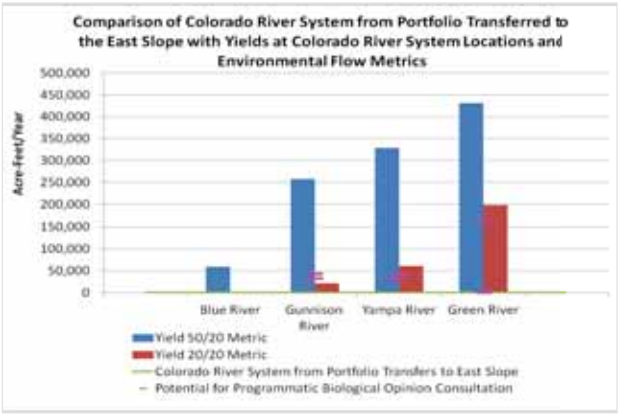


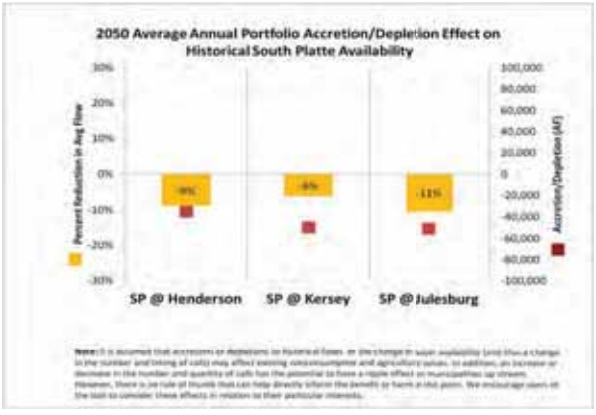
The selected portfolio assumes a that there is only additional water available for West Slope uses, and no additional transbasin water. West Slope nonconsumptive needs are met with less risk, however East Slope agriculture, and perhaps West Slope agriculture as a result, could be signficantly affected.

Furthermore, impacts to the Southe Platte River are significant.









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%

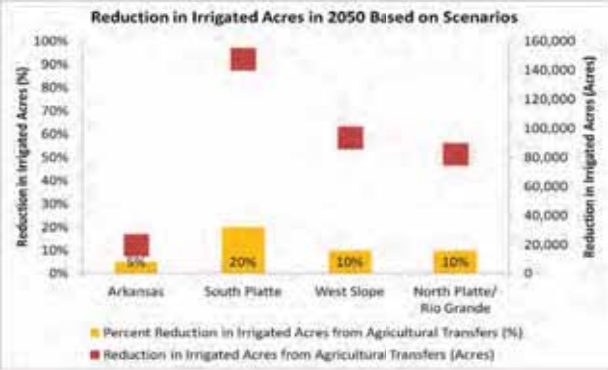
reuse factor of 1.5 represented by 100% of direct reuse in the tool

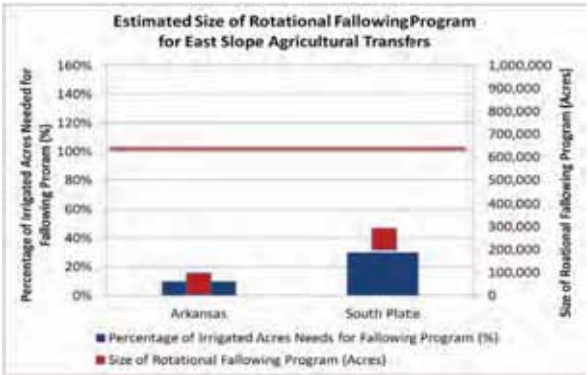
Portfolio & Trade-Off Summary

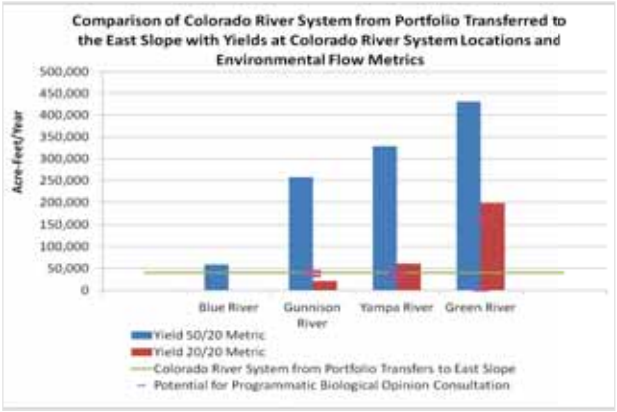
The selected portfolio assumes a high supply scenario. While the level of transbasin diversions was allowed to go up to 168,000 AF, with high conservation only about 40,000 AF was needed, and some of the reuse water could be used to meet some of the agricultural shortages. The level of transbasin diversions 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.

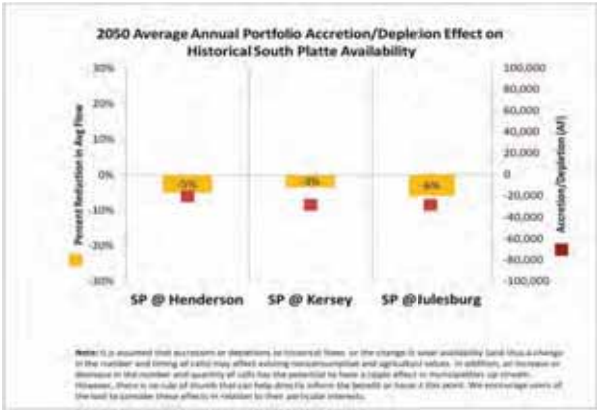
The roundtable indicated that they would consider additional trans basin waters if agricultural loss still allowed for west slope agriculture to be viable, however IPPs and urbanization still dry up a significant number of acres.

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









Colorado BRT Portfolio Summary for the 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)**

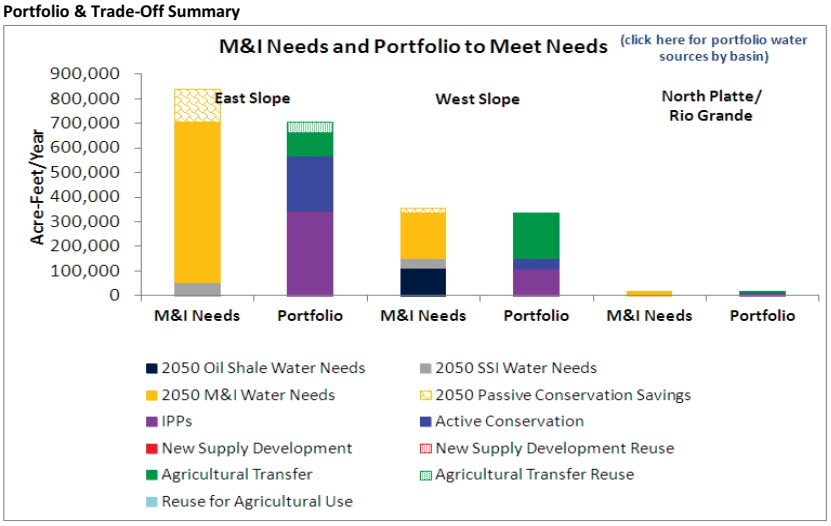
5. If desired, define percent of water that can be reused (Currently @ 30-50%)

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

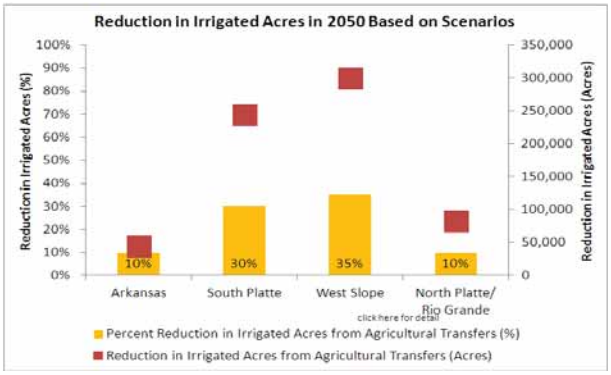


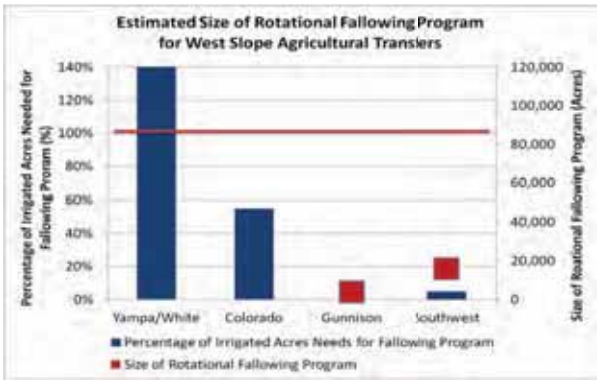
The selected portfolio represents a worste case scenario. Impacts to agriculture are severe, with more than 100% of the Yampa and White river basins irrigated agricultural needed to meet the high demands in their basin. A rotational fallowing program is not practicable on either the East or West Slopes.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

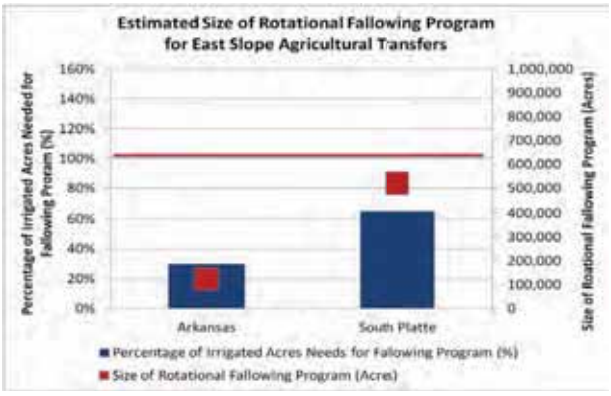
Impacts to nonconsumptive needs, especially riparian, may be significant, but the tool does not capture these.

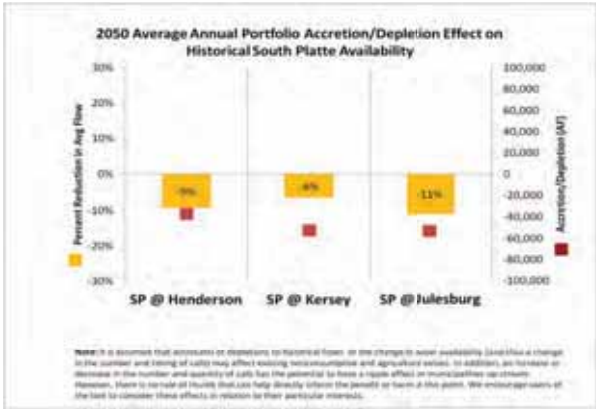
IPP success is higher for the Metro basin because it assumes the WIndy Gap and Moffat are 80% successful

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









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.

Date: May 25, 2012

To: Interbasin Compact Committee Members

From: Mark Koleber, Chairman of the Metro Basin Roundtable

Subject: Water Supply Paper

Below is a paper describing the Metro Roundtable's vision for meeting our basin's projected future supply gap.

As you may know, metro area water providers have the responsibility for over half of the state's future municipal water supply, which is the subject of the planning exercises that the roundtables conducted. The Metro Roundtable has put a lot of effort into understanding and explaining the practicalities of meeting our portion of the gap and developing what we feel are reasonable solutions for meeting the gap. Our hope is that this paper will help serve as a resource for your discussion about how to meet the gap.

The paper is in draft form because we would like to confer with roundtables before we prepare a final version. However, we are providing it to you now as you begin your own planning exercise on May 31st.

DRAFT 5.14.2012

Water Supply Paper for the Metro Basin Roundtable

1. Introduction and Purpose of Paper

This paper describes how the Metro Roundtable conducted the Portfolio Tool planning exercise. The outcome of the exercise was the development of the Metro Roundtable's vision for meeting the projected future gap in municipal supply needs which is also described in this paper. This paper contains five sections:

1) Introduction and Purpose of the Paper
2) Background Information on Portfolios
3) Supply Component of the Portfolios
4) Our Vision for Meeting the Municipal Supply Gap
5) Recommended Improvements to the Portfolio Planning Process
6) Concluding Comments

The Metro Roundtable prepared companion papers titled "Metro Roundtable Conservation Strategy" and "Selection of a Reuse Factor for the Portfolio Tool Planning Exercise." Together, these papers on filling the supply gap, conservation and reuse explain how the Roundtable performed its Portfolio Tool planning exercise.

The Portfolio Tool was developed by the Colorado Water Conservation Board for an exercise by the basin roundtables to consider various strategies or portfolios for meeting future municipal and industrial (M&I) water supply needs. Each basin roundtable has been directed to produce a set of portfolios using the Tool. To develop a portfolio, the user of the Tool needs to specify an amount of a hypothetical additional supply necessary for meeting future M&I water needs. The Tool requests user preferences for whether the additional supply would come from developing Colorado River Basin water ("New Supply" in the Portfolio Tool) or from water currently being used for agriculture ("Agricultural Transfer" in the Portfolio Tool) or from a combination of the two.

In earlier portfolio runs, the Metro Roundtable chose to not specify the source of additional water pending discussion with other roundtables. To facilitate comparison of the Metro Roundtable's portfolios with other roundtables, CWCB staff assumed 50 percent of the additional supply would come from New Supply and 50 percent from Agricultural Transfers. For

this final portion of the portfolio exercise, the CWCB staff has asked the Metro Roundtable to do an allocation of additional supply between New Supply and Agricultural Transfer

The Portfolio Tool was designed for statewide water planning. The Metro Roundtable only did the portfolio exercise for its own "basin," choosing to leave planning considerations of other basins to the local basin roundtables and future IBCC discussions. CWCB staff extrapolated the results of the Metro basin to the other basins.

As requested by the CWCB staff, this paper also considers possible implications of supply reductions

Disclaimer. It is important to note that the Portfolio Tool is a simplistic tool developed for a high level state-wide planning process for use by volunteer citizen groups. Information from the Tool is not necessarily applicable at the regional or water utility level or for professional water planning. The information in this paper and the information from the Tool are not suitable for use in regulatory and legal processes. Supply concepts in this paper are for discussion of general, hypothetical supply projects and are not intended to represent actual projects.

2. Background Information on Portfolios

This section provides background information on how the Metro Roundtable selected the supply component of its portfolio in the Portfolio Tool.

The portfolio exercise indicates that water utilities in the Metro basin are responsible for meeting over half of the state's municipal and industrial supply gap. It is important to understand the role of Metro basin water utilities in meeting this responsibility, in relation to the authority of other entities. Metro basin utilities have an obligation to meet the water service needs of their customers. Decisions about land development, transportation, economic growth incentives and other factors affecting growth of the customer base are generally within the purview of county and municipal governments, not water utilities. That said, water utilities are probably best situated to initiate discussions with decision-makers about the relationship between land use and municipal water demands. Moreover, water utilities promote conservation through education, incentives, watering schedules and water rate structures. Utilities can also prohibit water waste and develop water reuse and other water efficiency projects. However, water utilities generally do not have authority to enact regulations requiring high efficiency plumbing fixtures or low water-using landscapes. Depending on the type of regulation and jurisdiction, this authority rests with local, regional or state government. The Portfolio Tool has inherent limitations in its use, such as many embedded presumptions, a lack of transparency and an inability to adjust key planning variables, including conservation,

reuse factors and safety factors. To help overcome these limitations, the Roundtable performed its analysis on a simple spreadsheet that matched demand projections with supply strategies. The spreadsheet is attached.

To investigate a range of future conditions, the Roundtable prepared the portfolios for low, medium and high demands plus a condition with high demand and a warmer climate. A ten percent safety factor was included in the new and existing demands in all but the climate-adjusted demand to account for typical safety factors used in water utility planning to account for the inability to predict demand and supply.

In the climate-adjusted demand, total (new and existing) demand was increased by thirty percent to represent the impact of an assumed future climate with five degrees F of warming and no change in precipitation. This is in the mid-range of temperature projections for the watersheds that provide water supply for the Metro basin water utilities. Based on results of the Joint Front Range Climate Change Vulnerability Study and some simple analysis, the Roundtable estimated that demand would increase roughly ten percent due to increased demand associated with evapotranspiration of landscaping and that supply would decrease by roughly twenty percent due to increased evaporation, plant transpiration, and snow sublimation. Given the potential for a large increase in the supply gap, many Metro basin water utilities think it would be irresponsible to not consider the potential for climate change in the portfolio exercise.

Both, existing demand and new demand were adjusted by the safety factor or climate factors.

The variables in the Tool for "identified projects and processes" (IPPs), conservation, and reuse were set to the maximum levels considered to be achievable based on the experience and expectations of the participating water utilities. IPPs were set at 75 percent success rate of water yield for new projects and 100 percent success rate for growing into existing supplies. The conservation level used was between the low and medium assumptions in the Tool as explained in the companion conservation paper. The amount of conservation applied to the gap varied depending on the demand scenario and was set at 82-90 percent of the amount saved between 2000 and 2050. A conservation saving of 10-18 percent was reserved to buffer against uncertainty and durability of water conservation savings. Utilizing this more modest conservation estimate also allows for a buffer or reserve that can be called upon when and if more severe and/or frequent drought restrictions become necessary.

The reuse factor chosen for New Supply was 50 percent as described in the companion paper on reuse. The Metro Roundtable defines the reuse factor as the percentage of additional

supply available from the reuse of the New Supply and Agricultural Transfers. We assume that the New Supply project and additional Agricultural Transfers are both fully consumable and therefore could be entirely reusable to extinction. Please see the attached spreadsheet for details on the portfolios.

The remainder of the gap was met with additional supplies, either from New Supply or Agricultural Transfers as defined in the Portfolio Tool exercise.

3. Supply Component of the Portfolios

a. Bookends Approach

To help understand the range of options and impacts, the Metro Roundtable used a "bookends" approach to define the limits of meeting future demands exclusively with either New Supply or Agricultural Transfers. The first bookend assumes that all the additional supply would be met exclusively from Agricultural Transfers. The second bookend assumes all the additional supply is met with New Supply. While these bookends identify the expected range of possible future options, the Metro Roundtable is not advocating either. Rather, the Metro Roundtable believes this range of options between the bookends should be preserved for future generation to decide how best to meet their needs. The Metro Roundtable also believes in a balanced and flexible approach to meeting future needs that will fall between the bookends, as described below.

Bookend portfolios were developed for the four demand levels – low, medium, high and high plus a warmer climate. The bookends are described in the attached spreadsheet. The maximum demand to be met is about 220,000 acre-feet per year for the Metro Basin. The bookend approach is a simplification for the Tool exercise and either bookend may be overstated.

b. Key Considerations

There are obviously many important tradeoffs and issues to consider when choosing the amount of additional M&I water supply that would be developed from New Supply or Agricultural Transfers. Opinions vary among Metro Roundtable members about these considerations. While there is not complete consensus among members on all these issues, below is a summary of the discussion and current thinking among Metro Roundtable members.

Water Use Efficiencies. The Metro Roundtable is leading the state in water use efficiency and believes it is in its best interest to continue to lead the state into the future. The Metro Roundtable has the lowest gallons per person per day (gpcd) water use rate. This occurs even though the Metro basin has a higher industrial use per person than most of the communities in the rest of the state. The Metro Roundtable also has the highest municipal water reuse rate. Additional reuse is expected through innovative advanced water retreatment methods and cooperative water and facility sharing arrangements, such as the proposed WISE project. In the WISE project, water reused from west slope and other sources will extend the life and usefulness of the Denver Basin aquifer, making more efficient use of local resources, while negating the immediate need for additional water.

Nearly all unused municipal return flow is put to agricultural use in the Lower South Platte basin. The Metro basin has among the highest economic return per acre-foot of water used. Likewise the economic return on agricultural water use in the South Platte basin is among the highest in the state. However, it is also important to recognize that water uses in other parts of the state, and the environmental, recreational or aesthetic value of water, are just as important to the future of Colorado.

Water customers of Metro area water utilities have reduced per capita water use by approximately 20 percent in the last decade. Much of the metro area's lawn watering levels are at or near the minimum levels needed to maintain viability. Water providers are committed to increasing efficiencies in the future; however, they are also seeing limits to the amount of additional conservation savings that can be attained unless there is a broader societal decision to legislate high efficiency fixtures and change the urban environment to a more xeric landscape. Utilities encourage conservation through water rate designs, education, watering schedules and rebate programs, as well as water waste rules. Enacting ordinances and legislation to require more efficient plumbing fixtures and landscaping - the next step in water conservation requires unity in political will beyond the authority of metro water providers. The recently unsuccessful attempts to propose legislation to require the sale of more efficient toilets and to allow grey water use typifies the need for political will to gain higher levels of efficiencies. In its conservation paper, the Metro Roundtable described what it believes to be reasonably achievable maximum level of conservation that water utilities can achieve through 2050, absent more fundamental changes in lifestyle and development patterns.

The Metro basin has opportunities to redevelop lands for greater job and population densities. Increasing residential density, while not considered in the Portfolio Tool, has the potential to significantly increase water use efficiency. In addition to requiring less water, increasing density within existing urban service areas carries the added benefits of maintaining open space

and agricultural lands, reducing energy demands and increasing the efficiency of transportation systems. Again, this will take broad political support to achieve. Living and working in a more densely populated environment has and will continue to result in a lower impact on natural resources.

As mentioned above, decisions about land development are generally within the purview of county and municipal governments, but not water utilities. Similar to enacting water efficiency ordinances and legislation, enacting land development decisions that may result in more efficient water use will require political will beyond the authority of water utilities. Historically, water utilities have generally not attempted to influence land use decisions. However, it would be worthwhile for water utilities to discuss water efficiency measures with land use planners and decision-makers in their service areas. Water utilities that are governed by elected municipal officials may have more influence on land use decisions than utilities that are independent governmental entities.

Growth. Half of all population growth in Colorado will consist of people moving into Colorado to fill jobs, mostly into the urban areas along the Front Range. The other half of population growth will come from the existing population within the state, because the reproduction rate is greater than 1.0, i.e., the birthrate is higher than the death rate. Being able to supply the water needed for these new jobs and new people is in the best interest of the entire state. Likewise, providing that supply in a responsible way that best accommodates the needs of our environment and agricultural sector is also in the best interest of the entire state.

In order to accomplish this goal, metro basin water providers need the assistance of political and business leaders that promote job growth. We need support for state policies and legislation on conservation, for permitting of IPPs, for legislation enabling alternative agricultural transfer methods and for development of New Supplies. The IBCC and the basin roundtables have the responsibility for initiating and building this political will if they want to avoid the default to traditional Agricultural Transfers.

High Costs. The cost of developing additional M&I supply is rapidly increasing. Most of the gravity-fed, high water quality options have been developed. Most additional supplies will require long pipelines, pumps for large elevation lifts and advanced water treatment. The CWCB's SWSI 2010 technical team developed estimates of the total life-cycle unit costs (the net present value or capitalized cost of water, conveyance, facilities and operating and maintenance costs) of several 100,000 and 250,000 acre-foot projects. These include projects on the lower Yampa River, Green River at Flaming Gorge, the Gunnison at Blue Mesa, the lower Arkansas River and the South Platte River. Total life cycle cost (net present value of capital and

operation and maintenance costs) range from about $80,000 to $100,000 per acre-foot of additional supply. Smaller projects like the Green Mountain and Ruedi reservoir pumpback projects cost about $40,000 per acre-foot.

All these projects require long pipes and large elevation lifts. All of the New Supply projects would require expensive conveyance costs from long pipelines and pumping requirements for large elevation lifts. The Agricultural Transfer projects from the Arkansas or South Platte would also require expensive advanced water treatment in addition to conveyance costs.

Unless there is a large New Supply project available to smaller water utilities to share in the economies of scale, these smaller water providers might be unable to develop New Supply and hence would use Agricultural Transfers instead.

Similar to supply projects, much of the low hanging fruit of conservation and reuse projects has been picked. As a result, new water efficiency projects are becoming more expensive than previous projects and those being pursued at present.

Water Quality. As explained above, projects that take water from the lower reaches of rivers will require costly advanced water treatment. Likewise, growth in the Metro basin area results in increased wastewater discharges, lower dilution flows, and an increase in the costs to treat water from the South Platte River in the Metro basin area. Reuse projects and diversions from the South Platte in the Metro basin will require expensive water treatment. Blending with higher quality existing supplies may be possible at lower volumes of new supply. Advanced treatment includes reverse osmosis which has associated brine disposal challenges.

Managing the Risk of Reduced Supplies. Simple hydrology modeling performed for the Colorado River water banking study shows that there is a low probability of the Upper Basin failing to meet Colorado River Compact obligations at existing demand levels and using observed streamflow (recorded from the last 100 years). In fact, under these same assumptions the probability of failure to meet compact obligations remains less than a few percentage points in any given year even if 700,000 of acre-feet of additional depletions occur in the upper basin.

However, preliminary modeling indicates that the probability of curtailment would increase to a little over 10 percent if there were to be a streamflow decrease of 10% combined with the 700,000 acre-feet of additional depletions. A cooperative water bank study is exploring the concept of municipal water users paying agricultural water users to reduce water uses in order

to avoid curtailment or lessen the impact of curtailment on those municipal water users. The roundtable supports these efforts.

Other roundtables have discussed the concept of establishing triggers and other tools to manage use of Colorado River water in an effort to meet Compact obligations. The Metro Roundtable supports further discussions of these concepts as a way to adaptively manage and develop New Supply and recommends that voluntary demand reductions also be explored. An adaptive management approach that allows for full development of Colorado's Compact entitlement to supply future demands on both the east slope and the west slope should be explored instead of attempts to limit development of Colorado's allocation of water. The Metro Roundtable, however, opposes efforts to establish an arbitrary cap on water use.

Hydrology modeling of climate change projections that was performed for water utilities along the Front Range shows that a considerable range of possible streamflow changes, from wetter to drier conditions, are projected in the east and west slope watersheds that supply the urban communities along the Front Range. The ability to use or receive credits from *senior* agricultural water rights, from one or both slopes, could provide important coping strategies (hedges) against the risk of a hotter and/or drier climate.

While helping to preserve agriculture on the east slope, developing New Supplies on the west slope could affect west slope agriculture if it results in agricultural demand reduction strategies necessary to meet Compact obligations. Also, apparently some west slope roundtable members are concerned that if a transbasin pipeline is built, instead of filling it with New Supply (new water appropriations), Front Range water providers would instead use Agricultural Transfers on the west slope (buy senior agricultural rights) to create a more "firm" supply to better guarantee the success of their water supply project.

Storage. Nearly all future supply strategies require additional water storage. Storage makes more efficient use of water and provides benefits beyond M&I water supplies. Storage is also a method to hedge against drier conditions. If the state's climate becomes drier, it will be even more important to store water in wetter times for later use. The Metro Roundtable believes carefully designed and operated storage in reservoirs and aquifers such as the Denver Basin is a viable management tool for meeting future water needs. Conjunctive use of Denver Basin aquifers with New Supply available in average or wet years is an opportunity to stretch the Basin's significant groundwater resources to meet future demands.

The Roundtable has used Water Supply Reserve Account funding to study the viability of deep aquifer storage and recovery with the South Metro Water Authority. Past studies show that

surface storage is needed to temporarily capture streamflow when it is available during high runoff periods until there is capacity to pump it into the deep aquifers for long-term storage.

Identified Projects and Processes. The Portfolio Tool exercise helps highlight how critical the success of IPPs are to meeting the municipal supply gap. IPPs proposed by metro area providers, if successful, will provide much of the water supply needed for the project proponents through 2025. But they won't meet all needs of the Metro basin. IPPs are in fact the foundation of the entire portfolio exercise and the basis for the state to move forward to meet the water supply gap. The planning exercise has demonstrated that if these IPPs fail, the whole effort to meet the supply gap founders. Success is so important to meeting the gap that the Metro Roundtable believes that all roundtables and the IBCC must support the implementation of the water supply IPPs.

Success of IPPs is far from a safe assumption at this time. Many supply projects currently being pursued by Metro water providers are enlargements of or reoperations of existing water facilities and are designed to have less environmental impacts by using existing facilities. Unfortunately, these projects are stalled in long environmental review processes, some over 10 years, with no definite end in sight. For example, the effort to reallocate the storage capacity in Chatfield Reservoir from flood control to municipal water supply use has been in approval processes for 13 years, even though no new storage capacity is being constructed.

Alternative Agricultural Transfer Methods. The Metro Roundtable supports and is encouraged by the studies investigating methods for reducing the impacts of Agricultural Transfers. Additional study of practices that allow for continued agricultural production, while at the same time permitting municipal uses, is encouraged. Examples of such practices include, switching to cool weather crops, reducing soil moisture evaporation (e.g., mulching or drip irrigation), leasing/fallowing, deficit irrigation and dry year leasing.

When a local government issues a water tap, the water provider has the obligation to supply that tap continuously and permanently. To meet that obligation, most water utilities would need a permanent and dependable right to the use of agricultural water. However, some Denver Basin municipal water providers may be able to extend the life of their groundwater supplies significantly through the conjunctive use of agricultural water when it's available. In addition, some municipal water providers may have adequate base supplies, but lack adequate supplies to meet dry year demands and/or refill storage following a drought, a need that agricultural water may be well suited to meet to increase the reliability of the municipality's supplies. In short, there are many innovative ways to meet municipal water supply needs and to help maintain the viability of agricultural communities and economies. Holders of agricultural water rights should not, however, be prevented from selling their property right.

Environmental and Social Impacts. The Metro Roundtable understands the potential for negative impacts to local communities and environments from the development of New Supply and from Agricultural Transfers. The Roundtable seeks to better understand the concerns of the other roundtables on these issues.

Environmental and social impacts can occur on the east slope from Agricultural Transfers as well as on the west slope from New Supply development. The metro area residents benefit greatly from the food production and from the recreational amenities on both the east and west slopes. Likewise, we believe the recreational and agricultural communities benefit from the purchases of their goods and services by the metro area market. Preserving the mutual trade of values between areas of the state is important our future.

The Metro Roundtable believes there are opportunities to minimize the negative impacts of projects and in many cases produce positive impacts through close consultation with affected interests. Projects that are carefully designed, that embody multiple purposes and that feature adaptive management can lead to win-win solutions. The Colorado River Cooperative Agreement is the leading example of this approach.

Preserving Options. The portfolio exercises demonstrate the enormous challenges the state of Colorado faces in providing water for its economic and population growth. The roundtable is of the opinion that it is vital that the full range of M&I supply options be preserved for future generations to decide how best to meet their supply needs based on the circumstances they will face. Limiting options at this time would be irresponsible to future generations.

The Metro Roundtable believes that supply options should be preserved for all basin roundtables. This includes preserving New Supply options for future generations on both the west and east slopes. As noted above, some west slope roundtable members are concerned that new transbasin projects supplying the Front Range might use Agricultural Transfers on the west slope as the source of water instead of using New Supply (unappropriated water) on the west slope. Preserving the option to develop New Supply on the west slope could help avoid this concern. Otherwise, the state may be left with just the option of choosing between east slope and west slope Agricultural Transfers to meet future M&I needs.

There are many challenges to development of New Supply. These include water rights for recreational in-channel diversions and wild and scenic river designations, or their alternative protection plans. These actions can impede development opportunities and/or push them toward or past state lines, further away from the urbanized areas. On the Colorado River, this

could prevent use of the state's compact entitlement. Water efficiency enhancements (conservation and reuse) alone are not enough to meet the M&I supply gap.

Despite that fact, Metro basin water providers are up against great challenges to secure permits, even in developing small, incremental extensions of existing water systems. Without a fairly quick and strong reversal in lack of political will to protect the ability to develop New Supply, it appears that Agricultural Transfers will inevitably be the default for supplying the water for the economic and population growth of the state.

While the Metro Roundtable supports Agricultural Transfers as "one leg of the stool" to help meet the water supply gap, the Metro Roundtable does not support relying exclusively on Agricultural Transfers for the additional supplies needed to meet the water supply gap and instead urges a balanced approach which includes development of needed New Supply projects in the short-term and preservation of options to develop New Supplies in the long-term.

Summary of Considerations

- Metro basin water utilities are leaders in water efficiency and plan to push the practical limits of conservation and reuse. Achieving higher levels depends on lifestyle changes that will require broad statewide support and political will beyond the purview of metro area water utilities.
- Even at high levels, water efficiency (conservation and reuse) is not a panacea for meeting the water supply needs of the expected economic and population growth in the state.
- Small, incremental additions to existing supply projects, which have lower impact levels than building new supply projects, are detained in approval process with no definite end in sight.
- Substantial amounts of New Supply can be developed within the state's Colorado River Compact entitlement. Management techniques such as water banks and methods for temporarily reducing water use during dry conditions are available to manage a warmer and/or drier climate. However, artificially capping development due to a fear of a "compact call" merely shifts future risks to agriculture.
- Options to develop New Supply are systematically being closed, and a concerted effort is needed to preserve future options to develop New Supply. A balance needs to be struck between providing protections for in stream uses and retaining options to develop supplies in the future if and when they are needed.
- Additional storage is key part of the solution to the supply gap.

- The Portfolio Tool exercise highlights the realities that even by pushing water efficiency to practical limits, the difficulties in developing and preserving New Supply options makes some Agricultural Transfers the default option if decision makers do not exercise the political will to preserve and promote opportunities to develop New Supply for use along the urban Front Range. The Metro Roundtable opposes this default approach and seeks a more balanced approach.
- Alternative transfer methods may reduce impacts of Agricultural Transfers and such techniques should continue to be developed. To be successful, the transfer method must provide a permanent, reliable supply of water for water utilities. However, in some cases interruptible, drought leases may work and it might also work to have the ownership of the water and lands remain in agriculture. Innovative approaches like this may require supportive water rights legislation to address the difficulties that have been encountered in the water court process.
- Unfortunately, climate change is not directly considered in the Tool. The Metro Roundtable included in its portfolio exercise the consideration of a temperature increase of 5 degree F, which is in the mid-range of projections for 2050. Analysis indicates this would decrease supplies by about 20 percent and increase municipal demands by about 10 percent. This dramatically increases the supply gap. Because the consequences could be high and water utilities are taking this threat very seriously, the Metro Roundtable believes it is critical that the IBCC also consider climate change in its Portfolio Tool exercise.

4. Our Vision for Meeting the Municipal Supply Gap

As explained above, the Metro Roundtable believes in preserving the ability to use Colorado's entitlement under the Colorado River Compact and to pursue Agricultural Transfers. The bookends approach is an effort to preserve both of these options for water needs through 2050 and well beyond. Closing either of these options would be irresponsible to future generations who should be left with the ability to choose how to best use Colorado's water resources, depending on the conditions they face at the time. Those uses could be for municipal, industrial, agricultural, recreational, environmental or other yet-to-be identified uses.

The Metro Roundtable does not anticipate that either extreme will be pursued. A balance should be sought while maintaining options for future generations, as well as preserving and enhancing environmental and recreational values and protecting private property rights.

In this section, the roundtable describes a possible integrated, managed approach that is somewhere between the bookends. Much of the value of scenario planning (upon which the

Portfolio Tool is based) is lost when only a middle of the road option is available. Middle options tend to be paths of least resistance that don't prepare for the range of possible challenges. This middle option is being suggested only to the extent that it is considered in the context of the bookend approach, and the need to preserve a range of options for the future.

In essence, our vision is for the state to plan for an integrated, managed approach to meeting the M&I supply gap. This approach would develop, and preserve the potential to develop, New Supply, and more storage, and would utilize Agricultural Transfers while simultaneously enhancing efficiencies (conservation and reuse) and building our IPP's. Our goal is to prepare for future water needs in a way that maximizes the state-wide benefits of our water resources and while minimizing the impacts.

Ideally, projects would be multi-purpose, with associated recreational and environmental benefits. New Supply would be developed in a manner that does not exacerbate compact risks. East slope storage would come from enlarging existing reservoirs, building off-river storage, and using underground storage to minimize riparian impacts. New Supply and east slope storage would form the base of the M&I supply. East slope Agricultural Transfers and conjunctive use of the Denver Basin Aquifer would be used primarily for droughts and drought recovery. Alternative agricultural transfer methods including land and water conservation easements could be used to help maintain agricultural production and the local economic benefits of agriculture.

Our vision is to develop solutions to use New Supply and Agricultural Transfer in a coordinated manner to reduce recreational, environmental and social impacts and to equitably spread project impacts between the east and west slopes. We are proposing the building of projects that develop both sources of supply – from New Supply and Agricultural Transfers – instead of building a project that has a single source, from either New Supply or Agricultural Transfer. Because the facilities needed essentially doubles with dual source projects, the cost would roughly double compared to single source projects. These higher costs may be well beyond the ability of water utilities to finance. To afford the benefits of dual source systems, additional funding sources would probably be needed. This should be a research area for the IBCC to consider.

Far-sighted management would maintain the capability to scale and adjust project sizes and purposes as needed in the future, assuming the options to build the projects are preserved. For instance, a warmer climate could be managed through water banking or other demand management programs on the east and/or west slopes, while allowing additional supplies to be developed for future job and population growth.

For the near term, the next 20 to 40 years, all IPPs should be successfully implemented. Small supply projects on the west slope could be developed such as those identified in SWSI studies, Colorado River Water Conservation District studies and other studies. If properly designed and operated, these small supply projects should have multiple benefits for the east and west slopes while minimizing environmental impacts. The Metro Roundtable favors a risk management program for the Colorado River compact that addresses existing water uses and new water development and provides benefit for both the west and east slopes. On the east slope, new storage could be built through enlarging existing reservoirs and building off-river reservoirs and underground storage using the Denver Basin aquifer. This storage would be paired with east slope agricultural water for use in droughts and drought recovery.

Based on our bookend end approach for the scenario planning, we envision preserving New Supply and Agricultural Transfer options for meeting long term needs. Our vision is to preserve the following options for future generations to determine whether they should be developed:

- West slope multi-use New Supply projects capable of producing roughly 250,000 acre-feet of M&I supply for the urban Front Range from the Green, Yampa and/or Gunnison Rivers.
- East slope Agricultural Transfer projects (including the use of alternative transfer methods) capable of producing roughly 250,000 acre-feet of M&I supply for the urban Front Range from the South Platte and/or Arkansas rivers.
- Additional East slope storage opportunities to maximize the use of the new supplies.

To preserve these long-term options for future supplies, the following actions would be taken:

- Where needed, obtain water rights that protect the New Supply options described above. Use the IBCC process as a starting point to determine where water rights might be needed to protect the options describe above, when the water rights should to be filed, how they should be filed, who should file and hold the rights, and how the water rights would be maintained for the long-term.
- Consider legislation to establish a mechanism for the obtaining and maintaining of water rights that protect the New Supply options.
- Investigate the viability of obtaining Bureau of Reclamation water contracts in lieu of water rights.
- Require an allowance for these new projects in relevant Recreational In-channel Diversion projects and Wild and Scenic processes and alternative protection plans. (Note, until there would be a decision made on the merits of whether to build a supply project, the instream flows would remain unaffected. As described above, the project

would be designed to minimize impacts to and, where possible, enhance instream values).
- Ensure early state involvement in these new projects, supporting project proponents in all local, state and federal processes once initial concerns are identified and addressed.
- Obtain land or right-of-ways for project facilities.
- Continue efforts to recover federally listed endangered species and to keep new species from becoming listed.

While near term supply projects are being developed and the long term projects are being preserved, the water efficiency (conservation and reuse) challenges explained above should be overcome to continue to increase urban water use efficiency and minimize the need for additional supply development.

Recommended Improvements to the Portfolio Planning Process

Having developed its own spreadsheet to help overcome limitations in the Portfolio Tool and having considered the integrated, managed approach which is beyond the capability of the Tool, the Metro Roundtable recommends use of other evaluation tools or improvements to the Portfolio Tool or subsequent analyses before the IBCC selects its representative portfolio scenario planning exercises. These include the ability to:

- Display conservation since the year 2000, and base the amount applied to the gap on total conservation between 2000 and 2050.
- Add ability to custom select the values for the following variables: conservation, reuse factor, safety factor, climate factor and environmental flow metrics.
- Add the option to make additional use the Colorado River only in wet and average years and to pair that supply with storage and/or dry year leasing of agricultural water and/or water banking.
- Display flow impacts to actual flow not pre-development conditions. (For instance, the South Platte accretion/depletion calculations could be used statewide. These calculations display changes to actual flows, not pre-development conditions).
- Display the actual amount of additional supply diversions.
- Add a factor to reduce demand with increasing population density.
- Add a feature that adjusts returns flows available for reuse based on conservation measures employed. (This feature could be similar to how the calculation of South Platte accretion/depletion adjusts returns with municipal conservation.)
- Account for losses from source to treatment. (These losses can be as high as 30 percent).

- Identify the level of reliability of supply projects and their ability to meet supply needs.

The Metro Roundtable recommends that a disclaimer, similar in nature to the one on this paper, be added to all Portfolio Tool material to make clear the purpose and limitation of the Tool including that it is inappropriate for use in regulatory and judicial processes.

5. Concluding Comments

Our concluding comments are:

1. **The role of water utilities.** The role of water utilities is to serve customer's water needs. In the Metro Basin, this requires serving water for a growing population and growing businesses. The amount and pattern of this growth is determined by others. Metro area utilities will provide water for growth through conservation (see item 2 below), reuse and development of additional water supplies. Metro area water providers have the responsibility for meeting much of the state's future supply gap. Water providers take that responsibility very seriously.

2. **Achieving Higher Levels of Water Savings.** As statewide leaders in conservation, Metro basin utilities plan to push the practical limit of conservation and reuse. However, it should be recognized that the authority and role of utilities in planning for and achieving defined conservation goals is highly limited. The basic tools at our disposal are rates, advertising, rebates and incentives. Utilities cannot "regulate" water use. Utilities cannot control land use. Utilities cannot mandate grass be removed. Utilities cannot mandate high efficiency appliances and fixtures. Obtaining greater savings in outdoor water use would require major changes in landscaping. This goes beyond efficiency measures and involves lifestyle considerations about our urban environments. These decisions needed to be made and implemented at the broader community level, not at the water planner level. Achieving higher levels of indoor conservation will require broad political and public support for plumbing code changes and other measures that are beyond our sole control and involve lawmakers at multiple levels of government.

   Changes in land use planning, such as zoning modifications that could increase density levels, can increase water efficiency, but it also requires broad political support. Water utilities can help initiate change by discussing water efficiency measures with land use planners in their service area.

3. **Conservation is not the panacea.** The Tool exercise helps to demonstrate that even high levels of indoor and outdoor water saving won't meet the projected supply gap.

4. **Without the political will to support alternatives, dry-up of agriculture is the default supply.** The Portfolio Tool exercise demonstrates that without broad political support for the changes described in this paper for conservation measures, for alternative agricultural transfer methods, for successful implementation of IPPs, for new storage projects and for the development and preservation of new west slope supply options, large transfers of water from east slope agriculture use becomes the default source for filling the municipal supply gap. The most needed change, if large scale agricultural dry-up is to be avoided, is to develop support for small scale supply projects in the near term and for preserving the option to build large scale supply projects if needed in the longer term. However, the ability to pursue Agricultural Transfers, as well as agricultural water right owner's ability to sell their water, should be preserved as an option for development of additional supply in the future.

5. **Our vision is a balanced, integrated plan.** The Metro Roundtable does not support the agricultural default plan. And, we reject the false choice in the Portfolio Tool of picking between the west slope environment and east slope agriculture. We propose a balanced plan of conservation, reuse, IPPs, storage, New Supply development and Agricultural Transfers developed and operated in an integrated manner that maximizes benefits and minimizes impacts. A key measure in this plan is building integrated projects comprised of New Supply, Agricultural Transfer and new storage, operated in a manner to minimize impacts to agriculture and the environment and where possible to make enhancements. While minimizing impacts, this type of integrated project would be very expensive. Water utilities customers alone can't afford to pay for this approach. Broader political and financial support is essential if the state wants to minimize the water related impacts of growth.

6. **Support from beneficiaries of growth.** There is a close linkage and dependence between the economies of the various regions and business sectors of the state. Job growth is a key component of the state's economy. Job growth in the metro area provides economic growth in the agricultural, recreational, tourism, manufacturing and other sectors of the state's economy. New jobs mean more people and businesses using water. To provide that water, we need the support of those business communities and political leaders that promote and benefit from economic growth to help make the changes described above and to help avoid the default plan of agricultural dry-up.

7. **IBCC leadership is critical.** The Metro Roundtable calls for the IBCC to actively support new conservation legislation, full development of IPPs, water sharing projects between ag and municipal user, development of small scale supply projects and preservation of options to develop future supply projects on the West Slope, as described in this paper. Without leadership from the IBCC to build political support for this balanced plan, metro water providers will be left with the default of pursuing large ag transfers for meeting their water service obligations.

Portfolios for the Metro Roundtable

DRAFT 5/21/2012

	2050 DEMAND PROJECTIONS							SUPPLY STRATEGIES TO MEET DEMAND							
										New Supply					
Portfolio Number	Current Demand (2008 = 155 gpcd)	Future Increase (2008-2050)		Replace SM Groundwater	Safety Factor	Climate Factor	Total Demand	Current Supply	IPPs	Cons.	New Water - ES Ag	New Water - Co Riv	Reuse of New Water		Total Supply
	kaf/yr	level	kaf/yr	kaf/yr	factor	factor	kaf/yr	kaf/yr	kaf/yr	kaf/yr	kaf/yr	kaf/yr	factor	kaf/yr	kaf/yr
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	437	Low	261	21	1.1	1.0	**790**	437	120	75	0 105	105 0	0.5	53	**790**
2	437	Med.	282	21	1.1	1.0	**814**	437	140	75	0 108	108 0	0.5	54	**814**
3	437	High	350	21	1.1	1.0	**889**	437	170	75	0 138	138 0	0.5	69	**889**
4	437	High	350	21	1.0	1.3	**1050**	437	170	111	0 222	222 0	0.5	111	**1051**

Explanation

To investigate a range of future conditions, portfolios were 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

Conservation Potential

	2008	2050			
		Low	Medium	High	High (+10%)
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

Conservation Applied To Gap

	2050			
	Low	Medium	High	High (+10%)
2000-2008 conservation (100% to gap)	162	167	183	201
2008-2050 passive conservation (100% to gap)	75	75	75	75
2008-2050 active conservation (range to gap)	0	0	0	36
Total 2000-2050 conservation applied to meet new demand	237	242	258	312

Total % of conservation applied to gap	85%	84%	82%	90%
Future conservation to gap (Column 10)	75	75	75	111
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
1	There are 4 Portfolios. However, we have bookended each one to accommodate the breakdown between new water being developed from new Colorado River Supplies and East Slope ag to urban transfers.
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 estimate of 75,000 af.
5	Additional Demand to replace nontributary groundwater is 20,850 AF/yr from the Tool.
6	Typical safety factor used in a 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 (2+4+5)*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.
12-13	Bookends of new water developed from west and/or east slope as new water and/or ag to urban transfers.
14	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.
15	Equals columns (12 or 13)*14
16	Should roughly equal total demand. Equals columns 9+10+11+12+13+15

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.

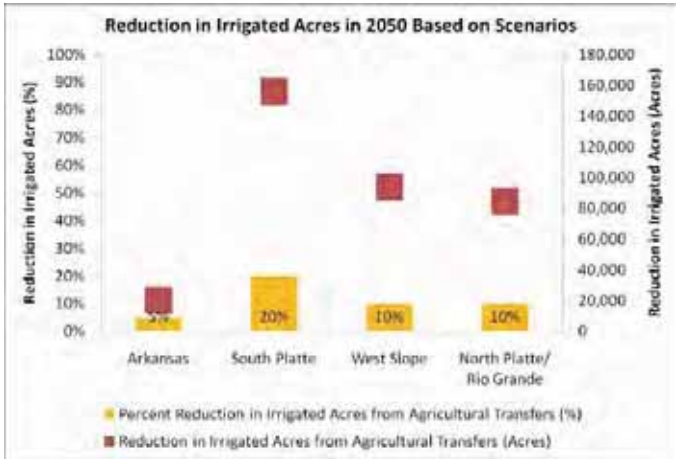
Table 1 Summary of Scenario Results

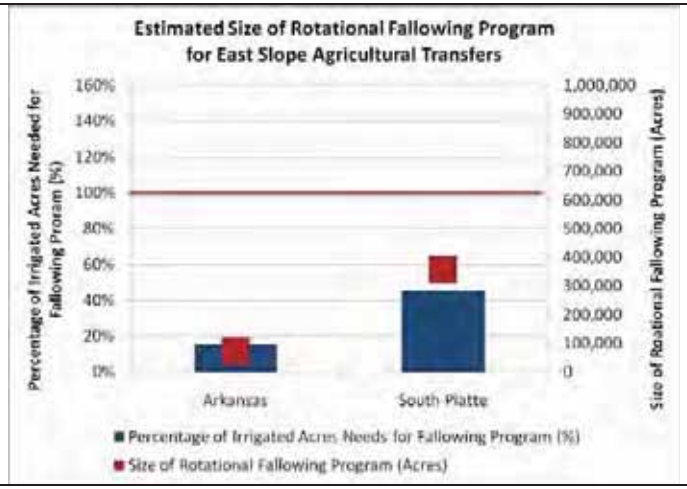
Portfolio Element	Scenario 1: Medium Demands/Low Conservation Strategy/150,000 AFY Colorado River System Water	Scenario 2: Medium Demands/Low Conservation Strategy/300,000 AFY Colorado River System Water	Scenario 3: Medium Demands/Medium Conservation Strategy/150,000 AFY Colorado River System Water	Scenario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





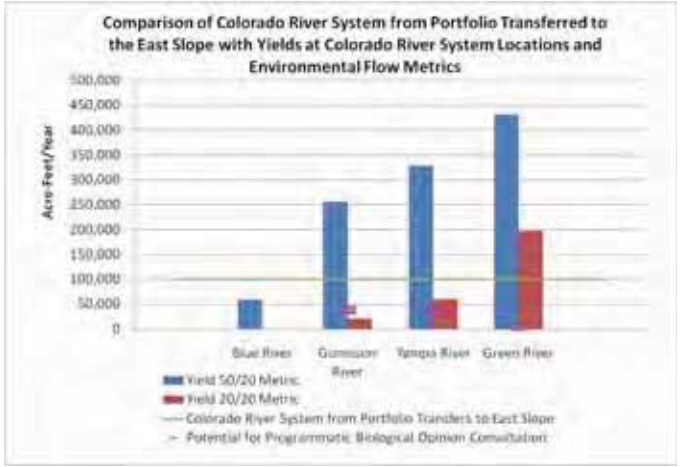
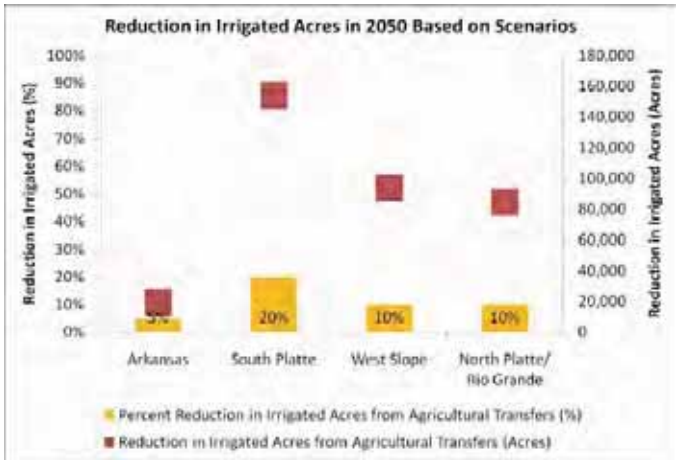
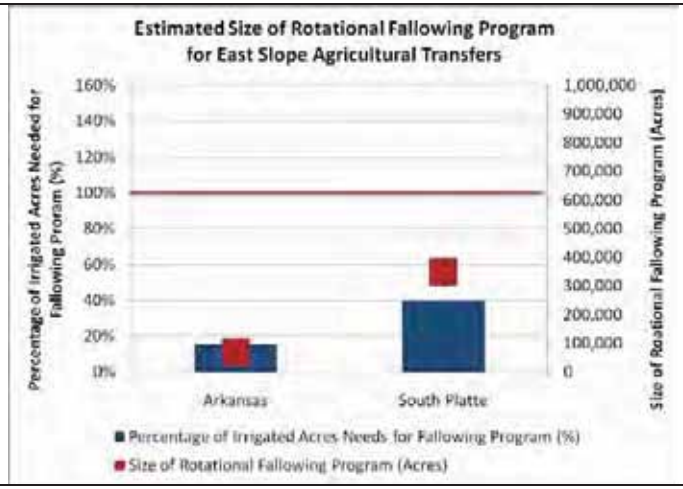


Table 3 Scenario 2 - Medium Demands/Low Conservation Strategy/300,000 AFY Colorado River System Water





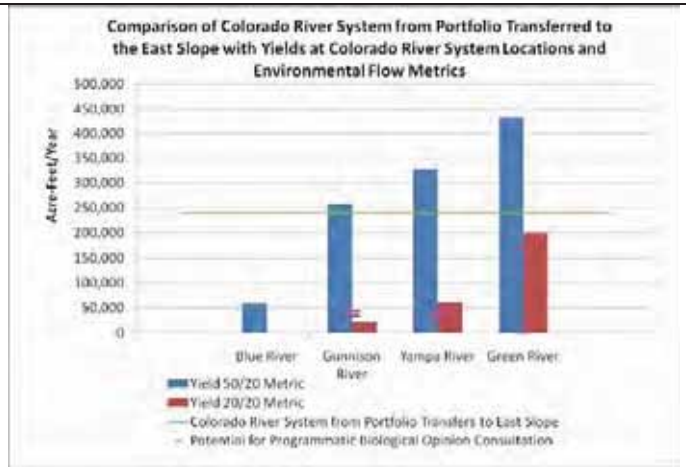
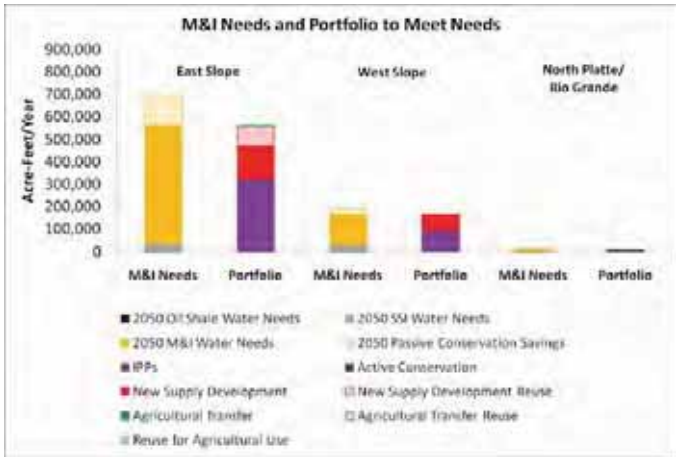
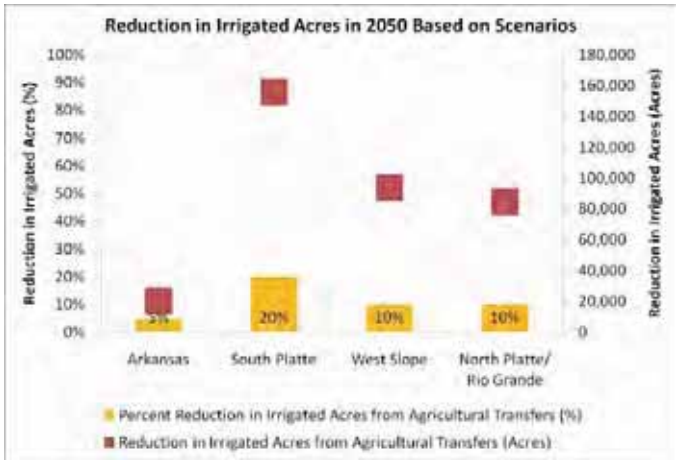
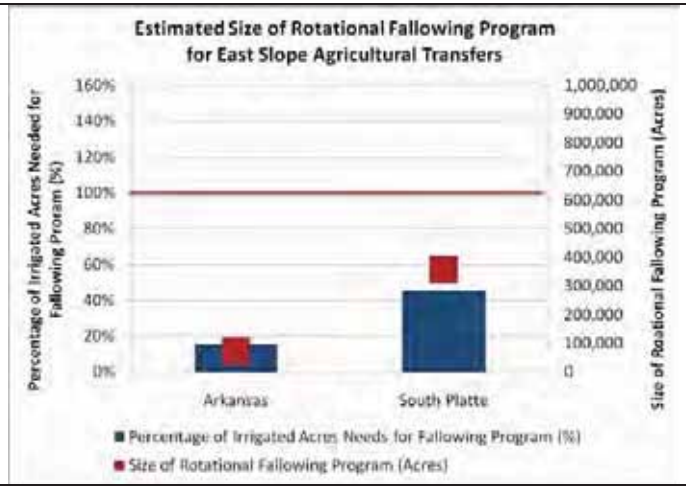


Table 4 Scenario 3: Medium Demands/Medium Conservation Strategy/150,000 AFY Colorado River System Water







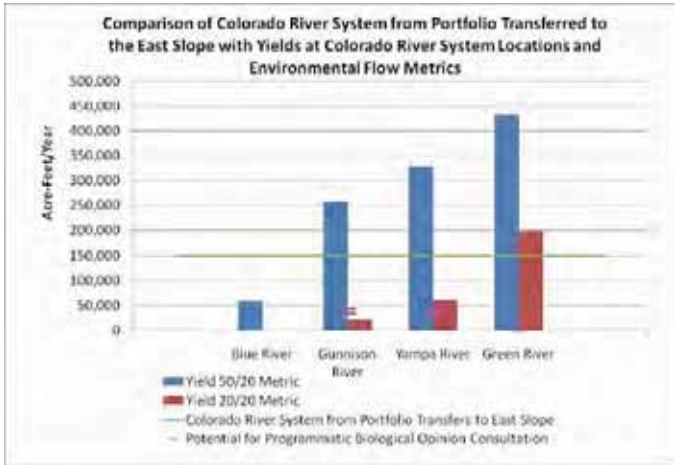
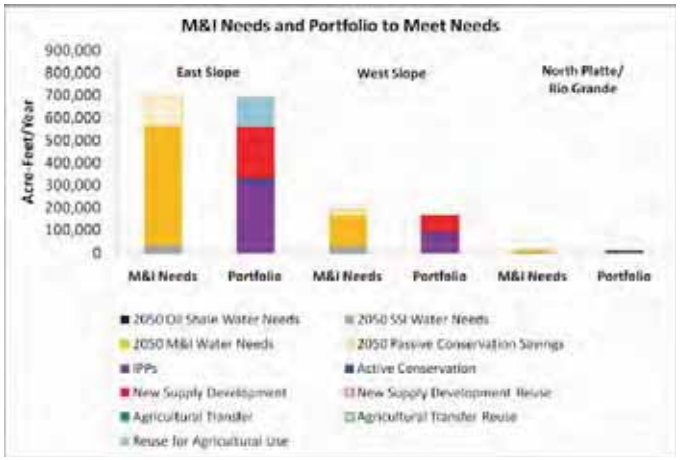
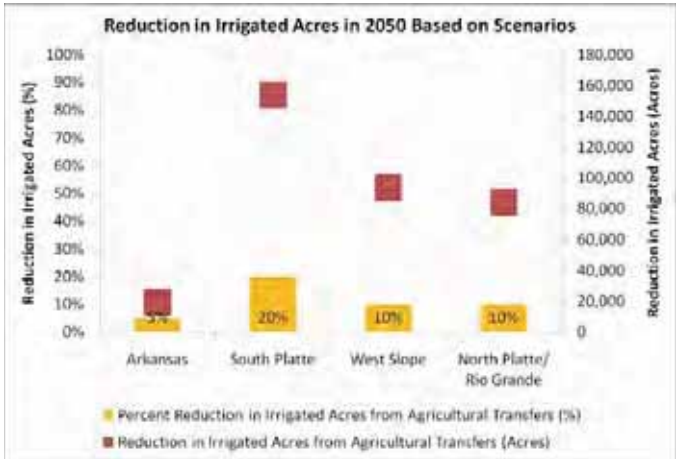
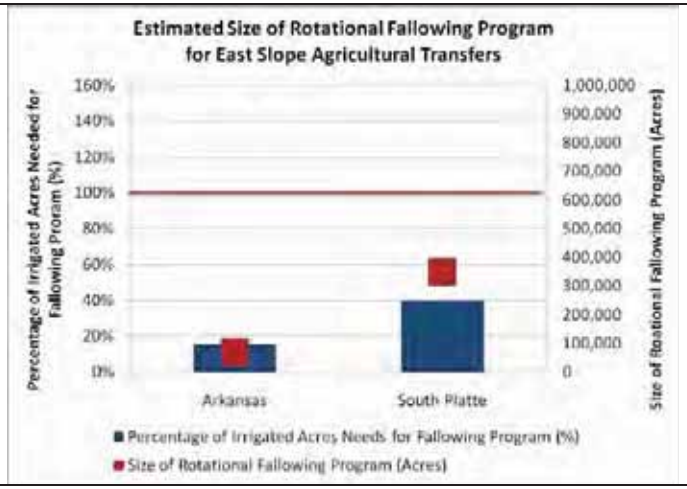
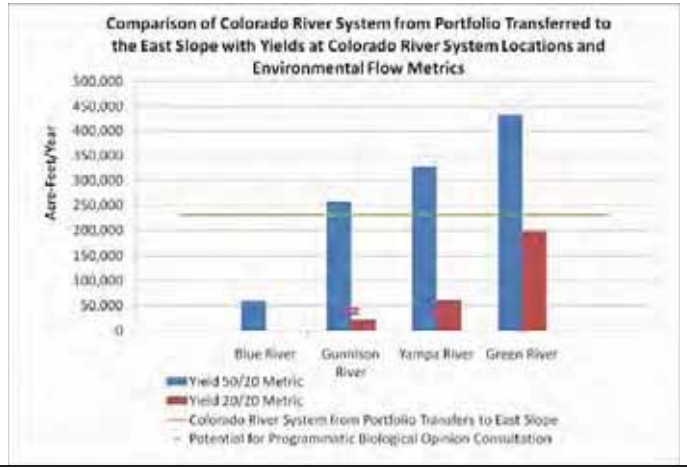


Table 5 Scenario 4 - Medium Demands/Medium Conservation Strategy/300,000 AFY Colorado River System Water









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.

Attachment to the Yampa White Roundtable Portfolios Submitted to the CWCB

The Yampa White (YW) Roundtable put forth portfolios using the "portfolio tool" at the behest of the Staff of the CWCB for use in statewide planning efforts. The basin put forth two scenarios, a high demand/low supply and a high demand/ high supply. The YW Roundtable put these forward to frame the issues of economic growth and the naturally highly variable hydrologic supply in our rivers. The fact that basins would like to enjoy economic growth and that water is often the limiting factor to that growth is well established in Colorado. Figure 1 shows the YW portfolios as depicted along with other portfolios in a CWCB summary slide at the Flaming Gorge meeting in Glenwood Springs on March 27, 2012. YW1 and YW2 represent two distinct hydrologic situations. YW1 shows that in times of drought insufficient water is available locally and no water is available for transcontinental diversion and YW2 shows in times of high supply water is available to meet the needs of the basin and excess water may exist. The intent was not to "include development for both sides of the divide", nor to necessarily preclude that. The intent was to frame the hydrologic variability within a high demand context.

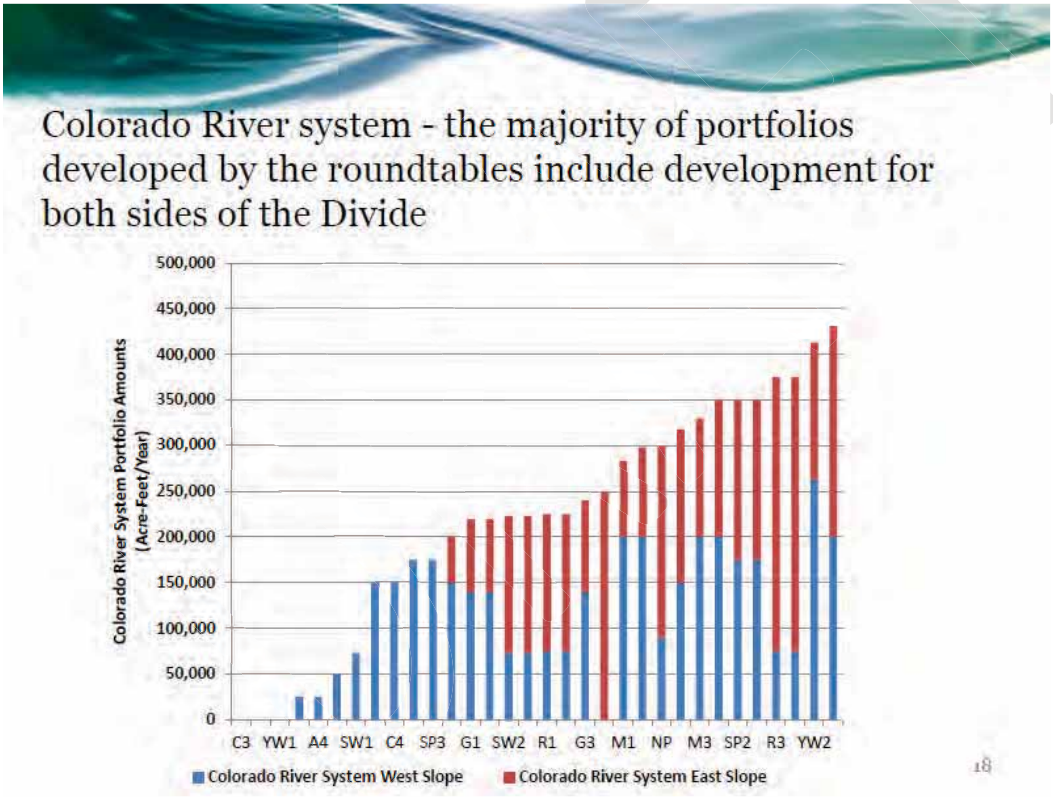


Figure 1: representation of YW portfolios YW1 and YW2

The portfolio tool is inadequate to deal with Colorado's variable hydrology. The portfolio tool requires users to pick individual demand and supply scenarios. In reality consistently high or low supply does not exist, rather it is the extreme variability of supply that drives water resources planning. That variability is not captured in the portfolio tool, thus any further planning relying on this tool is severely flawed. Roundtables were asked to pick mid-demand and mid-supply scenarios in their planning. The results of these portfolios have has been plotted by the CWCB on graphs (figure 2) and some suggest that this plot

shows that roundtables agree that water is available for diversion out of the Colorado River. Our roundtable suggests that this is an artifact of the portfolio tool, and should not be viewed as tacit agreement to transcontinental diversions.

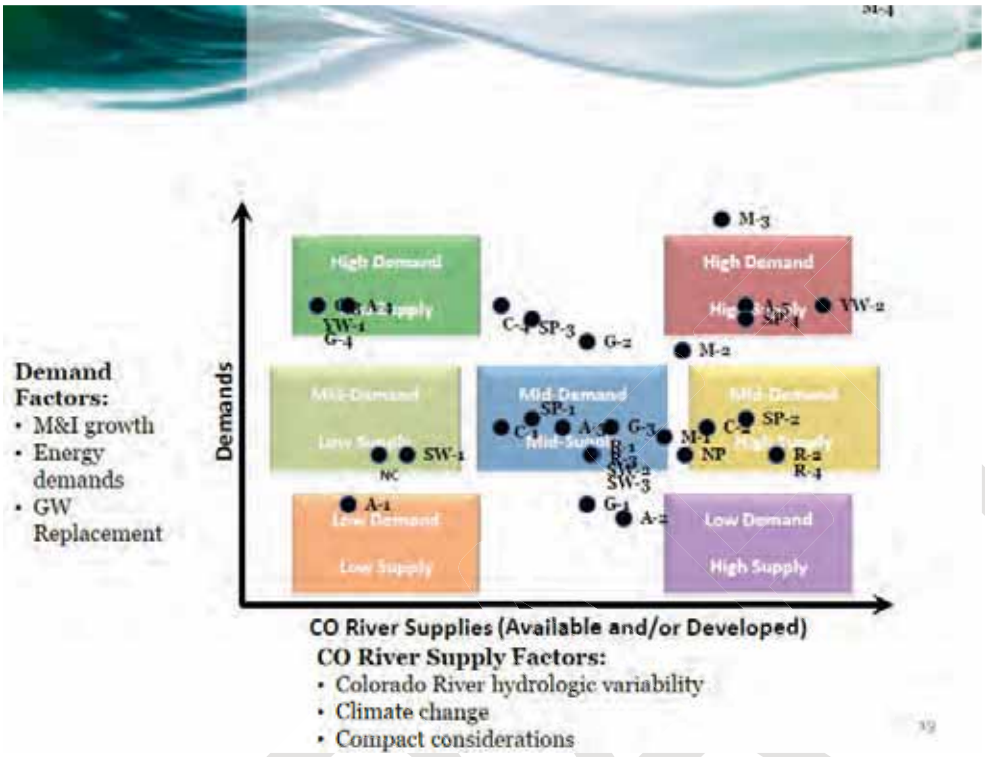


Figure 2: Plots of Roundtable Portfolios

Further statewide water planning must move forward acknowledging the temporal variability of Colorado water, the spatial complexity of topography, and local benefits and impacts. The portfolio tool is simply inadequate for the task. We suggest a simplified framework statewide CDSS model be developed to deal with spatial complexity and that within that framework a multiyear risk based hydrologic analysis be performed to move the conversation forward.

A statewide framework tool would allow conversations regarding several pending issues to be accomplished in a more understandable manner. For example discussions regarding administration of compacts governing the Colorado River, and particularly administration within the State of Colorado, would be enhanced. Also, the risk associated with hydrologic variability to existing and proposed projects could be more accurately evaluated. The portfolio tool cannot provide insight into these questions.

Understanding that the portfolio tool was intended to be a conversation starter we compliment the CWCB for the progress made to date in that regard. The continued use of this tool for any further planning efforts is, in our opinion, counterproductive. This explanation is to put forth a summary of the position of the YW roundtable regarding its use of the portfolio tool.

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***	