Summary Report:
Colorado Drought Tournament
September 18, 2012

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Sponsors:

Colorado Water Conservation Board

National Integrated Drought Information System

Contributors:

National Drought Mitigation Center

Agriculture and Agri-Food Canada
Science and Technology Branch

Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

Tournament Designers:
AMEC Environment and Infrastructure
1002 Walnut St Suite 200
Boulder, CO 80032
303-443-7839

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Colorado Water Conservation Board
Taryn Finnessey

National Integrated Drought Information System
National Oceanic and Atmospheric Administration
Genoveva Deheza
Chad McNutt

AMEC Environment and Infrastructure, Inc
Courtney Black
Jeff Brislawn
Lee Rozaklis
Graeme Aggett

Science and Technology Branch, Agriculture and Agri-Food Canada
Harvey Hill
Richard Reiger
Monica Hadarits

National Drought Mitigation Center
Mike Hayes
Deborah Bathke
Mark Svoboda

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1.0 INTRODUCTION

This report provides an overview of the Colorado Water Conservation Board (CWCB) and National Integrated Drought Information System (NIDIS) sponsored Drought Tournament. This gaming forum was held on September 18, 2012 as a precursor to the two-day State Drought Conference at the Colorado History Museum in Denver. Natural hazards such as earthquakes, hurricanes, flooding, wildfires and drought are a natural occurrence throughout the world and effective mitigation and response planning is necessary to minimize the negative impacts associated with these events. In addition to planning, exercises used to test established plans have proven to be an effective means to ensure preparedness. Such exercises may entail the simulation of a natural hazard, requiring participants to implement and test the plan. Droughts, due to their typically slow onset lasting months or years and multi-sector impacts, are challenging to address under the typical emergency exercise framework. The concept of a drought gaming forum was introduced as an alternate means of engaging preparedness for drought in Colorado. There are key differences between a gaming forum and an exercise. The gaming forum does not test an existing plan but requires participants to develop their response plans "on the fly" through a collaborative, team environment. The other key difference is that each team was judged and scored on the quality of their plans, further fostering collaboration through spirited competition. This report summarizes the tournament background, design, development, and delivery. Feedback on the tournament is also provided in this report, specifically addressing strengths, areas for improvement and possible future applications.

2.0 OVERVIEW OF THE TOURNAMENT

Tournament Background and Development

The concept of a drought gaming forum was introduced to AMEC and CWCB at the NIDIS-NDMC Engaging Preparedness Communities Drought Conference in Chicago in June of 2011 through a presentation by the Science and Technology Branch, Agriculture and Agri-Food Canada. Agriculture and Agri-Food Canada has implemented two drought tournaments in February of 2011 and March of 2012. The CWCB and NIDIS jointly provided funding for AMEC to modify the general concept and components introduced in the Canadian game for the State of Colorado. Specific objectives of the Drought Tournament included:

- Educate participants on the multidisciplinary and multi-sector implications of drought
- Encourage collaboration among stakeholders with various backgrounds
- Introduce the concept of the "gaming forum" as a tool to engage stakeholders and develop relationships
- Provide a forum to develop contacts and information useful for future local, regional and statewide drought planning purposes.
- Create an environment that was engaging, competitive, fun and worthwhile to attend from an educational and networking perspective

The drought tournament design was led by AMEC during June – August 2012 under guidance from an "Expert Panel" that included the CWCB, NOAA-NIDIS, the National Drought Mitigation Center (NDMC) and Agriculture and Agri-Food Canada. A series of design meetings

and conference calls were held leading up to the tournament. A key element of the design was a "simulation day" held on August 29th. This was a full day exercise of the draft tournament with the Expert Panel serving as the "players." Two rounds of the tournament were played using the pre-designed drought scenarios. AMEC served as the game facilitator and referee role while CWCB, NIDIS, NDMC and Agriculture and Agri-Food Canada played the game utilizing two teams. One of the teams including Canadian and NDMC staff participated remotely via video-conference. While the remote play was challenging, all participants welcomed the opportunity to test the game. The simulation day also provided an opportunity to train those that would eventually be referees at the event. The simulation day provided valuable input into the game's refinement, including further definition of the referee and sponsor roles, round timing, and game day agenda development.

Tournament Day Overview

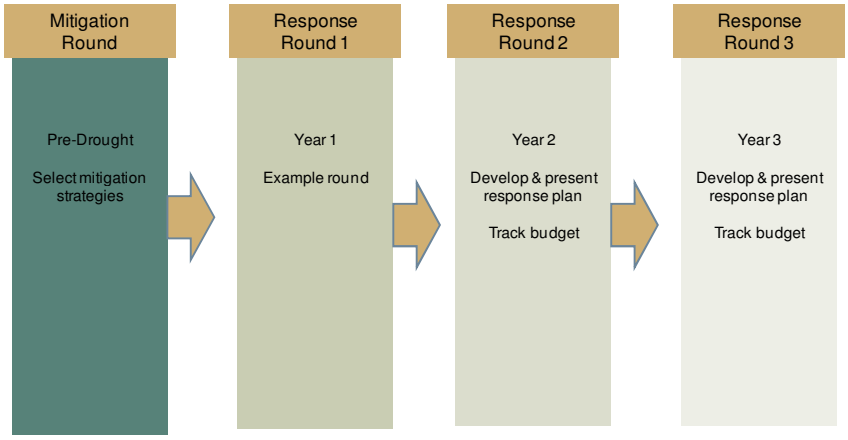
Approximately forty people were involved with the tournament either by directly playing the game or by facilitating, coordinating and developing the game. The participants included:

- Five teams of four to five players - Each team consisted of players representing multiple sectors including agriculture, municipal and industrial, environmental, energy and recreation and tourism. These teams were charged with playing the tournament and providing feedback at the conclusion of the event.
- Five referees – The referees consisted of drought and water resource experts from the National Drought Mitigation Center, Agriculture and Agri-Food Canada and from AMEC. The referees helped to facilitate discussion among the teams, provide clarification and guidance when needed, check the budgets for each of the teams' response plans and contribute to the tournament scoring.
- Fans and sponsors –Members from CWCB and NIDIS in addition to two "fans" from the states of Oklahoma and Texas observed the tournament and provided feedback.
- Sponsors, facilitators and coordinators – This included staff from CWCB, NIDIS and AMEC.

Each team represented a fictitious "Basin Drought Committee" and was charged with developing drought response plans for a fictitious watershed called Chance Basin. Chance Basin was developed as a politically and geographically neutral basin in order to avoid common geographic and political water related positions (i.e. east slope vs. west slope) and encourage an open, innovative discussion. Information on the Basin was provided by email to all participants ten days in advance of the tournament in a fictitious newspaper called "Chance Times." Key features of the Basin represented characteristics typical of many Colorado watersheds. These included an intensively used recreational mountainous area with two natural lakes and three storage reservoirs, a large agricultural area in plains of lower elevation, and three municipalities. The Basin was subject to river administration according to Colorado's prior appropriation system including an interstate compact obligation and transbasin diversions.

The tournament play included four "rounds." The first round consisted of a pre-drought mitigation round and the following three rounds represented an individual year of a hypothetical multi-year drought scenario applied to Chance Basin, using drought conditions in Colorado based on state historic hydrologic and climatic data.

During the first round each team had the opportunity to select three mitigation strategies out of six possibilities that would be implemented prior to the occurrence of the drought. The strategies represented pro-active actions and planning taken to prepare entities for a drought before it actually occurs. Teams used their selected mitigation strategies as a "wildcard" during the subsequent rounds to alleviate drought-related impacts. The mitigation strategies enhanced a team's resources to address drought impacts and if played "right," could have given teams an advantage in the tournament.



The remaining drought scenario rounds were initiated assuming it was the end of April, and a series of drought indicator data (i.e. drought indices, snow pack percentage, precipitation, etc) were presented to the teams. Teams were charged with characterizing the vulnerability of entities in the Basin, identifying potential drought impacts, and developing drought response strategies for implementation. Teams' response plans also had to remain within a fiscal budget. The first response round was an example/training round for teams to familiarize themselves with materials and concepts of the tournament. The remaining two response rounds were played out fully by the teams.

At the conclusion of response rounds 2 and 3, teams presented their response plans. Following the presentations a baseline summary of the drought and resulting impacts were provided for the irrigation season from the end of April through October. The summary assumed minimal response activities were implemented to address the drought. The referees and team players then scored the response plans against these "baseline" summary conditions.

The teams were assigned an initial budget of $20 million. Additional federal and state funding of $5 million was made available at the beginning of response round 3. The teams were required to select from a list of pre-determined mitigation and response strategies with fixed costs and purchase these strategies while remaining within their budget. During round 3 the teams had the option to develop up to three new innovative response strategies in addition to the fixed list of strategies. Costs associated with the innovative responses were determined by the referees.

Scoring of each teams' droughts response plans was based on how well the team addressed drought vulnerability, identified potential drought impacts and on

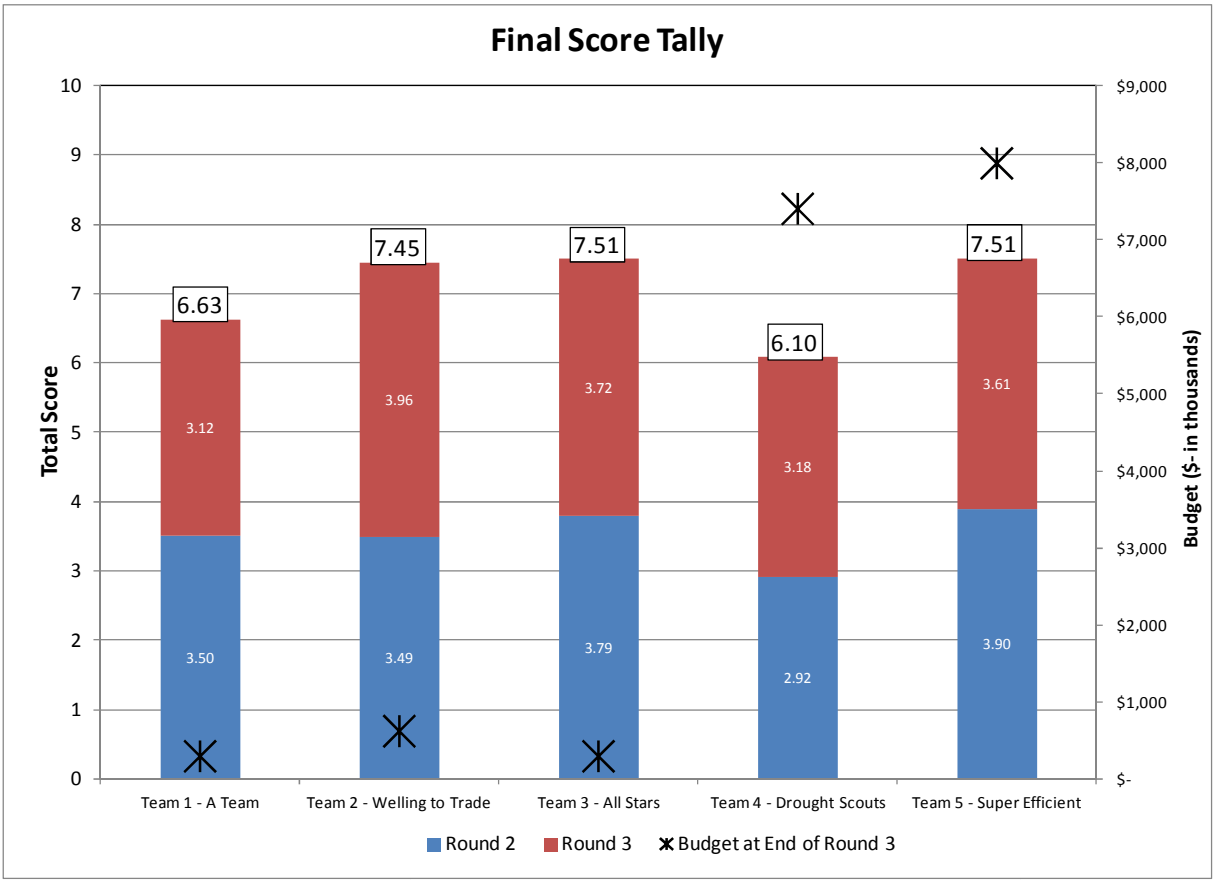
how effective their portfolio of response strategies could reduce impacts on a multi-sector level throughout the entire Basin. Response plans that addressed the social, environmental and economic aspects of drought on a multi-sector level received higher scores than plans that did not address the multi-dimensional aspect of drought. Scoring entailed a weighted three-component system where the players and referees both had the opportunity to participate. The players individually scored the other team's response plans. The average of the individual scores for each team was weighted by 25%. The teams also scored each others' response plans where each team determined a score for the other teams' response plans. The team scores were weighted by 25%. The referees were charged with scoring all of the teams' response plans. The referee scores for each respective team were averaged and weighted by 50%. At the conclusion of the scoring, each of three weighted scores were added together to determine a final overall team score.

Team 3,"All Stars," and Team 5, "Super Efficient," tied for first place with a score of 7.51. To break the tie between the two top teams, the amount of budget remaining at the end of the tournament was also assessed. Super Efficient had not used all of their money (in fact they had the most budget of any team remaining) whereas the All Stars had spent their entire budget on response strategies. Team 5 Super Efficient was awarded the Grand prize of chocolate and AMEC thumb drives since they had remaining funding if needed in the following year. Team 3 All Stars was awarded an AMEC flashlight and the remaining teams were awarded an AMEC rubber yoyo contraption as consolation prizes.

Some of the reasons that Super Efficient came out on top included the following:

- Consistently utilized low cost, "low hanging fruit" response options
- Effectively identified potential impacts
- Developed two reasonably priced innovative strategies
- Had a long-term focus, saving funding for the drought that could extend beyond three years.

Another observation of the tournament was that the teams were fairly consistent with the mitigation strategies chosen. See Appendix A for a summary of the options chosen, innovative strategies developed, and lessons learned (noted in round 3). The pre-drought water leasing arrangements and drought reserve funds options were popular among all teams and effectively used by team Super Efficient.



3.0 FEEDBACK ON THE TOURNAMENT

Following response round 3, a 30 minute post-game feedback session was facilitated to provide participants an opportunity to comment on their experience and provide input to the entire group. A survey asking the participants to assess and comment on the tournament was also distributed and collected at the end of the event. The two fans attending the event were asked to complete a more comprehensive survey of their observations. Information from each of these mediums is summarized below.

3.1 Tournament Design and Effectiveness in Meeting Objectives

Using a rating scale of 1 to 5, the post-game survey asked each of the participants to rate the design and facilitation of the tournament, as well as assess how well the tournament met objectives. Five represented strong agreement with the statements provided in Tables 1 and 2 and one indicated strong disagreement.

Table 1 shows that 88% or more of the surveyed participants were either in strong agreement (5 rating) or moderate agreement (4 rating) that the tournament was well structured and organized in a realistic fashion and that the gaming materials were useful and appropriate. The majority of

surveyed participants also indicated that the selection of stakeholders was appropriate for the level of each stakeholder and for the mixture of disciplines and that they would encourage others in their agency to participate in a similar process. Eighty percent of the participants indicated with strong or moderate agreement that they would encourage others in their agency/company to participant in another gaming exercise that would focus on obtaining other drought and water resources data while 13% of the participants were neutral and 7% were in moderate disagreement. The 7% moderate disagreement may be attributed to the fact that the tournament was developed in a fictitious setting and that conducting the game under a real-life scenario for data collection purposes would require more time for critical thinking and effort in fostering a collaborative environment.

Table 1 – Assessment of Tournament Design and Conduct

Assessment Factor	Percentage of Survey Responses				
	1- Strong disagreement	2	3	4	5 - Strong agreement
The tournament was well structured and organized.	-	-	13%	62%	25%
The tournament drought scenarios were plausible and realistic.	-	-	-	35%	65%
The facilitators were knowledgeable about the material, kept the tournament on target, and were sensitive to group dynamics.	-	-	6%	53%	41%
Available tools and information materials were appropriate and helpful to my role.	-	-	19%	43%	38%
Participation in the tournament was appropriate for someone in my position.	-	-	-	59%	41%
The participants included the right people in terms of level and mix of disciplines.	-	-	6%	38%	56%
I would encourage others in my agency/company to participate in another 'gaming exercise' similar to this process that would focus on obtaining other drought and water resources data.	-	7%	13%	27%	53%

Table 2 shows that at 88% or more of the participants were either in strong agreement (5 rating) or moderate agreement (4 rating) that the tournament was effective in educating participants on the multidisciplinary and multi-sector implications of drought, encouraged collaboration among participants of diverse backgrounds and was an effective tool for developing a competitive fun environment to engage stakeholders and develop relationships. Sixty-five percent of the surveyed participants agreed either strongly or moderately (ratings 4 or 5) that the gaming forum was an effective tool to collect information for planning purposes, while 29% was neutral and 6% were in moderate disagreement. As previously mentioned, the neutral and moderate disagreement may be attributed to the fact that the tournament was developed in a fictitious setting and that conducting the game under a real-life scenario for data collection purposes would require more time for critical thinking and effort in fostering a collaborative environment.

Table 2 – Effectiveness in Meeting Objectives

Assessment Factor	Percentage of Survey Responses				
	1- Strong disagreement	2	3	4	5 - Strong agreement
The tournament effectively educated participants on the multidisciplinary and multi-sector implications of drought.	-	-	13%	31%	56%
The tournament encouraged collaboration among those with diverse backgrounds.	-	-	6%	44%	50%
This "gaming forum" is an effective tool to engage stakeholders and develop relationships.	-	-	13%	43%	44%
This gaming forum is an effective tool to collect information for future planning purposes.	-	6%	29%	47%	18%
The tournament created an environment that was engaging, competitive and fun.	-	-	6%	41%	53%

The two fans were asked whether they saw a significant difference in group dynamic interaction between response rounds 2 and 3. One fan indicated that his team was much more aggressive and thorough in the third response round compared to the second response round since the team had a better understanding of what they were doing. The other fan did not see a significant difference between the second and third round. He indicated that his team had a unified approach to their application theory from the beginning.

3.2 Strengths of the Tournament

The tournament effectively engaged participants in the gaming process. This was evident at the conclusion of rounds 2 and 3 where participants, feeling short of time, continued to work diligently into "overtime" to complete their plans. Participants generally described the experience as rewarding and worthwhile. The following discussion outlines the comments provided by participants during the post-game feedback session and on the survey regarding what they liked most about the tournament.

Concept and Realistic Nature of the Tournament

Several participants commented on the overall concept of the tournament, stating that it provided an excellent forum for discussion and critical thinking about drought. They also commented on the realistic nature of the basin and gaming scenarios. While the basin was fictitious, participants stated that the basin, coupled with the drought scenarios, effectively captured many of the drought-related issues that Colorado watersheds currently confront today.

- *The concept is great!!!*
- *Great opportunity to discuss issues and think critically around an anonymous (but believable) basin*
- *Realistic*
- *This was a great product. Make sure you do it many more times!*
- *I think every state should have to do this*
- *Research was excellent. Very reflective of actual discussion that is currently being conducted.*

- *This exercise should be conducted at least once every two to three years*

Diversity of Stakeholders
The participants enjoyed the opportunity to develop new relationships with people of different sectors that they normally would not interact with. They also enjoyed the multi-disciplinary nature of the tournament while working on a common goal in a fun environment.

- *Allows people with very diverse experience and interests to work in collaborative way to seek common solutions.*
- *Diverse people with different job and backgrounds*
- *Working as a part of an inter-disciplinary team*
- *I liked pushing diverse groups to work as a team to problem solve. It was especially effective with a very focused goal.*
- *Meeting new people*
- *So fun. My team gelled really well. Everyone participated equally.*
- *Great cross-section participation*
- *Brought together a broad range of people from a variety of backgrounds, many of which I wouldn't normally interact with.*

Opportunity for Effective Collaboration
Participants found that they could effectively collaborate with representatives of other sectors to develop drought-related solutions in a relatively neutral political setting. The tournament effectively fostered a setting where participants were able to bring their experience "to the table" without needing to follow a specific agenda or special interest.

- *Interdisciplinary teams can arrive at better solution*
- *The collaboration, I learned from the participants and their experiences.*
- *Players actually seemed to 'take off their hats' for the exercise – great!*
- *Collaborative, creative and cooperative discussions and problem solving*
- *Collaborating with different stakeholders was an excellent opportunity. We were shoved so quickly into the details of the problem that we immediately forgot our differing factions and began working on our task. Very positive!*
- *Collaborative nature of discussions*
- *The opportunity to collaborate. It was good to see agriculture, wastewater, oil and gas, and environmental reach consensus.*
- *People have different ideas on how to complete the drought response actions. Getting ourselves organized and working together was a challenge.*
- *Discussion on strategies*

Quality of Preparation for the Tournament
Participants indicated that the effective development and thorough preparation of the tournament was a key success factor. Participants specifically commented on the effectiveness of the following: sending an overview of Chance Basin to prime participants prior to the game; presentation of the scores to encourage engagement; and the format of the drought response plan "template," requiring participants to not only address drought response, but to also think critically about specific vulnerabilities and drought impacts within the basin.

- *The preparation work was outstanding*
- *It was obvious it took a lot of time to prepare it.*
- *Preparation work was outstanding and mailed information was a great primer*
- *The presentation of scores was good. It kept everyone in the game.*
- *Seeing the refinements of the original Canadian game plus the additions developed by AMEC were significant and were impressive. The key new additions were the vulnerability and impacts in the response plans.*

The referees were asked to comment on the strengths of the tournament. Overall the referees were engaged and indicated that there were many strengths. Some of the strengths mentioned by the referees included:

- The opening mitigation round highlighted the importance of mitigation prior to a drought and was a great opening to the tournament.
- The fictitious Chance Basin and accompanying data was interesting and engaging to the teams.
- Posting the response plans on the back wall and identifying impacts was helpful during the scoring process.
- The innovative strategies provided a good forum for interesting discussion.

3.3 Suggestions for Improvement

Participants had the opportunity to provide suggestions on how the tournament could be improved during the post-game feedback session as well as on the written survey. The suggestions primarily focused on whether the tournament could be simplified, how the scoring process and materials could be improved, and new additions that could strengthen the game.

Level of Detail
Several participants indicated that there was too much information and that it was challenging to develop response plans within the time allotted while other participants indicated that while it there was a lot of information, it effectively addressed the "reality" of a Colorado basin and was quite appropriate since drought involves such a diverse set of multi-sector impacts. Comments included:

- *Possibly a little more flexibility in options (as allowed in the innovative part in Round 3).*
- *Simplify it.*
- *Simplify it a little bit. Too much information to absorb at once and too many possibilities and solutions*
- *Tweaking some of the details would help a wonky group. Either more details or zoom out further. I liked that we had enough information to make decisions but in some places a little more would have helped. (or caused a wonky-tonk!!)*

Materials
Several participants indicated that the amount of reading material should be reduced or that summary materials and "cheat sheets" should be produced to assist when playing the game. One participant recommended that the gaming binders be sent in advance so that players would have

an opportunity to take notes on the materials in preparation for the game. Another participant emphasized importance in having all of the information presented (in Powerpoint) provided in the handouts. Specific comments include:

- *Too much reading to do while trying to process information and strategize*
- *Supply a 'cheat sheet' for groups paralyzed by too much information. Maybe provide a step-by-step process for developing the drought response. The cheat sheet could also summarize the information provided.*
- *I took notes in my materials that were emailed – might consider sending binders in advance*
- *Some slides not available while brainstorming*

Scoring Process

Some participants commented on improvements that could be made to the scoring process. Several indicated that the individual and team scoring was not an efficient use of time and that it would be sufficient to limit the responsibility of the scoring to the referees.

- *The grading metrics need refinement to ensure consistency.*
- *Less emphasis on individual/team scoring. Referee scoring is enough and the scoring part is hard to focus on*
- *Remove the individual and team scoring so more time can be spent on the planning process. I felt overwhelmed by all the handouts, especially during round 2 as we were getting started. However, the materials were so helpful. I wouldn't say to leave them out – could you print round 2 and 3 on different colored paper stock so we can visually separate them – additional to the tabs.*
- *It would be beneficial to have QC corrections by the referees in red*
- *Scoring isn't important – group scoring seemed to be time wasted.*

Suggestions on New Additions to the Tournament

Suggestions for new additions to the tournament included: incorporate long-term issues at a greater scale; track water storage among individual teams to see how the teams' decisions affect available water supplies in the next round; incorporate economic trade-offs at a more detailed scale; provide "special" information to teams that select drought monitoring in the mitigation round and provide a means to track trade-offs with greater ease by recording imports/exports, leases, budget, etc. Specific comments include:

- *More ability to look at long-term issues rather than just a single year.*
- *Consider tracking storage for each team to see how decisions from prior rounds affect the current round (not sure this is a good idea, however!)*
- *The Economic Tradeoffs need to be more strongly articulated and considered.*
- *I thought the purchase of the Drought Monitoring would provide us with information during the season; not sure it was effective in guiding us to solutions.*
- *Provide a simple way to track transfers e.g. spreadsheet or table to account for imports / exports / trades – it was hard to tell if solutions were plausible and / or affordable / feasible. A similar type of tracking should be done for the budget.*
- *Incorporate more agricultural information and address food supply*

- *Other technologies could be used to improve the game (i.e. SCADA)*
- *Provide a means to more closely track trade-offs*
- *It was hard to quantify all mitigation options*

Other Suggestions
Additional suggestions for improvement include:

- *Testing the examples on round 1 (in action) would have helped.*
- *One message that can be confused because of the focus on drought is that without including excess moisture adaptation you can be unbalanced.*
- *Drought planning in Colorado is not done basin-wide so that scenario does not reflect our actual planning efforts*
- *A lot to absorb. Critical to ensure that each team has the same number of players to ensure equity and not overtax existing players.*
- *Have the 'practice' round be an actual practice round.*
- *There was an excess of money to work within our budgets. In real life, we have much less money to work with. Suggestion – offer less money to work with for budgets which will free us to prioritize more and practice making difficult choices. It would be nice to see what overall economic impact to the basin is by the choices we make.*
- *In the exercise, each team considered all the sectors (agriculture, M&I, recreation and tourism, energy, etc.) holistically. I'm not sure such a holistic approach is ever used in 'real life'. Typically, it's each sector doing everything in its control to lessen their pain*
- *What if you mixed the groups even more with irrigators and environmentalists so you have more opportunities to get dogmatic perspectives to work together? I think all the teams were pretty professional. It would have been "spicy" to have a radical perspective on each team!*
- *Separate teams with colors (i.e shirts, hats, nametags)*
- *Monitoring mitigation should have more benefit – document this*
- *Have people introduce themselves and affiliations*

The referees were asked to comment on future improvements to the tournament. These improvements included the following:

- Many of the questions that the players had during the tournament required a detailed knowledge of water management, which was not some of the referees' strengths. This underscores the importance of having a few of the referees be experts in the local water resources management specific to the tournament players and to the tournament basin(s).
- Referees could field questions and develop responses as a collective group during referee breaks. Such referee breaks could also provide an opportunity for the referees to discuss the team responses' collectively and overall enhance the scoring process. This was done during the Saskatoon Tournament in Canada.
- The time allotted for playing each round was limited resulting in a very fast-paced game. It was difficult to assimilate information, assess conditions and formulate responses and scoring in such a short timeframe. The tournament could be extended to two days or at a minimum introduce the rules and how to the play the game to the players the evening before the day of the tournament.

- While the fictitious basin was engaging and representative of many watersheds in Colorado, the complexity of the basin made scoring somewhat difficult. Some ideas on how scoring would be improved are 1) develop a means to score the teams as they are developing their plans, 2) develop a structured format for the teams to follow when presenting their plans and 3) conduct more research on methods to evaluate drought plans which could be applied in the future.
- It would be beneficial to develop a means to document information on the innovative rounds and store such information in a collective database.

3. 4 Time Allotment

The survey also specifically asked participants about the amount of time allotted for each portion of the tournament and whether more or less time was needed. Twenty percent of the participant survey responders indicated that the time allotted was sufficient. Several other participants indicated that more time would have beneficial, but acknowledged the time constraints of fitting everything into one day while others indicated that it would be beneficial to extend the exercise into a multi-day activity in order to develop higher quality plans. Specific comments are as follows:

- *Ok – hard to fit everything into one day*
- *Yes, more might have been helpful in Round 2, but at a certain point time limits are helpful in focusing*
- *Yes, it seemed rushed but finite time is what we all have – so I felt it was enough for what we had*
- *Obviously, more time would have been valuable, but you did the best job balancing / managing time while still being effective*
- *I needed more time to absorb the information provided in the handouts.*
- *First session might have been longer; it was overwhelming for the time but definitely made it less stressful for Round 2 and 3*
- *Yes, a little extra for Round 2 might have helped but everyone made it work.*
- *Always felt the need for more time – especially for round 1 while learning and then for the 'innovative' strategies addition*
- *I felt like we could have used a lot more time for a higher quality product. What if you extended it for 2 days or partial days for a week?*
- *There was an awful lot of information to process and work with over a very short period of time – in real life, we'd have a lot more time to evaluate and prioritize. This felt a lot like a MASH unit dealing with management and drought issues that are highly complex. Nevertheless, a great exercise and tool for learning.*

4.0 CONCLUSIONS, RECOMMENDATIONS AND FUTURE APPLICATIONS

This gaming forum proved to be an effective means to engage and educate stakeholders on multi-sector impacts of drought, drought mitigation and response strategies, and the complexities of responding to a drought in simulated real-time. There is also value in the gaming forum as a

tool to be applied in the future to collect critical information and data and develop strategic natural hazard mitigation and response plans. The following items summarize the key success factors to the Drought Tournament based on the participants' feedback and experience of the AMEC Team and also provide recommendations on the development of future gaming exercises. This is followed by a discussion on future directions and potential applications of the gaming forum.

Stakeholder Engagement and Collaboration: The Drought Tournament was successful engaging stakeholders in a competitive and fun environment by fostering collaboration on realistic drought issues and solutions. Stakeholders expressed the value they gained in relationship building through the gaming environment, and that they were able to "take off their hats" and work with a diverse group of people from various backgrounds and interests. While technical components in developing the Drought Tournament were very important, a significant amount of effort, prior to the event, was invested in selecting the proper stakeholder to invite and in the forming each team. Having diverse team membership was a critical component to the success of the tournament and should be an important aspect of future gaming exercises.

Game Design and Preparation: Many of the participants positively noted on the high quality of the preparation that went into the Drought Tournament. Preparation and development of the gaming framework, tools and materials are fundamental to the success of a gaming exercise. It is important that the gaming framework be customized to meet a predetermined list of objectives for each future application. For instance, a gaming exercise that focuses on finding realistic solutions for a real watershed would entail a higher degree of political and special interest affiliation than was needed for this Drought Tournament. Such a gaming environment would likely require more time for critical thinking amongst the participants, and also require a framework and facilitation techniques that strongly incentivize collaboration.

Competition Drives Collaboration and Creativity: The gaming environment was designed to encourage spirited competition in a politically neutral environment. The competitive nature of the game encouraged respectful, strong, and proactive collaboration towards meeting a common goal. A significant level of creativity resulted, benefiting both the participants' experience and overall success of the exercise. Emphasizing the "fun" aspect helped keep the participants engaged for the entire day.

Proactive Risk Management: Though each team was adept at developing response plans "on the fly," the gaming environment emphasized the need and importance of planning and mitigation in advance of a natural hazard event, as well as planning in the face of uncertain future conditions (climate, political, economic etc.).

Promotes Educational Awareness: The design of the game required teams to think through potential impacts and vulnerabilities in the development of their response plans. Individual participants learned about the broad-based impacts that drought can have outside of their particular sector or interest.

The outcomes, findings, and positive stakeholder feedback from this first Drought Tournament in Colorado support a core area of focus and action by the National Integrated Drought Information

Program (NIDIS). Through NIDIS's Engaged Preparedness Communities initiative, such examples of drought simulations are acknowledged as valuable exercises to identify successful and unsuccessful strategies in a non-threatening environment. These exercises assist in drought planning efforts before the drought event occurs. The drought planning process encourages holding drought exercises on a regular basis to promote educated, aware, and prepared communities.

Game Enhancements

The 2012 event, as in initial application of the drought gaming concept in the United States, was designed to meet specific objectives within limited resource and time constraints. Future renditions of this activity could be enhanced if budget and time allows. Design of future gaming forums should consider applicable enhancement options that could provide meaningful benefits. There are many features and technologies that can be incorporated into a gaming exercise to both streamline the gaming process, and increase the complexity of the gaming scenario. Ideas proposed by the participants and the AMEC Team include:

- Tracking of reservoir storage, multiple leasing arrangements and water budgets;
- Developing and tracking specific trade-offs among selected strategies;
- Tracking economic and sector impacts (i.e. agricultural and environmental impacts);
- Developing a means to address long-term or multi-year drought impacts;
- Incorporating visualization and mapping techniques; and
- Automating the game scoring process.

Future Directions and Applications

Participants were surveyed at the conclusion of the tournament to determine whether they would like to see future drought exercises, such as the Drought Tournament, conducted in Colorado, and if so, how they would like to see them implemented. Eighty-seven percent responded that the Drought Tournament would be a beneficial exercise to repeat and build upon. Surveyed participants also provided suggestions on how the gaming model could be implemented elsewhere, including developing games for specific entities in the State or other states. Suggestions on potential future applications provided by the participants and the AMEC Team include the following:

- The gaming exercise could be used for a variety of real-life planning efforts including: long-term water supply and management planning, climate adaptation planning, drought planning and for natural hazard mitigation and long-term recovery simulations.

- This exercise could be an effective tool to create trust among interest groups throughout the State and would be useful for key decision makers to participate in or simply observe.

- The exercise could be used as a means to collect specific data and information for larger planning purposes such as drought-related information for the next State Drought Mitigation and Response Plan update.

- The exercise could be used to test the implementation of existing state, regional and local plans (i.e. natural hazard plans and long-term water supply plans) and identify areas of improvement.

- The exercise can be an effective means to educate, engage, and foster stakeholder relationships among diverse economic sectors, specific water districts, watershed basins, states, etc. It can also serve as a "boot camp" to motivate stakeholders in the development of plans.

- Simpler and shorter versions could be implemented at larger forums such as conferences (i.e. experimental workshop that people could sign up for through the Colorado Foundation for Water Education or the Colorado Watershed Assembly).

- High school and college students could benefit from such a gaming environment. Each student team could have a water professional participating, creating opportunities for networking.

In conclusion, the drought gaming forum encouraged collaborative decision-making and provided a forum for multi-sector discussion. Most participants agreed that it provided a fun, competitive environment to learn and think of new ideas about drought preparedness and to debate politically-sensitive adaptation options and foster innovation. Participants felt that it was time well spent and recognized the value of further applications of the forum in the future. Participants, game sponsors and designers noted that there is real value in expanding this type of event into other arenas in the future. Several refinements have been identified that could be used to enhance the gaming concept in future applications.

APPENDIX A

Selected Mitigation Strategies, Innovative Strategies and Lessons Learned

Based on input recorded on team response plans

Team 1 – "A Team"

Mitigation Strategies Implemented
- Drought reserve funds
- M&I water efficiency – Wheat Ridge
- Pre-drought leasing

Innovative Strategies Developed
- "X-tra ag conservation: compensate for loss of production; rotational fallowing; farm improvements"
- "Cloud seeding"

Lessons Learned
- None listed on worksheet

Team 2 – "Welling to Trade"

Mitigation Strategies Implemented
- Drought reserve funds
- Drought monitoring
- Pre-drought leasing

Innovative Strategies Developed
- "Leasing half of transbasin transfer & storage"
- "Urban conservation (individual households) for environmental benefits (RICD, wetland, and basin-wide)"
- Water market (subject to 3rd party impacts)

Lessons Learned
- And "Proposed Improvements for long term planning"
- "Bonjour and Upper Orchard area had insecure and not diverse water supply – diversify"
- "Unexpected impacts – pests; Need better forest and fallowed land management"
- "Severe, multi-year drought = Limited options. Can't lease, build or conserve way out; must be willing to adopt all strategies"

Team 3 – "All Stars"

Mitigation Strategies Implemented
- Wetland State Park
- Drought monitoring
- Pre-drought leasing

Innovative Strategies Developed
- "Re-timing reservoir operations"
- "T1 – Partial purchase"

Lessons Learned
- "Take time to plan"
- "Creative strategies needed to deal with harshness of prior appropriate strictly applied"
- "Multi-use = more benefits"
- "No silver bullet solutions – menu of options need to be creatively applied"

Team 4 – "Drought Scouts"

Mitigation Strategies Implemented
- Drought reserve funds
- Pre-drought leasing
- M&I water efficiency

Innovative Strategies Developed
- "Rotational fallowing"
- "Alternative crops and cover crops"
- "Timed reservoir releases"

Lessons Learned
- None listed on worksheet

Team 5 – "Super Efficient"

Mitigation Strategies Implemented
- Drought reserve funds
- Pre-drought leasing
- M&I water efficiency

Innovative Strategies Developed
- "(T8 + G3) Substituting Stable Lake water with well water"
- "Long term $ and seed funding (paying for Stable Lake water)"

Lessons Learned
- "Bigger Social Costs. Should have used S1/S2 in Round 2"
- "Under estimated social and public health (impacts)"
- "Future/Long Term water 'firming' and solutions needed"

APPENDIX B

Roster of Participants

Drought Tournament
September 18, 2012

ROSTER

Player	Affiliation	Contact
Team 1		
Player 1 **Dave Kanzer**	CO River Water Conservation District	Dkanzer@crwcd.org
Player 2 **Ian Steyn**	CO Tourism Office, CO Campground & Lodge Owners Association	asteyn@aol.com
Player 3 **Larry Duran**	CO Public Utilities Commission	lawrence.duran@dora.state.co.us
Player 4 **Tom Schreiner**	CO Division of Parks & Wildlife	tom.schreiner@state.co.us
Player 5 **Chris Goemans**	Colorado State University	chris.goemans@colostate.edu
Team 2		
Player 1 **Bob Steger**	Denver Water	Robert.Steger@denverwater.org
Player 2 **Clare Sinacori**	CO Division of Parks & Wildlife	clare.sinacori@state.co.us
Player 3 **Jonathan Miller**	CO Governor's Energy Office	Jonathan.miller@state.co.us
Player 4 **Stacy Tellinghuisen**	Western Resource Advocates	sftellinghuisen@gmail.com
Player 5 **Carlyle Currier**	Colorado Farm Bureau	Cwcranch@aol.com
Team 3		
Player 1 **John Orr**	City of Thornton	John.Orr@cityofthornton.net
Player 2 **Amy Beatie**	Colorado Water Trust	abeatie@coloradowatertrust.org
Player 3 **Maude Grantham-Richards**	Tri-State Generation & Transmission Assoc.	mgrantham-richards@tristategt.org
Player 4 **Travis Smith**	San Luis Valley Irrigation District	slvid@centurytel.net
Player 5 **David Costlow**	Colorado River Outfitters Association	dcostlow@croa.org
Team 4		
Player 1 **Alfredo Rodriguez**	City of Aurora	drodrigu@auroragov.org
Player 2 **Kelly Barbello**	Colorado Tourism Office	Kelly.Barbello@state.co.us
Player 3 **Cindy Lair**	CO Department of Agriculture	Cindy.Lair@ag.state.co.us
Player 4 **Brad Udall**	Western Water Assessment	bradley.udall@colorado.edu
Player 5 **Pat Wells**	Colorado Springs Utilities	pwells@csu.org
Player 6 **Jim Reese (Fan)**	Oklahoma State Board of Agriculture	jim.reese@oda.state.ok.us
Team 5		
Player 1 **Doug Flanders**	Colorado Oil and Gas Association	doug.flanders@coga.org
Player 2 **Barbara Biggs**	Metro Wastewater Reclamation District, Denver	bbiggs@mwrd.dst.co.us
Player 3 **Becky Long**	Colorado Environmental Coalition	becky@cecenviro.org
Player 4 **Chris Kraft**	Badger Creek Farm, Quail Ridge Dairy	chrisbadgercreek@msn.com
Player 5 **Mike Bewley (Fan)**	State of Texas, Division of Emergency Management	Mike.Bewley@dps.texas.gov

Drought Tournament
September 18, 2012

Other Game Participants	Affiliation	Contact
Referees		
Harvey Hill	Agriculture and Agri-Food Canada, Science and Technology Branch	harvey.hill@agr.gc.ca
Deborah Bathke	NDMC	dbathke2@unl.edu
Michael Hayes	NDMC	mhayes2@unl.edu
Mark Svoboda	NDMC	msvoboda2@unl.edu
Lee Rozaklis	AMEC	lee.rozaklis@amec.com
Sponsors		
Veva DeHeza	NIDIS	veva.deheza@noaa.gov
Chad McNutt	NIDIS	chad.mcnutt@noaa.gov
Lisa Darby	NIDIS	lisa.darby@noaa.gov
Taryn Hutchins-Cabibi	CWCB	taryn.hutchins-cabibi@state.co.us
Kevin Reidy	CWCB	kevin.reidy@state.co.us
Game Organizers		
Jeff Brislawn	AMEC – Master of Ceremonies	jeff.brislawn@amec.com
Courtney Black	AMEC – Master Scorekeeper and Tournament Architect	courtney.black@amec.com
Graeme Aggett	AMEC – Game Coordinator	graeme.aggett@amec.com

Acronyms

CWCB – Colorado Water Conservation Board
NDMC – National Drought Mitigation Center
NIDIS – National Integrated Drought Information System