SESSION FOUR

Can We Grow the Pie? Conservation and Supply Opportunities

Moderated by Bruce Thomson, University of New Mexico

Bruce Thomson is a Regent's Professor in the Department of Civil Engineering at the University of New Mexico and is Director of the UNM Water Resources Program. He has a BS degree in civil engineering from the University of California at Davis, and MS and PhD degrees in environmental science and engineering from Rice University. Bruce teaches in the areas of water chemistry and treatment, groundwater hydrology and remediation, and water resources management. Recent research has included projects on water resources of New Mexico, the impact of energy and mineral development on water resources, and water reuse and treatment. He has served on many federal, state and local committees involved with management and protection of water resources. Bruce was recently elected to the Board of Directors of the Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA). He is a licensed Professional Engineer in New Mexico.

Working Toward Net Zero

Benny J. "BJ" Tomlinson, Fort Bliss Public Works

BJ Tomlinson is the Renewable Energy and Sustainability Program Manager for the Fort Bliss Garrison, Directorate of Public Works. He has bachelor's and master's degrees in mechanical engineering from the University of Texas at El Paso. He has over 17 years of government experience in program management, research and development, and systems engineering including military service as an officer in the United States Air Force, research engineering at the Air Force Research Laboratory specializing in space vehicle cryogenic cooling, energy generation and storage, and thermal management, and as the Operations Manager for the High Energy Laser System Test Facility and other test and evaluation activities at White Sands Missile Range.

I came to Fort Bliss about three years ago, hired as a person to come in, shepherd, and provide overall management to an initiative called "The Road to Net Zero" at Fort Bliss. "Net zero" is the term they came up with concerning the objectives that the Army wants to achieve on all their installations. The Army may have picked me for this job because of my systems engineering background. Basically I've done a whole lot of different things: dual spacecrafts, lasers, energy conservation, facility management, and so on. The Army wanted me to come in and help bridge the gaps among the various different groups within the garrison to achieve these very difficult objectives.

In April 2010, we self nominated to become a triple-net zero installation for the Army. This is a pilot program and there were only two installations selected to participate in the triple-net zero: Fort Bliss and Fort Carson. The current net zero focus is on: concept development/planning; energy initiatives task force development of the current near term project; ongoing conservation (energy, water, waste); and systems engineering/integration. The Army provided us with these focus areas. The net zero energy goal is to produce as much renewable energy as we consume, both electrical energy and thermal energy.

Dealing with water is a bit more difficult. There is talk about how to return the water back to the aquifer from which it came. We are looking at strict conservation and wastewater reclamation—but the definition gets very foggy on how to achieve that measure. Net zero waste is very simple: no waste actually makes it to a landfill. We reuse, reduce, and recycle. At the very tail-end, with whatever is left, we want to look at a waste energy process for disposal so it does not go into a landfill.

Several efforts are ongoing at Fort Bliss where we are looking at how plans could be implemented to meet net zero including how it would impact the environment, our mission, and everything else. Meanwhile, we are looking at concepts; we are looking at ways to do things better along with continuing all the other ongoing Army programs. The Army has always been involved with conservation, using less energy and water, and reducing waste. All of these efforts cost money so every time we do something smarter and are able to conserve, the Army saves money and that's a big deal. There are many places within the Army that are very wasteful, and we are trying to improve in those areas every day. Conservation has always been key to the Army.

Concerning energy and waste, we have many ongoing energy conservation projects. Most of these projects involve photovoltaics—panels on top of buildings and ground-mounted panels. These projects are an attempt to reduce the footprint of buildings or facilities that surround our renewable energy assets.

We also are studying large-scale waste-to-energy. This is an idea that partners with the City of El Paso. We are looking at the entire waste-stream for the City of El Paso, which amounts to about 1,000,000 tons of waste a year. The Army, the City, and the electric company are trying to come up with a project where the Army could achieve net zero through the energy that is produced with that project. The City could then solve its long-term problem with landfills filling up. All of this is in the conceptual stage; many of legal issues need to be overcome. I think everybody is willing to do these kinds of projects, the problem is nobody knows how to do it yet, and it's very difficult when you are the first one trying to figure it out for yourself.

Our efforts include an Energy Savings Performance Contract (ESPC). This contract with the Army allows a contractor to help us with energy conservation measures. They then get paid back with the savings generated by implementing those conservation measures. The Energy Initiatives Task Force is a group out of the Pentagon that is helping us with program development for these very large-scale renewable energy projects.

As far as waste goes, right now we are focusing on recycling and reduction of waste that we generate because of the way we buy things. In the future, we want to move to a waste management type of scheme where we look at everything, all the way down to how we actually collect the waste, separate it, and recycle it. This is in order to maximize that fraction of the waste-stream that is recycled and minimize the amount that actually goes out the door, which we call unusable waste.

This conference, of course, is focused on water. Net zero water is arguably the most difficult to achieve of all three of the net zero aspects. One of the reasons is because it just doesn't make economic sense if you look at it from a strict financial viewpoint. From a business perspective, you would say, "I pay this much for water right now. If I implement this project, it saves a lot of water. How long does it take to pay back my investment?" Our problem is that water infrastructure is so expensive that these paybacks are in terms of centuries instead of five- and six-year periods.

We looked at our water use and found that about 50 percent of our water goes to irrigation—that includes parade fields, golf courses, housing areas,

and so on. We can work on those areas by applying reclaimed water, but we need the water infrastructure to do so.

One of the many things we want to do is to develop solutions that not only include Fort Bliss but also the surrounding community. That will allow us to achieve our goals but not at the expense of the community. Thank you and please feel free to contact me if you have any questions.

Desalination Update

Michael Gabaldon, Bureau of Reclamation

Michael Gabaldon is the Director of Technical Resources for the Bureau of Reclamation located in Denver, Colorado. He oversees Reclamation's Technical Service Center, the Research and Development Office, the Power Resources Office, and the Design, Estimating, and Construction/ Dam Safety Office. A native of New Mexico, Mike earned a Bachelor of Science degree in civil engineering from the University of New Mexico, holds a degree in water technology/ utilities from New Mexico State University, and completed the Executive Leadership Program at Harvard University's Kennedy School of Government. He is a registered Professional Engineer in New Mexico and Colorado.

Thank you Dr. Thomson. Bruce was my fluid mechanics professor when I was in college in the late 70s. Bruce was a very young professor at that time; either that or I've aged a lot faster than he did.

I grew up in New Mexico in the middle Rio Grande valley, in Belen, and it's always great to be back in the Land of Enchantment. I was Reclamation's area manager in Albuquerque that covered this area for a few years in the mid-90s. We dealt with some difficult issues; in fact I was named in the silvery minnow lawsuit on the Rio Grande. It was a lot of fun in those days and I've worked with a lot of people in this room. I'm currently in Denver as part of the Commissioner's Office.

During the mid-50s there was a severe drought in this area—we've all seen the charts, one of the worst droughts on record. My father farmed in the middle valley and relied on farming for his livelihood. In those particular drought years, there was no water, therefore no farming. My mother also helped on the farm. They weren't farming much in those days so out of boredom they conceived a child. Here I am 56 years later, a direct product of the drought. And, I do have six brothers and six sisters so it was a pretty bad drought.

I would like to talk about a little niche with the Bureau of Reclamation, a niche that some of you may not be aware of, and that's advanced water treatment—desalination. We are very involved in desalination these days. "How do we grow the pie?" is what this panel is about and this is one way that we see as a means to grow that pie. We all need to get more and more involved in advanced water treatment.

We are and have been involved in it and we have an incredible facility in Alamogordo, New Mexico that we call the Brackish Groundwater National Desalination Research Facility. Reclamation partners with New Mexico State University to conduct research on brackish groundwater. The facility was the brainchild by Senator Pete Domenici back when he was a senator in Congress and after he retired, Senator Bingaman lead the charge to keep that facility running. Several others from this area, including NMSU, have put a great deal of effort into the facility.

A lot of research is being conducted at the facility in partnership with New Mexico State University—they do the research and we run the facility. We opened its doors a couple years ago and it is a very busy place with six

bays inside, which are always active with desalination research. The facility also includes three outside, larger bays that are also pretty tied up with research efforts. We can produce about any concentration of desal water to accommodate research—and it's great for researchers. We've performed research work with Veolia Engineering, along with UTEP, on a zero discharge project. The University of Nevada is also conducting a pressure retard osmosis pilot project. New Mexico State University teamed with GE on a reverse osmosis/nano filtration study. Suns River Solar is doing research on how to bring down the cost of implementing and incorporating renewable energy to the desalination process. We are very proud of that facility and the partnerships we have working with us at the facility.

Reclamation's mission; you heard the Commissioner talk about it, is to deliver water, we generate power—that's what we are about. Developing agriculture infrastructure was our primary purpose back in 1902 and we continue to be about agriculture. We built dams, we built facilities—we have 450 dams throughout the West including Hoover Dam and Elephant Butte Dam. Again, our main purpose was agriculture, but those facilities that we built also afforded hydropower development opportunities.

So that secondary part of our mission is hydropower production and there is definitely a nexus between hydro, water, and energy. When you have a drought, it affects everything, not only agriculture but also hydropower production. We are very involved with what is going on in water management, especially in trying to find new sources of water. Water is finite—I'm preaching to the choir—you all know that, there's not a whole lot of new water out there. But maybe, the next opportunity out there is brackish groundwater desalination. Certainly the Middle East and other places around the world are ahead of us in that area because they had to be—they had absolutely no other water source. We will continue working with all of you towards those goals that we share: to manage a finite resource in the most effective and efficient manner. To make that drop of water go as far as it can—to grow the pie! Thank you.

Water Restoration

Jack Chatfield, Canadian River Riparian Restoration Project

Jack Chatfield is a 5th generation rancher, husband, and father of three. He has managed the Canadian River Riparian Restoration Project since its creation in 2004.

I'm excited to be here today to talk about something very dear to my heart and that's watershed restoration. How many people out there, other than me, does it bother to see a picture of New Mexico without our little family farms? How can we keep those farms? How can we have a little more water? We can't force more rainfall, but we can do a better job of taking care of the water that we have.

We put together a project in northeastern New Mexico that will help us take care of our water. The Canadian River Riparian Restoration Project's goal is to restore the riparian corridors of the Canadian River, both on the mainstem and on its tributaries, to a healthy productive state that will provide native habitat for a variety of wildlife and water for communities, agriculture, and recreation throughout the course of the watershed. We have treated

about 24,000 acres so far. We know how to do it—we know how to treat the watershed and help protect the water in it.

One of the main causes of degradation of New Mexico's riparian corridors is infestation of salt cedar, Siberian Elm, Russian Olive, and other non-native invasive species. Those 30-foot tall trees not only use water, but nothing can grow underneath them, you lose the rushes and sedges that fold over and armor the banks of the streams, and they cause down-cutting. The streams draw the water out of the riparian area and the water level in the aquifer is never any higher than the bottom of that stream. You lose the meadows on the banks on both sides of the stream that provide food and habitat for elk, deer, cottontail rabbits, and all the animals that live there.

Our project is guided by a steering committee made up of eight Soil and Water Conservation Districts and the New Mexico Association of Conservation Districts. We receive technical advice and funding from a variety of state and federal agencies including Cooperative Extension Services, Natural Resources Conservation Service, New Mexico Department of Agriculture, New Mexico State Land Office, NMSU Range Improvement Task Force, U.S. Forest Service, U.S. Geological Survey, Resource Conservation & Development Councils, National Wild Turkey Federation, Bureau of Land Management, and a good number of others. Something that I am proud of is the cooperation we receive from state and federal agencies—they've got some skin in the game. We didn't just put their names down on the cooperator's list. They fund us, they provide technical expertise, and they actively participate in the project. These entities work together through a Joint Powers Agreement that allows for the sharing of funding and personnel.

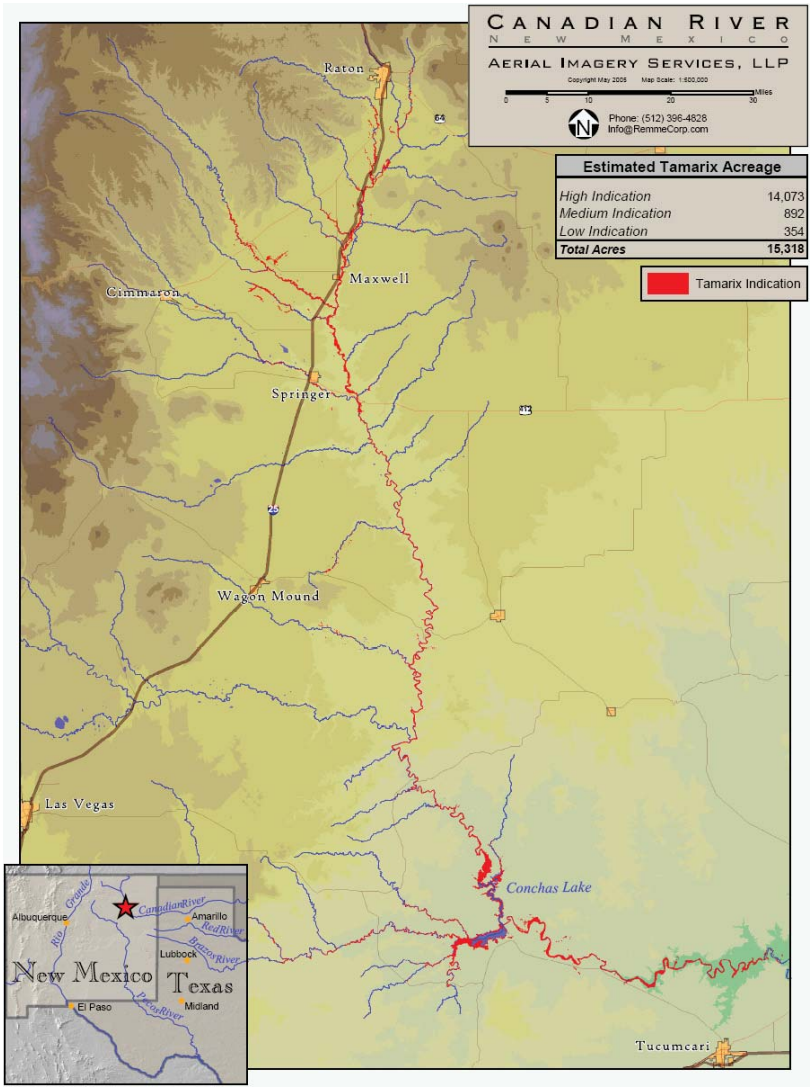

Figure 1. Canadian River Watershed map

One of the first things we did on the project was to map the Canadian River watershed (Figure 1) from the top near Raton down to Ute Reservoir. The map includes well over 2,000 miles of riparian corridor and is available in electronic GIS format. You can click on any spot on the map and it will tell you who owns that particular piece of property. It will tell you how much salt cedar is on that property as well as its density.

Figure 2 shows a Bell Jet Ranger hard at work in the Box Canyon of the Canadian River eradicating salt cedar. We use a new type of herbicide; it's not a poison like the old type herbicide. It is an enzyme blocker that blocks an enzyme in the plant

that causes the plant to produce a leaf. Without a leaf, the plant basically starves to death. The herbicide is harmless to humans, animals, fish, macro-invertebrates, and so on. We conducted scientific studies to monitor the macro-invertebrates before and after treatment in an area and we found no negative impacts.

Figure 3 shows one of our mulching machines hard at work on a good-sized stand of the 30-foot tall salt cedar. It does a good job, although we didn't get quite as good a kill as we got with the helicopter. We went back and treated the re-sprouts and Figure 4 shows what the area looked like after we finished.

Our rehabilitation efforts include pole planting, reseeding, mechanical clearing, chipping, biological renovation, encouraging individual landowner monitoring, and educating landowners to alter their management practices. Figure 5 shows us not only planting some major vegetation, but also teaching landowners how to restore their property with native vegetation. Thank you.

Figure 2. Bell Jet Ranger eradicating salt cedar in Box Canyon of the Canadian River

Figure 3. Mulching machine working on a 30-foot tall salt cedar

Figure 4. After treating for salt cedar

Figure 5. Educating landowners on restoring native vegetation

Multiple Benefits of Pecos River Restoration

Paul Tashjian, U.S. Fish and Wildlife Service

Paul Tashjian has worked as a hydrologist for the U.S. Fish and Wildlife Service since 1991. With over 20 years of professional experience in New Mexico, Paul's expertise includes water management and water protection for wildlife, river restoration, water law, and water monitoring. His current work focus includes quantifying and protecting National Wildlife Refuge water rights, conducting studies and workshops to improve wetland management through historic emulation, and monitoring river restoration responses on the Pecos River.

Lately I've been spending a lot of time looking at river systems historically in order to understand how these systems used to function. We try to emulate those functions in the modern, and possibly restore what processes we can. Through this work I have seen a loss of ecologic systems that is staggering. I want to start with this premise: Our rivers have been dramatically transformed by water development and this transformation is nothing short of a large-scale ecological disaster. What we have left are fragments of historical river systems.

The Endangered Species Act has been the most common voice for the conservation of these remnants. Where some sort of historic function remains there are remnants of historic ecology remaining. In these places the ecology is very commonly in a perilous state and often has endangered species associated with it. Beyond this ecologic loss, there are human costs to river engineering. There is a natural mathematical wisdom in a river system. Rivers move both water and sediment and when we dramatically alter how water and sediment move through these corridors, there are unintended economic consequences. These include river maintenance costs, flood maintenance costs, dangerous fires, and an increasing dependency on snowpack within our arid region.

Today we discuss how to grow the water pie in an overtaxed system. I think there is a false idea out there that when we start talking about water efficiency and water conservation, that it equates to an improvement for the environment. Water efficiency improvements without environmental safeguards can be death to an ecosystem. The tighter we get with water, the less water there is for these ecosystem islands.

There are two primary components to restoration: 1) flow modification and, 2) physical restoration. I am going to talk primarily about physical restoration on the Pecos, but I want to give a shout out to the importance of the flow modifications—you can't have one without the other. If you go out and do a lot of restoration and you have a big drought that dries the river channel, all your work can be for not.

The middle Pecos River between Fort Sumner and Carlsbad is a system that is close to working. This is largely because of work that has been done through the New Mexico Strategic Water Reserve to ensure minimum flows and the physical restoration work we have done with federal agencies. The restoration of the Pecos River at Bitter Lake National Wildlife Refuge has occurred since 2008 and encompasses over 12 river miles. The project includes 1,700 acres of salt cedar removal, removal of bank-lined levees along the 12 river miles resulting in a connection of the floodplain at the annual flood recurrence, connection of 1½ miles of former river channel, active planting of native vegetation including shrubs and grasses, and an annual treatment of salt cedar re-sprouts. Salt cedar must be kept at bay before you can get the natives established.

We have completed the bulk of the heavy lifting and continue to monitor and actively manage the river on the refuge. Partnerships have been key to this

effort and the primary partners include the New Mexico Interstate Stream Commission, the World Wildlife Fund, the Bureau of Reclamation, and the New Mexico Environment Department. The project was also helped by letters of support from the Carlsbad Irrigation District and Chavez County; both saw benefits from the project.

What are the benefits of his restoration effort? One, there's help with the Endangered Species Act. If you have better habitat for endangered species, there's greater resiliency and population dynamics when a drought comes and a better ability to make it through droughts. Second is ecotourism. Bitter Lake National Refuge has a fantastic, relatively new, visitor center named in honor of the late Congressman Joseph Skeen who was a strong advocate for the refuge. People want to see the Pecos River when they come to the refuge. It's a river of great historic lore and if people see it in a restored state this generates additional tourism. Third is fire threat reduction. Reduction of fire threat during dry years is done by removing salt cedar thickets. These fires not only threaten human infrastructure but also promote salt cedar growth, which comes in thicker after a fire. Fourth is flood control. By reconnecting the floodplain we have returned the natural functioning of the floodplain to put the brakes on flows during flood events. The farmland in Chavez County, below the refuge, abuts directly against the Pecos River. The historic floodplain has largely been eliminated in this area. By connecting 12 river miles of floodplain directly upstream of these farmlands, we are helping to take the punch out of flash floods.

Finally the water budget. Riparian evapotranspiration studies of the University of New Mexico have demonstrated that riparian plants consume water roughly equivalent to their leaf area. Where salt cedar control occurs with no follow-through, salt cedar often returns. When this happens, there is little benefit to the water budget. But at wildlife refuges and other places where we actively manage the landscape and have goals for returning grasslands to the riparian system, it means a dramatic reduction in leaf area. This is true in the Bosque del Apache, Sevilleta, and Bitter Lake National Wildlife Refuge. On the Pecos, at Bitter Lake, we removed 1,700 acres of salt cedar from floodplain and if you assume that two-thirds of the salt cedar will return, you still have an estimated reduction in water consumption of several thousand acre-feet a year. The water is not necessarily returning to the river, but it's returning to the system. We are doing much better than this, and we estimate at least 75 percent of the cleared areas have come back in non ground-water consuming grasslands and shrubs.

In conclusion, my policy recommendation is to further empower New Mexico's Strategic Water Reserve and the New Mexico River Ecosystem Restoration Initiative. Both these programs are state-based initiatives and lay the groundwork for long-term river ecosystem protection. Both programs are in need of funding. The state could have better coordination between the two programs and establish a proactive river restoration state-based program. We need these programs now more than ever to help preserve the ecosystem islands that remain. By doing so, we will see benefits that reach beyond wildlife and demonstrate our interconnectedness with healthy river corridors.

Thank you.

Salinity Control

Fred Phillips, New Mexico Tech

Fred Phillips is a professor of hydrology and director of the Hydrology Program at New Mexico Tech. He joined the university in 1981 after completing a PhD in hydrology from the University of Arizona. Fred also has an MS in hydrology from UA as well as a BA in history from the University of Santa Cruz. His scientific interest lies within the area where hydrology, geochemistry, and geology overlap. Fred has focused on the effects of climate change on the hydrologic cycle and the influence of the hydrologic properties of geologic materials on the transport of solutes in groundwater and soil water. His favorite tools for these investigations are stable and radioactive isotope techniques. Fred was elected into the American Geophysical Union in 2008 and in 2007, he was elected as a Fellow of the American Association for the Advancement of Science.

I'm going to take advantage of being the last speaker of the day and in addition to talking specifically about the issue of salinity on the Rio Grande, I'm also going to talk about some of the things I've heard throughout the day in relation to the issue of salinity—the bigger picture and the hard choices that are the theme of this conference. In terms of Rio Grande salinity, the biggest message I have to deliver is that unlike the weather where everybody talks about it but nobody does something, there is actually a plan to do something about salinity on the Rio Grande.

The salinity of the river goes from about 30 ppm at the headwaters near Creede, Colorado to 3,000 ppm down by Fort Quitman. That's a two orders of magnitude increase in the salinity, which is very impressive. The plan that has been formulated has been put together by the Rio Grande Salinity Management Coalition, which has 18 members and includes the Rio Grande Compact commissioners from Colorado, New Mexico, and Texas, the state environment departments and boards, municipal utilities, and practically every player on the basin. The goal is to reduce and manage salinity along the Lower Rio Grande.

Phase 1 of that project involved assessing salinity causes and the report that was issued in 2000 identified the six major sources of salinity on the river. The report recommendations were to monitor so we would have data to base decisions on, focus studies at sites of saline inflows, and follow that with modeling to show how it could be reduced. Phase 2 started with a management alternatives analysis that was published in 2011 and it performed semi-quantitative evaluation of the effectiveness of management alternatives at specific sites. Based on that analysis, three sites were selected. The highest priority was the distal Mesilla Basin, the second was the saline discharges at Truth or Consequences, and the third was near Fabens, Texas. The current phase involves detailed site investigations and modeling to show how mitigation alternatives might specifically affect salinity and that should lead to, within the next year or two, specific recommendations for projects at those sites or possibly recommendations that a project wouldn't be worthwhile. In fact, tomorrow there will be on meeting on that here on the New Mexico State campus.

Our moderator, Bruce Thomson, asked us to formulate our thoughts in terms of a couple of challenges and policy changes. Suppose we tackle those salinity sources. What are the kinds of challenges that we might be looking at in the future that we are only beginning to see now? I'm going to propose that a major challenge is going to be managing the effects of increased groundwater pumping during periods of drought. Almost every day you can open the newspaper or watch TV and see some-body talking about the drought and how terrible it is, all the bad effects, and so on. I think that very likely the reality is that what we are seeing today is the new normal. What we have seen in the studies that we've done at New Mexico Tech on groundwater and irrigation districts during drought is that the salinity of the water everywhere in the system goes up up up as the drought goes on. Farmers cope with

the drought by pumping groundwater, which itself is more saline than the surface water supply. They then reduce the flow in the drains and they recycle that pumped water through what ultimately ends up going out to the river, which is much more saline than water during normal conditions. If we are, in fact, going to experience long severe droughts—much worse than during the historical record as all the climate projections would seem to indicate—then we are going to effectively have a new source of salinity in the system that is going to have to be actively managed.

We were also asked to consider policy changes that might affect the situation. The policy that I am going to suggest here would involve officially recognizing the interconnection of water use and water quality in the legal and institutional framework within which we manage water in the state. We can't separate them. The example that I just gave you shows that in the old days even during a drought, the river would go down, but without this groundwater recycling you wouldn't get the kind of ramping up of salinity that happens today. The two are interconnected and the general usage affects water quality, especially during periods of low water supply.

We do have an extensive water infrastructure in the state and on the Rio Grande in particular, which gives us the flexibility to potentially manage that kind of situation. But the potential flexibility and the actual flexibility are two very different things because the usage of the water is actually governed by two institutions: the legal doctrine of prior appropriation and the Rio Grande Compact. Both of these are early twentieth century institutions, they are 100 years old now. How well do they really work in the modern environment? We heard a very frank assessment of that right after lunch in the former state engineer panel. Former state engineer Eluid Martinez said something I never thought a state engineer would say: that priority administration of water delivery, under the prior appropriation doctrine, really does not work and to try and implement it would be a disaster.

So how do we manage the water then? The answer is that we have a lot of ad hoc workarounds that work around the pro forma legal system and enable us to kind of do the job that we want to. How long will it continue to work? I don't think it is going to continue to work for very long and the reason is that nature has been relatively kind to us so far in terms of the water supply. But I think the changes that humans are producing in the climate system are going to make the water supply go down and when that happens, this sort of ad hoc system is not going to be the answer. I think we are going to have a three-way train wreck between the Rio Grande Compact, attempts to force priority administration, and salinity. You saw some of that in Howard Passell's presentation. My modest proposal here is maybe it's time to actually say—you know, the nominal system that we have isn't working very well, we really use another system, why don't we institutionalize the system we really use? Doing so would give us the opportunity to recognize salinity and management of salinity as one of the aspects of the system that we would like to deal with under the new regulations.

To wrap up, in terms of the big picture, we are still operating with early twentieth century institutions because the people back then had a vision for what they wanted to do with water. That vision can be summed up in four words: make the desert bloom. That doesn't correspond to the vision modern society has for the use of water in New Mexico. Maybe it's time to say, let's

institutionalize the way that we do it now and incorporate the goals we have today. Perhaps in doing so, it would enable us to address some of the hard choices we are facing.

Thank you.