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PARTICIPANTS:

Welcome and Introduction:

KIMBERLY CHURCHES
Managing Director
The Brookings Institution

Opening Conversation:

PAT MULROY, Moderator
Senior Fellow, William S. Boyd School of Law
University of Nevada, Las Vegas

BRUCE BABBITT
Former U.S. Secretary of the Interior

U.S. Water Infrastructure and Regulatory Reform:

Moderator:

PAT MULROY
Senior Fellow, William S. Boyd School of Law
University of Nevada, Las Vegas

Panelists:

BRET BIRDSONG
Professor of Law, William S. Boyd School of Law
University of Nevada, Las Vegas

JIM LOCHHEAD
Chief Executive Officer and Manager
Denver Water

PARTICIPANTS (CONT'D):

ROGER K. PATTERSON
Assistant General Manager, Strategic Water Initiatives
Metropolitan Water District of Southern California

JENNIFER PITT
Colorado River Project Director
Audubon Society

Global Water Security, Economics, and Geopolitics:

Moderator:

SAMANTHA GROSS
Fellow, Energy Security and Climate Initiative
The Brookings Institution

Panelists:

KUMUD ACHARYA
Ecological Engineering Program Director
Desert Research Institute

VANDA FELBAB-BROWN
Senior Fellow, Foreign Policy
The Brookings Institution

CHRIS GASSON
Publisher
Global Water Intelligence

BETSY OTTO
Director, Global Water Program
World Resources Institute

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P R O C E E D I N G S

MS. CHURCHES: Good morning, everyone. Good morning on this dreary Washington swampy-like day. I want to thank everybody for coming out for this joint Brookings and University of Nevada, Las Vegas event. I'm Kim Churches, managing director here at Brookings.

Today, we all know that the United States faces a water crisis from ongoing droughts in California to increasing strains on the Colorado River and threat of rising sea levels in my home state of Florida. We're facing them from coast to coast. Across the globe, the impact of climate change on water scarcity has fostered conflict at a great impact on the economy and human security issues, so this threat is urgent, as we all know.

Today, we're pleased to have a range of policy experts, who will be discussing these issues, in the U.S. and around the world. On behalf of Brookings, I'd particularly like to thank Dean Dan Hamilton, who's standing right here, of the William S. Boyd Law School at UNLV, for co-hosting this important discussion, and a timely one at that. In addition to those of you who are here in person this morning, I want to welcome those viewers who are watching us via the webcast, and please feel free to join in the conversation by posting questions or comments on Twitter via #waterproblem. Today's event also marks the launch of Pat Mulroy's fantastic new book, "The Water Problem," which looks at the increasing challenge of building water resilience in a changing global climate. Many of the contributors will be joining Pat today in discussion, and of course, copies are available out front for purchase.

To kick off today's program, though, I'm quite honored to be able to welcome the Honorable Bruce Babbitt, who will offer a few opening remarks before joining Pat in conversation. He served as the U.S. secretary of interior in the Clinton administration, where among many, many accomplishments, he led passage of the California Desert Protection Act and championed forest, natural resource, and wildlife protections. As the governor of Arizona, he personally negotiated the Arizona Groundwater Management Act of '80, which remains the most comprehensive water regulatory system in the nation today. Please join me in welcoming the Honorable Bruce Babbitt, and many thanks from Brookings and UNLV for all of you for being here today. Thank you.

SECRETARY BABBITT: Kim, thank you very much, and good morning. I want to explain at the outset of why I'm here, and the answer is simply, Pat Mulroy. I could not evade or find any excuse

sufficient to turn down her command that I join in this. I must acknowledge at the outset that Pat Mulroy and I have been fighting and collaborating, initially, mostly the former, across the Colorado River in Arizona-Nevada for a long time. It seems like almost since the Lincoln administration we have been at it.

We started way back then in the classic American water culture as adversaries, staring each other down across the Colorado River, which divided the basin states, and gradually, across the generations, we began to awaken to the possibilities of collaboration. It didn't come easy at first, but it gradually expanded to the point that I now view Pat as a great collaborator, and we are engaged now in some seemingly quixotic ventures like trying to bring peace to the water wars in California and other things like that.

I read this book, actually a couple of times, including last night. What strikes me about the importance of this effort is that it's not just a long description of what ought to be, but it's digging deeply into specific examples, specific case studies. The reason that's so important is because we have evolved, over the last several hundred years in this country, water management systems, which have been built from the ground up out of local experience.

If you look at water management writ large in this country, you got to conclude it's chaotic. It is an incomprehensible jungle and jumble of federal, state, and local initiatives, which are often a very imperfect fit, but that's our history, and reform, I think, has to be an inductive process. It cannot be a logical kind of deductive system. We really got to start at a very granular level and build up. That, to me, is the importance of this book.

Now, I'll try not to talk too long. I'm tempted to use the hour up talking so that I don't have to get into another fight with Pat Mulroy in front of you, but that'll be fun, so let me just talk about a couple of things.

One thing, though, I think, more than anything else, in addition to the issues of climate change, that is not being adequately addressed in water management in the United States is groundwater. Groundwater just is not on the agenda. In the eyes of most Americans, and particularly politicians, groundwater's kind of out of sight and out of mind. It just isn't a topic of discussion. You don't go fishing in groundwater. You don't go swimming in it. You don't sit by a body of groundwater and watch a beautiful sunset, and it's always just kind of been taken for granted. It's out there.

But we are now verging on a genuine crisis in this country, because groundwater, for the most part, not always everywhere, has to be viewed at the beginning as a nonrenewable resource; not always, but you better start there. It's a fossil reserve that has been built up over thousands of years, and it's been depleted at unsustainable rates. The Ogallala Aquifer, the largest aquifer in this country across eight states in the Midwest, there's enough water in that aquifer to cover all 50 states, including Alaska, with a foot-and-a-half of water, but it's, in fact, being drained on farms in Kansas and the southern Great Plains are now pumping dry wells or pumping beyond economic depths, and farms are literally going out of production.

The same thing is happening in California in a somewhat different context, but in an equally dramatic and urgent sense as the farming economy of the central valley of California starts to overdraft that aquifer and actually beginning to take agriculture out of production. Agriculture in California uses 70 percent of the state's water resource. California, writ large, the water balance in California, 40 percent of the water use in that state is groundwater, which is being drafted at an unsustainable rate.

Now, the question that I will leave you with before we turn to a conversation is, what can we do to bring this groundwater crisis into focus, and what are the respective roles of local, state, and national governments? I think of the way surface water has evolved in a management context in this country, it is an amalgam of local, state, and national laws and frameworks. It's chaotic.

I am now sharing a statewide negotiation in California over the future of the water systems of the San Joaquin Valley in the south, Sacramento River in the north, all coming together in the California Delta. It's a maddening process, because there are six or eight federal agencies at the table, probably more, probably 8 or 10 state agencies involved in the management of that water resource, which is the largest and most comprehensive hydrographic system in California, but that's what we've got. For better or for worse, it has served us well, even as we talk about ways in which to reform it. Groundwater, in comparison, the framework is not there. It is so locally perceived and so much tied to the perception of local rights, of property rights, that the framework for management is simply missing.

So where do we go? Given American history of these interlayered local, state, federal admittedly chaotic surface water systems, starting from the Clean Water Act, the Endangered Species Act, the Corps of Engineers and flood control, the Bureau of Reclamation, tiering down through all of the

different states and, ultimately, local, I think we have to ask the question, doesn't that, to some degree, suggest where we've got to go with groundwater management? Local is the beginning point.

Read John Fleck's book called, "Water is For Fighting." It's another new book that's out that talks about how it is that water policy is made, and he gives the biography of a woman named Ellen Osseran, a Californian, who actually won a Nobel Prize for trying to tease out how it is that water management policy is made, both in terms of economic science and the social context. Surely, when we look at this groundwater crisis in the United States and worldwide with a local focus, but it's not enough. It's not enough there. The lesson we learned from water management, writ large, is locals must be motivated to start finding solutions.

That motivation has to come in the first instance at the state level, but it's slow. Read Pat's book. Not much is happening. California, for the first time, believe it or not, two years ago, three years ago, passed a groundwater management act called the Sustainable Groundwater Management Act, SGMA. But as we celebrate the fact that Californians finally awakened to groundwater management, we have to look at the law. What does it say? It says, well, the locals need to get organized, and then they have 20 years to come up with a plan, 20 years.

Turn now to the Great Plains, those eight states which are depleting the resource and, ultimately, beginning to dry up the surface streams because of the hydrologic connection. Well, Kansas has finally got around to saying, you ought to measure your withdrawals. That is viewed, understandably, as a major step forward, but really, I mean, there's a long pathway out there.

I would conclude by saying we got to have a federal piece in this intergovernmental framework of putting the pressure on to manage our water system. Now, am I advocating a federal groundwater law? No. No. That will never happen. It's been surfaced a few times, but it's so contrary to the momentum and content of our historic experience that we can readily say, no, we're not going to solve this groundwater crisis by suiting up the federal government with an analog to the Clean Water Act, as logical as that might be, but that doesn't mean we should do nothing, and that's where we've got to get moving.

So how do we do something? The classic federal, state, local, intergovernmental system starts off with the idea that the Federal government can at least, that Congress can at least set up

incentives to motivate states to put some momentum into the system going downward. Just two or three small examples that you might think about, the first one is, wouldn't it be reasonable to say that we ought to move toward a state-federal framework in which groundwater uses are measured? Nobody can manage a resource until you can measure it. Most groundwater use is not only unregulated, it's unmeasured. Does that sound draconian, federal incentives to start getting the states to measuring the use and depletion of the resource? Not really. Every farmer and rancher in this country regularly reports all of their crop data, agricultural uses, agricultural statistics of all kinds to the federal government. Why? Because it's a federal law that on my ranch, I have to fill out that census form periodically for the good of formulating policy at all levels. It's a great place to start, because the Department of Agriculture has got great relations across this country with agriculture and farmers. So that's an entry point that we ought to move on.

The second and last one I will give you is, surely, the Congress and all of us, as we move toward this, ought to ask a question. How about some attention to planning, because this resource is being depleted, and we're going to have to start talking about managed decline and the economics of that and the implications for surface water. That's kind of a conjunctive use issue. How do we begin to interface the way we use water, both surface and groundwater? Well, that begs for getting three federal agencies involved in groundwater, the United States Geological Survey to compile statistics, just like it does for surface water in the national water registry. Well, the Bureau of Reclamation, which administers so much surface water, ought to be powered up to begin discussing with states conjunctive use. How do we preserve and manage the decline of these aquifers in a carefully calibrated way between surface water, which has this huge federal connection, and groundwater, which has none, to bring them together?

Okay, I've run out 25 minutes of my hour, so with that, I will yield to your author, compiler, and in my judgment, really, perhaps the most knowledgeable of all of our water folks. I would never say the most aggressive, but I've had that thought. Pat?

MS. MULROY: Well, Mr. Secretary, you've said some pretty provocative things -- can't talk unmic'ed. For you to suggest a federal role in managing groundwater in the Western United States is heresy, and you know it, as a former western governor. So in this data collection, where do you see the benefits? I mean, I can see where lots of states would see the threats. Share with me where the benefits

are.

SECRETARY BABBITT: Okay, well, let's start with Florida. How's that?

MS. MULROY: That's a great place to start.

SECRETARY BABBITT: Florida has a really difficult groundwater problem. Lots of water, but as those aquifers are pumped down, the sea water is coming in, and there's a salt water line inland, as you'll see from reading, which has to be stabilized. Who does that? Who puts the money out? The answer is, the Federal Government and the State of Florida. Until we know how much water is being withdrawn, it's very hard to get out there and do the planning and zoning and to say to municipal groups, locate your well field here or there. Florida's got relatively good data, but not enough, not enough.

California and the Great Plains, as agriculture goes out of production, surely we should have a managed plan, a plan for helping those farmers out and using data to project what's going to happen. So should it be a federal mandate? I guess I would back up and say we ought to encourage the states to put together plans and use some of those economic incentives like crop insurance, price supports, drought insurance, and all of that to say to the states and the farmers, we need the data, you need the data, and how about all this federal money that's coming your way. I haven't sold her. She's a states rights type, I'll tell you.

MS. MULROY: Actually, not entirely.

SECRETARY BABBITT: Not when it comes to money.

MS. MULROY: No, not -- well, of course not. No, I mean, you and I both come from states that very actively, conjunctively manage our groundwater.

SECRETARY BABBITT: Right.

MS. MULROY: The State of Nevada was paying the State of Arizona to recharge their unused Colorado River water in the groundwater basin. We stabilized. Southern Nevada tried to totally collapse its groundwater basin until the mid-'80s when we started recharging, and one of the biggest challenges we've had in the Colorado system, as you well know, are illegal diverters, which are no more than wells right along the Colorado River, correct?

SECRETARY BABBITT: That's right.

MS. MULROY: I mean, I don't disagree, it's just going to be a challenge, and so a

pathway forward that is, I would probably say, more carrot than stick might be exactly the answer. But I look at the California law that was just passed and I scratch my head. Twenty years seems like an inordinately long time to get your arms around this challenge.

SECRETARY BABBITT: It is. It's the best compromise a legislature could find in an ongoing struggle between agriculture and other water managers. But don't you see, you're making my case for a little federal pressure on California to do better, because the reason the groundwater deal got worked out between Nevada and Arizona was Nevada had a brilliant water director --

MS. MULROY: Who was then cattle flogged.

SECRETARY BABBITT: -- and there was some federal pressure, if you will remember.

MS. MULROY: By you.

SECRETARY BABBITT: Do something.

MS. MULROY: That was you. There was lots of federal pressure. Listen, I am the first person to say that where we are today in the Colorado system in a world where we can actually talk to one another, with the successes that we've enjoyed in the Colorado River Delta down in Mexico, would never, ever, ever have been possible had you not taken out your cattle prod in the '90s and taken this disparate group of cats and forced them around the table. I mean --

SECRETARY BABBITT: Had we not both been there at the same time.

MS. MULROY: We do make great fighters.

SECRETARY BABBITT: Yes.

MS. MULROY: I will definitely admit to that. But let's go -- Governor Brown has asked you to help to find now a solution for and bring the parties together on the Bay Delta, and I can't think of anybody who understands the complexities around probably the most quixotic water problem in the United States better than you do and has more experience to be able to bring it together. So where are we in this process?

SECRETARY BABBITT: I was hoping this would be over before you asked that question. In a nutshell, almost all of California's surface water resource converges down into San Francisco Bay, the region known as the Bay Delta. There has been an ongoing struggle for half a century between southern California interests who would like to put a straw in and move it down through these magnificent

aqueducts, state and federal, which traverse the entire state all the way up from the San Francisco Bay to the Mexican border, gathering water that's originating all the way up to the Oregon border. The problem is California has a fabulous salmon fishery which supports a huge ocean-going salmon industry, and the question is, how do you divide the water, allocating the right amounts between outflow to the ocean for the protection of the species and all of this extraordinary agricultural economy to the south.

Now, there are a lot of issues that are under play right now. I would add only one thing, and I know you'll rise to this bait. The ocean so far had to, in some large measure, been driven by the Endangered Species Act by federal regulators doing, really, micromanagement of the export pumps to protect not only the salmon but the famous delta smelt. The underlying question is, how much political problem can you stack on the back of the Endangered Species Act with federal regulators writing these prescriptive opinions but running the entire system for one or two listed endangered species, and that I think is a question that needs a lot of discussion, because, ultimately, at the bottom, it's a political problem. It's a political problem. How do you allocate water when the demand outstrips the supply?

MS. MULROY: Well, the conversation you and I have often had is one of overreach, and sitting here today, I mean, you read the news this morning, I read the news this morning. The regulations are being dismantled left and right, and it is a reaction to what some perceive as a regulatory overreach. But when you sit there and you read that Oroville Dam, one of the reasons Oroville Dam was so much water was held back was so that State Fish and Wildlife could move salmon from down below before they released water, and instead, communities had to be evacuated; you have to say, wait a minute. You can't tell me that there isn't a better fulcrum or balancing point in this conversation, and the reason Oroville hasn't been fixed is why? Because there have been people opposed to it who would probably rather see it being torn down, right, than it remaining. So that overreach is only going to create an equal and more exuberant reaction and isn't going to get it, so how do we get out of this yoyoing between these two extremes that get us nowhere?

SECRETARY BABBITT: Well, that's precisely the issue that I commend to this audience. Now, there's a movement in southern California, acquiesced in by our president apparently, to suggest that the Endangered Species Act should simply be disregarded or eliminated. Well, that's a fairly extreme view, in my judgment.

MS. MULROY: Very extreme.

SECRETARY BABBITT: The more interesting question is, how do you look at the Endangered Species Act through, what, 40 years of history now, in which it has chalked up enormous successes, and ask, what kinds of modifications could be made. They made a heroic effort in the state government over the last 5 or 10 years to do what's known as a habitat conservation plan. This idea was to use the Endangered Species Act to find the equilibrium rather than saying you cannot destroy a single smelt. It would say we're going to back up a bit and take some risks and find an equilibrium. They tried to do it in the form of a 50-year plan which would settle the equilibrium for 50 years. It got so complex and so expensive that it just collapsed. Governor Brown, in his frustration, took me and opened a cabinet in his office. He said, "Here's the planning," and this 10-foot stack of notebooks came cascading out. I could just see his frustration, and he threw up his hands and said, "That's why I invited you to California; do something." Well, I'm still there, but I don't know about doing anything.

MS. MULROY: Well, if anybody could do it, you can. I'm going to take you some place you didn't think we were going to go in this conversation. You've also been very, very active internationally in the climate forum and on international water issues. Casting your eye around the various hotspots around the world, what would you feel are the most pressing global challenges outside of the United States?

SECRETARY BABBITT: Well, that's the ultimate climate issue, because most of the world is surviving on water resources and water infrastructure which is really at the tipping point, and most populations of much of this world are right on the edge. Climate change (inaudible) dramatic effect. It's going to start in the tropics.

It's really ironic that the tropics, thought of as the wet places, are the places where droughts that impact on surface water resources are going to be most dramatic. Africa is front and center on that, and there are many, many other examples. There are groundwater resources, but not everywhere. A lot of Africa is in a tectonic framework that doesn't have a lot of storage space for groundwater, and you see those issues everywhere we go. We see it in the Great Plains, interestingly enough. I didn't mention that, but it's got a climate problem. It looks like across the Corn Belt of the United States that, as much as you can predict, and it's beginning to get a little more clearer, there will be

more precipitation in the northern Great Plains, counterbalanced by a lot less in the southern Great Plains. That, to me, suggests the need for a federal discussion to try to bring some of this together.

MS. MULROY: And that area of the Great Plains that is going drier, what would you suggest some of the solutions might be?

SECRETARY BABBITT: Times up. Well, no, no --

MS. MULROY: Well, let me just throw this out there, and this'll send you through the roof. But if we for 100 years in the west -- I mean, the west wouldn't exist the way it is today if we didn't move water around, correct?

SECRETARY BABBITT: Right.

MS. MULROY: And we have moved water from west to east for 100 years, right? We move it across the Continental Divide, we move it across desert basins, we move it everywhere, correct? Why would you not say, if portions are getting wetter and portions are going drier, reverse that?

SECRETARY BABBITT: Pat, I thought I heard you once propose that the solution for Kansas was a water project reaching all the way to the Mississippi River.

MS. MULROY: And reach out to the Ogallala.

SECRETARY BABBITT: Well, you don't lack in large visions, I must say.

MS. MULROY: No.

SECRETARY BABBITT: Well, my own view is a little more modest. I think in some of these areas where the expense and the disruption, like in this, compared to the economic results, we're going to have to talk about planned depletion. We're going to have to talk about areas where it will no longer be economical to use that resource. I guess I'm talking my way back into your proposal, and color me skeptical, I guess the first thing I'd like to see is some real management. We've depleted the Colorado River, there's nothing left, and I think we ought to moderate our thoughts about turning the Mississippi River westward.

MS. MULROY: I think the discussion has been, look at all the major flood events, how many more times are we going to let communities be flooded, be flooded out and wiped out, time and again? Would it not make sense -- I mean, Sacramento's protected by a diversion structure, correct, --

SECRETARY BABBITT: Right.

MS. MULROY: -- that actually moves the Sacramento River out of the path so that it doesn't destroy Sacramento during large flood events. Now, why would you not think that those flood events are opportunities to recharge areas that are being depleted?

SECRETARY BABBITT: Right. The answer is recharge. That's not about building dams.

MS. MULROY: I didn't say that.

SECRETARY BABBITT: That's about -- yeah, I know. I'm just trying to stir it up a little bit -- recharge. It's one of the really great opportunities. It goes back to this groundwater stuff, putting water into the ground. There are, interestingly enough, some of the best local examples are in southern California where in the Hayward Basin on the margin of Los Angeles, up through Pasadena and Altadena, and down in Orange County, those aquifers are being routinely recharged from the Colorado River and from storm water runoff. It is a vast area of opportunity.

When people see all that storm water in their cities and elsewhere running out unused, it's really an invitation to get a big local and national discussion going about how it is we do what the Bureau of Reclamation has always done and the Corps of Engineers, which is build dams, only just turn it upside down and put it in the ground.

MS. MULROY: Correct, as long as you protect reservoir levels and surface streams at the same time so that it's a balance, that one doesn't take precedent over the other.

SECRETARY BABBITT: Okay, we're verging on some common ground once again.

MS. MULROY: Once again. Well, I think with that, let's turn it over to questions from the audience. Yes, sir?

QUESTIONER: Good morning, Secretary. In California, the example you brought up with Orange County is a great example is treated waste water over a million gallons per day being reinjected into the groundwater system, highly treated. It's a great solution. Overall, in your work in California, one of the issues is dealing with regulators, state and federal, not being on the same page. How do you get beyond that mixed message to get to a global solution?

SECRETARY BABBITT: Well, state and federal not being on the same page, that, to me, takes us straight into the matrix of this book. How do you rationalize these conflicts? The big one in

California -- and I think it's a wonderful thought piece -- is the first of these longitudinal water projects, called the Central Valley Project, which brought the water all the way down to the outskirts of Los Angeles starting in the 1930s, is a federal project. Right next to it in the California Delta is another massive set of pumps with a parallel canal which head south for 700 miles -- it goes a little further; it goes over the mountain -- into Los Angeles, but you've got these parallel systems, vast, huge, unbelievable systems, each conveying several million acre-feet a year from the neighborhood of San Francisco almost to the Mexican border, run more or less independently by the state and the Federal Government. Now, the typical proposal has been, the state comes to Washington and says, give us the federal project. Well, the federal people sort of sotto voce say, no, federalize the whole thing; the state should give us their project. I think there's room for what I would call kind of merger talks, but this is one example.

MS. MULROY: Yes, sir?

SECRETARY BABBITT: If you just want to shout without the microphone, I may be able to hear you; I don't know.

QUESTIONER: Good morning, Mr. Secretary. My name's John Byrd. I help represent MAPPS, Association of Mapping and Geospatial Firms, as well as the National Society of Professional Surveyors, the licensed surveyors in each respective state. Two-part question I guess would be, number one, what kind of specific measurement data helped you as governor or secretary with the groundwater program and opportunities? And then, moving forward, if there is going to be some version of a federal mandate or something connected to this, partnership between USGS, Bureau of Reclamation, what exact kind of new data would help with the measurement and what specifically has changed in the last decade or so?

SECRETARY BABBITT: Okay, the basics of measuring groundwater withdrawal are really quite simple. It's not that it's not being done, it's just that it is not being done comprehensively. There's a lot of fascinating satellite stuff going on, but you leave that aside; it's really interesting. I'll just go for basics. There are only a few states which take this seriously, Kansas, driven by the dry-up of the Ogallala Aquifer now requires it. We did it overnight in Arizona. We just said you're using oil that pumps more than 35 gallons per minute, well, here's the regulation. It was kind of a state-centered mandate, but you can do it in a lot of other ways. What's the data good for? It's good for water quality issues. It's good

for planning recharge, which is a huge issue, and I think talking honestly about planned depletion, about the reality that some agriculture is going to contract.

MS. MULROY: Yes, sir?

QUESTIONER: Good morning. Thank you for your leadership, Marc Dettmann with the U.S. Water Partnership. I find this conversation to be really interesting, especially the mix between federal, local, and state actors, and as we are thinking about just the impact that climate change is going to really intensify a lot of these different challenges, where do you see -- and getting back to the point that you made with Ellen Osseran and the kind of governance aspect of this -- where do you see the role of, or what champions are emerging at those different levels to help facilitate these interactions between federal, state, and local? I'm thinking the conversation previously was going from what are the incentives from the federal down to the state to motivate, which I think is spot-on, but also, is there another way to go from state and local to the federal, especially as we're seeing right now with proposed budgets and the taking away funding from the Great Lakes region and some of our natural resources?

SECRETARY BABBITT: Well, with respect to the federal level, I don't think you need, as I stated, analogs of the Clean Water Act. What local communities need, as I think it's laid out clearly, very clearly in some of these chapters, particularly San Diego and Florida, is if you get a plan together, there should always be a careful assessment of what you can get at the federal level.

The appropriation process in the United States Congress is not fully appreciated. The real action is getting your share of the bacon, and it comes in so many different flavors that you've got all of these agencies with significant budgets, Environmental Protection Agency, all of the Interior agencies, the Army Corps of Engineers, is present at every Congressional district in this country. The Corps of Engineers historically is kind of like the American military. The military, to guarantee American support, has a base, multiple bases, in every state in this Union. That's not driven by strategic demands, it's driven by political reality. The Corps of Engineers has done the same thing. There's a flood control project in every nook and cranny of this country.

My first thought when I got a water project, I don't care what it looks like, my first thought is, well, a local officer in the Corps of Engineers, he'll have money, and he'll be happy to help lobby it in the Congress. And that's an oversimplified way, but you got to look across lines and into the (inaudible)

and not worry quite so much about the comprehensive law as how do we use this intergovernmental system to our advantage.

MS. MULROY: And just to do it as a postscript, beyond even the financial, if there is a avenue of communication between delegations, particular on the Senate side, and the states, it is amazing how much progress the seven states in the Colorado River Basin have been able to make because there's a seamless communication with their senators to where mischief can be avoided. It can help guide. We don't ask them to take an active role, but we ask them to kind of provide the sideboards, and the protection and the safe zone for the conversations to happen. A lot of things happened over the course of 20 years that would not have happened had there not been that cooperation between the delegations that represent the states and those that were charged with having to move forward.

SECRETARY BABBITT: I have one piece of specific advice. When I wanted to see the majority leader of the United States Congress, Harry Reid, a busy man who doesn't have time for most of us, I would call Pat Mulroy and we'd have an appointment with Harry Reid, the majority leader, the next week.

MS. MULROY: Well, there's a lot of things in the basin, I'm just going to do a shout-out for him. He's not there anymore, so I guess it's a safe zone right now, right? But listen, let's be very, very honest. The All-American Canal would never have been lined were it not for Harry Reid. There are any number -- probably the agreement with Mexico would have had a much bumpier ride staying as a minute rather than as an amendment to the treaty, had it not been for Senator Reid. So those kind of engagements and finding members of Congress that are willing to put in the due diligence and the time to learn this really complex issue, there are a few really good ones, and when they emerge, you absolutely partner with them and let them help you along the way. Yes, sir?

QUESTIONER: Is there sufficient data in the system (inaudible) to manage part of this system in the West, sufficient data?

SECRETARY BABBITT: Yeah, not only the West but the Gulf coast states where water tables are declining, everywhere. The surface water data is getting better and the reason is that the USGS, some time back, actively got into a stream measuring framework that engages all of the states, and the stream flow data is really quite good now. (inaudible) always be better, and it will have to get

better with climate change, but it's really very good. Once you get below ground, not there. And it's all on websites and, of course, it's really -- you can head to the USGS data, and it's fascinating stuff, and the Department of Agriculture has a bunch of it as well.

MS. MULROY: Yes, Mr. Saltman?

QUESTIONER: Could you give us a little bit more historical perspective. (inaudible), it's okay. Tell us what the two of you butted heads and how you solved the problem (inaudible).

MS. MULROY: Do you want your version or mine?

SECRETARY BABBITT: Well, here's my version in a nutshell. I was out of office in Arizona, a lawyer, looking for business, and a bunch of rural farmers from Nevada came to me, and I thought, wow, I've never been in Nevada. So I went, sat down with these farmers in central Nevada. We put together a little organization, because Pat was talking about building a pipeline into central Nevada. The farmers were all against it, and I organized all these farmers in straw hats, really great guys, and took them to Las Vegas and called a press conference and attacked Pat and her plans. That was not a good start. Not a good start.

My second version of this is things really warmed up when I because Secretary of the Interior, because she shows up with some of the most innovative ideas that I had ever imagined. She walked in the door and said, "We're going to store Nevada's water in Arizona." Well, and she had this kind of banking theory, and I'm trying to -- just looking at the ceiling saying, I've never heard anything like that before. Obviously, you had to have federal approval. It got done and it just took off from there in terms of all of the issues that we dealt with.

MS. MULROY: All right, for eight long years, Secretary Babbitt was at the reins of Interior, and since you've left, it is not often we see the Secretary at Colorado River Water Users, but you came every single time and beat heads together, and it was one of those magical moments in history when the right people were in the right place. I mean, Jim Lochhead and I lived in California during some periods more than we lived in our own home states, so there were any number of us who go back. But, in conclusion, since we're running out of time -- and I'm getting the one-minute sign -- you definitely have a special place in the history of the United States. Thank you, Mr. Secretary.

SECRETARY BABBITT: Thank you, Pat.

MS. CHURCHES: And we will now take a quick 10, 15-minute break before the -- no? No, we're going straight into the next panel.

MS. MULROY: Well, let's jump right into the first panel here this morning. We were beginning to talk earlier with former Secretary Babbitt about the regulatory process.

You know, one of the great challenges that are being faced by communities around the world is how do we adapt to climate change, while we talk about mitigating on the energy side the evolution and the progression of climate change.

Here on the ground, we're experiencing the impact of climate change as we speak and as we live. There are, however, in our structure, some impediments that make it very, very difficult for water utilities, water managers, water enthusiasts and those who care passionately about this business, for being able to come up with creative ideas and be able to move the discussion and actions around the country forward.

We're going to have a conversation about what some of those impediments are, and I think it's a very timely discussion. As I said to the Secretary earlier, as we woke up this morning, the newspapers are full of regulations that are being repealed, and policies that are being rethought and revisited.

In the midst of all this change, creating more uncertainty, the reality still lives with us here every day as we try to deliver water to millions of people across the country.

So, I am incredibly fortunate to have some of the best people in the field sitting here with me at the panel here this morning. People I've grown to know and respect over the years, who are amazing storehouses of wealth, and have given this issue a tremendous amount of thought, and let me introduce them briefly, before I ask each of them an opening question, which will give them an opportunity to speak at some length, and then we will go into a more iterative discussion.

Immediately to my left is someone who I have often viewed as a mentor. We kind of tease each other. We sort of started around the same time.

In a world of acrimony and in a world of combativeness and confusion, if you want a steady hand and someone who never gets excited, and who always looks for the right solution, it is the gentleman to my immediate left, Mr. Lochhead, who is now the CEO of Denver Water, and before that

was the Director of Natural Resources for the State of Colorado.

All those stories that Secretary Babbitt told of the negotiations, well, there's one fellow veteran of those days, and that is Jim Lochhead.

Sitting next to him is a lady for whom I have developed an immense amount of respect over the years. I've often said there is a continuum of individuals that are affiliated with environmental organizations and have environmental goals at heart.

There are only a very few that are incredibly able to find real solutions to actually bring the kind of ecosystem restoration and ecosystem protections to life, who have mastered the art of being able to find common ground.

Jennifer Pitt is currently with the National Audubon Society, their Colorado River Project, and before that, she was with the Environmental Defense Fund.

The fact that the Mexican Delta experienced a flush flow and was given a balanced flow over the last several years in great measure is due to her tireless efforts and her ability to negotiate a pathway to that delta restoration, which I know is near and dear to her heart.

At the far end next to her is a gentleman that I got to know when he was still with Reclamation, right? So, you have those long Federal roots. Then he was snagged up by the Metropolitan Water District of Southern California, by my friend, Jeff Kightlinger, and he couldn't have picked a more active individual and a more knowledgeable individual, and someone who just like Jim is a master of the deal, and that is Mr. Roger Patterson.

Jeff was going to be with us here today, Jeff Kightlinger from Metropolitan. Unfortunately, he decided that he was going to relive his teenage years and do some very aggressive skiing in Park City, and managed to fall and shatter his tibia and fibula, so as he lies in the hospital bed with steel and titanium in his leg trying to heal, he has sent the one individual in his organization who understands the complexities of the California Bay Delta and especially its relationship with the Colorado River as well as he does, and that is Mr. Roger Patterson.

On the far end, an individual that I have only recently gotten to know but for whom I have garnered a tremendous amount of respect. He is a professor at the Boyd Law School at UNLV, Mr. Bret Birdsong, and he was just released from having been the assistant solicitor at the Bureau of Land

Management during some of the Bureau's wilder times, perhaps is one way of describing the last several years, as the Old West met the New West, and the confrontations that ensured in probably Nevada, was a good battleground.

MR. BIRDSONG: All over the West.

MS. MULROY: There you go. BLM has lost a brilliant lawyer, and the law school is fortunate to have him back educating young lawyers to be in the art of negotiation and finding solutions rather than litigating.

So, with that, let me begin this discussion. Jim, if there's one thing you and I have talked about time and time again, it is the frustrations that we have experienced on the regulatory side where we feel we are just not being listened to, and there's no one trying to fully appreciate the pressures and the challenges that are being faced by urban managers.

Can you share with us what Denver's experiences have been?

MR. LOCHHEAD: Sure. I think Secretary Babbitt described it pretty well when he talked about this bottoms up process of water management in the United States and the way it developed, and the kind of anti-Federal view that historically underpins the way we now manage water throughout the U.S.

There's a disconnect between surface water and groundwater. There is a disconnect between land use approvals and water utility development. There's a disconnect in the regulatory environment between Federal, state, and local agencies.

There's a disconnect in political boundaries. John Wesley Powell once proposed that political boundaries be established along river basin lines, which from an economic, social, and environmental standpoint makes a lot of sense.

There's a lack of markets and ability to transfer and move water from place to place based on economic considerations in trading. There's a data disconnect between Federal agencies, local, state, among Federal agencies.

So, as we try to manage our way to water security in the face of population growth, in the face of the warming climate that is going to drastically alter hydrology in the way we deliver water, we face these enormous challenges of our ability to wind our way through the morass.

When we first started on the Colorado River, we were talking about surpluses. The deal that Secretary Babbitt brokered among the Colorado River Basin states was an argument about what to do with surplus water.

No sooner had we concluded that deal that we began the worse drought in the history of the Colorado River, that still exists today and persists today.

I don't think that we ever thought that in our careers we would be dealing with the possibility of a Colorado River compact call or violation or Lake Powell and Lake Mead being at critically low levels.

What we have found, I think, in the advent of climate change and a warming climate is the fact that things are moving much more quickly than we had ever anticipated. They're moving in directions that we don't know where they are going to take us.

The system that we have in place is so vulcanized and layered and siloed that my concern is that we don't have the ability as a country from an infrastructure, development, and maintenance standpoint, to be able to keep up with the challenges that we face with climate change, with growth, and with protection of the environment in the face of that climate change.

An example is a reservoir, dam raise, that we're trying to do at Denver Water that involves taking water from the West Slope of Colorado to the East Slope of Colorado. We began that process in 2002. We're still in the permitting process today.

It's a project in which we actually reached out -- Western Colorado/Eastern Colorado is much like Northern California/Southern California. We love to hate each other. We're at war with each other. Denver Water is the black hat. We are the evil empire on the Western Slope.

What we did was we sat down with Western Colorado and we said how can we move forward with this project in a way that makes the environment and the economy in Western Colorado better with the project than without the project. We went through six years of negotiations. We brokered a deal. We have the support of major environmental groups.

We are through this gauntlet of local, Federal, and state permitting processes, whereby it is a continued handoff from one agency to the other, where you have the U.S. Forest Service, the EPA, the U.S. Army Corps of Engineers, historical societies, state health departments, State Wildlife

Commission, local agencies, all with their own cultures, all with their own separate sets of data, all with their different methodologies of how to approach the permitting process.

I sat down with the U.S. Army Corps of Engineers' Colonel and the local EPA Regional Administrator, and begged them, let's just get all the regulators in the room together from all these Federal agencies, and let's just sort through the debate and manage this permitting process forward.

We can have a robust process, but do it in a more timely way. We sat in the room and literally watched Federal bureaucrats argue with Federal bureaucrats. State bureaucrats argue with Federal bureaucrats. State bureaucrats argue among themselves. It was about methodology, what the right science is, what the right modeling is, and nobody was on the same page.

Secretary Babbitt talked about this common set of data and information, and the ability to have a common platform for regulatory agencies to move through.

We just have to be able, without truncating the necessity for public input and scientific inquiry on impact, to move this process faster, if we are going to meet these challenges of growth in the face of a warming climate.

MS. MULROY: Thank you, Jim. Jennifer, you've been able to do what many have thought was the impossible, and that is actually negotiate a pathway to begin a rational conversation around the Colorado River Delta in Mexico.

It flies in the face of many of the experiences that agencies across the country have had. What was the magic ingredient?

MS. PITT: I think the magic ingredient has been both the curse for the Delta as well as its salvation, and that is sitting as it does at the border of the United States and Mexico, the classic border environmental challenge where our investing legal framework, and actually, Mexico's as well, really don't apply.

It's very hard to consider environmental laws in a border context, so technically, we don't, and I would argue that's why the Colorado River Delta was desiccated for the better part of 50 years. That would never have happened if that Delta was fully inside the United States.

At the same time, when I showed up on the scene, which was getting on 20 years ago, started working on this challenge of how to restore the Delta, we were essentially liberated from having to

work within that legal framework.

We knew that we didn't have the tools of the Endangered Species Act. Actually, some people thought maybe we did and tried to litigate on that topic, and the courts found that the treaty with Mexico actually trumps the ESA in the context of the main stem of the river.

So, we didn't have that legal framework, and I got some great advice from someone who was the assistant secretary after Secretary Babbitt, who said the law of the river on the Colorado is whatever you can get everybody to agree it is, so we set out trying to understand what it was that water managers in the United States and Mexico needed, what their challenges were, and we started to define a solution for the Delta within the context of knowing what water managers were seeking to improve.

So, rather than addressing it in a combative frame, we knew that we had to work through collaboration. We knew that the answer to the Delta was bringing water managers in the U.S. and Mexico closer together, that ultimately we felt those water managers would benefit from that closer relationship because in a climate warmed world with reducing or diminishing supply of water, we are going to need each other more than ever.

So, finding a solution for restoring very modest flows to the Colorado River Delta, to begin a very modest program of habitat restorations, was possible in that context.

It is also true, I would say, that the environmental community has a lot of experience at trying to get decision makers to pay attention to environmental issues, and it's not always those decision makers' top priority, to take the time on those topics. These are busy people with constituencies pressing for many issues, so restoring some forest lands along a river corridor may not be the way they want to spend their day.

As we were able to frame it in the context of the reliability of the reservoir system on the Colorado River, and to frame it in the context of the opportunity to have bi-national investments in water conservation and cooperation in sharing shortages as well as surpluses on the Colorado River, it became something that busy decision makers could take time for.

As I think about this challenge of our regulatory framework, I'm certainly not going to advocate that we need to dismiss that, but rather that we need opportunities to move elsewhere, incentives to bring people together, to look for these solutions, where we really can find common ground if

we take the time to get to know each other's risks and desires. There are really some significant opportunities, I think, that remain for us to make process.

MS. MULROY: So, what I'm hearing you say is shifting from singular goals that are very much in favor of where you're coming from, to actually finding co-equal goals, and pursuing both goals simultaneously.

MS. PITT: I think opportunities to define projects, we are on the cusp of having a big infrastructure discussion in this country, and I certainly hope that includes water infrastructure, and I hope as we get into that conversation that we're not thinking about single purpose projects but rather projects with multiple benefits.

In fact, we are going to need to revisit a lot of our existing infrastructure to consider how it's going to operate in a climate warmed world. We don't have that resilience in a lot of our existing infrastructure.

We need to address water supply reliability for urban communities, for our world communities, our farms and ranches, across the West, as well as for our rivers.

I'm actually quite optimistic that because we really have only just begun this exercise, we have operated as if water was a plentiful resource until quite recently, so we have ample, vast opportunities to do better with that resource as we examine how to share it across these many demands.

MS. MULROY: There is probably no more intractable water problem in the United States than the California Bay Delta. So, where are we, and what hope do you see going forward to find that magic solution?

MR. PATTERSON: I give up. (Laughter) No. Jeff sends his regards, by the way. Jeff and I have been accused of two people, one brain, and he has 80 percent of it.

I've worked around the West, I have worked in 13 different states over my career, and with different agencies and different levels, and maybe we can get into that a little bit.

I would agree that kind of the most complicated and noisiest problem since I've been around is what we call the San Francisco Bay Delta in California. It's really the hub of the water supply. California is one of those states where you have to move water a long way, very similar to Colorado and other places. We move water hundreds of miles to various locations.

It seems like people like to live where the water is not. In my district in Southern California, we have 19 million people within the boundaries of the Metropolitan Water District. The rainfall in San Diego is 12 inches a year, and in Los Angeles, it is 15 inches a year.

In the 1920s, it was pretty clear that economic development in Southern California was going to mean you're going to have to look elsewhere to bring some water in if you are going to field that economic development, and that's really what led to the creation of our agency, the Metropolitan Water District, and that was to come together and bring water into Southern California to supplement local supplies.

The first place was the Colorado River, got the National Guard in Arizona to come out and pay a visit when we went over to put a stake in the river, and actually Bill Parker, they have an aqueduct that goes 242 miles across the desert into Los Angeles.

Later, when Jerry Brown's dad was governor, Metropolitan knew that we needed to continue to supplement it. It was World War I, World War II, and then the Beach Boys, pretty much, caused these waves of people coming into Southern California, a great place to live, great place to work.

They didn't realize water, you take for granted. Our job was to make sure we continued to have the necessary water. Governor Pat Brown basically came down and said we need you to buy half of the state water project that we're going to build.

It took some strong arming by the governor, but Metropolitan ultimately agreed to sign on and buy into and pay for half of the state water project, which was really designed to capture water in Northern California, mostly snow melt, rainfall and snow melt, and move that across, down the Sacramento River, across the Bay Delta, and all the way down into Southern California.

Since the mid-1960s, all of the engineers have known, and if you're just passionate, you know the infrastructure needs to be improved on what it is, if you are going to be able to move water, which is essentially moving it sideways across an estuary that is being farmed.

I tell my people from some other states, I don't get why you guys -- you are one state, why can't you come together and figure this Bay Delta out. You know, you have to come to grips with -- first of all, it's not a delta. Second of all, these are not islands that are in the delta, and what we call levies are not really levies. In other words, nothing is really what you might think it's going to be.

When you go out there -- I know, Pat, you've been out there, it just looks like nothing that you can imagine. We have known for a long time that you can't sustain farming an estuary and shoving water sideways across the estuary into these pumps, it's a dead end, that brings the fisheries with them, and not have issues.

We have talked for years, and in the 1970s and 1980s, about a peripheral canal to shunt some of the water around and restore more natural flows. That went down in a statewide referendum when Jerry Brown was governor the first time.

We are now looking at a smaller, more sophisticated way to move the water consistent with the co-equal goals which our legislature endorsed in 2009, and the co-equal goals are healthy environment and reliable water supply. Most people believe in at least one of those. The problem is getting people to come together.

So, we have spent the better part of 10 years putting together a game plan with fits and starts to improve the infrastructure and improve the environment.

You talk about regulatory, this is kind of the poster child for regulatory issues. The EIS -- in California, for every Federal law, you have to have the companion but yet not exactly the same state law, so we have an Environmental Impact Report, an Environmental Impact Statement, that totals just under 100,000 pages. That is 33 feet if you stacked it, and 18 miles if you wanted to lay it out and read it. (Laughter)

When NEPA first came out, the guidelines said keep things under 300 pages so people can actually look at things and understand what you're talking about and be informed. (Laughter)

MS. MULROY: There's a concept.

MR. PATTERSON: We have a different approach here with pushing 100,000 pages. I will say this, it is coming to a head, we are within probably two or three months of having the final environmental permits, working that now with a new Federal Administration coming in. We're not quite sure exactly how that is going to play out, but we are getting down to the end. The governor is in his last term, and wants to break ground on this project in 2018.

It is a $15 billion project, and unlike any other project I've seen, there is no state or Federal subsidy, 100 percent of a $15 billion piece of infrastructure that is going to be paid for by the

ratepayers of 55 different water districts around the state.

So, this summer, we will be going to all 55 Boards of Directors and asking them if they want to buy in at their share, assuming we get the permits. It's expensive. It's going to add $200 an acre foot to the cost of water throughout most of California.

For somebody like Metropolitan that is selling water for close to $,1000, it's 20 percent, not that big a deal. If you're a farmer paying $100 an acre foot, you're going to go to $300, three times what you are paying now.

Hard decisions, but you couple that decision with the Groundwater Management Act that the Secretary talked about, these are coming to a head, and folks are going to have to decide where do you want to be in 20/30/40 years down the road.

The exciting part is it's coming to a head, and we get to make a decision. (Laughter)

MS. MULROY: So, you remain optimistic.

MR. PATTERSON: That has been the problem of my career. I'm always optimistic. I figure at some point, the adults prevail.

MS. MULROY: I tend to agree with you, Roger. Bret, having been in the BLM, this morning, the newspapers were full of regulatory reversals, and Congress recently reversed one of the latter regulations that the BLM issued on land use planning. What is that all about?

MR. BIRDSONG: Well, there are a couple of things, I guess, and we could think about the regulatory regime now and the instability in it along a number of different lines, but one of the things that has been hitting the news quite a bit, that you are referring to, is the Congressional Review Act, which until recent months was a relatively obscure law passed back in the 1990s, which had only been exercised once.

It allows Congress through a joint resolution and then signed by the president, to basically revoke any rule that has been adopted by an agency within the last 60 legislative days, and we know how Congress works, 60 legislative days actually means about six months or so.

Congress, now that we have Republican control of both Houses and a Republican White House, it has been busy getting some things done through the Congressional Review Act.

Unfortunately, the way the act operates is it is just an extremely blunt tool. So, with

relatively quick action, Congress is able to literally obliterate rules that have been sometimes many, many years in the working.

MS. MULROY: What was the purpose of the Land Use Planning Act? The BLM rule --

MR. BIRDSONG: Which was known as Planning 2.0, one of these that has been caught up. The President hasn't actually signed this revocation yet, although I haven't checked Twitter today. (Laughter) Both Congress and the Senate have sought to do it.

The BLM planning rule, in my view, was something that was relatively modest, and I'm very surprised to see it caught up. What it tried to do was to make some changes about how the BLM conducts land use planning, to enable some of the things we have been talking about, to enable smart management along jurisdictional lines that are not just sort of arbitrarily drawn on a map, but to think about landscape scale planning and management, something that's key, of course, to the water business.

So, it essentially gave more flexibility to the BLM managers to conduct planning for how the land would be managed, so that they can think about ecosystems, so they can think about mitigation of development of impacts in a smart way, informed by science, and on a scale that works for the particular problems.

Now, what surprised me is that's something that is so sensible, to try to do smart planning, really drew such eyers. I think the root of the eyers for this Congress and the folks that are rolling it back is because it is viewed as striking at local autonomy, so even though the BLM is a national agency, the BLM planning process to date has been mostly locally controlled. It's very solicitous of local and state interests.

Those interests, I think, viewed to some extent this greater flexibility as handing their power to the distant bureaucrats in Washington, even though the purpose of it was to enable this sort of smart planning across the landscape for how these work.

So, I think that's part of it, and I think that is something that is going to play out in the water context as well, and we talked about it, particularly with groundwater. How do we take something that has been viewed as local and make pathways for broader regional or national approaches to it.

In terms of the Congressional Review Act, I think one of the most troubling aspects -- we have seen actually other aspects in the water space but not so much water allocation, the stream

protection rule which protects streams from the adverse impacts of mountain top removal mining, also has been obliterated under the Congressional Review Act.

Although it's not eligible because it was enacted more than six months ago, the Waters to the United States rule, which this Administration is going to reconsider. Of course, that has to do with the jurisdiction under the Clean Water Act. That has been a 20-year dispute of regulatory oscillation.

There is just not a lot of certainty in the regulatory context right now.

MS. MULROY: Don't you think part of the problem is the one size fits all approach? What works in Maine by definition has to also work in California? I'm going to be very frank with you. I have my serious issues with Waters of the U.S. I think that East/West dichotomy is one of the real points on Waters of the U.S.

You're going to find a lot of water managers, especially in the Western United States, that look at it as somewhat of a scam.

MR. BIRDSONG: That may be true. It's always popular to attack something under the rubric of one size fits all. I think many of these rules are not as one size fits all as the rhetoric sometimes suggests.

What I think is an interesting theme in this book, and from the experience of the folks up here, is that self-determination is a very, very strong motivator, right? So, where there is regulatory uncertainty, there is an opportunity for deal making that will create the self-determination. That's happened in the delta. It's happened in land management.

I think one of the more durable, I hope it will be durable, things that the BLM accomplished over the last few years was in sage-grouse conservation. The threat there was that the sage-grouse was headed toward listing under the Endangered Species Act. That listing would have caused something of a one size fits all approach of ESA regulation.

MS. MULROY: Which would have devastated agriculture.

MR. BIRDSONG: It would have been very difficult for agriculture, and it turns out that sage-grouse habitat, maybe 70 percent of it is on Federal land, and the rest of it is on lands that are managed by states or private lands subject to state regulations.

So, the success there was that the governors and the Secretary and the BLM got

together, and the Forest Service was involved, too. They figured out a way to have self-determination, to put conservation measures in place that would be not tasty but palatable to the interests, and better than the regulatory default under the Endangered Species Act.

So, it will be interesting to see whether because of that self-determination aspect of it, that's going to be more durable than some of these regulations that are being rolled back under the Congressional Review Act.

MS. MULROY: I think from experience we know the people that have to live with the regulation, and if they helped craft it, will survive.

If we agree that the regulatory process today is somewhat rattled and isn't really responsive, there are some extraordinary examples right here in the D.C. area, you have D.C. Water negotiated a consent decree with the EPA and the DOJ for years, cost them millions of dollars, huge community effort, huge input. They signed the consent decree to be in compliance with the Clean Water Act, and lo and behold, they are ready to implement and along comes the National Park Service who had said nothing through this whole time, and now demands a three year EIS because the project, the Potomac Tunnel, will somehow touch National Park Service land.

As a former water manager and someone who understands that frustration, that's untenable. You just spent years and years negotiating with the Federal Government. Are you telling me that while we are talking to DOJ and EPA the Park Service can't come in and say something? They have to wait until everything is signed, everything is done, to elongate this for another three years?

In the meantime, another Hurricane Sandy, let's say it hits Washington, D.C. in a far more aggressive way than the last one did, causes these combines to overflow. Everyone is going to complain about the environmental impacts and the sewage rolling down the streets of the D.C. area.

Well, somewhere along the line, you have to grab yourself by the head and say this makes no sense. You and I have had this conversation. Isn't it mostly about process?

MR. LOCHHEAD: It is about process, and it's about a way to get the people in the room to find solutions. I talked about the regulatory conundrum that we're in in this permitting process for Denver Water. A possible solution is to come together in an adaptable nimble process that will allow us to meet our regulatory requirements in conjunction with the local community and Federal agencies.

So, what we have is a situation with Federal regulations, state regulations, primarily around temperature and water quality that are premised on specific parameters that are based on the past.

What we know with the warming climate is that the future is not going to look like the past. We have these rigid regulatory structures that are going to hamstring us in terms of being able to comply, and we have these processes whereby we can spend years litigating and arguing about who is right and who is wrong in terms of their modeling about the impacts, and in the meantime, the environment is suffering.

So, what we did in our process was we established a forum called Learning By Doing, and what we did is we invited Denver Water as the regulated entity, the local community, the local county, environmental groups, the U.S. Forest Service and other Federal agencies into a process whereby we all agreed that the future isn't going to look like the past, that we need to start doing something now to improve the aquatic environment today, to set the stage for the operation of this project.

We put the flexibility of the operation of our system on the table. We put money on the table. We began this process, it's an iterative process, whereby every single week there's a meeting by phone or in person to look at what's happening in the aquatic environment below our project, and how can we make adjustments.

One of the rules is that nobody gets the blame for causing a problem. The problem exists, and the group is charged with finding a solution on the ground to the particular problem. So, we avoid the arguments about who is in violation of a permit. It's a solution oriented process that's flexible, that's adaptable, that is going to meet those changing needs.

Now, that kind of blows the minds of the Federal regulators. They don't quite know what to do with this thing that we have created and how to incorporate that into a permit to make it a durable requirement.

We would have a contractual obligation with the local community and everyone involved that we are there essentially forever, which is another paradigm shift because usually in a project setting, the regulated entity builds the projects, they meet their permit requirements, and then they essentially walk away and they operate according to those permit requirements, and that may or may not solve the

ultimate problem.

The difference here is that from Denver Water's perspective, we're in it forever in terms of continually managing our project to meet these aquatic challenges that we face. So, we're not walking away from our obligations to the environment on this project.

I think that is one possible solution to the competing regulatory environment and also the rigidity of the Federal and state regulations in the face of climate change.

MS. MULROY: So, the key is recognizing that in any point in time, you're never going to have enough data and enough comfort about what lies ahead to make a permanent decision forever moving forward, recognizing that it's very much bracketed by time and how things evolve.

So, what becomes permanent is the process rather than "approval" or the specifics of how the pieces fit together.

MR. LOCHHEAD: Exactly.

MR. BIRDSONG: One of the impediments, right, is that the Federal environmental laws tend not to be based around that approach. They are based around an approach of let's do a study, let's predict what's going to happen, and then make a decision and move on.

What we have learned, right, over the last 40 years is well, first of all, our predictions are very often wrong.

MS. MULROY: Most times.

MR. BIRDSONG: That's right. More wrong than right in a lot of instances. To make changes along the way after the fact runs the risk of triggering the whole review process again. I think in terms of looking forward for positive legal reform, figuring out how to do adaptive management with NEPA and the Endangered Species Act is a really key issue, and conservation planning, I think, goes some distance towards that, but probably not far enough as we have seen it.

MS. MULROY: Well, the nimbler way to do it would be through regulatory changes, and re-definitions of what certain things mean. To the extent that you can avoid the sausage making process, the better off you're going to be.

Roger?

MR. PATTERSON: I wanted to talk a little bit about groundwater regulation and the

experience I had, it kind of bolsters your confidence, I think, that you can put a regulatory scheme together and people will make it work, and this is when I was in Nebraska.

The story of water is it saw no problem before its time, right? That is sort of what we do.

When I was Director of Water Resources and the Director of Natural Resources, we had a couple of lawsuits that involved the connectivity of groundwater and surface water. Our legal position when I went back there was well, the groundwater is not connected to the river. That's what our Attorney General was telling the Special Master for the Supreme Court. I talked to the governor, I said, you know, governor, that's wrong, right? Well, yeah. He was a water lawyer.

We have some groundwater laws in the state but they didn't really get at managing groundwater for more than what you do to your neighbors, but actually, if you are depleting a river, it may be 200 to 300 miles away from you and outside of your political boundary where the actual impacts are occurring.

The legislature had put together a group of about 50 interests, including the legislature, and I co-chaired with the chair of Natural Resources, to basically look at how we needed to restructure our groundwater laws.

Two-thirds -- we could look to Texas and Oklahoma and we could see what was happening in the Ogallala Aquifer, and it's a 3-billion-acre aquifer, and two-thirds of it was under Nebraska.

For a lot of these folks, and particularly these farmers, were we don't want to do that here. Well, if we keep doing what we are doing, that's exactly what's going to happen.

We put this group together. We had a professional facilitator. It probably took us six months to answer the question of whether we wanted to be sustainable or mine. We had 500 years' worth of mining. Of course, the easy high road is well, we want to be sustainable, my kids, my grandkids, et cetera.

Six months after that decision was made, and it really started to land, well, if we are going to be sustainable, what does that mean. That means we're going to have to measure all of our groundwater, have meters on every well. We're going to have to have allocations of how much water you can use, and in some cases, we have already overdeveloped local areas, and we have to back up the

train, which means we have to reduce our use.

Immediately, it was back to the first question, oh, we can't do that. Well, did we answer the first question wrong, do we want to mine.

Anyway, at the end of the day, we came up with a scheme, and it really -- locals want to be in control, but they usually know if there's a problem, so I was at the state level, it was a local resource, we want to manage it, and a couple of these local managers said we need the state to take over the decision making. Really? Why would you do that? You guys want to be in control.

What they really meant is what we need the state to do is tell us you're maxed out on the amount of development in any particular area, and then you let us figure out what to do. That was really the balance that we struck, every year I would look at the entire state, look at the basins, and say you're done, and the day I said you were done, you couldn't drill another well, not another well until the locals had their management plans in place.

So, there is a lot of incentive for them to do it, to do it in a way that worked with their neighbors, and now they could go to the grocery store and look their neighbors in the eye because we are setting something up, where before they knew we need to stop development, but they would have to make the decision themselves and they couldn't do it.

It was really kind of a heartening way of looking at a regulatory scheme that people bought into, and could get behind as opposed to I knew what they needed to do on day one, but if I had told them that, we would have gotten nowhere.

MS. PITT: I guess I wanted to reflect a little bit on where the environmental community has been at trying to address river health. When I came into this business, we had 19th century laws and 20th century infrastructure and 21st century water needs, but there is nothing we can do about it because that law is established. There are property rights that are derived from that law, and it is essentially an immobile system.

I think there is a legacy through the second half of the 20th century, certainly, of a lot of people asking for change in the health of our rivers, and not seeing that accomplished.

What I observe different today is that the challenge to the status quo of water management and this regulatory framework is not coming from us, it's coming from a physical reality, and

water manager, the state agencies, the local agencies, are at the point of saying we need to change the rules of the game if we want a resilient and reliable water supply.

I think the key for the environmental community at this point is to have a seat at that table, to work side by side with the people who are charged with ensuring that water delivery is successful to their communities, but to then bring to that discussion the opportunity to look for improvements in river health to support actually a huge economy that has been in the West around tourism and recreation, and I don't think we have ample polling data that shows that the public is behind us on this.

What is really interesting about this moment is that we actually have an opportunity. I think we all are in agreement that changes need to be made. So, the challenge is ours now to sit together and figure out how to maximize the benefits that come from those changes.

I give kudos to the water managers sitting around me here on this stage because you have all been leaders in opening up the door to the backroom where the water deals get made, and letting some new interest in, and that has made a huge difference.

MS. MULROY: Thank you, Jennifer. With that, I probably should open it up for questions from the audience, and engage you in this conversation we could continue having for the next six hours.

Yes, sir?

MR. HEAVELY: Steven Heavely from San Diego, just moved here, worked on water issues there. So, we are talking about a bigger picture scenario than very local level stuff. In Southern California, especially on the coast, a lot of environmental groups that are against desalination as a portion of new water supply.

I wanted to ask if there is maybe a scenario down the road where environmental groups in the West see desalination, along with other conservation and water recycling, as a source of water to reduce impacts on the Colorado River, and even to a certain extent, the Bay Delta in San Francisco.

MS. MULROY: Before we answer the question, the format that I've been asked to follow is that we ask three questions, and then we will take answers for all three questions at the same time.

There's another gentleman back there, if you will tell us your name.

MR. DORCHESS: Hello. I want to thank you for a very interesting discussion. My name is Vlad Dorchess. I am the Desk Officer for Water at OIRA, the Office of Information and Regulatory

Affairs. A couple of things. First of all, I think tension between Federal, state, and local interests is very real, so with that in mind and also given Executive Order 13711, a question for you.

Setting aside Lotus, which has its own set of issues, and working within some of the legal constraints that were mentioned, such as ESA and NEPA, which unless they are changed, they are the rules of the road under the law, are there recommendations given some of the challenges, the need for change that you have mentioned, opportunities to save burden on the public? That some of the agencies can do it at a Federal level that you would like to recommend some things that should be considered by the agencies.

MS. MULROY: Yes, sir?

MR. BYRD: Yes, good morning, John Byrd with MAPPS, the Association of Mapping and Geospatial Firms and International Society of Professional Surveyors.

I wanted to comment on Jennifer's point about take a look at water projects for multiple uses instead of single purpose infrastructure projects. There is a program in the United States Geological Survey called the "3-D Elevation Program," 3DEP. You may have heard of this. They use nationwide elevation data collection using LIDAR technology, including IfSAR Alaska.

Just trying to identify through their broad agency agreement, a BAA, for state and local government opportunities to put in project opportunities for Federal funding, that way you have the state and local approach asking for Federal funding help.

Can you all talk about those kinds of experiences where you have had the opportunity to leverage Federal leadership and funding to work on state and local projects connected to water infrastructure? Thank you.

MS. MULROY: Let's start with the question around desalination. Jennifer, that one was thrown right in your lap. (Laughter)

MS. PITT: I'm not a desal expert, but to the extent I have looked at it, I think there are some challenges around the cost. It is a rare community that has actually decided they are ready to pay that much, which is not to say there aren't any, but it is still not wildly popular because as I mentioned earlier, we have really just begun the exercise of seeing how we can stretch our water resource further. There are a lot of cheaper alternatives at the moment to desal.

I think another challenge that you see in Southern California is that Californians love their coast line, and it is where property values are highest. So, siting is a tremendous challenge. Then there are challenges that conservation groups raise about entrapments of species up the intake pipes, about mixing concerns about the brine and waste discharge on the coast.

I think there are probably technical fixes where if you spend the money and you invest in infrastructure right, you can overcome some of those marine ecosystem challenges. Again, I'm not an expert, but that is my understanding.

I think perhaps the biggest barriers remain in the cost and the siting issues, and people's perspectives on those issues will change over time as the water scarcity challenge changes over time.

For people who are interested, I commend a report produced -- I don't remember the title of it -- Pacific Institute, which is based in Oakland, produced a report on desal that really does go through many of these issues quite comprehensively.

MS. MULROY: Did that answer your question?

The other gentleman asked about recommendations for the Federal regulators. Who wants to take that? Jim?

MR. LOCHHEAD: Well, I think maybe the theme here is that the solutions are more on the ground. It's a great talking point to take a meat axe to Federal regulations, and it reflects a lot of frustration that people in this country feel about the Federal Government in general.

Regardless of what those regulatory structures say, the action is on the ground where those impacts are occurring, and I think from a process standpoint, President Obama tried an accelerated process for infrastructure projects. I've experienced a number of projects where with the right level of Federal, state, and local leadership, things are able to move forward, and I believe at the Federal level, if there is real leadership that is encouraging the agencies to move forward to move things, and that is being enforced, that we can work without getting hung up in the debate about what regulations are going to go away and how they are going to be changed.

It goes back to this learning by doing concept. Lotus has been around for many, many years. It's going to continue to be litigated and debated and talked about, and in the meantime, we just kind of sit and wait.

On the ground, we need to be moving forward. I think from a Federal agency standpoint, leadership needs to be there to act in the right way, to be a motivator, as Secretary Babbitt said. We need governors to be able to get their state agencies in line to move forward, and we need local agencies that are willing to step up and innovate, and be part of innovative solutions to move infrastructure projects forward in an environmentally responsible way.

MS. MULROY: In many ways, aren't some of these regulatory difficulties also huge barriers to incorporating state-of-the-art technologies and encouraging the development of that next generation of technological innovation?

Because we jump right to no, and right to well, what if, and can't find a pathway. I guess I've always felt that kind of technological innovation, you know, that is beginning to emerge in areas like Denver, Las Vegas, and in California, is what the future is about.

MR. LOCHHEAD: As a utility, we're risk adverse, right? We deal with public health. Failure is not an option for a water utility dealing with public health. Flint is the perfect example.

It's not as though we are looking to push the envelope in that regard. We want rigorous research. We want tested/proven methodologies, and we're not going to be on the leading edge of new technologies, and that is just the definition of a water utility.

At the same time, the reality is we need to be working toward solutions that promote total water efficiency within the urban water cycle, and using the right quality water for the right purpose, whether it is storm water, recycled water, whether it is reused, desal. Those are the solutions that in today's reality we're going to be looking at.

We need the regulators to be working with us to look at technologies that are frankly used all over the world, but which we struggle with to implement in the U.S.

MS. MULROY: The last question was around multipurpose use projects, how do we leverage that.

MR. PATTERSON: I wanted to respond a little bit to the data and the partnership with the Feds on that. We spend about probably $30 million a year collecting data. We have so much data we don't know what to do with it. That is part of the problem. It's like my 100,000 pages. You just get overwhelmed with it. A large part of that is collected by the USGS, by Fish and Wildlife Service, Bureau

of Reclamation, all the state agencies.

One thing I like about working at Met, we have a lot of resources and we have a lot of really smart people, and this one guy that works for me, three years ago he says we need to get an app that can sort through all this data and pull out what's important to us on any given day and put it in front of the whole group.

This is really bizarre. The Secretary talked about it. We actually every day have to make decisions on what's going on in the delta depending on how much flow is coming in, what do the pumping rates need to be, where are the fish. Every morning, including this morning, the first thing I look at is did we kill any fish yesterday, did we kill a delta smelt yesterday. The answer is no, today. It's a good day.

My guys and this consultant, they put together -- it is called Bay-Delta Live, I have it on my iPhone, you can get it, what we started to do was the folks before would come and say, well, you know, we saw something, but they didn't have the data and we don't even know if they really saw that you guys need to reduce pumping for whatever reason.

That evolved into let's start getting the data on the table, but a lot of it, well, it's not QA/QC checked yet, I'm using it today but you won't see it for six months.

We finally have broken through the barrier where as this data comes in, we are doing all these special surveys, we have three boats out there every day looking for fish, doing whatever, the next day we get the data, it integrates into Bay-Delta Live, and it is in front of everybody that has a dog in the fight, so to speak, and making the decision on what we are going to do on any given day.

It didn't cost a lot of money for the Feds. They spend a ton of money collecting the data, but we were able to take that and now they are very comfortable, they are using it.

Just one of those partnerships to take it and figure out in all of the stuff that's out there, what do you really need to know to make the decision, and can you get it in a Dashboard so somebody like me can look at it and go, well, it's pretty obvious, we're fine, the fish are way over there.
It's not as easy as that, but it's been a good partnership on that.

MS. MULROY: That kind of big data would also allow for those multiuse projects, right? I have often felt that as part of the solution for the challenge of paying for this new infrastructure that we all need because many urban systems are decaying, we start looking in larger swaths, and we start

thinking multi-jurisdictionally when we talk about building infrastructure. (a) your environmental footprint is that much smaller, and (b) it makes you that much more resilient to what climate change may bring us.

Comments?

MR. LOCHHEAD: I think the idea of data as support for decision making is really critical on a real-time basis. If we're going to be responsive on a daily basis in terms of protecting aquatic resources, watershed health, providing water for recreation, the idea of having data and decision support systems to inform those decisions is critical, and because as a water utility, we're not a single purpose agency.

We move water when there's a kayak festival, and we can supply water for a kayak festival, or if the fishing conditions aren't exactly perfect, we will move some water if we can do that.

We are in the process of buying water to move it through the urban reach in the middle of Denver to establish a gold medal fishery in the heart of Denver.

So, as a water utility, the health and sustainability of the aquatic systems and the watersheds is critical to our ability to keep doing this job 100 years from now. Data and decision support systems and the kinds of things Roger has are absolutely critical to make those real-time decisions about how we meet the needs of our customers, but also when we have these opportunities to promote watershed and aquatic health.

MS. PITT: I want to address the question a little differently, just on the observation that it still depends on how you look at those data, if you are local only in your focus, you will define your problem as within your local area.

I have found that if we have all found better pathways to bigger solutions, the bigger we have to find our problem area. Yet, I understand that if you're looking at your backyard and have those very local concerns, that is maybe not satisfactory.

But I do think it is something, you know, water resource management is particularly driven by, which is the fact that certainly in a basin like the Colorado River Basin, we are all in it together. We share in this resource, so if we can look at those data across a large watershed, then it drives us to solutions that might not otherwise be available.

MR. BIRDSONG: That has certainly played in in Las Vegas, right? It's only knowing

where the efficiencies can be gained in the system that Southern Nevada Water Authority can pay for drought two, or we can have the lining of the All- American Canal and know what water can be gained and how that's going to affect levels in Lake Mead.

So, I think that's a good example of how data across a broader system can help even the local decision makers meet their parochial needs.

MS. MULROY: Do we have some more questions out there? Yes, sir?

QUESTIONER: Do we need to create more water in the sense of further removals of our wastewater systems, publicly owned treatment plants?

MS. MULROY: What do you mean by "further removals?" You can take wastewater and turn it into distilled water.

QUESTIONER: Right, but as a nationwide policy --

MS. MULROY: You mean more applications of it?

QUESTIONER: So you can have more applications of it. We're kind of stuck at secondary treatment in a way. There are individual watersheds and wastewater utilities that have to remove more, but with population growth, don't we need to remove a lot more, and don't we need to find ways to pay for that?

MS. MULROY: Your name was?

MR. WEAVER: Bob Weaver.

MS. MULROY: Thank you. Yes, in the very back.

MR. WARNER: Thank you. I'm Jack Warner with Climate Institute. I wanted to see how private ownership of water factors into your decisions. I know in Colorado at one time you were able to own water as a mineral right on your property, and that law got changed. I think from what I understand down in California, there is a lot of private ownership of water, as it goes through all the agricultural areas of California, that some of the owners down there actually own how that water gets brought in and flows through to the different orchards and everything.

I just wanted to see how that factors into your decisions and whether you support private ownership, having folks the ability to own, drill their own wells on their property and so forth.

MS. MULROY: And one more. Chris?

QUESTIONER: A question about the proliferation of agencies. I think in California, you have about 5,000 water agencies. I think it was suggested that you might want to have another 3,000 as a result of the sort of groundwater regulation.

You are talking about going to the Federal level as well. It seems that one could end up with quite an enormous system.

MS. MULROY: If you give them a chance, I'm sure we can find one. That was a snide comment. Let's start with reuse and applying reuse more broadly.

MR. PATTERSON: Thanks for the question. When he asked, he already knew the answer. The answer is we do need to expand the reuse of wastewater, and we need to take it to a higher level. We're doing a lot of that in California, but particularly when you're the last guy in the system, and after you use it, you dump it in the ocean, my feeling is you have an obligation to put that to use if you can.

Our Board at Metropolitan just authorized us to run a pilot on a huge wastewater reuse plant that would be South of LAX. It would be twice as big as anything that's ever been done, 150 MGD.

Incredibly expensive, less than desal, probably in the end. By the time, if the Board authorizes the entire project, we get there, we know we can clean it up to drinking water level standards. Will we be able to do that at the time? Maybe not. We may have to do what we do now, take the wastewater, clean it up to basically drinking water level, put it in an aquifer, pump it out and reuse it.

That's essentially what we're doing now. We are going to continue to do that. There is a strong push to look at now we can put it in a small reservoir, if you have a certain amount of retention time before you pump it out and use it, so we're getting closer and closer to direct potable reuse.

That is a key part of our water supply future. We're still growing 150,000 people a year in our district, so that means in 10 years you have another 1.5 million people that we have to provide water to. We know we're going to have to do that through local water supply development, so wastewater reuse, another desal plant or two. There is the new one that just came on at Carlsbad. It's part of the portfolio, I think a pretty small part.

We'll continue to do those things, so when 1.5 million people show up, we will be able to meet their water supply needs and not be looking at either the Colorado or the Bay Delta for additional

supplies.

MS. MULROY: I think you said something very important that often gets missed in the reuse conversation, location, location, location. Especially in the West, one man's water supply is another man's reuse. So, you break that chain upstream at the head of the ditch, and you start creating a cascading problem downstream. So, location, location, location.

It's one of those where having a larger regional conversation about doing it becomes really important. If all of a sudden the West Slope of Colorado became addicted to rain barrels, the lower basin could have a heart attack.

MR. PATTERSON: One-hundred percent, and it does depend on where you are because your return flow is the next person's water supply, absolutely. Like I say, when you're the last one to use it and dump it in the ocean, you get no argument that you have essentially a moral responsibility to see if you can put that back to use.

When I worked at the Bureau of Reclamation, we had the Title XVI Wastewater Reuse Program, and I'd have people like Sacramento come in, you know, you're a low priority because your return flows now are feeding the delta which feeds the delta outflow which feeds -- it totally depends on where you are and who should be making those investments, which are not inexpensive.

MS. MULROY: From a regulatory perspective, what is intriguing to me, it's where the Clean Water Act meets the Safe Drinking Water Act, which is a brand-new territory for those of us who live in the regulatory space. That overlap is incredibly important.

Jennifer?

MS. PITT: Just a quick comment on the ideal situation of the Southern Californians to be working on reuse, which last week I picked up a small news press that Stone Brewing has made their vats of beer using recycled water. Kudos to the Southern Californians.

MR. BIRDSONG: Toilet to tap.

MR. PATTERSON: Flower to flower.

MS. MULROY: On that note, those kinds of things are not helpful. (Laughter). Private ownership, is that factored in, especially in Colorado. You're the water lawyer.

MR. LOCHHEAD: The West prides themselves on private ownership of water, a water

right is a private property right protected by the Constitution in every Western state. California is a little bit of an anomaly there.

It is embedded in social, political, legal doctrine in the West about private ownership. It is both a blessing and a curse. It's a blessing in that we know where the water is, we are measuring it. Colorado, in particular, is fully integrated from a groundwater/surface water supply.

For example, if Denver wanted to promote the one water concept of really efficiently managing our water resources through the whole urban water cycle, we have these downstream farmers that are raising a fit. It's illegal to capture rain in Colorado, because rain coming from the sky is the property of Colorado, and it is subject to the appropriation doctrine.

It limits our flexibility. The other problem is right now, mostly in the West, we lack the ability to develop innovative solutions between agriculture and urban water users in terms of moving water from one sector to another and being more drought resistant as a whole between the agriculture and urban sector.

We have this dynamic that we call "buy and dry," where municipalities, it is much easier to go to a farmer and basically say I'm just going to buy your water, and I will lease it back to you until I need it, but when I need it, you are going to dry your farm up and that's done.

We don't have the ability to have innovative market solutions that the market is frankly asking for. Agricultural producers are asking for the ability to deal with this private property right that they own, that they can tap into, to keep their businesses going for both themselves and their kids and their grandkids, and sustain a rural economy and a society that's incredibly important in America.

So, as I said, it's both a blessing and a curse as to how we deal with that. We have to find a way to recognize the private property nature of water rights in the West but also open up markets and the ability to transact in innovative ways. There is a lot of political and legal resistance to doing that.

MS. MULROY: It also butts its head against use it or lose it.

MR. LOCHHEAD: Right.

MS. MULROY: That's where it becomes even more complicated. If you don't use your water right, it is such a disincentive to conservation, it's such a disincentive to cooperation, and it is something that has been long overdue and needs to be looked at in the West.

MR. PATTERSON: Pat, one thing that I have learned since I have been with Metropolitan, Metropolitan has some pretty creative partnerships with some of the farmers. When I worked in Colorado, I was pretty familiar, and that was more the way. You go out and buy a piece of farm land and you essentially strip the water off it.

Metropolitan has three programs. One, where we spent money to improve the efficiency of the delivery system, and then we can share the gain and the returns there were going to a non-beneficial use location, it actually fit. We get 105,000 acre feet a year through that kind of a system.

We have another one with Palo Verde where it is a voluntary program with the farmers, and essentially, we made a payment to them to enlist in a following program. When we call for the water, they will actually make that water available to Metropolitan.

We pay them an additional fee at the time we make the payment, and it's a really good program, 35-year program. We essentially pay them the value of the land when they sign up, and then we pay them a pretty nice annual fee when they do it. It really works for the ag guys. For us, it's $200 an acre foot of water. It's really inexpensive.

Depending on which end you look, we both think we're getting a good deal. They were worried about impacts on the local economy, so we put a few million dollars into a local fund that they managed. You know, they would build a taco shop and a tire store and a few other things over in the community. They still have a lot of the money left, they did a good job.

Last summer, with some other farmers downstream, we're doing a follow-on program, it is kind of a stressing program where if they don't farm or don't irrigate at the hottest part of the year, which is when their yields are the lowest, but their water use is the highest, we will pay them not to do that. We will take that bit of water. They love it. They want to expand the program now and create two different sign up periods for this coming year.

It's a way for them to hang on to their legal use of the water, get some economic income out of it. That part, they only do a portion of what they have, so that part, they can count on. They know how much money they're going to bring in, and then as commodity prices bounce around here and there, this is kind of the stability piece of it, and that's the way they pay to go to Hawaii.

MS. MULROY: But the price difference between those kinds of approaches and what the

price of desalted water is are still phenomenal. You're talking $200 versus $2,400 an acre foot.

MR. PATTERSON: Exactly.

MS. MULROY: That is a huge differential, and as someone who knows how painful water rates are and manipulating and raising water rates are, that's not an insignificant conversation to have.

MS. PITT: Just some quick comments on the private property rights aspect of water management in the West, which is that the conservation community has embraced that as a way that we have to work. That is half of the system in Colorado. The state has an instream flow program. The state has to hold the rights, but essentially acquires property rights of those flows and manages them instream for the benefit of river health.

Similarly, in Mexico, a group of conservation organizations established a private water trust in the water market, and has acquired water rights, and has begun delivering them to habitat areas to support habitat restoration.

We find ways to work with that as well.

MR. BIRDSONG: Along those lines, I think it is important that one of the points is the private property right in water developed historically without any thought to environmental benefits of water, so it is a retrofit to think about our water right system and to recognize these instream flows as property rights.

The other thing is in the ag to urban transfer, there is an opportunity also to benefit the environment, to make up for lost time, right?

As we think about the right to use, which is the private property right in water, the right to use it in a particular place, in a particular way, and there are other people who are dependent on how it is used, because they get the return flows or whatever, but when there are ag to urban transfers or efficiency improvements in the system by urban areas paying for the farmers to improve their efficiency, one opportunity for the environment is to take a piece of the action and dedicate it back to the environment.

MS. PITT: Absolutely. Depending on where that transaction takes place in the system, if the new use is downstream from the old use, there is an opportunity to manage the flows that are now

going to a downstream user.

Particularly as basins in the Colorado systems consider improving the reliability of the supply at Lake Pell, that protects all the water users in the Upper Basin, we have an enormous opportunity to look at how that water is delivered downstream to Pell, and a double win in terms of river health at the same time.

MR. PATTERSON: In the last three years, Metropolitan and some other users have acquired some water on the Stanshaw River, and we worked with our NGO friends and the fish agencies, and essentially we said we're going to get 100,000 acre feet of water, you schedule it, you guys schedule it however you want, as long as we can pick it up and make use of it, you can use it for attraction flows, you can use it for migration.

It worked great. They were doing cartwheels because this was during the drought when there was very little water available to meet some of the fishery needs.

You don't think of those on your own, if you are just the utility manager maybe, but the more you broaden the conversation, as Jennifer said earlier, it's like it cost us absolutely nothing, and it was a tremendous win.

MS. MULROY: It gets right back down to having sufficient infrastructure to be able to be that flexible. That requires a reservoir capacity, that requires a pipe capacity. There are pieces that make that or break that.

I think that brings us full circle back to the whole infrastructure dilemma that this country is facing, and the impediments that are in its way.

I got the time signal. I think this is an appropriate time to say thank you to our panel members here. We will take a short 15-minute break, and we will be back for an international discussion. Thank you. (Applause)

(Recess)

MS. GROSS: As Pat mentioned as she was going, the second panel is about international issues pertaining to water, international challenges. A particular issue that comes up again and again and it came up in the last panel and you'll hear it again in this panel, is the dual role that water plays. It is both a human and ecological necessity. But it is also a finite economic good that there's a

business around and that people often need to pay for. So, you hear these issues come up again and again when we talk about the dual roles of water.

On top of this fundamental dichotomy, you add transporter issues, some of which make the Colorado problem we talked about this morning look like a piece cake. You talk about changing water availability in light of climate change and you also have crumbling or even nonexistent water and waste water infrastructure in many parts of the world.

So, each of my four panelists have unique and interesting expertise in international water areas. So, this should be a super interesting discussion. I'll start by doing a brief introduction. To my immediate left is Chris Gasson. He's the publisher of Global Water Intelligence, a publication that many of you are probably familiar with, with tracks major water products around the world and focuses on water industry strategy. Next, we have Kumud Acharya who is research professor at the Desert Research Institute in Las Vegas, Nevada. This is a center with extensive expertise in hydrology and water resources scholarship. Next, we have Betsy Otto. She's the global director of the water program at the World Resources Institute where she works to engage business, NGO and governments for positive change in water resource management. Finally, at the far end, we have Vanda Felbab-Brown. She's a senior fellow in the Center for 21st Century Security and Intelligence here at Brookings. She's an expert in nontraditional security threats including insurgency, organized crime and elicit economies. Her most recent work is on water theft and water smuggling. I should also introduce myself. I'm Samantha Gross. I'm a fellow in the foreign policy program at Brookings and you're moderator for the next hour.

I'd like to start the program and turn it over to Chris. We'll take about five minutes of opening statements from everyone so you can get to know their expertise a bit. We'll have a little discussion here at the front and then we'll open it up to discussion from the audience. So, let's start with Chris.

MR. GASSON: So, I thought I'd talk today a little bit about a project I was actually working on with the World Economic Forum with Pat. This is the Global Agenda Council on Water. We were given the job by the World Economic Forum to come up with some new model for water access. How could we get the billions of people who don't have access to safe drinking water and include sanitation. How can we accelerate change in that situation.

I suppose the way we started was we started by saying, what do we spend on water at the moment and is that money well spent and what is the cost of water. And is there a value to capture that could potentially make the thing more affordable.

So, we started to add up what people outside the advanced economies spend on water and sanitation. We came up with a figure of something like $241 billion on utility services, $154 billion on household sanitation, that's wash stands and toilets and so forth. And then we started looking at the other non-monetary costs such as the time wasted and if you're doing open defecation, you've got to get out there once a day into the fields or whatever and that takes a lot more time.

Similarly, if you've got to fetch water from outside the house, what is the value of that. We calculated this on the basis of some 30 percent of the average GDP per hour. And that came up with $132 billion. Then we looked at the cost of bad health, i.e. both a burden on health services around the world as well as the cost of time taken off work to tend to sick children and so forth and that was $71 billion.

And finally, we looked at the costs incurred on people as a result of coping with bad water. That means treating the water in the home rather than relying on treated water being provided by utilities which was $52 billion. Buying bottled water. I mean, in a lot of places, bottled water is a lifestyle to purchase but it is also the only, in some parts of the world, you can actually get a safe source of drinkable water and that is a $58 billion. Tanker deliveries, if you can't rely on the utility to deliver all the time, that's $7 billion and $3.7 billion spent on storing water in the home. That's tanks on the roof and other plumbing systems.

The interesting thing we came up with was that the total amount of what you might call the unnecessary cost of water. That is the time wasted, the health costs, the coping costs. That more or less adds up to the amount of money that you'd have to spend if you were going to give everyone 24/7 potable water plus a sewer connection with waste water treatment. So, there is something to play with there, i.e., actually if people don't pay for water it actually costs more if you don't have a viable utility system. People end up spending more on it either in terms of their health or on in terms of bottled water of point of use treatment and so forth.

So, we've been looking at ways that we can sort of change things around so that that

value can be captured and we can get everyone serviced. I think that there are a number of ideas that we came up with. A lot to do with decentralized systems particularly on the waste water side and on the drinking water side, somewhere between a pump in the yard and a proper utility system. It may be micro utilities.

I think the central part of all of this is the idea that it has to start with a social contract. Unless people come together to solve water, it will individually cost a lot more. And this is the final point I'll make in an American context. Looking at this data, the coping costs of bad service, that's bottled water point of use. Those are rising in the developing world at about twice the rate of spending on utility services. In the U.S. however, the rate of spending on bottled water and point of use treatment systems and all these things, is rising at four times the rate of the utility spending.

What are we doing to look like, what will the industry in this country look like in 20 years' time if individuals are working with their feet. They're saying we don't trust the utilities, we're going to look after this ourselves and we're not going to invest in the utilities improving themselves because we don't believe that they can.

MS. GROSS: A lot to think about in that statement. I'd to pass it on next to Kumud.

MR. ACHARYA: That's Samantha. While I was here, some of my experiences on global water scarcity and economics that I've dealt with and seen first-hand, I'll talk about a few places that I've seen that.

The first one is there is a reason in Indonesia called Gunung Guido which is about two hours' drive from Yogyakarta which is one of the largest cities in Indonesia. There is this huge community and a lot of small villages. They don't have a drinking water supply there and their geology is not very good. It is a course system so they don't have any ground water. All the rain they get, everything goes to the ocean.

People there are very obviously very poor. What they have to do, the only way for them to have some water is to store rain water that falls in winter and then keep it for the summer. If you go around those villages, you'll see the small tanks and almost every house will have a small tank, but that water is not enough. So, what they have to end up doing in summer is they have to actually sell their cattle to buy a tanker full of drinking water. That's one situation.

I've been working in China for about ten years on a lake called Lake Taihu which is one of the largest lakes, shallow water, shallow lakes in China. Its average depth is only about two meters deep. The lake is fairly large, it is 2300 square kilometers in size. There are over 50 million people in the watershed of that one single lake. That supplies drinking water for 20 million people. That is the area of China, there's been a lot of economic activities in that area. It's (inaudible) in Shanghai. There are a lot of cities like Ocee, Suzhou and all those cities that are growing very rapidly. And because of all those rapid growth and urbanization and all the pollutions from all the industry and people moving into that area, all this in runoff over the last 30 to 40 years getting into the lake. The lake is one of the most polluted lakes in the world.

In 2007, they had a massive outbreak of algae boom in that lake. Since the lake supplies drinking water for 20 million people, there is city nearby called Ocee city. At that time, the population of that city was only 5 million but not it is 7 million in ten years. People woke up in the morning, they opened their tap water and it was all smelly tap water. The tripping system couldn't handle that overwhelming algae boom in that system. The whole city ran out of bottled water within a few hours. People were very, very angry and upset as you can imagine. I met with the minister of water sources in China and all these people that say, okay what does it take us to fix this. I said, you can't fix it with money. It is going to take -- this lake is only two meters deep. In some places, the sediments are five meters deep, all the sediments coming from the watershed. So, the challenge is so big that it is going to take 30, 40, 50 years are very, very hard work.

Let me tell you one more example. About a year ago, a dairy industry in UAE, United Arab Emirates, contacted me and they said it is the largest dairy industry in UAE. There were over 12,000 cattle. They said, we have a big problem. We're running out of our water and we get our water from ground water, obviously, and that industry was only established in 1989. So, they started drawing ground water and now the ground water table has gone down from 30 meters to 100 meters in about 20 to 25 years. And the TDS in the water has tripled. So, they've been using that water and really in the next ten years, they'll have no ground water. That industry cannot survive without ground water or without a substantial amount of water coming. And UAE has desalination covers nearly 70 percent of their water needs. That's very expensive. Even the ground water they take out so they use RO system before they

use that and the RO system you can only use about 70 percent to 30 percent. They don't know what to do with the water. The disposal is very expensive. So, they want new technologies to dispose that.

So, these are the challenges that I've seen around. Obviously with challenges come opportunities but right now the challenges seem huge. I was born and raised in Nepal and I've seen 60 to 70 percent of the people in the country I was born, they still don't have a clean drinking water supply. In remote areas of Nepal, people actually have to walk miles to get a bucket full of water, still. And this is usually done by women. It is culturally that the women are the people who basically cook and prepare everything. The men are out in the field working. The challenges are just huge and tremendous and I think there is a lot of soul searching a lot of technological advances needed.

MS. GROSS: Even more to think about. Betsy, would you like to add to this somewhat challenging conversation.

MS. OTTO: Sure. Just to continue giving maybe the global context, international context. First of all, for those of you that don't know World Resources Institute, we work at the nexus of development environment. We're a global think tank. We work on food, forest, water, cities, energy and climate and I direct the water program.

I think it can feel like the future of water looks pretty bleak and I think it is really important to recognize that we are in the throes of quiet but growing crisis in much of the world. That we are really just ignoring or like the three monkeys, see no evil, pretending is not happening. By 2025, 1.8 billion people are going to be living in areas that are where they have absolute water scarcity. As much as 40 percent of the world's population, 4-0 percent of the world's population by 2035 could be living in seriously water stressed areas.

WRI developed about five years ago, a global water risk mapping tool. It is a completely open source. It is available to all users called Aqueduct. Many of you might be familiar with it. It is being very widely used by the private sector which is who it was first developed for because it was very difficult for them to get good information across watersheds on a consistent credible basis. We use the best available global data sets. We did an analysis where we did that baseline today of water demand by sector and in total, relative to available surface water supply. Of course, you could do the same kind of conjunctive analysis where you can get the good data for ground water and surface water, but just even

looking at surface water supply.

A growing number of countries, when we project forward demand and future climate impacts using international panel on climate change data, this is also included in this Aqueduct tool. A growing number of countries are going to be facing extreme water stress. That is 80 to 100 percent of their available water is going to be demanded, it is going to be used. Now some of that is redischarged and so on and reused multiple times as it moves down stream either through recycling projects or just because farmers use it and then some of it goes back into the stream. Energy, power generation plants and so on.

But the point is, is at the macroeconomic level, we really have to understand the importance of water in our economies and what the impact could be for growth in the future. It is that multi sectoral, the demand for energy which is growing at the same time the demand for food, the same time that urbanization is rapidly expanding. And in many countries, a rising standard of living is also requiring a higher water demand. And then climate change. We're seeing the new normal being much greater disruption and inter annual variability in droughts and floods. More extreme storms, more extreme droughts in many parts of the world and just really big disruptions to the nature of how precipitation is delivered. So, this sounds very wonky and technical but this has a really bottom line impact. Samantha, you said in the beginning, two economies.

So, what are we to do. Well first of all, I think it is very interesting that in the private sector, companies are beginning to take action. And in part, they're doing so because investors are asking them to disclose about where they are facing water related risks. Lots of information providers in the investment sector, MSCI, Bloomberg, many others, in fact, are using the Aqueduct and other water risk mapping and related tools. Companies are now starting to look across their operations and across their supply chains and start to see where they may be facing challenges.

So, one interesting thing that we're seeing is that it is the private sector in a lot of places, companies and investors, that are pushing governments to start to step up to the challenge. Because they are saying we are not going to continue to make investment in a lot of these countries unless we can be assured that there is going to be a sustainable water management situation. And, companies realize that they're part of the problem. In fact, in many instances, this just happened again with Coca-Cola in

India. They may lose their social license to operate. It becomes very difficult if you're a food and beverage manufacturer if you're operating in a place that is water scarce, if you're not engaging in collective watershed and water management stewardship.

So, there are some companies that are really starting to work on a strategy to figure out how you would actually set watershed targets. Where you have water demand and supply, I'll do my fancy graphics here with my hands, that are out of balance. And then what are the different strategies that can be undertaken and what are the tradeoffs and offsets across those different strategies for bringing that situation into balance. And that's really the challenge. We have to acknowledge that we have a finite resource and we have to take steps to bring it into balance.

Countries like Ethiopia which has very ambitious development goals, it is sort of a development darling growing at has been 10 plus percent GDP per annum and has very strong ambitions to become a lower middle income country. Still much of the population lives in rural areas so they're really trying to raise the base of the pyramid by increasing agricultural productivity and making it possible for families and young people to stay on the land. Fifty percent of the population in the next number of years in Ethiopia is going to be under 25 years old. So, jobs and economic growth is a huge challenge for that country.

So, they're five year growth plan calls for massively scaling of hydropower. Eight five percent of Ethiopia's power now comes from hydropower. Scaling up irrigated agriculture, scaling up agricultural processing and other kinds of industry that they think they can add value, add jobs with, and massive changes in urbanization, growth and urbanization. Where is the water going to come from? If you look across all those sectors, without some optimization across those, without some better efficiencies, there is literally not enough water in that country to meet those growth and development plans. And the government is well aware of this so it is trying to tackle that question, working with a lot of organizations, WRI included.

In places like China, China has 20 percent roughly of the world's population, about 8 percent of natural fresh water resources. China has really stepped up to the challenge in many ways. It has set, what it calls, its three red lines for how much water per unit GDP can be used, absolute limits. In fact, there are absolute limits on how much water is available from key basins, let's say the Yellow River

Basin, for example, the heart of civilization in China. And then also limits on water quality which China has tremendous challenges with on water pollution I should say.

We've been doing a very interesting project in Ningxia Province, I'll mention. It is just a small province in the northern part of the Yellow River Basin in China, which is at 95 percent of that limit on how much water it can take form the river. Cities are growing rapidly, there's tremendous growth in industry, chemical and other kinds of industries. And all the farms use flood irrigation in what is essentially as dry an area as the Nevada desert. So, we've been working with the government there to create a water rights allocation system. China is piloting this in eight provinces across the country. Because farmers right now don't actually even know when they're going to get their allocations of water through the canals from the Yellow River. They'll actually have an entitlement to water and a process for receiving that at the farm level from their village. And then the possibility to engage in a government mediated trading system where industry or cities can invest in making water efficiency improvements. We're talking about sprinkler irrigation, we're not even talking about we would consider, very efficient irrigation, but anything is better than flood irrigation. And taking some of that water savings, some of it needs to be maintained for ecological purposes but some of that water savings can then be used to manage and help other sectors.

The last area that I would mention is in cities. We've talked about this. We know there is rapid urbanization. Soon, as much as two thirds of the world's population is going to be living in urban areas. Many of them, as we've talked about, don't have access to good water or sanitation. We need a very different picture of what that is going to look like in the developing world. In many developing world cities, no more than 10, 15, 20 percent of the population is connected to any kind of piped water or sewer system. And the answer may not be a centralized pipe system. It may be a more decentralized approach, similar to the way we're thinking about energy now or not building centralized power plants, but we're doing more district heating and cooling, so a version like that for water.

And incorporated into that at a more regional level, thinking about maintaining the natural ecosystems, the nature infrastructure that is a critical component of continuing to provide the base of clean water for cities. So, there is a whole bunch of areas in there that we and many other groups are engaged in that, I think, give us reason for hope, too.

MS. GROSS: Thank you, Betsy. Last we have Vanda who is a good closer for this part of the discussion because she's done some work on what happens when some of these, the economic water systems start to fall apart. So, Vanda.

MS FELBAB-BROWN: Well, thank you. And may fall apart is not even the right term even though it is often what I work on. What happens when things fall apart in crime, illegal economies or violent conflict. But in many of these situations, as a number of my panelists have mentioned, formal legal water supply has never been delivered to very vast segments of populations. It is particularly a problem in cities that are rapidly organizing. It is controversial to talk about the legal water supply. That is a big dispute in the field, as I have learned, about whether there can be such a thing as illegal water supply. If water is considered a human right, then some would suggest that any language such as criminal behavior is inappropriate and any language suggesting policing is inappropriate. Coming, as being an interloper on the panel and in the morning, not a water expert but someone who works on crime and policing. I wrote this paper arguing for both that language and, in fact, for policing including punitive policing in the water system as a mechanism of assuring that water is delivered equitably and that, in fact, that basic human rights are satisfied.

What we currently face in very large parts of the world is water theft and water leakage in the amount of 30 to 70 percent of the formal water supply. That is the place in cities such as Karachi, such as Mumbai, Hyderabad, extraordinary levels of water is taken illegally. Now, what I mean by water theft and what is smuggling, it is, in fact, any violation of existing rules. Now there is wide complexity and by variety of rules as to how water can be appropriated and taken. You heard in the morning, the complexities in the United States viewed in scale of the national level, water regulations work very widely.

But typical examples of what I would consider water theft is unauthorized wells, unauthorized connections, hydrants or simply not paying your water bills. And again, in a place like Jamaica, not paying water bills can amount to 90 percent of the cost of water. So essentially, everyone is drinking water without paying for it which, of course, has tremendous consequences for water utilities. The inability to repair systems as well as tremendous consequences for any rational, equitable allocation of resources across the number of users, such as industry, such as energy, such as agriculture and, of course, personal use.

In some places, throughout Africa, Nigeria being a prime example, cities like Lagos but also Pakistan, India and even Brazil, the water theft can be enormously elaborate and does not just simply go to individual poor slum populations which incidentally pays for water that is illegally distributed by water tanks or otherwise, many, many times, the price that they would pay if they had legal supply of water. But the scope of water theft can be such that some industries in Pakistan, perhaps use up to 70 percent of water illegally without paying for it. Tapping, illegally setting up pipelines, illegally setting up hydrants, deploying, protection buoys that make sure that police or water management authorities they attempt to engage through no disruption. In fact, a lot of the illegal water supply and distribution often takes place in complicity with water management authorities through kickbacks that they get from some of the key violators.

The consequence, of course, is that especially as water scarcity increases, particularly in a place like Pakistan, the pressures on the illegally distributing water, illegally sourcing water, will only grow compounding all the management problems that we heard about and just increasing scarcity for everyone. We have really not seen instances yet on cross border water smuggling, though we have seen instances in the Middle East of rather elaborate lengthy smuggling of water. It grows substantial territories that has been little bit more effort in places like Jordan by the national authorities to crack down on that. I think one of the aspects of the future will, in fact, be the emergence of cross border water smuggling. That will not only present a difficult human rights legal policing challenges but also perhaps (inaudible) to do dimensions of conflict, places like Pakistan, India a prime example. And although we have not seen international water conflicts, a topic that people have spoken about since the 1990's, water is simply very much a dimension of at least non-violent conflict in places like India and Pakistan. Just a few days ago, Prime Minister Modi after authorizing new dams in the Indian side of Kashmir which Pakistan protests and believes these are not consistent with the Indus Water Treaty, suggested if Pakistan continues to export terrorism, water might not to Pakistan from India. Pakistan is, of course, terribly dependent on water from India and Afghanistan for its water supply. In fact, Modi said blood and water cannot flow together. And yet, we might, in fact, be seeing circumstances but that will be happening.

So, already at the domestic level, there is often tremendous social conflict associated

with illegal water distribution. I'll perhaps leave it at that and just leave as a teaser, the suggestion that I elaborate in the paper that policing should become, including punitive law enforcement, should become an element. But just to say, that doesn't mean that the poorest, most marginalized, should be simply cut off from water. And, in fact, water its access or denial is tremendous tool of political control. So, a lot of the denial of legal water supply to slums in Bangladesh is not incidental. It is a form of political control, often sanctioned by elite often representing the absence of the social contract that was raised before or its fundamental deficiency. But nonetheless, if you don't start considering that, lots of the water management issues will become all the harder.

MS. GROSS: Thank you, Vanda. To start the questions, I don't think I have to convince anyone in this room about the fundamental value of water. But a theme I hear across this panel and across everyone's comments is that water is often undervalued in an economic sense. We heard from Chris about the economic losses, if you were to add them up of a lack of adequate water provision. We've heard from Vanda that people, even though they're receiving water, are often not willing to pay for it.

I'm wondering in the panel can comment on some ways to perhaps start to capture this value, some of the lost value that Chris is talking about and turn that value into actual investments in water infrastructure. Has there been some thought in how to actually bring some of that lost value to bear in terms of financing?

MR. GASSON: I think what Vanda said was very interesting. Because, I think, it does illustrate the fact that actually people value water a hell of a lot more than they pay for it. It seems to me that the answer to the fact that guys are taking utility water and selling it for ten times the price in tankers to people who are not served by the utility. Perhaps if the utility charged the right amount in the first place, those people wouldn't be there having to buy tankers. There is this, we know what is good for you, we think water is a human right and because it is a human right we want to give it away and we don't really want to appreciate the fact that there is an economics to giving water away. We're acting as if you give it away you won't have anything to give. So, we do need to get a hell of a lot more realistic about the fact that water does need money.

If you pay for it, it will cost less. That, I think, is gradually seeping out but it is a very

difficult political thing that a lot of people do see water as a poor tax because everyone needs to have water. If politicians do look at it as a poor tax, they'll never want to raise it. So, you do need to have this depoliticization of the utility sector so that it isn't something where the mayor is basically not interested until somebody says we need to raise the rates and then suddenly he becomes very interested indeed and says no. People need to see that it is a service and a service that needs paying for and it needs to have an economic model to support it.

MR. ACHARYA: I think I agree with you, Chris, but one of the reasons I think people pay less and they feel like it is their right, a lot of these countries are emerging economies such as China and already developed UAE. Water is heavily subsidized and that gives a false sense of security to people that our government is helping us. Even in China, you can't have political unrest because of water. So, government will do anything to subsidize that water or supply water.

The same thing with UAE and maybe the same with Ethiopia. So, I'm conflicted as to how much should we be subsidizing water.

MS. GROSS: It is a tricky issue because when you think about the dichotomy I brought up at the beginning, a certain amount of water is a fundamental human right. But once you get past that level, you transition into it being an economic good that people need to pay for and that transition becomes very challenging.

MS. OTTO: And I think this is a very interesting conversation because it is the crux of the problem. I think, underlying that is this fundamental belief, which we keep saying, that water is a human right so it should be free or we shouldn’t have to pay much for it. Of course, there should be a certain amount, perhaps, that is available to all human beings at a certain rate. As we've all commented on, the poor, in fact, are paying far more than they should be because of how we mismanage water. So, let's be honest about what we're actually doing here, I think.

And then, I think we just, to use the economic language too, we have to think about right now in some ways I'm going to oversimplify this. We're kind of treating the marginal cost curve for water as flat, which it is not. And then when we run out of it, that curve goes vertical. That is a silly way to manage. We wouldn't do that with any other important element of our economies or of our lives. So, we need to start to fix that. And some of it, I think, is to acknowledge that there are limits.

The places that have done, in a sense, a cap and trade program, Australia is the poster child for this. During its millennial drought, it created essentially a cap and trade system, a closed basin system. It was lucky enough to have one of those. Marie Darling, the main river, the main basin serves most of the economic purposes and major cities in Australia is all within Australian control, even though it crosses over numerous states. They created a system where they determined what the entitlements to water by sector were going to be and those change how much you actually get delivered to that entitlement by how much is available given how much it is raining. How much water has been stored and so on. I'm over simplifying here. And it created a very robust, economic trading system as well where farmers could decide to farrow fields, to sell their water allocation to others who really wanted that water because they might have planted fruit trees or vineyards which they couldn't just fallow and it was worth it to them, they could get enough value for their crop to pay more for water from other farmers and so on.

There are eminently ways to do this. There are simple examples of this too. If you look at a small project that is underway that the World Bank is involved in and International Water Management Institute and others in India. Long ago, farmers in India were given either electric or diesel pumps where they essentially get the fuel for free to pump ground water. There is a dearth of surface water. We need to grow food in India, we need farmers to be able to make an income. So, they've been over drafting ground water, really, really rapidly. It is a huge problem, especially in Northwest India. It is really frightening, in fact. And what they're doing in this pilot project is they're giving them solar panels to run their pumps and they're encouraging the farmers through the system that they have, to sell the solar power back to the grid so that they're farming solar power. They're not over pumping ground water and just putting it on fields because it has no cost to it. They're still growing food but they're also thinking about other ways to improve livelihoods. It is kind of a way to deal with the political economy problem that they have around that question but to capture the value from it.

MS. FELBAB-BROWN: Well, that's actually a very interesting story because the India rural area, urban situation has been very complex and implicated in the illegal economy because of subsidies on diesel and energy in general. Over pumping of ground water, as you mentioned Betsy, is extraordinary. So, some of the farmers that are living in the rural areas close to urban areas of major cities, in fact, selling the water to what they call the water mafia. So, this illegal distribution of water, not

even using it for farming, on the belief that they will make considerable good income which they do in the short term, then from some long term sustained agriculture.

So, then the water mafias take it to the cities where they illegally sell it to everyone in the upper class, middle class. Depending on whether the water gets treated, some users might abstain from it but the distribution is illegal. They also sell it to industry.

Now, of course, over time this is just drying up the rural areas around the cities only pushing the farmers let's say for five years are pumping their water and selling it to the water mafia. They are run out of water, they can no longer stay in the villages and they move into the slum areas becoming then dependent, on perhaps, not the same act but the illegal water distributors that sells often at greater poverty rate than they had incurred before.

Now that said, connected slum areas legally to water supply is not easy and the issue of the human right and not paying water, comes up all the time. There has been a recent prominent case in South Africa where, in fact, there was a move to connect poor urban area for the first time to formally good water. But that, of course, came with meters and people had to pay for water which they didn't want to do so they would tamper with the meters and violate them, but then they would eventually be cut off from the water authority. That led to a major legal case where the slum residents, a few women, challenged the meter system on the basis that water is a human right and it should be not paid and they won. That was very much embraced and seen as a victory for human rights but I would really question really in the long term that, in fact, benefits some of the poorest and most marginalized.

In other cases, like Brazil and India, it is often the middle class that's a crucial obstacle to illegally connecting water to slum areas because the middle class doesn't want to pay for it. They oppose any taxes, they themselves depend on some illegal water distribution. The top elite often has totally private solutions whether legal or illegal to water. And so, the tax burden of extending formal water systems to slums would be done by new middle class and they are quite callus and indifferent to the lower strata they had left, perhaps not even a generation ago. And they often boycott being legal water whether through tankers but particularly because of the cost of the pipe systems.

So, the issues of the social contract are very complex. I guess my last point, I mentioned Brazil. It is not just areas of real water scarcity like the desert areas that have big problems with stolen

water. Brazil is one of the most water rich countries and yet pervasive levels of not paying for water just as that are at pervasive levels of not paying for electricity and other services.

MS. GROSS: I'd like to switch gears for just a second to ask, we've talked a lot about the political and economic barriers to provision of water. I think it might be interesting to spend just a moment talking about potential technology solutions. I heard one of you speak about, perhaps having smaller rather than more centralized systems. I'd like to hear a bit about potential technology solutions that can help us out of our water bind.

MR. GASSON: I think, you have the freshwater side and the wastewater side. On the freshwater side, there is a problem of the brine from the groundwater desalination is a pretty fundamental one. It is a hazardous waste and getting rid of it is incredibly difficult. There are technologies, I'd say Desalitech from Israel who's got one of them which squeezes out 90 percent of the freshwater rather than 70 percent of the freshwater from things. I think we are seeing improved membranes and what have you but there will always remain a reject from that salts effiration process which is incredibly difficult to get rid of if you're sitting in the middle of the country. It happens, to some extent, in this country with the frack water flow back in Pennsylvania where you can't reinject the water because the geology doesn't support it.

That is a fundamental technology change which, I think, would only really be so by salts effiration. Actually, there is a huge amount of very valuable metals in these things. If you can pull a lithium out of it and you can put the lithium into batteries or pull the magnesium out of it and put that into making lightweight vehicles and so forth. There's a huge value to be had. The science really needs to be focused on that, what do we do with the brine, how do we turn this into something valuable.

On the wastewater side, I think here, as I say, the thing that would make the biggest difference is changing the paradigm for waste water. I talked to a friend of mine at the World Bank. He said yesterday that 90 percent of the water we use is just used to dilute feces. It is used because of the wastewater systems that we have. If we change the wastewater systems in particularly low income countries.

Bill Gates has got this reinventing the toilet challenge. If you can come up with a water free toilet or a way of treating waste much closer to the home and getting some value out of it. Maybe some energy

out of it and getting some sort of water back from it without the need to build these enormously expensive sewers. They're just completely non-viable. When you think of a city like Dakar in Bangladesh where more than 20 million people and no sewers and the whole thing just oozing into the waterways that people are drawing their water from. There's got to be a better solution for that. I think it's going to be something to do with both toilets and treatment all in one at an affordable cost that would really make the difference.

MR. ACHARYA: There are obviously opportunities. I'm going to go back to my Indonesian case where I've done a little bit of work. So, what we decided to do was, we decided to teach the local people on rain water harvesting more effectively. And then use a local material, for example, to build like bamboo as a reinforcement instead of using steel and use the local sand and build tanks. And then also have a very simple treatment on the top before the water gets in from the roof to the tank and have a few sand and gravel treatment systems and it works. So, basically we didn't want to go and build everything. We built a few and we got the locals involved and we taught them how to build it.

Also, the ones that built it, we still needed, we wanted to put a small amount of tariff on them so that that money could be used for maintenance down the road. It is very difficult. They're willing to buy water in summer when they don't have anything but when you tell them, why don't you pay a little bit of money every time you take a gallon of water, it is a little bit difficult. Not only us but there are many other people that are doing that. Teaching, using local material building rain water harvesting systems.

I want to go back, for example, cities in the Middle East. I think the reuse has to happen down the road. Now it is a big taboo over there they use (inaudible) that the regulations don't allow you to reuse water and so many things. There are so many restrictions. You can use them in lawns and a few places where you don't come directly into contact with that water but how do you change the taboo. I think it is going to happen if you make them pay for the water. Reuse is conservation.

I'm from Las Vegas and I've been there from over 12 years. Las Vegas is one of the cities that leads by example in conservation. We've removed turf grasses and we've replaced them by desert landscaping and all of that. That culture, I don't see that in other parts like in China. The western part of China, there are cities smaller, villages being abandoned because there is no water in the western part of China. You know that, right. I've been to Shintyan and all those places. I've seen empty houses where

people have left because there is no ground water, they can't draw anything out of the ground.

Even if you go to other places, people just don't have the concept that we need to preserve water, we need to conserve water. I think we need to do a better job of reaching out to them and educating them and why this is very important. There are many ways. I agree with you on, Chris just spoke, there are technologies being developed in Israel. I work with a number of Israeli companies and we're trying to bring, they have good technologies. But I think we still are a little bit away from being able to solve the brine disposal because they still don't want to pay that much money for that.

MS. OTTO: I just want to pick up on this technology question too. Because there is no question that technology can help new membrane technologies, for example, for desalination and similar kinds of waste to energy, waste to reuse for recycled water systems. I like the thread here too, that I think is really important which is, I think we need to change our mindset and really invest very differently in more, what I would call, source controls versus end of the pipe solutions. It is like capturing rain water up front instead of letting it run off into a sewer, treating or not, and then having to re-withdraw it and treat it and so on. It just doesn't make any sense. It is more complicated to do that, oddly, it should be simpler and actually ancient systems in a lot of places are being unearthed again to do exactly that.

Investments in conservation and efficiency up front, demand side management, is the best hidden reservoir and the cheapest approach almost in every case, that you can think of as compared to investments in actual technology or infrastructure. And yet, we don't do it. It is not sexy, it is not interesting. By the way, it is difficult often to finance. You have to have a really strong leader and a Pat Mulroy in Las Vegas or the City of Seattle, who choose to spend their money that way.

The other thing I want to point to too, is resource recovery and reuse. We should stop talking about waste water, it's not a waste. There is more energy embedded in waste water than is required to treat it. D.C. Water here, has invested in this Cambi system from Europe, this thermal hydrolysis system for taking its sludge and getting and basically optimizing a methane biogas that it can get out of it. It can run the entire plant off the grid. Let's say another Hurricane Sandy came along and knocked out Pepco's energy system for a little while or the grid. They wouldn't have to dump untreated sewage. They can now run the plant entirely on that basis. They're looking to sell energy back to Pepco's grid. They are Pepco's number one largest customer right now. They're starting to take in and look at how to take in organic

waste from restaurants and food processing and so on. It is a huge, huge resource. Not to speak of the recycled water that you could get from that as well.

But back to this financial issue. When I talk to folks in the investment community there is $10 trillion of immediate, probably far more than that but you'll often hear a $10 trillion number used for immediate needs for water infrastructure investment globally. Lots and lots of interest in the private sector and amongst investors in putting money into that marketplace. But they don't want to do a project that is less than $250 million. So, a desal plant would be very nice for that, where a kind of classic 19th and 20th century infrastructure. It is very difficult to fund without a aggregation of securitization system of scheme which we haven't quite figured out how to do yet.

These smaller decentralized approaches, Philadelphia has tried to figure out how to do this because as part of its consent to create to deal with its combined sewer overflows. It is trying to create a sponge system, essentially, with rain gardens and rooftop gardens and so on. Over a quarter of the area of the hard surface of the city, that's what is in the plan. It is very hard to get there. They estimate it could be something like a billion dollars in investment that is necessary to do that. That is real money. The problem is, is that it's all in small pieces. So, what is the system that we need to have in place. There are some strategies that are being tried in some innovative approaches to creating a way where that becomes the new technology. It is smarter, it's cheaper, it just doesn't align very well with our financial investment system right now. I don't know if you would agree with this, Chris, but this is certainly what we see.

MS. GASSON: I think there are other ways of doing it which can be aligned. I think one of them, the most interesting things I've seen technology wise is in Melbourne where they have a big problem with storm water as you suggest. They were going to build a big storm water tank on top of that to capture the water which is coming down the hill. They decided that or at least one of the utility guys there decided, hey, how about we sell rain water to our customers as an alternative.

So, you can have a menu of water that you can buy from the utility and you can either buy utility drinking water or you can buy rain water. If you buy rain water, they'll come in and they'll put in a tank and the tank will have a small box in it and a pump in it. You can control the tank and the utility can control the tank. So, when there is a rain storm coming, the utility can push a button and they can empty

all of the tanks across the area. And the rain can then get into those tanks and they don't need to worry about the whole overflow. And they can continuously manage the flow of water from the tanks into the system or people can use it for their gardens. I think they also have a little UV thing that you can use it as great water uses in the household.

They also do the same thing with their sewer system. So, instead of having a great big traditional Victorian sewer, they have a 65 mm sewer with everyone having a holding tank in their garden with a pump and a control box in it. The big problem with the sewer system is that you have to build it for the peak use. That peak use might happen for a few hours a day once a year. But if you can control minute by minute, when those tanks are being pumped out, you can build the whole infrastructure by a quarter of the size that you might otherwise build it. You can empty house number one at two o'clock in the morning. House number two at 2:01 and it just needs to shoot out down this tiny little pipe. It is a much more effective way of managing a waste water network instead of huge overbuilt traditional infrastructure.

MS. FELBAB-BROWN: I would just return to the field of conservation of really being key and what we see in countries with some of the highest water rates. The government authority often reacts by thinking about how to build new infrastructure, new dams or how to build very long aqueducts or perhaps going to technologies. But that tends to be low or unable to really think about how to stop leakage and it is both leakage that is in the inadvertent consequence of illegally tampering with the hookups or creating illegal hookups as well as, of course, breaking down infrastructure. Because as a result of what they're being paid, authorities cannot then repair it.

I tend to very much want to emphasize the conservation elements of which law enforcement, in fact, is a very important one, although not one that is spoken about. To have really effective law enforcement, technologies can be very important because there is real difficulty in detecting illegal water, the draw in the real time. Particularly if this takes place on a massive scale in the city or a massive scale in the rural areas, for example, in Pakistan, the entire aqueducts has just scores and scores and scores of illegal hookups. It takes a lot of patrolling capacity which often is elusive for law enforcement officials and water enforcing, water regulation tends to be very, very low on the bottom of priorities for either water management authorities and particularly police forces. They usually do it only

when they are bribed and they usually do it only to enforce selectively against those who cannot bribe them. So, it is the poorest that are not capable to bribe the officials and have their illegal hookups disconnected and industries and agricultural sectors will get away with water theft.

There is real space in building technology into some of the policing elements that not sufficient. There are legal challenges, often prosecuting water theft, is enormously legally difficult. That is one reason why neither water authorities nor police want to get involved with it because of the body of evidence they need to present and the challenges. There are many other issues, but nonetheless, even in the policing aspect technology is something that would really help.

MS. GROSS: I'd like to open up to audience questions right now. I would ask you to state your name and where you're from. We'll take three questions at a time so that we can get some variety in what people answer. Also, please follow the Jeopardy rules and state it as a question. Please wait for the microphone. It is not so much for us, we can probably hear you, but it is more for our friends who are watching online. So, let's start here and then we'll go over to this gentleman in the orange.

MR. LIPSHUN: Thank you very much. My name is Clive Lipshun and I'm from the Arava Institute for Environmental Studies in Israel. I find this fascinating. A lot of my work is in this issue of transboundary water management between Israel, Palestine and Jordan. I want to just throw out there for the panel to consider from some of my work is one way to try to understand the issue of why people don’t pay for water, specifically in developing regions. In my experience, one way to get around that is to link water with energy.

So, in my experience, for example, where we are actually developing decentralized approaches to water and waste water management in the Palestine West Bank where over 70 percent of the population is not connected to a sewer network. What we found, is pretty much like in other examples that you've mentioned, people don't pay for water. They don't pay for water even if they're metered. They simply just don't pay for it. But what we did realize is that one way you can generate an economic incentive is to show that one way to cover the cost of putting in these decentralized systems is to show the value of the reuse of waste water for irrigation with an increase in crop yield income generation. So, that was one way to bring money in which then you can put into operation maintenance of the systems and also to start building a local utility.

The other example was something I'd like you to consider and I'd like to get your thoughts on this is for ground water pumping. So, here again they're not paying for the ground water for a variety of reasons but they're paying for the energy to pump. So, any way that you can reduce pumping costs is a way that you can leverage into covering or recovering the cost of the water. Thanks.

MR. GIRA: Hi, my name is Chun Gira. I'm a student at SAIS. My question is when you talk about value and economics, what role do you think the markets have to play in there and in terms of how they can actually feed into climate change, regulate the authorities and private sector. How can they can fit into climate change with the whole water market setup.

MR. SCHLOSSER: Lynn Schlosser, the American Council of Engineering Companies. It strikes me when you were talking about water utilities as a utility as a service. I was once a utility regulator. A fellow named Hernando Desoto some years ago, wrote a book, “Mystery of Capital.” His claim was there was $10 million of debt capital in the world because people were squatting and they had value in their homes and such on this property. And if they had title and property right, they could borrow money, raise capital, finance services. The other benefit, of course, is with title comes and address. If you have an address, you can enforce if you have rule of law.

So, it strikes me that one of the basic questions here that all of you seem to touch on is property rights, title. And does it enter your thinking at all in resolution of your problem.

MS. GROSS: I think all three of these questions have very deeply to do with water rights and property rights. Who would like to start in addressing this?

MR. GASSON: I think it is interesting. There are two places in the world where you can trade water, the western U.S. and in the Murray-Darling Basin. The rest of the world tends to have riparian rights or rights which can't be traded. It is an interesting question. Should everyone create systems of water rights. Because, once you've done it, you've done it. One of the worst things about water rights is that nature actually needs a right to water as well. Is everything is portioned out there is nothing left for nature and it becomes an incredibly expensive thing. When you're creating a system of water rights from not having a system of water rights, you're essentially conferring a huge amount of value to private systems which they don’t have at the moment.

I don't know, in Israel I have a system of annual allocations where essentially the

government owns all the water and you get told each year how much you're allowed to use it. I think that that has an advantage in that the government does have more control over things and it can decide how to invest and so forth. But, at the same time, the individual farmers don't have any real control over how they get value from the water and whether they individually should be spending more or less to conserve.

I don't think that there's any perfect water rights arrangement. Yes, it is good what you have in the western States here, but I think if you were to introduce it elsewhere it might be a massive giveaway which then made it very difficult to make everything work in the future.

MS. GROSS: Kumud, what is your point of view of water rights as a way of capturing the value inherent in the water?

MR. ACHARYA: It is a very interesting, I mean, I've lived in the western United States for 15 years now. I also lived in Arizona for three years before Las Vegas. I was always intrigued by the water rights issues and senior rights and junior rights and if you don't use it you lose it. Western countries where democracy works well, I think these things work pretty well. If you go to other countries where politically the government is always very controlling everything, individuals have no right for water. Whatever you get from the government, that's what you get. If you can buy it that's great, if you can't buy it, I mean, how about in China. I don't think it works there at all. I have very mixed feelings about this rights issue.

I wanted to get at his question about the role of markets and pricing and also the climate change. Obviously, I'm a scientist and I've worked on climate change and strongly believe that the climate is changing and we have to deal with it.

But I think that our most urgent and bigger issue is urbanization. Urbanization, cities like Dubai, Abu Dhabi and there are hundreds and hundreds of cities in China. The cities are growing and being developed without a sustainable water planning. They don't know how they're going to sustain the cities, where they're going to bring water from. Obviously we need to deal with climate change but that is the more pressing issue for me right now. What is Dubai going to do? They're going to build more desalination plant? That's what bothers me a lot.

MR. GASSON: I think they didn't. If you look at what happened, Dubai was building desal plants every two years or every one year until 2008. And then in 2009, they decided they were

going to, for the first time ever, charge Dubai citizens for water. They actually charged a fairly decent amount and immediately overnight, water demand in Dubai fell by about 15 percent. It can all be done. One can continue to --

MR. ACHARYA: I agree with you. That's why I've been saying from the beginning that people have to pay for it. You just can't expect that to come to you free, it is just not a right anymore. Maybe it was.

MS. GROSS: We're focused very much in this little discussion on first world problems.

MS. OTTO: Just on the water markets question and the climate change and governance issue, the governance issues, of course, become really, really challenging and are critical. It gets a land tenure on water rights pieces.

There are different ways to do it. The case that I mentioned in China, it remains to be seen if it will work. As I said, there are eight provinces that China intends to do water entitlements or water rights in a very general sense because the government owns the water and will continue to do so. But it will create an entitlement system, an allocation system that lays on top of that which will take into account, climate change and variability and just natural precipitation.

First of all, the ecosystem needs, by the way, have to be the first call. In the Murray-Darling system, they do. They set that first and then they do the allocations around that. If you're not maintaining the eco system, what's the point because it is the basis of even having the freshwater system.

The other thing I think you have to have are you either have in the Murray-Darling case and in Australia, fairly efficient markets. In fact, as I understand it, I'm not an expert on this, other may be. Farmers can make decisions within days once they know what their allocation is going to be of whether they're going to actually plant or not, whether they're going to sell. There are good spot markets, it is a very efficient system. It is a smaller system, it is a closed basin as I said.

And, the other thing that works really well is, if you already have large margins of inefficient water use, like the example I was giving in Ningxia where you've got flood irrigation in a desert. So, you're getting huge amounts of evaporation and inefficient water use. That is an enormous cushion to try to use water more efficiently. And you can quickly start to capture the economic value of that and

continue to ratchet down on that inefficient use. So, I think those are things to think about.

It is also interesting to look at the Chile example. Chile, I guess in the eighties, I believe it was, privatized and provided water rights and there is a very robust literature on this. The jury is out, actually. Some people would say that that really created much more efficient water use and really a much smarter economic value associated with water. Others would say that it disadvantaged some of the poor who were left out of the initial water rights system. There is a variety of feelings about that. It is a tough thing to do well.

But the reality is, that whether we call it water rights and trading system or just a water balance system with permits, we have to do this. We're treating everything like we're going to create a tragedy that comes. Where it is a race to the bottom of the aquafer and whoever can get it first, it is not going to work. We're going to create this problem where we're going to then have to draw the water from somewhere else or build hugely expensive desalination plants which have all the attendant challenges. We have to come to terms with appropriate solutions to this.

MS. FELBAB-BROWN: So bringing the environment in, I'm looking at Jennifer Peyton to designating the environment in the Colorado Delta as a user with rights or entitlements. But I want to come to the issue of titles and Desoto, who of course, was also one of the pioneers in thinking about informal and legal markets. Again, many complexities and fascinating dimensions, often tragic dimensions in water use. So, for example, in India, it is a right by a citizen to be delivered a certain amount of water. In fact, if you call the government then the government will come and it is obligated to either provide you with a fixed connection. If the fixed connection is likely an impossible dent to deliver with a tank in a certain amount of time, except in you live in the slums without a title. If you don't have a title, you don't have an official address, you're not allowed to be there and your right to water is being suspended as a result. Again, your only source of water is some form of illegality.

Now, the fact that water markets exist, they are illegal water markets. They are suboptimal, they are inefficient but that's what happens. In some countries, you mentioned Chile. Another Latin American country that is interesting is Ecuador where you again had very extensive illegal water distribution. Part of the governments solution and often quite violent behavior by the water mafias. They are not necessarily nice even though they acquire a great deal of political capital. In some countries

like Nigeria, they violently disrupt the formal pipes so that there is great market for their illegal activity. But in the Ecuador case, the government made the decision to license some of the illegal ones. Those that were better behaving were told you will become legal. You have to pay some tax and you have to behave with certain regulations and it was a very effective solution.

My last comment is that in some of the most illegal water markets such as in Tijuana slums that exist actually in the canal, the community itself, self-polices an allocated water rights. It decides that the resident of the illegal sediment who all of the community is entirely illegal water, the entire community is illegal. But even within this illegal community dealing with totally illegal water distribution, it allocates to each member, a certain amount that is fair share to the water and is being policed by the community itself.

MR. ACHARYA: I wanted to add to what you said, Vanda. The illegal and sometimes it is a gray area in South Asia. Illegal versus illegal. If you go to many countries in South Asia, India, Bangladesh, Nepal, many, many houses will have a pump in their back yard to draw ground water. There are no rules and regulations as to say, okay you can't take groundwater. The city cannot get any ground water because the groundwater table has gone so deep, but there aren't any regulations. Almost everybody draws water from the ground. And then obviously, your groundwater table goes down, then you buy a bigger pump. Whoever buys a bigger pump gets water. How do you solve that? It is huge issue and I think governance is a really, really important key here, I think, and setting regulations is really important, especially in that part of the world that I've seen.

MS. GROSS: Even in the American west, you see that race to the bottom of the aquafer and I think that we have relatively well developed water policy in that part of the world.

So, we could do this all day, but unfortunately, we've run out of time. I thank my panel, I thank all of you for coming today. I also thank those of you who are watching online. So, please join me in giving a round of applause, not just for this panel but for everyone who has spoken today.

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