The Hidden Value of Science in Planning

Wes Danskin, U.S. Geological Survey

Wes is a research hydrologist with the U.S. Geological Survey in San Diego, CA. His areas of expertise include optimal water management, groundwater simulation, constrained optimization, hydrogeologic analysis of regional systems, integrated surface-water/groundwater interpretations, conflict resolution, and technical mediation of water issues. Wes has been the project chief on efforts in Texas, New Mexico, Nebraska, California, Hashemite Kingdom of Jordan, and Ethiopia. He received the USGS Excellence in Science award in 2008. Wes received a BA in geology from Carleton College and an MS in applied hydrogeology from Stanford University.

This is a talk on uncertainty, and I guess the main uncertainty I have for you guys is will you stay awake, and the main uncertainty I have for myself is will I remember what I'm going to say. This morning I listened to various speakers, and it seemed like the elephant in the room from my standpoint was that on one side you have areas of groundwater management, hydrologic areas, which are political things that humans have created, and on the other side are the natural formations. The elephant is the dynamic between the areas created by humans and those created by God. In my experience, God wins. "Don't fool with Mother Nature" was a notion that I was brought up with and my background is actually in environmental planning.

How many people in the audience would consider themselves planners? How many people would consider themselves engineers? I started out in environmental planning and worked with geology and groundwater and so forth. What I would like to do now is to weave those things together. I will finish with the idea that science itself has some hidden values that can help us merge the political realm with the hydrologic realm.

Science costs money, so it's easy to ignore it or put forth the minimum effort. One of the concerns that I heard when I was chair of a planning commission was, "Can we just get done with it and build something? More planning, more studies, enough already – you've spent most of the budget telling us what we might do or how we can't do something rather than getting to work." Fair enough, much of that is true. On the other hand, if you build without planning, there is a whole litany of mistakes that could have been avoided.

What I've found is that science has hidden value. On the face of it, science defines our world. For many engineers, science is helpful because we learn how to define things and they become part of our familiar experience. We start from there and we go on to accomplish a lot. But the other aspect of science that I have discovered is that science is very useful for uniting people, people who have different agendas, different perspectives, come from different cultures, and have different wants. I'll go through all of these and give you an example of how we've used these in a real study. And finally, science inspires. It's not a coincidence that most of the popular shows on TV are not the sitcoms, they

are National Geographic, Discovery, Myth Busters – shows that discuss the natural environment, about investigation, about pursuits, about things that people only know a little bit. People are inspired by these programs. We should not forget this when we want to build something and we want just enough science for that one accomplishment.

About the time I was born a book came out that was referred to as "Magic, Science, and Religion." It was written as an anthropology text, and it said that as cultures go forward, life is uncertain for all people at all times to different degrees. When life is very uncertain, it forms the basis for myth or magic because the process is not understood. After awhile, it becomes codified, and that forms parts of religion, and after a time it becomes so routine that it migrates into science.

In most cultures there is a blurring between science and religion. In Africa, the Ethiopians are primarily orthodox Christians, some Muslim, but they also have shamanism as part of their culture. Some might argue the same is true in the United States. Not understanding our world leads to fears that encourage beliefs in mythology like believing that thunderstorms and hurricanes come about because we have misbehaved. Today you can get on your iPhone and see what the weather is going to be like; those earlier fears are no longer as powerful over us as they once were.

One thing I encourage you to do concerns the fearfulness that is pervasive with climate change and increasing climate variability. That is not a matter of dispute anymore. A couple of weeks ago I was in Kenya and it was amazing to me that issues concerning water were on the front page daily. The Kenyans are going through difficult times similar to the Iraqis. An Iraqi friend of mine had not been in Baghdad for 30 years and he recently went back as part of a water study team. He was so sad when I talked to him about his trip last week. He is a very stoic person, but his eyes showed his sorrow when I asked him about Baghdad, and he said, "The water is not there." He was visiting during the time of high floods, and he could see islands in the Tigris and that has never been the case. The water is being trapped in other areas like Turkey, Syria, and Iran. If you were going to make a water management area, you would need a larger area than just Iraq. The question is: "What did God make the area?" The drainage for the Tigris and Euphrates go well outside Iraq. To manage water in Iraq, you must look further afield. Sandia Labs is working on a project that was mentioned earlier regarding the snowpack and whether there really is a water problem in Iraq. Turkey says there is a drought, and Iraq wants to share the drought equally. Or maybe it is just a political drought. This is an example of where science can be used to unite people.

Most people are honest and trustworthy and they bring to the table their beliefs. Of course what one person brings to the table may be somewhat different from what someone else brings. It's not that they are trying to be duplicitous, untrustworthy, or lie, although that does occur but is rare in my experience. More often it is that they see the elephant from two different sides.

For example, I was involved in a study of the Owens Valley in California, which was made famous in the film "Chinatown." You may recall in the movie, Jack Nicholson in Chinatown, Los Angeles wanted water at the turn of 1900s and turned to Owens Valley for it, which is located on the eastern side of the Sierras. They got the water to Los Angeles and that's the story. Just before environmental reporting was required, additional water was taken by pumping groundwater. This caused a conflict between the Los Angeles Department of Water and Power and the local county of Inyo. As it was presented to me at that time, Los Angeles claimed to be pumping from a deep aquifer, so the pumping couldn't affect plants. The county people, however, clearly saw that the pumping was affecting plants and causing the "rings of death" around the wells where plants were dead or dying. As the story unfolds, you learn that there were grazing issues going on near the wells, which were located near irrigated land. There was a long history of the land being irrigated, and then not irrigated, over-grazed, not grazed. And to compound the situation, there were other things going on like the 1976 drought. So which was causing what? The plant people would say of course the wells are causing the problems. Los Angeles DWP would say no, they are pumping from a deep system that could not affect the shallow systems, and the problems were due to grazing and drought.

What we did was to use science to understand. We developed a groundwater flow model. After about five years, not five months, we gained an understanding of the wells, and it turned out that everyone was right. Los Angeles DWP was correct as almost all the water being pumped from the wells was coming from the lower system. In fact 95 percent of it was – not 100 percent though. From the plant people's standpoint, that 5 percent

difference amounted to 25 percent of the water for the plants, and in most years it didn't matter, but in drought years it mattered a lot. And if one of those 25-year-old plants died or became severely impacted, they didn't recover. The germination process didn't recover because there weren't enough carbohydrates in the plant to flower and thus there were no seeds, and moonscapes followed. Both sides were correct, and after we understood that, the debates about the process stopped.

Science also can unite, although what needs to be said should come from an insider, and in your case, from people who actually live in New Mexico. At one point, I worked on the Middle Rio Grande and I am very encouraged to come back and see this part of the landscape. If you make an area that is large enough to include your enemies and you invite them to the table, eventually they will show up. As military people have said, keep your friends close and your enemies closer. That includes people you don't understand and people who have different agendas. Only then can you either resolve the questions or at least stop spending travel funds trying to keep track of what the other people are doing.

Another example is a situation we had in a upper basin/lower basin type setting where the upper basin consisted of sand and gravel, not unlike the Rio Grande deposits, and which flowed down to a hard-rock area where there wasn't much of an aquifer. However, that happened to be where Camp Pendleton Marine Corps Base is located, next to the ocean. Camp Pendleton is where we launch wars from and the First Marine Corps Division includes the first guys to go. The people in charge at Camp Pendleton were very concerned that they wouldn't have enough water if something happens. Meanwhile, this is in Southern California where the upper basin is urbanizing and more wells are being drilled. Those wells are causing declines in the surface water. Nearly, every place on the planet goes through the same thing because drilling wells results in less surface water. Now we had lawsuits going back and forth. So we organized a technical committee. That is the first thing I would suggest, and it should be broad-based. In this case we included the hydrologic boundary. We invited most of the players, although initially we weren't successful. We started with litigators from the two sides of Camp Pendleton and the water district as well as a technical advisory group.

Next, we enforced the rule that the attorneys meet in one room and the technical people meet in another. The technical people could not mention attorney-type language when we met. Water rights are a human-defined issue and those issues stay with the attorneys. Because we are engineers, geologists, and scientists, we allowed the attorneys to be in charge of us. We would ask if we could look at both surface and groundwater, and they would say ok. Over a period of years, again 5-10 years honestly, we ended up being good friends, and we knew everybody's personality; we knew their jokes before they made them.

The good news from this effort is that we ended up with a stipulated judgment that meant money was not going to be spent in court where discovery can cost from $1 to $5 million just to find out what your opponents have been doing. The rule that we honored was "science first." The attorneys and judges figured out how to follow that rule with the legal rules of the road. In the technical advisory committee meetings, everybody brought their data to the table and everything was free and common knowledge. It was tough to get to that point but when you're scared of going to court and losing, this is a better option.

I hope this success encourages you to bring together the people in the hydrologic area. To be fair, we did not include the local Native Americans, which doesn't make sense to me because they have silver bullets in court; they ought to be at the table, too. The way it was phrased to me was, "We have enough issues ourselves, we need to get ourselves on the right path and then we will include them." And in truth, part of the stipulated judgment said, "Ok, we know what we know, five years from now we need to revise." This notion seems to be a theme – we can thank the Soviets for that. We will revisit our plans every five years and what we don't know now, we may next time.

I love different cultures; in many ways, everybody is the same, and water is the same everywhere. In Arabic there is a phrase something like in English 'step-by-step.' In Arabic its 'habba-habba.' When I was in Kenya, I asked what this idea translated to in Swahili, and it is 'hatua kwa hatua.' All cultures know change takes time, and you make progress set by step. If you are going to start with a hydrologic regional area, you can't win all the battles the first day, but you can use science to define your system and unite people with seemingly very divergent interests.

Science allows for transparency. If you are not of the belief that everyone is honest, then you can at least allow science to make the landscape clearer. People's agendas are very hard to hide when you have the science in front of you. If someone doesn't understand, or if they understood but they try to hide it, that will be evident. Transparency comes along with defining the world.

Lastly, science is inspirational. As you go forward in this time of tight budgets, put in enough effort to gain the power of the people. The movie "Gladiator" is inspirational to me because my son is a warrior in the U.S. Navy. One of the phrases used in "Gladiator" is "win the crowd." I would encourage you to win the crowd. That's what National Geographic does, that's what Discovery does, that's what Jacques Cousteau did. As we move forward in our water planning by creating areas that make sense to God, we also go forward with enough inspiration to gather the political votes and win the dollars that will continue to carry us forward.

My last example deals with what we are trying to do in San Diego. I'm running a very large surface and groundwater project in an area where there is essentially no water. In an area that is desperate for water, we are going to take brackish groundwater, somehow desalt it, and then somehow quantify it. We will honor the system – we are actually extending the boundary to the Tijuana River that starts in the United States, flows into Mexico, and comes back into the United States. It is right to include it. Is was not included in the first five years because it was too politically dangerous and could consume too much time, but now it is actually part of what we are doing. I encouraged the engineers to investigate the whole system to the point where we will have the background to answer questions twenty or fifty years in the future. We are drilling wells not 800 feet deep, which is the zone from which they are extracting, but 2,000 feet deep where we have found more continental deposits that could be a potential source of water, maybe not in the next five years but at some point in the future. This kind of information is inspiring to the boards, it's inspiring to the engineers, and yes, it does cost money. But it is something that brings people to the table because they are excited about what is being found. In an era of uncertainty, it brings hope that we will have some degree of control over what initially was unknown.

During times of uncertainty, science can be our friend. Science can help us define our problems and lessen our fears of the future. Science can unite people with different goals by providing a common language and understanding. And perhaps most importantly, science can inspire, and encourage us to act.

Thank you much.

This article was transcribed directly from Mr. Danskin's talk and has not been reviewed or edited by the USGS.