Chip Groat *was sworn in as the 13th Director of the U.S. Geological Survey in November 1998. He came to this position from the University of Texas at El Paso where he was Associate Vice President for Research and Sponsored Projects following a term as Director of the Center for Environmental Resource Management. His previous experience includes Associate Director and Acting Director of the University of Texas at Austin Bureau of Economic Geology, Chairman of the Department of Geological Sciences at the UTEP, State Geologist and Director of the Louisiana Geological Survey, Executive Director of the American Geological Institute, and Executive Director of the LSU Center for Coastal, Energy and Environmental Resources. He has been a member of the National Research Council Board on Earth Sciences and Resources and the Outer Continental Shelf Policy Board. Chip is a past President of the Association of American State Geologists and the Energy Minerals Division of AAPG. He holds a Ph.D. in geology from the University of Texas at Austin.*

USGS U.S.-MEXICO BORDER ENVIRONMENT AND HUMAN HEALTH INITIATIVE

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I'm going to talk about our border health initiative, but before I start on that issue, I can't resist the temptation to say a few things about some topics that were addressed earlier. One in particular is the critical importance of streamgaging–maintaining the network across this country that provides the information needed to manage critical water resources.

When people thought that water resource issues were principally found in the West and particularly the Southwest, there was less national visibility for water supply issues. But look today at the web page that shows our streamflow information, and you'll see real-time information from across the country plotted on what we call a "drought map," a map on which red and orange and yellow indicate bad-news areas and green and blue show the good news. You'll find that the Nation is endowed–or cursed, I should say–with lots of red and yellow dots on the map, indicating low, and in some cases record low, streamflow.

Many parts of the country share your dilemma, though not to the degree or perhaps with the gut-wrenching importance that it has here. But this ongoing drought has increased the visibility of the water supply situation across the country, not only in the West and in the Southwest, but in the East, where a drought has brought many people who never worried about water to a stark realization that their shallow wells and fractured-rock aquifers are going dry by the hundreds. They now realize that even Easterners need to worry about water.

That can't help but improve the national understanding of the water resource situation—a situation that is critical even in times of normal supply, because of our booming population, but that becomes particularly stressed in times of drought. So the need for an adequate, federally supported streamgaging system that meets the needs of this country has never been higher.

At the time of my confirmation hearing with the Senate, I made the rounds to the people on the Energy and Natural Resources Committee. When I met Senator Domenici, his first question was, "Is the fact that you're from Texas going to be a factor in your administration of this job, and do you have any prejudice in favor of Texas and against New Mexico in water issues?" I assured him that it wouldn't and I didn't. Even if I did, the fact is that we at USGS don't regulate anything, we don't manage anything, we don't set policy. We're a science organization, and personal preferences don't affect the outcomes of our research.

I will close with a few comments about water resources, particularly groundwater resources. But first let me focus on my main topic today: the U.S.-Mexico border health initiative. This may lead people to wonder whether the USGS has run out of things to do in dealing with environment and natural resources issues. But that's not the case. The fact is that the health initiative is really built on the traditional expertise and the core capabilities that the USGS has in water issues, in geochemistry, in surface and bedrock geology.

This expertise, and the information that we've been developing over decades, is relevant to many issues including animal and human health, not only to the health of the environment and the health of our natural resources. For example, in Fallon, Nevada, water-quality information that we've been gathering for a long time recently came into play as health officials started correlating leukemia clusters to the quality of water and particularly to levels of some of the radioactive elements in the water.

The arsenic in New England's groundwater has been linked to bladder cancer occurrences, so USGS is working with the Maine, New Hampshire, and Vermont departments of health and with the National Cancer Institute to develop an understanding of the distribution of groundwater and fractured rocks that contain arsenic and the correlation with occurrences of bladder cancer—a topic that is of great interest to the National Institutes for Health. The West Nile virus, which is now spreading across the country, was largely charted in its early stages by the USGS through our National Wildlife Health Center in Madison, Wisconsin.

In 1996, a biology unit joined our geology, mapping, and water units. The biology role within the USGS relates not only to wildlife health issues but also to human health issues. As more and more wildlife come into contact with humans and as we spread into their habitats, their diseases have a tendency to become our diseases—or at least our concern. Chronic wasting disease (CWD), for example, which is affecting deer and elk in many states in the West and Midwest, is something in which we have a significant role. CWD, though not known to infect livestock or people, is related to mad cow disease, the sheep disease scrapie, and Creutzfeldt-Jakob disease in humans.

USGS scientists played a large role in the aftermath of the World Trade Center collapse, looking at the dust that was developed there and what it might have carried into the lungs of firefighters and residents as they worked and lived in the area. The large clouds of dust that cross the Atlantic Ocean from Africa and get into the Caribbean and South Florida are significant factors in asthma and air pollution in the region, and we are making strong contributions to understanding how and where the dust travels.

We do a lot of things that relate to human health, and we're really trying to find a way to make our work both better known and of greater value to the biomedical and public health fields. We're not changing what we do, but we're finding more applications for our traditional science.

Clearly water and health issues are interwoven to a large degree. Water plays a key role in transporting health threats, especially in areas where shallow alluvial groundwater is the drinking-water supply, as it is for many disadvantaged populations. This also happens to be where these populations dispose of their waste, either through septic tanks in good areas, or through less efficient methods in others. So the interaction between health threats and water supply is a very strong one.

It's especially pronounced in the U.S.-Mexico border region. This is an area where population growth is exploding. In 2000, the population of the ten U.S. and Mexican states in the region was 11.8 million, and it's expected to reach 20 million by the year 2020. So

the area's natural resources—water, energy, land—are all under stress, which will affect the region's ability to meet the health challenges.

There is a long list of challenges along the border that are related to health. The sprawling population is a significant factor because it affects the demand for water as well as for land and energy. Motor vehicles are increasing, and their exhaust pollutes the air but also gets into the water. The growing population is generating increasing amounts of waste, both industrial and domestic, in an area that doesn't have all the resources it needs to treat those wastes. Raw sewage and untreated wastewater still, in parts of the border region, get into the surface channels and in some cases intermix with the water supply, carrying viruses and bacteria and hazardous wastes that can affect human health. Water is often an important transporter of contaminants. In the most fundamental sense, the region lacks adequate supplies of clean drinking water, which forces people to use water that is of lower quality, leading to more threats from water-borne diseases.

These health threats are motivating many of us in the science business and the business of gathering information about the environment, to portray this information in ways that might have some value in understanding the relationship of these factors to health. We ought to be making that information available, and that's the goal of this initiative.

In addition, it is a bi-national area, so this is not a United States border issue, it is a Mexico-U.S. border issue. We face the challenge and the opportunity to find ways to link this initiative across the border, not only with the science agencies, but with the cooperating public health agencies that make use of this information. The border area is drained by two international river basins, most notably the surface waters of the Rio Grande/Rio Bravo system. River waters are seriously challenged–not only the Rio Grande but the Colorado River as well. Regional aquifers also cross the border and are seriously overdrawn in many places. And when you add the fact that the consumptive use is close to or even greater than the renewable water supply in these basins, the result is a very complex setting of health-related problems and critical water supply challenges.

In this new initiative, we're building on core capabilities, in both the earth and the biological sciences, and we are partnering with people who are in the health business. We're not a health organization, and we don't plan to change to become one, but we have much health-related information to contribute. The National Institute for Environmental Health Sciences (NIEHS) expressed great interest in our work, as they looked at the populations at risk in areas where the environmental issues were not clearly understood. What is the distribution of pathogens in the environment? What is the distribution of pesticides and herbicides in soils and in waters? What is the distribution of geologic elements, those metals and those anions that affect health? How can we understand their distribution in relation to the patterns of occurrences of health problems and of health threats? We have a wonderful technology to do that. Geographic Information Systems (GIS) let us portray geologic, hydrologic, geochemical, and medical information and relate it to populations that are threatened by or are presently suffering disease.

The NIEHS and its partners, principally universities and health organizations discovered that the information we collected, using our scientific capabilities and working with our partners, was extremely useful to them. They can be the translator into their field, and we can be the developer in our field. So we're going to develop environmental information from the USGS, and also from other sources, in formats useful to the health community. It's critically important that the communication lines stay open, that the customer and the partner keep talking with the developer, to make sure we develop products that they can use because we are providing these products and this information to a non-traditional audience. During the first year, we're going to spend a lot of time analyzing existing data sets, compiling those data sets, assessing the gaps in information, and then working with our partners to better understand what they need.

Let me wrap up by pointing out specifically what we're going to do and what the next steps might be as they affect not only New Mexico but other parts of the border region. When we start all this we'll be affected by the '03 budget. The FY2003 appropriations process is stalled. We are operating under continuing resolution that will run through early January 2003, which delays any new starts that were planned for '03.

When we do begin, we will prepare health-focus summaries of toxic substances using GIS technology, including data on their distribution in the environment and the natural concentrations in rocks and soils. We have to remember that the earth does things in its own

way that humans have no influence over. So knowing where the rocks and soils are, the natural waters that provide these materials, is of great importance. We've been in that business for a long time. We want to characterize the natural processes that actually control the occurrence and the mobility and the distribution of these elements in the border region. We want to produce environmental geologic maps that relate environmental factors to the geology, that relate environmental factors to the hydrology, that show the distribution of elements, including such things as selenium and arsenic and uranium, that have health implications.

And we want to work with the health sciences to determine where these elements are exposed to populations who either have health problems or who are most at risk for problems. Last September, the group that is developing a plan for this initiative decided that the first effort would be in the Brownsville-Matamoras region—not just in the city, but extending into the lower valley of Texas. And one reason for choosing this area is that clearly our largest information system is there among the major urban areas along the border. We're going to review all the information that's available, we're going to combine it into a single database, we're going to look at additional source of data and download them, and then we're going to do the spatial analysis of these data.

We have to be thinking for the long-term, though. After we put this product together, if it's useful to the health community and if it's useful to others, what are the next steps? There may be data gaps in the original work done by us and by our partners that need to be filled. We need to conduct focused research with the health community as to what these relationships really mean, because relationships themselves don't necessarily mean causality. We need to determine whether there is a link. Or rather, in this case, they—our partners at NIEHS and elsewhere–need to determine it, because they are the health professionals. And we need to look at other areas along the border where we're going to expand this work on the basis of need.

This effort need not be limited to the border area. There are other parts of this country where human health is affected significantly by environmental factors related to the distribution of elements in the environment, a few of which I described briefly earlier in this talk. We also need to be sure that we're very strong in the partnership aspects. As I said earlier, we're not a health bureau, we're an environmental and natural resource organization. We develop reliable, unbiased information that can be used by others, in the health field and beyond.

We're really looking forward to working with our partners–the health centers, NIEHS, other government agencies–to provide this valuable information that will promote public health. Seen in a new light, our information can be applied to new uses that will be good for the border, be good for this state, and be good for the economic as well as the environmental health of the Nation.

Let me close then with just a couple of comments about groundwater supply, particularly on the border. As I said earlier, and as you all know, clean water and health are related. The importance of water supplies as a critical element in the economy and well-being of this region, New Mexico and the border, has been clearly demonstrated this morning. In fact it's hard for a talk on prospective health problems to be good news in light of all the challenging situations that have been described this morning and that are likely to be faced in the future.

But one of the best hopes we have, though it maybe a marginal one in the projected water situation, is looking at what we can do to develop new supplies. It's been clear that the surface supplies are already over-extended, even in good times, and in difficult times even more so. The likelihood that we're going to find new surface water is not very great, unless we have some significant climate change that brings us more water to work with. But an area where we don't know enough–and that's not just true in New Mexico, it's not just true on the border, it's true across the country–is our groundwater supplies. In many places we've done a fairly thorough job of developing groundwater for municipal, agricultural, and industrial use. But in many other places we haven't, because we haven't had to.

In areas now subject to drought, groundwater supplies are increasingly being looked to as an important resource for the future. I'm sure you've all read about the conflicts over water supply, endangered species, and irrigation issues over the past few years in the Northern Klamath Basin. We're doing significant work with the Oregon Water Resources department to characterize and model the groundwater system there. One hope is that perhaps unappreciated or inadequately understood groundwater supplies could

contribute to the water needs in that area. Groundwater may be the only hope for additions to the water supply there.

Are there other parts of the country where if we better characterize our groundwater supplies, we might open the door to some new supplies to meet our increasing needs? I think the answer is yes.

Fresh water is obviously the most desirable source of water, and if we can find new supplies that are immediately useable that's the best and quickest solution. But what's less obvious is that we have huge resources of saline waters in this country. We talk about the Pecos, we talk about the Canadian in this area, with saline water issues, but there are large amounts of surface flow across the country that are not used to the degree they could be because of their salinity. The same is true in the groundwater system. We haven't paid a lot of attention to characterizing, to inventorying, to understanding the chemical composition of the waters in the subsurface and their distribution, or to understanding the characteristics of the aquifers they occur in, because there aren't many people pumping salt water out of the ground on purpose, for practical use.

Now they're pumping it out in oil fields to get rid of it, but they're not pumping it out for practical use. As desalination technology has advanced, and as we increasingly are faced with critical water-supply needs, can we afford to ignore not only those groundwater resources that we don't understand that are fresh, but also the far larger quantities of saline water resources? We must study and characterize and understand them to enable advances in brackish-water conversion and saline-water conversion that will, in the long run, significantly increase our water supplies.

The Bureau of Reclamation, assisted by Sandia National Laboratories, has been developing a blueprint for advances in desalination technology across the West. We've been making the argument, which has received positive attention from Commissioner John Keys and others in Reclamation, that there needs to be a characterization of the saline water resources, particularly the groundwater resources, but including a good understanding of our saline or brackish surface-water resources. So that parallel with our engineering accomplishments in desalination technology and the economics that are moving toward making it a more favorable technology, we also develop a solid understanding of the water we're going to desalinate. No one wants to find out they've designed systems that are incompatible with the characteristics of the feed-water supply.

This characterization of the resource base is the job of those of us in the earth science business, in the hydrology business. It's the job of our water resources discipline within the USGS. It's the job of our partners in the state water agencies and the state geological surveys and water resources research institutes in the universities, particularly in New Mexico and the southwestern states, but in the West in general. The job is to put together an understanding of those saline and freshwater resources and to create better models of the resources that can be used by decision makers, like the Stream Control Commission and the state engineer, in understanding those resources and making decisions with appropriate input from streamgaging, from inventory assessment, and from modeling.

That's a challenge. So a parallel effort to the border health initiative is an initiative to fully characterize the water resources of the region, working with the partners I've just described, to lead to a better understanding of the surface-water resources and even more importantly, the groundwater resources in the border area, in the Southwest, and in the West.

In closing, let me reiterate that we look forward to working with you and all our partners to provide the essential scientific information on border environmental issues and water supply issues that will enable decision makers at all levels to ensure public health, public safety, and public prosperity.