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IMPROVING DROUGHT MONITORING AND FORECASTING: H.R. 5136, THE NATIONAL INTEGRATED DROUGHT INFORMATION SYSTEM ACT OF 2006

HEARING

BEFORE THE

SUBCOMMITTEE ON ENVIRONMENT, TECHNOLOGY, AND STANDARDS

COMMITTEE ON SCIENCE
HOUSE OF REPRESENTATIVES

ONE HUNDRED NINTH CONGRESS

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IMPROVING DROUGHT MONITORING AND FORECASTING: H.R. 5136, THE NATIONAL INTEGRATED DROUGHT INFORMATION SYSTEM ACT OF 2006

THURSDAY, MAY 4, 2006

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON ENVIRONMENT, TECHNOLOGY, AND STANDARDS,
COMMITTEE ON SCIENCE,
Washington, DC.

The Subcommittee met, pursuant to call, at 10:05 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Vernon J. Ehlers [Chairman of the Subcommittee] presiding.

HEARING CHARTER

SUBCOMMITTEE ON ENVIRONMENT, TECHNOLOGY, AND STANDARDS
COMMITTEE ON SCIENCE
U.S. HOUSE OF REPRESENTATIVES

Improving Drought Monitoring and Forecasting: H.R. 5136, The National Integrated Drought Information System Act of 2006

THURSDAY, MAY 4, 2006
10:00 A.M.—12:00 P.M.
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Purpose

On May 4, 2006 at 10:00 a.m., the Subcommittee on Environment, Technology, and Standards of the House Committee on Science will hold a hearing to better understand ways to forecast and predict occurrences of drought, which can have profound economic, social, and environmental impacts, and to receive comments on H.R. 5136, the *National Integrated Drought Information System Act of 2006* (see Appendix I for a section-by-section summary of H.R. 5136).

The Committee plans to explore these overarching questions:

1. How does the Federal Government currently forecast and monitor drought, and what are the major strengths and weaknesses of these systems?
2. What is the proposed National Integrated Drought Information System (NIDIS), and how would it improve the Federal Government's drought monitoring and forecast efforts?
3. What specific actions are needed to implement NIDIS, including data management, monitoring, and research, and how will H.R. 5136 promote those actions?

Witnesses:

Dr. Chester Koblinsky, Director, Climate Program Office, National Oceanic and Atmospheric Administration.

Mr. Duane Smith, Vice Chair, Western States Water Council; Representative, Western Governors' Association.

Mr. Kenneth Dierschke, President, Texas Farm Bureau.

Mr. Marc D. Waage, P.E., Manager, Raw Water Supply, Denver Water, Denver, Colorado.

Dr. Donald A. Wilhite, Director, National Drought Mitigation Center, University of Nebraska.

Background:

The National Oceanic and Atmospheric Administration (NOAA) estimates that drought results in total economic costs in the U.S. of $6 to $8 billion each year from such impacts as crop loss; premature livestock sales; degraded water quality; decreased tourism revenue from limited rafting, boating, fishing, golfing and skiing; decreased energy generation capacity; increased ground-water pumping costs; and reduced barge tonnage for commercial shipping. The total cost of particularly severe droughts, including economic impact and government aid to affected communities, has exceeded $60 billion in the past. While drought is not sudden or violent, it can be among the most devastating of natural disasters, and it affects all parts of the country. In every one of the hundred years ending in 1995, some part of the United States has experienced a severe or extreme drought.

Experts in drought mitigation contend that substantial losses due to drought are not inevitable. With adequate prior knowledge of a coming drought, the extent and severity of many impacts can be substantially mitigated. For example, urban water managers can change reservoir release schedules and impose pre-drought water restrictions; agricultural users can alter crop choice and timing of planting to minimize water needs and potential crop loss, including changing crop rotations and use of strategic irrigation techniques; forest managers can alter fire suppression and mitigation plans, including pre-positioning of assets and people, and can heighten public awareness of wildfire prevention needs; waterway managers may be able to plan water releases and dredging activities to maintain open waterways; managers of animal stocks can budget for increased feed costs and can sell excess stock when prices are more favorable; energy providers can manage to reservoir levels and fuel supplies to minimize cost increases due to reduced hydro-power capacity.

Substantial investments by Federal, State and local governments have targeted research on and monitoring of droughts. However, these efforts have generally been unconnected and uncoordinated. Many researchers and water users believe that tying together and building upon current drought research and monitoring efforts will result in significant improvements in forecasting of, planning for, and mitigation of drought and its impacts.

NOAA Drought Forecasting and Research Funding History

NOAA spends approximately $10 million annually on drought research, monitoring, and forecasting. However, this amount does not reflect NOAA's indirect investment in drought which includes expenditures on satellites and other tools that provide data and services that support a broad range of climate research, monitoring, and forecasting in addition to drought. Quantifying the total contribution to drought monitoring and forecasting by NOAA and other federal agencies is impractical (and virtually impossible) because of the many programs and data streams that contribute to, or can be utilized in, these efforts.

Before Fiscal Year 2007 (FY07), NOAA's budget did not include a specific request for drought research, monitoring, and mitigation efforts. Beginning in FY07, NOAA is requesting $7.8 million directly in support of the National Integrated Drought Information System (NIDIS). Of this amount, $4.0 million will sponsor research and research-to-operations transition projects and $3.8 million will support monitoring through the Climate Reference Network and improvements in regional observation systems required by NIDIS.

Development of a National Integrated Drought Information System

Experts believe that recent advances in statistical analysis could yield increased objectivity, accuracy and reliability in future drought forecasts. To facilitate development of a more comprehensive, real-time drought information and forecasting system, NOAA collaborated closely with other federal agencies, the Western Governors' Association (WGA) and other stakeholders to identify the drought product needs of State and local users and developed a plan for a National Integrated Drought Information System (NIDIS). The key goals of NIDIS are:

- to expand monitoring and data collection systems to include coordinated, comprehensive coverage of key indicators such as soil moisture and ground water;
- to implement an integrated data collection and dissemination system; and
- to develop effective and useful tools to support analysis and decision-making at all levels and geographic scales.

Coordination of monitoring efforts across agencies is expected to lead to more efficient and effective data collection, decreased duplication of effort, and more even and complete monitoring of critical regions. Expanded monitoring will include collection of soil moisture data (soil moisture is currently modeled but only sparsely measured) and more comprehensive ground water measurements.

Also as part of NIDIS, NOAA will develop a web portal as a single point of information for users of drought related information and tools, eliminating the need for water managers to collect data from multiple sites, in multiple formats. Part of the NIDIS plan includes development of new and higher-resolution tools to allow users to more closely examine the drought risk in their state, watershed, and county. NOAA also expects to significantly increase drought forecasting skill through an initiative to statistically re-evaluate drought-related data from the past 100 years. This effort is expected to yield a better understanding of the conditions that lead to drought in all regions of the country, providing information that NOAA scientists can use to improve drought prediction models. NOAA projects that it will take five to six years to fully implement NIDIS with gradual improvement in NOAA's

drought monitoring and forecasting capabilities occurring throughout the implementation process.

Weaknesses in Current Federal Drought Monitoring and Forecasts

Water managers, water users, and drought researchers have identified four primary weaknesses in the current drought monitoring and forecast system. First, no mechanism currently exists to comprehensively assess the extent, severity, or impacts of drought throughout the United States. Partly due to the lack of a standard definition of drought, and partly due to the existence of many disparate monitoring efforts, local governments each use different sets of indicators and triggers to determine when a drought occurs. Equally important, there is no comprehensive effort across all levels of government to measure the impacts of drought, leaving decision-makers in the dark as to the extent and severity of the agricultural, economic, and social consequences of drought.

Second, not all of the data collected by federal programs are delivered in a timely fashion, and in compatible formats. Some of the data come from cooperative programs that require periodic collection and delivery of the data, whereas other data are collected in a continuous manner. Furthermore, different federal programs use different data formats, making the combination of data from multiple sources difficult.

Third, current drought monitoring and forecast products—the U.S. Drought Monitor map and U.S. Seasonal Drought Outlook map, both described below—provide general guidance on current and future drought risk, but are updated infrequently and do not provide fine enough detail to meet the operational needs of most water managers and users. While water managers can use these tools to communicate the state and trends of drought, the maps do not distinguish drought conditions on an individual reservoir or watershed level, which is the level at which water managers need to make operational decisions.

Finally, there is no single coordinating agency that operates a clearinghouse or a prediction model incorporating the drought-related data and tools produced by the many federal, State, and local agencies that work on drought management and collect drought-related information. Current drought forecasts provided by the Federal Government involve manually collecting data and products from the many federal, State, tribal and local sources, subjectively weighing the value of the many forecast parameters and indices that may influence drought conditions, and manually drawing maps to represent "best estimates" of drought risk throughout the country.

Description of Current National Drought Monitoring and Forecast Products

Beginning in 1999 and 2000, the Federal Government began providing two major drought products as low-resolution national maps: the Drought Monitor, and the U.S. Seasonal Drought Outlook. Examples of these products are in Appendix II.

The Drought Monitor map (updated weekly at *http://www.drought.unl.edu/dm/monitor.html*) is an assessment product produced after consultation among scientists at NOAA, USDA, and the University of Nebraska. Published weekly since late 1999, it provides an overview of national-scale trends in drought extent and severity that attempts to synthesize many sources of drought-related information.

In contrast to the Drought Monitor which assess current conditions, the U.S. Seasonal Drought Outlook is a forecast that has been produced since March 2000 by NOAA's National Climate Prediction Center. This monthly map and accompanying information provide a seasonal-scale prediction of general, large-scale drought trends and can be found at: *http://www.cpc.noaa.gov/products/expert_assessment/seasonal_drought.html.* More details of the Drought Monitor and Seasonal Drought Outlook, and the data and indices on which they are based, are in Appendix III.

Water managers use the Drought Monitor and Seasonal Drought Outlook to communicate with decision-makers and the public. For example, water management authorities in the Denver area use these maps to help city officials and the public understand the need for water restrictions in municipal areas.

H.R. 5136, the National Integrated Drought Information System Act of 2006

H.R. 5136 was introduced on April 6, 2006 by Mr. Hall and Mr. Mark Udall. The bill establishes NIDIS and designates NOAA as the lead agency. It specifies that NOAA will coordinate with local, State, and federal entities to create a comprehensive network of drought information and provide decision-makers with the tools to manage water resources. A section-by-section summary of H.R.5136 is in Appendix I.

At a hearing by the Senate Committee on Commerce, Science, and Transportation on April 27, witnesses and Members expressed support for H.R. 5136, including an endorsement by NOAA of the authorized spending levels.

Witness Questions:

The witnesses were asked to address the following questions in their testimony.

Dr. Chester Koblinsky, Director, Climate Program Office, National Oceanic and Atmospheric Administration.

1. Please describe the drought monitoring and forecasting information currently provided by NOAA and other federal agencies.
2. What are the major components of NIDIS and what specific actions are needed to fully implement NIDIS? In particular, what is the timing of these actions and the budget needs to implement the program?
3. How would the proposed National Integrated Drought Information System (NIDIS) improve the quality and usefulness of the drought monitoring and forecasting information provided by the Federal Government?
4. Please provide specific comments on H.R. 5136, the *National Integrated Drought Information System Act of 2006.*

Mr. Duane Smith, Vice Chair, Western States Water Council; Representative, Western Governors' Association.

1. What are the major strengths and weaknesses of drought monitoring and forecasting information currently provided by the National Oceanic and Atmospheric Administration and other federal agencies? How do states use this information to inform water resource management decisions?
2. How would the proposed National Integrated Drought Information System (NIDIS) improve the quality and usefulness of the drought monitoring and forecasting information provided by the Federal Government?
3. Please provide specific comments on H.R. 5136, the *National Integrated Drought Information System Act of 2006.*

Mr. Kenneth Dierschke, President, Texas Farm Bureau.

1. What are the major strengths and weaknesses of drought monitoring and forecasting information currently provided by the National Oceanic and Atmospheric Administration and other federal agencies? How does the Texas agricultural community use this information?
2. How would the proposed National Integrated Drought Information System (NIDIS) improve the quality and usefulness of the drought monitoring and forecasting information provided by the Federal Government?
3. Please provide specific comments on H.R. 5136, the *National Integrated Drought Information System Act of 2006.*

Mr. Marc D. Waage, P.E., Manager, Raw Water Supply, Denver Water, Denver, Colorado.

1. What are the major strengths and weaknesses of drought monitoring and forecasting information currently provided by the National Oceanic and Atmospheric Administration and other federal agencies? How do you use this information to inform water resource management decisions?
2. How would the proposed National Integrated Drought Information System (NIDIS) improve the quality and usefulness of the drought monitoring and forecasting information provided by the Federal Government?
3. Please provide specific comments on H.R. 5136, the *National Integrated Drought Information System Act of 2006.*

Dr. Donald A. Wilhite, Director, National Drought Mitigation Center, University of Nebraska.

1. Please describe the drought monitoring and forecasting information currently provided by NOAA, other federal agencies and the National Drought Mitigation Center. Also, please describe the functions of the National Drought Mitigation Center and how it differs from the proposed National Integrated Drought Information System (NIDIS).
2. How would the NIDIS improve the quality and usefulness of the drought monitoring and forecasting information provided by the Federal Government?

3. What are the major data management, monitoring and research components of NIDIS and what specific actions are needed to fully implement those components?
4. Please provide specific comments on H.R. 5136, the *National Integrated Drought Information System Act of 2006.*

Appendix I:

Section-by-Section Summary of H.R. 5136, the National Integrated Drought Information System Act

Section 1. Short Title.

National Integrated Drought Information System Act of 2006.

Section 2. Definitions.

Defines two terms: 1) "drought" means a deficiency in precipitation that leads to a deficiency in surface or subsurface water supplies and that causes (or may cause) substantial economic or social impacts or physical damage or injury to people, property, or the environment; 2) "Under Secretary" means the Under Secretary of Commerce for Oceans and Atmosphere.

Section 3. NIDIS Program.

Directs the Under Secretary to establish the National Integrated Drought Information System (NIDIS) through the National Weather Service and other appropriate programs in NOAA.

Specifies that the system shall provide an effective drought early warning system and shall coordinate and integrate federal research in support of the system. Specifies that NIDIS: be a comprehensive system that collects and integrates information on drought for usable, reliable, and timely drought assessments and forecasts; communicate forecasts, conditions and impacts to the public and private sectors, and decision-makers at all levels of government in order to aid timely, informed decisions leading to reduced impacts and costs; include timely and real-time information and products reflecting local, regional, and State differences in drought conditions.

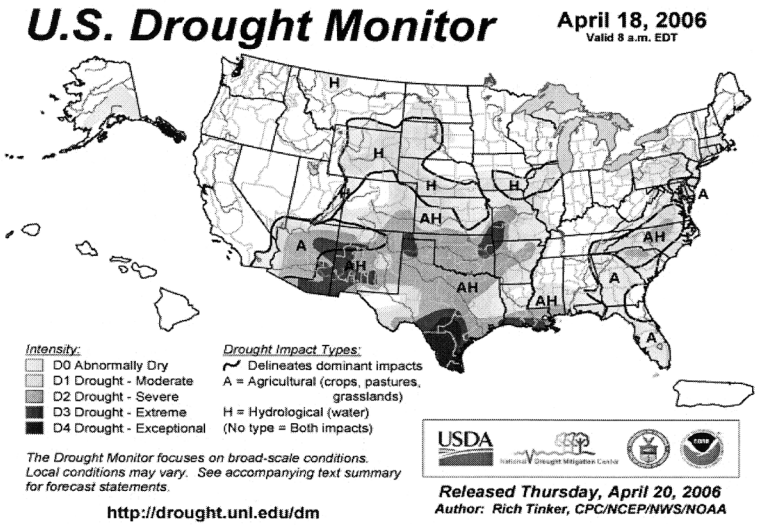
Directs the Under Secretary to consult with relevant federal, regional, State, tribal and local agencies, institutions, and the private sector in the development of NIDIS. Requires each federal agency to cooperate with the Under Secretary as appropriate in carrying out the Act.

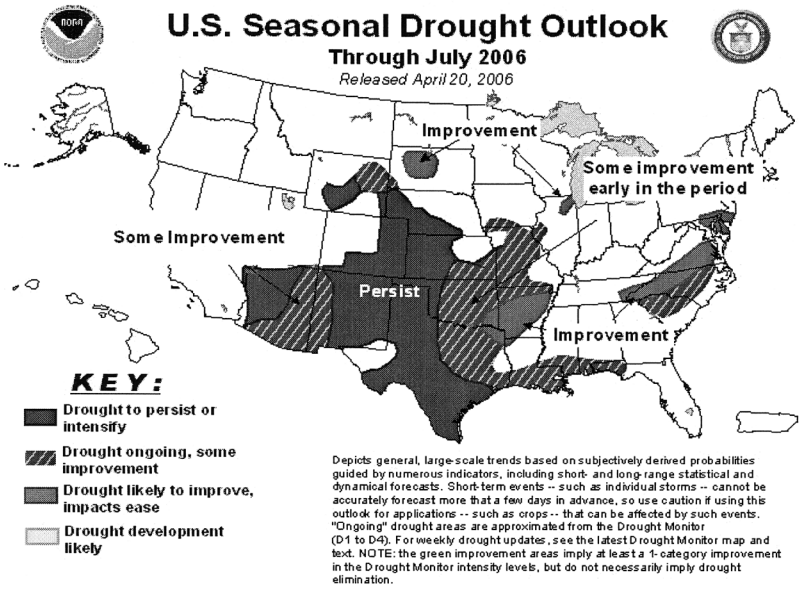
Section 4. Authorization of Appropriations.

Authorizes $12 million for FY07, $14 million for FY08, $16 million for each of FY09 and FY10, and $18 million for each of FY11 and FY12.

Appendix II:

Drought Monitor and Seasonal Drought Forecast Maps





Appendix III:

Definitions and Assessments of Drought

The American Meteorological Society's Glossary of Meteorology (1959) defines drought as "a period of abnormally dry weather sufficiently prolonged for the lack of water to cause serious hydrologic imbalance in the affected area." In lay terms, a drought is an abnormally long period of dry weather that causes serious problems such as crop damage and/or water supply shortages. As stated by NOAA, drought can be defined in one of four ways:

(1) Meteorological: refers to a situation when precipitation is below normal levels for that region.

(2) Agricultural: refers to a situation where the amount of moisture in the soil no longer meets the needs of a particular crop.

(3) Hydrological: refers to a situation when surface and subsurface water supplies are below normal.

(4) Socioeconomic: refers to the situation that occurs when physical water shortages begin to affect people.

The U.S. has engaged in quantitative monitoring of drought for over 40 years. The Palmer Drought Severity Index (PSDI), developed in 1965, was the first attempt to comprehensively quantify drought in the U.S. The most widely used of the drought indices, it incorporates temperature and rainfall information and is considered effective at monitoring the development of long-term droughts in regions that do not rely on snowpack for water. However, the PSDI is severely limited in its ability to identify fast-developing events.

In order to fill the need for monitoring fast-developing agricultural drought, experts developed the Crop Moisture Index (CMI) in the late 1960s. The CMI places greater emphasis on recent measurements and is therefore considered much more effective at monitoring fast-developing droughts but is considered ineffective in the context of long-term droughts because it only incorporates short-term water availability information.

In the 1980s and 1990s, new indices were developed to help monitor drought in individual basins (the Surface Water Supply Index) and to help track the impact of precipitation on the different components of the hydrological cycle (the Standardized Precipitation Index). Each of these indices must be calculated for different regions and conditions, and no single index meets the needs of all users.

Assessment of drought draws on a variety of environmental data, some of which are collected explicitly to monitor drought, and some of which are collected for multiple needs. Drought-related monitoring has grown to include numerous federal agencies: the U.S. Department of Agriculture (USDA) manages snow pack information; the Army Corps of Engineers and U.S. Bureau of Reclamation manage reservoir storage data; NOAA manages hydroclimatic data (i.e., precipitation and other weather-related data, including satellite data); the U.S. Geological Survey (USGS) manages ground water and streamflow information; and NOAA and the Environmental Protection Agency work with states and tribes to manage various water quality programs.

All of this information is used to develop the U.S. Seasonal Drought Outlook and the weekly Drought Monitor described in the main text of this charter. The Drought Monitor uses these categories to described drought conditions:

Category	Description	Possible Impacts
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures; fire risk above average. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered.
D1	Moderate Drought	Some damage to crops, pastures; fire risk high; streams, reservoirs, or wells low, some water shortages developing or imminent, voluntary water use restrictions requested.
D2	Severe Drought	Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed.
D3	Extreme Drought	Major crop/pasture losses; extreme fire danger; widespread water shortages or restrictions.
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; exceptional fire risk; shortages of water in reservoirs, streams, and wells, creating water emergencies.

Chairman EHLERS. Good morning. This hearing will come to order.

I would like to welcome everyone today to today's hearing, entitled: "Improving Drought Monitoring and Forecasting," encompassed in bill H.R. 5136, the *National Integrated Drought Information System Act of 2006*.

We are pleased to have you here, and pleased to have our panel of witnesses here on this hearing on improving drought monitoring and forecasting. I am pleased that we have such an excellent panel today to help us understand drought and its impacts on society, and most importantly, what we can do to better prepare for it and reduce these impacts.

I suspect most Americans are not aware of how serious the drought problem can be in this country. We tend to hear about drought in other countries, particularly Third World countries, become very concerned about it, but often neglect when it occurs in our own country, because it is usually a smaller area. But drought is a pernicious disaster. It can creep up on you in the form of pleasantly cloudless days, which most people love, but once it has arrived, it can destroy livelihoods, damage valuable ecosystems, and even threaten human health.

NOAA, the National Oceanic and Atmospheric Administration, estimates that we lose around $7 billion each year to this slowly emergent but devastating natural disaster. Since we cannot manufacture more water, our best defense against this creeping threat is knowledge and water conservation. We must provide clear and accurate warnings of coming droughts, so that we can seek appropriate solutions, and take preventive actions, such as increase water conservation, and better use of water.

Drought information should include enough details to make it useful for the people who work so hard to manage water resources, and minimize the effects of drought on our daily lives. The *National Integrated Drought Information System Act* seeks to provide just that kind of information. I am glad that my colleagues Ralph Hall and Mark Udall have brought this issue to our attention with their bill. I am pleased to welcome Mr. Hall to join our subcommittee today, and will recognize him in a moment for a brief statement.

It may be surprising to find out that someone who lives in the middle of the Great Lakes, in a state that has 11,000 small lakes, and borders four of the five Great Lakes, is concerned about drought, but I am very concerned about it. I am also very pleased that my home state of Michigan has taken major steps in water conservation. It is perhaps because we have so much of it, and value it so much, that we are concerned about this issue. Clearly, other States would love to have our water, and it is surprising to some to realize that we have droughts in Michigan as well. Certainly not as serious as those in the Southwest, but I was struck recently by a friend of mine who visited the Southwest, and came back amazed that we have better water conservation programs in effect in Michigan than they had in this arid Southwestern state that she visited.

So, we have much to learn from each other in this matter, and I appreciate the efforts put forward by my colleagues Ralph Hall

and Mark Udall in presenting this issue to us, and coming forward with this bill.

At this time, I am pleased to recognize Mr. Hall, to welcome him to our subcommittee, and recognize him for an opening statement.

[The prepared statement of Chairman Ehlers follows:]

PREPARED STATEMENT OF CHAIRMAN VERNON J. EHLERS

Good morning. Welcome to today's hearing on improving drought monitoring and forecasting. We have an excellent panel today to help us better understand drought and its impacts on society—and most importantly—what we can do to better prepare for and reduce those impacts. Drought is a pernicious disaster; it can creep up on you in the form of pleasantly cloudless days, but once it has arrived it can destroy livelihoods, damage valuable ecosystems, and even threaten human health. NOAA estimates that we lose around seven billion dollars each year to this slowly emergent, but devastating natural disaster. Since we cannot manufacture more water, our best defense against this creeping threat is knowledge. We must provide clear and accurate warnings of coming droughts so that we can seek appropriate solutions and take preventive actions, such as increased water conservation. Drought information should include enough details to make it useful to the people who work so hard to manage water resources and minimize the effects of drought on our daily lives. The *National Integrated Drought Information System Act* seeks to provide just that kind of information.

I am glad that my colleagues, Ralph Hall and Mark Udall, have brought this issue to our attention with their bill. I am pleased to welcome Mr. Hall to join our subcommittee today and recognize him for a brief statement.

Mr. HALL. Thank you, Mr. Chairman, and honored to be here, honored to be on a bill with Mark Udall.

I thank you and the Committee for holding this hearing on a very important topic, and I thank you men for your appearance here. I know it takes time and effort and background and knowledge, and then your day to come here to testify. You have a good Chairman, a knowledgeable Chairman. Our Chairman is the kind of fellow that I always admired but didn't like much in college, because he ruined the curve for guys like me. He is one of the better educated, and one of the more brilliant Members of Congress, and I am honored to be associated with him, and with Mark Udall.

Like so many areas of the country, my district has been tormented with drought, so much that USDA has declared every county in my district as a primary disaster area. Droughts have a devastating effect on our local, State, and national economies. The National Oceanic and Atmospheric Administration estimates that it results in probably $6 to $8 billion each year to the economy, and it is clear that we need to do a better job preparing and mitigating this disaster.

The bill that Mr. Udall and I have introduced, H.R. 5136, will coordinate drought efforts between local, State, and federal entities, and provide decision-makers with the best tools to manage our natural resources. It addresses, actually, Mr. Chairman, a fundamental problem that our nation faces relating to drought monitoring. It helps coordinate what are now ad hoc efforts, and better disseminate useful information to the people who need it the most. And I am pleased that this bill is supported by the Western Governors Association, the Texas Farm Bureau, and the American Meteorological Society.

The bill designates NOAA, as the Chairman has said, as a lead agency to devise this integrated system. It directs NOAA to build a National Drought Monitoring and Forecasting System, create a

Drought Early Warning System, provide an interactive drought information delivery system, and designate mechanisms for improved interaction with the public. The bill will hopefully improve our analysis of conditions, provide us with more accurate seasonal forecasts, and equip us with a better understanding of the climate interactions that produce droughts. While we can't stop nature, we can do a better job of predicting, monitoring, and mitigating this devastating problem.

And I would like to welcome the panel of experts today, and I look forward to hearing your perspectives on that, and how we can better address the long-term problem. I would like to particularly welcome my friend Kenneth Dierschke, President of Texas Farm Bureau, and Steve Pringle, who is the hardworking long time Legislative Director and Executive Advisor for the Texas Farm Bureau. As a cotton farmer from San Angelo, Texas, I think Ken knows full well the effects of how drought affects our community and our economy, and he knows why we better need resources to address this problem.

One day, not in my lifetime or maybe in your lifetime, but I think we will have huge areas that consume the runaway water that wastes and goes on down to the sea, and use them at a time when they would waste into the river, and go, and have them for a time when we need them. I think that is far off, but I think we need to be thinking about that. They can be huge, like a thousand acres, in strategic places, to save water and protect water, because today, I am told by these kids that go around with a computer in one hand and a bottle of water in the other that they pay more for that bottle of water than you would for that much gasoline, so it is a pretty important thing today.

Mr. Chairman, thank you for this, and thank you for opening your Committee to my testimony. I yield back.

Chairman EHLERS. I am certainly pleased to welcome you and thank you for introducing this bill. I also appreciate your comment about intelligence, but as I have always said, Solomon had it right in the Bible. Wisdom is far more important than intelligence, and so, I always aspire to wisdom, and I must say you have considerably more than I have.

I am also pleased to recognize the other sponsor of the bill, Congressman Mark Udall from Colorado, and give him the opportunity for an opening statement.

Mr. UDALL. Mr. Chairman, thank you. If I might, I would yield to the Ranking Member, who is——

Chairman EHLERS. My apologies. I didn't see the Ranking Member come in. I am pleased to recognize Mr. Wu for an opening statement.

Mr. WU. Thank you very much, Mr. Chairman. We are holding a very important hearing today on Mr. Udall and Mr. Hall's bill.

Drought is a natural hazard that can be very, very costly, as costly as tornadoes and hurricanes, earthquakes, tsunamis. However, unlike these other events, droughts don't knock down buildings. They don't roar through. It is a slow process, an insidious process, frequently with no clear beginning point, and no clear endpoint. Now, we do have serious droughts in the State of Oregon, but like I say, on my side of the Cascades, the drought starts the

third day after the rain stops, so they do have a beginning point in our state.

As this country has repeatedly seen, drought's effects on the economy are just as severe as any other natural disaster, costing the U.S. economy from $6 to $8 billion, and in 1988, the costliest U.S. drought of the last 40 years, caused more than $62 billion in economic losses. We can improve on drought prediction, preparation, mitigation, and response.

Several of the Members of this committee represent areas of the country that frequently struggle with the effects of multi-year drought, notably my colleague, Mr. Udall from Colorado, and Mr. Matheson from Utah. At this time, I would like to yield my time to Mr. Udall for a statement about his legislation.

Mr. UDALL. Good morning. I thank the Ranking Member. I thank the chairman for calling this important hearing, and of course, it is always a pleasure and honor to sponsor a bill with Mr. Hall, who does have wisdom, as the Chairman pointed out.

I am looking forward to hearing from each of you today, and I would echo the comments of everyone on the panel. We appreciate your taking the time to join us, in some cases from faraway places. I think all of you know that the Western portion of the country has really experienced some very severe drought conditions over the past few years. I don't have to look any further than my home State of Colorado, where reduced precipitation, in addition to abnormally high temperatures, have caused extreme wildfire conditions, water restrictions, in some cases, a decline in tourism, reduced crop yields, and many other harmful effects.

There is no doubt that drought has been very harmful to our economy, but as the Chairman pointed out, it is not always addressed as a national disaster, because it is slow to develop. Unlike disasters such as tornadoes, droughts do not have a clear beginning or end, but rather, precipitation slowly declines, and our reservoirs and soil become increasingly drier. The Department of Homeland Security is preparing for natural disasters such as floods and hurricanes, but I don't think we are doing enough to mitigate and reduce the effects of drought.

Let me be clear. I don't want to disparage the efforts of NOAA and the Drought Monitor. This program provides important seasonal drought information that has aided countless communities to make decisions to respond to the drought conditions, but I believe there is more that NOAA can do to provide detailed seasonal and long-term drought monitors on a regional and localized basis, and I believe we must do this by making the information more easily accessible and more understandable to the general public.

You all will help us understand further that there are several federal agencies that have some involvement in drought monitoring or forecasts. Often, their information, however, is not available to the general consumer, or requires the user to visit several different locations to piece together an accurate picture of the conditions in their area. So, the federal investment in drought research and mitigation is only useful if decision-makers can obtain and utilize the information, and that is where I believe NIDIS could be most useful. Not only would it allow for more comprehensive drought moni-

toring and forecasting, but it can provide a one stop shop location for drought information.

Obviously, as one of the sponsors of this legislation, it is no surprise that I am supportive of the NIDIS proposal, but I am here today to hear from you all and your opinions will be very helpful, as we look to make some improvements, if necessary, in the legislation, and overall, put in place an even better drought monitoring system, so we cannot only prepare for today, but for the long-term.

So, Mr. Chairman, again thank you for holding this hearing. Judge Hall, it is always a real honor to join you in a legislative initiative, and thanks again for being here.

[The prepared statement of Mr. Udall follows:]

PREPARED STATEMENT OF REPRESENTATIVE MARK UDALL

First, I would like to thank the Chairman and Ranking Member for scheduling this hearing and markup and assisting the speedy consideration of this bill.

I would also like to welcome our witnesses here today. I am very interested to hear from each of you about your experiences with planning for drought as well as the potential for a system such as NIDIS.

As most of you know, the western portion of this country have experienced severe drought conditions in the past few years.

In my own home State of Colorado, the reduced precipitation in addition to high temperatures have caused extreme wildfire conditions, water restrictions, a decline in tourism, reduced crop yields, and many other harmful effects.

There is no doubt that drought has extremely harmful affects on our economy, however it is not always addressed as a natural disasters because it is slow to develop.

Unlike disasters such as tornadoes, droughts do not have a clear beginning or end, but rather precipitation slowly declines and our reservoirs and soil becomes increasingly drier.

While the Department of Homeland Security is working to prepare for natural disasters such as floods and hurricanes, the Federal Government is not doing enough to mitigate and reduce the effects of drought.

I do not want to disparage the current efforts of NOAA and the Drought Monitor. This program provides important seasonal drought information that has aided countless communities to make decisions to mitigate drought.

But I believe there is much more NOAA can do to provide detailed, seasonal and long-term, drought monitors on a regional and localized basis.

I also believe we must do this by making information easily accessible and understandable to the general public.

There are several different federal agencies that have some involvement in drought monitoring or forecasts.

Often their information is not available to the general consumer, or requires a user to visit several different locations to piece together an accurate picture of the drought conditions in their area.

The federal investment in drought research and mitigation is only useful if decision-makers can obtain and utilize the information.

This is where I believe NIDIS can be most useful. Not only will this allow for more comprehensive drought monitoring and forecasting, but also can provide a one-stop-shop for drought information.

As one of the sponsors of this legislation, it is no surprise that I am supportive of the NIDIS proposal.

But we are here today to hear from our witnesses about NIDIS.

And I am intrigued to learn their opinions about NIDIS and how it can be most effective as well as what improvements we can make to our drought monitoring systems to provide the most informative data.

I again thank our witnesses for joining us here today and look forward to your testimony.

Chairman EHLERS. Thank you. If there are any further Members who wish to submit additional opening statements, their statements will be added to the record. Without objection, so ordered.

[The prepared statement of Mr. Matheson follows:]

PREPARED STATEMENT OF REPRESENTATIVE JIM MATHESON

I want to begin today by thanking the Subcommittee on Environment, Technology, and Standards for holding this hearing and for bringing attention to an issue that resonates deeply with my constituents and residents in every state.

Only a few years ago, Utah experienced its worst drought in over two decades. As I witnessed the profound impact of water scarcity on agricultural crop losses, forest fires, and the day-to-day lives of Utahns, I felt it was time to focus national awareness on the topic of drought and its impact on Utah's economy and resources. In 2002, with the help of Science Committee staff, I hosted a similar Full Committee hearing in Salt Lake City entitled, *"Drought: Prediction, Preparation, and Response."* We put together an expert panel of witnesses who illustrated many of the major challenges posed by drought in the West today and highlighted the need to accurately predict and manage drought conditions in this country.

The people of Utah have always understood the scarcity and importance of water much more clearly than the Federal Government. The West was, is, and always will be a land of little rain. When the first settlers arrived in Utah over 150 years ago, they faced huge challenges in successfully finding and moving water so that they could grow crops and develop communities. Utah's booming population and rapid growth continues to test the State's ability to meet the increased water demands of its residents to this day.

Recently, Mother Nature has shown Utah her kinder, gentler side, at least temporarily. Last year was wetter than average and drought conditions have somewhat abated for most of the state. But some regions aren't so lucky. Drought continues to affect the American West but is also crippling the southern Great Plains and south Texas. History has shown that no portion of the U.S. is safe from the ravages of extreme or severe drought conditions.

I believe that part of the solution must include a long-term plan to better predict and prepare for the drought conditions we will face throughout the United States. I am pleased the Subcommittee is marking up the bill, H.R. 5136, the *National Integrated Drought Information System Act of 2006,* because I believe we need a single, comprehensive network of drought information to update the tools decision-makers need to accurately forecast drought and manage water resources. This bill is a good first step, but I believe we should also invest in data collection by funding the agencies that monitor snowpack, streamflow and soil moisture that would better enable us to predict a drought.

More importantly, I also believe we need a comprehensive federal drought plan that integrates different regional responses and preparation for drought. That is why I am a co-sponsor of bipartisan legislation, H.R. 1386, the *National Drought Preparedness Act,* which calls for improved drought forecasting similar to H.R. 5136. In addition, the *National Drought Preparedness Act* creates a national drought policy, provides additional tools for drought preparedness planning, and coordinates the delivery of federal drought programs.

Drought is not a problem we are going to solve this year. It is complex, and it will continue to affect our nation in profound ways. But I thank the Subcommittee for raising awareness of this issue and moving legislation that helps solve one piece of the puzzle by improving drought forecasting and monitoring. I look forward to all the testimonies today and to working with my colleagues on the Science Committee and in Congress to further address this critical issue.

Thank you.

Chairman EHLERS. At this time, I would like to introduce our witnesses, and several will be introduced by other Members who are here.

The first witness is Dr. Chester Koblinsky, Director of the NOAA Climate Program Office, and this committee has a great deal of interaction with NOAA. We are pleased to have you here.

I will now turn to Mr. Lucas to introduce our next witness.

Mr. LUCAS. Thank you, Mr. Chairman, and I appreciate the opportunity to do that, and I am extremely proud to introduce our next witness, who hails from my home State of Oklahoma.

Mr. Duane Smith holds a Bachelor's degree in meteorology from the University of Oklahoma, and although my district includes Oklahoma State, which by the way, is my alma mater. We are all aware of the top quality meteorological school at Norman, and I am

especially pleased to have him here to testify before the Subcommittee today.

Mr. Smith has been with the Oklahoma Water Resources Board for the last 28 years, acting as Executive Director since 1997. He oversees the agency's five action divisions that carry out programs entrusted to the Oklahoma Water Resources Board, and one of the Board's most successful programs is its billion dollar financial assistance program, designed to assist Oklahoma communities and rural water districts in meeting financial needs to provide good quality water to Oklahomans.

Mr. Smith is also Oklahoma's Commissioner to three of Oklahoma's Interstate Stream Compacts. He is the Oklahoma representative to the Interstate Oil and Gas Compact Commission, and serves as the Chairman of the Oklahoma Weather Modification Advisory Board. He serves on the State's Drought Response Team as Chairman of the External Advisory Board to the MESONET Council, something we are very proud of in Oklahoma, the MESONET system. And Mr. Smith was recently appointed by Governor Henry to represent Oklahoma on the Western States Water Council, where he most recently served as Vice-Chairman.

This committee is very honored to hear the testimony from Mr. Smith, and I look forward with the great insight he will provide us, and once again, thank you, Mr. Chairman, for the opportunity to do this today.

Chairman EHLERS. And thank you for attending.

The next witness is Mr. Kenneth Dierschke, and I don't have any background data, I am sorry, President of the Texas Farm Bureau. I had planned to have Mr. Hall introduce you, but he had to go to a different meeting. But we are pleased to have you here as well.

Next, Mr. Udall will introduce the next witness. Mr. Udall is recognized.

Mr. UDALL. Thank you, Mr. Chairman.

It is a pleasure to introduce Mark Waage, who is here from the Denver Water Board, his responsibilities include the raw water supply for this very significantly sized institution. Denver Water serves over one million people in the Denver area, and we all, but particularly Denver, depend on mountain runoff for our source of water.

This organization has extensive experience in water management during a drought, and planning for drought conditions. Mr. Waage's experience is just as extensive. He has served 18 years in his current position. He doesn't look any worse for wear, as I can testify. He attended Colorado State University, received Bachelor's and Master's degrees in civil engineering, with a specialty in water resource engineering.

He currently manages the collections and storage system along the eastern and western slopes of Colorado. As I mentioned in my opening statement, Colorado was, by most accounts, in a decade-long drought cycle, and as a result, Mr. Waage has had the challenging task of managing the scarce water supply for a major metropolitan area, while also taking into consideration the implications of water use, both environmentally and economically. I am really glad that you are here today, and look forward to hearing your testimony.

Thank you so much.

Chairman EHLERS. Thank you. And finally, we recognize Dr. Donald Wilhite, Director of the National Drought Mitigation Center.

Clearly, we have a good panel of experts here, and we look forward to your testimony. As the witnesses presumably have been told, that little black box in the center there will tell you what—how much time we have. You can do whatever you wish with your written comments. We don't mind if those are long, but we ask that your restrict your spoken presentation to five minutes. The green light will tell you that you are within the first four minutes. The yellow light tells you that you are in the last minute, and the red tells you you are in deep trouble. So, we would ask you to wrap up as quickly as you can once the red light goes on.

And we are pleased to start with Dr. Koblinsky.

STATEMENT OF DR. CHESTER J. KOBLINSKY, DIRECTOR, CLIMATE PROGRAM OFFICE, OFFICE OF OCEANIC AND ATMOSPHERIC RESEARCH, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, U.S. DEPARTMENT OF COMMERCE

Dr. KOBLINSKY. Good morning, Mr. Chairman, and thank you, and Members of the Committee. My name is Chet Koblinsky, and I am the Director of the Climate Program Office at NOAA.

Chairman EHLERS. Could you lift your microphone up, please?

Dr. KOBLINSKY. And I also serve as the leader of NOAA's Climate Mission Goal, which oversees the development of all climate activities across NOAA's various offices. I appreciate the opportunity to testify at this hearing about the National Integrated Drought Information System.

NOAA's climate programs provide the Nation with services and information to improve the management of climate sensitive sectors, such as energy, agriculture, water, and living marine resources. Our services address climate change and variability on timescales ranging from weeks to decades for a variety of phenomena including drought. Let me begin by describing some key drought monitoring and forecast information products currently provided by NOAA and other federal agencies.

While there is no single definition of drought that meets all needs, drought refers to a deficiency in precipitation over a period of time, resulting in a water shortage that impacts both human activities and the environment. In order to determine if drought conditions exist, NOAA scientists evaluate observations of precipitation, soil moisture, temperature, ground and surface water, as well as crop and vegetation conditions for the present and recent past. This information is incorporated into the U.S. Drought Monitor, a weekly update of drought conditions across the Nation.

The Monitor is the result of a truly collaborative effort among experts from NOAA, the U.S. Department of Agriculture, and the National Drought Mitigation Center at the University of Nebraska. The current version of the Monitor highlights severe to exceptional drought conditions in the Southwest, the Great Plains from Kansas to Southern Texas, the northern Gulf Coast, as well as Virginia and the Carolinas. If you have been following the weather maps,

however, over the recent week, you know that some of these conditions have changed.

To show where drought will likely persist, ease, or develop, NOAA produces a monthly U.S. seasonal drought outlook. The outlook combines informations from NOAA's suite of daily seasonal—or suite of daily to seasonal forecast products. The outlook forecasts drought conditions over the next three and a half months. The most recent outlook, produced and released on April 20, projected that the persistence of current drought conditions into July would occur, with some exception of relief on the eastern sides of the Great Plains and the Gulf Coast, and indeed, this has happened over the past weekend, with severe rains on the eastern side of the Great Plains and the Gulf Coast.

Drought is not a purely physical phenomenon. It is an interplay between water availability and the needs of humans and the environment. It is slow in onset, and its secondary effects, such as impacts on tourism, commodity markets, wildfires, or hydropower, are frequently larger than the primary effects, such as water shortages or crop losses.

In recognition of these facts, NOAA conducts regional and sector-based studies to improve the utility of our climate information products. Through the development of decision support tools, NOAA helps to build bridges between technical experts and decision- or policy-makers. The increasing demand for drought information has motivated the development of a broad-based plan for a National Integrated Drought Information System, or as it is sometimes known by its acronym, NIDIS.

Initially proposed in 2004 by the Western Governors Association, this is an ambitious program to significantly enhance the Nation's ability to monitor and forecast drought. It will create an early warning system, to enable the Nation to move from a reactive to a more proactive approach to drought problems. The key components are integrated observations, data systems, and forecasts; tools for analysis and decision support; research on monitoring, forecasts and impacts; and information dissemination and feedback.

In response to a recommendation from the Western Governors for NOAA to lead the National Integrated Drought Information System, we have initiated its development, in partnership with other federal, regional, and State organizations. For example, within the U.S. Integrated Earth Observation System Strategy, federal agencies have worked together to identify current conditions to a drought—excuse me, current contributions to a drought information system, as well as its critical gaps in observations and information delivery mechanisms.

At this point, we are developing an implementation plan for the National Integrated Drought Information System with these other federal and State agencies. However, the overall strategy for the development of the system can be posed as happening in three basic steps. The first would improve observations, such as the soil, moisture and groundwater networks, and consolidate data and its delivery through Internet portals. It would conduct research to improve analyses, forecasts, and decision support, and build pilot projects in the most critically affected areas. Then, using lessons

learned from these pilot projects, we would move on to improve observing networks, data products, decision support tools, and public feedback. And finally, expand the pilot projects into a truly national system. If supported, we project that it will take five to six years to fully implement NIDIS.

The President's fiscal year 2007 budget request for NOAA includes an increase of $5.7 million to support the information system. Of this amount, $4 million will support drought impact research, while the remainder addressees the climate reference network and regional climate services. In addition, the budget includes a program entitled "Explaining climate conditions to improve predictions," that would reconstruct and understand the climate of the 20th Century, that would enable us to understand the causes of the major droughts of the '30s and '50s.

The National Integrated Drought Information System will improve the quality and usefulness of drought monitoring and forecast information. It will pull together existing drought information and forecasts, including the Monitor and the outlook, with additional observations and research. By integrating federal, regional, and State information, the National Integrated Drought Information System will become a dynamic and accessible system to address the Nation's needs. It will provide users with the ability to determine the potential impacts of drought and their associated risks. It will provide the decision support tools needed to better prepare for and mitigate the effects of drought.

As a result of being incorporated into the National Integrated Drought Information System, the Monitor and the outlook tools that I mentioned earlier will be able to provide improved information at a higher resolution. In general, drought monitoring and forecasting under this system will be more objective, comprehensive, and timely.

Mr. Chairman, this concludes my testimony, and I am pleased to answer any questions that you or the other Members of the Committee may have.

[The prepared statement of Dr. Koblinsky follows:]

PREPARED STATEMENT OF CHESTER J. KOBLINSKY

Good morning, Mr. Chairman and Members of the Committee. I am Chester (Chet) Koblinsky, Director of the National Oceanic and Atmospheric Administration's (NOAA's) Climate Program Office, which is part of NOAA's Office of Oceanic and Atmospheric Research. I am also the team leader of NOAA's Climate Mission Goal, which oversees all of NOAA's climate activities. Thank you for inviting me to discuss drought conditions in the United States and NOAA's role in drought research, monitoring, and forecasting.

NOAA's climate programs provide the Nation with services and information to improve management of climate sensitive sectors, such as energy, agriculture, water, and living marine resources, through observations, analyses and predictions, and sustained user interaction. Our services include assessments and predictions of climate change and variability on time scales ranging from weeks to decades for a variety of phenomena, including drought. In my testimony I will highlight: (1) the current drought conditions across the Nation; (2) the drought outlook for 2006; (3) NOAA's drought monitoring and forecasting capabilities; (4) the National Drought Information System (NIDIS); (5) NOAA's views on H.R. 5136; (6) NOAA's drought research activities; and (7) NOAA's interagency collaborations on drought.

Defining Drought

In the most general sense, drought refers to a period of time when precipitation levels are abnormally low, impacting human activities and the environment. While there is no single definition of drought that meets all needs, drought refers to a defi-

ciency in precipitation over a period of time resulting in a water shortage. Scientists evaluate precipitation, temperature, soil moisture, ground water, and surface water data for the present and recent past to determine if drought conditions exist. Drought is not a purely physical phenomenon, but is an interplay between water availability and the needs of humans and the environment. Drought is a normal, recurrent feature of climate. It occurs almost everywhere, although its features vary from region to region. For consistency, I will be referring to drought conditions as defined using the U.S. Drought Monitor methodology, unless otherwise noted, throughout the remainder of my statement.

Drought is a unique natural hazard. It is slow in onset, does not typically impact infrastructure directly, and its secondary effects, such as impacts on tourism, commodity markets, transportation, wildfires, insect epidemics, soil erosion, and hydropower, are frequently larger and longer lasting than the primary effects, such as water shortages and crop, livestock, and wildlife losses. Drought is estimated to result in average annual losses to all sectors of the economy of between $6 to $8 billion (in 2005 dollars). The costliest U.S. drought of the past forty years occurred in 1988 and caused more than $62 billion (in 2005 dollars) of economic losses. Although drought has not threatened the overall viability of U.S. agriculture, it does impose costs on regional and local agricultural economies. Severe fire seasons due to drought and frequent winds can also result in billions of dollars in damages and fire suppression costs.

Current Drought Status

Drought conditions across the United States are depicted in Figure 1. Although drought is affecting at least part of the West for the seventh consecutive year, drought conditions are much less expansive than in the recent past, with severe to extreme drought restricted to a relatively small region from Arizona eastward through much of New Mexico and southeastern Colorado.

The protracted, multi-year drought that had been plaguing the West has finally loosened its grip on central and northern parts of the region, where both precipitation and snowpack are near- to above-normal since the beginning of the 2005/2006 water year (October 1, 2005). This precipitation, in concert with copious precipitation that fell on central and southern parts of the West during the 2004/2005 water year, gradually eliminated drought conditions and boosted reservoir levels in most areas to the north and west of southern Colorado, although pockets of moderate drought persist in portions of Wyoming. Precipitation totals are now above-normal for time periods extending back two years along the West Coast and no drought conditions are reported for this region as of late April 2006.

There remain two aspects of the current drought which have not fully recovered from the multi-year dry spell, even though most of the West is no longer shown as abnormally dry in the Drought Monitor (Figure 1). First, ground water levels in some areas, such as southeastern Idaho, remain exceedingly low. Second, the largest reservoirs in the West, such as Lakes Mead (58 percent full) and Powell (44 percent full), have not had enough time to recharge, and remain well below capacity.

Drought has been slowly intensifying since the start of the 2005/2006 water year across Arizona and New Mexico. During October 2005–April 2006, less than 50 percent of normal precipitation fell over most of Arizona and New Mexico, resulting in a meager snowpack and unseasonably high fire danger. During the first three months of 2006, wildfires consumed almost 221,000 acres of land in the Southwest Area (comprised of western Texas, the Oklahoma Panhandle, New Mexico, and Arizona), more than five times the average January–March total for the previous nine years. Surface moisture shortages are also affecting agriculture with about 94 percent of New Mexico topsoils characterized as short or very short of moisture, and 67 percent of the State's winter wheat crop in poor or very poor condition as of mid-April 2006. A majority of both Arizona and New Mexico are now depicted as experiencing severe to extreme drought, according to the U.S. Drought Monitor. However, except for southwestern New Mexico, water supplies are not as problematic across the Southwest because of heavy precipitation that fell last water year (2004/2005) boosting reservoir levels.

Moderate drought covers a significant portion of the central Great Plains, although recent storms have erased lingering dryness in parts of the northern Plains. Severe to extreme drought, aggravated by record heat in mid-April, encompasses the southern Great Plains from southern Kansas and southwestern Missouri southward through central Texas. Farther south, exceptional drought, the most serious drought classification depicted by the U.S. Drought Monitor, has settled into southern Texas. Moderate to heavy rainfall during March eliminated extreme to exceptional drought conditions in southeastern Oklahoma and adjacent parts of Texas and Arkansas, with additional improvement in late April, but a broad area of severe drought lin-

gered in its wake. Record dryness occurred in 2006 with Kansas having the driest February on record, Oklahoma the driest November to February, and Arkansas the driest October to February and March to February.

The drought in the southern Great Plains has been highlighted by two particularly severe impacts: stressed winter wheat and dangerous wildfires. As of mid-April, 78 percent of Texas winter wheat was in poor or very poor condition, as was 67 percent of Oklahoma winter wheat. In contrast, 23 percent of Kansas winter wheat and just 12 percent of Nebraska winter wheat rated poor or very poor. Through the first three months of 2006, fire danger was frequently high in the Southwest, the Plains, and parts of the East, but the largest and most damaging wildfires have occurred in Texas and adjacent areas. A record season continues and as of April 20, 2006, the Texas Forest Service is reporting over 1.5 million acres burned in the State during 2006.

Across northern Illinois and southern Iowa, recent heavy rains have greatly ameliorated or eliminated the long-term drought which began affecting the region during the spring of 2005.

Severe to extreme drought has recently developed along the northern Gulf Coast, as six-month rainfall from early October to mid-April totaled less than 50 percent of normal from southern Louisiana into southern Alabama, though recent thunderstorms (especially on April 21) brought some relief. To the east, short-term dryness recently developed along the eastern half of the Gulf Coast, and the central and northern sections of the Atlantic Coastal Plain. As a result of depleted surface moisture, wildfires developed across Florida in March and April, and fire danger remained high, while the most noticeable impact of the short-term dryness from the Carolinas northeastward through southern Maine has been a sharp drop in streamflows relative to historic observations for this time of year. In the New England hydrologic region, 23 percent of reporting gauges set new daily low flows on April 20, 2006, with 13 percent setting low flows in the South Atlantic region, and 10 percent in the mid-Atlantic region. Heavy rains falling over the Appalachians, mid-Atlantic states, and New England on April 21–24 have significantly eased drought concerns for the time being.

The dryness across most of the eastern states generally developed over the course of the last few months. In the central Carolinas and adjacent Virginia, however, rainfall shortages date back much longer, affecting water supplies in some areas. Most of this region is classified as experiencing moderate to severe drought in mid-April, with the largest and longest-duration precipitation deficits observed in central North Carolina resulting in almost 10 percent of the State's population under mandatory water conservation measures.

Historical Perspective

From a historical perspective of droughts, some indicators depict the recent multi-year drought (1999–2006) as one of the most severe in the past 40 to 100 years, comparable to the severe droughts in the 1950s and 1930s in some areas. On a national scale, 51 percent of the contiguous U.S. was affected by moderate to extreme drought, as defined by the Palmer Drought Index, during the peak of the drought in the summer of 2002. This comes in third, behind 80 percent and 60 percent at the peak of the 1930s and 1950s national droughts, respectively.

For the western United States, the current drought started in 1999 and grew to affect 87 percent of the West at its peak in the summer of 2002. This is second only to the summer of 1934 when 97 percent of the West was affected. In terms of the combined effects of intensity and duration, the 1999–2006 and 1986–1993 western droughts are unprecedented in the 110-year historical record. However, based on tree rings and other paleoclimatic data, droughts that have been more extreme than the current one have periodically affected the West during the last one thousand years, with some droughts lasting 20 to 30 years or longer. Paleoclimatic dating of these multi-decadal drought coincide with evidence of societal stresses on native populations, including the Anasazi of the four corners region. Recent population growth throughout the U.S. and particularly in the West has placed increased demands on water supplies, so drought vulnerability has increased because of greater numbers of water users.

The Outlook

In order to fully appreciate the long-term outlook for the drought, it is helpful to understand the meteorological causes and ongoing research issues. Recent research, much of it coming from NOAA laboratories or from NOAA-funded projects at universities and based on collections of statistical and physical models, shows the important role existing ocean and ground conditions play in establishing wind patterns leading to "blocking" in the atmosphere. Blocking is an important factor in setting

up the weather conditions which cause prolonged warm and dry conditions and reduced rainfall and above-normal warmth. Climate trends should also be considered when forecasting the future evolution of a drought. Climate across much of the U.S. has been getting warmer for about 20–25 years, especially in the winter and spring. These conditions contribute to drought by increasing the rate of snow melt in the spring and early summer, and also by increasing water evaporation.

The seasonal drought outlook (Figure 2) incorporates medium and long-range forecasts of precipitation and temperature from NOAA's Climate Prediction Center and also considers the spring-summer streamflow forecasts from the U.S. Department of Agriculture and NOAA's National Weather Service. While precipitation has eliminated drought conditions across much of the West, recent precipitation in the Southwest will not be enough to make up for the extreme dryness experienced from October into early March. As of late April, mountain snow water content stood at less than 25 percent of normal for much of Arizona and New Mexico. As the dry season sets in, opportunities for further improvement will be quite limited through June. Furthermore, the official seasonal outlook produced by NOAA's Climate Prediction Center suggests that for May through July the Southwest will experience higher than normal temperatures which will increase mountain snow melt and evaporation. The latest streamflow forecasts for this spring and summer produced by USDA's Natural Resources Conservation Service and NOAA's National Weather Service indicate much below-normal streamflow for Arizona, New Mexico, southern Colorado and parts of southern Utah. Therefore, the seasonal drought outlook through July shows drought persisting over much of the region, although the monsoon season and its increased chance for showers and thunderstorms during July and August, should lead to some improvement in a few areas.

NOAA's seasonal forecasts indicate that there is an increased chance for below normal rainfall during the spring and summer over the central and southern Plains. These forecasts also indicate an enhanced probability for higher than normal temperatures. Persistent drought is expected throughout July over southern and western Texas, eastern New Mexico, western Oklahoma, western Kansas, and eastern Colorado, as well as southern Nebraska. Ongoing drought accompanied by varying degrees of improvement is expected from Missouri into eastern parts of Kansas, Oklahoma, and Texas, and along the Gulf Coast, with more significant improvement over Arkansas and adjacent parts of Oklahoma and Texas.

Elsewhere, the recent rains have reduced the odds for drought expansion or intensification from the mid-Atlantic states northeastward, but near-drought conditions will likely remain a concern this spring from Florida into southern Georgia.

Drought Monitoring and Forecasting

NOAA continues to work with its partners to improve our nation's ability to monitor drought. The U.S. Drought Monitor is produced on a weekly basis by drought experts from four U.S. organizations (NOAA's National Climatic Data Center, NOAA's Climate Prediction Center, the U.S. Department of Agriculture (USDA), and the National Drought Mitigation Center at the University of Nebraska) with input from other federal and State agencies, as well as feedback from a network of over 100 experts around the nation. The U.S. Drought Monitor provides a consensus on the current state of drought in all 50 states and Puerto Rico using multiple objective drought indices and indicators (e.g., soil moisture and streamflow) combined with reports of current conditions and impacts (e.g., weekly crop progress and condition reports) from a wide range of public and private sector partners at the federal, State, and local levels. Among its varied uses, federal officials have used the U.S. Drought Monitor in recent years to determine disaster assistance allocations to ranchers and farmers affected by severe drought.

NOAA continues to develop new products to improve our drought monitoring capabilities. More accurate precipitation mapping capabilities have resulted in experimental soil moisture products that are now being refined in collaboration with the National Aeronautics and Space Administration (NASA), Princeton University, and the University of Washington to create practical tools for monitoring soil moisture. NOAA's Climate Prediction Center operates a U.S. Precipitation Quality Control and Analysis program that produces daily high resolution maps of precipitation. To provide better coverage and more accurate measurements to aid in monitoring drought, NOAA continues to modernize its network of cooperative observation sites as well. NOAA continues to improve its drought forecasts. NOAA's Climate Prediction Center produces a monthly U.S. Seasonal Drought Outlook which forecasts drought conditions over the next three and a half months. The drought outlooks combine information from NOAA's suite of forecast products, from daily to seasonal, to show where drought will likely persist, ease, or develop during the next season. NOAA's National Centers for Environmental Prediction also creates other numerous

products useful for drought forecasting, such as two-week soil moisture forecasts based on temperature and rainfall forecasts and seasonal soil moisture forecasts based on soil moisture pattern from previous years. These forecasts help farmers, land managers and others prepare for and take steps to manage the effects of drought.

NOAA can report some instances where the Agency accurately predicted several of the recent and ongoing droughts with the seasonal drought outlooks, especially in recent months. The early December 2005 Outlook predicted drought expansion in the southern Plains and the Southwest and improvement in the Northwest by February 2006. The mid-January Outlook accurately projected that drought would expand into Kansas and the Southwest, and this occurred by mid-March leading to problems with winter crops and pastures and increasing the danger of wildfires The Outlook issued on March 16 warned of possible drought development from Florida northward into the mid-Atlantic region. By the end of March, drought had expanded northward into Virginia and Delaware and abnormal dryness had spread across Florida.

NOAA's drought monitoring is supported by critical remotely sensed data provided by NOAA's Geostationary and Polar-orbiting Operational Environmental Satellites (GOES and POES, respectively). POES satellites are used to monitor vegetation stress, a precursor for the early onset, severity and duration of drought. In the United States, vegetation stress is an indicator used by farmers and the agricultural industry to track the condition of crops. As an indicator of biomass, satellite data are valuable in assessing wildland fire potential. NOAA's next generation geostationary and polar-orbiting satellites—GOES–R and the National Polar-orbiting Operational Environmental Satellite System (NPOESS)—are being designed to continue these important drought monitoring capabilities. We urge the Committee to support the FY 2007 President's Budget Request for these programs.

National Drought Information System (NIDIS)

Drawing from experiences with stakeholders in drought-affected regions and recent reports on drought and stakeholder needs, NOAA has identified a significant demand for a concentrated research and stakeholder interactions effort that: (1) assesses the Nation's vulnerability to drought; (2) develops products useful for drought planning; and (3) develops ongoing collaborations with stakeholders to communicate climate impact information, co-produce tools, and participate in drought planning activities. In response to this demand and a request from the Western Governors' Association (WGA), NOAA has taken the lead on the development and implementation of a National Integrated Drought Information System (NIDIS) in partnership with other federal, regional and State organizations.

NIDIS is an ambitious program to significantly enhance the Nation's ability to monitor and forecast drought. It will establish a modern, dense network of observing locations to observe and monitor all aspects of drought and enhance stakeholder access to information on drought conditions, impacts, and forecasts. NIDIS, in turn, will be supported by a focused drought research program. NIDIS will create a national drought early warning system to enable the Nation to move from a reactive to a more proactive approach to drought. The vision is for NIDIS to be a dynamic and accessible drought information system that provides users with the ability to determine the potential impacts of drought and their associated risks and also provides the decision-support tools needed to better prepare for and mitigate the effects of drought.

NIDIS will provide more comprehensive and timely drought information and forecasts which are required by numerous sectors to mitigate drought-related impacts. The Bonneville Power Administration and other hydropower authorities will benefit from enhanced water supply forecasts and drought information for hydropower management decisions. Water resource managers will have access to more information when balancing irrigation water rights with the needs of wildlife. Purchasing decisions by ranchers for hay and other feed supplies will be enhanced through the use of drought information to identify areas of greatest demand and the potential for shortages. Farmers will be better positioned to make decisions on which crops to plant and when to plant them. Municipalities and State agencies will have improved drought information and forecasts when allocating domestic and industrial water usage. Since drought information is used in allocating federal emergency drought relief, improvements in monitoring networks will also lead to more accurate assessments of drought and, as a result, emergency declaration decisions that better reach out to those communities in need of assistance.

A hallmark of NIDIS will be the provision of decision support tools coupled with the ability for users to report localized conditions. To this end, NIDIS will link multi-disciplinary observations to 'on-the-ground' conditions that will yield value-

added information for agricultural, recreational, water management, commercial, and other sectors.

The four key components of NIDIS are: (1) improved integrated observations and data systems and forecasts; (2) new tools for analysis and decision support; (3) coordinated monitoring, forecast, and impacts research and science; and (4) improved information dissemination and feedback.

The implementation of NIDIS will require: (1) building a national drought monitoring and forecasting system; (2) creating a drought early warning system; (3) providing an interactive drought information delivery system for products and services—including an Internet portal and standardized products [databases, forecasts, Geographic Information Systems (GIS), maps, etc.]; and (4) designing mechanisms for improved interaction with the public (education materials, forums, etc.).

NOAA will work internally to integrate planning for the observing system requirements, research priorities, and operational needs of NIDIS. A NIDIS executive team will be established to oversee implementation and coordination of NIDIS among the federal partners [NOAA, U.S. Department of Agriculture (USDA), U.S. Army Corps of Engineers (USACE), Bureau of Land Management (BLM), Bureau of Reclamation (BOR), U.S. Geological Survey (USGS), Environmental Protection Agency (EPA), NASA] and will be facilitated by the National Science and Technology Council's Committee on Environment and Natural Resources. The result will be a sustained and coordinated interagency program, which will report regularly on its status, accomplishments, and plans for improvements.

The expertise and tools of a number of NOAA programs are being brought together under the NIDIS framework to help the nation address the challenge of drought. Climate services conducted in NOAA's National Weather Service; National Environmental Satellite, Data, and Information Service; and Office of Oceanic and Atmospheric Research will support NIDIS. NOAA's cooperative institute partners, Regional Integrated Sciences and Assessments (RISAs) teams, and Regional Climate Centers will be involved as well. NIDIS will also be supported by NOAA's current operational drought monitoring and outlook products and NOAA's applied climate research program.

The President's FY 2007 Budget Request for NOAA includes $16.2 million for Climate Observations and Services, with a $4.0 million increase to directly support NIDIS related activities. This increase will sponsor integrated, problem-focused research and research-to-operations transition projects. Additional increases of $1.2 million for the Climate Reference Network and $0.5 million for regional climate services will help NOAA realize improvements in observation systems required by NIDIS. NOAA is projecting that it will take five to six years to fully implement NIDIS with gradual improvement in NOAA's drought monitoring and forecasting capabilities occurring throughout the implementation process.

NIDIS is part of a larger NOAA effort over the past several years to deliver climate services that are produced and delivered in on-going consultation with affected stakeholders in order to ensure that the research-based insights, information products and expert opinions delivered are of the highest relevance and utility to the set of challenges at hand.

NOAA Views on H.R. 5136

H.R. 5136 establishes the National Integrated Drought Information System within NOAA. The bill largely parallels NOAA's on-going efforts to improve our nation's ability to monitor and forecast drought, by developing a comprehensive drought early warning system to help the Nation better prepare for and manage the effects of drought. NIDIS is currently being implemented within NOAA's existing authorities, which the Administration believes are sufficient to continue the program; however, should Congress wish to move forward with such legislation, the Administration will not oppose it.

NOAA leads the Federal Government effort on drought monitoring, forecasting and information provision, consistent with the aims of the United States Group on Earth Observations (USGEO). The language of H.R. 5136 supports ongoing USGEO activities in developing a U.S. Integrated Earth Observation System and focusing on NIDIS as one of six near-term opportunities to achieve results. The U.S. Integrated Earth Observation System serves as the U.S. component of the emerging Global Earth Observation System of Systems (GEOSS).

As noted above, the President's FY 2007 Budget Request includes significant investments in drought research and forecasting, as well as other areas which can be leveraged by NIDIS. We ask the Committee to support President's budget request for FY 2007, which will help NOAA implement NIDIS. We look forward to working with the Committee to make a robust NIDIS a reality.

Drought Research Activities

NOAA research activities support drought risk assessment and management. The research is focused on developing predictions of drought onset, termination, duration, and severity and the prediction of multi-year to decadal drought as a function of sea surface temperature variability, deep soil moisture/ground water variability, and other factors. NOAA's research also includes assessments of societal, economic, and environmental vulnerability to drought to inform risk reduction efforts. This work objectively quantifies drought and its associated economic impacts to accurately quantify the monetary benefits of improved drought prediction and mitigation. Our methods incorporate uncertain drought predictions to improve public and private sector planning and operational decision-making for water supply, transportation, hydropower, and irrigation.

An integral part of NOAA's drought research activities is NOAA's support over the last 15 years of university-based research focused on the use of seasonal and inter-annual climate prediction information in decision-making across a range of sectors (e.g., agriculture, water management, public health, forest fire management, fisheries). In recent years, these university-based researchers through NOAA programs, such as the Regional Integrated Sciences and Assessments (RISA), Sectoral Applications Research Program (SARP), and NOAA Climate Transition Program (NCTP), have been working with stakeholders at the local, State, and regional levels to determine what type of climate information would be useful to their decisions and determining how scientific information could help to reduce vulnerability to drought, in particular, along with other extreme events and long-term climate trends (e.g., declining snowpack). NOAA-funded researchers have been working with farmers, ranchers, State governors' offices, water management agencies, ditch companies, forest fire managers, and other stakeholders to analyze vulnerability to climate, assess the need for different types of climate information, and develop information of use to these decision-makers. NOAA-funded drought research activities support the U.S. Climate Change Research Program (CCSP), and are in turn enhanced by the broader CCSP research going on at universities and other federal agencies. By understanding the role of drought in human affairs and how information on the probability of drought can be integrated into existing decision environments, it is possible to move from drought response to pro-active drought management.

As NOAA's global climate models improve, particularly the land component of Earth System Models, NOAA will be able to aggressively focus on drought prediction in the United States, at seasonal–inter-annual time scales. In turn, as our understanding and skill at forecasting seasonal to inter-annual climate improves, the ability to use long-term climate models to assess regional drought risks increases as well. To better predict drought and other climate events, NOAA continues to invest in research to better understand the interdependencies of the ocean and land and their combined influence on climate.

Recent data shows a warming trend for the past several decades over much of the West, especially during the winter season. Climate models, using historical data, accurately simulate temperature increases consistent with this observed long-term warming trend. These models project the general warming trend will continue for the remainder of this century. However, neither climate model projections nor observations show any identifiable trend in precipitation, but they do reveal a changing distribution of precipitation intensity, similar to what would be expected in a warming climate. Specifically, NOAA's National Climatic Data Center and other research efforts have demonstrated that more of our precipitation is tending to fall in heavier precipitation events which can ultimately impact drought severity through changing precipitation run-off.

Research at NOAA's Earth System Research Laboratory indicates recent decadal swings in precipitation in the western U.S. may be largely attributable to decadal variations and trends in ocean temperatures, especially in the tropical Pacific and Indian Oceans. The causes of these changes in ocean temperature are not fully understood, but are likely due in part to a combination of long-term climate change and variability in the atmosphere and ocean. Even with unchanging total precipitation in the western United States, continuation of current temperature trends may significantly influence the annual water cycle as well as water demand, with subsequent implications for water management.

NOAA and sister science agencies in Mexico are co-leading the North American Monsoon Experiment (NAME), an international effort to enhance understanding of the sources and limits of predictability of warm season precipitations over North America, with emphasis on time scales from seasonal to inter-annual. Improved understanding and prediction of monsoon rainfall in the southwestern U.S. and Mexico is critical for water resource management in the region.

NOAA's research community continues to interact with researchers, nationally and internationally, to improve climate and statistical models based seasonal and longer-term outlooks, enabling a steady increase in our understanding of the causes of drought. Learning the mechanisms triggering drought will enable us to better forecast the likelihood of drought development months and years ahead of time.

To improve NOAA's ability to detect and analyze inter-annual-to-decadal variability in climate and weather-climate trends, NOAA has proposed in FY 2007 to invest in research to analyze and understand the causes of the 1930's and 1950's Dust Bowl droughts. One component of this research will be an extension of the current model-based reconstruction of climate back beyond 1948 to cover the entire 20th Century to enhance NOAA's ability to describe atmospheric conditions during the 1930's Dust Bowl. The second component in this effort will be research focusing on diagnosing the causes of 1930's and 1950's droughts and identifying opportunities to improve NOAA's capability to forecast the onset, severity and duration of high-impact scale droughts. This work will help NOAA address concerns and questions from stakeholders about comparisons between current conditions and those of the 1930's and 1950's.

NOAA drought forecasters routinely meet with researchers to explore methods to improve the drought forecasts. Advanced forecast methods based on statistical and global numerical models will continue to be incorporated into drought outlooks, using the best forecast tools and research available. We are encouraged by recent research which helps to explain the reasons behind drought development. Realistically, it is (and always will be) a continuing challenge to produce seasonal forecasts which are consistently accurate. However, as with our weather forecasts, we believe we can continuously improve.

Collaboration With Other Agencies

NOAA collaborates with many State and federal agencies (e.g., USDA, NASA, USGS, EPA, BOR, USACE, and others) and universities to understand, monitor, and predict drought. The U.S. Drought Monitor is only one example of this collaborative effort. NOAA works cooperatively with other agencies on research projects that can lead to improved drought monitoring tools. For example, we are currently working with NASA to incorporate additional satellite data from NASA and NOAA sensors into drought monitoring and forecasting. NOAA also works closely with the USDA on water supply forecasting in the western United States, and relies on the USGS for streamflow data critical to both water supply and flood forecasting. NOAA is also working with agencies, such as NASA, to improve seasonal drought forecasting. In May 2005, NOAA held a workshop with NASA to kick off this new effort in research collaboration. The workshop focused on what is needed to accelerate progress on drought prediction with a focus on developing capabilities and products that facilitate water management and agricultural applications for the Americas.

Drought is a climate phenomenon with major impacts in North America and around the world. In today's global economy the costs and effects of drought extend beyond international borders and the North American Drought Monitor helps address this challenge. The North American Drought Monitor is a monthly product that the U.S. drought monitoring team produces in collaboration with Canadian and Mexican meteorologists. NOAA works with the U.S. Agency for International Development's Famine Early Warning System Network (USAID FEWS–NET) to monitor drought and significant weather events affecting water and food supplies in Africa, Central America, and Afghanistan. NOAA's contribution through a United States Agency for International Development-Office of Foreign Disaster Assistance (USAID–OFDA) partnership has resulted in the production of prototype scientific decision tools, such as prediction models for hydropower resource management in Eastern Africa where more than 70 percent of the countries rely on hydropower for electricity.

Concluding Remarks

Mr. Chairman, this concludes my testimony. I thank you for the opportunity to discuss drought conditions in the United States; NOAA's role in drought research, monitoring, and forecasting; and NOAA's support for H.R. 5136. The topic of drought is critical given its economic and environmental impacts in the United States and the increasing demand for drought information to help manage the demand for water. I would be happy to answer any questions you or other Members of the Committee may have.

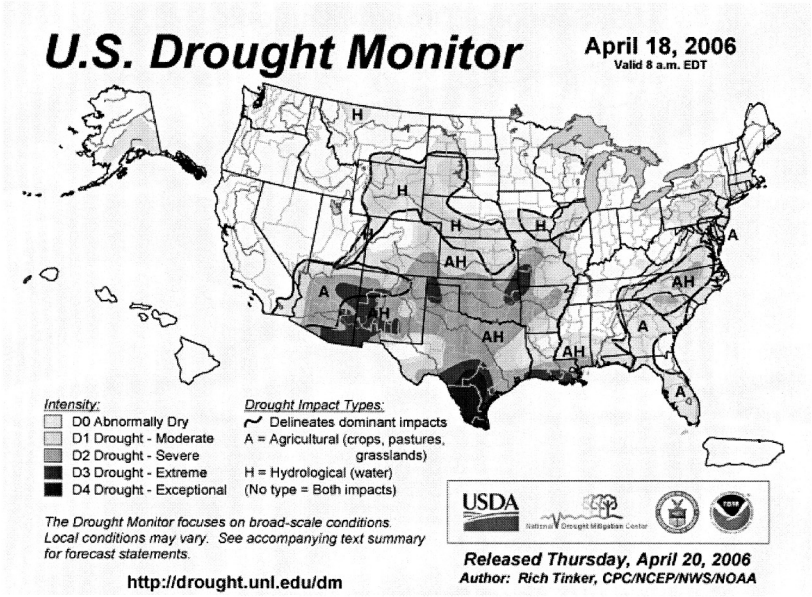


Figure 1. U.S. Drought Monitor released Thursday, April 20, 2006

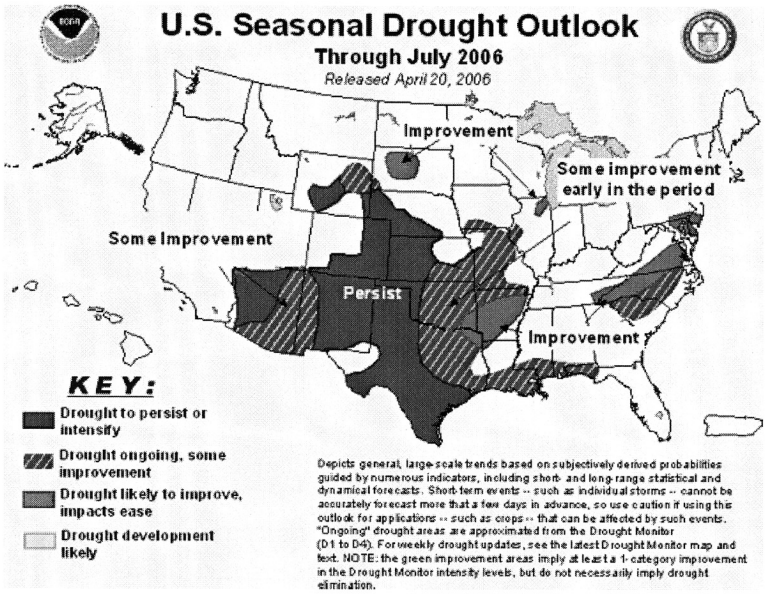


Figure 2. U.S. Seasonal Drought Outlook released April 20, 2006

Chairman EHLERS. Thank you. Mr. Smith.

Mr. SMITH. Good morning, Mr. Chairman, Members——

Chairman EHLERS. Is your microphone on?

Mr. SMITH. Now it is.

Chairman EHLERS. Thank you.

STATEMENT OF MR. DUANE A. SMITH, VICE CHAIR, WESTERN STATES WATER COUNCIL, REPRESENTATIVE, WESTERN GOVERNORS ASSOCIATION; EXECUTIVE DIRECTOR, OKLAHOMA WATER RESOURCES BOARD

Mr. SMITH. My name is Duane Smith. I am the Executive Director of the Oklahoma Water Resources Board, and I am testifying today on behalf of the Western Governors Association, as well as the Western States Water Council. I serve as Vice Chairman of the Western States Water Council.

Drought is a complex and widespread natural hazard affecting more people in the United States than any other natural hazard, including hurricanes, floods, and tornados, and accumulated annual estimated losses between $6 and $8 billion. The magnitude and complexity of drought hazards have increased with growing population, population shifts to dryer climates, urbanization, and changes in land and water use.

Although drought visits some part of our country every year, and causes billions of dollars in impacts, there does not exist a perma-

nent national policy to prepare for and respond to drought disasters. Current efforts at drought management depend upon data that are scattered throughout numerous federal, State, regional, and local agencies. The Department of Agriculture's USDA Natural Resource Conservation Service, NRCS, manages snowpack information. The Army Corps of Engineers and Bureau of Reclamation manage reservoir storage data. NOAA manages hydroclimatic data. Interior's Geological Survey has groundwater and stream water flow information, and EPA manages various water quality programs in concert with the states and tribes. Regional and State entities also provide considerable data and information services used for drought analysis in real time. These programs have generally evolved independently, require separate appropriations, and until recently, have not been available to users at a central location due to their complexity and the absence of tools to accomplish data integration.

The information produced by federal and non-federal partners that is critical to drought monitoring and prediction poses a problem for many users. The information is often technical, complex, and typically is not presented in a standardized format. Many potential users do not even know that the drought information even exists.

NIDIS will bring together a variety of observations, analysis techniques, and forecasting methods as an integrated system that will support drought assessment and decision-making at the lowest geopolitical level possible. The tools will allow users to access, transform, and display basic data and forecasts across the range of spatial and temporal scales most suited for their individual needs. NIDIS will provide drought information through the Internet, in an interactive environment. The Internet will allow quick, convenient, frequent, and low cost assessments of drought risks by users.

NIDIS will fill that gap by developing methodologies to collect and assess the social, environmental, and economic impacts of drought across the United States. These methodologies will also develop assessments from sectors not always at the forefront, such as livestock, timber, wildlife, energy, recreation, and tourism sectors.

Drought-related research is critical in the production of innovations and technology that lead to improved drought preparedness. The simple act of coordinating drought research within and between levels of government, as well as with private entities and universities, will help accelerate the development and provision of scientifically-based information products, enabling users to better prepare, manage, and respond to impacts of drought.

On June 21, 2004, the Western Governors unanimously adopted a report developed in partnership with NOAA entitled "Creating a Drought Early Warning System for the 21st Century: The National Integrated Drought Information System." The report describes the vision for NIDIS, and offers recommendations for its implementation. The Western Governors Association and Western States Water Council support NIDIS, and encourage its enactment.

We are already seeing impacts of the drought of 2006. According to the National Interagency Fire Center, there have been 32,988 fires between January 1 and April 24, on over two million acres of

land. This compares to the five-year average for this time period of 23,639 fires.

The Western Governors and the Western States Water Council believe that improved drought monitoring and forecasting is fundamental to a proactive approach to addressing not only drought, but water shortages. The National Integrated Drought Information System authorized by H.R. 5136 will allow policy-makers and water managers at all levels of the private and public sectors to make more informed and timely decisions about water resources, in order to mitigate or avoid impacts from droughts.

On behalf of the Western Governors Association and the Western States Water Council, I would like to commend Representative Hall and Representative Udall for introducing the *National Integrated Drought Information System Act of 2006.*

Thank you for your leadership.

[The prepared statement of Mr. Smith follows:]

PREPARED STATEMENT OF DUANE A. SMITH

On behalf of Western Governors' Association, Western States Water Council

Mr. Chairman and Members of the Committee, thank you for the opportunity to appear before you today to discuss an issue of great importance to Western states—drought monitoring and forecasting. My name is Duane Smith. I am the Executive Director of the Oklahoma Water Resources Board. I am testifying today on behalf of the Western Governors' Association, as well as the Western States Water Council. I currently serve as Vice Chair of the Western States Water Council.

The Western Governors' Association is an independent, nonprofit organization representing the governors of 19 states, American Samoa, Guam and the Northern Mariana Islands. Through their Association, the Western governors identify and address key policy and governance issues in natural resources, the environment, human services, economic development, international relations and public management.

The Western States Water Council is a "sister" organization to WGA consisting of representatives appointed by the governors of 18 western states (does not include Hawaii). The purposes of the Council are: (1) to accomplish effective cooperation among western states in the conservation, development and management of water resources; (2) to maintain vital State prerogatives, while identifying ways to accommodate legitimate federal interests; (3) to provide a forum for the exchange of views, perspectives, and experiences among member states; and (4) to provide analysis of federal and State developments in order to assist member states in evaluating impacts of federal laws and programs and the effectiveness of State laws and policies.

Please describe the impact of drought on states' ability to manage water resources.

Drought is a complex and widespread natural hazard, affecting more people in the United States than any other natural hazard, including hurricanes, floods, and tornadoes, and accumulating annual estimated losses between $6 and $8 billion. The magnitude and complexity of drought hazards have increased with growing population, population shifts to drier climates, urbanization, and changes in land and water use.

Drought is a normal part of the climate for virtually all regions of the United States, but it is of particular concern in the West, where any interruption of the region's already limited water supplies over extended periods of time can produce devastating impacts. Records indicate that drought occurs somewhere in the West almost every year. However, it is multi-year drought events that are of the greatest concern to the economic and ecological health of Western states.

Water scarcity continually defines and redefines the West. The steady growth that has been characteristic for much of the West today creates increased demands for agricultural, municipal and industrial water supplies. Population growth is continuing at an unprecedented rate in the West with ramifications not only for cities but rural communities and agricultural valleys. According to the 2000 Census Bureau statistics, population growth varied significantly by region in the 1990s, with the highest rates in the West (19.7 percent). The West increased by 10.4 million to reach 63.2 million people. While water resources are available for growth in the ag-

gregate, they are virtually entirely "appropriated" under regimes that have vested private property rights in water right holders.

As municipal and industrial water use increase relative to older agricultural uses, the demand becomes more inelastic. A farmer can forgo a crop year when water supplies are tight; a municipal water system cannot cut back or shut down without serious consequences to the community served.

Water demands are growing not only for traditional uses, but for non-traditional uses associated with so-called in-stream values for water quality, recreation, wildlife habitat and aesthetic purposes. Water for increasing energy needs is expected to exacerbate demands on available supplies. Unquantified Indian water right claims represent further demands on water bodies throughout the West. Such competing demands as the public's rising concern for meeting "quality of life" and environmental objectives create water supply management challenges in times of normal precipitation. Drought exacerbates these challenges.

Although drought visits some part of the country every year and causes billions of dollars in impacts, *there does not exist a permanent national policy to prepare for and respond to drought disasters.* At the federal level, droughts have historically been treated as unique, separate events—even though they are always a part of the natural variation of nature—and frequent, significant droughts of national consequences are inevitable in the years ahead. Actions are taken mainly through special legislation and ad hoc measures rather than through a systematic and permanent process, as occurs with other natural disasters. Frequently, federal funding to assist states has been unavailable, or not available in a timely manner.

What are the major strengths and weaknesses of drought monitoring and forecasting information currently provided by the National Oceanic and Atmospheric Administration and other federal agencies? How do states use this information to inform water resource management decisions?

Drought planning and mitigation by state water management agencies and water managers depend upon the gathering of high quality information related to a variety of physical, environmental and human conditions. Characterization of drought requires a combination of two types of information:

1. Observations of past and current physical states of the environment and their context within the relevant historical record.
2. Documented impacts on human and natural systems that are a consequence of the physical conditions.

It requires a network of scientists to maintain the physical observing system, collect and analyze the data, and collect and synthesize the information on drought impacts. These observations must meet data quality standards for siting, performance and maintenance.

The physical information needed by states and water managers includes observations of precipitation, soil moisture, snow water content and snow depth, soil and air temperatures, humidity, wind speed and direction, and solar radiation. Currently, the placement of soil temperature and soil moisture measurements is too sparse, and nonexistent in many areas, for effective use. The greatest current data shortfalls are on the local (city/county) and state levels. Physical information and drought impact information at these levels is almost impossible to obtain in a uniform manner across the nation. Drought information needs also differ greatly by region. In the West, for example, mountain snowpack is a critical component of water supply. It is thus essential to generate and distribute the best estimates possible of the water content of snow on the ground, snowmelt, and snow-to-vapor sublimation.

Current efforts at drought management depend upon data that are scattered throughout numerous federal, State, regional and local agencies. The Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) manages snowpack information, the Army Corps of Engineers (COE) and Bureau of Reclamation (BOR) manage reservoir storage data, NOAA manages hydroclimatic data, Interior's Geological Survey (USGS) has ground water and streamflow information, and the Environmental Protection Agency (EPA) manages various water quality programs in concert with the States and tribes. Regional and State entities also provide considerable data and information services used for drought analysis in real time. These programs have generally evolved independently, require separate appropriations and, until recently, have not been available to users at a central location due to their complexity and the absence of tools to accomplish data integration.

The information produced by federal and non-federal partners that is critical to drought monitoring and prediction poses a problem for many users. The information

is often technical, complex and typically is not presented in a standardized format. Many potential users do not even know some drought resources exist.

Weather and climate observations have limited value if they cannot become part of a larger drought risk mosaic. A wide variety of data networks currently exist throughout the U.S. Many of these networks transmit their observations with telecommunications that balance frequency and reliability with operation and maintenance costs. A large number of hydroclimatic observations, including the USGS streamflow network, are transmitted in near real-time by satellites (GOES). In the mountainous West, where data transmissions are often blocked by mountains, the meteor-burst technology used by the NRCS SNOTEL (SNOw TELemetry) network provides a reliable and cost-effective real-time data transmission method. In areas where terrain is not a constraint to data transmission, innovative partnerships have been established to "piggy-back" climate data over existing data networks. In Oklahoma, the Oklahoma Climatological Survey (OCS) has a partnership with the Oklahoma Law Enforcement Telecommunications System (OLETS) allowing the transmission of its Mesonet data through police, fire and emergency management offices throughout the state.

How would the proposed National Integrated Drought Information System (NIDIS) improve the quality and usefulness of the drought monitoring and forecasting information provided by the Federal Government?

NIDIS will bring together a variety of observations, analysis techniques and forecasting methods in an integrated system that will support drought assessment and decision-making at the lowest geopolitical level possible. The tools will allow users to access, transform and display basic data and forecasts across a range of spatial and temporal scales most suited to their individual needs.

NIDIS will provide drought information through the Internet in an interactive environment. The Internet will allow quick, convenient, frequent, and low-cost assessments of drought risk by users. Access to immediate drought information will be of continuing benefit, since drought impacts vary by time of year. On-demand risk analysis will provide the lead time needed to implement appropriate economic strategies to reduce drought impacts. Many people are aware of the need for water conservation and other measures during drought. But once drought is over, old habits tend to dominate. The benefits of sustained public awareness will be realized through NIDIS.

No systematic collection and analysis of social, environmental and economic data focused on the impacts of drought within the United States exists today. Examples of data that could be collected include drought-related relief payments; mental health visits in drought-stricken areas; losses of revenue due to low water, ranging from river rafting guide revenues to barge tonnage; reduced hydropower production; increased ground water pumping costs for agriculture and municipal purposes; revenues from fish camp and canoe outposts; golf course revenue; agricultural yield losses not eligible for relief payments (e.g., nurseries); skier days and snow-related tourism revenue; and ecological impacts data such as water quality, and impacts from wildland fires; etc. Because such data either are not centralized or not collected, officials often under-estimate economic and social costs related to drought.

NIDIS will fill that gap by developing methodologies to collect and assess the social, environmental and economic impacts of drought across the United States. These methodologies will also develop assessments from sectors not always at the forefront, such as the livestock, timber, wildlife, energy, recreation and tourism sectors. Understanding these impacts of drought will empower users and expand the comprehension of the full magnitude of drought losses. By so doing, it will encourage local, State and federal officials to increase efforts in drought planning, preparation, and mitigation. Comprehensive baseline data on drought impacts also will help to verify the relative cost effectiveness of "risk" versus "crisis-management" approaches to drought management.

Drought-related research is critical in the production of innovations and technology that lead to improved drought preparedness. Currently a coordinated and integrated drought research program does not exist at the national level, despite the enormous impact of droughts every year on the Nation's economy, society and the environment. Currently, drought research is scattered across many agencies, universities, and other research institutions, without formal coordination or planning to maximize the value of the research dollars spent and without effort to ensure that the priority needs of the public and decision-makers are being addressed. The simple act of coordinating drought research within and between levels of government, as well as with private entities and universities, will help accelerate the development and provision of scientifically-based information products, thereby, enabling users to better prepare for, manage and respond to the impacts of drought.

Please provide specific comments on H.R. 5136, the National Integrated Drought Information System Act of 2006.

On June 21, 2004, the Western Governors unanimously adopted a report developed in partnership with the National Oceanic and Atmospheric Administration (NOAA) entitled *Creating a Drought Early Warning System for the 21st Century: The National Integrated Drought Information System (NIDIS).* In the report, the Governors conclude that "Recognition of droughts in a timely manner is dependent on our ability to monitor and forecast the diverse physical indicators of drought, as well as relevant economic, social and environmental impacts." The report describes the vision for NIDIS and offers recommendations for its implementation. It is available online at *www.westgov.org.*

The National Integrated Drought Information System (NIDIS) authorized by H.R. 5136 would coordinate and integrate a variety of observations, analysis techniques and forecasting methods in a system that will support drought assessment and decision-making at the lowest geopolitical level possible. NIDIS will provide water users across the board—farmers, ranchers, utilities, tribes, land managers, business owners, recreationalists, wildlife managers, and decision-makers at all levels of government—with the ability to assess their drought risk in real time and before the onset of drought, in order to make informed decisions that may mitigate a drought's impacts.

The Western Governors' Association and Western States Water Council support the *National Integrated Drought Information System Act of 2006,* and urge its enactment. The Western states believe that enactment of NIDIS will help move the country toward a proactive approach that will avoid conflicts and minimize the damage caused by future droughts, thereby saving taxpayers money.

There is broad basis of support for NIDIS beyond the WGA report:

- In its May 2000 report to Congress, the National Drought Policy Commission recommended improved "collaboration among scientists and managers to enhance the effectiveness of observation networks, monitoring, prediction, information delivery, and applied research and to foster public understanding of and preparedness for drought."
- The Department of the Interior's report, *Water 2025: Preventing Crises and Conflict in the West States,* "As part of the effort to establish the National Drought Monitoring Network, Interior believes that one-stop shopping for Western water users on a single government web site will aid in problem solving, particularly in critical areas. Such a site can provide information on snowpack, runoff, river operations, forecasting, and drought prediction."
- The U.S. Group on Earth Observations has drafted a strategic plan for the U.S. Integrated Earth Observation System (IEOS), the U.S. contribution to the Global Earth Observation System of Systems (GEOSS). The IEOS Strategic Plan identifies the National Integrated Drought Information System as one of six "near-term opportunities."
- In June 2005, the Subcommittee on Disaster Reduction—an element of the President's National Science and Technology Council—issued its report, *Grand Challenges for Disaster Reduction.* The report finds "Compared to all natural hazards, droughts are, on average, the leading cause of economic losses." The SDR report states: "The slow onset of drought over space and time can only be identified through the continuous collection of climate and hydrologic data. To enhance decisions and minimize costs, drought warning systems must provide credible and timely drought risk information including drought monitoring and prediction products." The report includes a recommendation to "build and deploy a national instrument system capable of collecting climate and hydrologic data to ensure drought can be identified spatially and temporally, and develop an integrated modeling framework to quantify predictions of drought and drought impacts useful in decision-making."
- The President's FY '07 budget request includes $7.8 billion for NIDIS implementation and support.

Conclusion

As we approach summer, many of our western states—and much of the country—are seeing areas in drought. According to NOAA, about 26 percent of the contiguous U.S. is currently affected by moderate-to-extreme drought. Much of the Southwest had less than normal winter snowpack at the end of March, despite heavy snow during the month of March. Additionally, the January-March period was the fifth warmest ever recorded in the U.S., largely due to a record warm January.

We are already seeing the impacts of drought in 2006. According to the National Interagency Fire Center, there have been 32,988 fires between January 1 and April 24 on 2,195,768 acres. This compares to the five-year average for this time period of 23,639 fires on 485,308 acres.

We know from our past experiences, the costs of response efforts to drought have been staggering. The estimated cost of the 1988–1989 drought was $39 billion nationwide and was, at the time, the greatest single year hazard-related loss ever recorded. On average, the Federal Government spends $6–$8 billion on drought response. Federal wildfire suppression costs averaged $1.16 billion per year between 2000–2005. Additionally, much time and money have gone into trying to address the water conflicts arising in many of the large river systems in the West, including the Missouri River, the Colorado River, the Rio Grande, the Klamath River Basin, and the Snake River Basin.

The Western Governors and Western States Water Council believe that improved drought monitoring and forecasting is fundamental to a proactive approach to addressing not only drought, but water shortages. The National Integrated Drought Information System authorized by H.R. 5136 will allow policy-makers and water managers at all levels of the private and public sectors to make more informed and timely decisions about water resources in order to mitigate or avoid the impacts from droughts. On behalf of the Western Governors' Association and the Western States Water Council, I would like to commend Representative Hall and Representative Udall for introducing the *National Integrated Drought Information System Act of 2006*. The Western States urge its enactment this Congress.

BIOGRAPHY FOR DUANE A. SMITH

DUANE A. SMITH holds a Bachelor's degree in meteorology from the University of Oklahoma. He joined the Oklahoma Water Resources Board in 1978 and during the past 28 years has served as hydrologist, Chief of the Groundwater Division, and Assistant Director.

Appointed OWRB Executive Director in April 1997, Mr. Smith oversees the management of the agency's five action divisions that carry out the programs entrusted to the Oklahoma Water Resources Board. One of the Board's most successful programs is its billion-dollar Financial Assistance Program, designed to assist Oklahoma communities and rural water districts in meeting financial needs to provide good quality water to Oklahomans.

During his tenure in the Groundwater Division, Duane was instrumental in the development of the state's well driller's licensing program—now including 357 drillers and pump contractors and 650 operators and an on-line database of 35,000 well logs. Under Mr. Smith's direction, the Board has developed and implemented the Beneficial Use Monitoring Program (BUMP), the state's first monitoring program designed to document beneficial use impairments, identify impairment sources, and detect water quality trends.

Mr. Smith is Oklahoma Commissioner to three of Oklahoma's interstate stream compacts; Oklahoma representative to the Interstate Oil and Gas Compact Commission, and serves as Chairman of the Oklahoma Weather Modification Advisory Board. He serves on the state's Drought Response Team, and as Chairman of the External Advisory Board to the MESONET Council. Mr. Smith was appointed by Governor Henry to represent Oklahoma on the Western States Water Council, where he serves most recently as Vice-Chairman.

Chairman EHLERS. Thank you. Mr. Dierschke.

Mr. DIERSCHKE. Good morning, Mr. Chairman and Members of the Committee. My name is Kenneth Dierschke, and I am President of the Texas Farm Bureau.

Chairman EHLERS. Is your microphone on?

Mr. DIERSCHKE. Well, now it is. Is that right?

Chairman EHLERS. Yeah.

Mr. DIERSCHKE. Okay.

Chairman EHLERS. We need it for the transcription service.

STATEMENT OF MR. KENNETH DIERSCHKE, PRESIDENT, TEXAS FARM BUREAU

Mr. DIERSCHKE. Okay. And I am President of the Texas Farm Bureau, and I am here today on their behalf. I am a cotton and

grain farmer from San Angelo, Texas, and I appreciate the opportunity to speak today in support of H.R. 5136, the *National Integrated Drought Information System Act of 2006.* This legislation, when enacted, will be of significant benefit to agriculture producers, as well as the various State and federal agencies working to address weather monitoring systems.

For the record, let me state, in part, the American Farm Bureau policy regarding the National Weather Service. "We support accurate, timely reporting of weather information, and the maintenance and adequate funding of current weather analysis and information dissemination systems. We encourage federal, State, and private agencies to work to improve these systems and the coordination of user support and federal funds to assure continuity and improvement."

Last summer, Hurricanes Katrina and Rita ploughed into the Gulf Coast with all the fury that Mother Nature could muster. The images of this catastrophe were powerful, and delivered to every home in America. Americans and our government rightly responded with unprecedented levels of assistance for the crippled Gulf Coast.

There is now another catastrophe unfolding across a large part of the Nation. Part of it is playing out in my home State of Texas. Drought is literally squeezing the life out of Texas agriculture. This disaster is different from hurricanes. Only after weeks and months does its effects begin to become apparent. It is not only when a spark bursts into flame the tinder dry grass, consuming homes, barns, livestock, and human lives does the public hear much about it, again, through the vivid images of our television screens.

The Texas fires have been graphic evidence of the drought, but the burning countryside is only one symptom of this catastrophe. In Texas, the economic input of the drought will be more than match the effects of Hurricane Rita, the Category Five storm that hit our Gulf Coast. The Texas Cooperative Extension Service estimates that over $1 billion damage was done to the agricultural community in 2005, with additional losses caused by the wildfires in the Texas panhandle in March of this year. Over one million acres of range and grassland was destroyed, with thousands of miles of fence, animals, buildings destroyed in a little more than a week.

Drought is a slow motion disaster. It is a slow and creeping death for plant and animal life, and potentially, for the agriculture industry. Each day without rainfall deepens the crisis for the farm and ranch families. In 2005, more than 200 of Texas' 254 counties were designated disaster areas due to weather-related events. Unfortunately, during the last decade and a half, this has become a very common occurrence.

On the Internet, there is a website called Drought Monitor. It paints an interesting picture, stage by stage, graphically showing how this monster drought has consumed more and more of this countryside with each passing day. Altogether, some 20 states are impacted.

While some of our State has been fortunate to receive some rainfall in the recent months, the State as a whole is still in a drought situation. Specifically, the Rio Grande Valley and along the South

Texas coast has already lost most of its 2006 crop. Producers will be depending on insurance payments to keep them afloat in 2007.

When farm and ranchlands are in the grip of a severe drought, there are many levels of damage. There is the tremendous loss of crop, but also, in the case of rangeland, it can take many years of careful management and the cooperation of Mother Nature to set things right again.

Today, our focus is on drought preparedness and recognition. While this is not an attempt to cast blame, current technology does not provide information necessary for a producer to avoid the impact of droughts. The strength of our weather information system is a very high accuracy for its short-term predictions. The weakness is in that these highly accurate forecasts do little to prepare farmers and ranchers for the impact of extended periods of drought or other weather-related disasters. By the time the news of the rain front is reported, decisions have been made, crops have been lost, an economic disaster becomes a companion of the natural disaster.

The Farm Bureau supports the funding of research by NOAA to improve the ability to more accurately forecast these catastrophic events. Refining the techniques that can identify these events would truly be an asset to the agriculture industry.

The frequency of drought and the weather-related disasters is changing our culture in ways that are difficult to anticipate. In our view, H.R. 5136 is an investment in new technology and systems that will benefit the Nation far beyond an individual farm or ranch. But speaking for those farmers and ranchers, Congressman Hall's bill will certainly help us prepare for an all too uncertain future.

Farmers and ranchers across much of Texas the grim possibility that there may very little to harvest in Texas this year. We hope that we can salvage enough of this crop year, with various forms of assistance and aid, so that there can be another year beyond the dismal conditions we face now. If we can more accurately predict the next drought cycle, our planning and preparation will improve as well.

I thank you for the opportunity to be here, and look forward to your questions.

[The prepared statement of Mr. Dierschke follows:]

PREPARED STATEMENT OF KENNETH DIERSCHKE

Mr. Chairman, and Members of the Committee, my name is Kenneth Dierschke. I am President of the Texas Farm Bureau and I am here today on their behalf. I am a cotton and grain farmer from San Angelo, Texas. I appreciate the opportunity to speak today in support of H.R. 5136, the *National Integrated Drought Information System Act of 2006.* This legislation, when enacted will be of significant benefit to agriculture producers as well as the various state and federal agencies working to address weather monitoring systems.

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I appreciate the opportunity to be here today, and will be happy to address any questions from the Committee.

BIOGRAPHY FOR KENNETH DIERSCHKE

Kenneth Dierschke's love of agriculture boils down to the "smell" thing. The strong, musky odor of sandy clay loam soil and its promise to grow food and fiber has kept this San Angelo producer motivated through the unpredictable ups and downs of full-time farming since 1974.

Yes, the freedom and independence farming offers are important to Dierschke. But it's the aroma of agriculture that draws him back to the tractor seat at spring planting time year after year.

"The biggest reward is just the smell of freshly turned soil, and knowing there's going to be a new day," this cotton and grain farmer from Wall, east of San Angelo, says of the profession he loves.

FB background

The importance of Farm Bureau to agriculture dawned on Dierschke when he was just 18. Fresh out of high school, young Dierschke attended a Farm Bureau membership meeting in Waco with his dad, Norman, who had been on the Tom Green County Farm Bureau Board for several years.

"I went to Waco and I think some of the things I heard then were very instrumental in my feelings about Farm Bureau," Dierschke says.

That was in the late spring of 1960. Forty-three years later, Dierschke recalls his father's influence in shaping his participation in the state's largest farm organization: "When I came back into farming, he said, 'You need to be involved in Farm Bureau. They're a very good tool. If you want somebody else to make your decisions for you, go farm and don't get involved. But if you want to influence anything that happens as far as your occupation, you better get involved with Farm Bureau, because they're the voice of agriculture.'"

It was advice that has been central to Dierschke's philosophy throughout his many years of Farm Bureau involvement. He first served on the Tom Green County Farm Bureau board in 1975 and was immediately elected President.

Dierschke was on the first TFB National Affairs trip to Washington in the 1970s where he found the importance of becoming politically active.

He was later called by former TFB President S.M. True to serve on the Blue Ribbon Goals Committee, where the organization was studied and a number of changes made.

"I was on the Blue Ribbon Goals Committee when AGFUND was established," Dierschke says of Farm Bureau's political action arm, noting the involvement of other Farm Bureau leaders including former TFB president and present American Farm Bureau Federation President Bob Stallman, current State Director Don Smith, and former State Directors, Bob Turner, Jimmie Ray Adams and Dan Pustejovsky. "We thought it was very important to become involved in the legislative process. We were getting an audience with legislators but we weren't being heard. Now I think we have a much better rapport with all the legislature."

Dierschke became State Director for District 6 in 1996, when former State Director Bill Tullos retired. He became Vice President of Texas Farm Bureau in December 2000.

TEXAS Farm BUREAU

P.O. Box 2689 • Waco, Texas 76702-2689 • 254-772-3030

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April 28, 2006

The Honorable Vernon J. Ehlers
Chairman, Environment, Technology, and Standards Subcommittee
Committee on Science
2319 Rayburn Office Building
Washington, DC 20515

Dear Chairman Ehlers:

Thank you for the invitation to testify before the Subcommittee on Environment, Technology, and Standards of the Committee on Science of the U.S. House of Representatives on May 12th for the hearing entitled "Improving Drought Monitoring and Preparedness: H.R. 5136, the National Integrated Drought Information System Act of 2006". In accordance with the Rules Governing Testimony, this letter serves as formal notice of the federal funding I currently receive related to the hearing topic.

I received no federal funding directly supporting the subject matter on which I testified, in the current fiscal year or either of the two proceeding fiscal years.

Sincerely,

Kenneth Dierschke

Kenneth Dierschke
President

KD:SP:cjg

Chairman EHLERS. Thank you for your comments.

I would just like to point out there is obviously a fair amount of disagreement in this nation about global warming, which I always refer to as global climate change because it encompasses much more than warming, but with the information that I have read, drought is going to be a continuing problem, but the interesting thing is that it will shift to locations that are now quite verdant and receive plenty of water, and that is something we all should be concerned about. We hope that prediction is not correct, but you may be a forerunner of something that is going to concern a lot more people than America, if we don't—aren't careful about preserving our water resources and using water wisely. I have a brother-in-law who is a cotton farmer. I know very well how important it is to get—not only to have water, but to have it at the right time, and not have it come at the wrong time.

Mr. Waage.

STATEMENT OF MR. MARC D. WAAGE, MANAGER, RAW WATER SUPPLY, DENVER WATER, DENVER, COLORADO

Mr. WAAGE. Good morning. My name is Marc Waage, and I am the Manager of Raw Water Supply for Denver Water in Colorado.

As a water manager and a regular user of federal drought information, I would like to address how NIDIS could provide vital improvement to how we manage droughts. Denver Water is a municipal agency that supplies water to 1.2 million people in the Denver area, making it the largest supplier of drinking water in Colorado. We operate in a semi-arid climate with highly variable streamflow. To lessen the impacts of drought, we have developed a large raw water collection system in the Rocky Mountains west of Denver.

Parts of Colorado have been in drought for the last six years. In 2002, Denver's watersheds received the lowest runoff in approximately 200 to 300 years. Denver's reservoirs dropped to only 43 percent of capacity, and water use was restricted for three years, while we recovered storage levels. Operating through this experience has made me keenly aware of the advantage of better drought information.

During the drought, we relied heavily on snowpack and weather information from various federal agencies. Most critical to us were the streamflow forecasts from these agencies. We used this information to predict how much water we would have, how to budget the use of that water, and to guide our operations. These decisions affected not only our customers, but environmental and recreational interests, mountain watershed communities, and others within our system.

I would like to highlight four ways that NIDIS could help us better prepare for the next drought. First, NIDIS could create an Internet clearinghouse to make existing drought information more accessible and understanding. In a drought, timely and reliable information is key to making good decisions. As we discovered during the drought, information is spread across many federal agencies, and many times, in cryptic technical language that is difficult to understand. NIDIS could help better inform all those affected by drought.

Second, NIDIS could help federal agencies educate and interact with those affected by drought. A good model is the Western Water Assessment Program of NOAA, which uses teams of experts to assist water managers in the Intermountain West. It has allowed us to interact with drought researchers, to make better use of their research, and to provide feedback on our research needs.

Third, NIDIS could provide the vital forecasts that we use in droughts. Those are streamflow runoff forecasts, and long-range weather outlooks. NOAA's River Forecast Centers could provide more hydrometeorological monitoring of high elevation watersheds like ours, and combine that information with existing remote sensing of snowpack conditions, to provide more accurate streamflow forecasts in the smaller basins in which most water systems operate.

Long-range weather forecasts could also be improved by developing smaller scale prediction models. This was done on an experimental basis for Colorado by the Climate Diagnostic Center of NOAA. Their forecasts are closely followed by water users and media in Colorado. Denver Water funded research at the University of Utah to use sea and atmospheric conditions in the fall to produce a prediction of the volume of spring runoff. In the fall of 2001, the model predicted a low runoff was coming. This forecast supported our decision to stop using water for hydropower generation, saving us precious water before the start of the drought.

Fourth, NIDIS could help water suppliers better manage the impacts from population growth and climate change. To provide water for the booming populations of Colorado and other areas in the West is stressing our natural stream systems. Climate change threatens to exacerbate these problems, by making droughts longer and more severe. A common response to these problems is to increase water conservation goals. For systems like Denver's, this means there would be less non-essential water that could be cut off during droughts, thereby making the system even more vulnerable to drought. The result would be more frequent and more severe water rationing. Improved forecasts could help minimize the amount of rationing used during droughts.

In summary, NIDIS would provide the proactive and coordinated federal approach that water managers need to cope with droughts.

[The prepared statement of Mr. Waage follows:]

PREPARED STATEMENT OF MARC D. WAAGE

Mr. Chairman and Members of the Subcommittee:

Thank you for inviting me to address the important issue of drought monitoring and preparedness. I manage the operation of a large water collection system and I am a regular user of drought information provided by federal agencies. From that perspective, I would like to address why federal drought preparedness is so important, how federal drought information is used now and how the proposed National Integrated Drought Information System (NIDIS) could provide the much needed improvements in drought information to help water managers better cope with droughts.

1. Why is Drought Preparedness and Monitoring Important to Denver Water?

I work for Denver Water which is a municipal agency that supplies water to 1.2 million people in the Denver area. We are the largest supplier of drinking water in the state, providing service to about one of every four residents of Colorado. We

operate in a semi-arid climate characterized by low precipitation and variable streamflow. On average, Denver receives only 15 inches of precipitation per year. Snowmelt from the mountains to the west of Denver provides most of the city's supply. But that supply is highly variable. The natural streamflow of the South Platte River above Denver has ranged from 227 percent of average in wet years to 16 percent of average in drought years.

To reduce its vulnerability to drought, Denver Water collects water from 3,600 square miles of watersheds, transporting water up to 80 miles using three water tunnels under the Continental Divide to store water in 16 reservoirs, most of which are used for drought augmentation. [See Exhibit "A"—map of water system]. My job is to operate that water system and to make sure it does not run out of water.

Parts of Colorado have been in a drought for the last six years. In 2002, Denver's watersheds received the lowest runoff in approximately 200 to 300 years. Denver's storage reservoirs dropped to 43 percent of capacity—the lowest level in 38 years, and three years of drought restrictions were required to refill reservoirs to normal levels. Operating through this experience has made me keenly aware of the value of timely, accurate, and understandable drought information.

2. What Drought Information Does Denver Water Use?

Most of Denver Water's supply comes from mountain snowmelt. During the recent drought, my staff and I made frequent use of snowpack, streamflow, weather, and forecast information from various federal agencies plus information from the State of Colorado and our own monitoring. Below is a list of the most frequently used drought data.

A. Snowpack Monitoring

1) **NRCS.** Manual and automated Snotel site information from the Natural Resource Conservation Service (NRCS) of the U.S. Department of Agriculture. The State office of the NRCS provides a wide array of web-based daily snowpack, weather data and useful displays that are heavily used throughout the state by all types of water interests. Denver Water provides manual measurements of snowpack and some funding for Snotel sites. These data are used in all levels of operations.

2) **NOAA.** Later in the drought we were made aware of a National Oceanic and Atmospheric Administration (NOAA) product called the Snow Data Assimilation System (SNODAS). As described by NOAA:

"SNODAS is a modeling and data assimilation system developed by the NOHRSC to provide the best possible estimates of snow cover and associated variables to support hydrologic modeling and analysis. The aim of SNODAS is to provide a physically consistent framework to integrate snow data from satellite and airborne platforms, and ground stations with model estimates of snow cover."

SNODAS provides important visual information on snowpack conditions and holds promise for improving water supply projections.

B. Streamflow Monitoring

1) **USGS.** The U.S. Geological Survey provides near real-time web-based streamflow monitoring. Denver Water provides annual cost-share funding of the measuring sites. This system is heavily used by water interests throughout the state.

2) **State.** The State of Colorado provides near real-time web-based streamflow monitoring. It also incorporates USGS and other streamflow monitoring. This system is also heavily used throughout the state.

C. Storage Reservoir Monitoring. Data comes primarily from Denver Water monitoring, plus some state and federal reporting.

D. Weather Monitoring

1) **NWS.** The National Weather Service provides daily measurements of temperature and precipitation through its cooperative weather program. Denver Water is a cooperator and measures temperature and precipitation in the city and throughout its watersheds. These measurements are used to understand past water supply and use patterns and to make streamflow forecasts.

2) **NRCS.** Denver Water makes use of the Natural Resource Conservation Service's Snotel sites to track snowpack, precipitation and soil moisture in near real time. Denver Water financially supports a number of these sites and measures snowpack at other sites for the NRCS.

3) **CoCoRaHS.** This acronym stands for Community Collaborative Rain and Hail Study. CoCoRaHS provides high density daily precipitation data that helps us estimate short-term changes in water supply and use. The Colorado Climate Center runs this program with financial support from Denver Water and other users.

E. Weather and Climate Forecasts (Short- and Long-Range)

1) **NWS.** The National Weather Service provides short-term weather forecasts that are useful for projecting near-term water supply and use.
2) **CPC.** The Climate Prediction Center (part of the Physical Science Division of NOAA's Earth System Research Laboratory) provides long-range temperature and precipitation outlooks and other endeavors. These forecasts give Denver Water an understanding of the weather that is expected during the next one to six months and helps us with our planning.
3) **CDC.** The Climate Diagnostic Center, which is jointly funded by NOAA and the University of Colorado, supports research on long-range weather forecasting and other endeavors. Denver Water uses experimental forecasts produced by the CDC.
4) **Private Meteorologist.** Denver Water monitors long-range weather forecasts provided by a meteorologist with HDR Engineering, Inc.

F. Streamflow Forecasts

1) **NRCS and NWS.** These two agencies provide joint forecasts of seasonal snowmelt volumes. These forecasts are vital for managing water in the West.
2) **CBRFC.** The Colorado Basin River Forecast Center (a division of NWS) produces valuable probabilistic daily streamflow forecasts.

G. Drought Indices

1) **NOAA.** The Drought Monitor and Drought Outlook are occasionally used to display the progression and the extent of drought to non-technical audiences.

3. How Is the Drought Information Used?

The drought information described above is used to prepare short- and long-term operating plans for Denver Water's system. These are the critical forecasts that are used to predict water supply availability, budget water use, and guide operations during droughts.

The drought information is regularly used by staff, board members, media, customers and the public to access the status of droughts. Below are examples.

A. Denver Water management staff and board members use the information to determine water use restrictions and set water rates and surcharge prices during droughts.
B. Large customers using water for parks, schools, golf course, car washes, and various manufacturing processes use the information to meet water budgets enacted during droughts.
C. Media, customers, and the public use the information to monitor water supply conditions during droughts.
D. Recreational interests, environmental interests, government agencies, and mountain watershed communities use the information to monitor streams, reservoirs, and supply conditions within Denver Water's system during droughts.

4. How Can NIDIS Improve the Quality and Usefulness of Drought Monitoring and Forecasting Information Provided by the Federal Government?

A. Create an Internet Portal of easily accessible and understandable drought information.

During the drought, my staff and I have spent countless hours combing the web to identify all the drought information that is spread across many federal agencies. Much of the information is in cryptic technical language. It is quite difficult for casual users to access and understand this information. Non-technical users would greatly benefit from an Internet portal. During the record drought year of 2002, my staff and I spent considerable time collecting and disseminating information on the drought to our management

staff and board members, the media, water customers, watershed communities, environmental and recreational interests, and the general public. The Internet portal would promote much greater understanding by all those affected by drought. Denver Water's customers live many miles from their watersheds and there can be a great disparity between the weather in the watersheds and the city. The Internet portal would help link city residents to the droughts affecting their watersheds. This portal could also reduce time my staff and I spend explaining drought conditions to board members, media, interest groups, customers, and the public.

B. Educate and Interact With Those Affected by Drought.

Drought information can be hard to find and understand. The Western Water Assessment (WWA) (a cooperative venture funded by the Regional Integrated Sciences and Assessments Program of NOAA) uses multidisciplinary teams of experts in climate, water, law, and economics to assist water-resource decision makers in the Intermountain West. This program has increased Denver Water's understanding and use of federally available drought information. This is done through water conferences and other contacts with water users in Colorado. The WWA has allowed us to interact with scientists working on drought issues to make better use of federal research and to provide feedback on research needs. The WWA program could be a model for NIDIS for expanding education and interaction with those affected by drought.

C. Increase Monitoring in Watersheds.

In 2002, Denver's watersheds produced the lowest runoff in approximately 200 to 300 years. Winter snowpack levels were low but not as low as in previous drought years. However, the spring was exceptionally hot and dry. Rather than producing streamflow, much of the snowpack was consumed by sublimation (evaporation), vegetation, and soil recharge. Unfortunately, there was very little scientific monitoring of the watersheds to know the extent to which this was occurring. Without watershed monitoring, there was little early warning of the severe drought to come. As a result, watering restrictions were not fully enacted until well into the summer. Also, there was little warning that spring conditions in the watershed would produce the Hayman forest fire in June which was the worst in Colorado's recorded history. Along with record low streamflow, the massive fire caused serious water quality problems for Denver Water. Using NIDIS to monitor soil moisture, wind speed, humidity, solar radiation and model-based analysis of these data would help provide an early drought warning for our watersheds. Watershed monitoring could also be incorporated into forecast products as described below.

D. Improve Existing Products.

Below are examples of how NIDIS could be used to improve existing drought information products.

1) **Improve Streamflow Forecasts.** Streamflow forecasts are key indicators for managing water supplies in the West during droughts. Below are examples of improvements that could be made to forecasts provided by federal agencies.

   (a) **Incorporate New Watershed Monitoring.** The data from better watershed monitoring as described above could be incorporated into streamflow forecast models to fill a critical gap in dry year predictions and provide a much needed early warning system.

   (b) **Upgrade Models Used by the River Forecast Centers.** Denver Water has had a long partnership with the Colorado Basin River Forecast Center (CBRFC) of the NWS to demonstrate the value of daily probabilistic streamflow forecasts in water system operations. The benefits include helping recover endangered fish, improving environmental and recreational conditions on rivers, maximizing hydropower and reducing the risk of flooding in non-drought years. Improving and incorporating SNODAS data described above into the CBRFC streamflow model could increase forecast accuracy in the smaller sub-basins of the Colorado River in which most of the water systems operate. The Missouri Basin River Forecast Center is developing a daily streamflow forecast model for the South Platte River above Denver. The model holds promise for improving

Denver Water's water operations in the South Platte Basin much as it has in the Colorado River Basin.

2) **Improve Drought Indices.** Making the indices more understandable, accurate and relevant to drought management will increase their use with both technical and non-technical users. Plain language should be used to explain the indices.

3) **Improve Long-Range Weather and Climate Forecasts.**

   (a) **Seasonal Climate Outlook.** Developing a more understandable format than the tercile method and providing a plain language explanation of the accuracy and skill of the product could improve confidence in and use of the product.

   (b) **Localized Forecasts.** Developing smaller scale prediction models may increase the accuracy, skill and usefulness of long-term weather forecasts. The Climate Diagnostic Center of NOAA produces an experimental seasonal weather forecast for southwestern states including Colorado. These forecasts are carefully followed by water users and the media. Denver Water funded research at the University of Utah to use sea and atmospheric conditions in the fall to produce a probabilistic prediction of the volume of the spring runoff. In the fall of 2001 the model predicted a low runoff in the spring of 2002. This forecast supported our decision to stop releasing reservoir water for hydropower generation, saving precious water before what turned out to be the driest year on record. Overall, forecasts of drought onset, duration, severity, and end could be extremely helpful in the future.

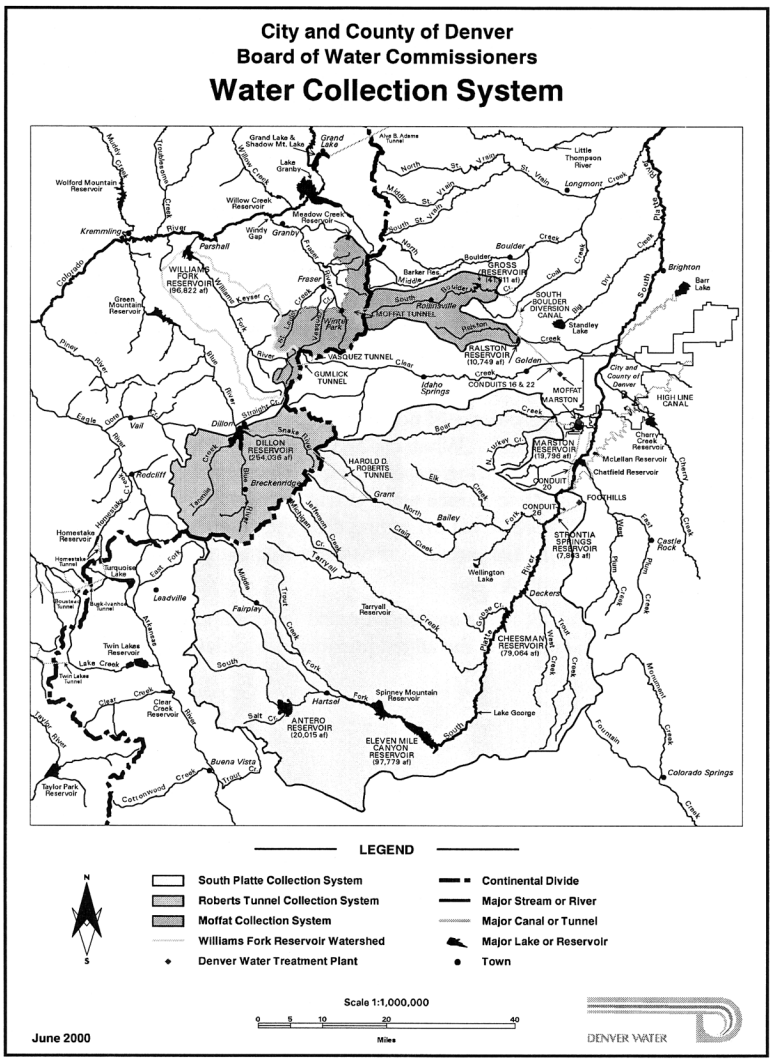
5. How Can NIDIS Help with Population Growth and Climate Change?

The need to provide water for the booming population of Colorado and other areas in the West is stressing natural stream systems and available water resources. The adverse impacts include the transfer of water from agricultural to municipal use. The demand for improved river environments and recreational opportunities increases with population growth. Climate change threatens to exacerbate these problems by making droughts longer and more severe.

A common response to the problems of population growth and climate change is to increase water conservation goals. When conservation is used by cities that depend on surface water to supply their growing populations, the increased efficiency of water use can greatly lower their ability to reduce water use in droughts. In other words, there is less non-essential water use to be cut off during droughts, thereby making the cities even more vulnerable to drought. This could lead to more frequent and more severe water use restrictions and water rationing.

NIDIS would provide the proactive and coordinated federal approach to droughts that water managers need to cope with the added impacts of population growth and climate change.

Exhibit A



BIOGRAPHY FOR MARC D. WAAGE

Marc Waage is the Manager of Raw Water Supply for Denver Water. He has been in this position for 18 years. Mr. Waage is responsible for meeting the water needs of 1.2 million people in the Denver area through the operation of an extensive raw water collection and storage system on the eastern and western slopes of Colorado. His primary challenge is to manage a scarce resource to meet municipal water needs while providing environmental, recreational and economic benefits to source watersheds. Mr. Waage also directs various water planning and management projects.

Mr. Waage worked briefly for the Bureau of Reclamation and the Bureau of Indian Affairs on water management projects. He is a professional civil engineer and

has a Bachelor's and Master's degree in civil engineering from Colorado State University, with a specialty in water resource engineering. Marc is a member of the American Society of Civil Engineers and the American Water Resources Association.

Chairman EHLERS. Thank you. Dr. Wilhite.

STATEMENT OF DR. DONALD A. WILHITE, DIRECTOR, NATIONAL DROUGHT MITIGATION CENTER, UNIVERSITY OF NEBRASKA

Dr. WILHITE. Good morning, Mr. Chairman and Members of the Committee. I am Don Wilhite, founder and Director of the National Drought Mitigation Center, located at the University of Nebraska Lincoln. I appreciate this invitation to discuss drought and drought management in the United States, the need to move this nation to a more risk-based management approach to lessen our vulnerability to this creeping natural hazard, and the role of the National Integrated Drought Information System, or NIDIS, in this process.

The National Drought Mitigation Center was formed in 1995. At the time, there was no national initiative or program that focused on drought monitoring, mitigation, and preparedness. The NDMC is unique. Our full attention is devoted to building awareness of and reducing vulnerability to the drought hazard. In the past eleven years, we have made considerable progress, but much work remains.

Some of the important accomplishments of the National Drought Mitigation Center include development of an Internet drought portal that provides users with comprehensive information on all aspects of the drought hazard, networking with federal and non-federal agencies on drought monitoring, mitigation, and preparedness, participation in a partnership with NOAA and the U.S. Department of Agriculture on the development of the U.S. Drought Monitor product, and hosting the U.S. Drought Monitor portal since its inception in 1999, assisting states, tribal, and local governments in the development of drought plans. Currently, 38 States have drought plans, and an increasing number are stressing mitigation over the reactive crisis management approach. Most of these States have used a drought planning methodology developed by the National Drought Mitigation Center.

Development of the Nation's first drought impact database, the web-based Drought Impact Reporter, which allows us to track drought impacts across the United States, research and development on drought monitoring tools to aid decision-makers, development of a new interactive, web-based decision support tools for agricultural producers, natural resource managers, and others, and conducting drought planning workshops and conferences throughout the United States. We are, in fact, co-sponsoring a National Drought Conference, which is going to be in Colorado this fall.

It is often said that drought is not purely a physical phenomenon, but rather an interplay between climate, human activities, and the environment. This is a key point. Although drought is a natural hazard, the way we manage or mismanage water and other natural resources determines, to a large extent, our vulnerability to drought. Therefore, improving drought management is not only about improvement, monitoring and prediction. It is also about understanding and assessing our vulnerabilities and man-

aging risk. Improved early warning and prediction alone will do little to reduce drought risk. We must deliver this information to natural resource managers and policy-makers in a timely manner, and demonstrate how this information can be applied in the decision-making process. We must conduct risk assessments to determine our vulnerabilities, and apply this knowledge to the development of comprehensive drought mitigation plans.

I am a strong supporter of NIDIS. NIDIS has the potential to significantly advance the science of drought monitoring and management in the United States. The NDMC has been involved in the evolution of this concept from the very beginning. I presented the final report on the NIDIS project to the Western Governors referred to earlier, in June of 2004. Given the NDMC's scientific expertise on drought, and our strong linkages to the user community, the NDMC can be a valuable partner to NOAA in the implementation of NIDIS in the coming years.

There is currently considerable technical capability in federal agencies, universities, and elsewhere, on drought monitoring, forecasting, mitigation, and preparedness. The challenge is to harness this capability, and direct it towards improving drought management. A key challenge for NIDIS and NOAA, as the implementing agency, is to assess this capability, coordinate the efforts of these agencies and organizations, and integrate this knowledge and technology into a drought early warning system and information system.

Improving drought monitoring, forecasting capabilities, mitigation, and preparedness also requires additional focused research. This research needs to be accomplished in a collaborative environment, because of the interdisciplinary nature of drought monitoring and management.

I have a few technical comments on H.R. 5136, and I have provided these to members of your staff. Mr. Chairman, this concludes my testimony. I wish to thank you for the opportunity to discuss the programs of the National Drought Mitigation Center, my vision on how improved management in the United States can occur, and how NIDIS can enhance this effort.

Thank you.

[The prepared statement of Dr. Wilhite follows:]

PREPARED STATEMENT OF DONALD A. WILHITE

I appreciate the opportunity to submit this statement to the House Committee on Science. My name is Don Wilhite; I am the founder and Director of the National Drought Mitigation Center (NDMC), located at the University of Nebraska in Lincoln. The National Drought Mitigation Center (NDMC) was formed in 1995 following a sequence of severe drought years between 1987 and 1994 that affected virtually all portions of the United States. At the time of the NDMC's formation, there was no national initiative or program that focused on drought monitoring, mitigation, and preparedness. I have been involved in drought-related research and outreach since 1980. My efforts have principally been focused on how to lessen the Nation's vulnerability to drought through improved monitoring and early warning, mitigation, and preparedness. We have made considerable progress, but much work remains. The National Integrated Drought Information System (NIDIS) has the potential to help improve the Nation's capacity to cope more effectively with severe drought episodes that create significant impacts on the Nation's economic, environmental, and social fabric.

It is imperative to point out that drought is a normal part of the climate for virtually all parts of the United States. For this reason, we need to be prepared for droughts, and focus our attention on mitigation and planning strategies that would

reduce impacts before drought strikes. On average, approximately 15 percent of the Nation is affected by drought each year, based on the historical record from 1895 to present. This drought record illustrates both single- and multi-year events; in particular the droughts of the 1930s, 1950s, 1960s, 1974–77, 1987–94, and 1996 to present are noteworthy for their intensity, duration, and spatial extent. During the most recent drought period, 35–40 percent of the country was affected and for some regions drought conditions persisted for five or more years. For example, parts of the southeast, particularly Georgia, North Carolina, South Carolina, and Florida experienced three to four consecutive years of drought between 1999 and 2002. States all along the east coast from Maine and New York to Florida were seriously affected in 1999. In the west, much of the southwest, especially Arizona and New Mexico, experienced five consecutive years of drought between 2000 and 2004 while much of Montana, Idaho, and surrounding states experienced severe drought for as many as seven consecutive years since 1999. My state, Nebraska, has experienced six consecutive years of drought.

Before I elaborate more broadly on the programs of the National Drought Mitigation Center and the changes necessary to shift the paradigm from crisis to risk management in the United States, I would first like to respond to questions submitted to me by the House Committee on Science.

1. Describe the drought monitoring and forecasting information currently provided by NOAA, other federal agencies, and the National Drought Mitigation Center. Also describe the functions of the National Drought Mitigation Center and how it differs from the proposed National Integrated Drought Information System (NIDIS).

NOAA, other federal agencies, and the NDMC each provide a broad suite of products and services for drought monitoring and forecasting. For example, NOAA is responsible for the collection of weather data from multiple networks across the country. They also archive that data for the purpose of tracking climate trends and describing climate characteristics. NOAA is also responsible for issuing forecasts for multiple time scales, usually classified as short-, medium-, and long-range. Other federal agencies also play an important role in drought monitoring and forecasting. For example, the U.S. Geological Survey monitors stream flow through a comprehensive network of stream gauging stations across the country. They also monitor ground water levels. USDA's Natural Resources Conservation Service (NRCS) is responsible for monitoring snowpack in the western states through a network of stations known as SNOTEL. The Corps of Engineers and the U.S. Bureau of Reclamation are both responsible for the operation and monitoring of reservoirs across the country. These reservoirs provide a critical buffer in water-short years in both the east and west. There are many other climate and water monitoring networks in existence at the State, regional, and national levels.

Drought differs significantly from other natural hazards. It is a slow-onset hazard and it is difficult to determine when it begins and ends or reaches its maximum severity. There is also no single definition of drought. There are literally hundreds of definitions in existence. Drought definitions are usually application (or impact) and region specific. Drought, unlike other natural hazards, can persist for many months or years. Managing water supplies through extended periods of precipitation deficiency is a considerable challenge for water and natural resource managers. Drought also differs from other natural hazards in terms of the spatial extent of the affected area. For example, during the 2002 drought, 40 percent of the Nation was in severe to extreme drought. In 1934, severe to extreme drought affected 65 percent of the Nation. Finally, the impacts of drought are largely non-structural and seldom result in loss of life, at least in the United States. However, FEMA has estimated annual losses at $6–$8 billion, making drought the Nation's most costly natural hazard.

Why is this information relevant in responding to this question? These characteristics of drought present a unique challenge for drought monitoring. Although it is true that all droughts originate from a deficiency of precipitation, to characterize drought intensity, duration, spatial extent, and impacts, it is necessary to integrate information from many different indicators. These indicators are precipitation, temperature, soil moisture, snowpack, stream flow, ground water levels, reservoir and lake levels, and vegetation. Forecasts, both meteorological and hydrological, are also important. Impacts are diverse and occur in many sectors, including agriculture, tourism and recreation, forests, transportation, health, energy, and the environment. Since the responsibility for monitoring and reporting information from these multiple indicators and sectors is fragmented between many federal and non-federal entities, an effective national drought monitoring and early warning system must analyze and integrate all of this information into a suite of user-oriented products

and deliver them to decision-makers from local to national levels in a timely manner. This is the challenge for NIDIS.

How does the National Drought Mitigation Center differ from NIDIS? The NDMC's program is directed at lessening societal vulnerability to drought through a risk-based management approach. The NDMC does not operate monitoring networks, as is the case with NOAA, USGS, and USDA. Our program's primary goal is to shift the emphasis of drought management in the United States from a crisis-based approach to a risk-based approach. This can be accomplished through improved drought planning and a greater emphasis on mitigation actions and programs. However, in order for a drought mitigation plan to be effective, it is dependent on a timely and reliable assessment of climate and water supply conditions and an accurate depiction of current and projected impacts. The NDMC has played the role of catalyst in improving drought monitoring in the United States by bringing federal, State, and regional entities together with a common purpose—providing better and timelier information to decision-makers. For example, as one of the original partners in the U.S. Drought Monitor with NOAA and USDA, we have improved awareness of drought conditions and potential impacts in the scientific and policy communities and the general public. This product has fostered greater coordination and cooperation between scientists in federal and non-federal agencies and institutions, leading to the development of other new tools to aid in assessing climate and water supply conditions. Without the NDMC's leadership in drought monitoring, mitigation, and preparedness, I do not believe we would be discussing NIDIS today.

To elaborate further on the NDMC's activities, the Center promotes and conducts research and outreach activities on drought monitoring, mitigation, and preparedness technologies; strives to improve coordination of drought-related activities and actions within and between levels of government; and assists in the development, dissemination, and implementation of appropriate mitigation and preparedness technologies in the public and private sectors. Emphasis is placed on research and outreach projects and mitigation/management strategies and programs that stress risk management measures rather than reactive, crisis management actions. It has been demonstrated that crisis management responses, such as drought relief, actually decrease self-reliance and, therefore, increase vulnerability to future drought episodes. Mitigation and preparedness increase self-reliance and reduce vulnerability. Programs that provide incentives for mitigation and preparedness are a very good investment for government at all levels and for the private sector as well. It has been demonstrated that for every dollar invested in mitigation and preparedness, four dollars are saved through reduced impacts when a natural disaster occurs. It is imperative that we shift the emphasis from crisis to risk management, as illustrated by the cycle of disaster management (Figure 1).

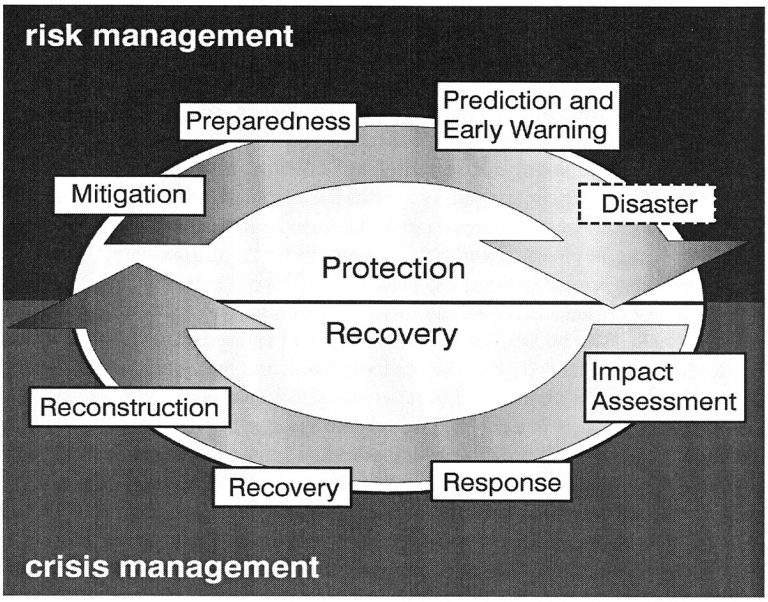


Figure 1. The Cycle of Disaster Management. (Source: National Drought Mitigation Center, University of Nebraska-Lincoln).

To respond effectively to the Nation's needs for drought early warning, mitigation, and preparedness, the NDMC has been conducting research and outreach activities since 1995 in the following areas:

- Developing and enhancing an information clearinghouse or web-based drought portal on drought early warning, impact assessment, mitigation, preparedness, and response options for decision-makers.
- Conducting and fostering collaborative research on drought monitoring, risk management, impact and vulnerability assessment, mitigation, and preparedness techniques and methodologies.
- Assisting State and federal agencies, tribal and local governments, and regional organizations in developing integrated assessments of drought severity and impacts, including current climate/drought and water supply assessments.
- Advising policy-makers and others by providing scientific and policy-relevant information on drought and water management issues.
- Organizing workshops, conferences, and seminars on drought preparedness planning and mitigation measures to reduce vulnerability to drought.
- Collaborating with and providing training for international scientists and facilitating the timely exchange of information on drought mitigation technologies with foreign governments, international and non-governmental organizations, and regional organizations.

2. How would the NIDIS improve the quality and usefulness of the drought monitoring and forecasting information provided by the Federal Government?

NIDIS would provide the mechanism to improve monitoring networks, standardize climate and water data currently available from federal and non-federal agencies, promote coordination and cooperation between agencies, increase the variety of decision support tools available to decision-makers, and lead to the development of a drought information portal or portals to deliver these data and informa-

tion to scientists and decision-makers at all levels through an interactive interface. NIDIS would promote increased research on drought monitoring and early warning, forecasts, impact assessment techniques, and mitigation tools and preparedness methodologies. It would also promote research on improving our understanding of societal vulnerability to drought from farm to national level.

3. What are the major data management, monitoring, and research components of NIDIS and what specific actions are needed to fully implement those components?

As stated previously, effective drought monitoring requires a wide variety of data to accurately assess the intensity, duration, spatial extent, and impacts associated with drought. These data requirements include climate parameters such as precipitation and temperature and other hydrologic indicators such as stream flow, reservoir and lake levels, ground water, soil moisture, and snowpack. It is also important to better understand the strengths and weaknesses of current climate and water indices and to develop new indices to improve the evaluation of drought and water supply conditions. Conducting research to determine the linkages between these indices and specific impacts in the many sectors that suffer the consequences of drought is also important. Understanding these linkages would provide water managers, for example, the opportunity to identify thresholds or triggers for various mitigation and response actions associated with drought plans. Improvements in the reliability of climate and water supply forecasts through greater investment in research will provide decision-makers with added lead times to adjust management decisions to reflect improving or deteriorating conditions. We must also improve our understanding of the complexities of drought impacts, develop methodologies to improve our assessment of these impacts, and create a national database of drought impacts.

A list of recommendations that address research and information needs in drought monitoring, mitigation, and preparedness is provided below:

- Implement the National Integrated Drought Information System (NIDIS) through a full partnership between NOAA and other federal agencies, non-federal agencies, and organizations, including the National Drought Mitigation Center, in order to improve monitoring and early warning systems and seasonal climate forecasts to provide better and more timely and reliable information to decision-makers; address data gaps in drought monitoring and enhance networks, particularly for soil moisture, snowpack, and ground water; and develop new monitoring and assessment tools/products that will provide resource managers at all levels with proper decision support tools at higher resolution.
- Improve knowledge of the scientific and policy communities and resource managers about the drought hazard.
    1. Augment paleoclimate and historical climate research to better understand the drought climatology of all regions for more effective planning and design.
    2. Communicate information on probabilities of single- and multiple-year drought events to natural resource managers and planners, policy makers, and the public.
- Improve the reliability of seasonal climate forecasts and train end users on how to apply this information to improve resource management decisions with the goal of reducing drought risk.
    1. Develop more competitive research grant programs to fund research on drought prediction. In particular, there is a need for enhanced observations and research on both the paleoclimate record and the drought-related dynamics of ocean-atmosphere coupling.
- Assess the economic, social, and environmental impacts associated with drought.
    1. Develop a standard methodology for assessing the impacts of drought on multiple economic sectors and the environment and systematically assess the losses associated with drought events at the local, State, and national levels.
    2. Evaluate the effect of mitigation actions in reducing the impacts of drought at the local and State level.
    3. Improve early assessments of drought impacts through the application of appropriate models (i.e., crop, hydrologic).

- Assess the science and technology needs for improving drought planning, mitigation, and response at the local, State, tribal, regional, and national levels.
  1. Evaluate current drought planning models available to governments and other authorities for developing drought mitigation plans at the State and local levels of government and require plans to follow proposed standards or guidelines.
  2. Develop improved triggers (i.e., links between climate/water supply indicators/indices and impacts) for the phase-in and phase-out of drought mitigation and response programs and actions during drought events.
  3. Develop vulnerability profiles for various economic sectors, population groups, and regions and identify appropriate mitigation actions for reducing vulnerability to drought for critical sectors.
- Increase awareness of drought, its impacts, trends in societal vulnerability, and the need for improved drought management.
  1. Initiate K–12 drought/water awareness programs/curriculum.
  2. Launch public awareness campaigns for adult audiences, directed at water conservation and the wise stewardship of natural resources.

Drought Mitigation, Preparedness, and Policy

I will elaborate further on some of the key issues associated with improving our understanding of drought, drought management, and shifting the paradigm from crisis to risk management. Improving drought management begins with improving our understanding of vulnerability and preparedness. Vulnerability to drought is dynamic and influenced by a multitude of factors, including increasing population, regional population shifts, urbanization, technology, government policies, land use and other natural resource management practices, desertification or land degradation processes, water use trends, and changes in environmental values (e.g., protection of wetlands or endangered species). Therefore, the magnitude of drought impacts may increase in the future as a result of an increased frequency of meteorological drought, changes in the factors that affect vulnerability, or a combination of these elements. The development of a national drought policy and preparedness plans at all levels of government that place emphasis on risk management rather than following the traditional approach of crisis management would be a prudent step for the United States to take. Crisis management, as illustrated by the hydro-illogical cycle in Figure 2, decreases self-reliance and increases dependence on government.

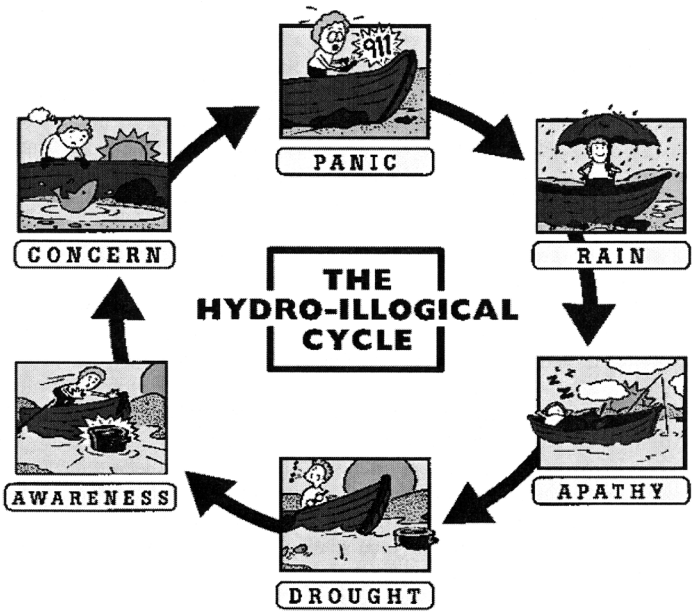


Figure 2. The hydro-illogical cycle. (Source: National Drought Mitigation Center, University of Nebraska-Lincoln)

The impacts of drought in recent years have been increasing and, it appears, at an accelerating rate, although a systematic national assessment and database of drought impacts has only recently been developed by the NDMC in the form of the web-based Drought Impact Reporter tool. FEMA (1995) estimated annual losses in the United States because of drought at $6–$8 billion, making drought the most costly natural disaster in the country. Losses from the 1988 drought have been estimated at more than $39 billion. The NDMC has estimated that losses associated with the 2002 drought exceeded $20 billion. It is important to note that these are estimates for a single drought year, while major drought events often occur over a series of years, as noted previously.

The impacts of drought have also been growing in complexity. Historically, the most significant impacts associated with drought have occurred in the agricultural sector (i.e., crop and livestock production). In recent years, there has been a rapid expansion of impacts in other sectors, particularly energy production, recreation and tourism, transportation, forest and wildland fires, urban water supply, environment, and human health. The recent drought years in the western United States, for example, have resulted in impacts in non-agricultural sectors that have likely exceeded those in agriculture. In addition to the direct impacts of drought, there are also significant indirect impacts that, in most cases, would exceed in value the direct losses.

In the past decade or so, drought policy and preparedness has received increasing attention from governments, international and regional organizations, and non-governmental organizations. Simply stated, a national drought policy should establish a clear set of principles or operating guidelines to govern the management of drought and its impacts. Creation of a national drought policy is one of the goals of the *National Drought Preparedness Act* (S. 802; H.R. 1386), and the National Integrated Drought Information System (NIDIS) is a component of this bill. National drought policy should be consistent and equitable for all regions, population groups, and economic sectors and consistent with the goals of sustainable development and the wise stewardship of natural resources. The overriding principle of drought policy should be an emphasis on risk management through the application of preparedness and mitigation measures. Preparedness refers to pre-disaster activities designed to increase the level of readiness or improve operational and institutional capabilities

for responding to a drought episode. Mitigation refers to short- and long-term actions, programs, or policies implemented in advance of and during drought that reduce the degree of risk to human life, property, and productive capacity. These actions are most effective if done before the event. Emergency response will always be a part of drought management because it is unlikely that government and others can anticipate, avoid, or reduce all potential impacts through mitigation programs. A future drought event may also exceed the "drought of record" and the capacity of a region to respond. However, emergency response should be used sparingly and only if it is consistent with longer-term drought policy goals and objectives.

A national drought policy should be directed toward reducing risk by developing better awareness and understanding of the drought hazard and the underlying causes of societal vulnerability. The principles of risk management can be promoted by encouraging the improvement and application of seasonal and shorter-term forecasts, developing integrated monitoring and drought early warning systems and associated information delivery systems, developing preparedness plans at various levels of government, adopting mitigation actions and programs, and creating a safety net of emergency response programs that ensure timely and targeted relief. A key element of an effective drought policy is the delivery of information in a timely manner so informed decisions can be made by resource managers and others. Creation of a user-friendly drought information system is one of the principal goals of NIDIS.

The traditional approach to drought management has been reactive, relying largely on crisis management. This approach has been ineffective because response is untimely, poorly coordinated, and poorly targeted to drought-stricken groups or areas. In addition, drought response is post-impact and relief tends to reinforce existing resource management practices. It is precisely these existing practices that have often increased societal vulnerability to drought (i.e., exacerbated drought impacts). The provision of drought relief only serves to reinforce the status quo in terms of resource management (i.e., it rewards poor resource management and the lack of preparedness planning.)

In the United States, there has been some progress in addressing the impacts of drought through the development of preparedness plans. The most noticeable progress has been at the state level, where the number of states with drought plans has increased dramatically during the past two decades. In 1982, only three states had drought plans—New York, Colorado, and South Dakota. In 2006, thirty-eight states have drought plans. The basic goal of state drought plans should be to improve the effectiveness of preparedness and response efforts by enhancing monitoring and early warning, risk and impact assessment, and mitigation and response. Plans should also contain provisions (i.e., an organizational structure or framework) to improve coordination within agencies of State government and between local and Federal Government. Initially, State drought plans largely focused on response efforts aimed at improving coordination and shortening response time; today the trend is for states to place greater emphasis on mitigation as the fundamental element of a drought plan. Thus, some plans are now more pro-active, adopting more of a risk management approach to drought management.

The growth in the number of states with drought plans suggests an increased concern at that level about the potential impacts and conflicts associated with extended water shortages and an attempt to address those concerns through planning. Initially, states were slow to develop drought plans because the planning process was unfamiliar. With the development of drought planning models, such as the 10-step drought planning process developed at the NDMC, and the availability of a greater number of drought plans for comparison, drought planning has become a less puzzling process for states. As states initiate the planning process, one of their first actions is to study the drought plans of other states to compare methodology and organizational structure.

The rapid adoption of drought plans by states is also a clear indication of their benefits. Drought plans provide the framework for improved coordination within and between levels of government. Early warning and monitoring systems are more comprehensive and integrated and the delivery of this information to decision-makers at all levels is enhanced. Many states are now making full use of the Internet to disseminate information to a diverse set of users and decision-makers. Through drought plans, the risks associated with drought can be better defined and addressed with proactive mitigation and response programs. The drought planning process also provides the opportunity to involve numerous stakeholders early and often in plan development, thus increasing the probability that conflicts between water users will be reduced during times of shortage. All of these actions can help to improve public awareness of the importance of water management and the value of protecting our limited water resources.

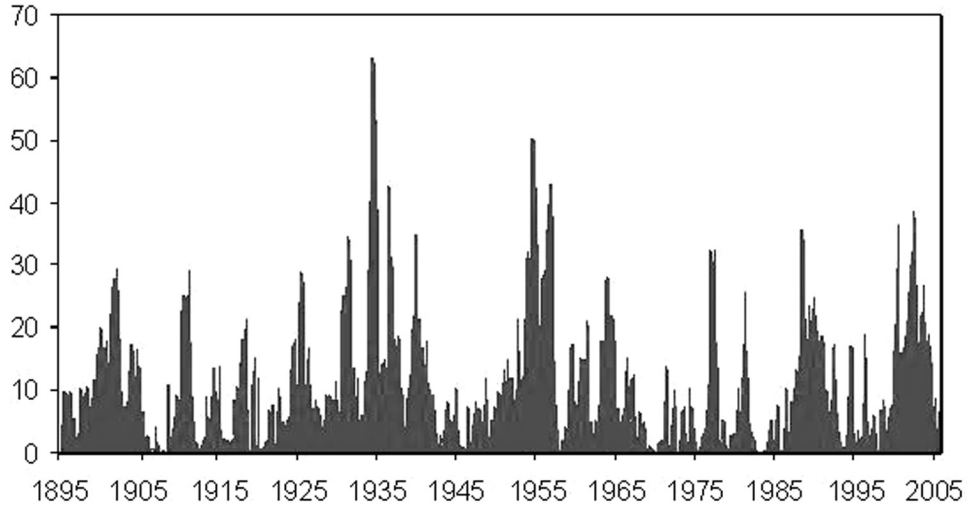
Drought mitigation plans have three essential components, regardless of whether they are developed at the State, national, regional, or local scale. First, a comprehensive monitoring and early warning system provides the basis for many of the decisions that must be made by a wide range of decision-makers as drought conditions evolve and become more severe. Equally important, early warning systems must be coupled to an effective delivery system that disseminates timely and reliable information. As drought plans incorporate more mitigation actions, it is imperative that these actions be linked to thresholds (e.g., reservoir levels, climate index values) that can serve as triggers for mitigation and emergency response actions. Second, a critical step in the development of a mitigation plan is the conduct of a risk assessment of vulnerable population groups, economic sectors, and regions. The purpose of risk assessment is to determine who and what is at risk and why. This is successfully accomplished through an analysis of historical and recent impacts associated with drought events. This risk assessment task is accomplished as part of the 10-step drought planning process developed by the NDMC. Third, after impacts have been identified and prioritized, the next step is to identify appropriate mitigation actions that can help to reduce the risk of each impact for future drought events. In many cases, appropriate response actions are also identified through this process, but these actions should not conflict with the basic goal of the drought mitigation plan: to reduce vulnerability to drought events. As noted earlier, some response actions may increase reliance on government and encourage the continuation of inappropriate resource management practices.

Summary

The National Drought Mitigation Center at the University of Nebraska-Lincoln strongly supports greater investment in research and policies directed at reducing this nation's vulnerability to drought through a more risk-based approach. The implementation of NIDIS is a critical step in this direction. Improved climate and water assessments, more reliable forecasts at various time scales, better decision-support tools, and more timely communication of this information to decision-makers through an interactive delivery system will greatly enhance management of water and other natural resources. The NDMC will help NOAA develop an implementation plan for NIDIS and partner with them and other federal and non-federal entities to ensure the success of this program. My years of experience with drought management have convinced me that a wise initial investment in improved monitoring, early warning and prediction, mitigation, and planning will reduce this nation's vulnerability to drought and concomitant impacts on economies, the environment, and the social well-being of its citizens.

Percent Area of the United States in Severe and Extreme Drought

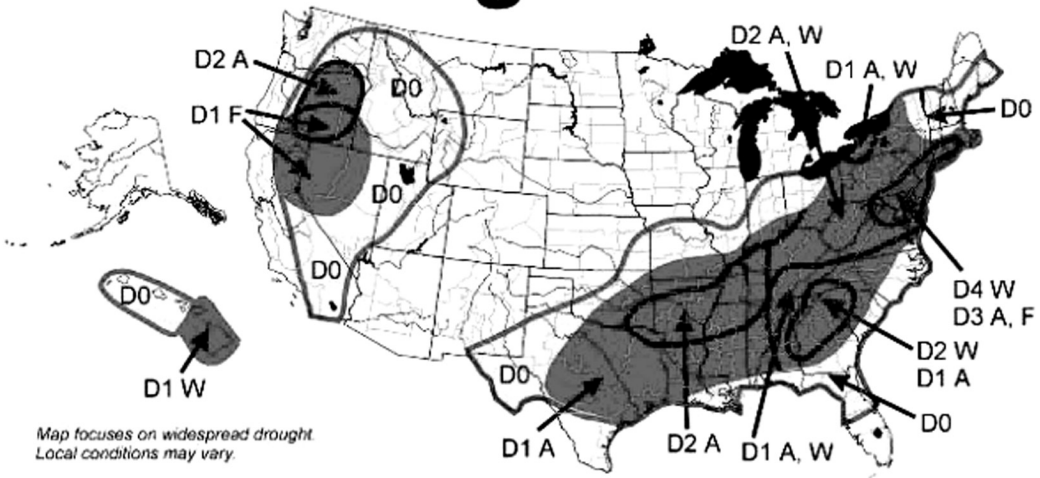
January 1895–January 2006



Based on data from the National Climatic Data Center/NOAA

August 24, 1999

U.S. Drought Monitor



Map focuses on widespread drought. Local conditions may vary.

- D0 Watch
- D1 Drought
- D2 Drought–Severe
- D3 Drought–Extreme
- D4 Drought–Exceptional

Drought type: used only when impacts differ

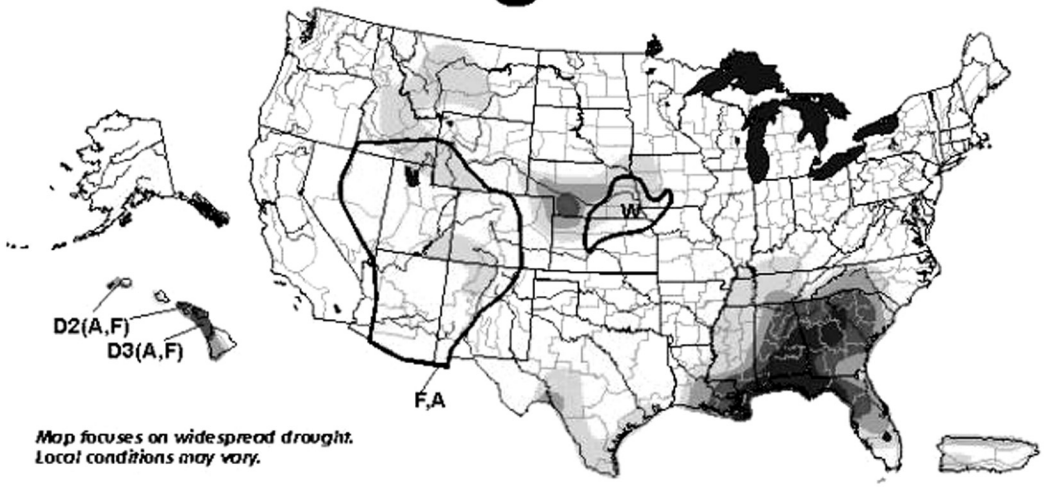
A = Agriculture
W = Water
F = Forest fire danger

Plus (+) = Forecast to intensify next two weeks
Minus (-) = Forecast to diminish next two weeks
No sign = No change in drought classification forecast

• ***Updated every Thursday morning*** •

July 18, 2000 Valid 8 a.m. EDT

U.S. Drought Monitor



Map focuses on widespread drought. Local conditions may vary.

D0 Abnormally Dry
D1 Drought–First Stage
D2 Drought–Severe
D3 Drought–Extreme
D4 Drought–Exceptional
Delineates Overlapping Areas

Drought type: used only when impacts differ

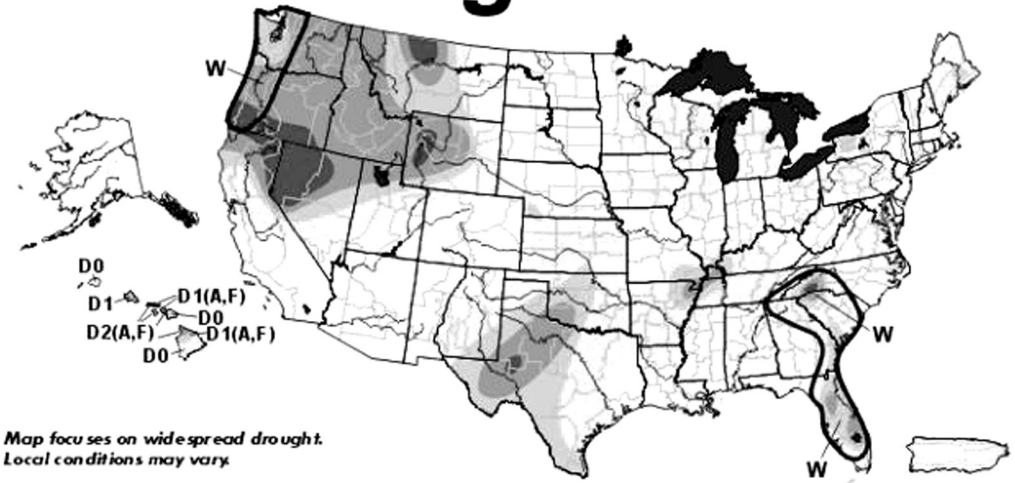
A = Agriculture
W = Water
F = Wildfire danger

See accompanying text summary for forecast statements

Released Thursday, July 20, 2000

July 24, 2001 Valid 8 a.m. EDT

U.S. Drought Monitor



Map focuses on widespread drought. Local conditions may vary.

D0 Abnormally Dry
D1 Drought–Moderate
D2 Drought–Severe
D3 Drought–Extreme
D4 Drought–Exceptional
Delineates Overlapping Areas

Drought Impact Types:
A = Agriculture
W = Water (Hydrological)
F = Fire danger (Wildfires)
(No type = All 3 impacts)

See accompanying text summary for forecast statements

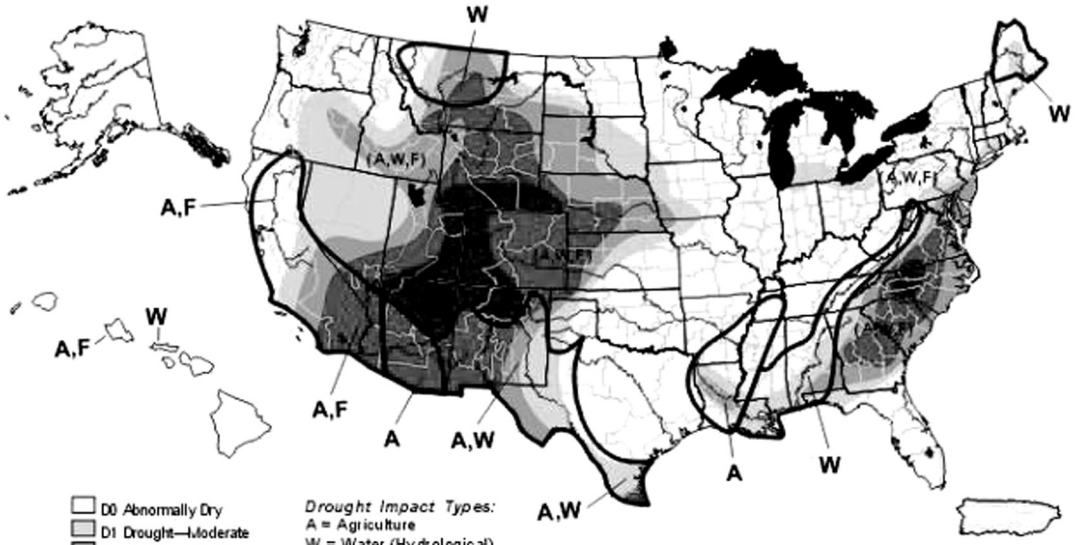
http://enso.unl.edu/monitor/monitor.html

● ***Released Thursday, July 26, 2001*** ●

Author: *Brad Rippey*

U.S. Drought Monitor

July 23, 2002
Valid 8 a.m. EDT



D0 Abnormally Dry
D1 Drought—Moderate
D2 Drought—Severe
D3 Drought—Extreme
D4 Drought—Exceptional

Drought Impact Types:
A = Agriculture
W = Water (Hydrological)
F = Fire danger (Wildfires)
Delineates dominant impacts
(No type = All 3 impacts)

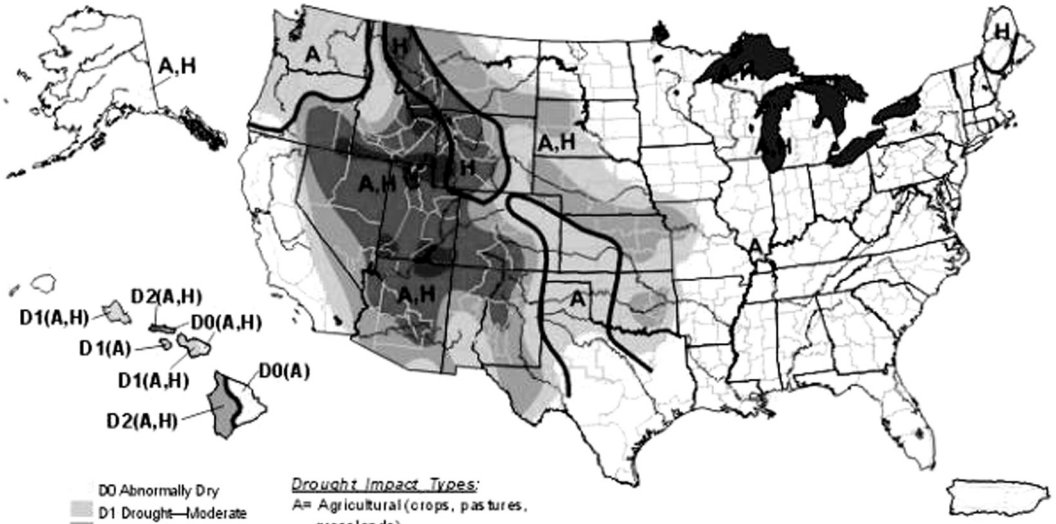
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://drought.unl.edu/dm

Released Thursday, July 25, 2002
Author: *Brad Rippey, USDA*

U.S. Drought Monitor

July 29, 2003
Valid 8 a.m. EDT



D0 Abnormally Dry
D1 Drought—Moderate
D2 Drought—Severe
D3 Drought—Extreme
D4 Drought—Exceptional

Drought Impact Types:
A= Agricultural (crops, pastures, grasslands)
H= Hydrological (water)
No type = both impacts
Delineates dominant impacts

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

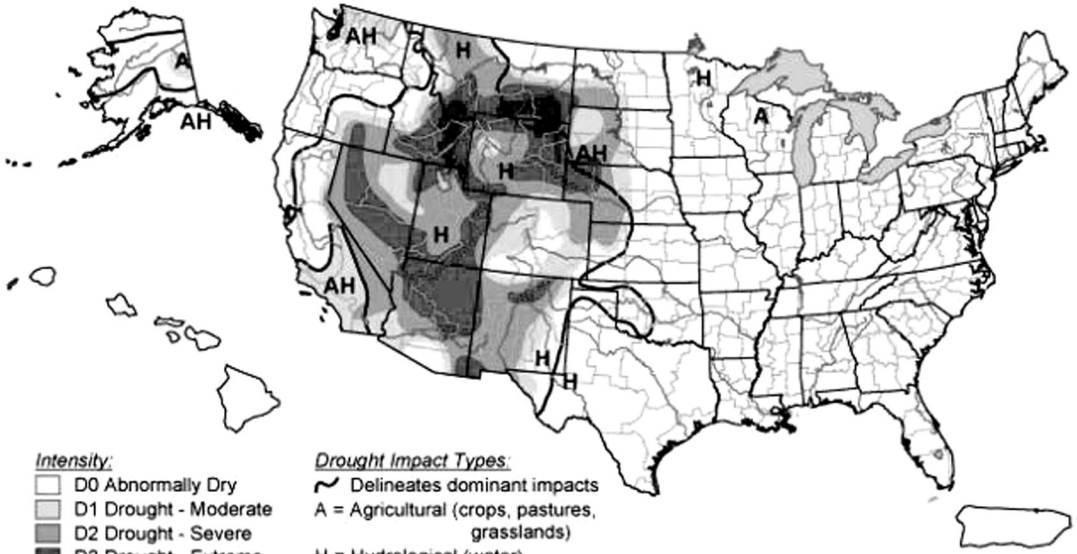
http://drought.unl.edu/dm

Released Thursday, July 31, 2003

Authors: *David Miskus, NOAA/CPC/JAWF and Brad Rippey, USDA/JAWF*

U.S. Drought Monitor

July 27, 2004
Valid 8 a.m. EDT



Intensity:
- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

Drought Impact Types:
- ~ Delineates dominant impacts
- A = Agricultural (crops, pastures, grasslands)
- H = Hydrological (water)
- (No type = Both impacts)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://drought.unl.edu/dm

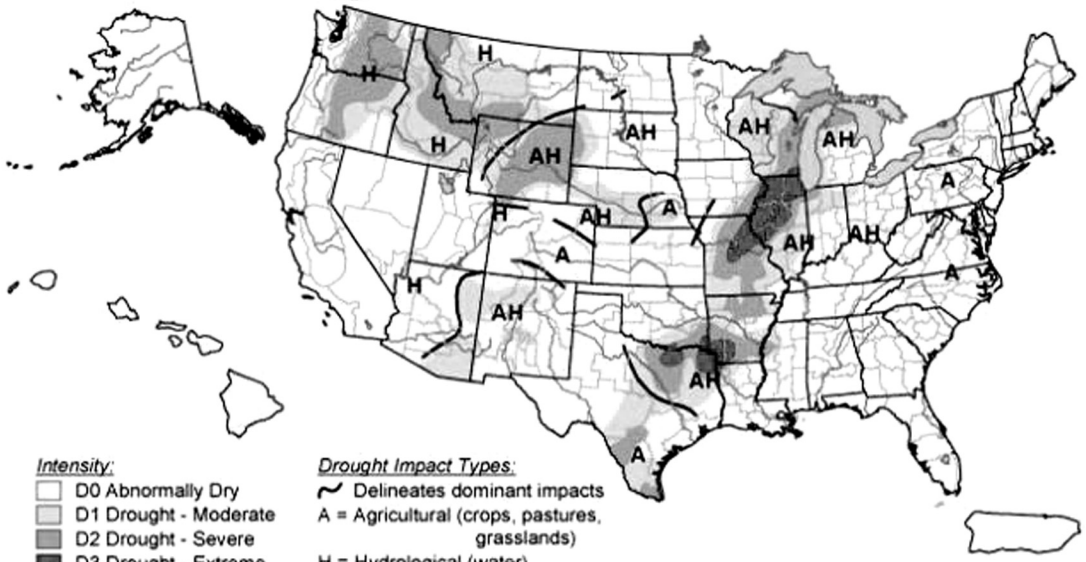
USDA National Drought Mitigation Center

Released Thursday, July 29, 2004

Authors: Richard Heim/Candace Tankersley, NOAA/NCDC

U.S. Drought Monitor

July 26, 2005
Valid 8 a.m. EDT



Intensity:
- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

Drought Impact Types:
- Delineates dominant impacts
- A = Agricultural (crops, pastures, grasslands)
- H = Hydrological (water)
- (No type = Both impacts)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

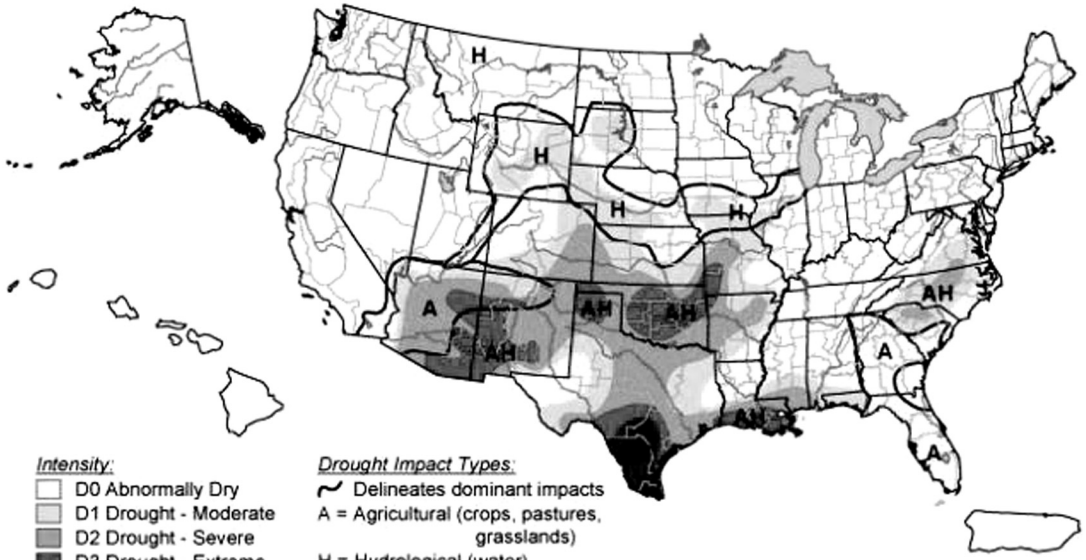
http://drought.unl.edu/dm

USDA National Drought Mitigation Center

Released Thursday, July 28, 2005
Author: C. Tankersley/J. Enloe, NOAA/NESDIS/NCDC

U.S. Drought Monitor

April 25, 2006
Valid 8 a.m. EDT



Intensity:
- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

Drought Impact Types:
- Delineates dominant impacts
- A = Agricultural (crops, pastures, grasslands)
- H = Hydrological (water)
- (No type = Both impacts)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://drought.unl.edu/dm

USDA National Drought Mitigation Center

Released Thursday, April 27, 2006
Author: Brad Rippey, U.S. Department of Agriculture

BIOGRAPHY FOR DONALD A. WILHITE

Dr. Donald A. Wilhite is Director of the National Drought Mitigation Center (NDMC) and Professor and Associate Director, School of Natural Resource Sciences, the University of Nebraska-Lincoln. Dr. Wilhite has more than 20 years of experience in the areas of drought monitoring, planning and mitigation and has worked with State, federal and regional organizations as well as with numerous foreign governments and international organizations. The NDMC is one of the partner institutions for the U.S. Drought Monitor, a weekly map illustrating drought conditions in the U.S. He is also leading efforts to establish regional drought preparedness networks throughout the world under sponsorship of several agencies of the United Nations. Dr. Wilhite holds a Ph.D. degree from the University of Nebraska-Lincoln in geography, an M.A degree from Arizona State University-Tempe and a B.S. degree from Central Missouri State University-Warrensburg.

DISCUSSION

Chairman EHLERS. Thank you, and thank you to all the witnesses for their testimony. We certainly appreciate your comments.

IMPLEMENTATION AND THE FUTURE

At this point, we will open our first round of questions, and the Chair recognizes himself for five minutes.

The first question I have, and maybe the only question, given the time constraint, is about what happens, assuming this bill passes and the National Integrated Drought Information System is put in place, what happens after that? NOAA is known for doing a good job with all aspects of issues relating to weather, and related issues. I am sure they will do a fine job on the drought program.

As we well know, just because NOAA forecasts something doesn't mean people respond, whether it is a gale coming across the Great Lakes, or a hurricane hitting the south coast, and what is really important is once the data is produced and given out, what will you do? What do you see happening after that? How do we coordinate the reaction so that meaningful steps are taken once the data are derived and distributed?

So, would you envision NOAA as being the agency to stimulate this, or do you see that out of all the various agencies, federal and otherwise, who receive this information, have to be charged with the responsibility for coordinating a response once they receive the information?

I would appreciate your comments on that, and we will go right to left this time. Dr. Wilhite?

Dr. WILHITE. Okay. Thank you very much.

Well, I see NIDIS as an end to end system, so in this case, NOAA is the implementing agency but the success of NIDIS will be in its ability to coordinate these activities, and to involve not only other federal agencies, but other non-federal agencies. And so, the key is not only developing the data and the information, and making that available, and that would come from multiple sources, through either one or multiple drought portals on the Internet, but also, in delivering this information to people, and making sure that they are aware that the information is available, but also, working with them in the development of some of these decision support tools. Because to not involve users in the development of the tools will most likely lead to the fact that they won't use the tools, and so, I think they have to be involved from the outset. So, I see this

as a coordinated end to end system, and the word integrated in National Integrated Drought Information System is really the key word here, bringing this all together from the sciences, scientists at the—at one level delivering this information to users, and complete interaction between them.

Chairman EHLERS. Do you believe the States have in place the agencies and the programs necessary to properly use the data that will be——

Dr. WILHITE. I think in general, the State agencies do exist. The key here is, I mean, since 38 States now have drought plans, they all have a coordinated or organizational framework, each of those 38 States, on how to use this kind of information. So, I think the agencies are available. I think the problem with dealing with drought is that water management and monitoring and decision-making is so fragmented between different agencies, at the federal level, and at the State level, that it is important to tie all these together, which is one of the goals of a drought plan, is to put in place an organizational framework, and I think NIDIS will help develop that organizational framework at the national level, but it will have to connect to, you know, the various states and state agencies, and then down to local utilities and so forth, at the user level.

Chairman EHLERS. Thank you. Mr. Waage.

Mr. WAAGE. Yeah. Well, I would like to answer that from my own experience of trying to collect information during the drought. I really think the best way to disseminate that information is through this Internet portal. Most of the decision-makers in a drought are not technical people. They are non-technical people. They don't understand these concepts. They don't have a lot of time to search for information, and making that information easily understood and easily accessed, I think will go a long way toward use, and I think if all the federal agencies were to promote a single portal for that information, that could all be, all these users could be funneled to one area, where they could find what they are looking for.

Chairman EHLERS. Mr. Dierschke.

Mr. DIERSCHKE.One place portals will work for us, probably, because we depend a lot on the weather in our business, and I don't want to be searching for a hundred different places to find out something that is going to be affecting my livelihood. So, I would like to see the one portal, probably directed to national, to the State, to an Internet site, I think will really work for agriculture.

Chairman EHLERS. Mr. Smith.

Mr. SMITH. I agree with everything that is said, and I would like to bring this to, I think, one of the points that we are working on specifically in Oklahoma, and this is a comprehensive, statewide water plan.

In the last 30 years in Oklahoma, we have had above average precipitation, if you look at the five year weighted average, it has been above average precipitation for the last 30 years in Oklahoma. That has led people—now that we enter a drought, the drought of 2006, where we now have lake levels that are down at 50 percent, in some cases. We have people that have been accustomed to this, and have not planned for this variability in climate that surely is

to come, and we don't understand that very well. The variability in climate is not well understood.

NIDIS will provide that information, provide research to help, I think, cities and communities plan for those drought times in the future, in terms of water supply.

Chairman EHLERS. And Dr. Koblinsky.

Dr. KOBLINSKY. Thank you, Mr. Chairman, and thank you for your kind words about NOAA and its abilities to work and develop the information observing system on this.

I am reminded, with your question, of a note in Everett Rogers' books on the diffusions of innovations, and he was talking about the development of the Green Revolution, and conveying modern agriculture information to farmers in the States, and he was doing this at the time, I believe, at the University of Iowa or Iowa State, and he was fascinated by the idea that while they were making great strides on the research side on improving agriculture as he drove home at night, and looked at the farmers, he didn't see the application of the new technology, and they grew quite concerned about how to actually make this transfer of knowledge to the people that could actually use that.

And I think in this case with drought we are approaching that same sort of challenge, and I think that NIDIS needs to face that challenge and will. I think you have heard a lot of the ideas we have for building the end to end system, the observing systems, the data information, the research to improve predictions, the work on impacts, the work on decision support tools. I think a challenge we will face is the evaluation of the system. I don't think we have quite gotten there yet with climate decision support activities, and that is something, I think, that NIDIS could begin to work on. Within NOAA, we see NIDIS as a tremendous opportunity to develop climate service in an integrated fashion, and propagate it even further than we have done with seasonal triennial forecasts, and providing that information.

And I think there is a real opportunity here to evaluate the system, and build an evaluation system into NIDIS, to understand its impact on the communities, and the best way of transferring this new technology and information to the user. And I look forward to doing that with the other agencies and the States. We are looking forward, right now, to holding a short workshop at the beginning of the summer, to engage interested parties, a small group of interested parties, of States, regions, and other federal agencies, and formulating a draft implementation plan for NIDIS, and that we would follow up with more of an all comers workshop in the fall.

I really sense a tremendous enthusiasm for this system, and getting back to your question, I think one issue I would like to bring to that group is the need for the evaluation with the eventual user, and getting their feedback to make the system effective and useful to everyone.

Thank you.

Chairman EHLERS. Thank you all for good answers, good guidance for us on this.

SCOPE

I am now pleased to recognize Mr. Wu for five minutes.

Mr. WU. Thank you very much, Mr. Chairman.

I intend to ask only one question, and then, yield the balance of my time to Mr. Udall. And this question is aimed principally at Dr. Koblinsky, but anybody else who wants to take a stab at it, you are welcome to do so.

This legislation is focused, or the subject legislation, this hearing is focused on drought. We have situations where there is too much water, and situations where there is too little water. Although the human consequences of too much water may be different from too little water, does it make sense to have something like NIDIS sort of broaden its scope to look at instances of too much water, and forestalling some of those consequences, as well as looking at too little water, and trying to forestall some of those consequences? So, we are looking at any situation that is two or three or four sigmas out, rather than, you know, just looking at one side of the abnormal curve, if you will.

Dr. KOBLINSKY. Thank you for your question, Representative Wu.

I think that this system will provide information that would be extremely useful for hydrological forecasting and flash floods, over strong precipitation events, et cetera, because in principle, it will be monitoring conditions that are very useful to the folks that are doing those forecasts for the reverse issue that you mentioned, the extreme events of heavy precipitation and flooding. And I know that within NOAA, our Office of Hydrology, for example, and the Weather Service, will be tightly linked, and very much involved for the river forecast, monitoring, and improving river forecasts, as part of this system.

And I think that we are talking about developing improved observing systems that will help understand groundwater, better measurements of soil moisture and conditions. Is the ground not only dry, but is it also saturated? Those same measurements will give us a sense of saturation, which I know from having lived in Oregon myself, is a key issue, as you get into the mountain streams, the saturation issue and the overflow of water in those streams.

Snowpack, snow depth, and coverage will be monitored, and part of this integration system, so that not only the lack of snow, but also, heavy snow conditions would also be picked up by this improved monitoring system and used to detect conditions and improve conditions, I think, for the opposite of drought, which would be early release of the snow, which was an issue often, I know, in the Cascades in Oregon, to detect that and improve that.

So, I see this system as, while it is focused on drought, a lot of the monitoring system, the information capabilities, disseminative information, improvement of predictions will also greatly facilitate what we do in hydrological forecasting.

Thank you.

Mr. WU. Terrific. Thank you very much, and I yield the balance of my time to Mr. Udall.

DECISION-MAKING

Mr. UDALL. I thank the gentleman for yielding, as has been the case for many weeks here, we have an awfully busy set of schedules, trying to compress everything into a couple days. I do have

another hearing, Mr. Waage, you will be interested, with the compensation plan for the Rocky Flats cohort. We are trying to do right by those gentlemen and gentlewomen, but if I could direct some questions to you.

Let me run three questions at you, and then give you a chance to respond. Could you talk about the decision-making structure within Denver Water, as it pertains to water management decisions, and then, include in those comments the role that the state and/or municipalities play, and how they utilize drought monitoring or forecast data? And if you could tie that, and I am giving you a big mountain to climb here, into what type of products would be most useful from NIDIS in that regard?

Mr. WAAGE. Sure. I would be glad to address that.

The decision-making structure at Denver Water is we are governed by a board of five citizens of the city of Denver, and those are non-technical people that are appointed by our mayor, and I think that is a good reason for this drought information to be kept in understandable terms. As a water manager, I spend a lot of time trying to educate those people, along with the media, and our customers, on what is happening with the drought. These better informed laypersons are making decisions, and having their decisions covered by the media, I think would be greatly benefited by just more education overall.

The role that the State, at least the State of Colorado, provides a lot of monitoring as well, streamflow conditions, weather conditions. They also have basically a drought taskforce that is used to coordinate all of the activities of state agencies, but the federal agencies are very active in providing forecasts and guidance for those agencies. That is information, then, that gets filtered down at the level that cities like us use.

I forgot your last question.

Mr. UDALL. My time—or Mr. Wu's time has expired. We will come back around.

Chairman EHLERS. The gentleman's time has expired. We are pleased to recognize Mr. Hall for five minutes.

SCOPE (CONT.)

Mr. HALL. Thank you, Mr. Chairman, and I thank you. Your testimony, your written testimony is available to us, and available to every Member, and we will use that, as we go along and nurse this thing through the legislative process, but to get to more practical, I guess that is the reason we get to ask you questions, to see how it is going to work in our districts, or districts that—or States that we are affected by drought.

So, Mr. Dierschke, in your testimony, you stated that current technology doesn't provide the information that farmers need to avoid the impacts of drought, and in your opinion, I guess I would like to know what are the most pressing bits of practical information needs, that your farmers have, and that could be met by the proposed system that we are working on, and if you would, provide some specific examples of how the Farm Bureau and how local people, farmers and ranchers, and folks that you will be working with, that you represent, would make use of this information?

Mr. DIERSCHKE. Okay. Thank you.

Weather, of course, in Texas, is the biggest problem we have. Texas is a big state, that has many different climate zones. We go from the tropics, almost, over in East Texas, to the desert over in West Texas. So currently, projections on drought probably don't go out very far, and we would like to see it go out further, so that we can make plans on South Texas right now, they were in a crunch when it came to planning time. They had no idea what type of seed to plant, or what their inputs were going to be. Some of the seed we are planting right now, the cost of it is very expensive, and if they would have had a little better idea that when it come time to plant, that they were not going to, they were going to be in a drought situation, they may have changed their plans a little bit.

Input costs have just gone sky high, fuel, fertilizers, they need that technology, so that they can make decisions further out on whether they want to buy that fertilizer ahead of time, or if they are going to wait and not put it out. So, that is some of the things that we need.

Also, wildlife is getting to be quite a big deal in our country with the ranchers. That is a good part of their income now, and if we know there is going to be a drought, and we have our white-tailed deer out there, and our quail and turkeys out there, that we can prepare to be feeding those for our income, and I have an ample supply of that wildlife out there, when the hunters do come.

So, those are a few deals, another one is livestock on our ranches. If we know there is going to be a drought situation coming up, and we know that, say, 180 days ahead of time, well, we can cut back our stocking rates, so that we are not out there depleting our grasses, that I think I said in my testimony, that it takes a number of years for the rains to come back, and we are conservationists, and we would like to pull those stocking rates down. If we knew that ahead of time, we could do that. Of course, if we know there is going to be an abundance of moisture, we can also increase our stocking rates, too. So, it will help us tremendously.

There is a lot of technology going on right now on drought tolerant crops. If I knew there was going to be a drought in my area, I would spend a little bit more money on a drought tolerant crop that I could plant, whereas otherwise, I wouldn't do it.

Mr. HALL. I thank you, and I thank you, Mr. Chairman. I yield back my time to you.

Chairman EHLERS. The gentleman yields back the balance of his time. We will now recognize Mr. Udall for five minutes on his own time.

DECISION-MAKING (CONT.)

Mr. UDALL. Thank you, Mr. Chairman. I turn to Mr. Waage for a minute or so.

I wanted to get a sense of the type of products that NIDIS could produce that would be useful to you all, and perhaps, if you might include the state in your comments, as well, that is, the State of Colorado.

Mr. WAAGE. Okay. Well, most of the State's water supply comes from snowmelt, and so, critical to us in a drought are forecasts of how much supply we are going to get from the snowmelt. And the

second most critical product is then the weather outlook, so that we can manage that supply during the summertime.

And those two—improving those two products, would improve our ability to manage water use restrictions. That is really the major tool that we have during droughts, to combat dryness, is restricting water use. The more we know about how much supply we are going to have, and how much demand we are going to have from warm or cold weather, we can do a better job of making use of what we have.

And the other thing is, it can help us reduce impacts to stream systems by our diversions, by not over-diverting water, if we are not going to need it.

Mr. UDALL. Yeah, I would note that in your testimony, in the terrible year of 2002, that we had below average snowfall, but it didn't seem to present a problem for us, until the spring dawned very dry and windy, and we were a little bit behind the curve in understanding what that was going to do to soil moisture levels, therefore, groundwater levels, and we were caught unaware.

Mr. WAAGE. Yes.

Mr. UDALL. As we know.

Mr. WAAGE. That was a perfect example of how science could have helped us have a good early warning. The snowpack wasn't as low as other years, but we had exceptionally dry weather. We didn't know what was happening to the snowpack, that it was melting into—or that it was just sublimating and disappearing. More monitoring would give us an early warning of those disastrous type years.

Mr. UDALL. Thank you, again, for being here today.

SCOPE (CONT.)

Mr. Smith, if I could turn to you. We have talked about monitors that would provide adequate real time information. Do you have a sense of the estimated cost to install and maintain these networks, and included in that question is, how many do you think we would need to have in place?

Mr. SMITH. I don't have a real good idea about cost. It varies. I can talk more specifically about Oklahoma. We have a MESONET program in Oklahoma, that we believe is one of the best monitoring systems in the world. We have sites across Oklahoma that monitor weather, soil moisture, all of these types of things, and that particular program is available, then, for users to buy into, and farmers can actually enroll in this program, and pay a fee to use the information, to determine when to apply fertilizers, and when to irrigate, and these types of things.

That particular program, off the top of my head, Representative Udall, I don't remember the cost of that particular program, but as we look at SNOTEL, as we look at stream gauges, as we look at all of these types of things, putting those together, I think that we can, I think those numbers are available, and we can get those to you.

Mr. UDALL. Could you get those to the Committee?

Mr. SMITH. Absolutely, we can. Yes.

Mr. UDALL. I really appreciate that.

Mr. SMITH. Yes.

TECHNOLOGY

Mr. UDALL. Dr. Koblinsky, if I could turn to you, Mr. Smith talked about, in his testimony, technologies that would increase the rate of receiving, and in turn, disseminating real time data. Could you discuss some of NOAA's current capabilities in real time monitoring, and the potential use of improved technologies?

Dr. KOBLINSKY. Certainly. The variety of observing networks that NOAA has range from ground observations, ocean observations, and satellite observations, as you are well aware. Most particular to the drought, it may surprise you that the Ocean Observing System is actually playing a very important role. We have had a great deal of success in our research demonstrating the impact of ocean surface temperatures, especially in the tropical belt, even over to the Indian Ocean, on the transport of water vapor transports that come into North America, where they come, and when they come, and so, observing systems in the ocean have actually provided a lot of valuable information, and are continuing to do so, and we are grateful for your support for helping us develop a Global Ocean Observing System in partnership with international partners.

On the ground system, we have got an observing system, the cooperative observing system, that measures temperature and precipitation, and provides information, some of it in real time, that is used by our operators. We have a dearth of soil moisture sensors, and that has been recognized in the NIDIS plan overall—a need to add soil moisture systems.

There are concerns about the stream gauging networks, I know at USGS and we would like to ensure that those are continued, and where needed, ground monitoring networks. We need improvement in the real time delivery of that. Those are provided through well monitoring by the USGS, again, and so, again, the NIDIS plan talks about trying to improve the relay of that information, to understand groundwater. Groundwater is really something that is not well monitored at this time, especially in the last—and we need better coverage there.

The SNOTEL system that USDA has monitors snowpack, coverage, and thickness, has been quite useful, and we would certainly like to augment that as much as possible, and make sure that has real time capability, but we do have current capability there, and NASA research satellites are providing snow coverage and snow depth information that would continue into the NPOESS era, we hope, as well.

So, in summary, that is a quick panoply, if you will, of a cross. I think that a big frontier, also, in the future, would be to improve precipitation monitoring directly, and certainly, the success of the Tropical Rainfall Mapping Mission within NASA has been successful, and we would like to see that continued with the Global Precipitation Mapping Mission that NASA, NOAA, and other agencies have been talking about.

Thank you.

Mr. UDALL. Thank you.

Chairman EHLERS. The gentleman's time has expired. We are now pleased to recognize Dr. Schwarz.

Mr. SCHWARZ. Thank you very much, gentlemen, for being here. I am from Michigan, in fact, Dr. Ehlers' district and mine abut each other, so we do not have the wide vicissitudes in rainfall, and the results of same that your parts of the country do. However, I am a property owner in western Montana, and we do, out there, so I have some interest in this.

One of the things that, and anyone can answer this, I think Dr. Koblinsky, this is probably going to be in your ballpark, but one of the things that my friends and neighbors in Montana talk about, is they look at reservoir levels, they look at snowpack, they look at rainfall, they look at the disastrous fires they have had in the past decade. One of the things that they believe, whether it is true or not, is that we believed, at least for the last several decades, maybe more than that, that this country was wetter than it really is, over a much longer period of time, over perhaps the last three or four or five centuries.

So, the first question is, have we lived, in the last 60 to 100 years, or maybe more, 150 years, in an era that was significantly more wet, significantly more rainfall and snowpack, than say, the previous couple of centuries. And are we paying the price for that now, on making some assumptions that, in places like Texas or eastern Colorado, or Nebraska, or eastern Montana, it was going to be wetter than it is, and agriculture would be a lot more successful than it has been, and there would not be these wide swings in rainfall, and the resultant droughts that we are seeing now. Were we off on what we thought the real norm of climate is in this part of the world, in our continent?

Dr. KOBLINSKY. Well, we have mentioned in many of our written testimonies that drought is a natural occurring feature, and as you mentioned, if you look back in the record, over the past even thousand years, now, from tree ring records, there have been times when droughts were far more severe and long-lasting, and we know those examples. In the current century, there is really no trend in precipitation across the Nation, but we know from looking at long-term levels in the reservoirs that you mentioned that, for example, the early part of the century had a lot of water, and there was some concern that perhaps, the Colorado Compact, for example, was negotiated in a time of plenty, whereas now, in the past, at least the past decade, that dryer conditions have existed, so it has made the use of that Compact a little bit more complicated.

But in general, I don't think, Representative, we have seen any trend, necessarily, in either drought intensity or drought frequency. There have been trends in the release of the snowpack, and the time of release in the water, especially in the western mountains in the Cascades and Sierras, that have been documented over the last thirty years, and there has been some link to that to the long-term temperature rise that we are seeing in North America.

But no, no, at this time, I am not aware of any trend across the continent, in terms of precipitation. It seems to be in a steady fashion.

Mr. SCHWARZ. Going forward, then, and briefly. Is the technology available now, if we set up a NIDIS, is the technology available, that we can be considered reliable technology, where trends are predictable, and we can predict drought, as well as deluge?

Dr. KOBLINSKY. Predicting precipitation has remained an incredible challenge for our forecasters. There are some very interesting breakthroughs, in terms of understanding the relationship between major climate events, like El Niño, and La Niña, and certain regions of North America. For example, in La Niña conditions, we came out, we are just coming out of a modest La Niña condition now, tends to mean wet in the Pacific Northwest, and dry in the Southwest and Southeast, and those are the conditions we are seeing now. El Niño conditions reverse that. You tend to have dryer conditions in the Northwest and wetter conditions in the Southeast, Southwest. And so, that is being utilized as much as possible, to try and provide information to various communities.

There is a tool that our Southeast consortium of universities has, that we support, has provided, called Ag Climate, that ties into that research, and tries to provide that information to farmers on the ground.

In terms of the much longer term sense of what is happening, I refer to some of the observed trends in temperature, and observed trends in snowpack release. If the warming trend continues, as the models are suggesting throughout this century, what it suggests are that the main atmospheric systems might move northward, and that the storm patterns would move northward, so if that comes to be, you might expect influences of more dryer conditions in the southern part of the country towards the end of the century than we currently see.

Mr. SCHWARZ. Thank you, sir. Thank you, Mr. Chairman.

Chairman EHLERS. Next, I am pleased to recognize Mr. Matheson for five minutes.

IMPLEMENTATION AND THE FUTURE (CONT.)

Mr. MATHESON. Thank you, Mr. Chairman, and thank you for holding this hearing.

I wanted to reference—I direct this towards Dr. Koblinsky. I was very pleased to see that H.R. 5136 requires the Under Secretary of Commerce for Oceans and Atmosphere to consult with relevant Federal, regional, State, tribal, local government agencies, research institutions, and the private sector, in the development of the National Integrated Drought Information System. That is the quote from the bill.

In my home State of Utah, we have a lot of local expertise, which I believe could help in developing the comprehensive and user-friendly drought information system. As an example, Utah State University has a climate center that is an institution that facilitates access to climate data in Utah, and it tries to develop products to benefit both public and local government agencies, and our ag extension system could be an important part in providing information and educational programs to help the public prepare for drought-related emergencies, cope with impacts of drought, and mitigate the effects of drought.

I was just wondering, the question for you, Dr. Koblinsky is, will the Under Secretary ensure that groups like these in Utah, and quite frankly, others that I am sure are all across the country, be consulted and have an avenue to express their thoughts and con-

tributions to the development of the National Drought Information System?

Dr. KOBLINSKY. Thank you for your question, Representative Matheson.

I have felt that is a major challenge for me, as the one who the Under Secretary has asked to take a leadership role in developing NIDIS, and I have been very active the past few months trying to engage many of these different communities, and received tremendous enthusiasm for them to be engaged, though, for example, we plan on having what we are calling an interim steering group meeting the first part of June, which would include a number of federal agency representatives, the U.S. Department of Agriculture, the Department of Interior, NASA, as well as NOAA, in addition to the other elements that you talked about, State representatives and regional representatives, university representatives, and private sector, to talk about how we could move forward and draft an implementation plan for NIDIS that would represent all of these communities, and their needs for NIDIS, as well as their interest in helping us develop this system.

And then, as I mentioned earlier, to bring that forward, to essentially, an all comers meeting of interested parties in the fall, to really engage in an open and transparent process, as we like to say, with all these communities. And then, I hope, as I mentioned earlier, that we can begin to evaluate as the system moves ahead, how well we are doing on that, and get feedback from the system to do the best we can.

Mr. MATHESON. I appreciate that. Let me ask you, NOAA has already worked on a plan to develop this system, how long do you think it will take to fully develop and implement a really comprehensive system that we envision by doing this? If this bill gets passed, what do you think the timeline is?

Dr. KOBLINSKY. Perhaps you weren't here earlier, and I talked about——

Mr. MATHESON. Sorry about that.

Dr. KOBLINSKY.—this in my oral testimony.

Mr. MATHESON. Sure.

Dr. KOBLINSKY. And let me just repeat it briefly. That what we sense now is a great desire on a number of States' parts to carry out pilot programs, and we would, in addition to augmenting the observing system and the data components of that, we would see that the initial stage of this would take place in pilots, to really learn by doing, essentially, and then to translate into a national, a fully national system, we think it can be done over the next five to six years, if properly appropriated, and then, fully implemented on a national basis.

Mr. MATHESON. And as you also probably know, the bill directs NIDIS to include products that reflect local, regional, and State differences in drought conditions, and, I am sure you know, more interface between the scientists that collect information and the users that need the data, is going to make this information more relevant.

How does NOAA identify the user groups for these products, and how does NOAA identify the parameters of particular importance

to users and organizations that rely on NOAA for drought information?

Dr. KOBLINSKY. Thank you. We have a number of mechanisms within NOAA, and certainly, I think, one of the beauties of NIDIS is and we are able to tap in to all the other agency interests and state interests as well, but we have research mechanisms that look at, from both the sector and regional basis. We have regional Centers of Excellence at universities. We have a number of operational centers. The National Weather Service, for example, has 120 local forecast offices around the country, as well as, you know, because Salt Lake City hosts the Western Regional Office, eight regional offices for the Weather Service, as well as coastal offices, et cetera. And so, we would see work on developing feedback mechanisms from these communities, utilizing not only the NOAA infrastructure and research entities, but also, state, regional, and local entities that you have talked about, as well.

I have an invitation to talk, for example, with the U.S. Conference of Mayors, coming up in a few months, and look forward to that to tap into the urban sector, as well.

Thank you.

Mr. MATHESON. Thank you for your answers, and Mr. Chairman, I will yield back.

TECHNOLOGY (CONT.)

Chairman EHLERS. Thank you, and for final wrap-up question.

Dr. Koblinsky, in your testimony, you mentioned that NOAA's next generation of polar orbiting weather satellites, the NPOESS system, will contain—will continue important drought monitoring capabilities. Can you tell us specifically which sensors on NPOESS will provide the drought monitoring capability?

Dr. KOBLINSKY. Yes, sir. As I have mentioned, important variables to monitor drought are such things as land conditions, land temperatures, snow cover, snow depth, ocean conditions, ocean temperatures, and the like, vegetation indices, for example. So, the key sensors on NPOESS would be the Visible and Infrared Imager and Radiometer Suite, what is called the VIIRS instrument, which augments the current optical and infrared sensors that are on the POES satellites, utilizing the capabilities that were developed in NASA for what is called the MODIS or medium optical sensor, that is flying on the Terra and Aqua satellites.

And that would provide useful information. It is an optical, or near infrared sensor, so temperatures, snow cover, some ocean surface temperature conditions, and the like. And then, the other critical sensor, I think, is the Conical Microwave Imaging Scanner, imager and scanner, and it allows us to see through clouds, so again, enhancing sea surface temperature measurements, improving snow measurements for both snow cover and snow depth, land surface temperature conditions, also being sound, providing sound information, so for precipitable water in the atmosphere, moisture in the atmosphere, temperature in the atmosphere, so we can trace some of these water vapor jets as they come off the ocean.

And then, finally, but less so, probably, is the infrared sounding instrument that would be useful, of course, for weather prediction, for moisture and temperature profiles through the atmosphere and

pressure. I think those are really the three key measurement systems that are on NPOESS that would be most valuable for drought.

Chairman EHLERS. Well, as you probably know, this committee has been very concerned about the fact that the NPOESS project is currently a billion dollars over budget, and three years, as much as three years too late. Our concern is that some sensors may be dropped from this project, and I hope that is not a real danger, but we are very concerned about it. If sensors are dropped, are they likely to drop any of the sensors that you would need to provide your drought information?

Dr. KOBLINSKY. Well, I certainly hope not. As you know, this is proprietary information right now, because the discussions for the Nunn-McCurdy response, and we are trying to actively lobby, or argue for the need for these particular sensors for continuation.

Chairman EHLERS. And this committee will be certainly joining in that fight, if it becomes necessary, because it seems silly to spend all that money to put the satellite up, and then not put all the sensors on that we really need.

Dr. KOBLINSKY. Appreciate your support, Representative.

Chairman EHLERS. Thank you for your comments on that.

I wanted to thank the entire panel. You are very good. I appreciated your comments. Your answers to the questions have been extremely helpful to us, and frankly, you have brought life to a rather dry subject.

The staff is going to give me trouble about that, because they always object to my dry humor, and I have tried to restrain myself today.

I do want to mention just one thing. I think it was Mr. Smith mentioned, the State Water Management Plan that you have developed, and I hope all States are doing that, looking hard at it, and communicating the information to the public.

I find it amusing, I am an environmentalist and conservationist, have been for years, and I am getting into trouble in the past year for advocating the use of waterless urinals. Now, as you know, the press gets obsessed with anything relating to normal bodily functions, and so, I have been castigated nationwide, including *USA Today,* because this was put on the pork list. I didn't realize water conservation was related to pork.

But in any event, it has been very interesting to me, because it is good for the environment. Each urinal saves, on average, 45,000 gallons of water a year. My effort was to get the Navy to use them. The Army is already using them, and the Army reports at one base, they are saving $10.2 million per year on water, and another base, they put it in just one building, and they are saving several—have saved several hundred thousand already.

I just hope the public takes this to heart, and while they are spending $8 billion, it is now up to $10 billion a year on bottled water, they are flushing away much more than that. And there are many, many ways we can conserve in addition to that. So, I hope the word gets out there, and I hope the public begins to cooperate. As I said, it is not crucial in my state, but we are doing quite a bit, and I hope every state takes it to heart, and does that.

Thank you again for being here. The plan is to close out this hearing, and immediately go into a markup to report out this bill to the Full Committee, which will consider it, I hope, later this month.

So, before we close it out, I want to thank you once again for your testimony, and for helping us out in this way. It has been highly educational, and it has been a major help to us.

If there is no objection, the record will remain open for additional statements from the Members, and for answer to any followup questions the Committee may ask of the witnesses in writing.

Without objection, so ordered.

The hearing is now adjourned.

[Whereupon, at 11:40 a.m., the Subcommittee proceeded to other business.]

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