House Committee on Science
Hearing on HR 5136
National Integrated Drought Information System
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Statement of

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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% 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% of the country was affected and for some regions drought conditions persisted for 5 or more years. For example, parts of the southeast, particularly Georgia, North Carolina, South Carolina, and Florida experienced 3 to 4 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 5 consecutive years of drought between 2000 and 2004 while much of Montana, Idaho, and surrounding states experienced severe drought for as many as 7 consecutive years since 1999. My state, Nebraska, has experienced 6 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.

Question 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 snow pack 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% of the nation was in severe to extreme drought. In 1934, severe to extreme drought affected 65% 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, snow pack, 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).

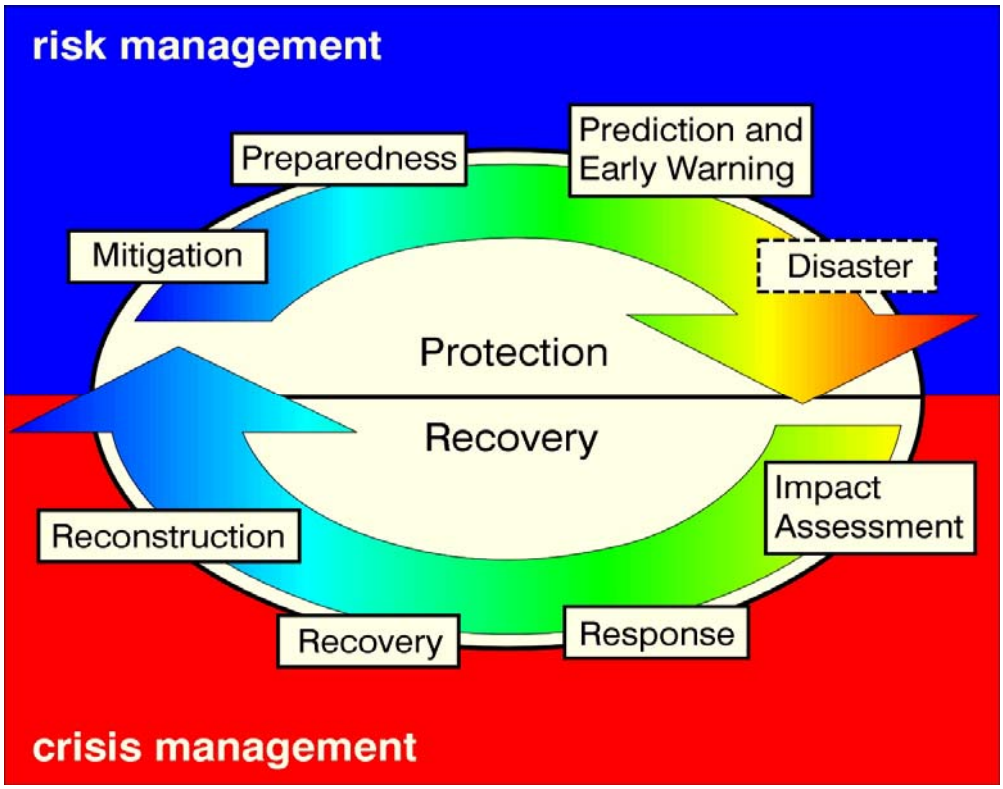

Figure 1. The Cycle of Disaster Management. (Source: National Drought Mitigation Center, University of Nebraska-Lincoln).

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.

Question 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 information 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.

Question 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 snow pack. 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, snow pack, 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.

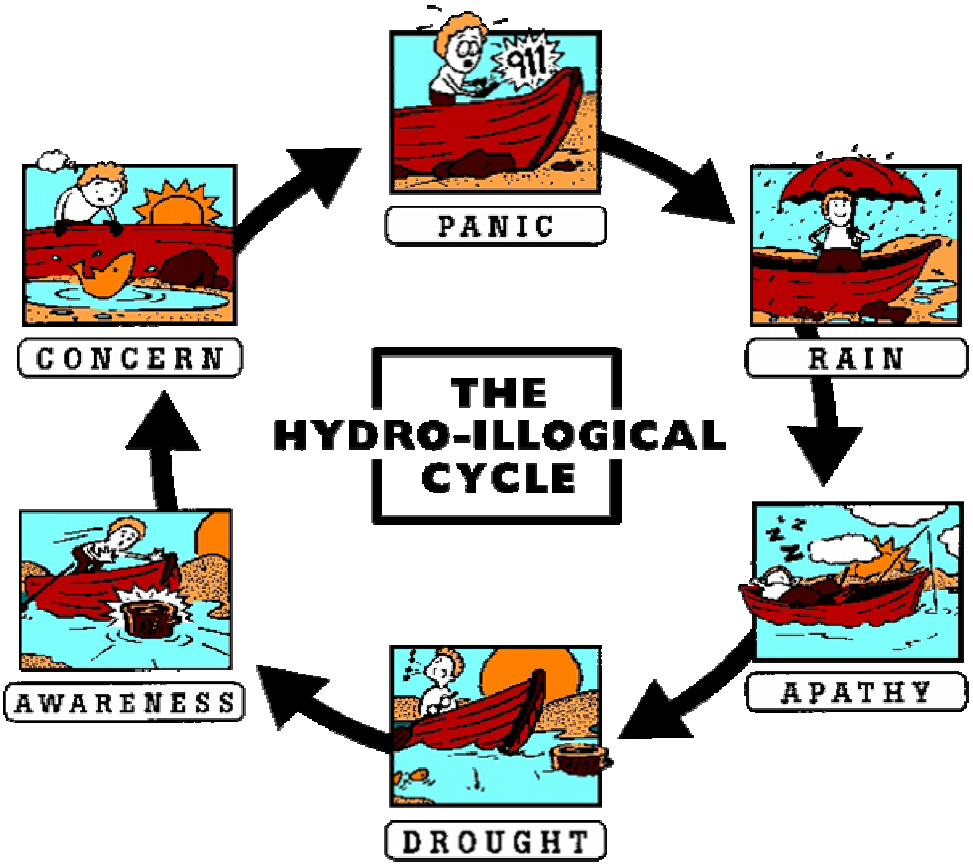

Figure 2.
The hydro-illogical cycle. (Source: National Drought Mitigation Center, University of Nebraska-Lincoln)

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; HR 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 timescales, 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.