DROUGHT MANAGEMENT PLAN

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INTRODUCTION

Overall Goals and Objectives of this Plan

The Tennessee Department of Environment and Conservation's Drought Management Plan is our plan on water management during extended periods of below average rainfall and streamflow as a result of drought.[1] One of our departmental goals is to maximize the ability of our water resources to support all of its uses.[2] This can be particularly challenging in the time of drought. However, history has shown that with effective management, proper planning and responsiveness, the impacts of a drought can be minimized.

This plan is an update to a drought management plan released in 1987.[3] Its purpose is to outline TDEC's role during a drought, to facilitate planning, and to provide a framework for action and cooperation in water resources management among the many local, state, and federal agencies with drought-related responsibilities. The plan, however, represents the state's plan on drought management, since we serve as the lead state agency on drinking water and water quality issues. This plan outlines the resources that other state, federal and local entities can provide and the ways in which we can work together to lessen the impacts of a drought.

Drought Defined

The onset and severity of a drought varies among the different types of drought which include the following:

[1] The authority for the plan is based on several related mandates in Tennessee statutes, including: Water Resources Division Act of 1957 (T.C.A. 69-8-101 et seq.), Water Resources Information Act of 2002 (T.C.A.69-8-301 et seq.), Tennessee Safe Drinking Water Act of 1983 (T.C.A. 68-221-701 et seq.) and the Tennessee Water Quality Control Act of 1977 as amended (T.C.A. 69-3-101 et seq.)

[2] Based upon the use classification for surface waters in the Rules of the Tennessee Department of Environment and Conservation Division of Water Pollution Control Chapter 1200-4-4.

[3]"Interim State Drought Management Plan," Tennessee Department of Health and Environment, January 1987.

Hydrologic drought is characterized by extreme low flows of streams and declining groundwater levels, but does not severely impact the production of crops. Hydrologic droughts reflect reduced precipitation over an extended period of time. The absence of rainfall, particularly during the winter and early spring when evapotranspiration is low and ground water resources typically recharge, can result in hydrologic conditions producing low streamflows.

Agricultural drought occurs when soil moisture is insufficient to meet the needs of a particular crop during its growing season. In Tennessee, an agricultural drought severely impacts crop, hay and nursery production. An agricultural drought would also stress lawns, golf courses, and athletic fields.

Socioeconomic drought occurs when the demand for goods or services exceeds the available supply as a result of precipitation conditions. Agricultural, hydroelectric generation and water supply impacts are the most obvious effects of drought; however, there are many others that are less obvious. For example, drought can lower basin water levels, which can slow, and sometimes halt, commercial shipping that is vital to the region.

For the purposes of this management plan, a "drought" may be any one of the above definitions as it relates to the condition and operation of community water systems, aquatic habitat, agricultural production, industrial water supply, water quality of a recreational stream, or other water use.

In monitoring drought, TDEC relies on the Tennessee Valley Authority, United States Geological Survey and other streamflow gauging stations, as well as the *U.S. Drought Monitor* produced by the National Drought Mitigation Center. The *Drought Monitor* is one of the most convenient and widely used drought monitoring indices to alert officials and the public of potential drought impacts. It is based on a synthesis of indices, outlooks and other inputs from the United States Department of Agriculture, National Oceanic and Atmospheric Administration, National Climatic Data Center and NDMC. In the map in

Figure 1, the *U.S. Drought Monitor* - Tennessee provides a declaration of drought intensities across the state. It also includes some historical drought data for the state.

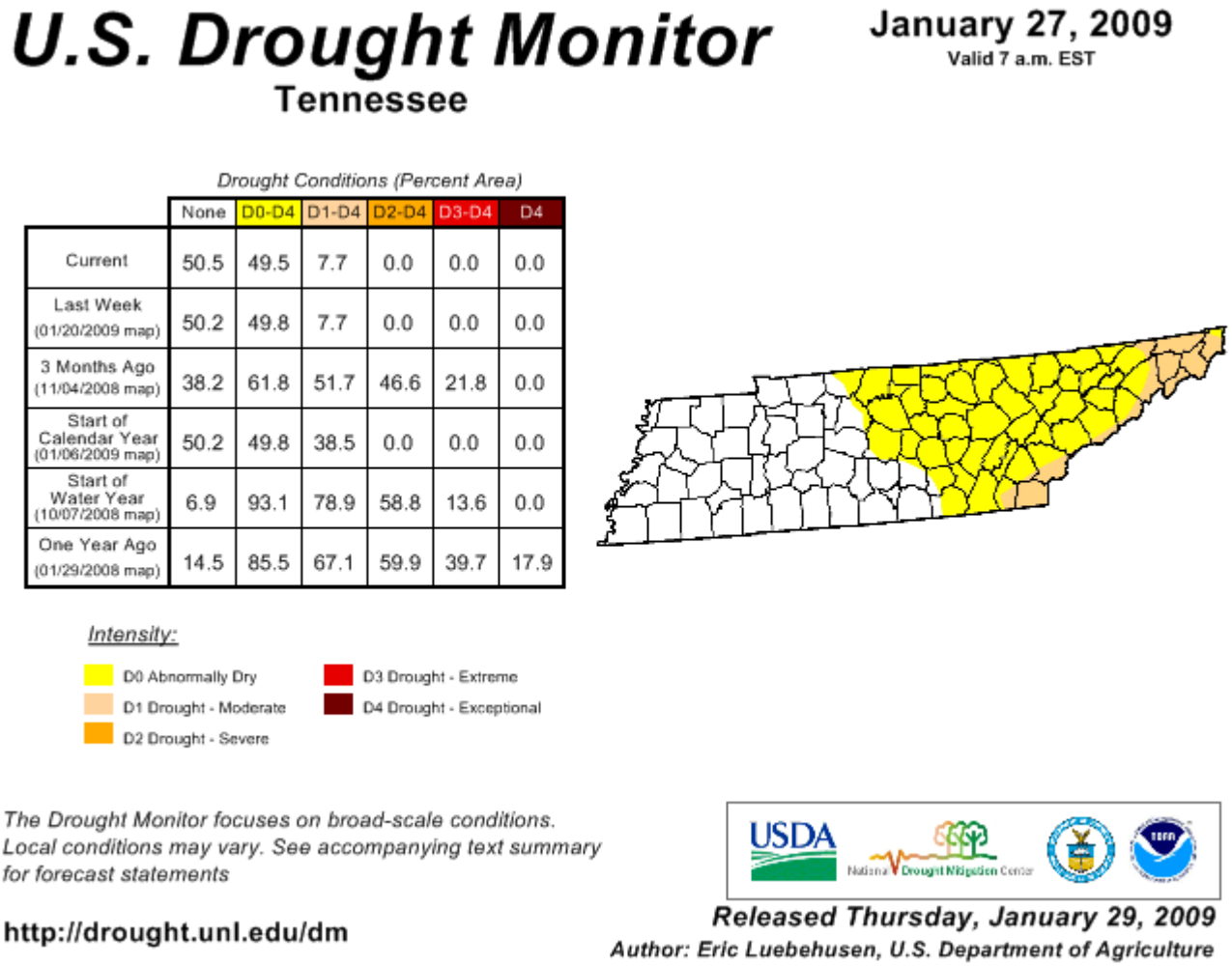

Figure 1 – U.S. Drought Monitor for Tennessee for January 27, 2009 (National Drought Mitigation Center)

The *Drought Monitor* focuses on broad-scale conditions. Local conditions, or the situation for a specific community water system, may vary from the drought intensity designation for a region. It is critical for community water systems to have drought management plans that are specific to their circumstances.

Potential Drought Impacts and Responses

Tennessee has transformed from an agricultural-based economy in the 40s and 50s to a more urban one. That transformation has been paralleled by the modernization of the community water systems. More water systems have become interconnected; and larger, more reliable sources are being utilized to support water systems. We do not respond to drought in the same way Tennesseans did in the past. Our current responses have evolved as a result of changing mandates, statutes, agencies, resource and facility development, technology, understandings, public expectations and values.

The droughts of the1930s, 1943-1944, and mid-50s resulted in impacts primarily on agriculture. By the mid-80s much of the economy of Tennessee had changed, with less reliance on agriculture and more attention given to aquatic life, the environment, industry and power production. At the same time, the cumulative demands – navigation, recreation, power production, etc. - that people have placed on a given reach of water have increased tremendously. Responding to those demands becomes particularly challenging during a period of drought.

The drought of 1986-87 is still considered one of the worst droughts in recorded Tennessee history. During that period, thousands of people were without water and there were serious ecological impacts as a result of the drought. However, the severity of the 1986-87 drought impacts did not approach the impacts experienced by many community water systems during previous droughts. This was due, in large part, to an improved awareness of source capabilities and uses, improved preparedness and higher standards of water service to communities.

What does this mean? It means that a drought's perceived severity varies with water use and those impacted by that use (e.g., agriculture, industry, domestic water supplies, recreation, streamflow, or reservoir surface elevation). As Tennessee has moved ahead to improve its drought preparedness and management over the past 60 years, the threat of an imminent water shortage and its most dire impacts have been reduced. Nevertheless, severe drought impacts are still possible.

The potential impacts that today's water resource managers might expect during an extreme drought include abnormally low streamflows, reservoir releases, and declining reservoir elevations which can affect water supplies, navigation, power generation, recreation, water quality and aquatic life. The extent of the potential impacts will vary from one location to another, and will depend on the time of year, length and severity of the drought. See Attachment A for a list of potential impacts. It is based on TVA's Tennessee River Drought Management Plan (March 2008), which served as a resource in the development of this plan.

During the drought of 2007, several water use management actions were implemented, including:

- Limits on withdrawals by community water systems due to sensitive aquatic habitats;
- Restrictions on the locking of barges;
- Modifications to the amounts of water released from reservoirs;
- Bans on illegal water withdrawals by golf courses above municipal water intakes;
- Additional water treatment to control taste and odor caused by aquatic plant growth;
- Water use restrictions banning lawn watering and other outside uses by approximately 30 community water systems;
- Extension of public water mains and lines to unserved areas; and
- Water dispensing sites for farmers to haul water to livestock, etc.

In excess of 500,000 people were on community water systems that imposed mandatory water restrictions. Despite the severity of the 2007 drought, because of the planning that had been done, the interconnection between systems, and the communication and collaboration among agencies and water systems, only one community water system, Orme, ran completely out of water. (See Attachment B for a profile of the water systems in Tennessee.)

For successful, proactive drought responses and lessened drought impacts, it is imperative that all the agencies and water systems continue to work together to manage the increasingly complex, interrelated and diverse uses of our water resources.

DROUGHT MANAGEMENT PLAN

The need for a drought management plan, defining the roles and responses of agencies under water shortage conditions, is evident considering the impacts of past droughts discussed in the introduction. Of course, no single plan or response can address every situation. Water systems are vulnerable to the specific characteristics of each situation. However, this plan does provide a framework for cooperation and communication amongst all the entities with drought-related responsibilities. (Attachment C gives an outline of potential responses for several general entities during various phases of a drought.) Other entities with drought-related, or drought-impacted, responsibilities should develop their own plans for managing drought situations. This plan focuses on TDEC's role in drought management and the related, and supporting, roles of other entities for the management of drought in Tennessee.

Tennessee Department of Environment and Conservation

TDEC has regulatory mandates to protect water quality and to ensure the provision of safe drinking water, both of which can be impacted by drought. The following are our primary responsibilities in drought management (many of which we have done in the past and will either continue to do or will improve upon the way we have done them):

- **Determine Drought Intensity**
  TDEC will work with the Tennessee Emergency Management Agency and other agencies to determine the drought levels across the state by region and/or county. TDEC will utilize, as baseline information, the drought intensities in the published US Drought Monitor for Tennessee in addition to other pertinent information.

- **Communicate Drought Information**
  TDEC will post the determined drought levels (by region and/or county), latest U.S. Drought Monitor – Tennessee map and drought conditions table and the drought situation report produced by the Tennessee

Emergency Management Agency's Drought Task Force on the TDEC website at http://state.tn.us/environment/water.

- **Require Development of Community Water Systems' Drought Management Plans**

  TDEC requires each community water system to have an Emergency Operations Plan (EOP). Chapter 1200-5-1-.17 (7) of Tennessee's Safe Drinking Water Rules states, "… all community water systems shall prepare an emergency operations plan in order to safeguard the water supply and to alert the public of unsafe drinking water in the event of natural or man-made disasters." We also require that community water systems have a drought management plan, separate from their EOP. One of the most significant components of a community water system's plan is the designation of trigger points – the points at which certain drought response actions are required as determined by that community water system – with identified corresponding actions. For example, increases in overall water treatment demand approaching the community water system's treatment capacity may be identified as one of the water system's trigger points. Once those demand conditions were met, the managers of the water system would take predetermined actions to reduce system demand, e.g., restricting certain water uses, contacting the media to get messages to the public regarding reductions, etc. We will encourage community water systems to adopt measures to increase the efficiencies of their systems, including the promotion of water-efficient products and practices to their customers.

- **Manage Wastewater Discharges**

  TDEC will require that wastewater discharges and releases from reservoirs be controlled to minimize risks to public health and the environment in times of drought. Alternative reservoir operating guides might be established based on various drought-related triggering conditions. Permits might be issued based on drought vulnerability whereby operations might be interruptible and /or additional treatment required.

- **Provide Guidance on Community Water Systems' Drought Management Plans**

  TDEC has developed a guidance document on the necessary elements of a drought management plan for community water systems. The Guidance for Developing Community Water System Drought Management Plans posted on the TDEC at http://www.state.tn.us/environment/dws/. The purpose of the guide is to promote and increase preparedness so that a drought's adverse impacts would be mitigated. The guidance includes suggested drought management planning steps. (See Attachment D for the outline of the guidance document.). TDEC will review each system's drought management plan, prioritizing those that have experienced drought issues in the past.

- **Encourage Regional Water Resources Management Planning**

  TDEC will encourage community water systems to evaluate their long-term water supply and consider regional water resources management opportunities as appropriate. We have partnered with the U.S. Corps of Engineers and other entities to pilot a planning process that can be utilized in other areas of the state.

- **Provide Technical Assistance**

  TDEC, along with other state agencies, will provide water management information and technical assistance. Critical steam flow data will be monitored during drought periods for specific streams in Tennessee. Data collected may include: average mean monthly flow for the period of record, mean monthly flow for the current year, the maximum and minimum daily discharge for the month, and the calculated 7Q10. (The 7Q10 flow is the lowest 7 consecutive day average flow that occurs at a frequency of once every 10 years.) Data collected will be made available to the public.

- **Provide Regulatory Oversight**
  TDEC will monitor water quality and the implementation of community water systems' drought management plans, reservoir management, as well as the status of wastewater discharges. We also will monitor community water systems' effectiveness in dealing with shortages and wastewater dischargers' compliance with standards.

- **Communicate with Other Agencies**
  TDEC, along with other state, regional and federal agencies, and our neighboring states, will coordinate and communicate information on drought conditions, impacts, and response actions. Conference calls, internet updates, e-mails, and news releases will be used to facilitate drought-related communications.

Water Resources Technical Advisory Committee

The Water Resources Technical Advisory Committee, authorized in the Tennessee Water Resources Information Act of 2002, was launched in late 2007. Members of this committee serve as an advisory group to TDEC by making recommendations on water resources issues in response to requests from the department. The committee includes representatives from academic institutions, environmental organizations, utility districts, the Tennessee Valley Authority, the U.S. Corps of Engineers and other state and federal agencies with water resources-related interests.

The following are the primary contributions that the committee may provide in drought management:

- **Inform TDEC of Impacts and Responses**
  The committee representatives may monitor discussions of realized drought impacts and proposed drought responses within their organizations and share that information with TDEC. The committee may provide TDEC with important information to be considered as we assess the regional drought intensity.

- **Inform the Public**
  The committee members, through their respective organizations, may assist TDEC in notifying the public, and other entities, of the drought intensities identified in various regions of the state.

- **Relay Drought Information**
  The committee members may assist in mitigating the impacts of drought by relaying drought information within their organization and encouraging their organization to take the appropriate steps in response to the drought situation. The committee members may encourage their organizations to follow through on the suggested responses outlined within this plan or within their own drought management plans.

- **Technical Assistance**
  The committee members may draw upon their professional expertise to advise TDEC on advancements in water management including conservation, reuse, rain harvesting, etc.

Community Water Systems

A public water system is a system providing water for human consumption to more than twenty-five people. Public water systems are divided into community and non-community systems. Community systems are those in which the twenty-five people are year-round residents. Non-community systems include restaurants, hotels, industry and churches.

The following are the primary actions that a community water system is responsible for in drought management:

- **Develop Drought Management Plans**
  Per Chapter 1200-5-1-.17 (7) of the Tennessee Safe Drinking Water Act, "… all community water systems shall prepare an emergency operations plan in order to safeguard the water supply and to alert the public of unsafe drinking water in the event of natural or man-made disasters."

Drought management must be addressed in a separate document. The plan should address all applicable elements identified in TDEC's guide. (See Attachment D for the outline of the guide.)

- **Identify Planned Responses**

  A critical aspect of a community water system's drought management, and the development of their drought management plan, is the identification of trigger-points and associated responses. Trigger-points are the defined conditions or circumstances that call for pre-determined actions. They are based on calculated and known factors, including:

  - water quality (e.g., taste and odor, disinfection byproducts);
  - system limitations (e.g., pump capacity, line size);
  - operating conditions (e.g., pressure below the mandated minimum of 20 pounds per square inch); or
  - loss of critical resources (e.g., declining lake levels).

  Each plan should detail responses that are phased to address trigger-points or increasingly severe drought conditions.

- **Identify Risks**

  It is important for community water systems to evaluate their water sources, anticipate availability problems, evaluate treatment and delivery capacities and identify essential needs. Systems must be aware of their limiting factors. These may include: established low flows, reservoir operating guides, downstream waste assimilation needs, water treatment capacity and design, distribution system capacity, source adequacy and/or water quality problems due to diminished streamflows and specific system needs.

  Community water systems must identify critical and competing uses (e.g., hospitals, fire suppression, sensitive aquatic environments, nursing homes,

etc.) For instance, many livestock producers have opted to install alternative watering systems for their livestock, and the use of community water systems has become a popular choice. During times of drought, it will be necessary for community water systems to take into account the water usage of the agricultural sector and to realize that water for livestock is a vital priority on par with other commercial or industrial uses.

Although some risk of water shortage will always be present, the toleration of risk will vary immensely among community water system users.

The level of risk is based on source capability and the extent to which it has been developed. Once this information is known, community water systems must develop plans for managing resources and demands under drought conditions. It is critical for community water systems to discuss their assessment of the relative risks with the impacted users and local government officials. Water systems may have to make some difficult decisions about which water users would be subject to reductions and under what circumstances. These considerations should occur in the development of the drought management plan, not in the midst of a crisis.

The development of a drought management plan should provide an equitable degree of protection to users. For community water systems with less developed sources and facilities, a management plan is an effective means for averting a water crisis during a short-term drought. Over an extended drought, however, effective management alone may not be sufficient. With more developed sources and facilities, a drought management plan can help avert a crisis during a drought of longer duration. The development of the plan may provide the community water system with an opportunity to establish their priorities and identify the means to meet this priority.

For these reasons, a drought management plan is often a companion to a regional water supply plan. Oftentimes, communities that conduct effective regional supply planning find that there is less of a need for drought management planning. In assessing their risk, community water systems often determine that the best drought preparation is developing interconnections with other facilities to form a regional water system and expand the adequacy of their sources.

- **Address All Uses**

  Community water systems must plan for drought by addressing all the uses in their system including drinking water, industries and livestock. An extensive list of potential drought responses for various users should be included in a community water system's drought management plan. Acceptable levels of service must be established for various uses and the available water resource managed accordingly. Priorities should be established for essential needs such as hospitals, nursing homes and firefighting.

- **Communicate with the Public**

  The community water system should communicate with the public and their customers while they are in the planning stages of a drought to ensure that the public and other users are aware of their system's trigger-points and the planned responses. Community water systems will also be the primary interface with their users on conservation. This may include the adoption of conservation pricing, pricing that serves as a disincentive for those customers not practicing conservation.

- **Report Conflicts**

  TDEC will expect community water systems to inform us of potential conflicts among water users that they identify in their drought management planning stage or actual conflicts that arise during the implementation of their drought management plans. Systems unable to

achieve adopted plan goals and objectives under any phase of implementation would be subject to enforcement action by the Commissioner of TDEC. Where conflicts over water rights and water quality problems emerge or local situations become "emergency" situations, TDEC, TEMA and the governor can enter the situation. Once a situation is declared an emergency, special actions can be taken under the governor's emergency powers' authority.

Local Governments

Local governments also include entities other than the community water system, e.g., county government offices. Local governments may assist their community water systems in drought management in the following ways:

- **Assist with Planning**
  Assist the community water systems within their jurisdictions to plan and coordinate the development of water supplies the extension of infrastructure and the coordination of resources, manpower and technical expertise. Assist the community water system in the development of the drought management plan.

- **Implement Drought Responses**
  Elected local government officials that have been involved in the development of the drought management plan will be informed about the trigger-points for the various drought phases and the planned responses. The local government may be able to assist in the implementation of some of those responses, especially those associated with emergency conditions. For instance, in certain phases of drought, county governments may be tasked to haul water for domestic and livestock use to self-supplied water users with inadequate sources.

- **Inform the Public**
  Local governments may assist the community water system in informing water users of water use restrictions during certain phases of a drought. Local governments can also help to inform users of necessary conservation measures during a drought or to educate users about conservation as a change in behavior.

Tennessee Emergency Management Agency

TEMA has authority for coordinating the efforts of the federal government with other departments and agencies of state government, county governments, municipal governments and school boards, and private agencies in case of a drought emergency.[1] TEMA has two critical roles in drought management:

- **Facilitate the Drought Task Force**
  Governor Phil Bredesen assembled the Tennessee Drought Task Force in June 2007. The task force is led by the Tennessee Emergency Management Agency along with TDEC. The two agencies work with local, state and federal agencies to track Tennessee's water needs and provide support where necessary. Agencies on the task force include the Tennessee Department of Agriculture, the Tennessee Wildlife Resources Agency, the National Weather Service, TVA, the U.S. Army Corps of Engineers and the Tennessee Association of Utility Districts. The task force provides a mechanism for agencies to exchange drought information, discuss issues and solutions and coordinate response activities related to the drought. The Drought Task Force provides TDEC with the *U.S. Drought Monitor for Tennessee* that will be posted on TDEC's website.

- **Manage Emergency Drought Situations**
  Where conflicts over water rights and water quality problems emerge or local situations become "emergency" situations, TDEC, TEMA and the governor can enter the situation. Once a situation is declared an

[1] T.C.A. 58-2-104 Creation of agency – Director and deputies

emergency, special actions can be taken under the governor's emergency powers authority.

Tennessee Department of Agriculture

The Tennessee Department of Agriculture has several focus areas related to drought planning and management across our state. The following are contributions that TDA can make to drought management:

- **Emergency Designations**
  The U.S. Secretary of Agriculture has the authority to designate natural disaster areas when sufficient agricultural losses are suffered. This designation allows farmers to apply for various federal disaster assistance programs including low-interest emergency loans, and crop and livestock loss payments. Generally, a county and the individual producer must show a 35 percent loss in any one area of production in order to qualify. When drought strikes, county-level farm damage assessment reports are generated by the local USDA Farm Service Agency (FSA) office and are reviewed by the FSA's State Emergency Committee. Since a disaster designation requires that the Governor make a formal request, TDA works with FSA to facilitate this action.

- **Participate in the Water Resources Technical Advisory Committee**
  TDA is represented on the Water Resources Technical Advisory Committee. In that role, TDA can provide the contributions to drought management presented separately in this document under the discussion of the committee.

- **Assistance to the Public**
  Often during periods of drought, livestock producers will contact TDA asking for assistance in transporting water from a source back to the farm. TDA refers these requests to the local Emergency Management Agency for action. Many rural areas have installed "dry hydrants" at various water

sources in the county, as a means to provide emergency water sources for firefighting. It is possible that these hydrants could be spatially identified and categorized as to their utility as a withdrawal point for supplemental water in the event of a drought.

TDA provides cost-share assistance to producers through the Tennessee Agricultural Enhancement Program, the 319 Nonpoint Source Management Program, and the Agricultural Resources Conservation Fund Grant Program. These programs provide cost-share assistance to producers to install a variety of drought-mitigating best practices; from alternative livestock watering systems, wells and ponds to irrigation systems for fruit and vegetable production, greenhouses and organic farming.

- **Preventing Fire during Drought Periods**

  The risk of forest fires is heightened during periods of drought. TDA's Division of Forestry works in cooperation with local governments to assess the need for bans on open burning on a county basis according to an established set fire risk indicators. The State Forester also has the authority to extend the state's burn permit requirements beyond the Oct. 15 through May 15 statutorily established period. Other forest management practices are dictated by the dry weather, such as planting and the need for weed control.

- **Communication**

  Communication is vital during periods of drought. TDA is committed to developing and maintaining a list of key agricultural industry contacts for use by governmental entities and public utilities, so timely and accurate information can be obtained as needed.

  TDA works in close partnership with the U.S. Department of Agriculture's National Agricultural Statistics Service (NASS). NASS performs the Census of Agriculture which obtains vital information from our state's

farmers. TDA could work with NASS in the next Census cycle to structure a set of questions related to water usage on Tennessee farms. This would provide more current and additional information for better program management and decision-making by government agencies.

Tennessee Wildlife Resources Agency

The mission of the Tennessee Wildlife Resources Agency is to preserve, conserve, protect, and enhance the fish and wildlife of the state and their habitats for the use, benefit, and enjoyment of the citizens of Tennessee and its visitors.[1] TWRA carries out its mission by working toward the safe use of the state's waters.

The following are the primary contributions that TWRA can make in drought management:

- **Work with TDEC to Monitor Aquatic Life**
  Each year TWRA biologists survey streams and rivers to determine the status of streams and the abundance of the fish populations. TWRA will work with TDEC to monitor areas impacted by drought conditions.

- **Work with TDEC to Enforce Protections of Aquatic Life**
  Both the Tennessee Water Quality Control Act and the Tennessee Wildlife Code require that water withdrawal not result in a condition of pollution or harm to aquatic habitat and that the resulting instream flow provides for the protection of fish and aquatic life. TWRA will work with us to ensure those protections remain in place, even in a period of drought.

  TWRA, the U.S. Geological Survey, The Nature Conservancy and TDEC have partnered in a project to define a process to determine instream flow ecological needs for Tennessee's various ecological / geographic regions. This project is a reflection of the agencies' collective commitment to the advancement and application of instream flow science and policy.

[1] T.C.A. 70-1-301 Creation – statement of policy of TWRA.

- **Provide Data on Conditions**
  TWRA has fishery and boating data on the TWRA lakes and fisheries they manage that might serve to confirm the onset of drought in a specific region. That information could be shared with TDEC to assist in the assessment of the drought status across the state.

- **Inform TDEC of Impacts and Responses**
  TWRA may inform TDEC of potential, or confirmed, impacts to fish and wildlife from drought conditions. They also can provide us with information about their planned responses to those impacts. TDEC and TWRA may decide to implement some collaborative responses to address a specific drought situation.

- **Exchange Information**
  There are a number of state and federal entities with drought-related responsibilities. TWRA should continue to exchange information with TDEC and other agencies on their observed drought impacts and planned responses.

- **Assist with Communications Plans**
  TWRA should assist in the efforts to keep the public informed of the drought status and planned responses. The communications may include specific responses required of the fishing and boating communities in drought-impacted regions.

Tennessee Department of Transportation

In addition to being responsible for Tennessee's road system, TDOT also is responsible for river ports in the state. With more than 1,062 navigable waterway miles, the waterways of Tennessee connect terminals on the Tennessee, Cumberland and Mississippi Rivers and their tributaries with ports in numerous states. One of TDOT's objectives is to increase the use of water transportation and to improve regional and

national economic conditions by increasing utilization of cost-effective, fuel-efficient and environmentally friendly waterway transportation.

TDOT can contribute the following to drought management:

- **Provide Data on Conditions**
  TDOT has access to navigation information from waterways across the state. That information could be shared with TDEC to assist in the assessment of the drought status in a specific region.

- **Inform TDEC of Impacts and Responses**
  TDOT may inform TDEC of potential, or confirmed, impacts to navigation from drought conditions. Impacts on our transportation network, and associated commercial shipping, can result in a socioeconomic impact for a region or the state.

- **Exchange Information on Drought Responses**
  The drought responsibilities of one entity are interwoven with the drought –related responsibilities of other state and federal entities. TDOT should continue to exchange information with TDEC, TVA and other agencies on their observed drought impacts and planned responses.

- **Assist with Communications Plans**
  TDOT should assist in the efforts to keep the public informed of the drought status and planned responses, specifically the information impacting the navigation network.

Tennessee Advisory Committee on Intergovernmental Relations

The Tennessee Advisory Commission on Intergovernmental Relations' (TACIR) primary mission is to monitor federal, state, and local government relations and to make recommendations for improvement to the legislature.[1] The Commission is composed of elected officials, primarily state legislators. One of TACIR's objectives is to serve as a

[1] T.C.A. 4-10-101 Legislative findings

research institution and public forum where issues are aired. The following are their potential contributions to drought management:

- **Participate in the Water Resources Technical Advisory Committee**
  TACIR is represented on the Water Resources Technical Advisory Committee. In that role, TACIR can provide the contributions to drought management presented separately in this document under the discussion of the committee.

- **Assist with Communications Plans**
  TACIR can provide a forum for discussion of the drought issues within their commission. They can also work with others to assess the fiscal capacity of local governments and utilities to deal with water issues.

  .

Federal Agencies

The role of federal and regional agencies in a drought will depend on the water-related resources under their management. In Tennessee, those federal agencies having major responsibilities include: TVA (a federally-operated corporation), U.S. Army Corps of Engineers, U.S. Geological Survey, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service and the U.S. Department of Agriculture – Rural Development. Some of these organizations have a regulatory role in water resources management. The following are some of the resources these organizations can provide in drought management:

- **Participate in the Water Resources Technical Advisory Committee**
  Some of these agencies have representatives on the Water Resources Technical Advisory Committee. In that role, they can provide the contributions to drought management presented in this document under the discussion of the committee. Federal and regional agencies also provide a mechanism for the expeditious exchange of information

regarding resources, impacts and other pertinent information related to drought.

- **Provide Data on Conditions**
  Many of these agencies have data on deteriorating water quality conditions and reservoir levels that could be shared with TDEC to assist in the assessment of the drought status across the state. Some of these agencies participate in the Tennessee Emergency Management Agency Drought Task Force and are charged with sharing information that may be pertinent to the drought intensity designations.

- **Assist with Communications Plans**
  These agencies should assist in the efforts to keep the public informed of the drought status and planned responses including, notifying recreational users of reservoir hazards due to poor water quality or low water level elevation, as applicable.

- **Assist with Implementation of Plans**
  The U.S. Department of Agriculture – Rural Development has the ability to provide loan and grant funding to eligible applicants who meet their funding requirements. Their programs has served as a significant source of funding for drinking water infrastructure in the state, and it will be an essential element for communities who need to implement future drought management plans.

Tennessee Valley Authority

TVA is referenced in the section on federal agencies; however, their role is so critical to drought management in Tennessee that a separate section is warranted.

TVA operates a system of dams and reservoirs with associated facilities—its water control system. As directed by the TVA Act[1], TVA uses this system to manage the water

[1] Tennessee Valley Authority Act of 1933." [48 Stat. 58-59, 16 U.S.C. sec. 831]

resources of the Tennessee River for the purposes of navigation, flood control, recreation, power production and economic development. TVA's mandate and mission encompass several states in the southeast U.S.; therefore, they are called to coordinate their responses to many situations, including drought, with local, state and other federal authorities and jurisdictions.

The following are some of the crucial roles TVA has in drought management:

- **Participate in the Water Resources Technical Advisory Committee**
  TVA is represented on the Water Resources Technical Advisory Committee. In that role, TVA can provide the contributions to drought management presented separately in this document under the discussion of the committee. Regional agencies, like TVA, also provide a mechanism for the expeditious exchange of information regarding resources, impacts and other pertinent information related to drought.

- **Share Information on Observed Impacts**
  TVA can provide important data about observed drought impacts at various points across the Tennessee Valley region to TDEC and other federal, state and local entities. Since TVA operates across state lines they also can provide data about drought impacts in neighboring states that might have an impact on Tennessee.

- **Exchange Information**
  TVA has finalized their " Tennessee River Drought Management Plan" (March 2008). The plan clarifies TVA's operating policy for the Tennessee River System and addresses the need for a plan for "times of extremely low rainfall and stream inflows." According to TVA, the plan was developed "to assist in communicating and coordinating drought conditions, impacts, and response actions." The Tennessee Valley Water Partnership Drought Committee consists of the designated representatives of the following states and agencies: TVA, Alabama, Georgia, Kentucky, Mississippi, North Carolina, Tennessee, Virginia, the Environmental

Protection Agency, and the United States Geological Survey. The committee is activated when drought conditions are severe or worse with tributary reservoir levels below the system minimum operating guide. The Tennessee Valley Water Partnership Drought Committee is a forum for the exchange of information and views by the participants; and is neither a decision-making nor an advisory body. TDEC is represented on the Tennessee Valley Water Partnership Drought Committee. Information that is pertinent to Tennessee and the protection of critical habitat will be exchanged with the Water Resources Technical Advisory Committee and TDEC.

- **Communicate with the Public**

  TVA has the ability to contribute significantly on the communication of drought information to the public. TVA's external web site will be updated to reflect current reservoir conditions and serve as a drought coordination web site. TVA's Corporate Communications will issue regular press releases. TVA will designate a Drought Response Coordinator to oversee internal activities and external communications. As a member of the Water Resources Technical Advisory Committee, TVA can utilize their resources to assist in relaying drought intensity information to the public and the associated responses, as well as educational information on conservation. As appropriate, TVA should inform recreational users of reservoir hazards due to poor water quality or low water level elevation.

- **Implement Drought Responses**

  TVA's "Tennessee River Drought Management Plan" includes five defined phases of drought and associated responses. The plan calls for TVA to communicate and coordinate with key river system stakeholders as the drought enters a phase requiring some operational response. Part of TVA's responsibility is to manage reservoir elevations and releases to provide flood-risk reduction, hydropower, water supply, recreation, and

natural resource benefits. TVA's reservoir operations plan outlines the releases and water level elevations that will be maintained through the year. When the river's water storage system is managed as such, streamflows have much less variation, particularly on the mainstems of the major rivers, where low and higher stream flows from tributary rivers tend more to average flows out a bit. In a drought, TVA's coordination of planned reservoir management responses with TDEC and other water resource entities is critical.

Private Sector

The private sector includes self-supplied industries, farmers and homeowners. The role of self-supplied water users is similar to public suppliers in that the water user best addresses the water provision. The following are the suggested responses to drought management for this sector:

- **Evaluate Sources and Uses**
  Self-suppliers should evaluate water sources and uses to anticipate availability problems, evaluate treatment and delivery capacities and identify essential needs.

- **Identify Risks**
  As with community water systems, it also is important for self-suppliers to evaluate their water sources, anticipate availability problems, evaluate treatment and delivery capacities and identify essential needs. They should identify risks and determine their competing uses. Self-suppliers must examine their critical water needs, including sensitive aquatic habitats requiring a specific stream flow. Developing a drought management plan can help to avert a crisis during a sustained drought.

- **Identify Measures in Case of Restriction**

  As with public suppliers, self-suppliers should identify measures they will take in case of source water restrictions. They should prioritize needs within their system during their drought management planning.

- **Communicate with TDEC**

  Where shortages or conflicts appear in source use, users should notify TDEC for assistance.

- **Implement Responses**

  The private sector should monitor the drought intensity for their region (as reported through the *U.S. Drought Monitor for Tennessee* and posted on the TDEC website at website at http://state.tn.us/environment/water. They should implement associated responses in their system, including conservation as appropriate. Attachment C includes other possible responses for the private sector during various phases of drought.

CONCLUSION

In this plan, TDEC approaches drought as a period of more intensive water management dealing with the supply and demand of water. We recognize that needs and responses to drought will vary across the state. Drought affects users differently due to the users' dependence on water, the source involved, the type of drought, the impacted area, storage development and many other factors. Therefore, solutions to these many situations will, and must, vary.

We've presented a framework for action and coordination that is flexible and responsive to the various needs that are likely to emerge in a drought situation. The management strategies developed by individual suppliers and users are essential to lessening impacts and delaying or averting further water use restrictions. These strategies involve issues of fairness, hardship and effectiveness.

Future plans should examine more fully a process for dealing with water use conflicts, declaring "limited" or regional water conservation emergencies and providing more detailed guidance in the development of local and user specific water shortage management plans. Future planning for drought management should allow for full participation by public water systems, industry, the agricultural community, TVA, the Corps of Engineers, and other users in a "regional" planning setting whereby standards, regulations, procedures and plans might be developed to address specific needs and issues.

Attachment A

Potential Drought Impacts [1]

Water Supply

- ❑ Reduced groundwater levels
- ❑ Lower stream flows in streams
- ❑ Water pressure issues in water systems, if demand is not managed
- ❑ Some reservoir intakes exposed (where reservoirs are below normal)
- ❑ Some tailwater intakes exposed or with inadequate water (where minimum flows not met)
- ❑ Increased treatment due to poorer water quality (potential taste/odor/dissolved iron and manganese problems)
- ❑ Non-essential uses are interrupted
- ❑ Increased aeration costs due to lower dissolved oxygen in reservoir releases
- ❑ Increased algal and aquatic-plant growth (resulting in taste and odor problems)

Water Quality

- ❑ Increased residence time, higher water temperatures, decreased dissolved oxygen levels in reservoirs
- ❑ Thermal impacts caused by power generation facilities are aggravated by lower drought flows
- ❑ Long retention in reservoirs causes chemical problems in the bottom layer of water when it just doesn't flow

Aquatic Environment

- ❑ Reduced aquatic habitat
- ❑ Increased aquatic vegetation due to increased water clarity and longer residence times
- ❑ Increased costs for controlling aquatic plants
- ❑ Increased water temperature with adverse aquatic life impacts
- ❑ Increased mortality from prolonged exposure to minimum flows and higher water temperatures

Recreation

- ❑ Decreased river and reservoir recreation due to lower flows and reservoir levels
- ❑ Recreational boating navigation hazards with lower lake levels
- ❑ Loss of boat launching facilities

[1] Based partially on TVA'S Tennessee River Drought Management Plan, March 2008.

- ❑ Stream and reservoir recreation and fisheries impacted by decreased flows and increased temperatures

Power Generation

Hydroelectric

- ❑ Reduced hydro generation and peaking operations
- ❑ Limited capacity due to reduced reservoir elevations

Nuclear

- ❑ Increased cooling-tower usage
- ❑ Possibility of power reductions due to cooling water requirements
- ❑ Potential Ultimate Heat Sink compliance issues

Fossil

- ❑ Possibility of power reductions due to cooling water requirements
- ❑ Constraints on coal deliveries by barge

Navigation

- ❑ Possibility of navigation impairment due to the lack of adequate river depths (see the Tennessee River Waterway Management Plan, 2003)
- ❑ Possible encounter of reduced channel widths and draft limitations by tows
- ❑ Encounter of navigation hazards, due to low water, by recreational boaters

Terrestrial Life (Agriculture and Wildlife)

- ❑ Reduced water availability for wildlife and habitat
- ❑ Reduced water availability for livestock
- ❑ Reduced agricultural production and crop loss
- ❑ Loss of nursery stock, meat and dairy production

Forestry

- ❑ Increased potential for wildfires due to dry vegetation
- ❑ Loss of harvestable timber

Flood-Risk Reduction

- ❑ Some impoundments may be maintained at higher levels at times in order to address potential drought impacts, and therefore flood risk reduction may be less

Attachment B

PROFILE OF WATER SYSTEMS IN TENNESSEE[1]

	Surface		Ground		GWUDISW		Purchased		Total	
	# Systems	Population	# Systems	Population	# Systems	Population	# Systems	Population	Systems	Population
Community	148	3,407,894	157	1,401,180	35	130,363	150	744,262	490	5,683,699
Trans. Non-Community	3	575	334	53,236	39	3,639	1	525	377	57,975
Non-Trans. Non-Comm.	7	7,898	31	7,332	3	253	2	12,000	43	27,483
Totals	158	3,416,367	522	1,461,748	77	134,255	153	756,787	**910**	**5,769,157**

Definitions

Community Water System means a public water system which serves at least 15 connections used by year round residents or regularly serves at least 25 year round residents

Transient Noncommunity Water System means a non-community water system that regularly serves at least 25 individuals at least 60 days out of the year. It generally serves a transient population such as motels, restaurants, campgrounds, service stations and churches.

Non-transient Noncommunity System means a non-community water system that regularly serves at least 25 of the same persons over 6 months per year. It generally serves industries and schools.

Surface water systems use a surface water source such as a lake, stream or reservoir.

[1] Tennessee Department of Environment and Conservation, Water Supply Division, September 2007

Ground water systems use a ground water source such as a well or spring, unless it shows surface water influence (bacteria and other microscopic organisms indicative of surface water).
GWUDISW stands for Ground Water Under the Direct Influence of Surface Water, which are those systems that do show surface water influence in the form of bacteria and other microscopic organisms indicative of surface water.
Purchased indicates those water systems who do not have a water source and rely exclusively on another system to provide water.

Attachment C

Drought Responses

Program Phase and Conditions	State and Federal Actions	Local Actions		
		Public Water Suppliers	Industrial	Agricultural and Self-Supplied
Normal Conditions				
• Water supply is adequate; water quality is acceptable under normal management	• Develop precipitation, streamflow, ground-water and water quality monitoring programs • Conduct state and regional water studies and coordinate recommended actions • Assist public water suppliers and local government in developing Emergency Water Management Plans (EOPs) • Establish public education program	• Develop Emergency Water Management Plans • Develop additional storage and treatment facilities; evaluate distribution system • Adopt standby rates, other necessary ordinances and codes and establish mutual aid agreement, interconnections, conservation education, etc.	• Develop Emergency Water Management Plans • Develop additional wastewater storage • Develop alternative water supplies, water storage and conservation measures • Purchase standby equipment and install permanent equipment as necessary for recycling	• Develop county emergency management plans • Evaluate need for irrigation • Enlarge ponds, purchase tanks, drill wells, install conservation devices and livestock water tanks • Evaluate agricultural water use and find where conservation could be used, including use of “drip” irrigation • Evaluate domestic water use and install water-saving devices, etc. to reduce stress on supply sources
Drought Alert				
• Lower than normal precipitation, declining streamflows and lower groundwater levels; greater than normal demand	• State issues Drought Alert to media and notifies targeted water users (Alerts may be regional or local) • Intensify selected monitoring activities • State initiates an awareness program	• Monitor water sources and daily water use for specific purposes and anticipate user demand	• Monitor water sources and daily water use for specific purposes and anticipate demand • Monitor water quality	• Monitor water sources and daily water use for specific purposes and anticipate demand
Voluntary Reductions				
• Water suppliers/water quality deteriorating or conflicts among users	• Disseminate water supply and water quality data • Monitor systems and users having past problems and monitor plan implementation • Coordinate state and federal supply and water quality actions • Respond to local and individual appeals for assistance • “Post” streams where water quality standards are not met • Commissioner issues orders to water suppliers and/or discharges	• Implement “Reductions” phase at plan triggering point(s). Potential water use reduction measures include curtailment of outside uses, education and pricing • If reduction goal is not obtained, implement mandatory restrictions • Notify TDEC of source conflicts	• Institute recycling, cut-back production, store wastewater, alter production schedule per industrial water management plan during a drought • If goals are not met, implement additional measures • Notify TDEC of source conflicts	• If assessed sources is capable, irrigate crops • Provide tanks, etc to meet water supply needs of livestock, fish and aquatic life • Continue reduced use of domestic supplies • Notify TDEC of source conflicts

Mandatory Restrictions				
• Continued decline in water supply and/or water quality	• Same responses as in Voluntary Reductions Phase	• Implement "Mandatory Restrictions" phase at plan triggerpoints; restrictions could include banning of some outdoor water uses, per capita quotas and percent reductions of non-residential users • Notify TDEC of source conflicts	• Institute additional cut-backs in production, storage of wastewater, or changes in production schedule, etc. per industrial water management plan • Notify TDEC of source conflicts	• Same responses as in Voluntary Reductions Phase
Emergency Management				
• Severe water supply or water quality problems due to very limited resource availability	• Governor responds to critical situation by declaring an emergency • TEMA takes actions • TDEC mediates in conflicts of source utilization under emergency powers	• Notify TEMA and request emergency declaration • Provide bottled water and sanitation suppliers to users • Make hospitals, firefighting, etc. priority • Initiate hauling of water • Comply with Commissioner's Orders	• Request emergency declaration of Governor • Comply with Commissioner's Orders • Request assistance from local government • Implement hauling water for sanitation, domestic uses	• Request local government assistance in obtaining water for domestic purposes and in supporting livestock • Implement hauling water, etc.

Attachment D

TDEC's Local Drought Management Planning Guide Outline

Step	Action
1	Preplanning
2	Organize the Process
3	Identify Existing Plans, Partnerships, Policies and Procedures
4	Coordinate with State and Regional Agencies
5	Plan the Management Phase Responses
6	Plan for Implementation – Monitoring, Detection and Trigger-points
7	Identify the Management Team
8	Review, Evaluate and Update the Management Plan

Attachment E

Links to Additional Drought Information

NDMC's Drought Impact Reporter

Palmer (long-term) Drought Index (updated weekly)

U.S. Climate at a Glance

US Precipitation Analyses

Weekly Weather and Crop Bulletin

Climate Report (updated monthly)

Seasonal U.S. Drought Outlook (updated last week of each month)

Current 6- to 10-day Outlook (updated Mondays, Wednesdays, and Fridays)

Soil Moisture Monitoring & Prediction

National Weather Service Home Page