2018

Tennessee's Roadmap to Securing the Future of Our Water Resources

Water-Related Natural Resources

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Executive Summary

Tennessee's abundant water resources, including its more than 60,000 miles of rivers and streams, 570,000 lake and reservoir acres, and an estimated 787,000 acres of wetlands (Division of Water Resources, Tennessee Department of Environment and Conservation, 2014, pp. 39, 41), are among the state's most valuable assets. One of the most biodiverse inland states in the nation, Tennessee is home to a diverse range of fish and other freshwater aquatic species, provides life-sustaining source waters for people and wildlife, and supports a wide variety of recreational opportunities that contribute substantially to the state's economy and quality of life. The state's rivers and streams provide habitats for some of the greatest aquatic species diversity in North America (Tennessee Wildlife Resources Agency, 2015, p. 74). Despite their tremendous value, these water resources face pressures and threats and are in need of proactive science-based management and protection.

This chapter on the state's water-based natural resources communicates some of the key challenges and offers recommendations for maintaining and improving the state of our waterways and the quality of life they afford while allowing for economic prosperity and growth.

I. The Natural Resources Working Group Process:

As part of the TN H2O planning effort, a Natural Resources Working Group was formed to develop a set of recommendations focused on the state's water resources, which underpin and serve as the source waters for a variety of critical human, fish and wildlife, and recreational uses. Given the expansive scope and wealth of Tennessee's natural resources, the Guiding Principle, "To protect and restore the fundamental natural processes that produce healthy and available water", was established to help direct the focus of this effort.

In addition to the Natural Resources Working Group participation, two focus groups were held to provide perspective and insight into the value of the state's water resources from managers, stewards, and end users. Both the Environment Focus Group and the Recreation & Tourism focus groups included participation by members of the environmental/conservation community, state government, and private industry and business (see appendix for lists of Natural Resources Working Group Members and focus group participants).

Given the strong reliance upon our waterways and significance of water-based recreation and tourism to Tennessee, these are addressed in a separate document on Recreation and Tourism.

II. Major Water-related Natural Resource Themes:

The Natural Resources Working Group identified several key, recurrent themes related to water resources that reflect the intrinsic and extrinsic values of water and its responsible management.

- Pride of Place - Tennessee is a special place to live, work and recreate because of our plentiful water resources, biodiversity and wildlife values.

- Citizen and Landowner Responsibility - There are impacts from our actions on all of the resources values that water provides. There needs to be strong support for a stewardship ethic that addresses personal responsibility on the part of those entrusted with these resources, and this responsibility must manifest itself in behaviors that value water availability and health.

- Water is our commonwealth - Through outreach and education, all citizens should expect that as a public resource they are entitled to healthy, clean and abundant water, but that this also comes with stewardship responsibilities.

Current State

Watershed Health and Natural Resources

Watershed health is the foundational concept that underlies all other characteristics and values of Tennessee's water resources. A comprehensive framework for maintaining water availability and achieving the objectives of the state's water quality and natural resource laws must be grounded in the protection and restoration of watershed health. The primary attributes of watershed health can be summarized in six general categories (EPA 2012):

> **Landscape:** Patterns of natural land cover, natural disturbance regimes, lateral and longitudinal connectivity of the aquatic environment, and continuity of landscape processes.
> **Geomorphic:** Stream channels with natural geomorphic dynamics (relating to water movement and stream formation and evolution).
> **Habitat:** Aquatic, wetland, riparian, floodplain, lake and shoreline habitat and hydrologic connectivity.
> **Water Quality:** Chemical and physical characteristics of water.
> **Hydrologic:** Hydrologic regime – Quantity and timing of flow or water levels fluctuation. Highly dependent on the natural flow (disturbance) regime and hydrologic connectivity, including surface-ground water interactions.
> **Biological:** Biological community diversity, composition, relative abundance, trophic structure, condition and sensitive species.

The 2015 "Tennessee Integrated Assessment of Watershed Health, A Report on the Status and Vulnerability of Watershed Health in Tennessee" written by RTI on behalf of the U.S. EPA Healthy Watersheds Program 2015 compiled watershed health indices for all Tennessee waters across these six attribute categories (RTI International 2015). Generally speaking, the watersheds demonstrating the highest overall index scores are located in those geographies maintaining higher degrees of natural land cover, have stable stream and river channels, lower variation from natural stream flow patterns, better water quality and habitat conditions that support a diversity of aquatic life (RTI International 2015). Areas with longer histories and higher intensities of land cover changes to urbanized and agricultural uses, and the accompanying changes to stream and river channels, have lower overall watershed health scores.

The current status of Tennessee's freshwater-dependent native species and habitats is also a direct reflection of the health of our watersheds. Available data from the wide variety of state and federal agencies that monitor, manage and research Tennessee's

freshwater resources provide insight into where species populations and habitats are stable and improving and where they have declined. This information is critical to consider alongside the chemical, physical, and biological data collected by the Tennessee Department of Environment and Conservation in order to complete an overall understanding of natural resource health across the state (EPA 2012).

A primary reference for tracking the status of fish and aquatic species and habitats in Tennessee is the State Wildlife Action Plan published by the Tennessee Wildlife Resources Agency (TWRA 2015). Every state and territory of the U.S. is required to publish a comprehensive State Wildlife Action Plan (SWAP) every ten years, with interim progress updates. In these plans, states are required to address the "full array of wildlife" in their jurisdictions and focus on state-defined "species in greatest need of conservation" (TWRA 2015). Included in these assessments are information on the distributions of species and their habitats, the conditions of their habitats and problems affecting them, and strategies to conserve them (TWRA 2015). TWRA also publishes a statewide strategic plan every six years that guides all the agency's wildlife resource management efforts, including game species and fisheries. As stated in the current strategic plan, "…it is the Agency's directive to manage the state's wildlife resources. The only way Tennessee's wildlife resources can be properly managed is if all basic requirements for life for each species are met and they are afforded the protection that ensures sustainability" (TWRA 2014).

As documented in both TWRA plans, as well as many others published by the Tennessee Department of Environment and Conservation, the status of our natural resources today cannot be separated from our history of land and water uses across the state. While Tennessee contains large acreages of wetlands and floodplains in some geographies, overall the state has lost approximately 59% of its historic wetland habitats to land clearing and drainage for agricultural purposes (Dahl 1990). Extensive deforestation and channelization of rivers in West Tennessee in the late 19th and early 20th century has resulted in widespread changes to river and floodplain stability and has facilitated the loss of upland soils across the landscape (TWRA 2014).

During the same era, commercial timber harvests and agricultural conversion expanded statewide, and in many watersheds poorly managed mineral and non-mineral mining led to severely degraded water quality from excess sediment and pollutants (TWRA 2014). Finally, the era of large dam and levee construction by the Tennessee Valley Authority and the U.S. Army Corps of Engineers from the 1930s -1970s led to major changes in natural river flows and the connections of mainstem rivers and their tributaries. In addition to large dams and reservoirs, the legacy of watershed fragmentation from small and outdated low-head dams, road culverts and bridge crossings are an additional issue

affecting all aspects of watershed health across the state (TWRA 2015). And while the majority of Tennessee's land cover remains in a naturally forested, open land, or agricultural land type, the rapid urbanization process beginning in the late 1980s and expanding through today has resulted in additional declines in watershed health and habitat quality in many locations throughout the state (TWRA 2015).

Despite these historic losses, Tennessee's freshwater systems remain some of the most ecologically diverse in North America still today and harbor the last stronghold populations of many native fish, mussel, snail and crayfish species in the world (TWRA 2015). The Tennessee SWAP identifies 276 freshwater species of greatest conservation need (SGCN) and another 411 subterranean, or cave (SGCN) – many of which are dependent on the stability and quality of surface and groundwater exchanges (TWRA 2015). Many different sportfish species are also found in streams and smaller rivers including trout, catfish, crappie, sauger, sunfish and three species of bass (TWRA 2014). Larger rivers and reservoirs also support these sportfish in addition to several types of commercial fisheries (TWRA 2014). A large variety of plant and other wildlife game species, such as migratory birds, are dependent on different types of wetland habitats for some or all of their life stages. Across the different physiographic regions of the state, river bottoms, floodplains, riparian areas and a diversity of other wetland types provide over 625,000 acres of priority habitat for Tennessee's SGCNs and the SWAP identifies 19 Conservation Opportunity Areas across the state largely designed around river systems (TWRA 2015).

Major stressors to natural resources:

The Tennessee Department of Environment and Conservation (TDEC) collects, maintains and publishes a wide variety of data on the status of water quality across the state. The biennial Water Quality Assessment publications and summary data reports provide consistent reviews of the quality of Tennessee's rivers, streams, lakes, reservoirs and ponds. According to the most recently published data from 2016, fewer than half (26,870) of the state's river and stream miles have been assessed, and of those evaluated 13,967 miles are considered impaired. The majority of Tennessee's lake and reservoir acreage has been assessed, and 208,092 of those acres – or 35% -- have water quality impairments. Of the designated uses with the highest percentages of impairment, fish and aquatic life and recreation are at the top of the list for rivers and streams (42% and 51% of assessed, respectively) and 33% of reservoirs are impaired for the recreation designated use (TDEC 2018a).

The primary causes of stream and river impairment are pathogens (specifically, *Escherichia coli*), excess sediment, habitat alterations, organic enrichment (resulting in

dissolved oxygen issues), and nutrients originating from livestock and crop production land uses, channelization, urban stormwater run-off, municipal sewer system overflows and point source discharges, and land clearance for construction (TDEC 2018a). For lakes and reservoirs, several pollutants lead the list of causes including dioxins, mercury, metals, pesticides and polychlorinated biphenyls (PCBs) along with other issues in common with rivers and streams including flow alterations, nutrients and organic enrichment, sediment. Water temperature change is an additional cause of impairment in some reservoir systems. Legacy pollutants, like chemicals that are often used and/or produced by industry and that remain in the environment long after they are first introduced, and other long-standing historical sources cause the largest percentage of impairment issues in reservoirs followed by atmospheric deposition, industrial, agricultural and construction related habitat alterations (TDEC 2018a).

Water quality impairment causes and sources have a direct impact on the quality and quantity of habitat for native species. These land and water uses can contribute to alterations in key watershed health attributes, resulting in detrimental impacts including: increased pollutant loading; increased impervious surface; reduced groundwater recharge; stream and river flow alterations; wetland and headwater stream loss; loss of upstream, downstream and floodplain connectivity; and altered biological integrity and loss of native species. Land use changes in urbanizing environments – including the loss of trees, changes to stream and wetland habitats, and the change from pervious land cover that allows rain to absorb into soils to impervious cover which increase direct run-off to streams – all result in a wide range of changes to watershed hydrology and biology (O'Driscoll et. al. 2010). Many native plant and animal species, including Tennessee SWAP SGCNs such as the streamside salamander (*Ambystoma barbouri*) are found in and around geographies experiencing rapid urbanization (TWRA 2015).

Finally, according to the Tennessee Aquatic Nuisance Species Management Plan, aquatic nuisance species (ANS) pose serious problems to the ecology and economy in Tennessee. The state's waters are impacted by a variety of aquatic invasive plant and animal species, defined as nonnative plants or animals that are likely to cause economic and/or environmental harm, and some may cause harm to human health as well. In Tennessee, zebra mussels, Eurasian water milfoil and Asian Carp are some of the more problematic aquatic nonnative species. In 2008, the Tennessee Aquatic Nuisance Species Task Force was formed to control existing ANS in the state and minimize the adverse impacts on native species, water quality, and economics by preventing the introduction and spread of any invasive species and by managing the impacts from those that are already in Tennessee. Still, there are several noteworthy ANS species - particularly Asian carp - that are of tremendous concern and threaten the

health of our waterways and recreational opportunities (Tennessee Aquatic Nuisance Species Task Force, 2008, pp. 3, 6).

Projected Future State

The future condition of Tennessee's freshwater natural resources is directly tied to the land and water management decisions and investments made today. Water quality degradation, loss of habitat, changes to stream and river flows, invasive species, and changes to precipitation and temperature patterns remain the major challenges to freshwater systems nationwide as well as in Tennessee (EPA 2012, RTI International 2015, TWRA 2015). Much is known about the causes and sources of these natural resource declines, and in past decades innovations in a wide variety of cross-disciplinary practices such green infrastructure for stormwater, improvements in water quality treatment practices, use of agricultural best management practices, reservoir release improvement technologies, and research have presented opportunities to protect and restore our natural resources, even in the face of the growing demands placed on them.

According to the TN State Wildlife Action Plan, the major issues that must be addressed today and into the future are the effects and impacts of urbanization and associated land use changes; agricultural and forestry best management practices; water management – including flow releases from reservoirs, water withdrawals, point sources and small dams; energy development, both renewable and non-renewable sources; transportation and utility corridors; and aquatic nuisance species (TWRA 2015). The 2015 "Tennessee Integrated Assessment of Watershed Health, A Report on the Status and Vulnerability of Watershed Health in Tennessee" developed vulnerability scores for the state's watersheds reflecting the potential for future degradation of freshwater system health (RTI 2015). This information also points to future challenges in land and water use demands, including how regions of the state may experience differing exposure to precipitation and temperature changes (RTI International 2015).

For Tennessee's natural resources, changes in rainfall patterns and temperatures mean changes to the conditions of habitats across the calendar year and in certain seasons which are critical for different plant and animal life stages. Changes to the time of year, amount, and duration of rainfall effects stream, river, wetland and reservoir habitats in a variety of ways (TWRA 2015). Infrastructure design and management decisions, such as reservoir release protocols, levee design and operation, water withdrawal and discharge allocations, stormwater management infrastructure, bridge and culvert designs, and floodplain & floodway regulations made to adapt to extreme ends of the change spectrum – low flows and flood impacts -- must ensure that stresses to freshwater resources are not further exacerbated. The spread of aquatic nuisance species such as Asian carp, emerging wildlife pathogens and water quality contaminants, are additional threats.

When assessing the projected future state of our resources, it is also critical to note that all these major issues have a distinct geographic footprint in different areas of Tennessee, meaning that the opportunity to target collaborative strategies in specific places to achieve desired natural resource outcomes can be achieved (TWRA 2015, RTI International 2015). For example, many of the river flow and water quality improvements achieved in the early to mid-1990s came from targeted changes to reservoir releases from Tennessee Valley Authority dams (TWRA 2015). In addition, the U.S. Department of Agriculture Natural Resources Conservation Service and the Tennessee Department of Agriculture have demonstrated many habitat and water quality improvement successes with targeting voluntary incentive programs to assist landowners implement best management practices.

Efforts to restore native species when habitat conditions improve have also been successful for several decades. The Tennessee Wildlife Resources Agency, Tennessee Department of Environment and Conservation, the U.S. Fish and Wildlife Service, and other partners have demonstrated the ability to restore populations of native plants, fish, and mussel species once in decline. Other examples of multi-agency and nonprofit collaborations, such as the Tennessee Healthy Watershed Initiative have achieved similar successes. Through the initiative, the Tennessee Department of Environment and Conservation has demonstrated the success of leveraging state funding investments alongside a variety of agency, local government, and non-profit partners to implement many successful water resource improvement projects (TDEC 2018b).

Certain geographies in Tennessee, particularly portions of some counties within the Metropolitan Statistical Areas (MSAs), are projected to experience the highest degree of increased urbanized land uses (TWRA 2015). In addition to the direct land cover changes, the associated need for improved and expanded infrastructure – including roads, water supply, and municipal sewerage – will place more stress on natural resources. In recent years many of these counties have developed comprehensive land use plans and implement stormwater management programs with goals and strategies designed to avoid and reduce negative impacts. Challenges exist in the funding and implementation of these programs; however, many of the planning and technical tools needed to affect positive changes already exist and can be deployed (Center for Watershed Solutions 2009). Streams and rivers in urbanizing areas provide very significant health, aesthetic, and recreational values to these communities and new research is demonstrating ways that these values can be incorporated into local planning and water management goals (O’Driscoll et al. 2010).

Areas of Concern

As population and public demand for recreational access to Tennessee waters increases, there will be increased need to consider effective ways to maximize watershed protection, conservation and restoration.

Four major themes emerged during the working group assessment process. These themes represent general areas of concern to be considered in the design and implementation of all TNH2O recommendations:

I. The regulatory framework and inclusive and more effective decision-making. There is a strong need for transparency, collaboration, and support for science at all levels that includes the public and private sectors.
II. Optimizing the ecological functions and health of rivers, streams and watersheds. There is a need to reduce pollution and to maintain and restore the ecological functions of streams and watersheds, including floodplains and riparian conditions, all of which our varied uses rely upon (fish and wildlife habitat, drinking water, wastewater, agriculture, industry, transportation, flood control, and recreation).
    - Improving urban stream health. Clean and plentiful waters that are fishable, swimmable, and provide adequate and reliable sources of drinking and wastewater are keys to equitable and sustainable communities.
III. Increased impervious surfaces and loss of pervious surface functions. There is a need to prioritize streams based on their greatest potential for restoration and community benefit, and to help growing communities manage the health of their local watersheds.
IV. Aquatic nuisance species (ANS). There is a need to substantially address invasive/exotic aquatic species, like Asian carp, and Eurasian milfoil and other types of aquatic vegetation that threaten waterways.

I. The regulatory framework

Tennessee has long recognized the value of its natural resources to its citizens and way of life. This value has been expressed in its laws and regulations, which are designed to protect and preserve game and fish, at both the federal and state levels. Several agencies (TDEC, TWRA, USGS, EPA, USACE and others) play key roles in establishing and overseeing the regulatory framework for water resource management in Tennessee. There are several key guiding laws and policies that shape the regulatory

and conservation climate, including the federal Clean Water Act and the Tennessee Water Quality Control Act, among others.

While there is a track record of demonstrated success related to the protection and management of Tennessee's water resources, the regulatory/legal arena is complex and there are still challenges and areas for improvement. As the Tennessee Water Resources Research Center aptly pointed out in their FY 2016 annual report there has historically lacked a single organization with the vision and capability to bring together all of the federal and state agencies that are responsible for the management and monitoring of water resources in the state (Tennessee Water Resources Research Center, 2016, p. 2). There is a need for more cross-collaboration among the agencies, as well as the regulated entities, the conservation/environmental community and industry. This will help to provide a more positive and predictable regulatory and policy environment for Tennessee's natural resources, something that was a key recommendation in Governor Haslam's Governor's Rural Challenge, A 10-Year Strategic Plan (Tennessee Department of Agriculture, 2013).

II. Optimizing the Ecological Functions and Health of Rivers, Streams and Watersheds

Restoration

In Tennessee, the two main laws focused on water resources reflect a desire to restore and reclaim the state's waters. The objective of the Clean Water Act is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." (Clean Water Act (FEDERAL WATER POLLUTION CONTROL ACT [As Amended Through P.L. 107–303, November 27, 2002]) Similarly, the purpose of the Tennessee Water Quality Control Act is "to abate existing pollution of the waters of Tennessee, to reclaim polluted waters, to prevent the future pollution of the waters, and to plan for the future use of the waters so that the water resources of Tennessee might be used and enjoyed to the fullest extent consistent with the maintenance of unpolluted waters." (2010 Tennessee Code Title 69 - Waters, Waterways, Drains And Levees Chapter 3 - Water Pollution Control, Part 1 Water Quality Control Act, 69-3-102 - Declaration of Policy and Purpose) It appears that the current regulatory approach is insufficient to meet the restorative intent and requirements of the laws as enacted. With nearly half of Tennessee's streams not meeting their designated uses, according to the Tennessee 303(d) list, there is a need for an approach that invests in and mobilizes resources that go beyond pollution reduction and control and that focuses on restoring degraded waters. Restored streams will help meet growing public demand for high quality aquatic resources, while providing valuable economic activity for local communities.

Watershed Conservation

Community involvement in the conservation and protection of local aquatic resources is an essential component of Tennessee's efforts to assure the availability of clean, safe water for municipal water supply, water contact recreation, biological diversity, and sportfishing. Tennessee should take every opportunity to support watershed organizations, stream clean-up projects, aquatic resource education, riparian zone restoration and conservation, and community-based conservation activities. A coordinated effort by Tennessee universities that have water resources programs and existing watershed organizations should be implemented to secure and support local community involvement.

Groundwater Protection

Groundwater in Tennessee is an essential source of water supply for individuals, municipalities, agriculture, and industry. The Karst groundwater aquifers of East Tennessee, those underlying the Cumberland Plateau, and aquifers beneath the Highland Rim and the Central Basin, are essential for both domestic water supply and as habitat for a significant component of Tennessee's rich aquatic biological diversity. The Memphis Sand Aquifer is essential to the public health and economic well-being of West Tennessee. The cumulative impacts of groundwater withdrawals, aquifer replenishment function, and the total extent and consequences of groundwater pollution, are not well understood, modelled, or monitored.

> Groundwater as a conservative "rainy-day fund" for long term economic viability and competitive advantage:
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> Clean water resources at the surface used in strategically well planned conservative multi-use balance allow the limited and long-term conservation of groundwater resources. Tennessee's critical groundwater provides a buffer for fluctuations in rainfall that directly impact surface water availability. When there is adequate groundwater supply that is not being depleted, it is available for long term planning. As water conservation efforts and technology progress to balance use with short-term rainfalls and available surface water, further avoidance of overuse of groundwater will help ensure that it will be available for high quality recruitment of businesses to the state into the future.
>
> Sophisticated companies want state economic partners who have long term strategic views and are giving more and more focus on water as a limited or

potentially limiting factor in growth plans. Conserving and seeing groundwater as the equivalent of a “rainy-day fund” for the days when it stops raining, gives the state a competitive advantage as water scarcity impacts other regions and other nations. During the next phase of economic growth, this perspective can be used to continue to drive water use conservation with a long-term goal of preserving groundwater as a backup, instead of as a primary initial source. By ensuring that surface water sources are protected and keeping groundwater as a backup “rainy day fund”, it will allow Tennessee to maintain prosperity in the face of long term drought. Such a strategic component will be impressive and enticing to future economic growth siting teams.

Drought Preparedness and Response

Drought preparedness and drought response are linked but are distinctly different challenges. Tennessee responds to the challenge posed by prolonged drought by bringing together state, community, utility district, federal and university expertise to provide a coordinated response.

As in most states, the end of drought in Tennessee generally means the end of a focused coordination effort. With the next prolonged drought, precious time is lost in reassembling the component parts of a coordinated response, including the assemblage of the appropriate entities and representatives. To retain drought response preparedness, including lines of communication, identification of needed expertise, and changing community infrastructure demands, Tennessee should consider assembling a core drought response team to meet annually and work toward the goal of providing the best possible coordinated drought preparedness.

The negative impacts and challenges associated with prolonged drought are widespread and include municipal water supply, ecological function of aquatic systems, agricultural activities such as irrigation, industrial activities including both water intakes and wastewater discharges, municipal wastewater discharge, and power generation, both steam electric and hydroelectric. As streams and rivers approach low flow, as either the September median flow or 7Q10 (seven consecutive days of low flow over a ten-year period) the cumulative impacts to Tennessee’s aquatic resources require a carefully coordination state-led response.

While the entities needed for a comprehensive drought response are well known, the lines of communication and cooperation can degrade quickly due to changing agency missions, retirement, reassignments, changing technology, and constantly expanding infrastructure and demands on aquatic systems.

A significant issue in drought preparedness is keeping track of the growth and demands of Tennessee Utility Districts as our population increases, service areas expand geographically, and increased need for regional cooperation during prolonged drought.

Tennessee's Drought Preparedness Team should be responsible for keeping an updated representation and contact list for state, federal utility district and university water center personnel with drought related responsibilities. Major federal agencies include the U.S. Army Corps of Engineers (USACE), the U.S. Geological Survey (USGS), the Tennessee Valley Authority (TVA) and U.S. Fish and Wildlife Service (USFWS). Major state agencies include Tennessee Department of Environment and Conservation (TDEC), Tennessee Emergency Response Agency (TEMA), Tennessee Department of Agriculture (TDA), Tennessee Wildlife Resources Agency (TWRA), and the Tennessee Advisory Commission on Intergovernmental Relations (TACIR). Universities with Water Resource Centers include Tennessee Technological University and University of Tennessee-Knoxville.

Tennessee's Drought Preparedness Team should also be responsible for keeping track of and having an open line of communication with the National Weather Service (NWS) and National Oceanic and Atmospheric Administration (NOAA), keeping track of the latest technologies for anticipating and recognizing the onset of drought, and a mechanism to keep partner agencies and entities informed and updated. Tennessee's Drought Preparedness Team should be responsible for the preparation and periodic updating of a Comprehensive Strategic Drought Response Plan.

Drought preparedness in Tennessee include consideration of the consequences of significant regional drought impacts on Southern Kentucky, Southwest Virginia, and Western North Carolina. The headwaters of both the Cumberland and Tennessee Rivers are in border states to our north and east. It is in Tennessee's best interest to have an established line of drought preparedness communication with both state and federal agencies responsible for drought preparedness and response in our neighboring states

<u>Need For Greater Water Role in Economic Development and Siting Decisions</u>
Plentiful clean water managed with a conservative long term strategic plan is enticing to new job location decision makers for many reasons including:

- Low comparative utility costs, but sophisticated companies are willing to pay fair prices as part of a balanced strategic approach to assure long term rates and reliability.
- High resource reliability as sources for reliable utilities.
- Location decisions are made with much more than just utility rates in mind. Tennessee's advantage offering no state income tax is not enough by itself. Quality

of life is a key when executives decide not just where they want their employees to live, but where they want to live as well.

Water as a Health-based Economic Factor

Water resources are a critical component of good health and given the huge portion of government and personal spending devoted to health care, any significant positive or avoidable negative impact should be a high priority. Not only is the obvious role of clean drinking water supply worth protecting, but also the mental health and physical recreational impacts of the outdoor lifestyles that Tennessee's lakes and rivers provide are immensely important to overcome our societal momentum toward the unhealthy impacts of being sedentary and disconnected from nature.

Agricultural Demand for Clean Sufficient Water Supply

Every farmer needs healthy and abundant water for crops or livestock. Similarly, farmers need to recognize and eliminate degradation of water resources from alteration of habitat, wasteful uses, livestock waste and runoff siltation.

USDA Natural Resources Conservation Service:

USDA Natural Resources Conservation Service (NRCS) has successfully provided conservation measures to protect natural resources on private land across Tennessee through Farm Bill programs and strong partnerships. Formal and informal partnership agreements have strengthened measures to help private landowners learn and take action to protect their natural resources on their land. All of Tennessee's 95 counties are represented by a five-member Soil Conservation District Board (SCD). This formal partnership with NRCS ensures that landowners in their county (district) have input and can provide guidance on how conservation funding should be used. This partnership enables NRCS to reach out to private landowners and farmers to implement conservation systems through voluntary programs. The SCD boards have provided a successful delivery and marketing strategy for other partners, as well.

Tennessee Department of Agriculture:

The Tennessee Department of Agriculture provides 319(h) non-point source funding directly to the SCDs to support administration and implementation of their programs. Multiple partners have realized the value of having local interest and input and liaise with the districts to help identify local resource concerns, provide funding, and ultimately accomplish their agency's missions.

III. Loss of Pervious Surface Function and Stormwater

Tennessee is successful in efforts to protect streams and rivers from degradation related to both point and non-point source pollution. Tennessee water quality reports (303(d) assessments and 305(b) reports) continue to add streams to the list of water bodies that have become degraded due to habitat destruction, streambank destabilization, increased sedimentation, flow alterations from intense rain events and changed peak velocities and increase in cumulative stormwater runoff from impervious areas. The loss of pervious surface function, with resulting loss of natural hydrologic function of streams, threatens to undo decades of successful stream protection.

Tennessee's most recent 305(b) report identifies Municipal Separate Storm Sewer System (MS4) discharges as the fourth leading source of impairment to the state's streams, trailing only animal agriculture, channelization, and crop production. MS4 discharges are by far the leading pollution source in Tennessee that is subject to regulation. View the 305(b) report at www.tn.gov/content/dam/tn/environment/water/documents/wr_wq_report-305b-2014.pdf

The State of Tennessee is authorized to issue the federal National Pollutant Discharge Elimination System (NPDES) general permit for discharges of municipal stormwater to communities that are designated as MS4s. These designated communities include cities, counties, some universities and some military installations that are located in urban areas of the state and/or may have other factors that may contribute to urban stormwater pollution into our streams, creeks, rivers, wetlands and lakes.

The Tennessee stormwater program is administered by the Tennessee Department of Environment and Conservation (TDEC). TDEC administers four Phase I MS4 permits to the cities of Knoxville, Nashville, Memphis, and Chattanooga. Tennessee issued the third iteration of the Small MS4 general Permit on September 30, 2016. There are 98 small MS4s under the general permit, including an individual Phase II permit for TDOT. The permit, the Notice of Determination and Rationale and all other associated documents may be found on TDEC's Permit Data Viewer: http://environment-online.state.tn.us:8080/pls/enf_reports/f?p=9034:34051:::NO:34051:P34051_PERMIT_NUMBER:TNS000000 (*The current appeal letters over the post-construction portion of the permit may also be found at this link.)*

These MS4s play an important role as integral partners for collaboration with water quality groups (i.e., watershed associations), water recreation and tourism groups (i.e., TN Scenic Rivers Association), and federal and state agencies (i.e., USACOE and

TDA). MS4s are required to address water quality pollution from urban sources and do complete visual assessment inspections and conduct some monitoring over a 5 year cycle.

Approximately 35 MS4s have implemented a stormwater fee, which is a transparent and dedicated funding source for the stormwater management program. These funds are used for rehabilitation of aging stormwater infrastructure, setting up routine maintenance programs, funding larger scale capital drainage projects, improve urban stormwater planning, as well as funding for watershed improvement projects – tree plantings, stream bank restoration, stream clean ups etc.

Although the stormwater programs in Tennessee and across the U.S. have made significant strides in curbing stormwater pollution and managing construction stormwater since MS4 permits were first issued in the 1990s, urban effects are continuing to be the greatest source of water quality degradation across the nation. Many of Tennessee's urban areas continue to experience significant population growth along with development and densification. Urban watersheds are under intense pressure from land use conversion, construction site runoff, and loss of headwater streams.

On a more positive note, Tennessee MS4 permit requirements since 2010 have been initiated to require new construction sites to utilize green infrastructure to infiltrate, evapotranspirate, capture and/or reuse the first inch of runoff after a significant rain event. The intent for this requirement is to remove the first flush of pollutants (sediment, trash, metals, fertilizers etc.) from being picked up by rain and carried to stormwater drainage infrastructure as well as to reduce the volume of stormwater runoff from overwhelming the catchment systems and further degrading the creeks.

Additionally, MS4s in Tennessee are working to halt and improve further degradation of water bodies through their public involvement and education events. Public support is so critical to successful MS4 program effectiveness in Tennessee and across the country. Collaborating with the NGO community and with federal and state agencies and also with adjacent MS4s is vital to preserving and improving green space and water quality in urban settings. Communities recognize that green space and clean water is vital to their economic growth, to tourism and fishing, for drinking water and industry, and also for its aesthetic and recreational value.

IV. Aquatic Nuisance Species (ANS)

Asian carp represent one of the single greatest threats to Tennessee's native fisheries resource and the recreation and tourism activity based upon our lakes and rivers across

the state. There are four species of Asian carp in the United States and in Tennessee, including bighead carp, silver carp, black carp and grass carp. All are from the Yangtze and Amur River systems in China. First imported into the United States for various aquaculture purposes back as early as 1970, they were unintentionally introduced into the waters of our country in the late 1980s and early 1990s when they escaped from aquaculture ponds in the delta areas of the Mississippi River during extreme floods.

All four Asian carp species were first found in the Mississippi River, where they are still abundant, and migrated into Tennessee waters via locks at Kentucky and Barkley dams. Carp are also known to have entered Reelfoot Lake during high flows through its spillway. All four Asian carp species can affect the fish and aquatic life in numerous ways, including having astounding spawning rates and competing directly with native Tennessee fishes. Bighead carp grow to a maximum of about 60 inches and 110 pounds. Silver carp also grow very fast compared to most native fishes in the United States. In aquaculture facilities, silver carp have grown to 12 pounds in one year, and may grow to a maximum of 39 inches and 60 pounds. Grass carp can eat up to 40% of their body weight per day, and grow to a maximum of 59 inches, 99 pounds, and live up to 21 years. Black carp can grow to a maximum of 48 inches, and 71 pounds, on a diet composed almost exclusively of snails, mussels, and other invertebrates.

The impact of these fish, if not challenged and brought to heal, stand to cause irreparable damage to natural and economic resources, and water-based recreation in Tennessee for years to come.

So too, in Tennessee, there is an issue with exotic invasive species, like hydrilla, milfoil and a variety of other non-native types of aquatic vegetation that are in need of management to keep them from outcompeting our native species. The aquatic vegetation management issue is detailed in the section on Recreation and Tourism due to its impacts to reservoirs and associated recreation.

Recommendations

A variety of targeted recommendations were generated by the Natural Resources Working Group that were informed by the discussions with working group members and learnings from focus group participants. These include addressing actions that encourage systemic improvements to processes that can protect and better manage Tennessee's water resources. One all-pervasive, desired improvement is the need to facilitate and elevate the significance of natural resource decision-making at all levels and in all sectors (e.g., permitting, grant-making, strategic planning, and other areas) to protect and restore our unique and diverse freshwater resources and species. Others recommendations pertain to the key issue areas related to regulation, administration and management of our water resources, as well as the inextricable link between water availability and healthy waters for sustainable economic growth and development.

1) Recommendation: Protect the foundational natural processes critical to sustaining the health and abundance of Tennessee's water. To accomplish this our leaders must prevent the weakening of water laws and rules pertaining to water health and abundance.

2) Recommendation: Actively, and with purpose, reaffirm public ownership of water and the state's role in ensuring the health, abundance and proper management of water resources across Tennessee.

3) Recommendation: Establish an approach for adaptive management of river flows and minimum flows that utilizes best available science and optimally protects ecological health and recreational uses of Tennessee rivers and streams long-term, and acknowledges that climate-related temperature and precipitation changes will exacerbate flow-related stressors.

4) Recommendation: Aggressively promote and communicate water conservation best practices and behaviors which support and help produce healthy and abundant Tennessee waters.
    - Develop and execute meaningful efforts to support existing education and outreach efforts of watershed associations, Adopt-A-Stream programs, community festivals and celebrations, and the like, that encourage water resources stewardship.
    - Engage private landowners and citizens in water conservation/watershed protection opportunities, and incentive programs through the development of concise and helpful information resources and delivery systems.

5) Recommendation: TDEC should develop robust, long-term and sustainable approaches, similar to the Tennessee Healthy Watershed Initiative, to successfully identify and marshal resources to protect and restore the health of Tennessee's waters and that fulfil the restorative intent and requirements of the federal Clean Water Act and the Tennessee Water Quality Control Act (see objective and purpose of the acts described on page 11).
   - Invest in capacity to coordinate across state agencies and with federal, local, and non-governmental partners to ensure collaboration on shared goals for watershed health.
   - Create a joint effort between the Department of Economic and Community Development (ECD) and TDEC that will establish a certification process to incentivize (within the existing ECD job creation incentive structure) and reward industry locating or expanding in Tennessee for restoring waters.
   - Work with ECD to develop incentives that encourage water stewardship (flood mitigation).
   - Identify critical target watersheds that can benefit and elevate the level of incentive that companies could receive.
   - Ensure that all companies are eligible to buy into the program to do beneficial work in existing areas of need.
   - Use the assessment information and natural resource plan updates in recommendation #6 to inform and guide the aforementioned efforts.

6) Recommendation: Conduct, and every five years update, a comprehensive, Tennessee Water Resource Assessment (using the Lower Mississippi River Assessment as a model), that describes current assets, as well as future outlooks (five, fifteen and thirty years). The goal of this assessment is to establish a foundation for action to provide Tennessee advantages for sustaining our financial success and quality of life. The work product of this assessment would be used to:

   - Update and inform a variety of other water related natural resource plans and assessments (state wetlands strategy, habitat assessments, flood studies, drought studies, recreation studies, economic assessments, regional supply plans, and the like. These could be used by counties/cities and the state to benefit tourism, recreation, flood control and rural development.
   - Enhance the existing Tennessee Drought Management Plan, and flood management planning emphasizing preparation and impact avoidance, in addition to response. The divergent perception of these risks, drought versus flooding, can mask opportunities to leverage practical steps that minimize risk of both. Rainfall is unpredictable, but the severity of negative impacts resulting from poor planning are a certainty. Good consensus as a factual

basis for planning helps assure effective interagency coordination and communication on these critical areas of community strength.

- Increase understanding of the significance of headwater reaches to protecting resilient water supply, flood risk reduction, biodiversity and clean drinking water supplies.
- Set goals for watershed protection and restoration efforts in collaboration with local jurisdictions, including identification of priority watersheds for remediation.
- Address complex issues like invasive aquatic plant and animal management and others that require multi-disciplined and multi-agency collaboration

7) Recommendation: Place water health and abundance considerations as a first step when considering recruitment of industry, and the permitting and grantmaking decision-making processes. Examples include programs such as Rural Development, 3-Star and other state and federal incentive grant processes.
   - Educate policy makers/managers about the value of Tennessee's water-based natural resources.
   - Encourage local governments to hire staff that have natural resource-related education and experience and can incorporate a conservation perspective into their work and decision making.

References

(n.d.). *Lower Mississippi River Resource Assessment .* From http://www.lmrcc.org/programs/lower-mississippi-river-resource-assessment/

Center for Watershed Solutions (CWS). 2009. Understanding Priorities, Activities, and Needs of MS4 Stormwater Programs in Tennessee. Part 2 of a Statewide Watershed Management Needs Assessment. CWS: A partnership initiative of the University of Tennessee-Institute for a Secure and Sustainable Environment and the Cumberland River Compact. Knoxville, TN.

Dahl, T.E. 1990. Wetland Losses in the United States, 1780's to 1980's. U.S. Department of Interior, Fish and Wildlife Service. Washington, DC.

Environmental Protection Agency (EPA). 2012. Identifying and Protecting Healthy Watersheds Concepts, Assessments, and Management Approaches. U.S. Environmental Protection Agency, Office of Water, Office of Wetlands, Oceans, and Watersheds. Washington, DC. EPA 841-B-11-002

O'Driscoll, M, S. Clinton, A. Jefferson, A. Manda and S. McMillan. 2010. Urbanization Effects on Watershed Hydrology and In-Stream Processes in the Southern United States. *Water* 2, 605-48. Doi: 10.3390/w2030605. Open access article distributed under the terms and conditions of the Creative Commons Attribution license (http://creativecommons.org/licenses/by/3.0/).

RTI. (2015). *Tennessee Integrated Assessment of Watershed Health, A Report on the Status and Vulnerability of Watershed Health in Tennessee.* US EPA Healthy Watersheds Program. From https://www.epa.gov/sites/production/files/2015-10/documents/tn_hwp_report_final_october2015.pdf

State of Tennessee. (2010). *Tennessee Forest Resource and Assessment Strategy.* State of Tennessee. From https://www.tn.gov/content/dam/tn/agriculture/documents/forestry/TN-FAP_1-Intro.pdf

Tennessee Aquatic Nuisance Species Task Force (TANSTF). 2008. Tennessee Aquatic Nuisance Species Management Plan. Tennessee Wildlife Resources Agency. Nashville, TN.

Tennessee Department of Agriculture. (2013). *Governor's Rural Challenge A 10-Year Strategic Plan.* Tennessee Department of Agriculture.

Tennessee Department of Environment and Conservation (TDEC). 2018a. State of Tennessee water quality information posted to the "Assessment, Total Maximum Daily Load (TMDL) Tracking and Implementation System (ATTAINS)" https://ofmpub.epa.gov/waters10/attains_state.control?p_state=TN&p_cycle=2016

Tennessee Department of Environment and Conservation (TDEC). 2018b. Information on the Tennessee Healthy Watershed Initiative: https://www.tn.gov/environment/program-areas/wr-water-resources/watershed-stewardship/tennessee-healthy-watershed-initiative.html. Accessed July 7, 2018.

Tennessee State Wildlife Action Plan Team (TWRA). 2015. Tennessee State Wildlife Action Plan 2015. Tennessee Wildlife Resources Agency. Nashville, TN.

Tennessee Water Resources Research Center. (2016). *Tennessee Water Resources Research Center Annual Report.*

Tennessee Wildlife Resources Agency. (2015). *Tennessee State Wildlife Action Plan.* Tennessee Wildlife Resources Agency.

Tennessee Wildlife Resources Agency (TWRA). 2014. Tennessee Wildlife Resources Agency Strategic Plan 2014-20. Nashville, TN.

U.S. Fish & Wildlife Service. (n.d.). *National Wetlands Inventory.* From https://www.fws.gov/wetlands/

USDA NRCS. (2015). *2012 Natural Resources Inventory Summary Report.* USDA. From https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcseprd396218.pdf

Appendix A

TN H2O Natural Resources Working Group Members:

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David Salyers, TN Dept. of Environment & Conservation Staff
Shari Meghreblian, TN Dept. of Environment & Conservation Staff
Jenny Adkins, Natural Resources Conservation Service
Jonathan Boggs, Arbor Springs Forestry
Keith Cole, Wolf River Conservancy
Evan Crews, TN Valley Authority
Jason Henegar, TN Wildlife Resources Agency
Mekayle Houghton, Cumberland River Compact
David McKinney, TN Wildlife Resources Agency
Chris Nischan, Trout Unlimited
Ed Penny, Ducks Unlimited, Southern Region
Jane Polansky, TN Dept. of Environment & Conservation Staff
Keith Sanford, Tennessee Aquarium
Dennis Tumlin, Rhea County Economic Development
Jennifer Watson, TN Stormwater Association
Greer Tidwell, Bridgestone Americas, Inc.
Brian Bivens, Bivens and Associates, LLC
Lindsay Gardner, TN Wildlife Federation
Jeremy Nelson, 3 Rivers Angler
Dennis Tumlin, Rhea County Economic Development
Tiffany Foster, TN Valley Authority

Appendix B

TN H2O Environment Focus Group
March 7, 2018
Tennessee Wildlife Resources Agency, Nashville, TN

Participants:

Mike Butler, TWF; Lindsay Gardner, TWF; Sally Palmer, TNC; Jim Redwine, Harpeth Conservancy; Dorie Bolze, Harpeth Conservancy; Jason Henegar, TWRA, Scott Banbury, Sierra Club; Paul Davis; Paul Sloan; Evan Crews, TVA; Greer Tidwell, Bridgestone Americas; Anne Passino, SELC; Wendy Smith, CRC; David McKinney, TWRA; Jenny Adkins, NRCS; John McFadden, TEC; Chris Nischan, TU; Tiffany Lynn, TVA.

Appendix C

TN H2O - Recreation & Tourism Focus Group
April 5, 2018
Tennessee Wildlife Federation Office, Nashville, TN

Participants

Participants: Mike Butler, TWF; Lindsay Gardner, TWF; Sally Palmer, TNC; Christina Treglia, TDEC; Elaine Boyd, TDEC; Shari Meghreblian, TDEC; Chris Nischan, Trout Unlimited; Jedd Grubbs, Cumberland River Compact; Kevin Mahoney, State of Tennessee Department of Tourism, Margaret Littman, Nashville Paddle Company; Jenny Paul, Cleveland State University/The Wildlife Society; Richard Quinn, Paw Paw Partners; Sherry Beard, Paw Paw Partners; Patty Schultz, Tennessee Scenic Rivers Association; Jason Henegar, TWRA; David McKinney, TWRA; Dennis Tumlin, Rhea County Economic Development; Jane Polansky, TDEC.