Southeast Aquatic Habitat Plan

Developed by the Habitat Subcommittee of the
Southeast Aquatic Resources Partnership

for the
Southeast Region of the United States

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SARP was formed in 2001 to address the here-to-fore uncoordinated management of aquatic resource issues in the southeastern United States. It is a voluntary collaboration of natural resource managers and professionals, both inland and coastal, working together to protect, conserve and restore aquatic resources throughout the Southeast. The core members of the partnership include the natural resource agencies in Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, Missouri, North Carolina, Oklahoma, South Carolina, Tennessee, Texas and Virginia, the U.S. Fish and Wildlife Service, National Oceanic and Atmospheric Administration National Marine Fisheries Service, the Gulf States Marine Fisheries Commission, the Atlantic States Fisheries Commission, and the Gulf and South Atlantic Fishery Management Councils. Nongovernmental organizations, industries and private citizens with goals and objectives that parallel those of the SARP member agencies participate in the partnership as well.

The plan was developed as a joint effort of all the member agencies and partners of SARP plus many other stakeholders throughout the region. It is broad and regional in nature, given the geographic and biological range of SARP's 14 member states.

SARP is recognized as an official partnership of the National Fish Habitat Initiative to implement its Action Plan (NFHAP) to conserve inland and coastal fishery habitats throughout the nation. This plan will be support NFHI restoration projects in the Southeast.

For additional information about SARP, see http://www.sarpaquatic.org, and on NFHI, see http://www.fishhabitat.org.

Because this is a regional plan, the targets to quantitatively and qualitatively evaluate progress towards achievement of objectives are based upon the best available data at the regional level from scientifically respected sources. The majority of the data came from reports by the U.S. Environmental Protection Agency and the H. John Heinz III Center for Science, Economics and the Environment.

Executive Summary

Habitats are the cornerstones of wildlife resources and provide the necessary food, water, shelter and space for plants, animals, and other organisms to thrive. The southeastern United States harbors a diversity of aquatic habitats and species unparalleled in the nation, and the states of the Southeast Aquatic Resources Partnership (SARP) – Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Missouri, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia – have recognized the importance of protecting habitats found in this region.

The quality and quantity of these spectacular and valuable aquatic resources have been in decline since European colonization. Deteriorating and disappearing habitats have led to reductions in biodiversity, as well as critical declines in some plant and animal populations. The problems and issues leading to these circumstances have many sources, natural and human-induced. Ongoing research is identifying new sources, like climate change, every day.

Government agencies, private organizations, businesses, and citizens recognize the value of aquatic resources and work every day to conserve aquatic habitats independently on state and local scales. By addressing aquatic habitat conservation at the regional and national scales, SARP will increase the effectiveness of individual efforts and bring greater funding and public support to aquatic habitat conservation.

During 2005, the SARP Aquatic Habitat Conservation Work Group sponsored research projects in four representative, geographically separate southeastern watersheds. Assessments of these ecosystems yielded much information about various aquatic habitats, and identified similarities and differences in the problems and issues plaguing them. The results of these studies on the Duck, Altamaha, Pascagoula and Roanoke watersheds led to development of this Southeast Aquatic Habitat Plan (the Plan). State Wildlife Action Plans (also known as Comprehensive Wildlife Action Strategies) provided a great deal of background and reference information for it, and the simultaneous development of the National Fish Action Plan (NFHAP) provided an opportunity to coordinate regional conservation and restoration efforts nationally. SARP is recognized as an official partnership to implement the National Fish Habitat Action Plan (NFHAP).

This science-based, landscape-style system for habitat conservation seeks to effectively apply limited resources to priority areas on a regional basis in order to reverse current trends and protect the Southeast's aquatic resources well into the future. The purpose of the Plan is to maintain, restore, and conserve the quantity and quality of freshwater, estuarine, and marine habitats to support healthy, sustainable fish and aquatic communities and sustain public use for the benefit of all in the southeastern region and the entire U.S.

In order to achieve this goal, multiple projects at many different levels will focus on eight objectives:

Objective 1: *Establish, improve and maintain riparian zones*
Objective 2: *Improve or maintain water quality*
Objective 3: *Improve or maintain watershed connectivity*
Objective 4: *Improve or maintain appropriate hydrologic conditions for the support of biota in aquatic systems*

Objective 5: *Establish, improve or maintain appropriate sediment flows*
Objective 6. *Maintain and restore physical habitat in freshwater systems*
Objective 7: *Restore or improve the ecological balance in habitats negatively affected by nonindigenous invasive or problem species*
Objective 8: *Conserve, restore, and create coastal estuarine and marine habitats*

The Plan is a living document, focused on adaptive management. It will be revised utilizing lessons and data from every project. For this initial version of the Plan, objectives are based on the major aquatic habitat types and attributes in the Southeast, focusing on broad indicators of habitat integrity, function and overall ecosystem health. Objectives and regional targets have been developed using the best available scientific data. These are described in detail in Section 2 of the Plan. Additional data and tools, currently under development, will assist SARP's adaptive management process of updating and maximizing the outcomes of this Plan.

Because of the size and variety of habitats in the southeastern region, habitat conservation needs are varied and spread out. In order to effectively use limited resources to reverse current trends and conserve the region's aquatic habitats, geographic priorities must be set periodically. Several tools will play a role in the prioritization process. In the long term, the implementation of the National Fish Habitat Science and Data Committee's assessment tool will allow a science-based approach for prioritizing aquatic habitat conservation and restoration projects nationwide. This assessment tool will help SARP refine its geographic priorities. SARP is developing a geo-referenced database with aquatic system condition data to help identify geographic priorities at a regional scale for the Plan. Details about this adaptive prioritization process are included in Section 3.

Conservation and restoration of specific aquatic habitats will be accomplished through many projects, utilizing implementation strategies to address location, threats, problems and issues. SARP members will be engaged in many of these projects, directly addressing the Objectives and Targets in Section 2, in partnership with other entities. However, effective implementation of the Plan depends upon SARP's collective management and facilitation at an integrated systems level. While on-the-ground projects will focus on the goal and one or more of the eight objectives, SARP must integrate and coordinate these projects to maximize outcomes and leverage dollars. To that end, stakeholders provided four strategies for SARP to integrate habitat conservation projects throughout the region. These four strategies are:

Integrated Conservation Strategy 1: *Information collection and dispersal*
Integrated Conservation Strategy 2: *Capacity building*
Integrated Conservation Strategy 3: *Management and restoration*
Integrated Conservation Strategy 4: *Law and policy.*

Details about each of these strategies are found in Section 4.

Monitoring will contribute to an understanding of the complex ecological systems within which the Plan's conservation and restoration projects are implemented. Analysis of these data will help SARP identify areas of habitat improvement and establish a record of conditions and trends. These data can also warn SARP of environmental decline, and identify gaps in existing scientific knowledge. Monitoring will provide the basis for a rigorous review of habitat project planning and implementation to determine whether project results are being achieved and if mid-course corrections are needed. Monitoring and evaluation will be conducted on two levels in order to assess the Plan's performance and each project's performance towards improving or sustaining the Southeast's aquatic habitats. Monitoring to provide data for both levels will be built into all projects at the

planning stage. GIS-based data will play a large role in monitoring and evaluation and will be used along with other monitoring processes. Details about monitoring and evaluation are found in Section 5.

When SARP was established in 2001, members identified six areas upon which the partnership would focus: public use, fishery mitigation, imperiled fish and aquatic species recovery, interjurisdictional fisheries, aquatic habitat conservation, and aquatic nuisance species. Over time, members realized that many of the issues and problems in all six areas could be addressed through a regional habitat conservation plan. This Plan is a blueprint for that effort.

Table of Contents

Why the concern about the habitats in Southeast Region of the U.S. ?

The southeastern United States harbors a diversity of aquatic habitats and species unparalleled in the nation. Over 1,800 species of fishes, freshwater mussels, freshwater snails, turtles and crayfish can be found in southeastern watersheds. More than 500 of these are endemic to these states or in individual watersheds within them. More than 70 major river basins in the region link with the south Atlantic-Gulf of Mexico coastline to nourish and support rivers, streams, lakes, bays, estuaries, reservoirs, and the bulk of the country's wetlands. The drainage basin for the Gulf of Mexico, which includes the area drained by the Mississippi River, is almost 60% of the land in the Continental U.S. (Beck et al. 2000). In addition, approximately 16% of the nation's coastal wetlands are located in the South Atlantic region, which includes Florida (White et al. 2002), and almost half of the nation's coastal wetlands are in Louisiana.

The freshwater and marine systems in the region provide tremendous economic and aesthetic benefits through angling opportunities, recreational and commercial activities, water supply and natural assimilation of wastes. For example, in 2001, over 48% of the anglers in the U.S. fished in the Southeast, accounting for over 42% of the nation's total fishing days. These sportsmen spent over $13 billion, accounting for almost 37% of the total recreational fishing expenditures nationwide (USFWS/USCB, National Survey of Fishing, Hunting and Wildlife Associated Recreation 2001). Public lands like the region's 171 National Wildlife Refuges, over 700 state parks, multiple wildlife management areas and scenic waterways provide opportunities for nonconsumptive nature tourism (hiking, camping and birding) that also contribute to local economies. In 2005, despite the impacts of hurricanes on commercial fishing capacity, over 1.75 billion pounds of finfish and shellfish were harvested in the SARP member states, with a direct economic value of almost $900 million, representing some 23% of the economic value of all commercial fisheries in the United States (NMFS, Fisheries of the United States 2005).

Regrettably, the quality and quantity of these spectacular and valuable aquatic resources have been in decline since European colonization. Nearly 100 species have become extinct across the region in the last century. Further, in its 1998 report entitled *Rivers of Life: Critical Watersheds for Protecting Freshwater Biodiversity*, The Nature Conservancy, looking at more than 2000 small watersheds across the continental U.S., identified 87 subwatersheds in the U.S. with 10 or more "at risk" species of freshwater fish and mussels. Seventy-five of these 87 "hot spots" are contained in the 14 SARP states, and 18 of the top 19 are in four basins within their boundaries – the Tennessee, Ohio, Cumberland, and Mobile (Master et al. 1998).

These declines have many sources, including hydrologic alteration, habitat destruction, reduced water quality, loss of connectivity and the negative effects of nonindigenous species. Some sources of habitat stress are direct such as stream piping, relocation, shoreline armoring, excessive siltation, introductions of nonindigenous species and/or contaminants, and often associated with development, commerce, agriculture, forestry and mining. For example, roughly one half of the exotic fish species introduced into the Southeast have become established, stressing or altering ecological systems (Benson et al. 2001). In coastal areas, upstream alterations in freshwater flows and sediment supply, including reductions in volume, can result in loss of vegetative habitat and changes in sediment deposition and nutrient transport (Sklar and Browder 1998). The indirect stress from greenhouse gases may exacerbate these declines because many river basins have already lost their ability to adjust (Palmer et al. 2008).

Less direct stressors, especially human population growth and climate change, cumulatively exert a persistent and growing landscape-level effect on fish and their habitats. As more people use increasingly limited natural resources, habitats are impacted. U.S. Census data from April 2000 indicates the human population of the 14 SARP states exceeds 90 million (97,371,542) and, when compared to 1990 figures, points to an increase of over 14 million (14,656,552) people in 10 years. Significant population growth in the Southeast is expected.

The pressures from human population growth have been especially heavy on coastal areas. Populations along the Gulf Coast increased 45% between 1980 and 2003. Atlantic coastal counties experienced an increase of 58%, the largest increase during that period of any coastal region in the continental U.S. (U.S. Census 2000, Population in Coastal Counties).

In tandem with human population growth, climate change has already affected and will more profoundly affect aquatic habitats in the Southeast over the remainder of this century. Climate models project that the Southeast's temperatures will increase on average by 4-10 degrees F over this period, with increasingly hotter summers and higher heat indices (Carter 2000). Based on recent precipitation trends in the region, increases and decreases in precipitation and temperature will be variably manifested geographically, potentially exacerbating existing droughts and developing water shortages in parts of the region. There is also an existing measurable trend in the Southeast for precipitation to occur in more intense events. This trend could intensify during the remainder of the century.

Some predicted environmental effects of these climate changes in the Southeast include fewer continuous acres of forests, reduced agricultural productivity, diminished fish and shellfish populations, and increased electricity demand (Titus 1989). While uncertainties in precipitation projections make it difficult to predict effects on stream and river flows, areas experiencing drought may respond with greater pressure on groundwater for irrigation and water supply, exerting indirect consequent impacts on natural systems. A study of possible effects from climate change on the world's major river systems indicates that by 2050, every populated basin in the world will experience changes in river discharge and many will experience serious declines in water quality and quantity. (Palmer et al. 2008.)

It is reasonable to expect these climate trends to increasingly stress species that are near the upper ranges of their temperature tolerances in the Southeast and those requiring specific habitats that may be affected by the associated hydrological changes. These factors, combined with already fragmented and degraded habitats, will likely cause increased rates of extinction and imperilment of some native species across the region. Additionally, increasing temperatures may enlarge the area of the Southeast vulnerable to establishment of populations of tropical aquatic nuisance species currently restricted to south Florida.

The most dramatic and predictable effect of climate change in the Southeast will be coastal wetland loss and major coastline changes. During the 20th century sea levels rose by 4-8 inches (Burkett et al 2001). The International Panel on Climate Change predicts that this trend will increase 2-5 fold during the 21st century. Under this scenario a sea level rise of approximately one meter is possible by the end of the century. A one-meter rise in sea level would inundate all of coastal southeast Louisiana (UA 2006). The Louisiana coastline would variably move from 10 to over 100 miles inland, inundating New Orleans and many other coastal communities, while altering just about all of the coastal wetlands that support the bulk of the productive fisheries of the northern Gulf of Mexico. Similar impacts, but on a lesser scale would occur in all coastal areas of the Southeast, including all of the keys, the Everglades and much of the city of Miami, Florida, would be under water.

Although the earth has always undergone climate variation, and people have always affected natural systems, the effects from these indirect stressors appear to be in a period of acceleration. They must be considered in planning actions to ameliorate the effects of direct stressors (Technical Review Committee on Global Climate Change and Wildlife, 2004).

Clearly, the public supports actions to conserve and restore healthy aquatic habitats. A study conducted in 2005 by Responsive Management for the Southeastern Association of Fish and Wildlife Agencies indicated that the value placed by the public on programs to conserve fish and wildlife habitat and to protect threatened and endangered species transcends state and local levels of action. This study also noted that water quality is a major fish and wildlife issue facing the southeastern states, and that water resources are of concern for the health of people, fish and wildlife. (Responsive Management, 2005, Executive Summary). Many government agencies, private organizations, businesses, and citizens recognize the value of aquatic resources and work every day to conserve them, but past efforts to halt their decline have been conducted independently on state and local scales. A regional approach is necessary.

Multiscale Approach to Conservation

SARP, comprised of state natural resource agencies from 14 southeastern states plus several federal agencies with natural resource responsibilities, along with concerned nongovernmental organizations (NGOs), was formally organized in 2001 to effectively approach the decline in the region's aquatic resources by integrating state, federal and individual interests and efforts. SARP's mission is – *with partners, to protect, conserve, and restore aquatic resources including habitats throughout the Southeast, for the continuing benefit, use, and enjoyment of the American people.* This partnership takes a comprehensive and systemic approach to watershed conservation. It coordinates the use of new and existing science-based data and expertise, and combines conservation dollars to improve outcomes and stem or possibly reverse aquatic resource decline.

The need to address the decline in fisheries habitats throughout the nation was recognized on a national scale at the same time as SARP's formation, when the U.S. Fish and Wildlife Service (FWS), the Association of Fish and Wildlife Agencies, and the American Fisheries Society sponsored a series of aquatic habitat stakeholder meetings, resulting in the National Fish Habitat Initiative (NFHI) with a mandate to develop an integrated landscape approach to conserve inland and coastal fishery habitats throughout the nation. The National Fish Habitat Action Plan (NFHAP), a non-regulatory, science-based program, implemented through partnerships, has resulted from the NFHI.

SARP has embraced this national initiative while pursuing a similar approach in the region. During 2005, the SARP Aquatic Habitat Conservation Work Group sponsored conservation assessments led by The Nature Conservancy in four representative, geographically separate southeastern watersheds. Assessment of water, flora and fauna of the interconnected ecosystems yielded much information about various habitats, and identified similarities and differences in the problems and issues plaguing them. The results of these studies of the Duck, Altamaha, Pascagoula and Roanoke watersheds provided guidance and parameters for SARP to develop this Southeast Aquatic Habitat Plan (Plan). It offers a science-based, landscape-scale model for habitat conservation, aimed at the protection, restoration, recovery, and sustainable use of aquatic resources in the Southeast. (The assessments can be found at http://www.sarpaquatic.org.)

Also in 2005, by Congressional direction, SARP member states submitted their Comprehensive Wildlife Conservation Strategies (CWCS) to the FWS for approval. The state CWCS plans (also known as State Wildlife Action Plans, or SWAPs) encompassed the variety of problems facing state-identified species of greatest conservation need (SGCN) and strategic conservation actions aimed at improving habitats and

populations of SGCNs. Recognizing the importance and value of incorporating related issues and strategies from its member states' CWCS or SWAP plans into the regional plan, SARP and The Nature Conservancy compiled a database of information related to aquatic habitats from the state plans. These data will help to support habitat restoration and protection strategies at the ground level that cross programmatic and political boundaries, increasing the effectiveness of existing agencies and organizations while leveraging and maximizing available funding to achieve regional-scale conservation objectives.

Proper land and resource management is crucial at multiple levels to protect the natural aquatic treasures found throughout the SARP states and to ensure that future generations will be able to enjoy them. Selecting one scale at which to implement strategies is difficult, especially considering that rivers, lakes, reservoirs and streams may be integrated with estuarine and marine systems, and watersheds often cross multiple jurisdictions. Federal, state, local, public and private agencies and organizations must join together with coordinated strategies to abate current and future threats to the aquatic systems in a comprehensive, landscape manner that minimizes infringements on the rights and needs of specific user groups and maximizes the participation of all stakeholders. As research continues, restoration and management must be adapted to sustain the region's aquatic resources.

This Plan seeks to effectively apply limited resources and adaptive management to priority areas on a regional basis in order to reverse current trends and protect the region's aquatic resources far into the future. The Plan is a living document. It will be revised often, utilizing lessons and data from every project implemented under the Plan's sponsorship. Additional data and tools, currently under development, will assist SARP's adaptive management process of updating and maximizing the outcomes of this Plan.

How can this plan conserve the Southeast's aquatic habitats?

Vision

The Plan will engage stakeholders and the public in protecting, maintaining, restoring and enhancing the Southeast's fish and aquatic communities through partnerships that foster habitat conservation, and improve the quality of life for the American people. Implementation of the plan will result in habitats with the biological, chemical, and physical integrity to sustain healthy communities. As such, the Plan's vision, its overriding spirit, is the:

> *Cooperative conservation of southeastern streams, rivers, lakes and reservoirs, estuaries, and coastal marine habitats to support fish and aquatic resources, and sustainable public use.*

Guiding Principles

Five principles framed the crafting of the Plan and will provide the fundamental underpinnings for its implementation. They are:

•*Communicate the value of the Southeastern aquatic habitats and the imperative for conserving them.*

Properly functioning aquatic habitats are vital and necessary attributes of aquatic ecosystems. They support healthy fish and wildlife populations, and sustainable public use. Knowledge and awareness of desirable functions stimulate action. The regional plan will be a vital tool in efforts to obtain the funding, public and political support, and other resources necessary to meet the goal and objectives that will achieve the plan vision.

•*Provide regional aquatic conservation planning based on sound science, rigorous research, open and inclusive planning processes, and input from a broad and diverse group of stakeholders.*

Application of regional conservation strategies and implementation targets will be guided by the best available information on aquatic systems and species. The Plan will also recognize the importance of research that expands our knowledge base and increases our ability to craft meaningful land and water management strategies and measure the success of strategic implementation.

•*Establish regional aquatic conservation priorities.*

Identifying and articulating regional priorities for habitat conservation efforts will focus scarce resources to maximize conservation benefits in the Southeast. Establishment will be based upon abating threats and conserving balanced, healthy ecological conditions in aquatic habitats. Regional priorities, identified as focal geographic areas, habitat types and species or species groups, will change as conditions change, problems are addressed, and new issues arise.

•*Support existing partnerships, and facilitate new ones, to effectively conserve southeastern aquatic systems.*

The challenges facing the southeastern region's aquatic resources demand new approaches to conserve them. This regional plan will be designed to support existing partnerships and foster effective creation of new ones at scales appropriate to meeting conservation challenges.

•*Integrate conservation strategies and measures within identified watersheds and across scales from watershed to region to national plans.*

The connectivity of aquatic ecosystems across local and state political boundaries improves consistency in conservation measures among different portions of watersheds, and the management of species across watersheds. This will be accomplished by increasing communication and project integration between freshwater, estuarine, and marine resource managers and practitioners to reduce the administrative barriers to working across ecosystem boundaries, and to ensure that the strategies implemented at all scales are mutually supportive, relevant, and effective in aquatic habitat conservation.

Goal

Living organisms and their habitats interact in changing ecological systems. These systems support human life by providing drinking water and food, and involve human activities such as farming, aquatic recreation, forestry and industry. Plants, animals, *and* people need healthy aquatic habitats. Although many healthy aquatic habitats thrive in the southeastern region of the U.S., some have disappeared. Others are endangered or declining. These losses in the Southeast have both natural and human-induced causes. Such reductions in habitat quantity, quality and function have negative impacts on animal, plant and human populations *and* their quality of life. Humans have the resources and abilities to conserve and restore these habitats. The goal is to:

Maintain, restore, and conserve the quantity and quality of freshwater, estuarine, and marine habitats to support healthy, sustainable fish and aquatic communities and sustainable public use for the benefit of all in the southeastern region and the entire U.S.

This goal of the Southeast Aquatic Habitat Plan will be achieved by taking collective action on eight primary objectives.

Limitations for all Objectives and Targets

Although the Plan was developed primarily to explain SARP's approaches in preserving, conserving and restoring aquatic habitat, it is designed for use by all groups with similar aims throughout the Southeast. Achievement of the Plan's objectives will be ongoing, with each project contributing in specific ways to the emergence of strong, healthy communities of fish, wildlife and people utilizing thriving aquatic habitats. While improving habitats, project results will also provide lessons learned and meet research needs to support continued planning and additional projects.

The relationship between healthy habitats and robust fish and wildlife populations is assumed in the Plan, and individual species will be one of many filters used to set project priorities and assess project outcomes. SARP

has captured data from the member states' CWCS or SWAP plans to effectively coordinate habitat restoration and protection strategies with states' identified species of greatest conservation need at the ground level across programmatic and political boundaries. However, it is important to remember that this is a plan to conserve and restore aquatic habitats in the region.

This Plan generally adheres to the principles of Strategic Habitat Conservation (SHC) (USGS 2006). However, this initial version of the Plan does not strictly apply that approach because data and models essential for doing so are incomplete or do not exist. In addition, the SHC approach utilizes population-based objectives, and at least for this initial version, the Plan's objectives are based on the major aquatic habitat types and attributes in the Southeast. The objectives focus on broad indicators of habitat integrity, function and overall ecosystem health. Consistent with SHC, objectives and regional targets have been developed using the best available scientific data. A systematic GIS-based system is being developed for refining future objectives and monitoring outcomes. Conservation delivery will be based on defined objectives and targets, and partnerships will be key to achieving those objectives. Adaptive management will be used to help refine objectives and conservation actions.

Although the following objectives focus individually on critical components of aquatic habitats, they function as an interrelated whole. The order of their mention in the document does not indicate any order of priority. All are important because the impacts from specific threats in a specific location must be considered cumulatively and on multiple scales. Using this Plan, individual threats to the health, quality, and function of aquatic habitats will be considered as part of interrelated processes, problems, and issues with interrelated outcomes.

Unless these outcomes can be measured, the effectiveness of actions to achieve outcomes cannot be assessed. Therefore, one or more resource targets (scientifically based quantitative and/or qualitative descriptions of desired changes) have been proposed for each objective. These targets attempt to establish a quantifiable basis for assessing progress in achieving the associated objective. In developing these regional targets, an attempt was made to adhere to the format and recommendations in the Proposed Interim National Targets (February 2007) developed by the National Fish Habitat Board's Science and Data Committee. The Plan's targets are primarily resource-based outcome targets, focusing on changes in the resource as a result of SAHP actions. Developing quantifiable targets for most of the objectives presents real challenges, primarily due to the lack of regionally analyzed and integrated data. For this reason some targets focus on measures that indirectly assess the resource attributes related to the objective and some targets are actions than can be pursued during implementation. The following quantitative targets are subjectively proposed as reasonable measures of improvement over 15 years, assuming that focused efforts are brought to bear and adequate resources are available. With the adaptive management process in mind, ideal targets are also described, even though the interim targets sometimes do not measure against them. Ideal targets provide the opportunity to identify data gaps for effective evaluation, and suggest needed research to better focus targets.

An additional challenge for some of the targets is presented when positive change may not be reflected in assessment and evaluation because of continuing research about various conditions. This challenge will be considered as applicable when assessing progress towards achieving each of the objectives.

It should be possible to develop resource-based targets that are more specific to the objectives once the first assessment of the nation's aquatic habitats, as proposed in *A Framework for Assessing the Nation's Fish Habitat* (NFHSDC 2006) is completed in about 2010. The targets in this version of the Plan should generally be viewed as interim targets subject to revision. Many of the current targets have their basis in information presented in *The State of the Nation's Ecosystems* (The Heinz Center 2002, 2003, 2005) and the *National Coastal Condition Report II* (USEPA 2004). The underlying data for both of these documents have been

periodically updated, reassessed and published by the USEPA and the Heinz Center. The Plan assumes that those updates will continue in the future. (Further explanation of these resources can be found on page 2.) In a few cases, targets are based on local data or proposed need. Note that in a few cases, targets are not structured on five-year intervals due to insufficient data or it was not meaningful to do so for a specific target. Unless otherwise stated, all targets are intended to be achieved over a 15-year time period following plan adoption (i.e., by 2022).

Objective 1: *Establish, improve and maintain riparian zones*

Riparian zones buffer the impacts on adjacent waterbodies from human land use activities while supporting aquatic as well as terrestrial habitats. Wenger (1999) defines riparian zones as land areas located adjacent to waterbodies, often naturally vegetated with grasses, shrubs and trees. Effective riparian zones function as efficient traps, filtering out sediments and nutrients. They provide structure for ephemeral or intermittent channel flow. Vegetation closest to the waterbody provides cover and habitat for wildlife, helps maintain normal water temperatures, slows over-bank flows, and provides energy in aquatic systems. Vegetative roots, especially from woody plants and trees, decrease erosion of the banks and shorelines (Pollen and Simon 2005). During certain periods or under certain circumstances, riparian zones play significant roles in changing water quality as well as in the life stages and life-sustaining activities of many aquatic animals. Natural riparian areas also provide important habitat and travel corridors for terrestrial wildlife. Both grassed and forested buffers trap sediment. Forested buffers provide other benefits as well, such as better runoff control while also allowing input of large woody debris and other matter necessary for aquatic organisms (Wenger 1999).

Urbanization, industrialization, agriculture and other types of development often degrade or reduce the size or health of riparian areas. Ideally, appropriately sized riparian zones in every watershed in the southeastern region should be permanently protected. In areas where vegetated riparian areas are already lost or loss is unavoidable, such as urban areas, methods to restore or provide the functions of healthy, natural riparian areas should be explored and utilized. The challenge is to maintain, conserve, permanently protect, construct or restore riparian zones in the southeastern region that can support healthy aquatic habitats and their populations of fish and other aquatic organisms while meeting public needs.

Target

An ideal riparian zone would extend over all land adjacent to a waterbody to the extent necessary for effective buffer and support. Buffer slope and the presence of wetlands have been determined to be the most important and useful factors in determining ideal buffer width. Long-term studies suggest that a 30 m (100 foot) riparian buffer is sufficiently wide to trap sediments under most circumstances, although they can vary based on type of soil, hydrology, slope and vegetation. Native forest vegetation should be maintained or restored to provide optimal benefit (Wenger 1999). Riparian buffers should extend along both sides of rivers and streams, including intermittent and ephemeral channels, and completely around natural lakes and impounded waters.

One ideal target for this objective would include a measure of habitat quality and quantity utilizing satellite data and geographic information system (GIS) analysis to determine the magnitude of change in percentage of 100-year floodplain areas of natural vegetative cover. Other target strategies may involve assessing maintenance of acres of existing riparian areas or determining the percentage of or number of new riparian areas in a watershed or the southeastern region. Permanently protected riparian areas may be included in the assessment of change. However, regional data have not been compiled or analyzed in a fashion that would allow development of such targets at this time. The initial target for this objective is limited by available regional data on riparian areas.

Using data compiled and processed by the U.S. Environmental Protection Agency's (EPA) National Exposure Research Laboratory that used the U.S. Geological Survey's (USGS) National Hydrography Dataset, the Heinz Center (2002) determined that, nationally, 23% of the lands within 100 feet of the waters' edge along streams nationwide were either farmlands or urban development in the early 1990s. Although those data are for the nation as a whole rather than only the Southeast and appear low for the southeastern region, they were used when developing the following targets for this objective pending development of current regional data for assessing the Southeast's riparian condition.

Target 1A. Ensure that adequate non-urban/non-agricultural riparian buffer habitats exist on at least 85% of the lands within 100 feet of rivers and streams in the Southeast by 2022.

•By 2012 ensure that at least 78% of the lands within 100 feet of rivers and streams in the Southeast have adequate riparian buffers.

•By 2017 ensure that at least 81% of the lands within 100 feet of rivers and streams in the Southeast have adequate riparian buffers.

•By 2022 ensure that at least 85% of the lands within 100 feet of rivers and streams in the Southeast have adequate riparian buffers.

Objective 2: *Improve or maintain water quality*

The quality of water includes physical, chemical, and biological characteristics that sustain plant and animal life and support a variety of human uses including drinking water, fishing and boating, agriculture and industry, and other types of recreation and transportation. Water quality characteristics can be altered by storms and seasonal changes; industrial, manufacturing or residential discharges and runoff; urbanization; agriculture; and other land uses, sometimes for many miles from the contamination site (e.g., the dead zone in Gulf of Mexico impacted by drainage from the Mississippi River Basin). Plants and animals in any aquatic community are sustained by the balance of temperature, nutrients, and organic material in the habitat. Maintaining good water quality and preventing, halting, or reversing alterations support these life-sustaining balances and reduce treatment costs for human use. The challenge is to maintain or adjust the balance of water quality characteristics in aquatic systems to meet the needs of fish, other aquatic and terrestrial organisms, and the public.

Targets

Ideally the magnitude of change for this objective will be measured by the maintenance of or increase in the percentage of, or the number of miles of, streams and rivers, or acres of estuaries, wetlands, lakes, reservoirs, and ponds with water quality characteristics that meet the designated use. An example of a designated use might be fishable/swimmable waters or waters supporting aquatic life and recreation, such as addressed in Section 303(d) of the federal Clean Water Act. A decrease in the percentage of waterbodies in the southeastern region with water quality unable to support healthy ecological systems is desirable.

The EPA maintains a database of waterbody segments/areas that are classified as impaired in accordance with Section 303(d). Although the data in that system are not consistently expressed quantitatively in terms of stream miles or areal extent, the 303(d) list includes a total number of impaired waterbody segments/areas. That number (7,073 as of June 2007) is used as an interim basis for Target 2A for this objective. Note that states have different listing criteria for these data. Some criteria are primarily anthropogenic in focus, some don't

consider emerging contaminants such as pharmaceuticals, and some may be less suitable for describing impairment in some of the Southeast's low gradient systems, such as some habitats of the lower Mississippi River floodplain. However, these are the best available data upon which to base many of the following targets. In addition, ongoing research has resulted in an increase in the number of 303(d) listings of impaired waterbodies every two years, presenting the challenge described on page 13. Data are available to meet this challenge in the target's assessment.

Several other targets were also developed for this objective focusing on specific water quality characteristics, as further described below, using data from The Heinz Center (2002). Although those data apply to the nation as a whole and not to the Southeast specifically, they were, nevertheless, used when developing targets pending future development of more specific targets when better data are available. Note that these targets are regional, and are not meant to apply at every individual site.

Target 2A. Restore at least 710 waterbody segments/areas in the Southeast (10% of impaired segments/areas as of June 2007) to nonimpaired status per the EPA 303(d) list.

•By 2012 restore at least 140 waterbody segments/areas in the Southeast to nonimpaired status per the EPA 303(d) list.

•By 2017 restore at least 350 waterbody segments/areas in the Southeast to nonimpaired status per the EPA 303(d) list.

•By 2022 restore at least 710 waterbody segments/areas in the Southeast to nonimpaired status per the EPA 303(d) list.

According to the Heinz Center (2002), the USGS National Water Quality Assessment (NAWQA) found that 77% of stream sites nationwide during the period 1992-1998 were exceeding at least one standard or guideline for contaminants that may affect aquatic life in water. This was used as a basis for Target 2B.

Target 2B. Reduce to 70% the stream sites in the Southeast exceeding at least one standard or guideline for contaminants or emerging contaminants affecting aquatic life.

•By 2012 reduce to 76% the stream sites in the Southeast exceeding at least one standard or guideline for contaminants or emerging contaminants in water affecting aquatic life.

•By 2017 reduce to 75% the stream sites in the Southeast exceeding at least one standard or guideline for contaminants or emerging contaminants in water affecting aquatic life.

•By 2022 reduce to 70% the stream sites in the Southeast exceeding at least one standard or guideline for contaminants or emerging contaminants in water affecting aquatic life.

The NAWQA (Heinz Center 2002) also found that 48% of stream sites nationwide during 1992-1998 were exceeding at least one standard or guideline for contaminants in sediments that affect aquatic life. This was used as a basis for Target 2C.

Target 2C. Reduce to 45% the stream sites in the Southeast exceeding at least one standard or guideline for contaminants in sediments affecting aquatic life.

•By 2012 reduce to 47% the stream sites in the Southeast exceeding at least one standard or guideline for contaminants in sediments affecting aquatic life.

•By 2017 reduce to 46% the stream sites in the Southeast exceeding at least one standard or guideline for contaminants in sediments affecting aquatic life.

•By 2022 reduce to 45% the stream sites in the Southeast exceeding at least one standard or guideline for contaminants in sediments affecting aquatic life.

The NAWQA (Heinz Center 2002) also found that during 1992-1998 approximately 48% of farmland streams and 18% of urban/suburban streams nationwide had nitrate levels in excess of 2 parts per million (ppm). These data were used as bases for Targets 2D and 2E.

Target 2D. Reduce to 40% the farmland stream sites in the Southeast exceeding 2 ppm nitrate concentration.

•By 2012 reduce to 47% the farmland stream sites in the Southeast exceeding 2 ppm nitrate concentration.

•By 2017 reduce to 44% the farmland stream sites in the Southeast exceeding 2 ppm nitrate concentration.

•By 2022 reduce to 40% the farmland stream sites in the Southeast exceeding 2 ppm nitrate concentration.

Target 2E. Reduce to 10% the urban/suburban stream sites in the Southeast exceeding 2 ppm nitrate concentration.

•By 2012 reduce to 17% the urban/suburban stream sites in the Southeast exceeding 2 ppm nitrate concentration.

•By 2017 reduce to 15% the urban/suburban stream sites in the southeast exceeding 2 ppm nitrate concentration.

•By 2022 reduce to 12% the urban/suburban stream sites in the Southeast exceeding 2 ppm nitrate concentration.

The NAWQA also found that during 1992-1998, approximately 73% of farmland streams, 68% of urban/suburban streams, and 54% of large river [defined as having average flows over 1,000 cubic feet per second (cfs)] sampling sites nationwide exceeded the EPA's recommended goal of 0.1 ppm concentration for phosphorus in order to prevent excess algal growth. These data were used as bases for Targets 2F, 2G, 2H.

Target 2F. Reduce to 65% the farmland stream sites in the Southeast exceeding 0.1 ppm phosphorus concentration.

•By 2012 reduce to 71% the farmland stream sites in the Southeast exceeding 0.1 ppm phosphorus concentration.

•By 2017 reduce to 68% the farmland stream sites in the Southeast exceeding 0.1 ppm phosphorus concentration.

•By 2022 reduce to 65% the farmland stream sites in the Southeast exceeding 0.1 ppm phosphorus concentration.

Target 2G. Reduce to 60% the urban/suburban stream sites in the Southeast exceeding 0.1 ppm phosphorus concentration.

•By 2012 reduce to 67% the urban/suburban stream sites in the Southeast exceeding 0.1 ppm phosphorus concentration.

•By 2017 reduce to 64% the urban/suburban stream sites in the Southeast exceeding 0.1 ppm phosphorus concentration.

•By 2022 reduce to 60% the urban/suburban stream sites in the Southeast exceeding 0.1 ppm phosphorus concentration.

Target 2H. Reduce to 45% the large river sampling sites in the Southeast exceeding 0.1 ppm phosphorous concentration.

•By 2012 reduce to 52% the large river sampling sites in the Southeast exceeding 0.1 ppm phosphorous concentration.

•By 2017 reduce to 49% the large river sampling sites in the Southeast exceeding 0.1 ppm phosphorous concentration.

•By 2022 reduce to 45% the large river sampling sites in the Southeast exceeding 0.1 ppm phosphorous concentration.

The NAWQA (Heinz Center 2002) found that 83% of farmland stream sites nationwide during 1992-1998 had at least one pesticide with concentrations exceeding aquatic life guidelines. This was used as a basis for Target 2J.

Target 2J. Reduce to 75% the farmland stream sites in the Southeast with at least one pesticide exceeding aquatic life guidelines.

•By 2012 reduce to 81% the farmland stream sites in the Southeast with at least one pesticide exceeding aquatic life guidelines.

•By 2017 reduce to 78% the farmland stream sites in the Southeast with at least one pesticide exceeding aquatic life guidelines.

•By 2022 reduce to 75% the farmland stream sites in the Southeast with at least one pesticide exceeding aquatic life guidelines.

Objective 3: ***Improve or maintain watershed connectivity***

Watershed connectivity in a habitat context can be described as physical, chemical, and biological conditions that accommodate the movements of aquatic organisms, nutrients, water, or energy into various necessary habitats or habitat types. Waterbodies, whether flowing or static, require regular and, at times, unrestricted movements of these to support their ecological systems. Watersheds need similar connectivity within and between rivers, streams, lakes and reservoirs, and between terrestrial and aquatic habitats. Some physical impediments to connectivity such as dams, levees, incised channels, armored shorelines, and culverts can block or change these movements. Impediments such as chemical, biological, and thermal barriers, invasive species, impervious areas, and reduction of the vegetated canopy can also affect connectivity. These impediments are more easily adjusted than the physical ones, although no adjustments are simple. Often barriers to connectivity have a positive use in one part of a watershed, but negatively affect the productivity of some ecosystems in other parts of the same watershed. Occasionally, the purpose for a barrier has disappeared altogether, but the barrier remains. The objective is to conserve or improve watershed connectivity in a manner that will maintain or improve the health of habitats, ecological systems, and populations of fish and other aquatic organisms and meet public needs within a watershed and the region.

Targets

For this objective the ideal targets would be measures of the maintenance of or increase in the number of watersheds in the Southeast with minimal (lowest number and degree of) impediments to connectivity. Since connectivity can be seen to support human needs as well as the life needs of aquatic plant and animal populations, an increase in the percentage or number of healthy aquatic habitats with minimal impediments to connectivity should demonstrate progress. Indicators of change might include chemical or physical changes in water quality, level or flow attributable to operations adjustments, number of dams removed, number of channels connected to floodplains, or alterations in land use patterns accompanied by increases in populations of certain species or functional guilds while continuing to meet human needs. While there are currently no compiled data on connectivity or aquatic habitat health as specific attributes per se, there are a few data sets that may be useful in assessing progress in meeting this objective. The FWS, in its Fish Passage Decision Support System database (FWS 2007), indicated as of June 2007 that there were at least 39,821 barriers to fish passage in the SARP states. Although the data in this database may not be complete, they have utility as a basis for identifying targets for this objective.

Target 3A. Restore 1,000 miles of fish access to rivers and streams in the Southeast by effectively removing* barriers to fish passage.

- By 2012 restore fish access to 500 miles of rivers and streams in the Southeast.
- By 2017 restore fish access to 750 miles of rivers and streams in the Southeast.
- By 2022 restore fish access to 1,000 miles of rivers and streams in the Southeast.

Target 3B. Restore 20,000 acres of fish access to lakes, reservoirs, and coastal estuaries in the Southeast by effectively removing* barriers to fish passage.

- By 2012 restore fish access to 10,000 acres of lakes, reservoirs and coastal estuaries in the Southeast.

* "Effectively removing" can mean physical removal, breaching of a barrier, installation of fish passage structures, or implementation of other fish passage strategies to result in effective fish passage aroundor through a barrier.

•By 2017 restore fish access to 15,000 acres of lakes, reservoirs and coastal estuaries in the Southeast.

•By 2022 restore fish access to 20,000 acres of lakes, reservoirs and coastal estuaries in the Southeast.

Objective 4: ***Improve or maintain appropriate hydrologic conditions for the support of biota in aquatic systems***

The quantity and flow of freshwater in waterbodies varies naturally by season and precipitation, and unnaturally by human alteration and withdrawal of water from rivers and lakes as well as groundwater from aquifers. Both are important to aquatic communities. High flows and elevated water levels are part of the natural renewal of some habitats and coastal waters. In rivers, reservoirs or natural lakes, high flows during spring and summer greatly enhance reproductive success and survival of offspring for many species of fish and other animals. These same water levels support public needs for transportation, irrigation, drinking water and recreation.

Estuaries, highly productive habitats for fish and other aquatic organisms, are formed in protected coastal areas where fresh water flows into and mixes with tidally-driven saline waters. Estuarine habitats are supported by the regularity and balance of volume, timing, and periodicity of these occurrences. When people dredge rivers to enhance navigation, create reservoirs and build levees, they may change the hydrologic conditions of waterbodies and watersheds. (Sklar and Browder 1998). The objective is to maintain and/or adjust the quantity and flow of freshwater in rivers, streams, reservoirs and estuaries in a manner that will enhance or sustain the habitats and populations of fish and other aquatic organisms while meeting public needs.

Targets

The magnitude of change for this objective should be measured as a percentage of increase in or increased number of miles of freshwater streams and rivers with instream flow protection plans; or acres of lakes, reservoirs, ponds, aquifers, and estuaries with hydrologic conditions that support sustainable populations of fish and other aquatic organisms compared to a referenced condition. The number of miles or acres of permanently protected freshwater bodies may be included in the measurement. However, data to assess these measures are currently either not available or have not been compiled and assimilated in a manner to allow such assessments to be made. Specific, quantifiable targets may be established for individual watersheds but would require further study to establish.

The Heinz Center (2002) analyzed changes in high and low flows and timing of those flows for 1930-1949 as a reference period and compared those data to the 10-year periods of the 1970s, 1980s and 1990s using USGS stream gauge data nationwide. The data showed in the 1970s that 55.1% of rivers had experienced a greater than 75% increase or decrease in flows or more than a 60-day change in timing of flows. For the 1980s and 1990s the data showed that 56.9% and 60.8%, respectively of rivers had experienced those changes from the reference period. Although these data are nationwide rather than specific to the Southeast, they were, nevertheless, used to formulate Target 4A pending future development of more specific targets after better data are available.

Target 4A. Reduce the percentage of rivers in the Southeast that have experienced more than a 75% change in high or low flows or more than a 60-day change in timing of flows since the 1940s to 58%.

•By 2012 reduce the percentage of rivers in the Southeast that have experienced more than 75% change in high or low flows or more than a 60-day change in timing of flows since the 1940s to 60%.

•By 2017 reduce the percentage of rivers in the Southeast that have experienced more than 75% change in high or low flows or more than a 60-day change in timing of flows since the 1940s to 59%.

•By 2022 reduce the percentage of rivers in the Southeast that have experienced more than 75% change in high or low flows or more than a 60-day change in timing of flows since the 1940s to 58%.

Using data from the USGS Circular Series *Estimated Use of Water in the United States*, which has been published every five years since 1950, The Heinz Center (2005) assessed freshwater withdrawals nationwide from all sources, for most purposes (such as public supply, domestic, irrigation, livestock, aquaculture, industrial, mining, and thermoelectric, not including freshwater diversions), using withdrawals in 1980 as an index. The year 1980 was chosen because it was the year of greatest water withdrawal (i.e., index value of 1.00) over the data series (1960-2000). Data showed that water withdrawals in the Southeast almost doubled between 1970 and 1980, declined to an index value of 0.77 in 1985, but then rose back to an index value of approximately 0.96 in 2000. Total freshwater withdrawals in the Southeast that year were 120.5 billion gallons per day (bgd). By contrast, human populations in the Southeast rose steadily in a nearly linear fashion from an index value of 0.72 in 1960 to 1.35 in 2000 (1.00 in 1980). These data were used as the basis for Target 4B.

Target 4B. Using freshwater withdrawal in 1980 as an index of 1.00 (125.56 bgd), reduce freshwater withdrawals in the Southeast from all sources to an index of 0.90 (113.0 bgd).

•By 2012 reduce freshwater withdrawals from all sources, using withdrawal in 1980 as an index of 1.00, to an index of 0.95 (119.2 bgd).

•By 2017 reduce freshwater withdrawals from all sources, using withdrawal in 1980 as an index of 1.00, to an index of 0.93 (116.7 bgd).

•By 2022 reduce freshwater withdrawals from all sources, using withdrawal in 1980 as an index of 1.00, to an index of 0.90 (113.0 bgd).

Areas of impervious surfaces (e.g., roads, parking lots, driveways, sidewalks, buildings) in urban and suburban areas can have major impacts on hydrology and water quality in these and downstream portions of watersheds. Although there are currently no data available to assess impervious surface area, The Heinz Center (2002), using data from the National Land Cover Dataset, a product of the Multi-Resolution Land Characterization Consortium [a partnership of USGS, U.S. Forest Service, the National Oceanic and Atmospheric Administration (NOAA) and EPA], determined the percentages of "natural" area patches in urban and suburban settings that fell into specified size groupings. Natural areas were defined as forest, grassland, shrubland or wetlands. They determined that in the Southeast 30% of urban/suburban natural areas in 1992 were patches of forest, grassland, shrubland or wetland, each 10-100 acres in size. Although not perfect, this approximate indicator for urban/suburban impervious area was used to formulate Target 4C.

Target 4C. Increase the percentage of urban/suburban natural area patches 10-100 acres in size in the Southeast to 35%.

•By 2012 increase the percentage of urban/suburban natural area patches 10-100 acres in size in the Southeast to 31%.

•By 2017 increase the percentage of urban/suburban natural area patches 10-100 acres in size in the Southeast to 32%.

•By 2022 increase the percentage of urban/suburban natural area patches 10-100 acres in size in the Southeast to 35%.

Objective 5: ***Establish, improve or maintain appropriate sediment flows***

In a watershed, some sediment is carried in suspension by flowing water from inland to coastal waters, while some is deposited on banks and channel beds, supporting and sustaining aquatic habitats and their ecological systems. Sediment can positively and negatively affect the size and health of wetlands, rivers, streams, lakes, reservoirs, and coastal areas. Increased sediment can raise costs of water purification and navigation channel maintenance as well as damage fisheries and aquatic habitat. It can also build or renew wetlands, banks and benthic areas. Sediment transport varies because of factors such as soil particle type and local geology, precipitation and runoff as well as barriers to flow due to channelization, roadways, dams and land-use-induced erosion. The challenge is to maintain or improve the balance of sediment flow within aquatic systems in a manner that sustains water resources and maintains or improves the health of the habitats and their populations of fish and other aquatic organisms. This multifaceted challenge includes the need to a) maintain or improve the balance of sediment transfer to support the waterbody's structure, habitats and their associated communities, and b) ensure sufficient sediment supply to nurture adjacent wetlands and coastal marshes, and offset subsidence and sea level rise while sustaining water resources for human use.

Targets

The magnitude of change for this objective could be measured by maintenance of or increase in the number of watersheds in the Southeast with a balance of sediment flows supporting healthy habitats with populations of fish and other aquatic organisms while meeting human needs. However, sediment needs vary from habitat to habitat, watershed to watershed. There is no regional norm. For example, White et al. (2002) concluded that upstream reservoirs have reduced sediment loads in the Trinity, Lavaca-Navidad, and Nueces river systems in Texas below those needed to maintain or improve the associated marshes and coastal areas. In some cases, the opposite is true within impounded areas. Reservoirs and small impoundments are especially susceptible to excessive sedimentation.

Determining a baseline to assess progress on this objective is equally difficult. On a nationwide basis The Heinz Center (2002) found in general that croplands most prone to water erosion decreased significantly from 30.3% in 1982 to 21.6% in 1997, but this measure does not address non-agricultural erosion that occurs along large rivers and stream banks. Under section 303(b) of the Clean Water Act, the regional offices of the EPA work with state water regulatory agencies to list impaired waterbodies and develop total maximum daily loads (TMDLs) for the contaminants (U.S. EPA 2007). TMDLs describe the amounts of a pollutant that a waterbody can receive and still meet water quality standards, and allocate loadings among point and nonpoint pollutant sources. Excess sediment can impair waterbodies. To establish a baseline for Targets 5A and 5B, SARP could work with data managed by EPA Regions 3, 4, 6, and 7 to identify those waters currently listed as impaired by excess sedimentation and in need of a load allocation strategy. Future targets and timelines for load reduction could be set in cooperation with EPA and state programs charged with implementing the load allocations.

Initially, the relationship of this objective with those on water quality, connectivity, and hydrologic condition, for which measurable targets have been proposed, can be used for indirect, qualitative assessment until baseline

data can be secured. Results from monitoring and assessing projects focusing on those objectives can, over time, provide some local and regional interim indicators that can be combined with emerging TMDL data. After 2010, development of additional data sources through the NFHI aquatic habitat assessment may provide other avenues to select targets. For this version of the Plan, Targets 5A and 5B are qualitatively described without specific milestones.

Target 5A. Reduce the number of stream miles impaired by excess sediment.

Target 5B. Rehabilitate estuarine or reservoir habitat where hydrological alteration has decreased sediment flows, resulting in aquatic habitat loss.

The portion of the Southeast where the lack of appropriate sediment transport is most profound and critical is the Louisiana coastal area. Since the 1930s, Louisiana has lost over 1.2 million acres (485,830 ha) of coastal wetlands (USACE 2004). In 2000 it was estimated this loss would continue at approximately 6,600 acres (2,672 ha) per year over the next 50 years. The Mississippi River transports a suspended sediment load of about 70 million cubic yards (5.4 million cubic meters) to its mouth each year. However, most of the material flows to deep waters of the Gulf of Mexico instead of being deposited on surrounding wetlands. The lack of sediment and nutrient input has reduced deposition rates to a point where they are not able to offset relative sea level change being caused by marsh subsidence and actual sea level rise. Besides its impact on local habitats, fisheries and economies, this sediment transport through one of the largest watersheds in the nation most likely is affecting a large portion of the habitats in the Southeast.

The USACE and the State of Louisiana have developed the Louisiana Coastal Area (LCA) Plan (USACE 2004) as a large scale effort to offset much of the projected future loss from this condition. The LCA Plan recommended five near-term critical restoration features for authorization. These were determined to address the most critical needs to offset losses projected to occur over the next 50 years if no action was taken. Target 5C is based on the LCA Plan. Three of the LCA Plan features specifically incorporate attempts to increase sedimentation rates into coastal wetlands through relatively large-scale diversions of river water and sediment. They seek large scale action at specific locations: the Hope Canal Diversion, the Bayou Lafourche Reintroduction, and the Myrtle Grove Diversion. Because the effects from achievement of these could have a significant effect on the achievement of this objective at the regional level while providing data and information about methods and problems related to sediment flow restoration projects, they are included as milestones for Target 5C. This target is based on the LCA Plan.

Target 5C. By 2050 offset approximately 62.5 percent (288,750 acres/116,853 ha) of the 462,000 acres (186,965 ha) of wetlands projected to be lost within the Louisiana Coastal Area if no action is taken.

- Achieve an annual sedimentation rate of at least 1,000 grams per square meter per year using the Hope Canal Diversion for a total benefit of restoring 36,000 acres of freshwater swamp by 2050.

- Achieve a net gain of 2,500 acres of coastal marsh through the Bayou Lafourche Reintroduction by 2050.
- Create/preserve 6,563 acres (2,656 ha) of coastal marsh through the Myrtle Grove Diversion by 2050.

The LCA Plan specifically incorporates attempts to increase sedimentation rates into coastal wetlands and through medium-scale diversions of river water and sediment. These include a 5,000 cubic foot per second

project and two smaller-scale projects. Because these three projects would have a moderately significant effect on achieving the overall LCA objective while providing data and information on methods and problems related to sediment flow restoration, they are incorporated into this Plan.

Objective 6. *Maintain and restore physical habitat in freshwater systems*

Physical habitats are the structural elements that make streams, rivers, lakes, reservoirs and wetlands suitable for aquatic species. Examples of physical habitat in southeastern waters include stream channel morphology, substrate composition (gravel, rocks, sediment, etc.), benthic contours of lakes and reservoirs, aquatic vegetation, shoreline vegetation, overhead canopy cover, and woody debris. Physical habitat plays an important role in healthy ecosystems, providing shelter, spawning sites, nursery areas, and foraging areas for fish and other aquatic animals. It also affects water quality and energy production. When physical habitat is changed by natural storm or flood events, aging and decomposition, or anthropogenic activities, the health of the waterbody may change suddenly, slowly, or sometimes in stages following a 'domino' effect. Not all changes are bad, but some activities such as draining wetlands or rerouting streams through pipes or channels can result in destruction of physical habitat. Of major importance has been the large-scale loss of wetland habitats such as forested large-river floodplain, oxbow, and backwater areas, coastal marsh and seagrass beds. The structural elements of many streams and rivers, degraded by an assortment of land use practices or natural events, can be improved using stream restoration techniques. In reservoirs, managers add new structure to offset the loss of the original woody debris, but it is difficult to add enough to maintain optimum fisheries. Reservoirs also tend to develop problems related to the presence or absence of aquatic vegetation due to water level fluctuations. The challenge is to prevent the destruction of physical habitat and promote its restoration and improvement in a manner that meets both ecological and human needs.

Targets

Achievement of this objective will be measured as a reduction in alterations of aquatic habitats, and as the total amount (miles, acres and numbers) of protected, restored and enhanced habitat. Sources of data to help in establishing such baselines may include but are not limited to the AFS Reservoir Committee, U.S. EPA procedures for calculating stream habitat metrics, the U.S. Army Corps of Engineers (USACE) and the National Wetlands Inventory (NWI). Historical data may also be helpful. Note that only those habitat characteristics that can be attributed to maintenance, restoration or establishment of one or more identified structural elements will be used to determine the magnitude of change.

As noted by The Heinz Center (2002), there is general agreement on key elements that should be measured to evaluate aquatic habitat quality, and work is underway by entities such as the EPA, USGS and the USACE to assimilate data and develop habitat quality indices. However, generally accepted methodologies for assessing data on either a local or regional basis are not yet available. Habitat values for particular systems must also take into account the habitat needs of the biota in those areas, so habitat indices need to be tailored to different communities, habitat types or areas. The FWS National Wetlands Inventory (NWI - http://www.fws.gov/nwi/) provides readily available data on wetlands nationwide. As of 2002, most of the wetlands data in the NWI were of 1980s vintage (FWS 2002), and it is not compiled regionally or by state. Hefner et al. (1994) provides the only regional compilation of wetland data for the Southeast, though these data do not correspond entirely to the Plan's area and were collected only through the 1980s. Development of additional data sources through the NFHI aquatic habitat assessment may provide additional avenues for development of targets following initial results of the assessment in 2010.

Target 6A. Reduction in acreage of freshwater wetlands drained or converted.

•By 2022 reduce the number of acres of altered freshwater wetlands drained or converted through development annually in the Southeast by 30%.

Target 6B. Reduction in number of stream miles destroyed or converted to unnatural or managed drainage systems

•By 2022 decrease miles of streams destroyed or converted by permitted construction into unnatural drainage systems annually in the Southeast by 30%.

SARP is working through the Southern Division of the American Fisheries Society Reservoir Committee to establish methods of tracking reservoir structural enhancements commonly installed by state fisheries professionals and local fishermen. Beginning in 2008, SARP partners will report all stream and river restoration or enhancement projects to measure accomplishments for achieving Targets 6C and 6D.

Target 6C. Increase number of lakes and reservoirs with adequate physical habitat structure.

•By 2022 improve the physical habitat for fisheries in an increased number of affected reservoirs and lakes in the Southeast.

Target 6D. Increase in the number of miles of streams with improved instream physical habitat.

•By 2022 improve the physical habitat of reaches in streams and rivers containing structural improvements in the Southeast. (This would not include downstream affected areas.)

Objective 7: ***Restore or improve the ecological balance in habitats negatively affected by nonindigenous invasive or problem species***

Habitats and diverse populations of biota thrive in balanced, interdependent, natural and human-created systems. Occasionally, the addition of one or more non-native species to biotic communities within a habitat can alter systems and degrade habitats. These changes in the biotic communities of habitats have altered water quality characteristics, energy, nutrient, and sediment flow, and species composition. In addition to the damage to natural resources, such habitat degradation often negatively affects food and water resources, recreation, and economics for people (ISAC, 2006; Pimentel et al 2005). The absence or overabundance of a species or functional guild, especially invasive species, parasites or pathogens, can be major causes of such changes or imbalance (Sarakinos, 1999). Pathogens can weaken or destroy whole populations. Invasive species, not native to the habitat, may have no natural enemies present to limit rapid population expansion. Their fecundity, early and rapid development, ability to thrive on available nutrition and tolerance of a broad range of conditions help them to out-compete, and often destroy native populations and disrupt interdependent systems (Williams & Meffe, 2005). Problem species can be introduced by natural occurrences such as storms and floods, and/or by human activities such as shipping, aquaculture, fishing, agriculture, horticulture, landscaping, exotic pet and aquarium trade, and stocking. Biota that improve the health of a system can be introduced in a similar manner. The objective is to encourage appropriate abundance of species or functional guilds within a watershed to establish or restore healthy ecological systems while supporting public use of resources. This will be achieved by controlling or preventing the introduction of new nonindigenous invasive or problem species.

Targets

Progress in meeting this objective will be assessed by using various state, regional, and national databases and management plans, as well as indices of population dynamics, aquatic community species composition, architecture function, and structure to identify problem species that threaten habitat health and establish baselines of habitat health in target watersheds. These changes may be expressed by an increase in the numbers of healthy essential species within a system, an increase in number or percentage of native animals or in acreage of native plants fitting unfilled niches, and/or a reduction in or eventual absence of populations of identified problem species within the target habitat. However, data on which to base such assessments are not yet available or compiled in a manner that can be readily analyzed, particularly for the SARP states as a whole. A suite of targets and strategies has been developed using available data. Development of additional data following initial results of the NFHI aquatic habitat assessment in 2010 may provide avenues for creation of more specific targets.

According to data from 1999 (Benson et al. 2001) for the FWS Southeast Region, the states in the FWS Southeast Region collectively reported, by individual state, a total of 564 nonindigenous aquatic species as having been introduced. However, some species are represented more than once in this total, as they have been introduced into more than one state. Based upon current (June 2007) data from the USGS Nonindigenous Aquatic Species (NAS) website (http://nas.er.usgs.gov/) for the 14 SARP states, comparable totals were 915 for the FWS Southeast Region states and 1,352 for the SARP states. Therefore, between 1999 and 2007 the numbers of introduced species increased in the FWS Southeast Region states by an average of 7.2% per year.

However, not all NAS that are introduced into a state become established and survive year to year, develop reproducing populations or cause problems. Those that do are the most problematic and are the ones referred to in the objective. Using the same data sources as described above, a total of 349 NAS were collectively reported by the FWS Southeast Region states, by individual state, as having become established in 1999. The 2007 comparable totals are 499 for the FWS Southeast Region states and 736 for the SARP states. Thus, between 1999 and 2007 the numbers of introduced species that had become established increased in the FWS Southeast Region states by an average of 5.3% per year. This figure was used as a proxy for the whole region when developing Target 7A since, at present, there is no regional baseline.

Target 7A. Reduce the average annual rate of increase for established NAS in states in the FWS Southeast Region to 3%.

•By 2012 reduce the average annual rate of increase for established NAS in states in the FWS Southeast Region to 5%.

•By 2017 reduce the average annual rate of increase for established NAS in states in the FWS Southeast Region to 4.5%.

•By 2022 reduce the average annual rate of increase for established NAS in states in the FWS Southeast Region to 3%.

Because some non-native species can cause habitat degradation while others may fill an unfilled niche or cause no apparent change to habitat health, additional targets might be set on the basis of certain watersheds or habitat types. These additional targets may be possible at a later date, when all of the SARP states have completed Aquatic Invasive Species Management Plans.

Objective 8: ***Conserve, restore, and create coastal estuarine and marine habitats***

The southeastern region's watersheds are critical to the biological productivity and sustainability of coastal estuaries and nearshore waters, and to the economic and sociological health of the coastal communities that depend on them. Actions taken to achieve Objectives 1 through 7 above will have direct and indirect impacts on the overall health of coastal habitats. In a very real way, management actions adopted upstream affect ecosystem health and community resilience along the coast.

As evidence of their value, vital estuarine and marine habitats in the Southeast have been identified as essential fish habitat for federally managed species by the South Atlantic Fishery Management Council, the Gulf of Mexico Fishery Management Council, and the National Marine Fisheries Service. These habitats, also considered important to fisheries managed by the Gulf States Marine Fisheries Commission and the Atlantic States Marine Fisheries Commission, provide food, cover, shelter, spawning sites and nursery areas for marine and estuarine fish and other species. Essential fish habitats in the Southeast include oyster reefs, seagrasses and other submerged aquatic vegetation, estuarine wetlands, mangroves, coral reefs, intertidal flats, estuarine and marine water column, and their underlying sand, mud, and shell bottom substrates.

Coastal habitats, especially in the Southeast, have suffered significant historic losses and degradation due to coastal development, erosion and subsidence, and upstream changes in watersheds. Without well-coordinated, ecosystem-based habitat protection and restoration, these coastal wetland systems will suffer irreparable losses. The challenge is to stop and reverse the loss and degradation of coastal and marine fish habitats in order to maintain fish populations in healthy ecosystems supported by healthy coastal habitats while meeting the needs of all sectors of the U.S. population.

Targets

Achievement of this objective will be measured by percentage of positive change to specific aquatic systems from a baseline condition. Ideally, targets for this objective would be expressed in terms of numbers of acres or percent increases in acreages of specific habitat types, such as oyster reefs, seagrasses, mangroves, and emergent wetlands. Although data on the extent of such areas on a regional basis are incomplete or not compiled in a manner to allow efficient and timely analyses, the EPA has evaluated all estuarine areas on a regional basis nationwide and assigned condition ratings using a standardized format that has been utilized in three coastal condition reports (USEPA 2001, 2004, 2006). These data have been utilized in developing several targets for this objective.

The National Coastal Condition Report II (NCCR II) (USEPA 2004) utilized data from the EPA's National Coastal Assessment (NCA), which gathers data on biota and environmental stressors; NOAA's National Standards and Trends Program, which utilizes site-specific data on toxic contaminants and their ecological effects; and the Fish and Wildlife Service's National Wetlands inventory (NWI), which provides information on the status of the nation's wetlands. In the NCCR II, five primary indices were developed using these data sources for (1) water quality, (2) sediment quality, (3) benthic habitat quality, (4) coastal wetlands and (5) fish tissue contaminants. Although these indices do not address all characteristics of estuaries and coastal waters, they do provide information on ecological conditions. Characterizing coastal conditions was a two-step process. The first step was to assess conditions at individual sites for each indicator. In the second step a regional rating for each indicator using a scale of five (1= poor, 2-4 = fair, 5 = good) was determined, based on the percentage of the area of each region in a given condition. The mean of the indices for the five indicators was then calculated to yield an overall condition index for each region. Using these indices, the NCCR II found that the overall condition for the Southeast Coast estuaries (North Carolina, South Carolina, Georgia and east

Florida coasts) was 3.8, and for the Gulf Coast estuaries, 2.4. Although the more recent National Estuary Program Coastal Condition Report (USEPA 2006) also assessed estuarine condition for these same regions using this process, only four of the five indicators were used. For this reason, the data from the NCCR II were used in developing Target 8A.

Target 8A. Increase the overall coastal condition indices for the Southeast Coast and Gulf Coast to 4.2 and 2.8, respectively.

•By 2012 increase the overall coastal condition indices for the Southeast coast and the Gulf coast to 3.9 and 2.5, respectively.

•By 2017 increase the overall coastal condition indices for the Southeast coast and the Gulf coast to 4.0 and 2.6, respectively.

•By 2022 increase the overall coastal condition indices for the Southeast coast and the Gulf coast to 4.2 and 2.8, respectively.

Targets 8B-8F are related to target 8A, but are identified for use in monitoring specific project performance.

The NCCR II found that 5% of the Southeast coast estuaries and 9% of the Gulf coast estuarine areas were in poor condition with respect to water quality. The water quality index was determined using dissolved oxygen, chlorophyll *a*, nitrogen, and phosphorus concentrations and water clarity as indicators. The Gulf coastal area that was rated did not include the large, seasonal hypoxic zone offshore of the Louisiana coast. These indices were used in developing Target 8B.

Target 8B. Reduce the percentage of Southeast coast and Gulf coast estuarine areas rated as being in poor condition with respect to water quality to 4% and 5%, respectively.

•By 2012 maintain the percentage of the Southeast Coast and reduce the percentage of Gulf Coast estuarine areas rated as being in poor condition with respect to water quality at/to 5% and 8%, respectively.

•By 2017 maintain the percentage of the Southeast Coast and reduce the percentage of Gulf Coast estuarine areas rated as being in poor condition with respect to water quality at/to 5% and 7%, respectively.

•By 2022 reduce the percentage of the Southeast Coast and Gulf Coast estuarine areas rated as being in poor condition with respect to water quality to 4% and 5%, respectively.

The NCCR II found that 8% of the Southeast coast estuaries and 12% of the Gulf coast estuarine areas were in poor condition with respect to sediment quality. The sediment quality index was determined using sediment toxicity, sediment contaminants, and sediment total organic carbon as indicators. These indices were used in developing Target 8C.

Target 8C. Reduce the percentage of Southeast Coast and Gulf Coast estuarine areas rated as being in poor condition with respect to sediment quality to 5% and 9%, respectively.

•By 2012 maintain the percentage of Southeast and Gulf Coast estuarine areas rated as being in poor condition with respect to sediment quality at 8% and 12%, respectively.

•By 2017 reduce the percentage of the Southeast and Gulf Coast estuarine areas rated as being in poor condition with respect to sediment quality to 7% and 11%, respectively.

•By 2022 reduce the percentage of the Southeast and Gulf Coast estuarine areas rated as being in poor condition with respect to sediment quality to 5% and 9%, respectively.

The NCCR II found that 11% of the Southeast coast estuaries and 17% of the Gulf coast estuarine areas were in poor condition with respect to benthic habitat quality. The benthic habitat quality index was determined using measures of benthic community diversity, the presence and abundance of pollution-tolerant species, and the presence and abundance of pollution-sensitive species. These indices were used in developing Target 8D.

Target 8D. Reduce the percentage of Southeast Coast and Gulf Coast estuarine areas rated as being in poor condition with respect to benthic habitat quality to 8% and 14%, respectively.

•By 2012 reduce the percentage of Southeast and Gulf Coast estuarine areas rated as being in poor condition with respect to benthic habitat quality to 10% and 16%, respectively.

•By 2017 reduce the percentage of Southeast and Gulf Coast estuarine areas rated as being in poor condition with respect to benthic habitat quality to 9% and 15%, respectively.

•By 2022 reduce the percentage of Southeast and Gulf Coast estuarine areas rated as being in poor condition with respect to benthic habitat quality to 8% and 14%, respectively.

The NCCR II found that indices for coastal wetland loss in the Southeast coast and Gulf coast estuarine areas were 1.06 and 1.30, respectively. These indices were calculated as the average of the mean long-term, decadal wetland loss (1780–1990) and the present decadal (1990–2000) wetland loss rate. These indices were used in developing Target 8E.

Target 8E. Reduce the wetland loss indices for the Southeast Coast and Gulf Coast estuarine areas, to 1.03 and 1.28, respectively.

•By 2012 reduce the wetland loss indices for the Southeast and Gulf coast estuarine areas to 1.05 and 1.29, respectively.

•By 2022 reduce the wetland loss indices for the Southeast and Gulf coast estuarine areas to 1.03 and 1.28, respectively.

The NCCR II found that 5% of the Southeast coast estuaries and 14% of the Gulf coast estuarine areas were in poor condition with respect to fish tissue contaminants. These indices were based on whole fish contaminants analyses and were used in developing Target 8F. Note that fish tissue contamination due to mercury is excluded from Target 8F as the element's presence is widespread and its sources range from historical to natural

(including atmospheric deposition from inside and outside the focus area), and control is not currently included through any of the Clean Water Act programs.

Target 8F. Reduce the percentage of Southeast Coast and Gulf Coast estuarine areas rated as being in poor condition with respect to fish tissue contaminants to 4% and 11%, respectively.

•By 2012 maintain the percentage of the Southeast Coast and reduce the percentage of Gulf Coast estuarine areas rated as being in poor condition with respect to fish tissue contaminants at/to 5% and 13%, respectively.

•By 2017 maintain the percentage of the Southeast Coast and reduce the percentage of Gulf Coast estuarine areas rated as being in poor condition with respect to fish tissue contaminants at/to 5% and 12%, respectively.

•By 2022 reduce the percentage of the Southeast Coast and Gulf Coast estuarine areas rated as being in poor condition with respect to fish tissue contaminants to 4% and 11%, respectively.

A combination of these available data can be used to set regional targets that focus on specific wildlife or plants common to the Southeast coasts that respond rapidly, directly and similarly to environmental changes and support habitat health and human needs. Target 8G is an example.

Target 8G. Reduce the percentage of closures of Southeast Coast and Gulf Coast oyster reefs due to contamination of water/tissues to 3% and 11%, respectively

•By 2012 maintain the percentage of closures of oyster reefs due to contaminated water/tissues in the Southeast Coast and Gulf Coast to 5% and 13%, respectively

•By 2017 maintain the percentage of closures of oyster reefs due to contaminated water/tissues in the Southeast Coast and Gulf Coast to 4% and 12%, respectively

•By 2022 maintain the percentage of closures of oyster reefs due to contaminated water/tissues in the Southeast Coast and Gulf Coast to 3% and 11%, respectively.

Data on coastal conditions from many studies may be used to set regional targets as well. Survey data by USGS shows coastal erosion effects in every state. Long-term loss rates range from three to over 60 feet annually. In *Our Living Resources,* a report to the nation on the distribution, abundance, and health of U.S. plants, animals and ecosystems (LaRoe et al, 1995), coastal erosion was classified as severely eroding, moderately eroding or relatively stable. Approximately 40% of the southeast region's shorelines were classified as severely eroding, and only 20% as relatively stable. Target 8H utilizes this baseline.

Target 8H. Prevent additional coastal erosion along 10% of coastlines classified as "severely eroding by 2050.

There are many data resources that can be used on the project level to achieve Objective 8. For example, the USGS' and USEPA's *Seagrass Status and Trends in the Northern Gulf of Mexico: 1940-2002* (Handley et al. 2007), provides an update to their 1995 status and trends report. The World summit on sustainable

development committed to reverse the trend of seagrass losses by 2010. Seagrass is valuable fisheries habitat, and some regional states have taken action on this issue. Similarly, an action plan for reducing, mitigating, and controlling hypoxia in the Northern Gulf of Mexico has been developed by the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force.

Where in the Southeast will this Plan be implemented?

Plan Prioritization

The eight objectives in Section 2 of this Plan define the conditions to be addressed through the implementation of the Plan. Because of the size and variety of habitats in the southeastern region, these objectives can guide restoration projects in many areas simultaneously with a broad range of outcomes. However, to most effectively use limited resources to reverse current trends and conserve the region's aquatic habitats, geographic priorities must be set. Careful, periodic selection is required for this Plan's landscape approach to maximize the direct outcomes of every project and sustain the effects at the watershed and regional levels.

In the long term, GIS analysis, incorporating data that are only partially available at the present time, will be used to identify and prioritize aquatic habitats where conservation and restoration actions are most needed and, hopefully, will have the greatest opportunity for local and regional success. In the short term, a less comprehensive prioritization method will provide geographic guidance.

Long-term

The implementation of the National Fish Habitat Science and Data Committee's assessment tool will eventually allow a standardized approach for prioritizing aquatic habitat conservation and restoration projects nationwide. As noted in the Committee's draft science and data report of December 2006, *A Framework for Assessing the Nation's Fish Habitat* (NFHISDC 2006), projects "should be prioritized in the following order: 1) protection of fully functioning aquatic systems to include those that are "untouched" to those that have "manipulated," but fully working aquatic processes; 2) rehabilitation of aquatic systems that have only a minor number of problems that impair one or more of the key processes that sustain them; 3) rehabilitation of aquatic systems that have a number of problems impairing one or more of the key processes; and 4) re-engineering modified systems to improve them for fisheries and aquatic production" (NFHI SDC, p.7). SARP is working directly with the Committee to coordinate the aquatic habitat condition assessment for the southeastern U.S.; and this assessment will enable SARP to enrich its GIS analysis, as described above, and refine its geographic priorities.

Because healthy habitats also affect the ecology, economy and sociology of human communities in the region, data on economic and social elements in the region will also be considered, when available, for objective analysis; consistent with the Plan's goal for restoration undertaken "for the benefit of all in the southeastern region and the entire U.S."

Interim

The need to stem the decline in fisheries habitats throughout the SARP states is urgent. Rather than wait until 2010 to begin this vital work, the year that the aquatic habitat condition assessments are scheduled for completion, SARP is developing a geo-referenced database populated with currently available aquatic system condition data to provide interim geographic priorities for the Plan. This prioritization process – to be used by SARP until the aforementioned condition assessments and an operational priorities database are in place – has

been developed by using available science-based resources in conformance with the Plan's guiding principles. It provides a less-than-perfect, but acceptable and immediately useful, graphic depiction of the Southeast's most at-risk geographic areas, as identified by one or more of four existing and reliable sources. These sources are:

1. Information on priority geographies from the State Wildlife Action Plans (SWAPs), wherein individual states have identified **priority habitats and habitats supporting species with the greatest conservation needs**. These data have been consolidated by SARP during the development of this Plan.

2. Information on priority watersheds from a 2006 USGS workshop, wherein recognized experts ranked and prioritized by **extant rareness of species and species richness** those southeastern watersheds most in need of protection and restoration. The process involved expert focus on critical areas in the Southeast. Rivers and drainages with the highest number of imperiled and/or at risk species (according to NatureServe), federally listed threatened and endangered species for each faunal group (fishes, crayfishes, mussels, snails, amphibians, turtles), and total richness of each major group were confirmed. Using this information and a set of agreed upon criteria, the workshop developed a list of the top freshwater biodiversity watersheds in the Southeast and the three highest priority watersheds for each state. (NatureServe represents an international network of biological inventories known as natural heritage programs or conservation centers. The objective scientific information about species and ecosystems developed by NatureServe is used by all sectors of the biological scientific community. Data are online at http://services.natureserve.org.)

3. Information on **freshwater, recreational fisheries, and identification of the specific waterbodies** supporting these fisheries, that would benefit the most from habitat enhancement, restoration or conservation activities has been provided by each SARP member state's fisheries management agency.

4. Information on the Southeast's most important estuarine and coastal habitats was also gathered. Each SARP member state with a coastline provided the names and locations of their **most important estuarine and coastal habitats** that could benefit the most from habitat restoration and conservation.

How can SARP facilitate and implement this Plan?

This Plan aims to conserve, protect and restore freshwater, estuarine, and marine habitats in the southeast region to preserve and restore healthy and diverse aquatic resources. Because habitat health depends upon the integration of geographical, geological, biological, sociological and economic systems, recovering and conserving aquatic habitats and communities is biologically complex and sociologically difficult. Watersheds are nested and cross political boundaries; lakes, reservoirs, rivers and estuaries are connected throughout the region. Therefore conservation strategies to accomplish the Plan's aims will be applied on multiple levels.

Habitat restoration, preservation or maintenance in a given geographic area will involve assessing the aquatic habitat's strengths and weaknesses, analyzing threats or problems, formulating partnership-driven action based upon the Plan's overall objectives, completing identified tasks, as well as monitoring and evaluating outputs at the project level and objectives at the Plan's regional level. Although implementation strategies will vary by conditions and time, all projects will utilize best management practices and the best available science of the time.

Science-based conservation strategies responding to causal effects addressed in the Plan's eight objectives are well known among aquatic habitat conservation leaders. These will be applied appropriately to achieve objectives and targets on a project level. As noted in Section 2, the targets will be redefined by new baseline data from research and lessons from individual projects. Through adaptive management, conservation strategies and actions on multiple levels will follow.

Conservation Strategies and Actions – SARP's Role

Although the individual members of SARP will be engaged in local conservation and restoration projects in partnership with other entities, effective implementation of the Plan depends upon SARP's collective management and facilitation at an integrated systems level as well. In this unique role, SARP must initiate, coordinate and lead partnership-driven actions toward the regional achievement of the Plan's goal and objectives.

The objectives and targets in the Plan were selected on the basis of SARP's earlier research in selected river basins, scientific literature, and reported conditions in the SARP states. A review of the SARP member states' SWAP identified common problems and strategies shared by the states in the region. SARP and stakeholders representing diverse habitat conservation and restoration experiences and expertise met and discussed conservation strategies, objectives and outputs. As the basis for these stakeholder discussions, a synthesis of the strategies and actions identified from SWAPs revealed six commonly applied strategic approaches that cross all levels: (1) information collection and distribution, (2) capacity building, (3) law and policy, (4) habitat acquisition, (5) commercial incentives, and (6) habitat management and restoration. The stakeholders advised that two of these strategies, commercial incentives and habitat acquisition, are most often applied on a local (i.e., project) level rather than on the broader, coordination level envisaged as SARP's role in the management and facilitation of this Plan. Therefore these two strategies have been incorporated into one or more of the other strategic approaches as they apply on the integrated systems level of Plan implementation. The strategy of commercial incentives has been incorporated primarily into Integrated Conservation Strategy 2 (capacity

building), and the strategy of habitat acquisition into Integrated Conservation Strategies 1 (information collection and distribution) and 4 (law and policy).

The description of each integrated conservation strategy below includes a number of specific actions that SARP and other landscape-level conservation groups can undertake to achieve the goal and objectives of this Plan. These actions, formed by input from stakeholders during Plan development, should be viewed as prospective and contingent on sufficient funds and staff resources, either corporate or through partners. Although actions for SARP are identified for some of the integrated conservation strategies, they are not otherwise prioritized. They are numbered only for convenience. Also, the actions are neither definitive nor inclusive of all actions that SARP and its partners might do, over time, to support the Plan and its implementing partnerships. Rather, they illustrate the forms of integration, management and facilitation that are considered necessary at this point in time. This Plan should be viewed as a work in progress, and specific tasks being undertaken or initiated at any point will, in all likelihood, change in response to environmental, fiscal, and system-level factors, many of which currently cannot be known or predicted.

Integrated Conservation Strategy 1: ***Information collection and dispersal***

Through the collection, availability and use of information, SARP can facilitate habitat conservation, restoration and maintenance in several important ways:

Data collection. Verified current and historical data about an area is used in research, and in planning project activities, monitoring projects and post project evaluation to determine the efficacy of achieving the Plan's goal and objectives. By facilitating information collection, developing guidelines to increase data integration, establishing archives, and making information accessible, SARP and its aquatic habitat partners can help project planners secure and integrate scientific data from educational institutions, federal and state databases and archives, as well as private and corporate records. In this way, SARP can enhance GIS analysis and various types of modeling. Such well organized and easily accessed data facilitates multiple-scale habitat planning and coordination. In addition, information about specific habitat conservation and restoration techniques facilitates regional consistency in their application and leads to a more effective use of tools, people, and funding while increasing compatibility between individual projects.

Information distribution. Broadly distributed information provides the basis for public support of a habitat project's actions – from land acquisition to limited use – and public enthusiasm for the general concept of habitat conservation. Information distribution is also an educational strategy. Individuals, corporate officers, and public officials can learn about and participate in a range of activities from planning active restoration of a habitat to applying project guidelines to policymaking. School curricula can evolve from project success stories, as well as from guidelines for particular restoration processes.

The following actions will be ***undertaken by the SARP Steering Committee*** in the first year to implement **ICS 1:**

> **ICS Action 1A.** Establish a Science and Data Committee to identify existing information and data gaps associated with the freshwater, estuarine, and marine aquatic habitat types in the Southeast for purposes of Plan implementation. Thereafter, this SARP committee will encourage data collection, and broad distribution and integrated use through ICS action items 1C and 1D to achieve the Plan's objectives.

ICS Action 1B. Establish an Education and Outreach Committee to distribute and explain this Plan broadly among elected officials at all levels, government agency managers, NGOs, industry, stakeholders and the public throughout the Southeast. Thereafter, this SARP committee will integrate information distribution with efforts of project partners to accomplish ICS action items 1E, 1F, and 1G (below).

The following action items will be ***undertaken by the SARP Steering Committee, its committees and partners*** to implement **ICS1**:

ICS Action 1C. Develop an Internet web site to serve as a portal for a variety of information and databases on aquatic habitat conservation in the Southeast, to encourage data sharing among partners, and to inform and educate stakeholders.

ICS Action 1D. Support the National Fish Habitat Science and Data Committee in developing science-based tools for on-going assessment of fish habitats nationwide through the coordinated development of a process to better assess fish habitat conditions in the Southeast.

ICS Action 1E. Identify guidelines and guideline sources where needed, on specific aquatic habitat management tools and practices such as stream corridor restoration, fee-title land acquisition, easements, project permitting and monitoring.

ICS Action 1F. Develop educational and outreach tools for specific purposes such as facilitating establishment of conservation easements, or sharing and coordinating best management practices (BMP) in accomplishing aquatic habitat conservation in the Southeast.

ICS Action 1G. Develop general outreach and education tools to be used throughout the region regarding the protection of watersheds, importance of aquatic habitats, and methods for their protection and restoration.

The following action will be ***undertaken by the SARP Aquatic Habitat Plan Committee*** to implement **ICS1**:

ICS Action 1H. Assess progress at five-year intervals, using available information as identified in each objective's targets in the Plan, and report to agency and elected officials, partners, stakeholders and the public. This action will be supported by the Education and Outreach Committee and the Science and Data Committee, both created in the Plan's first year.

Integrated Conservation Strategy 2: *Capacity building*

Habitat conservation, maintenance and restoration projects require tactical alliances among public and private stakeholder groups, solid leadership and adequate funding. By building alliances, encouraging leadership and seeking funding, SARP can facilitate capacity building in the following ways:

Alliances. To build alliances, SARP will facilitate recruitment of new, project-specific partners by integrating groups with specific jurisdictional responsibilities (e.g., states, the EPA, U.S. Army Corps of Engineers and Natural Resource Conservation Service) with local landowners, municipal and county officials, and a variety of NGOs of all sizes, especially those with a Plan-related purpose.

Leadership. Responsible leadership doesn't just happen. A major part of SARP's strategic capacity building aims to identify and support (with funds and information) responsible leadership among project partners. Coordination and integration of these individuals builds leadership capacity. As one project leads to and/or affects another, good leaders can see such connections and, with support, integrate activities to make best use of available dollars and labor.

Funding. Restoration capacity depends heavily on available funds. Identification of funding resources includes encouraging use of federal incentives and stimulating private, state and local incentives. With SARP's coordination, it will be possible to leverage existing funds on a broad basis and possibly to integrate commercial with environmental goals. Sometimes bringing various groups to one table can create the resources needed for a project.

SARP itself is a strong partnership, and its members can contribute leadership, funding capacity, and in-kind resources for various habitat restoration projects and their coordination. Importantly, SARP and the Plan's stakeholders collectively understand that the specific actions needed to successfully support capacity building must be persistent and ongoing.

The following actions will be ***undertaken by the SARP Steering Committee*** to implement **ICS 2:**

ICS Action 2A. Maintain close coordination with existing partnerships, initiatives, and organizations (such as, but not limited to, the Upper and Lower Mississippi River Conservation Committees, the Gulf of Mexico Program, National Estuary Programs, Restore America's Estuaries, the Gulf of Mexico Alliance, the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, Chesapeake Bay Program, the Comprehensive Everglades Restoration Plan, migratory bird joint ventures, and all NFHAP-recognized partnerships) and identify new groups focused on specific aquatic habitat issues or southeastern geographic areas.

ICS Action 2B. Support the development and efforts of NFHAP implementation units in the Southeast to encourage participation by diverse partners, including groups that have not been directly involved with SARP in the past.

ICS Action 2C. Continue coordination with individual southeastern states, the Southeastern Association of Fish and Wildlife Agencies (SEAFWA) and other partners to assure that aquatic habitat conservation efforts are consistent and coordinated with each state's CWCS (SWAP).

ICS Action 2D. Serve as a catalyst to coalesce NGOs, professional societies and fisheries groups to develop projects, secure funding and build partnerships for aquatic habitat conservation in the Southeast.

ICS Action 2E. Develop and share tools to facilitate partner capacity building, such as templates for memoranda of agreement, grant proposals, bylaws, and operational procedures.

ICS Action 2F: Support and encourage opportunities for communication and coordination among leaders of implementation units to maximize outcomes of aquatic habitat conservation projects.

ICS Action 2G. Serve as a clearinghouse for public and private funding sources for aquatic habitat restoration and conservation.

ICS Action 2H. Work with state, regional, corporate and private partners to facilitate development of economic and other incentives for aquatic habitat restoration.

ICS Action 2J. Stimulate an increase in the level of funding for fish habitat conservation efforts throughout the Southeast from federal, state, and private sources using all appropriate approaches, including initiatives seeking public funds in order to leverage corporate and other private sources.

ICS Action 2K. Stimulate cooperative and integrated use of existing resources, especially habitat conservation funding programs by federal, state, tribal and local agencies, NGOs, landowners, and other stakeholders towards achieving the Plan's objectives.

Integrated Conservation Strategy 3: ***Management and restoration***

Multiple-scale coordination and integration of Plan and project objectives are necessary roles for SARP. Because changes made in one part of a watershed often affect other portions, regional integration on a higher level maximizes the effectiveness of all conservation efforts.

Thus, besides coordinating partnership-driven aquatic habitat restoration projects – which represent joint ventures on many different scales – SARP will take the lead in supporting and enhancing regional habitat management activities wherein all southeastern states can plan and participate together in the compatible uses of resources, integrating activities to protect threatened and endangered species, and control and prevent domination by invasive and problem species. Central to this process, regional priorities will be explored and agreed upon and various project approaches – such as integration by problem, objective, or habitat – investigated so as to maximize available leadership and resources.

The following actions will be ***undertaken by the SARP Steering Committee*** to implement **ICS 3:**

ICS Action 3A. In the first year, identify priority areas and habitats to best achieve the Plan's objectives, sharing conclusions with other aquatic habitat partnerships, organizations and programs throughout the Southeast to encourage compatibility in resource management decisions. Thereafter, the Science and Data Committee will use best available information to review and revise these priorities.

ICS Action 3B. In the first year, develop project prioritization and selection guidelines for specific projects to be implemented with funding from NFHI or similar initiatives or programs in which SARP is a direct participant or serving as a grantor. Thereafter, these guidelines will be revised by adaptive management.

ICS Action 3C. Continue to support SARP states, and the Gulf & South Atlantic and the Mississippi River Basin regional ANS panels in the development and implementation of state and regional ANS management plans. In conjunction with those plans, facilitate integration of early detection and rapid response plans and coordination of management activities to address the issues associated with invasive or problem species affecting watersheds of the Southeast.

ICS Action 3D. Coordinate the development and implementation of uniform standards for mitigating damages to wetlands and other aquatic habitats across the Southeast.

ICS Action 3E. Develop a comprehensive regional approach to reservoir habitat management, restoration, and enhancement.

ICS Action 3F. Facilitate implementation of appropriate activities to address the problematic habitat structure issues affecting watersheds of the Southeast.

ICS Action 3G. Collaborate with other fish habitat partnerships, state, federal, tribal and local agencies, NGOs, and other natural resource partnerships to protect through fee title acquisition, easement, or other arrangements the high quality freshwater, estuarine, and marine aquatic habitats in the Southeast.

The following actions will be ***undertaken by the SARP Education and Outreach Committee*** to implement **ICS 3**:

ICS Action 3H. Encourage use of quality, 'smart' or sustainable growth standards in local and regional land use planning and regulations associated with aquatic habitats.

ICS Action 3J. Facilitate the development and use of standardized aquatic habitat restoration best management practices (BMPs) in projects, including use in requests for proposals, restoration and management activities, and project evaluation criteria.

The following actions will be ***undertaken by the SARP Science and Data Committee*** to implement **ICS3:**

ICS Action 3K. Encourage and facilitate integration of relevant data from state and federal water quality agencies, NGOs and grassroots watershed organizations in the Southeast to address the problematic water quality issues affecting watersheds in the Southeast.

ICS Action 3L. Encourage and facilitate integration of relevant data from state, regional and federal groups concerning identification, introduction, and control of invasive species in the region.

Integrated Conservation Strategy 4: *Law and policy*

Although laws and policy to protect aquatic habitats in the Southeast exist on federal, state and local levels, they are neither universally compatible nor universally applied. Some are enforced throughout the region; others are enforced only in certain areas or under certain conditions. These differences can reduce the effectiveness of landscape-level habitat conservation and restoration throughout a watershed or the region.

Sometimes interjurisdictional overlaps or differences are not noticed until attention is brought when initiating a project or through litigation. Through education on law and policy, such differences could be accommodated early on, prior to implementation of a joint venture. For example, a universal understanding of land use and zoning ordinances throughout a watershed or the region would be an appropriate step in coordinating projects located in several different areas addressing the same problem or focusing on the same watershed. Likewise, support for coordination of instream-flow policies would ensure watershed or regional conservation outcomes and facilitate monitoring activities.

When necessary, tools such as cooperative agreements can be developed to integrate state and local policies, facilitating acceptance and perhaps even universal standards. In addition, policy-related procedures or new

legislation can maximize aquatic habitat restoration outcomes. For example, land acquisition may be a necessary part of certain conservation or restoration projects. A streamlined, regionally agreed-upon process for aquatic habitat-related land acquisition or easement acquisition would be an important step in securing broad support and cooperation in a watershed or the region.

SARP's role under the law and policy integrated conservation strategy is to gather and make available relevant data, tools and protocols that can be used by appropriate government bodies to enact or change legislation and policy. SARP does not advocate specific changes in law and policy. It coordinates and shares information about existing laws and policies (and gaps in them) so that appropriate government bodies can enable aquatic habitat protection, conservation and restoration to meet the Plan's objectives.

The following actions will be ***undertaken by the SARP Steering Committee*** to implement **ICS 4**:

> **ICS Action 4A.** In the first three years, work with the Instream Flow Council, state water agencies, state legislators and conservation NGOs to develop adequately staffed instream flow programs in each of the southeastern states and a network to integrate stream flow and mitigation standards in the region. This process will create a procedural template for additional law and policy actions to meet the Plan's objectives.
>
> **ICS Action 4B.** Opportunistically, develop tools, guidelines and protocols to facilitate law and policy focusing on uniform regional water quality standards, TMDLs for sediment and stormwater issues, and the habitat needs of at-risk aquatic species.
>
> **ICS Action 4C.** Using the procedural template from action item 4A, identify and convene as needed networks of experts to assist in developing region- or watershed-wide policies or legislation to facilitate coordinated projects to achieve the Plan's objectives.

The following action will be ***undertaken by the SARP Education and Outreach Committee*** to implement **ICS 4:**

> **ICS Action 4D.** Support workshops for user groups such as city and county planners, describing laws, policies, potential conflicts, jurisdictional overlaps and information gaps relevant to aquatic resources and habitats.

How can SARP and project partners measure success?

Monitoring Habitat Conservation and Recovery

This Plan suggests the pathway to conserve and restore the inland, coastal and estuarine habitats of the 14 member states of the Southeast Aquatic Resources Partnership (SARP). As SARP facilitates and manages the implementation of the Plan, it is vital to understand and document the Plan's conservation and restoration performance and, in view of that performance, adapt the Plan's program and project approaches to improve future conservation and restoration practices and projects.

Monitoring will contribute to an understanding of the complex ecological systems within which the Plan's conservation and restoration projects are implemented, and result in identifying habitat improvement. It can warn of environmental decline, establish a record of conditions or trends, and identify gaps in existing scientific knowledge. It will also provide the basis for a rigorous review of habitat project planning and implementation to determine whether project results are being achieved and if mid-course corrections are necessary. This will allow for design improvements in future projects, provide tools for planning additional habitat management strategies, and provide essential information on whether project results are good measures for anticipating progress on Plan objectives.

The Plan's monitoring approach has a two-tier structure that corresponds to program-level performance measurement of the Plan's objectives at ecosystem and regional scales and, at local scales, project-level monitoring of the performance of specific projects against their purposes and objectives.

Tier 1 – Monitoring the Plan's performance

Because the resource targets in the current version of the Plan rely on existing databases and analyses as described under each objective, program-level monitoring under Tier 1 will use those databases and analyses as further developed in future years. Certain limitations will be inherent in this monitoring approach because these databases and analyses are managed independent of SARP. Where possible, SARP will attempt to secure and use the underlying data from these sources to independently develop assessments of progress in cases where analysis or assessment may not be completed by the source organization.

SARP has begun development of GIS-referenced analysis tools that will allow it to conduct regional aquatic habitat condition assessments using methodology described by the NFHAP Science and Data report. The first phase of this project, focused on the Tennessee-Cumberland watershed, will yield a GIS-referenced database that can eventually be developed for Tier 1 analysis. SARP's long-term plan, as funds can be secured, is to collect and analyze data and conduct habitat condition assessments for all major watersheds in the region in a manner compatible with the NFHAP. GIS analysis of various combinations of these data can provide graphic description to better assess achievement of the objectives' targets as well as assist in future habitat restoration project planning and prioritization. The tool(s) will be compatible with the NFHAP National Habitat Condition Assessments.

When fully developed, such tools can be used for effectively monitoring and evaluating aquatic habitat health in the Southeast. Once sufficient data have been developed, compatible data set formats identified and NFHAP National Habitat Condition Assessments are available, the status and trends of the aquatic habitats in the region will be assessed at the Tier 1 level every five years. A variety of data can be used, based upon the targets identified for the objectives. For NFHI projects, these evaluations will be guided by the NFHAP condition assessment processes and protocols. Conditions in SARP's priority watersheds will be examined in particular detail, and compared to Plan targets and conditions generally throughout the SARP states as an indicator of the effectiveness of the Plan's efforts at ecosystem and regional scales.

Tier 2 – Monitoring project performance

Through the Plan, large-scale habitat conservation and restoration in the SARP states will be achieved by managing aquatic habitat projects implemented through new and existing partnerships, and facilitating project funding. However, many, if not all, of these projects will be completed at local, project level (i.e., watershed, sub-watershed and municipal) scales. While monitoring at the input and output levels for project management purposes is expected, monitoring those Plan objectives associated with the project is also necessary. The former provides SARP and project managers with information on whether the project is doing what it promised to do; and the latter gives information on whether or not the project is contributing to achievement of the Plan's objectives.

To ensure that data is accumulated on these scales, every project proposal will be required to include a monitoring plan. An example will be provided in the request for proposals. The data gathered in this process can then be in forms that can be analyzed on several levels, such as written reports, photographic documentation, information on survival rates or anticipated life spans of physical and biological changes, and hydrologic data. It is expected that monitoring efforts will be periodic in the first year and annually thereafter. This type of monitoring plan can improve the project's success by including contingency measures specifying remediation procedures to be followed if success criteria or scheduled performance criteria are not fully satisfied. Adaptive management activities can then be used to adjust to unforeseen or changing circumstances.

Sharing monitoring data and analyses

To be useful, monitoring findings, conclusions and "lessons learned" have to be shared. Information resulting from a well-designed and conducted monitoring program supports the timely and successful management of on-going habitat conservation and restoration projects, and the success of the Plan itself. Project and Plan managers can use results in adaptive management to make mid-course corrections in specific project features. Additionally, monitoring information regarding the performance of both a project overall and its constituent features is highly useful to individuals designing current and future projects with similar features and goals or in similar habitats. Monitoring data, results analysis, and a discussion of lessons learned will be made available by SARP in many ways, especially on the SARP web site.

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Algae – A variety of single-celled to complex multicellular plants that are common in aquatic ecosystems.

Amphibian – A class of cold-blooded vertebrate, such as a frog or salamander, with gilled aquatic larvae (e.g. tadpole) that develop air-breathing lungs as an adult (e.g. frog).

Anadromous – A type of migration in which adult fish spend their lives at sea and return to freshwater to spawn.

Anthropogenic – Effects, processes, objects, or materials derived from human activities.

Aquatic – Growing, living in, or frequenting water. Taking place in or on water.

Aquatic habitats – All bodies of flowing and standing water such as streams, rivers, reservoirs, lakes and ponds; estuarine, palustrine, lacustrine and forested wetlands; riparian areas along streams, rivers, lakes and reservoirs; karsts; coastal freshwater dune swales; coral reefs, oyster reefs, sand and algal flats.

Aquifer – An underground layer of water-bearing permeable rock or unconsolidated materials such as gravel, sand, silt or clay from which water can be usefully extracted.

Armored Shoreline – Areas along a waterbody where the land has been structurally reinforced.

At risk – A description of populations that are likely to become severely reduced or extinct due to imminent threats.

Backwater – A waterbody created by a flood or tide or by being held or forced back by a dam.

Benthic; benthonic – On the bottom, under a body of water.

Benthos – Organisms and habitats under a body of water, on the floor of fresh and salt waterbodies.

Biocide – a chemical substance capable of killing living organisms.

Biodiversity – The variety of life and its processes, including the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur.

Biotic integrity – A healthy balance of biota in a habitat. It is measured by one of a number of multi-metric indices (IBI) that have been developed by study of aquatic ecology. The metrics reflect the richness and composition of biota in a habitat as well as the trophic organization and function, reproductive behavior and condition of all individual species.

Bog – A palustrine wetland with poorly drained, wet spongy soil full of plant residue, frequently surrounding open water.

Buffer – Land located immediately adjacent to a waterbody that has sufficient size and vegetative composition

to perform the function of filtering surface and soil water as it finds its way to the stream channel.

Canopy – A layer or multiple layers of branches and foliage at the top or crown of a forest's trees.

Channel – The natural or man-made bed in which a stream of water runs; the area between two stream banks at bank-full elevation.

Channelization – The process of reconstructing the natural course of a stream in order to make it flow into a restricted path.

Clear cut – A harvesting and regeneration method that removes all trees within a given area. Clear-cutting is most commonly used in pine and hardwood forests, which require full sunlight to regenerate and grow efficiently.

Community – A group of species that share an ecosystem.

Connectivity – The ability of water, nutrients and organisms to move unobstructed along water courses to include movement upstream and downstream, lateral movement to floodplains, and vertical movement to recharge aquifers.

Conservation – Planned management of the use of the biosphere to benefit the present generation in a way that ensures continuing availability for future generations; careful use of natural resources for sustainability. Also, the use of methods and procedures necessary to bring any endangered or threatened species to a point at which the measures provided under the Endangered Species Act are no longer necessary.

Contaminants – substances that are harmful or toxic to aquatic life.

Cubic feet per second (cfs) – Measurement unit to describe how much water is flowing in a stream or river. Flow (or discharge) is measured as the volume (cubic feet) of water that passes a given point each second.

Culvert – A conduit used to enclose a flowing body of water. Culverts can be made of many different materials such as steel, polyvinyl chloride, and concrete.

Dam – A barrier across flowing water that obstructs, directs or retards the flow, often creating a reservoir, lake or impoundment.

Denitrification – The process of reducing nitrate and nitrite, highly oxidized forms of nitrogen available for consumption by many groups of organisms, into gaseous nitrogen, which is far less accessible to life forms.

Detritus – Non-living particulate organic material, such a decaying plant and animal matter.

Development – New construction projects that convert land from green space to buildings and impermeable surfaces.

Discharge – The amount of water that is flowing in a stream channel. Measured as volume per unit of time such as cubic feet per second (cfs).

Dissolved oxygen – The amount of gaseous oxygen molecules (O_2) found in water. Water molecules also contain oxygen, but only this gaseous form is readily available for respiration by aquatic plants and animals.

Dredging – The removal of material from the bottom of a waterbody, typically done to make the area deeper for navigation, or to harvest gravel or sand for building materials.

Easement – A contractual agreement between a landowner and another party, or government agency on behalf of the public, that allows specific uses of the property for a specified time period, but does not release the ownership of the land.

Ecology – Science concerned with the interrelationships of organisms and their environments.

Ecosystem – Any dynamic and interrelated community of living things interacting with nonliving chemical and physical components that form and function as a natural environmental unit.

Emergent wetlands – Marshes dominated by grass-like plants, rooted in bottom sediments, and emerging or appearing above the surface of the water.

Endangered species – An animal or plant species in danger of extinction throughout all or a significant portion of its range.

Endemic – Restricted in distribution to a particular geographic area or drainage. Term used with reference to any plant or animal taxon.

Ephemeral – Living or lasting for only one or a few days.

Erosion – Process of weathering or wearing away stream banks and adjacent land slopes by water, ice, wind, or other factors. Removal of rock and soil from the land surface by a variety of processes including gravitational stress, mass wasting, or movement in a medium.

Estuary – A semi-enclosed coastal body of water which has a free connection with the open sea and within which sea water is measurably diluted or mixed with fresh water from land drainage.

Estuarine – Of, relating to, or formed in an estuary.

Fauna – Collectively, the animal life of a particular area region, or special environment. A list of animal species and descriptions for a particular area or time period.

Fecundity – Reproductive fruitfulness. Relative number of eggs, sperm, or young produced by an animal.

Fen – Bog with alkaline, mineral rich water.

Floodplain – Palustrine wetland adjacent to a river. When a river's water exceeds its banks, it enters the floodplain and is forced to spread out, losing most if its velocity and capacity to rise.

Flora – The plant life of a particular area, region, or special environment. A list of plant species characteristic of a specific place or time period.

Flow – To move or movement in a continual change of place.

Forested wetland – Wetland dominated by trees, similar to a true swamp but lacking continuously standing water, although repeated flooding is common.

Freshwater – Water that contains less than 1,000 milligrams per liter (mg/L) of dissolved solids. Water that is not salty.

Freshwater marsh – A wet meadow with saturated soil and dominated by grasses and sedges adjacent to a bog or marsh with persistent emergent plants and open water.

Functional guild – A group of organisms that are considered influential in providing particular ecosystems services. For instance, freshwater mussel species as well as net-spinning caddis flies may improve water quality by filtering a wide array of suspended particles and nutrients such as ammonia and nitrates from the water column, and converting it to animal biomass.

GIS – Acronym for Geographic Information System. An integrated collection of computer software and data used to view and manage information about geographic places, analyze spatial relationships, and model spatial processes. Provides a framework for gathering and organizing spatial data and related information for display and analysis.

Groundwater – Water located beneath the ground surface in soil pore spaces and in the fractures of geologic formations.

Guild – An association of animals with similar food and reproductive habits, and habitat use.

Habitat – Area in which natural functions provide the necessary food, water, shelter and space for a system of plants, animals, and other organisms to live.

Habitat enhancement – Manipulation of the physical, chemical, or biological characteristics of a site to heighten, intensify, or improve specific functions.

Habitat establishment – Manipulation of the physical, chemical, or biological characteristics present to create and maintain habitat that did not previously exist on the site.

Habitat improvement – On-the-ground restoration, enhancement, establishment or protective action to restore or artificially provide physiographic, hydrological, or disturbance conditions necessary to establish or maintain native plant and animal communities.

Habitat maintenance – Manipulation of the physical, chemical, or biological characteristics of an existing, functioning habitat to preserve or continue the efficacy of specific functions.

Habitat restoration – Manipulation of the physical, chemical, or biological characteristics of a site to return some or all of its natural and historic functions.

Horticulture – The science and art of growing fruits, vegetables, flowers, or other plants.

Hydrologic – Having to do with the properties, distribution, and circulation of water on the surface of the land, in soil and underlying rocks, and in the atmosphere.

Hydrology – The science of dealing with the properties, distribution, and circulation of water on the surface of land, in soil and underlying rocks, and in the atmosphere.

Hypoxic – State of having too little oxygen in the tissues or water for normal metabolism or a healthy ecosystem.

Impaired – Made worse or diminished in some respect. Relative to aquatic systems, a particular waterbody has been negatively impacted so that it does not meet its designated use of fishable, swimmable, or some other criterion.

Imperiled species – Species of concern, species of greatest conservation need, a population of a species that is in danger of disappearing due to a variety of circumstances.

Impervious – Refers to material through which water cannot pass or passes with great difficulty.

Impoundment – A natural or artificial body of water that is confined by a structure such as a dam to retain water, sediment or wastes.

Integrated – Incorporated or melding various parts into a cohesive, larger unit. Unified.

Integrity – The unimpaired condition of a habitat or environment.

Interim – An intervening period of time, not final.

Interjurisdictional – Between political jurisdictions. A species, area, or responsibility shared among various state, federal or other public entities.

Intertidal flats – That portion of the sea bottom between high and low tide lines with a very slight gradient. Depending on tidal amplitude and slope of the bottom, intertidal flats may be narrow or wide.

Invasive species – Any nonindigenous species, including its seeds, eggs, spores, or other biological material, propagating or able to propagate in a specific ecosystem, whose introduction does or is likely to cause economic or environmental harm or harm to human health.

Karst –Terrain usually formed on carbonate rock where groundwater has made openings to form a subsurface drainage system. Caves with standing or moving water.

Lacustrine habitat – All habitats situated in a lake, depression or dammed channel, lacking trees, shrubs, persistent emergent plants, emergent mosses or lichens with greater than 30% aerial coverage. Total area usually exceeds 20 acres. Waters may be tidal or nontidal, but always less than .05% salinity.

Lentic – An aquatic system with standing or slow flowing water such as a lake, pond, reservoir or wetland, with a nondirectional net flow of water.

Levee – A natural or artificial embankment or earthen dike, which parallels the course of a river.

Lotic – An aquatic system with flowing water such as a brook, stream or river, with unidirectional net flow of water from headwater to mouth.

Marine – Of or relating to the sea and saltwater.

Marsh – A wetland with emergent vegetation, and located in zones progressing from terrestrial habitat to open water. May be dominated by either salt or freshwater.

Metrics – Standard units of measure for certain characteristics of habitat, biota, organization or function.

Morphology – Physical attributes of a waterbody.

Native – Plant or animal species that occur naturally in aquatic or terrestrial habitats.

Niche – Ecological position of an organism within its community or ecosystem that results from the organism's structural adaptations, physiological responses, and specific behavior.

Nitrification – The process of binding gaseous atmospheric nitrogen to soil or water, usually by conversion into ammonia or nitrate. Nitrification is an important step in the nitrogen cycle.

Nonindigenous – An organisms that is not native to a particular waterbody, basin, or region. Non-native.

Nutrient – Element or compound essential for growth, development, and life for living organisms.

Organic – Of biological origin.

Palustrine habitat –Any inland wetland which lacks flowing water and contains ocean-derived salts in concentrations of less than .05%. Inland marsh, swamp, bog, fen, tundra or floodplain.

Parasites – An animal or plant that lives in or on a host (another animal or plant) and obtains nourishment from the host without benefiting or killing it.

Partner – Any entity that voluntarily participates with another on a project.

Parts per million (ppm) – A unit of concentration equal to a number of parts of one substance in one million parts of the solution. One ppm equals 0.283 gallons/cubic foot, 0.0038 grams/gallon, 2.72 pounds/acre foot, and one milligram/liter.

Pathogens – An organism that causes disease in another organism.

Pesticide – any chemical used to control populations or organisms that are undesirable to humans.

Pollutant – a chemical or waste product contaminating the air, soil, or water.

Preservation – Protection of ecologically important aquatic resources in perpetuity through the implementation of appropriate legal and physical mechanisms.

Priorities – Most critical geographic and or habitat areas, sometimes described in species-related terms.

Productivity – (1) Capacity or ability of an environmental unit to produce organic materials. (2) Rate of formation of new tissue or energy use by one or more organisms.

Reservoir – Anything used to store water with easy access for addition or removal. Most often, it is an artificial lake, created by a dam.

Resource – (1) A living or non-living substance of value to humans. Often classified as renewable (fish, forest, water, etc.) or nonrenewable (minerals, fossil fuels, etc., that cannot sustain a rate of formation relative to human use).

Riparian – Pertaining to, situated or dwelling on the margin of a river or other waterbody.

Riparian corridor – Area between the topographic floodplain banks of a flowing waterbody, excluding the stream channel.

Runoff – surface water from rain, snow melt and other sources that flows overland and into waterbodies.

Saltwater – Water containing dissolved salts, especially salts of alkali metals or magnesium.

Saline – Consisting of or containing salt, especially relating to the salts of alkali metals or magnesium.

Sediment – Particulate matter, especially loose pieces of mineral and rock that may be carried by flowing water, settled in benthic areas, or suspended in a water column.

Siltation – Settling of fine, suspended sediments in water where water velocity is reduced.

Species – A classification of individual organisms with common attributes, which actually or potentially interbreed.

Species of concern –A species that might be in need of conservation action.

Sprawl – Growth of an urban area that is unplanned and uncontrolled.

Stakeholder – A person or group of people having direct interest, involvement, or investment in an issue or resource.

Subsidence – Lowering of surface elevations caused by loss of support and subsequent settling or caving of subsurface materials.

Substrate – Mineral and organic material forming the bottom of a waterway or waterbody.

Sustainability – The continuity of economic, social, institutional and environmental aspects of human society to meet their needs and express their greatest potential in the present, while preserving biodiversity and natural ecosystems, and planning and acting for their maintenance in the long term.

Swamp – A wetland dominated by woody plants.

Target – Desired quantitative and/or qualitative result of restoration, conservation, or maintenance actions.

Terrestrial – Belonging to, or living on, land, the ground or earth.

Threatened species – Any animal or plant species likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

Toxicity – Quality, state, or degree of a harmful effect in organisms that results from alteration of natural environmental conditions.

Urbanization – Increase over time of the population and extent of cities and towns.

Water – A binary compound that occurs at room temperature as a clear, colorless, odorless, tasteless liquid, freezing into ice below 0 degrees C. and boiling above 100 degrees C.

Water quality – Description of the chemical, physical and biological characteristics of water in an aquatic area or waterbody, usually in relation to its uses or suitability for a particular purpose.

Waterbody – Any area with water flowing or standing above ground to the extent that evidence of an ordinary high water mark is established in any normal year. It can be a stream, river, lake, spring, backwater, bayou, creek, ocean, bay, pond, or wetland.

Watershed –The catchment basin bounded by ridges, from which the waters of a stream, marsh, river, lake or groundwater system are drawn.

Watershed connectivity – Spatial and temporal connections for aquatic and riparian species within and between watersheds that provide physically, chemically and biologically unobstructed movement for their survival, migration and reproduction.

Wetland – Land areas containing much soil moisture, usually poorly drained, and characterized by hydrophytic vegetation, and hydric soils. The land area may have permanent or periodic inundation by water or prolonged soil saturation generally resulting in anaerobic soil conditions.