District of Columbia
Wildlife Action Plan

2015 UPDATE

District Department of the Environment

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Updating the District of Columbia's State Wildlife Action Plan required guidance, technical analysis, review, and editing from technical committees, internal groups, and sister agencies.

Members of the DDOE review team were Jonathan Champion, Julia Robey Christian, Adriana Hochberg, Kate Johnson, Hamid Karimi, Bryan King, Karim Marshall, Daniel Ryan, Steve Saari, Mary Searing, and Matt Weber.

Individuals from local, regional, and federal agencies; academia; and conservation organizations provided invaluable input concerning species, ecosystems, habitats, threats, conservation challenges, and solutions for the District.

Preface

The District of Columbia is a rapidly growing city, known in part for its beautiful parks and green spaces. With large sites like Rock Creek Park, Fort DuPont Park, the National Arboretum, and the Chesapeake and Ohio Canal Historical Park, and smaller places like Pope Branch, Alger, Linnean, and Hillcrest Parks, the District has the second highest amount of green space per capita of any city in the country. These spaces provide great value to the District's residents and visitors, but they also act as homes or refuges for somewhat less apparent residents. Bald eagles nest overlooking the Anacostia River. American shad and rockfish swim thousands of miles to spawn in the Potomac River. Spotted turtles swim through the marshes of Kenilworth Park and Aquatic Gardens, and five-lined skinks tread the boardwalk on Analostan Island (also known as Theodore Roosevelt Island). Monarchs find milkweed in meadows and backyards, and rocky, ice-scoured forests along the Potomac River retain plants typically found on the Great Plains. Oxon Run Park is home to globally rare magnolia bogs, and the Hay's Spring amphipod, a tiny shrimp-like crustacean, lives in a few springs in Rock Creek Park and nowhere else in the world.

The District Department of the Environment's Fisheries and Wildlife Division manages these diverse wildlife resources. The District is unique in that it is the only completely urban jurisdiction required to manage its wildlife as a state. This aspect provides a host of novel challenges and opportunities that are addressed in this plan.

This update of the District's Wildlife Action Plan is a roadmap for the next ten years of conserving, sustaining, and protecting the District's wildlife and habitats for the benefit and enjoyment of residents and visitors. It is an adaptable document that allows agencies, landowners, and natural resource managers to adjust methods to meet emerging threats, and it provides metrics to measure the effectiveness of conservation actions. The Wildlife Action Plan also serves as a companion to the Sustainable DC plan and other citywide plans that aim to protect and enhance the District's natural systems.

The update to this plan also provides an opportunity to strengthen relationships and cooperation with federal, regional, and local partners and with sister agencies. Success will depend on coordinating the goals, plans, and conservation efforts of numerous partners and stakeholders.

Success also depends on public input and participation. This plan includes rewarding opportunities for residents to play a role that has significant benefits for local wildlife. These opportunities include participating in the citizen science program's cottontail rabbit survey, planting pollinator gardens, and creating backyard habitats.

Working together to implement this Wildlife Action Plan will ensure the District of Columbia is not only a sustainable city, but continues to be a living city for the enjoyment of current and future generations.

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Chapter 1 Introduction

The District of Columbia's Wildlife Action Plan is a comprehensive, citywide plan and framework for managing and conserving the District's diverse animal wildlife and their habitats. The District is a part of a federal grant program that funds efforts to prevent the extinction of rare species and—just as critically—to prevent common species from becoming rare. All 50 states, the District, U.S. territories, and many Native American tribes participate in the State Wildlife Grant (SWG) program.

The State Wildlife Grant program supports the conservation and management of non-game animal wildlife and their habitats. Within each state's program, rare and declining wildlife are designated as Species of Greatest Conservation Need (SGCN). These species and their critical habitats are targeted for management in the State Wildlife Action plans (SWAPs). Each SWAP designates SGCN and critical habitats and assesses the threats to both. The SWAP identifies conservation actions that will be implemented to reduce and mitigate the threats to SGCN; actions range from habitat restoration to land acquisition and from wildlife inventory to regulations. SWAPs and SWGs are used regionally and nationally to enhance coordination of landscape management and efforts to prevent species from becoming threatened or endangered.

The District of Columbia developed its first SWAP in 2005. At that time, the District Department of Health, Environmental Health Administration, Fisheries and Wildlife Division (FWD) worked with partners and stakeholders to prepare the 2005 Wildlife Action Plan (SWAP 2005) (Pfaffko and Palmer 2006). The Fisheries and Wildlife Division now resides in the Natural Resources Administration of the District Department of the Environment (DDOE). FWD has updated the District's SWAP in 2015 (SWAP 2015) to meet the requirements of the SWG program. This is a comprehensive update based on a foundation of ten years of research, inventory, and monitoring of the District's wildlife.

1.1 Sustaining Biodiversity

The District of Columbia is a developed urban city that is also home to abundant and diverse wildlife and habitats. The District is the only completely urban jurisdiction required by federal law to manage its fisheries and wildlife resources. There are significant challenges to managing wildlife diversity in an urban area that has seen rapid growth in its human population and continued urbanization and development. This plan seeks to balance the protection of the District's unique natural diversity with human and economic needs.

The District of Columbia is a 69-square-mile city located at the junction of the Anacostia and Potomac Rivers at the geologic fall line between the Appalachian Piedmont and Atlantic Coastal Plain. The District has a temperate/subtropical climate and is 78% developed land and 12% undeveloped land. The remaining 10% of the District is open waters of the Potomac and Anacostia Rivers. There are more than 6,700 acres of land protected as National Parks and 900 additional acres of District-owned park land. The forests, waters, meadows, and wetlands in the District provide habitat for approximately 240 species of birds, 78 fish, 29 mammals, 21 reptiles, 19 amphibians, and thousands of invertebrates. Abiotic factors such as landform, climate, and soils have driven the evolution of diverse plant communities, including ice-scour floodplains scrub forests along the Potomac River and the globally rare endemic magnolia bogs in the hills east of the Anacostia River.

The District has an abundance of notable wildlife, including nesting bald eagles; the federally threatened northern long-eared bat; recovering populations of American shad; and the endemic, endangered Hay's Spring amphipod.

The continued and successful growth of the District as a global, metropolitan, and urban city highlights the challenge of sustainably managing human encroachment into precious natural areas while allowing or encouraging some uses. The District is home to approximately 659,000 people —its highest population since the 1980s. Since 2010, the District has experienced a sustained period of 9.5% population growth —nearly three times the national average of 3.3% (U.S. Census Bureau 2015). Beyond the proximate threats of urban development and land use, climate change will affect nearly every aspect of natural resource management, land use planning, and future development in the long term. The District's climate change adaptation plan (DDOE 2015a, in prep.) and Sustainable DC Plan (2012) call for actions that provide access to green spaces; preserve natural systems, wildlife, and landscapes; ensure the resilience of natural and human systems; and encourage District residents to value the benefits of a healthy relationship with natural resources and the environment.

1.2 DDOE Jurisdiction

The management of fisheries and wildlife is a state function. DDOE serves as a state agency in this regard and has jurisdiction over the conservation and management of fish, wildlife, and habitats in the District of Columbia. Currently, DDOE is limited in the authority to protect and manage threatened or endangered species or to acquire and designate wildlife areas. These deficiencies are addressed in this plan.

Although DDOE is not legally the state trustee agency for fish and wildlife resources, it is responsible for providing biological expertise to review and comment on environmental documents and impacts relating to development, infrastructure, and other projects that may impact federally listed species or SGCN.

1.3 Vision for the District's Wildlife

Through SWAP 2015, DDOE seeks to conserve the wildlife and habitats of the nation's capital by focusing on ecosystem-based wildlife resource management actions that address the unique issues that wildlife face in an urban city and the significant challenge of climate change. This plan is based on the best available science and remains flexible so actions can be implemented and adapted as situations change. Implementation relies on making conservation information more accessible to resource managers, conservation organizations, and the public. The development of this plan relied on partnerships with a broad array of government agencies, organizations, businesses, and citizens. The effectiveness of this plan will rely on ongoing input and assistance from the same array of partners. DDOE's vision is to sustain the current biodiversity and enhance habitat value in the District over the next decade. The strategies and actions laid out in this plan establish the framework for ongoing conservation for future generations.

1.4 State Wildlife Grant Program

The SWG Program was created by the Department of the Interior and Related Agencies Appropriations Act of 2002, Title I, Public Law 107-63. It was developed with support from Teaming with Wildlife, a bipartisan coalition working to increase state funding for wildlife conservation. This program provides funding to prevent wildlife population declines and keep common species common. The funds are intended to work in conjunction with other funding sources, and are only a small portion of the funding that is actually required to implement the SWAP conservation actions. The other necessary funds will be matched by partners.

Taken as a whole, SWAPs represent a massive effort to bring together the best science available to conserve priority fish and wildlife and their habitats through innovative public-private partnerships. The SWG program is the primary funding source available for state fish and wildlife agencies and their conservation partners to restore and actively manage the nation's declining wildlife. Although it does not have a dedicated funding stream, financial backing has continued at relatively modest annual levels for each state and territory. Without the SWG program, funding for state fish and wildlife diversity programs to prevent endangered species listings may be greatly curtailed or eliminated.

Overall, the SWAPs have identified more than 12,000 species that are at risk of becoming endangered. They have offered a diverse set of conservation actions to address threats to wildlife. The SWG program has had strong bipartisan backing in Congress, and is supported by over 6,300 conservation organizations and businesses that make up the Teaming with Wildlife coalition (www.teaming.com). The coalition was founded to advocate for the creation of the SWG program and continues to advocate for dedicated funding to ensure this successful program continues.

1.4.1 Required SWAP Elements

Each SWAP must be approved by the U.S. Fish and Wildlife Service (USFWS) director and must consider the broad range of fish and wildlife and associated habitats, with priority given to those species with the greatest conservation need. The states must review and, if necessary, revise their SWAPs at least every ten years. Revisions to each SWAP must follow the guidance issued in the July 12, 2007, letter from the USFWS director and the president of the Association of Fish and Wildlife Agencies (AFWA). To satisfy this guidance, SWAP 2015 must address the eight elements of a comprehensive wildlife conservation strategy required by Congress:

Element 1: Species Distribution and Abundance
Information on the distribution and abundance of species of wildlife, including low and declining populations as the state fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the state's wildlife. These species are referred to as Species of Greatest Conservation Need (SGCN).

Element 2: Critical Habitats and Habitat Condition
Descriptions of locations and relative condition of key habitats and community types essential to conservation of SGCN.

Element 3: Threats to Wildlife and Wildlife Habitats, and Research Needs
Descriptions of problems that may adversely affect SGCN and their critical habitats and priority research and survey efforts needed to identify factors that may assist in restoration and improved conservation of SGCN and habitats.

Element 4: Conservation Actions and Priorities
Actions necessary to conserve SGCN and habitats and priorities for implementing such actions.

Element 5: Monitoring and Adaptive Management
A plan for periodic monitoring of SGCN, habitats, and the effectiveness of the conservation actions in Element 4 and for adapting these conservation actions to respond appropriately to new information or changing conditions.

Element 6: SWAP Review and Update Process
Procedures to review the SWAP at intervals not to exceed 10 years.

Element 7: Coordination with Conservation Partners
Provisions for coordinating the development, implementation, review, and revision of the SWAP with federal, state, and local agencies and Indian tribes that manage significant land and water areas within the state or administer programs that significantly affect the conservation of identified species and habitats.

Element 8: Public Participation Strategies
Provisions to provide the necessary public participation in the development, revision, and implementation of its strategy.

1.4.2 Summary of Key Changes from SWAP 2005

SWAP 2015 has been substantially updated and revised from SWAP 2005. Some changes and inclusions are based on guidance documents for the revision process from USFWS (2007) and AFWA (2009, 2011, and 2012). Updates to SGCN lists are based on nearly a decade of occurrence data on current SGCN and other animal species in the District. SWAP 2005 described how DDOE was data deficient for many animal taxa; therefore, the primary goal of SWAP 2015 is to improve knowledge about the District's wildlife.

Key changes to SWAP 2015 include the following:

- A new, more rigorous, quantitative approach to determine the status of SGCN
- A three-tiered prioritization scheme for SGCN
- Detailed analysis of habitat types
- Detailed analysis of habitat condition with prioritization of critical habitats
- Designation of Conservation Opportunity Areas in critical habitats
- Systematic identification and ranking of threats
- Integration of threats and issues related to climate change
- Prioritization of resource management actions over species inventory and monitoring
- Focal Conservation Actions that cut across SGCN and habitats
- Renewed emphasis on partnerships and collaboration
- Effectiveness measures for conservation strategies and adaptive management

1.5 SWAP 2015 Approach

DDOE approached the SWAP 2015 update with a focus on quantitative assessment of the District's wildlife and habitats and an emphasis on resource management projects that will improve whole ecosystems. Conservation actions focus on habitat; improvements, creation, conservation of endemic habitats and plant communities, and new opportunities for research and monitoring in both critical habitats and developed areas. The District will increase its overall ecological integrity by creating and expanding habitat areas and improving and enhancing whole systems at a large scale—wildlife, plants, habitats, abiotic factors, and processes. This approach will benefit all wildlife, including SGCN. Landscape-scale and ecosystem-based management will also help to enhance water quality, reduce erosion, and develop greater resilience for species and habitats, in addition to enhance societal, aesthetic, and health values.

1.5.1 SWAP Development Team and Technical Committees

Using the eight required elements as an outline, DDOE began its update of the plan with analyses of the SWAP 2005 SGCN list and recent trend data and a search for external data. The SWAP Coordinator and Internal Working Group in DDOE led all aspects of SWAP 2015 development. Technical committees for birds, fish, reptiles and amphibians, mammals, invertebrates, and habitats assisted with these tasks.

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The SWAP Coordinator's role was to oversee and coordinate the SWAP update, represent the District in regional SWAP meetings, working with the Internal Working Group to develop SWAP 2015. The group met formally and informally as necessary. During the development phase, the group's tasks included, but were not limited to the following:

- Searching, collecting, and mapping species, habitat, and climate data
- Convening technical committees

- Analyzing species data
- Ranking and prioritizing SGCN
- Analyzing habitat condition
- Assessing and prioritizing threats
- Assessing, prioritizing, and developing conservation actions
- Developing effectiveness measures and adaptive management plans
- Planning and conducting stakeholder outreach
- Planning and conducting outreach to encourage public participation
- Incorporating comments from partners, stakeholders, and the public

Technical Committees

DDOE fish and wildlife biologists led technical committees, including representatives from federal, state, and local agencies; conservation organizations; academic institutions; natural resource-based businesses; and private citizens. They provided valuable data, guidance, and expertise to assess threats, select SGCN, identify priority habitats, and recommend conservation actions and monitoring protocols. The technical committees also provided essential knowledge of existing programs of agencies and organizations in the region. DDOE integrated this information in SWAP 2015 to ensure that it would be comprehensive and effective. See Chapter 8 for more information about the technical committees and other stakeholder outreach.

1.5.2 Designating SGCN and Critical Habitats

The Internal Working Group and technical committees analyzed data for species master lists that included 387 current or historically resident vertebrate species and approximately 315 current or historically resident invertebrate species. They used a quantitative scoring and ranking system to analyze vertebrate populations and set criteria for listing species as SGCN. Ultimately, the listing criteria varied slightly between each taxon (birds, mammals, fish, reptiles, and amphibians) based on regional wildlife priorities and input from the technical committees. The criteria for listing invertebrates were based on recent occurrence data, state and regional rankings, federal status under the Endangered Species Act, and national or regional population trends. The criteria also varied for listing each invertebrate taxon (dragonflies, damselflies, butterflies, bees, amphipods, copepods, crayfish, snails, mussels, and sponges) and were based largely on input from the technical committee.

SGCN were prioritized based on several factors, including the feasibility of implementing species and habitat conservation strategies, estimations of

available resources and the economic feasibility of recovery, and the expectation of a reasonable chance of improving conservation status. The selection and prioritizations processes are described in detail in Sections 2.3 and 2.4.

Wildlife habitat data were collected, categorized, and analyzed. Habitat data included maps and other spatial data provided by the National Park Service, DDOE, and the District's Office of the Chief Technology Officer – District of Columbia Geographic Information System, as well as vegetative data DDOE collected. Habitats were classified into a hierarchical system that conforms to regional and national standards so that these data can be integrated into regional projects and plans in the future. Habitats were classified into various natural systems based on vegetative plant communities and into developed land use systems based on human density and the built environment.

DDOE used a variety of spatial data and maps to assess the condition of habitats and score and rank them. This assessment included data for SGCN diversity, SGCN abundance, the degree and extent of invasive plants, soil quality, the impact of deer browse, and the extent of tree canopy. Each data set was scored, weighted, and summed. The output of the habitat condition analysis indicates specific locations where habitat quality is high. The output was categorized into tiers to indicate areas that are critical, extremely significant, and highly significant to SGCN.

National and regional guidance recommends that states designate discrete, spatially distinct areas that offer the best opportunities and potential for SGCN conservation. These are called Conservation Opportunity Areas. DDOE selected eight Conservation Opportunity Areas that include high SGCN diversity, endemic species and rare vegetative communities. Habitat, habitat conditions, and Conservation Opportunity Areas are described in detail in Chapter 3.

1.5.3 Threats, Actions, and Effectiveness Measures

The Internal Working Group and technical committees identified threats to wildlife and wildlife habitats. These threats were categorized based on international and national hierarchies that correlate specific conservation actions to specific threats. Threats were separated into those that will affect habitats and impact wildlife that use those habitats (such as invasive plants or urban wastewater) and those that impact wildlife independent of their habitats (such as diseases and pathogens). Threats were ranked as having high, moderate, or low impacts using characteristics such as severity, immediacy, and spatial extent. High-ranking threats to both aquatic and terrestrial habitats are prioritized and described in Chapter 4.

The threats and impacts of climate change on SGCN and habitats were assessed separately. A fine-scale climate change vulnerability assessment was performed. Climate, precipitation, and soil moisture were modeled to predict changes in vegetative habitats and how those changes would impact certain SGCN. Results showed that sea level rise and changes in soil moisture will impact vulnerable habitats, such as emergent wetlands, upland forests, and vernal pools. These models, the predicted impacts, and the actions that may increase the resiliency of habitats are addressed in Chapter 5.

The threats that are prioritized in Chapter 5 are addressed with specific conservation actions in Chapter 6. Under the threat hierarchies, each particular threat is tied directly to a corresponding conservation action that has been determined to be the most effective way to mitigate or reduce that threat. Each threat is mapped directly an individual action. DDOE addressed the highest priority habitat-based threats with six overarching actions and identified actions for all additional threats to each habitat. Specific actions are listed, with the lead agency and any partners that may assist with implementation. Non-habitat based actions are similarly detailed.

Additionally, DDOE selected a number of Focal Conservation Actions (FCA). These are broad-scale conservation efforts that may apply to many habitat types and species and represent on-the-ground natural resource management projects that go beyond inventory and monitoring. FCAs represent the District's desire to improve existing wildlife habitat by restoring reclaimed wetlands, creating vernal pools, and propagating native plants. But FCAs also represent the need to accommodate wildlife and expand their access to habitat in developed areas. That need is expressed in FCA's such as creating new meadow habitat, creating artificial nesting opportunities, citizen science initiatives, and native plant propagation.

A monitoring program will be developed to determine the effectiveness that any conservation actions have in reducing the threats facing the District's wildlife and habitats. Indicators of success will be used to assess the status of those conservation targets. Adaptive management techniques will allow flexibility for improving the status of SGCN and achieving SWAP goals.

1.5.4 Stakeholder and Public Input

The creation of this document included comprehensive conservation planning and coordinated efforts to involve stakeholders and the public. The SWG program is meant to supplement state-level programs that aim to improve habitats and populations of both game and non-game wildlife species, but DDOE cannot lead and implement all of the conservation actions in this document alone. Implementation will require significant additional planning

and coordination efforts. The many partners, landowners, and members of the public who have contributed to the development of the SWAP must continue to be involved throughout the entire process. The public is the focus of many of the conservation actions, such as education and outreach, and can assist with the implementation of additional conservation actions.

Conservation and wildlife stakeholders were engaged in the SWAP 2015 update through individuals and organizations who participated as subject matter experts on technical committees. These stakeholders made significant contributions to the development of this plan.

1.5.5 Conclusion

The District of Columbia's wildlife and their habitats face unique and varied challenges. The purpose of SWAP 2015 is to identify those challenges and recommend the actions necessary to conserve wildlife in the District. As this plan will demonstrate, the conservation measures needed to protect the District's wildlife are within reach. The tools and ability to improve the condition of wildlife populations in the District already exist. This expertise spans a variety of networks and partnerships that can be tapped as necessary.

SWAP 2015 is a community document designed for public use. It is a plan for the District as a whole—federal landowners, park managers, conservation organizations, legislators, business leaders, educators, and concerned individuals—not solely District government agencies. SWAP 2015 can provide a strong foundation and inspiration for anyone who seeks to conserve wildlife in the nation's capital. The information it contains should be widely disseminated. By itself, SWAP 2015 cannot guarantee the future of wildlife in the District, which has been—and will continue to be—under threat from many directions. However, it can help any agency or person who desires to undertake the necessary and important steps toward that goal.

Chapter 2 Species of Greatest Conservation Need

2.1 District of Columbia's Wildlife Diversity

Despite being a highly urbanized city, the District of Columbia has unexpectedly high wildlife diversity, which is due, in part, to the wide variety of habitats found throughout the city and a large amount of undeveloped land. This chapter addresses Element 1 by describing the diversity of the District's animal wildlife and the process used to select and rank SGCN for SWAP 2015. One hundred ninety-eight animal species have been listed as SGCN in SWAP 2015 (see Table 1). Thirty-seven species were removed and eighty-eight species were added as SGCN as a result of the selection process described in this chapter, which is based on 10 years of wildlife inventory and monitoring projects.

Table 1 Revisions to the District's SGCN list by Taxa

Taxa	SGCN 2005	SGCN 2015	Removed	Added
Birds	35	58	4	27
Mammals	11	21	2	12
Reptiles	23	17	6	0
Amphibians	16	18	2	4
Fish	12	12	4	4
Dragonflies & Damselflies	9	26	2	19
Butterflies	13	10	6	3
Bees	0	4	N/A	4
Mollusks	9	13	0	4
Crustaceans	19	22	6	9
Sponges	0	2	N/A	2
Total	**147**	**203**	**32**	**89**

2.1.1 Terrestrial Wildlife Diversity

The District has a substantial number of terrestrial animal species, and diverse natural communities provide an extensive variety of habitat settings for wildlife. Twenty-four Habitat Systems support the terrestrial animal species—including

central Appalachian dry oak-pine forests, Potomac River ice-scour floodplains, and old-field meadows. Some species are habitat generalists, able to survive in many different conditions and to make use of many resources to meet their needs for survival. Other species are habitat specialists, needing specific habitat conditions and plant communities that can be rare in natural areas surrounded by urbanity.

The District's vertebrate wildlife species include approximately 21 reptile species, 19 amphibian species, 240 bird species, and 29 mammal species. Invertebrate diversity is more difficult to quantify. More than 2,500 insect species have been identified in a local collection (Smithsonian 2002). A BioBlitz in Rock Creek Park in 2007 identified 154 insect species and 44 other invertebrates (National Geographic 2007). Many of these species, including all of the amphibians and all Odonata (dragonflies and damselflies), use both aquatic and terrestrial habitats for parts of their life cycle.

The District has notable native fauna, including three nesting pairs of bald eagles, the rare and declining spotted turtle, the recently federally listed northern long-eared bat (listed as threatened), and recovering populations of American beaver. Recent reports of coyotes have also become prominent, as this predator begins to establish in urban settings.

2.1.2 Aquatic Wildlife Diversity

The District exhibits a wide range of aquatic habitats, which similarly drives the diversity of aquatic animals. Nine Habitat Systems support a diverse array of wildlife —including perennial rivers and creeks, ephemeral streams, vernal pools, tidal wetlands, and submerged aquatic vegetation. Two major rivers flow through the District: the Potomac River and the Anacostia River. Tidal and non-tidal freshwater wetlands provide important wildlife habitat and critical ecological services by sequestering and transforming polluted runoff, controlling floods, moderating sediment delivery, promoting groundwater recharge, sequestering carbon, and protecting shorelines from erosion (Wohlgemuth1991). Some wetlands remain saturated year round; others may evaporate during the dry season. Vernal pools are one type of seasonal wetland that is important to the District's wildlife. Many specially adapted crustaceans, amphibians, insects, and plants occur only in vernal pools.

The District's aquatic and transitional wildlife include 78 fish species, 19 amphibian species, and many other species of birds, mammals, and reptiles. Aquatic habitats are important to invertebrate diversity as well. Freshwater mussels and snails, crayfish, sponges, aquatic crustaceans, and aquatic insects are all represented on the District's list of SGCN.

Importantly, many of the species mentioned as notable native fauna make use of aquatic habitats as well as terrestrial habitats. Bald eagles and spotted turtles both nest on land, but use aquatic habitats to forage. Spotted turtles are primarily aquatic. Northern long-eared bats hunt for insects above streams in the evening. Beaver are ecosystem engineers that create ponds and forage on land. Other notable aquatic species include restored populations of American shad and the endangered Hay's Spring amphipod, which is endemic to the District.

2.1.3 Wildlife Ecology

Birds

Birds are adapting to the urban environment with nearly 20% of all known species living in cities (Aronson et al 2014). DDOE has recorded 256 bird species since 2005 and is home to an average of 230 species of birds annually. It is part of the Mid-Atlantic Flyway and serves as a stopover point for a large numbers during migration. More than 60 species breed in the District, and its rivers are wintering locations for thousands of waterfowl. The District became a U.S. Fish and Wildlife Service Urban Bird Treaty City in 2011.

Mammals

32 species of mammals have been observed in the District since 2005. Twenty-one species of mammals are listed as SGCN. Several taxonomic groups are represented, including bats. The northern long-eared bat has shown huge population declines as a result of white-nose syndrome (WNS) and was recently listed as threatened under the Endangered Species Act. Some mammals found in the District are habitat generalists and are widespread, but even habitat generalists can be rare—Virginia opossum and Eastern chipmunk are both listed as SGCN. Habitat specialists are limited to locally appropriate habitat, which can make them more vulnerable to a host of threats. The only mammal that is currently managed in the District is the white-tailed deer.

Reptiles and Amphibians

DDOE has observed and recorded 21 reptile species and 19 amphibian species since 2005. These unique groups of species occupy both terrestrial and aquatic habitats in the District, making the taxa vulnerable to threats within both systems. Species in both groups are most frequently found in forested and freshwater wetland habitats. Some reptiles and amphibians found in the District are generalists and utilize a variety of habitats, while others are more specialized, making them more vulnerable to a host of threats. Emerging diseases, such as ranavirus and snake fungal disease, threaten both amphibian and reptile

species, making them one of the selection criterion for the new SGCN. In the revised SWAP, 17 reptiles and 18 amphibians were listed as SGCN.

Fish

Fish are a well-studied group of animals in the District. They use a wide variety of aquatic habitats from the deep channel in the Potomac River to shallow vegetated wetlands and steep streams. There are 78 species of fish documented in the District. Many species are actively monitored as game fish or for restoration projects. The District is the upper limit of tidal waters on the Potomac River. Several species of anadromous fish, including striped bass, white perch, American shad, hickory shad, gizzard shad, blueback herring, and alewife, spawn in the Potomac and Anacostia Rivers and their tributaries.

Invertebrates

Invertebrates use a wide variety of habitats in the District: tree canopy, forest floor, soil, air, groundwater, mudflats, riverbeds, and more. The District has observed and recorded more than 65 species of invertebrates since 2005. Forty-four insects, 13 mollusks, 22 crustaceans, and two sponges are listed as SGCN. The wide variety of invertebrate species makes it difficult to summarize their ecology, beyond mentioning their ubiquity in every habitat and their basis as the foundation of the food chain for most vertebrates.

2.2 What is an SGCN?

Element 1 requires that the District provide information on the distribution and abundance of species that are indicative of the diversity and health of the District's wildlife, including low and declining populations. As such, the following section lists the District's SGCN and indicates any known status and/or trend for those species.

As part of protecting the diversity of the District's wildlife, it is critical to conserve all types of wildlife species, including birds, mammals, reptiles, amphibians, fish, and invertebrates. The District's wildlife also includes a variety of types including resident, breeding, migratory, endemic, and federally protected species. The District's resident and breeding species keep the nation's capital high in biodiversity and ecologically healthy. Many of these species are economically significant. For example, American shad (*Alosa sapidissima*) is a fish species of greatest conservation need that supported an important recreational fishery until it became over-harvested and one of the District's most threatened fish species. The District is located such that it is a stopover point for many migratory species. Maintaining the integrity of migratory stopover points benefits the entire migration path of the species. Conserving habitats located within the District is

vital to supporting the efforts made by other states that share these migratory pathways.

Despite the District's limited area and urban character, it is home to two known endemic species. The Hay's Spring amphipod (*Stygobromus hayi*) and Kenk's amphipod (*Stygobromus kenki*) have been found only in the Rock Creek Valley. They are restricted to shallow groundwater communities in only five springs along Rock Creek (Pavek 2002). As endemic species, the District has the sole responsibility for ensuring their persistence. There are six federally threatened or endangered wildlife species protected by the U.S. Fish and Wildlife Service under the Endangered Species Act of 1973 (16 U.S.C. 1531-1544, 87 Stat. 884, as amended), with current or historical ranges that include the District. They include the northern long-eared bat, bog turtle, Atlantic sturgeon, shortnose sturgeon, dwarf wedgemussel, and Hay's Spring amphipod. The District has no federally threatened or endangered amphibian or avian SGCN.

2.3 Selection Process for SGCN

The selection of SGCN for SWAP 2005 was made using the best possible information and expertise at the time. Over the past 10 years, DDOE Fisheries and Wildlife Division biologists have inventoried and monitored species identified as SGCN in the original plan, as well as other non-game species in the District. The resulting data was used as the primary source of information to assess species population trends to select SGCN for SWAP 2015.

2.3.1 Millsap Process

Due to the variety of national, regional, and local data that was available for different taxa, each technical committee used several selection processes to select SGCN. The backbone of qualitative selection for most taxa was based on the process described in *Setting Priorities for the Conservation of Fish and Wildlife Species in Florida* (Millsap et al 1990). This monograph (henceforth referred to as Millsap) describes a ranking process for wildlife species developed by the Florida Game and Fresh Water Fish Commission. Millsap uses Biological Variables, Action Variables, and Supplemental Variables to score and rank species.

Biological Variables

- Population size – Estimated number of adults throughout North America
- Population trend – Overall trend throughout the taxon's range over the last two decades
- Range size – The area over which a species is distributed when most restricted

- Distribution trend – Percent change (since European settlement) in the range occupied by the taxon
- Population concentration –Degree to which populations congregate at specific locations
- Reproductive potential for recovery – Ability of a species to recover from serious population declines
- Ecological specialization – Degree to which the species is dependent upon environmental factors

Action Variables for the District

- Distribution in the District
- Population trend in the District
- District population limits
- Ongoing management activities in the District

Supplemental Variables

- Population trend and/or Percent of Occupied Area (POA) of taxon in the District
- Last documented
- Range size/concentration throughout the District/POA
- Impacted by known emerging disease
- Habitat specialization within the District

Due to the limited geographic size of the District, variables were added to the Millsap selection process, which relies on national and regional data, to balance the process with local observations and trends. The Millsap criteria were augmented with local variables such as "Most Recent Documentation in the District," "Emerging Diseases," and "Ongoing Management Activities in the District." The Millsap ranking process was used for birds, herpetofauna, mammals, and fish. Invertebrate selection relied upon regional and state rankings, as well as element occurrence and Maryland's draft 2015 SGCN list. See Appendices A–I for the variable scores and final ranks for birds, mammals, herpetofauna, and fish and for the criteria used to select dragonflies, damselflies, butterflies, bees, mussels, amphipods, copepods, and sponges.

2.3.3 Vertebrate SGCN Selection

Avian SGCN Selection
Species were sorted based on their aggregate Millsap score, ranging from the American woodcock (82) to the mallard (3) and Canada goose (3), which tied with the lowest scores. Ranked avian species were broken out into guilds based on habitat association. From these habitat guilds, those species with the highest ranking scores were selected as candidate SGCN for 2015.

Mammal SGCN Selection
Species were sorted based on their aggregate Millsap scores, ranging from the northern long-eared bat (85) to the southern bog lemming (32.7). Species with the highest ranking scores were selected as SGCN for 2015, with the lowest score for selection as SGCN set at 40.

Herpetofauna SGCN Selection
Species were sorted based on their aggregate scores ranging from the queen snake (89.9) to the eastern hognose snake (29). Species with the highest ranking Millsap scores were selected as SGCN for 2015. The lowest score for inclusion as SGCN for reptiles was 40, and the lowest score for inclusion as SGCN for amphibians was 50.

Fish SGCN Selection
Species were scored individually by biological, action variables, and supplemental variables. Biological scores ranged from 2 to 41.3 with a median of 4. Action scores ranged from 0 to 31 with a median of 10. Supplemental scores ranged from 10 to 19 with a median of 13.

SGCN above the median Millsap biological score (4) were considered for inclusion as SGCN. Action and supplemental scores from Millsap were used to exclude or include certain species with a good historical record or those considered to be stable within the District of Columbia. Conversely, species that are considered highly vulnerable but could not be scored due to lack of data, such as the bowfin, were included as SGCN. Multiple conservation assessments (IUCN Red List, federal listings, and ranks) were used to further identify SGCN.

2.3.4 Invertebrate SGCN Selection

Dragonfly and Damselfly SGCN Selection
Species were selected based on five criteria: occurrence data in the District (three or fewer locations since 2005), the NatureServe state rank S3 or lower (NatureServe Explorer 2015, Faber-Langendoen et al 2012), the regional rank (R3 or lower) (White et al 2014), listing as SGCN in Maryland's 2015 SWAP update (unpublished, preliminary data), and listing as SGCN by the District in 2005. Species were listed if they met three of the five criteria. A few species were

included as SGCN if they met only two of the above criteria. These were included, based on expert opinion, as populations that are declining locally or are locally (but not regionally) rare or as species tied to rare endemic habitats with historical records in the District.

Butterfly SGCN Selection
Species were selected based on five criteria: occurrence data in the District (3 or fewer locations since 2005), the NatureServe District rank S3 or lower, the NatureServe Maryland state rank (S3 or lower), listing as SGCN in Maryland's 2015 SWAP update, or listing as SGCN by the District in 2005. Species were listed if they met two of the five criteria. A few species were included as SGCN based on regional or national rarity or decline, such as the monarch, and species that are targeted for conservation by the Mid-Atlantic states.

Bee SGCN Selection
Species were listed if they met three criteria: a contemporary record in the District, an estimated state rank of S3–S1 (Nature Serve rank adjusted by expert opinion), and proposed for listing as SGCN in Maryland in 2015 (only species whose range includes the District).

Mussel SGCN Selection
The list of freshwater mussels is unchanged from SWAP 2005. No recent occurrence data exists.

Amphipod SGCN Selection
Species were listed based on their global rank, state ranks in the District and Maryland, the Maryland state endangered species list, species to be listed as SGCN by Maryland in 2015, and species listed as SGCN by the District in 2005.

Copepod SGCN Selection
Species were listed if they were globally ranked G1–G3, District ranked S1–S3, a candidate species for listing under the Endangered Species Act, listed as SGCN by Maryland in 2015, or if records showed the species was limited to certain habitats.

Three crayfish are listed as SGCN. Species were included based on range maps from the *Maryland Key to the Crayfish of Maryland* (Swecker 2010). One species, Acuminate crayfish (*Cambarus acuminatus)*, is also listed as an SGCN in Maryland.

Four terrestrial snails were added as SGCN. These were included based on recent discovery in the District (Steury and Pearce 2014), state rank in Maryland or Virginia, and proposed listing in Maryland in 2015. One aquatic snail, Appalachian springsnail (*Fontigens bottimeri)*, remains listed.

Sponge SGCN Selection
Two freshwater sponge species were added to the SWAP 2015. Freshwater sponges are extremely rare in the District, with few recorded occurrences in Rock Creek Park.

2.4 Prioritization Process for SGCN

Species selected as SGCN were ranked into a three-tiered system with the input from the technical committee members. The tiers are based on several factors, including the ability to implement species and habitat conservation strategies, available resources, estimated economic feasibility, and the expectation of a reasonable chance of improving conservation status.

Tier 1: Management Species

- Species observed in more than one location and/or in a variety of habitats
- Habitat can be improved with management or other conservation efforts
- Conservation efforts are economically feasible
- High probability of successful improvement of habitat and species population

Tier 2: Species Seen on Occasion

- Recent observations exist, but the species is rarely recorded in formal surveys
- Habitat may be improved with management or other conservation efforts
- Conservation efforts are not as economically feasible
- Lower probability of successful improvement of habitat and species population

Tier 3: Historical Species

- Reliable historical documentation, but there were no recent observations in the District
- Habitat requirements may be lacking or nonexistent
- Minimal probability of observation; species are listed mainly due to a case of incidental observation so that conservation actions can be applied if observed

2.5 SGCN Designations

Table 2 lists SGCN for the District. Highlights from the species listing process are described by taxa in this section.

Bird SGCN

Out of 213 species of birds, 58 ranked high enough to be considered SGCN. Species were selected using the Millsap criteria, with additional variables, such as regional species of conservation needs status (RSGCN), *2nd Atlas of the Breeding Birds of Maryland and the District of Columbia* (Ellison 2010) population trends, management in the District, and the *State of the Birds 2014* (North American Bird Conservation Initiative 2014) report. The American woodcock (*Scolopax minor*) was the highest ranked SGCN. Top ranked species were divided into associated habitat guilds. Species that were well documented and had a high chance of positive impacts through economically sound conservation actions were listed as Tier 1. Eastern meadowlark (*Sturnella magna*), grasshopper sparrow (*Ammodramus savannarum*), and bobolink (*Dolichonyx ozyzivorus*) are all Tier 1 species that can benefit from meadow creation. The eastern screech-owl (*Megascops asio*) and red-headed woodpecker (*Melanerpes erythrocephalus*) are both Tier 2 species. They have recent records in the District and should be targeted for inventory, but not any formal conservation actions at this time. The eastern whip-poor-will (*Caprimulgus vociferous*) is a cryptic goatsucker and Tier 3 species. Since there is only one record of detection since 2000, more research is needed to determine population status and trends.

Mammal SGCN

Out of the 32 species of mammals, 21 ranked high enough to be considered SGCN through the scoring in Section 2.3.3, with additional resources such as NatureServe and other historical species accounts from the Smithsonian Museum Collections (Smithsonian National Museum of Natural History, 2015). The highest ranked species was the northern long-eared bat, scoring 85. Overall, bat species scored high in the ranking process, largely in part due to WNS, which hit the Northeast U.S. in 2007, and has decimated bat populations. All selected SGCN were placed in Tier 1. With ongoing monitoring and management, attempts can be made to recover the bat populations. Other mammals such as the northern short-tailed shrew (*Blarnia brevicauda*), meadow vole (*Microtus pennsylvanicus*) and eastern cottontail rabbit (*Sylvilagus floridanus*) can benefit from habitat restoration and meadow creation. Aquatic mammals such as the northern river otter (*Lonatra canadensis*) and American mink (*Neovison vison*) can be expected to benefit from wetland restorations and water quality improvement actions.

Reptile and Amphibian SGCN

Out of the 21 species of reptiles and 19 species of amphibians, 17 and 18, respectively, ranked high enough to be considered SGCN. Species were scored

using the system described in Section 2.3.3., with additional resources such as NatureServe and other historical species accounts from the Smithsonian Museum Collections. The two highest ranked reptiles are the queen snake (*Regina septemvittata*) and the spotted turtle (*Clemmys guttata*). The highest ranked amphibians are the spotted salamander (*Ambystoma maculatum*) and the wood frog (*Lithobates sylvatica*). The majority of the species were selected to be in Tier 1 because they were expected to benefit from habitat management and restoration, such as stream restorations (incorporating vernal pool designs) and meadow creations. Tier 2 species included the marbled salamander (*Ambystoma opacum*) and the wood turtle (*Glyptemys insculpta*). Both species have been documented in recent years, but not with enough numbers to consider them a strong candidate for recovery. Tier 3 species included the green tree frog (*Hyla cinerea*) and the bog turtle (*Glyptemys muhlenbergii*). The green tree frog was documented calling in 2013 on one occasion. As the climate continues to change and become further unstable, it is expected to see shifts in species ranges such as in the case of the green tree frog. The bog turtle has not been documented in the city in recent history, but given its federal status as endangered, it remains an SGCN on the chance it is sighted.

Fish SGCN

Out of 78 species of fish, 12 ranked high enough to be considered SGCN. Species were scored using the Millsap criteria. Fish species with a high biological score were classified as SGCN, and species with high action or complemental scores were reevaluated as to their inclusion/exclusion as SGCN. Commonly occurring species, such as American shad (*Alosa sapidissima*), striped bass (*Morone saxatilis*), and alewife (*Alosa pseudoharengus*), are listed as Tier 1 species. These species are the most likely to succeed from both conservation and a management aspects. Tier 2 included species that have rarely been encountered within the District. Bowfin (*Amia calva*) and shortnose sturgeon (*Acipenser brevirostrum*) are listed as Tier 2 species. The Atlantic sturgeon (*Acipenser oxyrinchus*), which is federally listed as endangered or threatened, received a Tier 3 rank due to its absence in the District. Species that have never been encountered but are not federally ranked were also included as Tier 3 species. These historical species include pearl dace (*Margariscus margarita*) and bridle shiner (*Notropis bifrenatus*). The inclusion of species that have never been encountered within the District was extrapolated from historical species maps of the area and expert opinion.

Invertebrate SGCN

Forty-three insects, 16 mollusks, 13 crustaceans, and two sponges are listed as SGCN. Species from several new taxa were added, including four bee species,

four terrestrial snails, two freshwater sponges, and three crayfish. Federally listed species known to occur in the District were ranked as Tier 1 species. Species that are targeted for regional conservation, such as the monarch (*Danaus plexippus*), and Baltimore checkerspot (*Euphydryas phaeton*) were also listed as Tier 1 species. Tier 2 included many species that should be targeted for inventory, but not any formal conservation actions. These include numerous dragonfly and damselfly species that have been observed rarely and many species in the newly added taxa (bees, crayfish, and sponges). Several Tier 3 species have never been encountered within the District or have not been encountered in more than 75 years, but they were included in case of discovery.

Table 2 District of Columbia Species of Greatest Conservation Need 2015 (Additions to SWAP 2015 are shown in green.)

Species	Common Name	Tier Priority
Birds		
Aix sponsa	Wood Duck	1
Ammodramus savannarum	Grasshopper Sparrow	1
Anas rubripes	American Black Duck	1
Antrostomus vociferus	Eastern Whip-poor-will	3
Botaurus lentiginosus	American Bittern	2
Cardellina canadensis	Canada Warbler	2
Catharus fuscescens	Veery	1
Certhia americana	Brown Creeper	2
Chaetura pelagica	Chimney Swift	1
Chordeiles minor	Common Nighthawk	2
Cistothorus palustris	Marsh Wren	2
Coccyzus americanus	Yellow-billed Cuckoo	2
Colinus virginianus	Northern Bobwhite	3
Dolichonyx oryzivorus	Bobolink	1
Egretta caerulea	Little Blue Heron	1
Empidonax traillii	Willow Flycatcher	1
Euphagus carolinus	Rusty Blackbird	1
Falco peregrinus	Peregrine Falcon	1
Falco sparverius	American Kestrel	1
Gallinago delicata	Wilson's Snipe	1
Geothlypis formosa	Kentucky Warbler	2
Haliaeetus leucocephalus	Bald Eagle	2
Helmitheros vermivorum	Worm-eating Warbler	2
Hylocichla mustelina	Wood Thrush	1
Icteria virens	Yellow-breasted Chat	2

Species	Common Name	Tier Priority
Icterus galbula	Baltimore Oriole	1
Ixobrychus exilis	Least Bittern	3
Megascops asio	Eastern Screech-Owl	2
Melanerpes erythrocephalus	Red-headed Woodpecker	2
Mniotita varia	Black-and-white Warbler	1
Nyctanassa violacea	Yellow-crowned Night Heron	1
Nycticorax nycticorax	Black-crowned Night Heron	1
Parkesia motacilla	Louisiana Waterthrush	1
Pipilo erythrophthalmus	Eastern Towhee	1
Piranga olivacea	Scarlet Tanager	1
Porzana carolina	Sora	2
Progne subis	Purple Martin	1
Protonotaria citrea	Prothonotary Warbler	2
Rallus limicola	Virginia Rail	2
Scolopax minor	American Woodcock	1
Seiurus aurocapilla	Ovenbird	1
Setophaga caerulescens	Black-throated Blue Warbler	1
Setophaga castanea	Bay-breasted Warbler	2
Setophaga cerulea	Cerulean Warbler	2
Setophaga citrina	Hooded Warbler	1
Setophaga discolor	Prairie Warbler	1
Setophaga fusca	Blackburnian Warbler	1
Setophaga pensylvanica	Chestnut-sided Warbler	2
Setophaga virens	Black-throated Green Warbler	1
Spizella pusilla	Field Sparrow	1
Sterna forsteri	Forster's Tern	2
Sturnella magna	Eastern Meadowlark	1
Toxostoma rufum	Brown Thrasher	1
Tringa flavipes	Lesser Yellowlegs	2
Vermivora chrysoptera	Golden-winged Warbler	1
Vermivora cyanoptera	Blue-winged Warbler	2
Vireo flavifrons	Yellow-throated Vireo	2
Vireo griseus	White-eyed Vireo	1
Mammals		
Myotis septentrionalis	Northern Long-Eared Bat	1
Myotis leibii	Eastern Small-Footed Bat	1
Myotis lucifugus	Little Brown Bat	1
Perimyotis subflavus	Tri-colored Bat	1
Lontra canadensis	Northern River Otter	1
Mephitis mephitis	Striped Skunk	2

Species	Common Name	Tier Priority
Lasiurus cinereus	Hoary Bat	1
Nycticeius humeralis	Evening Bat	1
Neovison vison	American Mink	2
Lasiurus borealis	Eastern Red Bat	1
Ondrata zibethicus	Muskrat	1
Eptesicus fuscus	Big Brown Bat	1
Lasionycteris noctivagans	Silver Haired Bat	1
Castor canadensis	Beaver	2
Tamias striatus	Eastern Chipmunk	1
Glaucomys volans	Southern Flying Squirrel	1
Urocyon cinereoargentus	Gray Fox	1
Didelphis virginiana	Virginia Opossum	1
Blarnia brevicauda	Northern Short-tailed Shrew	1
Microtus pennsylvanicus	Meadow Vole	1
Sylvilagus floridanus	Eastern Cottontail	1
Reptiles		
Agkistrodon contortrix	Northern Copperhead	1
Carphophis amoneous	Eastern Worm Snake	1
Chrysemys picta picta	Eastern Painted Turtle	1
Clemmys guttata	Spotted Turtle	1
Crotalus horridus	Timber Rattlesnake	3
Diadophis punctatus	Northern Ringneck Snake	1
Glyptemys insculpta	Wood Turtle	2
Glyptemys muhlenbergii	Bog Turtle	3
Kinosternon subrubrum	Eastern Mud Turtle	1
Opheodrys aestivus	Rough Green Snake	1
Plestidon faciatus	Five-lined Skink	1
Pseudemys rubriventris	Eastern Redbelly Turtle	1
Regina septemvittata	Queen Snake	1
Sternotherus odoratus	Common Musk Turtle	1
Storeria dekayi dekayi	Northern Brown Snake	1
Terrepene carolina carolina	Eastern Box Turtle	1
Thamnophis sirtalus	Eastern Garter Snake	1
Amphibians		
Ambystoma maculatum	Spotted Salamander	1
Ambystoma opacum	Marbled Salamander	2
Anaxyrus americanus	American Toad	1
Anaxyrus fowleri	Fowler's Toad	1
Desomognathus fuscus	Northern Dusky Salamander	1
Eurycea bislineata	Northern Two-lined Salamander	1

Species	Common Name	Tier Priority
Hyla chrysoscelis	Cope's Gray Tree Frog	1
Hyla cinerea	Green Tree Frog	3
Hyla versicolor	Gray Tree Frog	1
Lithobates clamitans	Green Frog	1
Lithobates palustris	Pickerel Frog	1
Lithobates sphenocephalus	Southern Leopard Frog	1
Lithobates sylvatica	Wood Frog	1
Notopthalmus viridescens	Eastern Newt	1
Plethodon cinereus	Redback Salamander	1
Pseudacris crucifer	Northern Spring Peeper	1
Pseudacris feriarum	Upland Chorus Frog	1
Pseudotriton ruber	Northern Red Salamander	1
Fish		
Acipenser brevirostrum	Shortnose Sturgeon	2
Acipenser oxyrinchus	Atlantic Sturgeon	3
Alosa aestivalis	Blueback Herring	1
Alos mediocris	Hickory Shad	1
Alosa pseudoharengus	Alewife	1
Alosa sapidissima	American Shad	1
Ameriurus nebulosus	Brown Bullhead	1
Amia calva	Bowfin	2
Anguilla rostrata	American Eel	1
Margariscus margarita	Pearl Dace	3
Morone saxatilis	Striped Bass	1
Notropis bifrenatus	Bridle Shiner	3
Dragonflies and Damselflies		
Anax longipes	Comet Darner	2
Archilestes grandis	Great Spreadwing	1
Argia sedula	Blue-ringed Dancer	2
Arigomphus villosipes	Unicorn Clubtail	1
Cordulegaster erronea	Tiger Spiketail	1
Enallagma aspersum	Azure Bluet	2
Enallagma basidens	Double-striped Bluet	2
Enallagma divagans	Turquoise Bluet	1
Enallagma traviatum	Slender Bluet	2
Erpetogomphus designatus	Eastern Ringtail	2
Gomphus exilis	Lancet Clubtail	2
Gomphus vastus	Cobra Clubtail	2
Hagenius brevistylus	Dragonhunter	1
Ischnura kellicotti	Lilypad Forktail	1

Species	Common Name	Tier Priority
Ischnura ramburii	Rambur's Forktail	2
Lestes forcipatus	Sweetflag Spreadwing	2
Lestes inaequalis	Elegant Spreadwing	2
Nasiaeschna pentacantha	Cyrano Darner	1
Nehalennia gracilis	Sphagnum Sprite	3
Nehalennia irene	Sedge Sprite	3
Neurocordulia obsoleta	Umber Shadowdragon	2
Somatochlora filosa	Fine-lined Emerald	3
Somatochlora linearis	Mocha Emerald	1
Somatochlora tenebrosa	Clamp-tipped Emerald	2
Stylogomphus albistylus	Eastern Least Clubtail	2
Stylurus plagiatus	Russet-tipped Clubtail	1
Butterflies		
Callophrys irus	Frosted Elfin	3
Danaus plexippus	Monarch	1
Euphydryas phaeton	Baltimore Checkerspot	1
Hesperia leonardus	Leonard's Skipper	1
Lycaena hyllus	Bronze Copper	2
Polites origenes	Crossline Skipper	1
Pompeius verna	Little Glassywing	3
Satyrium edwardsii	Edwards' Hairstreak	3
Speyeria cybele	Great Spangled Fritillary	2
Speyeria idalia	Regal Fritillary	2
Bees		
Bombus affinis	Rusty-patched Bumble Bee	2
Lasioglossum michiganense	A Sweat Bee	2
Protandrena abdominalis	A Mining Bee	2
Pseudopanurgus virginicus	A Slender Tri-color Mining Bee	2
Mussels and Snails		
Alasmidonta heterodon	Dwarf Wedgemussel	3
Alasmidonta undulata	Triangle Floater	2
Alasmidonta varicosa	Brook Floater	2
Anguispira fergusoni	Coastal-plain Tigersnail	2
Anodonta implicata	Alewife Floater	2
Fontigens bottimeri	Appalachian Springsnail	3
Lampsilis cariosa	Yellow Lampmussel	2
Lasmigona subviridis	Green Floater	2
Leptodea ochracea	Tidewater Mucket	2
Ligumia nasuta	Eastern Pondmussel	2
Oxyloma effusum	Coastal-plain Ambersnail	2

Species	Common Name	Tier Priority
Oxyloma subeffusum	Chesapeake Ambersnail	2
Stenotrema barbatum	Bristled Slitmouth	2
Crustaceans		
Acanthocyclops columbiensis	Copepod sp.	1
Attheyella (Mrazekiella) carolinensis	*Copepod sp.*	2
Attheyella (Mrazekiella) obatogamensis	Copepod sp.	2
Attheyella (Mrazekiella) spinipses	A harpacticoid copepod	2
Bryocamptus zschokkei alleganiensis	Copepod sp.	2
Bryocamptus (Bryocamptus) hutchinsoni	Copepod sp.	2
Bryocamptus (Bryocamptus) minutus	Copepod sp.	2
Bryocamptus (Limocamptus) nivalis	Copepod sp.	2
Cambarus acuminatus	Acuminate crayfish	2
Cambarus diogenes	Devil Crawfish	2
Cambarus dubius	Upland Burrowing Crayfish	2
Diacyclops harryi	Copepod sp.	2
Diacyclops navus	Copepod sp.	2
Eucyclops elegans	Copepod sp.	2
Macrocyclops albidus	Copepod sp.	2
Paracyclops poppei	Copepod sp.	2
Skistodiaptomus pallidus	A calanoid copepod	2
Stygobromus hayi	Hay's Spring Amphipod	1
Stygobromus kenki	Kenk's Amphipod	1
Stygobromus pizzinii	Pizzini's Cave Amphipod	2
Stygobromus sextarius	Capital Area groundwater amphipod	2
Stygobromus tenuis potomacus	Potomac Groundwater Amphipod	1
Sponges		
Ephydatia sp.	A Freshwater Sponge	2
Spongilla sp.	A Freshwater Sponge	2

2.6 Changes from SWAP 2005

The large amount of data collected from the surveying species in the District drove the addition and removal of a number of species to the 2015 SGCN list. Species were removed or added for a variety of reasons. Species were removed if recent occurrence data indicated that the species populations were secure or if historical and contemporary data showed that the species had been extirpated long-term. Other species were removed if there were no records of

that species ever existed in the District. See Table 3 for a complete list of the species that were removed and why.

Species were scored based on the Millsap ranking criteria where recent local or regional data suggested declining populations or new data was available for species that were not assessed in 2005. Finally, some new taxa (bees, terrestrial snails, crayfish, and sponges) have been added based on local and regional data and conservation goals.

Table 3 SGCN Removed from SWAP 2015

Species	Common Name	Reason for Removal
Birds		
Bubo virginianus	Great Horned Owl	District and regional populations stable and increasing
Buteo lineatus	Red-shouldered Hawk	
Buteo platypterus	Broad-winged Hawk	No longer breeding in District, uncommon migrant
Empidonax virescens	Acadian Flycatcher	District and regional populations stable and increasing
Mammals		
Neotoma magister	Allegheny Woodrat	No historical records of ever being documented in the city
Synaptomys cooperi	Southern Bog Lemming	No historical records of ever being documented in the city
Reptiles		
Thamnophis sauritus	Eastern Ribbon Snake	No current records of occurrence
Elaphe guttata	Corn Snake	No current records of occurrence
Cemophora coccinea	Scarlet Snake	No current records of occurrence
Sceloporus undulatus	Eastern Fence Lizard	No current records of occurrence
Heterodon platirhinos	Eastern Hognose Snake	No current records of occurrence
Coluber constrictor	Black Racer	No current records of occurrence
Amphibians		
Acris crepitans	Cricket Frog	No current records of occurrence
Pseudotriton montanus	Mud Salamander	No historical records of ever being documented in the city
Fish		
Campostoma anmalum	Central Stoneroller	District and regional populations stable and increasing
Ericymba buccata	Silverjaw Minnow	
Etheostoma blennioides	Greenside Darter	
Lepomis gulosus	Warmouth	

Species	Common Name	Reason for Removal
Dragonflies and Damselflies		
Lestes dryasa	Emerald Spreadwing	No historical records of ever being documented in the city
Tachopteryx thoreyi	Grey Petaltail	No historical records of ever being documented in the city
Butterflies		
Erynnis martialis	Mottled Duskywing	No historical records of ever being documented in the city
Euptoieta claudia	Variegated Fritillary	District and regional populations stable and increasing
Polygonia comma	Eastern Comma	
Polygonia interrogationis	Question Mark	
Pyrgu wyandot	Appalachian Grizzled Skipper	No historical records of ever being documented in the city
Vanessa atalanta rubria	Red Admiral	District and regional populations stable and increasing
Bees		
N/A		
Mollusks		
None removed		
Crustaceans		
Acanthocyclops villosipes	Copepods	Questions about taxonomy
Attheyella villosipes		
Attheyella (Canthocamptus) illinoisensis		No recent or established trends or overall threats to this species/group
Attheyella (Mrazekiella) illinoisensis		
Attheyella (Mrazekiella) obatogamen		
Paracylcops fimbriatus chiltoni		
Sponges		
None removed		

Chapter 3 Habitats

3.1 District of Columbia's Diverse Habitats

The District is a fully developed urban city that also contains significant wildlife habitat in its parks and other natural areas. There are dense commercial areas, moderately dense suburban areas, and two large rivers, all located directly adjacent to permanently protected natural areas. The dichotomy between developed areas and undeveloped habitats, coupled with the small total area of the District, creates a unique dynamic between wildlife and habitat conservation and human use of local natural areas. It also presents opportunities to view and study the urban and suburban parts of the District as integral components of the habitats that SGCN require. District includes more than 900 acres of city parks and more than 6,700 acres of national parkland (District of Columbia Office of Planning 2006). While it can be difficult for humans and wildlife to coexist within the borders of one city, the early protection of large areas of the city (Rock Creek Park in 1890 and Fort Circle Parks in 1925) and the location of the city at the geographic fall line has led to an unexpectedly wide diversity of wildlife and habitats. This combination of developed and natural areas leads to interesting dynamics in terms of the interface between humans and wildlife.

The District's varied land uses, protected areas, soils, geography, topography, and hydrology support a variety of plant communities that provide habitat for animal wildlife. This chapter identifies these habitats, provides an assessment of their condition, and details the selection of key habitat areas (Conservation Opportunity Areas) that will be the targets of direct conservation actions. In the context of this plan habitat is defined as the place where an animal normally lives or spends time while it is present in the District. This includes broad categories such as river or forest, specific natural and semi-natural vegetative communities, and developed areas that may support some wildlife.

3.1.1 Local Context

Habitat type is ultimately driven by abiotic factors such as soil and climate. This section provides brief descriptions of abiotic factors that underlay the vegetative habitats of the District.

The District is bisected by two physiographic regions, which define and influence the local habitat context. The geologic fall line separates the Appalachian Piedmont region and the Mid-Atlantic coastal plain. This fall line marks a

transitional zone where the sedimentary rock, softer soils, and sloping hills of the coast intersect with more resilient, steeper, metamorphic rocks of the piedmont. This split provides an increased variety of habitats and the animal species associated with those habitats. The physiographic regions are further classified into smaller ecoregions based on both abiotic and biotic factors. An ecoregion is defined by the World Wildlife Fund as a large area of land or water that contains a geographically distinct assemblage of natural communities that share a large majority of species and ecological dynamics, share similar environmental conditions, and interact ecologically in ways that are critical for longtime persistence. They can also be described as a composition of biotic and abiotic phenomena, including geology, physiography, vegetation, climate, soils, land use, wildlife, and hydrology, that affect or reflect differences in ecosystem quality and integrity (Wiken 1986; Omernik 1987, 1995).

The Environmental Protection Agency (EPA) created a hierarchical categorization of ecoregions with four levels of detail. The level III and IV ecoregions for the Mid-Atlantic states are shown in Figure 1. Above the fall line, the western part of the District is in the EPA level III Ecoregion 64: Northern Piedmont. The Northern Piedmont includes the foothills of the Appalachian Mountains in the Mid-Atlantic region. It extends from Virginia to northern New Jersey and covers approximately 66,491 square kilometers in total. The region is bordered by Mid-Atlantic coastal plain to the east and the Appalachian Mountains to the west. From the geographic fall line at approximately 60 meters elevation, the Piedmont extends west to the Blue Ridge and the Ridge and Valley regions of the Appalachian Mountains, reaching elevations of 300–600 meters. The topography of the Piedmont is descending rolling hills and the soils and underlying bedrock are composed of erosion-resistant igneous and metamorphic rock (Kearney 2003). Below the fall line the eastern part of the District is in the EPA level III Ecoregion 65; Southeastern Plains. This section of the Mid-Atlantic coastal plain extends into Virginia, Maryland, Delaware, Pennsylvania and New Jersey and it covers approximately 56,220 square kilometers. The region is bordered by the Atlantic Ocean to the east and the Piedmont to the west. The region exists as a result of alluvial deposition of eroded rock and clay from the Piedmont and Appalachian mountains. Steep, high energy rivers that arise in the Appalachian Mountains slow down below the fall line and release sediment onto the Coastal Plain. The low-lying plain begins at an elevation of less than 80 meters and extends down to sea level. The lowest elevations are characterized by bays and tidal rivers, such as the Chesapeake Bay and Potomac River. The soils are primarily derived from the slow-draining clay sediments deposited from the mountains, leading to the development of many types of expansive wetlands (Watts 1999).

In 1995, Bailey provided descriptions of the ecoregions of the U.S. Forest Service classification system (McNab and Avers1994, Bailey1995). The Nature

Conservancy (TNC) adapted Bailey's system (1995) to classify ecoregions for its regional planning effort (Groves 2002). The District falls within TNC's Chesapeake Bay Lowlands and the Lower New England Northern Piedmont Ecoregion. In 1998, the North American Bird Conservation Initiative, in conjunction with Partners in Flight, developed its Bird Conservation Regions (BCR) based on TNC's Ecoregions. The District falls within two Bird Conservation Regions: the Piedmont (BCR #29) and the England/Mid-Atlantic Coast (BCR #30) (Kearney 2003, Watts 1999).

The District shares these ecoregions with the surrounding states of the Mid-Atlantic region, including Maryland, Virginia, Pennsylvania, and New Jersey, making the District geographically similar to those states. This has many important implications for conservation planning. Issues important to habitats within the District are also important to the surrounding states. Therefore, coordination with those states should be a central component to developing conservation strategies.

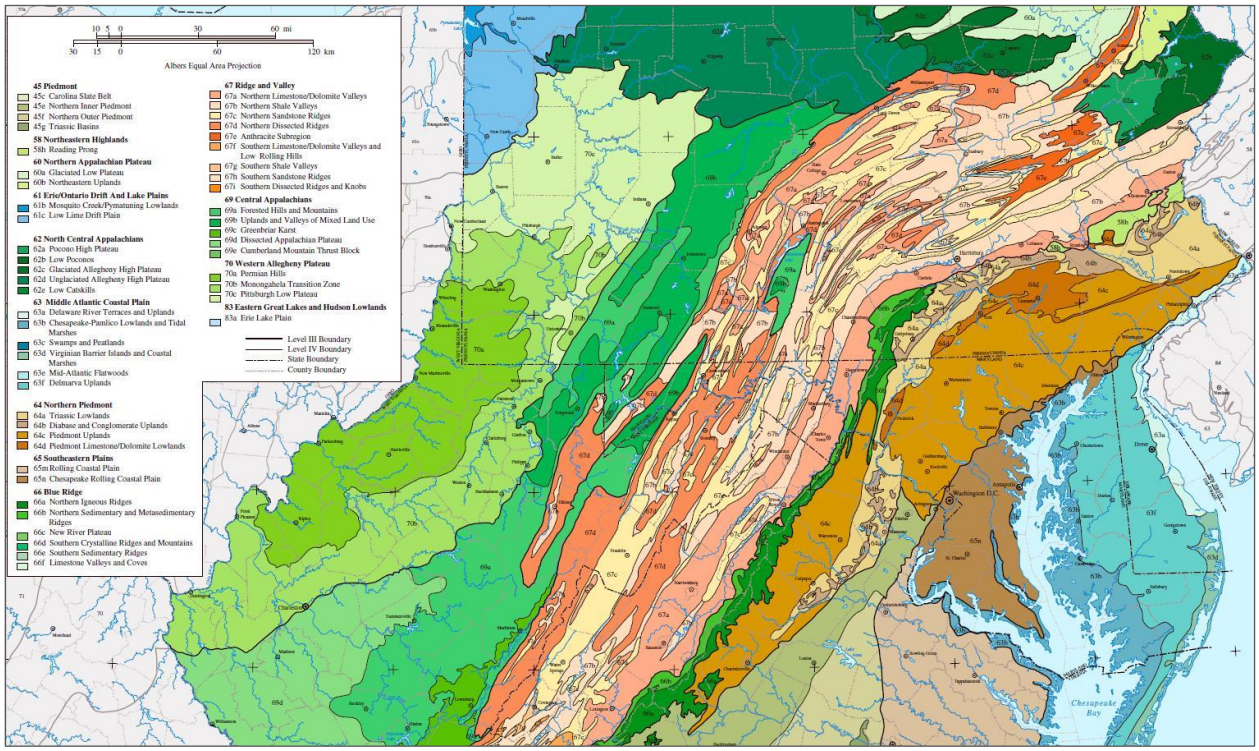

Figure 1 Level III and IV Ecoregions from the Environmental Protection Agency's hierarchical classification system. (EPA Western Ecology Division, 2015)

3.1.2 Northeast Regional Context

The District is part of the northeastern U.S. region that extends from Maine to Virginia. From the NE Regional Synthesis: The Northeast is over 60% forested, with an average forest age of 60 years, and contains more than 200,000 miles of rivers and streams, 34,000 water bodies, and more than 6 million acres of wetlands. Eleven globally unique habitats, from sandy barrens to limestone glade, support 2,700 restricted rare species. Habitat fragmentation is one of the greatest challenges to regional biodiversity, as the region is crisscrossed by over 732,000 miles of roads. The region also has the highest density of dams and other obstacles to fish passage in the country with an average of seven dams and 106 road-stream crossings per 100 miles of river (Martin and Apse 2011). Conversion to human use has also impacted much of the Northeast landscape, with one-third of forested land and one-quarter of wetlands already converted to other uses through human activity. Total wetland area has expanded slightly in the Northeast over the past twenty years, although 67% of wetlands are close to roads and thus have likely experienced some form of disruption, alteration, or species loss.

Many of the threats described above are directly applicable at the finest scale to wildlife habitat in the District. Habitat conditions in the District can serve a proxy for future conditions across the northeast region as human-dominated land uses continue to encroach upon undeveloped wildlife habitat.

3.2 Process for Defining and Describing Habitats

Vegetative habitats were classified using the Northeast Lexicon and the Northeastern Terrestrial Wildlife Habitat Classification System (Gawler 2008). Aquatic habitats are based loosely on the Northeastern Aquatic Habitat Classification System (Olivero and Anderson 2008).

The Northeast Terrestrial Habitat Classification System (NETHCS) was developed in 2008 to provide a coarse but cohesive system to describe the physical and biological characteristics relevant to wildlife conservation (Gawler 2008). The Habitat System corresponds to the ecological system units developed by NatureServe (Comer et al 2003) which occur in the Northeast, with additional systems for altered habitats and land-use types. The hierarchical system uses the terms Formation, Macrogroup and Habitat System (Table 4) as increasingly fine-grained categories of habitat types. The system includes 7 Formation Classes at the top level, 15 Formations in the second tier, 35 Macrogroups in the third tier, and 143 Habitat Systems (Crisfield and NEFWDTC 2013). In this plan the terrestrial habitat types are classified to the Habitat System level, although some finer-scale plant associations are called out in the descriptions of unique habitats.

The Northeastern Aquatic Habitat Classification System was developed to create a standard classification system that describes freshwater aquatic systems, particularly rivers and streams, across the northeastern United States. "The goal of the classification system is to consistently represent the natural flowing-water aquatic habitat types across this region in a manner deemed appropriate and useful for conservation planning by the participating states. The system is meant to unify state classifications and promote an understanding of aquatic biodiversity patterns across the region" (Olivero and Anderson 2008). The hierarchical system uses Drainage Area, Gradient, Buffering Capacity, and Temperature to classify streams. Drainage Area is a measure of river or stream size, which is a critical factor determining the aquatic animal community. Gradient affects the morphology and substrate of the steam bed, and the velocity of the water. Buffering Capacity is a measurement of the stream's underlying soils and bedrock, which influences the pH of the stream. Acidic water can be detrimental to the health of fish and other organisms (Allan 1995). Aquatic organisms are also limited by stream temperature for successful reproduction and overall survival. Non-vegetated intertidal aquatic habitats are from the NETHCS. Other aquatic habitats include freshwater ponds, reservoirs, riverine ponds, vernal pools, and springs and seeps.

Table 4 Formations and Macrogroups Comprising the Northeast Terrestrial Wildlife Habitat Classification System from *The Northeast Lexicon* (Crisfield and NEFWDTC 2013)

Formation Class	Formation Name	Macrogroup
Forest and Woodland	Southeastern Upland Forest	Longleaf Pine
	Northeastern Upland Forest	Southern Oak-Pine
		Central Oak-Pine
		Northern Hardwood & Conifer
		Plantation and Ruderal Forest
		Exotic Upland Forest
	Northeastern Wetland Forest	Southern Bottomland Forest
		Coastal Plain Swamp
		Central Hardwood Swamp
		Northeastern Floodplain Forest
		Northern Swamp
	Boreal Upland Forest	Boreal Wetland Forest
		Boreal Forested Peatland
Shrubland and Grassland	Grassland and Shrubland	Glade and Savanna
		Outcrop & Summit Scrub
		Lake & River Shore
		Ruderal Shrubland & Grassland
	Coastal Scrub-Herb	Coastal Grassland & Shrubland
	Peatland	Northern Peatland
		Coastal Plain Peatland
		Central Appalachian Peatland
	Freshwater Marsh	Coastal Plain Pond
		Emergent Marsh
		Wet Meadow / Shrub Marsh
		Modified / Managed Marsh
	Salt Marsh	Salt Marsh
Polar and High Montane	Alpine	Alpine
Aquatic (in part)	Intertidal	Intertidal Shore
Sparsely Vegetated Rock	Cliff and Rock	Cliff and Talus
		Flatrock
		Rocky Coast
Agricultural	Agricultural	Agricultural
Developed	*No name provided*	Maintained Grasses and Mixed Cover
		Urban/Suburban Built
		Extractive

3.3 Habitat Descriptions

The District of Columbia is 69 square miles in total area. It is 78% developed land; 10% open water; and 12% undeveloped forest, shrubland, or grassland (Table 5). The District is located at the geographic fall line between the Appalachian piedmont and Atlantic coastal plain. Two tidal rivers, the Anacostia and Potomac, converge in the District. Developed land makes up the largest proportion of the District. This includes industrial and commercial areas, roads and other paved areas, residential areas, and mowed grasslands such as athletic fields and roadside rights-of-way. The forests in the District are in the Northeastern Upland Forest and Northeastern Wetland Forest Formations. Most forested areas are found in National Park land in Rock Creek Park, National Capital Parks-East and Chesapeake and Ohio National Historical Park. Shrublands, emergent wetlands, and meadows are typically found in these parks as well. The natural areas in the District include a broad range of habitat types, including a globally rare plant community (Gravel Terrace Fall-Line Magnolia Bog) and the diverse ice-scour forest communities of the Potomac Gorge ecosystem. The Anacostia and Potomac Rivers make up a large portion of the open water of the District and several medium and small-sized creeks are tributaries of both larger water bodies. Rock Creek is a tributary of the Potomac River, while Oxon Run, Watts Branch, and many other creeks are tributaries of the Anacostia River.

Soils

Most soils have been altered by development or dredge/fill operations, but much of the soils in parks remain undisturbed. Soils types are influenced by the geologic history of the Piedmont and Coastal Plain. Soils of the Piedmont are underlain by bedrock. Erosion and weathering of the bedrock contribute to the soil type. Soils of the Coastal plain are the result of the geologic erosion and weathering of the softer stone of the Appalachian Mountains, and by the most extreme southerly glaciation of past ice ages. Silty loams dominate the piedmont soils, while sandy, gravelly soils dominate the higher elevations of the Coastal Plain. Low elevations of the coastal plain are typically clayey soils. Low elevations of the Potomac Gorge area are dominated by boulder-underlain Fluvaquent soils. Low elevations along the Anacostia River are nearly 100% altered Udorthent soils, dominated by coarse textured soil materials, silt and loam, often severely compacted (Smith 1976).

Climate

The District's climate is temperate/sub-tropical, with hot humid summers and cold winters. Average precipitation is 39.7 inches per year, and the mean annual temperature is 58.2 degrees Fahrenheit. The warmest month is July, and

the coldest month is January. Average monthly precipitation is 3.2 inches, and the wettest month is May and the driest month is January (NOAA 2014). Severe weather can include hurricanes, winter blizzards and ice storms, riverine flooding, and high wind events.

Table 5 Area and Percent of Developed Land and Habitat Areas in the District Categorized by Formation Class from the Northeast Terrestrial Wildlife Habitat Classification System

Formation Class	Acres	Hectares	Percent
Water	4,573.4	1,850.8	10.4
Developed Land	34,162.0	13,823.3	77.8
Forest and Woodland	4,728.7	1,913.6	10.8
Shrubland and Grassland	440.6	178.3	1.0
Total	**43,904.6**	**17,766.0**	**100.0**

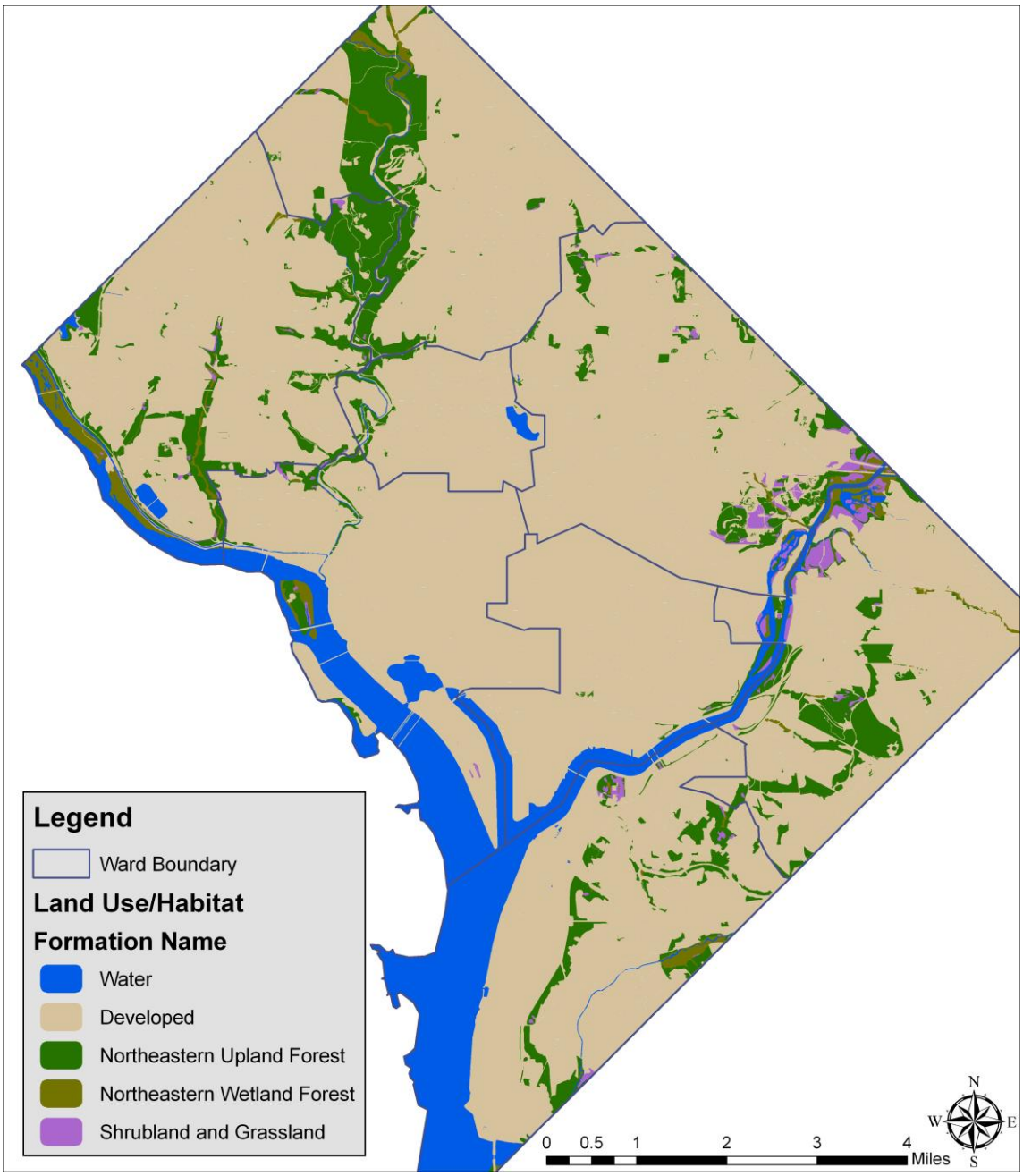

Figure 2 District of Columbia habitat formation map.

3.3.1 Critical Habitat and Vegetation Systems

In the Land Use /Habitat Formation map (see Figure 2), the natural vegetation types are Northeastern Upland Forest, Northeastern Wetland Forest, and Shrubland and Grassland. These areas represent locations where the best wildlife habitats can be found in the District. The variety of vegetation types within these Formations is detailed below. Describing these habitats wildlife in

greater detail will help provide an understanding of the complexity of the land in the District, and will create a greater understanding of the threats to wildlife and their habitats and how these areas will change and respond to threats. Nine undeveloped (or natural) and four developed Macrogroups are included, as are seventeen natural and eight developed Habitat Systems. The natural vegetative Habitat Systems will be described in detail. Within the Habitat Systems a few of the rare and endemic vegetative habitats will be described to the plant association level, a higher level of detail. The Habitat System level will allow us to implement conservation actions to various threats to critical habitats. In cases where data is incomplete for population trends for certain taxa, such as reptiles, amphibians and invertebrates, conservation actions at the habitat level may be the best way to ensure conservation of rare species in those habitats.

The classification of the vegetative community types was performed by DDOE using Geographic Information System (GIS) data layers and field surveys of District-owned land. A vegetative community data layer was provided to DDOE by the National Park Service. This dataset contains discrete polygons representing the natural vegetation and other land cover for the National Parks in the National Capital Region. Natural and semi-natural vegetation was classified to the association level of the U.S. National Vegetation Classification (USNVC) or were combined into vegetation complexes. Cultural and developed land cover types were mapped according to the National Land Cover Database 2001. The dataset was developed by photo interpretation of several sets of high-resolution aerial photography with additional ancillary data layers. The dataset was developed as part of the NPS/USGS Vegetation Mapping Program (NPS, 2014a).

Forested and other habitat areas on non-NPS land (District-owned, federal, institutional, and private lands) were extracted from various DCGIS layers and were merged with the NPS vegetation layer described above. Forest vegetative communities were determined using a rapid habitat assessment. Canopy trees and shrubs were identified in several locations in each forested patch. In smaller patches (<1 acre) the entire patch was assessed. In larger patches the plant community was identified in several areas and extrapolated to the rest of the patch.

The species in these patches were compared to nearby patches from the NPS data layer, and were categorized based on the dominant plant species using the same classification system as the NPS data. The U.S. Department of Agriculture's National Arboretum provided a GIS data layer that included forest and meadow types classified to the association level of the USNVC. For developed areas the DCGIS Land Use/Land Cover data layer was used to extract existing land use delineations the District. The data layer was originally developed to support in the District's 2004 Comprehensive Plan review and is

updated annually by DCGIS. Impervious surfaces (roads), commercial areas, industrial areas, institutions, and residential areas were re-classified according to the Northeast Terrestrial Wildlife Habitat Classification System.

3.3.2 Vegetative Systems

Habitat systems are described below. The natural, undeveloped vegetative systems are described first, followed by semi-natural and successional systems, and finally, developed habitats. Habitat System descriptions shown in italics are taken from the Northeast Habitat Guides: A Companion to the Terrestrial and Aquatic Habitat Maps (Anderson et al 2013). Table 6 shows the total area of each Habitat System. Figure 3 shows Habitat Systems for the District as a whole. Figures 4–6 show detailed views of the habitats in the upper Anacostia River area, Rock Creek Park, and the upper Potomac River area.

Table 6 Area of District of Columbia Habitat Systems

Formation Name	Macrogroup	Habitat System	Area	
			Hectares	Acres
Aquatic*		*Aquatic habitats are detailed in a separate table.	1,894.5	4,681.3
Northeastern Upland Forest	Central Oak-Pine	Central Appalachian Dry Oak-Pine Forest	317.0	783.3
		Southern Interior Low Plateau Dry - Mesic Oak Forest	161.5	399.0
		Successional Virginia Pine Forest	4.4	10.9
	Northern Hardwood & Conifer	Southern Atlantic Coastal Plain Mesic Hardwood Forest	681.2	1,683.2
	Plantation & Ruderal Forest	Northern and Central Hardwood and Conifer - Ruderal Forest	507.0	1,252.8
Northeastern Wetland Forest	Coastal Plain Swamp	Northern Atlantic Coastal Plain Tidal Swamp	10.6	26.2
		Successional Woody Wetland	20.0	49.5
	Northeastern Floodplain Forest	Central Appalachian River Floodplain	147.7	364.9
		Central Appalachian Stream and Riparian	78.8	194.7
		Northern Atlantic Coastal Plain Stream and River	27.2	67.3
Shrubland & Grassland	Emergent Marsh	Northern Atlantic Coastal Plain Fresh/Oligohaline Tidal Marsh and Created Marsh	40.0	98.8
	Modified/ Managed Marsh	Introduced Wetland and Riparian Vegetation	0.3	0.7
	Ruderal Shrubland & Grassland	Introduced Shrubland	35.6	88.0
		Ruderal Upland - Old Field	102.9	254.2
Developed	Maintained Grasses & Mixed Cover	Canopy Trees and Recreational Grasses	151.8	375.0
		Urban and Recreational Grasses	1,669.0	4,124.3
	Urban/Suburban Built	Commercial/Industrial	6,250.6	15,445.5
		Residential - High Intensity	1,695.4	4,189.5
		Residential - Medium Intensity	4,044.8	9,995.0
		Total	**17,840.3**	**44,084.3**
		Total Square Miles		**68.9**

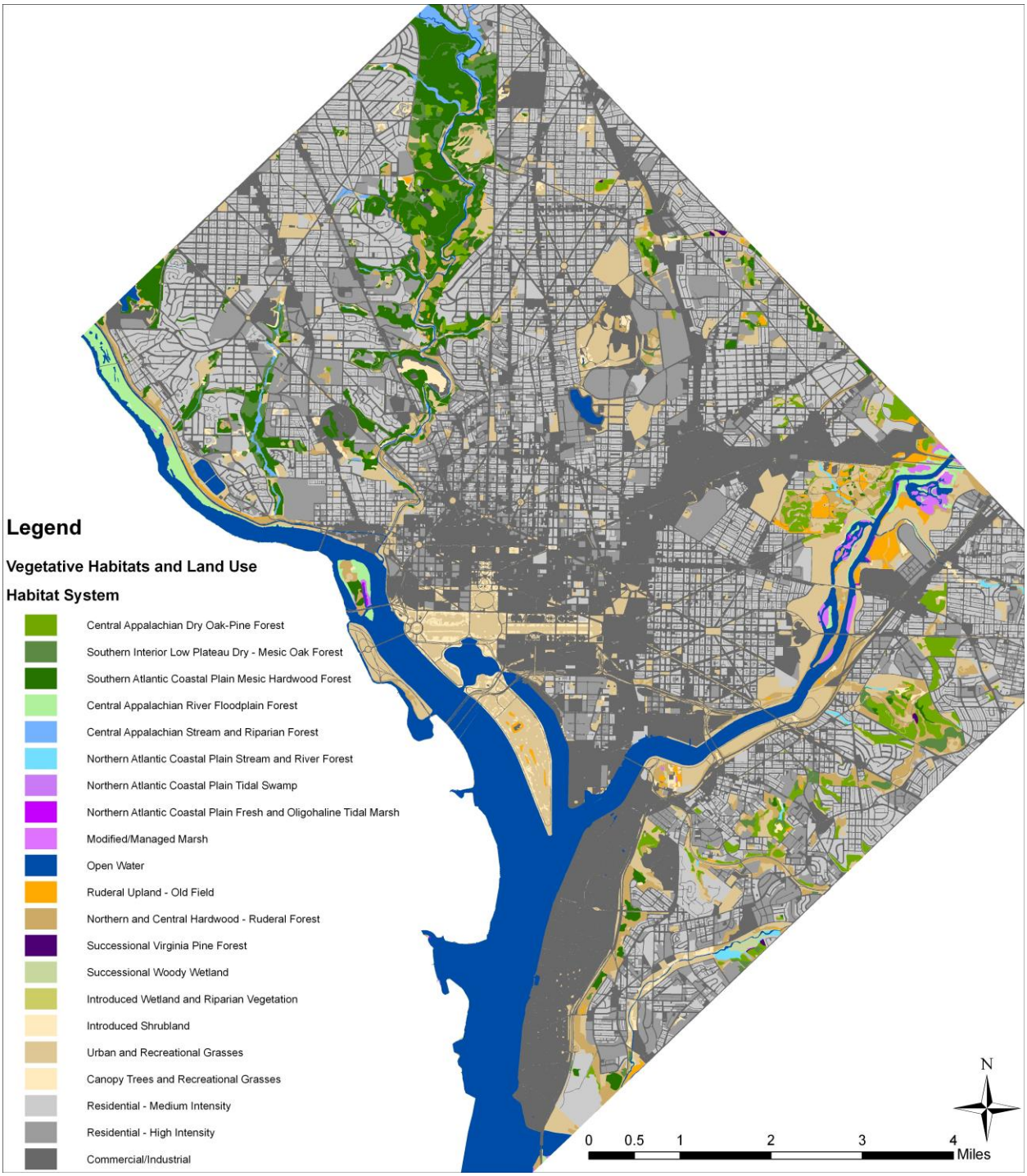

Figure 3 District of Columbia vegetative habitats and land use classified into Habitat System categories.

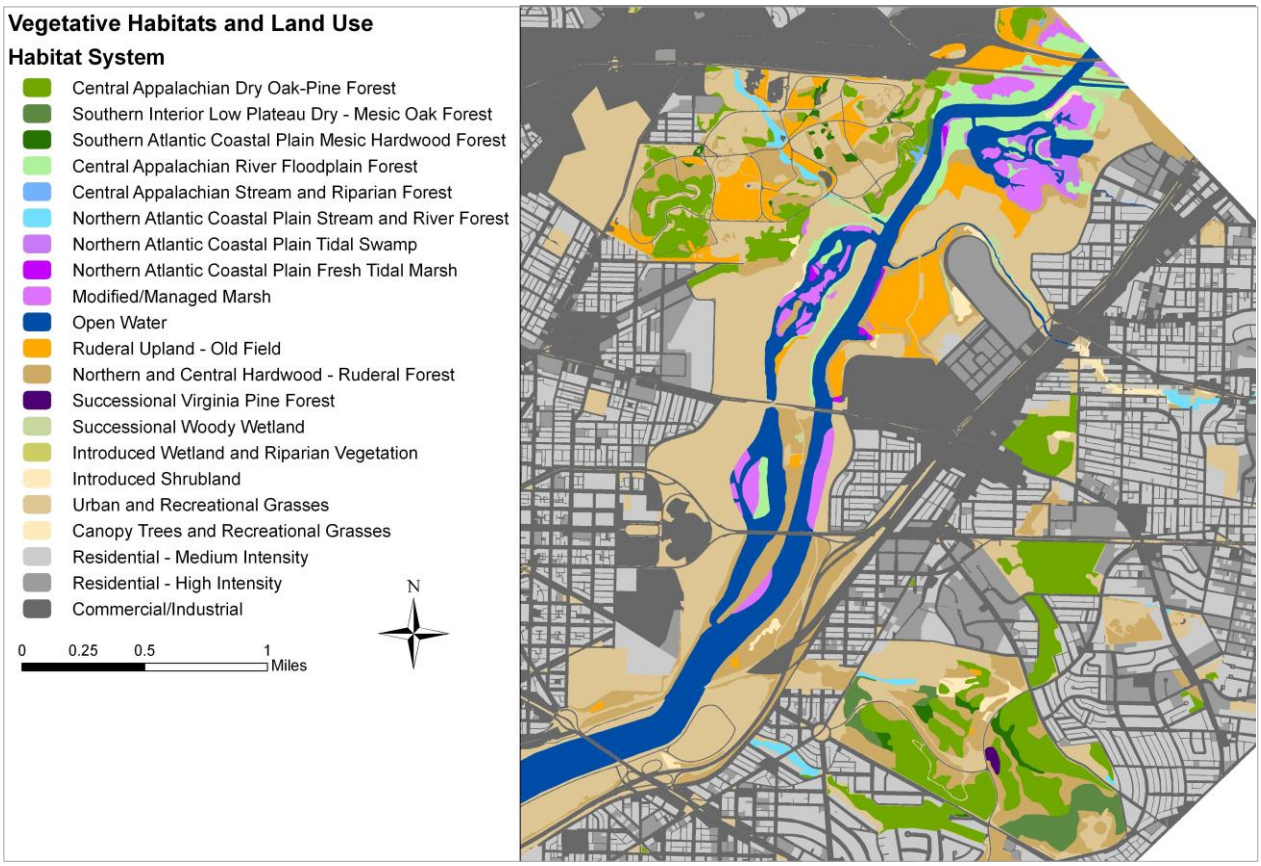

Figure 4 Vegetative habitats and land use in the upper Anacostia River area of the District of Columbia, classified into Habitat System categories.

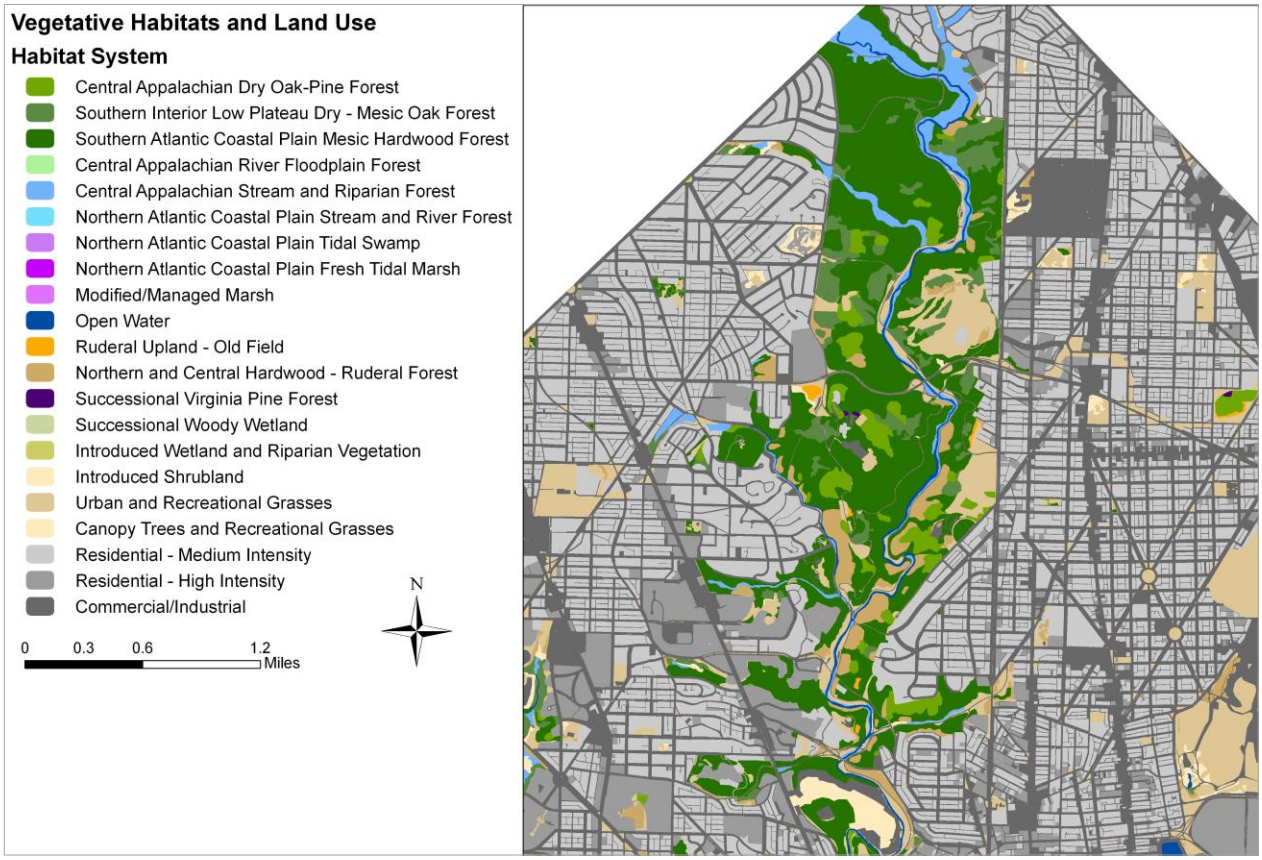

Figure 5 Vegetative habitats and land use near Rock Creek Park in the District of Columbia, classified into Habitat System categories.

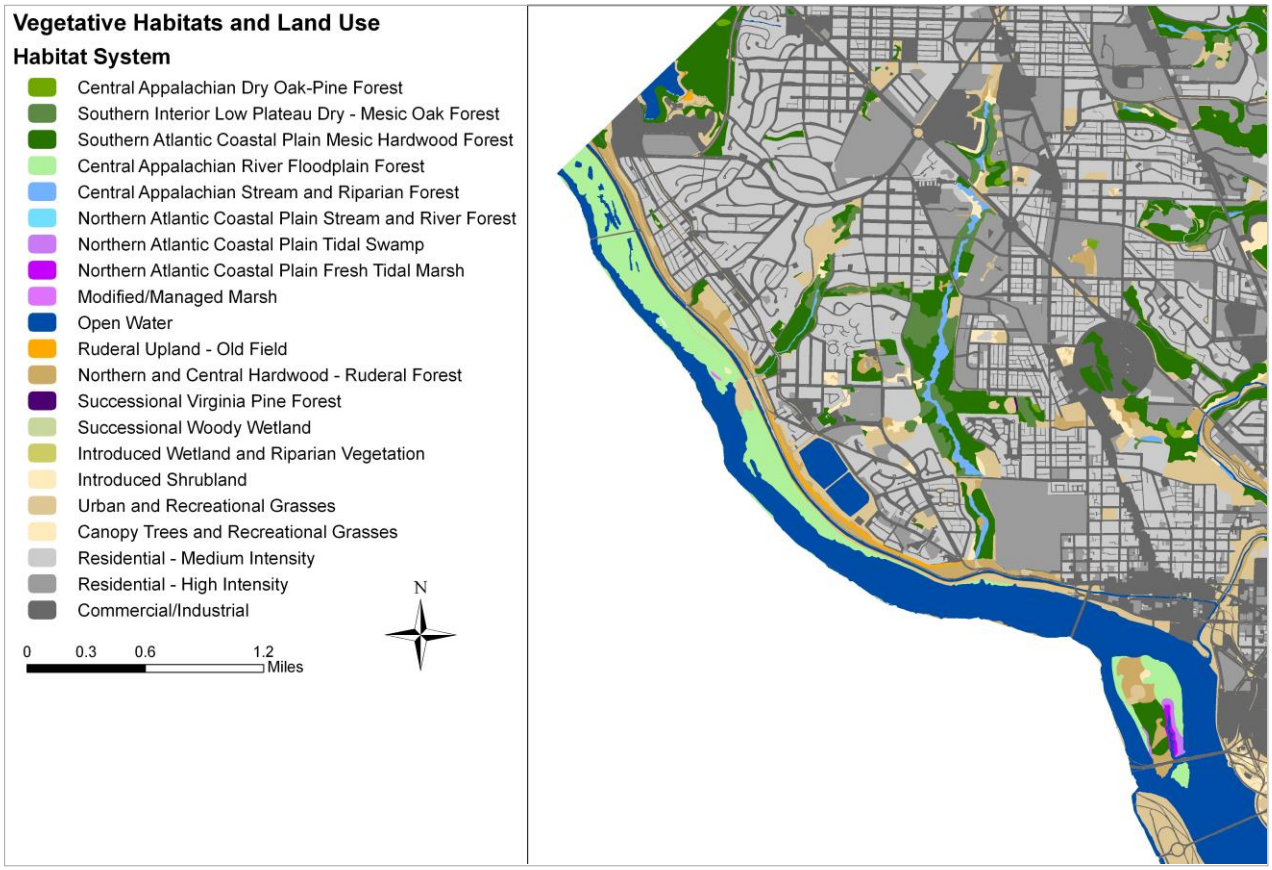

Figure 6 Vegetative habitats and land use near the upper Potomac River and northwest sections of the District of Columbia, classified into Habitat System categories.

Northeastern Upland Forest; Central Oak-Pine; Central Appalachian Dry Oak-Pine Forest

An oak or oak-pine forest of dry sites, characterized by a variable mixture of drought tolerant oaks (chestnut oak, white oak, red oak, black oak, scarlet oak) and pines (pitch, white, Virginia). It occurs broadly in the Central Appalachians and northern Piedmont ecoregions, most commonly as a large (to very large) patch habitat. It has a much more limited range in New England, where hickories may be present. Community structure ranges from open woodlands to closed forest. Heath shrubs are common in the understory; the herb layer is often sparse and lacks diversity. In the absence of fire this system may tend to succeed to hemlock and locally common hardwoods.

In the District this type is found on the gravel-terrace hills of the Coastal Plain. The dominant trees are Chestnut and White Oak, and the dominant understory shrubs are Mountain Laurel and other heath species such as blueberry and azalea. These hilly locations include the Fort Circle Parks (Ft. Chaplin, Ft. Dupont, etc.), and some steep, well-drained slopes in Rock Creek Park. This habitat type is typically the highest quality forest habitat in the District. The parks where this type is found are relatively free of invasive plants, deer browse, and the impacts of human recreation.

Northeastern Upland Forest; Central Oak-Pine; Southern Interior Low Plateau Dry - Mesic Oak Forest

A successional semi-natural forest type of rich mesic soils, characterized by tulip poplar, northern red oak, American beech, maples, spicebush, eastern redbud. It occurs in the central Piedmont region and Coastal Plains, in the interior Low Plateau west of the Appalachian Mountains and at low elevations of the Appalachian Mountains, typically where soils disturbed by agriculture have re-forested through natural succession. The shrub and sub-canopy layers are lush, and the herbaceous layer can be dominated by non-native invasive plant species.

In the District this habitat is found in patches throughout the northern part of Rock Creek Park and smaller parks west of Rock Creek. Where this type is adjacent to streets and other urban areas, the forest edges are dominated by invasive vines shrubs and herbaceous plants. The forests have been moderately impacted by deer browse. There are few tree seedlings, and few saplings less than 15 years old. The shrub layer is dominated by deer-resistant species such as spicebush and arrowwood, and there is a sparse herbaceous layer in most places. Human recreation impacts also decrease habitat quality. Formal and informal trails extend through this habitat, which allows invasive plants to penetrate into the forest interior.

Northeastern Upland Forest; Northern Hardwood & Conifer; Southern Atlantic Coastal Plain Mesic Hardwood Forest

A hardwood forest of the coastal plain with a significant component of mesophytic (moist but non-wetland) species, such as American beech or southern sugar maple. Upland and bottomland oaks at the mid-range of moisture tolerance are usually also present, particularly white oak, but sometimes also southern red oak, cherrybark oak, or Shumard oak. Loblolly pine is sometimes present, but it is unclear if it is a natural component or has entered only as a result of past cutting. Understories are usually well-developed. Shrub and herb layers may be sparse or moderately dense. Ranging south from New

Jersey to Georgia, these mostly large patch coastal plain forests occupy a variety of moist sites that are naturally sheltered from frequent fire.

This system is extensive in Rock Creek Park and other forested areas in the Piedmont region of the District. Most of the upland forest canopy of Rock Creek Park is this type but the quality is low. The forest edges are dominated by invasive vines shrubs and herbaceous plants. The forests have been extremely impacted by deer browse. There are few tree seedlings, and few saplings less than 15 years old. There is little or no herbaceous layer in most places. Human recreation impacts also decrease habitat quality. Formal and informal trails extend through this habitat, which allows invasive plants to penetrate into the forest interior.

Northeastern Wetland Forest; Northeastern Floodplain Forest; Central Appalachian River Floodplain

A complex of wetland and upland vegetation on floodplains along larger rivers, where temporary to seasonal flooding affects vegetation composition and dynamics. Vegetation includes both non-forested bar and scour communities and a diverse group of more extensive forests. Microtopographic heterogeneity is high, and forests tend to be differentiated by depositional landforms such as levees, sloughs, terraces, and abandoned channels. Better drained soils may support wet site oaks, shagbark hickory, and sweetgum. Wettest swamps are often dominated by green ash and red maple. Bald cypress may occur, but does not dominate. Understories are generally open, with sedges and grasses or moisture-loving forbs in the herb layer.

This system is found in the Potomac River floodplain in the Potomac Gorge, on Theodore Roosevelt Island, and in the upper Anacostia River. This system includes highly biodiverse plant communities that occur in rocky floodplains that are frequently scoured by ice and periodic flooding:

- Riverside Rock Outcrop and Prairie,
- Ice-Scour Woodland,
- Potomac Gorge Ice-Scour Sycamore Floodplain Forest
- Potomac Gorge Willow Oak Floodplain Forest

This system is driven by disturbance, but periodic flooding coupled with human-influenced factors has reduced the quality of this system in the District. Flooding has brought lesser celandine and Japanese stiltgrass from upstream and allowed them to infiltrate the forest interior. These species form monocultures on the forest floor in spring and summer, respectively. The forest edges and interior are dominated by invasive vines whose seeds are transported by flooding. The

system has been extremely impacted by deer browse. There are few tree seedlings, and few saplings less than 15 years old. Deer browse and invasive plants have replaced the native herbaceous layer in most places. Human recreation impacts also decrease habitat quality. Formal and informal trails extend through this habitat, which allows invasive plants to penetrate into the forest interior. Where ash trees occur, the Emerald Ash Borer (*Agrilus planipennis*), an invasive beetle, has the potential to severely damage this system. In Kenilworth Aquatic Gardens the beetle has killed most of the ash trees in this system.

Northeastern Wetland Forest; Northeastern Floodplain Forest; Central Appalachian Stream and Riparian

A complex of wetland and upland vegetation on floodplains of medium to large rivers in Atlantic drainages. They are typical of larger rivers but they can occur on smaller rivers where the stream gradient is low and a broad floodplain develops. The vegetation complex includes floodplain forests in which silver maple, sycamore, box elder, and cottonwood are characteristic, as well as herbaceous sloughs, shrub wetlands, ice scours, riverside prairies, and woodlands. Most areas are underwater each spring; microtopography determining how long the various habitats are inundated. Depositional and erosional features may both be present depending on the particular floodplain.

This system is found in the floodplain of Rock Creek Park and other small creeks in the Piedmont region of the District. This system is driven in part by disturbance, but infrequent flooding and human-influenced factors have reduced the quality of this system in the District. Flooding has facilitated the invasion of Lesser Celandine into the forest interior. This species forms monocultures on the forest floor in spring. The system has been somewhat impacted by deer browse. Invasive plants have replaced the native herbaceous layer in most places, although careful management of the Lesser Celandine has allowed native spring ephemeral wildflowers to thrive in a few locations. Human recreation impacts also decrease habitat quality. Formal and informal trails extend through this habitat, which allows invasive plants to penetrate into the forest interior.

Northeastern Wetland Forest; Northeastern Floodplain Forest; Northern Atlantic Coastal Plain Stream and River Floodplain Forest

This system is found throughout the northern Atlantic Coastal Plain from Virginia to New Jersey along low-gradient small streams and rivers with little to moderate floodplain development. This system is influenced by overbank flooding, groundwater seepage and occasional beaver impoundments. The vegetation is a mosaic of forests, woodlands, shrublands, and herbaceous communities. Canopy composition and cover can vary within examples of this system, but

typical tree species may include bottomland oaks, Atlantic white cedar, red maple, green ash, black gum, black birch, sweetgum, and sycamore. Shrubs and herbaceous layers can vary in richness and cover. Some characteristic shrubs include alder, musclewood, and spicebush. Seepage forests dominated by red maple and/or sweet bay can often be found within this system, especially at the headwaters and terraces of streams.

This system includes a globally rare plant community called Fall-line Terrace Gravel Magnolia Bog. Magnolia Bogs of this type are found only in the District and surrounding counties in MD and VA (McAtee 1918, Simmons et al 2008). They form at the base of gravelly hills where acidic water seeps from the hillside onto a clay soil lens. The forested wetlands in Oxon Run Park include a remnant Magnolia Bog plant community and swamps dominated by red maple, sweetbay magnolia, and possumhaw. Other locations of this system include successional floodplains of small creeks in the Coastal Plain region. Another system in the Coastal Plain Swamp Macrogroup, the Successional Woody Wetland, is similar to Northern Atlantic Coastal Plain Stream and River Floodplain system. It is a River Birch/Red Maple/Sweetgum Successional Forest with similar tree species, but Spicebush and some non-native invasive plants dominate the understory. This system is also found in Oxon Run Park. In this system the forest edges are dominated by invasive vines, shrubs, and herbaceous plants. In some cases the forests have been moderately impacted by deer browse.

Northeastern Wetland Forest; Coastal Plain Swamp; Northern Atlantic Coastal Plain Tidal Swamp

A tidally flooded hardwood forest and shrubland in lower river floodplains and estuaries of the North Atlantic Coastal Plain. Deciduous hardwood species predominate, especially ash (green or pumpkin), black gum, or water tupelo, along with red maple, American elm, and black willow. Alder and silky dogwood are common shrubs. Lianas and vines are common: poison ivy, greenbrier, and Virginia creeper. Species richness in the herbaceous layer is exceptionally high due to microtopographic features. Regularly flooded hollows primarily support flood-tolerant swamp species such as orange jewelweed, arrow arum, and various smartweeds. Water hemlock and smallspike false nettle are typical of elevated hummocks.

This system is the flooded forest on Theodore Roosevelt Island and parts of the upper Anacostia River. This system is driven in part by disturbance such as infrequent flooding. Fragmentation and human-influenced factors have reduced the quality of this system in the District. Flooding has facilitated the invasion of Lesser Celandine into the forest interior. This species forms monocultures on the forest floor in spring. Where ash trees occur, the Emerald Ash Borer, an invasive beetle, has the potential to severely damage this system.

In Kenilworth Aquatic Gardens the beetle has killed most of the ash trees in this system.

Grassland and Shrubland; Ruderal Shrublands and Grassland; Ruderal Upland - Old Field

Herbaceous or herb-shrub vegetation resulting from succession following virtually complete removal of native woody cover of an area, primarily on lands cleared for agriculture or pasture. Soils often show a plow layer, which alters the successional pathway and may increase the likelihood of invasions by exotic species. Lands may have been cleared decades ago or more recently, but have been maintained in a non-forested state (at least until relatively recently) and may still be annually mowed to control tree incursion. It is generally characterized by unnatural combinations of native and alien species; in the Northeast, they most commonly take the form of fields dominated by pasture grasses plus early-successional native or introduced forbs including goldenrods, asters, Queen Anne's lace, black-eyed Susans, hawkweeds, teasel, etc., usually with some shrub component of raspberries, meadowsweet, shrub dogwoods, or viburnums; poison ivy is a common vine. Compared to the pasture/hay system (under the Agricultural formation), this type has more forbs (excluding legumes that may be a pasture component) and more shrubs, and does not produce useable hay.

This system is found in small patches throughout the District, usually adjacent to forest patches or on former landfill sites. This is an uncommon habitat in the District. Most patches have low plant diversity and are dominated by non-native grasses, although native forbs have naturally dispersed into some sites, and have been planted in others. Eastern red cedar, eastern cottonwood, black locust and non-native woody plants dominate the shrubby patches. In addition to its rarity and patchiness, the condition of this habitat is reduced by woody and herbaceous invasive plant species.

Freshwater Marsh; Emergent Marsh; Northern Atlantic Coastal Plain Fresh and Oligohaline Tidal Marsh and Modified/Managed Marsh; Tidal Wetland Restoration and Experimental Areas

A graminoid-dominated wetland of fresh to slightly brackish zones along tidal rivers in very southeast Virginia and the southern shores of the James River. Water salinity varies from nearly fresh (oligohaline) in the drowned creeks and inland estuaries to saltier brackish water near the coast and on or near barrier island inlets. These marshes typically occur as complexes dominated by large graminoids such as salt hay, bulrushes, cattails, and rushes, sometimes with species-rich associations of shorter graminoids, forbs, and floating or submerged

aquatics. Brackish marshes tend to be low diversity communities of intertidal flats cut off from direct oceanic influence by protective barrier islands.

In the District this system also includes tidal wetland restoration and experimental areas that were created and are obviously managed wetlands. The vegetative community in these restoration areas is high and can be similar to Northern Atlantic Coastal Plain Fresh and Oligohaline Tidal Marsh after these wetlands have been in place for ten years (Paul, Krafft, and Hammerschlag 2004).

3.3.3 Semi-natural Systems

Plantation and Ruderal Forest; Northern Hardwood and Conifer; Ruderal Forest

Undifferentiated upland forests, typically even-aged, resulting from succession following virtually complete removal of native woody cover of an area, i.e. land clearing for agriculture or (sometimes) forestry. In the case of agriculture, alteration of the soil through plowing or grazing can sometimes lead to low-diversity forests, often with exotic species in the understory, that do not resemble more-natural forest systems. The limited structural diversity and low plant diversity apparent in some of these forests can limit insect diversity and other factors important to wildlife. In the case of clearcutting with less soil disturbance, the system may revert to a recognizable "natural" system within a fairly short time. This ruderal system is reserved for combinations of early-successional trees that cannot be identified as natural ecological systems even in an incipient state. (If a forest has sufficient cover of indicator trees for a particular "natural" ecological system, even with a prevalence of early-successional trees, it is classed as that forest system.) In the Northeast, these forests often contain substantial amounts of red maple, white pine, Virginia pine, red-cedar, tuliptree (south of New York), aspen, and/or white or gray birch, with associates of sassafras, persimmon, black locust, hawthorn, apple, pin cherry, and sometimes walnut. They may contain lesser amounts of more natural matrix forest species such as oaks, northern hardwoods, and hemlocks. Where soil disturbance has not been severe, many sites will follow a trajectory towards one of the later successional and more "natural" forest systems.

In the District this system can vary widely in habitat quality and degree of invasiveness depending on the age of the stand, location, and soil type. Young-age patches on poor soils are dominated by successional tree species such as black locust and eastern cottonwood, with non-native vegetation such as bush honeysuckle and Japanese knowtweed in the understory. Older-age stands are dominated by oaks and tulip poplars. The quality of the understory of old-age stands can vary widely as well. Along Canal Road, the Potomac bluff is dominated by oaks, with vine-shrublands in the understory. In the National Arboretum, these Habitat Systems are closed canopy forests and the understory

is usually dominated by native vegetation. These patches are adjacent to Central Oak-Pine forests and could readily be classified as such.

Grassland and Scrubland; Ruderal Shrublands and Grassland; Introduced Shrubland

These shrublands are dominated by aggressive exotic species including honeysuckles, multiflora rose, barberry, privet, kudzu, and others. They are primarily upland but can occur in seasonally wet situations, and most typically develop on disturbed former fields where soil structure and/or chemistry have been altered. Return to native species dominance requires intensive and prolonged intervention.

This system is found throughout the District, typically in isolated areas with significant past disturbance, such as historic homesites or former commercial areas, and in areas where the slender forested parks and parcels are surrounded by urban areas. Habitat condition is very low due to the dominance of invasive plants.

Freshwater Marsh; Modified / Managed Marsh; Introduced Wetland and Riparian Vegetation

Wetlands dominated by introduced species: primarily herbs, but may be a mixture of shrubs and herbs. Species may include purple loosestrife, giant reed, or in aquatic settings exotic milfoils, pondweeds, water chestnut, etc. In the District these are dominated by invasive Phragmites grasses. Few other plants survive.

Due to repeated management of NPS sites by NPS and the Anacostia Watershed Society, few patches of this system remain in the District.

3.3.4 Aquatic Habitat Systems

The aquatic habitats of the District are dominated by two tidal, urbanized rivers. The historic extent of the Potomac and Anacostia Rivers, and the tidal emergent wetlands that were associated with them, have been greatly reduced by past land reclamation. Reclamation resulted in the construction of Hains Point, Poplar Point, the RFK Stadium grounds, Kingman Island, and much of Anacostia Park. The Anacostia River is reduced to half of its natural width in many places and both rivers are bounded by a sea wall for much of their length within the District (see Figure 21), Map of historic Anacostia wetlands). Few tidal wetlands remained before the restoration of the Kenilworth wetlands in 1997 (Hammerschlag et al 2004)) and the River Fringe/Kingman Island wetlands in 2004 (Hammerschlag et al 2009). There are also many creeks and smaller tributaries. These creeks are impacted by urbanization, including combined

sewage outflow, stormwater flows, fragmentation, and pollution. See table 7 for estimates of the area of aquatic habitat types in the District.

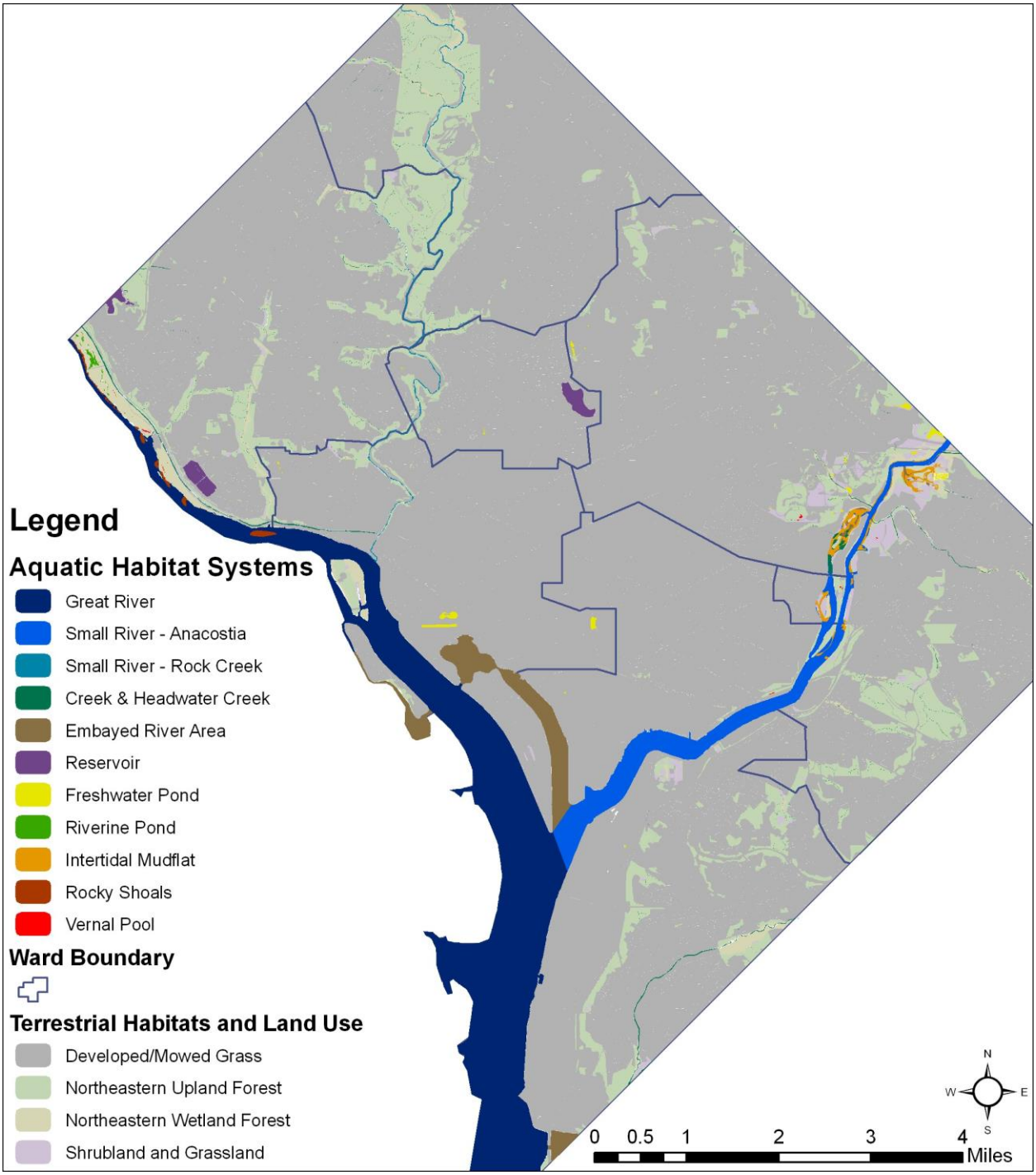

Figure 7 Aquatic Habitat Systems of the District.

Table 7 Area of District of Columbia Aquatic Habitats

Aquatic Habitat	Hectares	Acres
Great River	1,296.9	3,204.8
Small River - Anacostia	273.4	675.6
Small River - Rock Creek	27.7	68.6
Creek & Headwater Creek	74.9	185.0
Embayed River Area	165.4	408.7
Freshwater Pond	17.0	42.0
Intertidal Mudflat	34.7	85.8
Reservoir	23.7	58.6
Riverine Pond	3.7	9.2
Rocky Shoals	11.2	27.7
Vernal Pool	1.2	2.9
Seeps & Springs	N/A	N/A
Total Acres	**1,929.9**	**4,768.8**
Total Square Miles		**7.5**

Great River: Potomac River

The Potomac River is classified as a Great River (≥9,653 square miles) in the Northeast Aquatic Habitat Classification System (Olivero and Anderson, 2008). Its catchment drainage area is 14,670 square miles and extends from West Virginia and Pennsylvania through Maryland and Virginia. It passes from the Appalachian Mountains through the Piedmont and onto the Atlantic Coastal Plain. The Potomac River drains into the Chesapeake Bay, and is the second largest catchment in the Chesapeake Bay watershed. In the District it is a low-gradient (0.02%–0.1%), tidal river. It is a moderately buffered, warm river, but it has a relatively high average pH of 8.1 (DDOE, 2014). The Potomac varies in depth from 80 feet at Chain Bridge to less than a foot in some embayed areas. At Chain Bridge the Potomac is a high energy river that flows over solid bedrock as it emerges from the Mather Gorge and the fall line cascades of Little Falls. Farther south, below Georgetown, the river widens and slows. South of the Key Bridge in Georgetown, the riverbanks are bounded by a sea wall or stone rip-rap. There are few natural shorelines. At the southern end of the District the Potomac is 3/4 mile wide and shallow (3–11 feet) except in the navigable channel (26 feet). Below Georgetown much of the riverbed substrate is silt and sand. The Potomac River includes intertidal shore systems such as rocky shoals and intertidal mudflats, as well as beds of submerged aquatic vegetation. These systems are described below.

Small River: Anacostia River

The Anacostia River is a tributary of the Potomac River and is classified as a Small River (38–200 square miles) in the Northeast Aquatic Habitat Classification. Its catchment drainage area is 176 square miles and extends through Montgomery and Prince George's Counties in Maryland. In the District it is a low-gradient (0.02%–0.1%), tidal river. It is a moderately buffered, warm river with but an average pH of 7.5 (DDOE 2014). The Anacostia varies in depth from 30 feet in the navigation channel to less than a foot in some embayed areas. For its entire length in the District the Anacostia's riverbanks are bounded by a sea wall. There are no natural shorelines, but accretion has created riverine wetlands and mudflats in some areas. Where it enters the District the Anacostia is 150 feet wide, and at its mouth at the Potomac River it is 1,000 feet wide. The Anacostia River includes intertidal shore systems such as intertidal mudflats, as well as beds of submerged aquatic vegetation.

Small River: Rock Creek

Rock Creek is a tributary of the Potomac River that is classified as a Small River in the Northeast Aquatic Habitat Classification. Its catchment drainage area is 76 square miles and extends 22 miles into Montgomery County, Maryland. In the District, it is both a low-gradient (0.02%–0.1%) tidal creek and a moderate gradient (0.1%–0.5%) piedmont creek. It is a moderately-buffered, neutral, warm river with but an average pH of 7.8 (DDOE 2014). Rock Creek varies in depth from inches to several feet in the downstream tidal areas. There is a mile-long, high energy reach of rocky shoals and cascades where the creek passes the fall line. Rock Creek includes intertidal shore systems such as intertidal sand flats and rocky shoals.

Creek and Headwater Creek; Watts Branch, Broad Branch, Fort DuPont Creek, Foundry Branch, Hickey Run, Klingle Branch, Maddox Branch, Nash Run, Normanstone Creek, Pinehurst Branch, Pope Branch, Soapstone Run, Springhouse Run

Creeks and headwater creeks in the District can vary in size and energy level. Creeks on the western slopes of the Rock Creek Valley can be steep, high energy systems that pass over rocky cascades. Some creeks on the Coastal Plain start in the gravel terrace hills and can be moderately-high gradient streams. These streams do not pass over bedrock, but through clay and gravel soils and occasional iron-rich sandstone (bog iron). Other creeks east of the Anacostia River pass between those hills and are low gradient, low energy creeks. All creeks and streams in the District are impacted by high-flow events, driven by the piping of street runoff and other stormwater into the stream valleys.

Intertidal shore; Rocky shoals

Intertidal areas with exposed rocks located along rivers where bedrock is present. The amount of exposed rock varies with tide and river level. These areas can contain herbaceous plants in soils deposited on the rocks. In the District these shallow areas are important for freshwater mussels, and serve as spawning grounds for striped bass and several species of shad. The rocks serve as loafing areas for cormorants and other bird species. Submerged aquatic vegetation may also be present.

North Atlantic Intertidal Mudflat

Intertidal mudflats are usually located in quiet pockets of bays and protected by headlands. Sand-sized particles are mixed with silt and clay. These flats can be highly productive of clams and other invertebrates, and are important habitats for many shorebird species, including the solitary sandpiper, lesser yellowlegs, greater yellowlegs, spotted sandpiper, and least sandpiper. In the summer, green macroalgae, such as sea lettuce and hollow green weed, can cover these mudflats. Other characteristic species include ditch-grass and eelgrass.

Freshwater Pond

Pond habitats in the District consist of artificial small impoundments. They can be groundwater-fed, stream-fed, or stormwater-fed. Many have natural vegetated shorelines, while others have hardened shorelines. These ponds serve as habitat for native and non-native fish, insects and other invertebrates, native and non-native turtles, and as foraging areas for birds. Examples include Beech Pond and Boxwood Pond at the National Arboretum, Constitution Gardens, the lily ponds at Kenilworth Aquatic Gardens the Birdhouse Ponds at the National Zoo, and fishing ponds at the Armed Forces Retirement Home.

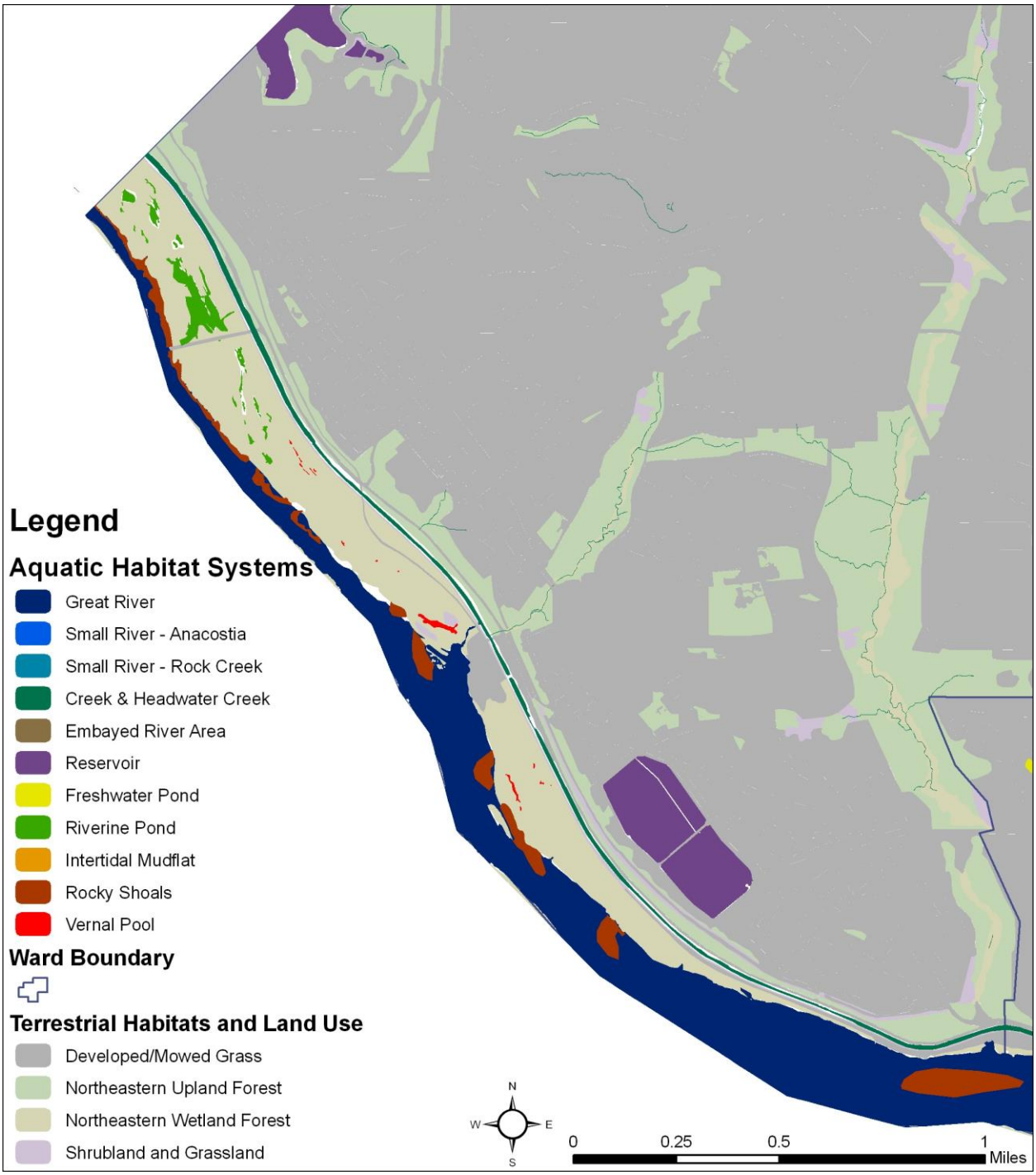

Figure 8 Aquatic Habitat Systems of the upper Potomac River in the District.

Lake/Reservoir

The District has no natural lakes. There are several large reservoirs with un-hardened shorelines and beds that store untreated water (Dalecarlia Reservoir and MacMillan Reservoir), and one that stores treated water and has hardened bed and shorelines (Georgetown Reservoir). These open water areas serve as loafing and foraging habitat for birds, especially winter-resident ducks. Dalecarlia Reservoir takes water directly from the Potomac River, and may have small fish and other aquatic organisms.

Riverine Pond

Riverine ponds are low areas in the Chain Bridge flats area of the Potomac River floodplain near the western border of the District. These rocky ponds are filled by groundwater seepage and periodic flooding. These ponds host native and non-native fish species (carp and snakehead are common), many species of dragonfly, wading birds and dabbling ducks. One riverine pond is located upstream of Fletchers Cove. It has a slightly higher elevation, and can dry out in summer and act as vernal pool habitat for several amphibian species.

Vernal Pool

Vernal pools are seasonal bodies of water that flood each year for a few months during the spring and dry up by the end of summer. Because they are not permanently flooded, they do not support fish populations. Instead, they provide important breeding habitat for many species of amphibians. Some species, such as the spotted salamander and wood frog, are obligate vernal pool species. The habitat is most often found in woodland areas where the land forms shallow dips and clay soils hold water, but some are also found in the rocky floodplain area of the Potomac River. They are found in Central Oak-Pine and Northeastern Floodplain Forests.

Vernal pools in the District are typically found on federally-protected land. Their condition is variable, and can be dependent upon the condition of the surrounding forest habitat. Some pools have windblown and runoff-borne trash. Several vernal pools and 40 acres of surrounding forest were lost to development in the Ft Lincoln area in 2012. Vernal pools can host ranavirus and other diseases that threaten herpetofauna.

Spring Seeps

Springs and seeps occur where groundwater flows to the surface. A spring has a concentrated flow, whereas a seep has a diffuse flow (Chicago Region Biodiversity Council 1999). Springs occur when the water table is higher than the ground surface and pressure forces the water out of the land. They serve as a

water source for wildlife. The District's had many springs that were once a source of drinking water in the 1700s and 1800s, but many springs have disappeared due to the diversion of rainwater, direct piping into the sewers, filling or contamination (Pavek 2002). Seeps are areas where groundwater continuously surfaces and flows as a sheet down a slope. They support habitats made up of tiny mosses, lichens, ferns and flowering plants that cling to peaty soils that develop on the slope. In the District springs and seeps are home to two endemic species and a federally listed endangered species. The Hay's Spring amphipod is both endangered and endemic and Kenk's amphipod is endemic to Rock Creek.

Spring and seeps can be found in a variety of locations in undeveloped habitats. Springs are found on the western and eastern slopes of the Rock Creek valley. Seeps are more common at the base of many gravel terrace hills east of the Anacostia River.

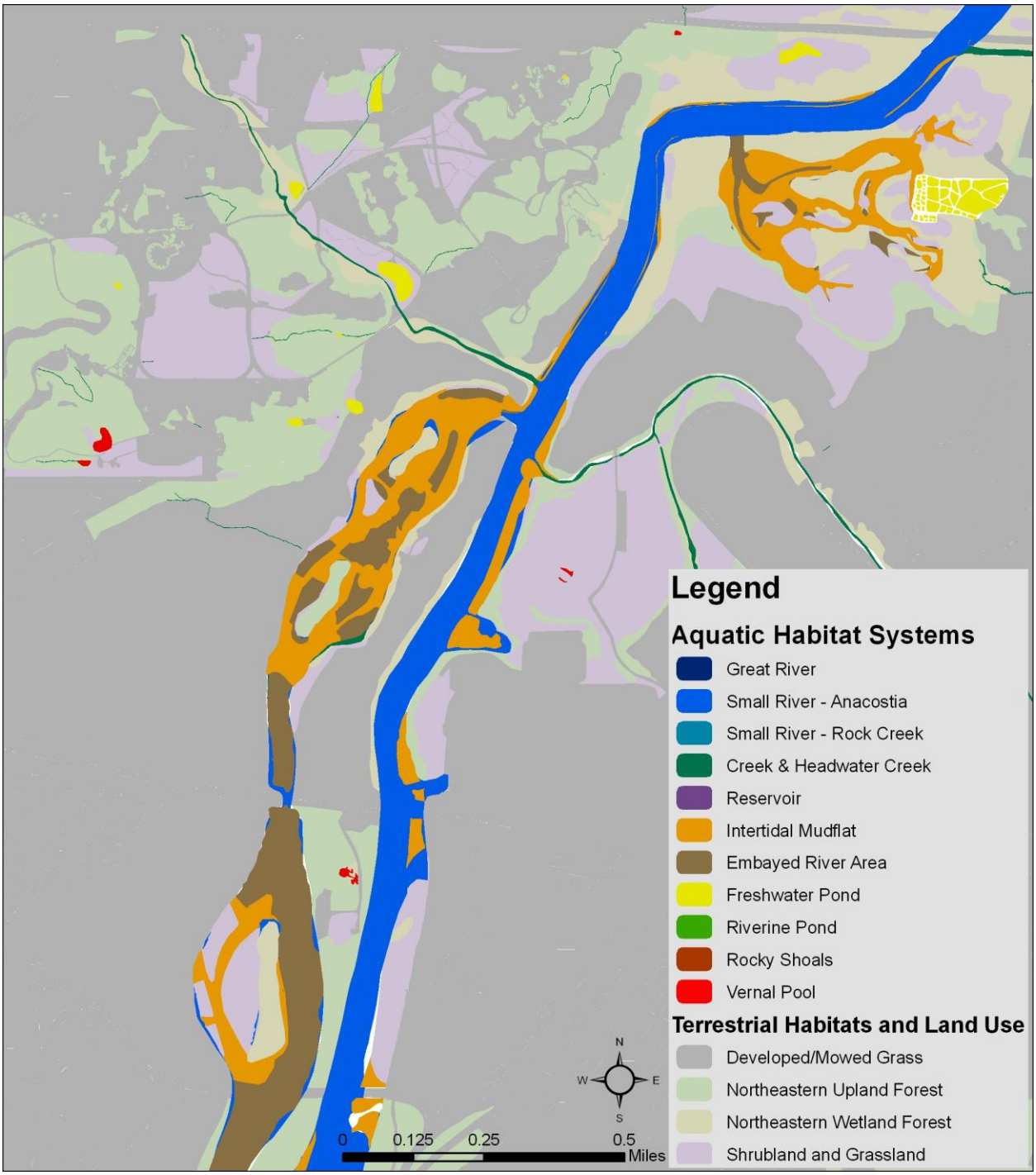

Figure 9 Aquatic Habitat Systems of the upper Anacostia River in the District.

3.3.5 Developed Systems

Developed systems include areas that have been converted or significantly altered for human use. It can include areas typically considered "green space": mowed grassy areas, athletic fields, picnic areas, roadside rights-of-way, and golf courses. These areas hold little value for wildlife. Developed systems also include suburban and urban residential housing and yard space, commercial areas, industrial areas, and paved roadways.

Maintained Grasses and Mixed Cover; Canopy Trees and Recreational Grasses

Mowed or otherwise managed non-native grasses with sparse canopy trees, usually left standing to provide shade for picnic areas. Canopy-height native trees in recreational areas may provide some habitat value to birds and invertebrates.

Maintained Grasses and Mixed Cover; Urban and Recreational Grasses

Areas of mowed or otherwise managed non-native grasses used for recreation. Athletic fields, golf courses, picnic areas, roadside rights-of-way.

Urban/Suburban Built; Commercial/Industrial

Developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses, commercial/industrial areas, roadways and other impervious surfaces. Impervious surfaces account for more than 80% of the total cover.

These areas have little or no habitat value. Roadways and large buildings represent impediments to dispersal and migration for many animal species. Industrial areas have historically polluted adjacent vegetative and aquatic communities.

Urban/Suburban Built; Residential - High Intensity

Areas with a mixture of constructed materials and vegetation in which impervious surfaces account for 50%–80% of total cover (generally corresponding to lot sizes of <1/4 acre); mostly single-family housing units.

These areas have little or no habitat value, although some high density residential areas in the District do have large, canopy-height native trees in roadway tree boxes and yards. These trees may provide some habitat value to birds and invertebrates.

Urban/Suburban Built; Residential - Medium Intensity

Areas with a mixture of constructed materials and vegetation in which impervious surfaces account for 25%–50% of total cover (generally corresponding to lot sizes of ¼–½); mostly single-family housing units.

These areas have little habitat value. Some medium density residential areas do simulate forest edge habitat, and can provide habitat for SGCN meso-mammals, small mammals, and birds. These areas also support large canopy trees in fairly large patches (see Figure 10). Large, canopy-height native trees in roadway tree boxes and yards may provide some habitat value to birds and invertebrates.

Figure 10 An example of large native street trees, wooded residential areas, and forest canopy in upper northwest Washington, DC.

3.4 Condition of Vegetative Habitats

Guidance from USFWS and AFWA suggests that state agencies should include an assessment of habitat condition or quality and should identify "conservation opportunity areas." Conservation opportunity areas are spatially explicit areas

identified in the SWAP that offer the best opportunity and potential for conservation of SGCN. FWD modelled habitat condition using in-house and regional spatial data to create a ranking score for habitat in the District at a five-meter resolution. The score ranked each five-meter pixel from 0 to100. The assessment included six data layers, though several of those layers were the result of aggregation of other spatial data. The six layers were species richness, species abundance per unit effort, core habitat/degree invaded (invasive plants), soil type/quality, deer browse, and tree canopy. The development of the data layers and the ranking process are described below.

3.4.1 Core Habitats/ Invaded Habitat Data Layer

The vegetative system/developed habitat layer was used to create a data layer that represents core forest habitat and degree invasiveness. Core forest habitats are important to forest interior-dwelling birds, box turtles, worm snakes, and a number of other SGCN. The process for this data layer:

1. Core forest areas were defined as areas >25 meters from the forest edge.
2. A 25 meter internal buffer was created in these habitat patches, with the core areas categorized as 10.
3. The 25 meter forest edge was categorized as 5 as a proxy for the impacts of invasive plants and other edge effects.
4. Trail areas within core forest habitats were mapped and a 5 meter buffer was calculated. Trail areas within core forests were categorized as 8.
5. Known habitat types that are described as semi-natural or include invasive plants as a part of their description were ranked as 5 or 3, depending on the known degree to which they are invaded by non-native plants.
6. Open water areas (river, pond, etc.), were ranked as 6. No invasive plants are known to affect non-fish species in aquatic habitats.
7. Residential areas were ranked as 2 due to overall low habitat value for SGCN.
8. Commercial/Industrial areas and transportation corridors (roads) were ranked as 1. They have little or no value for wildlife, and impose barriers to wildlife.

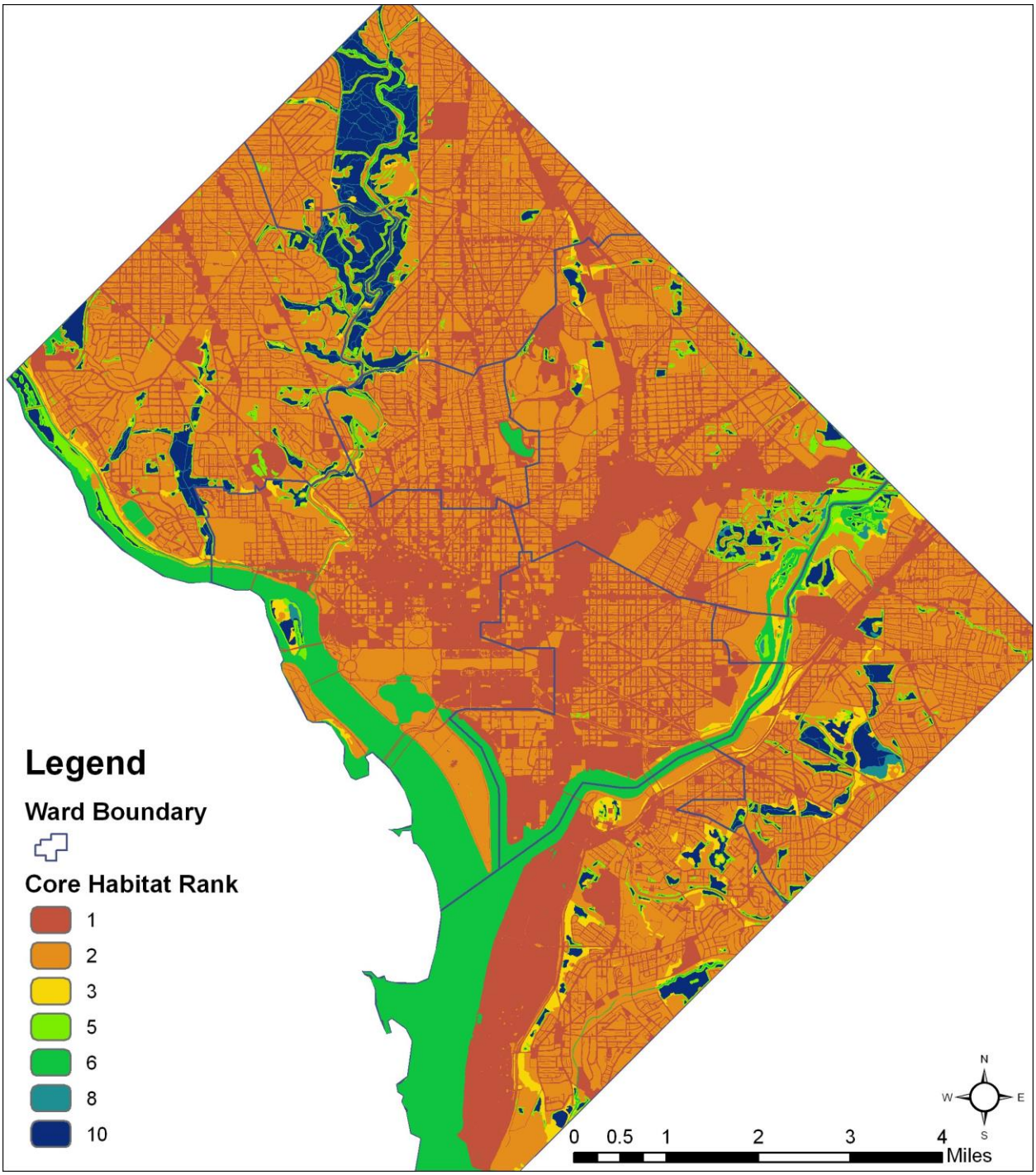

Figure 11 Habitat areas of the District ranked by value.

3.4.2 SGCN Richness and Abundance Data Layers

Point files of SGCN occurrences were provided by DDOE biologists and were aggregated into one file. Data from several surveys were included: breeding bird, migrating bird, winter resident waterbird, small mammal, meso-mammal, bat acoustical monitoring, bats from residences (from District of Columbia Department of Health), vernal pool amphibian egg mass, frog call, herpetofauna coverboards, turtle hoop net, spotted turtle telemetry, dragonfly and damselfly transect, and butterfly transect. Incidental observations were included. Species richness of SGCN was calculated at each point. Survey points within 50 meters of each other in similar habitats were merged into one point. SGCN abundance at each point, normalized by unit effort (as total number of visits to the site for each survey) was also calculated. Raster files were made from the point files a using a kernel density calculation in Environmental Systems Research Institute (ESRI) ArcGIS.

Kernel density calculates the density of features in a radius around those features, and can use a "population" field to weight certain features more heavily than others. The ESRI (2009) Help File describes the kernel density function: "A smooth curved surface is fitted over each point using a defined search radius so that each raster cell's value is highest at the location of the point and diminishes with increasing distance from the point. The density at each output raster cell is calculated by adding the values of all the kernel surfaces where they overlay the raster cell center. The kernel function is based on the quadratic kernel function described in Silverman (1986)."

3.4.3 Soil Data Layer

This data layer is based on a digital soil survey map prepared by DCGIS, which is the most detailed level of soil geographic data developed by the National Cooperative Soil Survey for the District. Soil types were ranked from 2 to 9 for their degree of disturbance, association with urban areas, and degree to which they are the result of dredge/fill operations. Rivers and other open water were ranked as 1 to minimize their influence on terrestrial habitats.

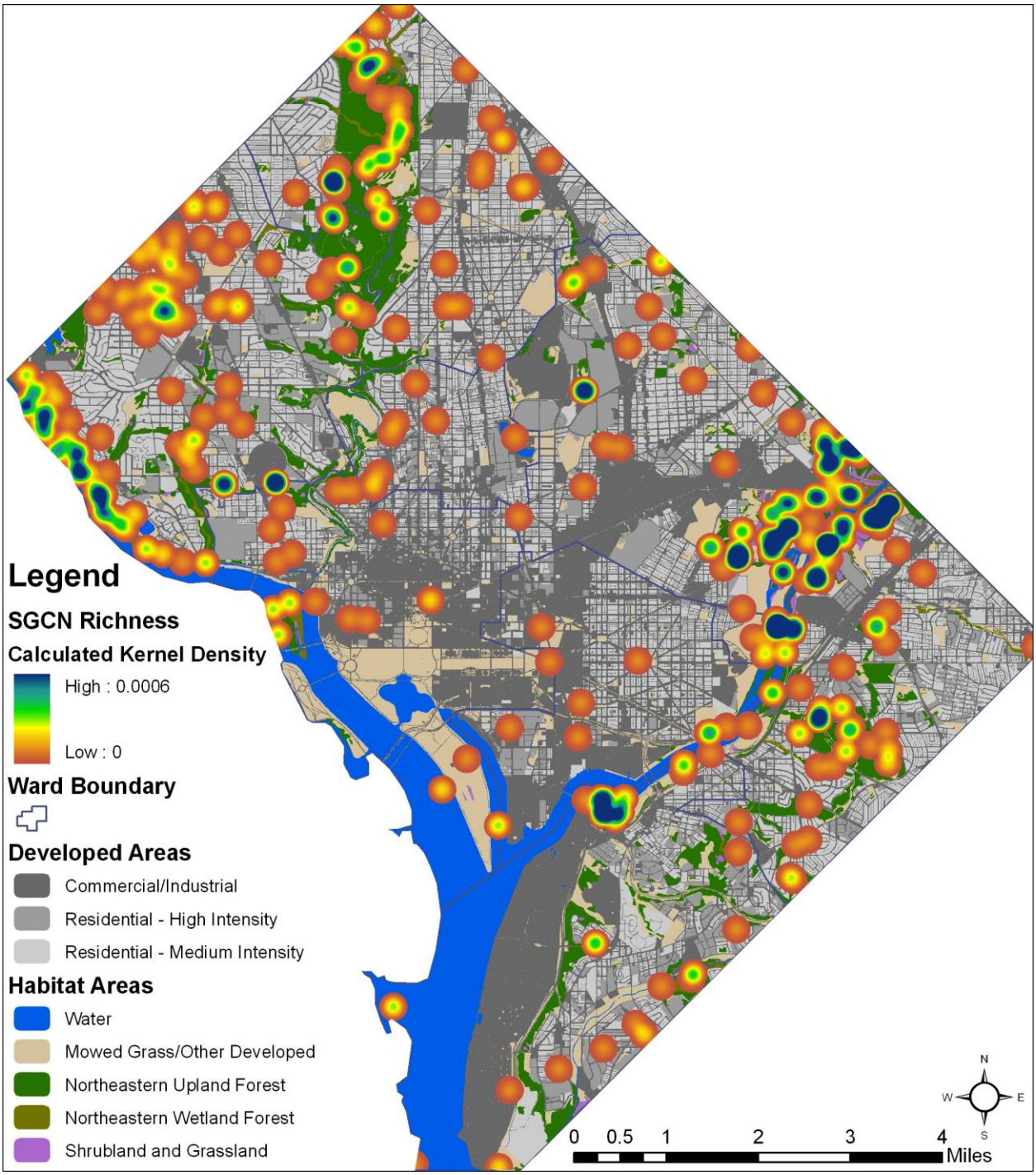

Figure 12 Species richness in the District by SGCN. Number of species per point converted to a surface using a quadratic kernel function.

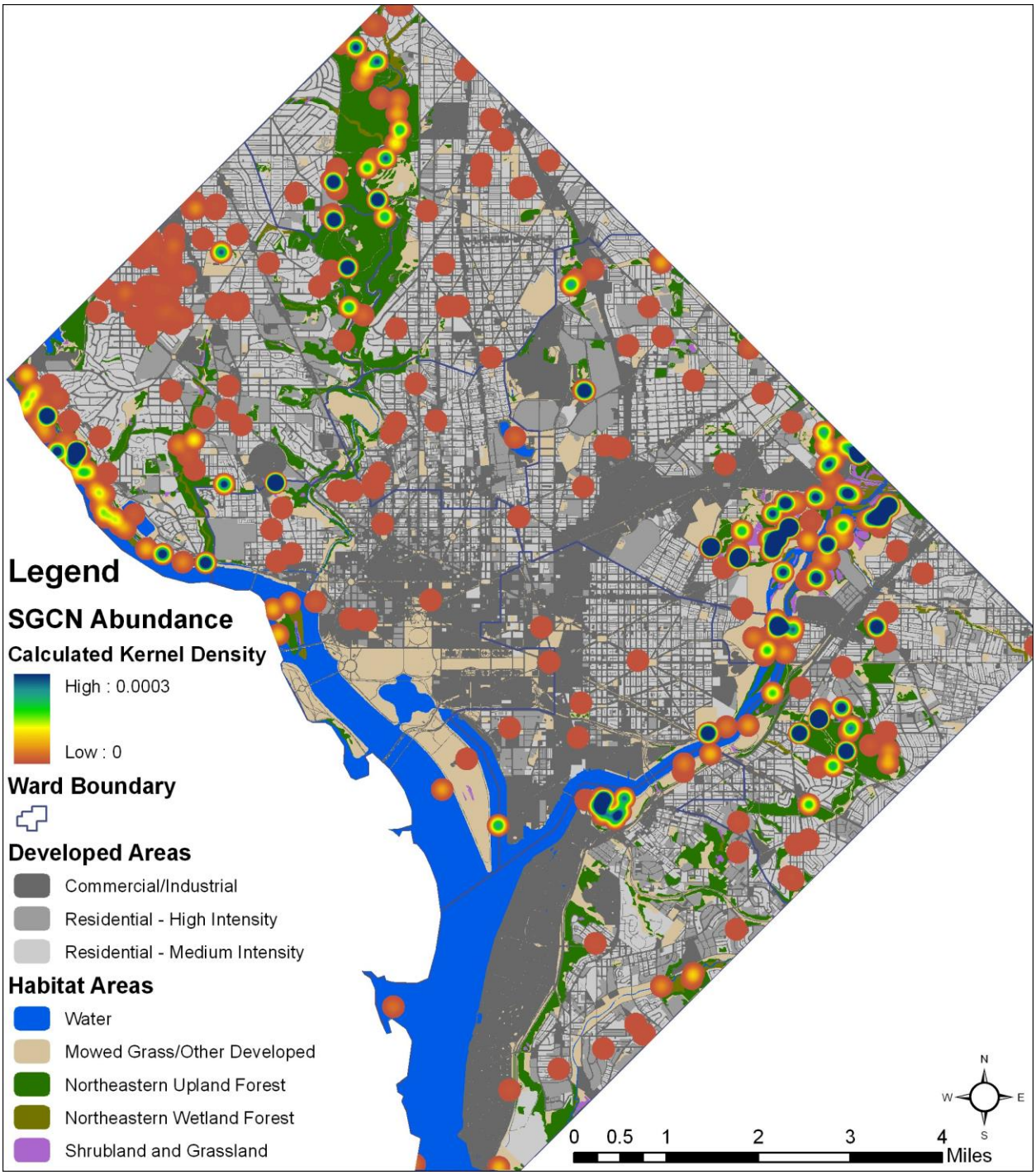

Figure 13 Species abundance in the District by SGCN. Number of SGCN observations per point, normalized by unit of effort and extrapolated to a surface using a quadratic kernel function.

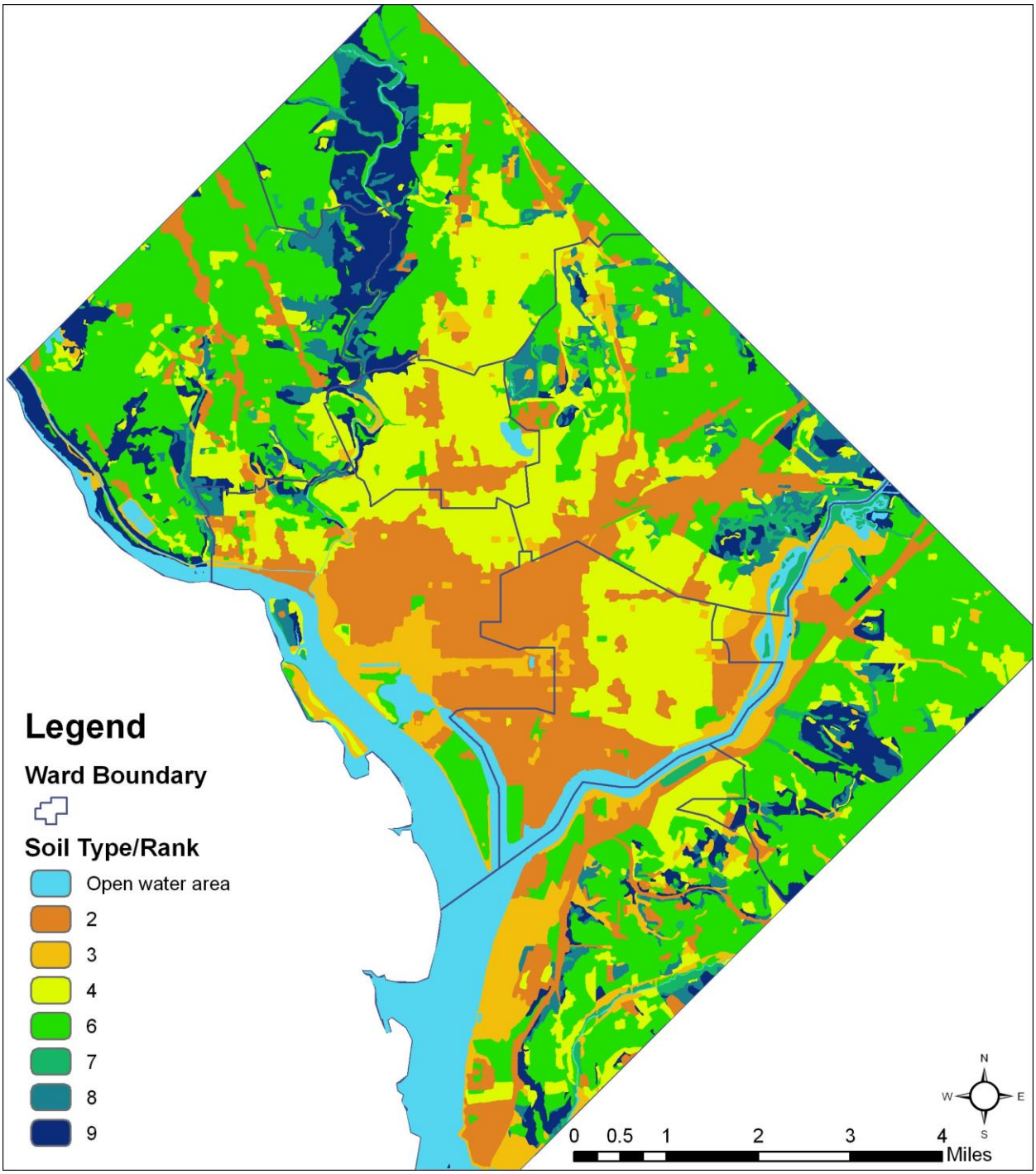

Figure 14 Soil types in the District ranked by type and disturbance. Disturbed soils (such as those in dredge and fill areas) and urban complex soils were ranked lowest. Undisturbed soils were ranked higher.

3.4.4 Tree Canopy Data Layer

Tree canopy can be used by wildlife even in residential and urban areas. This layer combines wooded areas classified by DCGIS and large native street trees. The DCGIS Wooded Areas layer contains data for patches of forest or tree canopy in parks and in residential areas. This can include tree canopy that exists over short buildings in residential areas. The DDOT Urban Forestry Administration provided a data layer of trees in street rights-of-way. The dataset contains locations and attributes of Trees, created as part of the District of Columbia, Department of Transportation (DDOT) Street Spatial Database. Native tree species that are greater than 15 inches DBH (diameter at breast height - tree diameter measured 4.5 feet from the ground) and in excellent, good, or fair condition were extracted to a point file. The canopy cover of each tree was then estimated as ½ DBH (in inches) converted to meters. For example a 24-inch tree has an estimated tree canopy of a 12 meter diameter circle. This canopy was created using a buffer command in ArcGIS. The street tree and wooded data layers were merged and converted to a raster where canopy = 10 and non-canopy = 1.

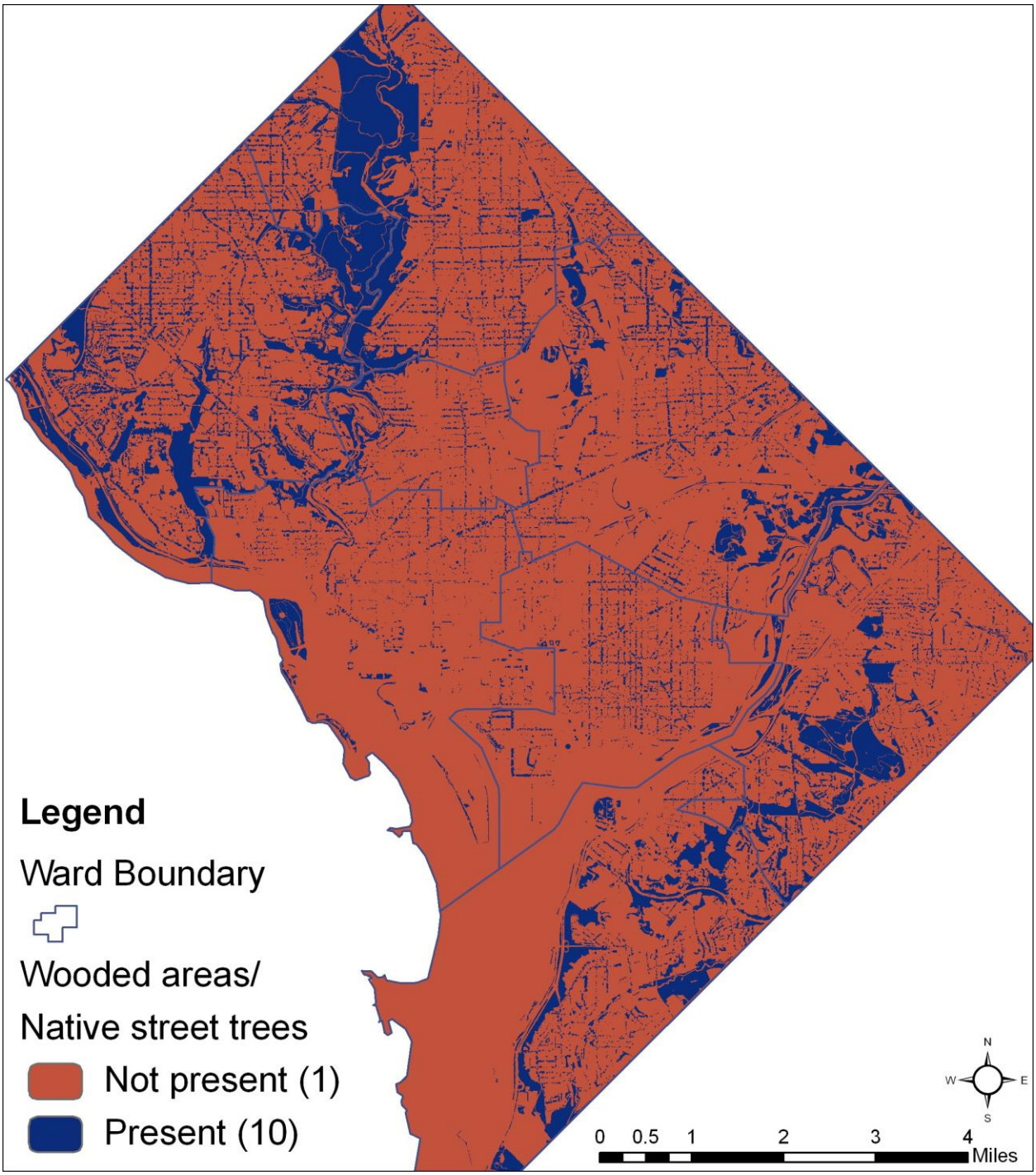

Figure 15 Wooded areas of the District. Mature tree canopy from classification of aerial imagery by DCGIS, combined with native street tree canopy. 1 = no canopy; 10 = canopy.

3.4.5 Deer Browse Data Layer

The impact of deer browse on vegetative and developed habitats was estimated using site visits in the field, data from deer spotlight surveys, data from NPS deer browse plots, and other observations.

1. Areas with no habitat value were given the lowest rank of 1.
2. Vegetative habitat areas with severe impacts from deer browse were ranked as 2.
3. Residential areas with severe deer browse and known high deer densities were ranked 3.
4. Areas of good vegetative habitat and moderate deer browse were ranked 4.
5. Developed residential areas west of the Anacostia River with low deer density were ranked 5.
6. Riparian habitat and residential areas east of the Anacostia River with low deer density were ranked 6.
7. Vegetative habitat areas with low impacts from deer browse were ranked as 7.
8. Vegetative habitat areas with very low impacts from deer browse were ranked as 8.
9. Vegetative habitat areas where deer have been actively managed for more than five years were ranked as 9.

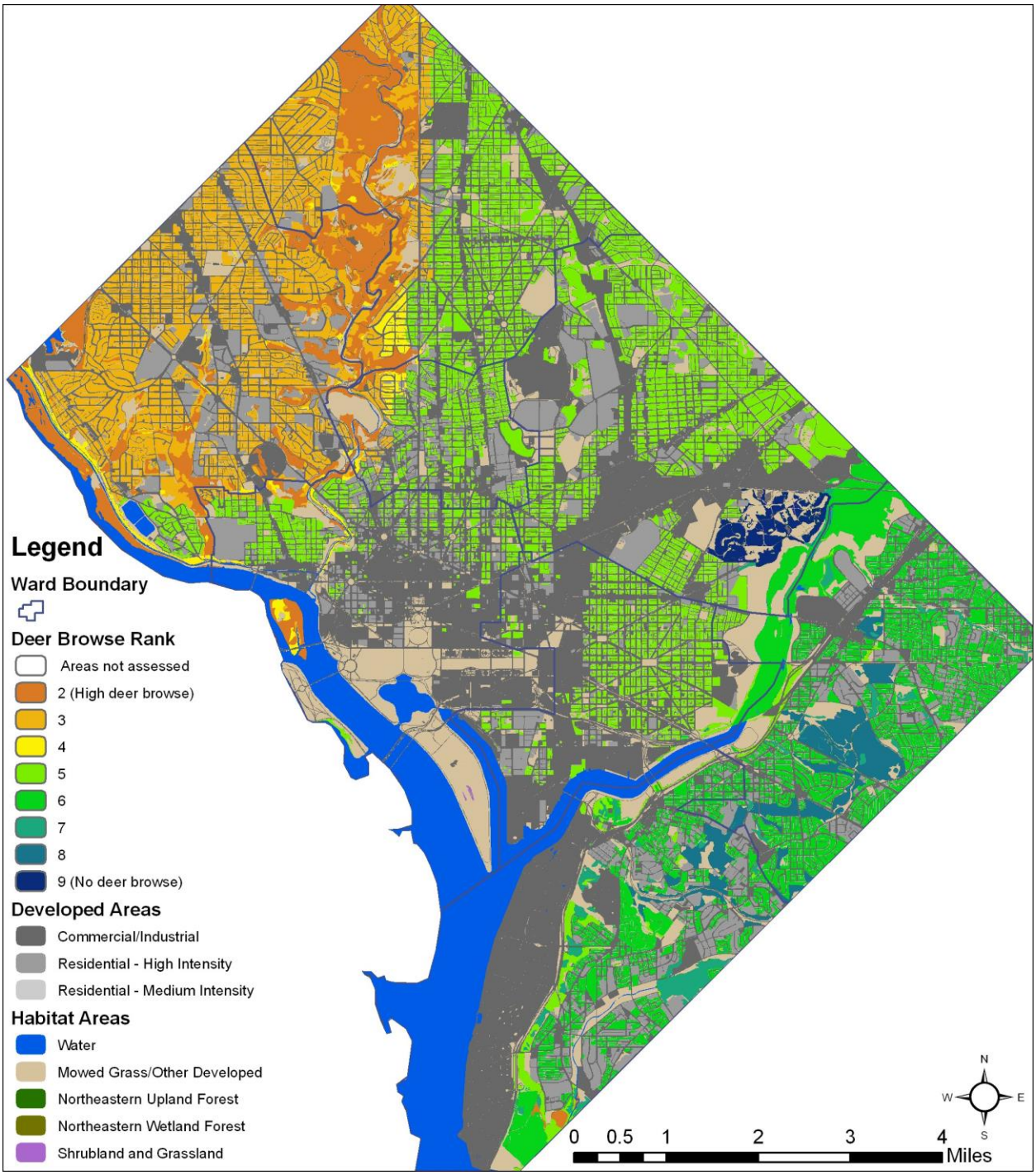

Figure 16 Areas of the District ranked by impact of deer browse. Areas where no or few deer browsed ranked high, while habitats impacted by overabundance of deer ranked low. Commercial, industrial, and high density residential areas were excluded.

3.4.6 Ranking Process for Habitats

The classified values of the six layers used in the analysis were weighted based on data quality and value to the analysis. The species richness and abundance data were collected by DDOE biologists and represent known locations where habitat already supports SGCN. The core habitat/invaded areas layer represents known areas of good forested and other habitats in good condition, as well as known locations where habitat condition is poor. The six layers with their final weighted values are:

- Species richness (30)
- Abundance normalized by units of effort (20)
- Core habitat/Invaded areas (20)
- Soils (10)
- Mature tree canopy (10)
- Deer browse (10)

3.4.7 Final Map

The original classified rasters were normalized and re-classified to their weighted value using Arc GIS and summed using Map Algebra in ArcGIS. The model is shown in Figure 17.

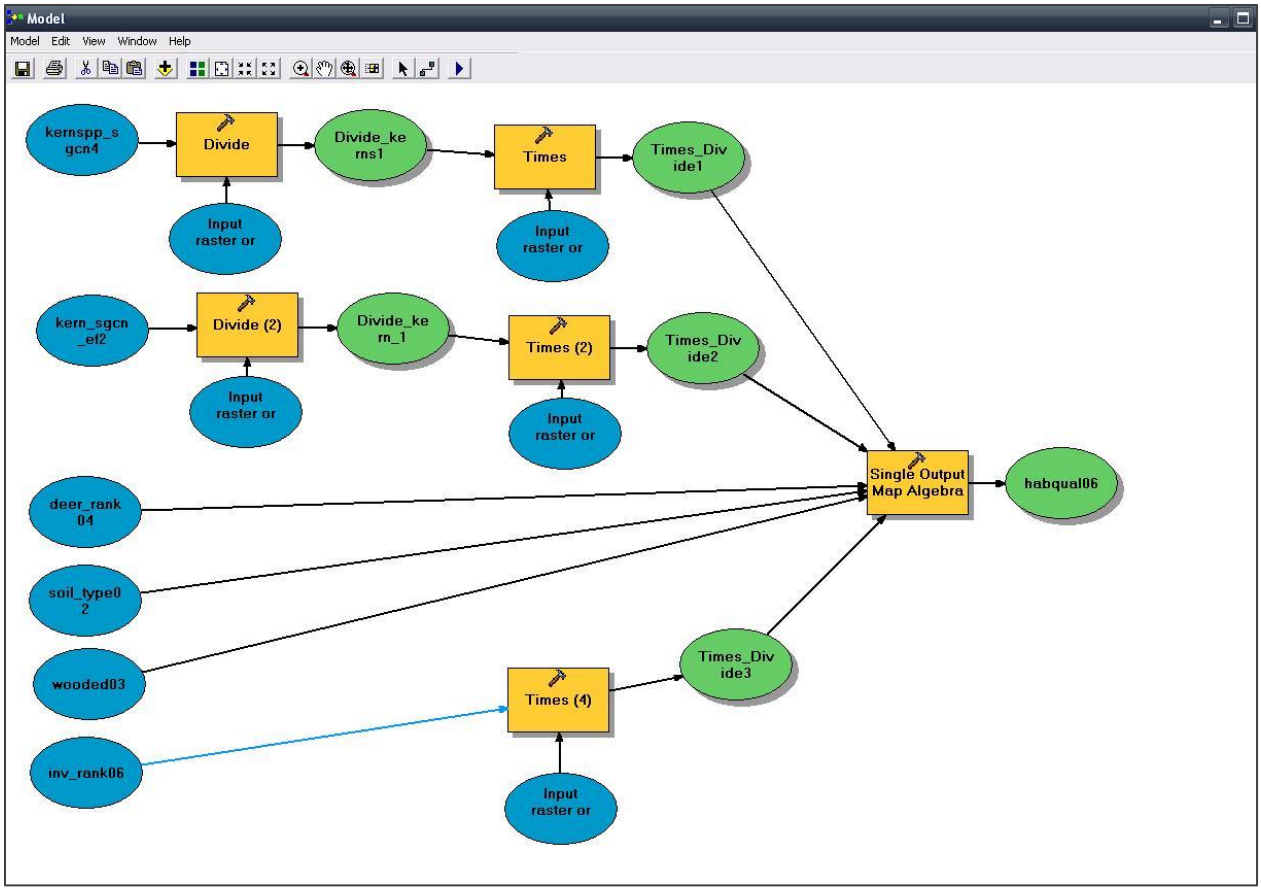

Figure 17 Model for determining values for final District map.

3.4.8 Results and Discussion

The raw output of the habitat condition analysis is shown in Figure 18. This output indicates locations where good habitat and SGCN species are concentrated. The output was subsequently ranked into three tiers based on the score: Tier I areas area critical for the conservation of biodiversity, Tier II areas are extremely significant for the conservation of biodiversity, and Tier III areas are highly significant for the conservation of biodiversity (see Figure 19).

Tier I areas should be targeted for resource management actions that will prevent degradation of habitats. These locations should also be protected from development; especially where the land is administered or owned by the District government. Tier II are locations where some SGCN are found but habitat is marginal. These areas should be targeted for resource management actions that will improve habitat. For example, the riparian forests along the Potomac River have good SGCN diversity and abundance in some places, but the habitats are impacted by invasive plants and deer browse. Management of deer populations and invasive plants in this habitat may increase the density

and diversity of SGCN. Tier III locations are often locations where habitat is good or marginal, but SGCN were not represented in the analysis. It is possible that these locations do have SGCN, and their absence simply indicates areas that have not yet been targeted for inventory and monitoring. These locations should be targeted for both monitoring and resource management. The output of this assessment has informed the designation of Conservation Opportunity Areas (COA) below, and informed the Focal Conservation Actions in Chapter 6.

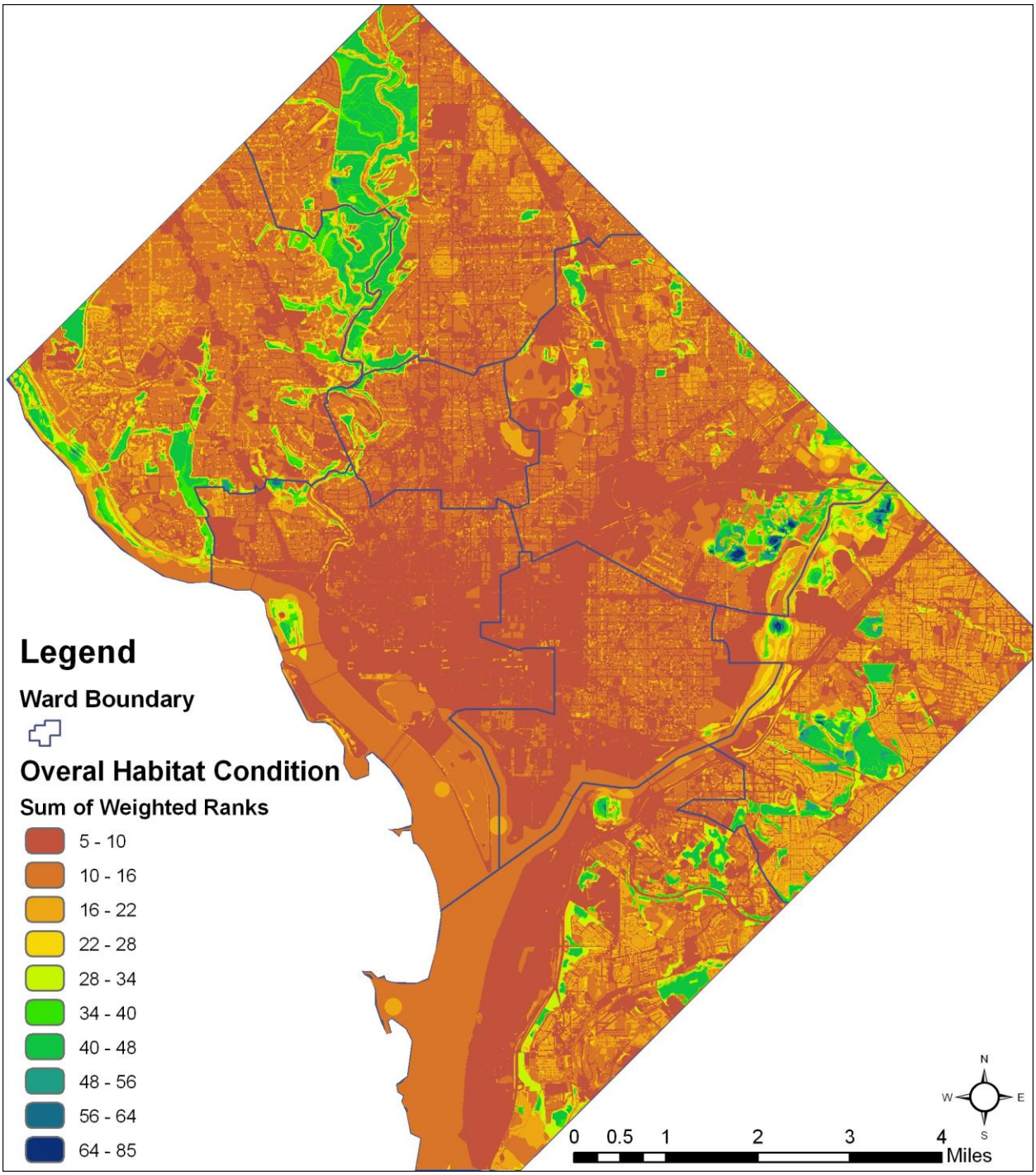

Figure 18 Raw output of the habitat condition assessment (3.4.7a). Map of habitat condition using the previous six data layers weighted and summed. Highest value habitats are blue.

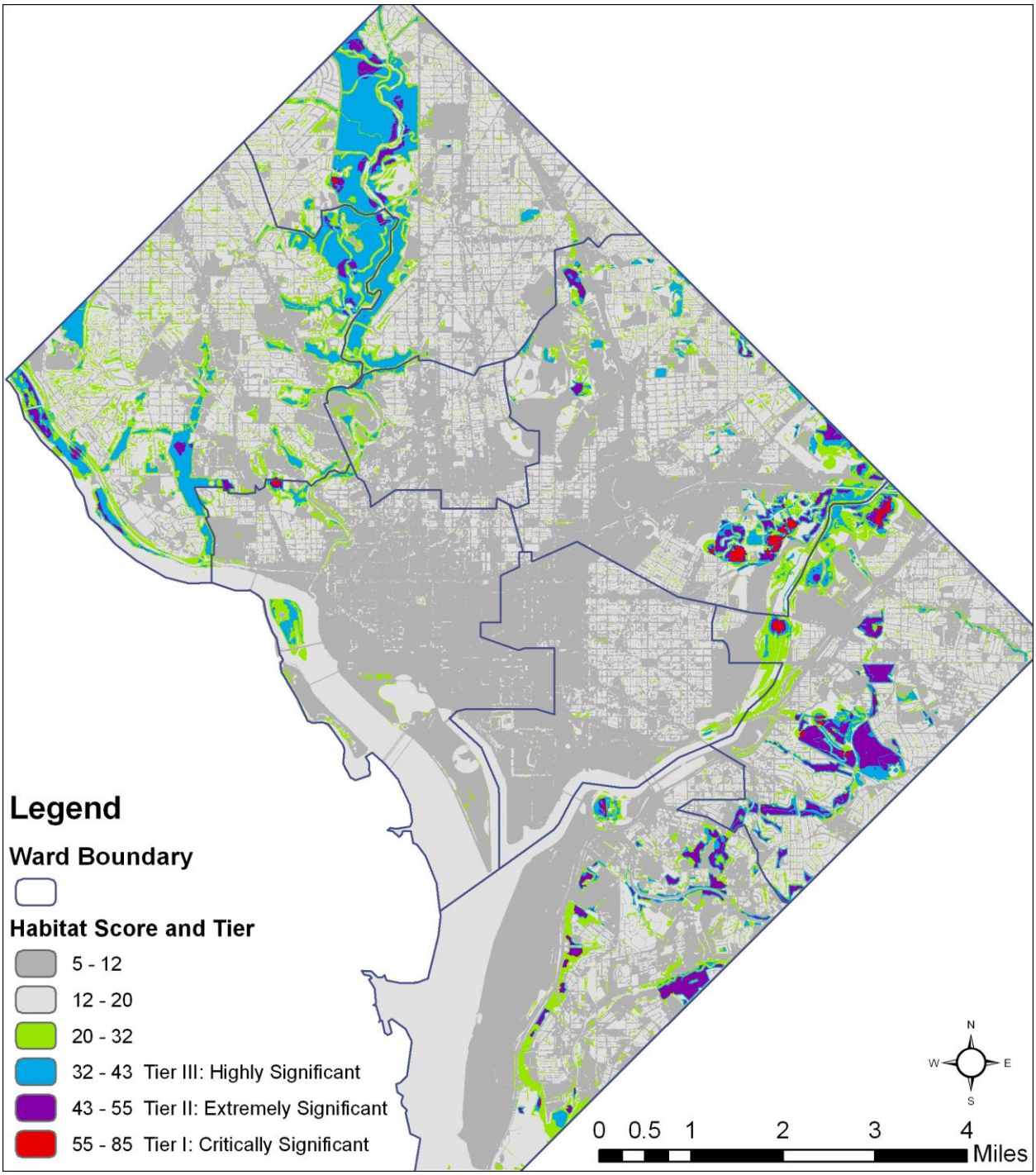

Figure 19 Output of the habitat condition assessment ranked into three tiers (3.4.7b).

3.5 Condition of Aquatic Habitats

The condition of aquatic habitats in the District is very poor, but still supportive of aquatic life in the larger water bodies and some smaller water bodies. Rockfish, shad, catfish, American eels, and smaller fish, as well as a variety of turtles, snails, crayfish and mussels can be found in the Potomac River. Catfish, northern snakehead, and turtles can be found in the Anacostia River. Rock Creek supports some game fish, smaller fish, snails, crayfish, turtles and salamanders. Some small streams and vernal pools support salamanders, but diversity is low in most due to poor conditions.

The DDOE Water Quality Division monitors water quality in the District at 47 locations and reports on 36 waterbody segments. The following text is paraphrased from the District of Columbia Water Quality Assessment 2014 Integrated Report to the US Environmental Protection Agency and Congress, pursuant to Sections 305(b) and 303(d) of the Clean Water Act (pp. 97–117):

> *Thirty-six waterbody segments were monitored for the goals of the Clean Water Act that apply to the District. Each of the waterbodies has been assigned "designated uses" in the District's water quality standards. These include Overall Use, Swimmable Use, Secondary Contact Recreational Use, Aquatic Life Use, Fish Consumption Use and Navigation Use. The use standards outline numeric and narrative criteria that must be met if a waterbody is to support its uses. Various types of water quality data collected during the period of 2009 to 2013 were evaluated to assess use support of the waterbodies. The evaluation found that the designated uses that directly relate to human use of the District's waters were generally not supported. The uses related to the quality of habitat for aquatic life were not supported. No waterbody monitored by the Water Quality Division fully supported all of its designated uses. The water quality of the District's waterbodies continues to be impaired.*
>
> *The major causes of impairment to the District's rivers, streams, and lakes are organic enrichment/low dissolved oxygen. The sources with major impacts on District waters are combined sewer overflows (CSO), and urban runoff/storm sewers. Municipal point sources on the estuaries also have a major impact. Rivers and streams are also impacted by bacteria and toxics.*
>
> *Both of the main waterbodies, the Potomac and Anacostia Rivers support fish and other wildlife populations. But the small streams aquatic communities are still stressed. The Potomac River continues to benefit from the CSO improvements and the implementation of*

improvements and biological nutrient removal at the Blue Plains wastewater treatment plant. The Anacostia River remains aesthetically and chemically polluted. Much remains to be done.

There have been considerable changes in the submerged aquatic vegetation (SAV) attributes from year to year including; species diversity, cover density, and total acreage values for the grass beds that are observed. The one thing that has remained consistent is the direct relationship that exists between the relative abundance of certain fish species, and the presence or absence of viable SAV beds.

Rivers and Streams

All of the rivers were impaired for one or more of their designated uses. The aquatic life use was fully supported along 0.8 square miles of river, and not supported along 5.13 square miles of river. No river in the District supported its primary contact use due to pH, turbidity and or E. coli violations. Both rivers have low DO or turbidity impairments, but they are most pronounced in the Anacostia River. No District stream supported its aquatic life use. No stream in the District supported its primary contact use due to pH, turbidity and or E. coli violations.

The causes of impairment to streams and rivers are varied, and include pathogens, oxygen depletion, flow alterations, stream bed or streamside habitat alterations, toxic inorganic chemicals, toxic organic chemicals, heavy metals, pesticides, acidity, and sedimentation. A source of impairment that is common to the District's rivers and streams is urban runoff from imperviousness. Habitat modification still has an impact on many of the streams as riparian vegetation is removed and stream banks are destabilized due to heavy runoff. Combined sewer overflow affects small streams as well as Rock Creek, the Anacostia River and the Potomac River.

Embayed Areas

Three enclosed or embayed waterbodies were monitored for designated use support. These are Kingman Lake, C&O Canal, and the Tidal Basin. All of these waterbodies were impaired for one or more of their designated uses. Based on physical/chemical data, the aquatic life use was fully supported in the C&O Canal and Kingman Lake. No lake in the District supported its primary contact

use due to pH, turbidity and or E. coli violations. All the lakes are highly impacted by turbidity and pH levels.

Submerged Aquatic Vegetation

The DDOE Fisheries Management Branch has been monitoring submerged aquatic vegetation (SAV) since 1993. In this time, DDOE has compiled an extensive amount of data that reflects the growth and decline of SAV species within the District. Not only does SAV provide an important habitat for aquatic life, it provides sediment stabilization as well as improvements in water quality. It is an important component to the health of the District's aquatic ecosystem. Nutrient and sediment pollution are both limiting factors for SAV viability.

2013 observations revealed 8 species of SAV including: Ceratophyllum demersum, Hydrilla verticillata, Najas guadlupensis, Najas minor, Heteranthera dubia, Vallisneria americana, Potamogeton crispus, and Stuckenia pectinata. This is an increase of three species since 2011. A total of 203.9 acres of SAV were reported in 2013, this is a dramatic increase from 2011 when the reported acres was 31.41. Overall, SAV species diversity and cover densities vastly improved in 2013.

SAV beds provide an important habitat for both juvenile and adult fish in the District. SAV beds are ecologically important in a watershed system. They are necessary to fish and other aquatic organisms as areas for refuge, feeding, and reproduction (Kraus and Jones 2012). DDOE's records of SAV area and fish diversity from electrofishing data collected during the months SAV is present have demonstrated the important relationship between fish and SAV in the Potomac (DDOE-Water Quality Division 2014).

3.6 Conservation Opportunity Areas

AFWA and the USFWS recommend that states designate discrete, spatially distinct areas that offer the best opportunities and potential for SGCN conservation and label them Conservation Opportunity Areas (COA) (AFWA 2012). DDOE selected eight COA's based on habitat condition analysis and SGCN diversity (also see Figure 20):

1. *Potomac River and the floodplain from the District boundary to Three Sisters Island*

This COA includes diverse ice-scour shrublands and forests, riverine pools, vernal pools, tidal mudflats, rocky shoals, deep water habitat and fish spawning areas. Exemplary SGCN include: striped bass, American shad, prothonotary warbler, yellow-throated vireo, northern river otter, mocha emerald, wood frog and northern copperhead.

2. *Theodore Roosevelt Island and surrounding aquatic habitats*

   This COA includes several upland and wet forest types, a tidal emergent wetland, mudflats and SAV beds. Exemplary SGCN include: lesser yellowlegs, American eel, gray tree frog, eastern painted turtle, little brown bat, regal fritillary, and triangle floater.

3. *Heritage and Kingman Islands and the surrounding tidal wetlands*

   This COA includes wet forest in Heritage Island, successional upland forests on Kingman Island and other riparian areas, including vernal pools and restored freshwater tidal wetlands. Exemplary SGCN include: American black duck, eastern redbelly, spotted salamander, tricolored bat, unicorn clubtail, and brown bullhead.

4. *Northern Rock Creek Park*

   This COA includes the northern floodplain of Rock Creek Park and the surrounding upland forests. There are several forest Habitat Systems, including upland and wet forests, two groundwater-fed wetlands, and several large vernal pools. Exemplary SGCN include: red-headed woodpecker, eastern box turtle, redback salamander, northern long-eared bat, southern flying squirrel, Baltimore checkerspot, Hay's Spring amphipod, and pearl dace.

5. *Poplar Point*

   This COA includes successional wet forests, successional upland forests, and several meadow and scrub habitats. Exemplary SGCN include: willow flycatcher, queen snake, Fowler's toad, striped skunk, comet darner, and rusty-patched bumble bee.

6. *Fort Lincoln and Kenilworth complex*

   This COA includes the restored tidal wetlands and wet forests in Kenilworth Aquatic Gardens, riparian forests on both banks of the Anacostia, two infrequently-flooded wetlands along the western shore of the Anacostia River, and several large meadow and scrub habitats in Kenilworth Park. Exemplary SGCN include: American woodcock, eastern mud turtle, eastern newt, American beaver, lilypad forktail, devil crawfish, and hickory shad

7. *Large Fort Circle Parks (Fort DuPont, Fort Chaplin, and Fort Mahan)*

   This COA includes the most undisturbed upland forests in the District. These sites are dominated by Oak-Heath forests. One site includes rare white ladyslipper orchids, and large stands of pinxter azalea, blueberry and

mountain laurel. Exemplary SGCN include: ovenbird, blue-winged warbler, rough green snake, upland chorus frog, gray fox, and capital area groundwater amphipod.

8. *Oxon Run Magnolia Bog*

   This COA contains a globally rare plant community endemic to the District and surrounding counties in Maryland and Virginia. Exemplary SGCN include: hooded warbler, eastern worm snake, southern leopard frog, silver haired bat, sphagnum sprite, and bronze copper.

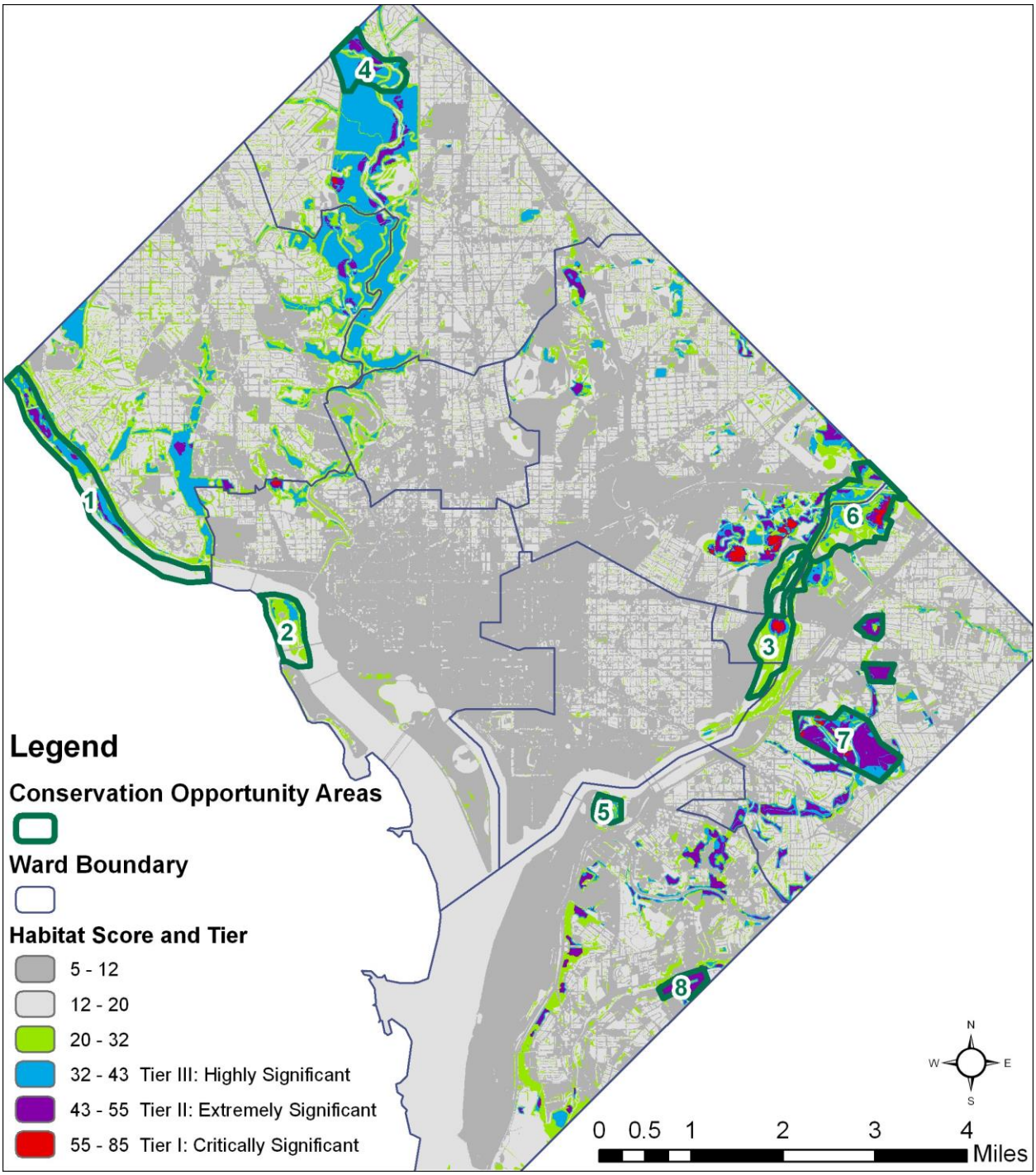

Figure 20 Conservation opportunity areas in the District.

1) Potomac River and the floodplain from the District boundary to Three Sisters Island, 2) Theodore Roosevelt Island and surrounding aquatic habitats, 3) Heritage and Kingman Islands and the surrounding tidal wetlands, 4) Northern Rock Creek Park, 5) Poplar Point, 6) Fort Lincoln and Kenilworth complex, 7) Large Fort Circle Parks, 8) Oxon Run Magnolia Bog.

Chapter 4 Threats to SGCN and Critical Habitats

4.1 Overview: What will impact wildlife and habitats?

The District was established as the capital of the United States in 1792. It initially encompassed 100 square miles of Virginia and Maryland. At the time of its designation there was little development in the area, apart from large landholdings and the colonial towns of Georgetown and Alexandria. Since then, much of the land that was originally forested has been altered by development, construction, soil disruption, and fragmentation. Aquatic habitats have been impacted by land reclamation, stormwater runoff, and pollutants. Wildlife have lost habitat to development, and much of the remaining habitat is being further impacted by additional threats. This chapter details the problems and threats to the District's species of greatest conservation need and their critical habitats. These threats can be anything that adversely affects species and habitats, as well as management deficiencies which may contribute to deficiencies in data or resources needed to address particular needs. Threats may impact wildlife and habitats directly or indirectly through a combination of stressors or intermediary processes.

A variety of stable habitats are vital for the long term welfare of wildlife and the recovery of species that experienced population declines or have been extirpated from an area or region. Some species utilize the same habitat year round, while others may breed in one and migrate through others. Summer and winter habitats may be as different as pine barrens and tropical rainforest. Some species can travel thousands of miles during a migration cycle, while others may occupy a single vernal pool. Human activities and habitat degradation can and do occur in all locations and all times of the year. Healthy, stable habitats can be used a proxy for predicting robust wildlife populations. The ultimate goal of this plan is to target habitat-based threats with actions that will recover and restore degraded critical habitats, coupled with protecting habitats that are in good condition from new threats and degradation. Non habitat-based threats to individual species, such as diseases, depredation, and overfishing are also critical threats that require local and regional action to reverse declines in several SGCN populations.

4.2 Regional Threats

There is no comprehensive assessment of threats across the Northeast region. However, numerous threats to fish, wildlife, and their habitats have been identified by the northeastern states as part of their individual SWAPs. After the completion of these 2005 SWAPs, a survey was conducted to identify common threats listed by states (AFWA 2011). The 13 Northeast states and the District of Columbia identified 37 common, recurring threats to SGCN or their habitats (AFWA 2011). The most frequently mentioned threats included invasive species (mentioned by 100% of Northeast states) and industrial effluents; commercial and industrial areas; housing and urban development; and agricultural and forestry effluents (all of which were mentioned by at least 83% of Northeast states). Other important challenges mentioned by 50% or more of the Northeast states included: dams and water management; habitat shifting and alteration; recreational activities; roads and railroads; storms and flooding; temperature extremes; logging and wood harvesting; problematic native species; harvest or collection of animals; lack of information or data gaps; and droughts. In addition to the specific threats mentioned in the 2005 Wildlife Action Plans, recent work by the Northeast states has emphasized the importance of additional, emerging threats such as climate change, exurban developments, new invasive species, and diseases.

4.3 Threat Selection and Prioritization

Key threats in the Northeast Region were identified through Regional Conservation Needs (RCN) collaborative efforts and projects and summarized in the Northeast Regional Synthesis for State Wildlife Action Plans (Terwilliger and NEFWDTC 2013). Threats to both habitats and species were based on the Northeast Lexicon (Crisfield and NEFWDTC 2013), which uses the International Union for Conservation of Nature (IUCN) Threat Categorization Scheme (Version 3.2) (Salafsky et al 2008, IUCN 2015) and is linked to threats in the USFWS Tracking and Reporting Actions for the Conservation of Species (TRACS) system (USFWS 2015) (see Table 8). The IUCN Threat Categorization Scheme was not developed to address completely urban areas. Some of the IUCN nomenclature identifies Level 2 threats that may not directly correlate to urban areas, such as agricultural and forestry effluents; however, the Level 3 threats in that category (nutrification soil erosion, and sedimentation) are directly related.

Table 8 IUCN Hierarchy of Conservation Threats in the District

IUCN Level 1	IUCN Level 2	IUCN Level 3
Residential and Commercial Development	Housing and Urban Areas	List the type of development
	Commercial and Industrial Areas	
	Tourism and Recreational Areas	
Transportation and Service Corridors	Roads and Railroads	List the specific type of road
	Utility and Service Lines	List the specific type of utility line
	Flight Paths	List the specific type of flight path
Biological Resource Use	Hunting and Collecting Terrestrial Animals	Intentional Use
		Unintentional effects
		Persecution/Control
	Fishing and Harvesting of Aquatic Resources	Intentional Use (subsistence/small scale)
		Intentional Use (large scale)
Human Intrusions and Disturbance	Recreational Activities	List the specific activity
	Work and Other Activities	
Natural Systems Modifications	Dams and Water Management/Use	Abstraction of Surface Water (domestic use)
		Small dams
	Other Ecosystem Modifications	List the specific source of alteration
Invasive and Other Problematic Species, Genes and Diseases	Invasive Non-native/Alien Species/Diseases	Named or Unspecified Species
	Problematic Native Species/Diseases	
	Problematic Species/Diseases of Unknown Origin	
	Viral/Prion-induced Diseases	Named or Unspecified Species (Disease)
	Diseases of Unknown Cause	----------
Pollution	Domestic and Urban Wastewater	Sewage
		Run-off
		Type Unknown
	Industrial and Military Effluents	Oil Spills
		Type Unknown
	Agricultural and Forestry Effluents	Nutrient Loads
		Soil Erosion and Sedimentation
		Herbicides and Pesticides
	Garbage and Solid Waste	type, source, specific pollutants of concern
	Excess Energy	Light Pollution
		Thermal Pollution
		Noise Pollution
Climate Change and Severe Weather	Habitat Shifting or Alteration	List the specific problem
	Droughts	
	Temperature Extremes	
	Storms and Flooding	
	Sea Level Rise	

4.4 Resource Deficiencies and Programmatic Threats

There can be many administrative and management challenges to implementing the conservation actions included in this SWAP. These challenges can be viewed as threats to SGCN and habitats just as development and resource extraction are threats to wildlife. This section presents some of the obstacles that must be overcome before the District will be able to effectively implement its conservation actions.

There is a significant lack of initial baseline knowledge or inventory for a number of taxa. Bees, mussels, snails, crayfish, copepods and other invertebrates have not been sufficiently studied in the District. Lack of knowledge of these taxa resulted in low certainty of listing some species as SGCN and caused DDOE to rely on expert knowledge and regional data.

There is an overall lack of aquatic resources and wildlife education facilities in the district and limited avenues for large-scale outreach and education of adults and children. Outreach and education about SGCN and wildlife habitats can foster an appreciation for wildlife and for the critical places that wildlife use.

Limited resources in the form of funding and grants will impair the ability to properly execute some aspects of the SWAP. Additionally, resources will be targeted towards Tier I species for fiscal efficiency. This may lead to negative population trends in Tier II species that do no benefit from District wide conservation actions.

Although DDOE is responsible for the development of the SWAP for the entire District, implementation must fall to many partner and stakeholders organizations. Additionally, much of the District's wildlife habitats are on federal land. Conservation actions must be coordinated with federal land managers. Determining the role of each and serving everyone's interest presents challenges to a coordinated conservation effort. The District also shares habitat with the surrounding states and region. It is home to several stopover points for migratory species that transverse the region. Since species and their habitats are not limited by administrative boundaries, the District must coordinate with federal entities, states, and land managers of the region and attempt to address cross-border issues.

4.5 Habitat-Based Threats

Threats to habitats can be shown to impact a wide number of wildlife species. For instance, construction of commercial development on a formerly forested parcel results in the total loss of habitat for all of the wildlife that used that parcel. Stormwater runoff in streams can damage the stream bank, wash out fish and invertebrates, and allow pollutants to leach into the groundwater. The

same assessment of species and their habitats in this plan that informed the SGCN and critical habitats lists also included a habitat-based threat selection, ranking, and prioritization process. It is necessary to rank and prioritize habitat-based threats so that those species and habitats in most dire need can be targeted for conservation actions.

Prioritization of Threats by Habitat

Threats to habitats were scored and ranked using the threat characteristics listed in Chapter 3 of the Northeast Lexicon. These include severity, reversibility, immediacy, spatial extent, certainty, and likelihood. These characteristics are described in Table 9. Each habitat was ranked for each of these threat characteristics. Low impact characteristics were scored with a 1, moderate impact characteristics were scored with 2, and high impact characteristics were score with a 3. Scores were averaged for each Habitat System, and then re-averaged for each habitat Macrogroup. Since the District is so small, threats to similar systems within each Macrogroup can be treated as a threat to the entire Macrogroup, and conservation actions can be applied in Conservation Opportunity Areas or in other locations that are targeted for the recovery of one or more specific species.

The overall table of habitat-based threats at the Habitat System level can be found in Appendix XX. Table 10 shows the habitat-based threats at the Macrogroup level for aquatic and terrestrial habitats. The top overall habitat threats are invasive species, urban wastewater, nutrification/sedimentation, and problematic native species. The top threats for terrestrial vegetative habitats are invasive species, problematic native species, recreational activities, and development of recreational areas. The top threats for aquatic habitats are urban wastewater, invasive species, nutrification/sedimentation, and ecosystem modifications. Threats were not ranked for Urban Landscapes, since they are not inherently quality wildlife habitat, but conservation actions were identified to address related threats (Table 17), since low density suburban areas and large, native street trees do provide limited SGCN habitat. The top Macrgroup level habitat threats are discussed in the remainder of Section 4.5.

Table 9 Threat Characteristics and Categorical Ratings

Threat Characteristic	Low Impact	Moderate Impact	High Impact
Severity	Slight Severity: Degree of ecological change is minor	Moderate Severity: Degree of ecological change is substantial	Severe: Degree of ecological change is major
Reversibility	Reversible: Effects of the threat can be reversed by proven actions	Reversible with difficulty: Effects of the threat may be reversed but costs or logistics make action impractical	Irreversible: Effects of the threat are irreversible
Immediacy	Long-term: Effects of the threat are expected in 10–100 years given known ecosystem interactions or compounding threats	Near-term: Effects of the threat are expected within the next 1–10 years	Immediate: Effects of the threat are immediately observable (current or existing)
Spatial Extent	Localized: (<10%) A small portion of the habitat or population is negatively impacted by the threat.	Dispersed or Patchy: (10%–50%)	Pervasive: (>50%) A large portion of the habitat or population is negatively impacted by the threat.
Certainty	Low Certainty: threat is poorly understood, data are insufficient, or the response to threat is poorly understood	Moderate Certainty: some information describing the threat and ecological responses to it is available, but many questions remain	High Certainty: Sufficient information about the threat and ecological responses to it is available
Likelihood	Unlikely: Effects of the threat are unlikely to occur (<30% chance)	Likely: Effects of threat are likely to occur (30%–99% chance)	Occurring: Effects of the threat are already observable

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Table 10 Threat Priority Ranking of Vegetative and Aquatic Macrogroup Habitats

IUCN 1	IUCN 2	Vegetative Macrogroups						
		Central Oak-Pine	Northern Hardwood & Conifer	Early Successional	Coastal Plain Swamp	Northeastern Floodplain Forest	Emergent & Modified Managed Marsh	Average Score, Vegetative Macrogroups
Invasive & Other Problematic Species, Genes and Diseases	Invasive Non-native/ Alien Species/ Diseases	16	16	17	16	16.7	16	16.3
	Problematic Native Species/ Diseases	12.7	17	0	6	11.3	17	10.7
Residential & Commercial Development	Housing & Urban Areas	6.3	9	0	0	0	0	2.6
	Commercial & Industrial Areas	7	9	0	0	0	0	2.7
	Tourism & Recreational Areas	12	16	10	4	10.3	6	9.7
Human Intrusions & Disturbance	Recreational Activities	14	16	10	4	10.3	6	10.1
Pollution	Domestic & Urban Wastewater	0	0	0	13.5	13.5	14	6.8
	Agricultural & Forestry Effluents; Erosion/	0	0	0	8	16	15	6.5
	Industrial & Military Effluents	0	0	0	0	0	0	0.0
	Garbage & Solid Waste	0	0	11	0	0	13	4.0
Natural Systems Modifications	Ecosystem Modifications	0	0	10	0	10	10	5.0
	Dams & Water Management/ Use	0	0	0	0	0	0	0.0
Biological Resource Use	Fishing & Harvesting of Aquatic	0	0	0	0	0	0	0.0
Resource Management Needs	Resources Information Collection Needs	10	10	10	10	10	10	10.0
Education/ Outreach Needs	Education Needs	7	7	7	7	7	7	7.0

Aquatic Habitats									Overall Average Score
Great River & Embayed River Areas	Small River	Creek/ Stream	Ponds (Freshwater & Riverine)	Intertidal Shore (Mudflats & Rocky Shoals)	Reservoir	Vernal Pool	Springs & Seeps	Average Score Aquatic Habitats	
14	14	14	14	0	14	14	14	12.3	14.0
0	0	0	14	0	14	14	0	5.3	7.6
0	0	17	0	0	0	17	7	5.1	4.0
17	0	0	0	0	7	13	7	5.5	4.3
7	0	0	7	4.5	7	10	11	5.8	7.5
0	0	0	6	4.5	6	10	10	4.6	6.9
16	13.5	15	14	12	10	15	15	13.8	10.8
0	15.5	15	15	11	10	15	15	12.1	9.7
0			0	10.5	10	0	0	3.4	1.7
16	16	16	0	7	0	0	0	6.9	5.6
0		10	10	0	10	15	15	8.6	6.9
16	16	16	0	0	0	0	0	6.0	3.4
12	0	13	0	0	0	0	0	3.1	1.8
10	10	10	10	10	10	10	10	10.0	10.0
7	7	7	7	7	7	7	7	7.0	7.0

4.5.1 Invasive Species

Non-native invasive species are an organism that is non-native to the ecosystem under consideration and whose introduction causes, or is likely to cause, economic or environmental harm, or harm to human health (Invasive Species Advisory Committee 2006). Invasive species have been introduced to habitats either intentionally or unintentionally. Habitats may be susceptible to invasive species if they are already stressed by fragmentations, nutrification, hydrological changes, or soil compaction. Invasive species become overabundant in habitats because they lack the natural control mechanisms of predation and diseases that limited their populations in their native environments (National Invasive Species Council 2008).

Invasive plant and animal species are the greatest threat to both terrestrial and aquatic habitat types within the District. Invasive species can include non-native plant and animal species. An example of an invasive plant species is lesser celandine (*Ficaria verna)*. Lesser celandine is an ephemeral spring plant that begins growing in mid-winter. It occupies moist floodplain soils where it can grow thick monoculture mats which limit the growth of native spring ephemeral wildflowers such as spring beauty (*Claytonia virginiana*) and Virginia bluebells (*Mertensia virginica*). Lesser celandine is ubiquitous in Northeastern Floodplain Forest habitats in the District. Examples of invasive animal species are Northern snakehead (*Channa argus*), which is native to Asia, and blue catfish (*Ictalurus furcatus)*, which is native to the Mississippi River basin. They are predatory fish found in the Anacostia and Potomac Rivers, in floodplain ponds, the freshwater ponds at Kenilworth Aquatic Gardens, and in tidal freshwater wetlands. These species prey on smaller fish, snails, and crayfish resulting in increased predation on some of the District's SGCN. Populations of these predators have reached historic highs and have reduced productivity for many species across all habitat types.

4.5.2 Urban Wastewater

Urban wastewater includes stormwater runoff and sewage. Increases in stormwater runoff occur concurrently with high levels of impervious surfaces and changes in land use during development. Because much of the District was developed prior to modern stormwater regulations, runoff is directed into streams and artificial gullies where it produces significant erosion, even in naturally vegetated areas. Untreated stormwater leads to erosion, the transport of pollutants, and dramatic changes in water temperature in the District's creeks, streams and rivers.

Other pollutants can enter habitats through stormwater runoff. The District, as an urban center, is especially vulnerable to both point and non-point source water

pollution. Point source pollution includes municipal wastewater and stormwater discharges. For example, millions of gallons of raw sewage may be released from combined sewer outfalls into the Anacostia and Potomac Rivers, even after relatively minor storm events. Stormwater pollution results from vast urban development, roads, construction, impervious surfaces, and new development, both in the District and upstream, bringing pollutants into the Potomac, Anacostia, and Rock Creek watersheds.

4.5.3 Nutrification/Sedimentation

Sedimentation in the District is mainly a function of activities occurring in jurisdictions bordering the Potomac and Anacostia Rivers outside of the District. Due to land disturbance caused by housing and road construction, changes in the hydrologic regime, and the concurrent increase in impervious surfaces, stormwater runoff during rain events moves large quantities of soil from land surfaces into the waterways. Once the rivers begin to widen and slow in the District, the sediment which had been transported downstream with the swift upstream currents begins to precipitate. Additionally, headwater creeks and streams in the District receive stormwater and carry nutrients and sediments from land in the District. Sedimentation is also caused by water moving soil from disturbed sites in the District.

Nutrification results from excess phosphorous and nitrogen in aquatic habitats. These nutrients can come from combined sewer outfalls, non-point sources and stormwater runoff. This can lead to hypoxic conditions in the water column and fish kills. Nutrification can also create conditions which further favor invasive plant species over native plants in both aquatic and wetland systems.

4.5.4 Problematic Native Species

Problematic native species include native animals that have become overabundant due to introduction, habitat changes, and a lack of natural control mechanisms. White-tailed deer (*Odocoileus virginianus*) are a native species that has become overabundant in the forests of Rock Creek Park and surrounding medium-density residential areas. The National Park Service estimated the density of deer in Rock Creek Park to be 70-80 deer/square mile (NPS 2014b). Fifteen deer per square mile is maximum density that allows for forest regeneration in most eastern forests (Marquis, Ernst, and Stout 1992).

Canada geese (*Branta canadensis)* are another problematic native species. Migratory Canada geese are native to the District and are a common and abundant winter resident. More than 5,000 wintering geese were been counted by DDOE in 2015. These migratory geese are the eastern subspecies, *Branta canadensis* subspecies *canadensis*, which return to northern Canada to nest. A different subspecies, *Branta canadensis* subspecies *maxima*, was introduced to

the area in the 1930s and 40s. This introduced population became non-migratory, creating a resident population of approximately 550 Canada geese along the Anacostia River. The non-migratory geese overbrowse and decimate the vegetation in the freshwater tidal wetlands along the Anacostia River. (NPS 2014c)

4.5.5 Other Top Habitat-Based Threats

Recreational activities and development of recreational areas are the other top threats to terrestrial vegetative habitats systems, and ecosystem modification was a top threat to aquatic systems.

Recreation-based threats include both pressures from tourism and recreational infrastructure, and pressures from tourism and recreational activities. Recreational infrastructure includes construction of bicycle and hiking trails, creation of unofficial social trails, new athletic fields, new mowing regimes, new docks and access ramps, and other recreational construction. These continue to be developed in the District. The Anacostia Riverwalk trail was recently extended from Kenilworth Park to the District border, resulting in the loss of Coastal Plain Swamp and Northeastern Floodplain Forest habitats. New, unofficial trails are beaten into the forest by foot traffic. There is an extensive and growing network of unofficial trails in Rock Creek Park, C&O Canal Park, and other locations in many forest habitats in the District. Impacts from trail users can extend beyond the trails. Many camera traps that DDOE uses during winter meso-mammal surveys capture off-leash dogs, far from any trails. Off-leash dogs are a threat to ground-dwelling animals, can impact herbaceous plants in forests, disperse invasive plant seeds, harass wildlife, and can damage sensitive vernal pool habitats

Ecosystem modification includes changes to hydrology, vegetation patterns, changes to land forms, cement stream channelization, changes to fire regimes, and other human-driven ecosystem changes. In aquatic systems the greatest threats to wildlife habitats are the presence of dams and other instream obstructions, and stream channelization. Hydrological alterations can affect a number of vegetative systems, particularly the endemic Magnolia Bog, a Northeastern Floodplain Forest, and Coastal Plain Swamp habitats. The Magnolia Bog has become drier with changes to land use near Oxon Run Park, which is leading to changes in its vegetative community. Instream obstructions have disconnected many small tributaries from the Anacostia River.

Landform changes can apply to both upland and aquatic habitats. Landfill remediation may affect a significant portion of the meadow habitat in the District. Kenilworth Park sits on former landfill sites and contains several large ruderal meadows. These sites are under study to be capped with additional soil

to remediate for runoff and other infiltration of pollutants. Capping of these meadows without significant restoration will result in the loss of most of the meadow habitat in the District. Stream modifications that have the main goal of improving water quality can impact instream and riparian habitats by altering stream morphology (introducing step pools and cascades, reducing sinuosity), altering streambed composition, introducing non-native plants and soils, and opening closed-canopy systems. These threats to SGCN can be minimized and overall habitat can be improved with detailed planning that keeps wildlife habitat, in addition to water quality, as a goal.

4.6 Species-Based Threats

In addition to threats that directly and indirectly impact the habitats utilized by the wildlife of the District, non-habitat based threats must also be addressed. The improvement in the quality and healthy of a habitat or ecosystem may not secure the conservation of a declining species, if non-habitat based threats are excluded from the overall strategy to conserve and positively affect SGCN.

4.6.1 Diseases and Pathogens

Wildlife diseases and pathogens have the potential to impact a wide range of species and decimate populations in a short time span. Zoonotic pathogens may become transmissible to humans, can economically impact commercial animals, and infiltrate pet populations. A number of current and emerging diseases are either currently impacting or may impact wildlife in the District in the near future:

Rabies – Rabies is a preventable, fatal disease transmitted from animals to humans, caused by a virus (lyssavirus) that attacks the central nervous system. Symptoms include brain swelling, convulsions, paralysis, and ultimately death. The virus is present in the saliva of infected animals and transmitted primarily through bites. The virus is most often found in raccoons, skunks, foxes, and bats, but can be in unvaccinated dogs and cats. There were 727 reported cases of rabies in the District between 1982 and 2009, with 78% of those cases being infected raccoons (District Department of Health, 2009).

White-nose Syndrome – has killed more than 5.7 million hibernating bats in the Northeast. The disease is named for a white fungus (*Geomyces destructans*) that invades the skins of hibernating bats and is seen around the nose and eyes. Infected bats are aroused from torpor more often than healthy bats, contributing to higher mortality rates. Much about the disease is still unknown and research is ongoing (National Wildlife Health Center 2015).

***Batrachochytrium dendrobatidis* (*Bd*)** – Chytrid is a type of fungus species that lives exclusively in water and moist environments. *Bd* is species of the fungus

which is linked to devastating declines in amphibian populations and has caused extinctions and extirpations of a number of species from the wild (Rosenblum et al 2010). Because of the rapid progression of population declines and the speed in which it can spread and exterminate herpetofauna, the threat of *Bd* in the District must be of concern. *Bd* has been found in eastern North America. The pet trade in the region may be a vector for the spread of *Bd* to District habitats.

Avian Influenza (H5N1) – H5N1 is a highly pathogenic influenza virus that occurs mainly in birds, is highly contagious among avian species, and has a high mortality rate in poultry. Fortunately, H5N1 does not infect humans easily and is difficult to spread between people. Because all influenzas have the ability to mutate, public education and monitoring for potential changes may be required.

West-Nile virus (WNV) – WNV is most often spread to people from the bite of an infected mosquito. WNV normally cycles between mosquitoes and birds, but humans may be infected if bitten by a WNV positive mosquito. Corvid populations (jays and crows) were heavily impacted by WNV in the United States, but most are recovering since the highest mortality levels in 2003-2004 (McLean 2006). Public education and monitoring of outdoor workers may be required.

Lyme Disease (*Borrelia burgdorferi*) – Lyme disease is a bacterium transmitted through the bite of infected ticks. Typical symptoms include fever, headache, fatigue, and skin rashes. If untreated, infection can inflame joints, the heart, and the nervous system. In from 2004-2013, 84% of Lyme disease cases were reported in the Northeast (Centers for Disease Control and Prevention 2015). White-tailed deer are part of the bacterium's host cycle and may need management to reduce human infections.

Avian Vacuolar Myelinopathy (AVM) – AVM is a recently discovered, fatal disease impacting waterbirds and raptors. AVM affects neurological pathways, reducing muscle function, and makes flying and swimming difficult. It has been linked to epiphytic cyanobacteria (*Aetokthonos hydrillicola*) (Williams et al 2006, Wilde et al 2014). The bacteria are found on hydrilla (*Hydrilla verticillata*), an invasive submerged aquatic plant, which is in the District.

Parvovirus – Various parvoviruses infect wild carnivores and can cause disease. Feline panleukopenia or canine parvovirus are highly contagious and found in domestic animals. Raccoons have been shown to harbor parvoviruses. Wild canids, such as gray fox, red fox, and coyotes may also harbor and be able to transmit parvoviruses.

Canine Distemper – Canine distemper is a highly contagious virus with a high mortality rate. This virus has spread from domestic dogs and can infect and devastate multiple species of wildlife. The disease can spread through populations of raccoon, skunk, fox, and similar animals quickly.

Ranavius – Ranavirus is a DNA based virus responsible for the massive die-off of amphibians and turtles, specifically Eastern box turtles (*Terrapene carolina carolina*). Presence of the virus in wetlands can result in mortality of hundreds to thousands of amphibians within 1-5 days. Because of the seasonality of the ranavirus events, it is suspected to be linked to spring frog and salamander larvae. Symptoms of the virus include lethargy, erratic swimming, swelling in the body, and lesions (National Wildlife Health Center 2013a).

Toxoplasmosis – Toxoplasmosis is caused by the Toxoplasma gondii parasite, which has recently been linked to the mortality of aquatic mammals. These parasites are found globally and distributed into water resources from feline feces. The infection from these parasites can lead to inflammation in the brain and other tissues of the body (Gibson et al 2011).

Snake Fungal Disease – Snake fungal disease is a newer disease emerging in populations of wild snakes. Clinical signs of the fungus include scabs on the scales, nodules, abnormal molting, opaqueness of the eyes, skin ulcers and swelling of the head and face. Population level impacts are not widely known at this point and seemingly hard to monitor given the cryptic nature of snake species (National Wildlife Health Center 2013b).

Chronic Wasting Disease – Chronic wasting disease is a disease of the nervous system that affects deer and elk populations causing brain lesions. Although currently not documented in deer within the District, occurrences have been documented in Maryland and Virginia (National Wildlife Health Center 2013c).

4.6.2 Invasive Animal Species

Invasive animal species not only impact habitats, they are responsible for the direct take of species through depredation and competition for resources. Free roaming cats kill an estimated 1.3–4.0 billion birds and 6.3–22.3 billion small mammals in the United States annually (Loss, Will, and Marra 2013, North American Bird Conservation Initiative 2014, American Bird Conservancy 2015a). The northern snakehead (*Channa argus*) was first discovered in the Potomac River watershed in 2002 in Crofton, MD. Since then, it has spread throughout the Chesapeake Bay system. Northern snakehead are voracious eaters, consuming fish, frogs, crustaceans, and in some instances, small birds, mammals, and reptiles. The blue catfish (*Ictalurus furcatus*) is a very large catfish introduced to the region in the 1970's. They grow quickly, and can be as long as five feet and weigh more than 100 pounds. Blue catfish are opportunistic feeders, impacting

stocks of shad and herring. European starlings (*Sturnus vulgaris*) and House sparrows (*Passer domesticus*) are aggressive, non-native birds which out compete native secondary cavity nesters for breeding opportunities and will often kill nesting native species.

4.6.3 Other Threats

Endocrine (Hormone) Disruptors – Field and laboratory studies have shown that exposure to certain endocrine and hormone disruptors have contributed to adverse effects in some wildlife species and populations. Endocrine disruption has the potential to cause reproductive and behavioral changes, impair immune systems, and cause neurological problems and tumors (USFWS 2014). These effects can be subtle changes in physiology or more overt. The extent to which hormone disruptors permeate the environment and cause lasting impacts is unknown.

Noise Pollution – The nearly constant background noise of an urban area, punctuated by sirens, vehicles, planes, and other auditory spikes may be a contributing factor to alterations in wildlife behavior and a decline of certain populations. Hearing loss or the inability to hear breeding or warning calls over ambient noise may lead to males not being able to find a mate or the detection of a predator too late. Birds have to sing longer and louder to compete in urban areas, expending valuable energy resources, while others have altered pitch and singing times to compete (Mioron et al 2015).

Light Pollution – The use of street lights and other sources of direct and ambient light throughout the District have the potential of being a disturbance for nocturnal and corpuscular wildlife. Bright lights can disorient and become a source of mortality for migratory birds, bats, and some invertebrates.

Collisions with Glass and Buildings – An estimated 300 million to 1 billion birds are killed annually from collisions with glass on buildings and homes (Seewagen and Sheppard 2014, American Bird Conservancy 2015b). The urban character of the District creates a dangerous gambit for migratory and residential species.

4.7 Development and Redevelopment

Developed habitats offer little to no value to most wildlife species. Few native species are adapted to survive in commercial and industrial areas, although some, such as grey squirrel and Virginia opossum make use of human spaces and detritus. Some birds, rabbits, and other species use the residential areas of the District. The threats to natural habitats that are detailed above are fully realized in developed areas. Urban habitat patches are small, fragmented, patchy, disconnected, and mimic the forest edges. Non-native and invasive plants are common in suburban landscaping, and commonly escape and

encroach into more natural habitats. Roads and walkways reduce habitat connectivity, are an impediment to dispersal and foraging, and are a source of polluted stormwater runoff.

Redevelopment and increased density in some developed locations may further reduce already low habitat values. The aging of the street tree and suburban tree canopy may result in the loss of mature tree canopy and reduce the value of these areas. Increasing the use of native street trees where practicable instead of non-natives such as Norway maple (*Acer platanoides*) or Japanese zelkova (*Zelkova serrata*) could improve the value of urban habitats.

4.8 Climate Change

Although many threats associated with climate change are on a global, national, or regional scale and outside the scope of being solved through local conservation actions, the species and habitats of the District will be impacted by climate change. See Chapter 5 for an assessment of the predicted condition of habitats, threats to SGCN and habitats, and possible conservation actions relating to climate change.

Chapter 5 Climate Change Vulnerability Assessments

5.1 Introduction

State Wildlife Action Plan coordinators have been challenged with incorporating climate change impacts and species responses when updating the plans in 2015. DDOE utilized the Northeast Climate Center's draft guidelines *Integrating Climate Change into Northeast and Midwest State Wildlife Action Plans* (Staudinger et al. 2015, in review) along with several other global and regional sources to help guide and compose the climate change vulnerability assessments in this chapter.

The conservation of species threatened by climate change is, unfortunately, outside the scope of the District's conservation and climate-smart actions alone. Wildlife species face threats that are outside of the District's small sphere of influence; these threats are regional, national, international, or even global in character. However, anticipating threats and the corresponding management needs will help the District proactively face the challenges climate change presents.

5.2 Climate Change Predictions

There is overwhelming evidence and scientific-consensus that the climate is warming at a rate faster than it has at any point the last millennium (Kennedy et al, 2010, Masson-Delmotte et al, 2013). According to an ongoing temperature analysis conducted by scientists at NASA's Goddard Institute for Space Studies (GISS), the average global temperature on Earth has increased by about 0.8 degrees Celsius (1.4° Fahrenheit) since 1880. Two-thirds of the warming has occurred since 1975, at a rate of roughly 0.15–0.20 degrees Celsius per decade. The vast majority of the temperature change is because of human emissions of carbon dioxide and other greenhouse gases.

The global temperature record represents an average over the surface of the planet. The temperatures we experience locally can fluctuate significantly because of predictable cyclical events like time of day, season, and hard-to-predict wind and precipitation patterns. But the global temperature primarily depends on the quantity of energy the Earth receives from the Sun and how much it radiates back into space; this amount changes very little. The amount of energy the earth is able to radiate back into space depends primarily on the

chemical composition of the atmosphere, particularly the amount of heat-trapping greenhouse gases.

Greenhouse gases accumulate slowly and take much longer to leave the atmosphere. Fossil fuel use increases in the post-World War II era (5 % per year), boosted these greenhouse gases in the Earth's atmosphere. According to the 2014 National Climate Assessment, the strong warming trend of the past 50 years "can only be explained by human influences," especially the greenhouse gas emissions from burning of fossil fuels and deforestation (U.S. Global Change Research Program 2014).

Under a "business as usual" scenario of emissions growth throughout the 21st century, global temperature is projected to rise by 3–5 degrees Celsius; under a scenario where emissions are aggressively reduced, temperature rise could likely be held in the 2–3 degree Celsius range (Collins et al, 2013). Even if emissions were stabilized, warming and sea level rise would continue for centuries owing to time lags in climate system feedbacks and also because once greenhouse gases are emitted, they remain in the atmosphere for decades to centuries (Solomon et al. 2009).

5.3 Global Predictions

Numerical models (General Circulation Models or GCMs), representing physical processes in the atmosphere, ocean, cryosphere and land surface, are the most advanced tools currently available for simulating the response of the global climate system to increasing greenhouse gas concentrations. Only GCMs, often in conjunction with nested regional models, have the potential to provide geographically and physically consistent estimates of regional climate change which are required in impact and vulnerability analysis. Downscaling coarse climate projections to finer spatial resolution is increasingly being used to better align the scale of projections with the scale of land management processes and decisions. These climate projections, or climate scenarios, are valuable for considering the direction and magnitude of potential changes and prioritizing locations for adaptation actions. Downscaling climate projections to a spatial resolution relevant to manageable units allows decision-makers to better visualize what these different futures imply locally and regionally. However, these projections are based off of many scenarios of future emissions and different models of the climate. Rather than impossibly attempting to identify the "most accurate" climate scenario, it is often beneficial to explore the maximum possible range of projected variability through the use of multiple climate scenarios. This allows us to identify where these scenarios are in agreement and the range of possible future conditions. Regional assessments of the "trends" of these models are the starting point for most land managers.

5.4 Regional Predictions

Regional assessments of projected climatic trends and impacts are rapidly proliferating throughout the United States. Leading sources include National Oceanic and Atmospheric Administration (NOAA) funded Regional Impact and Science Assessment groups and some states, such as Virginia, have funded climate impact assessments through universities. The Department of the Interior and some Landscape Conservation Cooperatives have initiated numerous regional assessments that are compiling information on regional climate projections and impacts. Nearly all of these impact assessment programs are sources of climate projection information for individual regions.

Because of the small size and limited resources of the District of Columbia, DDOE is utilizing the vast publically available data, projections and predictions, report, studies, and guidelines currently available for the District, Maryland, and Virginia. The following is a list of the primary bodies of work DDOE used to compile the climate change predictions and threats cited in this chapter:

- *Virginia's Climate Modeling and Species Vulnerability Assessment: How Climate Data Can Inform Management and Conservation*. (Kane, et al 2013)
- *Summary of Potential Climate Change Impacts, Vulnerabilities, and Adaptation Strategies in the Metropolitan Washington Region: A synopsis of lessons learned from the Metropolitan Washington Council of Governments' climate adaptation planning initiatives from 2010–2012*. (Metropolitan Washington Council of Governments. 2013)
- *Building a Climate Resilient National Capital Region Federal and community agencies working together on climate preparedness and resilience*. Summary of Climate Change Vulnerability and Adaptation Workshop Results Built Systems: September–December 2013 Workforce, Community and Natural Systems: February–April 2014
- *Integrating Climate Change into Northeast and Midwest State Wildlife Action Plans*. USGS Cooperative Report. (Staudinger, Morelli, and Bryan. 2015. In review).
- *Climate Projections & Scenario Development: Climate Change Adaptation Plan for the District of Columbia*. District Department of the Environment (2015 expected). Prepared by AREA Research, Kleinfelder, & Perkins+Will. Under review.
- *The Vulnerabilities of Fish and Wildlife Habitats in the Northeast to Climate Change*. A report to the Northeastern Association of Fish and Wildlife Agencies and the North Atlantic Landscape Conservation Cooperative. (Manomet Center for Conservation Sciences and National Wildlife Federation. 2013)

5.5 Climate Change Threats to the District of Columbia Region

Projections consistently show continued warming over the next century across all 22 states included in the Northeast Climate Science Center region (Hayhoe et al. 2007, 2008; Rawlins et al. 2012; Kunkel et al. 2013). This region includes the District of Columbia.

In general, the following trends have a high level of model agreement (i.e., there is a measure of confidence in their occurrence) across many emission scenarios for the region area as time progresses:

- Warming is occurring in every season.
- Heatwaves are becoming more frequent, more intense, and lasting longer.
- Precipitation amounts are increasing, particularly in winter and with respect to high-intensity events in summer.
- Snow is shifting to rain, leading to reduced snow packs and extent of snow cover.
- Atmospheric moisture is increasing.
- Wind speeds are declining, though wind gusts may intensify.
- Soil moisture and evapotranspiration trends are neither robustly observed nor consistent amongst modeling studies.
- Streamflow patterns may be intensifying with heavier rainfall events.
- Streams are warming.
- Severe weather may become more severe.
- Floods are intensifying and occurring more often with heavier rainfall events, yet droughts are also on the rise as dry streaks between events get longer.
- Growing seasons are getting longer, with more growing degree days expected.
- Sea level is rising at an accelerating rate.
- Tropical cyclones and hurricanes are intensifying and storm tracks are shifting northward along the coast.
- Oceans are warming and becoming more acidic.

Given all of these regional threats, the District of Columbia is obviously vulnerable to a range of issues including extreme temperatures, heavy precipitation, and sea-level rise. These changes are likely to cause widespread ecosystem disruption (Kopp et al. 2014).

5.5.1 Temperature

There is potential for the District to experience an increase in frequency, magnitude, and duration of heat waves (Meehl and Tebaldi 2004). Winter minimum temperatures are projected to rapidly rise, reducing the frequency of extremely cold days. Such, increases in temperature will negatively affect wildlife habitats and SGCN.

Pyke et al. (2008), as a part of the Chesapeake Bay Program Science and Technical Advisory Committee, projects that temperatures in the Chesapeake Bay region may increase by as much as 11 degrees Fahrenheit by 2100. In the past in the District (1981–2000), there has been an average of 11 days per year exceeding 95 degrees Fahrenheit. Researchers at AREA research projected that the District will have an average of 18-20 days exceeding 95 degrees Fahrenheit per year by 2020, 30–45 days exceeding 95 degrees Fahrenheit per year by 2050, and as many as 40–70 days exceeding 95 degrees Fahrenheit per year by 2080. Ultimately, these changes in air temperature along with more concentrated precipitation regimes could result in drier, more drought-prone summers.

Most models predict the greatest warming to occur during summer, with maximum potential increases for the region ranging from 6 to 10 degrees Fahrenheit by the 2080s, and an increase in extremely warm days, clustered in the summer months, under conditions of modest winds. The timing of this warming is significant not only because it would increase evapotranspiration and decrease soil moisture, but also because it would result in warmer water temperatures in the bay and surrounding waters during the time that hypoxia is most prominent.

Increased temperatures may lead to heat stress for species, decreased water quality and dissolved oxygen content as well as changes to food availability (Boicourt and Johnson, 2010; Kane, 2013). Temperature increases may also be problematic for species at the edge of their ranges. For example, if species are at the more southern end of their range and unable to migrate, they may not survive significant increases in temperature that are greater than they can withstand (Pyke et al. 2008). Warmer temperatures may also result in warmer waters, which could favor parasites and other pests in aquatic environments (Pyke et al. 2008; Najjar et al. 2010; Kane 2013).

Warming temperatures will also lead to changes in plant phenology, as has already been observed (Primack et al. 2004, Miller-Rushing and Primack 2008). These changes may have significant impacts on ecosystems by changing existing natural land cover types and by allowing for the spread of pests into previously unaffected regions.

5.5.2 Precipitation and Severe Storms

Precipitation trends are hard to constantly model because of the complexity of pattern and the District is in a transition zone between a predicted drier south and wetter northeast. From 1950 to 2008, the region has experienced a slight increase in average annual precipitation (Davis and Campbell 2013). In general, the region is projected to have less precipitation in the summer but more in the autumn by 2080. Regional models suggest precipitation will be concentrated in fewer events, and there will be an increase in intensity of coastal storms. These two threats will likely lead to an increase in flooding (see Figure 21). When predictions were done specifically for the District, these patterns for the smaller area of the District mimicked the patterns of the region as a whole.

Flooding will become increasingly problematic if precipitation continues to fall in heavier events, sea level rises, and storms intensify. Flooding is also heavily influenced by the amount and type of development, shore protection measures, site and building design, storm water drainage infrastructure, and other flood mitigation measures.

The Potomac and Anacostia rivers' overbank flooding originates from precipitation in the river basins; storm surge is caused by coastal storm dynamics. Both have major implications for the wildlife habitat in the District. This threat will be compounded by the impact of high levels of impervious surface. These predictions imply that a greater amount of surface water, often laden with pollutants, will arrive into the Potomac and Anacostia Rivers at a faster rate. These storm surges and flooding events will likely lead to a degradation of water quality and changes in hydrology, habitat structure, and aquatic biodiversity.

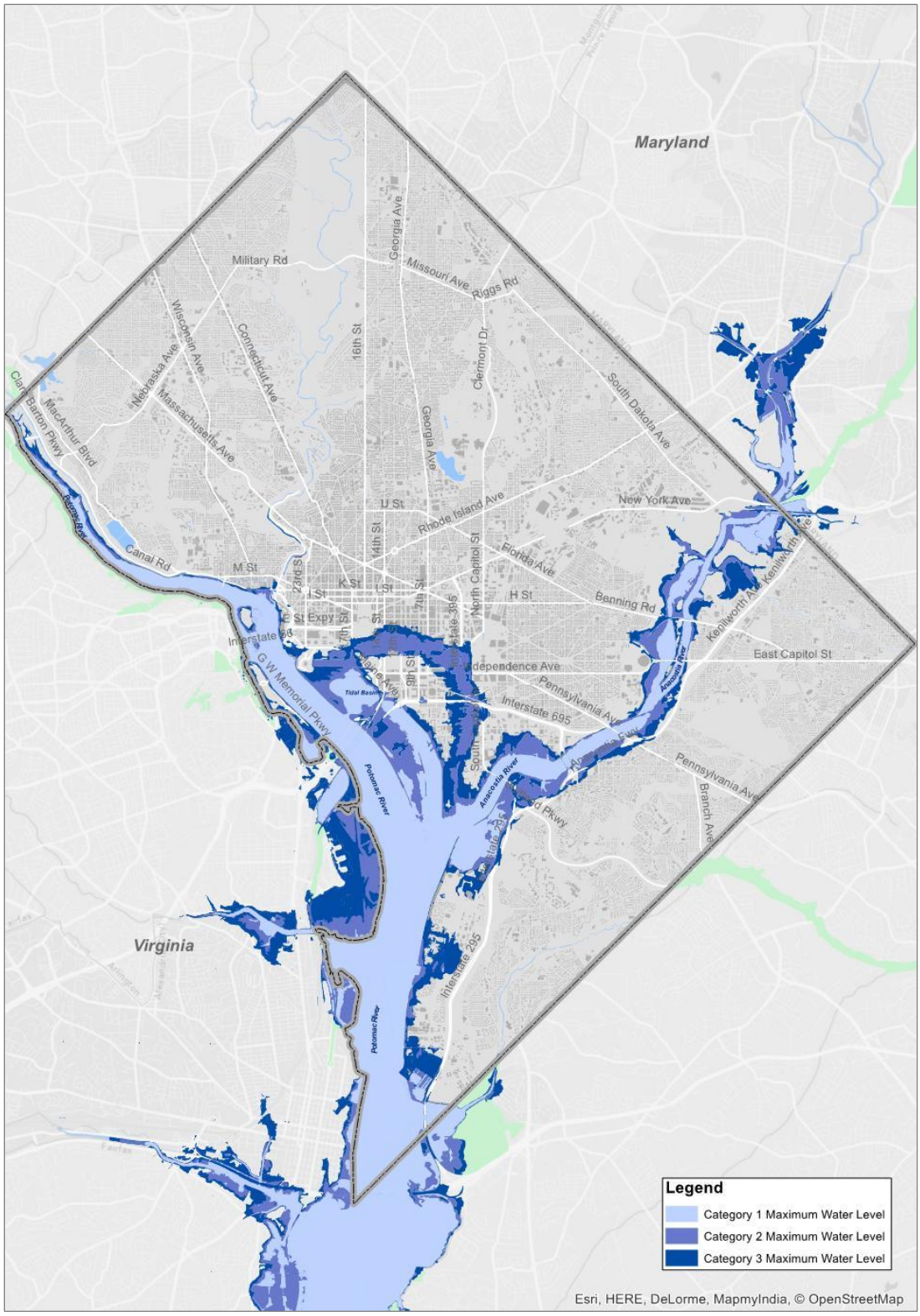

Figure 21 Sea, Lake, and Overland Surges from Hurricanes (SLOSH) hurricane storm surge inundation predictions for Washington DC for present-day Category 1, 2, and 3 storms (North Atlantic Coast Comprehensive Study data)

5.5.3 Sea-level Rise

The Potomac and Anacostia rivers are tidal water bodies that run through the core of the metropolitan Washington region. Sea-level rise over the last century on the Potomac River in Washington, DC is approximately one foot, over a third of which is due to subsidence.

The Chesapeake Bay has also already experienced 1 foot of sea level rise over the last century and is expected to experience up to 5 feet of sea level rise by 2100 (U.S. Army Corps of Engineers 2015). This includes local geological land subsidence. Future sea level rise in the District will depend on increases in future emissions and the rate at which ice melts globally. However, the Virginia Institute of Marine Science (VIMS) (2013) used climate scenarios from the Intergovernmental Panel on Climate Change to determine a range of sea-level rise projections for Virginia. Based on that analysis, VIMS recommends planning for 1.5 feet of sea-level rise over the next 20 to 50 years. Specific projections for the District indicate a relative sea level rise that ranges from 0.6 to 1.9 feet by 2050 and 0.9 to 3.8 feet by 2080 (DDOE, 2015, in review). That research also supports the prediction that tropical storm events are expected to become more intense. Sea-level rise and more intense storm events are expected to increase shoreline erosion, facilitate salt water intrusion, destroy habitats and ecological systems, and increase storm water overflows and sewage contamination.

As sea levels rise, marshes can be inundated and converted to shallow open water habitats or non-tidal and brackish wetlands may convert to higher salinity marshes. As a result, vegetative composition will change, affecting the wildlife species that depend on these habitats. Additionally, as storms become more intense, more frequent inundation may also pose problems for vegetation and fish and wildlife species with low salinity tolerances.

DDOE used the Sea Level Affecting Marshes Model (SLAMM) to simulate impacts from sea level rise in the District region (Clough et al. 2012). DDOE was specifically interested in identifying major transitions and areas of concern for the Potomac and Anacostia Rivers. As expected, some of the primary habitats these will impact are the tidal and non-tidal wetlands and forests adjacent to the rivers and some additional impact in the reaches of Rock Creek. Specifically, SLAMM predicted (2.3 feet by 2100) increases in tidal marsh and regularly flooded areas in the National Arboretum, Kenilworth Park and Aquatic Gardens Park, Anacostia Park, and lower Rock Creek. This does not include stochastic storm surge impacts, which could have devastating effects on the river ecosystems around the District. Output from a similar model used in the North Atlantic Coast Comprehensive Study (U.S. Army Corps of Engineers, 2015) is shown in Figure 22.

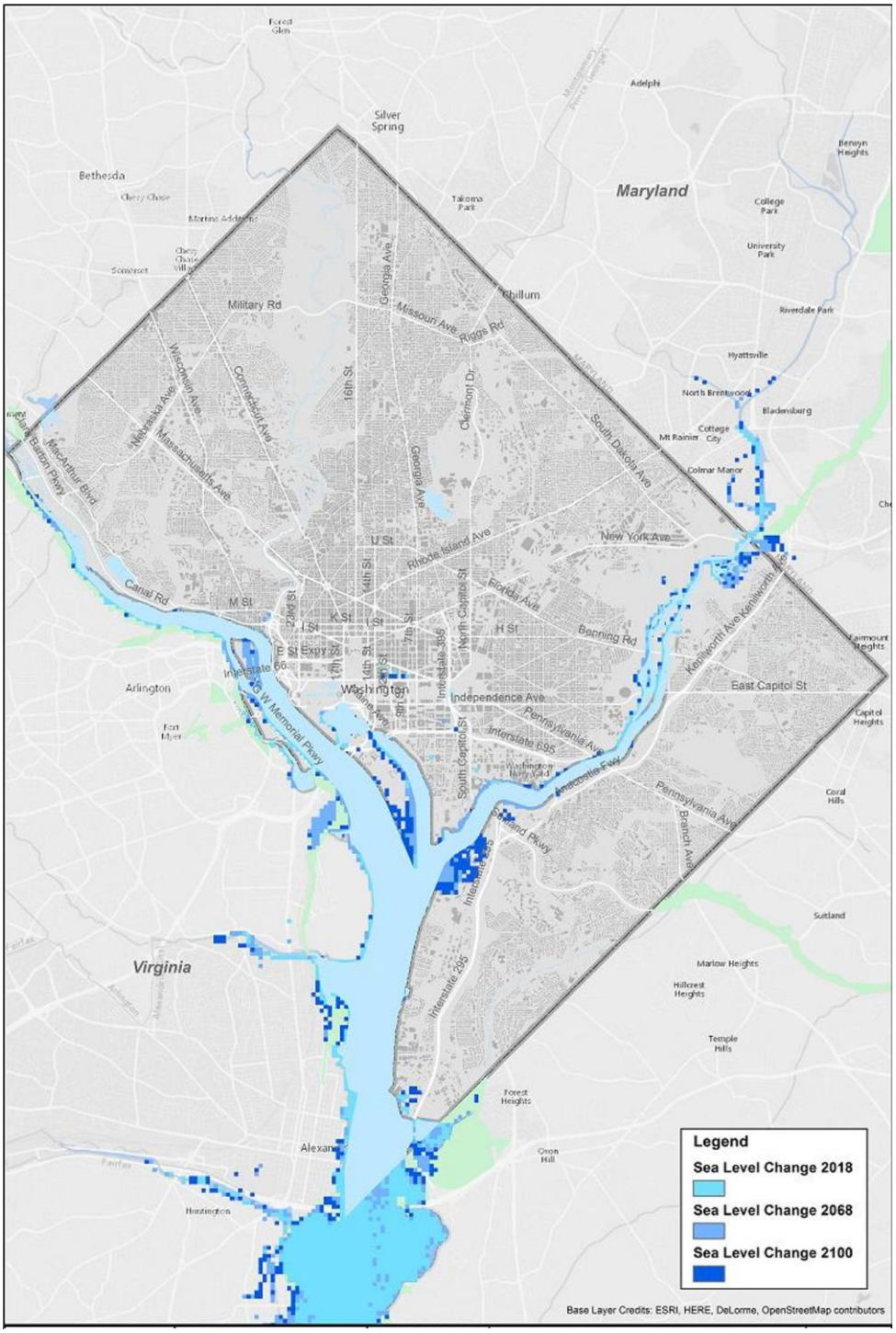

Figure 22 Relative sea level rise inundation predictions in Washington, DC from the North Atlantic Coast Comprehensive Study (U.S. Army Corps of Engineers). High sea level rise scenario for years 2018, 2068, and 2100.

5.6 Species and Habitats at Greatest Risk and Most Vulnerable to Climate Change

This section outlines the major implications of climate change on the District's SGCN and critical habitats. DDOE recognizes that habitat and species are vulnerable to climate change, but any analysis of threats must take into account the geographical context. The District has very small amounts of wildlife habitats and small wildlife populations in comparison to the entire northeast region. Regardless, it is beneficial to identify expected changes and threats to the habitats and wildlife that do exist in the District. While it may not be feasible to significantly mitigate climate change impacts due to the District's size and urban character, understanding the threats and prioritizing any potential mitigation is still important.

DDOE identified several habitats and several species on which to focus climate vulnerability assessments. These are species and habitats that may be disproportionately impacted by the threats of climate change. As more climate projection data becomes available DDOE may further expand these vulnerability analyses and consider additional species.

5.6.1 Habitats

To assess changes to habitats, DDOE reviewed and summarized the major ecosystems and land cover types identified by the Manomet Center for Conservation Science's report entitled "The Vulnerabilities of Fish and Wildlife Habitats in the Northeast to Climate Change" (MCCS and National Wildlife Foundation (NWF) 2013) and investigated the fates of specific tree species in the U.S. Forest Service's Tree Atlas program (Landscape Change Research Group 2014) to assess specific forest changes in the District.

Upland Forests

Based on the work of Hector Galbraith and others (MCCS and NWF 2013), there are two general types of forest land cover that are vulnerable within the District: Northern Hardwood forests and Central Mixed Oak-Pine forest, ranging from highly vulnerable to vulnerable, respectively. These two categories are analogous to the Macrogroups presented in Chapter 3. Northern Hardwood Forest habitats are distinct by region and occur in many different forms across the northeast region and overall floristic composition varies with location and specific site conditions. For example, the Macrogroup contains Habitat Systems common to both the oak-hickory forests of the south and the boreal forests of the north. Central Mixed Oak-Pine forests are also comprised of many different varieties, depending on soil, climate, slope, and land use history. In comparison with Northern Hardwood forests, Central Mixed Oak-Pine forests are typical of

warmer climatic conditions and a longer growing season. They generally occur further south, on sunnier, warmer south- or west-facing slopes, and at lower elevations than Northern Hardwoods (Collins and Anderson 1994, Fike 1999, Thompson and Sorenson 2000, Edinger et al. 2002, Harrison 2004, Sperduto and Nichols 2004, Virginia Natural Heritage Program 2011).

DDOE utilized the Tree Atlas program (Iverson et al, 2008) to help identify potential changes to specific forest species. The primary areas with these forest types in the District occur in Rock Creek Park, Fort DuPont Park, the National Arboretum, Glover Archibold Park, and areas along the Potomac River. Tree Atlas projected a decrease in flowering dogwood (*Cornus florida*), white oak (*Quercus alba*), and northern red oak (*Quercus rubra*). In general, we expect to see encroachment by heat-tolerant pine species in both forests, but Northern Hardwood forests will be the most vulnerable.

Based on regional predictions, while there may not be drastic changes in forest structure, there will likely be an increase in heat-tolerant conifer species in both forest types and a potential shift to oak-pine forest in some areas (Prasad et al. 2007).

Tidal Wetlands/Vernal Pools/Riparian Forests

The health and quality of tidal and non-tidal wetlands will be affected by climate change. As the quality of a wetland degrades, so does the value of that wetland to the District's wildlife. More precipitation can lead to increased erosion and sedimentation and thus adversely affect priority habitats such as submerged aquatic vegetation in the District as well as species of greatest conservation need that are dependent on them such as the Queen snake.

As sea levels rise, marshes can be inundated and convert to shallow open water habitats or non-tidal and brackish wetlands may convert to higher salinity marshes. These new shallow water habitats and higher salinity marshes will not support the same vegetative composition as the existing non-tidal and tidal wetlands in the District, which will affect the wildlife that depend on these habitats. Additionally, as storms become more intense, more frequent inundation may also pose problems for vegetation and fish and wildlife species with low salinity tolerances.

Vernal pools or ephemeral wetlands are important temporary wetlands that support a wide variety of macroinvertebrates and provide breeding grounds for amphibians, such as the wood frog. These pools are typically precipitation-filled, and their hydrology is dependent on precipitation and evaporation. These characteristics make them sensitive to climate and climate change. Vernal pools will likely be impacted by higher temperatures and longer durations

between rain events, which will directly, negatively impact the populations that depend on these pools.

Meadows

Changes in temperature and precipitation regimes could negatively affect meadows as temperatures increase and summers become drier and more drought prone. However, research is showing that many meadow plant species are already relatively drought tolerant. Shrublands and meadows may not be as affected by climate change as other habitats if they can maintain their diverse composition of vegetation species (Craine et al. 2012). It is important to note that meadows may succumb over time if there is extended, severe drought (Craine et al. 2012). To maintain diversity and help build resiliency in meadows within the District, it will be important to implement any management options available to support these habitats.

5.6.2 Species

For the in-depth vulnerability consideration for SGCN, DDOE considered Tier 1 SGCN. Of those Tier 1 species, DDOE identified several SGCN that could be disproportionately impacted by the threats of climate change. This was based on range, habitat need, life history, available data, and professional consensus. For example, if species are at the southern end of their range, they may not survive significant increases in temperature (Pyke et al. 2008). Also, if a species is a habitat specialist or dietary specialists, or is dependent on habitats that will likely change greatly due to climate change, they are at greater risk (Both et al. 2009; Glick et al. 2011; Bellard et al. 2012; Lurgi et al. 2012; Staudinger et al. 2013; Pacifici et al. 2015). However, if a species is in the heart of its range in DC, it is more likely to persist, especially if the probability of its occurrence is high.

Once these species were selected, we attempted to evaluate general vulnerability by identifying how each species might react, based on their exposure, sensitivity and adaptive capacity (Staudinger et. al. 2015). DDOE use a peer-reviewed literature search, species vulnerability models, such as NatureServe's Climate Change Vulnerability Index (CCVI) (Young et al. 2011, Faber-Langendoen et al. 2012), and expert opinion. The CCVI, as applied to the selected species, resulted in a variety of predictions, all of which reflected increased vulnerability. This was not surprising given the fact that we selected species that had specific life-history trait that would be impacted by climate change. Because of these generalizations, we choose to assign two categories: Vulnerable or Highly vulnerable. The assessment of vulnerable indicates we think that abundance and/or range within the District will likely decrease by 2050. The assessment of highly vulnerable indicates we think that abundance and/or range within the District will likely significantly decrease by 2050.

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Herpetofauna

Freshwater turtles are perhaps the best studied taxonomic group in terms of response to climate change. They will be affected by climate change in a variety of ways, but most impacts are from changes in water temperature and flow. The turtle we selected for vulnerability consideration was the spotted turtle (*Clemmys guttata*) because of severe weather predictions and changes in hydrology in the District. We consider the spotted turtle highly vulnerable to climate change because of the potential for increased flooding which may displace large parts of populations, elevate mortality rates, and decrease breeding success.

The queen snake (*Regina septemvittata*) was selected and ranked as highly vulnerable to climate change because of its direct, documented dependence on clean running streams and watersheds with cool water. The specificity surrounding the habitat requirements of water quality, temperature, and

substrate make this designation reasonable. The habitat requirements are directly related to their primary prey, fresh water crayfish.

Amphibians are particularly susceptible to the effects of changing climates because of their restrictive physiological requirements and low movement ability. We selected two amphibians for climate change vulnerability assessment: spotted salamander (*Ambystoma maculatum*) and wood frog (*Lithobates sylvaticus*).

Based on our expert-opinion and the CCVI, both amphibians were assessed as highly vulnerable because of their close association with vernal pools or ephemeral wetlands and adjacent upland forest. This designation was primarily based on potential future changes in precipitation and overall hydrologic regimes. Changes in precipitation and vegetation can both significantly impact the vernal pools and ephemeral wetlands these species utilize for breeding. Plants, especially trees, influence vernal pool water levels through transpiration and by creating shade which slows evaporation and moderates pool temperatures. Therefore, any climate-induced change in the timing and duration of leaf-on in the deciduous vegetation will likely have an effect on ground water patterns. This could change how and when the areas refill with water, which will in turn affects salamander reproductive success. Additionally, an increase in the magnitude, frequency and/or change in the timing of major storm events in the late summer or early fall may adversely affect breeding conditions, by causing the areas to fill prematurely. Lastly, higher temperatures may cause drying through evaporation before the eggs have hatched.

Birds

Massive modeling projects and demographic analyses have been done by many different organizations and agencies to attempt to quantify what the bird world will look like as the climate warms. For example, Audubon scientists have used hundreds of thousands of citizen-science observations and sophisticated climate models to predict how birds in the U.S. and Canada will react to climate change (National Audubon Society 2014). For many species that have the southernmost edge of their summer range near Maryland and Virginia, the changing climate will likely push the range of these birds farther North. The American kestrel (*Falco sparverius*), scarlet tanager (*Piranga olivacea*), veery (*Catharus fuscescens*), bobolink (*Dolichonyx oryzivorus*), and the Baltimore oriole (*Icterus galbula*) are a few such birds.

Allowing for migration in this one instance, the bird we selected for vulnerability consideration was the wood thrush (*Hylocichla mustelina*). In the late 20th century, the Wood Thrush was commonly investigated to determine the health of Eastern forests. Nest parasitism, nest predation, and habitat fragmentation

were commonly cited as the reasons for the bird populations' sharp decline. DDOE predicts that the wood thrush will be highly vulnerable to climate change, and in fact, the Audubon's climate model projects an 82 percent loss of its current summer range by 2080. This species favors areas with moist soil and high understory cover. Therefore, continued persistence of Wood Thrush in the District is likely to depend solely on forest composition and forest health (see Upland Forest). Climate change likely threatens the Wood Thrush primarily through increasing temperatures, which decreases soil moisture and alters forest vegetation.

Small Mammals

Mammals represent a diverse group of vertebrates in the District with respect to range of habitats occupied, dispersal ability, and body size. Mammals occupy both aquatic and terrestrial habitats; while only the bats are capable of flying, none of the mammal species have restricted dispersal ability as defined by the CCV index. However, some small mammal species, such as shrews, are physically limited by the urban character of DC, and tend to move more when it rains. Other small mammals are dependent on rain events for dispersing. Therefore, changes in rainfall and extreme rain and storm events can have a detrimental effect on small mammal populations, and thus overall diversity, potentially favoring particular species (Pauli et al. 2006). Because of these issues, we selected the northern short-tailed shrew (*Blarnia brevicauda*) and the meadow vole (*Microtus pennsylvanicus*) for vulnerability assessment. The meadow vole's optimal habitat consists of moist, dense grassland with substantial amounts of plant litter. Habitat selection is largely influenced by relative ground cover of grasses and forbs; soil temperature and moisture. Unfortunately, open meadows in the district are already stressed with high rates of invasive species and flashy hydrology. Climate change will likely aggravate those conditions further. Climate change threats will likely impact the meadow vole population through loss of soil moisture from higher temperatures and vegetation changes in their primary habitat. Similarly, the Northern short-tailed shrew prefers mesic soils and leaf litter with natural land cover. As periods of drought extend, soil moisture will likely decrease, resulting in a reduction of the shrews' prey base, primarily insects, earthworms, voles, snails, and other shrews. For these reasons, DDOE designated both mammals as vulnerable.

5.7 General Biological Responses, Adaptations, and Actions for SGCN and Their Habitats

5.7.1 General Actions

DDOE will prioritize areas with high ecosystem services and habitat value for restoration and/or protection such as stream buffers, wetlands, open meadows, and forest. All of these habitats are vulnerable and given the lack of natural land cover in DC, it is crucial that we protect what is there and restore what we can. Climate-smart management actions are presented here within the context of habitats management only. Each species assessed will be addressed under their respective land cover/habitat type.

5.7.2 Upland Forests

To best manage forest as the climate changes, it will be imperative to understand how climate may affect potential future composition of forests in the District and how that may affect SGCN. Managers must routinely consult recently available climate data through programs such as the U.S. Forest Service's Tree Atlas when planning management and conservation of these forests. Primary management of forested lands within the District should focus on forest health, promoting the protection of private forested land, and reestablishment of forest when appropriate. In regards to forest health, conservation and management efforts may need to focus on trees that can better withstand higher salinities, increased temperatures, and drought, among other impacts. Invasive species monitoring and prevention will also become even more important to include in forest management as climate change may favor vine growth, tree pests, diseases, and invasive species. Protection of private forested lands through incentive programs and incentives such as present use value tax status, forest mitigation bank programs, or transfer of development rights is crucial (Davis and Campbell 2012) and should be promoted. These types of actions will be some of the only options for managing for species such as the Wood thrush.

5.7.3 Wetlands/Vernal Pools/Riparian Forests

Wetland habitats are the primary land cover type and habitat used by the majority of the species we selected for vulnerability consideration. The queen snake, spotted turtle, wood frog, and spotted salamander all fall under consideration when managing these types of areas.

When feasible, DDOE will restore and enhance vegetation within existing wetlands to support changing conditions (e.g., using vegetation species that can withstand a broader array of conditions like more frequent inundation and higher salinity levels).

When planting, restoring, or maintaining riparian buffers, managers will attempt to plant only native tree and shrub species that can tolerate flood conditions, and inundation tolerance will be considered when selecting plant species. Because sea-level rise will likely be an issue in many of these areas, vegetation species that have a broader salinity tolerance should be considered. Furthermore, shading species (to reduce water temperatures) must be included when working in riparian areas.

Additionally, considering native species that may provide better erosion control (broader, deeper roots) than other species also could be used. Techniques and tools may be needed (e.g., fencing, biomats, etc.) to ensure success. Minimizing impervious surface will be even more important under climate change as increased storm intensity will result in increased levels of storm water runoff. Improving stormwater control methods, to ensure they account for predicted changes in precipitation and flow, will help minimize the future impacts of stormwater as the climate warm (Kane, 2013).

5.7.4 Meadows

DDOE must work to protect, preserve, and create large tracts of open meadow habitats that provide refugia for many SGCN. Focusing on removing non-native species and ensuring a diverse mix of plant species will ensure that species such as the meadow vole and northern short-tailed shrew. Although the shrew often uses a variety of habitats, grasslands are one of its preferred habitat types. Both species depend on moist, healthy soils. The more diverse, healthy, and abundant the meadows are in the District, the more likely these and other SGCN will have the resilience to persist in the District.

Chapter 6 Conservation Actions

Natural resource managers in the District of Columbia must coordinate efforts to address a variety of conservation actions that address threats to SGCN and critical habitats in order to preserve, protect, and restore its SGCN populations. The security of many SGCN relies on the amount and condition of their habitats, while other SGCN face threats, such as diseases, that are disassociated from their habitats. Similarly, some habitats share conservation needs, such as invasive plants, while others face unique threats. Mitigating threats to SGCN requires coordinated and comprehensive conservation planning and targeted natural resource management that includes many partners and landowners.

The District has identified twenty-two Level II threats (Salafsky et al, 2008) that are affecting critical habitats or will likely impact habitats in the near future. Four of these threats ranked highest across all habitats, one was highest for aquatic habitats and one was highest for terrestrial vegetative habitats. These overarching threats are:

1. Invasive species (plants, insects, pathogens, and fish);
2. Urban wastewater;
3. Nutrification/sedimentation;
4. Problematic native species;
5. Ecosystem modifications (aquatic habitats); and
6. Recreational activities/development of recreational areas (vegetative habitats).

To identify conservation actions, DDOE compared and cross-walked the IUCN threats with USFWS-TRACS threats classification (USFWS 2015). USFWS-TRACS threats are mapped directly to Conservation Actions, which are in turn linked to the USFWS-TRACS conservation planning and grant reporting systems. This methodology will allow for easier reporting in USFWS-TRACS, and will allow for regional coordination of conservation actions.

This chapter describes conservation actions that address the six overarching threats to habitats. These overarching threats require immediate action. Although a variety of agencies are addressing several already, additional coordination that takes SGCN into account is necessary. This chapter also includes tables that describe actions which address every threat to each habitat Macrogroup and indicate lead and partner agencies for each action.

Finally, this chapter includes a section on Focal Conservation Actions (FCA). These are broad-scale actions that address data deficiencies and programmatic threats, wildlife protections, the lack of specific habitat types in urban areas, and actions that will support SGCN in developed habitats. These actions apply to many habitat types, but will target Conservation Opportunity Areas. Several of the FCAs describe on-the-ground natural resource management projects that will improve or expand habitats.

6.1 Overarching Actions

6.1.1 Invasive Species

Invasive species are non-native (also known as alien, exotic, or non-indigenous) plants, animals, and pathogens that cause or are likely to cause ecological disruption, economic losses, or harm to habitats and wildlife. There have been intentional and accidental introductions regionally and in the District. Invasive species have not co-evolved with the habitats they invade, so most do not have natural control systems. They tend to out-compete native species for resources and may permanently alter natural ecosystems. Some invasive species are now found throughout the District, to the extent that complete eradication is unfeasible.

The most effective defense against invasive species is to prevent them from being introduced, which requires monitoring and regulating the pathways by which they arrive. In most instances, however, prevention is not feasible. In these cases, early detection and rapid response programs are designed to coordinate a response plan to control the initial outbreak and eradicate the species before it becomes established. Both preventive and rapid response actions require planning, education, a strong commitment of resources, and a coordinated approach among local, state, federal, and private partners.

Invasive Plants

Three groups currently address invasive plants: the District of Columbia Cooperative Weed Management Area (DC-CWMA) partnership, the National Park Service (NPS) Exotic Plant Management Team (EPMT), and DDOE. DC-CWMA is a partnership of local and federal agencies, conservation organizations, and academic institutions that work cooperatively to coordinate invasive plant management across political and ecological boundaries to restore habitats and protect biodiversity in the District. Techniques include coordinated volunteer efforts, funding summer invasive plant crews, biological controls, outreach, education, and regulation. The three groups improve habitats through a coordinated response to restore native plants: seeding,

planting, collecting seeds throughout the region, and maintaining a native plant nursery at UDC.

DC-CWMA, in particular, focuses on early detection and rapid response (ED/RR) of new invasive plants. In March 2015, a DC-CWMA member reported a newly found plant, incised fumewort corydalis, to DC-CWMA and the Mid-Atlantic Invasive Plant Council. This plant has now been reported in New York, Pennsylvania, and Virginia, and a regional effort is underway to eradicate it from natural areas. Another ED/RR target is wavy-leaf basketgrass (*Oplismenis undulatifolius ssp. undulatifolius*), which grows in shaded forest understories and has been found only in Maryland and Virginia. NPS EPMT has assessed many other ED/RR target plant species and published 37 fact sheets that are publicly available (NPS 2015).

Performance measures:

- Area of invasive plants mapped and inventoried
- Area of invasive plants treated
- Area invasive plants removed
- Area revegetated with native plants
- Number of RiverSmart Homes/Schools/Communities participants and/or native plant projects

Invasive Insects

A number of invasive insects are detrimental to District habitats. Emerald ash borer (*Agrilus planipennis*) is spreading through critical habitats along the Anacostia River, including Kenilworth Aquatic Gardens and the National Arboretum. This Asian native has killed nearly all the white ash (*Fraxinus americana*) and green ash (*Fraxinus pennsylvanica*) trees in those areas.

Early detection and rapid response are imperative to limiting the spread of insects and pathogens to other habitats, including sudden oak death, thousand cankers disease, Southern pine beetle (*Dendroctonus frontalis*) and Asian long-horned beetle (*Anoplophora glabripennis*. These ED/RR actions require coordination between DDOE, the US Department of Agriculture Animal and Plant Health Inspection Service, NPS, the Maryland Invasive Species Council, and other agencies.

Performance measures:

- Area of insect infestation mapped and inventoried
- Number of infested trees mapped and inventoried

- Number of trees and plants treated for infestation/disease

Invasive Fish

Three damaging invasive fish species have established themselves in the District: northern snakehead, blue catfish, and flathead catfish. At all of their life stages, these non-native fish compete with native species for food. Their diets consist of zooplankton, insect larvae, small crustaceans, fry, native fish, crustaceans, frogs, small reptiles, and sometimes birds and mammals.

The northern snakehead (*Channa argus*) is a freshwater, air-breathing fish that was first detected in Maryland in 2002 (USFWS). Blue catfish (*Ictalurus furcatus*) was first introduced to the region in the 1970s and is a voracious eater, preying upon menhaden, blue crab, American shad, crustaceans, and even large birds. Flathead catfish (*Pylodictis olivaris*) were introduced to the region in the 1960s and are similar in size to the blue catfish, weighing up to 100 pounds. They also have a varied diet and prey upon SGCN.

Since it is not feasible to remove these species from District waters, conservation actions focus on mitigating their impacts, including encouraging recreational and commercial fishing, surveying populations and distribution, and studying the ecology and potential impacts on prey species.

Performance measures:

- Area of aquatic habitats surveyed for invasive fish
- Number of invasive fish tagged for study
- Number of invasive fish removed

6.1.2 Urban Wastewater

Most urban wastewater consists of stormwater runoff and sanitary sewage. Stormwater is rainfall that does not infiltrate into the ground, but instead flows over hard, impervious surfaces, carrying trash and pollutants through storm drain channels into the nearest waterbodies. Sanitary sewage is the wastewater from homes and businesses. In certain areas of the city, stormwater and sewage frequently flow untreated into the Potomac and Anacostia Rivers and Rock Creek.

Like many older U.S. cities, the District has an original combined sewer system (CSS) that carries stormwater runoff and sewage in the same pipes, and a newer municipal separate storm sewer system (MS4) that carries them in separate pipes. One third of the District is still served by the CSS. During normal weather conditions, the CSS sends stormwater and sewage to the District of

Columbia Water and Sewer Authority (DC Water) facilities for treatment. The MS4 sends sewage to DC Water for treatment, and discharges stormwater directly into local waterbodies.

DC Water's Blue Plains facility is the largest advanced wastewater treatment facility in the world, with a treatment capacity of 370 million gallons per day and a peak capacity of more than 1 billion gallons per day (DC Water 2015). However, during periods of significant rainfall, CSS pipes that exceed their capacity are designed to discharge overflow directly into local waterways, through what is called a combined sewer overflow (CSO) outfall. There are currently 53 CSO outfalls in the District, with approximately 3.2 billion gallons of sewage and stormwater overflows annually.

Untreated sewage and stormwater runoff cause environmental degradation to District waterbodies by reducing dissolved oxygen, spreading diseases, creating algae blooms, introducing toxins and metals into the water column, changing water temperatures, and increasing acidity.

DC Water is addressing CSO through its Long Term Control Plan (DC Water 2002) the Clean Rivers Project, which includes deep storage tunnels and Low Impact Development (LID) implementation.

Additionally, DDOE is using a combination of stormwater management regulations, incentive programs, and direct investment in LID, as described in the consolidated Total Maximum Daily Load implementation plan. The District has also initiated a Stormwater Retention Credit trading program for green infrastructure, a Green Area Ratio sustainable zoning regulation, and has one of the largest green roof programs in the nation (covering over 54 acres).

Performance measures:

- Number of acres of impervious surface managed in accordance with the District's retention standards
- Number of gallons of stormwater retained/treated
- Number of CSOs eliminated
- Reduction in floating trash on receiving waters

6.1.3 Nutrification/Sedimentation

Nutrification is the nutrient loading of waterbodies resulting from excess phosphorus and nitrogen. High nutrient loads are associated with fecal coliforms in urban areas. Rapid nutrification overwhelms natural systems, causing eutrophication (or nutrient enrichment) of waterbodies. Sedimentation is when suspended particles precipitate out of the water column. As a water system

slows, these particles are deposited. Erosion, coupled with heavy rainfall events, can lead to increased sedimentation covering large riverbed areas. These impacts can be compounded by CSOs and impervious surfaces. The combination of nutrification and sedimentation can create a hypoxic environment (deprived of adequate oxygen supply) with decreased water transparency.

Nutrification opportunities are being reduced through regulations requiring the use of low phosphorus fertilizer and limiting nitrogen applications (Anacostia River Clean Up and Protection Fertilizer Act 2012).

DDOE is also leading projects to restore and daylight streams and other channeled water systems, raise eroded creek beds, and install regenerative stormwater conveyance systems to slow streams, allow for rainfall to infiltrate soils, and reduce sedimentation at CSOs.

Performance measures:

- Number of feet of streams altered/restored
- Average age of sewer infrastructure

6.1.4 Problematic Native Species

A problematic native species is a plant, animal, or pathogen that is originally found in a native ecosystem, but has exited its natural range of variation due to some factor or combination of factors and is compromising native habitats. These factors could include changes in range, reaction to climate change, or introduction into a new area. There are two main problematic native species in the District: white-tailed deer and Canada geese.

White-tailed deer (*Odocoileus virginianus*) are one of the most easily recognized wildlife species in the District. Lack of population controls has allowed white-tailed deer populations to increase and severely impact critical wildlife habitats. Deer browsing (eating the leaves, twigs, and buds of woody plants) has degraded SGCN habitats and is restricting the regeneration of hardwood forests. White-tailed deer are also responsible for private property damage, vehicle collisions, and tick-borne illnesses. Deer management and monitoring is ongoing in Rock Creek Park. Management is needed in the C&O Canal Historical Park, Fort DuPont, Fort Mahan, Fort Chaplin, and Kenilworth Aquatic Gardens.

Canada geese (*Branta canadensis*) are native waterfowl that have historically wintered in the region. In the early 1900s, a subspecies (*Branta canadensis maxima*) was imported to populate wildlife refuges and hunt clubs. This subspecies became non-migratory, and there are currently more than 550

Canada geese that are now resident breeders in the District, leading to herbivory of native plants on mudflats and in emergent wetlands. Goose management is ongoing in East Potomac Park, but is needed along the Anacostia River. The goal should be to reduce the resident Canada goose population to zero through a variety of lethal control measures.

Performance measures:

- Percent reduction in density of white-tailed deer
- Percent reduction in density of Canada geese

6.1.5 Recreational Activities and Infrastructure

Recreational activities impact wildlife habitat when the human population density is high enough that use of the area is almost constant. Recreational infrastructure impacts wildlife though the loss of habitat to new trails, fragmentation and new edges in habitat patches, and the transport of invasive plant materials. Trail systems through wildlife habitat can alter bird species composition, increase nest depredation and brood parasitism, and limit ranges for specialist species (Miller 1998). There are more than 32 miles of official trails in Rock Creek Park and 35 miles of unofficial trails (social trails).

To mitigate these pressures, land owners should implement informed management policies regarding trail use and restrictions, eliminate social trails (informal trails created by erosion due to human foot traffic), and enforce laws that protect habitat integrity. Other actions include education and outreach such as signage that promotes the value of wildlife in natural areas. Consideration and mitigation of impacts on SGCN and critical habitats should be a part of trail and recreational infrastructure planning. Finally, mowing grassy areas should be timed to minimize damage to nesting birds and other SGCN.

Performance measures:

- Number of miles of social trails eliminated
- Number of acres of wildlife habitat with increased connectivity

6.1.6 Ecosystem Modifications

Ecosystems throughout the District are highly modified. Many of the actions described for urban wastewater and nutrification/sedimentation (see Sections 6.1.2 and 6.1.3) will mitigate threats from ecosystem modifications. Additional actions that can minimize or reverse the impacts of these modifications include the following:

- Restore the hydrology of vernal pools and the Oxon Run Magnolia Bog, and groundwater-fed wetlands in Rock Creek Park, using stormwater infiltration techniques.
- Use stormwater infiltration techniques to develop vernal pools in areas where the landform and soils might promote their development. Modify landforms to create vernal pools where large-scale stream restoration projects are planned and in other approporate locations.
- Minimize large-scale changes to forest vegetation composition. Limit the removal of canopy trees in closed canopy forests for any projects, including trails, stream restoration, and development.
- Remove cement stream channels and restore natural stream bed and floodplain to Oxon Run. Reconnect disconnected streams, such as Oxon Run, Pope Branch, Fort DuPont Creek, using stream daylighting techniques. Remove or modify instream obstructions to restore fish passage.

Performance measures:

- Number of acres of natural hydrology restored
- Number of acres of natural streambed and floodplain restored
- Number of feet of channeled or piped streams daylighted
- Number of feet of stream now accessible after dam/barricade removal

6.1.7 Inventory and Monitoring

The District must continue to inventory and monitor species, especially sensitive species (Tier I), in order to effectively implement the SWAP 2015 conservation actions. While SWAP 2005 centered on building a baseline inventory for many species and monitoring the trends of those species, there were still data deficiencies years later for many taxa, including bees, mussels, snails, crayfish, copepods, and other invertebrates. Data gaps and performance measures for ongoing and new monitoring projects are discussed in detail in Chapter 7 Monitoring and Adaptive Management.

The District must address the lack of resources needed to support wildlife conservation. Additional funding will be necessary to implement the SWAP 2015 conservation actions. This funding would support additional staff, equipment, and supplies for new projects. Additional funding and grants would also support ongoing monitoring of sensitive species (Tier 1) and allow DDOE to recruit staff or consultants who have the expertise to reduce data deficiencies for less-studied taxa in the District.

Implementing the conservation actions in SWAP 2015 also requires partnerships and coordination with federal and District land managers, in parks where much

of the District's wildlife habitats are located. Such partnerships would also help to leverage staff expertise to address data deficiencies and species monitoring.

6.2 Regional Actions and Coordination

The close proximity of many northeastern states has engendered a culture of cooperative and/or complementary management approaches. The Northeast Association of Fish and Wildlife Agencies has traditionally supported a strong technical committee structure to further wildlife conservation. Technical committees are species- or habitat-focused groups that exchange ideas and develop common approaches to wildlife issues. Typically, these conservation actions are implemented by individual states using their own funds; however, in some cases, additional funding has been made available through the Northeast Directors.

The Regional Conservation Needs (RCN) Program formalizes a cooperative approach to address SGCN needs across multiple states. The purpose of the RCN program is to develop, coordinate, and implement conservation actions that are regional/sub-regional in scope, and to build upon the many regional initiatives that already exist. The RCN program utilizes a funding mechanism that is equitable to all Northeast states and the District of Columbia, creating a base of funding for regional projects. Since 2007, 37 different projects have been selected. The resulting reports and products are available at RCNgrants.org.

The District will coordinate with USFWS, the Northeast Association of Fish and Wildlife Agencies, the North Atlantic Landscape Conservation Cooperative, other states in the region to develop and implement conservation actions for threats that are most effectively addressed at a regional or multi-state scale. The projects will include the input and involvement of the many parties involved in the creation and implementation of the State Wildlife Action Plans in the Northeast region.

Performance Measures:

- number of conservation action/research projects selected and completed
- number of articles, publications, and technical reports developed each year as a result of funded projects

6.3 Conservation Actions by Habitat

In this section, tables 11–25 describe actions that address all threats to each habitat Macrogroup. These tables indicate the Level II and III IUCN threats to the habitat, the USFWS TRACS Level II and III actions, and indicate lead and partner agencies for each action. The Level III actions are described and include examples of specific activities that will address each particular threat.

Table 11 Conservation Actions to Address Threats to Central-Oak Pine Habitat in the District

Identified Threats	Description	TRACS Level 2 Action	TRACS Level 3 Action	Lead	Partners
Invasive Non-Native Species	Invasive plants	Invasive species control	Inventory of invasive plants	DC-CWMA	NPS, AWS
			Mechanical, biological, and chemical control of garlic mustard, English ivy, Oriental bittersweet, burning bush, and other invasive plants	DC-CWMA	NPS, AWS
Problematic Native Species	White-tailed deer overabundance/ overbrowse	Wildlife damage management	Deer population monitoring in Kenilworth Park, Fort Dupont, Fort Mahan, Fort Chaplin, and other Fort Circle Parks	NPS	DDOE
			Deer management through lethal and sub-lethal measures	NPS	DDOE
Tourism and Recreational Areas	Pressures from Tourism and Recreational Infrastructure	Regulations	Include mitigation of impacts to SGCN and critical habitats in all recreational infrastructure planning	DDOE	
		Direct resource management	Eliminate social trails	NPS	
		Regulations	Enforcement of closed trails	NPS	
Recreation	Pressures from Tourism and Recreational Activities	Education and outreach	Education and Outreach with signage	NPS	
		Regulations	Enforcement of park regulations	NPS	
		Regulations	Enforce leash laws	NPS	

Table 12 Conservation Actions to Address Threats to Northern Hardwood and Conifer Habitat in the District

Identified Threats	Description	TRACS Level 2 Action	TRACS Level 3 Action	Lead	Partners
Invasive Non-Native Species	Invasive plants	Invasive species control	Inventory of invasive plants	DC-CWMA	NPS, AWS
			Mechanical, biological, and chemical control of English ivy, bush honeysuckle, Oriental bittersweet, and other invasive plants	DC-CWMA	NPS, AWS
Problematic Native Species	White-tailed deer overabundance/overbrowse	Wildlife Damage Management	Deer population monitoring in Rock Creek Park	NPS	DDOE
			Deer management through lethal and sub-lethal measures	NPS	DDOE
Tourism and Recreational Areas	Pressures from tourism and recreational infrastructure	Regulations	Include mitigation of impacts to SGCN and critical habitats in all recreational infrastructure planning	NPS	
		Direct resource management	Eliminate social trails	NPS	
		Regulations	Enforcement of closed trails	NPS	
Recreation	Pressures from tourism and recreational activities	Education and Outreach	Education and outreach with signage	NPS	
		Regulations	Enforcement of closed trails	NPS	
		Regulations	Enforcement of park regulations	NPS	
		Regulations	Enforce leash laws	NPS	

Table 13 Conservation Actions to Address Threats to Early Successional Habitat in the District

Identified Threats	Description	TRACS Level 2 Action	TRACS Level 3 Action	Lead	Partners
Invasive Non-Native Species	Invasive plants	Invasive species control	Inventory of invasive plants	DC-CWMA	NPS
			Mechanical and chemical control thistles, mile-a-minute, and other invasive forbs and grasses	DC-CWMA	NPS
			Biological controls for mile-a-minute	DC-CWMA	NPS
Tourism and Recreational Areas	Pressures from tourism and recreational infrastructure	Regulations	Include mitigation of impacts to SGCN and critical habitats in all recreational infrastructure planning	DDOE	
		Direct resource management	Eliminate social trails	NPS	
		Regulations	Enforcement of closed trails	NPS	
Recreation	Pressures from tourism and recreational activities	Education and outreach	Education and Outreach with signage	NPS	
		Regulations	Enforcement of closed trails	NPS	
		Regulations	Enforce leash laws	NPS	
Ecosystem Modifications	Historical habitat loss and changes to fire regimes	Meadow creation	Meadow restoration (see focal conservation actions, Section 6.5)	DDOE	NPS, AWS

Table 14 Conservation Actions to Address Threats to Coastal Plain and Swamp Habitat in the District

Identified Threats	Description	TRACS Level 2 Action	TRACS Level 3 Action	Lead	Partners
Invasive Non-Native Species	Invasive Plants	Invasive species control	Inventory of invasive plants	DC-CWMA	NPS, AWS
			Mechanical, biological, and chemical control of Japanese knotweed, bush honeysuckle, wavyleaf basketgrass, Japanese stiltgrass, and other invasive plants	DC-CWMA	NPS, AWS
Problematic Native Species	White-tailed deer overabundance/ overbrowse	Wildlife damage management	Deer population monitoring in Kenilworth Aquatic Gardens and Oxon Run Park	NPS	DDOE
			Deer management through lethal and sub-lethal measures	NPS	DDOE
	Canada goose overabundance/ overbrowse		Manage goose populations with lethal and sub-lethal methods (NPS 2014)	NPS	AWS, DDOE
			Restore riparian areas with native vegetation	AWS	NPS, DDOE
Tourism and Recreational Areas	Pressures from tourism and recreational infrastructure	Regulations	Include mitigation of impacts to SGCN and critical habitats in all recreational infrastructure planning	DDOE	
Recreation	Pressures from tourism and recreational activities	Education and outreach	Education and Outreach with signage		
Ecosystem Modifications	Hydrological alterations/ stormwater	Instream modification	Restore natural stream flow to existing marshes, minimize high flow occurrences		
Domestic and Urban Wastewater	Run-off	Water management	Significantly reduce stormwater runoff at the watershed level	DDOE	
	Sewage		Significantly reduce sewage at the watershed level	DC Water	
Garbage and Solid Waste	- - -	Hazard or infrastructure removal	Regulate plastic bottles or add deposit to encourage recycling.	DDOE	
			Employ measures to reduce or recover opportunistic litter	DDOE	

Identified Threats	Description	TRACS Level 2 Action	TRACS Level 3 Action	Lead	Partners
Agricultural and Forestry Effluents	Soil erosion and sedimentation	Instream modification	Stream restoration	DDOE	

Table 15 Conservation Actions to Address Threats to Northeastern Floodplain Forest Habitat in the District

Identified Threats	Description	TRACS Level 2 Action	TRACS Level 3 Action	Lead	Partners
Invasive Non-Native Species	Invasive plants	Invasive species control	Inventory of invasive plants	DC-CWMA	NPS, AWS
			Mechanical, biological, and chemical control of lesser celandine, Oriental bittersweet, Japanese stiltgrass, and other invasive plats	DC-CWMA	NPS, AWS
Problematic Native Species	White-tailed deer overabundance / overbrowse	Wildlife Damage Management	Deer population monitoring in Potomac River, Anacostia River, and Rock Creek floodplain forests	NPS	DDOE
			Deer management through lethal and sub-lethal measures	NPS	DDOE
Tourism and Recreational Areas	Pressures from tourism and recreational infrastructure	Regulations	Include mitigation of impacts to SGCN and critical habitats in all recreational infrastructure planning	DDOE	
Recreation	Pressures from tourism and recreational Activities	Education and Outreach	Education and Outreach with signage	NPS	
		Regulation	Enforcement of closed trails	NPS	
			Enforcement of park regulations		
			Enforce leash laws		

Domestic and Urban Wastewater	Run-off	Water Management	Significantly reduce stormwater runoff at the watershed level	DDOE	
	Sewage	Water Management	Significantly reduce sewage at the watershed level	DC Water	
Garbage and Solid Waste	- - -	Hazard or infrastructure removal	Regulate plastic bottles or add deposit to encourage recycling.	DDOE	
			Employ measures to reduce or recover opportunistic litter	DDOE	

Table 16 Conservation Actions to Address Threats to Emergent/Modified Managed Marsh Habitat in the District

Identified Threats	Description	TRACS Level 2 Action	TRACS Level 3 Action	Lead	Partners
Invasive Non-Native Species	Invasive plants	Invasive species control	Inventory of invasive plants	DC-CWMA	NPS, AWS
			Mechanical and chemical control of Phragmites, purple loosestrife, yellow flag	DC-CWMA	NPS, AWS
			Biological controls for purple loosestrife.	DC-CWMA	NPS, AWS
	Invasive fish and turtles		Manage invasive fish populations using recreational fishing, commercial fishery, and FWD direct management	DDOE	NPS
Problematic Native Species	Canada goose overabundance/ overbrowse	Wildlife damage management	Manage goose populations with lethal and sub-lethal methods (NPS 2014)	NPS	AWS, DDOE
			restore tidal wetlands and riparian areas with native vegetation	AWS	NPS, DDOE
			Protect wetlands with fencing	NPS, USGS	AWS, DDOE
			SAV restoration	DDOE	NPS, AWS
Tourism and Recreational Areas	Pressures from tourism and recreational infrastructure	Education and outreach	Include mitigation of impacts to SGCN and critical habitats in all recreational infrastructure planning	NPS	DDOE
		Direct resource management	Eliminate social trails	NPS	DDOE
		Regulations	Enforcement of closed trails	NPS	

Identified Threats	Description	TRACS Level 2 Action	TRACS Level 3 Action	Lead	Partners
Recreation	Pressures from tourism and recreational activities	Education and outreach	Education and Outreach with signage	NPS	DDOE
		Regulations	Enforcement of closed trails	NPS	
			Enforce leash laws	NPS	
Ecosystem Modifications	Hydrological alterations/ stormwater	Instream modification	Restore natural stream flow to existing marshes, minimize high flow occurrences	DDOE	NPS
Domestic and Urban Wastewater	Run-off	Water management	Significantly reduce stormwater runoff at the watershed level	DDOE	
	Sewage		Significantly reduce sewage at the watershed level	DDOE	
Garbage and Solid Waste	- - -	Hazard or infrastructure removal	Employ measures to reduce or recover opportunistic litter	DDOE	AWS, DDOE
			Enforcement of bag and foam laws	DDOE	
Agricultural and Forestry Effluents	Soil erosion and sedimentation	Instream modification	Manage runoff, sewage, and trash at the watershed level	DDOE	NPS, AWS
			Streambank stabilization		

Table 17 Conservation Actions to Address Threats to Urban Landscapes Habitat in the District

Identified Threats	Description	TRACS Level 2 Action	TRACS Level 3 Action	Lead	Partners
Invasive Non-Native Species	Invasive Plants	Invasive species control	Inventory of invasive plants	DC-CWMA	NPS, AWS
			Mechanical, biological, and chemical control of invasive plants	DC-CWMA	NPS, AWS
Problematic Native Species	White-tailed deer overabundance/ overbrowse	Wildlife Damage Management	Deer population monitoring in suburban areas	DDOE	
	Canada Goose overabundance/ overbrowse	Wildlife Damage Management	Canada goose population management	NPS	AWS, DDOE
Tourism and Recreational Areas	Pressures from tourism and recreational Infrastructure	Regulations	Include mitigation of impacts to SGCN and critical habitats in all recreational infrastructure planning (LID projects)	DDOE	
Recreation	Pressures from tourism and recreational activities	Education and Outreach	Education and outreach with signage		
Housing and Urban Areas Development	Human cities, towns, and recreational areas	Regulations	Include mitigation of impacts to SGCN and critical habitats in all development planning	DDOE	
Commercial and Industrial Areas	Industrial and other commercial development	Regulations	Include mitigation of impacts to SGCN and critical habitats in all development planning	DDOE	
Ecosystem Modifications	Hydrological alterations/ stormwater	Instream Modification	Stream daylighting, restoration of natural hydrology, minimize high flow occurrences	DDOE	
	Loss of tree canopy	Vegetation Planting	Planting native trees for all projects	DDOE	DDOT
Domestic and Urban Wastewater	Run-off	Water Management	Significantly reduce stormwater runoff at the watershed level	DDOE	
	Sewage	Water Management	Significantly reduce sewage at the watershed level	DDOE	

Identified Threats	Description	TRACS Level 2 Action	TRACS Level 3 Action	Lead	Partners
Garbage and Solid Waste		Hazard or infrastructure removal	Employ measures to reduce or recover opportunistic litter		
			Enforcement of bag and foam laws	DDOE	
Agricultural and Forestry Effluents	Soil erosion and sedimentation	Instream Modification	Stream restoration	DDOE	

Table 18 Conservation Actions to Address Threats to Great River Habitat in the District

Identified Threats	Description	TRACS Level 2 Action	TRACS Level 3 Action	Lead	Partners
Fishing and Harvesting of Aquatic Resources	Illegal take	Biological resource management	Regulations and law enforcement	DDOE	NPS
Invasive Non-Native Species	Fish	Invasive species control	Manage invasive fish populations using recreational fishing, commercial fishery, and FWD direct management	DDOE	NPS
Recreation	Pressures from tourism and recreational activities	Education and outreach	Education and outreach with signage	NPS, DDOE	
Dams and Water Management/ Use	Dams (size unknown)	Dam and barrier removal	Obstruction removal, creation of fish passage areas	DDOE	
Resource Information Collection Needs	Lack of initial baseline inventory	Research, survey, or monitor habitat	Baseline inventory for species with data gaps	DDOE	
Education Needs	Lack of aquatic resources and wildlife education facilities	Student training	Aquatic resource education	DDOE	
Commercial and Industrial Areas	Development	Wildlife management areas	Restoration or creation of new SAV areas to replace losses due to Reagan National Airport runway extension	DDOE	
Domestic and Urban Wastewater	Runoff	Water management	Significantly reduce stormwater runoff at the watershed level	DDOE	
	Sewage		Significantly reduce sewage at the watershed level	DC Water	
Garbage and Solid Waste	- - -	Hazard or infrastructure removal	Employ measures to reduce or recover opportunistic litter	NPS	AWS, DDOE
			Enforcement of bag and foam laws	DDOE	
Agricultural and Forestry Effluents	Soil erosion and sedimentation	Water treatment	Stabilization of streambanks		
	Nutrient loads		Runoff management, erosion control, vegetation buffers		

Table 19 Conservation Actions to Address Threats to Creeks and Headwater Habitat in the District

Identified Threats	Description	TRACS Level 2 Action	TRACS Level 3 Action	Lead	Partners
Fishing and Harvesting of Aquatic Resources	Illegal take	Biological resource management	Regulations and law enforcement	DDOE	NPS
Invasive Non-Native Species	Fish	Invasive species control	Manage invasive fish populations using recreational fishing, commercial fishery, and FWD direct management	DDOE	NPS
Recreation	Pressures from tourism and recreational activities	Education and outreach	Education and outreach with signage	NPS, DDOE	
Dams and Water Management/ Use	Dams (size unknown)	Dam and barrier removal	Obstruction removal, creation of fish passage areas	DDOE	
Resource Information Collection Needs	Lack of initial baseline inventory	Research, survey, or monitor habitat	Baseline inventory for species with data gaps	DDOE	
Education Needs	Lack of aquatic resources and wildlife education facilities	Student training	Aquatic resource education	DDOE	
Ecosystem Modifications	Hydrological alterations/ stormwater	Instream modification	Stream daylighting, restoration of natural hydrology, minimize high flow occurrences	DDOE	NPS
Domestic and Urban Wastewater	Run-off	Water management	Significantly reduce stormwater runoff at the watershed level	DDOE	
	Sewage		Significantly reduce sewage at the watershed level	DC Water	
Garbage and Solid Waste	- - -	Hazard or infrastructure removal	Employ measures to reduce or recover opportunistic litter	NPS	AWS, DDOE
			Enforcement of bag and foam laws	DDOE	
Agricultural and Forestry Effluents	Soil erosion and sedimentation	Water treatment	Stabilization of stream banks		
	Nutrient loads		Runoff management, erosion control, vegetation buffers		

Table 20 Conservation Actions to Address Threats to Embayed River Areas Habitat in the District

Identified Threats	Description	TRACS Level 2 Action	TRACS Level 3 Action	Lead	Partners
Fishing and Harvesting of Aquatic Resources	Illegal take	Biological resource management	Regulations and law enforcement	DDOE	NPS
Invasive Non-Native Species	Fish	Invasive species control	Manage invasive fish populations using recreational fishing, commercial fishery, and FWD direct management	DDOE	NPS
Recreation	Pressures from tourism and recreational activities	Education and outreach	Education and outreach with signage	NPS, DDOE	
Dams and Water Management/ Use	Dams (size unknown)	Dam and barrier removal	Obstruction removal, creation of fish passage areas	DDOE	
Resource Information Collection Needs	Lack of initial baseline inventory	Research, survey, or monitor habitat	Baseline inventory for species with data gaps	DDOE	
Education Needs	Lack of aquatic resources and wildlife education facilities	Student training	Aquatic resource education	DDOE	
Commercial and Industrial Areas	Development	Wildlife management areas	Restoration or creation of new SAV areas to replace losses due to Reagan National Airport runway extension	DDOE	
Domestic and Urban Wastewater	Run-off	Water management	Significantly reduce stormwater runoff at the watershed level	DDOE	
	Sewage			DC Water	
Garbage and Solid Waste	- - -	Hazard or infrastructure removal	Employ measures to reduce or recover opportunistic litter	NPS	AWS, DDOE
			Enforcement of bag and foam laws	DDOE	
Agricultural and Forestry Effluents	Soil erosion and sedimentation	Water treatment	Stabilization of stream banks		
	Nutrient loads	Water treatment	Runoff management, erosion control, vegetation buffers		

Table 21 Conservation Actions to Address Threats to Pond Habitats in the District

Identified Threats	Description	TRACS Level 2 Action	TRACS Level 3 Action	Lead	Partners
Invasive Non-Native Species	Invasive plants	Invasive species control	Inventory of invasive plants	DC-CWMA	NPS, AWS
			Mechanical and chemical control of purple loosestrife, yellow flag, and other invasive plants	DC-CWMA	NPS, AWS
	Invasive fish and turtles		Manage invasive fish populations using recreational fishing commercial fishery, and FWD direct management of red-eared sliders	DDOE	NPS
Problematic Native Species	Canada goose overabundance/ overbrowse	Wildlife damage management	Manage goose populations with lethal and sub-lethal methods (NPS 2014b)	NPS	AWS, DDOE
			Restore riparian areas with native vegetation	AWS	NPS, DDOE
			SAV restoration	DDOE	NPS
Tourism and Recreational Areas	Pressures from tourism and recreational infrastructure	Regulations	Include mitigation of impacts to SGCN and critical habitats in all recreational infrastructure planning	NPS, DDOE	
		Direct resource management	Eliminate social trails	NPS, DDOE	
		Regulations	Enforcement of closed trails	NPS, DDOE	
Recreation	Pressures from tourism and recreational activities	Education and outreach	Education and outreach with signage	NPS, DDOE	
		Regulations	Enforcement of closed trails	NPS, DDOE	
			Enforce leash laws	NPS, DDOE	
Ecosystem Modifications	Hydrological Alterations/ stormwater	Pond modification	Pond reconfiguration		
Domestic and Urban Wastewater	Runoff	Water management	Significantly reduce stormwater runoff at the watershed level	DDOE	
	Sewage		Significantly reduce sewage at the watershed level	DC Water	

Identified Threats	Description	TRACS Level 2 Action	TRACS Level 3 Action	Lead	Partners
Garbage and Solid Waste	- - -	Hazard or infrastructure removal	Employ measures to reduce or recover opportunistic litter	DDOE	AWS
			Enforcement of bag and foam laws	DDOE	
Agricultural and Forestry Effluents	Soil erosion and sedimentation	Pond modification	Bank stabilization	DDOE	

Table 22 Conservation Actions to Address Threats to Intertidal Shore Habitat in the District

Identified Threats	Description	TRACS Level 2 Action	TRACS Level 3 Action	Lead	Partners
Garbage and Solid Waste	- - -	Hazard or infrastructure removal	Regulate plastic bottles or add deposit to encourage recycling	DDOE	AWS
			Enforcement of bag and foam laws	DDOE	
Tourism and Recreational Areas	Pressures from tourism and recreational infrastructure	Regulations	Include mitigation of impacts to SGCN and critical habitats in all recreational infrastructure planning	NPS, DDOE	
Recreation	Pressures from tourism and recreational activities	Education and outreach	Education and outreach with signage	NPS, DDOE	
Domestic and Urban Wastewater	Runoff	Water management	Significantly reduce stormwater runoff at the watershed level	DDOE	
	Sewage		Significantly reduce sewage at the watershed level	DC Water	
Agricultural and Forestry Effluents	Soil erosion and sedimentation	Modification	Stabilization	DDOE	
Industrial and Military Effluents	Historical and contemporary contamination	Regulations	Enforcement and spill response	DDOE	

Table 23 Conservation Actions to Address Threats to Reservoir Habitat in the District

Identified Threats	Description	TRACS Level 2 Action	TRACS Level 3 Action	Lead	Partners
Invasive Non-Native Species	Invasive plants, fish, turtles	Invasive species control	Inventory of invasive plants	ACoE	DDOE
			Mechanical and chemical control of hydrilla and other aquatic plants	ACoE	DDOE
			Manage invasive fish populations using recreational fisheries, commercial fishery, and FWD direct management	ACoE	DDOE
Tourism and Recreational Areas	Pressures from tourism and recreational infrastructure	Regulation	Include mitigation of impacts to SGCN and critical habitats in all recreational infrastructure planning	ACoE	
Recreation	Pressures from tourism and recreational activities	Education and Outreach	Education and Outreach with signage	ACoE	
Ecosystem Modifications	Hydrological alterations/ stormwater	Modification	Reconfiguration		
Domestic and Urban Wastewater	Runoff	Water management	Significantly reduce stormwater runoff at the watershed level	DDOE	
	Sewage		Significantly reduce sewage at the watershed level	DDOE	
Agricultural and Forestry Effluents	Soil erosion and sedimentation	Modification	Stabilization	DDOE	

Table 24 Conservation Actions to Address Threats to Vernal Pool Habitat in the District

Identified Threats	Description	TRACS Level 2 Action	TRACS Level 3 = Action	Lead	Partners
Invasive Non-Native Species	Invasive plants, fish, turtles	Invasive species control	Inventory, mechanical, biological, and chemical controls of invasive species	DC-CWMA, DDOE	NPS, AWS
Tourism and Recreational Areas	Pressures from tourism and recreational infrastructure	Regulations	Include mitigation of impacts to SGCN and critical habitats in all recreational infrastructure planning	NPS, DDOE	
			Enforcement of closed trails	NPS, DDOE	
Recreation	Pressures from tourism and recreational activities	Education and outreach	Education and Outreach with signage	NPS, DDOE	
		Regulations	Enforcement of closed trails	NPS	
			Enforcement of park regulations		
			Enforce leash laws		
Ecosystem Modifications	Hydrological alterations/ stormwater	Modification	Restoration of groundwater hydrology	DDOE	
	Historical habitat loss	Vernal pool creation	Vernal pool creation (see focal conservation actions, Section 6.5)	DDOE	NPS, AWS
Agricultural and Forestry Effluents	Soil erosion and sedimentation	Modification	Stabilization	DDOE	
Housing and Urban Areas	Human cities, towns and settlements, encroachment	Wildlife management areas	Partnerships, administrative, land acquisition, translocation, best management practices		

Table 25 Conservation Actions to Address Threats to Spring and Seep Habitats in the District

Identified Threats	Description	TRACS Level 2 Action	TRACS Level 3 Action	Lead	Partners
Invasive Non-Native Species	Invasive plants	Invasive species control	Inventory, mechanical, biological, and chemical controls	DC-CWMA	NPS, AWS
Tourism and Recreational Areas	Pressures from tourism and recreational infrastructure	Regulations	Include mitigation of impacts to SGCN and critical habitats in all recreational infrastructure planning	NPS, DDOE	
			Enforcement of closed trails	NPS, DDOE	
Recreation	Pressures from tourism and recreational activities	Education and outreach	Education and outreach with signage	NPS, DDOE	
		Regulations	Enforcement of closed trails	NPS	
			Enforcement of park regulations		
			Enforce leash laws		
Ecosystem Modifications	Hydrological alterations/ stormwater	Modification	Maintain and restore natural groundwater hydrology	NPS	
Domestic and Urban Wastewater	Runoff	Water management	Significantly reduce stormwater runoff at the watershed level	DDOE	
	Sewage		Significantly reduce sewage at the watershed level	DC Water	
Industrial and Military Effluents	Groundwater contamination	Regulations	Enforcement and spill response	DDOE	
Agricultural and Forestry Effluents	Soil erosion and sedimentation	Modification	Stabilization	DDOE	

6.4 Non-Habitat/Species Based Actions

6.4.1 Invasive Species

Cats (*Felis catus*) are non-native predators that have been among the worst invasive species globally (Lowe, Browne, and Boudjelas 2000). In the District, they take the form of free-ranging animals that damage bird, mammal, and reptile populations. Government-sanctioned Trap-Neuter-Return (TNR) programs in the

District should be revisited. TNR animals are often released on National Park Service property and into prime wildlife habitats. Captured free-ranging cats can be taken in by several adoption facilities operating in the District. Education and outreach programs supporting 'cats indoors' programs should be promoted.

Northern snakeheads and blue catfish have infiltrated most of the riverine systems in the District. Since complete removal is not feasible, these invasive species should be promoted as sport fish to encourage catch for commercial use and assist in managing populations. Additional monitoring is required as well as gathering information about distribution, diet, and life cycles.

European starlings and house sparrows are secondary cavity nesting species, which aggressively displace native species, often killing nestlings and adults in the process. Nest box programs and artificial nesting platforms targeted at SGCN, such as chimney swift towers, wood duck boxes, and purple martin community housing, will provide nesting opportunities for native birds. Education and outreach programs focused on bird houses, feeders, and creating backyard wildlife habitats should be promoted to increase participation by District residents and organizations.

Performance Measures:

- Number of participants in backyard habitat programs
- Number of participants in backyard bird programs

6.4.2 Diseases and Pathogens

A host of pathogens are either currently found in the District or may expand their range to impact the region in the near future. As with invasive plants, a timely response is paramount for effective actions. ED/RR can reduce spread and contain outbreaks. Protocols that include decontamination of equipment regularly and when leaving potentially impaired sites will limit accidental spread. Areas that have been identified with virulent diseases should be quarantined until a strategic response can be implemented. The importation of exotic animals is a common source of emerging diseases. The pet trade within the District and the import of animals and viscera will be regulated. Collaboration with other regional agencies is required to address diseases and limit their impacts.

Performance measures:

- Number of decontamination protocols implemented District-wide
- Number of monitoring (regional) protocols implemented

6.4.3 Endocrine Disruption

Collaboration between the District and regional agencies is necessary to ensure continued monitoring levels for organic pollutants, metals, and pesticides that may alter endocrine activity. The District will continue to monitor SGCN species that are exposed to these sources or exhibit physiological changes from endocrine disruptors.

Performance measures:

- Decrease in levels of endocrine disruptors found in species
- Decrease in levels of endocrine disruptors found in water bodies

6.4.4 Noise Pollution

While it may not be possible to reduce noise pollution in a completely urban environment, the District can target residents and commercial enterprises through education and outreach.

6.4.5 Light Pollution

The multiple sources of light pollution in urban areas include street lights, electronic signs, buildings, sports venues, and towers. With a plethora of sources contributing to urban night glow, complete elimination is not practical. Light pollution can be reduced through Low Impact Design (LID) strategies, redirecting street lights, and turning out commercial and government building lights during migration periods. Lights Out programs, like the City Wildlife program in the District, use education and outreach to encourage residents and businesses to turn lights off during peak migration periods (City Wildlife 2015).

Performance measures:

- Number of buildings participating in Lights Out programs
- Number of buildings participating in light-reducing LID strategies

6.4.6 Collisions with Glass and Buildings

Urban habitats are full of buildings with glass windows and other structures that are threats to migratory and resident wildlife; however, a number of strategies can reduce collisions. Long-term solutions include smart design and use of bird-safe, fritted glass. Less expensive actions include removing vegetation from window areas and installing window decals, tempera paint, bird tape, and other window-marking films. The American Bird Conservancy's *Bird Friendly Building Design* guide offers additional solutions (Sheppard 2011).

Performance measures:

- Reduction in number of building/window strikes
- Number of buildings participating in bird friendly design programs

6.5 Focal Conservation Actions

Focal Conservation Actions are broad-scale conservation actions that can apply to many habitat types or that may be extensions of or additions to other actions. For instance, invasive plant management must be performed in many habitat types, and it should be followed by habitat restoration with native plants.

The following Focal Conservation Actions address habitat- and non-habitat-based threats throughout the District, including historical habitat loss through urbanization and land reclamation. These actions represent on-the-ground natural resource management projects that will move the DDOE Fisheries and Wildlife Division's Wildlife Management Branch beyond the baseline inventory and monitoring actions that have dominated the majority of effort under SWAP 2005. The District's Focal Conservation Actions include restoring meadows and tidal wetlands, propagating native plants, creating vernal pools, installing artificial nesting and roosting structures, establishing a trustee for natural resources, expanding the Citizen Science Program, and identifying wildlife corridors.

6.5.1 Meadow Restoration

DDOE will begin restoring meadows in grassy areas where mowing can be significantly reduced and native plants can be introduced. Restoring these meadows will provide highly valuable edge and meadow habitat for a diversity of wildlife, including small mammals, birds, and reptiles. Healthy, productive, native meadows are composed of highly diverse herbaceous plants and include a number of foundation grasses and wildflowers, such as Virginia wild rye (*Elymus virginica*), little bluestem (*Schizachryum scoparium*), common milkweed (*Asclepias syriaca*), ironweed (*Vernonia noveboracensis*), fleabane (*Erigon annuus*), and others.

DDOE will use two primary management actions to restore mowed areas and create meadows. Depending on the current species present in each of the highest priority mowed sites, one of these methods will be suitable:

- Restrict mowing to once per year, preferably in the early spring or late fall. This action will allow perennial herbaceous grasses and wildflowers to establish while keeping woody shrubs and trees from succeeding into the meadows.

- Combine weed control with planting of native grasses and wildflowers to selectively augment plant diversity at meadow sites.

  On very large sites, several plots throughout the restoration area (ranging in size from 9, 15, or 25 square meters) can be cleared by tilling, solarization, and hand pulling, and transplanted with native plants (seeds, plugs, or potted plants).

  On smaller sites the existing grass can be killed using an herbicide and those areas sown with a native seed mix of annual and perennial grasses and wildflowers. The seeds should be covered with straw for three to six weeks and kept from drying out completely. This method has the advantage of reducing the potential for erosion of tilled areas.

Maintenance is critical during the post-planting establishment period. For the first two to three years, regular site maintenance must occur to ensure plant survival and to control invasive plants. Maintenance can be minimized after the plants have fully established. Maintenance of an established native meadow consists of once-annual mowing. In some cases, mowing can be reduced to every two to three years with an annual effort to remove woody plants (trees and shrubs) that may try to establish in the meadow; they can be removed by cutting them, digging them up, or applying herbicides.

DDOE has surveyed potential meadow restoration sites using a geographic information system (GIS) analysis coupled with on-the-ground inspections. Figure 23 shows 71 prioritized meadow restoration sites that are located on District property or in District Department of Transportation (DDOT) rights-of-way. 64 additional sites on federal and institutional property have not yet been prioritized. DDOE prioritized sites based on patch size and connectivity to natural habitat. Table 26 describes the 30 highest priority meadow restoration sites.

The size criteria were

- Very large: 7–12 acres
- Large: 3–7 acres
- Medium: 1–3 acres
- Small: <1 acre

The connectivity criteria were

- Connected: directly connected to existing patches of forest or meadow habitat
- Adjacent: near to patches of forest or meadow habitat, but disconnected by a road or other obstruction

- Disconnected: disjunct from any habitat patches, surrounded by roads or developed land

Performance measures:

- Number of acres of meadow restored
- Increase in grassland/meadow habitat associated SGCN populations

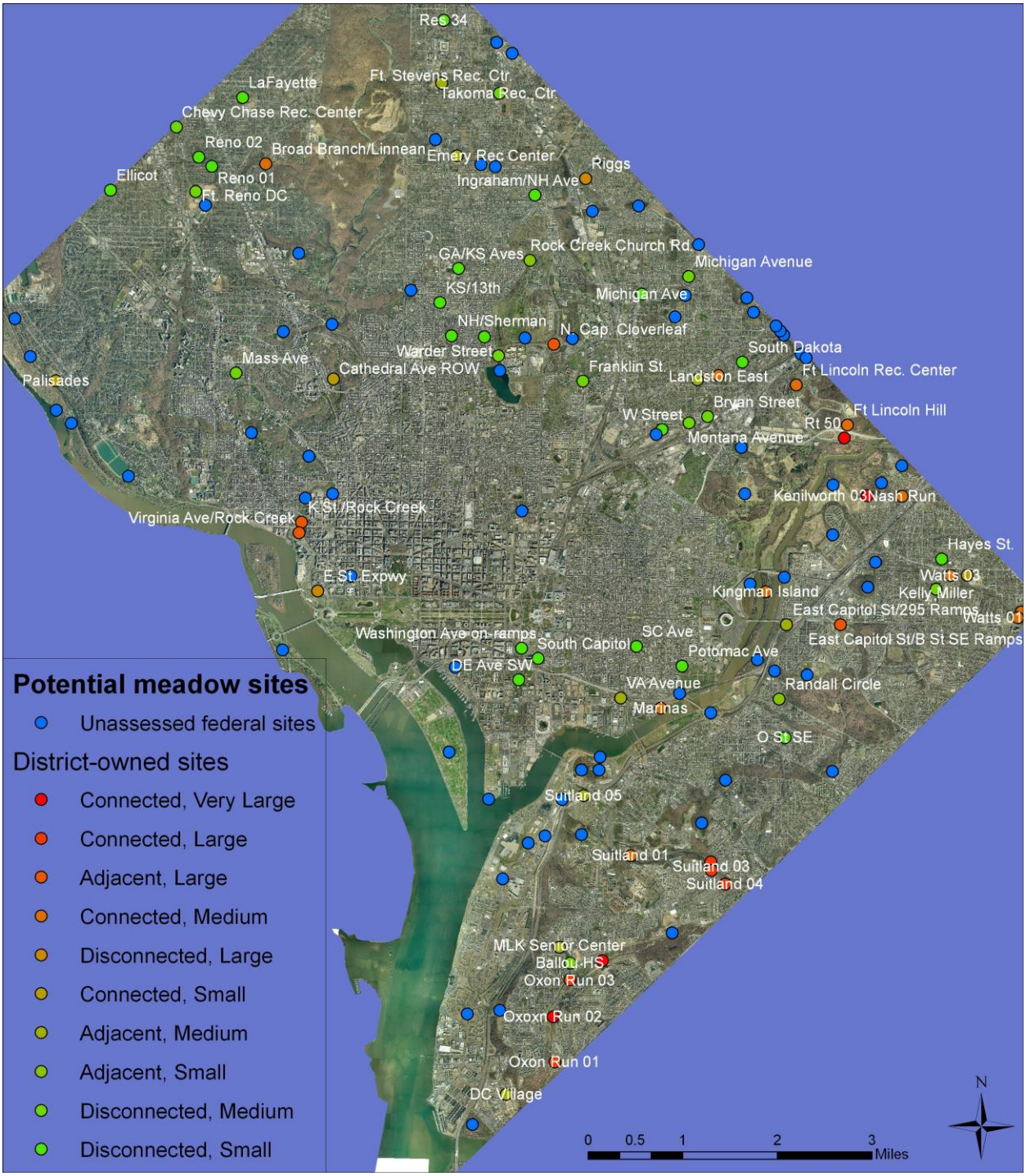

Figure 23 Potential District-owned meadow restoration sites prioritized by habitat connectivity and estimated size.

Very large = >7 acres; large = 3–7 acres; medium = 1–3 acres; small = <1 acre. Connected = directly connected to existing patches of forest or meadow habitat; adjacent = near patches of forest or meadow habitat, but disconnected by a road, obstruction, or other development; disconnected = disjunct from any habitat patches, surrounded by roads or developed land.

Table 26 District of Columbia Highest Priority Meadow Restoration Sites

Priority	Name	Estimated Area	Connectivity	Location	Ownership
High	Oxon Run 02	Very Large	Connected	1st and Atlantic Streets SE	DGS/DPR
	Kenilworth 03			Kenilworth-Parkside Recreation Center	DDOT right-of-way
	Route 50			Rt. 50 and South Dakota Avenue on-ramp area	
	Oxon Run 04			Wheeler and Valley Avenues SE	DGS/DPR
	East Capitol Street/295	Large		East Capitol Street and 295 access ramps	DDOT right-of-way
	Oxon Run 03			Mississippi Avenue and Wheeler Street SE	DGS/DPR
	Oxon Run 01			South Capitol Street and Southern Avenue SE	DDOT right-of-way
	Suitland 03			Suitland Parkway and Alabama Avenue access ramp northwest area.	
	Suitland 02			Suitland Parkway and Alabama Avenue access ramp southwest area	
	Suitland 04			Suitland Parkway and Alabama Avenue access ramps northeast area.	
	East Capitol Street/B Street SE Ramps		Adjacent	East Capitol Street and B Street access ramps adjacent to Benning Stoddert Recreation Center	
	K Street/ Rock Creek			K Street/Water Street and Rock Creek Parkway interchange access ramp	
	North Capital Cloverleaf			North Capitol Street and Irving Street interchange cloverleaf and ramp	
	Virginia Avenue/ Rock Creek			Virginia Avenue and Rock Creek Parkway interchange access ramp	
Medium	Broad Branch/ Linnean	Medium	Connected	Along Broad Branch daylighting, Broad Branch and Linnean Avenues NW	DDOT right-of-way
	Watts 03			Along Watts Branch between 50th and Division Streets SE	DGS/DPR
	Watts 01			Along Watts Branch between 58th and 61st Streets NE	
	Watts 02			Along Watts Branch between 58th and 61st	

Priority	Name	Estimated Area	Connectivity	Location	Ownership
				Streets NE	
	Nash Run			Between Ord and Douglas Streets NE	
	Langston East			Fields near Langston Pool in NE	
	Ft. Lincoln Recreation Center			Grassy area along Ft. Lincoln Drive NE	
	Ft. Lincoln Hill			Hillside east of Costco next to Route 50 access ramp to South Dakota Avenue	
	Suitland 01			Inbound Suitland Parkway NW of Stanton Road	DDOT right-of-way
	Kingman Island			South of 3100 Benning Road on Kingman Island	DGS/DPR
	Marinas			Seafarers Marina and District Yacht Club areas	
	DC Village		Adjacent	Fields in DC Village/Fire Academy area	
	MLK Senior Center			MLK Jr. Avenue and Trenton Place SE	
	Suitland 05			Suitland Parkway and 295 cloverleaf areas	DDOT right-of-way
	E Street Expressway	Large	Disconnected	E Street and I-66 access ramp grassy areas	
	Riggs			Riggs Road and South Dakota Avenue, east of interchange	

Thirty priority meadow sites based on size and connectivity. Very large = >7 acres; large = 3-7 acres; medium = 1-3 acres; small = <1 acre. Connected = directly connected to existing patches of forest or meadow habitat; adjacent = near patches of forest or meadow habitat, but disconnected by a road, obstruction, or other development; disconnected = disjunct from any habitat patches, surrounded by roads or developed land.

6.5.2 Tidal Wetland Restoration

The Anacostia River was once part of a large functioning ecosystem of freshwater tidal wetlands. Originally, these wetlands comprised more than 2,000 acres within the tidal portions of the river. From the 1890s through the 1940s, the U.S. Army Corps of Engineers (ACoE) filled the wetlands with dredge material from the Anacostia shipping channel to reclaim land for development and to minimize the impacts of raw sewage and malaria. ACoE redirected portions of the river in Prince George's County, Maryland and constructed a seawall on both banks of the river along its entire length in the District; they constructed

Kingman and Heritage Islands, and created Kingman Lake. Dredge material was used as fill for these projects. Few acres of emergent tidal wetland remain (Hammerschlag et al, 2004).

Figure 24 shows an approximation of the original extent of the wetlands of the upper Anacostia River in the District based on two maps housed at the Library of Congress: "Map of Anacostia River in the District of Columbia and Maryland / surveyed under the direction of Lieut. Colonel Peter C. Hains, Corps of Eng'rs." (1891) and "Part of the District of Columbia: June 1896 /compiled and drawn at the Office of the Engineer Commissioner, District of Columbia" (Library of Congress Geography and Map Division Washington, 2015).

In 1996, ACoE and NPS constructed 32 acres of wetland in Kenilworth Park (Hammerschlag et al, 2004). ACoE also constructed an additional 14 acres of wetland in Kingman Lake in 2000 and 15 acres in the main stem of the Anacostia River in 2003(Hammerschlag et al, 2009). 30 acres of tidal wetlands have also been restored near Bladensburg, Maryland in Prince George's County (MD DNR, 2001).

DDOE's Fisheries and Wildlife Division and Watershed Protection Division will work together to seek grants and other funding to plan and implement new tidal wetland restoration projects. DDOE will focus restoration efforts on locations where native, natural soils and seed banks may remain beneath areas filled from the 1890s to 1940s. Figure 24 shows six potential tidal wetland restoration sites (blue circles) in locations that may contain natural historic wetland soils and seed banks.

Performance measures:

- Number of acres of tidal wetlands restored or created
- Increase in tidal wetland habitat associated SGCN populations

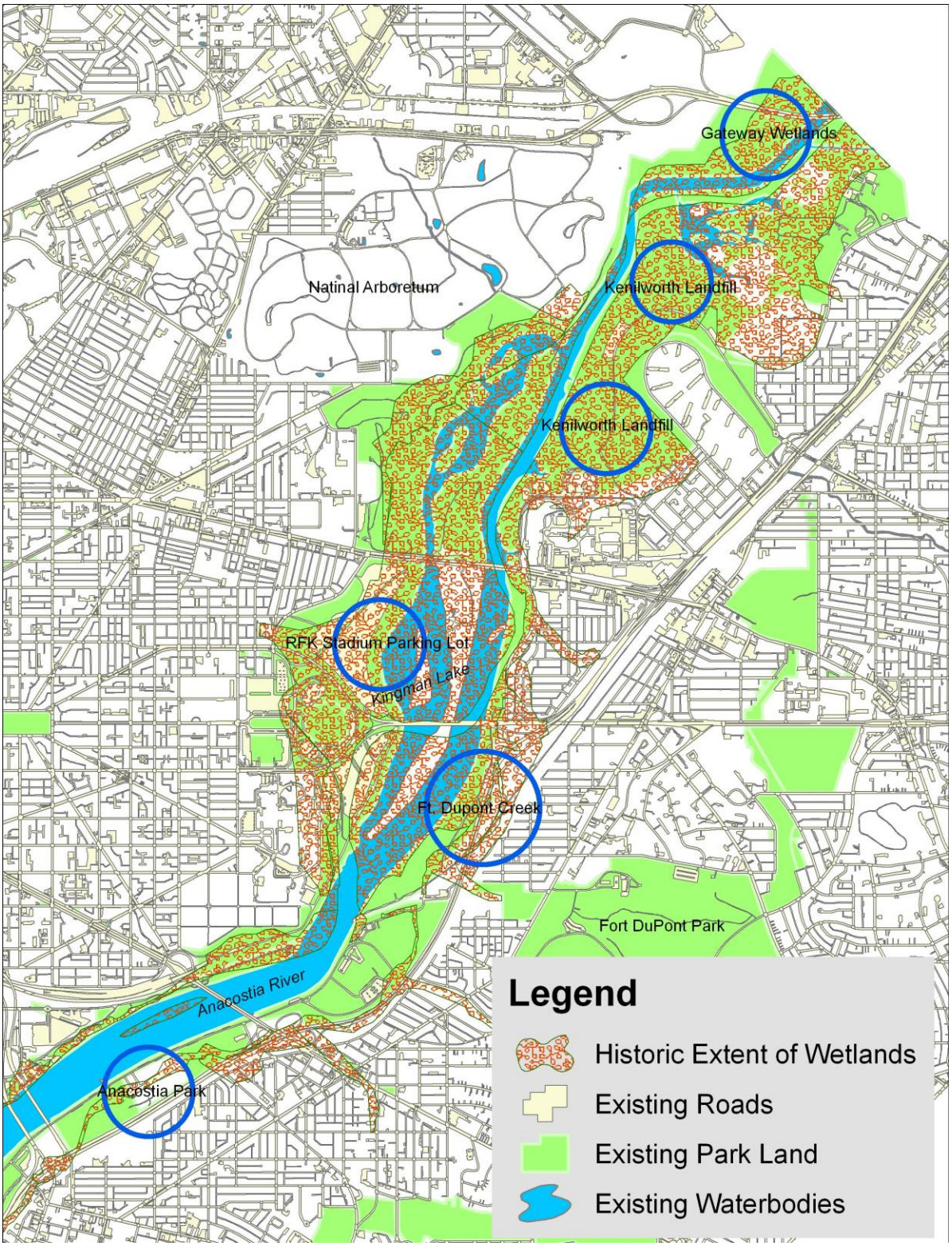

Figure 24 An approximation of the original extent of the wetlands of the upper Anacostia River in the District based on historic maps. Blue circles indicate six potential tidal wetland restoration sites in locations that may contain natural historic wetland soils.

6.5.3 Native Plant Propagation

Using a capital grant from the Sustainable DC grant program, DDOE, the University of the District of Columbia (UDC) Cooperative Extension Service, and DC-CWMA have collaborated to build a greenhouse and establish a native plant nursery at the UDC Bertie Backus Campus.. The site will produce native plants and seeds needed to restore biodiversity to local habitats, following invasive plant management, stream restorations, and meadow restoration projects in natural areas throughout the District. The site will also serve as a training facility, where students can gain technical job skills such as greenhouse management, plant production, invasive plant management, and habitat restoration.

UDC will operate the native plant nursery with assistance from DC-CWMA members and will provide plants and seeds to DC-CWMA members and the District government. The nursery may also sell plant materials for general landscaping purposes to District government agencies and the general public; proceeds must support greenhouse operations and management.

The nursery will offer training in specialized skills needed for employment in the invasive plant management field, the landscape industry, and the greenhouse industry. DC-CWMA currently provides free invasive plant management training events two times per year and will add training—at the nursery and in the field—for native plant propagation and habitat restoration. Existing green job training programs, including those run by local non-profits, will have the opportunity to participate in all phases of greenhouse management, plant propagation, invasive plant management, and habitat restoration.

Performance measures:

- Number of attendees to native plant propagation training classes
- Number of plants produced by native plant nursery
- Number of habitat restoration projects utilizing plants from native plant nursery

6.5.4 Vernal Pool Creation

Vernal pools are a unique type of seasonal wetland. These ephemeral pools are often shallow and small with no inflow or outflow of a permanent water source. They can occur in a variety of landscapes, including uplands, floodplains, parts of streams and seepage systems, or as a part of a larger wetland complex.

Because of the short hydroperiod of vernal pools, predators such as fish are unable to inhabit the system. As a result, they are important breeding habitats

for species such as wood frogs and spotted salamanders, whose eggs and tadpoles are vulnerable to such predators. Eggs hatch and tadpoles quickly develop into small frogs and salamanders before the pools dry up in the summer months.

Urbanization and development are among the top threats to vernal pool ecosystems. Many amphibians will return to the same pool annually to breed; therefore, the threats of development can lead to the permanent loss of a population. Wetland regulations would help protect vernal pool habitats.

DDOE's Fisheries and Wildlife Division will collaborate with other DDOE divisions to incorporate vernal pools into stream restoration designs. DDOE will target parcels of land as sites to hold workshops to encourage multiple partners to participate in creating vernal pool habitats within the District.

Performance measures:

- Number of acres of vernal pools restored or created
- Increase in vernal pool habitat associated SGCN populations

6.5.5 Artificial Nesting Structures and Opportunities

Habitat loss and competition from invasive species have decreased nesting opportunities and shelter for a variety of mammals and birds. The use of artificial nesting structures for cavity nesting birds is a widely accepted tool for wildlife management and a cost-effective method to assist in species recovery. Boxes can provide secure nesting sites in urban areas and degraded habitats where natural cavities are limited, as long as the structures are properly placed and maintained.

Ten bird SGCN species have been shown to use artificial nesting structures: wood duck, purple martin, eastern screech-owl, red-headed woodpecker, prothonotary warbler, chimney swift, American kestrel, peregrine falcon, brown creeper, and bald eagle. Structures include nest boxes, colonial housing towers, chimney towers, ledge scrapes, and platforms.

Artificial structures are not only important for nesting, but can provide shelter. While bats migrate or hibernate in caves during the winter months, summers are spent in trees, under bridges, or in abandoned structures. Bat boxes mimic the space between the tree trunk and bark shingles and have a 52% success rate of occupation (Kennedy et al 2013). Creating bat boxes provides more bat habitats, which assists in reducing the number of bats found in human-occupied dwellings. During the breeding season, bat houses can provide a place for female bats to roost and establish maternity colonies for pups. The southern flying squirrel (*Glaucomys volans*) also utilizes nest boxes for breeding and as

wintering dens for small groups. Several parks in the District have nest boxes occupied by flying squirrels.

Artificial nesting structures are a cost-effective method for providing nesting assistance to SGCN. Nest box programs may be necessary, until direct resource management can reinforce decay patterns in woodlands to provide enough snags and cavities for natural nesting opportunities. Nest boxes, however, should not be viewed as a remedy for the chronic problem of habitat loss and degradation (Fiehler, Tietje, and Fields 2006).

Performance measures:

- Number and type of nesting structures installed
- Number of nesting structures utilized by target species
- Number of successful nesting attempts by target species in artificial structures

6.5.6 Trustee for Natural Resources

There are a number of non-federally owned, natural spaces sprinkled throughout the District that, with proper management, could become prime wildlife habitat. These parcels include but are not limited to the following:

- Pope Branch
- Kingman and Heritage Islands
- Suitland Parkway Buffer Area
- Dalecarlia Parkway Buffer Area
- Langdon Recreation Center Forest
- Hillcrest Recreation Center Forest
- Alger Park
- Undeveloped Fort Lincoln Forest

Performance measure:

- Number of acres under management as habitat

6.5.7 Citizen Science Program

Citizen science is a method of study in which the public collects and forwards specific data to the principal scientist. This method has proven to be a beneficial resource. It encourages the public to observe and learn about area wildlife and is a relatively efficient way to provide biologists with crucial data.

In the fall of 2013, DDOE initiated the first Citizen Science Program, seeking volunteers for assistance in reporting on the eastern cottontail rabbit, an SGCN species. The public responded positively and the program continues to flourish. Community members report sightings that provide biologists with crucial data needed to determine the abundance, density, and distribution of the eastern cottontail rabbit. Due to the success of this project, DDOE plans to expand the Citizen Science Program to other SGCN species.

Performance measures:

- Number of participants in citizen science programs
- Number of species accounts collected through citizen science programs

6.5.8 Wildlife Corridors

Due to urbanization, growing human populations, and ever present infrastructure, contiguous tracts of habitat have become broken or fragmented. Fragmentation, a threat to wildlife and habitat, occurs when roads transect wildlife travel corridors or bisect home ranges. Fragmentation effectively divides territories, changes home ranges, and alters species movements. When roadways are built in wildlife travel corridors, animals increasingly use roads for passage and inevitably come in contact with vehicles. For both wildlife management and human safety, there is a need to track conflicts between wildlife and vehicles and to design and implement measures to reduce these potentially dangerous interactions.

To address this concern, DDOE will identify areas known as hotspots—where wildlife-vehicle collisions are likely to occur. DDOE will design measures to reduce vehicle strikes, increase the safe passage of wildlife, and reduce risks to public safety in these particular areas.

Performance measures:

- Number of collision records collected
- Number of hotspots identified
- Number of preventative measures taken

Chapter 7 Monitoring and Adaptive Management

Determining the effectiveness of conservation actions and reducing the threats facing the District's natural resources will be tracked through a monitoring program which focuses on indicators of success for conservation targets (see Table 27). Indicators of success will be used to assess the status of those conservation targets. The monitoring program will also be used to determine if a conservation action was not only successful, but economically efficient. Adaptive management techniques will be implemented as conditions change to improve chances for the long-term conservation of natural resources and achieving SWAP goals.

For our purposes adaptive management is defined as "adjusting the type, frequency or intensity of management techniques based on the observed effects of previously implemented management techniques, based on feedback from monitoring the original and managed state of the target species, habitat or area". Monitoring, research, and assessment studies of wildlife populations and habitat condition are integral to an adaptive management framework. New information can also be gleaned from credible scientific sources. Conservation strategies must be periodically re-evaluated and adjusted to ensure that conservation and management strategies and practices meet long-term goals.

For many SGCN there was insufficient local data to quantitatively and confidently assess their status, monitoring protocols have not yet been developed, or DDOE lacks the expertise or resources to monitor them. DDOE and other partners will strive to inventory and monitor species with data gaps, and assign conservation targets and indicators for success for these species in the future. As these data gaps are filled, more relevant and specific monitoring regimes can be developed.

7.1 Planned Monitoring and Adaptive Management

The District will use multiple tools for information management and tracking conservation efforts, including; the Northeast Regional Monitoring and Performance Reporting Framework (NRMPRF), Northeast Lexicon Project, and USFWS-TRACS. Conservation actions will be monitored and measured throughout the 10-year implementation of SWAP 2015.

The NRMPRF is a collaborative effort of states in the Northeast, federal land management agencies, NGO's, and academics to assist in the meeting of monitoring and performance reporting requirements for SWAPs. The Northeast Lexicon is a regional conservation lexicon that can be used by the District and other state agencies and partners to define conservation projects. This uniformity will allow for greater communication and synergy across the region. TRACS is a federal reporting tool that tracks project outputs, effectiveness measures, and species and habitat incomes through a UWFWS database. TRACS has the ability to track short- term measures and long-term outcomes for species and habitats. TRACS contains classifications for threats and conservation actions that are associated with the IUCN system.

Table 27 Identified Conservation Targets and Indicators of Success

Conservation Target Example	Indicators of Success
Northeastern Upland Forest and Northeastern Wetland Forest	Forest Fragmentation Index
	Browse Index
	Invasive Species Index
	Forest Bird Population Trends
Great River, Small River, Creek, and Headwater	Distribution and Population Status of Fish SGCN
	Water Quality
	Macro-Invertebrates Index
	Invasive Fish Species Index
	Dissolved Oxygen Index
	Waterbird Population Trends
	SAV Index
Northeastern Wetland Forest Emergent Marsh, Riverine Pond, Freshwater Pond	Size and Area of Freshwater Tidal Wetlands
	Invertebrate Population Trends
	Water Quality
	Wetland Bird Population Trends
	Invasive Species Index
	Canada Goose Browse Index
Vernal Pools	Herpetofauna Population Trends
	Size and Area of Vernal Pools
Grasslands and Meadows	Size and Area of Grasslands and Meadows
	Grassland and Meadow Population Trends
	Monarch Butterfly Population Trends
	Dragonfly/Butterfly Population Trends
	Invasive Species Index
	Herpetofauna Population Trends
Migratory Species	Migratory Bird Population Trends
	Bat Population Trends

Conservation Target Example	Indicators of Success
	Monarch Butterfly Population Trends
	Diadromous Fish Population Trends
Regional SGCN	Regional SGCN Population Trends in the District
District SGCN	Bird Population Trends
	Mammal Population Trends
	Invertebrate Population Trends
	Fish Population Trends
	Herpetofauna Population Trends
Aquatic Habitats	Sedimentation Index
	SAV Index
	Fish Population Trends
	Contaminants Monitoring
	Hydrology Changes

7.1.1 Ongoing Species Monitoring Programs

There are numerous monitoring programs in the District with a goal of monitor individual wildlife species and important taxa such as winter waterbirds or obligate vernal pool species. Existing programs are the primary method that DDOE and other wildlife agencies use to monitor and track SGCN. Data from these programs are collected and reported to wildlife managers at state agencies and nearby federal and non-profit partners to provide information that will be used as feedback to inform adaptive management of important wildlife populations.

- Nightjar Survey
- Striped Bass Passive Integrated Transponder Tagging
- Shad propagation
- Ultrasonic Fish Tag Survey
- American Eel Survey
- Canada Goose Survey
- White-tailed Deer Population Survey
- Christmas Bird Count
- Breeding Bird Survey
- Brent Elementary Winter Bird Count

- Bat Mist Netting and Acoustical Monitoring
- Box Turtle and Spotted Turtle Radio Telemetry
- Frog Call Surveys
- Cover Board Surveys
- Amphibian Egg Mass Surveys
- Lotic Dipnet Surveys
- Aquatic Turtle Trapping
- Small Mammal Trapping
- Meso-mammal Camera Traps
- Flying Squirrel Nest Boxes
- Osprey Nest Monitoring
- Bald Eagle Nest Monitoring
- Eastern Cottontail Citizen Science Survey
- Lepidoptera transects
- Odonata transects

7.1.2 Ongoing Habitat Monitoring/Restoration Programs

- SAV Surveys
- Anacostia Watershed Society Rice Ranger Wetland Restoration project
- Anacostia Watershed Society Phragmites monitoring
- Anacostia Watershed Society Freshwater mussel surveys
- Non-Migratory Canada Goose Survey
- White-tailed Deer Population Survey

7.2 Potential New Monitoring/Restoration Programs

- Pre- and post-construction monitoring of stream restoration projects
- Native plant propagation
- Fate of propagated native plants used in habitat restoration in meadows, forests and wetlands
- Meadow creation in currently mowed grassy areas
- Citizen Science Programs

7.3 Important Data Gaps

Through monitoring efforts, data has been gathered for less than 500 species in the District. This includes a small percentage of the number of invertebrates which have been identified. The data gaps for the population status and trends for gastropods, mollusks, crayfish, bees, and sponges will be addressed through the life of SWAP 2015.

Invertebrate survey needs include the following:

- Crayfish
- Mussels
- Freshwater Snails
- Terrestrial Snails
- Copepods
- Amphipods
- Tiger Beetles
- Bees
- Freshwater Sponges

Partner coordination:

- Anacostia Watershed Society (mussels)
- American University (copepods and amphipods)
- Howard University (snails)
- USGS and George Washington University (bees)
- NPS-Center for Urban Ecology (sponges)

7.4 Periodic Plan Review and Revision

By tracking indicators of success and other effectiveness measures, needed information will be gathered to adaptively manage natural resources in the District. If monitoring and adaptive management techniques identified in this SWAP are not adequate to the whole or parts maybe be revised to conserve SGCN and their habitats.

Similarly, In order for the SWAP to remain relevant, periodic review and revisions may be necessary. The emergence of new threats, discovery of extirpated species, or a habitat related changes occur, the plan must be amendable to address these changes. Performance measures should be selected that are

realistic and translate to USFWS's Wildlife TRACS. The current SGCN list will be revisited and, if needed, revised in no more than five years after the submittal of SWAP 2015.

Chapter 8 Stakeholder and Government Participation

8.1 Stakeholder Participation

Stakeholders were initially engaged in the SWAP 2015 rewrite through the solicitation for and selection of individuals to participate as subject matter experts on technical committees for various taxa (avifauna, herpetofauna, mammals, and invertebrates) and habitats. A broad effort to contact and encourage participation was conducted by DDOE biologists, who have developed an extensive network of local partners and regional expertise since the development of the District's original SWAP in 2005. This enabled the process to draw from a large pool of knowledge, to expand the scope of conservation actions, and to fill data gaps. More than 40 organizations and individuals were represented on technical committees.

Technical committees began meeting in October 2014, and met as needed throughout the SGCN selection process. The committees played a key role by reviewing the SGCN ranking and selection process, offering opinions on species where data was lacking, assessing the threats to the finalized list of SGCN and habitats, and assisting in the development of specific conservation actions that would address those threats.

Technical committees (see Table 28) consisted of biologists from the DDOE Fisheries and Wildlife Division and representatives from other federal, state, and local conservation agencies and organizations, as well as NGOs, including the following:

Federal

- National Park Service (NPS)
- US Geological Survey (USGS)
- US Fish and Wildlife Service (USFWS)
- US Department of Agriculture

State

- Maryland Department of Natural Resources
- District Department of Health
- District of Columbia Cooperative Extension Service

Non-Governmental Organizations

- DC Audubon
- The Nature Conservancy
- Defenders of Wildlife
- Association of Fish and Wildlife Agencies (AFWA)
- Natural Heritage Program
- Smithsonian Migratory Bird Center
- American Bird Conservancy
- City Wildlife
- Anacostia Watershed Society
- Metropolitan Washington Council of Governments
- The University of Maryland
- Howard University
- Smithsonian Mason School of Conservation
- George Washington University
- University of the District of Columbia

Table 28 Technical Committee Participants and their Affiliations

Avian Technical Committee – Dan Rauch (DDOE-FWD)	
Alicia King	US Fish and Wildlife Service
Robert Reitsma	Smithsonian Migratory Bird Center
Robert Steele	National Park Service
Jason Berry	American Bird Conservancy
Anne Lewis	City Wildlife
James Monsma	City Wildlife
Paul Pisano	DC Avian Record Keeper
Hugh McGuiness	Maret School
Zack Slavin	DC Audubon
Herpetofauna Technical Committee – Lindsay Rohrbaugh (DDOE-FWD)	
Matthew Gallagher	Metropolitan Council of Governments
George Middendorf	Howard University
Andrew Dietrich	U.S. Geological Survey - Patuxent
Scott Bates	National Park Service
Ken Ferebee	National Park Service
Tasha Foreman	US Geological Survey - Patuxent
Thomas Akre	Smithsonian Mason School of Conservation
Mammal Technical Committee – Lindsay Rohrbaugh (DDOE-FWD)	
Jennifer Murrow	University of Maryland
Paula Goldberg	City Wildlife
Abby Hehmeyer	City Wildlife
Scott Bates	National Park Service
Ken Ferebee	National Park Service
Maria Hille	Department of Health
Susan Greeley	U.S. Department of Agriculture
Invertebrate Technical Committee – Damien Ossi (DDOE-FWD)	
David Culver	American University
Adam Smith	George Washington University
Kenneth Hayes	Howard University
Richard Orr	Mid-Atlantic Invertebrate Field Studies, Inc.
Same Droege	US Geological Survey
Jennifer Frye	Maryland DNR
Natasha Garcia-Andersen	DDOE
Fish Technical Committee – Shellie Spencer (DDOE-FWD)	
Martin Gary	Potomac River Fisheries Commission
John Odenkirk	Virginia Dept. of Game and Inland Fisheries
Mary Groves	Maryland Dept. Natural Resources
Joseph Love	Maryland Dept. Natural Resources

Steve Minkkinen	US Fish and Wildlife Service
Dave Secor	University of Maryland CES
Vicki Blazer	US Geological Survey
Phong Trieu	Metropolitan Council of Governments
Mikaila Milton	National Park Service
Jorge Bogantes Montero	Anacostia Watershed Society
Matthew Ogburn	Smithsonian Environmental Research Center
Ken Penrod	Guide
Steve Chaconas	Guide
Charlie Taylor	Angler/Retired Guide
Mike Bailey	Angler
Robert Nixon	Earth Conservation Corps
Robert West	Earth Conservation Corps
Donavan Dean	Earth Conservation Corps
Habitat Technical Committee – Damien Ossi (DDOE-FWD)	
Andrew Landsman	National Park Service CHOH
Mikaila Milton	National Park Service NACE
Jorge Bogantes Montero	Anacostia Watershed Society
Ann Aldrich	Dumbarton Oaks Conservancy
Alex Sanders	Rock Creek Conservancy
Mary Farrah	UDC Cooperative Extension Service
Geoff Sanders	National Park Service CUE
Joe Kish	National Park Service ROCR

Stakeholder Meeting

Once a final draft is complete, there will be a District wide stakeholder meeting to present the SWAP for review by all of the stakeholders who were involved in the creation of the SWAP, and others. The USFWS encourages states to include partners and stakeholders as participant and leaders in relevant conservation actions. A full agenda and outcomes of that meeting will be added to this section once the meeting occurs. That meeting is tentatively scheduled for late July 2015.

8.2 Public Participation

On July 31, 2015, DDOE will publish the draft SWAP 2015 in the *DC Register* and post it on DDOE's website for a 30-day public comment period through August 31, 2015. DDOE will conduct two public meetings (August 5 and 6, 2015) to inform and educate residents on the District's biodiversity, the work of the DDOE's Fisheries and Wildlife Division, and key elements of SWAP 2015. DDOE will email a variety of stakeholder groups to encourage the public to participate in

meetings and comment on the draft, including residents who participated in the RiverSmart Homes Program, the Backyard Habitat Program, or in developing the Sustainable DC Plan. The public can submit comments at the public meetings or by email.

DDOE will post the public comments and a comment response document on its website and include them as an appendix to this plan. DDOE will address any necessary changes before submitting the final document to USFWS. Public involvement will continue through citizen science projects, outreach and education, ANC meetings, and other public events.

8.3 Successful Implementation of SWAP 2005

Radio-telemetry of relocated eastern box turtles in the District of Columbia

Terrapene carolina carolina (eastern box turtle), once a fairly common species, is declining in its range throughout North America, primarily due to habitat loss and destruction. NatureServe assigned the eastern box turtle a rating of S3, or vulnerable, in the District. The eastern box turtle was listed as and SGCN in SWAP 2005 and is identified as an SGCN in SWAP 2015.

The recent approval of a large-scale development project threatened a community of eastern box turtles. To conserve this particular population, ten individuals were relocated to suitable habitats within the District. However, given the nature of eastern box turtles to use homing instincts, long-term monitoring is required after the relocation. To monitor the success of this effort, turtles were fitted with radio-transmitters and have been tracked by DDOE biologists since May 2011. In addition to conserving the population in question, this project will produce data regarding the effectiveness of turtle relocation as pertains to movement patterns and home range re-establishment.

Knowing the effects that relocation has on new home range establishment will allow conservationists to implement best management practices in accordance with SWAP 2015, which will further ensure the survivability of current and future turtle populations. Additionally, data collected from this effort will continue to document some of the effects that urbanization has on turtles, their movements, and their survivability.

As of July 2014, six turtles remained fitted with transmitters. In 2014–2015, two of the transmitters failed, one turtle succumbed to ranavirus, and there was one fatality due to a vehicle collision. By 2014, all but one turtle had stopped homing and settled, while the final turtle demonstrating homing instincts was hit by a car in 2015.

American Shad Restoration in the District of Columbia

In 2004, DDOE began a restoration project focused on creating a spawning stock of American shad in the Anacostia River. Since that time more than 8 million chemically marked yolk sac fry have been stocked in the District's portion of the Anacostia. While no adult American shad have been observed in the Anacostia River there has been an increase in American shad encountered in various fisheries surveys in the District's portion of the Potomac River. In order to better understand the shad population structure within the District DDOE preforms an adult American shad gillnet survey accompanied by otolith analysis. The analysis of this data allows DDOE to assess restoration efforts by determining the percentage of hatchery reared American shad versus wild fish. In conjunction with the adult American shad survey a push net survey is conducted in the District to obtain juvenile American shad. All otoliths of juvenile American shad caught in push net survey are analyzed for the presence of an OTC mark. This allows DDOE to determine percent of hatchery juvenile American shad to wild American shad.

In 2014 DDOE biologists were able to examine all of the otoliths collected in the adult gill net survey. No OTC marks were found on the 17 readable samples, indicating only wild spawned American shad were captured in the 2014 gill netting survey. To date, no hatchery spawned American shad have been found in the gill netting survey. DDOE biologists examined all of the juvenile American shad captured during the push net survey in the Anacostia River in 2014. This sample included 164 juvenile fish of which 3 were determined to be of hatchery origin. These figures indicate that 1.8% of the juvenile American shad population in the Anacostia River in 2014 were DDOE's hatchery contribution.

8.4 Implementation

The District is a complex puzzle of multiple federal jurisdictions, fragmented land ownership, and shared river systems, bracketed by neighboring states. Implementation of the SWAP will depend on the strength and coordination of partnerships between a variety of agencies and organizations. Conservation actions will be more effective when they are part of a coordinated effort to accomplish defined goals.

The SWAP will be implemented by the DDOE and stakeholder organizations, which have been essential to the implementation of SWAP 2005, and were essential in the development of this document. Successful implementation will depend on the strength and coordination of partnerships between a variety of agencies and organizations. As newsworthy conservation actions are conducted and parts of the plan successfully completed, announcements will be made through various media.

Resources for Residents

Learn what residents can do to help wildlife and birding in the District of Columbia.

Your Backyard Guide to Helping Reptiles and Amphibians
http://www.northeastparc.org/products/pdfs/NEPARC_backyard.pdf

Bat house information:

- Bat house general information
  http://www.batmanagement.com/Batcentral/batboxes/bathouse.html
- How to build a bat house
  http://www.batmanagement.com/Batcentral/boxbuild/build1.html
- How to install a bat house
  http://www.batmanagement.com/Batcentral/boxinstall/install1.html

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Abbreviations

ACoE	U.S. Army Corps of Engineers
AFWA	Association of Fish and Wildlife Agencies
AWS	Anacostia Watershed Society
Bd	*Bathrachochytrium dendrobatidis*
C&O Canal	Chesapeake and Ohio Canal Historical Park
CCVI	Climate Change Vulnerability Index
COAs	Conservation Opportunity Areas
CSOs	Combined Sewer Overflows
CSS	Combined Sewer System
DC Water	District of Columbia Water and Sewer Authority
DC-CWMA	District of Columbia Cooperative Weed Management Area
DDOE-WQD	District Department of the Environment - Water Quality Division
DDOT	District Department of Transportation
DGS	District Department of General Services
DPR	District Department of Parks and Recreation
ED/RR	Early Detection/Rapid Response
EPA	U.S. Environmental Protection Agency
EPMT	Exotic Plant Management Team
ESRI	Environmental Systems Research Institute
FCAs	Focal Conservation Actions
FWD	Fisheries and Wildlife Division
GIS	Geographical Information System
IUCN	International Union for the Conservation of Nature

LID	Low Impact Development
MD DNR	Maryland Department of Natural Resources
MS4	Municipal Separate Stormwater System
NEFWDTC	Northeast Fish and Wildlife Diversity Technical Committee
NETHCS	Northeast Terrestrial Habitat Classification System
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRMPRF	Northeast Regional Monitoring and Performance Reporting Framework
NWF	National Wildlife Federation
POA	Percent of Occupied Area
RCN	Regional Conservation Needs
SAV	Submerged Aquatic Vegetation
SGCN	Species of Greatest Conservation Need
SLAMM	Sea Level Affecting Marsh Model
SWAP	State Wildlife Action Plan
SWAP2005	2005 State Wildlife Action Plan
SWAP2015	2015 State Wildlife Action Plan
SWG	State Wildlife Grant
TNC	The Nature Conservancy
TNR	Trap-Neuter-Return
TRACS	USFWS Tracking Actions for the Conservation of Species
UDC	University of the District of Columbia
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

USNVC	United States National Vegetation Classification
VIMS	Virginia Institute of Marine Science

Glossary

amphibian — Ectothermic, tetrapod vertebrates of the class Amphibia

amphipod — Of the order of malacostracan crustaceans with no carapace and generally with laterally compressed bodies Amphipods range in size from 1 to 340 millimeters and are mostly detritivores or scavengers

anadromous — A fish that migrates up rivers to spawn

aquatic — Of or relating to water

avifauna — The species of birds of a region, habitat, or environment

bioblitz — An intense period of biological surveying in an attempt to record all the living species within a designated area

biodiversity — The variety of living organisms, and the communities and ecosystems in which they occur

canopy — The layer of foliage formed by the crowns of trees in a forest stand

climate change — Change in global or regional climate patterns, in particular a change apparent from the mid to late 20th century onwards and attributed largely to the increased levels of atmospheric carbon dioxide produced by the use of fossil fuels

connectivity — The degree to which the landscape facilitates or impedes movement among resource patches, influences gene flow, local adaptation, extinction risk, colonization probability, and the potential for organisms to move as they cope with climate change

copepod — A group of small crustaceans found in the sea and nearly every fresh water habitat

crustacean — A large group of arthropods, usually treated as a subphylum, which includes such familiar animals as crabs, lobsters, crayfish, shrimp, krill and barnacles

dissolved oxygen — A measure of how much oxygen is dissolved in the water

distribution (species) — The manner in which a biological taxon is spatially arranged

disturbance — Temporary changes in environmental conditions caused by either natural or humans based actions

early successional — Uplands where the potential natural vegetation is predominantly grasses, grass-like plants, forbs, or shrubs

ecological systems — Reoccurring groups of biological communities that are found in similar physical environments and are influenced by similar dynamic ecological processes

ecosystem — A natural community of organisms interacting with its physical environment

edge habitat — The transition between two types of vegetation and habitats

effluents — Outflowings of waste material discharged into the environment

emergent marsh — The marsh found around shorelines out to relatively shallow water

emerging disease — A disease is one that has appeared in a population for the first time, or that may have existed previously but is rapidly increasing in incidence or geographic range

encroach — To advance beyond the usual or proper limits

endangered species — any species of plant or animal defined through the Federal Endangered Species Act or state Endangered Species Act as being in danger of extinction throughout all or a significant portion of its range

Endangered Species Act (ESA) — Federal legislation that was signed into law in 1973, the ESA protects plant and animal species and is jointly administered by the US Fish and Wildlife Service and NOAA Fisheries, to provide protection for species that are in danger of extinction and to conserve the habitats on which those species depend.

endemic — Native or restricted to a certain country or area

ephemeral (wetland) — Wetland, spring, stream, river, pond or lake that only exists for a short period following precipitation or snowmelt

evapotranspiration — The sum of evaporation and plant transpiration from the Earth's land and ocean surface to the atmosphere

extirpated — Status of a species or population that has completely vanished from a given area or region but that continues to exist in some other location

exurban developments — Low density residential developments, displacing specialist wildlife species with generalists, increasing human-wildlife conflict

by intrusion of humans in wildlife habitat caused by expanded roads and driveway networks

fauna — The animals of a particular region, habitat, or geological period

federally listed species — Refers to those species officially listed under the Federal Endangered Species Act as either endangered, threatened, or a species at risk

floodplain — Flat or nearly flat land that may be submerged by floodwaters; a plain built up or in the presence of being built up by stream deposition

flora — All the plant associated with a given habitat, country, area, or period

fragmentation (habitat) — The disruption of extensive habitats into isolated and small patches

freshwater mussels — Freshwater bivalve mollusk

freshwater sponges — Genus in the family Spongillidae found in lakes and slow streams

geographic information system (GIS) — A computerized system to compile, store, analyze and display geographically referenced information

goatsucker — Common name for nocturnal or crepuscular birds of the order Caprimulgiformes, which includes the frogmouth, the oilbird, potoos, and nightjars

greenhouse gases — Gases that contribute to the greenhouse effect by absorbing infrared radiation, e.g., carbon dioxide and chlorofluorocarbons

habitat — An ecological or environmental area that is inhabited by a particular species of animal, plant, or other type of organism

habitat specialists — Species that can only thrive in a narrow range of environmental conditions or habitats

herpetofauna — The reptiles and amphibians of a particular region, habitat, or geological period

hydrology — Study of the movement, distribution, and quality of water on Earth and other planets, including the hydrologic cycle, water resources and environmental watershed sustainability.

hydroperiod — The period in which a soil area is waterlogged

impervious surface — Mainly artificial structures, such as pavements, roads, sidewalks, driveways and parking lots, that are covered by impenetrable materials such as asphalt, concrete, brick, and stone. Soils compacted by urban development are also highly impervious

impoundment — A body of water, such as a pond, confined by a dam, dike, floodgate, or other barrier, which is used to collect and store water for future use

infiltration — The process by which water on the ground surface enters the soil

insect — Class of invertebrates within the arthropod phylum that have a chitinous exoskeleton, a three-part body, three pairs of jointed legs, compound eyes and one pair of antennae

intertidal — Of, relating to, or being part of the littoral zone (the shore zone between high and low tide marks) above low-tide mark

invasive species — Introduced species (also called "non-indigenous" or "non-native") that adversely affect the habitats and bioregions they invade economically, environmentally, and/or ecologically. Such invasive species may be either plants or animals and may disrupt by dominating a region, wilderness areas, particular habitats, or wildland-urban interface land from loss of natural controls (such as predators or herbivores). This includes non-native invasive plant species labeled as exotic pest plants and invasive exotics growing in native plant communities

invertebrate — Animal species that do not possess or develop a vertebral column, derived from the notochord

IUCN category of threats — A hierarchical classification of the broadest range of species according to their global extinction risk adopted originally in 1994 and later revised in 2000 by the International Union for Conservation of Nature

mammal — Clade of endothermic amniotes distinguished from reptiles and birds by the possession of hair, three middle ear bones, mammary glands, and a neocortex

meso-mammal — term used to describe mammals of small to intermediate in size

migratory — Moving from one place to another at different times of the year; of or relating to migration

mollusk — A large phylum of invertebrate animals known as the Mollusca that have a soft body without a backbone and that usually live in a shell

nutrification — Whereby water bodies such as lakes and estuaries receive excess nutrients from a variety of sources (primarily agriculture, aquaculture and sewage) setting off a cascade of environmental changes

odonata — Order of carnivorous insects, encompassing dragonflies (Anisoptera/Epiprocta) and damselflies (Zygoptera)

perennial (stream or river) — Stream or river that has continuous flow in parts of its stream bed all year round during years of normal rainfall

phenology — A branch of science dealing with the relations between climate and periodic biological phenomena

plant community — A collection of plant species within a designated geographical unit, which forms a relatively uniform patch, distinguishable from neighboring patches of different vegetation types. The components of each plant community are influenced by soil type, topography, climate and human disturbance

population (species) — Summation of all the organisms of the same group or species, which live in a particular geographical area, and have the capability of interbreeding

reptile — A cold-blooded vertebrate of a class that includes snakes, lizards, crocodiles, turtles, and tortoises. They are distinguished by having a dry scaly skin, and typically laying soft-shelled eggs on land

riparian — Related to or living or located on a bank of a natural watercourse

riverine — Of, relating to, or situated on a river or riverbank; riparian

ruderal — Of disturbed land

sea level rise — The change in globally mean sea level due to steric contribution (volume increase due to an increase in average ocean temperature, which reduces average seawater density), mass contribution (volume increase due mainly to melting of land supported ice glaciers, ice caps, and ice sheets), and subsidence

sedimentation — The action or process of forming or depositing material suspended by water, wind, or ice

social trails — Unofficial/informal trails created by erosion due to human foot traffic

species abundance — The number of individuals per species

Species of Greatest Conservation Need (SGCN) — Wildlife species indicative of the state or territory that is deemed most rear, imperiled, and/or requires conservation needs

species richness — The number of different species represented in an ecological community, landscape or region

taxa — Plural of taxonomic groups

taxonomy — Orderly classification of plants and animals according to their presumed natural relationships

terrestrial — Of or relating to land

topography — The configuration of a surface including its relief and the position of its natural and man-made features

Total Maximum Daily Load (TMDL) — EPA required caps on the amounts of pollutants that waterbodies can receive and still meet water quality standards

upland — Of or relating to dry ground

vernal pool — Depressions holding water for a temporary period in the spring, and in which various amphibian lay eggs

vertebrates — Belonging or pertaining to the Vertebrata, a subphylum of chordate animals, comprising those having a brain enclosed in a skull or cranium and a segmented spinal column; a major taxonomic group that includes mammals, birds, reptiles, amphibians, and fishes

vulnerability assessment (climate change) — Tools structured to determine the level of vulnerability (sensitivity, exposure, adaptive capacity) to climate change

zoonotic pathogen — A disease that can be passed between animals and humans